Federal Energy Regulatory Commission
Office of Energy Projects
Washington, DC 20426

FINAL
ENVIRONMENTAL IMPACT STATEMENT
FOR THE
JORDAN COVE ENERGY PROJECT

Docket Nos. CP17-494-000 and CP17-495-000

FERC/FEIS-0292F

November 2019

Cooperating Agencies:

FEDERAL ENERGY REGULATORY COMMISSION
WASHINGTON, D.C. 20426

OFFICE OF ENERGY PROJECTS

In Reply Refer To:
OEP/DG2E/Gas Branch 3
Jordan Cove Energy Project L.P.
Docket No. CP17-495-000
Pacific Connector Gas Pipeline, LP
Docket No. CP17-494-000
FERC/EIS-0292F

TO THE INTERESTED PARTIES:

The staff of the Federal Energy Regulatory Commission (FERC or Commission), with the participation of the cooperating agencies listed below, has prepared a final environmental impact statement (EIS) for the Jordan Cove Liquefied Natural Gas Project proposed by Jordan Cove Energy Project L.P. (Jordan Cove) and the Pacific Connector Gas Pipeline Project proposed by Pacific Connector Gas Pipeline, LP (Pacific Connector) (collectively referred to as the Jordan Cove Energy Project or Project). Under Section 3 of the Natural Gas Act (NGA), Jordan Cove requests authorization to construct and operate a liquified natural gas (LNG) terminal in Coos Bay, Oregon, capable of liquefying up to 1.04 billion cubic feet of natural gas per day for export to overseas markets. Pacific Connector seeks a Certificate of Public Convenience and Necessity under Section 7 of the NGA to construct and operate a natural gas transmission pipeline providing about 1.2 billion cubic feet per day of natural gas from the Malin hub to the Jordan Cove terminal, crossing portions of Klamath, Jackson, Douglas, and Coos Counties, Oregon.

The final EIS assesses the potential environmental effects of the construction and operation of the Project in accordance with the requirements of the National Environmental Policy Act (NEPA). As described in the final EIS, the FERC staff concludes that approval of the Project would result in a number of significant environmental impacts; however, the majority of impacts would be less than significant because of the impact avoidance, minimization, and mitigation measures proposed by Jordan Cove and Pacific Connector and those recommended by staff in the EIS.

The United States (U.S.) Department of the Interior Bureau of Land Management, (BLM), Bureau of Reclamation (Reclamation), and Fish and Wildlife Service; U.S. Department of Agriculture Forest Service (Forest Service); U.S. Department of Energy; U.S. Army Corps of Engineers; U.S. Environmental Protection Agency; U.S. Department of Commerce National Oceanic and Atmospheric Administration National Marine Fisheries Service; U.S. Department of Homeland Security Coast Guard; the Coquille

Indian Tribe; and the U.S. Department of Transportation Pipeline and Hazardous Materials Safety Administration participated as cooperating agencies in preparation of this EIS. Cooperating agencies have jurisdiction by law or special expertise with respect to resources potentially affected by the proposal and participate in the NEPA analysis. The cooperating agencies provided input into the analyses, conclusions, and recommendations presented in the EIS. Following issuance of the final EIS, the cooperating agencies will issue subsequent decisions, determinations, permits, or authorizations for the Project in accordance with each individual agency's regulatory requirements.

The BLM, with the concurrence of the Forest Service and Reclamation, would adopt and use the EIS to consider issuing a Right-of-Way Grant for the portion of the Project on federal lands. Other cooperating agencies would use this EIS in their regulatory process, and to satisfy compliance with NEPA and other related federal environmental laws (e.g., the National Historic Preservation Act).

The BLM and the Forest Service would also use this EIS to evaluate proposed amendments to their District or National Forest land management plans that would make provision for the Pacific Connector pipeline. In order to consider the Pacific Connector right-of-way grant, the BLM must amend the affected Resource Management Plans (RMPs). The BLM therefore proposes to amend the RMPs to re-allocate all lands within the proposed temporary use area and right-of-way to a District-Designated Reserve, with management direction to manage the lands for the purposes of the Pacific Connector right-of-way. Approximately 885 acres would be re-allocated. District-Designated Reserve allocations establish specific management for a specific use or to protect specific values and resources. In accordance with Code of Federal Regulations (CFR) part 36 § 219—Planning, the Forest Service is considering amendments of Land and Resource Management Plans (LRMP) for the Umpqua, Rogue River, and Winema National Forests. Proposed amendments of LRMPs include reallocation of matrix lands to Late Successional Reserves and site-specific exemptions from 15 standards to allow construction of the Pacific Connector pipeline. Exemptions from standards include requirements to protect known sites of Survey and Manage species, changes in visual quality objectives at specific locations, limitations on detrimental soil conditions, removal of effective shade at perennial stream crossings and the construction of utility corridors in riparian areas.

The Commission mailed a copy of the Notice of Availability of the final EIS to federal, state, and local government representatives and agencies; elected officials; environmental and public interest groups; Indian Tribes; potentially affected landowners and other interested individuals and groups; and newspapers and libraries in the Project area. The final EIS is available in hard copy at libraries in the area of the Project and in electronic format. It may be viewed and downloaded from the FERC's website (www.ferc.gov), on the Environmental Documents page (https://www.ferc.gov/industries/gas/enviro/eis.asp). In addition, the final EIS may be accessed by using the eLibrary link on the FERC's website. Click on the eLibrary link (https://www.ferc.gov/docs-filing/elibrary.asp), click on General Search, and enter the docket number in the "Docket Number" field, excluding the last three digits (i.e., CP17-494 or CP17-495). Be sure you have selected an appropriate date range. For assistance, please contact FERC Online Support at FercOnlineSupport@ferc.gov or toll free at (866) 208-3676, or for TTY, contact (202) 502-8659.

Questions?

Additional information about the Project is available from the Commission's Office of External Affairs, at **(866) 208-FERC**, or on the FERC website (www.ferc.gov) using the eLibrary link. The eLibrary link also provides access to the texts of all formal documents issued by the Commission, such as orders, notices, and rulemakings.

In addition, the Commission offers a free service called eSubscription that allows you to keep track of all formal issuances and submittals in specific dockets. This can reduce the amount of time you spend researching proceedings by automatically providing you with notification of these filings, document summaries, and direct links to the documents. Go to www.ferc.gov/docs-filing/esubscription.asp.

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TECHNICAL ACRONYMS AND ABBREVIATIONS

°C	degrees Celsius
°F	degrees Fahrenheit
µg/m^3	micrograms per cubic meter
µPa	microPascal
AAQS	ambient air quality standards
AASHTO	American Association of State Highway Transportation Officials
ACDP	air contaminant discharge permit
ACEC	Area of Critical Environmental Concern
ACHP	Advisory Council on Historic Preservation
ACI	American Concrete Institute
AIChE	American Institute of Chemical Engineers
AKWA	Area of Known Wolf Activity
AMSL	above mean sea level
ANFO	Ammonium Nitrate and Fuel Oil
ANSI	American National Standards Institute
APCO	Al Pierce Company
APE	area of potential effect
API	American Petroleum Institute
applicant	Jordan Cove Energy L.P. and Pacific Connector Gas Pipeline L.P.
AQCR	Air Quality Control Region
AQRV	Air Quality-Related Values
ARSC	Aquatic Resources of Special Concern
ASCE	American Society of Civil Engineers
ASME	American Society of Mechanical Engineers
ASR	Annual Species Review
ATC	Applied Technology Council
Authorization	Section 3 Authorization
AVERT	Avoided Emission and Generation Tool
BA	biological assessment
BBS	breeding bird survey
B.C.	British Columbia
Bcf/d	billion cubic feet per day
BCC	Birds of Conservation Concern
BCR	Bird Conservation Region
BE	Biological Evaluation
bgs	below ground surface
BIA	U.S. Department of the Interior Bureau of Indian Affairs
BLEVE	boiling-liquid-expanding-vapor explosion
BLM	U.S. Department of the Interior Bureau of Land Management
BMP	best management practice
BO	biological opinion
BOG	boil-off gas
BPA	Bonneville Power Administration
BPVC	Boiler and Pressure Vessel Code
Btu	British thermal units
Btu/ft^2-hr	British thermal units per square foot per hour

Btu/ft-hr-°F	British thermal units per foot per hour per degrees Fahrenheit
BWE	ballast water exchange
BWM	Ballast Water Management
CAA	Clean Air Act
CadnaA	computer aided noise abatement
CBC	Christmas Bird Count
CBNBWB	Coos Bay-North Bend Water Board
CCPS	Center for Chemical Process Safety
CDI	Coastal-Dependent Industry
CEQ	Council on Environmental Quality
Certificate	Certificate of Public Convenience and Necessity
CFR	Code of Federal Regulations
CHE	Coast and Harbor Engineering
CHU	critical habitat unit
CMP	Compensatory Mitigation Plan
CO	carbon monoxide
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalent
Coast Guard	U.S. Department of Homeland Security Coast Guard
COE	U.S. Army Corps of Engineers
Commission	Federal Energy Regulatory Commission
Coquille Tribe	Coquille Indian Tribe
COTP	Captain of the Port
Cow Creek Tribe	Cow Creek Band of Umpqua Tribe of Indians
CP	cathodic protection
CRPA	Cultural Resources Protection Agreement
CSZ	Cascadia subduction zone
CTCLUSI	Confederated Tribes of Coos, Lower Umpqua, and Siuslaw Indians
CWA	Clean Water Act
CWD	coarse woody debris
cy	cubic yard
CZMA	Coastal Zone Management Act
dB	decibel
dBA	A-weighted decibels
dbh	diameter at breast height
dB_{RMS}	decibels root mean squared
DCS	distributed control system
DE	Design Earthquake
DEA	David Evans & Associates, Inc.
DEGADIS	dense gas dispersion model
DEM	digital elevation model
DHS	Department of Homeland Security
DMEF	Dredged Material Evaluation Framework
DOD	U.S. Department of Defense
DOE	U.S. Department of Energy
DOE/FE	U.S. Department of Energy, Office of Fossil Energy
DOGAMI	Oregon Department of Geology and Mineral Industries
DP	Direct Pipe
DPS	Distinct Population Segments

DWSA	drinking water source area
EA	Environmental Assessment
Eagle Act	Bald and Golden Eagle Protection Act of 1940, as amended
EAR	existing access road
ECA	Emissions Control Area
ECRP	Pacific Connector's *Erosion Control and Revegetation Plan*
ECSI	Environmental Cleanup Site Information
EEZ	economic exclusion zone
EFH	essential fish habitat
eGRID	Emissions & Generation Resource Integrated Database
EI	environmental inspector
EIA	U.S. Energy Information Administration
EIS	Environmental Impact Statement
EJSCREEN	Environmental Justice Mapping and Screening Tool
EL	elevation
EO	Executive Order
EPA	U.S. Environmental Protection Agency
EPAct	Energy Policy Act of 2005
ERMA	Extensive Recreation Management Area
ERP	emergency response plan
ESA	Endangered Species Act
ESCP	Erosion and Sediment Control Plan
ESD	emergency shutdown
ESU	Evolutionarily Significant Units
FAA	Federal Aviation Administration
FEED	front-end engineering design
FEMA	Federal Emergency Management Agency
FERC	Federal Energy Regulatory Commission
FGS	Fire and Gas Systems
FHWA	Federal Highway Administration
FLPMA	Federal Land and Policy Management Act of 1976
FOI	Forest Operations Inventory
Forest Service	U.S. Department of Agriculture Forest Service
Fort Chicago Holdings	Fort Chicago Holdings II US LLC
fps	foot per second
FR	*Federal Register*
FSA	Facility Security Assessment
FSH	Forest Service Handbook
FSM	Forest Service Manual
FSP	Facility Security Plan
ft^3	cubic feet
FTA	free trade agreement
FTE	full-time equivalent
FWCA	Fish and Wildlife Coordination Act of 1934
FWS	U.S. Department of the Interior Fish and Wildlife Service
g/hp-hr	grams per horsepower per hour
GeoBOB	Geographic Biotic Observations
GHG	greenhouse gas
GIS	geographic information system

GMD	geomagnetic disturbance
gpm	gallons per minute
Grand Ronde Tribes	Confederated Tribes of the Grand Ronde Community of Oregon
GRI	GRI Geotechnical and Environmental Consultants
GTN	Gas Transmission Northwest LLC
HAP	Hazardous Air Pollutant
HAZID	Hazard Identification
HAZOP	hazard and operability review
HCA	high consequence area
HDD	horizontal directional drill
HF	high-frequency
HMA	Herd Management Area
hp	horsepower
HPMP	Historic Properties Management Plan
HPRCS	Historic Properties of Religious and Cultural Significance
HRA	Historical Research Associates, Inc.
HUC	Hydrologic Unit Code
Hz	hertz
I-5	Interstate 5
IM	Instruction Memorandum
IMO	International Maritime Organization
IMPLAN	Impact Analysis for Planning
IRA	Inventoried Roadless Area
ISA	International Society for Automation
ISO	International Organization for Standardization
IWWP	industrial wastewater pipeline
Jordan Cove	Jordan Cove Energy Project L.P.
Jordan Cove's *Plan*	Jordan Cove's *Upland Erosion Control, Revegetation, and Maintenance Plan*
Jordan Cove's *Procedures*	Jordan Cove's *Wetland and Waterbody Construction and Mitigation Procedures*
Kentuck project	Kentuck Slough Wetland Mitigation project
KOAC	known owl activity center
km	kilometer
KOP	key observation point
kPa	kilopascals
kW	kilowatt
kW/m^2	kilowatts per square meter
L_{dn}	day-night sound level
L_{eq}	equivalent sound level
L_{max}	maximum sound level
LCM	lost circulation material
LDC	local distribution company
LF	low frequency
LFL	lower flammable limit
LiDAR	light detection and ranging
LLA	likely to adversely affect
LMP	Land Management Plan
LNG	liquefied natural gas

LOD	Letter of Determination
LOI	Letter of Intent
LOPA	Layer of Protection Analysis
LOR	Letter of Recommendation
LOS	level of service
LPG	liquified petroleum gasoline
LRMP	Land and Resource Management Plan
LSOG	late-successional old-growth
LSR	Late Successional Reserve
LSRA	Late-Successional Reserve Assessment
LWD	large woody debris
m^2	square meter
m^3	cubic meters
m^3/hr	cubic meters per hour
MA	Management Area
MAMU	marbled murrelet
MAOP	maximum allowable operating pressure
MBF	thousand board feet
MBTA	Migratory Bird Treaty Act
MCE	Maximum Considered Earthquake
mcy	million cubic yards
MF	mid-frequency
mg/l	milligram per liter
mgd	million gallons per day
mg/kg	milligram per kilogram
MIS	management indicator species
MLA	Mineral Leasing Act
MLLW	mean lower low water
MLRA	Major Land Resource Area
MLV	mainline block valve
mm	millimeter
MMBF	million board feet
MMBtu/hr	million British thermal units per hour
MMPA	Marine Mammal Protection Act
MOA	Memorandum of Agreement
MOF	material offloading facility
MOU	Memorandum of Understanding
MP	milepost
mph	miles per hour
MPRSA	Marine Protection, Research, and Sanctuary Act
MR	Mixed Refrigerant
MRI	mean recurrence interval
ms	millisecond
MSA	Magnuson-Stevens Fishery Conservation and Management Act
MSL	mean sea level
MTBM	micro-tunnel boring machine
mtpa	metric tonnes per annum
MTSA	Maritime Transportation Security Act

MUSY	Multiple Use, Sustained Yield Act of 1960
MW	megawatt
na	Not applicable
NAAQS	National Ambient Air Quality Standards
NAS	non-indigenous aquatic species
NAVD88	North American Vertical Datum of 1988
NCDC	National Climatic Data Center
NCM	navigation channel mile
NE	no effect
NEPA	National Environmental Policy Act
NESHAP	National Emission Standards for Hazardous Air Pollutants
NF	National Forest
NFMA	National Forest Management Act
NFPA	National Fire Protection Association
NFS	National Forest System
NGA	Natural Gas Act
NHPA	National Historic Preservation Act
NJ	Not likely to jeopardize the continued existence for proposed species
NLAA	not likely to adversely affect
NMFS	National Marine Fisheries Service
NNL	National Natural Landmark
NNSR	Nonattainment New Source Review
NO	nitrogen oxide
NO_2	nitrogen dioxide
NOA	Notice of Availability
NOAA	U.S. Department of Commerce National Oceanic and Atmospheric Administration
NOI	Notice of Intent
NO_x	oxides of nitrogen
NPDES	National Pollutant Discharge Elimination System
NPS	National Park Service
NRC	National Research Council
NRCS	Natural Resources Conservation Service
NRF	Nesting-Roosting-Foraging
NRHP	National Register of Historic Places
NRIS	Natural Resource Information System
NSA	noise-sensitive area
NSO	northern spotted owl
NSPS	New Source Performance Standards
NSR	New Source Review
nT	nano-Tesla
NTU	nephelometric turbidity unit
NVIC	Navigation and Vessel Inspection Circular
NWFP	Northwest Forest Plan
NWI	National Wetlands Inventory
NWPP	Northwest Power Pool
NWR	National Wildlife Refuge
NWS	National Weather Service
O_2	oxygen

O&C	Oregon and California Railroad
O&C Act	Oregon and California Revested Lands Sustained Yield Management Act of 1937
OAR	Oregon Administrative Rule
OBE	Operating Basis Earthquake
OCMP	Oregon Coastal Management Program
OCRM	National Oceanic and Atmospheric Administration Office of Coast and Ocean Resource Management
ODA	Oregon Department of Agriculture
ODE	Oregon Department of Energy
ODEQ	Oregon Department of Environmental Quality
ODF	Oregon Department of Forestry
ODFW	Oregon Department of Fish and Wildlife
ODLCD	Oregon Department of Land Conservation and Development
ODNRA	Oregon Dunes National Recreation Area
ODOT	Oregon Department of Transportation
ODSL	Oregon Department of State Lands
OEP	FERC's Office of Energy Projects
OHWM	ordinary high water mark
OHV	off-highway vehicle
OHWM	ordinary high water mark
OIMB	Oregon Institute of Marine Biology
OISC	Oregon Invasive Species Council
OPRD	Oregon Parks and Recreation Department
OPS	Office of Pipeline Safety
OPUC	Oregon Public Utilities Commission
ORBIC	Oregon Biodiversity Information Center
ORS	Oregon Revised Statute
OSHA	Occupational Safety and Health Administration
OSMB	Oregon State Marine Board
OSMRE	Office of Surface Mining Reclamation Enforcement
OSWB	Oregon State Weed Board
OWRD	Oregon Water Resources Department
Pacific Connector	Pacific Connector Gas Pipeline L.P.
PAG	plant association group
PAH	polynuclear aromatic hydrocarbon
PAR	permanent access road
PBF	physical or biological features
PCB	polychlorinated biphenyl
PCT	Pacific Crest Trail
Pembina	Pembina Pipeline Corporation
PES	PES Environmental, Inc.
PGA	peak horizontal ground acceleration
PHMSA	Pipeline and Hazardous Materials Safety Administration
PILT	Payment In Lieu of Taxes
PLF	product loading facility
Plan	*Upland Erosion Control, Revegetation, and Maintenance Plan*
PM_{10}	particulate matter with a diameter of less than 10 microns
$PM_{2.5}$	particulate matter with a diameter of less than 2.5 microns

POD	Plan of Development
Port	Oregon International Port of Coos Bay
ppm	parts per million
ppmvd	parts per million by volume, dry basis
ppmvd @ 15 percent O_2	parts per million by volume, dry basis, corrected to 15 percent oxygen
PPV	peak particle velocity
PRICO®	Poly Refrigerant Integrated Cycle Operation
Procedures	*Wetland and Waterbody Construction and Mitigation Procedures*
Project	Jordan Cove LNG Project and Pacific Connector Gas Pipeline Project
PSD	Prevention of Significant Deterioration
PSE	Puget Sound Energy
PSEL	plant site emission limit
PSET	Portland Sediment Evaluation Team
Psi	pounds per square inch
psig	pounds per square inch gauge
PST	Pacific Standard Time
psu	practical salinity unit
PTS	permanent threshold shift
PVC	polyvinyl chloride
PWA	Potential Wilderness Area
R.	Range
RAP	Remedial Action Plan
RBC	risk-based concentration
Reclamation	U.S. Department of the Interior Bureau of Reclamation
RFSSS	Regional Forester's Special Status Species
RHA	Rivers and Harbors Act
RM	river mile
RMA	Recreation Management Area
RML	rapidly moving landslide
RMP	Resource Management Plan
RMS	Riparian Management Strategy
RNA	Research Natural Area
ROD	Record of Decision
ROW	right-of-way
RQD	rock quality designation
Ruby	Ruby Pipeline LLC
RV	recreational vehicle
SAFE Port Act	Security and Accountability For Every Port Act
SAP	sampling and analysis plan
SAV	submerged aquatic vegetation
SBS	Siskiyou BioSurvey, LLC
SD	scaled distance factor
SDS	safety data sheet
SDWA	Safe Drinking Water Act
SEL_{cum}	cumulative sound exposure level
SEV	severity of ill effect
SH	State Highway
SHN	SHN Consulting Engineers & Geologists, Inc.

SHPO	State Historic Preservation Officer
SIL	significant impact level
Siletz Tribes	Confederated Tribes of the Siletz Reservation
SIS	Safety Instrumentation Systems
SMYS	specified minimum yield stress
SO_2	sulfur dioxide
SONCC	Southern Oregon/Northern California Coast
SORSC	Southwest Oregon Regional Safety Center
SOULA	Southern Oregon University Laboratory of Anthropology
SPCC	Spill Prevention, Containment, and Countermeasures
SPL	sound pressure level
SPL_{peak}	peak sound pressure level
SRMA	Special Recreation Management Area
SSA	sole or principal source aquifer
SSE	Safe Shutdown Earthquake
SSTEMP	Stream Segment Temperature Model
SSURGO	Soil Survey Geographic (Database)
STATSGO	State Soil Geographic (Database)
SVOC	semivolatile organic compound
T.	Township
T&E	Threatened and Endangered
TACT	Typically Achievable Control Technologies
TAR	temporary access road
TCP	Traditional Cultural Property
TEWA	temporary extra work area
t/hr	metric ton per hour
TMBB	temporary material barge berth
TMDL	Total Maximum Daily Load
TMP	Transportation Management Plan
TPH	total petroleum hydrocarbon
TPY	tons per year
TSS	total suspended solids
TVS	total volatile solids
TWIC	Transportation Worker Identification Credential
UCSA	uncleared storage area
UDP	Unanticipated Discovery Plan
U.S.	United States
U.S.C.	United States Code
USDA	United States Department of Agriculture
USDOT	U.S. Department of Transportation
USGCRP	United States Global Change Research Program
USGS	U.S. Geological Survey
UTV	utility task vehicle
VGP	General Permit for Discharges Incidental to the Normal Operation of Vessels
VLCC	very large crude carrier
VOC	volatile organic compound
VQO	Visual Quality Objective
VRM	visual resource management

WHPA	wellhead protection area
WNF	Winema National Forest
WRP	Wetland Reserve Program
WSA	Waterway Suitability Assessment
WSR	Waterway Suitability Report

EXECUTIVE SUMMARY

The staff of the Federal Energy Regulatory Commission (FERC or Commission) has prepared this final environmental impact statement (EIS) to assess the impacts of constructing and operating the Jordan Cove Liquefied Natural Gas (LNG) Project proposed by Jordan Cove Energy Project L.P. (Jordan Cove) and the Pacific Connector Gas Pipeline Project proposed by Pacific Connector Gas Pipeline, LP (Pacific Connector). The purpose and need of the Jordan Cove LNG Project is to export natural gas supplies derived from existing natural gas transmission systems to overseas markets. The purpose and need of the Pacific Connector Gas Pipeline Project is to connect the existing natural gas transmission systems of Gas Transmission Northwest, LLC and Ruby Pipeline, LLC with the proposed LNG export terminal. Collectively, Jordan Cove and Pacific Connector are referred to as the Applicant or Applicants, and the projects are referred to collectively as the Jordan Cove Energy Project or simply the Project.

The purpose of this EIS is to inform FERC decision-makers, the public, and other permitting agencies about the potential adverse and beneficial environmental impacts of the proposed Project and as appropriate recommend measures that would avoid, reduce, and mitigate adverse impacts to the extent practicable. We[1] prepared this analysis based on information provided by the Applicants; our independent review of this information; in consultation with federal cooperating agencies (see below); and in consideration of comments provided by state and local agencies, Indian Tribes, non-governmental organizations, and individual members of the public. This EIS was prepared in accordance with the requirements of the National Environmental Policy Act of 1969 (NEPA) and the Commission's implementing regulations under Title 18 of the Code of Federal Regulations, Part 380 (18 CFR 380).

The FERC is the federal agency responsible for authorizing onshore LNG facilities, and is responsible for regulating the siting and construction of natural gas transmission pipelines. the FERC is the lead federal agency responsible for the preparation of this EIS. The United States (U.S.) Department of the Interior Bureau of Land Management (BLM), Bureau of Reclamation, and Fish and Wildlife Service; U.S. Department of Agriculture Forest Service (Forest Service); U.S. Department of Energy; U.S. Army Corps of Engineers (COE); U.S. Environmental Protection Agency (EPA); U.S. Department of Commerce National Oceanic and Atmospheric Administration National Marine Fisheries Service; U.S. Department of Homeland Security Coast Guard (Coast Guard); the Coquille Indian Tribe; and the U.S. Department of Transportation Pipeline and Hazardous Materials Safety Administration are cooperating agencies for the development of this EIS consistent with 40 CFR 1501.6(b). A cooperating agency has jurisdiction by law or has special expertise with respect to the environment potentially affected by the Project. The cooperating agencies provided input into the analyses, conclusions, and recommendations presented in the EIS. Following issuance of this final EIS, the cooperating agencies will issue subsequent decisions, determinations, permits or authorizations for the Project in accordance with each individual agency's regulatory requirements.

[1] "We," "us," and "our" refer to the environmental and engineering staff of the FERC's Office of Energy Projects.

PROPOSED ACTION

On September 21, 2017, the Applicants, in Docket Nos. CP17-494-000 and CP17-495-000, filed applications with the Commission pursuant to Sections 3 and 7 of the Natural Gas Act (NGA) seeking an Authorization and a Certificate of Public Convenience and Necessity to construct and operate an LNG export terminal and a natural gas transmission pipeline. The LNG terminal would be located in Coos County, Oregon on the North Spit of Coos Bay and would be capable of liquefying up to 1.04 billion cubic feet of natural gas per day for export. The 200-acre LNG terminal site would include:

- an access channel from the existing Coos Bay Federal Navigation Channel to the LNG terminal;
- modifications to the existing Federal Navigation Channel;
- a marine slip containing two berths (one Production Loading Berth and one Emergency Lay Berth), a dock for tug and escort boats, and a material offloading facility;
- LNG loading platform and transfer line;
- two full-containment LNG storage tanks and associated equipment;
- five natural gas liquefaction trains;
- a pipeline gas conditioning facility;
- a temporary workforce housing facility;
- the non-jurisdictional Southwest Oregon Regional Security Center and Fire Department building; and
- other security and control facilities, administrative buildings, and other support structures.

As proposed, the LNG terminal would be called upon by about 120 LNG carriers per year.

The pipeline would originate at interconnections with existing pipeline systems in Klamath County, Oregon, and would span parts of Klamath, Jackson, Douglas, and Coos Counties, Oregon, before connecting with the LNG terminal. The approximately 229-mile-long, 36-inch-diameter pipeline would be capable of transporting up to 1.2 billion cubic feet of natural gas per day. Operating the pipeline would require the use of one compressor station and other associated facilities including mainline block valves, pig[2] launchers and receivers, communication systems, and meter stations.

PUBLIC INVOLVEMENT

The Applicants began participating in the Commission's Pre-filing Process in early 2017 (Docket No. PF17-4-000). The FERC's Pre-filing Process encourages the early involvement of interested stakeholders and responsible regulatory agencies to identify and resolve environmental issues before an application is filed with the FERC. During the Pre-filing Process, the Applicants held Open Houses in Coos Bay and along the pipeline route in March of 2017 to provide the public with information about the Project and to solicit its concerns about the Project.

In June 2017, the FERC issued a *Notice of Intent to Prepare an Environmental Impact Statement for the Planned Jordan Cove LNG Terminal and Pacific Connector Pipeline Projects, Request for*

[2] A pig is a remotely operated pipe inspection and cleaning tool.

Comments on Environmental Issues, and Notice of Public Scoping Sessions (NOI). The NOI was sent to affected landowners; federal, state, and local government agencies; elected officials; environmental and public interest groups; interested Indian tribes; and local libraries and newspapers. The NOI also began a 30-day scoping period. During the scoping period, the FERC along with the BLM and Forest Service, held joint public scoping sessions in Coos Bay and along the pipeline route to receive comments about the Project. Each session was attended by at least 150 people, and some sessions were attended by substantially more. During scoping, we also met with several federally recognized Indian Tribes in person and via teleconference to discuss their respective concerns about the Project.

On March 29, 2019, the Commission issued a Notice of Availability (NOA) of the draft EIS. The NOA established a 90-day period to receive comments on the draft EIS, ending on July 5, 2019. The 90-day comment period was established to meet public review requirements of the BLM for the proposed amendments to BLM and Forest Service Land Management Plans. A formal notice was also published by the EPA in the *Federal Register* on April 5, 2019, indicating that the draft EIS was available.

The NOA announced the time, date, and location of four public comment sessions in Oregon to take comments on the draft EIS. Locations and dates of the public sessions included Coos Bay on June 24, 2019; Myrtle Creek on June 25, 2019; Medford on June 26, 2019; and Klamath Falls on June 27, 2019. Transcripts of the sessions were placed in the public record for these proceedings.[3] A summary of the comments received from the public sessions, as well as written comments on the draft EIS submitted by the public and agencies, is provided in the EIS and appendix R of this EIS which also includes our response to these comments. Most comments received during scoping and on the draft EIS concern land use, purpose and need, safety and security, potential geological hazards (tsunamis and mountainous terrain), wildlife, water quality, and the FERC's approach to the NEPA process. Comments from Indian Tribes expressed concern about meaningful consultation, cultural resources, environmental resources including fish (salmon) and vegetation, impacts on traditional use(s) of the land, environmental justice, cumulative impacts, and documentation of concerns in the EIS. Additionally, many comments raised concerns that are outside the scope of this EIS. Examples include comments regarding the public benefit or need to export LNG; comments on the State's permitting process; history of the Project (i.e., the multiple past applications); horizontal hydraulic drilling through shale formations during exploration for natural gas (often referred to as "fracking"); greenhouse gas emissions resulting from the combustion of exported gas; the concept of a "programmatic" EIS to cover LNG export terminals throughout the United States; the structure and format of FERC public meetings; the availability of hard copies of the draft EIS; the differences between "FERC Recommendations" versus "FERC Conditions"; and administrative information technology system operations at the FERC. These issues are not addressed in this EIS.[4] However, all other comments received were considered and addressed as appropriate in our analysis.

[3] Copies of the transcripts of the public sessions to take comments on the draft EIS were placed into the dockets through the FERC's eLibrary system. See Accession Nos. 20190624-4003, 20190625-4001, 20190626-4005, and 20190627-4004.

[4] As appropriate, these issues would be addressed in any Order the Commission may issue.

PROJECT IMPACTS

Constructing and operating the Project would impact geological resources, soils and sediments, water resources, wetlands, vegetation, wildlife, aquatic resources, threatened and endangered species, and other species of concern, land use, recreation, visual resources, socioeconomics, transportation, cultural resources, air quality, and noise. Our analysis also evaluates cumulative impacts on these resources.

Constructing and operating the LNG terminal would permanently impact about 200 acres of land. Coos Bay would temporarily experience increased turbidity and sedimentation due to the construction of the marine facilities. Wildlife in the vicinity of the LNG terminal, especially those species who are sensitive to noise and light would experience increased rates of stress, injury, and mortality and would likely avoid and relocate from the Project area. Areas adjacent to the Coos Bay Federal Navigation Channel would be modified. The Coast Guard has determined that the Federal Navigation Channel is suitable to support the LNG carriers that would call on the terminal. LNG carriers would cause delays for other marine traffic in the waterway. Vehicle traffic and associated commute times near the LNG terminal site would also increase. Permanent and temporary structures at the LNG terminal as well as LNG carrier operations in the Federal Navigation Channel would exceed Federal Aviation Administration obstruction standards and could significantly impact Southwest Oregon Regional Airport operations. Constructing the LNG terminal would also have a temporary significant impact on the short-term housing market in Coos County. The LNG terminal would also permanently and significantly impact the visual character of Coos Bay, and pile driving at the terminal would result in a significant noise impact on the surrounding area. The LNG terminal design accounts for possible tsunamis and includes safeguards and protections to ensure facility integrity and public safety.

Constructing the pipeline would require the temporary use of more than 4,900 acres of land. Operating the pipeline would permanently impact about 1,400 acres of land; however, many land uses including livestock grazing would not be permanently affected. The pipeline would be located across steep terrain through the Cascade Mountains, but Pacific Connector has planned minimization and mitigation measures accordingly for potential landslides and erosion. The pipeline would also cross over 300 waterbodies including the Coos, Rogue, and Klamath Rivers. These larger rivers would be crossed using horizontal directional drills to avoid and reduce impacts. The pipeline would also impact over 2,000 acres of forest including over 750 acres of late stage old-growth forest that provides habitat for the marbled murrelet, the northern spotted owl, and other federally-listed threatened and endangered species. Several federally-listed threatened the and endangered species are likely to be adversely affected by the Project. Recreation areas crossed by the pipeline would be temporarily disturbed and users of these areas would likely find construction to be an annoyance and an inconvenience. Vehicle traffic on area roads would increase as well as demand for local services and business, but these increases would be temporary. Following construction, the primary impact of the Project would be the visible nature of the permanent pipeline easement. The visual impact of the easement would be similar to that of other utilities and roadways in the region.

ALTERNATIVES CONSIDERED

As required by the NEPA and in consultation with the cooperating agencies, and considering public comments, we identified and considered reasonable alternatives to the Project to determine if the implementation of an alternative would be preferable to the proposed action. An alternative is considered reasonable if it meets the stated purpose of the Project and is technically and economically feasible and practical. A preferable alternative would offer a significant environmental advantage over the proposed action.

In our alternatives analysis we considered the no action alternative, system alternatives, LNG terminal site alternatives, and pipeline route alternatives and variations. Our analysis considers and the EIS evaluates alternatives developed by staff, developed by the Applicants, or suggested by stakeholders that were able to meet the Project's purpose and were feasible or practical.

Under the No Action alternative, the environmental impacts associated with constructing and operating the Project would not occur. However, exports of LNG from one or more other LNG export facilities may occur if developers elect to apply for export authorization based on these same market considerations. Thus, although the environmental impacts associated with constructing and operating the Project would not occur under the No Action Alternative, impacts could occur at other location(s) in the region as a result of another LNG export project seeking to meet the demand identified by Jordan Cove.

The systems alternatives we considered include existing and proposed LNG terminals in Alaska, Canada, and Mexico; an LNG project currently under construction in Tacoma, Washington; an existing Northwest Pipeline natural gas transmission pipeline system in Oregon; and a non-jurisdictional intrastate pipeline in Coos County. Existing and proposed LNG terminals in Alaska, Canada, and Mexico are too far removed (700 to 3,000 miles) from the interconnections in Klamath County to offer a significant environmental advantage over the proposed action. The Tacoma LNG Project is designed to serve local customers and provide marine vessel fuel and would not meet the Project's stated purpose for export. The Northwest Pipeline system and the Coos County Pipeline have insufficient capacities to meet the design requirements of the proposed pipeline. Modifications to these systems to create such capacity would result in equal or greater environmental impacts and would not offer a significant environmental advantage over the proposed action.

The LNG terminal site alternatives we considered include a site in Humboldt Bay, California; sites in Oregon and Washington; another site in Coos Bay; and an inland site east of Coos Bay. The impacts of constructing an LNG terminal and pipeline to Humboldt Bay would be comparable to that of the proposed Project. Alternative sites in Oregon and Washington would result in greater impacts on the environment. Therefore, alternative LNG terminal sites in California, Oregon, and Washington would not offer a significant environmental advantage over the proposed action. The Coos Bay site alternative would also not offer a significant environmental advantage over the proposed action. The inland site alternative would be located at least 5 miles east of Coos Bay and would require the construction of an LNG cryogenic pipeline to the proposed marine loading facilities. Our analysis indicates that the relocation of the terminal site would reduce, but not eliminate impacts on wetlands; it would also still result in impacts on Coos Bay, and would likely increase overall impacts on the environment due to the need for an LNG cryogenic pipeline. Therefore, an inland alternative would not offer a significant environmental advantage over the proposed action.

Pipeline route alternatives considered include three major route alternatives and nine pipeline route variations. Based on our analysis as described in the EIS, we conclude that one route variation would be preferable to the corresponding proposed action. We are recommending that Pacific Connector incorporate the Blue Ridge Variation into its proposed route for the Project. We have determined that this variation would offer a significant environmental advantage over the proposed action.

The Survey and Manage Species Variation, East Fork Cow Creek Variation, and the Pacific Crest Trail Variation were recommended in the draft EIS, and Pacific Connector has since adopted these variations into the proposed action between the draft and final EIS. The final EIS includes these route modifications in the project description and impact assessment.

CONCLUSIONS

We conclude that constructing and operating the Project would result in temporary, long-term, and permanent impacts on the environment. Many of these impacts would not be significant or would be reduced to less than significant levels with the implementation of proposed and/or recommended impact avoidance, minimization, and mitigation measures. However, some of these impacts would be adverse and significant. Specifically, we conclude that constructing the Project would temporarily but significantly impact short-term housing in Coos County and that constructing and operating the Project would permanently and significantly impact the visual character of Coos Bay. In addition, noise impacts from pile driving at the LNG facility would temporarily, but significantly impact the Coos Bay area. The Project could also have a significant impact on the operations of the Southwest Oregon Regional Airport. Furthermore, constructing and operating the Project is likely to adversely affect 15 federally-listed threatened and endangered species including the marbled murrelet, northern spotted owl, and coho salmon. Additionally, the Project is likely to adversely affect three species proposed for listing. Our conclusions are based wholly or in part on the following factors:

- the Project would be constructed in compliance with all applicable federal laws, regulations, permits, and authorizations;
- the Applicants would implement all best management practices, the measures described in their Erosion Control and Revegetation Plan, Wetland and Waterbody Construction and Mitigation Procedures and Upland Erosion Control, Revegetation, and Maintenance Plans, and other impact avoidance, minimization, and mitigation measures;
- the Applicants' *Compensatory Wetland Mitigation Plan* would satisfy the COE's regulatory requirements to mitigate unavoidable impacts on wetlands and waters of the U.S.;
- the BLM and Forest Service's plan amendments would provide for the crossing of federal lands;
- compliance with the Endangered Species Act would be complete prior to construction;
- a Memorandum of Agreement would be developed with the goal of resolving adverse effects under Section 106 of the National Historic Preservation Act, and compliance with the National Historic Preservation Act would be complete prior to construction;
- the LNG terminal was designed consistent with maximum tsunami run-up elevations and considered tsunami wave heights and inundation elevations;
- the LNG terminal would include protections and safeguards that ensure facility integrity and public safety;

- the Coast Guard issued a Letter of Recommendation indicating the Coos Bay Federal Navigation Channel would be considered suitable for the LNG marine traffic associated with the Project; and
- FERC's environmental and LNG engineering construction inspection programs would ensure compliance with the Applicants' commitments, and the conditions of any FERC Authorization and Certificate.

In addition, we recommend that the Project-specific impact avoidance, minimization, and mitigation measures that we have developed (included in this EIS as recommendations) be attached as conditions to any Authorization and Certificate of Public Convenience and Necessity issued by the Commission for the Project.

1.0 INTRODUCTION

The vertical line in the margin identifies text that is new or modified in the final EIS and differs materially from corresponding text in the draft EIS. Changes were made to address comments from cooperating agencies and other stakeholders on the draft EIS; incorporate modifications to the Project after publication of the draft EIS; update information included in the draft EIS; and incorporate information filed by Jordan Cove Energy Project, L.P. and Pacific Connector Gas Pipeline, LP in response to our recommendations in the draft EIS. As a result of these changes, some of the recommendations identified in the draft EIS are no longer applicable to the Project and do not appear in the final EIS, while some recommendations identified in the draft EIS have been substantively modified in the final EIS, and some new recommendations have been added in the final EIS.

1.1 PROJECT SUMMARY

The staff of the Federal Energy Regulatory Commission (FERC or Commission) prepared this final Environmental Impact Statement (EIS) to describe our assessment of the potential environmental impacts that may occur from constructing and operating the Jordan Cove Liquefied Natural Gas (LNG) Project and Pacific Connector Gas Pipeline Project.

On September 21, 2017 Jordan Cove Energy Project L.P. (Jordan Cove) and Pacific Connector Gas Pipeline, LP (Pacific Connector)[1] filed applications with the FERC pursuant to Sections 3 and 7 of the Natural Gas Act (NGA) to construct and operate an LNG terminal and associated pipeline facilities. A Notice of Application for the Jordan Cove and Pacific Connector Projects[2] was issued by the FERC on October 5, 2017.

In FERC Docket No. CP17-495-000, Jordan Cove seeks an NGA Section 3 Authorization (Authorization) to construct and operate an LNG export terminal in Coos County, Oregon. The terminal would be capable of receiving, processing, and liquefying natural gas[3] into LNG, then storing and loading the LNG onto LNG carriers. The Jordan Cove facilities could receive a

[1] Collectively, Jordan Cove and Pacific Connector are referred to in this EIS as the “Applicant” or the “Applicants”.
[2] Individually, the Jordan Cove proposal may be referred to in this EIS as the Jordan Cove LNG Project, LNG Project, or the Jordan Cove facilities; the Pacific Connector proposal may be referenced similarly, as the Pacific Connector Pipeline Project, Pacific Connector pipeline, or Pipeline Project. Both proposals combined are referred to as the Project.
[3] Natural gas is a fossil fuel, consisting primarily of methane, that is used for a variety of purposes, including electrical generation, home heating and cooking, fuel for motor vehicles, and other industrial/commercial applications. Natural gas is obtained from underground wells and transported from places of production to consumers mainly by way of pipelines. LNG is natural gas that has been cooled to about -260 degrees Fahrenheit (°F). As a liquid, LNG is about 600 times more dense than natural gas in a vapor state and can be stored and transported much more efficiently than the equivalent amount of gas. There are specially designed vessels (referred to as LNG carriers) that can transport LNG overseas from points of origin to customers. Exported LNG can be vaporized at receipt terminals, returned to natural gas, and then transported by pipelines to end-users.

maximum of 1.2 billion cubic feet per day (Bcf/d) of natural gas from the Pacific Connector pipeline and produce a maximum of 7.8 million metric tons per annum of LNG.

In FERC Docket No. CP17-494-000, Pacific Connector seeks a Certificate of Public Convenience and Necessity (Certificate), under NGA Section 7, to construct and operate an approximately 229-mile-long, 36-inch-diameter natural gas transmission pipeline, crossing through Klamath, Jackson, Douglas, and Coos Counties, Oregon.[4] The pipeline would transport about 1.2 Bcf/d of natural gas from interconnections with the existing Ruby Pipeline LLC (Ruby) and Gas Transmission Northwest LLC (GTN) systems[5] near Malin, Oregon to the Jordan Cove terminal.

As specified by the NGA and the Energy Policy Act of 2005 (EPAct), the FERC is responsible for authorizing onshore LNG terminals and natural gas transmission facilities. EPAct also establishes the FERC as the lead federal agency responsible for coordinating applicable federal authorizations and complying with the requirements of the National Environmental Policy Act (NEPA). The FERC's regulations for implementing the elements of the NEPA are at Title 18 Code of Federal Regulations (CFR) Part 380.

Consistent with federal regulations, applicable guidance, and other agreements,[6] the United States (U.S.) Department of the Interior Bureau of Land Management (BLM) Oregon State Office; U.S. Department of Agriculture Forest Service (Forest Service) Pacific Northwest Region; Bureau of Reclamation (Reclamation) Klamath Basin Area Office; U.S. Department of Energy (DOE); U.S. Army Corps of Engineers (COE) Portland District; U.S. Environmental Protection Agency (EPA) Region 10; U.S. Department of the Interior Fish and Wildlife Service (FWS) Oregon Fish and Wildlife Office; U.S. Department of Commerce National Oceanic and Atmospheric Administration's (NOAA) National Marine Fisheries Service (NMFS); U.S. Department of Homeland Security Coast Guard (Coast Guard) Portland (Sector Columbia River); the Coquille Indian Tribe[7]; and the Pipeline and Hazardous Materials Safety Administration (PHMSA) within

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[4] Pacific Connector also requested a blanket certificate to allow for future construction, operation, and abandonment activities under Subpart F of Title 18 Code of Federal Regulations (CFR) Part 157 of the Commission's regulations and requested a blanket certificate to provide open-access transportation services under its tariff in accordance with Subpart G of Part 284.

[5] GTN is owned by TransCanada, while Ruby is owned by Pembina.

[6] May 2002 "*Interagency Agreement on Early Coordination of Required Environmental and Historic Preservation Reviews Conducted in Conjunction With the Issuance of Authorizations to Construct and Operate Interstate Natural Gas Pipelines Certificated by the Federal Energy Regulatory Commission*", signed by the FERC, Advisory Council on Historic Preservation, CEQ, EPA, Department of the Army, Department of Agriculture, Department of Commerce, DOE, Department of the Interior, and USDOT. February 2004 "*Interagency Agreement Among the Federal Energy Regulatory Commission, United States Coast Guard, and Research and Special Programs Administration for the Safety and Security Review of Waterfront Import/Export Liquefied Natural Gas Facilities*." June 2005 "*Memorandum of Understanding Between the United States Army Corps of Engineers and the Federal Energy Regulatory Commission Supplementing the Interagency Agreement on Early Coordination of Required Environmental and Historic Preservation Reviews Conducted in Conjunction with the Issuance of Authorizations to Construct and Operate Interstate Natural Gas Pipelines Certificated by the Federal Energy Regulatory Commission*," executed 30 June 2005.

[7] The Project would be located across ancestral territory of the Coquille Indian Tribe (Coquille Tribe). Due to their continued presence in the area, their modern and historic interest throughout their five-county fee-to-trust / service area, their concern for the land, and their special expertise regarding the natural environment, the Coquille Tribe are participating as a cooperating agency. The Coquille Tribe manages over 10,000 acres of land, primarily as sustainable forest; and provides education assistance, health care, elder services, and housing assistance to its members. The Coquille Tribe provided a unique and invaluable perspective to the development of this EIS.

the U.S. Department of Transportation (USDOT) are cooperating agencies in the development of this EIS. Cooperating agencies have jurisdiction by law or special expertise with respect to any environmental impacts involved in a proposal. The responsibilities of cooperating agencies are summarized in 40 CFR 1501.6, the Council of Environmental Quality (CEQ) regulations for implementing the NEPA.

1.1.1 Previous Proposals

Beginning in 2006, Jordan Cove and Pacific Connector sought to import LNG into a terminal at Coos Bay, Oregon, and transport natural gas through a sendout pipeline to interconnections with existing pipeline systems at the Malin hub.[8] The import terminal and associated sendout pipeline applications were authorized by the Commission with conditions; however, due to changes in the natural gas industry, the facilities were never constructed, and the Commission withdrew its previous approval for the Project.[9] Although the facilities required for the import of LNG are different than those required to export LNG, the original terminal location and footprint and the pipeline route are similar to the current Project proposed in Docket Nos. CP17-494-000 and CP17-495-000.

In 2012, Jordan Cove and Pacific Connector sought to export LNG from a terminal at Coos Bay, Oregon, with an associated feeder pipeline proposed to transport natural gas from existing pipeline systems near Malin.[10] In response to those applications, the Commission issued an Order Denying Applications for Certificate and Section 3 Authorization on March 11, 2016 for Docket Nos. CP13-483-000 and CP13-492-000, and upheld its decision in its Order Denying Rehearing issued December 9, 2016. However, because the denial was without prejudice, Jordan Cove and Pacific Connector were able to file new applications in Docket Nos. CP17-494-000 and CP17-495-000.

1.1.2 Proposed Action

The facilities addressed in this EIS and described further in section 2 are the proposed LNG and pipeline facilities identified by Jordan Cove and Pacific Connector in their respective applications, and are summarized as follows:

<u>LNG Project Facilities</u>:

- an access channel from the existing Coos Bay Federal Navigation Channel to the LNG terminal;
- modifications to the marine waterway, including four dredge locations located adjacent to the Federal Navigation Channel;
- a terminal marine slip containing two berths (one Production Loading Berth and one Emergency Lay Berth), and a dock for tug and escort boats, and a material offloading facility (MOF);
- LNG loading platform and transfer line;
- LNG storage system, consisting of two full-containment storage tanks;

[8] The originally proposed Pacific Connector sendout pipeline (in Docket No. CP07-441-000) would have connected with the existing GTN, Pacific Gas and Electric Company, and Tuscarora pipelines near Malin, Oregon. The original Jordan Cove LNG import project was authorized by the Commission in an “Order Granting Authorizations Under Section 3 and Issuing Certificates” issued on December 17, 2009 in Docket No. CP07-444-000.

[9] On April 16, 2012, the Commission issued an “Order Granting Rehearing in Part, Dismissing Request for Stay, and Vacating Certificate and Section 3 Authorizations” in Docket Nos. CP07-441-000 and CP07-444-000.

[10] Like the current Project, the first LNG export and feeder pipeline proposal had the Pacific Connector pipeline connecting with the existing GTN and Ruby pipelines near Malin, Oregon.

- five natural gas liquefaction trains;
- a pipeline gas conditioning facility;
- Southwest Oregon Regional Security Center (SORSC); and Fire Department building; and
- other security and control facilities, administrative buildings, meteorological station, and other support structures associated with the terminal.

Pipeline Project Facilities:

- a 229-mile-long, 36-inch-diameter welded steel underground pipeline, extending between interconnections near Malin in Klamath County and the Jordan Cove LNG terminal in Coos County, Oregon;
- the Klamath Compressor Station, at the eastern end of the pipeline; and
- other associated facilities (e.g., meters stations, mainline block valves, pig launchers, and communication systems).

The general location of LNG terminal and pipeline facilities are depicted in figure 1.1-1 and section 2.

The primary differences between the previously proposed LNG terminal facilities (in Docket No. CP13-483-000) from the currently proposed Project are as follows:

- The South Dunes Power Plant has been eliminated from the current proposal.
- The locations of the workforce housing facility, the SORSC, and the Project related Fire Department have been relocated.
- New staging areas have been added at Oregon International Port of Coos Bay (Port) Laydown and Boxcar Hill sites.
- The Al Pierce Company (APCO) sites (APCO 1 and 2) would be used for some Project related dredge disposal.
- The number of LNG carriers that would visit the terminal has increased to 110 to 120 vessels per year.
- The proposal now includes the excavation of four submerged areas (removing about 700,000 cubic yards of material) lying adjacent to the existing federally-authorized Federal Navigation Channel, and dredge slurry pipelines in Coos Bay; and
- The habitat mitigation areas at West Jordan Cove and West Bridge locations have been eliminated.

Figure 1.1-1
General Location
Mileposts
Proposed PCGP Route
USBR Klamath Basin Project
BLM District Boundaries
National Forest Boundaries
Federal Lands
BLM
USFS
N
0 4 8 16
Miles
Jordan Cove Meter Station at MP 0.00
Harness Mtn. Comm Tower
Blue Ridge Comm Tower
Signal Tree Comm Tower
Sheep Hill MW
Starveout Creek Comm Tower
Flounce Rock Comm Tower
Robinson Butte Comm Tower
USBR Klamath Basin Project
Stukel Mtn. Comm Tower
Klamath Compressor Station,
Klamath-Eagle Meter Station, and
Klamath-Beaver Meter Station at MP 228.81
Deschutes National Forest
Willamette National Forest
Winema National Forest
Umpqua National Forest
Roseburg
BLM District
Coos Bay
BLM District
Rogue River
National Forest
Winema National Forest
Medford
BLM District
Siskiyou
National
Forest
Winema
National
Forest
Lakeview
BLM District
Rogue River National Forest

The primary differences between the previously proposed pipeline Project (Docket No. CP13-492-000) from the currently proposed Project are as follows:

- Multiple horizontal directional drill (HDD) crossings have been newly proposed, including an approximately 5,200-foot-long HDD crossing under Coos Bay from about mileposts (MP) 0.12[11] to 1.11.
- Multiple route modifications have been made based on detailed civil survey, project design enhancements, and landowner or land-management agency input.
- Increased compression at the Klamath Compressor Station from 41,000 horsepower (hp) to 93,300 hp.
- Elimination of the Clark's Branch Meter Station.

1.2 APPLICANTS' PURPOSE AND NEED

The FERC does not plan, design, build, or operate natural gas transmission infrastructure. As an independent regulatory commission, the FERC reviews proposals to construct and operate such facilities. Accordingly, the project proponent is the source for identifying the purpose for developing, constructing, and operating a project.

In its application, Jordan Cove states the purpose of its Project is to export natural gas supplies derived from existing natural gas transmission systems (linked to the Rocky Mountain region and Western Canada) to overseas markets, particularly Asia.[12] According to Jordan Cove, the Project is a market-driven response to increasing natural gas supplies in the U.S. Rocky Mountain and Western Canada production areas, and the growth of international demand, particularly in Asia.

In its application, Pacific Connector states that the purpose of its Project is to connect the existing natural gas transmission systems of GTN and Ruby with the proposed Jordan Cove LNG terminal.

1.3 FEDERAL AGENCY ROLES AND RESPONSIBILITIES

The NEPA requires all federal agencies to consider the environmental consequences of federal actions or undertakings. The Commission's environmental staff, in partnership with the aforementioned cooperating agencies, has prepared this EIS to comply with the requirements of the NEPA. This EIS discloses and assesses the potential environmental effects that are likely to result from the construction and operation of the Project. In addition to complying with the NEPA, our purposes for preparing this EIS include:

- identify and assess potential impacts on the human environment that would result from the implementation of the proposed action;
- identify and assess reasonable alternatives to the proposed action that would avoid or reduce adverse impacts on the human environment;

[11] Notice that the MPs for the Pacific Connector pipeline in Docket No. CP17-494-000 are reversed from the actual direction of natural gas. Although the natural gas would flow east (from Malin) to west (to Coos Bay) in the current Project, the MPs are numbered from west (0.0. at the Jordan Cove Meter Station) to east (MP 228.8 at the Klamath Compressor Station).

[12] Note that the Commission will consider as part of its decision whether or not to authorize natural gas facilities, all factors bearing on the public interest, including the project's purpose and need. Additional information regarding the Commission's process and considerations in regard to the project's purpose and need are provided in section 1.3.1.

- identify and recommend specific mitigation measures to reduce environmental impacts; and
- facilitate public involvement in identifying significant environmental impacts on specific resources.

The information and analyses presented in this EIS are intended to support subsequent conclusions and decisions made by the Commission and the cooperating agencies. For example, the BLM would use this EIS in its assessments of amendments to the Resource Management Plan (RMP) for the Coos Bay, Roseburg, Medford, and Lakeview Districts, and the Forest Service would use this EIS in its assessments of amendments to the Land and Resource Management Plan (LRMP) for the Umpqua, Rogue River, and Winema National Forests (see figure 1.1-1). In addition, the BLM would use this EIS when considering the issuance of a Right-of-Way Grant to Pacific Connector for a pipeline easement over federal lands, with concurrence from the Forest Service and Reclamation (as further discussed below in sections 1.3.2, 1.3.3, and 4.7). The NMFS would use this EIS when considering the issuance of an authorization pursuant to the Marine Mammal Protection Act of 1972, as amended (MMPA) section 101(a)(5) for the take of marine mammals incidental to the proposed action (as further discussed in section 1.5.1.3).

1.3.1 Federal Energy Regulatory Commission

Sections 3 and 7 of the NGA provide the Commission with the authority to regulate the siting, construction, and operation of onshore LNG terminals, and pipelines engaged in the transportation of natural gas. The Commission would consider the findings in this EIS during its review of Jordan Cove's and Pacific Connector's applications. The identification of environmental impacts related to Project construction and operation, and the mitigation of those impacts, as disclosed in this EIS, would be components of the Commission's decision-making process. The Commission would issue its decision in an Order. The Commission may accept the application in whole or in part, and can attach engineering and environmental conditions to the Order that would be enforceable actions to assure that the proper mitigation measures are implemented.

Specifically, regarding whether to authorize the siting of an LNG terminal under NGA Section 3, the Commission would approve the proposal unless it finds the proposed facilities would not be consistent with the public interest. In considering whether or not to issue a Certificate to a natural gas pipeline under NGA Section 7, the Commission would balance public benefits against potential adverse consequences,[13] as documented in the Order. The Commission bases its decision on technical competence, financing, rates, market demand, gas supply, environmental effects, long-term feasibility, and other issues concerning a proposed project.

1.3.2 U.S. Department of the Interior Bureau of Land Management

The Pacific Connector pipeline would cross portions of four BLM Districts: Coos Bay District (of which about 17.1 miles would be crossed), Roseburg District (crossing about 13.3 miles), Medford District (crossing about 15.2 miles), and Lakeview District (Klamath Falls Resource Area; crossing about 1.3 mile). The BLM anticipates adopting this EIS pursuant to 40 CFR 1506.3(c).

[13] The Commission developed a "Certificate Policy Statement" (see *Certification of New Interstate Natural Gas Pipeline Facilities*, 88 FERC ¶ 61,227 (1999), clarified in 90 FERC ¶ 61,128, and further clarified in 92 ¶ 61,094 (2000)), that established criteria for determining whether there is a need for a proposed project.

The EIS will address potential impacts resulting from the pipeline route crossing BLM land, and potential impacts resulting from BLM RMP amendment that allow the pipeline.

BLM land use planning requirements were established in Sections 201 and 202 of the Federal Land Policy and Management Act of 1976 (FLPMA, 43 United States Code [U.S.C.] 1711-1712) and the regulations in 43 CFR 1600. These laws and regulations require a unit-specific Land Management Plan (LMP) for each BLM administrative management unit (also known as RMP). All projects or activities on BLM land must be consistent with the governing RMP.

Representatives of the BLM have worked cooperatively with the FERC staff and Pacific Connector during pipeline route selection over BLM lands and incorporation of best management practices (BMP) to reduce environmental consequences. The BLM has determined that the Pacific Connector Pipeline Project would not be consistent with certain requirements of the RMPs of the BLM Districts crossed. To address these inconsistencies, the BLM proposes to amend the RMPs to make provision for the Project.

For the BLM, the primary purpose of this EIS is to consider and disclose the environmental consequences of construction and operation of the Pacific Connector pipeline on BLM lands and to evaluate proposed RMP amendments. The need for this EIS arises from the BLM's obligation to respond to the application for a Right-of-Way Grant submitted by Pacific Connector. The BLM will utilize this EIS to consider Pacific Connector's right-of-way application and decide, with concurrence from the Forest Service and Reclamation, to grant, grant with conditions, or deny the Temporary Use Permit and the Right-of-Way Grant. The BLM is also using this EIS process to identify specific stipulations (including project design features and mitigation measures) related to resources within its respective jurisdiction for inclusion in the Right-of-Way Grant.

The BLM has identified suites of "Project Design Features" or "Project Requirements" that are deemed necessary to accomplish the management objectives and direction in the respective RMPs.[14] The project design features or requirements specific to the pipeline crossing of BLM lands are included as attachments to Pacific Connector's Plan of Development (POD). There are 28 attachments to the POD; these include draft monitoring elements as needed to ensure that the wide array of actions are implemented and to assess the effectiveness of the actions relative to the management objectives and direction in the respective RMPs. Collectively, the POD is incorporated into the Project's description and provided in appendix F.10 of this EIS.

In the 2015 EIS that evaluated the Pacific Connector Project, the BLM had required a compensatory mitigation plan to offset the unavoidable adverse impacts of the Project. This offsite mitigation plan would have been included in the Right-of-Way Grant, had the grant been approved. The BLM issued new policy and agency guidance regarding the imposition of offsite compensatory mitigation within the December 6, 2018 Instruction Memorandum (IM) No. 2019-018, which superseded the July 24, 2018 in IM No. 2018-093.[15] The policy states: "Except where

[14] The BLM, Forest Service, and Reclamation use the term "Project Design Features" or "Project Requirements" rather than "mitigation" to describe elements of a plan that occur within the area of authorized project construction, operation, and decommissioning activities and are standard requirements of a project. The BLM and Forest Service reserve the term "mitigation" to describe measures taken to reduce or compensate for otherwise unavoidable impacts. The term "mitigation" as used elsewhere in this EIS refers to the full range of activities designed to reduce adverse effects of the Project.

[15] The new IM is essentially the same as the earlier version except that the BLM may consider mitigation if it is required by state law.

the law specifically requires or as described in this IM, the BLM must not require compensatory mitigation from public land users. While the BLM will consider voluntary proposals for compensatory mitigation, and state-mandated compensatory mitigation, the BLM will not accept any monetary payment to mitigate the impacts of a proposed action." The policy does not affect compensatory mitigation required under federal laws other than the FLPMA, or the ability of any state government, or other non-federal party, to require and enforce mandatory compensatory mitigation as authorized under state law. This new policy addresses compensatory mitigation and does not affect the Project design features and Project requirements that are contained in the POD.

The BLM will continue to coordinate with the Applicant on the voluntary compensatory mitigation they have proposed, and with other federal and state agencies that identify compensatory mitigation as a matter of law on lands managed by the BLM. Any compensatory mitigation that is developed as a result of this coordination would be attached to the POD and included in the Right-of-Way Grant if the grant is approved. This EIS includes, as appendix F.12, the *Compensatory Mitigation Plan* (CMP) submitted by the Applicant, and table 2.1.4.1-1 lists specific projects from that plan that are proposed on lands managed by BLM.

The BLM Oregon State Director is the authorized officer for decisions related to amendments of the respective BLM RMPs, issuance of the Temporary Use Permit, and issuance of a Right-of-Way Grant, if authorized.

1.3.3 U.S. Department of Agriculture Forest Service

The Pacific Connector pipeline route would cross portions of the Umpqua, Rogue River, and Winema National Forests (see figure 1.1-1). As a cooperating agency, the Forest Service anticipates adopting this EIS pursuant to 40 CFR 1506.3(c).

Forest Service land use planning requirements were established by the National Forest Management Act (NFMA) and the regulations in 36 CFR 219. These laws and regulations require a unit-specific LMP for each National Forest (LRMPs). All projects or activities within a National Forest must be consistent with the governing LRMP.

On December 15, 2016, the Department of Agriculture Under Secretary for Natural Resources and Environment issued a final rule that amended the 36 CFR 219 regulations pertaining to National Forest System Land Management Planning (the planning rule) (81 Federal Register [FR] 90723, 90737). The amendment to the 219 planning rule clarified the Department's direction for amending LRMPs. The Department of Agriculture Under Secretary of Natural Resources and Environment also added a requirement for amending a plan for the responsible official to consider "which substantive requirements of §§ 219.8 through 219.11 are likely to be directly related to the amendment" (36 CFR 219.13(b)(2), 81 FR at 90738). Whether a rule provision is directly related to an amendment is determined by any one of the following: the purpose for the amendment, a beneficial effect of the amendment, a substantial adverse effect of the amendment, or a lessening of plan protections by the amendment.

Representatives of the Forest Service have worked cooperatively with the FERC staff and Pacific Connector during pipeline route selection over Forest Service lands and incorporation of BMPs to reduce environmental consequences. The Forest Service has determined that the linear nature of the Pacific Connector Pipeline Project would not be consistent with certain requirements of the

LRMPs of the National Forests crossed. To address these inconsistencies, the Forest Service proposes to amend the LRMPs of the respective National Forests to make provision for the Project.

For the Forest Service, the primary purpose of this EIS is to consider and disclose the environmental consequences of construction and operation of the Pacific Connector pipeline on National Forest System (NFS) lands and to evaluate proposed LRMP amendments. The Forest Service will use this EIS to assess which, if any, substantive requirements of the planning rule are likely to be directly related to the amendment. The Forest Service is also using this EIS process to identify specific stipulations (including project design features and mitigation measures) related to resources within their jurisdiction for inclusion in the Right-of-Way Grant.

The Forest Service has identified suites of "Project Design Features" or "Project Requirements" that are deemed necessary to accomplish goals and objectives of the respective LRMPs. The project design features or requirements specific to the pipeline crossing Forest Service lands are included as attachments to Pacific Connector's POD. There are 28 attachments to the POD; each of these includes draft monitoring elements to ensure that the wide array of actions are implemented and assess the effectiveness of the actions relative to the goals and objectives of the respective LRMPs. Collectively, the POD is incorporated into the Project's description and included in appendix F.10. The Forest Service would require a CMP be developed for implementation on lands they manage and would require that this CMP be attached to the POD. This CMP would focus on off-site actions such as reallocation of land from the Matrix land allocation to the Late Successional Reserve (LSR) land allocation, placement of large woody debris (LWD), snag creation, stand density/fuels reduction, road resurfacing and decommissioning, culvert replacement, stream crossing repairs, invasive weed control, pre-commercial thinning, fire suppression facilities development, and meadow restoration.

Although these compensatory mitigation actions required by the Forest Service (which are summarized in section 2.1.4.2 of this EIS and described in appendix F of this EIS) are specific in terms of activity and location, this EIS addresses them in a programmatic fashion. Many of these mitigation actions may require additional analyses and surveys to comply with the NEPA and ensure consistency with LRMPs. The Forest Service anticipates that this EIS would provide the basis for tiering subsequent site-specific NEPA analyses, in accordance with the CEQ regulations at 40 CFR 1508.28(b). The Forest Service would conduct any needed supplemental environmental analysis and consultation efforts with various federal, state, and local entities, as well as tribal governments, prior to authorizing future site-specific mitigation actions described in the CMP. Environmental compliance for these mitigation actions could be concurrent with authorized project actions.

The Forest Supervisor for the Umpqua National Forest is the authorized officer for decisions related to amendments of Forest Service LRMPs and issuance of a concurrence letter for a right-of-way grant to BLM, if warranted.

1.3.4 U.S. Department of the Interior Bureau of Reclamation

The Pacific Connector pipeline route would cross a portion of Reclamation's Klamath Basin Project area (see figure 1.1-1). As a cooperating agency, Reclamation anticipates adopting this EIS pursuant to 40 CFR 1506.3(c). Although Reclamation's Klamath Basin Area is not subject to an LMP, the agency has also worked closely with the FERC staff and Pacific Connector to address issues related to the siting, construction, and operation of the pipeline where it would cross

Reclamation lands and facilities that are part of Reclamation's Klamath Irrigation Project. These procedures are outlined in the POD, including Pacific Connector's *Klamath Project Facilities Crossing Plan* (Attachment O of the POD) and its *Winter Construction Plan for the Klamath Basin* (Appendix E.1 attached to Resource Report 1 of Pacific Connector's application to the FERC).

Reclamation and Pacific Connector have not identified specific mitigation projects at this time; therefore, Reclamation may conduct additional environmental compliance activities to meet their responsibilities under the NEPA and other federal laws and regulations prior to implementation of any mitigation requirements specific to Reclamation jurisdiction. The Responsible Official for Reclamation regarding issuance of a concurrence letter for a right-of-way grant to the BLM, if warranted, is the Area Manager of Reclamation's Mid-Pacific Region Klamath Basin Area Office.

1.3.5 U.S. Department of Energy

The DOE's Office of Fossil Energy (DOE/FE) may adopt this EIS to consider the environmental effects associated with its decision whether to authorize the export of LNG, as proposed by Jordan Cove, to countries with which the United States does not have a free trade agreement (FTA) requiring national treatment for trade in natural gas. The purpose and need for the DOE/FE action is to respond to the application filed by Jordan Cove with the DOE/FE to export LNG to non-FTA countries. The DOE/FE must meet its obligations under Section 3 of the NGA, to authorize the import and export of natural gas, including LNG, unless it finds that the proposed import or export would not be consistent with the public interest. The DOE/FE's authority to regulate the export of the natural gas commodity arises from Section 3 of the NGA. By law, under Section 3(c) of the NGA, applications to export natural gas to countries with which the United States has FTAs that require national treatment for trade in natural gas are deemed to be consistent with the public interest and the Secretary of the DOE must grant authorization without modification or delay. In the case of applications to export LNG to non-FTA nations, NGA Section 3(a) requires the DOE/FE to conduct a public interest review and to grant the applications unless the DOE/FE finds that the proposed exports will not be consistent with the public interest. Additionally, DOE/FE must consider the environmental effects of its decisions regarding applications to export natural gas to non-FTA nations.

On September 22, 2011, Jordan Cove filed an application with the DOE/FE seeking authorization to export up to 1.2 Bcf/d of natural gas converted to LNG from its proposed terminal at Coos Bay, Oregon to FTA nations. The DOE/FE issued its *Order Granting Long-Term Multi-Contract Authorization to Export Liquefied Natural Gas by Vessel from the Jordan Cove LNG Terminal to Free Trade Agreement Nations* on December 7, 2011, in DOE/FE Docket No. 11-127-LNG (DOE/FE Order No. 3041).

On March 23, 2012, Jordan Cove filed an application with the DOE/FE, in DOE/FE Docket No. 12-32-LNG, seeking authorization to export LNG to non-FTA nations. The DOE/FE issued its *Order Conditionally Granting Long-Term Multi-Contract Authorization to Export Liquefied Natural Gas by Vessel from the Jordan Cove LNG Terminal in Coos Bay, Oregon to Non-Free Trade Agreement Nations* (DOE/FE Order No. 3413) on March 24, 2014. This Order would allow Jordan Cove to export up to the equivalent of 438 Bcf/year of natural gas, in the form of LNG, for 30 years after either the first shipment or 10 years after the date of the Order. The LNG may be exported to any country with which the United States does not have an FTA, which currently has or in the future could develop the capacity to import LNG, and with whom trade is not prohibited by United States law or policy. The authorization was conditioned on the satisfactory completion of the environmental review process in FERC Docket Nos. CP13-483-000 and CP13-492-000, to comply with the NEPA, and on issuance by DOE/FE of findings of no significant impact or a record of decision (ROD) pursuant to the NEPA. Jordan Cove would have to also comply with all preventive and mitigation measures required by federal and state agencies for the Project. Under that conditional authorization, Jordan Cove must also file with the DOE/FE copies of executed long-term contracts for both natural gas supply and the export of LNG.

Jordan Cove submitted an amendment to its FTA application and non-FTA application on February 6, 2018 to reflect the new export capacity of the LNG terminal under the current proposal. The DOE/FE authorized Jordan Cove's amended request for export to FTA countries on July 20, 2018, reflecting a new authorized export volume of approximately 395 Bcf/year over a 30-year term, beginning on the earlier of the date of first export or 10 years from the date of the amended authorization. The DOE/FE is currently reviewing this amendment in regard to exports to non-FTA countries. If export to non-FTA countries is approved, this authorization would be considered a new authorization that supersedes the previous conditional authorization.

Because the Project may involve actions in floodplains, in accordance with 10 CFR Part 1022, *Compliance with Floodplain and Wetland Environmental Review Requirements,* this EIS includes a floodplain assessment. A floodplain statement of findings would be included in any DOE/FE determinations. Section 4.3 of this EIS discusses elements of the Project that may be within floodplains, so that the FERC, as lead federal agency, can document compliance with Executive Order (EO) 11988.[16]

1.3.6 U.S. Army Corps of Engineers

The COE exerts regulatory authorities over waters of the United States pursuant to Sections 9, 10, and 14 (i.e., Section 408) of the Rivers and Harbors Act of 1899 (RHA), Sections 404 of the Clean Water Act (CWA), and Section 103 of the Marine Protection Research and Sanctuaries Act of 1972 (MPRSA). The laws and regulations underpinning the COE's actions are further discussed below in section 1.5 and table 1.5.1-1. The agency's purpose for participating in the development of the EIS is to streamline the COE's review of the Applicant's Regulatory and Section 408 application evaluation processes by working with the FERC to eliminate duplication of efforts. The EIS can reduce duplications of efforts in COE permit and permission reviews for the Project by allowing the FERC to be the lead federal agency and fulfill obligations for compliance with a variety of federal environmental laws. The COE may adopt the EIS for the purposes of exercising its regulatory authorities.

Approval from the COE is required for alterations to, or to temporarily or permanently occupy or use, any COE federally authorized civil works project pursuant to Section 408 of the RHA. Proposed alterations must not be injurious to the public interest or affect the COE project's ability to meet its authorized purpose. The Project as currently proposed may affect multiple COE civil works projects including the Coos Bay Federal Navigation Channel or other designated navigation channels (e.g., the Coos River where a proposed HDD would occur), the federal pile dike structures west of the proposed slip (where a rock apron is currently proposed to reduce impacts on this

[16] EO 11988, *Floodplain Management*, requires federal agencies to avoid adverse impacts associated with the occupancy and modification of floodplains, and to avoid floodplain development wherever there is a practicable alternative. The objectives of the EO include the minimization of impacts from floods resulting from agency actions, and the preservation of floodplains where possible. While the FERC, as an independent commission, is not subject to EOs, the other federal permitting agencies must confirm compliance.

structure), and a 40-acre multi-use COE real estate easement located partially within the proposed LNG terminal site (i.e., Ingram Yard). Placement of the rock apron would require Jordan Cove to obtain a temporary construction license from the COE, and for construction of the Project terminal, Jordan Cove would need the COE to grant consent over the 40-acre easement at the terminal location, in the form of consent agreements with the landowners (i.e., Fort Chicago Holdings II US LLC and Roseburg Forest Products). The COE is currently reviewing the current Applicant proposal to determine if these Project-related effects to the civil works projects would constitute an injury to the public interest or affect the COE project's ability to meet its authorized purpose or impair its usefulness.

The COE is currently evaluating a permit application from Jordan Cove and Pacific Connector to conduct work and/or construct structures in navigable waters of the U.S. pursuant to Section 10 of the RHA and to discharge dredged and fill material into waters of the U.S. pursuant to Section 404 of the CWA. The COE's involvement in the EIS process may assist the COE in complying with the NEPA, informing the COE's public interest determination, and informing the COE's evaluation of the Applicant's proposal pursuant to the CWA 404(b)(1) Guidelines.

1.3.7 U.S. Environmental Protection Agency

The EPA has responsibilities under the Clean Air Act (CAA), CWA, and MPRSA (see section 1.5.1 of this EIS for more details). The EPA shares responsibility for administering and enforcing Section 404 of the CWA with the COE and has authority to veto COE permit decisions.

In addition, Section 309 of the CAA directs the EPA to review and comment in writing on the environmental effects associated with all major federal actions. This obligation is independent of its role as a cooperating agency under NEPA regulations. Consistent with this direction, the EPA evaluates all federally issued EISs for adequacy in meeting the procedural and public disclosure requirements of the NEPA.

1.3.8 U.S. Fish and Wildlife Service and National Marine Fisheries Service Review

The FWS and NMFS are charged with the protection of federally-listed threatened and endangered species as described in the Endangered Species Act (ESA) of 1973, as amended. As requested, the FWS and NMFS will consult with the lead federal agency (i.e., the FERC) for actions that may affect ESA-listed species and/or critical habitats. The FWS and NMFS also have the authority under the Fish and Wildlife Coordination Act of 1934 (FWCA), as amended, to review applications for CWA Section 404 and Section 401 permits. The FWS has authority under the Bald and Golden Eagle Protection Act of 1940, as amended (Eagle Act), to protect bald and golden eagles, and to issue permits for actions that would negatively affect eagles or their nests. The FWS also has authority under the Migratory Bird Treaty Act of 1918, as amended (MBTA) to conserve migratory birds; EO 13186 encourages federal agencies to consider conservation actions for birds in the course of their operations, documented in Memoranda of Understanding (MOU). The NMFS has the authority under the Magnuson-Stevens Fishery Conservation and Management Act of 1976, as amended (MSA) and MMPA to review a project's effects on essential fish habitats (EFH) and to protect marine mammals, respectively. The process for review and potential subsequent authorizations under each law are described further in section 1.5.1.

1.3.9 U.S. Department of Homeland Security Coast Guard

The Coast Guard serves as a subject matter expert for and providing recommendations on the maritime safety and security aspects of the Project. The Coast Guard does not issue a permit, license, order, or record of decision in this context, but is responsible for assessing the suitability of the waterway and issuing a Letter of Recommendation (LOR).

The Coast Guard exercises regulatory authority over LNG facilities that affect the safety and security of port areas and navigable waterways under EO 10173; the Magnuson Act; the Ports and Waterways Safety Act of 1972, as amended; and the Maritime Transportation Security Act of 2002. The Coast Guard is responsible for matters related to navigation safety, vessel engineering and safety standards, and all matters pertaining to the safety of the facilities or equipment located in or adjacent to navigable waters up to the last valve immediately before the LNG storage tanks. The Coast Guard also has authority for LNG facility security plan review, approval, and compliance verification, and siting as it pertains to the management of vessel traffic in and around the LNG facility. As required by its regulations, the Coast Guard is responsible for issuing an LOR as to the suitability of the waterway for LNG marine traffic.

On June 14, 2005, the Coast Guard issued a Navigation and Vessel Inspection Circular (NVIC), *Guidance on Assessing the Suitability of a Waterway for Liquefied Natural Gas (LNG) Marine Traffic* (NVIC 05-05). The purpose of the NVIC 05-05 is to provide Coast Guard Captains of the Port (COTPs)/Federal Maritime Security Coordinators, members of the LNG industry, and port stakeholders with guidance on assessing the suitability of a waterway for LNG marine traffic that takes into account conventional navigation safety/waterway management issues contemplated by the existing Letter of Intent (LOI)/LOR process. In addition, maritime security implications were also considered. In accordance with this guidance, each LNG project Applicant is to submit a Waterway Suitability Assessment (WSA) to the cognizant COTP. On December 22, 2008, the Coast Guard published a second NVIC, *Guidance Related to Waterfront Liquefied Natural Gas (LNG) Facilities* (NVIC 05-08; Coast Guard 2008). The purpose of NVIC 05-08 was to revise the format of the LOR to conform to its intended effect of being a recommendation of the waterway suitability to the FERC. NVIC 05-08 is further discussed in section 4.13. On January 24, 2011, the Coast Guard published a third NVIC: *Guidance Related to Waterfront Liquefied Natural Gas (LNG) Facilities* (NVIC 01-2011). The purpose of NVIC 01-2011 was to revise the format of the LOR to conform to its intended effect of being a recommendation to the FERC as to the suitability of the waterway. In this NVIC, the Coast Guard has added guidance on release of the LOR and message management and provided an updated template for the LOR analysis.

The Waterway Suitability Report (WSR) for the Jordan Cove LNG Project was issued pursuant to NVIC 05-05. The final review and LOR were issued pursuant to NVIC 05-08, which replaced NVIC 05-05. NVIC 05-08 eliminated the term WSR and replaced it with "Letter of Recommendation (LOR) Analysis." For the purpose of clarity, the WSR is equivalent to the LOR Analysis. Section 813 of the Coast Guard Authorization Act of 2010 requires the Coast Guard to consider recommendations made by the States prior to making a recommendation to the FERC on the suitability of the waterway for marine traffic associated with an LNG facility. Although this law was effective after the WSR and LOR were issued, the Oregon Department of Energy (ODE) (as lead State agency) was an active participant in the WSA validation committee and concurred with the verbiage of the WSR and LOR.

On January 13, 2014, Jordan Cove forwarded its most recent annual review of the WSA to the Coast Guard, who responded on February 14, 2014, with the following statement: "we have no objection to your conclusion that the minor changes do not change the risk associated with the waterway or the facility as originally evaluated in your 2007 WSA." On February 27, 2014, the Coast Guard accepted the annual review of the WSA for the Jordan Cove LNG Project. On January 23, 2017, the Coast Guard accepted the Project's existing WSA as it relates to the new proposed project and stated that a new "Follow-On" WSA is not required.[17] On May 10, 2018, a revised LOR was issued, in which the Coast Guard stated that "the Coos Bay Channel be considered suitable for accommodating the type and frequency of LNG marine traffic associated with this project." On November 7, 2018, the Coast Guard confirmed that the vessel transit simulation studies conducted by Jordan Cove demonstrated that Jordan Cove could use any class of LNG carrier (membrane, Moss, or segregated ballast tanks) with physical dimensions equal to or smaller than those observed during the simulated transits.

1.3.10 U.S. Department of Transportation

The USDOT has prescribed the minimum federal safety standards for LNG facilities in compliance with 49 U.S.C. 60101. Those standards are codified in 49 CFR 193 and apply to the siting, design, construction, operation, maintenance, and security of LNG facilities. The National Fire Protection Association (NFPA) Standard 59A, Standard for the Production, Storage, and Handling of Liquefied Natural Gas (2001 ed.), is incorporated into these requirements by reference, with regulatory preemption in the event of conflict. In accordance with the 2004 Interagency Agreement, the USDOT participates as a cooperating agency on the safety and security review of waterfront import/export LNG facilities. The USDOT does not issue a permit or license but, as a cooperating agency, assists FERC staff in evaluating whether an Applicant's proposed siting criteria meets the USDOT requirements in Part 193, Subpart B. On August 31, 2018, the USDOT and FERC signed a new MOU to improve coordination throughout the LNG permit application process for FERC jurisdictional LNG facilities. Under the 2018 MOU, the USDOT issues a Letter of Determination (LOD) determining whether a proposed LNG facility is capable of complying with Part 193, Subpart B, Siting (see section 4.13 of this EIS). The LOD is provided to the Commission for consideration in its decision on the Project application. The USDOT also has the authority to enforce safety regulations and standards related to the design, construction and operation of natural gas pipelines, under the Natural Gas Pipeline Safety Act. The USDOT would also monitor the construction and operation of the natural gas facilities to determine compliance with its design and safety standards.

1.3.11 Federal Aviation Administration (FAA)

The FAA is a federal agency under the USDOT, which has the authority to regulate all aspects of civil aviation. The FAA is responsible for enforcing the elements of 14 CFR 77 (i.e., Objects Affecting Navigable Airspace), which would include an assessment of whether the proposed project could represent a hazard to aircraft at the Southwest Oregon Regional Airport.

1.4 PUBLIC REVIEW AND COMMENTS

On January 23, 2017 Jordan Cove and Pacific Connector filed a request to implement the Commission's Pre-filing Process for the Project. The FERC established the Pre-filing Process to

[17] The WSA is considered Sensitive Security Information and is therefore not publicly releasable. Public documents related to the Coast Guard's determination can be found in appendix B of this EIS.

encourage early involvement of interested stakeholders, facilitate interagency cooperation, and identify and resolve environmental issues before an application is filed with the FERC and facility locations are formally proposed. The FERC granted this request to use the Pre-filing Process on February 10, 2017 and established pre-filing Docket No. PF17-4-000 for the Project.

Prior to and during the Pre-filing Process, Jordan Cove and Pacific Connector contacted federal, state, and local agencies to inform them about their respective projects and discuss project-specific issues and concerns. The Applicants initiated contact with potentially affected landowners prior to entering the FERC Pre-filing Process. These initial contacts were in the form of a letter describing each Applicant's project and seeking permission to conduct environmental and cultural resource surveys on landowner property. Jordan Cove held an Open House meeting in North Bend on March 21, 2017. Pacific Connector held additional Open House meetings in Canyonville, Medford, and Klamath Falls during the week of March 22, 2017. These Open House meetings were advertised to the public through notices published in local newspapers. The FERC staff as well as the BLM, Forest Service, and COE attended these Open House meetings and were available to answer questions from the public regarding the FERC and NEPA process.

On June 9, 2017, the FERC issued a *Notice of Intent to Prepare an Environmental Impact Statement for the Planned Jordan Cove LNG Terminal and Pacific Connector Pipeline Projects, Request for Comments on Environmental Issues, and Notice of Public Scoping Sessions* (Notice of Intent, or NOI). The NOI was sent to affected landowners; federal, state, and local government agencies; elected officials; environmental and public interest groups; interested Indian tribes; and local libraries and newspapers. The NOI described the Project; listed currently identified environmental issues; outlined the proposed actions of the DOE, BLM, and Forest Service; discussed the scoping and environmental review process; announced the date, location, and time of public scoping sessions; and explained how the public could participate in the review process and comment on the Project.

During the week of June 27, 2017, the FERC, BLM, and Forest Service held joint public scoping sessions in Coos Bay, Roseburg, and Klamath Falls to receive comments about the Project.[18]

Throughout the Pre-filing Review Process, we received comments on a wide variety of environmental issues. Between February 10, 2017 (when pre-filing was initiated) and July 10, 2017 (i.e., the end of the announced scoping period), we received more than 5,100 comments. These comments were provided via 1,174 discrete comment letters/documents; including 1,028 letters from individuals, 55 letters from non-governmental organizations, 1 letter from a federal agency, 16 letters from state and local agencies, 64 letters from private companies, 2 letters from members of the U.S. Congress, and 8 letters from federally recognized Tribes. We also received 462 form letters during this time. In addition, between July 10, 2017, and issuance of this EIS, the FERC received more than 3,700 additional comments contained within over 700 discrete documents, and an additional 14 form letters. All comments received in the Commission's administrative record prior to the writing of the EIS were considered. The analysis in the EIS addressed all relevant environmental topics raised during scoping.

Table 1.4-1 categorizes environmental issues raised in letters to the FERC and considered in the draft EIS. The table does not account for the out-of-scope issues (as discussed below) and general

18 Transcripts of all of the public scoping meetings for this Project were placed into the FERC public record for the proceedings.

environmental concerns or non-specific comments. The most frequently expressed comments concerned land use, purpose and need, safety and security; potential geological/topographical hazards, and the FERC's approach to the NEPA process (e.g., length of scoping periods, number of public meetings, etc.).

TABLE 1.4-1

Environmental Issues Identified During the Pre-filing Public Scoping Process for the Jordan Cove and Pacific Connector Project

Specific Issue/Comment	EIS Section Where Comments are Addressed
Purpose and Need, and FERC Process/NEPA Process/State Process .	1.0
Comments about scoping period and meeting locations.	
Project Description	**2.0**
Life of Project, decommissioning	
Concerns over temporary work areas (TEWAs), uncleared storage areas	
BLM, Forest Service, and FERC process	
Alternatives	**3.0**
Comments urging that investments be redirected towards renewable, domestic energy sources such as wind, solar and wave power.	
Request rigorous analysis of pipeline route alternatives (evaluate more than action/no-action)	
Geologic Hazards	**4.1**
Regional seismic activity (earthquake and/or tsunami) on the export terminal or pipeline.	
Soils and Minerals	**4.2**
Concerns over erosion of sensitive soils.	
Sedimentation of streams as a result of soil disruption	
Soil and slope stability along the pipeline route.	
Water Resources	**4.3**
Effects of construction and operation of the project elements, including export terminal facilities and pipeline crossings, on surface water and groundwater, including drinking water and salmon spawning habitat, and especially that of the Rogue River.	
Concerns over horizontal directional drilling under streams and rivers along the pipeline route.	
Concerns over hydrostatic testing of the pipeline.	
Wetlands and Riparian Areas	**4.3**
Effects on sensitive wetlands in the vicinity of the export terminal and pipeline.	
Biological Resources	**4.4, 4.5, and 4.6**
Effects on threatened and endangered species.	
Effects on fisheries and EFH.	
Effects on wildlife habitat, including connectivity.	
Effects on pipeline construction on forestlands, including sensitive forest types.	
Introduction and propagation of noxious weeds in the pipeline ROW.	
Land Use and Recreation	**4.7 and 4.8**
Location of access roads, hydrostatic test locations, uncleared storage areas, cleared areas.	
Effects on recreational opportunities, recreation-based tourism.	
Comments supporting and opposing the use of federal lands for the pipeline corridor.	
Comments making specific pipeline alignment adjustments (generally to avoid private properties, also to avoid resources.	
Concerns over BLM and Forest Service LMP Amendments.	
BLM and Forest Service Plan Amendments, and associated mitigation/restoration requirements	

TABLE 1.4-1 (continued)

Environmental Issues Identified During the Pre-filing Public Scoping Process for the Jordan Cove and Pacific Connector Projects

Specific Issue/Comment	EIS Section Where Comments are Addressed
Visual Resources	**4.8**
Concerns over specific views, typically from private properties.	
Socioeconomics	**4.9**
Opposition to use of eminent domain to acquire pipeline easements, especially when some land uses would not be allowed or practicable once the pipeline is installed.	
Comments supporting and opposing the creation of local jobs; reconcile with environmental effects and safety risks involved.	
Effects on the local economy, including anticipated drop in tourism (fishing, birding).	
Concerns over application of eminent domain.	
Concerns over decreased property values.	
Temporary housing and local housing availability.	
Transportation	**4.10**
Effects and risks of proximity to the Southwest Oregon Regional Airport.	
Cultural Resources	**4.11**
Effects on tribal lands and lands traditionally used by tribal members.	
Request outreach to the tribes.	
Air Quality and Noise	**4.12**
Effects on climate change.	
Concerns over operations emissions of the LNG carriers and terminal on local communities (respiratory health).	
Safety and Security/Public Health/Monitoring and Accountability/Siting	**4.13**
Risk of catastrophic events, either accidental, intentional (terrorism) or as a result of a natural disaster on the export terminal, LNG carriers or the pipeline.	
Availability and readiness of emergency response personnel in the event of a catastrophic incident, especially in remote areas.	
Concerns over the health effects of spilled or leaked gas on nearby communities.	
Emergency response planning (tsunami, earthquake).	
Concerns over pipeline weakness, potential for leak or explosion leading to wildfire.	
Concerns over rural pipeline safety, including non-odorized gas and construction standards.	
Monitoring and mitigation; accountability and responsibility.	
Cumulative Impacts	**4.14**
Effects of increased marine traffic.	
Effects from other energy projects.	

The BLM and Forest Service also reviewed scoping comments to identify any concerns specific to their proposed plan amendments and the Forest Service's mitigation actions. Comments were received that addressed concerns about the Forest Service planning regulations that govern amending LRMPs as well as the need for further detail on proposed BLM plan amendments. Comments were also received that identified concerns regarding the proposed mitigation actions of the BLM and Forest Service and the need for additional alternatives that would avoid impacts on areas such as LSRs and riparian areas. These issues are addressed in more detail in a scoping report prepared by the BLM and Forest Service in appendix F.8 (Federal Lands Review) of this EIS.

The FERC issued a Notice of Availability (NOA) of the draft EIS on March 29, 2019. The NOA established a 90-day comment period ending on July 5, 2019. The 90-day comment period was established to meet public review requirements of the BLM for the proposed amendments to BLM and Forest Service LMPs. A formal notice was also published by the EPA in the *Federal Register* on April 5, 2019, indicating that the draft EIS was available.

Public comment sessions on the draft EIS were held in Coos Bay on June 24, 2014; Myrtle Creek on June 24, 2019; Medford on June 26, 2019; and Klamath Falls on June 27, 2019. Transcripts of the sessions were placed in the public record for these proceedings.[19]

Between the issuance of the NOA for draft EIS on March 29, 2019, and the close of the comment period on July 5, 2019, FERC received approximately 1,449 individual written letters commenting on the draft EIS, including 3 letters from federal agencies, 3 letters from state agencies (including one combined letter from various Oregon state agencies); 27 letters from federal and state senators and congressmen; 12 letters from a local government agencies and officials; 7 letters from Indian tribes; 106 letters from companies and organizations (including multiple submittals that combined letters from different organizations/individuals under one accession number); and 1,291 letters from individuals (which also included submittals that combined letters from different individuals under one accession number).

Additionally, of the comments received, numerous individuals and organizations raised issues that are outside the scope of this EIS. Examples of out-of-scope issues include comments regarding the public benefit or need to export LNG (by a Canadian company); comments on the State's permitting process; history of the Project (multiple applications) and its effect on communities; horizontal hydraulic drilling through shale formations during exploration for natural gas (often referred to as "fracking"); induced production of natural gas; number and percentage of easement agreements; downstream greenhouse gas emissions resulting from the combustion of exported gas; the concept of a "programmatic" EIS to cover LNG export terminals throughout the United States; the structure and format of FERC public meetings; the availability of hard copies of the draft EIS; the differences between "FERC Recommendations" versus "FERC Conditions"; and administrative information technology system operations at the FERC. These issues are not addressed in this EIS. As appropriate, some of these issues may be addressed in any Order the Commission may issue.

A summary of the comments from the public sessions, as well as written comments on the draft EIS submitted by the public and agencies, are provided along with our responses in appendix R. All comments received have been considered, and as appropriate, we have made changes in this final EIS to address substantive comments raised.

In accordance with the CEQ's regulations implementing the NEPA, no agency decision on a proposed action may be made until 30 days after the EPA publishes an NOA of the final EIS. However, the CEQ regulations provide an exception to this rule when an agency decision is subject to a formal internal process that allows other agencies or the public to make their views known. In such cases, the agency decision may be made at the same time the notice of the final EIS is published, allowing both periods to run concurrently. Should the Commission issue an Order

[19] Copies of the transcripts of the public sessions to take comments on the draft EIS were placed into the dockets through the FERC's eLibrary system. See Accession Nos. 20190624-4003, 20190625-4001, 20190626-4005, and 20190627-4004.

authorizing the Project, it would be subject to a 30-day rehearing period. Therefore, the Commission could issue its decision concurrently with the EPA's NOA.

This final EIS includes BLM Proposed Plan Amendments to the Northwest and Coastal Oregon Record of Decision and Resource Management Plan (BLM 2016a) and the Southwestern Oregon Record of Decision and Resource Management Plan (BLM 2016b) and the BLM Proposed Right-of-Way Action, in response to an Application for Right-of-Way submitted by Pacific Connector Gas Pipeline, LP. These BLM Proposed Actions are described in section 2.1.1.1 of this final EIS and incorporate several specific FERC-recommended route variations and conditions.

In accordance with the FLPMA, the Proposed Plan Amendments are subject to administrative protest. BLM planning regulations at 43 CFR 1610.5-2 describe the protest procedures and state that any person who meets the conditions, as described in the regulations, may protest the BLM's Proposed RMP Amendments. A person who meets the conditions and files a protest must file the protest within 30 days of the date that the EPA publishes its Notice of Availability of the final EIS in the Federal Register. This administrative protest period is specific to the BLM Proposed Plan Amendments and is offered concurrently with FERC's rehearing period, the Forest Service's Objection Period, and any other administrative procedures of the cooperating agencies.

In accordance with the NFMA, the Proposed Forest Service Plan Amendments are subject to administrative objections. Forest Service planning regulations at 36 CFR 219 Subpart B and 36 CFR 218 Subpart A and B describe the procedures and eligibility requirements to file an objection. Decisions by the Forest Service to approve "plan level" amendments to LMPs (proposed amendments for reallocation of matrix lands to late-successional reserves) are subject to the Pre-Decisional Administrative Review Process Regulations at 36 CFR 219 Subpart B. The term "plan level" refers to plan amendments that would apply to future management actions. Decisions by the Forest Service to approve "project-specific" plan amendments (proposed amendments for site-specific changes in standards and guidelines) are subject to the Administrative Review Process of 36 CFR 218 Subpart A and B, in accordance with 36 CFR 219.59 (b). The term "project specific" refers to amendments that would only apply to the proposed project and would not apply to any future management actions. Refer to appendix F.11, Draft Record of Decision, *Administrative Review/Objections*, for specific requirements on filing objections related to Forest Service decisions associated with this project.

1.5 PERMITS, APPROVALS, AND CONSULTATIONS

1.5.1 Federal Environmental Laws, Regulations, Permits, Approvals, and Consultations

In addition to the NGA, EPAct, and NEPA, the FERC and cooperating agencies are required to comply with other federal laws and regulations including, but not limited to the CWA, Coastal Zone Management Act (CZMA), ESA, MSA, MMPA, MBTA, and the National Historic Preservation Act (NHPA). Numerous comments on the draft EIS suggested that state permit requirements should be adhered to by the Applicant and included in the final EIS. The Commission encourages cooperation between pipelines and local authorities. However, this does not mean that state and local agencies, through application of state or local laws, may prohibit or unreasonably delay the construction, operation and abandonment of facilities if approved by the Commission. The Applicant would be required to comply with all federal and federally-delegated permits. These permits along with other state and local permits are identified in table 1.5.1-1.

As the lead federal agency for the Project, the FERC has taken on the lead role for consultation under these statutes for itself and in collaboration with the cooperating agencies. The BLM will make its determinations in accordance with the FLPMA, NFMA, and Mineral Leasing Act (MLA), as it relates to the Pacific Connector's Right-of-Way Grant application to cross federal lands, with concurrence necessary from the Forest Service and Reclamation (see section 1.3). Some federal permits or approvals, such as Section 401 of the CWA, the CAA, and the CZMA, have been delegated to state agencies, as discussed below.

In accordance with Section 313(d) of the EPAct, the FERC is required to keep a complete consolidated record of all actions or decisions made by agencies undertaking federal authorizations. On October 19, 2006, in Order No. 687, the FERC issued implementing regulations regarding the maintenance of a consolidated record.

Table 1.5.1-1 lists the major federal, state, and local permits, approvals, and consultations identified for the Project.

TABLE 1.5.1-1

Major Permits, Approvals, and Consultations for the Jordan Cove and Pacific Connector Project

Agency	Authority/Regulation/ Permit	Agency Action	Initiation of Consultations and Permit Status
FEDERAL			
Federal Energy Regulatory Commission (FERC)	Sections 3 and 7 of the National Gas Act (NGA)	Order Granting Section 3 Authorization and Issuing Certificate of Public Convenience and Necessity.	Jordan Cove and Pacific Connector filed applications with the FERC on September 21, 2017.
	Section 311 of the EPAct		In September 2017, Pacific Connector filed an application with the FERC under Section 7 of the NGA. The FERC's decision is pending.
USDA Forest Service (Forest Service)	Mineral Leasing Act (MLA)	Concur with Right-of-Way (ROW) Grant.	Pending. The Forest Service letter on concurrence of the ROW grant is pending until after preparation of a Record of Decision (ROD).
	36 CFR 219 Subpart B 36 CFR 218 Subpart A and B	Amend Land and Resource Management Plans (LRMP).	Pending. The Forest Service proposed decision(s) on plan level amendments of LRMPs are subject to Administrative Review Regulations at 36 CFR 219 Subpart B. Decisions by the Forest Service to approve project-specific plan amendments are subject to the Administrative Review Process of 36 CFR 218 Subpart A and B. A final decision will follow consideration and resolution of any administrative reviews.

TABLE 1.5.1-1 (continued)

Major Permits, Approvals, and Consultations for the Jordan Cove and Pacific Connector Project

Agency	Authority/Regulation/ Permit	Agency Action	Initiation of Consultations and Permit Status
Bureau of Land Management (BLM)	Section 28 of MLA	Issue ROW Grant for crossing federal lands.	Pending. The BLM decision on the ROW Grant will follow BLM and Forest Service decisions on LRMP amendments and receipt of Letters of Concurrence from the Forest Service and Reclamation.
	Federal Land Policy and Management Act of 1976, as amended, Section 202	Resource Management Plan (RMP) Amendments.	Pending. BLM's proposed decision(s) on amendments of RMPs are subject to Protest following completion of the final EIS. A final decision will follow consideration and resolution of any Protests.
	Federal Land Policy and Management Act of 1976, as amended, Section 501	Issue a ROW Grant for the proposed wastewater line near the Jordan Cove LNG facility.	Anticipated. An application for ROW related to the wastewater line has not been submitted by the Applicant to the BLM.
Bureau of Reclamation	MLA	Concur with issuance of the ROW Grant	Pending.
U.S. Department of Energy (DOE)	Section 3 of the NGA	Long-Term authority to export LNG to Free Trade Agreement (FTA) Nations	FTA authorization granted December 7, 2011 (DOE/FE Order No. 3041). DOE authorized amendment to FTA authorization on July 20, 2018 (DOE/FE Order No. 3041-A).
	Section 3 of the NGA	Long-Term conditional authority to export LNG to Non-FTA Nations.	Conditional non-FTA authorization issued on March 24, 2014; subject to satisfactory completion of the NEPA review and related conditions. DOE is currently reviewing the amendment request with respect to the non-FTA application.
U.S. Army Corps of Engineers (COE)	Section 10 and 408 of the Rivers and Harbors Act (RHA)	Process permit applications for structures or work in or affecting navigable waters of the United States. Approval of requests to alter COE civil works projects.	Pending. The Applicants requested COE initiate the project's review per the RHA and have submitted both regulatory and Section 408 applications to the COE. The Applicants are continuing to work with the COE to provide supplemental information regarding the RHA review.
	Section 404 of the Clean Water Act (CWA)	Process permit application for the discharge of dredged or fill material into waters of the United States.	Pending. The Applicants requested the COE initiate the Project's review per the CWA and have submitted a regulatory application to the COE. The Applicants are continuing to work with the COE to provide supplemental information regarding the CWA review.
U.S. Environmental Protection Agency (EPA)	Section 404 of the CWA	Co-administers CWA 404 program with the COE. EPA retains veto authority for wetland permits issued by the COE.	Pending.

TABLE 1.5.1-1 (continued)

Major Permits, Approvals, and Consultations for the Jordan Cove and Pacific Connector Project

Agency	**Authority/Regulation/ Permit**	**Agency Action**	**Initiation of Consultations and Permit Status**
	Section 309 of the CAA	Reviews and evaluates EIS for adequacy in meeting the procedural and public disclosure requirements of the NEPA.	Pending.
U.S. Fish and Wildlife Service (FWS)	Section 7 of the ESA	Provide a BO if the Project is likely to adversely affect federally listed threatened or endangered aquatic species or their habitat.	Pending. The FERC has prepared a biological assessment (BA) that was submitted to the FWS and NMFS. The FWS has notified the FERC that formal consultation under section 7 of the ESA has been formally initiated for the Project based on the BA.
	Fish and Wildlife Coordination Act of 1934 (FWCA)	Provide comments to prevent loss of and damage to wildlife resources.	Pending. FWS generally addresses FWCA issues via comments on the FERC NEPA and COE 404 permit processes.
	MBTA Executive Order 13186	Consultation regarding compliance with the MBTA.	Pending. The Applicants are currently consulting with the FWS regarding the projects requirements under the MBTA.
	Eagle Act	Coordination regarding compliance with the Eagle Act	Pending. The Applicants will consult with the FWS regarding the project's requirements under the Eagle Act. Jordan Cove and Pacific Connector would apply for an Eagle Act permit if needed.
National Marine Fisheries Service (NMFS)	Section 7 of the ESA	Provide a BO if the Project is likely to adversely affect federally listed threatened or endangered aquatic species or their habitat.	Pending. The FERC has prepared a BA that was submitted to the NMFS. The NMFS has notified the FERC that formal consultation under section 7 of the ESA has been formally initiated for the Project based on the BA.
	MMPA	Authorize, upon request, take of marine mammals incidental to otherwise lawful activities, subject to mitigation monitoring and reporting requirements.	Pending. The Applicants have filed an Incidental Take Authorization with the NMFS. The NMFS review is pending.
	MSA	Provide conservation recommendations if the Project would adversely impact EFH.	EFH was addressed in the FERC BA.
U.S. Coast Guard	Ports and Waterway Safety Act	Captain of the Port (COTP) issues a Letter of Recommendation (LOR) recommending the suitability of the waterway for LNG marine traffic.	Jordan Cove submitted LOI on January 9, 2017. Coast Guard issued LOR on May 10, 2018.
		Review Emergency Manual.	Pending. Must be completed prior to receiving first LNG carrier.
		Review Operations Manual.	Pending. Must be completed prior to receiving first LNG carrier.
		Establish safety and security zones for LNG vessels in transit and while docked.	Pending.

TABLE 1.5.1-1 (continued)

Major Permits, Approvals, and Consultations for the Jordan Cove and Pacific Connector Project

Agency	Authority/Regulation/ Permit	Agency Action	Initiation of Consultations and Permit Status
	Maritime Transportation Security Act	Review and Approve Facility Security Plan.	Pending. Must be completed 60 days prior to receiving first LNG carrier at the facility
	Navigation and Vessel Inspection Circular – Guidance related to Waterfront LNG Facilities	Develop LNG Vessel Transit Management Plan.	Pending. Must be completed prior to receiving first LNG carrier.
		Validate WSA and produce LOR and LOR Analysis.	Issued LOR and LOR Analysis on May 10, 2018.
U.S. Department of Transportation Pipeline and Hazardous Materials Safety Administration (USDOT PHMSA)	Natural Gas Pipeline Safety Act	Administer national regulatory program to ensure the safe transportation of natural gas and issue LOD on the project's compliance with the siting requirements of 49 CFR 193.	Applicants met with PHMSA in November 2017 to review their technical design package. The USDOT PHMSA submitted the LOD to the FERC on September 11, 2019, which found that the proposed siting of the Project complies with the Federal Pipeline Safety Standards set forth in 49 CFR 193.
U.S. Department of Defense (DOD)	Section 311(f) of the EPAct and Section 3 of the NGA Memorandum of Understanding (MOU) between the FERC and DOD	Consult with the Secretary of Defense to determine whether an LNG facility would affect the training or activities of an active military installation.	In November 2012, the DOD indicated that the previously proposed project would have minimal impacts on military operations in the area. In December 2017, the DOD indicated that because it had previously reviewed the last proposal, it has "no issues" concerning the current Project.
DOE, Bonneville Power Administration (BPA)	Land Use Agreement for electric transmission line crossings	Permit review.	Pending.
USDOT, Federal Aviation Administration (FAA)	18 CFR Subchapter E Federal Aviation Regulations (FAR) Part 77 IAW FAA Order 7400.2G, 6-1-6	Aeronautical Study of Objects Affecting Navigable Airspace. Feasibility Study for Hazard Determination.	Pending. The FAA has issued a Notice of Presumed Hazard. Jordan Cove is currently consulting with the FAA to address potential impacts on airport operations.
Advisory Council on Historic Preservation (ACHP)	Section 106 of the NHPA	Opportunity to comment on the undertaking.	Pending.
Federal Communication Commission	License for fixed microwave stations and service	Review proposals for new or additions to existing communication towers.	Pending.
U.S. Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS)	Farmland Protection Policy Act	Determine if the Project would result in the permanent conversion of prime farmland.	Pending.
STATE – OREGON			
Oregon Department of Geology and Mineral Industries (DOGAMI) – Mineral Land Regulation and Reclamation (MLRR)	Building Code Section 1802.1 Oregon Revised Statute (ORS) 455.446	Required to consult with DOGAMI for assistance in determining the impact of tsunamis on the proposed development, and for assistance in developing mitigation.	Pending.

TABLE 1.5.1-1 (continued)

Major Permits, Approvals, and Consultations for the Jordan Cove and Pacific Connector Project

Agency	Authority/Regulation/ Permit	Agency Action	Initiation of Consultations and Permit Status
Oregon Department of Agriculture (ODA)	Oregon Endangered Species Act Oregon Senate Bill 533 and ORS 564	Consult on Oregon listed plant species, and ODA would review botanical survey reports covering non-federal public lands prior to ground-disturbing activities where state listed botanical species are likely to occur.	Pending.
Oregon Department of Consumer and Business Services – Building Code Division	ORS 455.446	Site-specific exemption approval under the state building code,	Pending.
Oregon Department of Energy (ODE)	State Authorities under Section 311 of the EPAct	Furnish an advisory report on state safety and security issues to the FERC regarding the Jordan Cove LNG terminal proposal and conduct operational safety inspections if the facility is approved and built. ODE requires all applicants to enter into an MOU to meet state established minimum standards for LNG safety, security, and emergency preparedness.	Pending.
Oregon Department of Environmental Quality (ODEQ)	Water Quality Certification Section 401 of the CWA	Issue a license or permit to achieve compliance with state water quality standards.	Applicant submitted their CWA Section 401 application package to the ODEQ on April 6, 2018. On September 25, 2018, the Applicant requested that the 401 application be withdrawn and resubmitted to allow ODEQ additional time to consider the request. On May 5, 2019, the ODEQ denied the application without prejudice.
	Section 402 of CWA	Issue National Pollutant Discharge Elimination System (NPDES) permits for discharge of stormwater.	NPDES permit for storm water (e.g., effluent discharge to the ocean outfall) issued in July 2015 and expires in June 2020.
	Ballast Water Management	Review liabilities and offences connected to shipping and navigation.	Pending.
	CAA – Title V	Issue Title V Air Quality Operating permit. Issue Enforce Greenhouse Gas (GHG) Reporting Requirements.	Permit application to be filed by Pacific Connector one year after beginning operations of the Klamath Compressor Station.
	Air Contaminant Discharge Permit CAA	Review air quality analyses to ensure compliance with all applicable Ambient Air Quality Standards.	Pending.
	Hazardous Waste Activity ORS 466 Oregon Administrative Rule (OAR) 340-102	Review plans for storage and management of hazardous waste	Pending.
	Oregon's Water Quality Pollution Control Facility (WPCF) Permit	A permit required for wastewater discharges to land during construction.	Pending

TABLE 1.5.1-1 (continued)

Major Permits, Approvals, and Consultations for the Jordan Cove and Pacific Connector Project

Agency	Authority/Regulation/ Permit	Agency Action	Initiation of Consultations and Permit Status
Oregon Department of Fish and Wildlife (ODFW)	FWCA and the Oregon Endangered Species Act under ORS 496, 506, and 509 OAR 635	Consult on sensitive species and habitats that may be affected by the Project and, in general, regarding conservation of fish and wildlife resources (including state listed species).	Pending.
	Fish and Wildlife OAR 345-22 & 60	Consult on and approve fish and wildlife mitigation plan.	Pending.
	Oregon Fish Passage Law ORS 509.-585 OAR 635-412-5 to 40	Review stream crossing plans for consistency with Oregon Fish Passage Law and screening criteria.	Pending.
	In-Water Blasting ORS 509-140, et al. OAR 635-425 to 50	Consider issuance of in-water blasting permits.	Pending.
Oregon Department of Forestry (ODF)	Easement on State lands Oregon Forest Practices Act OAR 629 ORS 477 ORS 527	Management of State Forest lands for Greatest Permanent Value, develops Forest Management Plans, stewardship under State's Land Management Classification System, monitors harvests of timber on private lands, and protects non-federal public and private lands from wildfires.	Pending.
Oregon Department of Land Conservation and Development (ODLCD)	CZMA 15 CFR Part 930 ORS 196.435	Determine consistency with CZMA program policies.	Pending. A joint CZMA Certifications and Necessary Data and Information application was submitted to ODLCD on April 12, 2019. The ODLCD consistency review is scheduled to be finalized on February 17, 2020.
Oregon Department of Transportation (ODOT)	Section 303(c) DOT Act 49 CFR 303 OAR 734-030(4) OAR 734-051-4020	Review and approve traffic management plans	Pending. A draft traffic impact analysis was provided to ODOT, Coos County, and City of North Bend on December 4, 2017 by the Applicant. ODOT and North Bend provided comments on December 21, 2017. The Applicant continue to work with ODOT.
	State Highway ROW ORS 374-305 OAR 734- 55	Permits to be issued from each ODOT District Office to allow construction within State Highway ROW and use of State Highways for Project access, and where utilities would cross over, under, or run parallel to ODOT ROWs.	Pending. Applications for ODOT Approach and Utility Permits to be submitted with enough advance notice (which could be up to 12 months or more depending on individual District requirements) prior to construction activities to ensure adequate time to review the specific proposals.
Oregon Department of State Lands (ODSL)	Submerged and Submersible Land Easement OAR 141-122	Grant submerged land easements.	Pending.
	Lease and Registrations OAR 141-082	Issue wharf registrations	Pending.

TABLE 1.5.1-1 (continued)

Major Permits, Approvals, and Consultations for the Jordan Cove and Pacific Connector Project

Agency	Authority/Regulation/ Permit	Agency Action	Initiation of Consultations and Permit Status
	Sand and Gravel Lease/License OAR 141-014	Issue licenses or leases for removal of state-owned materials.	Pending.
	Joint Removal-Fill Law ORS 196-795-990 OAR 141-85	Approve removal or fill of material in waters of the state.	Pending.
	Special Use Permits OSAR 141-125	Allow work within state-owned lands	Pending.
	Compensatory Wetland Mitigation Rules OAR 141-85-121	Review and approve wetland mitigation plans.	Pending.
Oregon Water Resources Department (OWRD)	New Water Rights ORS 537 OAR 690-310	Issue permits to appropriate surface water and groundwater.	Pending.
	Temporary Water Use ORS 537 OAR 690-340	Issue limited licenses for temporary use of surface waters.	Pending.
Oregon Public Utilities Commission (OPUC)	OAR 860-031	Authorize intrastate electric transmission lines. Inspect the natural gas facilities for safety.	Pending Pacific Connector's submittal of appropriate applications to OPUC.
State Historic Preservation Office (SHPO)	Section 106 of the NHPA 36 CFR 800 ORS 338-920	Review cultural resources reports and comments on recommendations for National Register of Historic Places eligibility and project effects. Issue permits for excavation of archaeological sites on non-federal lands.	Pending. SHPO wrote a letter to the FERC on June 21, 2017 offering to assist FERC with the development of the definition of the area of potential effect (APE) for the projects. (FERC directs Applicant to work with SHPO in developing the appropriate APE and for determining eligibility for listing on the National Register of Historic Places [NRHP].) SHPO sent subsequent letters on January 18 and September 24, 2018, commenting on reports submitted by the Applicant. SHPO sent another letter on July 19, 2019 to the FERC indicating their office has determined the Traditional Cultural Property (TCP) *Q'alya ta Kukwis shichdii me* eligible for listing on the NRHP.

TABLE 1.5.1-1 (continued)

Major Permits, Approvals, and Consultations for the Jordan Cove and Pacific Connector Project

Agency	Authority/Regulation/ Permit	Agency Action	Initiation of Consultations and Permit Status
LOCAL – COUNTIES and CITIES			
Various County Permits	Coos County Zoning and Land Development Ordinance, Coos County Comprehensive Plan, and Coos Bay Estuary Management Plan (CBEMP) Douglas County Comprehensive Plan and Douglas County Land Use and Development Ordinance Jackson County Comprehensive Plan and Jackson County Land Development Ordinance Jackson County Comprehensive Plan and Jackson County Land Development Ordinance Klamath County Land Development Code Various Road Crossing; Grading; and Solid Waste Disposal North Bend Comprehensive Plan North Bend City Code	Issue Conditional Use Permits. Zoning Changes and Verifications. Issue Land Use Compatibility Statement under Statewide Planning Goals.	Pending.

1.5.1.1 Endangered Species Act

Section 7 of the ESA, as amended, states that "Federal agencies shall, in consultation with and with the assistance of the Secretary, utilize their authorities in furtherance of the purposes of this Act by carrying out programs for the conservation of endangered species and threatened species listed pursuant to Section 4 of this Act," and any project authorized, funded, or conducted by a federal agency should not "jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of habitat of such species which is determined...to be critical". The lead federal agency, or the Applicant as a non-federal party, is required to consult with the FWS and the NMFS to determine whether any federally listed or proposed endangered or threatened species or their designated critical habitat occur in the vicinity of the Project. If, upon review of existing data, or data provided by the Applicant, one (or both) of the Services find that any federally listed species or critical habitats may be affected by the Project, the FERC is required to prepare a biological assessment (BA) to identify the nature and extent of adverse effects, and to recommend measures that would avoid, reduce, or mitigate effects on habitats and/or species. The FERC's request for consultation with the BA begins the consultation process. The consultation process concludes with the issuance of a biological opinion(s) as to whether or not the proposed action may result in jeopardy to the species or adverse modification to critical habitat. If the determination is no jeopardy/adverse modification, an incidental take statement is included when needed. An incidental take statement would contain reasonable and prudent measures necessary or appropriate to reduce the proposed action's impact and terms and conditions that must be complied with by the federal agency(s) and Applicants. See section 4.6 of this EIS, as well as the BA, for further information regarding the Project's effects on federally listed species and protected habitats. We submitted the BA to the Services in July 2019, and a copy of it is included in appendix I of this EIS.

1.5.1.2 Magnuson-Stevens Fishery Conservation and Management Act

The MSA, as amended by the Sustainable Fisheries Act of 1996, established procedures designed to identify, conserve, and enhance EFH for those species regulated under a federal fisheries management plan. The MSA requires federal agencies to consult with the NMFS on all actions or proposed actions authorized, funded, or undertaken by the agency that may adversely affect EFH. Although absolute criteria have not been established for conducting EFH consultations, the NMFS recommends consolidated EFH consultations with interagency coordination procedures required by other statutes, such as the NEPA, the FWCA, or the ESA to reduce duplication and improve efficiency.

See sections 4.5 and 4.6 of this EIS for further information regarding the Project's effects on EFH. Our EFH assessment was included in the BA we submitted to the Services in July 2019 (see appendix I).

1.5.1.3 Marine Mammal Protection Act

All marine mammals are protected under the MMPA. This act was amended by the U.S. Congress in 1994. Sections 101(a)(5)(A) and (D) of the MMPA (16 U.S.C. 1361 et seq.) direct the Secretary of Commerce (as delegated to the NMFS) to allow, upon request, the incidental, but not intentional, taking of small numbers of marine mammals by U.S. citizens who engage in a specified activity (other than commercial fishing) within a specified geographical region if certain findings are made and either regulations are issued or, if the taking is limited to harassment, a notice of a proposed authorization is provided to the public for review (note that the FWS has jurisdiction over some species of marine mammals, but none within Oregon).

An authorization for incidental takings shall be granted if the NMFS finds that the taking will have a negligible impact on the species or stock(s), will not have an unmitigable adverse impact on the availability of the species or stock(s) for subsistence uses (where relevant), and if the permissible methods of taking and requirements pertaining to the mitigation, monitoring and reporting of such takings are set forth. The NMFS has defined "negligible impact" in 50 CFR 216.103 as an impact resulting from the specified activity that cannot be reasonably expected to, and is not reasonably likely to, adversely affect the species or stock through effects on annual rates of recruitment or survival.

The MMPA states that the term "take" means to harass, hunt, capture, or kill, or attempt to harass, hunt, capture, or kill any marine mammal. Except with respect to certain activities not pertinent here, the MMPA defines "harassment" as: any act of pursuit, torment, or annoyance which has the potential to injure a marine mammal or marine mammal stock in the wild (Level A harassment); or has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering (Level B harassment).

The NMFS may use relevant portions of this EIS during its review and may adopt measures to protect marine mammals outlined in this EIS. It may also require additional mitigation, monitoring, and reporting measures to ensure that the taking results in the least practicable adverse impact on affected marine mammal species or stocks. The public would have an opportunity to comment to the NMFS in response to its publication of a notice of proposed Incidental Take Authorization, or in response to its publication of a notice of proposed rule.

See sections 4.5 and 4.6 of this EIS for further information regarding the Project's effects on marine mammals.

1.5.1.4 National Historic Preservation Act

Section 101(d)(6) of the NHPA states that properties of traditional religious and cultural importance to Indian tribes[20] may be determined eligible for the National Register of Historic Places (NRHP). In carrying out our responsibilities under Section 106 of the NHPA, the FERC consulted on a government-to-government basis with Indian tribes that may attach religious and cultural importance to properties in the area of potential effect (APE), in accordance with the implementing regulations at 36 CFR 800.2(c)(2)(ii). Those consultations with tribes are detailed in section 4.11.1.2 of this EIS.

Section 106 of the NHPA requires that federal agencies take into account the effects of their undertakings on historic properties and afford the Advisory Council on Historic Preservation (ACHP) an opportunity to comment. Historic properties include prehistoric or historic sites, districts, buildings, structures, objects, landscapes, or properties of traditional religious or cultural importance listed on or eligible for listing on the National Register of Historic Places (NRHP). Jordan Cove and Pacific Connector, as non-federal parties, can provide cultural resources data, analyses, and recommendations to the FERC, as allowed by the regulations for implementing Section 106. However, the FERC remains responsible for all findings and determinations.

The FERC is responsible under Section 106 and its implementing regulations, to consult with the Oregon State Historic Preservation Office (SHPO), identify historic properties within the APE, and make determinations of NRHP eligibility and project effects, on behalf of all the federal cooperating agencies. Section 4.11 of this EIS summarizes the status of our compliance with the NHPA.

1.5.1.5 Rivers and Harbors Act

The RHA (33 U.S.C. 403) regulates the discharge of refuse matter of any kind into the navigable waters, or tributaries thereof, of the United States. The RHA also made it illegal to dam navigable streams without a license (or permit) from Congress.

Section 10 of the RHA prohibits the unauthorized obstruction or alteration of any navigable water of the United States. This section provides that the construction of any structure in or over any

[20] Indian tribes are defined in 36 CFR 800.16(m) as: "an Indian tribe, band, nation, or other organized group or community, including a Native village, Regional Corporation, or Village Corporation, as those terms are defined in Section 3 of the Alaska Native Claims Settlement Act (43 U.S.C. 1602), which is recognized as eligible for the special programs and services provided by the United States to Indians because of their special status as Indians."

navigable water of the United States, or the accomplishment of any other work affecting the course, location, condition, or physical capacity of such waters is unlawful unless the work has been authorized by the COE.

1.5.1.6 Clean Water Act

The CWA establishes the basic structure for regulating discharges of pollutants into the waters of the United States and regulating quality standards for surface waters. Section 404 of the CWA outlines procedures by which the COE can issue permits (after notice and opportunity for public hearings) for the discharge of dredged or fill material into waters of the United States at specified disposal sites.[21] The EPA has the authority to review and veto COE decisions on Section 404 permits. The FWS and NMFS use their FWCA authorities to review and comment during the 404 permitting process. The authority to issue Water Quality Certifications pursuant to Section 401 of the CWA and National Pollutant Discharge Elimination System (NPDES) permits pursuant to Section 402 of the CWA has been delegated to the ODEQ (see section 1.5.2.4).

See section 4.3 of this EIS for further information regarding water quality issues.

1.5.1.7 Clean Air Act

The primary objective of the CAA as amended, is to establish federal standards for various pollutants from both stationary and mobile sources, and to provide for the regulation of polluting emissions via state implementation plans. In addition, the CAA was established to prevent significant deterioration in certain areas where air pollutants exceed national standards and to provide for improved air quality in areas that do not meet federal standards (non-attainment areas).

The EPA has regulatory authority under the CAA. Section 309 of the CAA directs the EPA to review and comment in writing on environmental effects associated with all major federal actions. The EPA has delegated permitting authority under the CAA to the ODEQ. Emissions from all phases of construction and operation of the proposed LNG terminal and pipeline would be subject to applicable federal and state air regulations.

See section 4.12.1 of this EIS for further information regarding air quality issues.

1.5.1.8 Coastal Zone Management Act

In 1972, Congress passed the CZMA to "preserve, protect, develop, and where possible, to restore or enhance, the resources of the nation's coastal zone for this and succeeding generations" and to "encourage and assist the states to exercise effectively their responsibilities in the coastal zone through the development and implementation of management programs to achieve wise use of the land and water resources of the coastal zone".

Section 307 (c)(3)(A) of the CZMA states that "any applicant for a required federal license or permit to conduct an activity, in or outside the coastal zone, affecting any land or water use or

[21] For activities involving CWA Section 404 discharges, a permit will be denied by the COE if the associated discharge does not comply with the EPA's 404(b) (1) Guidelines. The Guidelines are binding regulations and provide substantive environmental standards by which all Section 404 permit applications are evaluated. The Guidelines specifically require that "no discharge of dredged or fill material shall be permitted if there is a practicable alternative to the proposed discharge which would have less adverse impact on the aquatic ecosystem, so long as the alternative does not have other significant adverse effects." The burden of proving no practicable alternative exists is the sole responsibility of the Applicant.

natural resource of the coastal zone of that state shall provide a certification that the proposed activity complies with the enforceable policies of the state's approved program and that such activity will be conducted in a manner consistent with the program." In order to participate in the coastal zone management program, a state is required to prepare a program management plan for approval by the NOAA Office of Coast and Ocean Resource Management (OCRM). Once the OCRM has approved a plan and its enforceable program policies, a state program gains "federal consistency" jurisdiction. This means that any action requiring a federally issued licenses or permits that takes place within a state's coastal zone must be found to be consistent with state coastal policies before the action authorized by the federal license or permit can occur.

All components of the Project from MP 0.0 to approximately MP 53.2 are within the designated Oregon coastal zone and are subject to federal CZMA review. The ODLCD is the state's designated coastal management agency and has established the Oregon Coastal Management Program (OCMP). The program's mission is to work in partnership with coastal local governments, state and federal agencies, and other stakeholders to ensure that Oregon's coastal and ocean resources are managed, conserved, and developed consistent with statewide planning goals. To accomplish this mission, the program combines various state statutes for managing coastal lands and waters into a single, coordinated package. These include: (1) the 19 Statewide Planning Goals, which are Oregon's standards for comprehensive land use planning; (2) city and county comprehensive land use plans; and (3) state agencies and natural resource laws such as the Oregon Beach Bill and the Removal-Fill Law. Under the provisions of the CZMA, Jordan Cove and Pacific Connector must provide a certification to the FERC, COE, and the ODLCD that their projects comply with and would be conducted in a manner consistent with the state's approved management program (15 CFR 930.50 Subpart D).

See section 4.7 of this EIS for further information regarding the FERC's compliance with the CZMA.

1.5.1.10 Migratory Bird Treaty Act

The MBTA protects 1,027 species (50 CFR §10.13). Intentional destruction or disturbance of active migratory bird nests, or any eggs or young contained within it, without authorization, is a violation of the MBTA.

EO 13186 encourages federal agencies to find ways to conserve birds protected under MBTA, especially those of greatest conservation concern, in the course of conducting agency activities. On March 30, 2011 the FERC and FWS entered into an MOU that focuses on migratory birds and strengthening conservation through enhanced collaboration between the agencies. This voluntary MOU does not waive legal requirements under the MBTA, Eagle Act, ESA, or any other statutes, and does not authorize the take of migratory birds. Under the MOU, the FERC would promote the Applicants' use of BMPs to avoid and reduce impacts on birds to the extent practicable during project implementation.

See sections 4.5 and 4.6 of this EIS for further information regarding the migratory bird species that inhabit the Project area, as well as measures the Applicants would implement to avoid, reduce, or mitigate effects on migratory birds.

1.5.1.11 Bald and Golden Eagle Protection Act (Eagle Act)

The Eagle Act prohibits the "take" of bald and golden eagles, including their parts, nests, or eggs, without a permit. "Take" is defined as "pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest or disturb."

Activities that may affect an eagle's ability to forage, nest, roost, breed, or raise young, constitute 'disturbance' and require a permit; habitat manipulation in this project might result in disturbance and require a permit. The FWS can issue permits for non-purposeful take under the Eagle Act and encourages Applicants to coordinate early to avoid and reduce impacts on bald and golden eagles that may be in the vicinity of the project.

See section 4.6 of this EIS for further information regarding bald and golden eagles that inhabit the Project area, as well as measures the Applicants would implement to avoid, reduce, or mitigate effects on bald and golden eagles as required by the Eagle Act.

1.5.2 State Agency Permits and Approvals

In addition to the federal permitting authorities that have been delegated to the states, as discussed above, various Oregon laws pertain to the Project. Permits, authorizations, and consultations with state agencies relevant to the Project are listed in table 1.5.1-1.

The FERC encourages cooperation between Applicants and state and local authorities, but this does not mean that state and local agencies (through application of state and local laws) may prohibit or unreasonably delay the construction or operation of facilities approved by the FERC. Any state or local permits issued with respect to FERC regulated facilities must be consistent with the conditions of any Certificate the FERC may issue.[22]

1.5.2.1 Oregon Department of Geology and Mineral Industries (DOGAMI)

The mission of the DOGAMI is to provide earth science information for the citizens of Oregon. DOGAMI identifies and quantifies natural hazards, and works to reduce potential effects of earthquakes, landslides, and tsunamis. Its administrative rule at Oregon Administrative Rule (OAR) 632 includes the identification of Tsunami Inundation Zones under Division 5. The agency is also the steward of Oregon's mineral resources on non-federal lands, and it regulates mining activities, as well as oil and gas exploration and production on non-federal lands.

1.5.2.2 Oregon Department of Agriculture (ODA)

The ODA maintains the state list of endangered and threatened plant species, in accordance with OAR Chapter 603, Division 73, and reviews reports of botanical surveys under Oregon Senate Bill 533 and its corresponding Oregon Revised Statute (ORS) 564. These state laws and regulations require surveys for state listed species on non-federal public lands prior to ground-disturbing activities, unless habitat for the species does not exist in the Project area. Furthermore, the ODA Noxious Weed Control Program and the Oregon State Weed Board maintain the State Noxious Weed List for the State of Oregon.

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[22] *See* 15 U.S.C. § 717r(d) (state or federal agency's failure to act on a permit considered to be inconsistent with Federal law); *see also Schneidewind v. ANR Pipeline Co.*, 485 U.S. 293, 310 (1988) (state regulation that interferes with FERC's regulatory authority over the transportation of natural gas is preempted) and *Dominion Transmission, Inc. v. Summers,* 723 F.3d 238, 245 (D.C. Cir. 2013) (noting that state and local regulation is preempted by the NGA to the extent it conflicts with federal regulation, or would delay the construction and operation of facilities approved by the Commission).

1.5.2.3 Oregon Department of Energy (ODE)

According to the EPAct, the Governor of a state in which an LNG terminal is proposed is to designate an appropriate state agency to consult with the Commission. That state agency should provide the FERC with an advisory report on state and local safety concerns, within 30 days of the FERC's notice of an application for an LNG terminal, for the Commission to consider prior to making a decision. The ODE has been designated by the Governor of Oregon as the state agency to coordinate the review of proposed LNG projects by other state agencies and consult with the FERC. Furthermore, as lead state agency, the ODE provides oversight regarding the development and implementation of safety, security, and emergency response plans and strategies of proposed LNG projects.

1.5.2.4 Oregon Department of Environmental Quality (ODEQ)

The ODEQ is responsible for protecting and enhancing Oregon's water and air quality, managing the proper disposal of hazardous and solid waste, overseeing clean-ups of spills or releases of hazardous materials, and enforcing Oregon's environmental laws and regulations. The agency's duties to regulate sewage treatment and disposal systems are found in ORS Chapter 454, for solid waste management in Chapter 459, hazardous materials in Chapters 465 and 466, air and water quality in Chapter 468, and ballast water in Chapter 783. The EPA has delegated authority to the ODEQ under both the CWA and CAA.

Under its delegated responsibilities required by the CAA, the ODEQ issues air contaminant discharge permits (ACDP). The agency is also responsible for enforcing greenhouse gas (GHG) reporting requirements, and collecting data on GHG emissions for certain facilities that hold Title V or ACDP operating permits. In addition, ODEQ makes determinations about the Prevention of Significant Deterioration (PSD) of air quality from new major sources or major modifications at existing sources, and reviews air quality analyses completed to comply with National Ambient Air Quality Standards (NAAQS).

1.5.2.5 Oregon Department of Fish and Wildlife (ODFW)

The OODFW is responsible for keeping the state sensitive fish and wildlife list and developing the state's Wildlife Diversity Plan. The purpose of the Fish and Wildlife Habitat Mitigation Policy (OAR 345-22-60) developed by the ODFW is to apply consistent goals and standards to mitigate effects on fish and wildlife habitat caused by land and water development actions. The policy provides goals and standards for general application to individual development actions, and for the development of more detailed policies for specific classes of development actions or habitat types. In implementing this policy, the ODFW will recommend or require mitigation for losses of fish and wildlife habitat resulting from development actions; priority is given to native species.

ORS 509.585 (Oregon Fish Passage Law) applies to all project components that cross waters of the state where native migratory fish species are or were historically present. The ODFW would also review fish screening at water intakes under ORS 498-306. Under ORS 509 and OAR 635, the ODFW has responsibilities for review of stream crossing plans to provide for passage of native migratory fish.

OAR 635-425-000 through 635-425-0050 requires in-water blasting permits to be issued by ODFW for locations where explosives may be used to cross streams. While, in general, in-water blasting is discouraged, unless it is the only practicable method for accomplishing project goals, the ODFW may issue a permit if it contains conditions for preventing injury to fish and wildlife and their habitats.

1.5.2.6 Oregon Department of Forestry (ODF)

The ODF manages State Forests for the Greatest Permanent Value. The ODF has created a Forest Management Plan to provide strategic direction and guide management activities. Part of the plan is to identify multi-purpose objectives, and protect sensitive resources according to the state's Land Management Classification System. The ODF also monitors the commercial harvest of forest products from private timber lands, according to the Oregon Forest Practices Act. The ODF is responsible for protection of non-federal and private forest lands from wildfires.

Pacific Connector would be required to submit a Notification to the ODF, as well as a written plan for all areas where operations would occur. The Notification serves three purposes: notification of a forest operation, a request for a Permit to Use Fire or Power Driven Machinery, and notice to the Department of Revenue of timber harvest. A separate notification should be filed for each county and timber owner affected by the Project. All notifications require a 15-day waiting period before activity may begin unless a waiver is requested. Also, any action that would result in the conversion of forestland to other land uses or practices not in statute or rule would require the submission of a Plan for Alternate Practice and written approval from the State Forester.

1.5.2.7 Oregon Department of Land, Conservation, and Development (ODLCD)

The ODLCD assists communities and citizens in improving the built and natural environment. Under Oregon's statewide land use planning program, the ODLCD provides protection for farm and forest lands, conservation of natural resources, plans for orderly development, and coordinates among local governments. Comprehensive land use planning coordination is required under ORS 197. All cities and counties in Oregon have adopted plans that meet state standards and adhere to 19 Statewide Planning Goals and Guidelines.

In addition, NOAA has delegated to the state of Oregon the finding of consistency with the CZMA. In accordance with ORS 196.435, the ODLCD's Ocean and Coastal Services Division has been designated the state's coastal zone management agency and administers the CZMA federal consistency review program. Applicants for certification of CZMA consistency are encouraged by the ODLCD to obtain state and local permits and other authorizations required by enforceable policies. The requirements of the CZMA are applicable to NPDES permits and must be included in the NPDES permit for the Jordan Cove industrial wastewater treatment facility.

1.5.2.8 Oregon Department of Transportation (ODOT)

The ODOT has the responsibility to preserve the operational safety, integrity, and function of the state's highway facilities. The ODOT must also ensure that improvements to the highway system can be accomplished without undue effects or damage to utilities within the highway right-of-way. Construction that may affect the state right-of-way is subject to ORS 374.305, under which no person, firm, or corporation may place, build, or construct on any state highway right-of-way, approach road, structure, pipeline, ditch, cable or wire, or any other facility, thing, or appurtenance without first obtaining written permission from the ODOT. A permit from the ODOT is required for any work on a highway that is part of the state highway system, including but not limited to interstate highways, other highways on the National Highway System, and routes on the federal-aid highway system.

1.5.2.9 Oregon Department of State Lands (ODSL)

Under Oregon's Removal-Fill Law, permits are issued by the ODSL for projects requiring the removal or fill of 50 cubic yards or more of material in waters of the state; the removal or fill of any material regardless of the number of cubic yards affected in a stream designated as essential salmon habitat; and the removal or fill of any material from the bed and banks of scenic waterways regardless of the number of cubic yards affected.

An application to the ODSL should demonstrate independent utility, identify best use of waters, and outline measures to reduce effects on water resources. To meet the requirements of OAR Division 85, compensatory mitigation should be offered to replace all lost functions and values of wetlands and waterbodies effected by a project.

1.5.2.10 Oregon Water Resources Department (OWRD)

The mission of the OWRD is to address the state's water supply needs through the restoration and protection of stream flows and watersheds. The OWRD is charged with administering state laws and regulations governing surface and groundwater resources, such as the Ground Water Act under ORS 537-505. Its core functions include collecting water resources data and enforcing water rights, under OAR Chapter 690. All water is publicly owned in Oregon, and users must obtain a permit or water right from OWRD, including water withdrawals from underground wells, streams, or lakes. OWRD also maintains a database of water well locations, and a database for stream flows and lake levels. The Applicants utilized the OWRD database for their application to the FERC.

1.5.2.11 Oregon State Historic Preservation Office (SHPO)

The FERC, as the lead federal agency, on behalf of the federal cooperating agencies, is consulting with the Oregon SHPO regarding the identification of historic properties and determination of Project-related effects, in accordance with 36 CFR 800, in order to comply with Section 106 of the NHPA. The SHPO also has authority under ORS 358-920 to issue permits for the excavation of archaeological sites on non-federal lands. Jordan Cove and Pacific Connector would obtain applicable permits from the SHPO prior to conducting other archaeological work on non-federal lands related to the Project.

2.0 DESCRIPTION OF THE PROPOSED ACTION

As described herein, Jordan Cove proposes to construct and operate an LNG production, storage, and export facility in Coos County, Oregon. Pacific Connector proposes to construct and operate a natural gas transmission pipeline and associated facilities in Coos, Douglas, Jackson, and Klamath Counties, Oregon. The proposed action also includes amendments to BLM and Forest Service LMPs. In addition to the proposed action and amendments, this section also describes impact mitigation projects.

2.1 PROJECT OPERATIONAL COMPONENTS

2.1.1 Jordan Cove LNG Project

The Jordan Cove LNG export terminal would be located on the bay side of the North Spit of Coos Bay, Oregon. The general location of the terminal and associated temporary construction work areas including marine facilities and mitigation sites is shown on figure 2.1-1. The primary components of the LNG terminal include five liquefaction trains[23], two full-containment LNG storage tanks, vessel loading facilities, a vessel slip, and a marine access channel. The terminal site would also include a connection to the Pacific Connector pipeline and a gas conditioning facility. Jordan Cove is proposing five mitigation sites (i.e., the Kentuck Slough Wetland Mitigation project [Kentuck project]; the Eelgrass Mitigation site; and the Lagoon, Panhandle, and North Bank upland wildlife habitat mitigation sites). As shown on figure 2.1-2, portions of the terminal site are referred to as Ingram Yard which would contain the main terminal facilities; South Dunes, which would contain the SORSC, administration building, and temporary workforce housing and laydown areas; and an access and utility corridor between the Ingram Yard and South Dunes. Components that make up the proposed LNG terminal are described below, and the location of specific components are shown on figure 2.1-3.

The proposed LNG terminal site is within a potential tsunami inundation zone, and Jordan Cove has incorporated measures into the proposed facility design to account for potential tsunami inundation. Measures include elevating some site components and protecting some site components with berms or wall. Details are discussed as appropriate within this EIS.

2.1.1.1 Gas Conditioning

Natural gas would require conditioning prior to liquefaction to remove components that could freeze out and clog the liquefaction equipment or would otherwise be incompatible with the liquefaction process such as mercury, hydrogen sulfide, carbon dioxide (CO_2), water, and heavy hydrocarbons that would freeze during the liquefaction process. Heavy hydrocarbons removed would be blended into the fuel gas stream, so no on-site storage or disposal would be required.

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[23] A liquefaction train consists of all components of the liquefaction process arranged in a linear relationship.

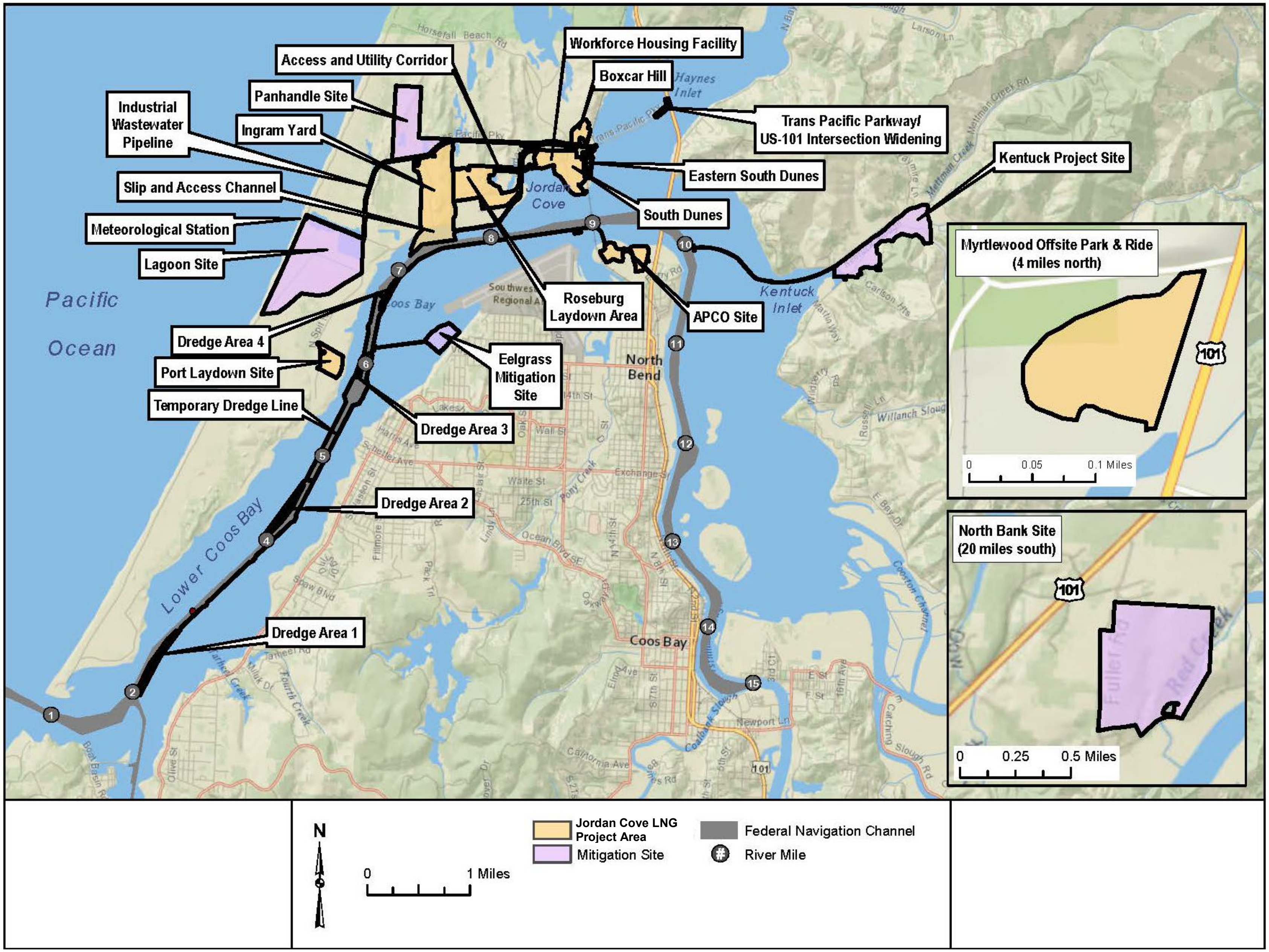


Figure 2.1-1
Jordan Cove LNG Project General Location

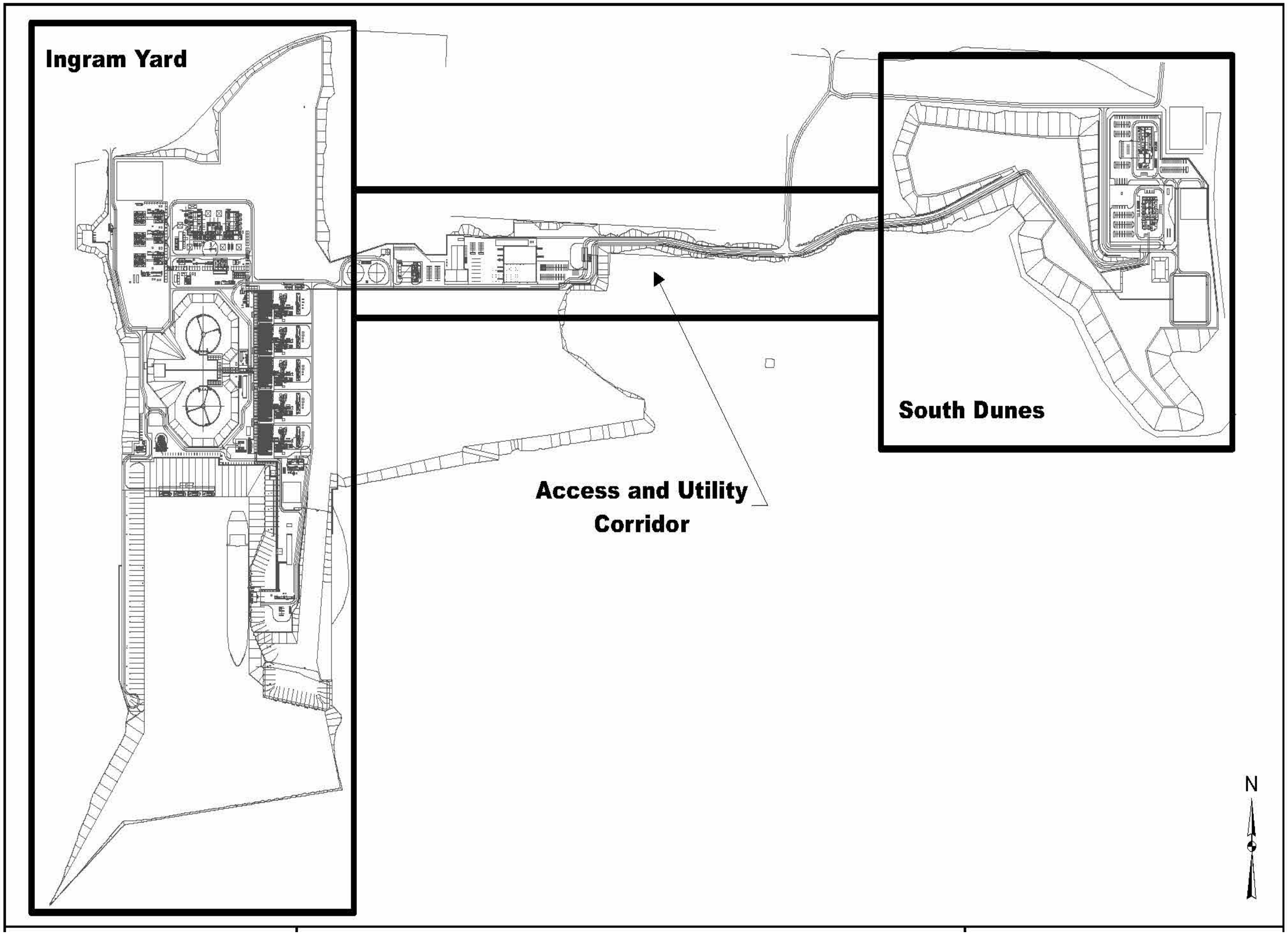


Figure 2.1-2
LNG Terminal Facilities

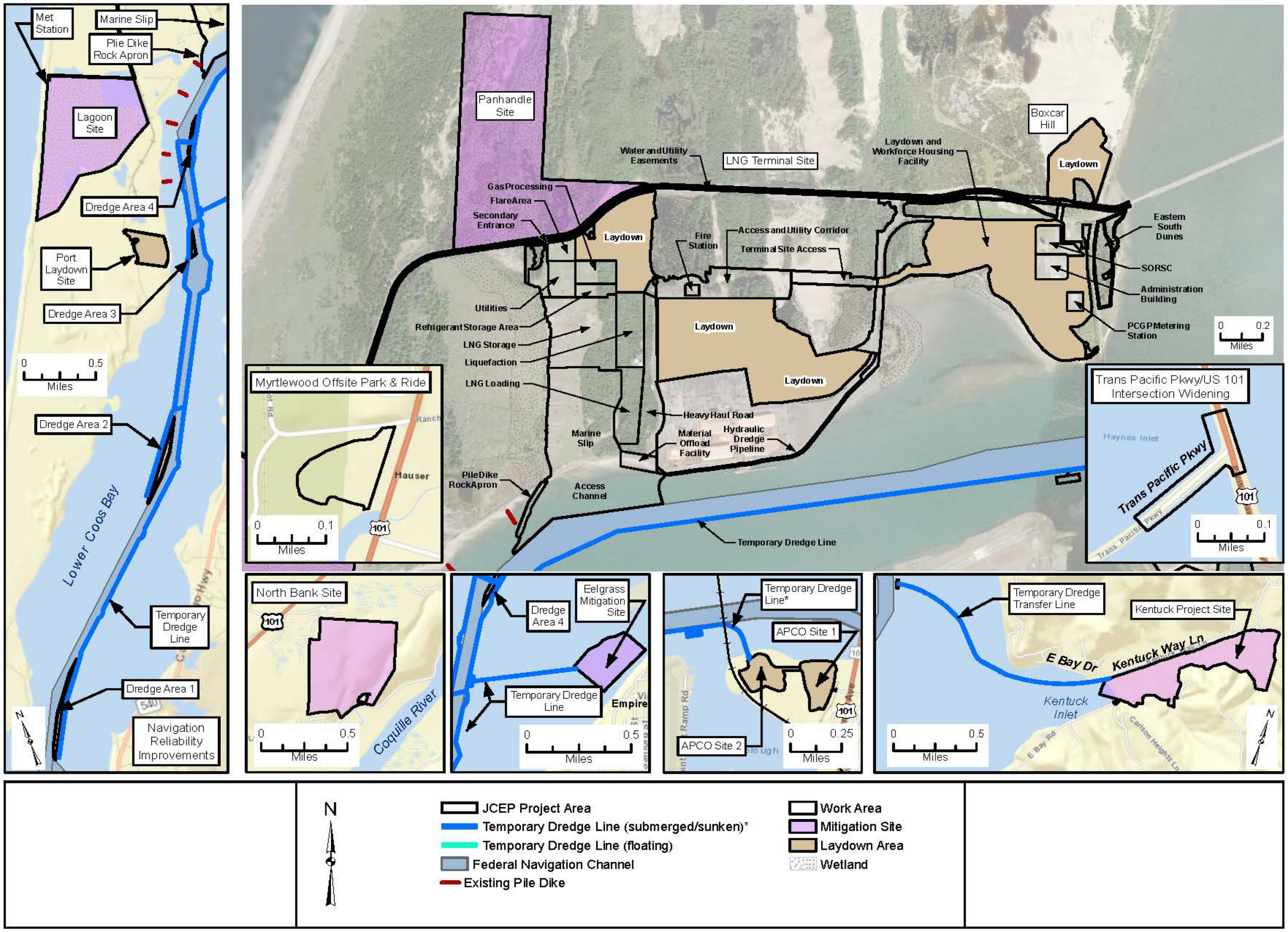


Figure 2.1-3
Jordan Cove LNG Project Detail

2.1.1.2 Liquefaction

The liquefaction trains would use Black & Veatch proprietary Poly Refrigerant Integrated Cycle Operation (PRICO®) LNG technology, each with a maximum annual capacity of 1.56 metric tonnes per annum (mtpa), for a total annual capacity of 7.8 mtpa for export. Gas delivered from the conditioning units would be divided equally among the five liquefaction trains where it would be turned into liquid by cooling to approximately -260°F. Upon leaving the LNG trains the produced LNG would be conveyed to the LNG storage tanks.

2.1.1.3 LNG Storage Tanks

The terminal would include two full-containment storage tanks, each designed to store 160,000 cubic meters (m^3) (1,006,000 barrels) of LNG at an approximate temperature of -260 degrees Fahrenheit (°F) at atmospheric pressure. Each storage tank would consist of a nine percent nickel inner steel container and a secondary concrete outer container wall with a steel vapor barrier, and would be designed so that both the primary inner container and the secondary outer concrete shell are capable of independently containing the entire volume of stored LNG.

The base elevation of the LNG storage tanks would be at about +27 feet above mean sea level (MSL). The top of the tanks (dome) would be about 190 feet above grade, and the diameter of the outer tank would be about 267 feet wide. Jordan Cove would construct an earthen berm around the tanks that would be about 19 feet high. The berm would provide spill containment capacity for the contents of one 160,000 m^3 storage tank.[24]

Each LNG storage tank would be built on a shallow mat foundation. Cellular glass would be applied to the insulation and a glass wool blanket would be installed on the inner tank. The remainder of the annular space between the outer tank and inner tank would be filled with expanded perlite to keep the stored LNG at a temperature of approximately -260°F while maintaining the outer container at near ambient temperature. The LNG storage tanks would have top connections only with piping that would allow top and bottom filling. Top filling would be done via a spray device or a splash plate while bottom loading would be achieved via a standpipe to allow mixing of incoming LNG as it combines with the LNG inventory within the LNG storage tanks. A conceptual design drawing of a typical full containment LNG storage tank is illustrated in figure 2.1-4.

[24] The full-containment LNG storage tanks are designed to contain an LNG spill in accordance with NFPA 59A. According to 49 CFR 193.2181, the secondary containment volume required for an LNG tank spill equals 110 percent of the liquid volume of the inner tank, which is accomplished by the outer concrete shell. Jordan Cove proposes to satisfy this secondary containment requirement through the use of an outer shell.

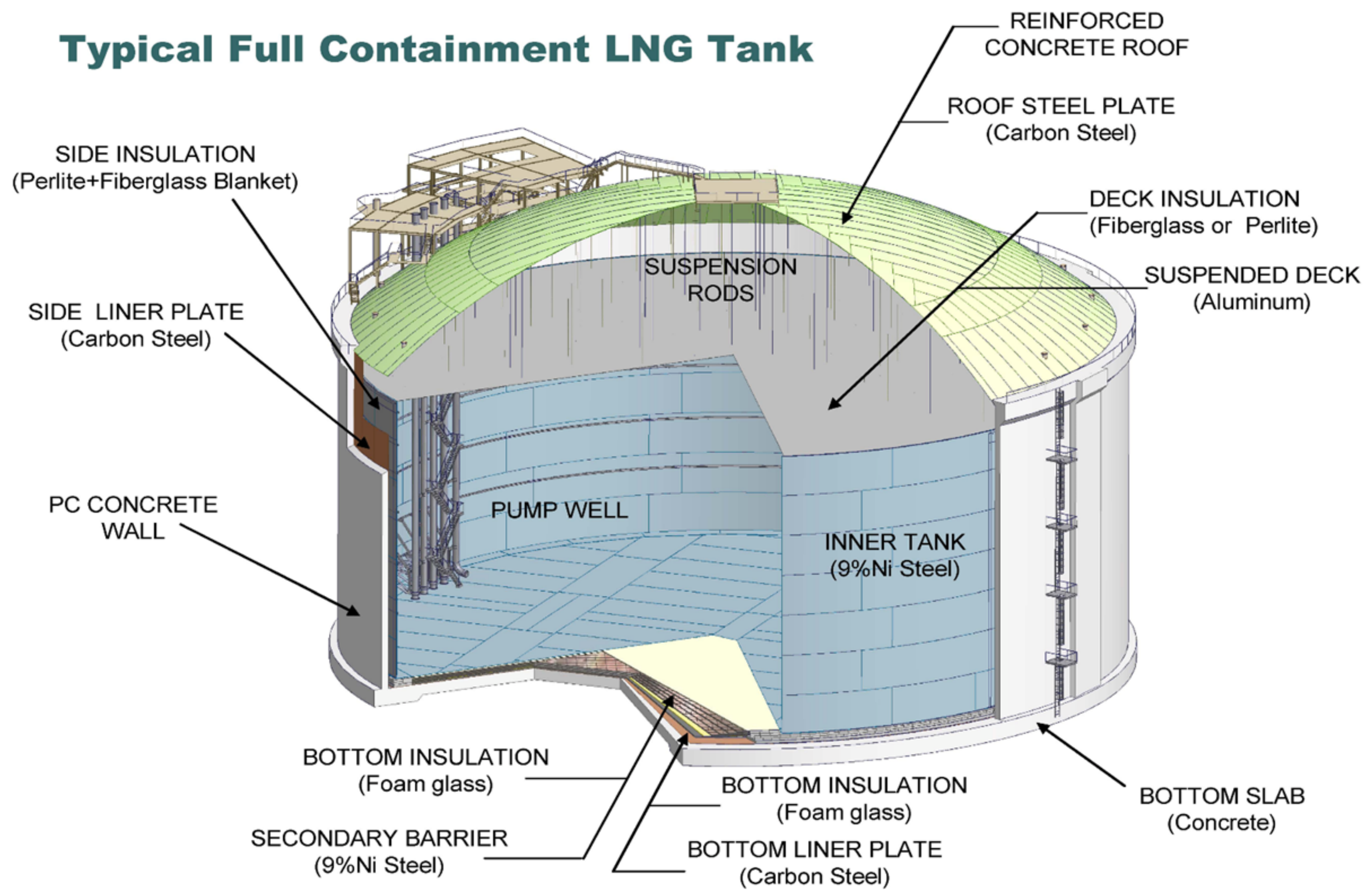


Figure 2.1-4

Typical Full Containment LNG Storage Tank

2.1.1.4 Terminal Access, Utility Corridor, and Parking

The feed gas supply pipeline and other utilities including power, water supply, and communications would be located in an approximately one-mile-long corridor connecting the South Dunes and Ingram Yard. The corridor would also provide temporary and permanent access to the LNG terminal site. Paved access between the South Dunes portion of the site and the western portion of the access and utility corridor would be via the existing Jordan Cove Road. A two-lane access road would be installed to the northwest of Ingram Yard to provide emergency, marine terminal, and occasional maintenance access from the Trans-Pacific Parkway.

2.1.1.5 Other Terminal Support Systems

The LNG terminal operation would require installation of several other systems within the LNG terminal site, as described below.

Vapor Handling System

The liquefaction and vessel loading processes would result in the creation of LNG vapors (i.e., boil-off gas), which would be recovered and directed into a vapor handling system and used as fuel gas or recycled into the liquefaction process for re-condensation.

Ground Flares

The LNG terminal would have three separate flare systems for occasional pressure relief or plant protection conditions: one flare system for warm (or wet) reliefs, one for cold cryogenic (or dry) reliefs, and one for low-pressure cryogenic reliefs from the marine loading system. The warm and cold flares would both be combined within a shared multi-point ground flare, while the marine flare would be within an enclosed cylindrical ground flare. The multi-point ground flare systems would be located at the northern end of the LNG terminal site and the enclosed ground flare would be located north of the marine vessel slip. The flare systems would only be used during emergency plant-protection situations, maintenance activities, cases of purging, off-design loading scenarios (e.g., warm or contaminated ship gassing up), and initial commissioning/start-up.

During initial commissioning and startup flaring would occur for approximately 1 week, at 10 to 20 percent of the flare design capacity. For dryout and cooldown, flaring would occur for approximately 2 weeks at less than about 20 percent of the flare design capacity. When each subsequent liquefaction train is started, flaring may occur for approximately 2 hours, and each train would be staggered by about 1 month between startups. Flaring during other commissioning activities would occur intermittently but would consist of individual pieces of equipment being isolated with very small volumes flared compared to the flare design capacity until the system is depressurized.

Instrumentation and Process Control System

The facility would be operated through a distributed control system (DCS) that would include control panels and numerous field-mounted instruments connected to remote input/output cabinets that would interface with the central control room. In addition, independent Safety Instrumented Systems (SIS) and Fire and Gas Systems (FGS) would monitor hazardous conditions and provide emergency shutdown capability.

Electrical Systems

Operating the LNG terminal would require approximately 39.2 megawatts (MW) (holding mode) and 49.5 MW (loading mode) of electricity. Electrical power would be generated by three on-site steam turbine generators capable of generating a total maximum of 24.4 MW; and brought to the site from a connection with the local power grid (15 to 26 MW). Also, an auxiliary boiler would be used to generate steam to power the generators when gas turbines are not in operation.

Imported electric power would be provided to the LNG terminal via an underground 12.47-kilovolt connection point at the northeast corner of the South Dunes site. The 12.47-kilovolt feeder would be routed underground from the connection point through the South Dunes site and along the access and utility corridor. The approximate length of the underground cable would be 10,500 feet, located entirely within the LNG terminal property.

The "black start power supply"[25] for the steam turbine generators would be provided through the grid (as described above); however, Jordan Cove has indicated that they may consider installing one standby diesel generator to provide redundant black start power supply as well. There would be two standby diesel generators for the SORSC.

Lighting System

Twenty-four-hour facility lighting would be required for security and personnel safety during operation of the LNG terminal. A final lighting plan, including lighting of the LNG storage tanks, would be developed during detailed LNG terminal design; however, Jordan Cove states that only lighting required for operation and maintenance, safety, security, and meeting FAA requirements would be used on the LNG storage tanks.

Water Systems

Jordan Cove would design and construct a stormwater management system to gather runoff from impervious surfaces within the terminal and direct the flow to designated areas for disposal. Stormwater collected in areas that are potentially contaminated with oil or grease would be pumped or would flow to oily water collection sumps before discharging to the industrial wastewater pipeline (IWWP). No untreated stormwater would be allowed to enter federal or state waters.

Sanitary waste would either be directed to a holding tank and disposed of by a sanitary waste contractor as necessary or would be treated by a packaged treatment system and directed to an existing IWWP.

During construction of the Jordan Cove LNG Project, an existing IWWP would be abandoned, replaced, and relocated. The new replacement pipeline would consist of 16-inch-diameter slip joint polyvinyl chloride (PVC). It would run for about two miles from the South Dunes portion of the site along the shoulder of the Trans-Pacific Parkway within an easement owned by the Port to connect with the existing outfall pipe west of the Weyerhaeuser lagoon on the North Spit (see figure 2.1-5).

[25] A black start is the process of restoring electric power station without relying on the external electric power transmission network.

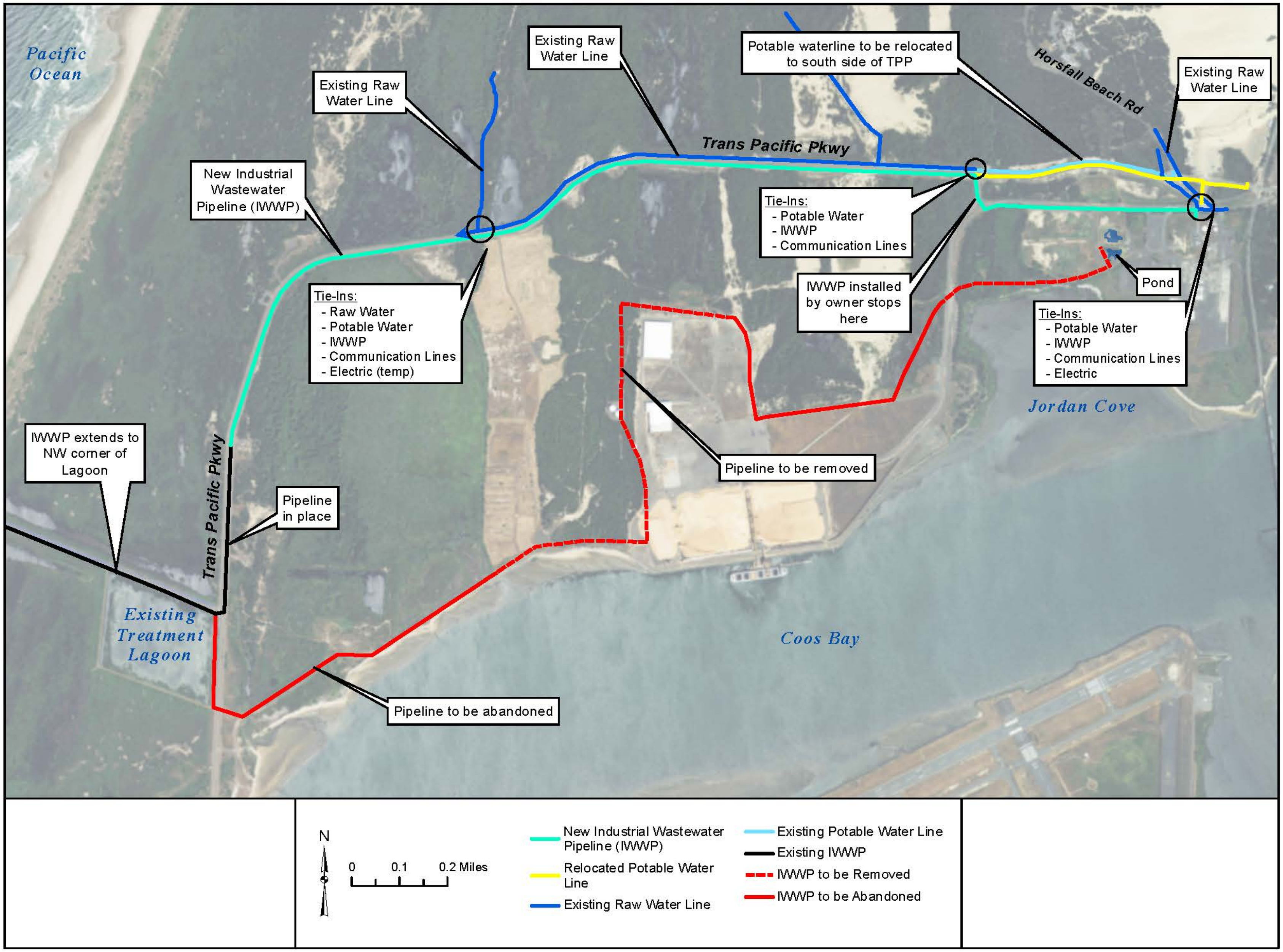


Figure 2.1-5
Industrial Wastewater Pipeline, Water Pipelines Relocation, and Utility Tie-Ins

Jordan Cove proposes to use raw water from the existing Coos Bay North Bend Water Board (CBNBWB) raw water pipeline for construction water needs, including hydrostatic testing of the LNG storage tanks. Following testing and ODEQ approval, the water would be locally discharged to the stormwater system for infiltration or discharged into the IWWP according to the applicable NPDES permit requirements.

An interconnect to the CBNBWB potable water pipeline would be used for all normal operational water needs in the LNG terminal, which includes fire water makeup, utility water used for such items as equipment and area cleaning, and potable water required to supply buildings and eyewash/safety shower stations. In addition, the raw water pipeline tap at the LNG terminal site would remain connected after construction, but there are no normal operational uses anticipated for this raw water supply. The water pipelines and proposed taps are shown on figure 2.1-5.

During construction of the terminal, Jordan Cove would use approximately 595.5 million gallons of water for various activities, including hydrostatic testing. During terminal operations, about 71.5 million gallons of water would be consumed annually. Water usage and impacts are more fully discussed in section 4.3 of this EIS.

The LNG terminal would include a fire suppression system with the main fire water supply for the system provided by two aboveground firewater storage tanks located in the access and utility corridor. Water supply for the two tanks would be potable water obtained from CBNBWB. Each tank would hold a minimum usable capacity of 3,240,000 gallons. This would supply approximately 4 hours of firefighting water. The fire water systems would also include stationary fire water pumps, fire hydrant mains, fixed water spray systems, automatic sprinkler extinguishing systems, high expansion foam system, and remotely controlled monitored spray systems. The fire water supply would also be used to provide water for on-site firefighting trucks.

Support Buildings

The LNG terminal would include buildings to house LNG process equipment, administration and office space, warehouse and receiving, guard houses and security, tugboat storage, and chemical and material storage. Support buildings would also include the non-jurisdictional SORSC and fire department building (see section 2.2). The SORSC would be located adjacent to the LNG terminal administration building on the South Dunes portion of the site. The fire department building would be located in the access and utility corridor.

2.1.1.6 Marine Waterway including Proposed Modifications to the Marine Waterway[26]

The Coast Guard defines the waterway for LNG marine traffic as extending from the outer limits of the United States territorial waters 12 nautical miles off the coast of Oregon, and 7.3 nautical miles up the Federal Navigation Channel to the LNG terminal site (figure 2.1-6). The Federal Navigation Channel extends from the mouth of Coos Bay to the city of Coos Bay Docks at about river mile (RM) 15.1. Jordan Cove would dredge four areas abutting the current boundary of the navigation channel between RM 2 to RM 7 (figure 2.1-1). Dredging would modify the physical morphology of the channel, by widening four turns along the channel, to allow for more efficient

[26] The proposed modifications to the marine waterway (i.e., dredging at four points along the Federal Navigation Channel) are referred to as "marine waterway modifications" or "navigation channel modifications" in this EIS.

transit of LNG carriers.[27] These proposed dredging actions would not result in a change in the overall depth of the Federal Navigation Channel (only a widening of four turns along the channel). The COE is currently evaluating if the dredging of these four turns would alter the Federal Navigation Channel. The four dredging actions are summarized below.

- **Enhancement #1 – Coos Bay Inside Range channel and right turn to Coos Bay Range:** To reduce constriction to vessel passage at the inbound entrance to Coos Bay Inside Range. Widen channel from the current 300 feet to 450 feet, and lengthen the total corner cutoff on the Coos Bay Range side from the current 850 feet to about 1,400 feet.
- **Enhancement #2 – Turn from Coos Bay Range to Empire Range channels:** Widen the turn area from the Coos Bay Range to the Empire Range from current 400 feet to 600 feet and lengthen the total corner cutoff area from the current 1,000 feet to about 3,500 feet.
- **Enhancement #3 – Turn from the Empire Range to Lower Jarvis Range channels:** Add a corner cut on the west side in this area that would be about 1,150 feet wide to provide additional room for vessels to make this turn.
- **Enhancement #4 – Turn from Lower Jarvis Range to Jarvis Turn Range channels:** Widen turn area from current 500 feet to 600 feet and lengthen total corner cutoff area from the current 1,125 feet to about 1,750 feet, to allow vessels to begin a turn in this area earlier.

In addition, Jordan Cove would install five meteorological ocean data collection buoys to aid navigation within the waterway, by measuring wind speed and direction, current speed and direction, as well as tide height. Jordan Cove also intends to upgrade and modify three existing buoys (two within Coos Bay and one located offshore near the Coos Bay entrance) by installing physical oceanographic real-time system sensors to the buoys and anchoring systems. Two new buoys would be installed and located near the access channel.

[27] While banks of the dredged areas are intended to be stable, some insignificant side slope equilibration may occur over about a 6-year period (see section 4.5.2 for more details).

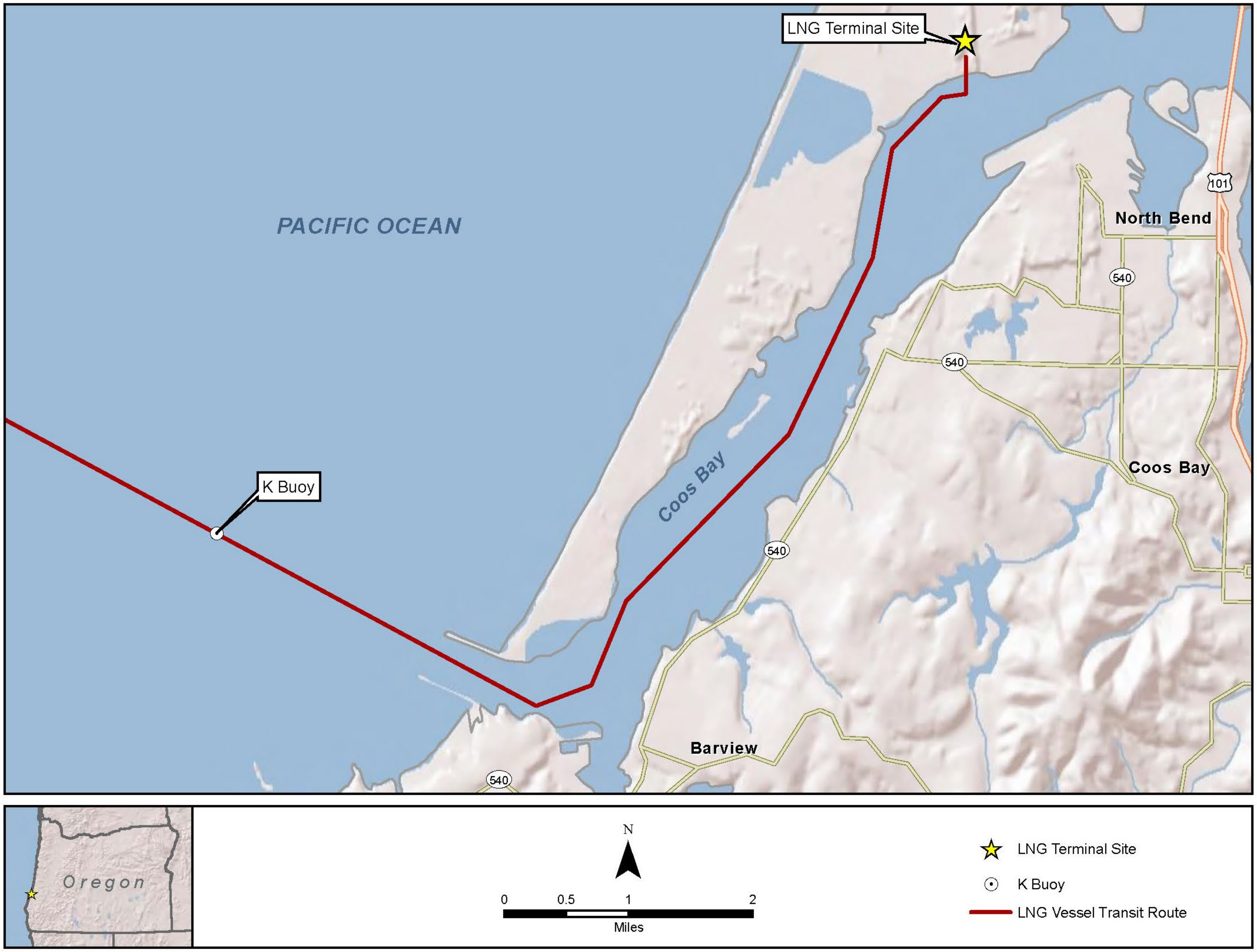


Figure 2.1-6
Proposed LNG Carrier Transit Route

2.1.1.7 Marine Access and Facilities

Access Channel

Jordan Cove would construct an access channel to connect the terminal to the Federal Navigation Channel (figure 2.1-7).[28] The access channel would begin at the confluence between the Jarvis Turn and the Upper Jarvis Range at about navigation channel mile (NCM) 7.3, and would be about 2,200 feet wide at the navigation channel and about 780 feet wide at the terminal. The distance from the north edge of the navigation channel to the mouth of the terminal would be about 700 feet. The walls of the access channel would be sloped to meet the existing bottom contours at an angle of 3 feet horizontal to one foot vertical (3:1) and are expected to equilibrate over time to 8:1 near the northwest outer dredged slip area. The access channel would be approximately 45 feet deep and would cover about 22 acres below the highest measured tide elevation of 10.3 feet (North American Vertical Datum of 1988 [NAVD88]).

Terminal Slip

Jordan Cove would construct a marine slip to support vessel operations at the north end of the access channel. This would be a single use slip that would be sized to provide flexibility to safely maneuver an LNG carrier from the access channel into the slip when another LNG carrier is already berthed on the east or west sides. The slip would also be sized to allow for tugs to move a temporarily disabled LNG carrier away from the loading berth on the east side of the slip to the emergency lay berth on the west side of the slip if necessary. The slip would be bounded on the east and west sides by sheet pile walls, creating a vertical face to support mooring structures. The northern side of the slip would be sloped to meet the existing bottom contours at an angle of 3 feet horizontal to one foot vertical (3:1). The minimum water depth within the slip would be -45 feet (NAVD88) in order to maintain at least 10 percent under-keel clearance when the ships are in dock. A berm/tsunami wall would also be constructed between the western edge of the slip and Henderson Marsh to approximate elevation +34.5 feet to increase tsunami resistance (figure 2.1-7).

Material Offloading Facility

The MOF would be constructed to receive components of the LNG terminal that are too large or heavy to be delivered by road or rail. The MOF would cover about 3 acres on the southeast side of the slip (see figure 2.1-7). The MOF would be constructed using the same sheet pile wall system as the LNG loading berth to an elevation approximately +13.0 feet (NAVD88). Following construction, the MOF would be retained as a permanent feature of the LNG terminal to support maintenance and replacement of large equipment components. The MOF would not be available for use by other parties.

[28] The access channel and a portion of the marine slip would be within state waters managed by the ODSL. Jordan Cove would construct the access channel and would transfer responsibility for maintenance to the Oregon International Port of Coos Bay (Port) following construction. The Port has already obtained an easement from ODSL for operation and maintenance of the access channel and the in-water portion of the slip. Jordan Cove would reimburse the Port for costs associated with its operation and maintenance of the access channel and slip.

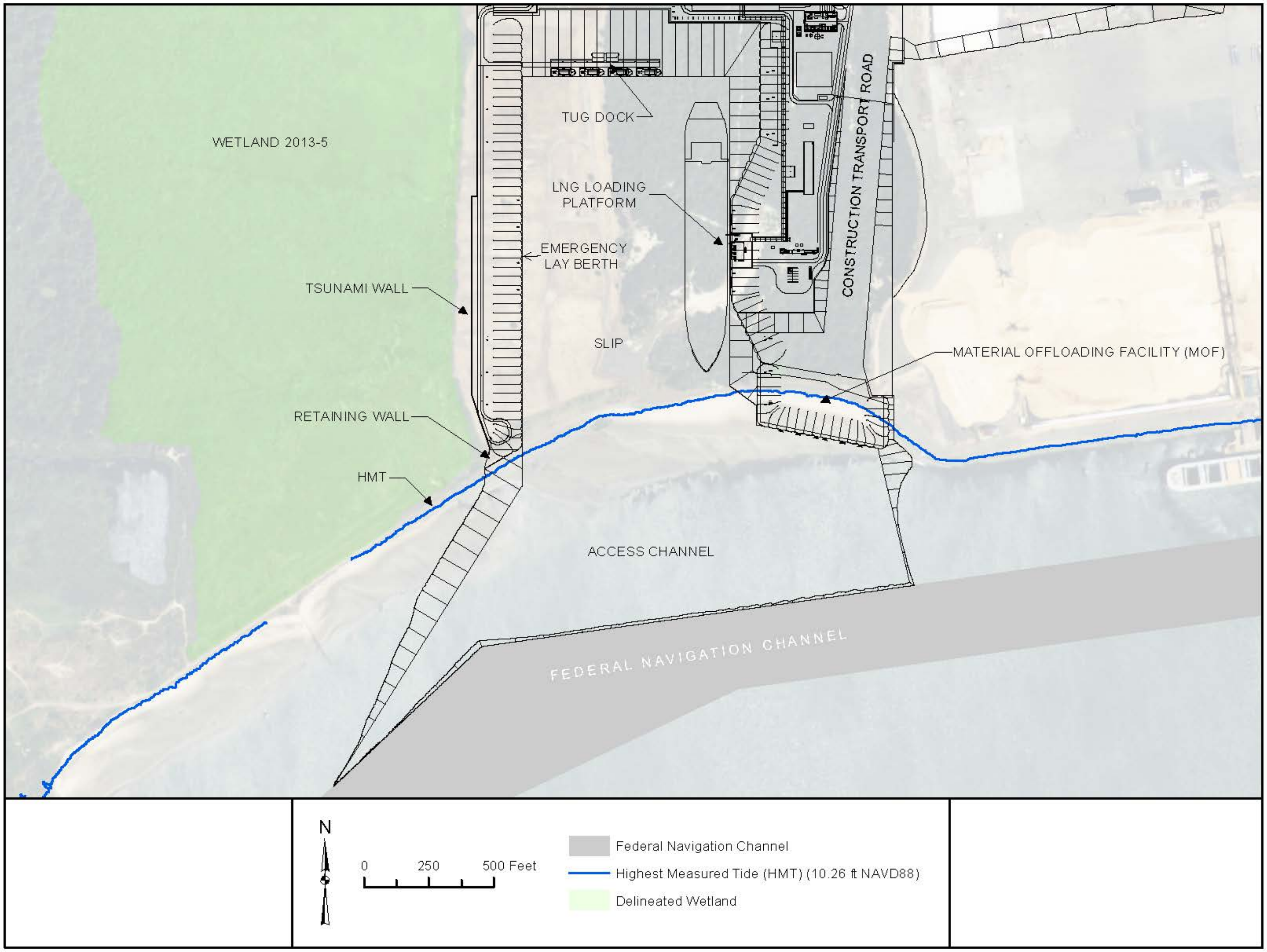


Figure 2.1-7
Plot Plan of the Marine Facilities

LNG Carrier Loading Berth and Product Loading Facility

An LNG carrier loading berth would occupy the eastern side of the slip. A profile of the loading berth is provided in figure 2.1-8. The loading berth would be constructed of steel sheet piles that support surface structures (the loading area) and provide the foundation for the breasting and mooring structures. The berth support wall would extend from the bottom of the slip (elevation approximately -45 feet) to approximate elevation +34.5 feet (NAVD88).[29]

The product loading facility (PLF), or LNG loading platform, would be a pile-supported concrete slab that provides structural support to the marine loading arms, terminal gangway, and other ancillary equipment at the berth. The PLF would be constructed on top of the sheet pile wall at approximate elevation +34.5 feet (NAVD88), with a foundation of reinforced concrete supported by steel pilings.

Emergency Lay Berth

An emergency vessel lay berth on the west side of the slip would be constructed to safely moor a temporarily non-operational LNG carrier (figure 2.1-7). This berthing facility would be supported by the west side sheet pile wall with a top-of-wall elevation of approximately +20 feet (NAVD 88). Support infrastructure would include an access road from the tug berth area, duct bank with cabling for powering the mooring hooks and capstans, and lighting of the ship access area.

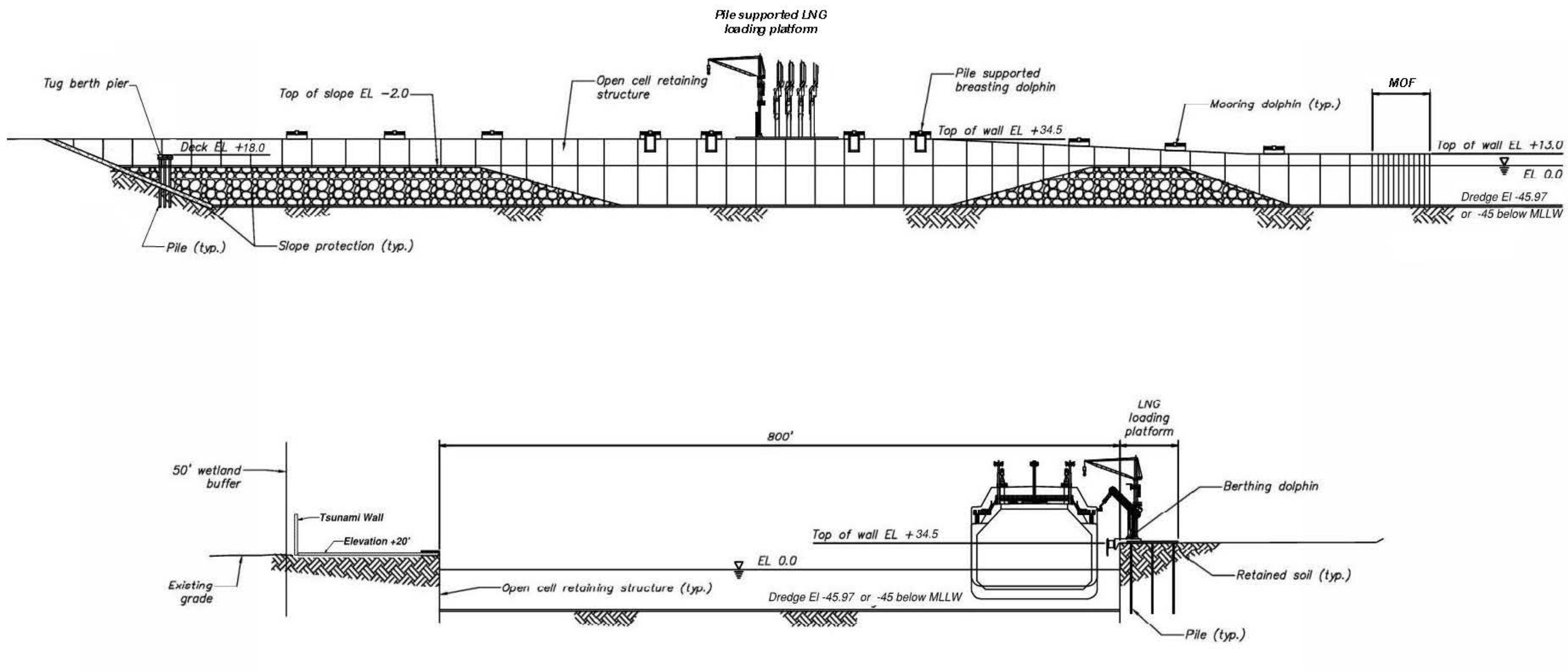
Tug and Escort Boat Berth

A berth, also referred to as a tug dock, would be constructed on the north side of the marine slip (figure 2.1-7) to accommodate up to four tugboats, two sheriff's escort boats, and six other visitor boats with similar characteristics as the sheriff's boats. This dock would be about 470 feet long and 18 feet wide and would be precast concrete supported by steel piles. The tug dock would be accessible from land by a pile-founded trestle. Included as part of the dock would be two boat houses. North of the dock would be a tug operator building.

LNG Marine Traffic

Section 2.1.1.6 defines the extent of the marine waterway. For the analysis in this EIS, and the corresponding BA and EFH Assessment specific to species covered by the ESA and MSA, we also considered impacts from LNG carrier marine traffic extending out to the edge of the Outer Continental Shelf. Jordan Cove estimated that it would take an LNG carrier up to 90 minutes to transit the waterway from the "K" buoy to the terminal at speeds ranging from 4 to 10 knots (a description of the LNG carriers is provided in section 2.2.1). An additional 90 minutes would be necessary for the LNG carrier to be turned in the access channel and parked at the terminal berth, with the assistance of tug boats. The entire round-trip transit time for a single LNG carrier to travel from Buoy K through the waterway, turn and dock at the berth, take on a full cargo of LNG, and then exit the terminal slip and travel through the waterway back out to the open ocean past Buoy K would be about 22 hours.

[29] The slip and berth would be designed to accommodate LNG carriers as large as 217,000 m^3 in capacity.



All elevations are to the NAVD88 datum

NOT TO SALE

Figure 2.1-8
Profile of Marine Berth

Rock Apron

The COE expressed concern that erosion resulting from the Jordan Cove LNG Project's operation could result in impacts on Pile Dike 7.3 (located immediately west of the access channel) as well as the Project's slip. As a result, Jordan Cove would construct a rock apron west of the access channel to arrest slope migration, or equilibration, before it can progress to a condition that could potentially negatively impact Pile Dike 7.3 or the proposed slip. The design involves a 50-foot-wide by 3-foot-thick by approximately 1,100-foot long rock apron set back approximately 20 feet from the top (slope catch point) of the access channel side slope. The size of rock to be used is well graded 6-inch to 22-inch angular stone with a median size of 14 inches. The rock apron design also includes an approximately 100-foot-long extension of the slip's sheetpile bulkhead at the northwest corner of the access channel to reduce slope cut-back at this location. Total required rock volume is approximately 6,500 cy.

2.1.1.8 Dredged and Excavated Material Disposal

Dredging for the Marine Facilities

Dredging for the marine facilities, including the marine waterway modifications, would generate about 6.32 million cubic yards (mcy) of dredged and excavated material (see table 2.1.1.8-1). Of this, approximately 3.8 mcy would be dredged and excavated for the proposed slip. About 1.4 mcy would be dry excavated and then about 2.2 mcy would be dredged in the water pocket in the slip area and access channel (i.e., behind an earthen berm that would remain in place to separate work prior to dredging activities in the bay). The remainder of the dredged material would be removed during open water dredging while exposed to the bay and Federal Navigation Channel.

TABLE 2.1.1.8-1

Materials Excavated and Dredged During Construction of LNG Terminal Marine Facilities

Area	Construction Phase	Volume (mcy)	Disposal Location
Slip	Excavation and Dredge Behind Berm	3.6	Ingram Yard, Corridor, South Dunes, Roseburg site
Slip	Salt Water Dredge	0.2	Ingram Yard, Corridor, South Dunes, Roseburg site
Protective Berm	Upland Excavation	0.03	Ingram Yard, Corridor, South Dunes
Protective Berm	Salt Water Dredge	0.5	Ingram Yard, Corridor, South Dunes, Kentuck Project
Access Channel	Upland Excavation	0.004	Ingram Yard, Corridor, South Dunes, Roseburg site
Access Channel	Salt Water Dredge	1.4	Ingram Yard, Corridor, South Dunes, Roseburg site
Marine Waterway Modifications	Salt Water Dredge	0.59	APCO Sites 1 and 2
	Total:	**6.32**	

Most of the material excavated and dredged during construction of the marine facilities would be used to raise the elevation of the terminal facilities above the tsunami inundation zone. Ingram Yard, the access and utility corridor, and the South Dunes portions of the site, including temporary use areas (see section 2.1.1.10), would receive material to raise their respective site elevations. Some material would also be deposited at the adjacent Roseburg Forest Products property, and at the Kentuck project mitigation site. Material dredged for the marine waterway modifications would be deposited at Al Pierce Company (APCO) Sites 1 and 2.

Dredging for the Marine Waterway Modifications

Approximately 590,000 cy of material would be excavated/dredged to complete the marine waterway modifications. Storage of the dredge material would be distributed between the APCO 1 and APCO 2 upland disposal sites (see figure 2.1-1), or placed entirely at APCO Site 2 if shown to be feasible.

Operational Maintenance Dredging

Jordan Cove proposes to conduct maintenance dredging about every 3 years with about 115,000 cy of material removed per dredging interval for the first 10 years of operation, and after that maintenance dredging could be done about every 5 years with up to 160,000 cy of materials removed during each dredging event.[30] For the marine waterway modification projects within the channel, maintenance dredging would also be conducted about every 3 years with about 27,900 cy of materials removed during each dredging event. Jordan Cove proposes to distribute maintenance dredge material between the upland APCO Sites 1 and 2 (see figure 2.1-3). Jordan Cove may be required to acquire a new permit from the COE if future dredge materials could not be distributed at the upland APCO Sites 1 and 2, due to unforeseen future conditions.

2.1.1.9 Applicant Proposed Mitigation Areas

This section describes mitigation actions proposed by Jordan Cove and Pacific Connector to address established mitigation policies and programs at the federal and state level. Jordan Cove and Pacific Connector have identified several areas that would be affected by the measures they have proposed to mitigate Project-related impacts. These mitigation measures are addressed in subsequent analyses, as appropriate.

Jordan Cove developed two wetland/aquatic vegetation mitigation sites per the requirements of section 401 and 404 of the CWA.

- Jordan Cove and Pacific Connector propose to mitigate the loss of wetlands (including estuarine areas) through the Kentuck project (i.e., wetland impacts include permanent and temporary impacts and loss of aquatic resource types, functions and values; see section 4.3). The Kentuck project includes about 140 acres on the eastern shore of Coos Bay at the mouth of Kentuck Slough (see figures 2.1-1 and 2.1-3). Formerly, this property was the Kentuck Golf Course, but it is currently owned by Jordan Cove. On August 30, 2016, the Coos County Board of County Commissioners granted Jordan Cove's request for a conditional use permit to allow for mitigation and restoration within this property.

- Jordan Cove proposes to mitigate for the loss of aquatic vegetation via an eelgrass restoration program in Coos Bay, near the Southwest Oregon Regional Airport in North Bend, including establishing new eelgrass beds (see figures 2.1-1 and 2.1-3). Additional information about wetland impacts and mitigation is presented in section 4.3.3.

Jordan Cove developed three upland mitigation sites per recommendations from the ODFW in response to the mitigation policy set forth in OAR 635-415-0000 through 0025. The proposed

[30] Proposed maintenance dredge frequency and volume is based on a sedimentation study conducted by Jordan Cove and summarized in Jordan Cove's *Dredged Material Management Plan* filed as Appendix N.7 in Resource Report 7 as part of its September 2017 application to FERC.

upland habitat mitigation sites include the Panhandle site, the Lagoon site, and the North Bank site.

- The Panhandle site is approximately 133 acres in size and is located north of Trans-Pacific Parkway. The site would be used by Jordan Cove for upland wildlife habitat mitigation, including 52.7 acres of in-kind and 79.9 acres of out-of-kind habitat mitigation. Mitigation activities conducted at this site would include removing Scotch broom (*Cytisus scoparius*) from selected portions of the parcel followed by restoration with native species, and providing a conservation easement. The entire parcel would be managed by Jordan Cove for the life of the Project.

- The Lagoon site is approximately 320 acres and is located adjacent to the meteorological station. The site would be used by Jordan Cove for upland wildlife habitat mitigation, including 41.2 acres of in-kind and 71.7 acres of out-of-kind habitat mitigation. Mitigation activities conducted at this site would include burying existing power lines on the site to reduce collision risks to birds, and providing a Jordan Cove-owned conservation easement and management of the entire parcel for the life of the Project.

- The North Bank site is approximately 156 acres and is located on the north bank of the Coquille River adjacent to the Bandon Marsh National Wildlife Refuge (NWR). The site would be used by Jordan Cove for upland wildlife habitat mitigation, including 1.6 acres of in-kind and 92.7 acres of out-of-kind habitat mitigation. This site was originally managed for rotational timber harvest, and in the absence of a conservation easement the parcel would be subject to ongoing logging. Therefore, Jordan Cove proposes to purchase the land and eliminate the ongoing clearcutting. Silviculture activities (e.g., including thinning, snag creation, and placement of large woody debris) would be conducted to allow the area to restore in time to a mature forested habitat. Weed species (e.g., Scotch broom, gorse [*Ulex* sp.], English ivy [*Hedera helix*], and blackberry [*Rubus bifrons*]) would be removed from the site to the extent practical. Jordan Cove would establish a Jordan Cove-owned conservation easement and management the parcel for the life of the Project.

2.1.1.10 Temporary Construction Use Areas

During construction of the LNG terminal, temporary use areas outside of the footprint of the permanent LNG terminal, would be required for equipment and material staging, dredge material disposal and transport, workforce housing, workforce parking, and road improvement. These facilities and their locations are shown on figures 2.1-1 and 2.1-3, and summarized below.

Laydown Yards

Jordan Cove would use several construction laydown areas immediately adjacent to the LNG terminal site, including at the north side of the Ingram Yard, within the Roseburg Forest Products property east of marine terminal facilities, and within the South Dunes portion of the site (figure 2.1-3). Jordan Cove would also use one laydown yard (Boxcar Hill) on the north side of the Trans-Pacific Parkway just north of the South Dunes portion of the site, one laydown yard (Port Laydown Site) within Port property about 2 miles south of the LNG terminal site, and two laydown yards across Coos Bay on North Point in North Bend (APCO Sites 1 and 2) (figures 2.1-1 and 2.1-3). The laydown yards would be used during construction to house construction offices, workforce lunchrooms, warehousing, equipment maintenance, and laydown of materials after delivery to the site.

Dredge Pipelines

During construction of the marine slip and access channel, a slurry pipeline and return water pipeline would be laid across the Roseburg Forest Products tract to the South Dunes portion of the site. A temporary dredge pipeline would also be laid adjacent to the Federal Navigation Channel (via a floating or submerged pipe) to transport dredge material from the four marine waterway modification sites to the APCO Sites 1 and 2, and a temporary dredge line would be laid between the Federal Navigation Channel and the Kentuck project site to transfer dredge material from marine transport barges to the disposal sites. A temporary dredge pipeline would also be laid extending west from the Eelgrass Mitigation site to the Federal Navigation Channel, where dredged material would be loaded on to barges for transport to an upland disposal site.

Workforce Housing

Jordan Cove proposes to construct a temporary workforce housing facility within the South Dunes portion of the LNG terminal site that could accommodate common facilities and 200 to 700 beds. Parking would be provided on-site, and shuttle buses would be provided to and from local communities to reduce traffic on the road network after working hours. After completion of construction and commissioning activities the entire facility would be decommissioned and removed from the site.

Off-Site Parking

To reduce construction traffic on U.S. Highway 101 north of North Bend/Coos Bay, Jordan Cove would establish a Project park-and-ride facility at the vacated Myrtlewood RV park near the community of Hauser (figures 2.1-1 and 2.1-3).[31] Minimal modifications and maintenance would be performed at this site. Jordan Cove would also provide dedicated buses, subject to demand, to and from private RV parks housing construction personnel.

2.1.2 Pacific Connector Pipeline and Associated Aboveground Facilities

The 36-inch-diameter, Pacific Connector natural gas pipeline would extend for about 229 miles across Klamath, Jackson, Douglas, and Coos Counties, Oregon and terminate at the proposed LNG export facility in Coos County (figure 1.1-1 in section 1). As identified in table D-1 in appendix D, the pipeline would be located adjacent to, but separated from, existing rights-of-way including powerlines, roads, and other pipelines for about 97.7 miles (43 percent).

The pipeline would have a design capacity of 1.2 Bcf/d of natural gas, with a maximum allowable operating pressure (MAOP) of 1,600 pounds per square inch gauge (psig).[32] The pipeline (and aboveground facilities) would be designed, constructed, tested, operated, and maintained to conform with USDOT requirements found in 49 CFR Part 192, *Transportation of Natural and Other Gas by Pipeline: Minimum Safety Standards*; the FERC requirements at 18 CFR 380.15, *Site and Maintenance Requirements*; and other applicable federal and state regulations. The

[31] Jordan Cove has indicated that they are working with local developers to identify a second park-and-ride that would be used for the Project. However, at this time the only park-and-ride that has been identified and filed with the FERC is the Myrtlewood RV park-and-ride.

[32] On October 5, 2018, Pacific Connector notified the Commission that it would use thicker pipe than initially proposed in order to increase the design pressure from 1,600 psig to 1,950 psig and allow for possible increased volume in the future, however the proposed MAOP remains at 1,600 psig. Any addition or change to the proposed psig would require additional review and approval from the FERC, and is not covered within the scope of the EIS.

location of the proposed pipeline Project facilities is shown on detailed maps included in appendix C and described below.

2.1.2.1 Aboveground Pipeline Facilities

New aboveground facilities would include one compressor station, 3 meter stations, 5 pig launcher/receiver assemblies, 17 mainline valves (MLV), and 15 communication towers (table 2.1.2.1-1).

TABLE 2.1.2.1-1

Pacific Connector Aboveground Facilities

Facility	MP	Acres Disturbed a/	County	Ownership/ Jurisdiction
Jordan Cove Meter Station, MLV #1, Pig Receiver, and Communication Tower	0.0	1.7	Coos	Private
MLV #2 (Boone Creek Road)	22.2	0.1	Coos	Private
MLV #3 (Myrtle Point Stikum Road)	32.5	0.1	Coos	Private
MLV #4 and Communication Tower	51.6	0.1	Douglas	Private
MLV #5 (South of Olalla Creek)	59.6	0.1	Douglas	Private
MLV #6 and Launcher/Receiver (Clarks Branch)	71.5	0.5	Douglas	Private
MLV #7 (Pack Saddle Road)	80.0	0.1	Douglas	BLM
MLV #8 (Highway 227)	94.7	0.1	Douglas	Private
MLV #9 (BLM Road 33-2-12)	113.7	0.1	Jackson	Private
MLV #10 and Communication Tower (Shady Cove)	122.2	0.1	Jackson	Private
MLV #11, Communication Tower, and Launcher/Receiver (Butte Falls)	132.5	0.3	Jackson	Private
MLV #12 (Heppsie Mountain Quarry Spur)	150.7	0.1	Jackson	BLM
MLV #13 (Clover Creek Road)	169.5	0.1	Klamath	Private
MLV #14 and Launcher/Receiver (Keno)	187.4	0.4	Klamath	Private
MLV #15 and Communication Tower – Klamath River	196.6	0.1	Klamath	Private
MLV #16 and Communication Tower	211.6	0.1	Klamath	Private
Klamath Compressor Station, Klamath-Beaver and Klamath-Eagle Meter Stations, MLV #17, Pig Launcher, and Communications Tower	228.8	21.4	Klamath	Private
Blue Ridge Communication Tower	Approx. 20	0.2	Coos	BLM
Signal Tree Communication Tower	Approx. 45	0.2	Coos	BLM
Sheep Hill Communication Tower	Approx. 70	0.2	Douglas	Private
Harness Mountain Communication Tower	Approx. 75	0.0	Douglas	Private
Starveout Communication Tower	Approx. 115	0.2	Jackson	Private
Flounce Rock Communication Tower	Approx. 123	0.2	Jackson	BLM
Robinson Butte Communication Tower	Approx. 159	0.2	Jackson	Forest Service
Stukel Mountain Communication Tower b/	Approx. 209	0.2	Klamath	BLM

a/ Values are rounded to the nearest tenth of an acre.
b/ Assumes that existing BLM communication Site Plan is sufficient. If not, supplemental environmental compliance may be required.

Meter Stations

The Jordan Cove Meter Station would be located within the South Dunes portion of the terminal. The meter station would be comprised of one building which would house gas chromatographs, moister analyzer, communication equipment, and flow computer. A canopy would also be installed to cover the control valves and ultrasonic meters. The Jordan Cove Meter Station would also include an MLV, a pig launcher/receiver, and a 140-foot-high steel communication tower. The station would be enclosed by a 7-foot-high chain-link fence, and the interior of the yard would be graveled.

The Klamath-Beaver and the Klamath-Eagle Meter Stations would be co-located within the fenced boundaries of the Klamath Compressor Station at about MP 228.8. The Klamath-Beaver Meter

Station would include an interconnection with the existing GTN pipeline system; while the Klamath-Eagle Meter Station would serve as the interconnect with the existing Ruby pipeline system.

Klamath Compressor Station

The Klamath Compressor Station would be located approximately 1.8 miles northeast of the town of Malin, at the eastern terminus of the Pacific Connector pipeline, and would be accessible from Malin Loop and Morelock Roads. The station would include the Klamath-Eagle and Klamath-Beaver Meter Stations and would be located adjacent to the existing GTN Malin/Tuscarora Gas Transmission Company Meter Station and the Ruby Turquoise Flats facility.

The compressor station would include 62,200 International Organization for Standardization (ISO) hp of new compression and a 31,100 ISO hp standby compressor unit, consisting of turbine-driven, natural gas fired centrifugal compressor units. Other facilities would include an inlet filter/separator, lube oil cooler, inlet air silencer/cleaner, exhaust system, and gas coolers. The compressor building would include skid-mounted fuel gas conditioning, measuring, and regulation equipment. Related suction and discharge headers and piping would be installed between the pipeline and the compressor units. Other buildings inside the station would include a control room/ancillary equipment building and unit valve skid buildings. The ancillary equipment building would include an air compressor system, hot water boiler, and back-up generator. A high-pressure vent system with a silencer would be installed to allow the compressor to be blown down. There would also be a small office in one of the buildings and the station would contain aboveground pig launcher/receiver equipment, an MLV, and a 140-foot-high communication tower. The compressor station would be secured by a 7-foot-high chain-link fence.

The Klamath Compressor Station would be utilized as a maintenance base for operation of the pipeline facilities. The station would not be manned 24 hours per day, but would have emergency pipe, spare parts, and equipment and tools stored on site.

Mainline Block Valves

Pacific Connector would install 17 MLVs along its pipeline in compliance with USDOT requirements (CFR 192.179) (see table 2.1.2.1-1). The MLVs would be within the construction and operational right-of-way for the pipeline, except for the MLVs at meter stations, the compressor station, and that include pig launchers and receivers. Five of the MLVs would be automated to allow remote operation, which would require a 40-foot communication tower to be installed within the facility's fenced footprint.

Pig Launchers/Receivers

Pig launchers and receivers would allow Pacific Connector to maintain the interior of its pipeline using pipe inspection and cleaning tools (known as "pigs"). A pig launcher would be located within the proposed Klamath Compressor Station, and a pig receiver would be installed at the proposed Jordan Cove Meter Station. There would also be pig launcher and receivers at MLVs #6, #11, and #14. The pig launcher and receiver facilities would be fenced at all locations.

Gas Control Communications

The meter stations and compressor station would require a communications link with the gas control monitoring system. New radio towers are proposed at the Jordan Cove Meter Station, the Klamath Falls Compressor Station, and at five MLVs. Pacific Connector has conducted initial communications studies and determined that leased space on eight existing communication towers would also be needed for gas control communications (see table 2.1.2.1-2 and figure 1.1-1). For the five locations on federal lands, Pacific Connector prepared a *Communication Facilities Plan* (dated January 2013) as part of its POD.

TABLE 2.1.2.1-2

Proposed and Existing Gas Control Communication Towers

Facility	County	Landowner	Tower Height (ft)	Operational Acres a/
Proposed New Towers Within Proposed Aboveground Facility Sites				
Jordan Cove Meter Station b/	Coos	Private (Pacific Connector)	140	1.7 c/
MLV #4	Douglas	BLM	40	0.1
MLV #10	Jackson	Private	40	0.1
MLV #11, Launcher/Receiver (Butte Falls)	Jackson	Private	40	0.3
MLV #15 (Klamath River)	Klamath	Private	40	0.1
MLV #16 (Hill Road)	Klamath	Private	40	0.1
Klamath Compressor Station	Klamath	Private (Pacific Connector)	140	17
Existing Communication Tower Sites d/				
Blue Ridge	Coos	BLM (Coos District)	170	0.2
Signal Tree (Kenyon Mt.)	Coos	BLM (Coos District)	120	0.2
Sheep Hill	Douglas	Private	125	0.2
Harness Mountain e/	Douglas	Private (Northwest Pipeline)	150	0.0
Starveout Communication	Jackson	Private	115	0.2
Flounce Rock	Jackson	BLM (Medford District)	120	0.2
Robinson Butte	Jackson	Forest Service (Rogue River National Forest)	125	0.2
Stukel Mountain	Klamath	BLM (Lakeview District)	100	0.2

a/ Acreages are rounded to the nearest 0.1 acre.
b/ A tower at this site would only be necessary if Pacific Connector is unable to mount an antenna on one of the structures within the LNG terminal site.
c/ The towers at meter or compressor stations and MLVs would be within the fenced operational area of the facilities.
d/ Space would be leased on an existing tower, or a new tower and equipment building installed if lease space is not available. Operational acres column assumes worst case.
e/ Communication equipment would be installed on an existing tower.

2.1.3 BLM and Forest Service Land Management Plan Amendment Actions

2.1.3.1 Proposed Amendments of the BLM Districts RMPs

Approximately 46.9 miles of the proposed Pacific Connector pipeline route would cross federal land administered by BLM Coos Bay, Roseburg, and Medford Districts and the Klamath Falls Field Office of the Lakeview District.

Similar to a county zoning ordinance, projects or activities that occur on BLM lands must be consistent with the respective RMP where the project or activity occurs. The proposed right-of-way for the Project on BLM-managed lands would not conform to the Southwestern Oregon RMP and the Northwestern and Coastal RMP (RMPs for Western Oregon). The RMPs for Western Oregon allow for the construction of linear rights-of-way within the LSR "as long as northern Spotted Owl (NSO) nesting-roosting habitat continues to support nesting and roosting at the stand level, and NSO dispersal habitat continues to support movement and survival at the landscape level," and construction of linear rights-of-way "as long as the occupied stand continues to support marbled murrelet nesting" (BLM 2016b: 71; BLM 2016a: 65). BLM staff initially evaluated that the proposed right-of-way would cross approximately 268 acres of LSR and approximately 116 acres of known or presumed occupied marbled murrelet (*Brachyramphus marmoratus*; MAMU) habitat and/or northern spotted owl (*Strix occidentalis caurina*; NSO) nesting-roosting habitat within LSR. Additional analysis concluded that the clearing and removal of vegetation required within the LSR for the proposed Project would likely result in some NSO habitat no longer continuing to support nesting and roosting at the stand level, and some MAMU habitat no longer continuing to support nesting at the stand level (see section 4.6, our BA [in appendix I of this EIS], and appendix F.1).

BLM management direction in the RMPs for Western Oregon specific to wildlife prohibits activities that "*disrupt marbled murrelet nesting at occupied sites ... within all land use allocations within 35 miles of the Pacific Coast and... within reserved land use allocation between 35-50 miles of the Pacific Coast*" (BLM 2016b:118; BLM 2016a: 98). BLM staff concluded that construction of the Project would likely result in disruption of MAMU nesting at some occupied sites within these two discrete geographic ranges.

In order to consider the Right-of-Way Grant, the BLM must address these inconsistencies by amending the affected RMPs to make provisions for the Project. BLM therefore proposes to amend the RMPs to re-allocate all lands within the proposed temporary use area and row to a District-Designated Reserve, with management direction to manage the lands for the purposes of the Pacific Connector Gas Pipeline right-of-way. Approximately 879 acres would be re-allocated. District-Designated Reserve allocations establish specific management for a specific use or to protect specific values and resources. Other uses that are compatible with the purpose of the District-Designated Reserve may be authorized.

District-Designated Reserve is an existing land use allocation in both the Northwestern and Coastal Oregon RMP and the Southwestern Oregon RMP. Under these RMPs, District-Designated Reserves encompass a wide variety of lands, including constructed facilities, infrastructure, roads, communication sites, seed orchards, quarries, lands biologically or physically unsuitable for timber production, Areas of Critical Environmental Concern (ACEC), and lands managed for their wilderness characteristics. District-Designated Reserves are reserved from sustained-yield timber production in order to manage them for another set of specific values and resources. Within the District-Designated Reserve, the BLM would maintain the values and resources necessary for construction, operation, maintenance, and decommissioning of the proposed Project.

Specifically, BLM proposes to add the following text to the RMPs for Western Oregon (BLM 2016a:59; BLM 2016b: 57):

> <u>District-Designated Reserve – Pacific Connector Gas Pipeline</u>
>
> **Management Objectives**
>
> - See *District-Designated Reserves* management objectives.
> - Maintain the values and resources for which the BLM has granted the right-of-way for the Pacific Connector Gas Pipeline Project.
>
> **Management Direction**
>
> - Allow the construction, operation, maintenance, and decommissioning of the Pacific Gas Connector Pipeline, notwithstanding the restrictions and requirements of management direction described for resource programs.

The Project-specific amendment would not change RMP requirements for other projects or authorize any other actions. Therefore, resource impacts of the proposed plan amendments are those associated with construction, operation, maintenance and decommissioning of the proposed pipeline. With this amendment, the granting of a right-of-way on BLM-managed lands for the Pacific Connector Project would conform to the Southwestern Oregon Record of Decision and Resource Management Plan (BLM 2016b) and the Northwestern and Coastal Oregon ROD and RMP (BLM 2016a).

Amendment Approaches Considered

Four different approaches were considered to address the identified plan conformance issues. Three were evaluated and determined to have resource and management impacts beyond those associated with the direct, indirect, induced and cumulative effects of construction, operation, maintenance, and decommissioning the proposed Project.

<u>Change Management Direction for LSR, NSO, and MAMU to Accommodate Rights-of-Way</u>

The BLM considered eliminating the requirement that rights-of way maintain NSO nesting-roosting habitat function and continue to support MAMU nesting in occupied stands within LSR at the stand level and removing the prohibition on activities that disrupt MAMU nesting at occupied sites within 35 miles of the Pacific coast. Similar rights-of-way that may be proposed in the future would conform with plan direction for LSR, NSO, and MAMU.

No projects of a similar nature have been proposed. However, this approach would reduce protections for LSR, NSO, and MAMU provided by the RMPs for Western Oregon throughout the LSR land use allocation and in all allocations within 35 miles of the Pacific coast, and could substantially alter the effects analysis conducted by the BLM for NSO and MAMU in the two RMPs for western Oregon. This alternative could trigger re-initiation of ESA consultation on BLM RMPs for western Oregon.

This amendment approach would generate environmental effects beyond those associated with the construction, operation, maintenance, and decommissioning of the proposed Project pipeline and is beyond the scope of the application submitted by the proponent and currently under consideration by the BLM. For these reasons, the BLM determined that this amendment approach would not meet the BLM's purpose and need. This amendment approach was not analyzed in further detail.

<u>Change Management Direction for LSR, NSO, and MAMU at Specific Locations</u>

The BLM considered amendments to the RMPs for Western Oregon to specifically exempt the proposed Project from management direction for LSR, NSO, and MAMU in with known conformance problems (known MAMU occupied stands, existing MAMU nesting habitat, and existing NSO nesting-roosting habitat). This amendment approach would not create environmental effects beyond those associated with construction, operation, maintenance, and decommissioning of the proposed Project. However, unanticipated or currently unknown conformance problems, such as newly identified MAMU occupied stands, could arise which would require additional amendments and supplemental analysis following completion of the FERC-prepared EIS.

This amendment approach presents a risk that could require additional amendments and supplemental analysis, and would result in identical environmental effects if the proposed Project right-of-way is granted. For these reasons, the BLM determined that this amendment approach is substantially similar to the proposed action and would not fulfill the BLM's commitment as a cooperating agency in the preparation of the EIS should supplemental analysis be required. This amendment approach was not analyzed in further detail.

Designate All Lands within the Proposed Right-of-Way as a Right-of-Way Corridor

Designation of a Right-of-Way Corridor under 43 CFR 2806 would be for the purpose of construction, operation, maintenance, and decommissioning of the proposed Project. Designated Rights-of-Way Corridors are typically 1,000 to 2,000 feet in width and designed to encourage co-location of additional facilities in the future. Designating a Right-of-Way Corridor would require an analysis of reasonably foreseeable projects that could be co-located in the future and could substantially alter the effects analysis conducted by the BLM for NSO and MAMU in the two RMPs for western Oregon. This amendment approach could trigger re-initiation of ESA consultation on BLM RMPs for Western Oregon.

This amendment approach would generate environmental effects beyond those associated with the construction, operation, maintenance, and decommissioning of the proposed Project pipeline and is beyond the scope of the application submitted by the proponent and currently under consideration by the BLM. For these reasons, the BLM determined that this amendment approach would not meet the BLM's purpose and need. This amendment approach was not analyzed in further detail.

BLM Proposed Resource Management Plan Amendments and Preferred Alternative

BLM regulatory requirements at 43 CFR 1610.4-8 require that the BLM select and disclose in the final EIS the Proposed Resource Management Plan Amendment. As described above, the Proposed Resource Management Plan Amendment designates all lands within the proposed temporary use area and right-of-way to a District-Designated Reserve, with management direction to manage the lands for the purposes of the Pacific Connector Gas Pipeline right-of-way.

In addition, the BLM proposes to adopt several FERC-recommended route variations and environmental measures into the Right-of Way Grant. These changes to the proposed action as analyzed in the final EIS would result in approximately 777 acres re-allocated compared to the approximately 885 acres that would be re-allocated under the proposed action as analyzed in the final EIS. With the proposed adoption of these route variations and conditions, the BLM identifies its Preferred Alternative as required by 43 CFR 1610.4-7.

Specifically, the BLM would adopt the following route variation identified in the final EIS: 1) Blue Ridge Variation. With adoption of this variation, approximately 41.1 miles of the proposed Pacific Connector pipeline route would cross federal land administered by the BLM Coos Bay, Roseburg, and Medford Districts and the Klamath Falls Field Office of the Lakeview District. The proposed right-of-way would cross approximately 95 fewer acres of LSR and remove 16.4 fewer acres of NSO nesting-roosting habitat and remove 10.4 fewer acres of overlapping MAMU nesting habitat.

The BLM would also adopt FERC recommended condition #24 requiring adherence to FWS recommended timing restrictions within threshold distances of MAMU and NSO stands during construction, operations, and maintenance of the pipeline facilities. Application of this stipulation would be included as a stipulation of the Right-of-Way Grant.

2.1.3.2 Proposed Amendments of National Forest LRMPs

Approximately 30.7 miles of the Pacific Connector pipeline route would cross NFS lands administered by the Umpqua, Rogue River, and Winema National Forests (see figure 1.1-2). NFS lands are managed according to current LRMPs. Similar to a county zoning ordinance, projects or activities that occur on NFS lands must be consistent with the respective LRMP where the project or activity occurs. As proposed, the Pacific Connector Pipeline Project would not be consistent with certain provisions of the affected Forest Service LRMPs. Before the Forest Service can consent to the BLM Right-of-Way Grant application, the Forest Service must amend the affected LRMPs to make provisions for the Pacific Connector Project. With the exception of amendments to reallocate Matrix lands to LSR, the LRMP amendments described below are specific to the Pacific Connector Pipeline Project. The project-specific amendments would not change LRMP requirements for other projects or authorize any other actions. With these amendments, the Pacific Connector Pipeline Project would be a conforming use of the affected National Forests.

In addition to the proposed amendments specific for each National Forest described in the sections below, table 2.1.3.2-1 describes the proposed amendments that would apply to all three National Forests.

TABLE 2.1.3.2-1

Forest Service LRMP Amendments Associated with the Pacific Connector Pipeline Project that Apply to the Umpqua, Rogue River, and Winema National Forests

Amendment #	Amendment	Description
FS-1	Project-Specific Amendment to Exempt Management Recommendations for Survey and Manage Species on the Umpqua, Rogue River and Winema National Forests:	These National Forest LRMPs would be amended to exempt certain known sites within the area of the proposed Pacific Connector ROW grant from the Management Recommendations required by the 2001 "Record of Decision and Standards and Guidelines for Amendments to the Survey and Manage, Protection Buffer, and other Mitigation Measures Standards and Guidelines. For known sites within the proposed ROW that cannot be avoided, the 2001 Management Recommendations for protection of known sites of Survey and Manage species would not apply. For known sites located outside the proposed ROW but with an overlapping protection buffer only that portion of the buffer within the ROW would be exempt from the protection requirements of the Management Recommendations. Those Management Recommendations would remain in effect for that portion of the protection buffer that is outside of the right of way. The proposed amendment would not exempt the Forest Service from the requirements of the 2001 Survey and Manage Record of Decision, as modified, to maintain species persistence for affected Survey and Manage species within the range of the northern spotted owl. This is a project-specific plan amendment applicable only to the Pacific Connector Pipeline Project and would not change future management direction for any other project. The amendment would provide an exception from these standards for the Pacific Connector Project and include specific mitigation measures and project design requirements for the project. The 36 CFR 219 planning rule requirements that are likely to be directly related to this amendment include: § 219.9(a)(2)(ii) – [the plan must include plan components to maintain or restore] "Rare aquatic and terrestrial plant and animal communities." § 219.9(b)(1) – "The responsible official shall determine whether or not the plan components required by paragraph (a) provide ecological conditions necessary to: …maintain viable populations of each species of conservation concern within the plan area."

2.1.3.3 Proposed Amendments Specific to the Umpqua National Forest LRMP

The Forest Service proposes to amend the Umpqua National Forest LRMP. The proposed amendments are described in table 2.1.3.3-1.[33]

TABLE 2.1.3.3-1

LRMP Amendments Associated with the Pacific Connector Pipeline Project Specific to the Umpqua National Forest

Amendment #	Amendment	Description
UNF-1	Project-Specific Amendment to Allow Removal of Effective Shade on Perennial Streams:	The Umpqua National Forest LRMP would be amended to exempt the Standards and Guidelines for Fisheries (Umpqua National Forest LRMP, page IV-33, Forest-Wide) to allow the removal of effective shading vegetation where perennial streams are crossed by the Pacific Connector ROW. This change would potentially affect an estimated total of three acres of effective shading vegetation at approximately five perennial stream crossings in the East Fork of Cow Creek subwatershed from pipeline mileposts (MP) 109 to 110 in Sections 16 and 21, T.32S., R.2W., W.M., OR. The amendment would provide an exception from these standards for the Pacific Connector Pipeline Project and include specific mitigation measures and project design requirements for the project. This is a project-specific plan amendment applicable only to the Pacific Connector Pipeline Project and would not change future management direction for any other project. The 36 CFR 219 planning rule requirements that are likely to be directly related to this amendment include: § 219.8(a)(3)(i) – The plan must include plan components "to maintain or restore the ecological integrity of riparian areas in the plan area, including plan components to maintain or restore structure, function, composition, and connectivity."
UNF-3	Project-Specific Amendment to Exempt Limitations on Detrimental Soil Conditions within the Pacific Connector ROW in All Management Areas:	The Umpqua National Forest LRMP would be amended to exempt limitations on the area affected by detrimental soil conditions from displacement and compaction within the Pacific Connector ROW. Standards and Guidelines for Soils (LRMP page IV-67) requires that not more than 20 percent of the project area have detrimental compaction, displacement, or puddling after completion of a project. The amendment would provide an exception from these standards for the Pacific Connector Pipeline Project and include specific mitigation measures and project design requirements for the project. This is a project-specific plan amendment applicable only to the Pacific Connector Pipeline Project and would not change future management direction for any other project. The 36 CFR 219 planning rule requirements that are likely to be directly related to this amendment include: § 219.8(a)(2)(ii) – [The plan must include plan components to maintain or restore] "soils and soil productivity, including guidance to reduce soil erosion and sedimentation."

[33] In the draft EIS there was a proposed amendment (UNF-2) that would have amended a standard that stated "Utility/transportation corridors, roads or transmission lines may cross but must not parallel streams and lake shores within the riparian unit." The proposed reroute of the pipeline in the East Fork Cow Creek eliminated the parallel alignment and therefore the amendment is no longer needed (see final EIS section 3.4.2.8).

TABLE 2.1.3.3-1 (continued) **LRMP Amendments Associated with the Pacific Connector Pipeline Project Specific to the Umpqua National Forest**		
Amendment #	**Amendment**	**Description**
UNF-4	Reallocation of Matrix Lands to LSR	The Umpqua National Forest LRMP would be amended to change the designation of approximately 585 acres from Matrix land allocations to the LSR land allocation in Sections 7, 18, and 19, T.32S., R.2W.; and Sections 13 and 24, T.32S., R.3W., W.M., OR. This change in land allocation is proposed to partially mitigate the potential adverse impact of the Pacific Connector Pipeline Project on LSR 223 on the Umpqua National Forest. This is a plan level amendment that would change future management direction for the lands reallocated from Matrix to LSR. The 36 CFR 219 planning rule requirements that are likely to be directly related to this amendment include: § 219.8(a)(1)(i) – [the plan must include plan components to maintain or restore] "Interdependence of terrestrial and aquatic ecosystems in the plan area." § 219.8(b)(1) – [the plan must include plan components to guide the plan area's contribution to social and economic sustainability] "Social, cultural and economic conditions relevant to the area influenced by the plan." § 219.9(b)(1) "The responsible official shall determine whether or not the plan components required by paragraph (a) of this section provide the ecological conditions necessary to: contribute to the recovery of federally listed threatened and endangered species, conserve proposed and candidate species, and maintain a viable population of each species of conservation concern within the plan area," and § 219.9(a)(2)(ii) – [the plan must include plan components to maintain or restore] "Rare aquatic and terrestrial plant and animal communities."

If any of the proposed amendments to the Umpqua National Forest LRMP described above are determined to be "directly related" to a substantive rule requirement, the Responsible Official must apply that requirement within the scope and scale of the proposed amendment and, if necessary, make adjustments to the proposed amendment to meet the rule requirement (36 CFR 219.13 (b)(5) and (6)).

2.1.3.4 Proposed Amendments Specific to the Rogue River National Forest LRMP

The Forest Service proposes to amend the Rogue River National Forest LRMP. The proposed amendments are described in table 2.1.3.4-1.[34]

[34] In the draft EIS, there was a proposed amendment for visual resources (RRNF-3) that addressed visual guidelines for the Pacific Crest Trail. The proposed new crossing of the Pacific Crest Trail on an existing road has eliminated the need for this amendment (see section 3.4.2.9 of the final EIS).

TABLE 2.1.3.4-1

LRMP Amendments Associated with the Pacific Connector Pipeline Project Specific to the Rogue River National Forest

Amendment #	Amendment	Description
RRNF-2	Project Specific Amendment of Visual Quality Objectives (VQO) on the Big Elk Road:	The Rogue River National Forest LRMP would be amended to change the VQO where the Pacific Connector pipeline route crosses the Big Elk Road at about pipeline MP 161.4 in Section 16, T.37S., R.4E., W.M., OR, from Foreground Retention (Management Strategy 6, LRMP page 4-72) to Foreground Partial Retention (Management Strategy 7, LRMP page 4-86) and allow 10-15 years for the amended VQO to be attained. The existing Standards and Guidelines for VQO in Foreground Retention where the Pacific Connector pipeline route crosses the Big Elk Road require that VQOs be met within one year of completion of the project and that management activities not be visually evident. The amendment would provide an exception from these standards for the Pacific Connector Pipeline Project and include specific mitigation measures and project design requirements for the project. This is a project-specific plan amendment that would apply only to the Pacific Connector Pipeline Project in the vicinity of Big Elk Road and would not change future management direction for any other project. The 36 CFR 219 planning rule requirements that are likely to be directly related to this amendment include: § 219.10(a)(1) – […the responsible official shall consider: …] "(1) Aesthetic values,… scenery,... viewsheds...". § 219.10(b)(i) – [the responsible official shall consider] "Sustainable recreation; including recreation settings, opportunities,…and scenic character…"
RRNF-4	Project-Specific Amendment of Visual Quality Objectives Adjacent to Highway 140:	The Rogue River National Forest LRMP would be amended to allow 10-15 years to meet the VQO of Middleground Partial Retention between Pacific Connector pipeline MPs 156.3 to 156.8 and 157.2 to 157.5 in Sections 11 and 12, T.37S., R.3E., W.M., OR. Standards and Guidelines for Middleground Partial Retention (Management Strategy 9, LRMP Page 4-112) require that VQOs for a given location be achieved within three years of completion of the project. Approximately 0.8 miles or 9 acres of the Pacific Connector ROW in the Middleground Partial Retention VQO visible at distances of 0.75 to 5 miles from State Highway 140 would be affected by this amendment. The amendment would provide an exception from these standards for the Pacific Connector Pipeline Project and include specific mitigation measures and project design requirements for the project. This is a project-specific plan amendment that would apply only to the Pacific Connector Pipeline Project in Sections 11 and 12, T.37S., R.3E., W.M., OR, and would not change future management direction for any other project. The 36 CFR 219 planning rule requirements that are likely to be directly related to this amendment include: § 219.10(a)(1) – […the responsible official shall consider: …] "(1)Aesthetic values,… scenery,... viewsheds...". § 219.10(b)(i) – [the responsible official shall consider] "Sustainable recreation; including recreation settings, opportunities, . . . and scenic character...".
RRNF-5	Project-Specific Amendment to Allow the Pacific Connector Pipeline Project in Management Strategy 26, Restricted Riparian Areas:	The Rogue River National Forest LRMP would be amended to allow the Pacific Connector ROW to cross the Restricted Riparian land allocation. This would potentially affect approximately 2.5 acres of the Restricted Riparian Management Strategy at one perennial stream crossing on the South Fork of Little Butte Creek at about pipeline MP 162.45 in Section 15, T.37S., R.4E., W.M., OR. Standards and Guidelines for the Restricted Riparian land allocation prescribe locating transmission corridors outside of this land allocation (Management Strategy 26, LRMP page 4-308,). The amendment would provide an exception from these standards for the Pacific Connector Pipeline Project and include specific mitigation measures and project design requirements for the project. This is a site-specific amendment applicable only to the Pacific Connector Pipeline Project and would not change future management direction for any other project. The 36 CFR 219 planning rule requirements that are likely to be directly related to this amendment include: § 219.8(a)(3)(i) – The plan must include plan components "to maintain or restore the ecological integrity of riparian areas in the plan area, including plan components to maintain or restore structure, function, composition, and connectivity"

TABLE 2.1.3.4-1 (continued)

LRMP Amendments Associated with the Pacific Connector Pipeline Project Specific to the Rogue River National Forest

Amendment #	Amendment	Description
RRNF-6	Site-Specific Amendment to Exempt Limitations on Detrimental Soil Conditions within the Pacific Connector ROW in All Management Areas:	The Rogue River National Forest LRMP would be amended to exempt limitations on areas affected by detrimental soil conditions from displacement and compaction within the Pacific Connector ROW in all affected Management Strategies. Standards and Guidelines for detrimental soil impacts in affected Management Strategies require that no more than 10 percent of an activity area should be compacted, puddled or displaced upon completion of project (not including permanent roads or landings). No more than 20 percent of the area should be displaced or compacted under circumstances resulting from previous management practices including roads and landings. Permanent recreation facilities or other permanent facilities are exempt (RRNF LRMP 4-41, 4-83, 4-97, 4-123, 4-177, 4-307). The amendment would provide an exception from these standards for the Pacific Connector Pipeline Project and include specific mitigation measures and project design requirements for the project. This is a project-specific plan amendment applicable only to the Pacific Connector Pipeline Project and would not change future management direction for any other project. The 36 CFR 219 planning rule requirements that are likely to be directly related to this amendment include: § 219.8(a)(2)(ii) – [The plan must include plan components to maintain or restore] "soils and soil productivity, including guidance to reduce soil erosion and sedimentation."
RRNF-7	Reallocation of Matrix Lands to LSR	The Rogue River National Forest LRMP would be amended to change the designation of approximately 522 acres from Matrix land allocations to the LSR land allocation in Section 32, T.36S., R.4E. W.M., OR. This change in land allocation is proposed to partially mitigate the potential adverse impact of the Pacific Connector Pipeline Project on LSR 227 on the Rogue River National Forest. This is a plan level amendment that would change future management direction for the lands reallocated from Matrix to LSR. The 36 CFR 219 planning rule requirements that are likely to be directly related to this amendment include: § 219.8(a)(1)(i) – [the plan must include plan components to maintain or restore] "Interdependence of terrestrial and aquatic ecosystems in the plan area." § 219.8(b)(1) – [the plan must include plan components to guide the plan area's contribution to social and economic sustainability] "Social, cultural and economic conditions relevant to the area influenced by the plan." § 219.9(b)(1) "The responsible official shall determine whether or not the plan components required by paragraph (a) of this section provide the ecological conditions necessary to: contribute to the recovery of federally listed threatened and endangered species, conserve proposed and candidate species, and maintain a viable population of each species of conservation concern within the plan area", and § 219.9(a)(2)(ii)– [the plan must include plan components to maintain or restore: …] "(ii) Rare aquatic and terrestrial plant and animal communities".

If any of the proposed amendments to the Rogue River National Forest LRMP described above are determined to be "directly related" to a substantive rule requirement, the Responsible Official must apply that requirement within the scope and scale of the proposed amendment and, if necessary, make adjustments to the proposed amendment to meet the rule requirement (36 CFR 219.13 (b)(5) and (6)).

2.1.3.5 Proposed Amendments Specific to the Winema National Forest LRMP

The Forest Service proposes to amend the Winema National Forest LMRP. The proposed amendments are described in table 2.1.3.5-1.

TABLE 2.1.3.5-1

LRMP Amendments Associated with the Pacific Connector Pipeline Project Specific to the Winema National Forest

Amendment #	Amendment	Description
WNF-1	Project -Specific Amendment to Allow Pacific Connector Pipeline Project in Management Area 3:	The Winema National Forest LRMP would be amended to change the Standards and Guidelines for Management Area 3 (MA-3) (LRMP page 4-103-4, Lands) to allow the 95-foot-wide Pacific Connector pipeline project in MA-3 from the Forest Boundary in Section 32, T.37S., R.5E., W.M., OR, to the Clover Creek Road corridor in Section 4, T.38S, R.5. E., W.M., OR. Standards and Guidelines for MA-3 state that the area is currently an avoidance area for new utility corridors. This proposed Pacific Connector Pipeline Project is approximately 1.5 miles long and occupies approximately 17 acres within MA-3. The amendment would provide an exception from these standards for the Pacific Connector Pipeline Project and include specific mitigation measures and project design requirements. This is a project-specific plan amendment applicable only to the Pacific Connector Pipeline Project and would not change future management direction for any other project. The 36 CFR 219 planning rule requirements that are likely to be directly related to this amendment include: § 219.10(a)(1) – [the responsible official shall consider] "Aesthetic values,… scenery,... viewsheds...". § 219.10(b)(i) – [the responsible official shall consider] "Sustainable recreation; including recreation settings, opportunities,…and scenic character…"
WNF-2	Project-Specific Amendment of VQO on the Dead Indian Memorial Highway:	The Winema National Forest LRMP would be amended to allow 10-15 years to achieve the VQO of Foreground Retention where the Pacific Connector ROW crosses the Dead Indian Memorial Highway at approximately pipeline MP 168.8 in Section 33, T.37S., R.5E., W. M., OR. Standards and Guidelines for Scenic Management, Foreground Retention (LRMP 4-103, MA 3A, Foreground Retention) requires VQOs for a given location be achieved within one year of completion of the project. The Forest Service proposes to allow 10-15 years to meet the specified VQO at this location. The amendment would provide an exception from these standards for the Pacific Connector Pipeline Project and include specific mitigation measures and project design requirements for the project. This is a project-specific plan amendment that would apply only to the Pacific Connector Pipeline Project in the vicinity of the Dead Indian Memorial Highway and would not change future management direction for any other project. The 36 CFR 219 planning rule requirements that are likely to be directly related to this amendment include: § 219.10(a)(1) – […the responsible official shall consider: …] "(1) Aesthetic values,… scenery,... viewsheds...". § 219.10(b)(i) – [the responsible official shall consider] "Sustainable recreation; including recreation settings, opportunities,… and scenic character…".
WNF-3	Project -Specific Amendment of VQO Adjacent to the Clover Creek Road:	The Winema National Forest LRMP would be amended to allow 10-15 years to meet the VQO for Scenic Management, Foreground Partial Retention, where the Pacific Connector ROW is adjacent to the Clover Creek Road from approximately pipeline MP 170 to 175 in Sections 2, 3, 4, 11, and 12, T.38S., R.5E., and Sections 7 and 18, T.38S., R.6E., W.M., OR. This change would potentially affect approximately 50 acres. Standards and Guidelines for Foreground Partial Retention (LRMP, page 4-107, MA 3B) require that VQOs be met within three years of completion of a project. The amendment would provide an exception from these standards for the Pacific Connector Pipeline Project and include specific mitigation measures and project design requirements for the project. This is a project-specific plan amendment that would apply only to the Pacific Connector Pipeline Project in the vicinity of Clover Creek Road and would not change future management direction for any other project. The 36 CFR 219 planning rule requirements that are likely to be directly related to this amendment include: § 219.10(a)(1) – […the responsible official shall consider: …] "(1) Aesthetic values,… scenery,... viewsheds...". § 219.10(b)(i) – [the responsible official shall consider] "Sustainable recreation; including recreation settings, opportunities,…and scenic character…".

TABLE 2.1.3.5-1 (continued)

LRMP Amendments Associated with the Pacific Connector Pipeline Project Specific to the Winema National Forest

Amendment #	Amendment	Description
WNF-4	Project -Specific Amendment to Exempt Limitations on Detrimental Soil Conditions within the Pacific Connector ROW in All Management Areas:	The Winema National Forest LRMP would be amended to exempt restrictions on detrimental soil conditions from displacement and compaction within the Pacific Connector ROW in all affected management areas. Standards and Guidelines for detrimental soil impacts in all affected management areas require that no more than 20 percent of the activity area be detrimentally compacted, puddled, or displaced upon completion of a project (LRMP page 4-73, 12-5). The amendment would provide an exception from these standards for the Pacific Connector Pipeline Project and include specific mitigation measures and project design requirements for the project. This is a project-specific plan amendment applicable only to the Pacific Connector Pipeline Project and would not change future management direction for any other project. The 36 CFR 219 planning rule requirements that are likely to be directly related to this amendment include: § 219.8(a)(2)(ii) – [The plan must include plan components to maintain or restore…] "Soils and soil productivity, including guidance to reduce soil erosion and sedimentation".
WNF-5	Project-Specific Amendment to Exempt Limitations on Detrimental Soil Conditions within the Pacific Connector ROW in Management Area 8:	The Winema National Forest LRMP would be amended to exempt restrictions on detrimental soil conditions from displacement and compaction within the Pacific Connector ROW within the Management Area 8, Riparian Area (MA-8). This change would potentially affect approximately 0.5 mile or an estimated 9.6 acres of MA-8. Standards and Guidelines for Soil and Water, MA-8 require that not more than 10 percent of the total riparian zone in an activity area be in a detrimental soil condition upon the completion of a project (LRMP page 4-137, 2). The amendment would provide an exception from these standards for the Pacific Connector Pipeline Project and include specific mitigation measures and project design requirements for the project. This is a project-specific plan amendment applicable only to the Pacific Connector Pipeline Project and would not change future management direction for any other project. The 36 CFR 219 planning rule requirements that are likely to be directly related to this amendment include: § 219.8(a)(2)(ii) – [The plan must include plan components to maintain or restore…] "Soils and soil productivity, including guidance to reduce soil erosion and sedimentation".

If any of the proposed amendments to the Winema National Forest LRMP described above are determined to be "directly related" to a substantive rule requirement, the Responsible Official must apply that requirement within the scope and scale of the proposed amendment and, if necessary, make adjustments to the proposed amendment to meet the rule requirement (36 CFR 219.13 (b)(5) and (6)).

2.1.4 Mitigation Actions Specific to the Right-of-Way Grant on Federal Lands

Representatives of the BLM, Forest Service, and Reclamation have worked cooperatively with the FERC staff and the Project proponent to incorporate BMPs, project design features, and project requirements which would avoid, minimize, rectify, reduce, or eliminate environmental consequences (40 CFR 1502.14(f) and 1508.20(a-d)). The agencies deem these BMPs, project design features, or project requirements necessary to meet the respective regulatory requirements, accomplish the goals and objectives of their respective management plans, and to prevent unnecessary and undue environmental degradation. The BMPs, project design features, or requirements specific to the authorized use of BLM, NFS, and Reclamation lands are included as attachments to the Applicant's POD. There are 28 appendices in the POD; they include draft monitoring elements to ensure that the wide array of actions are implemented and assess consistency of the actions relative to the goals and objectives of the respective LMPs. Collectively, the POD is incorporated into the Project's description, is included in appendix F.10, and is summarized in section 2.6.3 below.

In addition to the POD, the Forest Service has identified compensatory mitigation requirements. Additional detail is provided in section 2.1.5 below and in appendix F.2.

Under existing authorities and policy, the BLM may not specify compensatory mitigation specific to its lands or facilities; however, the BLM may consider compensatory mitigation proposed by an applicant, and may incorporate the compensatory mitigation requirements of other agencies into the Right-of-Way Grant.

Reclamation has not identified any off-site compensatory mitigation measures specific to its lands or facilities.

2.1.4.1 Mitigation Plan Specific to BLM Lands

In accordance with IM 2019-018, the Applicant has proposed compensatory mitigation projects on BLM-managed lands. The proposed compensatory mitigation was filed September 3, 2019 (see appendix F.12). These projects are listed in table 2.1.4.1-1 and are made available for public review in this EIS. They have not been considered in the analysis of the proposed action or variations. These compensatory mitigation actions would require additional analysis and surveys to comply with NEPA prior to implementation. The public would have the opportunity to review and comment on specific project proposals at that time. The BLM would provide assurance that adopted compensatory mitigation projects are completed through right-of-way stipulations and bonding. Subsequent environmental analysis for mitigation actions would not preclude the BLM from issuing authorizations necessary for construction and operation of the proposed pipeline project.

Table 2.1.4.1-1 describes the individual mitigation projects. These projects would be analyzed and implemented by a yet-to-be-determined third-party entity utilizing funding provided by the Applicant.

TABLE 2.1.4.1-1

Compensatory Mitigation Projects Proposed by the Applicant on BLM Lands

Unit	Watershed	Project Type	Mitigation Group	Project Name	Quantity a/	Unit
Coos Bay District	East Fork Coquille River	Road Surfacing	Road Sediment Reduction	Road Surfacing - South Fork Elk Creek	2.6	miles
		Road Surfacing	Road Sediment Reduction	Road Surfacing - Yankee Run Mainline	2	miles
		Road Surfacing	Road Sediment Reduction	Road Surfacing - Yankee Run Spurs	0.9	miles
		Fire Suppression	Fire Suppression	Heli-Pond construction	2	sites
	Middle Fork Coquille River	Fire Suppression	Fire Suppression	Helipond Construction	1	site
		LWD instream	Aquatic Habitat	Upper Rock Creek In-stream Large Wood Placement	2.1	miles
		Road Surfacing	Road Sediment Reduction	Road Surfacing - Fall Creek System	0.9	miles
		Road Surfacing	Road Sediment Reduction	Bridge Approach paving -Sandy & Jones Creek Roads	2	sites
	North Fork Coquille River	LWD instream	Aquatic Habitat	Woodward and Steinnon Creek In-stream Large Wood Placement	1.5	miles
		LWD instream	Aquatic Habitat	Upper North Fork Coquille In-stream Large Wood Placement	2.2	miles

TABLE 2.1.4.1-1 (continued)

Compensatory Mitigation Projects Proposed by the Applicant on BLM Lands

Unit	Watershed	Project Type	Mitigation Group	Project Name	Quantity a/	Unit
Coos Bay District	North Fork Coquille River	Road Surfacing	Road Sediment Reduction	Bridge Approach paving - Woodward & Alder Creek Roads	2	ea
Klamath Falls District	Spencer Creek	Road Closure	Road Sediment Reduction	Spencer Cr. Repair Existing Road Closure	12	sites
		Road Drainage	Road Sediment Reduction	Spencer Cr. Drainage Improvements and Sediment Trap Removal	15	sites
		Road Drainage	Road Sediment Reduction	Keno Access Road Repair and Culvert Replacement	1	site
Medford District	Big Butte Creek	Habitat Improvement	Terrestrial Habitat Imp.	Big Butte Cr. Fritillaria Habitat	600	acres
		Road Surfacing	Road Sediment Reduction	Big Butte Cr. Road stormproofing	6.4	miles
	Little Butte Creek	Fish Passage	Fish Passage	Little Butte Creek Fish Screen	1	site
		LWD instream	Aquatic Habitat	Little Butte Cr. LWD	8.6	miles
		Road Decommissioning	Road Sediment Reduction	Little Butte Cr. Road Decommissioning Butte Falls RA	2.4	miles
		Road Drainage and Surface Enhancement	Road Sediment Reduction	Little Butte Cr. Road Improvement	3.5	miles
		Road Surfacing	Road Sediment Reduction	Little Butte Cr. Road Resurfacing (Butte Falls Resource Area)	9.35	miles
		Road Surfacing	Road Sediment Reduction	Little Butte Cr. Road Resurface (Ashland Resource Area)	9	miles
	Shady Cove Rogue River	Fuels Reduction	Stand Density Fuel Break	Shady Cove Fuel Hazard Reduction	866	acres
		Fuels Reduction	Stand Density Fuel Break	Shady Cove Fuel Hazard Maintenance	866	acres
		LWD instream	Aquatic Habitat	Shady Cove LWD	2.5	miles
		Road Drainage and Surface Enhancement	Road Sediment Reduction	Shady Cove Road Improvement	1.3	mile
		Road Surfacing	Road Sediment Reduction	Shady Cove Road Resurface	1.5	miles
	Trail Creek	Fuels Reduction	Stand Density Fuel Break	Trail Creek Fuel Hazard Reduction	687	acres
		Fuels Reduction	Stand Density Fuel Break	Trail Cr. Fuels Hazard Maintenance	687	acres
		LWD instream	Aquatic Habitat	Trail Creek LWD	2.6	miles
		Road Decommissioning	Road Sediment Reduction	Trail Creek Road Decommissioning	2.7	miles
		Road Storm-proofing	Road Sediment Reduction	Trail Creek Road Stormproofing	4.3	miles
		Road Surfacing	Road Sediment Reduction	Trail Creek Road Resurfacing	16.3	miles
Roseburg District	Middle Fork Coquille River	Road Surfacing and Cross Drain Replacements	Road Sediment Reduction	Dice, Boulder, and Twelvemile Creek Road Systems	8	miles
		Fish Passage	Fish Passage	Boulder Creek and Battle Creek culvert replacements	2	miles
		LWD instream	Aquatic Habitat	Middle Fork Coquille LWD Placement	0.6	miles
		Road Drainage and Surface Enhancement	Road Sediment Reduction	Camas Mountain Road Drainage and Surface Enhancement	3.5	miles
	MS Umpqua River	Road Drainage	Road Sediment Reduction	East Fork Willis Creek Tributary Culvert Replacement	1	project

TABLE 2.1.4.1-1 (continued)

Compensatory Mitigation Projects Proposed by the Applicant on BLM Lands

Unit	Watershed	Project Type	Mitigation Group	Project Name	Quantity a/	Unit
Roseburg District	MS Umpqua River	Fish Passage	Fish Passage	McNabb Creek Box Culvert (fish passage) replacement	1	site
		Road Drainage	Road Sediment Reduction	Judd Creek Culvert Removal	1	project
	Myrtle Creek	Fish Passage	Fish Passage	Slide Creek Culvert Replacement	1	project
		Road Stabilization	Road Sediment Reduction	South Myrtle Hill Slide Repair	1	project
		Road Drainage and Surface Enhancement	Road Sediment Reduction	Slide Creek Road Drainage and Surface Enhancement	1	miles
	Olalla- Looking-glass Creek	Culvert Replacement	Aquatic Habitat and Road Sediment Reduction	Unnamed Tributary to Lower Olalla Creek	1.0	project
		Road Stabilization	Road Sediment Reduction	Olalla Tie Road Renovation	1	project
	South Umpqua River	Fish Passage	Fish Passage	Beal Creek culvert replacement	2	sites
		Fuels Reduction	Stand Density Fuel Break	Hazardous Fuel Reduction	1000	acres
		LWD instream	Aquatic Habitat	West Fork Canyon Creek Large Wood and Boulder Placement	0.8	miles
		Culvert Replacement	Road Sediment Reduction	Corn Creek	1	project
		Road Drainage and Surface Enhancement	Road Sediment Reduction	South Umpqua Road Drainage and Surface Enhancement	10	miles
		Road Storm-proofing	Road Sediment Reduction	31-4-3.2 Road Storm-proofing	1	project
	Myrtle Creek	Habitat Improvement	Special Status Plant	Habitat Improvement for Cox Mariposa Lily	50	acres
		Fire Suppression	Fire Suppression	Bilger Creek Pump Chance	1	sites
	South Umpqua River, Myrtle Creek, and MS Umpqua River	Fire Suppression	Fire Suppression	Dry Hydrants	6	sites

a/ Acres are rounded to the nearest whole acre and mile are rounded to the nearest tenth of a mile.

2.1.5 Mitigation Plan Specific to NFS Lands

These compensatory mitigation actions are addressed programmatically in this EIS and may require additional analyses and surveys to comply with NEPA. The Forest Service anticipates this EIS would provide the basis for tiering subsequent site-specific NEPA analyses, in accordance with the CEQ regulations at 40 CFR 1508.28(b). As applicable, the Forest Service would conduct supplemental environmental analysis and consultation efforts with various federal, state, and local entities, as well as tribal governments, prior to authorizing future site-specific mitigation actions described in the CMP. The public would have the opportunity to comment on specific project proposals at that time. Subsequent environmental analysis for mitigation actions would not preclude the BLM from issuing authorizations necessary for construction and operation of the proposed pipeline project.

Forest Service interdisciplinary teams have developed a CMP for the Pacific Connector Pipeline Project specific to the national forests that would be impacted by the proposed project. The CMP is based on the respective LRMPs, the recommendations of the (2011) NSO recovery plan, the recommendations of the final Southern Oregon/Northern California Coast (SONCC) Coho Salmon Recovery Plan (2014), applicable Late Successional Reserve Assessments (LSRA), and fifth-field

Watershed Analyses for watersheds where impacts of the Pacific Connector Pipeline Project would occur. Members of the interagency team used professional judgment and knowledge of the affected landscapes to develop the mitigation actions described below. Mitigation measures reduce or compensate for environmental consequences of an action. Off-site mitigation is a supplemental mitigation to address important LRMP management objectives and standards and guidelines that cannot be fully mitigated on-site. Proposed mitigation actions are intended to be responsive to LRMP objectives that include:

- Compliance with the Aquatic Conservation Strategy;
- Habitat for Threatened or Endangered (T&E) species including the NSO and coho salmon;
- Mitigation of impacts and compliance with standards and guidelines for LSRs;
- Compliance with National Forest Management Act 2012 planning rule sustainability criteria at 36 CFR §§ 219.8 through 219.11; and
- Specific resource issues as they occur by watershed.

A central provision of the Forest Service CMP is that it is to remain adaptable to new information and changed conditions.

Table 2.1.5-1 describes the individual mitigation projects related to LRMP management goals and objectives on NFS lands that are included in the proposed action. These projects would be implemented by the Forest Service as a subsequent phase of the Pacific Connector Project with funding provided by the Applicant. The Applicant is also responsible for providing funding to Forest Service for planning efforts related to these mitigation actions.

TABLE 2.1.5-1

Mitigation Projects to Address LRMP Objectives on NFS Lands

Unit	Watershed	Mitigation Group	Project Type	Project Name	Quantity a/	Unit
Umpqua National Forest	Days Creek - South Umpqua	Stand Density Fuel Break	Fuels Reduction	Days Creek - South Umpqua Matrix Integrated Fuels Reduction	194	acres
		Stand Density Fuel Break	Fuels Reduction	Days Creek - South Umpqua LSR Integrated Fuels Reduction	254	acres
		Terrestrial Habitat Improvement	Snag Creation	Days Creek - South Umpqua LSR Snag Creation	32	acres
		Terrestrial Habitat Improvement	Snag Creation	Days Creek - South Umpqua Matrix Snag Creation	14	acres
		Terrestrial Habitat Improvement	Lupine Meadow Restoration	Upper Cow Creek Lupine Meadow Restoration	23	acres
	Elk Creek - South Umpqua	Aquatic and Riparian Habitat	Fish Passage	Elk Creek Fish Passage Culverts	5	sites
		Road sediment reduction	Road Storm-proofing	Elk Creek Road Storm-proofing	9.2	miles
		Road sediment reduction	Road Decommissioning	Elk Cr. Road Decommissioning	5.9	miles
		Stand Density Fuel Break	Fuels Reduction	Elk Creek Matrix Integrated Fuels Reduction	176	acres
		Stand Density Management	Commercial Thinning	Elk Creek LSR Enhancement	91	acres
		Stand Density Management	Off-site Pine Removal	Elk Creek LSR Off-site Pine Removal	300	acres
		Terrestrial Habitat Improvement	LWD Upland Placement	Elk Creek LSR LWD Placement	99	acres

TABLE 2.1.5-1 (continued)

Mitigation Projects to Address LRMP Objectives on NFS Lands

Unit	Watershed	Mitigation Group	Project Type	Project Name	Quantity a/	Unit
Umpqua National Forest	Elk Creek - South Umpqua	Terrestrial Habitat Improvement	Lupine Meadow Restoration	Elk Creek LSR Lupine Meadow Restoration	101	acres
		Terrestrial Habitat Improvement	Noxious Weed Treatment	Elk Creek Roadside Noxious Weeds	6.7	miles
		Terrestrial Habitat Improvement	Snag Creation	Elk Creek LSR Snag Creation	68	acres
		Fire Suppression	Water Source Improvement	Elk Creek Pump Chance	2	sites
	Evans Creek	Stand Density Fuel Break	Road Shaded Fuel Break	Evans Cr LSR Road Shaded Fuel Break	63	acres
	Trail Creek	Road sediment reduction	Road Decommissioning	Trail Creek Road Decommissioning	0.3	miles
		Road sediment reduction	Road Storm-proofing	Trail Creek Storm-proofing	2.2	miles
		Stand Density Fuel Break	Fuels Reduction	Trail Creek Matrix Integrated Fuels Reduction	500	acres
		Stand Density Fuel Break	Road Shaded Fuel Break	Trail Creek LSR Road Shaded Fuel Break	175	acres
		Terrestrial Habitat Improvement	Snag Creation	Trail Creek Matrix Snag Creation	109	acres
		Stand Density Management	Pre-commercial	Trail Creek LSR PCT Enhancement	112	acres
	Upper Cow Creek	Aquatic and Riparian Habitat	Fish Passage	Upper Cow Creek Fish Passage Culverts	6	sites
		Fire Suppression	Water Source Improvement	Upper Cow Creek Pump Chance	1	site
		Road Sediment Reduction	Road Closure	Upper Cow Creek Road Closure	1.2	miles
		Road Sediment Reduction	Road Decommissioning	Upper Cow Creek Road Decommissioning	1.0	miles
		Stand Density Fuel Break	Fuels Reduction	Upper Cow Creek LSR Integrated Fuels Reduction	632	acres
		Stand Density Fuel Break	Fuels Reduction	Upper Cow Creek Matrix Integrated Fuels Reduction	730	acres
		Stand Density Fuel Break	Road Shaded Fuel Break	Upper Cow Creek LSR Road Shaded Fuel Break	378	acres
		Stand Density Management	Commercial Thin	Upper Cow Creek LSR Enhancement	197	acres
		Stand Density Management	Pre-commercial Thinning	Elk Creek LSR PCT Enhancement	116	acres
		Terrestrial Habitat Improvement	LWD Upland Placement	Upper Cow Creek LSR LWD Placement	65	acres
		Terrestrial Habitat Improvement	Snag Creation	Upper Cow Creek LSR Snag Creation	90	acres
		Terrestrial Habitat Improvement	Snag Creation	Upper Cow Creek Matrix Snag Creation	11	acres
		Reallocation of Matrix Lands to LSR	Land Re-Allocation from Matrix to LSR	LRMP Amendment UNF 4 LSR 223 Reallocation	585	acres
Rogue River National Forest	Little Butte Creek	Aquatic and Riparian Habitat	LWD In-stream	South Fork Little Butte Creek. LWD	1.5	mile
		Aquatic and Riparian Habitat	Stream Crossing Repair	Little Butte Creek Stream Crossing Decommissioning	32	sites
		Road sediment reduction	Road Decommissioning	Little Butte Creek Road Decommissioning	57.5	miles
		Stand Density Fuel Break	Pre-commercial Thinning	Little Butte Creek LSR Pre-commercial Thin	618	acres
		Terrestrial Habitat Improvement	Habitat Planting	Little Butte Creek Mardon Skipper Butterfly	20	acres
		Terrestrial Habitat Improvement	LWD Upland Placement	Little Butte Creek LSR LWD Placement	511	acres
		Terrestrial Habitat Improvement	Snag Creation	Little Butte Creek LSR Snag Creation	622	acres

TABLE 2.1.5-1 (continued)

Mitigation Projects to Address LRMP Objectives on NFS Lands

Unit	Watershed	Mitigation Group	Project Type	Project Name	Quantity a/	Unit
Rogue River National Forest	Little Butte Creek	Reallocation of Matrix Lands to LSR	Land Reallocation from Matrix to LSR	LRMP Amendment RRNF 7, LSR 227 Reallocation	25	acres
	Big Butte Creek	Reallocation of Matrix Lands to LSR	Land Reallocation from Matrix to LSR	LRMP Amendment RRNF 7, LSR 227 Reallocation	497	acres
Winema National Forest	Spencer Creek	Aquatic and Riparian Habitat	Riparian Planting	Spencer Creek Riparian Planting	0.5	miles
		Aquatic and Riparian Habitat	Fencing	Spencer Creek Fencing	6.5	miles
		Aquatic and Riparian Habitat	LWD In-stream	Spencer Creek In-stream LWD	1.0	miles
		Aquatic and Riparian Habitat	Stream Crossing Repair	Spencer Creek Ford Hardening and Interpretive Sign	1	sites
		Aquatic and Riparian Habitat	Stream Crossing Repair	Spencer Creek Stream Crossing Decommissioning	25	sites
		Road sediment reduction	Road Decommissioning	Spencer Creek Road Decommissioning	29.2	miles
		Visuals	Stand Density Reduction	Clover Creek Visual Management.	114	acres

a/ Acres are rounded to the nearest whole acre and miles to the nearest tenth of a mile.

These mitigation actions would be a condition of the Forest Service letter of concurrence and would be included in the Right-of-Way Grant, if one were issued for this project. Implementation and funding of these actions would be carried out through negotiated agreements between the Forest Service and the Applicant. A more detailed description of these mitigation actions is included in appendix F of this EIS.

2.1.5.1 Public Comments on Forest Service Compensatory Mitigation in the draft EIS

During scoping and in comments on the draft EIS, concern was expressed that thousands of acres of commercial logging has been proposed as mitigation for take of NSOs and MAMUs. Commenters also expressed a concern about whether receipts from commercial timber sales would be used to reduce Pacific Connector's expenses, requested clarification of the NEPA pathway for these projects, and questioned the applicability of fuels reductions in mature or old-growth forests. We are addressing these comments here to clarify possible misunderstandings.

Commercial logging is not being used as mitigation for incidental take of NSOs and MAMUs. Fuel reduction projects may remove some commercial-sized material to accomplish fuels reduction objectives. The intent of the mitigation actions is to reduce the risk of stand-replacing fires in late successional old-growth (LSOG) forests. Monitoring of the Northwest Forest Plan (NWFP) for the past 25 years has shown that the largest single factor contributing to the loss of LSOG forests (and hence NSO habitat) has been high-intensity stand replacement fire (Moeur et al. 2011; Davis et al. 2015; Spies et al. 2019). The NWFP anticipated the need to reduce fuels to reduce the risk of stand replacement fire in LSOG forests (Forest Service and BLM 1994b: C-12). The Recovery Plan for the NSO also recognized the need for fuels reduction in dry forest habitats of the Klamath Province (FWS 2011a: III-20). The LSRAs for LSR 223 have also documented the need for fuels reduction to reduce the risk of stand replacement fire in LSOG forests (Forest Service et al. 1998; BLM and Forest Service 1998).

The Pacific Connector Pipeline Project would remove approximately 68 acres of LSOG forest in LSR on Forest Service lands. Additional acres would be directly impacted from the use of UCSAs and indirectly affected by edge effects and fragmentation. As a partial mitigation for this impact, the Forest Service proposes to accomplish approximately 3,100 acres (table 2.1.5-1) of integrated fuels reduction in overstocked stands along the Pacific Connector corridor. The primary purpose of these fuels reduction projects is not to have commercial timber sales; it is to reduce the risk of stand-replacement fire and possible losses of LSOG forest/NSO habitat. No estimate has been made of the total acres of fuels reduction projects that may involve commercial timber removal. Subsequent site-specific environmental analysis would further define the details of these proposed projects. The mitigation actions are being designed to be consistent with the LRMPs as well as the recommendations in watershed assessments and the LSR assessments.

Several comments were received on the draft EIS questioning the efficacy of the proposed fuel treatments and suggested the treatments were not necessary and would be detrimental to LSOG habitat. In one comment letter, two studies were mentioned in support of their comments. One study titled "Historical Northern spotted owl habitat and old-growth dry forests maintained by mixed-severity wildfires" was authored by William L. Baker (2015) and looked at the importance of mixed severity fires to NSO habitat in the Eastern Oregon Province. The author concluded that efforts to reduce fuels and to prevent these fires in all areas will likely reduce future NSO habitat.

It should be noted that the NWFP and the LSR assessments also recognized the importance of fire and other natural disturbances in shaping habitat for LSOG-dependent species. The proposed fuel treatments are strategically located in a limited area and are not designed to remove all fire. The treatments are focused on reducing the risk of high-intensity stand replacement fire. In the study the author also stated that to maintain NSO habitat likely first requires restoration of historical fuels. The proposed fuel treatments are in areas that have high fuel loadings above historical levels due to fire suppression activities over the last century. The treatments are designed to bring fuel levels closer to historical levels.

The other study that was mentioned is titled "Effects of Fire and Commercial Thinning on Future Habitat of the Northern Spotted Owl" (Odion et al. 2014). This study assessed whether the beneficial effects of commercial thinning from reduced fire risk outweighed the adverse effects of the thinning on NSO habitat. The authors concluded that the long-term benefits of commercial thinning would not outweigh the adverse impacts on NSO habitat. This study, however, was looking at commercial thinning prescriptions that reduced the basal area of dense late successional forest by nearly half and mostly well below the minimum level known to function as nesting and roosting habitat for the NSO. The fuel treatments that have been proposed are focused on reducing fuels and would remove primarily smaller trees and shrubs.

A number of comments on the draft EIS suggested that it did not account for the receipts from commercial timber sales that may occur in conjunction with off-site mitigation measures. The purpose of the proposed mitigation is to reduce the risk of stand-replacing fires and to enhance the development of LSRs. Projects proposed to meet these objectives could result in commercial size trees being removed. This removal of commercial size trees would be incidental to achieving these objectives (see appendices F.2 and F.3 for additional discussion). Pacific Connector would not perform the compensatory mitigation actions and would not receive any receipts from this work. All of the off-site mitigation measures incorporated into the proposed action would have costs that the agencies do not otherwise have funding for. The Forest Service would plan these activities consistent with the standards in the current LRMPs. Any timber sale receipts from these projects would be subject to the normal contract payment provisions and timber sale receipt regulations of the Forest Service.

2.1.6 Right-of-Way Grant to Cross Federal Lands

Pursuant to the Mineral Leasing Act of 1920 and in accordance with federal regulation 43 CFR Part 2880, the Pacific Connector Pipeline Project must secure a Right-of-Way Grant from the BLM to cross BLM, NFS, and Reclamation lands. Pacific Connector has applied to the BLM for a Right-of-Way Grant to cross federal lands. The BLM proposes to consider issuance of a Right-of-Way Grant that provides terms and conditions for construction and operation of the Pacific Connector Project on federal lands in response to the proponent's application. Issuance of the Right-of-Way Grant must be in accordance with 43 CFR Parts 429, 2800, and 2880 and relevant BLM manual and handbook direction. In making this decision, the BLM would consider several factors including conformance with BLM RMPs and impacts on resources and programs. Following adoption of this EIS and receipt of concurrence from the Forest Service and Reclamation, the BLM would issue a Record of Decision that documents the agency's decision whether to amend the BLM RMPs and issue the Right-of-Way Grant. The right-of-way would incorporate the stipulations, project design features and mitigation, including compensatory mitigation specified by the concurring agencies.

This Right-of-Way Grant would be in addition to any authorization for the Project issued by the FERC. The Right-of-Way Grant, if approved, would be authorized by issuance of a Temporary Use Permit for up to three years for the pipeline clearing and construction, which would terminate upon completion of construction, and issuance of a Right-of-Way Grant for ongoing pipeline operations and maintenance for a 30-year term. The Temporary Use Permit contains the specific temporary construction and work areas necessary to build the Project. Once the Project is constructed and in operation, the Right-of-Way Grant would be modified to reflect the final location of the Project and the associated 50-foot-wide maintenance corridor[35] plus any roads on federal lands or under federal easements that are necessary for operations.

2.1.7 Mitigation on Non-Federal Lands

Both Jordan Cove and Pacific Connector are currently developing mitigation plans to address environmental impacts occurring on non-federal lands as part of their proposed action. Currently, these mitigation plans include the CMP for wetland impacts (see section 4.3), as well as the avoidance and minimization plans included in the POD[36] (though initially developed for federally-managed lands, most of the POD attachments apply to non-federal lands as well). Mitigation and BMPs are discussed in conjunction with the respective affected resources in section 4 of this EIS.

2.2 NON-JURISDICTIONAL FACILITIES

Under the NGA, the FERC is required to consider, as part of a decision to authorize jurisdictional facilities, all facilities that are directly related to a proposed project where there is sufficient federal control and responsibility to warrant environmental analysis as part of NEPA environmental review for the Project. Some proposed projects have associated facilities that do not come under the jurisdiction of the Commission. These "non-jurisdictional" facilities may be integral to the

[35] In this EIS, the 50-foot-wide corridor may be referred to as the "operational maintenance corridor," "permanent maintenance corridor," "permanent pipeline easement," "permanent pipeline right-of-way," or similar, depending on the resource discussion and context. On all federal lands, the 50-foot-wide corridor would be based on a 30-year right-of-way with the federal land managing agencies, and would not constitute a permanent easement on federal lands.

[36] The POD was filed with the FERC as Appendix F.1 in Resource Report 1 as part of Pacific Connector's application on September 23, 2017. It is included as appendix F.10 in this EIS.

need for the proposed facilities, or they may be merely associated as minor components of the jurisdictional facilities that would be constructed and operated as a result of authorization of the proposed facilities. Non-jurisdictional actions associated with the Project were identified in association with both the LNG facility and the pipeline, as described below. Available environmental data further characterizing the impacts of the non-jurisdictional facilities is provided in our cumulative impacts analysis (section 4.14).

2.2.1 LNG Carriers

LNG exported from the Jordan Cove terminal to overseas markets would be transported in vessels (LNG carriers) specially designed and built for transporting LNG. Jordan Cove expects that its terminal would be visited by about 100 to 120 LNG carriers per year. These carriers would be loaded with LNG at the terminal and deliver the cargo to customers, most likely around the Pacific Rim. LNG carriers would be under the ownership and control of third parties, not Jordan Cove, and are not regulated by the FERC. The third-party owners and operators of the LNG carriers would have agreements with Jordan Cove for the transportation of the LNG to designated ports or customers. Specific information about the individual LNG carriers that would be used to transport the LNG from the terminal is not available; however, the slip and berth would be designed to accommodate LNG carriers as large as 217,000 m^3 in capacity. Furthermore, the exact destinations for the LNG cargo and the specific routes across the Pacific Ocean are not known at this time and are not addressed in our analyses.

2.2.2 Southwest Oregon Regional Safety Center

Jordan Cove would construct the SORSC, a non-jurisdictional multi-organizational office complex, in the South Dunes area of the LNG terminal site. The SORSC would house the Jordan Cove Security Center, Coos County Dispatch Center, Coos County Emergency Operations Center, and offices for various businesses and agencies.

2.2.3 Fire Department

Jordan Cove would construct a stand-alone fire department building located in the access and utility corridor adjacent to the fire water tanks. This building would house the Jordan Cove Fire Department chief and staff.

2.2.4 Trans-Pacific Parkway/U.S. 101 Intersection Widening

Jordan Cove would add a turning lane to the Trans-Pacific Parkway (approximately 600 feet in length) to manage traffic entering U.S. Highway 101 from the west, and the addition of an automated traffic control signal. Approximately 1,150 wood piles would be installed along the road as part of this road-widening effort. The general location of the intersection is shown on figures 2.1-1 and 2.1-3.

2.2.5 Utility Connections for the Pipeline Facilities

All of the aboveground pipeline facilities would require either electrical power and/or telephone service. At the Klamath Compressor Station, electricity would be supplied by Pacific Power, which would require upgrades to an existing substation and distribution line immediately adjacent to the compressor station. New disturbance would be limited to the extension of three-phase distribution onto the compressor station property, and Pacific Connector states that Pacific Power does not anticipate disturbance would be required in new areas outside of the existing road right-of-way or existing Pacific Power right-of-way or fenced facilities. Water would be provided from water wells located on property owned by Pacific Connector, immediately adjacent to the compressor station. Telecommunications would be provided by Cal-Ore, which would require a short tie-in from the existing service available immediately adjacent to the compressor station.

For the Jordan Cove Meter Station, Pacific Power would supply electricity through a connection to an existing powerline located adjacent to the Trans Pacific Lane southwest of Ingram Yard. Telecommunications would be supplied from three existing networks, ORCA Communications, LS Networks, and Frontier Communications, through extensions of fiber optic and cable that would be installed to the SORSC proposed by Jordan Cove.

Pacific Connector has located its automated MLV facilities near available electrical power facilities such that only short tie-ins would be required. If it were to become necessary, in lieu of purchased power, thermal power generation equipment would be installed to provide electricity for the minimal power requirement at these sites.

2.3 LAND REQUIREMENTS

2.3.1 Jordan Cove LNG Terminal Facilities

The LNG Project would require the use of about 1,355 acres of land. When complete, the Jordan Cove LNG terminal would occupy about 203 acres. Jordan Cove owns about 295 acres at the terminal site and would acquire the use of the remaining area (e.g., via easements or lease). Table 2.3.1-1 lists the land requirements for the Jordan Cove LNG terminal facilities.

TABLE 2.3.1-1

Land Requirements for the Jordan Cove LNG Project a/

Facilities	Acres Required During Construction b/	Acres Required During Operation b/
Jurisdictional Facilities		
Total for Jurisdictional Facilities	202.6	197.1
Non-Jurisdictional Facilities		
Southwest Oregon Regional Safety Center	5.4	5.4
Fire Department	0.8	0.8
Total for Non-Jurisdictional Facilities	**6.2**	**6.2**
Temporary Construction Areas		
Total for Temporary Construction Areas	**368.1**	**0**
Mitigation Sites		
Eelgrass Mitigation Area and Dredge Line	33.4	0
Kentuck Project and Dredge Line	135.6	0
Panhandle Site	132.6	0
Lagoon Site	320.3	0
North Bank Site	156.1	0
Total for Mitigation Sites	**778.0**	**0.0**
GRAND TOTAL	**1,355.1**	**203.3**

a/ This table lists the acres of land that would be encompassed by Project components or mitigation areas, but may not directly relate to areas that would experience direct effects (e.g., the entire footprint of each of the mitigation areas may not experience direct effects such as clearing, but are included in this table to disclose the scope of the projects footprint). See section 4 for the acres of land and resources that would be affected by the Project.
b/ Columns may not sum correctly due to rounding.

2.3.2 Pacific Connector Pipeline and Associated Aboveground Facilities

Constructing and operating the Pacific Connector pipeline would require the use of about 4,937 acres and 1,404 acres of land, respectively. Table 2.3.2-1 lists the land requirements for the Pacific Connector Pipeline Project.

TABLE 2.3.2-1

Land Requirements for the Pacific Connector Pipeline Project a/

Project Component	Land Required During Construction (acres) b/	Land Required During Operation (acres) b/
Pipeline ROW	2,585.5	1,375.8 c/
Temporary Extra Work Areas	925.8	0
Uncleared Storage Areas	671.2	0
Rock Source & Disposal Sites d/	41.2 d/	0
Contractor and Pipe Storage Yards	661.3	0
Access Roads (PARs, TARs, & Road Improvements)	28.8 e/	2.6
Aboveground Facilities	23.0 f/	25.4 g/
Totals	**4,936.8**	**1,403.8**

a/ This table lists the acres of land that would be encompassed by Project components or designations (e.g., permanent easements), but may not directly relate to areas that would experience direct effects (e.g., the entire permanent easement would not be cleared during operation). See section 4 for the acres of land and resources that would be affected by the Project.
b/ Columns may not sum correctly due to rounding.
c/ 50-foot-wide permanent pipeline easement (on federal lands, 30-year maintenance corridor).
d/ Includes rock source and disposal sites that would remain disturbed following construction but would not be used during operation of the Project and therefore are not included in the operational total.
e/ Road improvements would remain following construction, but these roads would not be used for operation of the Project and therefore are not included in the operational total.
f/ Construction impacts associated with the aboveground facilities are included in the construction land requirement for the pipeline ROW and TEWAs except the potential off-ROW communication tower sites (1.6 acres) and the Klamath Compressor station (21.4 acres), which are included here..
g/ Includes Klamath Compressor Station, Jordan Cove Meter Station, and permanent mainline block valve acreages.

For private and non-federal lands crossed by the pipeline, Pacific Connector would need to negotiate a mutually agreed upon easement for its pipeline with the affected landowners. The agreement between Pacific Connector and the landowner would specify compensation for the easement, compensation for damage to property and loss of use during construction, and loss of renewable and nonrenewable or other resources. The agreement would also specify uses of the permanent right-of-way after construction. If the company is unable to reach an agreement with a landowner, and if the Project is authorized by the FERC, the Certificate would convey the right of eminent domain under section 7h of the NGA. In these situations, Pacific Connector could initiate condemnation proceedings, and the value of the easement and the amounts for compensatory damages would be determined by a local, state, or district court.

2.3.2.1 Pipeline

Construction Right-of-Way

As illustrated in figure 2.3-1, Pacific Connector would generally construct the pipeline using a 95-foot-wide right-of-way. Pacific Connector would also use, as necessary, temporary extra work areas (TEWAs) to accommodate construction across waterbodies, roads, steep terrain, dense forest, and other areas of concern.[37] Where feasible (i.e., where topographic conditions allow) through forested and scrub-shrub wetlands as well as stream crossings, the construction right-of-way would be narrowed to 75 feet in width to reduce impacts on these resources and be consistent with the FERC's *Procedures* (Section VI.A.3). See additional discussion in section 4.3 of this EIS.

[37] About 42 acres of the TEWAs would be existing quarries, rock sources, or rock disposal areas that would be permanent storage areas for excess rock, and these areas would remain as exposed rock sites following construction.

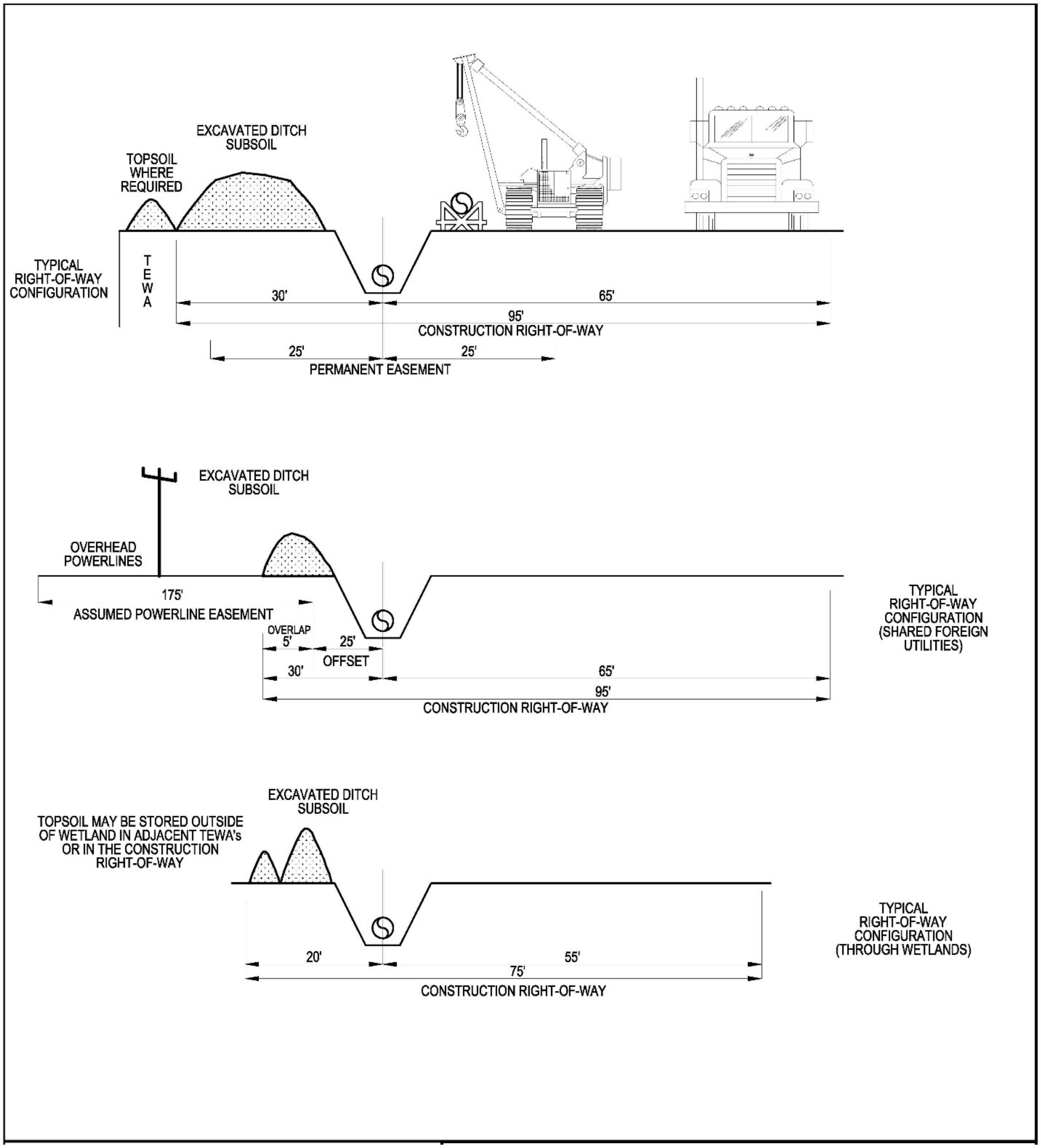


Figure 2.3-1. Typical Pipeline Right-of-Way Cross Sections

Pacific Connector would also use approximately 676 acres of uncleared storage areas (UCSA). UCSAs would not be cleared of trees during construction. UCSAs would be used to store forest slash, stumps, and dead and downed log materials that would be removed from the construction work area before construction and then scattered back across the right-of-way after construction.

In some locations, the UCSAs may be used to store spoil or to temporarily park equipment between the mature trees. However, storage and temporary parking of equipment/vehicles would not occur immediately adjacent to any trees so as to reduce tree damage. In extremely steep and side sloping topography, the UCSAs may be required as a contingency location to contain rock which rolls beyond the construction limits. Along extremely steep and narrow ridgeline areas, logs, slash, and dead and downed material may be used as cribbing to contain materials disturbed or excavated during right-of-way grading and trenching activities. During restoration, some of the materials that are pulled out of the cribbing may roll beyond the construction limits. Where feasible, Pacific Connector would retrieve materials that have rolled downhill using cables and chokers attached to standard on-site restoration equipment (i.e., bulldozers and trackhoes) to winch the material back to the right-of-way. There may be some cases where retrieval of the lost cribbing material may cause more harm to resources than allowing it to remain where it settled. On federal lands, Pacific Connector would protect trees within the UCSAs in accordance with the procedures outlined in its *Leave Tree Protection Plan* (Appendix P of its POD [appendix F.10 of this EIS]). After construction, the UCSAs would be restored to their pre-construction condition and use.

Operational Pipeline Right-of-Way

Pacific Connector would retain a 50-foot-wide permanent easement for the long-term operation and maintenance of the pipeline on non-federal lands. On federal lands, an operational right-of-way may be issued for a specific period of use, with potential for extension. After construction, workspace outside of the maintenance easement would be restored to its original condition and use to the extent possible (although mature forest would take many years to be re-established). The restoration and revegetation of the temporary construction right-of-way would be done in accordance with Pacific Connector's *Erosion Control and Revegetation Plan* (ECRP). On NFS and BLM lands where Riparian Reserves[38] would be affected, up to a 100-foot riparian strip or to the edge of the existing riparian vegetation would be replanted adjacent to stream crossings.

Access Roads

Pacific Connector would primarily use existing roads to access pipeline workspaces. Existing roads that would be used for construction access are listed in table D-2 in appendix D of this EIS. Pacific Connector has identified 10 locations where it would be necessary to construct new temporary access roads (TARs). Pacific Connector has also identified 27 existing roads that would need to be modified to handle construction traffic. The roads would be stabilized using gravel and appropriate BMPs, as outlined in the ECRP, to reduce potential surface water runoff and to avoid potential sedimentation impacts. Following construction, new TARs would be removed, and the affected areas restored to pre-construction conditions.

[38] As a key element of the Aquatic Conservation Strategy, Riparian Reserves provide an area along all streams, wetlands, ponds, lakes, and unstable and potentially unstable areas where riparian-dependent resources receive primary emphasis.

Pacific Connector would construct 15 new permanent access roads (PARs) to access the pipeline and aboveground facilities. These roads would provide access during construction as well as during operations and maintenance activities. Most of the new PARs would be within Pacific Connector's operational pipeline easement.

Contractor and Pipe Storage Yards

Pacific Connector has identified 35 potential sites for yards and rail ports that may be used during construction to off-load and store pipe and stage contractor equipment (see table D-9 in appendix D). These sites are near the pipeline but generally not immediately adjacent to the proposed pipeline.

Pacific Connector has identified approximately 920 acres of TEWAs that would be disturbed during construction of the pipeline. All of these areas are considered temporary disturbance and would be restored upon completion of construction. All TEWAs that were forested prior to construction would be replanted with trees.

Rock Source and Permanent Disposal Sites

Pacific Connector has identified 20 potential rock source/disposal sites. These sites are indicated on the Mapping Supplement included as appendix C of this EIS. Of these locations, 15 sites are existing quarries/gravel pits or abandoned quarries/gravel pits. Although some of the existing/abandoned sites appear to have land use types other than quarries/gravel pits, Pacific Connector would not expand these sites beyond the existing or previously disturbed footprints.

Cathodic Protection System

Pacific Connector would protect the pipeline from corrosion over time through a cathodic protection (CP) system. The CP system would consist of below ground rectifier/anode beds that input a low voltage electrical charge into the pipeline. These rectifier/anode beds would be spaced about 30 to 40 miles apart and typically installed within previously disturbed areas near the permanent pipeline right-of-way. Each CP site would use electric power from a local utility. A typical CP site would include installation by a standard backhoe within an area up to 500 feet long by 15 feet wide and 5 feet deep. In limited locations a deep CP site may be required which would be installed by a truck-mounted drill rig. Identification of the CP sites and installation itself would occur about one year after pipeline installation to allow the trench to stabilize and for collection of post-construction data on electro-conductivity soil potentials, which is required before the system can be designed and installed. Pacific Connector would consult with appropriate federal, state, and local regulatory agencies after pipeline construction to determine the level of environmental compliance and agency authorizations necessary for the installation and maintenance of the CP system. On federal lands, any ground-disturbing construction and installation work to install the CP system would require separate authorization and environmental review.

2.3.2.2 Aboveground Facilities

Land required for construction and operation of the proposed aboveground facilities is listed in table 2.3.2-1 above. Operation of the aboveground facilities would require about 27 acres outside of the pipeline operational right-of-way.

2.3.2.3 Pipeline Facilities on Federal Lands

The Pacific Connector pipeline would cross 46.9 miles of federal land managed by the BLM, 30.7 miles managed by the Forest Service, and 0.31 mile managed by Reclamation (see table 2.3.2.3-1). The temporary and permanent acres of impact from the specific components are also provided in table 2.3.2.3-1. Tables 2.3.2.3-2 and 2.3.2.3-3 show the breakout by BLM District and by National Forest of the miles crossed through the various 2016 BLM RMP and NWFP land allocations. Table 2.3.2.3-4 lists the Reclamation jurisdictional facilities, with their milepost locations, easement widths, acres of impact, and townships, ranges, and sections.

TABLE 2.3.2.3-1

Federal Lands Affected by the Pacific Connector Pipeline Project

Pipeline Facility/Component	Jurisdiction BLM	Forest Service	Reclamation
Miles Crossed by Pipeline	46.9	30.7	0.31
Temporary Construction Acreage Requirements (acres)			
Construction ROW	535.36	351.14	3.69
TEWAs	165.19	103.34	0.46
UCSAs	178.84	126.08	0.00
Off-site Source/Disposal	6.99	9.26	0.00
Contractor and Pipe Storage Yards	0.00	0.00	0.00
Existing Roads Needing Improvements in Limited Locations a/	4.71	1.00	0.00
Temporary Access Roads	0.69	0.24	0.00
Total Temporary Impacts (acres)	**891.08**	**591.06**	**4.15**
ROW (50 feet)	284.24	186.11	1.90
Permanent Access Roads	0.22	0.00	0.00
Aboveground Facilities	0.17 b/	0.00	0.00
30-Foot Maintained	170.38	111.66	1.14

a/ Includes those existing roads requiring widening in specific locations; does not include limbing/brush clearing or blading/grading for potholes.
b/ MLVs #4, #7, and #12 are located on BLM lands.

TABLE 2.3.2.3-2

BLM Federal Land Allocations – Miles Crossed by the Pacific Connector Pipeline

Land Use Allocation	Coos Bay District	Roseburg District	Medford District	Lakeview District	Total
District-Designated Reserve (No Harvest)	0.09	0.37	5.02	0.00	**5.48**
District-Designated Reserve (Non-Forest)	0.76	1.62	2.31	0.04	**4.73**
Eastside Management Area	0.00	0.00	0.00	0.26	**0.26**
Harvest Land Base (Low Intensity Timber Area)	0.72	0.00	0.68	0.00	**1.40**
Harvest Land Base (Moderate Intensity Timber Area)	2.56	1.70	0.00	0.00	**4.26**
Harvest Land Base (Uneven-Aged Timber Area)	0.00	2.77	2.00	0.97	**5.75**
Late-Successional Reserve (Dry Forest)	0.00	5.08	4.21	0.00	**9.29**
Late-Successional Reserve (Moist Forest)	11.45	1.51	0.00	0.00	**12.96**
Riparian Reserve a/ (Dry Forest)	0.00	0.16	0.93	0.02	**1.11**
Riparian Reserve a/ (Moist Forest)	1.52	0.11	0.00	0.00	**1.63**
Totals	**17.10**	**13.32**	**15.15**	**1.30**	**46.87**

a/ Calculated using 2016 RMP DATA\RWO_ROD_SWO.gdb/RWO_ROD_SWO_LUA_poly and 2016 RMP DATA\RWO_ROD_NCO.gdb/RWO_ROD_NCO_LUA_poly.

TABLE 2.3.2.3-3

Forest Service Federal Land Allocations – Miles Crossed by the Pacific Connector Pipeline

Jurisdiction	Late Successional Reserves (miles)	Matrix (miles)	Total	Riparian Reserves a/ (miles)
Forest Service – Umpqua	5.00	5.80	**10.80**	0.80
Forest Service – Rogue River-Siskiyou	13.88	0.00	**13.88**	0.24
Forest Service – Fremont-Winema	0.00	6.02	**6.02**	0.32
Total	**18.88**	**11.82**	**30.70**	**1.36**

a/ Riparian Reserves overlay other land use allocations.

TABLE 2.3.2.3-4

U.S Bureau of Reclamation Administered Lands and Canals

U.S Bureau of Reclamation Jurisdictional Facilities (Easement Width) a/	Approx. Pipeline Milepost	Length of Pipeline Crossing (feet)	Index No. Easement Width	Waterbody ID b/	Quarter Quadrant	Township	Range	Section
C-4-E Lateral c/	NA	Not Crossed c/	KO-20-080 30 feet	ADX293	SWNE	39S	9E	20
Withdrawn Land	NA	Not Crossed	KO-20	N/A	SWNE	39S	9E	20
No. 1 Drain	200.54	14.59	KO-20-276 60 feet	ADX294	SWNE	39S	9E	20
C-4-E Lateral	201.63	15.49	KO-20-164 40 feet	ADX096	NENW	39S	9E	28
C-4 Lateral	204.12	48.18	KO-09-013 50 feet	ADX100	NWNE	40S	9E	3
C-4-F Lateral	204.33	12.91	KO-09-013 50 feet	ADX101	NWNE	40S	9E	3
No. 3 Drain	204.74	17.80	KO-09-14 60 feet	ADX105	NWNW	40S	9E	2
C-4-C Lateral	205.50	18.28	KO-09-018 60 feet	ADX109	SWNE	40S	9E	2
C Canal	205.96	54.90	KO-09-027 75 feet d/	ADX111	NWSW	40S	9E	1
D-2 Lateral	206.51	23.76	KO-09-050 60 feet	ADX113	NWNE	40S	9E	12
5-A-1 Drain	207.11	4.00	KO-09-053 60 feet	AW-114	NESE	40S	9E	12
5-A Drain	207.26	28.61	KO-09-054 50 feet d/	ADX115	NESE	40S	9E	12
C-4-7 Lateral	207.40	15.20	KO-10-031 60 feet	ADX116	NWSW	40S	10E	7
5-A Drain	207.42	16.84	KO-10-032 50 feet	ADX117	NWSW	40S	10E	7
5-A Drain	207.60	61.56	KO-10-032 50 feet	ADX118	SWSW	40S	10E	7
5-A Drain	207.99	25.26	KO-10-034 50 feet	ADX119	NENW	40S	10E	18
5-A Drain	208.18	19.94	KO-10-034 50 feet	ADX123	SENW	40S	10E	18
5-K Drain	209.02	24.95	KO-10-048 30 feet d/	ADX130	SESE	40S	10E	18
C-9 Lateral	209.15	16.03	KO-10-047 30 feet	ADX134	NWNW	40S	10E	20
No. 5 Drain	210.26	17.90	KO-10-061 50 feet	ADX143	SESE	40S	10E	20
5-H Drain	210.85	10.71	KO-10-074 20 feet	ADX260	SWNW	40S	10E	28

TABLE 2.3.2.3-4 (continued)

U.S Bureau of Reclamation Administered Lands and Canals

U.S Bureau of Reclamation Jurisdictional Facilities (Easement Width) a/	Approx. Pipeline Milepost	Length of Pipeline Crossing (feet)	Index No. Easement Width	Waterbody ID b/	Quarter Quadrant	Township	Range	Section
G Canal	213.87	43.90	KO-10-086 165 feet	ADX275	SESE	40S	10E	26
Total		**490.81**						

a/ Reclamation Facility Name, (easement width) Reclamation ID, and Index No included as attributes in Bureau of Reclamation Pacific Connector-Crossing Shapefile provided to Pacific Connector - January 7, 2009. Easement widths determined from scanned easement plats provided by Reclamation.
b/ Waterbody ID from Pacific Connector wetland and waterbody surveys as shown on the Environmental Alignment Sheets in Appendix AA to the POD.
c/ The C-4-E Lateral is not crossed by the centerline but the easement for the lateral is within the construction ROW for approximately 270 feet.
d/ Canal easement widths not provided on easement plats provided by Bureau of Reclamation; therefore, crossing widths estimated based on photography and similar canal easements on adjacent canals.

In addition to the permanent and temporary access roads needed for construction listed in the preceding tables, existing federal roads would also be used. It is estimated that approximately 276 miles of BLM roads, 113 miles of Forest Service roads, and 2 miles of Reclamation roads would be utilized for construction activities.[39] All of the requirements for the use of federal roads are included in Appendix Y of the POD (i.e., the *Transportation Management Plan* [TMP]). This POD attachment outlines the requirements for road use permits, maintenance, modification and reconstruction, road decommissioning, culvert/bridge upgrades, new road construction (PARs and TARs), and traffic management. The federal agencies are continuing to coordinate with the Applicant in refining the TMP, and road miles may vary as a result.

2.4 CONSTRUCTION PROCEDURES

Under the provisions of the Natural Gas Pipeline Safety Act of 1968, as amended, Jordan Cove would design, construct, operate, and maintain the LNG terminal facilities in accordance with the USDOT's Liquefied Natural Gas Facilities: Federal Safety Standards (49 CFR 193). The loading facilities and any appurtenances located between the LNG carriers and the last valve immediately before the LNG storage tank would be required to comply with applicable sections of the Coast Guard regulations in Waterfront Facilities Handling Liquefied Natural Gas (33 CFR 127).

The proposed pipeline facilities would be designed, constructed, operated, and maintained in accordance with USDOT regulations in Transportation of Natural and Other Gas by Pipeline: Minimum Federal Safety Standards (49 CFR 192). Among other design standards, these regulations specify pipeline material selection; minimum design requirements; protection from internal, external, and atmospheric corrosion; and qualification procedures for welders and operations personnel. In addition, Pacific Connector would comply with the siting and maintenance requirements of the FERC's regulations at 18 CFR 380.15, and other applicable federal and state regulations.

[39] Estimates derived from Table A.8-1 in Resource Report 8 of Pacific Connector's September 2017 application to the FERC.

Jordan Cove and Pacific Connector would construct the Project in accordance with its project-specific *Erosion and Sediment Control Plan* (ESCP), its *Upland Erosion Control, Revegetation, and Maintenance Plan* (Jordan Cove's *Plan*) and its *Wetland and Waterbody Construction and Mitigation Procedures* (Jordan Cove's *Procedures*).[40] Jordan Cove adopted elements of the FERC's *Plan* and *Procedures* (May 2013 versions) into its *Plan* and *Procedures* as applicable for the Project (see appendix E for modifications). We have reviewed Jordan Cove's *Plan* and *Procedures* and find them to be consistent with the FERC's *Plan* and *Procedures*. In addition, Jordan Cove has prepared Spill Prevention, Containment, and Countermeasures (SPCC) Plans for both construction and operations.[41]

2.4.1 Jordan Cove LNG Terminal

2.4.1.1 Upland Site Preparation

Temporary Concrete Batch Plant

One of the first construction procedures that Jordan Cove would undertake is the installation of a temporary concrete batch plant within the LNG terminal site or within a construction laydown area. The concrete batch plant would support construction of LNG terminal facilities that include concrete. A washout area would be located adjacent to the batch plant to allow for containment and disposal of waste water related to concrete batching operation.

Demolition and Clearing

Site preparation would include demolition, clearing, and removal and relocation of existing infrastructure to enable earthworks to progress. During this initial phase the IWWP and several existing utilities would be relocated. Other demolition and clearing activities would include:

- Removal and disposal of hydrocarbon contaminated soils – The South Dunes portion of the site contains small areas of hydrocarbon-contaminated soils remaining after the decommissioning of the former Weyerhaeuser paper mill. The contamination is located in the vicinity of the proposed site for the permanent buildings. Jordan Cove plans to conduct additional testing to further characterize the area of potentially contaminated soils and would develop a disposal plan for the approval of ODEQ and would remove and dispose of the contaminated soils in accordance with the approved plan.
- Clearing – The dune areas at the LNG terminal site would be cleared and any merchantable timber would be processed for commercial sale. Scrub and stumps would be processed into mulch for use during construction.

2.4.1.2 Material Deliveries

Transportation of materials, supplies, and staff to the LNG terminal site would be accomplished via a combination of road, marine transport, and rail. The larger and heavier pieces of equipment would be delivered to the site by marine transport in two phases. Initial marine deliveries would be via a temporary material barge berth, constructed in the existing shoreline within the footprint

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[40] Jordan Cove's ESCP including its *Plan* and *Procedures* was attached as Appendix H.7 in Resource Report 7 as part of the Environmental Report included with Jordan Cove's September 2017 application to the FERC.

[41] Jordan Cove's construction and operation SPCC Plans were included as Appendices F.2 and G.2 of Resource Report 2, respectively, of its September 2017 application filed with the FERC.

of the eventual marine slip. The temporary material barge berth would allow for material deliveries by barge while the permanent MOF is under construction and would be removed when construction of the MOF is completed.

Jordan Cove anticipates that some bulk materials, such as temporary buildings, construction equipment, steel reinforcement, pipe spools, cable drums, and insulation, would be delivered to the site by road. An existing rail line is located adjacent to the LNG terminal site and would be utilized for deliveries as permitted.

2.4.1.3 Earthworks and Soil Improvement

Earthworks would include removal of topsoil and storage for re-use, cut (excavation and dredging), fill (placement of excavated material), and grading of material to the approximate design elevations. The upland earthworks phase would include work by heavy equipment and require some periods of 24-hour operation. Jordan Cove would construct a temporary traffic overpass to allow separation of the traffic traveling to and from the existing Roseburg Forest Products Company from the large, off-road haul trucks and equipment required for the earthworks phase. During this phase boiler ash previously disposed on the site of the LNG terminal would be relocated to the South Dunes portion of the site where it would be buried within the fill.

The soil conditions at the site require improvement before any aboveground facilities can be constructed. These conditions include peat, clay, buried driftwood, and liquefiable soil, which could cause excessive settlement and stability concerns, or issues associated with liquefiable soils should a seismic event occur. Liquefiable soils within the LNG terminal site have been delineated in distinct soil layers from the groundwater table to various depths down to about 30 feet. A peat layer about 2-4 feet thick is present in areas of the site generally from just below the groundwater table to about 7 to 15 feet below grade. A layer of clay up to about 2.5 feet thick has been identified in areas of the South Dunes, and there are several areas in the South Dunes portion of the site where accumulations of buried driftwood are estimated to be present.

Jordan Cove plans to conduct additional site investigations to further characterize the existing subsurface conditions at the site and based on results would develop a plan for soil improvement, however potential soil improvements identified by Jordan Cove are listed below.

- Soil Densification Method 1 – Vibro-compaction could be utilized to condition liquefiable soils. This method consists of driving a vibration device into the sand layers to compact the soils.
- Soil Densification Method 2 – Sand compaction piles could be utilized to compact liquefiable soils, depending on the availability of suitable equipment.
- Organic Material Treatment Method 1 – Excavation and removal would be the preferred method to remove larger peat deposits where dewatering of the excavation pits is possible without affecting adjacent wetlands or waterbodies.
- Organic Material Treatment Method 2 – Excavation and removal of peat without dewatering the excavation pits may be attempted in areas with adjacent off-site wetlands and waterbodies.

- Organic Material Treatment Method 3 – Mixing of the mineral surface soils with peat layers may be attempted where excavation is not feasible.

During the operation of the Weyerhaeuser mill, boiler ash was deposited at Ingram Yard. Jordan Cove would dry excavate this boiler ash, and relocate it to South Dunes, where it would be buried with the fill.

2.4.1.4 Subsurface Civil Work

Piling

Construction of the LNG terminal and associated marine facilities would require the installation of approximately 3,600 pipe piles and 11,800 sheet piles. Piles would be installed using vibratory hammering methods for the sheet piles and vibratory and impact methods for the pipe piles. Jordan Cove states that pile driving would be done over two 10-hour shifts per day, 6 days per week (not on Sundays or major holidays) over a 31-month period.

On-site Underground Utilities

Installation of underground utilities and services would be completed early in the site preparation phase to allow completion of site grading for stormwater control, completion of plant roadways, and installation of foundations and aboveground work. Underground work would be closely coordinated with the site preparation earthwork to install as much of the underground facilities as possible while the site is still being brought to grade.

Foundations

Major foundation work for equipment and structures would generally follow the installation of pilings and underground utilities. Typically, shallow isolated or raft foundations would be used for equipment and structures unless the design requires the use of deep foundations. All foundation loads, analysis, design, and construction would be in accordance with statutory and regulatory requirements. Where required, foundations would be evaluated and designed to mitigate the hazards associated with settlement, bearing capacity, overturning, sliding, buoyancy, erosion, and scour. Formwork for foundations would comprise a mix of metal form systems and job-built wooden forms. Rebar required for foundations would be fabricated off-site, delivered, and tied into place on-site. The temporary on-site batch plant would provide concrete as required for poured foundations.

2.4.1.5 Marine Facilities

Construction of the marine facilities would be done in three phases. The first phase would include upland excavation of the slip. The second phase would include excavation and dredging of the slip area above the natural earthen berm maintained in place to separate the freshwater construction activities from Coos Bay. Maintaining the berm would allow year-round work without being in contact with the waters of Coos Bay. The third phase would require work within Coos Bay and would include excavating the access channel (including the area around the MOF), removal of the berm and excavation/dredging of the berm area, and installation of MOF fender piles. This third phase would occur during periods when fisheries considerations allow in-water work, between

October 1 and February 15.[42] The estimated volume of material removed from each phase and component of excavation and dredging for the marine facilities are listed in table 2.1.1.8-1. Additional details for construction of the marine facility components are described below.

Construction of Sheetpile Walls

The sheetpile system would serve as a retaining wall for the shoreline on the east and west sides of the slip. It would be designed to support the dead loads of the soils and structures, as well as the live loads of the LNG carrier at berth and LNG transfer equipment; it would also be designed to meet the seismic criteria for the facility and water-imposed loads. The sheetpile wall system would include face sheet piles for retaining the soils as well as tail-walls for anchorage of the retaining wall. Sheet piles and tail-walls would be driven from the land during the first phase of marine facilities construction while the slip construction activities are isolated from Coos Bay.

Dry Excavation

The existing natural ground surface is at an elevation of approximately +20 feet NAVD88. The water table across the slip occurs at an elevation of approximately +10 feet NAVD88. Material above an elevation of approximately +10 feet NAVD88 would be removed by conventional earthmoving equipment such as excavators, scrapers, bulldozers, and front-end loaders. Excavated material would be hauled by trucks to upland disposal within the Ingram Yard, Access/Utility Corridor, South Dunes, and Roseburg site. A berm would be maintained as a barrier to the bay during this construction phase. The north slope of the slip would be finished at 2.5 to 1 horizontal to vertical slope. The same slope would be maintained on the slip side of the temporary berm to preserve the integrity of the berm during excavation and dredging. Contouring of the final slip perimeter above +10 feet NAVD88 would be performed during this step.

Slip Dredging

The material removed from the slip area that is at or below the water table would be removed by means of hydraulic dredging using a barge mounted cutter-suction dredge. The dredge would be delivered by ocean-going barge to the site, partially disassembled, and then pulled over the berm into the slip area. A dredge slurry pipeline would connect the dredge to the South Dunes portion of the site, and a decant water return pipeline would return the water to the slip area or purpose-built decant basin. The hydraulic dredge would be capable of dredging to the final slip depth.

The slurry and decant water pipelines would follow the shoreline and then the route of the future access and utility corridor. The pipes would be made of 18- to 20-inch-diameter seamless polypropylene pipe placed on the ground, braced as necessary, and would span any wetlands or waterbodies along the route. At any point along the pipeline route where the slurry pipeline could rupture, and the contents could potentially enter the waters of Coos Bay, secondary containment would be provided. When the hydraulic transport has been completed, the pipelines would be drained, flushed with clean water, and cut apart only in those areas where any residual material in the pipeline could not potentially be released into the bay, wetlands, or other waterbodies. The pipeline would be removed and taken off-site for reuse, recycling, or disposal in a permitted landfill.

[42] ODFW indicated in its comments on the draft EIS that it will require in-water work to be completed between October 1 and January 31.

Dredged material that would be placed at the Kentuck project site would be transported along the Federal Navigation Channel via marine transport barge in the wet and then deposited on the site using a temporary transfer pipeline. Approximately 0.3 mcy of material would be deposited at the Kentuck project site.

Access Channel and Proposed Modifications to the Marine Waterway

The access channel would be dredged using a barge-based hydraulic dredge system or a clamshell bucket. Jordan Cove has stated that the hydraulic system using a cutter suction head would be the primary/preferred method of dredging. The operation would start at the MOF and progress out to the navigation channel. Jordan Cove anticipates that access channel dredging would occur around the clock in order to complete within the available window for in-water work from October 1 to February 15. The channel dredging would occur during the second available in water work window (with the MOF being constructed during the first available in-water window). Dredged material would be loaded into material barges and the barges would be towed to shore and the material transferred to trucks for placement at Ingram Yard, the access and utility corridor, Roseburg Forest Products property, or the South Dunes portion of the site. Material dredged from the along the Federal Navigation Channel (as part of the proposed marine waterway modification) would be transported to APCO Sites 1 and 2 by temporary dredge pipeline laid adjacent to the Coos Bay navigation channel (via a floating or submerged pipe).

Driving of Piling for Marine Structures

Marine piling for the tug dock would be driven "in-the-dry" by land-based mobile cranes, meaning the piles would be installed prior to or concurrent with the freshwater dredging of the slip and while the berm is still in place separating the slip from Coos Bay. All piles required for the LNG loading foundation, and all mooring and berthing structures for the LNG and emergency berths would be located behind the sheetpile walls and would be driven on dry land.

Connection of Slip to the Channel

After completion of the slip excavation and dredging while working behind the berm, the berm would be removed, and the remaining area of the slip would be dredged. This work would be conducted during the allowed in-water work window of October 1 to February 15. Dredging may be conducted from both the Coos Bay side and the slip side to reduce the duration of the activity. Additional dredging to contour the access channel at the connection of the channel and slip would also be conducted at this time. Material would be removed by hydraulic dredge or clam-shell dredge (with the hydraulic system using a cutter suction head being the primary/preferred method by Jordan Cove). A portion of the material may be transported to the Kentuck project to be used as fill, and the remainder would be placed at the South Dunes portion of the site. Armoring of the remaining unarmored slip side slopes would then be completed.

Restoration of Marine Facilities

Following the excavation activities, all areas disturbed by marine facilities construction, including exposed slopes, would be protected from erosion and stabilized with an erosion protection system and/or an approved seed mixture specified for the site. The northern slip face would be armored with rip rap to protect the slope from scour. The dredge slurry and decant water return pipelines would be removed, and any areas that are disturbed by the haul truck or pipelines route that do not become part of the access and utility corridor would be restored to pre-construction condition.

2.4.1.6 LNG Loading Platform and Facilities

The LNG carrier loading facilities would be constructed once the eastern sheet pile wall system is complete. All of the loading facilities would be on the shore side of the slip, with no facilities located in the water of the slip. The platform with the loading arms (inclusive of the loading and vapor return arms) would be constructed on a concrete pad at the edge of the slip. The LNG transfer piping would be located over LNG troughs that would contain any spills and divert the LNG to a containment basin. The LNG carrier loading facilities would be constructed using land-based equipment. Installation of berth piping and equipment, and hookup and commissioning of the loading system and utilities would follow.

2.4.1.7 LNG Storage and Support Facilities

LNG Storage Tank Construction

Construction of the LNG storage tanks would be the most time-consuming element in the development of the LNG terminal. General steps would include installation of the foundations and tank bottom slab, construction of the outer concrete container wall, insertion of the bottom carbon steel vapor liner, construction of the steel dome roof and suspended deck, installation of the 9 percent nickel steel inner tank, installation of the internal tank accessories (pump columns, instrumentation, and piping), installation of external tank accessories, installation of insulation, and installation of LNG pumps. Following a successful inner container hydrotest (see below), the tank would be washed down and cleaned. After installation of the LNG pumps, the tank would be closed and purged with nitrogen to a positive gauge pressure. At this point in the construction process, the tank would be ready for cooldown with LNG.

Support Facilities

Construction of buildings and installation of major mechanical equipment would occur once LNG storage tank construction is underway. Installation of mechanical equipment would be followed by electrical and instrumentation installation. As the construction of the process portion of the LNG terminal progresses, work would commence on the pre-commissioning activities, so that these activities would be completed concurrently with the completion of the LNG storage tanks.

2.4.1.8 Testing

Jordan Cove would conduct testing of the LNG storage tanks in accordance with API 620, while piping would be tested in accordance with the American Society of Mechanical Engineers (ASME) B31.3. Some of the tests are described below.

Testing of the LNG Storage Tanks

Jordan Cove proposes to use raw water from the existing CBNBWB raw water pipeline for hydrostatic testing of the LNG storage tanks. The inner container of each LNG storage tank would be hydraulically tested by filling the tank with water, and then pressurizing the tank. To reduce water usage, the two tanks would be hydrotested with the same water by transferring the water at the conclusion of the hydrotesting of one tank to the other tank. For both tanks combined, about 60 million gallons would be used during hydrostatic testing. Following testing, the water would be locally discharged, following ODEQ approval, to the stormwater system for infiltration or discharged into the IWWP according to applicable NPDES permit requirements. If the hydrostatic test water is discharged to the IWWP, it has the capacity to handle the anticipated discharge of

2.9 million gallons per day (mgd). Jordan Cove would use a pneumatic test on the outer container for each LNG storage tank. The pneumatic test would be completed in accordance with API 620 Section R.7.

Testing of Pipework

Piping within the LNG terminal facility would be tested using hydrostatic or pneumatic methods. In general, cryogenic piping (piping that would transfer LNG) would be pneumatically tested with dry air or nitrogen. Non-cryogenic piping (piping that would transfer natural gas) would be hydrotested using clean water. Water used for testing of pipeworks would be discharged in the same manner as water used for hydrostatic testing of the LNG storage tanks, as described above.

2.4.2 Pacific Connector Pipeline and Associated Aboveground Facilities

Construction of the proposed pipeline would primarily involve standard cross-country pipeline construction as described in section 2.4.2.1; typical construction activities are depicted in Pacific Connector's Resource Report 1 (filed with the FERC on September 2017). Special construction techniques would also be used when constructing across wetlands; waterbodies; roads, railroads, and other utilities; agricultural and residential areas; and rugged terrain. These special construction techniques are described in section 2.4.2.2. Construction of the aboveground facilities is discussed in section 2.4.2.3.

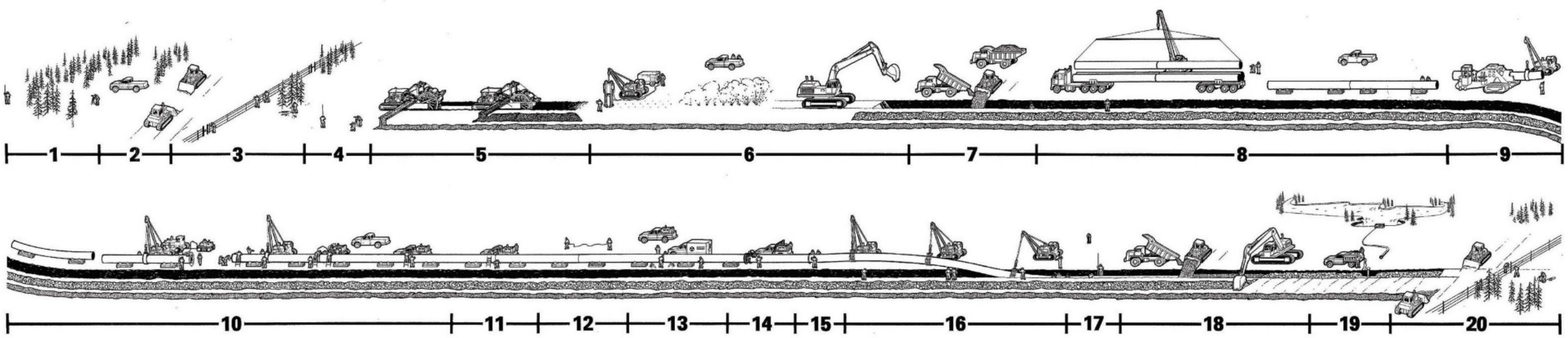
Minor alignment shifts or additional temporary workspace may be required prior to and during construction to accommodate currently unforeseeable site-specific constraints related to construction, safety, engineering, landowner, and/or environmental concerns. All such alignment shifts or workspace needs would be subject to review and approval by the FERC and the other permitting agencies prior to construction, as appropriate.

2.4.2.1 General Pipeline Construction Techniques

Figure 2.4-1 shows the typical steps of cross-country pipeline construction, which proceeds in the manner of an outdoor assembly line of specific activities that make a linear construction sequence. Typical steps include survey and staking of the right-of-way, clearing and grading, trenching, pipe stringing and bending, welding and coating pipe, lowering-in pipe and backfilling, hydrostatic testing, right-of-way cleanup, and restoration. Pacific Connector anticipates construction would be divided into eight separate construction spreads, with each spread consisting of all construction activities necessary to construct the pipeline along that spread, as follows:

- Early Works MPs 0.00-7.34R;
- Spread 1 MPs 7.34R-29.54;
- Spread 2 MPs 29.54-51.58;
- Spread 3 MPs 51.58-71.37;
- Spread 4 MPs 71.37-94.75;
- Spread 5 MPs 94.75-132.52;
- Spread 6 MPs 132.52-162.40; and
- Spread 7 MPs 162.40-228.81.

GENERAL PIPELINE CONSTRUCTION SEQUENCE



1. Right-of-Way Survey
2. Clearing, Erosion Control Installation and Grading
3. Fencing
4. Centerline Survey of Ditch
5. Ditching (Rock-Free)
6. Ditching (Rock)
7. Padding Ditch Bottom
8. Stringing
9. Bending
10. Line Up, Stringer Bead and Hot Pass
11. Fill and Cap Weld
12. As-Built Footage
13. X-Ray and Weld Repair
14. Coating Field and Factory Welds
15. Inspection (Jeeping) and Repair of Coatings
16. Lowering and Tie-Ins
17. As-Built Survey
18. Pad and Backfill
19. Test and Final Tie-In
20. Replace Topsoil, Clean-Up and Revegetation

Figure 2.4-1

Typical Pipeline Construction Sequence

Surveying and Staking

Prior to the start of construction, the exterior limits of the approved construction right-of-way and boundaries of TEWAs would be civil surveyed and clearly staked and signed. Professional land surveyors licensed in the state of Oregon would perform all work and would hold a valid and current Certified Federal Surveyor certificate for federal land surveying and setting of monuments. All surveys would be performed in accordance with procedures found in the *Manual of Surveying Instructions* (U.S. Department of the Interior 2009), and all applicable state or county statutes, codes and regulations, and specifications of the County Surveyor. Pacific Connector's environmental inspectors (EIs) would verify the limits of the staked right-of-way and TEWAs, and would monitor the stakes throughout construction. Any pre-existing property line or survey monuments that occur within the construction right-of-way would be protected where possible, and if damage occurs during construction, these monuments would be replaced according to state and federal standards. Approved access roads would be signed. Also signed would be sensitive environmental areas that would be off-limits to construction crews.

Property line monuments or survey corners on BLM-managed and NFS lands would be reestablished according to federal standards if damaged during construction. Civil surveys on federal lands would adhere to guidelines established by the BLM, Forest Service, and Reclamation. Pacific Connector developed a *ROW Marking Plan* in consultation with the BLM and Forest Service as part of the POD (see Appendix T to the POD [appendix F.10 of this EIS]). This plan identifies the survey standards and types of survey markings that would be used on federally-managed lands.

Access to the Construction Right-of-Way

Equipment involved in pipeline construction would be moved onto the right-of-way using approved access roads and would then generally proceed down the right-of-way. The standard 95-foot-wide construction right-of-way would include a travel lane for construction equipment and vehicles. Pacific Connector would place mats over wetlands and bridges over waterbodies along the travel lane, in accordance with its *Plan* and *Procedures*, and install temporary erosion control devices in accordance with its ERCP. Pacific Connector has produced a TMP for federal lands as Appendix Y of its POD and also a TMP for non-federal lands.[43]

Clearing and Grading

The construction right-of-way and TEWAs would be cleared of brush and trees. Pacific Connector has produced a *Right-of-Way Clearing Plan for Federal Lands* as Appendix U of its POD. The general clearing procedures outlined in that plan would also apply to non-federal lands. During clearing existing fences crossed by the pipeline route would be cut and braced, and temporary gates installed to control livestock and limit public access to the right-of-way. Temporary erosion control devices would be installed at the end of clearing activities.

Hayfields, pastures, and grassy areas would not be cleared except in areas directly over the trench or where grading would be required to create a level working surface. Tall shrubs, such as sagebrush, would be mowed or scalped off with a motor-grader or a bulldozer. Cleared grasses

[43] Appendix F.8 in Resource Report 8 included as part of Pacific Connector's September 2017 application to the FERC.

and brush would be stockpiled along the edge of the right-of-way or within TEWAs or UCSAs, then mulched and spread back over disturbed areas during final cleanup and restoration.

In forested areas, timber would be cut and cleared from the right-of-way and TEWAs. Clearing would follow seasonal timing restrictions as discussed in section 4.5 of this EIS. Merchantable timber would be removed and/or sold according to landowner stipulations. In general, ground-based skidding and cable (where feasible) logging methods would likely be the standard method; however, in some isolated rugged topographic areas with poor access, helicopter logging may be used. See additional discussion in section 4.4 of this EIS.

Following clearing, the right-of-way would be graded where necessary to create a reasonably level working surface to allow safe passage and operation of construction equipment. During grading, topsoil would be separated from subsoils in certain areas, and each would be stored in segregated piles within the construction right-of-way and TEWAs. Where topsoil would be segregated on non-federal lands,[44] Pacific Connector has requested 10 additional feet of TEWA for topsoil storage in addition to its nominal 95-foot-wide construction right-of-way in uplands. On BLM-managed and NFS lands, Pacific Connector would segregate topsoil in all wetlands according to its *Procedures*. Pacific Connector may segregate topsoil in other areas as determined from the results of biological surveys for federal Survey and Manage species and Region 6 sensitive species including moss, lichen and fungi. Where these species are identified within the construction right-of-way, Pacific Connector would consult with the Forest Service to determine if topsoil segregation in these areas is a feasible and appropriate mitigation or management measure to reduce impacts on these species.

The *Prescribed Burning Plan* (see Appendix R to the POD [appendix F.10 of this EIS]) describes the protocols that Pacific Connector would follow to obtain appropriate agency authorization on all lands (federal, state, and private) crossed by the pipeline, where it is necessary to dispose of forest slash by burning. This plan also outlines the appropriate BMPs that would be utilized to safely conduct slash burning and disposal operations.

Trenching

A rotary trenching machine, rock trencher, track-mounted backhoe, or similar equipment would be used to excavate a trench for the pipeline. Spoil excavated during trenching would be temporarily stockpiled to one side of the right-of-way adjacent to the trench. The depth of the trench would vary according to site-specific conditions and USDOT requirements in 49 CFR 192.327, which specifies that the minimum depth of cover must be:

- 30 inches in normal soil and 18 inches in consolidated (solid) rock for Class 1 locations; and
- 36 inches in normal soil and 24 inches in consolidated rock for Class 2, 3, and 4 locations, and under drainage ditches, public roads, and railroad crossings.

Pacific Connector states that it would strive to exceed USDOT depth requirements where possible and bury its pipeline up to 36 inches deep in Class 1 areas with normal soils and 24 inches deep in

[44] For example, topsoil salvaging would occur in areas occupied by Applegate's milkvetch, Kincaid's lupine, and Gentner's fritillary, per the *Federally-listed Plant Conservation Plan* (see section 4.6).

Class 1 areas with consolidated rock. The trench may be deeper at stream crossings with scour concerns based on Pacific Connector's study of channel migration and scour analysis.

In areas where bedrock is found within the pipeline trench depth, Pacific Connector would first attempt to dig the trench with specialized equipment, such as rock saws, or ripping using hydraulic hammers. If these methods are ineffective, blasting may be necessary to achieve the required trench depth. Pacific Connector has identified a high potential for blasting for about 100 miles of the proposed pipeline route. All blasting would be done by licensed contractors under the terms of applicable regulatory requirements. Pacific Connector produced a *Blasting Plan* as Appendix C of its POD (appendix F.10 of this EIS). Blasting is further discussed in section 4.1 of this EIS.

Stringing, Bending, and Welding

After trenching, pipe sections would be trucked to the right-of-way and strung along the route, using side-boom tractors to unload the pipe from the flatbed trucks. A hydraulic bending machine would bend some pipe sections to fit the contour of the trench bottom, and in some locations pipe sections would be factory bent, or special pre-fabricated pieces would be used. A separate, trained crew of welders would weld the pipe sections together and place them on wooden skids adjacent to the trench. All welds would be visually inspected, nondestructively tested (using radiographic or equivalent methods), and repaired, if necessary. Line pipe, normally mill-coated prior to stringing, would require field applied coating at the welded joints prior to final inspection and the entire pipeline coating would then be inspected and repaired as needed.

Lowering-in and Backfilling

After welding and coating, the pipe would be lowered into the trench by side-boom tractors and excavators, after first inspecting the trench to ensure it is free of rocks or debris that could damage the pipe or the coating, and after adding padding such as sandbags at the bottom of the trench. To prevent water from the trench from entering wetlands or waterbodies, Pacific Connector would install permanent trench plugs, consisting of sandbags, foam, or bentonite, at the base of slopes adjacent to wetlands and waterbodies. Drain tiles crossed by the pipeline would be checked, and if damaged, they would be repaired before backfilling. Segregated topsoil, where applicable, would be replaced after backfilling the trench with subsoil. Following backfilling, a small crown of material would be left over the trench line to account for any future soil settling that might occur.

Hydrostatic Testing

After backfilling, the pipeline would be hydrostatically tested in accordance with USDOT regulations to ensure that is capable of operating at the MAOP. During the test, sections of the pipeline would be filled with water and pressurized. Should a leak or break occur during testing, the line would be repaired and retested until the specifications are achieved. Pacific Connector produced a *Hydrostatic Test Plan* as Appendix M of its POD (appendix F.10 of this EIS), which provides the location of the proposed hydrostatic test water withdrawal locations.

The pipeline would be tested in approximately 35 sections, each with varying lengths and water volume requirements. Pacific Connector would reuse test water from one section to the next as much as practical and reduce release between test sections (called cascading). The required volume of test water would range between approximately 26 to 65 million gallons depending on how much water would be reused by cascading. Water for hydrostatic testing would be obtained from commercial or municipal sources or from surface water right owners. If water for hydrostatic testing is acquired from surface water sources, Pacific Connector would obtain all necessary appropriations and withdrawal permits prior to construction, including permits through the OWRD. As part of this process, ODEQ and ODFW would review OWRD applications reviewed to evaluate potential impact on water quality and fish and wildlife and their habitats. Pacific Connector would negotiate water appropriations with private owners in the year prior to construction. There are no proposed discharge sites on NFS lands. There are two water release sites on BLM lands at approximate MP 141 and 151 that would be within the right-of-way (see Appendix M, *Hydrostatic Test Plan,* in the POD [appendix F.10 of this EIS] for additional information).

Pumps used to withdraw surface water would be screened according to ODFW and NMFS standards to prevent entrainment of aquatic species. In addition, Pacific Connector included BMPs in its *Hydrostatic Test Plan* to avoid the potential spread of aquatic invasive species and pathogens of concern. BMPs were developed in consultation with the BLM, Forest Service, the Center for Lakes and Reservoirs and Aquatic Bioinvasion Research and Policy Institute, and ODEQ. There are no proposed water withdraws for hydrostatic testing on federal lands.

Following testing the hydrostatic test water would be released from the pipeline test sections, potentially at each of the 35 test section breaks, or at fewer sites if cascading of water between test sections is used. Hydrostatic test water would be discharged in upland areas into erosion control devises typically constructed of hale bales and silt fence, in accordance with Pacific Connector's ECRP and the POD. Water discharged during testing would not be used to fill existing or proposed fire suppression sources (e.g., heli-ponds). Pacific Connector would apply for permission from the ODEQ prior to discharge of hydrostatic test water. Additional discussion of hydrostatic testing discharges can be found in section 4.3 of this EIS.

Dust Control

Fugitive dust[45] may be created by pipeline construction activities. To control dust, Pacific Connector would use water trucks to spray the right-of-way. Water for dust control would be obtained from multiple sources (assuming most would be commercial or municipal sources), and all appropriate approvals and/or permits would need to be obtained prior to withdrawal. Pacific Connector produced an *Air, Noise, and Fugitive Dust Control Plan* as Appendix B to its POD. See additional discussion of dust control measures in sections 4.3 and 4.12 of this EIS.

Cleanup and Permanent Erosion Control

After the pipeline is installed and the trench is backfilled, Pacific Connector would complete final grading, returning the right-of-way to its approximate original contours or to a stable contour in areas of steep slope. Fences, gates, drainage ditches, culverts, and other structures that may have been temporarily removed or damaged during construction would be permanently repaired, returned to their pre-construction condition, or replaced. All construction debris, including excess rock, would be removed from the right-of-way and placed in authorized disposal locations. On federal lands, site-specific crossing restoration plans would be implemented for perennial stream

[45] Fugitive dust consists of small particles of dust suspended in the air, which are an inadvertent by-product of construction or other project-related activities.

crossings. The right-of-way would be mulched, seeded, and revegetated in accordance with Pacific Connector's ECRP. Erosion control fabric would be used on streambanks.

Pacific Connector would install permanent erosion control devices consistent with the requirements of Section V.B. of FERC's *Plan* and as described in its ECRP. The permanent erosion control measures include trench breakers, slope breakers, and revegetation to stabilize disturbed areas. Pacific Connector would consult with the BLM, Forest Service, and Reclamation regarding the installation of permanent erosion control structures on federal lands, and with the NRCS regarding such structures on non-federal lands. Table 2.4.2.1-1 lists specifics from Pacific Connector's ECRP for the installation of slope breakers.

TABLE 2.4.2.1-1

Permanent Slope Breaker Spacing from Pacific Connector's ECRP a/

Slope	Highly Erosive Granitic Soils b/	Soils with Moderate or Low Potential for Erosion
0 to 5 percent	None required	None required
5 to 15 percent	100 feet	200 to 300 feet
15 to 30 percent	50 to 75 feet	75 to 100 feet
Greater than 30 percent	50 feet	50 feet

a/ Actual spacing would be determined at the time of installation based on site-specific topographic conditions on the ROW to ensure proper slope breaker construction and proper drainage to stable off-site areas. On the Umpqua National Forest between about MPs 109 and 110, where the alignment would cross the historic Thomason cinnabar claim group, waterbars would be installed at 50-foot intervals as recommended by the Forest Service.

b/ Granitic formations would be crossed by the pipeline between: MPs 87.43 to 87.69; MPs 88.35 to 88.82; MPs 95.28 to 95.52; MPs 96.96 to 100.42; MPs 100.46 to 101.16; MPs 102.99 to 103.19; and 103.30 to 103.69

Revegetation

All areas disturbed by construction, including the construction right-of-way, TEWAs, UCSAs, and contractor yards as necessary, would be restored and revegetated in accordance with Pacific Connector's ECRP. A seedbed would be established to a depth of up to four inches where necessary. Consistent with the FERC's *Plan*, if final grading occurs more than 20 days after pipe installation and backfilling, Pacific Connector would apply mulch on all disturbed areas prior to seeding. Based on recommendations provided to Pacific Connector by the Oregon State University Extension Service related to the fertilization rates for nitrogen fertilizer on new pasture seedlings, Pacific Connector would use a standard fertilization rate of 200 pounds per acre bulk triple-16 fertilizer on disturbed areas to be seeded. The Natural Resources Conservation Service (NRCS) did not recommend the addition of lime or other soil pH modifiers. Fertilizer would not be used in wetlands unless required by the land-managing agencies and would not be applied within at least 100 feet of flowing streams that have domestic use or support fisheries and would not be applied during heavy rains or high wind conditions.

It is expected that seeding would be timed to begin in August and could extend into the winter months at lower elevations. Disturbed areas would be seeded within six working days of final grading, weather and soil conditions permitting. Seeding may be done by broadcast methods, drilling, or hydroseeding. Broadcast seeding, using a mechanical broadcaster seeder, is the preferred method of seeding on steep slopes. After broadcast, the seedbed would be lightly dragged by chains or other appropriate harrows to cover the seeds thinly with soil. A drill seeder pulled by a plow may be used as an alternative to broadcast seeding in gently sloping areas. Hydroseeding would be done in accessible upland areas. Seed mixtures were determined in consultations with land-managing agencies and the NRCS. The seed mixtures are listed in Pacific Connector's ECRP and are further discussed in section 4.4 of this EIS. During right-of-way easement negotiations, private landowners may select their own seed mixtures other than those proposed for elsewhere along the pipeline route. The seed mixtures on BLM land were developed based on BLM Instruction Memo-2001-014, which specifies the use of native species, if possible. The POD has additional requirements for revegetation on federal lands.

Mulch would be applied on slopes were necessary to stabilize the right-of-way after seeding. Mulch would consist of native wood, certified weed-free straw, or hydromulch. The BLM and Forest Service have established ground cover standards and fuel loading requirements that are further discussed in section 4.4 of this EIS.

In forested lands, Pacific Connector would replant vegetation according to state and federal reforestation requirements. Reforestation efforts would occur in any given area the first winter/spring (between December and April) after the pipeline is installed in that area. On all forest lands crossed by the pipeline, trees would be replanted across the construction right-of-way up to 15 feet from either side of the pipeline centerline. In riparian areas, shrubs and trees would be replanted across the right-of-way for a width of 25 feet from the waterbody bank. Within Riparian Reserves, Pacific Connector would replant shrubs and trees to within 100 feet of the ordinary high-water mark (OHWM). A list of species to be replanted is included in Pacific Connector's ECRP, and revegetation is further discussed in section 4.4 of this EIS.

2.4.2.2 Special Pipeline Construction Techniques

Construction in rugged topography; across wetlands and waterbodies; through agricultural, residential, commercial, and industrial areas; at road and railroad crossings; and across existing buried pipelines and other utilities may require special construction techniques. These techniques are described below.

Rugged Topography

The Pacific Connector pipeline route would cross several mountain ranges, with steep and rugged topography (e.g., along the Coast Range and foothills between MPs 6.53R to 69.00, as well as between MPs 70 and 127.00). Through those mountains, the pipeline route would follow ridgelines, where feasible, to reduce the amount of cut and fill, and to avoid steep slopes, geologic hazards, and waterbody crossings, and to reduce erosion potential. In areas of steep slopes, two-tone construction techniques may be necessary, creating two step-wise level surfaces within the construction right-of-way (see Drawing #3430.34-X-0019 in Attachment C of Pacific Connector's ECRP, included with Resource Report 1 filed with Pacific Connector's application to the FERC). In addition, Pacific Connector's *Geological Hazards and Mineral Resources Report* identified geological hazards along the pipeline route. Site-specific mitigation measures for the crossing of some of these hazards are discussed in more detail in section 4.1.

During construction through rugged topography, Pacific Connector would consider the following factors:

- Identify adequate work areas to safely construct the pipeline.
- Provide a safe working grade.
- Utilize appropriate construction techniques for site-specific situations.

- Construct during the dry season as much as possible.
- Install temporary erosion control devices during construction.
- Install trench breakers, as appropriate, on slopes and near waterbody and road crossings.
- Backfill the trench immediately after pipe installation.
- Install permanent erosion controls soon after completing rough grading.
- Revegetate slopes with quick germinating seed mixtures.
- Mulch or install erosion control fabric on slopes, as necessary.
- Monitor and maintain the right-of-way as necessary to ensure stability.

Additionally, Pacific Connector's ECRP outlines procedures for fill on slopes exceeding a gradient of 3H:1V, including fill materials, slope preparation, and fill placement and compaction. The POD includes additional factors that would be considered on federal lands.

Waterbody Crossings

Construction of the Pacific Connector pipeline would affect approximately 352 waterbodies.[46] Waterbodies would be crossed in accordance with the FERC's *Procedures* and applicable permits or approvals from other agencies. Pacific Connector filed a *Wetland and Waterbody Crossing Plan* as Appendix BB of its POD (in appendix F.10 of this EIS). Crossings of perennial streams on NFS lands would be subject to site-specific plans that include construction restoration and monitoring requirements to ensure consistency with the Aquatic Conservation Strategy, and on BLM lands would be subject to the requirements of the BLM's 2016 RMPs. A more detailed discussion of impacts on waterbodies is provided in section 4.3 of this EIS.

TEWAs would be located more than 50 feet away from the edge of waterbodies where possible, and Pacific Connector has identified locations where site-specific conditions or other constraints prevent a 50-foot setback (see appendix E). Hazardous materials, chemicals, fuels, and oils would be stored at least 100 feet from the edge of waterbodies and wetlands (150 feet on federal lands).

Construction equipment would cross waterbodies on temporary bridges. The bridges would be designed to span the entire OHWM of the waterbody, wherever possible. Soil would not be used to stabilize bridges. In order to construct the temporary bridges, waterbody crossings may require one machinery pass through the waterbody without isolation measures in place to construct temporary equipment bridges. On BLM and NFS lands, all streams, whether wet or dry, would be crossed with (1) a bridge, (2) a temporary culvert, or (3) a low water ford with a rock mat.

All waterbodies would be crossed during the in-water work window recommended by the ODFW, or within an approved in-water work window developed through consultation with the ODFW, NMFS, COE, and FERC. Pacific Connector would attempt to cross intermittent streams and irrigation canals and ditches when they are dry, using standard upland cross-country construction methods. The standard depth of cover would be five feet below channel bottom of intermittent streams and ditches.

[46] This value does not include the wetlands that would be affected by the Project.

Pacific Connector would use the following methods to cross waterbodies with flowing water at the time of construction: diverted open cut, dry open cut, conventional bore, HDD, or Direct Pipe® (DP) technique. These are briefly described below.

Wet Open-Cut Crossing

No wet open-cut crossings are currently proposed for this Project. However, an open-cut crossing method may be required if all other crossing methods are attempted and fail. If an open cut crossing method is required, then additional permitting and impact analysis may be required before the applicable agencies could allow the crossing to occur. A wet open-cut crossing method involves excavation of the pipeline trench across the waterbody with a backhoe-type excavator while water is still present in a waterbody. The excavators operate from one or both banks of the waterbody. Spoil excavated from the trench is placed above the OHWM for use as backfill, with the top 12 inches being segregated for use as the top layer of backfill. The pipe segment needs to be weighted, as necessary, to provide negative buoyancy prior to installation. Once the pipe is installed and the trench backfilled, the banks and stream bottom are restored to pre-construction contours and stabilized. However, as indicated above, this crossing method is not currently proposed, and would only be implemented if all other crossing methods (described below) fail, and may require additional analysis and permitting requirements.

Diverted Open Cut Crossing

Pacific Connector would use a diverted open cut for the eastern (second) crossing of the South Umpqua River at about MP 94.7. The river at this location is too wide for a typical dry crossing using either dam and pump or flume methods, and geotechnical studies indicate that subsurface conditions are not suitable for an HDD or conventional boring. At the proposed crossing location, the South Umpqua River channel is sufficiently flat, wide (175 feet bank to bank), and shallow (varying from a few inches to 15 feet deep), with flow slow enough to allow water to be diverted to one side while work is conducted on the opposite bank. Pacific Connector developed a site-specific plan for the eastern crossing of the South Umpqua River at MP 94.7.[47]

Dry Open Cut

Flume

The flume method would be used to cross streams less than 100 feet across. Water would be directed across the work area through one or more flume pipes. Sandbag and plastic sheeting would be used to support and seal the ends of the flume and to direct stream flow into the flume and over the construction area. Temporary dams at both the upstream (inlet) and downstream (outlet) sections of the flume would contain stream channel disturbance. After fish are salvaged from the confined area between the dams, water would be pumped out, through an upland dewatering structure, to create a dry work area for pipeline installation. Spoil from trenching would be stored in TEWAs located at least 10 feet away from the stream banks; with piles surrounded by silt fence. In-stream work (trenching, pipeline installation, and backfilling) would be conducted while the flume is in place, and the flume would be removed immediately after backfilling and bottom recontouring is completed. Details about stream fluming procedures were attached to the application filed with the FERC.[48]

[47] See Appendix E.2 in Resource Report 2 as part of Pacific Connector's September 2017 application to the FERC.

[48] See Appendix C.2 in Resource Report 2 as part of Pacific Connector's September 2017 application to the FERC.

Dam-and-Pump

The dam-and-pump method is an alternative dry construction technique that can be used to cross small or intermediate width waterbodies that are classified as coldwater fisheries. This method is preferred where the stream bottom is bedrock, and blasting may be necessary during trench excavation. Two temporary in-stream dams would be installed, with sandbags with plastic liner or other structures such as steel plates or water bladders. Stream flow would be diverted around the work area by pumping water through hoses. Intakes would be screened to prevent the entrainment of aquatic species. An energy-dissipation device would be used to prevent scouring of the streambed at the downstream discharge location. The area between the dams would be dewatered, and the trench then excavated. Spoil would be stored in TEWAs located at least 10 feet from the banks; surrounded by silt fence. After pipeline installation and backfilling the dams would be removed and stream banks restored and stabilized. Pacific Connector would cross streams using the dam and pump method during the ODFW recommended in-water work windows. Details about dam and pump procedures were attached to the application filed with the FERC.[49]

<u>Conventional Bore</u>

Pacific Connector proposes to use conventional bore methods to cross under the Medford Aqueduct at MP 133.4, and all Reclamation water conveyance facilities (canals, laterals, and drains) associated with the Klamath Project. During a standard boring operation, pits are excavated on both ends of the bore, and the pipe fabricated and installed horizontally from one pit to the other beneath the feature being crossed. The walls of the bore pits may be supported by trench boxes or metal sheet piling. If groundwater seeps in to the bore or bore pits, a dewatering system would need to be used.

When crossing irrigation canals associated with Reclamation's Klamath Project, Pacific Connector committed to complying with Reclamation's Engineering and O&M Guidelines for Crossings – Bureau of Reclamation Water Conveyance Facilities (Canals, Pipelines, and Similar Facilities) unless otherwise described in the *Klamath Project Facilities Crossing Plan* (Appendix O of its POD [appendix F.10 of this EIS]). All crossings would require Professional Engineer–stamped design drawings approved by Reclamation prior to installation.

<u>Horizontal Directional Drilling</u>

Pacific Connector proposes to use the HDD method to cross under the Coos Bay Estuary (MPs 0.3–1.0 and 1.5–3.0) and three major waterbodies (Coos River at MP 11.1R; Rogue River at MP 122.7; and Klamath River at MP 199.4). This method involves drilling a pilot hole under the feature being crossed, then enlarging that hole through successive reaming until large enough to install the pipeline. High-pressure drilling fluids, usually consisting of a slurry made of bentonite clay mixed with water, would be used during drilling operations. As necessary, fluid additives may be incorporated into the slurry to facilitate and/or improve drilling operations. The drilling fluid is circulated downhole through the drill pipe and back to the drill entry point along annular space between the outside of the drill pipe and the drilled hole. The primary purpose of the drilling fluids is to remove the drill cuttings, and advance and stabilize the drilled hole. Pipe sections long enough to span the entire crossing would be staged and welded along the construction work area on the opposite side of the waterbody, hydrostatically tested, and then pulled through the drilled

[49] See Appendix D.2 in Resource Report 2 as part of Pacific Connector's September 2017 application to the FERC.

hole. Upon completion of HDDs, the drilling mud returns would be hauled off-site and disposed of at an approved disposal facility in accordance with all applicable federal and state regulations. The right-of-way between the entry and exit hole of an HDD would generally not need to be cleared or graded, except for the area of the guide wires, and direct impacts on the waterbody and adjacent riparian vegetation would be avoided.

Pacific Connector prepared an HDD feasibility analysis and hydraulic fracture[50] and drilling fluid release analyses for each of the HDD crossings based on the results of site-specific subsurface exploration borings drilled along each of the crossings. The results of these studies showed the crossings to be technically feasible with minimal chance for hydraulic fracture and subsequent inadvertent return of drilling fluids into the waterbody.[51,52] Loss of drilling fluids would be monitored in accordance with Pacific Connector's HDD plan, discussed below.

Coos Bay Estuary Crossing

The feasibility assessment for the HDDs under the Coos Bay estuary recommended that the drill should be completed in two sections (Coos Bay west and Coos Bay east) with a total length to cross the waters of Coos Bay and navigational channels of about 11,921feet. These HDDs would have a maximum drill profile elevation in Coos Bay west of -100 feet (86 to 58 feet below the bottom of the tidal estuary and navigation channel, respectively), and in Coos Bay east a drill profile elevation of -200 feet (60 to 160 feet below the navigation channel and 200 feet below the tidal estuary). The Coos Bay west HDD design is 5,137 feet long as measured along the HDD centerline. The alignment crosses a federal navigation channel and beneath the span of a railroad trestle bridge within Coos Bay. The Coos Bay west HDD alignment is horizontally offset approximately 15 feet southeast of the nearest pier foundation associated with the railroad trestle bridge, 49 feet lower in elevation than the as-built pier depth, and 58 feet below the deepest part of the navigation channel. The subsurface conditions anticipated along the Coos Bay west drill profile include very loose sand to depths of about 30 feet underlain by dense to very dense sand.

The design horizontal length of the Coos Bay east crossing is 8,970 feet. Due to the substantial length of the Coos Bay east HDD, pilot hole intersect methods would be necessary to complete the crossing, and as such there would be an east side drill entry point and west side drill entry point. The Coos Bay west HDD alignment extends eastward from North Point in North Bend, crosses the Coos Bay navigation channel, and terminates at the mouth of Kentuck Slough east of East Bay Road. Subsurface exploration borings drilled along the alignment encountered loose to very dense sands overlying siltstone bedrock. The bottom of the drill profile would be at an elevation of -200 feet, with the intent that the bottom tangent and horizontal curve would be maintained within bedrock at that depth, and with a 71-foot minimum depth of cover below the Federal Navigation Channel. The hydraulic fracture and drilling fluid return analysis showed that the potential for a release is high within approximately 520 feet of the east side entry point for the drill; however, because the drill path enters the sand below depths of 90 feet, the risk of hydraulic drilling fluid surface release becomes relatively low for the remainder of the bay crossing. In order

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[50] Hydraulic fracture is a term typically used to describe the condition in which the downhole drilling fluid pressure exceeds the overburden pressure and shear strength of the soil surrounding a drill path.

[51] Attached as Appendix G.2 of Resource Report 2 as part of Pacific Connector's 2017 application to the FERC.

[52] COE Section 408, 90% Design Review, for the Jordan Cove LNG Project Attachment G: Coos Bay HDD Feasibility Evaluation and Plans; Revised Horizontal Directional Drilling Feasibility Evaluation. Pacific Connector Gas Pipeline Project Coos Bay *For* Pacific Connector Gas Pipeline, LP April 12, 2019.

to mitigate for a release of drilling fluids, large-diameter temporary surface casing would be installed at the east side entry.

Coos River

The horizontal alignment for the Coos River HDD crossing would be about 1,600 feet long (516 feet across the waterbody) with a bottom elevation of -65 feet NAVD 88 (a depth of approximately 57 feet below the river bottom). The north bank of the Coos River is approximately 500 feet south of the entry point and the south bank is approximately 630 feet north of the exit point. Subsurface exploration borings drilled along the alignment encountered clay with organic matter, organic clay, and clayey sand overlying siltstone in the borings to the north of Coos River, and interbedded silt, silty sand, sand with silt, and fat clay in the borings completed on the south side of the river. The hydraulic fracture analysis showed that there is a relatively high risk of hydraulic fracture and drilling fluid surface releases along the first 500 feet and last 300 feet of the HDD, and a low risk of hydraulic fracture and drilling fluid release when the drill passes beneath Coos River.

Rogue River

The HDD crossing of the Rogue River would be about 3,050 feet long (143 feet across the waterbody) with a bottom elevation of 1,350 feet MSL (depth of 76 feet bs) along the upland area on the northwest (exit) side of the drill alignment, and 56 feet below the bottom of the Rouge River. Subsurface exploration borings drilled along the alignment encountered within the upland areas hard lean clay, medium dense sand and very dense gravel (colluvium) and weathered bedrock overlying bedrock consisting of sandstone, claystone, volcanic breccia and basalt. A few volcanic ash layers were encountered interbedded with the breccia. Exploration borings completed in the valley floor segment of the alignment southeast of the Rogue River encountered very dense gravel alluvium (river deposits) overlying fractured basalt and volcanic breccia. A qualitative analysis of drilling fluid loss in the volcanic bedrock material, based on rock quality designation (RQD)[53] values obtained from bedrock cores show that formational fluid loss could occur when drilling through the shallow (upper 2-foot) intervals of the volcanic bedrock; however, below a depth of 29 feet, bedrock RQD values ranged between 60 and 100 percent (fair to excellent) except for isolated zones between 2 to 4 feet in thickness where the RQD values ranged from 0 to 47 percent (very poor to poor). The low RQD intervals could also present a moderate risk for localized hole instability along the HDD profile. Overall there is a low risk of drilling fluid surface release along the proposed HDD profile, except within about 50 to 100 feet of the entry and exit points where the HDD profile passes through alluvial and colluvial soils, and the cover between the HDD profile and the ground surface is relatively thin.

Klamath River

The HDD crossing of the Klamath River would be about 2,300 feet long (973 feet across the waterbody) with a depth of 70 to 140 feet bgs below the Klamath River (elevation of 4,000 to 3,940 feet MSL). Eight exploration borings were drilled to depths ranging between 91.5 feet bgs and 165.1 feet bgs along the drill alignment. Based on subsurface conditions encountered in the borings and the HDD design, the proposed HDD profile (from entry to exit) passes through stiff

[53] RQD is a modified core recovery in which all the core piece length of 4 inches and greater are summed and divided by the length of the core run. It is simply a measurement of good rock recovered from the core hole. Problematic rock that is highly weather, fractured, sheared and jointed is counted against the rock mass. Description of rock quality based on RQD percentages are: 0 to 25 percent very poor; 25 to 50 percent poor; 50 to 75 percent fair; 75 to 90 percent good; and 90 to 100 percent excellent (Deere and Deere 1988).

to very stiff elastic silt, stiff silt, sandstone, and siltstone. The borings completed on the west side of the river encountered about 15 feet of silt, sand and peat overlying sandstone bedrock; borings completed in the river encountered between approximately 90 to 110 feet of elastic silt overlying weathered siltstone bedrock; and borings completed on the east side of the river encountered elastic silt. The HDD profile was designed to be within the sandstone/siltstone bedrock under the river in order to reduce the risk of drilling fluid releases to the river during HDD operations. The hydraulic fracture analysis indicates a moderate to high risk of hydraulic fracture and drilling fluid surface releases while the HDD profile is within the stiff silt alluvium, and a low risk of hydraulic fracture and drilling fluid releases within bedrock. The analysis showed that risk increases to high within 250 feet of the exit point as the drill profile emerges from the bedrock and is located with variable overburden soils including peat. All segments of the drill exhibiting a high risk of release are within terrestrial environments and the river crossing segment exhibits a low risk of release.

Pacific Connector prepared a Project-specific *Drilling Fluid Contingency Plan for Horizontal Directional Drilling Operations* to mitigate for an unanticipated release of drilling fluids.[54] Drilling fluid surface releases (inadvertent returns) can be prevented through proper drilling procedures. For all HDD crossings, Pacific Connector would utilize a down-hole annular pressure monitoring tool during the initial drilling of the pilot hole when drill pressures would be at their greatest and the highest potential for hydraulic fracture is possible. During all phases of drilling, Pacific Connector would execute the following operational elements in order to reduce the potential for inadvertent returns:

- maintaining adequate pump volumes;
- monitoring and maintaining ideal drilling fluid properties; and
- maintaining appropriate penetration rates to maintain proper drilling fluid circulation.

If a drilling fluid surface release occurs, the HDD operation would be stopped temporarily to determine an appropriate response plan. Pacific Connector would attempt to determine the cause of the hydraulic fracture and drilling fluid surface release and would implement procedures which may control the factors causing the hydraulic fracture and/or drilling fluid release in order to reduce the chance of recurrence. A combination of measures may be utilized to control or correct drilling fluid surface releases and would include:

- increasing the drilling fluid viscosity in an attempt at sealing the point at which fluid is lost;
- utilizing downhole lost circulation materials (LCM);
- installation of temporary steel casing to provide a conduit for drilling fluids; and
- installation of a downhole grout mixture to seal fractured zones.

Direct Pipe Technology

DP technology is a trenchless construction method that can be used to install pipelines underneath rivers or roads without surface impacts. It is a combination of a micro-tunneling process and HDD. DPs are completed using an articulated, steerable micro-tunnel boring machine (MTBM) mounted on the leading end of the pipe or casing. Bentonite slurry is used to increase lubrication and advance the MTBM. The pipeline is pre-fabricated and welded in sections to the back of

[54] Attached as Appendix H.2 to Resource Report 2 as part of Pacific Connector's 2017 application to the FERC.

subsequent sections as the MTBM advances. Because the product pipe is attached to and advances with the MTBM like microtunneling, it benefits from a continuously supported hole during the drilling process, and allows for the product pipe to be installed in varying formations such as gravel and cobbles. Additionally, the bentonite lubrication system used to lubricate the annulus between the product pipe and the excavation is introduced at a relatively low pressure, reducing the potential for hydraulic fracture and inadvertent drilling fluid returns. Because the drilled hole is continuously supported and the risk of hydraulic fracture is low, the DP alignment can be designed much shallower than is typical for an HDD. Pacific Connector proposes to use DP technology to install its pipeline under the western crossing of the South Umpqua River at about MP 71.3 and the associated crossings under I-5, Dole Road, and the Central Oregon & Pacific Railroad. The South Umpqua River DP crossing would be about 1,680 feet long (200 feet across the waterbody), with a maximum depth along the alignment of 90 feet bgs, and a depth of 20 to 30 feet below the bottom of the river. Subsurface conditions at the site were evaluated by drilling two borings to depths of 60 feet bgs and 80 feet bgs. In general, the borings encountered about 25 feet of clay, sand, and gravel overlying siltstone and mudstone bedrock that was generally soft to medium hard, very closely fractured and ranged from slightly weathered to partially decomposed. DP installation was selected at the South Umpqua River crossing due to highly fractured bedrock conditions encountered, and the associated potential for substantial loss of drilling fluids and hole instability with utilizing HDD construction.

Wetland Crossings

Pacific Connector would construct the pipeline across wetlands in accordance with the FERC's *Procedures*. The construction right-of-way through wetlands would be limited to a 75-foot width or less, where possible, and TEWAs would be located at least 50 feet away from wetlands, except where topographic constraints prevent this. Grading and stump removal in wetlands would only occur over the trench. Silt fence and straw bales would be installed at the edges of the construction right-of-way through wetlands. Trench plugs would be put in where the pipeline enters and exits wetlands. In saturated wetlands, Pacific Connector may use low ground weight equipment operating off pre-fabricated wooden mats. Pipe stringing in saturated wetlands may be done next to the trench or in adjacent TEWAs. If the wetland is flooded, Pacific Connector may use "push-pull" or "float" techniques. Pipeline installation through wetlands is further discussed in section 4.3 of this EIS.

Agricultural and Residential Areas

The FERC's *Plan* requires topsoil segregation in all residential areas, cultivated or rotated agricultural lands, pasture, and hayfields, or where requested by landowners. In these areas, topsoil would be stripped and segregated from either the full construction right-of-way, or over the trench line and subsoil storage area. Pacific Connector identified areas, in addition to most wetlands, where it intends to salvage and segregate topsoil along the pipeline route (see table D-4 in appendix D). Where topsoil segregation is proposed, Pacific Connector has requested 10 feet of TEWA in addition to the 95-foot construction right-of-way to stockpile segregated soils. Agricultural lands are further discussed in section 4.2 of this EIS and residential lands in section 4.7.

Another requirement of the FERC's *Plan* is that excess rock should be removed from at least the top foot of soil in all actively cultivated or rotated cropland, pasture, hayfields, and agricultural lands. Pacific Connector would use rock pickers where necessary to remove excess rocks from these areas during cleanup. Rocks would be removed consistent with the size, density, and distribution in areas adjacent to the right-of-way. Excess rock would be disposed of in existing rock quarries and permanent disposal sites (see table D-7 in appendix D). Pacific Connector also attached an *Overburden and Excess Material Disposal Plan* as Appendix Q to its POD (appendix F.10 of this EIS).

The FERC's *Plan* requires that soils in agricultural and residential areas be tested for compaction after construction, and any compaction should be alleviated. According to Pacific Connector's ECRP, during restoration activities soil compaction would be relieved by regrading and scarifying. This may include ripping and chisel plowing up to 18 inches deep.

Pacific Connector would work with individual landowners in agricultural areas to determine how the right-of-way would be restored where the pipeline would cross cropland, orchards, nurseries, or vineyards. If requested by the landowner, the landowner would restore the agricultural land and Pacific Connector would compensate the landowner. In residential areas, Pacific Connector would restore disturbed lawns, ornamental shrubs, gardens, and other landscape features in accordance with their agreement with the landowner. A contractor familiar with local horticultural or landscape practices would do the restoration work in residential areas, or Pacific Connector may choose to compensate a landowner to restore their property.

Pacific Connector has developed site-specific construction mitigation plans for residences within 25 feet of work areas. Some of the typical measures to be taken in residential areas include notification of landowners, limiting hours of construction, dust control, maintaining access, fencing, reducing the width of the right-of-way to increase the buffer to the pipeline, and replacing landscaping (see section 4.7 of this EIS).

Road, Railroad, Pacific Crest Trail, and Utility Crossings

The Pacific Connector pipeline would include multiple road and railroad crossings. Conventional bores are typically used to cross under railroads, with DP and HDD technology proposed for one crossing each (see table D-2 in appendix D). Roads would either be bored or open cut. At least five feet of cover would be maintained over pipeline crossings of paved county, city, and state roads, as well as railroad crossings. A conventional bore would also be used to cross the Pacific Crest Trail (PCT).

Pacific Connector would obtain all necessary permits from applicable county, state, or federal land-managing agencies for public roads to be crossed, and permission to cross private roads from the landowners. Pacific Connector produced a TMP for federal lands (as Appendix Y to the POD [appendix F.10 of this EIS]) and a TMP for non-federal lands.[55] Transportation management is discussed in more detail in section 4.10 of this EIS.

Pacific Connector would endeavor to notify agencies and private landowners at least seven days in advance of any road work or closures caused by pipeline construction activities. During an open cut crossing, Pacific Connector would try to keep one lane of the road open for traffic, with detours around construction, plating over the open trench, or other methods. However, in some situations the road may have to be closed for a day when the pipeline would be installed across it. Where

[55] Attached as Appendix F.8 in Resource Report 8 as part of Pacific Connector's September 2017 application to the FERC.

road closures occur, Pacific Connector would provide access around the construction site for local residents and emergency vehicles. Advanced signage would be used to provide notice of construction activities. In addition, Pacific Connector would utilize traffic control measures, such as signs, lights, barriers, and flaggers to ensure public safety and provide for efficient movement of traffic through or around the construction area, and to protect workers.

The Pacific Connector Pipeline would cross numerous existing utilities, including other pipelines, powerlines, and cables. Prior to construction, Pacific Connector would contact the local "One Call" or "Call Before You Dig" system to determine the location of utilities to be crossed and these utility crossings would then be marked in the field during pre-construction surveys. Pacific Connector would coordinate with each utility owner/operator to design crossings. In most instances, the new pipeline would have to be installed beneath the existing buried utility to maintain the necessary depth of cover.

2.4.2.3 Aboveground Facility Construction

Aboveground sites would be cleared and graded as applicable to accommodate the planned facilities. Excavation would be performed as necessary to accommodate the new reinforced concrete foundations for meter and compressor station equipment. The meter and compressor station equipment would be shipped to the site by truck. All components in high-pressure natural gas service would be strength tested prior to placing in service. Before being placed in service, all controls and safety equipment and systems would be checked and tested. MLVs would be installed within Pacific Connector's operational easement. The installation of the MLVs would meet the same standards and requirements established for pipeline construction.

2.5 CONSTRUCTION SCHEDULE AND WORKFORCE

The date for the start of construction would depend on completion of all required environmental and safety reviews and receipt of all necessary permits, approvals, and Commission authorization. Jordan Cove states that construction of the LNG terminal and slip we be expected to take five years. All in-water work for the terminal, including placement of material for the MOF, dredging, and work required to remove the berm separating the slip and the access channel would occur during an in-water work window between October 1 and February 15. Jordan Cove estimates that the construction workforce would average about 1,020 workers with a peak of about 2,000 workers occurring in year 3 of construction.

Pacific Connector states that construction and restoration of the pipeline and associated facilities would take place over the course of five years. Early works, including the two HDD crossings of Coos Bay, would begin in year one. Some forest clearing along the pipeline would beginning during year 2. Mainline pipeline and aboveground facility construction would take place during years 3 and 4, with the pipeline being placed into service by about the middle of year 4. Right-of-way restoration would begin during year 4 and continue into year 5. The total workforce during construction of the pipeline and associated facilities is estimated to range between about 88 and 4,242 workers, with an average of about 886 workers, with the peak occurring during summer and fall of year 1 of mainline construction (see section 4.9).

2.6 ENVIRONMENTAL INSPECTION, AND COMPLIANCE MONITORING

2.6.1 Jordan Cove Environmental Inspection Program

During construction, Jordan Cove and Pacific Connector would provide contractors with all Project design documents, including environmental alignment sheets, and copies of all applicable federal, state, and local permits. Jordan Cove would provide environmental training before a contractor or Jordan Cove employee steps out to a work area, and training records would be kept to demonstrate training activities. Numerous individuals, including company Chief Construction Inspectors, would supervise construction activities. Environmental Inspectors (EI) would be hired to ensure compliance with approved construction methods and all applicable permit and consultation requirements and conditions.

EIs would have peer status with all other activity inspectors along with the authority to stop activities that violate the environmental conditions of the FERC authorization, other permits, or landowner/land managing agency requirements, and to order appropriate corrective actions. The EIs would also be responsible for advising the chief construction inspector when conditions (such as wet weather) make it advisable to restrict construction activities. EI duties would include maintaining status reports and training records.

The EI's responsibilities would include:

- ensuring compliance with the requirements of the Jordan Cove and Pacific Connector's *Plan* and *Procedures* (including modifications), the environmental conditions of the section 3 and Certificate authorization, the mitigation measures proposed by the Applicant (as approved and/or modified by FERC's authorization), other environmental permits and approvals, and environmental requirements in landowner easement agreements;
- verifying that the limits of authorized construction work areas and locations of access roads are properly marked before clearing;
- verifying the location of signs and highly visible flagging marking the boundaries of sensitive resource areas, waterbodies, wetlands, or areas with special requirements along the construction work area;
- identifying erosion/sediment control and soil stabilization needs in all areas;
- ensuring that the location of dewatering structures and slope breakers would not direct water into known cultural resources sites or locations of sensitive species;
- verifying that trench dewatering activities do not result in the deposition of sand, silt, and/or sediment near the point of discharge into a wetland or waterbody. If such deposition is occurring, the dewatering activity would be stopped and the design of the discharge would be changed to prevent reoccurrence;
- identifying, documenting, and overseeing corrective actions, as necessary to bring an activity back into compliance; and
- keeping records of compliance with the environmental conditions of the FERC Certificate, and the mitigation measures proposed by the Project sponsor in the application submitted to the FERC, and other federal or state environmental permits during active construction and restoration.

2.6.2 FERC Environmental Compliance Monitoring

During construction of the Project, third-party Compliance Monitors representing the FERC would be present on a full-time basis to inspect construction procedures and mitigation measures and provide regular feedback on compliance issues to the FERC and Jordan Cove and Pacific Connector's environmental inspection team. Construction progress and environmental compliance would be tracked and documented by the Compliance Monitors. The Compliance Monitors would report directly to a Compliance Manager who would report directly to the FERC Project Manager. Other objectives of the third-party Compliance Monitoring program would be to facilitate the timely resolution of compliance issues in the field; provide continuous information to FERC regarding noncompliance issues and their resolution; and review, process, and track construction-related variance requests. Changes to previously approved mitigation measures, construction procedures, and construction work areas due to unforeseen or unavoidable site conditions would require various levels of regulatory approval, with the delegation of some authority to the third-party Compliance Monitors. FERC would also receive regular construction status reports filed by Jordan Cove and conduct periodic field inspections during construction and restoration of the Project. FERC would have the authority to stop any activity that violates an environmental condition of the FERC authorization issued to Jordan Cove. Other federal, state, and local agencies could also monitor the Project to the extent determined necessary by the agency.

2.6.3 Monitoring by Land Managing Agencies on Federal Lands

Monitoring is an essential element of project implementation (CEQ 2011). If the BLM issues a Temporary Use Permit and a Right-of-Way Grant for the Pacific Connector Pipeline Project, those authorizations would provide the terms and conditions for construction, operation, maintenance, and eventual termination of the facility on federal public lands. As cooperating agencies with jurisdiction by law for activities that occur on lands they administer, the BLM, Forest Service, and Reclamation have a responsibility to monitor implementation of the Pacific Connector Pipeline Project to assure that the terms and conditions of the Right-of-Way Grant are carried out (43 CFR 2885.24). This monitoring would be in addition to the Environmental Compliance Monitoring carried out by third-party Compliance Monitors representing the FERC.

CEQ regulations for the NEPA (40 CFR 1505.3) also provide that a monitoring and enforcement program should be adopted as part of the decision to implement the Project. Many of the requirements of the POD that are a part of the BLM Right-of-Way Grant on federal lands are project design measures that reduce the environmental consequences of the Project on-site. The Forest Service has also proposed off-site compensatory mitigation plans (see section 2.1.5). In addition to monitoring implementation of the Temporary Use Permit and the Right-of-Way Grant, the BLM, Forest Service, and Reclamation also have a responsibility to monitor authorized actions, whether they are project design features described in the POD or off-site mitigation measures included in Forest Service mitigation plans. As needed, agency representatives of the BLM, Forest Service, and Reclamation would participate in the monitoring process to assure that agency priorities are accomplished and agency obligations are fulfilled. Reclamation agency representatives would be on-site during all crossings of Reclamation facilities. Reclamation would require a minimum 48-hour notice for each crossing to ensure that Reclamation agency representatives are able to be on-site during the crossing installations.

Pacific Connector worked closely with the BLM and Forest Service to reduce impacts on federal lands during the proposed pipeline route selection and construction footprint design process. In developing the POD interdisciplinary teams of the BLM and Forest Service worked with Pacific Connector to implement project design features that would reduce impacts on LSR, Riparian Reserves, soil resources, water quality, recreation, and other resources as described in the POD attachments below. Additional discussion on the steps taken to avoid or reduce impacts on LSR and Riparian Reserves is included in appendices F.3 and F.4. The POD developed by Pacific Connector is part of the Right-of-Way Grant application and includes monitoring requirements to ensure that impacts from construction and operation of the Project are reduced and that objectives of the respective land management plans are accomplished. The POD includes 28 attachments, 27 of which were developed in cooperation with the BLM, Forest Service, and Reclamation (the remaining attachment is the Environmental Alignment Sheets for the Project). These attachments are individual plans detailing Pacific Connector's proposed method for construction and operation of the proposed pipeline on federal lands (see appendix F.10). A description of the POD is summarized in table 2.6.3-1. Ongoing discussion between the Applicant and agencies may result in refinements to the POD. Because the proposed actions specific to federal lands include amendments to LMPs, the regular monitoring and reporting programs of the respective BLM RMPs and Forest Service LRMPs would be used in addition to those identified in the POD.

TABLE 2.6.3-1

Pacific Connector's Plan of Development

Appendix	Appendix Title	Description
A	Aesthetics Management Plan for Federal Lands	The purpose of this Plan is to outline methods that Pacific Connector would implement to ensure compliance with agency land and resource management plans pertaining to visual and aesthetic resources within the Pipeline Project area. This Plan establishes goals for managing visual resources as they relate to construction, reclamation and management of the Pacific Connector Pipeline Project and describes actions to be taken by Pacific Connector to minimize impacts on visual resources.
B	Air, Noise and Fugitive Dust Control Plan	This Plan describes the practices that would be implemented during construction of the Pacific Connector Pipeline Project to minimize or control the potential impacts on air quality or the impacts caused by noise or fugitive dust on federal lands crossed by the pipeline project. The minimization and control measures described in this plan are also important to protecting the safety of construction workers, visiting agency personnel, and the general public that may use the public roads during the construction activities or reside near the construction ROW.
C	Blasting Plan	The purpose of this Blasting Plan is to provide guidelines for the safe use and storage of blasting materials proposed for use during construction of the Pacific Connector Pipeline Project. This Blasting Plan is intended to help ensure the safety of construction personnel, the public, nearby facilities and sensitive resources.
D	Communication Facilities Plan	The purpose of this plan is to describe the construction, modification, operation and maintenance of communication facilities necessary for the operation of the Pacific Connector Pipeline Project on federal lands managed by the BLM and the Forest Service. The communication facilities are necessary to enable communications between facilities constructed in conjunction with the pipeline project and the Pacific Connector gas control center.
E	Contaminated Substances Discovery Plan	The purpose of the Contaminated Substances Discovery Plan is to outline practices to protect human health and worker safety and to prevent further contamination in the event of an unanticipated discovery of contaminated soil, water, or groundwater during construction of the Pacific Connector Pipeline Project.
F	Corrosion Control Plan	Pacific Connector would implement methods to protect the pipeline system from external, internal, and atmospheric corrosion in accordance with USDOT 49 CFR 192. Corrosion Control is critical to public safety and the safe/reliable operation of the pipeline. This plan will illustrate methods used to identify the corrosion control needs for the pipeline project, as well as methods to provide the required protection and mitigation.

TABLE 2.6.3-1 (continued)

Pacific Connector's Plan of Development

Appendix	**Appendix Title**	**Description**
G	Environmental Briefings Plan	The purpose of this Plan is to outline the environmental reporting procedures, briefings, or notifications that Pacific Connector would provide to the federal land-managing agencies prior to construction, during construction, post construction, and during operations of the Pacific Connector Pipeline. Detailed compliance management documents would be developed based on the conditions in the permits/authorizations issued for the project and would be provided to the federal land-managing agencies prior to construction.
H	Emergency Response Plan	The purpose of this Emergency Response Plan is to identify the standards and criteria that Pacific Connector would follow to minimize the hazards during pipeline operation resulting from a gas pipeline emergency in accordance with the Pipeline and Hazardous Materials Safety Administration's regulations in 49 CFR 192.615 and 192.617.
I	Erosion Control and Revegetation Plan	The Erosion Control and Revegetation Plan outlines the erosion control and revegetation procedures that Pacific Connector would utilize during construction of the pipeline to minimize erosion, sedimentation and enhance revegetation success on all lands crossed by the pipeline.
J	Plant Conservation Plan	The purpose of this plan is to describe the conservation measures that Pacific Connector would implement to minimize the potential effects on federally-listed plants, including one plant identified as a species of concern, that have been documented during Pipeline Project survey efforts to-date, or that may be documented during subsequent survey efforts prior to ground-disturbing activities. The plan outlines avoidance, minimization, propagation, restoration and other mitigation measures for federally-listed plant species.
K	Fire Prevention and Suppression Plan	The Fire Prevention and Suppression Plan describes the measures to be used by Pacific Connector and its contractors (Contractor) to ensure that fire prevention and suppression techniques are carried out in accordance with federal, state and local regulations.
L	Fish Salvage Plan	The fish salvage plan has been developed to minimize adverse effects on Endangered Species Act (ESA) listed salmonids (Southern Oregon/Northern California Coast coho salmon and Oregon Coast coho salmon), non-listed salmonids (Chinook, steelhead, cutthroat trout) and ESA-listed catostomids (Lost River sucker and shortnose sucker) during construction of the Pacific Connector Pipeline Project as well as other aquatic organisms.
M	Hydrostatic Test Plan	In accordance with USDOT 49 CFR Part 192, Pacific Connector would strength test (or hydrostatic test) the pipeline system (in sections) after it has been lowered into the pipe trench and backfilled. The purpose of the hydrostatic test is to verify the manufacturing and construction integrity of the pipeline before placing it in service to flow natural gas.
N	Integrated Pest Management Plan	This plan would provide Pacific Connector's management and staff with the necessary BMPs to address the control of noxious weeds, invasive plants, forest pathogens, and soil pests across the route of the Pipeline. The BMPs have been created to minimize the potential spread of invasive species and minimize the potential adverse effects of control treatments.
O	Klamath Project Facilities Crossing Plan	The Plan identifies the locations within Klamath County, Oregon where the Pacific Connector alignment crosses facilities within the Klamath Project that are administered by the Klamath Basin Area Office of Reclamation and the methods proposed to construct the pipeline project across Reclamation facilities.
P	Leave Tree Protection Plan	The purpose of this plan is to describe the measures that would be implemented during construction of the Pacific Connector to identify, conserve and protect selected trees (living and snags) within or along the edges of the pipeline project's certificated work limits.
Q	Overburden and Excess Material Disposal Plan	The purpose of this Plan is to identify the proposed locations on federal lands that may be used for the permanent and temporary storage of excess rock, timber, and spoil generated during timber removal and pipeline construction of the Pacific Connector Pipeline Project.
R	Prescribed Burning Plan	The Prescribed Burning Plan describes the protocols that Pacific Connector would follow to obtain appropriate agency authorization on all lands (federal, state and private) crossed by the pipeline, where it is necessary to dispose of forest slash by burning. This plan also outlines the appropriate BMPs that would be utilized to safely conduct slash burning operations.

TABLE 2.6.3-1 (continued)

Pacific Connector's Plan of Development

Appendix	Appendix Title	Description
S	Recreation Management Plan	The purpose of the Plan is to assist in the management of existing recreation resources on lands within the pipeline project area or impacted by the pipeline. This Plan establishes goals for managing recreation in the vicinity of the pipeline and describes actions to provide continued safe access, prevent resource damage, and to avoid potential user conflict.
T	ROW Marking Plan	The purpose of this Plan is to identify the survey standards and types of survey markings that would be used by Pacific Connector on federal lands during the pre-construction, construction, and operational phases of the pipeline project.
U	ROW Clearing Plan	The purpose of this ROW Clearing Plan (Plan) is to outline the methods that Pacific Connector would implement during timber (and other vegetation) removal within the construction ROW and TEWAs. This Plan was developed utilizing applicable BMP compliance protocols outlined in the Erosion Control and Revegetation Plan for the pipeline project.
V	Safety and Security Plan	The purpose of this plan is to describe safety standards and practices that would be implemented to minimize health and safety concerns related to the construction of the pipeline project.
W	Sanitation and Waste Management Plan	The purpose of the Plan is to outline the procedures that would be implemented by Pacific Connector and its contractors to manage sanitation and waste materials during construction and operations of the Pacific Connector Pipeline Project.
X	Spill Prevention, Containment, and Countermeasures Plan	The Plan identifies measures to be taken by Pacific Connector and its contractors to prevent, contain and respond to spills during the construction of the pipeline project.
Y	Transportation Management Plan	The purpose of the plan is to cover all pipeline project transportation-related activities involving Agency-jurisdiction roads or rights-of-way and identifies ongoing cooperative procedures.
Z	Unanticipated Discovery Plan	This plan provides the procedures Jordan Cove, Pacific Connector, its personnel and consultants would follow in the event that unanticipated discoveries of historic properties, archaeological objects, archaeological sites, or human remains are made during the construction and operation of the Project.
AA	Environmental Alignment Sheets	A set of photo-based maps depicting the centerline and construction ROW at a scale of 1":200' and the associated environmental features and requirements.
BB	Wetland and Waterbody Crossing Plan	The Plan outlines the construction methods, restoration procedures, and BMPs that Pacific Connector would utilize during construction of its pipeline. The measures set out in this plan would be employed to avoid, minimize, and restore potential impacts associated with wetland and waterbody crossings, as well as to minimize potential effects on aquatic resources.

2.7 OPERATION AND MAINTENANCE PROCEDURES

2.7.1 LNG Terminal Facilities

Jordan Cove would operate and maintain its facilities in compliance with 49 CFR 193, 33 CFR 127, National Fire Protection Association (NFPA) 59A, and other applicable federal and state regulations. Before commencing operation of the LNG terminal, Jordan Cove would prepare and submit for approval operation and maintenance manuals that address specific procedures for the safe operation and maintenance of the LNG storage and processing facilities. Jordan Cove would also prepare an operations manual that addresses specific procedures for the safe operation of the ship unloading facilities in accordance with 33 CFR 127.305. Operating procedures would address normal operations as well as safe startup, shutdown, and emergency conditions.

All operations and maintenance personnel at the terminal would be trained to properly and safely perform their jobs. Jordan Cove states that operators would meet all the training requirements of the Coast Guard, USDOT, ODOE, Oregon State Fire Marshall, Coos Bay, Fire Departments in Coos County, and other regulatory entities. The SORSC would provide on-site resources and assets, including a Sherriff's office and fire department.

The LNG terminal and related facilities would be staffed with about 180 full-time equivalent employees working three shifts, so there would be coverage 24 hours a day, 365 days a year. The terminal's full-time staff would conduct routine maintenance and minor overhauls. Major overhauls and other major maintenance would be handled by bringing in maintenance personnel specifically trained to perform the maintenance. All scheduled and unscheduled maintenance would be entered into a computerized maintenance management system.

2.7.2 Pipeline and Associated Aboveground Facilities

Pacific Connector would test, operate, and maintain the proposed facilities in accordance with USDOT regulations provided in 49 CFR Part 192; the FERC's guidance at 18 CFR 380.15; rules and regulations promulgated by PHMSA; and maintenance provisions of its ECRP. The pipeline right-of-way would be clearly marked where it crosses public roads, waterbodies, fenced property lines, and other locations as necessary. All pipeline facilities would be marked and identified in accordance with applicable regulations.

The aboveground facilities would be inspected for the life of the pipeline at intervals that meet USDOT requirements. Pipeline personnel would perform routine checks of the facilities, including calibration of equipment and instrumentation, inspection of critical components, and scheduled and routine maintenance of equipment. Safety equipment, such as pressure-relief devices, fire detection and suppression systems, and gas detection systems, would be tested for proper operation. Corrective actions would be taken for any identified problem. Vegetation at aboveground facilities would be periodically maintained using mowing, cutting, trimming and the selective use of herbicides.

To facilitate periodic pipeline corrosion/leak surveys, a corridor centered on the pipeline and up to 10 feet wide would be maintained in an herbaceous state, with no vegetation greater than 6 feet in height. Trees that are located within 15 feet of the pipeline and that are greater than 15 feet in height would be cut and removed from the right-of-way. Vegetation within the permanent easement would be periodically maintained by mowing, cutting, and trimming (either by mechanical or hand methods). Maintenance activities are expected to occur approximately every three to five years depending on the growth rate. During maintenance, trimmed or cut vegetation would be scattered across the operational easement to naturally decompose and to discourage off-highway vehicle (OHV) and all-terrain vehicle traffic. Occasionally, where site conditions allow, chipping of this material may also occur. Herbicides would not be used for brush control; however, if noxious weed infestation occurs on the permanent easement, selective use of herbicides would be used to control these species. Herbicides would not be used in or within 100 feet of a waterbody's mean high-water mark, unless exceptions are granted by the applicable land management agency.

Pacific Connector would employ a permanent staff of 15 employees, including six operations technicians in the Coos Bay pipeline office in Coos County, five employees in the Medford pipeline office in Jackson County, and four employees at the compressor station near Malin in Klamath County. In addition, the pipeline and aboveground facilities would be monitored all the time using Pacific Connector's gas control communication system and radio towers reporting back to the Pacific Connector gas control center.

2.8 FUTURE PLANS AND ABANDONMENT

We received numerous comments during scoping and on the draft EIS requesting that the EIS address decommissioning of the Project if/when the Project lifespan is complete. The Applicants have no reasonably foreseeable plans for expansion or abandonment of the Project facilities; therefore, it is not appropriate to address these speculative future actions in this EIS. Abandonment of the Pacific Connector pipeline would require a subsequent NEPA analysis and Commission approval.

3.0 ALTERNATIVES

As required by the NEPA, Commission policy, and in cooperation with the COE, BLM, Forest Service, Reclamation, and the other NEPA cooperating agencies, we identified and evaluated reasonable and practical alternatives to the facilities (and locations) proposed by Jordan Cove and Pacific Connector as described in section 2.1 of this document. Specifically, and consistent with the Purpose and Need of the Project as described in section 1.2, we evaluated the No Action Alternative, System Alternatives, LNG Terminal Site Alternatives, and Pipeline Alternatives (including Federal Lands Alternatives and Compressor Station Alternatives). To satisfy its responsibilities per the CWA Section 404(b)1(1) Guidelines, the COE will also evaluate whether the alternatives identified by the Applicants and/or cooperating agencies would be practicable.[56]

Our evaluation of alternatives is based on Project-specific information provided by the Applicants, affected landowners, and other concerned parties; publicly available information; our consultations with federal and state resource agencies; federally recognized tribes; and our expertise and experience regarding the siting, construction, and operation of LNG export facilities and interstate natural gas transmission facilities and their potential impact on the environment. In evaluating alternatives, we considered and addressed, as appropriate, the comments provided to the Commission regarding possible alternatives.

As described in section 1.4, the Commission received thousands of letters and comments expressing concern about the Project during scoping and in response to the draft EIS. Many of these letters requested that we evaluate alternatives to the Project or expressed concern about our alternatives analyses. In response to these comments, we required the Applicants to provide additional environmental information, requested they assess the feasibility and practicability of alternatives as proposed by the commenters (including other federal agency alternatives requests); conducted site visits and field investigations; met with affected landowners and local representatives and officials; and consulted with federal and state regulatory agencies and tribes. All comments received concerning alternatives were considered, and many, but not all, of these alternatives are included in this analysis. Not included in this analysis is an assessment of renewable energy resources as an alternative to the Project. Renewable energy resources include, but are not limited to, wind, solar, and hydroelectric power. These resources are alternatives to electrical power production. Because the Project's purpose is to transport natural gas across southern Oregon and convert it to LNG for export to overseas markets, not generate electricity, the development and use of renewable energy resources would not meet the purpose of the Project, and therefore is not a reasonable or practicable alternative to the proposed action and is not considered further in this analysis. Additionally, several comments on the draft EIS suggested that measures proposed as mitigation for the impacts of the previous iteration of this Project should be considered as a potential alternative. In preparation of the draft EIS, we determined that mitigation for a previous iteration of this project was inappropriate as an alternative, and as stated previously, where we

[56] When making a decision on whether to issue a permit for the Project, the COE must consider whether the proposed Project represents the least environmentally damaging practicable alternative pursuant to the CWA section 404(b)(1) guidelines. The term "practicable" means available and capable of being done after taking into consideration cost, existing technology, and logistics in light of the overall purpose of the Project. The COE may only permit discharges of dredged or fill material into waters of the U.S. that represent the least damaging practicable alternative, so long as the alternatives do not have other significant adverse environmental consequences.

consider additional mitigation necessary, we are including recommendations to the Commission that if adopted would avoid, reduce, or mitigate environmental impacts.

The purpose of this analysis is to satisfy NEPA requirements that agencies take a "hard-look" at a project's impacts, inform the public of these impacts, and determine whether the adoption and implementation of an alternative(s) would be preferable to the proposed action. As described below, we consider numerous reasonable and practicable alternatives to the proposed action. In consultation with the NEPA cooperating agencies, using our collective professional judgment, and through environmental comparison, each alternative is considered until it is clear that the alternative would not satisfy one or more of the evaluation criteria (see below). Furthermore, it is important to note that the Commission's role under the NGA is to review applications filed with it, not to develop a general plan for energy infrastructure. Thus, comments suggesting that the Commission require Applicants to pursue alternatives that are substantially different than their proposals will be considered, but may not result in a reasonable alternative that would be addressed in our alternatives analysis.

In response to the draft EIS, a number of route variations recommended by staff were adopted by Pacific Connector and incorporated into the proposed action described in section 2 of this EIS. The changes to the proposed action have been considered in the preceding environmental analysis. Additionally, in response to concerns raised by the BLM regarding recent biological surveys, an additional pipeline route variation has been included in the following analysis. We also received in response to the draft EIS numerous comments concerning the need for site-specific construction alternatives for each waterbody crossed by the pipeline, and dredging method alternatives for the proposed dredging within Coos Bay, and similar site-specific resource alternatives. The proposed action including all waterbody crossings and the proposed dredging methods for the marine facilities in Coos Bay have been reviewed and assessed in this EIS. As our review concludes that the proposed crossing methods provide adequate protection of the affected resources, we are not including an alternatives analysis for each crossing. Staff considered alternatives, and as appropriate, discusses them herein.

Evaluation Process

The purpose of this evaluation is to determine whether an alternative would be preferable to the proposed action. To determine if an alternative would be preferable to a proposed action, we generally evaluate an alternative using three criteria:

1. does the alternative meet the stated purpose of the project;
2. is it technically and economically feasible and practical; and
3. does it offer a significant environmental advantage over a proposed action.

The alternatives were reviewed against the evaluation criteria in the sequence presented above. If the alternative would not meet the Project's purpose, or is not feasible or practical, we did not compare environmental information to determine if the third evaluation criterion was satisfied.

The first consideration for including an alternative in our analysis is whether or not it could satisfy the stated purpose of the Project. As described previously, the purpose and need of the Jordan Cove Project is to export natural gas supplies derived from existing interstate natural gas transmission systems to overseas markets; and the purpose and need of the Pacific Connector Project is to connect the existing interstate natural gas transmission systems of GTN and Ruby with the proposed Jordan Cove LNG terminal. Alternatives that do not achieve these purposes cannot be considered as feasible or reasonable alternatives to the Project. Furthermore, the Commission cannot simply ignore a project's purpose and substitute a purpose it or a commenter deems more suitable.

The only location where the GTN and Ruby pipeline systems interconnect is near Malin, Oregon. Malin is a major natural gas trading hub providing access to multiple supply basins in the United States and Canada. GTN and Ruby have a combined natural gas transportation capacity of 3.8 Bcf/d at Malin providing access to diverse and abundant supplies to support Jordan Cove's export operations. Therefore, in the alternatives analyses below, all pipeline alternatives originate near Malin, Oregon. All of the alternatives considered here, except the No Action Alternative, are able to meet the Project purpose stated in section 1.2 of this EIS.

Not all conceivable alternatives are technically and economically feasible and practical. Technically feasible alternatives, with exceptions, would generally involve the use of common LNG facility and pipeline construction methods. Economically practical alternatives would result in an action that generally maintains the price competitive nature of the proposed action. An alternative that would involve the use of a new, unique, or experimental construction method(s) may be technically feasible, but not economically practical. Generally, we do not consider the cost of an alternative as a critical factor unless the added cost to design, permit, and construct the alternative would render the Project economically impractical.

To determine if an alternative is practicable and would provide a significant environmental advantage over the proposed action, we compare the impacts of the alternative and the proposed action (e.g., number of wetlands/waterbodies affected by the alternative and number of wetlands/waterbodies affected by the proposed action). To ensure consistent environmental comparisons and to normalize the comparison of resources, we generally use "desktop" sources of information (e.g., publicly available data, aerial imagery) and assume the same construction and operation right-of-way widths and general workspace requirements. We evaluate data collected in the field if surveys were completed for both the proposed action and the corresponding alternative. Our environmental comparison uses common factors such as (but not limited to) total amount, length/distance, and acres affected of a resource. Furthermore, this analysis considers impacts on both the natural and human environments. The natural environment is generally characterized by vegetation, waterbodies, wildlife, and other biological resources; while the human environment includes land use, existing infrastructure, and community (socioeconomic) characteristics. Where appropriate and available, we also use site-specific information. In comparing the impact between resources, we also consider the magnitude of the impact anticipated on each resource. As applicable, we assess impacts on resources that are not common to the alternative and the proposed action (e.g., an alternative affects old growth forest whereas the proposed action affects agricultural lands). Our determinations attempt to balance the overall impacts (and other relevant considerations) of the alternative(s) and the proposed action. Recognizing the often-competing interests driving alternatives and the differing nature of impacts resulting from an alternative (i.e., impacts on the natural environment versus impacts on the human environment), we also consider other factors that are relevant to a particular alternative or discount or eliminate factors that are not relevant or may have less weight or significance. Ultimately, an alternative that is environmentally comparable or results in minor advantages in terms of environmental impact would not compel us to shift the impacts from the current set of landowners to a new set of landowners.

The factors considered for an aboveground facility alternative are different than those considered for a pipeline route alternative because an aboveground facility is a fixed location rather than a linear facility which is routed between two points. In evaluating aboveground facility locations, we consider the amount of available land, current land use, adjacent land use, location accessibility, engineering requirements, stakeholder comments, and impacts on the natural and human environments.

In its comments on the draft EIS, the Applicant suggested that a number of alternatives assessed and not recommended by staff were erroneously analyzed and should have been found to not be technically and economically feasible and practical. We considered these comments and as appropriate have modified our discussions.

3.1 NO ACTION ALTERNATIVE

The NEPA requires federal agencies to consider and evaluate a No Action Alternative. Additionally, a No Action Alternative serves as a baseline against which the impacts of the proposed action are compared and contrasted. Under the No Action Alternative, the proposed action would not occur, the permits and authorizations listed in section 1.5 would not be required, and as a result, the environment would not be affected.

Under the No Action Alternative, the RMPs of the Coos Bay, Roseburg, Medford, and Klamath Falls Resource Area of the Lakeview District and the LRMPs of the Rogue River, Umpqua, and Winema National Forests would not be amended to make provision for the Project. Furthermore, the Forest Service would not consent to the BLM to grant an easement because construction of the Project would not be consistent with the National Forest LRMPs. The BLM would not issue a Right-of-Way Grant for the Project because the Project would not be a conforming use of federal land. Under the No Action Alternative, there would be no need for Reclamation to concur with BLM with respect to issuance of a Right-of-Way Grant. Also, several consultations and permits would not be completed or issued under the No Action Alternative because there would be no impact on the environment. Furthermore, under the No Action Alternative specific to the COE's role in the Project review, construction of the Project would result in a modified project design or location that eliminates work that would require a Department of the Army review (i.e., avoidance of aquatic resource impacts).

In Order No. 3041-A issued July 20, 2018, the DOE amended its previous authorization to export LNG from the Jordan Cove LNG Project to countries with which the U.S. has an FTA (DOE 2018). By law, under Section 3(c) of the NGA, applications to export natural gas countries with which the U.S. has FTAs that require national treatment for trade in natural gas are deemed to be consistent with the public interest. The DOE also issued a conditional authorization to the Jordan Cove Project to export to non-Free Trade Agreement countries in Order No. 3413 on March 24, 2014. For the non-Free Trade Agreement conditional authorization, granted under Section 3(a) of the NGA, the DOE determined that exports from the Jordan Cove Project were not inconsistent with the public interest, provided the Project successfully completes the environmental review. In its application to FERC, Jordan Cove states the purpose of its Project is to export natural gas supplies derived from existing interstate natural gas transmission systems (linked to the Rocky Mountain region and Western Canada) to overseas markets, particularly Asia. According to Jordan Cove, the Project is a market-driven response to increasing natural gas supplies in the U.S. Rocky Mountain and Western Canada markets, and the growth of international demand, particularly in Asia.

Given that the Project is market-driven, it is reasonable to expect that in the absence of a change in market demand, if the Jordan Cove LNG Project is not constructed (the No Action Alternative), exports of LNG from one or more other LNG export facilities may occur. Thus, although the environmental impacts associated with constructing and operating the Project would not occur under the No Action Alternative, impacts could occur at other location(s) in the region as a result of another LNG export project seeking to meet the demand identified by Jordan Cove.

As stated in the introduction to this section, the No Action Alternative would not meet the Project's purpose and need. Therefore, we conclude that the No Action Alternative does not meet the Project purpose (criterion 1) and an alternative project to meet the market demand has not been proposed but would require a similar footprint. Although the resources that would be affected by an alternative project are not defined, we conclude that it would not likely provide a significant environmental advantage over the proposed action (criterion 3). Therefore, we do not consider the No Action Alternative further. However, the other NEPA cooperating agencies, consistent with their review and regulatory responsibilities, may choose to select this alternative.

3.2 SYSTEM ALTERNATIVES

System alternatives would make use of existing or other proposed LNG facilities and pipelines to meet the purpose of the Project. Implementing a system alternative would make it unnecessary to construct all or part of the Project, although some modifications or additions to existing LNG facilities or pipeline transmission systems/facilities, or other proposed LNG or pipeline transmission systems/facilities might be necessary. The pipeline portion of a system alternative would involve the use of all or portions of other natural gas transmission systems to transport natural gas from near Malin, Oregon, to the proposed terminal near Coos Bay, Oregon. Existing natural gas pipelines in southern and central Oregon include the jurisdictional interstate transportation systems operated by Northwest, GTN, and Ruby, and the non-jurisdictional intrastate Coos County Pipeline (figure 3.2-1).

As of the issuance of this EIS, there are no existing LNG export (or import) terminal facilities located on the west coast of the contiguous United States (Washington, Oregon, and California). Additionally, we are not aware of any proposed LNG export (or import) terminals on the west coast of the contiguous United States. Existing and proposed East Coast and Gulf Coast LNG export facilities are located 2,000 – 3,000 miles from Oregon, and would not be reasonable alternatives. According to USDOT PHMSA, there are four LNG storage facilities (peak-shaving plants) in Oregon and Washington connected to natural gas pipeline systems. These facilities are not designed to export LNG, are insufficient to meet the purpose of the Project, and would require significant modifications to meet the Project's purpose. Additionally, an LNG storage facility is being built in Tacoma, Washington (i.e. the Tacoma LNG) that would provide fuel for marine vessels and natural gas service for local residential and commercial customers. However, this facility which is located on a 30-acre site in a highly industrialized area is physically constrained with insufficient land available for the expansion necessary to meet the Project's purpose. Therefore, we conclude that there are no reasonable LNG system alternatives located on the west coast of the contiguous United States.

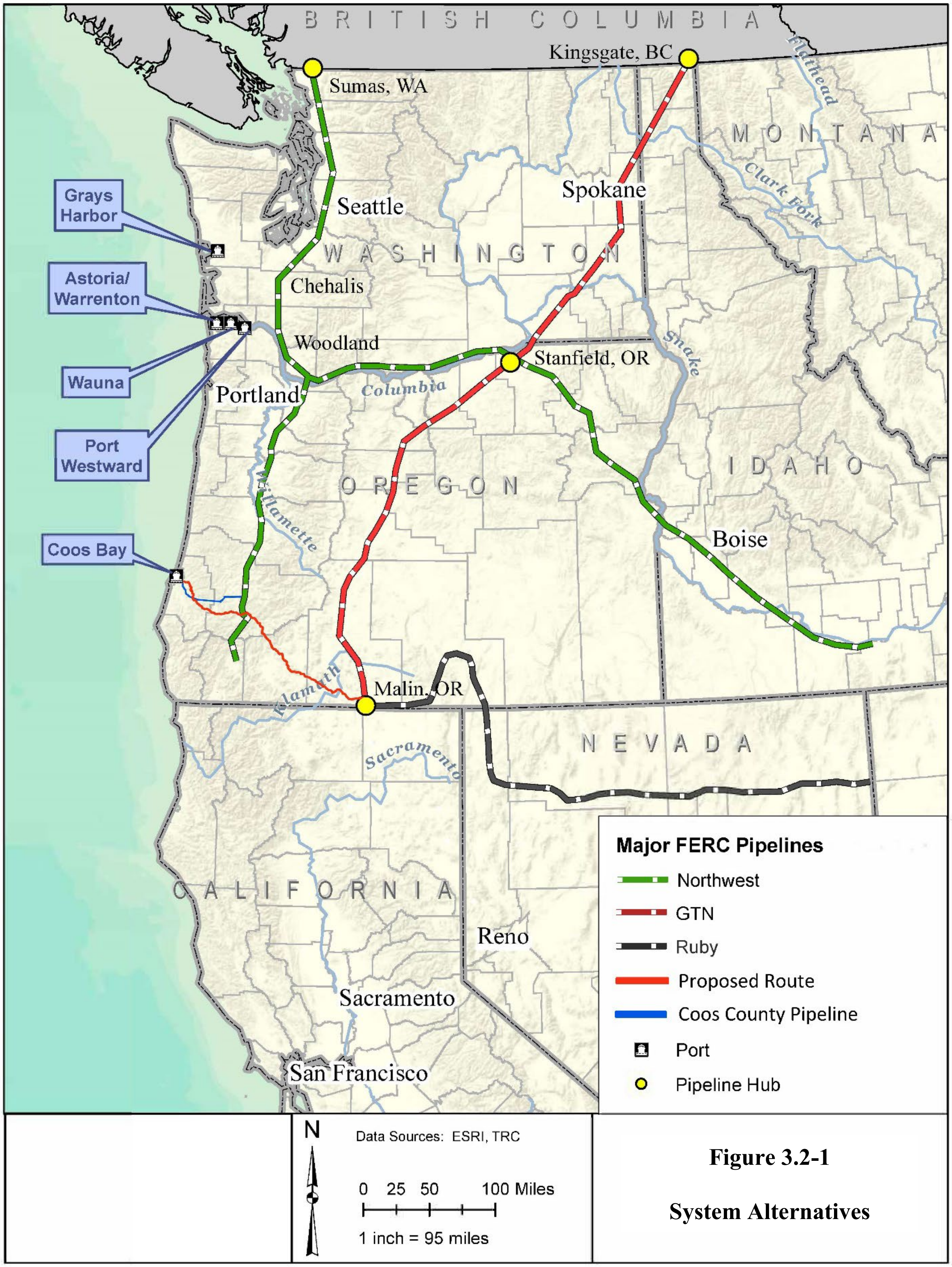


Figure 3.2-1

System Alternatives

We received several comments suggesting this analysis consider existing and proposed LNG export facilities located in Alaska, Canada, and Mexico. In Alaska, there is an idle LNG export facility on the Kenai Peninsula; however, there is a proposal with the Commission in Docket No. CP19-118-000 to bring this facility back online to allow for the import of LNG. The Commission is also currently reviewing an application (FERC Docket No. CP17-178-000) to construct and operate a new LNG export facility in Nikiski, Alaska. These facilities are not connected to the "lower-48" natural gas transmission pipeline network and although constructing a pipeline from the existing GTN and Ruby pipelines systems near Malin, Oregon to the existing or proposed facility in Alaska (a distance of close to 3,000 miles) is technically feasible, it is not economically practical. Furthermore, constructing a pipeline to Alaska from Malin would result in significantly more environmental impacts than the proposed Project as this pipeline would be an order of magnitude longer than the currently proposed pipeline. Based on the length of the Pacific Connector Pipeline and the total footprint, including all extra workspace, the pipeline would affect about 21.6 acres per mile of length. Therefore, adding 2,700 miles would affect as much as 58,320 acres of land. Consequently, we conclude that an LNG system alternative making use of the existing or proposed Alaska LNG facilities would not provide a significant environmental advantage and do not consider it further in this analysis.

According to Natural Resources Canada (2018), 13 LNG export facilities have been proposed in British Columbia, Canada (see table 3.2-1). The final specifications and permitting/ construction statuses of these facilities are unknown. Assuming these facilities have been designed to accommodate a pre-determined need/level of service, it may be possible that with modifications, one or more of these facilities would be able to provide an equivalent level of service to that which would be provided by the Project. However, we are unable to determine what modifications would be necessary and what the impacts of those modifications would be. Furthermore, although constructing a pipeline from the existing GTN and Ruby pipelines systems to western Canada (a distance ranging from 700 to 1,400 miles) is technically feasible, it would increase the Project footprint by between about 10,100 and 25,300 acres. Therefore, we conclude that an LNG system alternative making use of a proposed western Canada LNG facility would not provide a significant environmental advantage and do not consider it further in this analysis.

TABLE 3.2-1

Proposed Canadian LNG Projects

Project	Terminal Location	Output (Max Bcf/d)
Cedar LNG Project	Near Kitimat, B.C.	0.8
LNG Canada Project	Port Edward, Prince Rupert Island, B.C.	3.5
WesPac LNG Marine Terminal	Tilbury Island, B.C.	0.6
Kitimat LNG Project	Kitimat, B.C.	1.3
New Times Energy Ltd.	Prince Rupert area, B.C.	1.6
Orca LNG Project	Prince Rupert area, B.C.	3.2
Steelhead LNG Project	Sarita Bay, Vancouver Island, B.C.	4.3
Woodfibre LNG Project	Near Squamish, B.C.	0.3
Stewart Energy Project	Stewart, B.C.	4.0
Discovery LNG Project	Campbell River, Vancouver Island, B.C.	2.6
Kitsault Energy Project	Kitsault, B.C.	2.7
Triton LNG Project	Floating facility – TBD near Kitimat or Prince Rupert, B.C.	0.3
Watson Island LNG	Watson Island, near Prince Rupert, B.C.	Unknown

There are no existing LNG export facilities on the west coast of Mexico. However, there are two import facilities—the Costa Azul LNG Project in Baja California, and the Manzanillo LNG Project in Colima. The owner of the Costa Azul Project (Sempra Energy) is proposing to convert this project into an LNG export terminal. We are not aware of any other proposed LNG facilities in

Mexico; however, we acknowledge that additional proposals may exist. Similar to the proposed Canadian LNG facilities, the final specifications and permitting/construction status of the Costa Azul LNG Project is unknown. Assuming this facility has also been designed to accommodate a pre-determined need/level of service, it may be possible that with modifications, it would be able to provide an equivalent level of service to that which would be provided by the Project. However, we are unable to determine what modifications would be necessary and what the impacts of those modifications would be. Although constructing a pipeline from the existing GTN and Ruby pipelines systems to Baja California (a distance of about 900 miles) is technically feasible, it would increase the Project footprint by about 14,500 acres. Therefore, we conclude that an LNG system alternative making use of the Costa Azul LNG facility would not provide a significant environmental advantage and do not consider it further in this analysis.

The Northwest Pipeline is an approximately 3,900-mile-long bi-directional interstate natural gas transmission system. This system crosses the states of Washington, Oregon, Idaho, Wyoming, Utah, and Colorado. This transmission system provides access to British Columbia, Alberta, Rocky Mountain, and San Juan Basin natural gas supplies. We received comments on the draft EIS stating that the Northwest Pipeline system should be assessed as a potential system alternative, with some comments suggesting the system has available existing capacity or could be expanded to provide the needed capacity. Commenters noted that the Northwest Pipeline is generally sited parallel to the coast (see figure 3.2-1) and could be connected to an LNG facility on the coast with less new pipeline construction required than the proposed Project. As stated above, to meet the Applicant's stated Project purpose, the pipeline needs to originate near Malin, Oregon. The distance from Malin to the closest point of the Northwest Pipeline is approximately 250 miles. Assuming some excess capacity is available in the Northwest Pipeline, a pipeline loop would still need to be constructed in order to provide the total proposed capacity. Co-locating this pipeline loop with the existing Northwest Pipeline would require the construction of at least an additional 125 miles of pipeline. Lastly, the modified Northwest Pipeline would then need to be connected to the coast and new LNG terminal facilities. Depending on the location of these terminal facilities, at least 50 miles of additional pipeline would need to be constructed. Constructing 425 miles of new pipeline to connect to Malin may be technically feasible and economically practical, but would not result in a significant environmental advantage when compared to the proposed action; therefore, use of the existing Northwest Pipeline is not evaluated further.

In Oregon, two lateral pipelines connect to the Northwest mainline system. The Camas to Eugene and the Eugene to Grants Pass Lateral are generally parallel to I-5, running north to south through western Oregon. The laterals begin in the north as dual 20-inch-diameter pipelines, and consist of a single a 10-inch-diamter pipeline at the southern end. The only portion of the Northwest Pipeline system that could potentially serve as a system alternative to move gas from near Malin to the LNG terminal in Coos Bay would be a portion of the north-south Eugene to Grants Pass Lateral. Such an alternative would require modifying roughly the eastern one-half of the proposed pipeline to connect to the southern end of the Grants Pass Lateral, then constructing about 70 miles of "looping" pipeline north along the Grants Pass Lateral to near Sutherlin, Oregon, and then constructing about 50 miles of new pipeline west to Coos Bay. Such an alternative would result in roughly the same length of pipeline as proposed; however, may affect more forested area, and could result in similar or greater environmental impacts. Therefore, the implementation of a system alternative involving the use of the Northwest Pipeline Grants Pass Lateral would not provide a significant environmental advantage over the proposed action.

The GTN interstate natural gas transmission system includes about 600 miles of 36- and 42-inch pipeline beginning at Kingsgate, British Columbia, traversing through northern Idaho, southeastern Washington, and central Oregon, and terminating near Malin. Natural gas for the GTN pipeline originates primarily from western Canadian supplies; although it can receive Rocky Mountain gas through interconnections with Northwest near Spokane and Palouse, Washington and Stanfield, Oregon. The Ruby interstate natural gas transmission system includes about 680 miles of 42-inch-diameter pipeline beginning near Opal, Wyoming, and extending west through Montana and Idaho to Malin. Neither GTN nor Ruby would be suitable as system alternatives and neither would be able to meet the purpose of the Project because both systems terminate near Malin and would require a connection to a west coast LNG facility similar to the proposed pipeline route from Malin to Coos Bay. Therefore, systems alternatives involving these systems would not provide a significant environmental advantage over the proposed action.

The Coos County Pipeline is a non-jurisdictional 12-inch-diameter local distribution company (LDC)[57] pipeline that extends about 60 miles from the Northwest Grants Pass lateral, near Roseburg, to Coos Bay. The Coos County Pipeline has a MAOP of 1,000 psig and was designed to bring gas to the communities around Coos Bay. The terminus of the Coos County Pipeline is approximately 7.7 miles south of the proposed Jordan Cove LNG terminal. Northwest Natural built a pipeline lateral from the terminus of the Coos County pipeline across Coos Bay to the North Spit, as part of its LDC system. The diameter and available capacity of the Coos County Pipeline are too small to meet the purpose of the Project. The Coos County Pipeline does not connect to the GTN and Ruby Pipeline systems. Expanding the Coos County Pipeline as needed to provide the required natural gas capacity from the GTN and Ruby Pipeline systems would result in similar impacts as that of the proposed action. For these reasons, the Coos County Pipeline as an existing system cannot meet the Project purpose and expanding it to meet the purpose would not provide a significant environmental advantage.

3.3 LNG TERMINAL SITE ALTERNATIVES

We received numerous comments stating that LNG site alternatives in California, Washington, Canada, and Mexico be considered. Commenters suggested that sites in these states and countries could be more suitable for an LNG terminal. We do not evaluate in this EIS alternative projects or LNG terminal sites located in Canada or Mexico. Below we address the potential for an LNG terminal to be sited in California, and then we address potential alternative sites in Oregon and Washington.

As stated previously, the Commission's staff evaluates a proposal and reasonable alternatives. While we may ask the project proponent to evaluate alternative technologies or facility layouts to reduce impacts, we do not completely redesign proposals. Additionally, some alternative technologies and/or facility designs represent such a large departure from the Applicant's proposal that they could significantly affect the feasibility and economic practicality of the proposal. Consequently, we are not evaluating offshore site alternatives that would require specialized LNG carriers. We do however, to ensure a comprehensive review of alternatives, evaluate the concept of an inland (non-waterfront) alternative (see section 3.3.4) and a shoreside berth alternative (see section 3.3.5).

[57] LDCs (local distribution company) are intrastate systems that are regulated by the state, and do not come under the jurisdiction of the FERC.

3.3.1 LNG Terminal Site Alternatives in California

California has 11 public ports. The closest deepwater port to Coos Bay in California is the Port of Humboldt Bay. The Port of Humboldt Bay is located approximately 185 miles south of Coos Bay and 225 miles north of San Francisco (the next closest deepwater port is in San Francisco bay). The Samoa Peninsula lies between the Pacific Ocean and Humboldt Bay and hosts several active and former marine facilities, berths, docks, and terminals. According to the 2018 Humboldt Bay Maritime Industrial Use Market Study, 948 acres of land have been designated for Coastal-Dependent Industry (CDI) on the Samoa Peninsula including the approximately 344-acre Eureka Municipal Airport site which has waterfront access and is the largest single property on the peninsula. It is unknown whether a combination of other CDI properties equaling approximately 200 acres is available. The channel system leading into and within Humboldt Bay varies in length, width, and depth. The Bar and Entrance Channel is approximately 8,500 feet long, 500 to 1,600 feet wide, and is authorized to a depth of 48 feet mean low level water (MLLW). The North Bay Channel which serves the Samoa Peninsula is 18,500 feet long, 400 feet wide, and is authorized to a depth of 38 feet MLLW. The distance by air from Malin, Oregon to Humboldt Bay is about 170 miles (the distance from Malin, Oregon to Coos Bay by air is also about 170 miles). We estimate the pipeline distance between these two points would be at least 200 miles, which is comparable to the proposed pipeline.

An LNG terminal in Humboldt Bay would impact the environment in a manner similar to that of the proposed Project, including; permanent conversion of land use, dredging, turbidity, loss of wetlands, visual impacts, air quality and noise. Concerns at this location such as marine traffic restrictions, socioeconomic impacts, tsunamis, and public safety would also be the same as the proposed Project. A natural gas transmission pipeline from Malin, Oregon to Humboldt Bay, California would traverse Klamath County, Oregon as well as Siskiyou and Humboldt Counties, California. The environment crossed by a pipeline from Malin to Humboldt Bay would be similar to that of the proposed route, including; mountainous terrain, several large rivers, three national forests, and BLM-managed lands. This pipeline route would also cross the ranges of over 20 federally-listed threatened and endangered species including NSO, MAMU, and salmon. Concerns with this pipeline route such as rural property values, socioeconomic impacts, and public safety would also be the same as the proposed Project.

Based on the similarity of impacts of an LNG terminal in Humboldt Bay and the associated natural gas transmission pipeline from Malin, Oregon to Humboldt Bay, we conclude this alternative would not result in a significant environmental advantage when compared to the proposed action.

3.3.2 LNG Terminal Site Alternatives in Oregon and Washington (LNG Terminal Site Characteristics)

As provided in Jordan Cove's application and identified in table 3.3.2-1, we are evaluating four terminal site alternatives. We determined that a reasonable LNG terminal site alternative should include the following site characteristics.

1. **Available Land** – a parcel or combination of parcels available[58] for development and large enough to accommodate the proposed LNG terminal facilities and associated safety

[58] Section 3 of the NGA does not grant the authority of eminent domain. In some cases, a site may be of adequate size for an LNG terminal, but the owner is unwilling to sell or lease the property.

exclusion zone, about 200 acres to accommodate the facilities and associated workspace proposed by Jordan Cove.

2. **Deep Channel Access** – a channel with depth of at least 36 feet MLLW in order to accommodate the draft of anticipated LNG carriers.
3. **Waterfront Access** – a site that can safely accommodate the mooring of an LNG carrier and the facilities required to transfer LNG from the terminal to the carrier.
4. **Comparable Pipeline** – a site that could be reached by a comparable natural gas transmission pipeline from the intersection of the GTN and Ruby pipeline systems.

For the purposes of our alternatives analysis of sites, we do not further evaluate sites that do not or could not satisfy these LNG site requirements. For example, sites that are of insufficient size or are unavailable for purchase or lease are not carried forward into this analysis.

Locations having the four necessary characteristics were identified in Astoria, Wauna, and Port Westward, Oregon, and Grays Harbor, Washington (figure 3.2-1). An environmental comparison and discussion of these LNG terminal site alternatives is provided below.

Each alternative site would require construction of new natural gas pipelines, and in some cases modifications and upgrades to existing transmission pipelines to access western Canadian and U.S. Rocky Mountain natural gas sources from the intersections of the GTN pipeline and Ruby pipeline near Malin, to meet the stated Project purpose. An estimate of the pipeline length required for each alternative is included in table 3.3.2-1. In each of these alternatives, the associated natural gas supply pipeline would need to cross the Cascade Mountains.

TABLE 3.3.2-1

LNG Terminal Port Alternatives Comparison

Feature	Alternative Port				
	Proposed (Coos Bay)	**Astoria, OR**	**Wauna, OR**	**Port Westward, OR**	**Grays Harbor, WA**
Available Site Size (acres)	412	519	321	336	272
Supply pipeline length (miles)	229	399	375	332	379
Pipeline construction footprint (acres) a/	4,946	8,618	8,100	7,170	8,186
Freshwater wetland impacts (acres) b/	83	143	49	51	61
Estuarine/open water impacts (acres) b/	35	130	35	60	42
Number of listed species with potential habitat	21 c/	10	15	16	9
Existing residences within 1 mile (number)	116	975	5	828	1,637

a/ Estimated using the average area per mile that would be affected by the proposed pipeline, including all extra temporary work space (21.6 acres/mile).
b/ Assuming all mapped resources within the site would be affected.
c/ This includes the LNG terminal site and LNG carrier transit in the waterway. There are only seven federally listed species that may occur at the LNG terminal site itself.

As shown in table 3.3.2-1, environmental features and potential impacts from use of the alternative sites would vary when compared to the proposed site. Three sites (Astoria, Port Westward, and Grays Harbor) would have a significantly greater number of residences located within 1 mile, while one site (Wauna) would have significantly fewer. Three sites (Wauna, Port Westward, and Grays Harbor) would have less impact on freshwater wetlands than the proposed site, while one site (Astoria) would have more. One site (Astoria) is estimated to require significantly more impact on estuarine and open water habitats than the proposed site. All four alternative sites would require at least 100 more miles of supply pipeline than the proposed site, ranging from an estimated 103 miles (Port Westward) to 170 miles (Astoria) of additional pipeline required, which would require an estimated 2,224 to 3,672 additional acres of disturbance for pipeline construction. When evaluating these potential impacts, we have not identified an alternative site that would result in a significant environmental advantage over the proposed site. Therefore, we conclude that none of the regional alternative sites would result in a significant environmental advantage over the proposed site in Coos Bay.

3.3.3 Coos Bay Terminal Alternatives

We evaluated one alternative site for the LNG terminal facilities within Coos Bay. The alternative site is located west of the swinging railroad bridge and on the western side of the Coos Bay Navigation Channel. The swinging railroad bridge is an impediment to vessel traffic and the eastern side of the channel does not contain any sufficiently sized parcels due to the presence of the North Bend and Coos Bay communities. Sites along the west side of the North Spit are not suitable because navigational accessibility is limited by exposure to the open ocean.

The Jordan Point alternative site is located about 1 mile east of the proposed LNG terminal site at about river mile 8.5 of the Coos Bay Federal Navigation Channel (figure 3.3-1). The Jordan Point site would be approximately the same size as the proposed site, and Jordan Cove indicates the site would be available for development of an LNG facility. The alternative site overlaps part of the South Dunes portion of the proposed site. A comparison of major environmental factors between the Jordan Point site and the proposed site are listed in table 3.3.3-1.

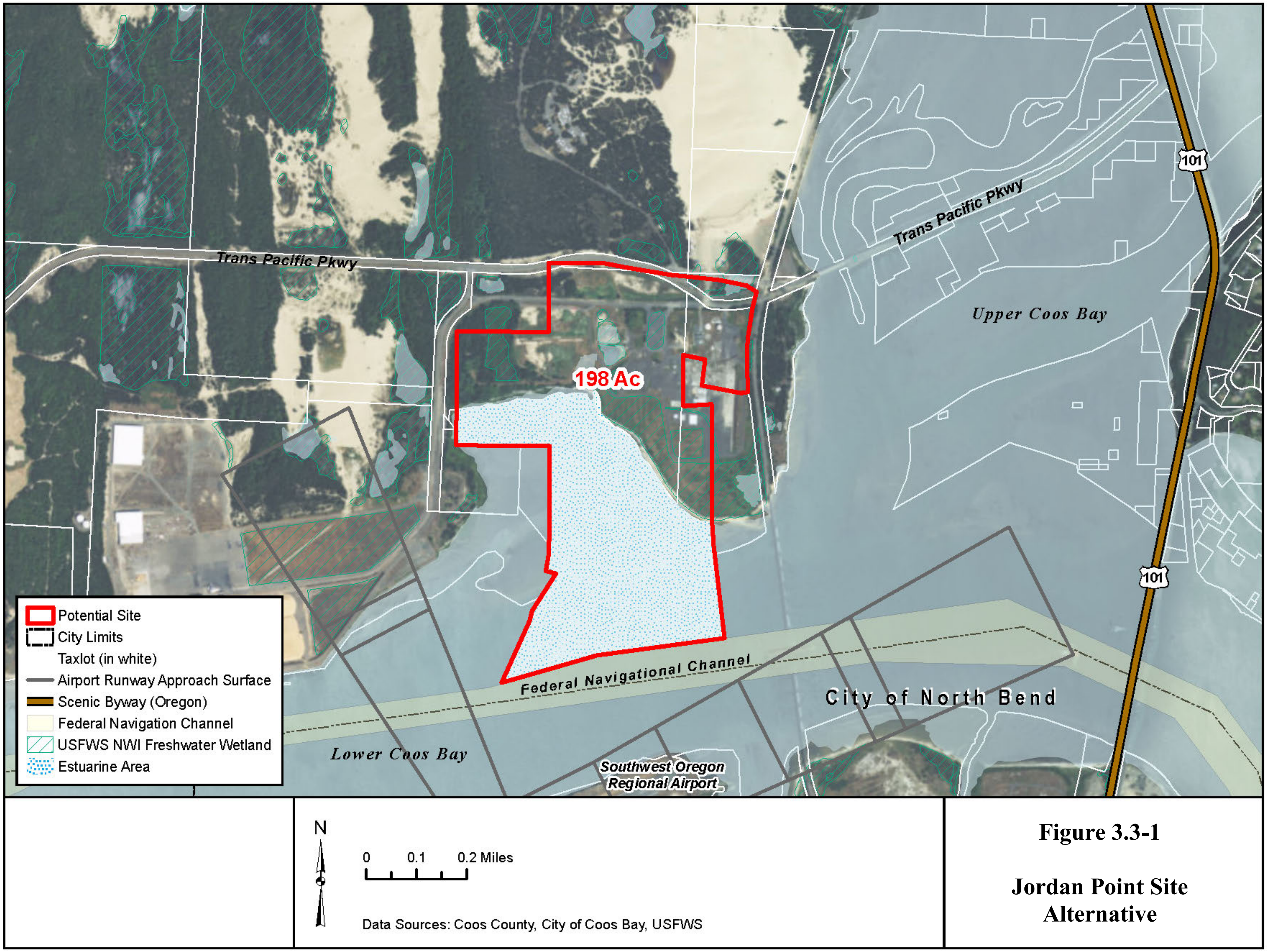


Figure 3.3-1

Jordan Point Site Alternative

TABLE 3.3.3-1

Comparison of Proposed and Jordan Point Alternative LNG Sites

Environmental Factor	Proposed Site	Jordan Point Site
Estuarine Area (acres) a/	32	101
Wetland Area (acres) b/	2	22
Threatened and Endangered Species (number) c/	9	9
Approximate Site Size (acres)	199	198
Land Availability	Y	Y
Federal Land Affected (acres) d/	0	0
Within Airport Runway Approach Zone	No	No
Adequate Area for Safety Exclusion Zone	Y	Y
Existing Residences within 1 Mile (number) d/	116	128

a/ Based on approximate boundary of shoreline to the edge of the Federal Navigation Channel or waterward extent of the potential site boundary.
b/ Based on NWI wetland GIS data within potential site boundary, See Figures 10.3-9 to 10.3-11 in Jordan Cove Resource Report 10.
c/ Based on FWS 2017a and NMFS 2015.
d/ Based on GIS tax lots.

The number of residences within 1 mile would be slightly more for the Jordan Point site (128) than for the proposed site (116), and LNG carriers would have to travel about 1 mile farther along the Federal Navigation Channel to reach the site. Based on NWI mapping, the Jordan Point site would also include more wetlands (approximately 22 acres) compared to the proposed site (approximately 2 acres). The primary disadvantage of the alternative site is its farther distance from the Federal Navigation Channel, which would require a greater area of dredging within the estuarine area between the site and channel (approximately 101 acres) compared to the proposed site (32 acres). For the reasons described above, the Jordan Point site would not provide a significant environmental advantage over the proposed site.

3.3.4 Inland (Non-Waterfront) Alternative

We received comments from the COE requesting that we evaluate an inland LNG terminal site, in order to reduce impacts on wetlands and Coos Bay. An inland alternative site would locate the liquefaction and LNG storage facilities at an upland location outside of Coos Bay and would be connected to the proposed marine loading facilities by an LNG cryogenic pipeline or LNG trucking system. At the proposed site, approximately 86.1 acres of wetlands would be affected by construction and approximately 22.3 acres of wetlands would be permanently altered (see table 4.3.3.1-1). An inland site would not completely eliminate impacts on wetlands as numerous operational and safety facilities would still be required along the shoreline to support the marine loading and LNG carrier berth facilities. Operational and safety facilities would include spill containment systems and utilities such as compressed air, nitrogen, potable water, utility water, fire water, and electrical equipment. An inland site would also require the use of a marine berth and turning basin; therefore, dredging in Coos Bay would still be necessary. As a result, impacts on Coos Bay would not be substantially reduced by an inland terminal site.

Due to the presence of the Oregon Dunes National Recreation Area immediately north of the proposed site, the cities of North Bend and Coos Bay, immediately south, and the Pacific Ocean to the west, any inland site alternative would need to be located at least five miles east of the proposed site. Furthermore, due to the steep topography east of Coos Bay, the distance from the marine loading facilities to a suitable parcel of land for the terminal facilities would likely be greater than five miles and likely require a larger site with more ground disturbance (50 acres or more) to accommodate the significant earthwork (spoil storage, leveling, and slope considerations) that would be required to create an appropriate site. The marine loading facilities would remain at the proposed site because LNG carriers are prevented from travelling farther east by the rail and Highway 101 bridges across Coos Bay.

An LNG cryogenic pipeline, which would be subject to expansion and contraction due to temperature fluctuations, could be located aboveground or underground within a tunnel system. Regardless of the pipeline placement, the USDOT's siting requirements and regulations would apply. In order to ensure pipeline integrity and public safety, the USDOT may require the operating company to obtain legal control of activities up to 400 feet on each side of the pipeline, resulting in an additional 450 acres of land encumbered by the permanent easement. The subsequent amount of affected land when compared to the amount of land typically affected by a natural gas pipeline would be significantly greater. In addition, the USDOT siting requirements for LNG cryogenic pipelines require security features (fencing and exclusion zones) and spill containment systems. At a minimum, an LNG cryogenic pipeline system would need to accommodate the LNG ship loading pipe, an LNG recirculating and cooldown pipe, and the ship vapor return pipe as well as access points for inspection and maintenance work. The cryogenic pipelines would also require insulation along the entire length to maintain (low) operating temperatures. These facilities would require a larger permanent operational easement and would likely require a larger construction right of way, both of which would increase impacts on the environment. Unlike an interstate natural gas pipeline regulated under Section 7 of the NGA that provides for the use of eminent domain, temporary and permanent easements required for an LNG cryogenic pipeline regulated under Section 3 of the NGA must be obtained without the use of eminent domain which could result in a longer pipeline route further increasing impacts on the environment. An LNG cryogenic pipeline would also require pump stations to ensure LNG flows and pressures are maintained. These pump stations would need additional provisions for electrical power, security, firewater, control room, etc. and would require the permanent use of additional lands and impacts on the environment. A cryogenic pipeline transporting LNG from an inland terminal site to the marine loading facilities is technically feasible, but would require numerous design and siting changes, resulting in additional environmental impacts, and could affect the economic competitiveness of the Project.

An inland LNG terminal alternative could impact a larger footprint than the proposed site and would affect other resources. Because the proposed site has been previously disturbed, the impacts of an inland LNG terminal could be greater than the impacts at the proposed site. Furthermore, constructing a LNG cryogenic pipeline would require several additional systems and measures to be designed and implemented to ensure safety and integrity. Ultimately, when considering the footprint of the inland terminal, the marine loading facilities, power infrastructure for the pumps, and the difficulties and costs associated with a redesigned pipeline, we conclude that while perhaps feasible, an inland site would not be practical.

A trucking system transporting LNG from an inland terminal site to the marine facilities at the proposed output volumes would require thousands of truck trips per day. This amount of traffic on area roads would be a significant impact and would greatly increase public safety concerns. In addition, exhaust emissions from the trucks would impact local air quality. Therefore, we conclude that an inland terminal with a trucking system would not provide a significant environmental advantage over the proposed LNG terminal.

3.3.5 Shoreside Berth Alternative

At the request of the COE we assessed an LNG terminal layout at the proposed site that includes a shoreside dock and berth (parallel to the shoreline). As shown on figure 2.1-7, the navigation channel at RM 7.5 is not wide enough to accommodate a docked LNG carrier within the existing channel; therefore, a new berth would be required. Under this alternative a single, new in-water berth could be dredged to the north of the existing channel, generally parallel to the shoreline, and long enough to accommodate an LNG carrier approximately 1,000 feet in length. Docking and LNG loading structures would then need to be constructed from the land-based LNG facilities into the bay to connect to the new berth, estimated to be about 400 to 500 feet. In addition, such a shoreside berth alternative would also require dredging of a turning basin to allow turning of the LNG carriers before entering the berth. Assuming a turning basin would be roughly centered on the existing navigation channel and would be about 1,500 feet in diameter, and the berth would be dredged parallel to the shoreline at the north edge of the turning basin, we estimate that this alternative would require dredging a minimum of about 30 acres outside of the existing navigation channel. In addition, approximately 5 acres of dredging would also be required to create an access channel between the berth and MOF, although it is possible this could be at a reduced depth than required for the LNG carrier berth and turning basin. In total approximately 35 acres of dredging within Coos Bay, outside of the existing navigation channel, would be required for this alternative. As shown in table 4.5.1.1-2, approximately 37 acres of water-based or intertidal habitat would be affected by the proposed Project. Therefore, a shoreside berth alternative would require essentially the same amount of in-water dredging than the proposed configuration. The shoreside berth alternative would, however, eliminate about 42 acres of upland excavation that would be required for construction of the berth as proposed, and the creation of new deep subtidal habitat within the berth area as proposed.

Further, the proposed Project includes an emergency lay berth; therefore, this facility would need to be included in the alternative. Assuming a second berth could utilize the same turning basin, construction of a second emergency berth in a shoreside configuration would add an estimated 15 acres of dredging, bringing the total area of dredging to about 50 acres. However, the current Jordan Cove site is not large enough to allow for two berths placed end-to-end parallel to the shoreline, therefore, agreements with adjacent landowners would likely be required to allow for placement of an emergency berth, either east or west of the proposed site.

As described above, the shoreside berth alternative could eliminate the need for about 42 acres of upland excavation required for construction of the proposed berth and the creation of new deep subtidal habitat within this new berth area. However, a shoreside berth alternative would require about the same area of in-water dredging and associated impacts on aquatic and benthic resources as proposed for a single berth (35 vs. 37 acres), and more area of estimated in-water dredging and associated impacts on aquatic and benthic resources as proposed (50 vs. 37 acres) to include an emergency lay berth. While it is possible that a similar shoreside berth alternative could be located at a different site within Coos Bay, the amount of dredging required would be the same as estimated for the proposed site.

One disadvantage of a shoreside berth alternative would be a reduced level of safety and reliability related to placing the LNG carrier berth along an outside bend in the channel. The shoreside berth alternative would place docked LNG carriers in the direct path of other vessel traffic navigating north (up river) at the RM 7.5 curve, and therefore in danger of allision from a vessel that fails to navigate the turn. This danger could be avoided by shutting down up-river traffic for the entire time that an LNG carrier is at berth (approximately 18 hours). The proposed slip would place LNG carriers at dock to be in a protected berth generally perpendicular to the navigation channel and would allow for other vessel traffic to continue within the navigation channel while an LNG carrier is at berth.

Because in-water dredging and the associated impacts on aquatic and benthic resources would be similar or greater than the proposed berth and access channel, we conclude the shoreside berth alternative does not offer a significant environmental advantage over the proposed action. Therefore, a shoreside berth alternative is not considered further in this EIS.

3.3.6 Refrigeration Compressor Power Supply Alternatives

In response to comments on the draft EIS, we compared the potential emissions from the proposed natural gas-fired direct drive combustion turbines that would supply the refrigeration compressors to the estimated emissions that would result from using electric refrigeration compressors operated exclusively with grid-supplied electric power, and also to the potential emissions from using an on-site power plant to provide power for electric compressors.

The previously proposed LNG export terminal as described in the 2015 final EIS (FERC 2015), included a purpose-built power plant (the South Dunes Power Plant) to provide power for electric refrigeration compressors. As described in the 2015 final EIS, the previous design included four electric refrigeration compressors each rated at 65,000 hp, with a maximum electric power demand of 310 MW for the entire terminal. The South Dunes Power Plant was planned to have a nominal power output of 420 MW. Table 3.3.6-1 presents estimated emissions for the South Dunes Power Plant from the 2015 final EIS, with a comparison to the potential emissions from the currently proposed Project combustion turbines, and to the estimated indirect, off-site emissions that would be produced by using existing power plants in the regional grid to supply the power required for electric compressors. Although the South Dunes Power Plant was to have a nominal capacity of 420 MW, for the purpose of this analysis we have estimated off-site regional grid emissions on the assumption that electric refrigeration compressors would require no more than 310 MW of power. Also, for the purpose of this analysis we did not attempt to re-design the previously proposed on-site South Dunes Power Plant although we recognize that it was to have larger power output than the off-site alternative evaluated here. Indirect emissions were estimated using the Avoided Emissions and Generation Tool (AVERT), which looks at emissions using historical patterns of actual generation in one selected year. Currently, AVERT has data for 2007-2018, and we used the 2018 dataset.

AVERT's dispatch model is able to determine incremental demand increases (or decreases) for specific generation facilities based upon historic patterns of usage for specific changes in power demand in the region. The model generates an output which determines annual decreases or increases in NOx, SO_2, particulate matter with an aerodynamic diameter less than 2.5 micrometers ($PM_{2.5}$), and GHGs. The model also allows emission increases by specific generation plant and county.

TABLE 3.3.6-1

Potential Emissions from Proposed Natural Gas-Drive, On-Site Electric Generation, and Grid-Supplied Electric Power Compressor Options

	Annual Emissions (tpy)			
Pollutant	**Gas Turbine Driven Refrigeration Compressors (Proposed)**	**420 MW Purpose-Built Power Plant to Drive Electric Compressors (from 2015 design) a/**	**AVERT Generated Indirect Emissions from 310 MW of Off-Site Generation to Drive Electric Compressors b/**	**Net Change for Proposed Option over Next-Best Option**
NO_x	82.22	154.1	1,700	-72
VOC	32.82	74.8	N/A	-42
CO	98.55	132.3	N/A	-34
SO_2	35.19	46.1	1,320	-11
PM_{10}	112.37	180.4	N/A	-68
$PM_{2.5}$	112.37	180.4	107	-68
CO_2e	1,292,894	1,695,525	2,250,000	+402,982

CO = carbon dioxide; CO_2e = carbon dioxide equivalent; NO_x = oxides of nitrogen; PM_{10} = particulate matter with a diameter of less than 10 microns; $PM_{2.5}$ = particulate matter with a diameter of less than 2.5 microns; SO_2 = sulfur dioxide; tpy = tons per year; VOC = volatile organic compound

a/ Purpose-built power plant based on potential emissions for the South Dunes Power Plant included in the 2015 final EIS, which employed selective catalytic reduction for control of NO_x, an oxidation catalyst for control of CO and VOC, and natural gas as the only fuel for control of SO_2, PM_{10}, $PM_{2.5}$, and CO_2e.

b/ Indirect emissions would be produced by existing power generation facilities distributed across the regional grid service area. Emissions estimated based on the AVERT 2018 model for the Northwest Power Pool subregion. https://www.epa.gov/statelocalenergy/avoided-emissions-and-generation-tool-avert

As shown in table 3.3.6-1, the currently proposed Project design using direct-drive refrigeration compressors powered by gas-fired combustion turbines would produce less emissions than would be produced by either alternative method for powering electric compressors, for all pollutants except GHG. Using the AVERT metric, it is estimated that the regional grid power needed to operate electric compressors would result in significantly higher emissions of NO_x and SO_2, slightly lower emissions of $PM_{2.5}$, and significantly greater emissions of CO_2. Therefore, we conclude that electric power supply alternatives using electric refrigeration compressors powered either exclusively with grid-supplied electric power or from electric power from an on-site power plant would not provide a significant environmental advantage over the proposed design.

3.4 PIPELINE ROUTE ALTERNATIVES AND VARIATIONS

We evaluated numerous pipeline route alternatives and variations to determine whether their implementation would be preferable to the proposed corresponding action. Major route alternatives are generally greater than 50 miles in length and can deviate from the proposed route by a significant distance. Route variations are generally less than 50 miles in length and deviate from the proposed route to a lesser degree than a major route alternative.

Route alternatives and variations were identified based on public comments received during the scoping and draft EIS comment periods, information provided by Pacific Connector, agency consultations, and our independent review of the Project. Also, as required by Subsection 28 (p) of the Mineral Leasing Act, the agencies considered opportunities for co-location with existing rights-of-way where the proposed pipeline would cross federally managed lands. In addition to alternatives and variations evaluated in this EIS, during the course of refining the proposed route, Pacific Connector incorporated a number of minor route modifications to address agency concerns and landowner requests, constructability issues or constraints, to avoid cultural resources or geological hazards, or reduce impacts on special status, threatened, or endangered species. These include minor modifications recommended by the BLM between MPs 119.5 and 119.8, at MP

126.0, and at MP 131.5, and between MPs 183.9 and 187, and recommended by the Forest Service between MPs 154.7 and 155.1, MPs 157.1 and 158.7, and MPs 171.2 and 173.0.

3.4.1 Major Route Alternatives

Elements we considered during our analysis of potential alternatives included pipeline length, use of or co-location with existing rights-of-way, forest land, agricultural land, waterbody and wetland crossings, residences, known cultural resources, habitat for federally listed threatened or endangered species, and geological hazards and slope stability.

3.4.1.1 All Highway Alternative

We evaluated the All Highway Alternative as a potential alternative that would follow existing highways as much as possible in order to co-locate rights-of-way and reduce the creation of new corridors through resource areas. This alternative would follow Highway 50 west from Malin to Highway 39, northwest to Klamath Falls, then along Highway 140 west to Medford, then along I-5 north to Winston, then west along Highway 42, and then north along Highway 101 to Coos Bay. This route would be approximately 281 miles long, or about 52 miles longer than the proposed route, resulting in approximately 600 acres of additional construction right-of-way disturbance.

The potential advantage of the All Highway Alternative is that the pipeline would be co-located with the existing highway right-of-way, co-locating new disturbance and associated impacts with existing disturbance. However, as explained below, the pipeline would be placed adjacent to, but not within, highway rights-of-way, and therefore the alternative would still require acquisition of new right-of-way. The Federal Highway Administration (FHWA) historically prohibited the installation of new utility facilities within the rights-of-way of access-controlled freeways except in some extraordinary cases. This prohibition was consistent with the American Association of State Highway Transportation Officials (AASHTO) policies for longitudinal accommodation. However, with a 1988 amendment to the FHWA regulations, the FHWA's policy changed to allow each state to decide whether to permit new utility facilities within these rights-of-way, or continue to adhere to the stricter AASHTO policies (FHWA 2014). Oregon defines its policy for accommodating utilities in highway rights-of-way in OAR 734-055-0080. In general, Oregon does not allow utilities to occupy interstate rights-of-way with the exception of perpendicular crossings (Caswell 2008).

In addition to the further disturbance that would result from the longer length of the alternative, there are disadvantages related to its location parallel to highways. The pipeline route paralleling the highway rights-of-way has constraints such as highway cuts and fills; elevated roadway sections, bridges, overpasses and underpasses; clover leaf and other interchanges; as well as commercial, industrial, and residential developments located immediately adjacent to the rights-of-way and interchanges. To be technically feasible, the pipeline would need to divert from the highway right-of-way to avoid cuts and fills, overpasses and other highway infrastructure, and existing developments, which would reduce the area of co-location and increase the pipeline length and associated environmental impacts. For these reasons, we have determined that implementation of the All Highway Alternative would not result in a significant environmental advantage and is not preferable to the proposed route.

3.4.1.2 Federal Lands Route Alternative

We considered a conceptual Federal Lands Alternative that would place the pipeline entirely on federal lands as a potential alternative to avoid or significantly reduce impacts on private property. Given the patchwork nature of federal land holdings in the Project area in southern Oregon, with federal blocks scattered between private tracts, we were unable to identify a route between Malin and Coos Bay that would be entirely on federal lands and not cross private lands. Therefore, a route that would be entirely on federal land and would avoid private property is not feasible and is not considered further in this EIS.

3.4.1.3 Federal Lands Avoidance Route Alternative

We attempted to identify a pipeline route alternative that would avoid crossing federally managed lands. However, given the extensive Forest Service lands and the checkerboard nature of BLM-managed lands in southwest Oregon (see figure 1.1-1), we were unable to identify a route between Malin and Coos Bay that would avoid crossing federally managed lands. We also attempted to identify a pipeline route that would avoid crossing federally managed lands by heading in any direction from Malin and eventually reaching Coos Bay, regardless of length. Again, due to the extensive and connected Forest Service lands to the north, east, south, and southwest of Malin, we were unable to identify a route that could reach Coos Bay without crossing federally managed lands. Therefore, a federal lands avoidance route alternative is not feasible and is not considered further in this EIS.

3.4.2 Pipeline Variations

3.4.2.1 Coos Bay Estuary Variations

We received a number of comments during the scoping and draft EIS comment periods concerning the impact of the pipeline crossing of the Coos Bay estuary, including comments from the Confederated Tribes of Coos, Lower Umpqua, and Siuslaw Indians (CTCLUSI). Pacific Connector proposes to cross the Coos Bay estuary using HDD in two segments between MPs 0.3–1.0 and MPs 1.5–3.0. We evaluated several pipeline variations in this area that would modify the crossing location and method to determine if any alternatives might reduce effects on the estuary, including a North Route Variation, a Modified North Route Variation, and a Haynes Inlet East Avoidance Variation (see figure 3.4-1).

The North Route Variation and the East Avoidance Variation would begin at the pipeline terminus and cross north of Haynes Inlet to the north of Sherwood, and both include HDDs to avoid impacts on the Mangan and Wetle Natural Resource Conservation Service Wetland Reserve Program (WRP) easements on the west and east side of Haynes Inlet (see figure 3.4-1). The Modified North Route Variation would have the same route as the North Route Variation until a point north of Sherwood where it includes an HDD (approximately 5,200 feet in length) that extends from ridgeline to ridgeline on either side of the inlet.

A comparison of major environmental and land use features crossed by each of these variations compared to the corresponding segment of the proposed route is included in table 3.4.2.1-1. The potential advantage of the variations is avoidance of pipeline-related disturbance on the North Point area of North Bend, and avoidance of the Federal Navigation Channel that would be crossed twice, by HDD, at MP 0.66 and MP 1.6 of the proposed route. However, activities proposed by Jordan Cove, which would still occur with use of any of these variations, would affect both the North Point area and the Federal Navigation Channel, essentially negating any advantage of avoiding these areas with the pipeline. The North Point would still be used for construction laydown yards and dredge spoil disposal (within APCO sites 1 and 2, see sections 2.1.1.8 and 2.1.1.10) and the Federal Navigation Channel would still be affected by dredging for the access channel and the marine waterway modifications (see section 2.4.1.5).

The primary disadvantages of the Coos Bay Estuary variations are greater pipeline length and greater associated construction disturbance. Other disadvantages include greater number of waterbody crossings, more forest clearing, and greater number of private land parcels affected.

For the reasons described above, we have determined that implementation of these alternatives would not result in a significant environmental advantage and are not preferable to the proposed route.

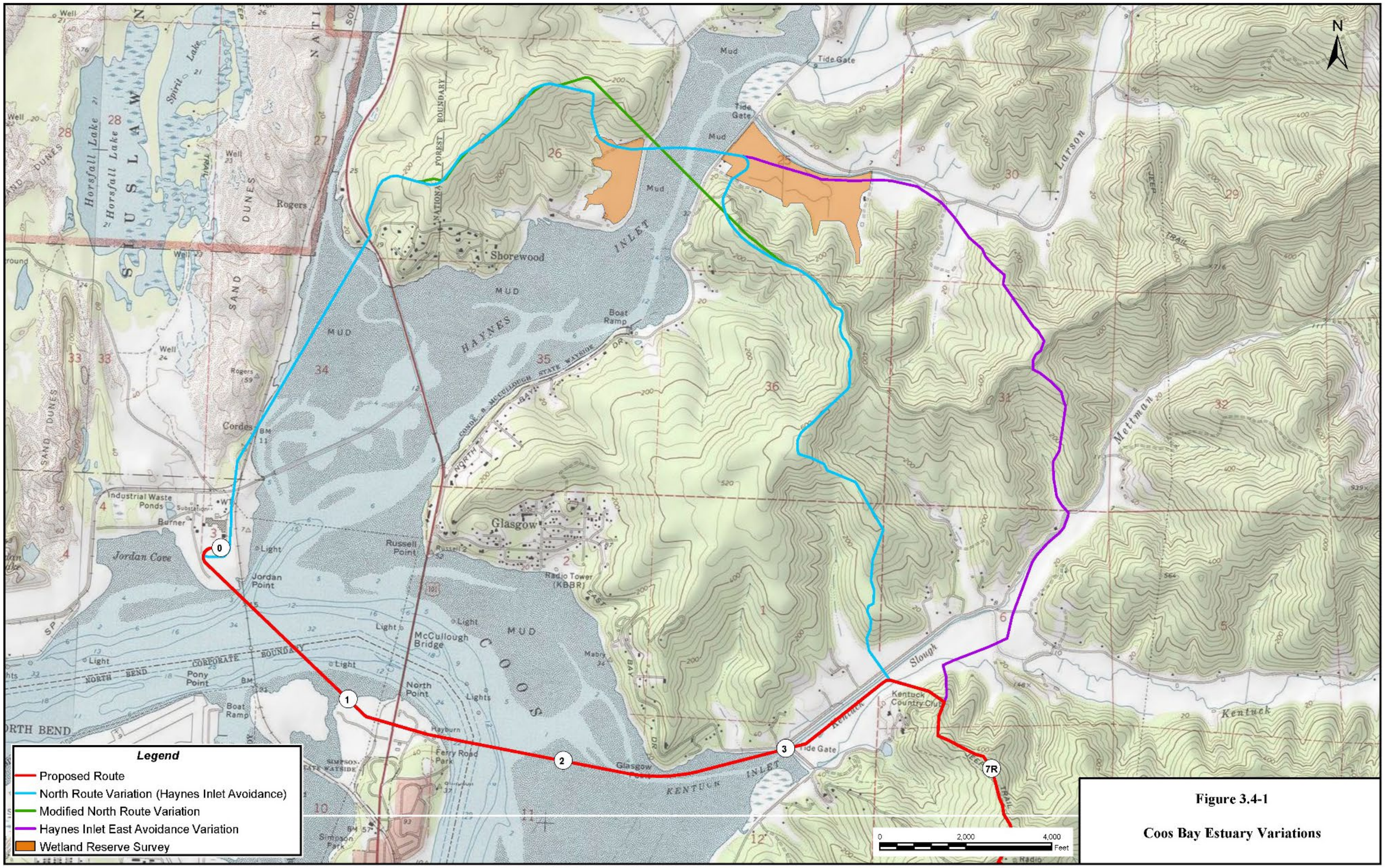


Figure 3.4-1

Coos Bay Estuary Variations

TABLE 3.4.2.1-1

Comparison of Coos Bay Estuary Variations with Proposed Route

Impact/Issue		Proposed Route	North Route Alternative	Modified North Route Alternative	Haynes Inlet East Avoidance Alternative
Variation length (miles) a/		3.43 (2.20 HDD)	7.15 (1.65 HDD)	6.55 (2.54 HDD)	7.55 (1.65 HDD)
Construction ROW (acres) b/		9.3	65.5	52.4	67.9
Temporary extra work areas (TEWA) (acres)		54.9	60.9	49.3	64 c/
Total acres of construction disturbance		64.2	126.4	101.7	131.9
Operational easement (acres) d/		9.8	36.3	30.0	45.8
Land ownership (miles)	Private	0.2	5.5	5.1	5.3
	State	3.3	1.7	1.4	2.3
	Federal	0.0	0.0	0.0	0.0
Number of residences within 50 feet of the construction ROW		0	0	0	1 (HDD)
Number of waterbodies crossed e/		3	7	6	16
Length of wetland crossings (feet) e/		3,168	3,711	950	12,936
Agricultural land affected (miles)		0.5	0.5	0.2	2.2
Forest lands affected (miles) f/		0.0	3.5	3.8	2.8
Miles of ROW parallel or adjacent to existing rights-of-way (percent of route length)		0.2	1.9	1.9	2.5
COE 408 facilities g/		2	0	0	0
NRCS WRP Easements h/		0.0	0.4	0.0	0.9
Miles of critical habitat for federal T&E species and EFH species		0 (2.2 avoided by HDD)	0 (1.3 avoided by HDD)	0 (1.2 avoided by HDD)	0 (1.3 avoided by HDD)

General: All values are rounded (acres to nearest whole acre, miles to nearest tenth of a mile, feet to nearest whole foot).

a/ Variation lengths are measured from the point where they deviate from and then return to the proposed route. Lengths cannot be accurately calculated by comparing mileposts due to shifts in the alignment.

b/ The construction right-of-way (ROW) for the proposed route and alternatives is 9 feet wide in upland areas and, where HDDs are proposed, the ROW width has been removed.

c/ TEWAs for the Haynes Inlet East Avoidance Variation are estimated.

d/ The assumed permanent easement width is 50 feet.

e/ NWI coverages and photo interpretation were used for the Proposed Route and the Haynes Inlet East Avoidance Variation.

f/ Includes all forestland types: Evergreen forest, Mixed conifer, Regenerating forests and clear-cuts. The routes do not cross late successional nor old-growth forests.

g/ The proposed route would traverse under the Coos Bay Federal Navigation (shipping) Channel twice at MPs 0.66 and 1.6 by HDD. The alignment of the Haynes Inlet East Avoidance Variation was realigned to avoid crossing dikes associated with the Larson Inlet Flood Damage Reduction (FDR) Project located along Larson Slough. According to the National Levee Database (http://geoplatform.usace.army.mil/home), the Larson Inlet FDR Project is a federally authorized and constructed and a non-federally operated and maintained, agricultural flood-protection project.

h/ The Mangan WRP would be crossed by both North and East Avoidance Variation on the west side of Haynes Inlet for approximately 1,150 feet. The Wetle WRP would be crossed on the east side of Haynes Inlet by the North Route Variation for approximately 1,130 feet and by the East Avoidance Variation for approximately 3,450 feet.

3.4.2.2 Blue Ridge Variation

Based on comments received during scoping and concerns expressed by the BLM regarding steep topography, late-successional old-growth (LSOG), and potential impacts on threatened and endangered terrestrial species, we evaluated an alternative between MPs 11 and 25 referred to as the Blue Ridge Variation. The 15.2-mile-long Blue Ridge Variation, which is depicted in figure 3.4-2, would deviate from the proposed route near MP 11 just south of the Coos River, continuing southwest across Catching Slough, turning south/southeast, generally co-locating with an existing utility right-of-way before rejoining the proposed route near MP 25. Table 3.4.2.2-1 compares the variation to the corresponding segment of the proposed route. Additional details regarding the assessment of this variation can be found in appendix F.9. In response to the draft EIS, we received numerous comments on the Blue Ridge Variation analysis. We also received additional information from the Applicants. These comments and this information are incorporated as appropriate into the following revised analysis.

The Blue Ridge Variation is longer and would affect about 174.5 acres compared to 161.8 acres for the proposed route. The Blue Ridge Variation more than doubles the number of private parcels (from 21 to 47) and miles of private lands crossed (from 6.5 to 13.8).

When compared to the corresponding segment of the proposed route, the Blue Ridge Variation would reduce clearing of LSOG forest (late-successional forest stands greater than 80 years old) from 32 acres to 9 acres, or from 1.7 miles to 0.6 miles. Additional analysis, specific to BLM lands, was conducted by the BLM utilizing the agency's Forest Operations Inventory (FOI) in response to comments received on the draft EIS. This analysis determined that 18 acres of the 32 acres of LSOG habitat that would be removed by the proposed route was complex LSOG. Similar data was not available to assess the complexity of the 9 acres of LSOG occurring on private lands.

Late-successional forest stands have a well-defined, multi-tiered canopy, which creates microhabitats for many species (Bingham and Sawyer, Jr. 1991; Spies and Franklin 1996), including the federally listed NSO and MAMU. The Blue Ridge Variation would substantially reduce the acres of occupied and presumed occupied (suitable habitat) MAMU stands removed from 25 acres to 3 acres and reduce the acres of NSO nesting, roosting and foraging habitat removed from 36.3 acres to 9 acres. The Blue Ridge Variation would remove 29 acres less of ODFW-designated Category 1 Habitat (see definition and discussion in section 4.5.1.1).

The Blue Ridge Variation increases the number of perennial waterbodies crossed from 3 to 31; increasing the number of known and assumed anadromous fish-bearing streams crossed from 4 to 18 (includes intermittent anadromous fish-bearing waterbodies). The acres of wetlands crossed under this variation also increases from 13.4 acres to 32.4 acres, of which, 1.2 acres would be permanently converted. The Blue Ridge Variation would also increase construction in landslide prone areas from two areas, totaling 1,088 feet, to five areas, totaling 7,137 feet.

As indicated in the comparison table, the above discussion, and the analysis contained in appendix F.9, the primary trade-offs between the proposed route and the variation are between terrestrial resources (e.g., LSOG forest and MAMU stands/habitat) and aquatic resources (e.g., waterbody crossings and anadromous fish habitat), as well as public and private lands. With respect to terrestrial and aquatic resources, the measures that would be implemented to avoid or reduce these impacts differs considerably. Constructing and operating the pipeline along the proposed route would result in a permanent[59] loss of LSOG forest and would adversely affect MAMU (see sections 4.4, 4.6, and appendix F.9 for discussions regarding these resources). The Applicants have very minimal options available for avoidance and minimization measures to address these permanent effects to upland resources (i.e., complex LSOG habitat, MAMU and NSO nesting habitat), and have not proposed mitigation for these long-term effects. The MAMU timing constraints required by BLM's RMP would require construction to occur over several years on BLM lands for the proposed route resulting in a number of direct and indirect effects on both the human and natural environment (e.g., noise, water quality, traffic). In contrast, these constraints are not expected to cause construction delays along the Blue Ridge Variation due to the small amount of BLM lands that provide MAMU habitat along the variation.

As illustrated in table 3.4.2.2-1, some of the impacts on aquatic resources, waterbodies, and anadromous fish would be temporary to short-term with the implementation of Jordan Cove's and Pacific Connector's proposed impact minimization and waterbody restoration measures (e.g., Jordan Cove's *Plan*, *Procedures,* and ECRP), as well as our recommendations (see sections 4.3 and 4.5 for discussions regarding these resources). For waterbody crossings on federal lands the Applicants have adopted construction and restoration procedures and also proposed compensatory mitigation to avoid, reduce, and compensate for the effects to waterbodies and anadromous fish as part of the federal Right-of-Way Grant application (see appendices F.10 and F.12). However, some permanent unmitigated effects on waterbodies and anadromous fish would occur in the form of the permanent loss of mature riparian areas associated with affected waterbodies.

Our experience from reviewing stream crossings by FERC-regulated pipelines constructed in numerous habitats across the U.S. has confirmed that the short duration of the crossing and the prompt restoration of the stream bed and stabilization of the stream banks results in very few impacts on waterbodies that extend in time beyond the construction and initial restoration of the right-of-way. This is in part due to implementation of best management practices such as dry crossing methods, timing and duration, and restoration methods that are required by the FERC's *Plan* and *Procedures*, which are methods that the Applicants have incorporated into their proposal. By comparison, the removal of LSOG habitat is a permanent impact for the operational right-of-way and, even in temporary work areas, recovery of the habitat would take at least 80 years.

We acknowledge that the variation would increase the number of private parcels crossed. Numerous public comments in the Commission's administrative record express concerns about how these lands would be affected. However, we note that although many additional private parcels are affected by the variation, only one residence is located within 50 feet of the construction right-of-way. This EIS addresses numerous measures to be employed during and following construction that would reduce impacts and facilitate restoration of the right-of-way.

We also acknowledge the concerns expressed by the NMFS and the COE regarding the increased impacts on waterbodies, threatened and endangered aquatic species, and adjacent riparian vegetation; and the BLM, FWS, and Tribes regarding the impacts on LSOG forest, threatened and endangered terrestrial species, and other upland managed resources. As stated previously, there are considerable trade-offs between the proposed route and the variation.

[59] The removal of LSOG habitat would result in a long-term (80+ year) timeframe for conifers to mature to a point where they could provide functional LSOG habitat.

In the alternatives methodology described at the beginning of this section, we state that an alternative would be preferable if it meets the stated purpose of the Project; is technically and economically feasible and practical; and if implemented would result in a significant environmental advantage when compared to the proposed action. We also state that when making an alternatives determination we attempt to balance the overall impacts (and other relevant considerations) of the alternative and the proposed action. Therefore, recognizing the trade-offs between the proposed route and the variation; the differences between terrestrial and aquatic resource impacts in regard to temporal effects, as well as the scope of avoidance, minimization, and mitigation for these effects; and the magnitude of the effects, we have determined that the Blue Ridge Variation would result in a significant environmental advantage when compared to the corresponding segment of the proposed route. Our conclusion is based primarily on the variation's ability to reduce long-term permanent impacts on LSOG habitat affected by the proposed route. Both the sensitivity and value of this habitat and the duration of the impact contribute to this finding. Therefore, **we recommend that:**

- **<u>Prior to construction</u>, Pacific Connector should file with the Secretary, for review and written approval by the Director of OEP, revised alignment sheets that incorporate the Blue Ridge Variation into its proposed route between MP 11 and MP 25.**

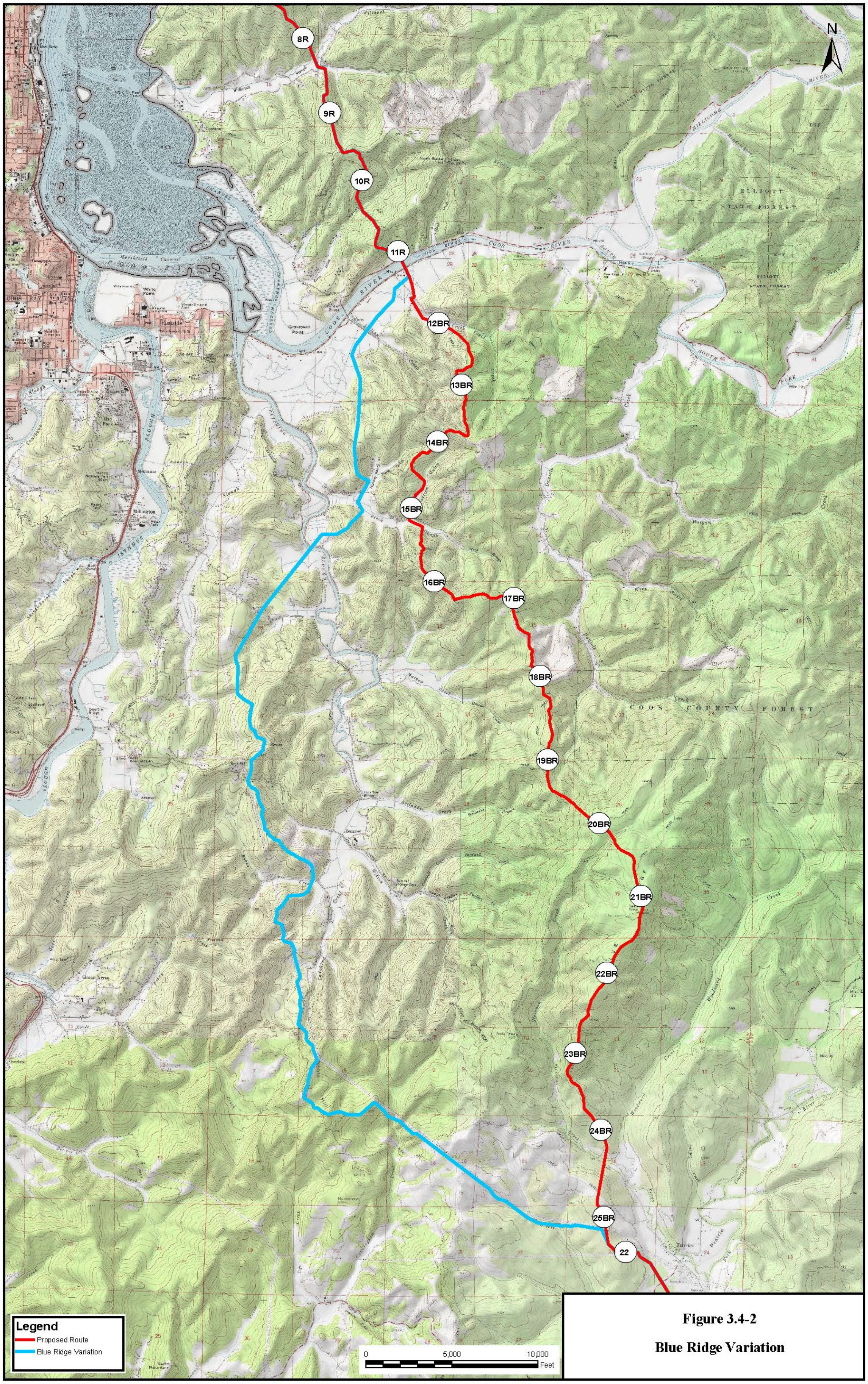


Figure 3.4-2

Blue Ridge Variation

TABLE 3.4.2.2-1

Comparison of Blue Ridge Variation with the Proposed Route

Alternatives Analysis		**Proposed Route**	**Blue Ridge Variation**
General			
Length (miles) a/		14.0	15.2
Construction right-of-way (acres)		161.8	174.5
Temporary extra work areas (TEWA) (acres)		37.5	57.0
Uncleared storage areas (acres)		44.7	1.5
Temporary access roads (TARs) Permanent access roads (PARs)		1 (TAR 12.08/0.2 ac) 1 (PAR 22.16 BR/0.1 ac)	1 (TAR 13.8/0.2 ac) 1 (PAR 15.6/0.3 ac)
Land Use			
Permanent easement (acres) b/		85.2	92.3
Land ownership (miles)	Private	6.5	13.8
	BLM	7.5	1.4
	State	0.0	<0.1
Number of landowner parcels crossed	Private	21	47*
	BLM	12	4
	State	2	2
BLM Coos Bay Wagon Road Lands crossed (miles) c/		7.5	1.4
BLM Public Domain Lands crossed (miles) c/		0.0	<1.0 miles
Number of residences within 50 feet of the construction right-of-way (ROW)		0	1
Waterbodies and Wetlands			
Number of waterbodies crossed	Field survey data	3 perennial 7 intermittent d/ e/ (5.7 unsurveyed)	30 perennial 29 intermittent 1 estuarine (4.6 unsurveyed)
Length of wetland crossings (miles)		0.8	1.8
Permanent conversion of wetlands (acres)		0.0	1.2
Vegetation			
Designated Riparian Reserves on BLM-managed lands Impacted (acres)		12.3	9.1
Agricultural pastures affected (acres construction right-of-way)		8.6	11.1
Coniferous forest (acres construction ROW) f/	LSOG	22.8	8.8
	Mid-seral	59.7	37.5
	C – R	78.5	129.0
LSRs crossed (miles/acres)		5.5 miles / 97.3 acres	0.44 mile / 5.16 acres
Direct LSOG Effects, all ownerships (miles/acres)		1.7 miles/32 acres	0.6 miles/9 acres
Direct LSOG Effects on BLM Lands (acres) m/		49.0	0.2
Direct Complex LSOG Effects on BLM lands (acres) m/		18.0	0.0
Biological Resources			
Northern Spotted Owl (NSO) home range (1.5-mile radii)		1 / 1.23 miles	1 / 0.75 mile
High NSO NRF and NRF habitat removed on all lands (acres) g/		22.8	8.8
Direct Effects on NSO Nesting Habitat on BLM Lands (acres)		16.4	0.0
Indirect Effects on NSO Nesting Habitat on BLM Lands (acres)		60	0.0
Direct Effects on NSO NRF Habitat on BLM Lands (acres)		1.4	0.0
Indirect Effects on NSO NRF Habitat on BLM Lands (acres)		11.4	0.0
Number of marbled murrelet (MAMU) stands (all lands) crossed by ROW		3 occupied stands; 14 presumed occupied stands h/	3 presumed occupied stands
MAMU Suitable Habitat removed on all lands (acres) i/		25 (5.8 acres occupied; 19.1 acres presumed)	3.0
MAMU Suitable Habitat Modified on all ownerships (Indirect Effect)		9	0
Occupied/Potential MAMU stands on BLM Lands		3/1	0/0
Direct Effects on MAMU Nesting Habitat on BLM Lands (acres)		10.4	0.0
Indirect Effects on MAMU Nesting Habitat on BLM Lands (acres)		34.3	0.0
Construction Effects on ODFW Irreplaceable Essential Habitat – BLM Lands (acres)		27	<1
Construction Effects on ODFW Irreplaceable Essential Habitat – Other Lands (acres)		5	3
Operational Effects on ODFW Irreplaceable Essential Habitat – BLM Lands (acres)		5	<1
Operational Effects on ODFW Irreplaceable Essential Habitat – Other Lands (acres)		1	1
Number of anadromous fish-bearing streams crossed j/	Known	4	9
	Assumed	0	9

TABLE 3.4.2.2-1 (continued)

Comparison of Blue Ridge Variation with the Proposed Route

Alternatives Analysis		Proposed Route	Blue Ridge Variation
Fisheries critical habitat	Coho k/	4	7
(streams crossed)	Green Sturgeon l/	0	0
Number of anadromous fish species (BLM)		0	0
Number of resident fish species (BLM)		1	0
Number of EFH fish species (BLM)		0	0
Number of ESA fish species (BLM)		0	0
Number of anadromous fish species (other)		5	15
Number of resident fish species (other)		5	19
Number of EFH fish species (other)		5	9
Number of ESA fish species(other)		5	9
Geotechnical			
Landslide prone areas m/		2 landslide areas (totaling 1,088 feet)	5 landslide areas (totaling 7,137 feet)
Cultural Resources			
Number of known cultural resources sites		1 n/ o/	0
Number of newly identified cultural resources		1 n/	0 p/
Other			
Right-of-way adjacent to existing rights-of-way (miles and percent of route length) q/		8.3 (59 percent)	7.1 (47 percent)

General: All values are rounded (acres to nearest whole acre, miles to nearest tenth of a mile, feet to nearest whole foot).
* Does not include county parcels associated with existing county roads.
a/ Route Alternative lengths are measured from the point where they deviate from and then return to the proposed route. Lengths cannot be accurately calculated by comparing mileposts due to shifts in the alignment.
b/ Acres of permanent easement calculated based on a 50-foot-wide permanent easement.
c/ See further explanation of these land categories in section 4.7.3.3.
d/ Includes waterbodies not crossed by the centerline but within the right-of-way.
e/ Field surveys on BLM lands and desktop analysis on private lands.
f/ Evergreen Forest: LSOG (late successional/old-growth forest) = 80+ years; Mid-seral = 40 to 80 years; C-R (Clear-cut/regenerating forest) = 0 to 40 years.
g/ Acreage is based on 2019 updated NSO habitat coverage for the pipeline project (nesting, roosting, and foraging habitat: NRF, High NRF).
h/ "Presumed occupied stands" have not been surveyed following the species-specific survey protocol (Mack et al. 2003). "Occupied stands" are confirmed occupied based on the species-specific survey protocol.
i/ Acreage is based on 2019 updated MAMU habitat coverage for the pipeline.
j/ ODF (2017). Each crossing would include clearing of some riparian vegetation.
k/ NMFS (2008a).
l/ NMFS (2009).
m/ Defined in appendix F.9 of this EIS.
n/ Surveys are incomplete on approximately 6.0 miles (43 percent) of the route on private lands.
o/ The historic Barker-Morris Families Cemetery, dating to 1872, is located on private land in Township 27 S, Range 12 W, Section 14. The historic cemetery is situated at MP 24.3 of the proposed route. The cemetery is shown on the McKinley 7.5-minute quadrangle approximately 24 meters east of the construction right-of-way. However, cultural surveys have not been conducted on this privately-owned parcel, and the exact location of the cemetery has not been verified. The cemetery is listed in the Oregon Burial Site Guide but has not been recorded as an archaeological site with the Oregon State Historic Preservation Office.
p/ Surveys have not been conducted along the entire route of the variation.
q/ The Blue Ridge Variation is adjacent to a BPA Powerline corridor, whereas the proposed route is adjacent to logging roads.

3.4.2.3 Weaver Ridge Variations

At the request of the BLM, we evaluated several route variations between MPs 42.7 and 49.8 to determine if impacts on MAMU and NSO critical habitat could be reduced. As illustrated in figure 3.4-3, we evaluated the Deep Creek Variation, Weaver Ridge Variation 1, Weaver Ridge Variation 2, Weaver Ridge Variation 2a, Weaver Ridge Variation 3, Weaver Ridge Variation 3a, and Weaver Ridge Variation 4.

The Weaver Ridge Variation 1 would deviate from the proposed route around MP 46.0 crossing the logging spur road north of a reservoir and head almost due east on the north side of a tributary of Wildcat Creek over ridges, reconnecting with the proposed route at about MP 49.8. This alternative would be slightly shorter than the proposed route. However, the Weaver Ridge Variation 1 would cross more miles of critical habitat for MAMU and NSO, and would cross two MAMU occupied stands (compared to one along the proposed route) and five NSO home ranges (compared to four along the proposed route).

The Weaver Ridge Variation 2 would start at the same location as Variation 1 but deviate from Variation 1 east of the proposed route at about MP 46, crossing a logging spur road, pass the Signal Tree Quarry, then follow Signal Tree Road for about 3 miles. It would head south over ridges, then join Variation 3 along Wildcat Creek. Weaver Ridge Variation 2a would deviate from Variation 2 just across the Coos County line along Signal Tree Road, cutting diagonally along Wildcat Creek to rejoin Variation 2 Route across the Douglas County line.

The Weaver Ridge Variation 3 would deviate from the proposed route at about MP 42.6. It would follow ridges for about 3.5 miles, crossing Signal Tree Road and Upper Rock Creek. The variation would then turn east and follow ridges for almost 4 miles, crossing Wildcat Creek before rejoining the proposed route at about MP 48.5. Weaver Ridge Variation 3a would deviate from Variation 3 and follow Wildcat Creek for 1.5 miles to join the proposed route at about MP 49.0.

A comparison of the environmental features of the Weaver Ridge Variations and the corresponding segment of proposed route are shown in table 3.4.2.3-1. Weaver Ridge Variations 2, 2a, 3, and 3a are all longer than the corresponding segment of proposed route and would cross more miles of MAMU and NSO critical habitat. Variations 3 and 3a would cross six NSO home ranges, while Variations 2 and 2a would cross five NSO home ranges (compared to four for the corresponding segment of proposed route). Compared to the proposed route, these variations would require clearing more LSOG and affect more acres of LSR on lands managed by the BLM. As a result, none of these variations within this area would ultimately reduce impacts on MAMU and NSO critical habitat. Therefore, we have determined that implementation of Weaver Ridge Variations 2, 2a, 3, and 3a would not result in a significant environmental advantage and are not preferable to the proposed route.

Weaver Ridge Variation 1 would be shorter than the corresponding segment of proposed route and would cross less waterbodies than the proposed route; however, it would have greater impacts on forested habitats, cultural resources, as well as MAMU and NSO critical habitat. Therefore, we have determined that implementation of Weaver Ridge Variation 1 would not result in a significant environmental advantage and is not preferable to the proposed route.

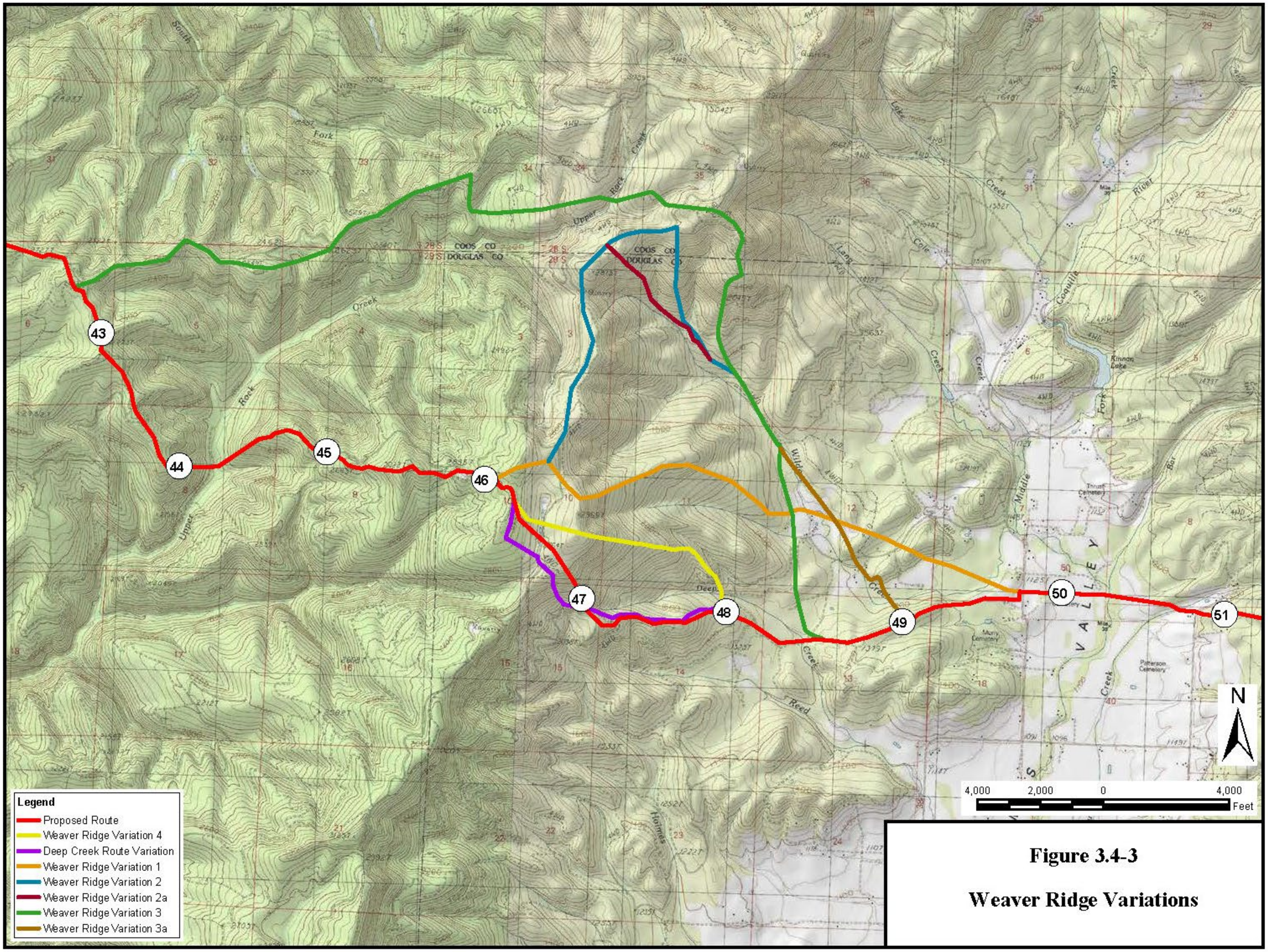


Figure 3.4-3

Weaver Ridge Variations

TABLE 3.4.2.3-1

Comparison of Weaver Ridge Variations with the Proposed Route

Alternatives Analysis		Proposed Route	Deep Creek Variation	Weaver Ridge Variations 4	1	2	2a	3	3a
General									
Total length (miles) a/		7.3	7.4	7.2	7.0	9.3	9.0	8.6	8.2
Construction ROW (acres) b/, c/		84	85	82	80	107	103	99	94
Operational easement (acres) d/		44	45	43	42	56	54	53	50
Number of Parcels Affected	BLM	4	4	4	3	5	4	4	4
	Private	12	12	11	11	15	14	12	13
	State	0	0	0	0	0	0	0	0
Land ownership (miles)	BLM	2.7	2.8	3.3	2.5	3.4	2.8	3.6	3.2
	Private	4.6	4.6	3.9	4.5	6.0	6.2	5.0	5.0
	State	0	0	0	0	0	0	0	0
Waterbodies and Wetlands									
Number of waterbodies crossed e/		5	5	5	2	7	7	11	11
Total wetland crossing length (feet) f/		0	0	0	0	0	0	0	0
Land Use									
Land Allocations (miles)	Matrix	2.1	2.1	2.1	1.1	1.4	1.4	0.7	0.4
	LSR	0.6	0.7	1.2	1.4	1.9	1.4	2.9	2.9
	Riparian Reserves	0.5	0.7	0.5	<0.1	0.5	0.3	0.6	0.5
Evergreen forest, Mixed conifer (late successional/old-growth) (miles)		0.4	0.7	0.4	1.8	2.2	1.7	1.2	1.7
Regenerating/mid-seral forest (miles)		3.7	5.4	3.9	3.4	4.5	4.5	6.3	5.2
Total forest lands affected (miles)		6.0	7.1	5.9	6.3	8.5	8.1	8.0	7.4
Other land use types (miles)		1.3	0.3	1.3	0.7	0.8	0.8	0.7	0.8
Right-of-way parallel or adjacent to existing rights-of-way (miles)		3.2	3.8	3.6	2.4	3.6	3.2	2.7	2.3
Number of previously identified cultural resources along the route f/		0	0	0	1	0	0	0	0
Newly identified cultural resources along the route (number) f/		0	0	0	0	0	0	0	0
Endangered Species									
MAMU critical habitat crossed (miles)		0.6	0.7	1.2	1.4	2.0	1.4	2.9	2.9
Number of MAMU occupied stands crossed		1	1	2	2	1	1	0	0
MAMU occupied stands crossed (miles)		<0.1	<0.1	0.4	1.0	<0.1	<0.1	0	0
NSO critical habitat crossed (miles)		0.9	1.0	1.0	1.1	1.7	1.3	2.5	2.5
Number of NSO home ranges crossed		4	4	4	5	5	5	6	6
NSO home ranges crossed (miles)		5.9	6.0	5.8	6.0	8.1	7.8	7.3	7.0
Number of NSO 500-acre core areas crossed		1	1	0	1	2	2	2	2
NSO core areas crossed (miles)		0.6	0.6	0	1.1	1.4	1.0	1.9	1.9

TABLE 3.4.2.3-1 (continued)

Comparison of Weaver Ridge Variations with the Proposed Route

Alternatives Analysis	Proposed Route	Deep Creek Variation	Weaver Ridge Variations 4	1	2	2a	3	3a
Number of 30-acre nest patches crossed	0	0	0	1	1	0	0	0
NSO 30-acre nest patches crossed (miles)	0	0	0	0.1	0.4	0	0	0

General: All values are rounded (acres to nearest whole acre, miles to nearest tenth of a mile, feet to nearest whole foot).
a/ Variation lengths are measured from the point where they deviate from and then return to the proposed route. Lengths cannot be accurately calculated by comparing mileposts due to shifts in the alignment.
b/ Assumes a 95-foot-wide construction right-of-way (ROW) for all variations.
c/ TEWAs for all route variations have not been designed and are not included in the total acres of disturbance.
d/ The assumed operational easement is 50 feet; however, Pacific Connector would only maintain vegetation within 15 feet of the pipeline centerline for a total of 30 feet during operation.
e/ Waterbodies from PNW Hydrography Framework Clearinghouse.
f/ NWI CONUS data.

Weaver Ridge Variation 4 would deviate from the proposed route at about MP 46.3 and head southeast over ridges on the north side of Deep Creek, crossing the logging spur road south of the reservoir and reconnecting with the proposed route at about MP 48.0. The Deep Creek Variation would deviate from the proposed route at about MP 46.3 and follow a ridge north of Holmes Creek Spur Road and an unnamed four-wheel-drive road back to the proposed route at about MP 47.0 and cross to the north side of the proposed route and parallel that route for about 1 mile before reconnecting with the proposed route near MP 48.0. The Deep Creek Variation would be about 0.1 mile longer than the corresponding segment of proposed route. Based on a geotechnical review, a high risk of landslides and surface erosion were identified where the Deep Creek Variation would cross the eastern flank of Weaver Ridge above a first order stream. Similarly, where Weaver Ridge Variation 4 would cross Weaver Ridge, it would traverse an extremely steep, narrow rock outcrop that would require blasting. These areas would be avoided by the proposed route where it would ascend Weaver Ridge westward from a forest plantation near MP 46.5 up the slope to the north avoiding the rock outcrop. For these reasons, we have determined that implementation of the Deep Creek Variation and Weaver Ridge Variation 4 would not result in a significant environmental advantage and are not preferable to the proposed route.

3.4.2.4 Camas Valley Northern Variation

Pacific Connector had initially identified a potential variation through the Camas Valley between MPs 50 and 53 to reduce impacts on MAMU habitat (i.e., the Camas Valley Northern Variation), and we evaluated this variation to see if it would be environmentally preferable to the proposed route. This variation is illustrated on figure 3.4-4 and compared in table 3.4.2.4-1.

The Camas Valley Northern Variation would deviate from the proposed route at about MP 50.2 and head northeast across the Camas Valley then turn southeast over forested hills before rejoining the proposed route near MP 53.0. This variation would cross habitat and one occupied stand for MAMU and habitat for NSO on BLM-managed lands. For this reason, the BLM found it unacceptable. We agree and have determined that implementation of the Camas Valley Northern Variation would not result in a significant environmental advantage and is not preferable to the proposed route.

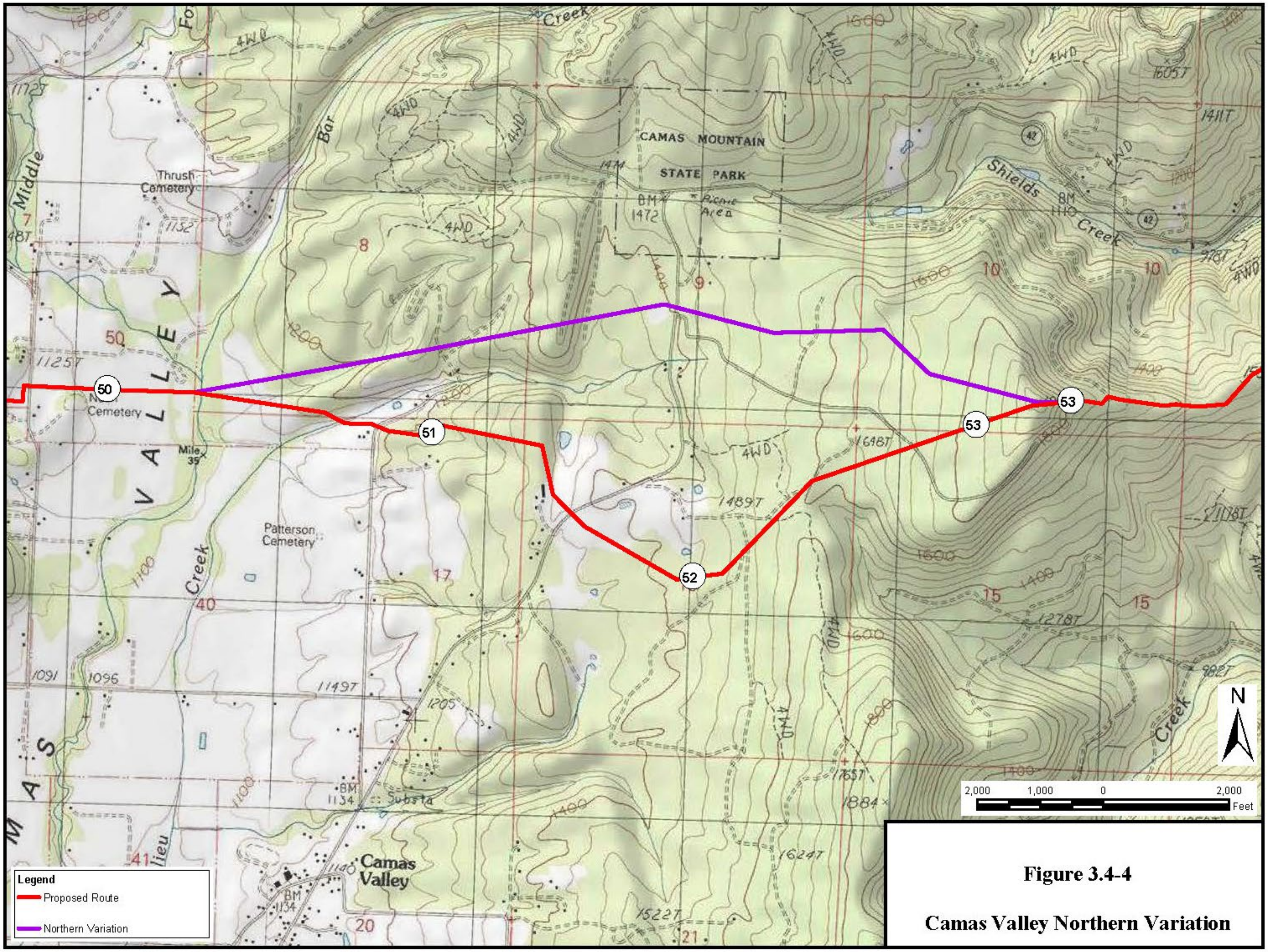


Figure 3.4-4

Camas Valley Northern Variation

TABLE 3.4.2.4-1

Comparison of Camas Valley Northern Variation with the Proposed Route

Alternatives Analysis		Proposed Route	Camas Valley Northern Variation	
General				
Length (miles) a/		2.9	2.7	
Construction ROW (acres)		33	31	
Permanent easement (acres) b/		17	16	
Land Use				
Land Ownership (miles)	Private	2.3	2.0	
	State	0	0	
	Federal (BLM/NFS lands)	0.6	0.8	
Number of landowner parcels crossed		15	8	
Number of residences within 50 feet of construction ROW		0 c/	0	
Right-of-way parallel or adjacent to existing rights-of-way (miles)		0.1	0.1	
LSR - Federal land use designation (acres)		5 d/	0	
Riparian Reserves - federal land use designation (acres)		1	3	
Waterbodies and Wetlands				
Number of waterbodies crossed e/		4	11	
Length of wetland crossings (feet) f/		0	0	
Vegetation				
Agricultural lands affected (acres)		8	2	
Total forest clearing (acres)		28	39	
Clearcut/ Regenerating (0 to 40 years) (acres) g/		14	22	
Mid-Seral Forest (40 to 80 years) (acres)		8	10	
Late-Successional Forest (80 to 175 years) (acres)		6	2	
Old-Growth Forest (175 years +) (number)		0	4	
Biological Resources				
MAMU suitable habitat crossed (feet) h/		5	18	
MAMU stands		No known stands	Occupied	Alignment crosses 1,043 feet of Occupied Stand R3027
		No known stands	Presumed	Alignment crosses 350 feet of potential MAMU Stand B12 not likely to be occupied based on 2-year survey protocol.
MAMU critical habitat (acres)		5 Pacific Connector made a minor adjusted to the Southern Route Variation to avoid crossing approximately 175 feet of the old-growth forest within this Critical Habitat Unit.)	0	
NSO suitable habitat crossed (acres) i/		20	33	
NSO nest patch/cores		No known nest patch/cores	None	
NSO critical habitat crossed (feet)		0	0	
Area affected by habitat category (acres) j/			Category	
		2	1	5
		13	2	5
		17	3	15
		16	4	18
		2	5	2
		3	6	2

TABLE 3.4.2.4-1 (continued)

Comparison of Camas Valley Northern Variation with the Proposed Route

Alternatives Analysis	Proposed Route	Camas Valley Northern Variation
Kincaid's lupine	Approximately 1.1 miles of habitat may be suitable for Kincaid's lupine.	Approximately 2.2 miles of potential habitat crossed; 0.8 mile surveyed of which 0.3 mile was considered suitable.
ESA fish species present/habitat k/	1 stream crossing known, 3 stream crossings unknown. 1 stream crossing - Oregon Coast ESU Coho, assumed.	1 stream crossing known, 3 stream crossings unknown. 1 stream crossing - Oregon Coast ESU Coho, assumed.
StreamNet – anadromous fish distribution l/	None	None
Geotechnical		
Steep or difficult terrain (miles) m/	0.0	0.0
Highly erosive soils (miles) n/	0.2	0.2
Cultural Resources		
Number of previously recorded cultural resources	2 sites	3 - Isolated finds; 2- sites
Number of newly identified cultural resources o/	1- isolated find	N/A

General: All values are rounded (acres to nearest whole acre, miles to nearest tenth of a mile, feet to nearest whole foot).
a/ Variation length is measured from the point where it deviates from and then returns to the proposed route. Length cannot be accurately calculated by comparing mileposts due to shifts in the alignment.
b/ Assumes 50-foot-wide operational easement.
c/ There are 2 outbuildings (barns/sheds) in the vicinity of the proposed route that are within 50 feet of the construction right-of-way (ROW) (MP 51.4 and MP 51.9). Neither of these structures is suspected of being residences; however, during the ROW acquisition phase, Pacific Connector would attempt to locate the construction ROW at least 50 feet from any residences, where feasible.
d/ Approximately 5 acres of LSR would be affected, with 3 acres occurring within clear- cut/regenerating forests (0 to 40 years) and 2 acres occurring within mid-seral forest (40 to 80 years).
e/ Waterbodies from PNW Hydrography Framework Clearinghouse.
f/ NWI CONUS data.
g/ Forest Age Classes: Includes recent clearcut forests and areas of inroad construction where forest clearing would be reduced.
h/ Huff et al. (2006).
i/ Forest Service (2005a).
j/ Based on surveys completed by Pacific Connector.
k/ FWS, NMFS, and StreamNet (http://www.streamnet.org).
l/ ODFW (2000, 2006a); StreamNet.
m/ Based on Soil Mapping Units that have slopes of 50-75 percent and have a water erosion rating of high or severe (NRCS 2004).
n/ Based on Soil Mapping Units that have a water erosion rating of high or severe (NRCS 2004).
o/ Variation has not been completely surveyed.

3.4.2.5 Umpqua National Forest Variations

In consultation with the Forest Service and to evaluate potential options to reduce impacts on forested lands, we evaluated three route variations within the Umpqua National Forest between MPs 104.8 and 111.5. The proposed route and variations are shown on figure 3.4-5.

Variation 1 would generally follow along Wildcat Ridge close to the proposed route between MPs 105 and 109, where it would then turn east and then southeast, crossing near Long Prairie, then south before rejoining the proposed route near MP 111.2. Environmental features crossed or affected by Variation 1, and a comparison to the corresponding segment of proposed route, are included in table 3.4.2.5-1.

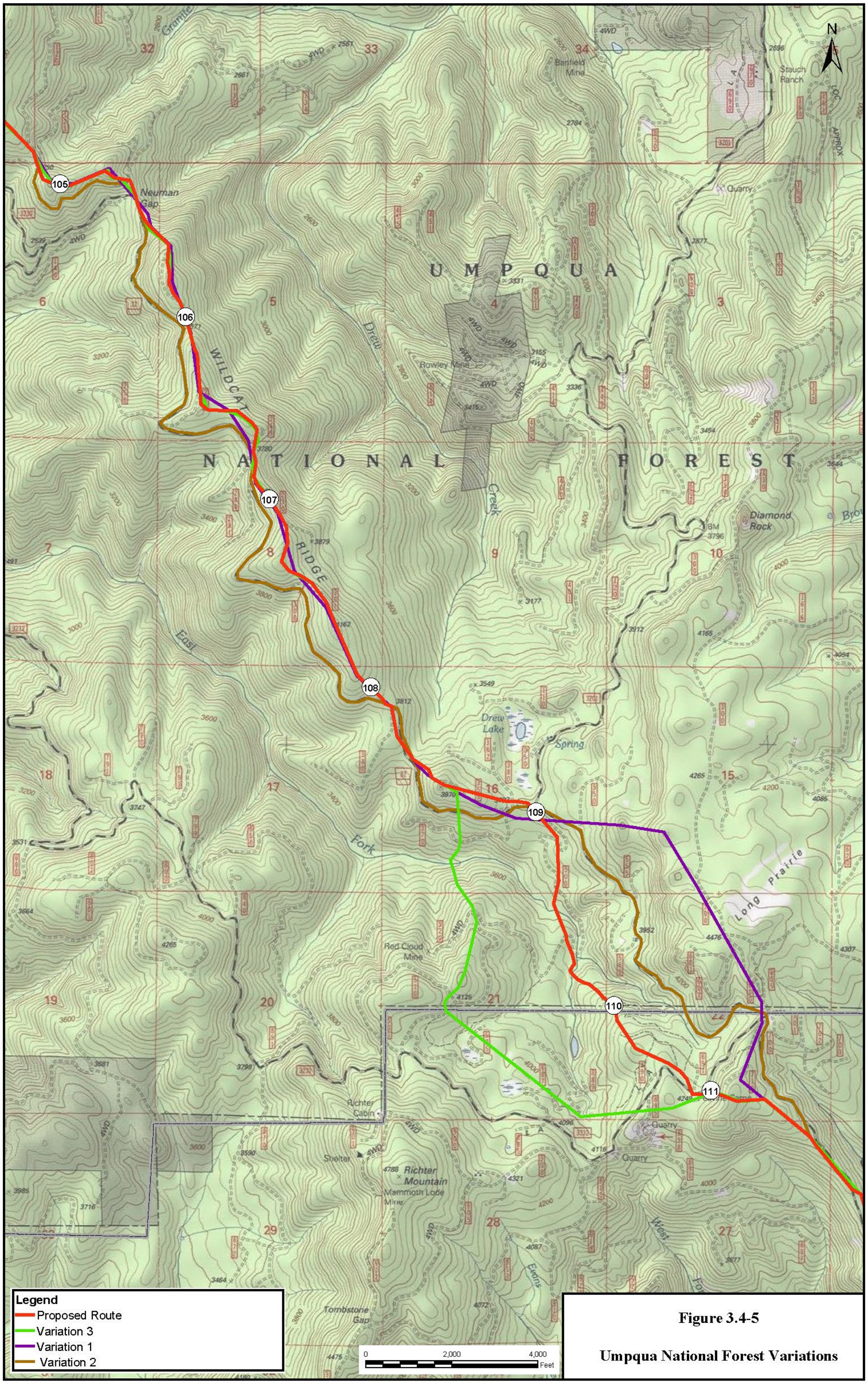


Figure 3.4-5

Umpqua National Forest Variations

TABLE 3.4.2.5-1

Comparison of Umpqua National Forest Variations with the Proposed Route

Impact/Issue	Proposed Route	Variation 3	Variation 1	Variation 2
General				
Total length (miles) a/	6.4	6.7	6.4	7.5
Construction ROW (acres) b/	73	77	73	86
Total construction disturbance (acres)	110	117	110 c/	129 c/
Operational easement (acres) d/	45	41	45	45
Land Ownership (miles)				
Forest Service	6.4	6.7	6.4	7.5
Geotechnical				
Steep or difficult terrain crossed (miles) e/	0.2	0.4	0.1	7.5 (side hill along existing road)
Waterbodies and Wetlands				
Number of waterbodies crossed f/	5	6	1	13
Wetlands crossed (feet) f/	150	120	0	30
Waterbody and wetland disturbance during construction (acres)	0.2	0.3	0	0
Land Use				
Land allocations crossed (miles):				
Matrix	2.9	3.3	3.1	3.3
LSR	3.5	3.4	3.3	4.2
Riparian Reserves	0.5	0.2	0.0	0.3
Evergreen Forest, Mixed conifer (miles)	4.2	3.9	3.4	5.6 h/
Regeneration Forest (miles)	1.8	2.3	2.7	1.8 h/
Clearcuts (miles)	0.0	0.0	0.1	0.0 h/
Total forest lands crossed (miles)	6.0	6.2	5.9	7.4 h/
Other land use types	0.4	0.5	0.4	0.1 h/
Parallel or adjacent to existing rights-of-way (miles)	5.6	5.1	5.4	7.3
Cultural Resources				
Number of previously identified cultural resources along route	0	1 – site 2 – isolated finds	3	0
Number of newly identified cultural resources along route	3 – site 1–isolated find	Information not available	1	Information not available
Critical Habitat g/				
Federally listed critical habitat for NSO affected (acres)	52	33	34	40 (95-foot ROW only)
Federally listed critical habitat for NSO crossed (miles)	6.4	6.7	6.3	7.5
Number of NSO core areas crossed (0.5-mile buffer of nest site)	3	4	3	3

General: All values are rounded (acres to nearest whole acre, miles to nearest tenth of a mile, feet to nearest whole foot).
a/ Variation lengths are measured from the point where they deviate from and then return to the proposed route. Lengths cannot be accurately calculated by comparing mileposts due to shifts in the alignment.
b/ Assumed construction right-of-way (ROW) 95 feet wide.
c/ TEWAs for the variation have not been designed but are estimated assuming they would be comparable to the proposed route.
d/ The assumed operational easement is 50 feet.
e/ Based on slopes that are greater than 50 percent (based on 10-meter digital elevation model).
f/ Waterbodies identified using USGS National Hydrography Dataset, and wetlands identified using FWS National Wetland Inventory mapping.
g/ Includes acres of impact associated with the construction ROW and TEWAs. This analysis used the final revised critical habitat designation (2008).
h/ Variation 2 follows existing Forest Service Road 3200 which is assumed would require extensive side-cuts, therefore, miles crossed considered habitat adjacent to the road.

Most environmental impacts from Variation 1 would be similar to those from the proposed route. The primary environmental advantage would be fewer waterbodies crossed (1 compared to 7), and less NSO critical habitat affected (34 compared to 52 acres) than the corresponding segment of proposed route. The primary disadvantage of the variation is that it has the potential to impact an important traditional cultural property as identified by the Forest Service and Cow Creek Tribe.

Based on this concern, we have determined that implementation of Variation 1 would not result in a significant environmental advantage and is not preferable to the proposed route.

Variation 2 would follow a route suggested by the Forest Service that would follow existing Forest Service Road 3200 between about MPs 104.8 and 111.5 of the proposed route. The rationale for this variation is to utilize the existing cleared road corridor to reduce forest fragmentation and reduce impacts on LSRs. Variation 2 would be about 1.1 miles longer and result in about 19 additional acres of construction disturbance and would follow 7.3 miles of existing roadway (97 percent) compared to 5.6 miles (88 percent) along the proposed route. Environmental features crossed or affected by Variation 2, and a comparison to the corresponding segment of proposed route, are included in table 3.4.2.5-1.

Most environmental impacts from Variation 2 would be similar to those of the proposed route. The primary environmental advantage would be its location along an existing roadway which would reduce creation of a new linear forest clearing. The primary disadvantages of Variation 2 would be that more perennial waterbodies would be crossed (13 compared to 7) and that the route would be located adjacent to steep sideslopes along the existing narrow Forest Road 3200. A high risk of landslide occurrence from pipeline installation has been identified along Forest Service Road 3200 headwall swales and constructed fill slopes that would be required to create a working surface for pipeline installation. Steep side slopes along Forest Road 3200 would require significant excavations to construct a 95-foot-wide construction corridor. Pacific Connector estimates the cut slope required to create the work space would be between 100 to 135 feet in height and extend at least 50 feet upslope of the existing cut slope along the road. The required extra cut and fill construction impact area would negate any advantage from following the existing roadway. For these reasons, we have determined that implementation of Variation 2 would not result in a significant environmental advantage and is not preferable to the proposed route.

Variation 3 would begin at MP 108.5 where it would turn south from the proposed route, and then turn southeast and then east, rejoining the proposed route at MP 111.1. Environmental features crossed or affected by Variation 3, and a comparison to the corresponding segment of proposed route, are included in table 3.4.2.5-1.

The Forest Service has stated that Variation 3 would cross an area planned for expansion of the Peavine rock quarry and therefore considers the variation an incompatible use, and identified concerns with potential slope instability and aquatic impacts at the crossing location of the East Fork Cow Creek. The Peavine quarry is the largest and most extensively developed quarry within the upper reaches of the watershed and is of strategic importance to the Umpqua National Forest. For these reasons, we have determined that implementation of Variation 3 would not result in a significant environmental advantage and is not preferable to the proposed route.

3.4.2.6 Rogue River National Forest Variations

To evaluate potential alternatives that may reduce impacts on LSR and Riparian Reserves, we consulted with the Forest Service and evaluated two route variations within the Rogue River National Forest in the vicinity of Robinson Butte and Cox Butte between about MPs 155.1 and 168.9. Table 3.4.2.6-1 provides a comparison of Variation 1 and Variation 2, and the corresponding segment of proposed route. These variations and the proposed route are shown on figure 3.4-6.

TABLE 3.4.2.6-1

Comparison of Rogue River National Forest Variations with the Proposed Route

Impact/Issue		Proposed Route	Variation 1	Variation 2
General				
Total Length (miles) a/		13.8	12.9	15.7
Construction ROW (acres) b/		159	148	180
Total construction disturbance (acres)		209	194 c/	236 d/
operational easement (acres) e/		84	78	95
Land ownership crossed (miles)	Forest Service	12.5	11.5	14.3
	Private	0.5	0.5	0.6
	State	0.0	0.0	0.0
Waterbodies and Wetlands				
Number of waterbodies crossed f/		6	2	14
Land Use				
Land allocations crossed (miles)	Matrix	0.0	0.0	0.0
	LSR	12.5	11.5	14.3
	Riparian Reserves	0.4	1.5	1.1
Evergreen Forest, Mixed Conifer crossed (miles)		6.1	6.8	6.0
Regeneration Forest crossed (miles)		5.6	5.9	5.4
Clearcuts crossed (miles)		0.3	0.1	0.0
Total Forest lands crossed (miles)		12.0	12.8	11.4
Right-of-way parallel or adjacent to existing rights-of-way (miles)		4.4	1.6	14.0
Visual Resources				
Visual Impacts along existing Forest roads		Moderate where parallel to existing roads (4.4 miles)	Minimal except at existing road crossings	Existing road corridors expected to be significantly altered from 95-foot-wide construction footprint along 13.6 miles of Forest roads.
Cultural Resources				
Number of previously identified cultural resources along route		1	1	0 g/
Habitat for Federally Listed Species				
Federally listed critical habitat for the NSO (acres) h/		159	148	180
Number of NSO activity centers crossed		2 - ½ mile buffer of site	2 - ½ mile buffer of site	2 - ½ mile buffer of site

General: All values are rounded (acres to nearest whole acre, miles to nearest tenth of a mile, feet to nearest whole foot).
a/ Route Alternative are measured from the point where they deviate from and then return to the proposed route. Lengths cannot be accurately calculated by comparing mileposts due to shifts in the alignment.
b/ The construction right-of-way (ROW) for the preferred route and original proposed alignment is 95 feet.
c/ Pacific Connector estimates that the Variation 1 would likely require more TEWAs compared to the compromise route because of side slope construction between approximately MPs 149 and 152.9 and because of the increased number of stream crossings along the Variation 1. However, because they have not been designed, we have estimated the area of TEWAs based on a comparable length of the proposed route.
d/ TEWAs have not been designed for this route; however, we have estimated the area based on a comparable length of the proposed route.
e/ The assumed operational easement for all routes is 50 feet. However, Pacific Connector would only maintain vegetation within 15 feet of the pipeline centerline for a total of 30 feet in the long term.
f/ Waterbodies from PNW Hydrography Framework Clearinghouse.
g/ Surveys are incomplete or in progress on the proposed route.
h/ Includes acres of impact associated with the construction ROW.

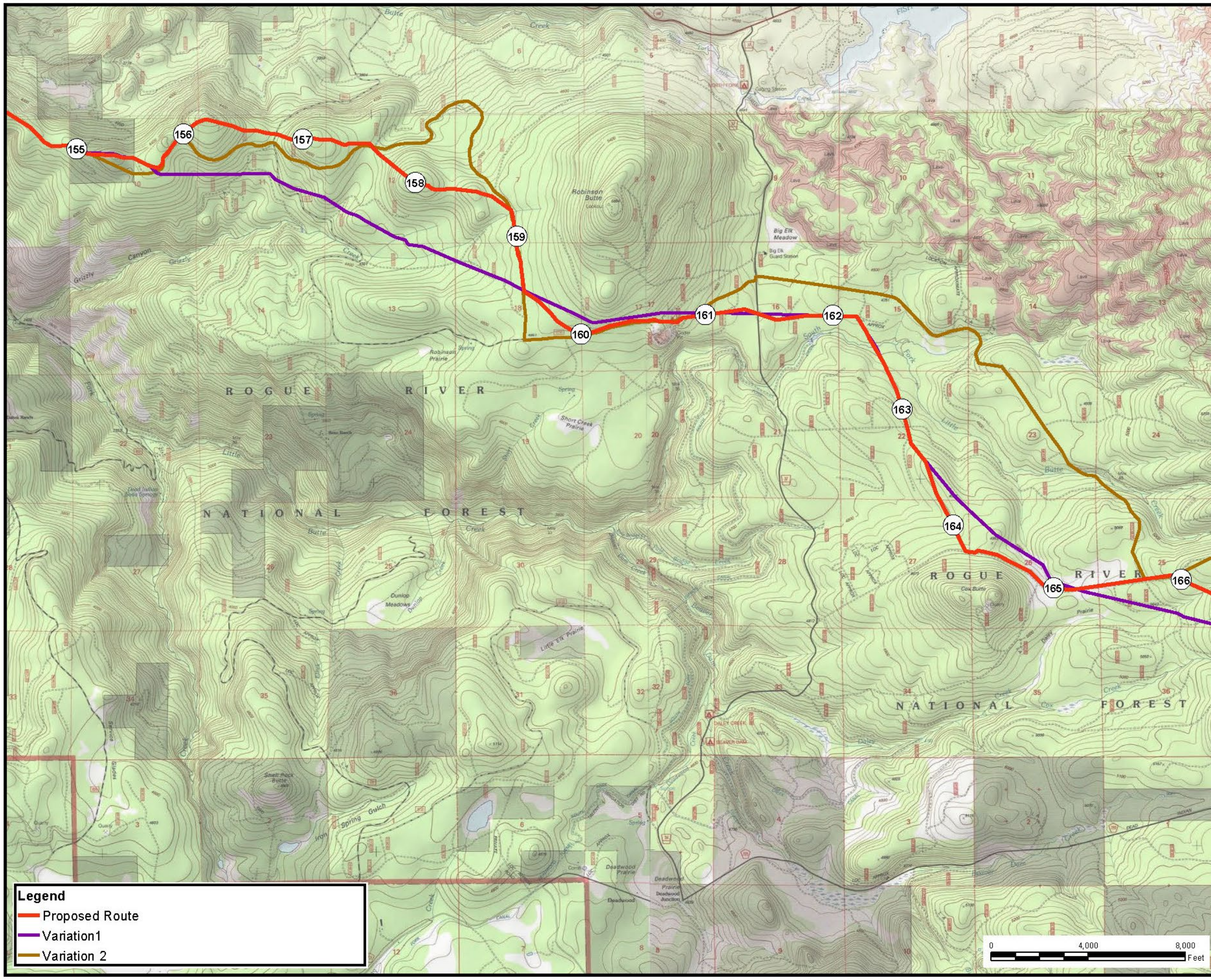


Figure 3.4-6

Rogue River National Forest Variations

Variation 1 would deviate from the proposed route at about MP 155 and remain south of it on the south side of Robinson Butte near MP 159. From that point, Variation 1 would closely follow the proposed route but would be straighter and cross through older forests, which provide NSO habitat. Variation 1 would cross Big Elk Road, cross northeast of Cox Butte, and would cross Daley Prairie, then cross into Klamath County and rejoin the proposed route near MP 169. Variation 1 would be about a mile shorter than the corresponding segment of proposed route. The variation would be adjacent to existing rights-of-way for 1.6 miles (12 percent) compared to 4.4 miles (32 percent) for the corresponding segment of the proposed route.

The primary advantage of Variation 1 is it would require less construction disturbance (194 compared to 209 acres), cross fewer waterbodies (2 compared to 6), cross less LSR (11.5 compared to 12.5 miles), and affect less critical habitat for NSO (148 compared to 159 acres) than the corresponding segment of the proposed route.

The primary disadvantages of Variation 1 are that it would affect more forest (12.8 compared to 12.0 acres), more Riparian Reserves (1.5 compared to 0.4 acres), and less length adjacent to existing rights-of-way (12 percent compared to 32 percent) than the corresponding segment of proposed route. As described above, the variation would have some environmental advantages and some environmental disadvantages over the corresponding segment of proposed route. Overall, we do not believe that the advantages overcome the disadvantages, and for this reason we have determined that implementation of the Rogue River National Forest Variation 1 would not result in a significant environmental advantage and is not preferable to the proposed route.

The rationale for evaluating Variation 2 was to evaluate the potential for reducing forest vegetation clearing by utilizing the existing cleared roadways as part of the construction corridor, thereby reducing some of the forest fragmentation and habitat loss in LSR 227. Also, this variation would cross the PCT along an existing road, reducing potential impacts on trail users by eliminating a separate crossing. Variation 2 would deviate from the proposed route at about MP 155, north of Grizzly Canyon, and head east along Forest Service Roads 410 and 300, around the south side of Robinson Butte along Forest Service Road 3730, south of Big Elk Guard Station along Forest Service Road 3705, across the South Fork Little Butte Creek, turn east along Forest Service Road 3720, entering Klamath County, to Forest Service Road 700, cross the PCT several miles south of Brown Mountain, then head southeast cross-county into the Winema National Forest, across Dead Indian Memorial Highway, and would rejoin the proposed route along Clover Creek Road north of Burton Butte just east of MP 169.

Variation 2 would be about 3 miles longer than the proposed route and would require widening the existing roads, which are generally between 20 and 30 feet wide. This would require cutting mature forest in portions of the right-of-way. Based on input from the engineering review conducted by Pacific Connector, the pipeline would not be constructible along portions of some roads due to the steep terrain and side slope and the tight radius turns. For this reason, we have determined that implementation of the Rogue River National Forest Variation 2 is not technically feasible and do not consider it further.

3.4.2.7 Forest Service Survey and Manage Species Variations

During the development of the proposed route, Pacific Connector and the Forest Service identified seven locations where the pipeline could impact Survey and Manage species that occupy habitat on NFS lands managed by the Rogue River and Winema National Forests. The Forest Service developed seven minor route deviations at these locations which were accepted by Pacific Connector and are incorporated into the proposed route, and that would ensure the pipeline in these locations would not have a negative effect on the viability and persistence of these Survey and Manage species. These deviations were incorporated into the proposed action analyzed in this EIS. Additional documentation of the development of the seven minor deviations is included in FERC 2015, and appendix F.5 provides additional information on the species, location, and minor route deviations. The minor deviations would avoid impacts on the following Survey and Manage species and are briefly summarized below.

- *Gymnomyces abietis*
- *Sedecula pulvinate*
- *Albatrellus ellisii*
- *Boletus pulcherrimus*
- *Cortinarius olympianus*
- *Gomphus kauffmanii*
- *Albatrellus dispansus*
- *Hygrophorus caeruleus*
- *Choiromyces alveolatus*
- *Arcangeliella crassa*

<u>Rogue River National Forest, MPs 154.7–154.9</u>: To avoid Survey and Manage fungus species *Gymnomyces abietis* identified during surveys. This deviation shifted the alignment 180 feet to the south to ensure an adequate buffer for this species.

<u>Rogue River National Forest, MPs 158.1–158.2</u>: To avoid Survey and Manage fungus species *Sedecula pulvinata* identified during surveys. This deviation shifted the alignment 130 feet to the south to ensure an adequate buffer for this species.

<u>Rogue River National Forest, MPs 162.5–162.8</u>: To avoid a cluster of Survey and Manage species, including *Albatrellus ellisii*, *Boletus pulcherrimus*, *Cortinarius olympianus*, *Gomphus kauffmanii*, and *Albatrellus dispansus*, a Forest Service strategic species, identified during surveys. This deviation creates a protective buffer between right-of-way clearing and these species.

<u>Rogue River National Forest, MPs 164.2–164.3</u>: To avoid a Survey and Manage fungus species *Hygrophorus caeruleus*, identified during surveys. This deviation shifted the alignment and construction right-of-way to the south side of Forest Service Road 37200000 to avoid this species.

<u>Winema National Forest, MPs 168.6–169.1</u>: To avoid Survey and Manage fungus species *Hygrophorus caeruleus* identified during surveys. This deviation shifted the alignment approximately 500 feet to the north at the crossing of Dead Indian Memorial Road to ensure an adequate buffer for this species.

<u>Winema National Forest, MPs 171.9–173.0</u>: To avoid Survey and Manage fungus species *Choiromyces alveolatus* identified during surveys. This deviation shifted the alignment 125 feet to the north to ensure an adequate buffer for this species.

<u>Winema National Forest, MPs 173.2–173.3</u>: To avoid Survey and Manage fungus species *Arcangeliella crassa*, identified during surveys. This deviation shifted the alignment to the north so that the construction right-of-way would avoid this species by 125 feet or more.

In addition to the minor deviations described above, in the draft EIS we evaluated a route variation between MPs 111.5 and 111.6 that would avoid impacts on *Sarcodon fuscoindicus,* a Survey and Manage fungi species identified during surveys conducted within the Umpqua National Forest, and in the draft EIS we recommended that Pacific Connector incorporate the variation into the proposed route. After issuance of the draft EIS, Pacific Connector incorporated this variation into the proposed route and this final EIS has been revised as appropriate. Below is a summary of this route change and how it accomplishes the objective of avoiding impact on *Sarcodon fuscoindicus*.

The previously proposed pipeline location as evaluated in the draft EIS would affect a portion of one site where two observations of this species have been documented on NFS lands. This Survey and Manage site is located in the Trail Creek watershed on the ridge just east of the South Fork Cow Creek watershed between MPs 111.5 and 111.6. The location of this site is shown in appendix F.5 (section 2.27, figure SAFU-5).

The previously proposed pipeline location would disturb vegetation and soils within approximately 1.2 acres (30 percent) of the site where this species was identified, which would consist of construction right-of-way (0.8 acres) and UCSA (0.4 acres). The area within the site is mostly forested and the construction and operational right-of-way could modify microclimate conditions around the recorded observations. The removal of forests and host trees and disturbance to soil could also negatively affect *S. fuscoindicus* in adjacent areas by removing its habitat, disturbing soil or duff around trees or roots of trees, and affecting its mycorrhizal association with the trees, potentially affecting site persistence even if the entire site is not disturbed. In addition, modification of shading, moisture, and habitat conditions within 100 feet of the species could make habitat within the site no longer suitable for the species. Restored portions of the right-of-way and workspace would be dominated by early seral vegetation for approximately 30 years, which would result in long-term changes to habitat conditions. A 30-foot-wide corridor centered on the pipeline would be maintained in low-growing vegetation for pipeline maintenance and would not provide habitat for the species during the life of the Project. Material storage within UCSAs could damage individuals and would disturb understory habitat within the site, which could modify microhabitats near individuals that are not removed or damaged, potential making the habitat no longer suitable for the species. Based on this analysis, the Forest Service concluded that *S. fuscoindicus* is not likely to persist at this location if the pipeline was constructed along the previously proposed location. This site is the only site on NFS lands in the local area, and the nearest sites on NFS lands are approximately 45 miles to the northeast and 75 miles to the southwest.

The route modification shifts the construction right-of-way between MPs 111.5 and 111.6 at least 25 feet to the northeast and eliminates the UCSA on the southwest side of the construction right-of-way. As a result, at least one of the two known occurrences of this species within the site would be at least 100 feet from any Project-related disturbance and protected (see figure 3.4-7). The proposed route now includes a no-disturbance buffer for *Sarcodon fuscoindicus* at this location which is necessary to protect these sites and to comply with the 2001 Survey and Manage ROD to maintain the persistence of the affected species within the range of the NSO (see also section 4.6.4.3 of this EIS).

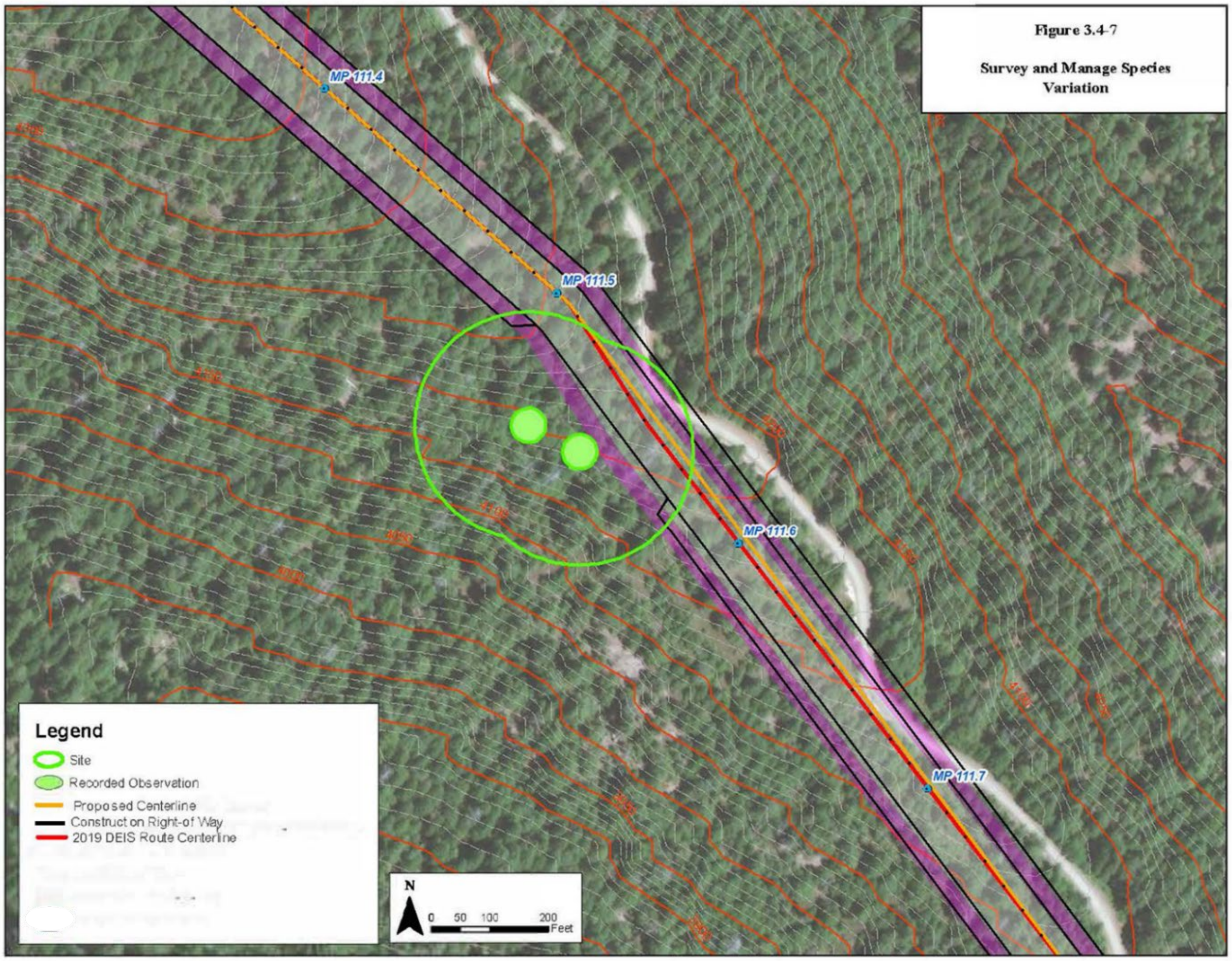


Figure 3.4-7
Survey and Manage Species Variation

3.4.2.8 Revised East Fork Cow Creek Variation

In the draft EIS we evaluated the East Fork Cow Creek Variation and based on that evaluation and consultation with the Forest Service recommended that Pacific Connector incorporate the variation into its proposed route. Since issuance of the draft EIS Pacific Connector incorporated this variation into the proposed route and this final EIS has been revised as appropriate. Below we evaluate the Revised East Fork Cow Creek Variation, which is the previously proposed route as evaluated in the draft EIS, and compare it to the current proposed route in this location.

The variation would be between MPs 109.7 and 109.8 of the proposed route and includes an alternative crossing of East Fork Cow Creek and a crossing of a tributary just upstream of the FS Road 3200-500 crossing of East Fork Cow Creek that would result in a parallel pipeline alignment between the upper reaches of the perennial streams in close proximity to these crossings. The Revised East Fork Cow Creek Variation would proceed southeasterly crossing a tributary of the East Fork Cow Creek and then continue in a southeasterly direction where it would cross the East Fork Cow Creek before climbing the ridgeline before rejoining the proposed route at MP 109.9 (see figure 3.4-8). This variation would parallel about 0.23 miles of the East Fork Cow Creek and its tributaries, and therefore would be inconsistent with the Umpqua National Forest LRMP with respect to water and riparian areas.[60] Use of this variation would require an amendment to the LRMP.

As indicated in table 3.4.2.8-1, the variation is 0.01 mile shorter and would impact 1.3 acres less NFS land, it would require more clearing of LSOG habitat (0.73 acres) and slightly more clearing of Riparian Reserve (0.06 acres) than the corresponding segment of proposed route. This variation would have a direct impact on eight Survey and Manage species compared to four Survey and Manage species by the corresponding segment of the proposed route, and the variation would also indirectly impact four other Survey and Manage species. The variation traverses a narrow ridgeline that supports old-growth forest/high nesting-roosting-foraging (NRF) habitat within Riparian Reserves.[61] The potential for long-term restoration and monitoring of Riparian Reserve and associated geomorphic and water quality conditions affected during construction would be decreased due to the steeper slopes and incised nature of the channels crossed by this variation.

The proposed route in this location would avoid a parallel alignment with perennial streams, whereas the Revised East Fork Cow Creek Variation would be parallel to perennial streams for about 535 feet. For the reasons described above, the Revised East Fork Cow Creek Variation would not result in a significant environmental advantage and is not preferable to the proposed route.

[60] Standard & Guideline 1 (UNF LRMP IV-33). Maintain all effective shading vegetation on perennial streams. Prescriptions C2-II (LRMP IV-173 par.1, 1st sentence) and C2-IV (LRMP IV-177 last par. last sentence) Utility/transportation corridors, roads or transmission lines may cross but must not parallel streams and lake shores within the riparian unit.
[61] There are overlapping Riparian Reserves associated with channels on either side of this ridge.

TABLE 3.4.2.8-1

Revised East Fork Cow Creek Variation

Alternatives Analysis	Proposed Route	Revised East Fork Cow Creek Variation
General		
Length (miles)	0.42	0.42
Construction right-of-way (acres)	4.6	4.8
Number of temporary extra work areas (TEWAs)	9	7
Acres of TEWAs	1.0	0.91
Number of Uncleared Storage Areas (acres) a/	2 (1.34)	0 (0.0)
Permanent Easement (acres) All NFS lands b/	2.55	2.55
Land Use		
Miles of right-of-way parallel or adjacent to existing rights-of-way (percent of alternative length) c/	0.00 (0.0%)	0.02 (6.7%)
Late Successional Reserve - Federal Land Use Designation (acres)	0.0	0.0
Matrix (Federal Land Use Designation (acres)	4.63	4.75
Riparian Reserves - Federal Land Use Designation (acres)	4.41	4.26
Riparian Reserves Cleared (acres)	3.0	3.06
Riparian Reserves Parallel (miles)	0.0	0.23
Waterbodies and Wetlands		
Number of waterbodies crossed d/	2	2
Length of waterbody crossings (feet) e/	12	7
Alignment parallel to waterbody (feet) d/	0	535
Number of wetlands crossed	0	0
Vegetation		
Total forest clearing (acres)		
Acres clear-cut/regenerating (0-40 years)	2.19	2.22
Acres mid-seral forest (40-80 years)	0.51	0.26
Acres Late Successional Forest (80-175 years)	0.00	0.00
Old Growth Forest (175 +)	2.65	2.70
Biological Resources		
Northern Spotted Owl Suitable Habitat Crossed (High NRF & NRF) (acres)	2.65	2.70
Northern Spotted Owl nest patch/cores (NSO)	0	0
Northern Spotted Critical Habitat Crossed (acres)	5.66	5.64
Survey & Manage Species Sites Direct Impact	4	8
Survey & Manage Species Indirect Sites Impact	4	0
Survey & Manage Species Total Sites Impacted	8	8

General: All values are rounded (acres to nearest whole acre, miles to nearest tenth of a mile, feet to nearest whole foot).

a/ Acres of Uncleared Storage Areas are not included in the impact comparison (acres) of the various resources because grading and tree clearing will not occur in these areas.

b/ Acres of permanent easement calculated based on a 50-foot width.

c/ Based on inventoried roads included in Umpqua NF Road data and BLM GTRN data (https://www.blm.gov/or/gis/data.php).

d/ Based on field surveys (see Table A.2-3 to Appendix A.2 to Pacific Connector's Resource Report 2, supplemental wetland delineation report filed in May 2018, supplemental Survey and Manage Species surveys available as of October 2018.

e/ Based on the proposed alignment between the tributaries to East Fork Cow Creek (FS-HF-J and FS-HF-K) (MPs 109.7 to 109.8). In this area the alignment follows a narrow ridge.

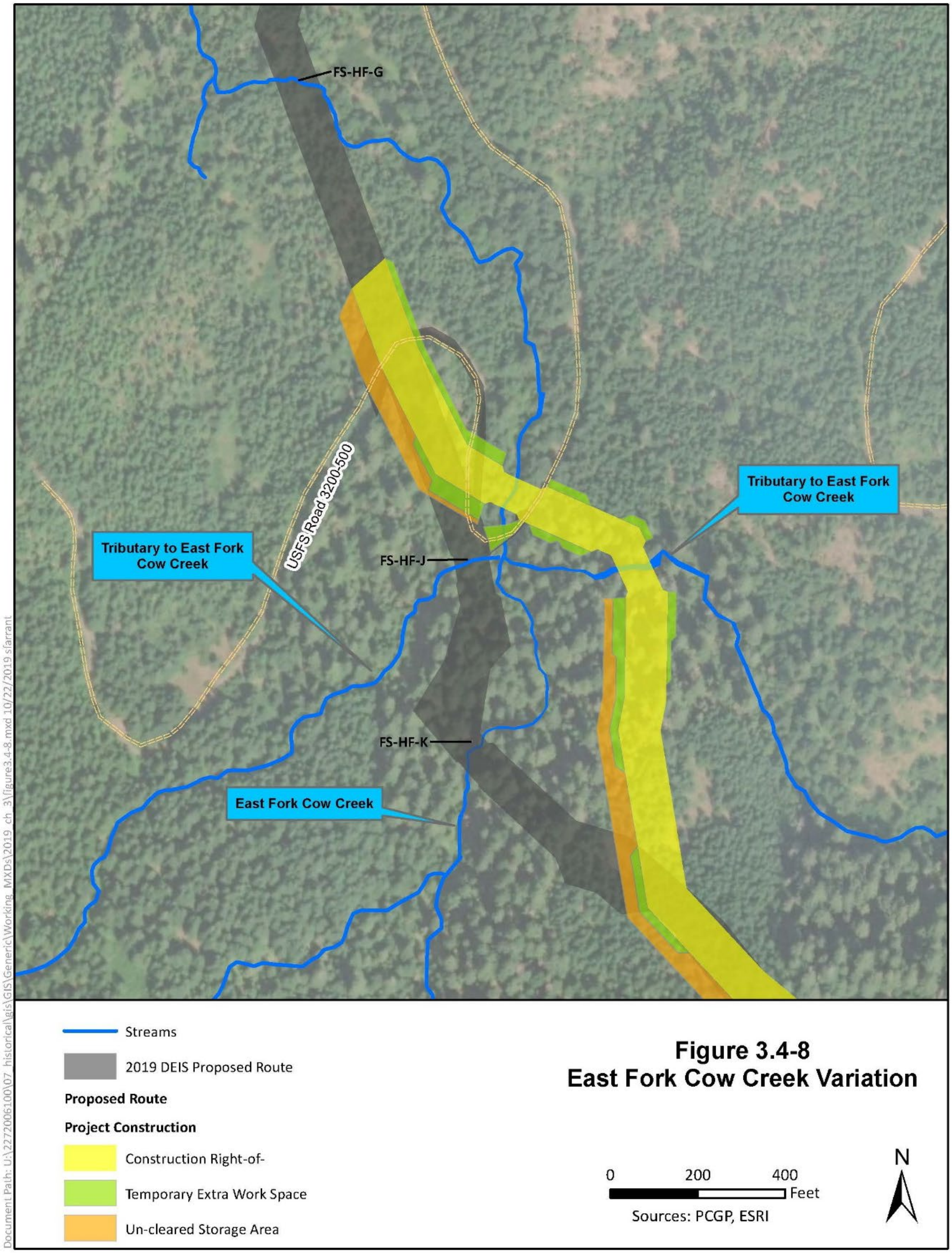


Figure 3.4-8
East Fork Cow Creek Variation

3.4.2.9 Revised Pacific Crest Trail Variation

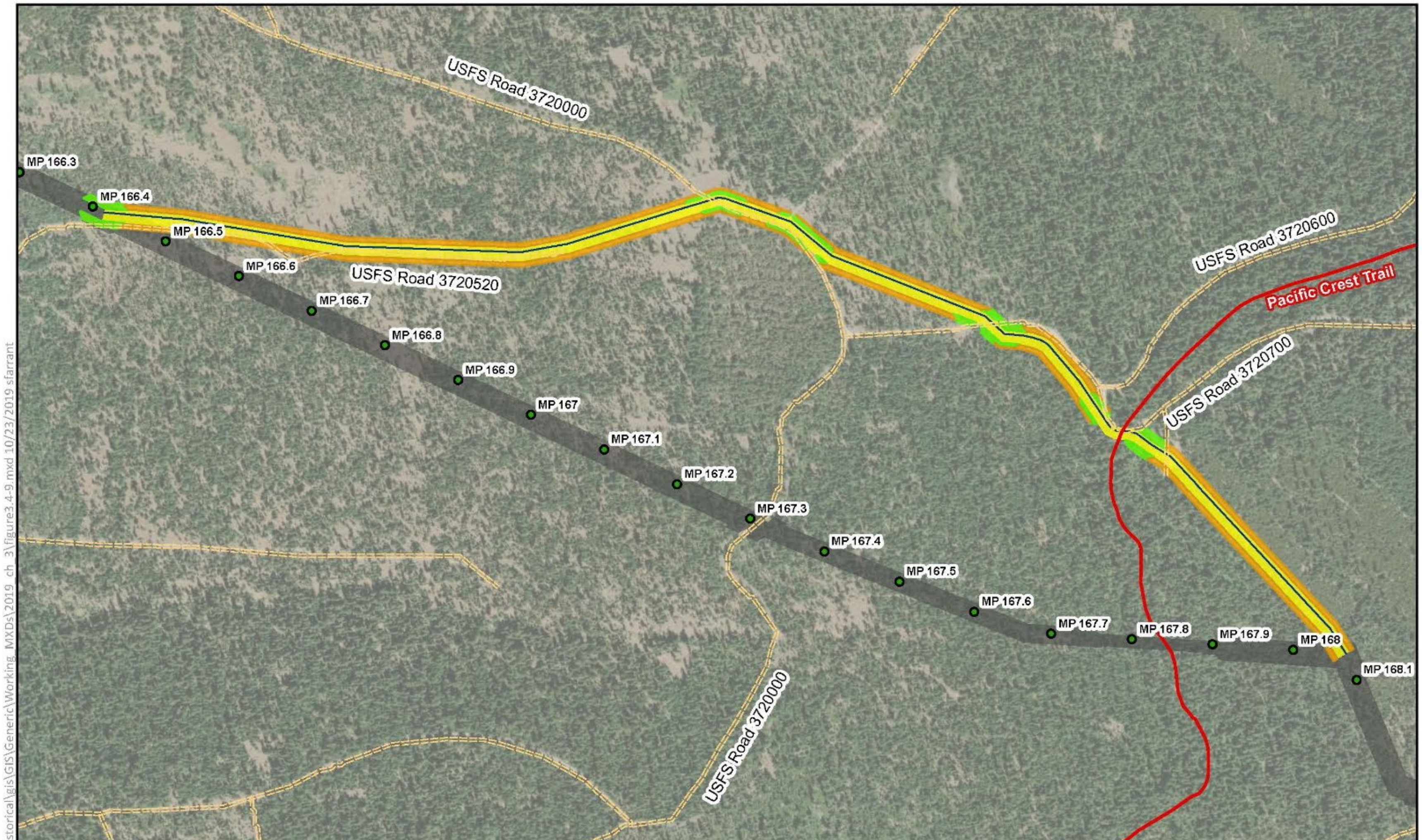
In the draft EIS, we evaluated the PCT Variation, and based on that evaluation and in consultation with the Forest Service, recommended that Pacific Connector incorporate the variation into its proposed route. Pacific Connector revised the proposed route by incorporating this variation, and this final EIS has been revised as appropriate. Below we evaluate the Revised PCT Variation, which is the previously proposed route as evaluated in the draft EIS, and compare it to the current proposed route in this location.

The variation would begin at about MP 166.4 and run in a southeasterly direction crossing Forest Service Road 3720 at about MP 167.3, then continuing on and crossing the PCT at about 167.8, essentially perpendicular to the PCT (see figure 3.4-9). The variation then continues east until it rejoins the proposed route at about MP 168.1. Near MP 167.7, the variation would be approximately 600 feet north of the South Brown Mountain Shelter, a small log cabin that has a woodstove and a seasonal water supply for various recreational users. Under the Rogue River National Forest LRMP, the existing standards and guidelines for VQOs in Foreground Partial Retention in the area where the variation crosses the PCT require that visual mitigation measures meet the stated VQO within three years of the completion of the project and that management activities be visually subordinate to the landscape. If the variation were used, it would require an amendment to the LRMP to change the VQO objective to Modification, and to allow 15-20 years for amended VQOs to be attained; essentially to allow tree growth adequate to screen the pipeline corridor from PCT users and blend in with the surrounding old-growth forest.

An open-cut crossing of the PCT by the variation would directly affect PCT users for a short duration of time during construction (estimated as 48 hours), and noise associated with construction in the general vicinity of the PCT would be ongoing for several weeks on either side of this crossing, and also audible to occupants of the South Brown Mountain Shelter.

The primary advantage of the Revised PCT Variation would be a slight reduction in length and corresponding decrease in overall acres of NFS lands affected. The variation would also have less impact on the Forest Service road system and less impacts on NSO critical and suitable habitat. The disadvantages of this variation are related to inconsistency with the Rogue River National Forest LRMP VQOs, direct and indirect impacts on PCT users during construction, visual impacts on PCT users extending over a decade after construction, impacts on old-growth forest, and direct and indirect impacts on Survey and Manage species. Table 3.4.2.9-1 provides a comparison of the proposed route and the Revised PCT Variation.

As described above, the Revised PCT Variation would include some environmental advantages and some disadvantages compared to the proposed route. However, for the reasons described above, the disadvantages of the variation would outweigh the advantages, and the Revised PCT Variation would not result in a significant environmental advantage and would not be preferable to the corresponding proposed route.



Pacific Crest Trail

Rouge River National Forest Roads

2019 DEIS Proposed Route

Proposed Route

Project Construction

Construction Right-of-Way

Temporary Extra Work Area

Un-cleared Storage Area

Figure 3.4-9
Pacific Crest Trail Variation

0 500 1,000 Feet

Sources: PCGP, ESRI

N

Document Path: U:\22720061\00\07_historical\gis\GIS\Generic\Working_MXDs\2019_ch_3\figure3.4-9.mxd 10/23/2019 sfarrant

TABLE 3.4.2.9-1

Comparison of the Revised Pacific Crest Trail Variation with the Proposed Route

Alternatives Analysis		Proposed Route	Revised PCT Variation
General			
Length (miles)		1.77	1.65
Construction right-of-way (acres)		20.14	18.64
Number of temporary extra work areas (TEWAs)		15	7
Acres of TEWAs		1.81	1.16
Number of Uncleared Storage Areas (acres) a/		8 (10.61)	5 (8.72)
Total NFS lands Cleared (acres)		21.95	19.8
Permanent Easement (acres) b/		10.73	10.00
NFS total acres impacted		32.56	28.52
Land Use			
Land Ownership (miles)	Private	0	0
	State	0	0
	Federal (Rogue River-Siskiyou NF)	1.73	1.59
	Federal (Fremont-Winema NF)	0.04	0.06
Number of landowner parcels crossed		1	1
Number of road crossings (centerline) c/		6 (1 is bored)	3
Miles parallel or adjacent to existing ROWs (acres of construction ROW) d/		1.37 (14.46)	0.19 (0.25)
Late Successional Reserve cleared/modified (acres)		20.14/10.61	18.64/8.72
Riparian Reserves cleared (acres)		0.0	0.0
Matrix cleared/modified(acres)		1.38/0.28	0.24/0.39
Visual Quality Objective (miles) e/		0.53-FGPR 0.13-FGR	0.52-FGPR
Waterbodies and Wetlands			
Number of waterbodies crossed f/		1 (bored)	0
Length of waterbody crossings (feet) f/		4 (bored)	0
Vegetation			
Acres clear-cut/regenerating (0-40 years)		8.70	16.95
Acres mid-seral forest (40-80 years)		5.64	0.00
Acres Late Successional Forest (80-175 years)		2.15	0.00
Old Growth Forest (175 + years)		0.44	2.75
Biological Resources			
Northern Spotted Owl Suitable Habitat Crossed (High NRF & NRF) (acres) g/		4.60	2.75
Northern Spotted Owl nest patch/core area (NSO) (acres)		2.87	3.39
Northern Spotted Critical Habitat Crossed (acres)		21.47	20.01
Survey & Manage Species Sites Direct Impact		0	5
Survey & Manage Species Indirect Sites Impact		1	2
Survey & Manage Species Total Sites Impacted		1	7

a/ Acres of UCSA are not included in the impact comparison of the various resources because grading and tree clearing would not occur in these areas. Acres modified equates to UCSA impacts.
b/ Acres of permanent easement calculated based on a 50-foot width.
c/ Based on inventoried roads included in Rogue River-Siskiyou NF travel route data and BLM GTRN data (https://www.blm.gov/or/gis/data.php).
d/ Based on inventoried roads included in Rogue River-Siskiyou NF travel route data and BLM GTRN data (https://www.blm.gov/or/gis/data.php), as well as non-inventoried roads identified during civil surveys (June 2018).
e/ FGPR = Foreground Partial Retention; FGR = Foreground Retention
f/ Based on field surveys (see Table A.2-3 to Appendix A.2 to Pacific Connector's Resource Report 2 and supplemental wetland delineation report filed in May 2018) and subsequent site visit (May 31, 2018). The pipeline centerline stream crossing on the proposed route would occur within the FS 3720700 Road, where the stream is culverted.
g/ Rogue River-Siskiyou National Forest (Forest Service 2017a).

3.5 CONCLUSION

We reviewed alternatives to the proposed action based on our independent analysis and comments received. Although many alternatives are technically feasible, we identified only one alternative that would provide a significant environmental advantage over the corresponding proposed route (i.e., the Blue Ridge Variation). We have included a recommendation that this alternative be adopted. Based on these findings, we conclude that the proposed Project, as modified by our recommendation, is the preferred alternative that can meet the Project purpose.

4.0 ENVIRONMENTAL ANALYSIS

In this section, we describe the existing natural and human environment, and assess the impacts on it resulting from construction and operation of the Project. When describing impacts on the environment resulting from "construction" and/or "construction activities" related to the LNG Terminal (and marine facilities) or the pipeline, unless specifically noted, these descriptions include impacts related to temporary workspaces, access roads, contractor yards, and all other associated and ancillary facilities and activities identified and described in section 2.0. Our independent analysis, which was prepared in consultation with the NEPA cooperating agencies, considers the affected environment, the Applicants' proposed construction methods, their impact minimization and mitigation[62] measures, and, as appropriate, makes recommendations (boldface and bulleted text) to avoid or further reduce/minimize impacts on the environment. This analysis also considers cumulative impacts that may result when the Project's impacts are added to those of past, present, and reasonably foreseeable future projects. The analysis is organized by resource, includes as appropriate information pertaining to federal lands, and by resource concludes with a determination of significance.

For the purposes of this analysis, we discuss four impact durations: temporary, short-term, long-term, and permanent. A temporary impact generally occurs during construction with the resource returning to preconstruction condition almost immediately afterward. A short-term impact could continue for up to three years following construction. An impact is considered long-term if the resource would require more than three years to recover. A permanent impact would occur if an activity modifies a resource to the extent that it would not return to preconstruction conditions during the life of the Project. Permanent impacts may also extend beyond the life of the Project. For example, we consider the clearing of mature forests a permanent impact because it would take several decades for these habitats to attain their pre-construction condition. The construction and operation of aboveground facilities would also cause permanent impacts. When determining the significance of an impact(s), we consider the duration of the impact; the geographic, biological, and/or social context in which the impact would occur; and the magnitude and intensity of the impact. The duration, context, and magnitude of impacts vary by resource and therefore significance varies accordingly. Lastly, our analysis considers and addresses direct and indirect[63] and primary and secondary impacts on resources collectively.

The structure of this EIS follows the standard format used by the Commission with respect to the order and content of the resources affected by the Project. Each resource section in section 4 includes a focused discussion of effects on federally managed lands (i.e., lands managed by the BLM, Forest Service, and Reclamation). As described in section 2, the BLM and Forest Service have identified the need to amend their respective land and resource management and resource management plans in order to ensure any action authorized by FERC would be compliant with these plans. Section 2 also describes the mitigation the Forest Service would require to ensure that the effects of these amendments are adequately mitigated. While the BLM is not requiring mitigation, the Applicant has proposed voluntary mitigation that could be implemented on BLM

[62] We do not consider mitigation measures that offset impacts as components of the proposed action, but we do consider in our resource impact analyses the effects of implementing said mitigation measures.

[63] Indirect effects are effects that occur later in time or are farther removed in distance, but are still reasonably foreseeable to occur.

lands in order to mitigate the impacts of BLM plan amendments. While specific effects of the project, including BLM and Forest Plan amendments and the associated mitigation measures on federally managed lands are addressed in each resource section, section 4.7.3 of this EIS provides a detailed discussion of consistency with these management plans and evaluations of the proposed plan amendments and associated mitigation measures.

The Project would cross ecologically diverse areas from Coos Bay to the Klamath Basin (see figure 4-1). The Project lies within four ecoregions: (1) the Coast Range; (2) the Klamath Mountains; (3) the Cascades; and (4) the Eastern Cascades Slopes and Foothills (Bryce et al. 2003). This diversity in ecoregions crossed results in a wide variety of conditions, habitats, and environments that could be affected by the Project.

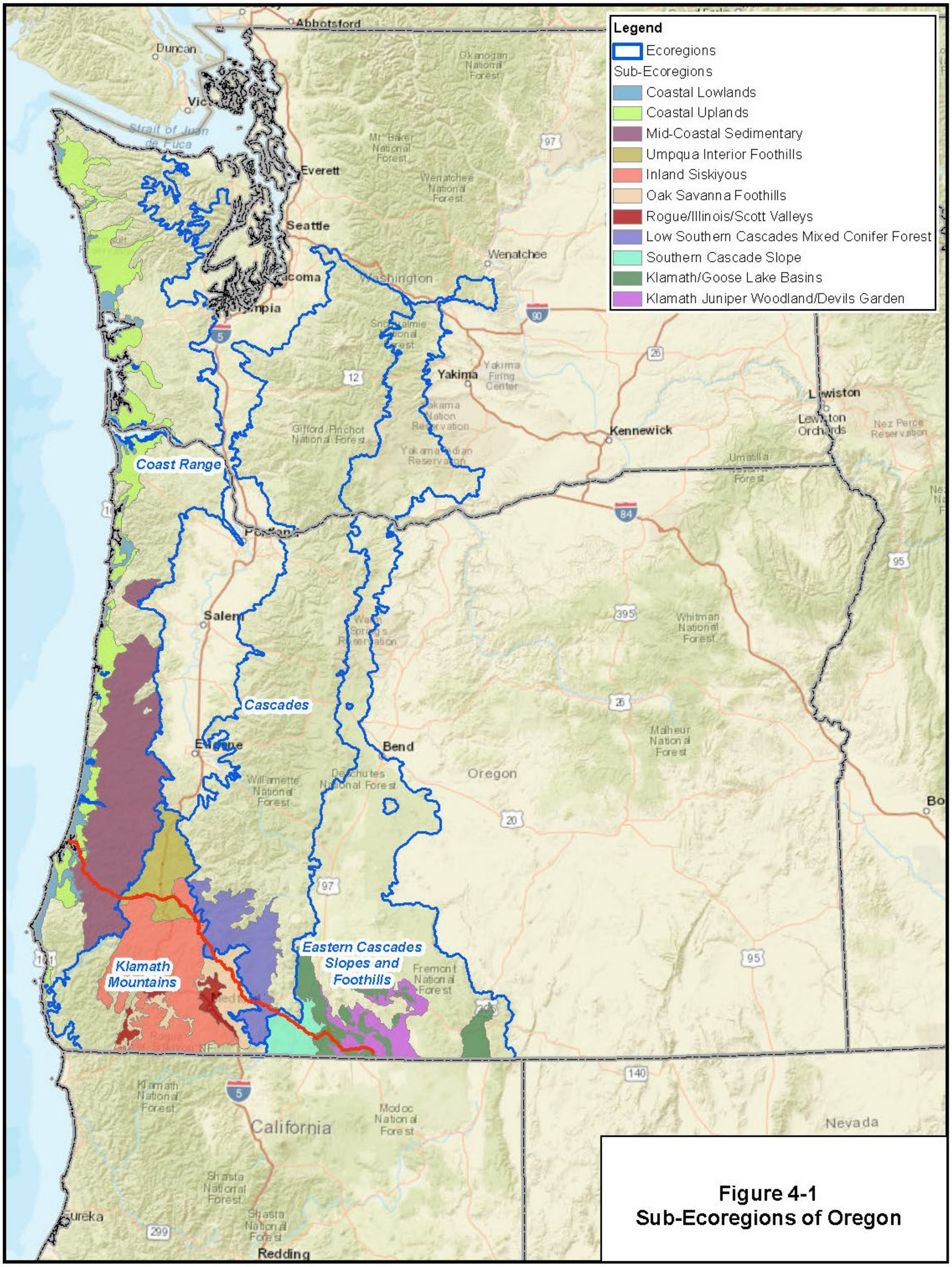


Figure 4-1
Sub-Ecoregions of Oregon

4.1 GEOLOGICAL RESOURCES

The following section describes geological resources and potential impacts related to the various aspects of the Project, including the Jordan Cove LNG terminal and the Pacific Connector pipeline and associated facilities.

4.1.1 Jordan Cove LNG Project

4.1.1.1 Geologic Setting

The Jordan Cove LNG Project site is located within the Pacific Border physiographic province at the western edge of the coastal headlands of the Central Coast Mountain Range, on the North Spit of Coos Bay. The North Spit of Coos Bay marks the southern edge of the Holocene-age Coos Bay Dune Sheet (Peterson et al. 2005).

The LNG terminal site is underlain by loose to dense fill and a relatively clean, fine-grained sand, which is in turn underlain by a very dense silt-sand unit . Fill depths are typically 10 to 15 feet at the Ingram Yard and up to 25 feet at the mill site. The clean, fine-grained sand is a dune sand of Holocene and Pleistocene age (Peterson et al. 2005) with thicknesses of over 100 feet. Sand fill is also present to a depth of about 15 feet at the location of the Trans-Pacific Parkway/U.S. 101 intersection. The lower-lying portions of the Kentuck project site are mantled and underlain by soft alluvial deposits to depths of more than 100 feet in some areas.

Bedrock underlies these dune sands and includes Eocene marine interbedded siltstones and sandstones of the Coaledo Formation (Baldwin et al. 1973). The upper member of the Coaledo Formation is composed of gray, coarse to fine-grained weathered, very dense, weakly cemented sandstone with silt and minor amounts of coal. The sand-silt unit is present beneath the native sand at elevations ranging from −110 feet to −140 feet. In the South Dunes portion of the site, materials above -30 feet vary and include sands and occurrences of peat/organics. Native sand is present in the area to elevation -151 feet, with very stiff to very hard, clayey silt and sand that includes cementation below. Sands above -30 feet in the access and utility corridor are composed of areas of fill and native material; areas of organics/peat were only encountered in the western portion of the corridor.

Jordan Cove completed 11 deep borings GRI (2007a) at the location of the LNG storage tanks to obtain geotechnical information for the design of the LNG terminal. These subsurface explorations identified sand extending to depths of 124 to 133 feet. Organic mill waste was encountered in the fill at the ground surface at the Ingram Yard and also in several landfills in the vicinity of the mill site. A geotechnical report by GRI (2017a) provides additional geotechnical subsurface investigations performed in 2012 and 2013, and more recently continuing into 2017, at the Jordan Cove site. As noted in the geotechnical report, Jordan Cove plans to conduct additional subsurface investigations to support detailed design. More recently, a Geotechnical Data Report (i.e., *2018 Subsurface Investigation Program*; Jordan Cove LNG 2019a) that covers the South Dunes, Ingram Yard, access and utility corridor, and Roseburg areas was filed with the FERC in July 2019. Jordan Cove would provide a geotechnical data report covering APCO Site 2 to the FERC in 2020. Recent geotechnical investigations and geophysical surveys are described in greater detail in section 4.13.1.

Jordan Cove also conducted two overwater geophysical seismic reflection surveys between the LNG terminal site and the Southwest Oregon Regional Airport located on the east side of the Coos Bay navigation channel. The subsurface profile indicates shallow bedrock, which becomes progressively deeper toward Pony Slough (southeast of the airport), to a depth of approximately 150 feet below the bay floor (GRI 2007a), and to a depth of approximately 120 feet near the south edge of the proposed slip (DEA 2017a).

Effects on surface geology would be limited primarily to the construction phase of the LNG terminal, when the topographic features at specific locations on the site would be altered by clearing, mechanical excavation, dredging, and fill placement. Construction of the slip and access channel would change the surface geology of the site as a result of excavation and dredging. No blasting would be required during any phase of construction of the LNG terminal because the entire site consists of unconsolidated material. Any shoreline areas disturbed by construction would be armored to protect against erosion or shifting beyond the Jordan Cove project design limits.

4.1.1.2 Mineral Resources

The principal mineral production of Oregon in order of value was crushed stone, construction sand and gravel, Portland cement, diatomite, and crude perlite (USGS 2013a). Mineral resources available in Coos County, Oregon, include chromium, gold, clay, manganese, sand and gravel, silica, stone, and titanium. Coal was mined historically in Coos Bay, starting in 1855 until the early decades of the twentieth century. Coal deposits are known to occur in the upper and lower members of the Coaledo Formation (Newton 1980). The Steva coal seam and the Hardy coal seam have been identified within the vicinity of the Kentuck project site (Diller 1914). The closest major productive coal mine was known as the Libby, which operated until about 1920, located south of city of Coos Bay at the head of Coalbank Slough.

Based on the State of Oregon Mineral Information Layer for Oregon-Release 2, there are no permitted coal mines or oil and gas wells within 0.25 mile of the LNG terminal site (DOGAMI 2017). There are three permitted sand and gravel mines within 0.25 mile of the LNG terminal site; however, all three of these mines are closed and are not producing material (DOGAMI 2017). Based on available database information, construction and operation of the LNG terminal is not anticipated to have effects on identified mineral resources, active mines, or oil and gas production facilities.

4.1.1.3 Seismic and Related Hazards

Seismic-related hazards including earthquakes, ground-shaking, volcanic hazards, surface rupture, soil liquefaction, lateral spreading, tsunamis, subsidence, and scour hazards are addressed in section 4.13 of this EIS (i.e., the Reliability and Safety section).

4.1.1.4 Paleontological Resources

There are no state or federal laws or regulations that protect paleontological resources on private lands (Niewendorp, DOGAMI, personal communication, 2008). The Antiquities Act of 1906 protects "objects of antiquity" on federal lands. The Paleontological Resources Preservation Act of 2009 applies to federal lands including BLM and NFS lands, as well as "Indian" lands, but does not apply to private land. See section 4.1.3.

4.1.2 Pacific Connector Pipeline Project

The pipeline would be constructed by conventional cross-country techniques as described in section 2. Typical pipeline trench depth would range from 6 to 10 feet, although it would be deeper at stream crossings with scour concerns or areas with geological hazards. In Class 1[64] areas, the pipeline would have 36 inches of cover and 24 inches of cover in Class 1 areas with consolidated rock. Excavation of the trench would encounter a range of soil and rock materials. Special construction methods for crossing rugged terrain were also previously discussed in section 2.

The proposed route would cross a wide variety of terrain and geological conditions. The proposed route was evaluated for seismic, landslide, erosion and scour, mine, and volcanic hazards that may potentially occur across or near the alignment and that could adversely affect the pipeline. In addition, an evaluation was made of the potential impact that pipeline construction and operation could have on the natural geological environment and geological processes in the pipeline vicinity. During route planning, Pacific Connector identified and attempted to avoid geological resource areas and hazards.

Pacific Connector selected the proposed route with input from agencies, stakeholders, and land managers/owners to avoid areas with high risk of geological hazards. The initial proposed route was changed in numerous locations to avoid high hazard areas as more detailed data were collected. During construction, Pacific Connector would implement site-specific construction techniques and BMPs to mitigate local geological hazards that could not be completely avoided. The following sections discuss these hazards and how they would be mitigated.

4.1.2.1 Geologic Setting

The proposed route crosses four regional physiographic provinces in Oregon: the Coast Range, Klamath Mountains, Cascade Range, and Basin and Range. The proposed route begins within the Klamath Basin, which is part of the larger Basin and Range physiographic province of the Great Basin; an area characterized by ridges and valleys that are separated by faulting (Burns 1998). The route would then head westward over the High Cascades sub-province, a chain of geologically active volcanoes with high andesitic peaks, and the Western Cascades sub-province, an ancestral range of deeply eroded (extinct) volcanoes. The proposed route then passes through the Klamath Mountains physiographic province, which consists of several complex geological terrains composed of metamorphosed and fractured volcanic and marine sedimentary rocks. The proposed route would proceed over the Coast Range physiographic province, an area underlain by estuarine and alluvial deposits in lowland areas and sedimentary rocks in the uplands and terminate at the Oregon Coast. Between the mountain ranges are several valleys, predominantly filled with recent alluvial materials. Some of the major river valleys and their tributaries crossed by the proposed route heading west to east include the Coquille River Valley, Umpqua River Valley, Rogue River Valley, and Klamath River Valley (see section 4.3 of this EIS for more information about waterbodies).

The pipeline alignment is located within varying soil and lithologic units ranging from soft sediments to hard granite and basaltic rock. Unconsolidated silt, sand, and cobbles occur locally

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[64] Pipeline Class designations are described in 49 CFR § 192.5 as locations within 220 yards of the pipeline centerline. A Class 1 location has 10 or fewer buildings intended for human occupancy; and a Class 2 location has more than 10 but fewer than 46 buildings intended for human occupancy.

in streambeds, alluvial fans, and valley floodplains in all four physiographic provinces. Detailed descriptions of geology along the proposed route are included in Table B-1 in Appendix B of the *Geologic Hazards and Mineral Resources Report* (GeoEngineers 2017a) filed with Resource Report 6 of Pacific Connector's application to the FERC. Below is a west to east description of the physiographic provinces crossed by the pipeline.

Coast Range

The proposed route passes through the southernmost part of the Coast Range province for approximately 71 miles (approximately MP 0 to MP 71). The Coast Range is 30 to 60 miles wide and averages 1,500 feet in elevation, although the highest point (Mary's Peak) reaches an altitude of 4,097 feet (Orr and Orr 2012).

The Coast Range is composed of relatively soft marine sedimentary rock units that overlie basalt at depth. The wet conditions of the western slopes of the Coast Range, along with steep terrain composed of relatively weak rock, contribute to an active erosional environment with frequent landslides.

Uplift of the Coast Range deposits has deformed the bedrock units with folds and faults. Coastal uplift of the present Coast Range over the past 10 to 15 million years has been simultaneous with stream incision and coastal erosion and depositional processes. Ocean-cut terraces exist near the shoreline, some of which have been elevated to altitudes of up to 1,600 feet (Orr and Orr 2012). Low-lying areas near the coast are underlain by modern beach deposits, sand dunes, estuarine mud and alluvial sediments.

Klamath Mountains

The proposed route passes through the northeast corner of the Klamath Mountain physiographic province for approximately 49 miles (approximately MP 71 to MP 120). The province has a rugged landscape of high peaks and deep canyons, with a total local relief of 2,000 to 5,000 feet (Baldwin 1964). The highest peak of the Klamath Mountains in the state of Oregon is Mt. Ashland, at 7,530 feet (Burns 1998). Most of the Klamath Mountain physiographic province is composed of highly deformed volcanic and marine sedimentary rocks, as well as metamorphic terranes. The physiographic province also contains deformed pieces of the oceanic crust (accreted terrain from the Cascadia subduction zone [CSZ]) and granitic intrusive bodies (Walker and MacLeod 1991). Bedrock is often intensely metamorphosed and fractured.

The proposed route passes through three tectonic geological terranes in the Klamath Mountain segment of the alignment. West to east and youngest to oldest, these terranes are: (1) the Franciscan and Dothan belt; (2) the Western Jurassic terrane; and (3) the Western Paleozoic and Triassic terrane. The alignment crosses through the northernmost part of the Franciscan and Dothan belt, an area composed of turbidite sandstone, mudstone, and chert formed on the continental slope and subsequently scraped off the ocean floor during accretion. East of the Franciscan and Dothan belt, the alignment passes through the northern section of the Western Jurassic terrane, an area composed of volcanic flows and ash altered to greenstone, ophiolite, and metamorphosed ocean sediments, including conglomerate, siltstone, and sandstone. Between the Western Jurassic terrane and the Western Paleozoic and Triassic terrane, the alignment crosses the White Rock pluton (a large body of intrusive igneous rock that solidified within the crust). The

Western Paleozoic and Triassic terrane is composed of metamorphosed pieces of ocean crust (ophiolites) and metamorphosed ocean-island basalt (Orr and Orr 2012).

Cascade Range

Approximately 60 miles (approximately MP 120 to MP 180) of the route crosses Oregon's southern Cascade Range. The Cascades consist of two north-south trending mountain chains: (1) the older, more weathered Western Cascades; and (2) the younger, higher-elevation High Cascades. The Western Cascades drain westward and reach altitudes of 5,800 feet. The southern High Cascades drain toward the east and the west and reach altitudes of up to 9,493 feet at the summit of Mt. McLoughlin (USGS 2006).

Precipitation of 60 to 100 inches annually on the western side of the Cascades results in extreme weathering of bedrock and soil deposits and the existence of larger rivers in the physiographic province (Orr and Orr 2012). Both the Western Cascades and the High Cascades consist primarily of volcanoes formed as a result of the subduction of the Juan de Fuca oceanic plate beneath the North American continental plate. The Western Cascades terrain consists of deeply dissected volcanoes that formed between about 42 and 8 to 10 million years ago (USGS 2006). The volcanoes of the High Cascades began erupting about 5 million years ago. As the High Cascades volcanoes erupted, their magma chambers emptied and collapsed, creating calderas (large craters). Crater Lake, north of the pipeline alignment in Klamath County, is one of these caldera lakes. During the Quaternary, andesitic cones formed the range's notable high peaks.

After the formation of the high-altitude andesitic peaks, volcanic activity in the High Cascades has continued intermittently to the present. Minor volcanic vents manifest near the pipeline alignment. These include Brown Mountain, which is a Quaternary-aged volcano situated about 3 miles north of the proposed route near MP 167.

Repeated glaciation of the High Cascades during the Pleistocene Epoch produced glacial U-shaped valleys, cirques, and jagged mountain ridges. No active glaciers exist along or near the pipeline alignment.

Basin and Range

Approximately the easternmost 45 miles (approximately MP 180 to MP 224) of the pipeline alignment pass through the southwestern corner of the Basin and Range province in Oregon, a geographic area named the Klamath Basin. The Basin and Range province contains the Upper Klamath Lake and Lower Klamath Lake National Wildlife Refuge, which, unlike the rest of the province, drain to the Pacific Ocean via the Klamath River.

The Basin and Range is a complex series of alternating uplifted mountain blocks (horsts) and down-dropped basins (grabens). These mountain ranges and valleys are separated by generally north-south trending normal (extensional) faults. The altitude of the Basin and Range province is generally over 4,000 feet, and the summit of Steens Mountain in southeast Oregon reaches 9,670 feet.

Crustal extension is responsible for development of the Basin and Range physiographic province. The extension occurred in two phases, the first of which happened between 20 and 10 million years ago and produced widespread volcanic activity resulting in thousands of feet of basaltic flows and tuffs. The second phase of extension occurred in the last 10 million years and produced the distinct horst and graben block faulted topography.

The low precipitation and runoff rates east of the Cascades restrict the amount of erosional debris that can be transported from watersheds. As a result, sediment has accumulated in the basins, in thicknesses greater than 1,000 feet in some places. Eroded material is deposited in alluvial fans and channels around the margins of the basins and as marsh and lake deposits in the lower elevations. During the wetter and cooler periods of the ice ages, the basins were occupied by much larger lakes; at maximum extent, Pluvial Lake Modoc extended over the pipeline alignment from Klamath Marsh, north of Upper Klamath Lake, to the Tule Lake basin in northern California (Orr and Orr 2012:304).

4.1.2.2 Mineral Resources

Mineral resources that occur in the pipeline area include the following metals: chromite, copper, gold, manganese, mercury, and silver. Other rock and mineral resources include basalt, cinders, coal, conglomerate, limestone, natural gas (including coal bed methane), sand and gravel, sandstone, shale, silica, talc, and tuff/breccia (DOGAMI n.d.). Most of the non-metal minerals are mined to produce aggregate. Mineral resources, surface and subsurface mines, mining claims and leases, mineral material disposals, and oil and gas fields located within one-half mile of the Pacific Connector pipeline construction right-of-way were identified from USGS topographic maps, BLM and Forest Service mineral resource databases (including oil and gas leases, geothermal leases, and mining claims), ODOT aggregate resources Geographic Information System (GIS) data, DOGAMI GIS data, published reports, published and unpublished maps, county mineral overlay maps, and the updated Oregon MILO-2 mineral information layer (DOGAMI n.d.).

Portions of the pipeline alignment cross six areas with county zoning that recognizes the potential for future mineral resource development. This zoning implies that mines and oil and gas wells could be sited at any location within these areas in the future as long as the zoning remains compatible with the resource extraction operations.

Table B-5 of Appendix B from GeoEngineers (2017a) identified the active and inactive mineral resources or mining sites (organized by MP) within 0.25 mile of the pipeline that might present potential hazards. Twenty-two mineral or mine locations were identified as within 500 feet of the pipeline. Sixteen of these mines identified within 500 feet of the alignment are aggregate or quarry-related mines. The aggregate or quarry-related mines generally consist of open excavations and the primary potential hazards at these mines would be related to failure of steep slopes and/or high walls. Pacific Connector's civil survey crews did not observe such conditions along or adjacent to the alignment. Pacific Connector would provide a more comprehensive evaluation of such conditions during the final detailed design.

The remaining seven non-aggregate-related mines were investigated by Pacific Connector through field reconnaissance on January 23 and 24, 2007, and June 13 and 15, 2007. The reconnaissance of the seven mines did not identify any apparent mine workings located within 500 feet of the pipeline alignment. However, adits associated with the Nivinson Prospect/Mars Fraction Lode and Thomason mines were identified within 500 feet of the proposed pipeline. Therefore, Pacific Connector conducted a site-specific mine hazards assessment for those prospects as well as the nearby Red Cloud Mine, and the findings of that study were provided in a stand-alone report dated

August 23, 2007, and its 2009 addendum (GeoEngineers 2007a, 2009a). The reports document the existence of naturally occurring mercury in the vicinity of the mines. Six samples were collected along a previous pipeline route and indicated that very low concentrations of naturally occurring mercury mineralization exists. Mercury was not detected in any of the samples at levels that exceed applicable ODEQ and EPA screening levels for protection of worker health. However, a 2,000-foot section of the pipeline route was moved 2,500 feet to avoid the area of the mines.

No mine hazards related to subsidence or slope stability have been identified by the research and investigations completed by Pacific Connector to date. Pacific Connector's ECRP includes erosion and sediment control measures that would be employed to avoid potential impacts from the naturally occurring mercury concentrations identified in the vicinity of the Nivinson Prospect/Mars Fraction (MP 108.7).

Pacific Connector also identified areas where the pipeline would cross: (1) areas where county land-use zoning allows mineral resource extraction, or (2) federal land that has been or is available for mineral resource or geothermal leases (GeoEngineers 2017a). The BLM Legacy Rehost System, LR 2000, was accessed on April 26, 2013 and again in September 2017 by Pacific Connector to include the more recent information. The BLM would review and verify the validity of this database query by Pacific Connector during their right-of-way permit review (the costs of this effort would be borne by Pacific Connector).

Coos County recognizes three coal-basin resource areas between MPs 0 and 7.6, and one between MPs 13.2BR and 13.4BR. Although 39 BLM oil and gas leases were identified in the immediate vicinity of the pipeline route, the database listings are all indicated to be closed. Although 11 mining claims were identified in the immediate vicinity of the pipeline route, the listings are indicated to be closed. One mine, a chromite resource, and a quarry are located in the immediate vicinity of the pipeline alignment between MPs 46.9 and 110 in Douglas County. Two geothermal resources areas are located in the immediate vicinity of the pipeline alignment between MPs 170.1 and 216.8 in Klamath County.

Constructing and operating the pipeline could affect future mineral extraction operations. Surface mining activities (including materials storage) across the permanent pipeline easement would be prohibited and heavy equipment crossings of the pipeline would be restricted to specific crossing locations. Sub-surface mining could occur, but would require coordination between the pipeline and the mining company, and the implementation of measures to ensure pipeline integrity.

Mine Hazards

Mine hazards potentially exist in areas underlain by or adjacent to underground mine workings and surface mines that have not been properly stabilized, closed, and made safe in accordance with applicable local, state, and federal laws. Pacific Connector identified surface and subsurface mines within 0.5 mile of the proposed construction right-of-way from USGS topographic maps, BLM and Forest Service databases, and LR 2000 (2017). DOGAMI GIS data, published reports, published and unpublished maps, and county mineral overlay maps. No mine hazards were identified at the aboveground facilities locations.

The primary hazards involve the potential for:

- subsidence in areas underlain by or adjacent to air shafts, tunnels, underground workings, and mine tailings;
- rockfalls and slides caused by the failure of unstable benches, slopes, and tailing piles in nearby surface mines, including those benches and slopes occurring within water-filled pits; and
- the presence of tailings or waste piles containing naturally occurring metals.

According to Pacific Connector's application (Table B-5 of Appendix B from GeoEngineers 2017a), the pipeline alignment was identified as being located within 500 feet of potential mine hazards based on the information provided in the databases at 22 locations. Sixteen of the 22 mines identified within 500 feet of the alignment are aggregate or quarry-related mines. Aggregate or quarry-related mines generally consist of open excavations. The primary potential hazards at these mines would be related to failure of steep slopes and/or high walls. These are expected to be localized conditions. Civil survey crews involved with surveying the right-of-way did not observe these conditions along or adjacent to the alignment. Consequently, these potential hazards are not expected to pose a threat to the pipeline.

The remaining non-aggregate-related mines were investigated by field reconnaissance on January 23 and 24, 2007, and June 13 and 15, 2007. The database indicated that these mines are located at MPs 9.8, 10.0, 16.2, 58.8, 75.3, 105.6, 108.7, 109.3, 109.4, 110.7 142.6, and 150.5. The reconnaissance of these mines did not identify any apparent mine workings located within 500 feet of the pipeline alignment. Adits [65] associated with the Nivinson Prospect/Mars Fraction Lode and Thomason mines were identified within 500 feet of the pipeline location. Therefore, a site-specific mine hazards assessment was completed for those prospects as well as the nearby Red Cloud Mine, and the findings of that study were provided in a stand-alone report dated August 23, 2007, and its 2009 addendum (GeoEngineers 2007b, 2009a). The following summarizes the report findings with regard to the proposed route.

Nivinson Prospect/Mars Fraction Mercury Mine

The pipeline alignment at MPs 108.6-108.7 does not cross the Nivinson Prospect mercury mine but is approximately 200 feet upslope from mine adits. Based on documented excavated depths, trends, and distances from the pipeline, it was concluded from the field investigation that the adits of the Nivinson Prospect mercury mine likely do not extend into the right-of-way and do not pose a risk to the pipeline. However, the pipeline route was moved 2,500 feet from these areas to avoid potential risks.

Red Cloud Mercury Mine

The pipeline alignment is approximately 400 feet west of the Red Cloud mercury mine at MP 109.3. No evidence of the mine was observed during site reconnaissance of the alignment.

[65] A horizontal passage leading into a mine for the purposes of access or drainage.

Thomason Mine (Inactive)

The pipeline alignment at MP 109.4 crosses the mapped location of the Thomason Mine. No evidence of the Thomason Mine was observed during site reconnaissance of the alignment. Approximately 260 feet downslope of the mapped Thomason Mine location at MP 109.4, the proposed route crosses East Fork Cow Creek. The proposed route crosses the East Fork Cow Creek outside of the Thomason Mining Group boundaries and all other mining groups mapped by Brooks (1963).

Heppsie Quarry

The proposed alignment at MP 150.5 is located within approximately 80 feet northeast of the Heppsie quarry, and parallels the length of the quarry. The Heppsie quarry is a regional hard rock quarry and to utilize this rock quarry it is necessary to blast the rock. The BLM and Pacific Connector determined that due to the proximity of the pipeline to the quarry and the incompatibility of production blasting the rock quarry near the pipeline; that 70,000 cubic yards of rock would be blasted at the expense of Pacific Connector and left on site. The BLM is requiring this blasting because the BLM will not assume unknown risk associated with complications, limitations, or liability associated with utilizing this quarry in the future. The BLM assumes that a portion of this blasted rock would be reserved for BLM use and the remainder would be available for purchase through the 43 CFR 3600 regulations. Based on aerial photographs and the BLM data Pacific Connector has shown that the pipeline parallels the quarry. The BLM has provided Pacific Connector with core drill logs, maps, and a development plan for use of the quarry.

4.1.2.3 Seismic and Related Hazards

The degree of risk to the proposed pipeline from seismic and related hazards varies and depends on several factors, including the magnitude (or size) of the earthquake, the distance of the earthquake origin from the pipeline facilities (lateral and vertical), soil/rock conditions and slope angle of the ground. The proposed route crosses a complex geological area that has developed through extensive crustal deformation and volcanic activity. Two primary mechanisms for generating earthquakes of design significance exist along the pipeline alignment: (1) a major, regional earthquake associated with the CSZ; and (2) local earthquakes associated with a seismic hot spot near Klamath Falls. Based on the catalogs of recorded earthquakes from the Pacific Northwest Seismograph Network, 1872 to September 2017, and the Earthquake Database for Oregon, 1833 to 1994 (Wong and Bott 1995; Johnson et al. 1994), 336 earthquakes have been recorded within 100 miles of the Pacific Connector pipeline alignment. It is noted that the pre-seismograph earthquake records are likely only complete for earthquake magnitudes greater than 4.0. Table 4.1.2.3-1 lists the recorded historical earthquakes by magnitude range and by epicentral distance to the nearest segment of the Pacific Connector pipeline. Major historical earthquakes near the proposed route include an estimated magnitude 7.0 earthquake at the southwestern tip of Oregon that occurred in 1873. Due to the lack of seismographic information, the specific epicenter and magnitude of the earthquake have been estimated. An estimated magnitude 6.3 earthquake occurred near Coos Bay. In addition, a magnitude 6.0 event occurred in 1938 approximately 75 miles south of Coos Bay. Closer to the planned alignment, two earthquakes occurred within about 2 hours of each other on September 21, 1993 that had epicenters located about 15 miles northwest of Klamath Falls: both were magnitude 6.0 earthquakes (Yelin et al. 1994; Braunmiller et al. 1995). However, most of the pipeline construction area has experienced very few earthquakes of magnitude 6 or greater during the period of historical record. In addition, based on the geological record, large magnitude earthquakes with an approximate magnitude of 9 have occurred on the CSZ during the past 11,000 years, most recently documented in the year 1700.

Geological maps of the pipeline area show many faults that cross the pipeline alignment or are located near the pipeline corridor (Walker and MacLeod 1991; USGS 2014b; Black and Madin 1995; Personius 2002a; Mertzman et al. 2007; Mertzman 2008; Hladky and Mertzman 2002). However, with the exception of the Klamath Falls area, these mapped surface faults are not considered active based on evidence of recent Quaternary tectonic activity and are not believed to be capable of renewed movement or earthquake generation (USGS 2009a, 2010, 2014a, 2014b, 2014c). Many earthquakes of magnitude 2.0 and larger have occurred during historical times in the Klamath Falls area. Most earthquake epicenters are clustered northwest of Klamath Falls, near the southwest shoreline of Upper Klamath Lake with over 400 earthquake aftershocks of magnitude greater than 1.5 associated with the 1993 magnitude 6.0 earthquakes previously described (DOGAMI 1993). Epicenters of these earthquakes are typically at depths of about 3 to 5 miles. These events seem to be associated geographically with the boundary between the Basin and Range province and the Cascade Range province. The earthquake clusters also may be associated with volcanic activity (Cole and Bugni 1993).

TABLE 4.1.2.3-1

Historical Earthquakes within 100 Miles of the Proposed Pacific Connector Pipeline a/

Magnitude Range b/	Number of Earthquakes	Epicenter Distance From Alignment (miles)
3.0 to 3.99	174	5 to 100
4.0 to 4.99	143	3 to 99
5.0 to 5.99	15	8 to 100
6.0 to 6.99	3	9 to 74
7.0 to 7.99	1	82

a/ Earthquake catalog data from the USGS Earthquake (i.e., the Comcat database) Search (January 1, 2006, to August 28, 2013), Pacific Northwest Seismograph Network (2006) and the Earthquake Database for Oregon, 1833 to 1993 (Johnson et al. 1994).
b/ Earthquakes with less than magnitude 3.0 are termed micro-earthquakes and are not usually felt (Reiter 1990). Earthquakes of magnitude 5.0 and greater are generally considered to have engineering significance.

The primary seismic hazards to pipelines include potential strong ground shaking, surface fault rupture, soil liquefaction (and related lateral spreading), earthquake-induced landslides, and regional ground subsidence. The degree of risk from these hazards varies and depends on several factors, including the magnitude (or size) of the earthquake, the distance of the earthquake origin from the pipeline facilities (lateral and vertical), soil/rock conditions, and slope angle of the ground.

Empirical reviews of historical earthquakes demonstrate that welded steel pipelines are not prone to failure due to earthquakes. Modern buried pipes with welded joints have low vulnerability to elastic ground displacement related to earthquake shaking. Ground displacements from wave propagation occur over widespread areas and lack the local strain concentrations necessary to damage a modern welded pipeline. A 1996 study of earthquake performance data for steel transmission lines and distribution supply lines operated by Southern California Gas over a 61-year period found that post-1945 arc-welded transmission pipelines in good repair have never experienced a break or leak during a southern California earthquake and are the most resistant type of piping, vulnerable only to very large and abrupt ground displacement (e.g., severe landslides), and are generally highly resistant to traveling ground wave effects and moderate amounts of permanent deformation (O'Rourke and Palmer 1994). The study included evaluation of pipeline performance during the 1933 Long Beach earthquake (magnitude 6.4), the 1952 (magnitude 7.3) and 1954 Kern County earthquakes (magnitude unknown) the 1971 San Fernando earthquake (magnitude 6.5-6.7) and the 1994 Northridge earthquake (magnitude 6.7). A study of water transmission pipeline response to the 2011 Tohoku earthquake (magnitude 9) indicated that steel pipe over 137 kilometers required 12 repairs – a rate of approximately 0.1 repair per kilometer (Wakamatsu et al. 2016). Similar studies for large (magnitude 8 and greater) earthquakes were not available for natural gas transmission pipelines.

In addition to ground shaking, subsidence and ground rupture from seismic activity, tsunamis can be generated by strong ground motions associated with offshore earthquakes or submarine landslides. Coastal areas of Oregon, including Coos Bay, could experience the effects of tsunamis. The portion of the pipeline near the LNG terminal occurs in the relatively sheltered areas of Coos Bay, where the effects of a tsunami on the pipeline would be expected to be relatively minor (GeoEngineers 2017a).

Seismic hazards for the pipeline were evaluated by reviewing available historical data, by researching geological evidence of prehistoric earthquakes for the Pacific Northwest, and by qualitatively evaluating the potential risk to the pipeline along the overland sections of the alignment. Quantitative evaluation of the potential for liquefaction, lateral spreading, and tsunami inundation was accomplished for the Coos Bay crossing, where liquefaction and lateral spreading hazard were identified during the initial assessment (GeoEngineers 2017a).

Cascadia-type earthquakes are discussed in section 4.13 (i.e., the Reliability and Safety section) for the Jordan Cove LNG Project. In general, interplate earthquakes on the CSZ are associated with eastward movement of the Juan de Fuca tectonic plate beneath the North American plate. Another type of earthquake associated with the CSZ is an intraplate earthquake within the subducting Juan de Fuca plate as it sinks and breaks up below the North American plate. If a Cascadia-type earthquake of magnitude 8 or greater occurred during the operating life of the pipeline, the ground shaking and possible ground subsidence would be strongest in the Coast Range province and in low-lying areas near Coos Bay. Although ground shaking would likely be felt throughout the length of the pipeline from a Cascadia event, hazards would diminish in the eastward direction, with increasing distance from the offshore epicenter. Documented subsidence zones associated with the 1960 subduction zone earthquake in Chile (Plafker and Savage 1970) indicate subsidence on the order of 3 to 6 feet vertically distributed over a wide trough of approximately 60 miles. Pacific Connector studies (GeoEngineers 2017a) have indicated that the resultant strain accrual on a welded steel pipeline distributed over that length of pipe would not pose a substantial risk to the integrity of the pipeline.

Ground Shaking and Peak Horizontal Ground Acceleration

Earthquake magnitude and ground motion are two different parameters discussed in relation to CSZ events. Earthquake magnitude describes the earthquake source, and peak horizontal ground acceleration (PGA) describes the effect of the earthquake at a certain distance from the source and based on the geological conditions. The PGA used to design for a certain earthquake is therefore based on the earthquake magnitude as well as other factors. As described below, the pipeline would be designed using PGA values that correspond with the design standard 475-year return period. However, it is noted that, as previously discussed, modern welded steel pipe has performed well in earthquakes up to magnitude 6.7 and a water pipeline in earthquakes of magnitude 9.

Using the historical seismicity record including the records for CSZ earthquakes and the available data on Quaternary faults in the United States, the USGS (2009a, 2014a, b, c) has produced probabilistic seismic hazard mapping for the United States in general, and for the region that would be crossed by the pipeline in particular. This mapping has generally been used to address two risk levels: (1) a 10 percent probability of exceedance in 50 years (475-year return period); and (2) a 2 percent probability of exceedance in 50 years (2,475-year return period). The output from the seismic hazard mapping includes estimates of the PGA and spectral accelerations for 0.2 and 1.0 second structural periods. The PGA values are given in percentages, or decimal fractions, of the acceleration of gravity (g). The acceleration resulting from gravitational forces (g) is defined as 32 feet per second squared. PGAs for the Project were calculated for the specific 475-year and 2,475-year return periods and the site-specific PGA for each corresponding milepost interval of the pipeline alignment (GeoEngineers 2017a).

The 10 percent probability of exceedance in 50 years (475-year return period) is defined by the American Society of Civil Engineers (ASCE) Technical Council on Lifeline Earthquake Engineering as the contingency design earthquake for pipeline design (ASCE 1984). The highest 475-year return period PGAs expected along the pipeline alignment range from 10.5 to 29.5 percent (MP 0 to 2.0 and MP 9R to 16BR) of gravity.

The University of Washington (2001) noted that these intensities are moderate and relate Instrumental Intensity VIII and a "Moderate to Heavy" potential damage to aboveground structures as described by the Modified Mercalli Intensity scale as follows:

> *Steering of cars affected. Damage to masonry C; partial collapse. Some damage to masonry B; none to masonry A. Fall of stucco and some masonry walls. Twisting, fall of chimneys, factory stacks, monuments, towers, elevated tanks. Frame houses moved on foundations if not bolted down; loose panel walls thrown out. Decayed piling broken off. Branches broken from trees. Changes in flow or temperature of springs and wells. Cracks in wet ground and on steep slopes.* (USGS 1931)

The USGS (1931) indicates that instrumental intensities of IX up to XII are seismic conditions where damage to pipelines may occur. It is noted that the intensity scale was created in 1931 and that modern pipeline materials and design protocols have improved considerably, as discussed in the following section. The potential damage to buried pipelines from the ground-shaking intensity at the site (intensity of VIII or greater) is, therefore, considered to be low. The pipeline would be designed to shut down automatically if a mechanical failure poses risk to the equipment or otherwise constitutes a hazard. Additional discussion of public safety concerns related to potential earthquake damage to the pipeline is provided in section 4.13 (i.e., the Reliability and Safety section).

Surface Rupture Potential from Faulting

Differential, or shear, movements of fault surfaces can be entirely subsurface, or they can extend to the ground surface as surface fault rupture. The nature of the shear movements at the surface depend on the character of fault movement. In general, surface fault rupture across a pipeline alignment can result in rapid differential ground displacements across the pipe, with displacement magnitudes ranging from a few inches to several feet. The typical mechanics of fault movement in the Basin and Range province (crossed by the pipeline between MP 160 to MP 224) is normal faulting at near-vertical inclinations (dip angle) caused by crustal extension. This extension forms grabens, or down-dropped blocks of the earth's crust bounded on both sides by normal faults. Although deep earthquakes occur beneath the continent within the subducting Juan de Fuca Plate in association with the CSZ, there is no risk of fault offsets at the ground surface associated with these deep earthquakes.

Based on the USGS Faults and Folds Database (USGS 2014b) and the DOGAMI geologic mapping (Black and Madin 1995; Personius 2002a; Mertzman et al. 2007; Mertzman 2008; Hladky and Mertzman 2002), and review and interpretation of light detection and ranging (LiDAR) data available from DOGAMI (http://www.oregongeology.org/lidar/), the pipeline alignment crosses the following regional Quaternary and Holocene age fault zones:

- Sky Lakes fault zone (includes Lake of the Woods Fault), near MPs 172 to 182;
- West Klamath Lake fault zone, near MP 187;
- Lower Klamath Lake section of the Klamath Graben Fault system near MPs 204 to 206 (4-5 crossings); and
- The South Klamath Lake section of the Klamath Graben Fault system near MPs 212 to 213 (Stukel Mountain fault).

The mapped Holocene age fault (defined by the USGS as active within the last 10,000 years) that would be crossed by the pipeline alignment occurs within the South Klamath Lake section of the Klamath Graben fault system, in the vicinity of Klamath Falls near MP 213. This fault is specifically named the Stukel Mountain Fault. Review of USGS data sources (Personius 2002a, 2002b) does not provide potential earthquake magnitude along this fault, but provides other information about slip rate and fault length. LiDAR imagery of recent alluvial sediments in this area does not show linear features typical of fault movements at the ground surface. Recently acquired color stereo aerial photographs do not show linear features or changes in soil color indicative of fault movement at the ground surface.

The location of the Stukel Mountain Fault was evaluated further by completing a seismic reflection survey (NORCAL Geophysical Consultants 2015) in the vicinity of the mapped fault location. The survey confirmed that a near-vertical normal fault extends southeastward from Stukel Mountain into the valley fill area and that the structural offset in bedrock is large—about 1,800 feet to 850 feet—and indicates that the graben is increasing in depth to the north. The disturbed zones from the two seismic lines align well with the USGS and DOGAMI interpretations of fault extensions into the valley fill. The fault offset extends from the bedrock surface (at about 325 feet deep) to shallower than 60 feet, the shallowest depth that could be explored by the seismic reflection survey. Thin alluvial cover over the disturbed sediments indicates that little time has passed since the fault displaced, supporting a conclusion that the Stukel Mountain fault is active.

The data generated by NORCAL indicates that the faulting in bedrock and valley fill commenced long ago and has continued intermittently into the Holocene; this affirms the published classification that the fault is active and has the potential for surface rupture. Based on the NORCAL survey locational information, a fault crossing assessment and design is needed between about MP 212.8 and MP 212.9, a 600-foot-wide zone of potentially active faulting.

Pacific Connector conducted a detailed hazard assessment and mitigative design for the fault crossing (SSD, Inc. 2017). The design fault displacement was computed using a simple and conservative MCE approach, which neglects probabilistic seismic hazard methods and assumes that the entire fault is capable of rupturing all at once. The fault is relatively short and is capable of, at most, about 3.3 feet of differential movement. The force on the pipe would be limited to the weight of backfill on top of the down-dropped side based on the nature of the fault. Therefore, detailed numerical simulation of the pipe-soil interaction of a potential maximum 3.3-foot offset was performed using a proprietary software called PIPLIN. The preliminary results of the Stukel Mountain numerical simulation analyses indicate that mitigative construction is not necessary.

Pacific Connector would further evaluate and select specific designs for fault mitigation during the final detailed design. In general, Pacific Connector would follow published guidance to estimate the potential amount and direction of fault offsets as well as the magnitude of strain accumulation at the pipe crossing location (Takada et al. 2001; Honegger and Nyman 2004). Based on trench observations during pipeline construction by EIs, if mitigation becomes necessary at any of the suspected Quaternary fault crossings, it is anticipated that the mitigation design would consist of trenches with shallow-angled sidewall slopes that are backfilled with loose, cohesionless sand and/or gravel. Site-specific numerical simulation would be used to develop optimum trench geometry for the pipeline alignment where the mitigation is implemented. If backfill material is obtained from federal land and not sourced from within the right-of-way itself, 43 CFR 3600 regulations must be followed. This applies to any material required for constructing access roads and pads. This mitigation option would use trenches with shallow-angled sidewall slopes that are backfilled with loose, cohesionless sand and/or gravel material. Pipeline load reduction with low-strength backfill is likely the most cost-effective mitigation approach for fault rupture hazards. This mitigation option also involves the use of isolation valves on opposite sides of a fault crossing. In the event of a fault-induced rupture or leak of the pipeline, the isolation valves would detect the pressure loss and close automatically, thus preventing flow of gas to the location of the rupture. Such mitigation options are typically only utilized if warranted by site conditions.

The performance of a buried pipeline subjected to fault rupture can be improved further by using different backfill material surrounding the pipe, such that the pipeline is less restrained to movement, thereby reducing shear and bending stresses (ALA 2001, 2002). Also, a coating material can be applied to the pipe to reduce the soil-pipe interface friction, such that the tensile and compressive stress of the pipe can be reduced. This technique has been used by All American Pipe Line Company for its pipeline that crosses the San Andreas Fault in California, by the Sakhalin II Pipeline (Sakhalin Energy Investment Corp. 2008) that crosses multiple active faults in Russia, and by the BTC Pipeline in the Republic of Georgia. In addition, use of stronger material (additional wall thickness) would increase the load capacity of the pipeline, hence increasing the amount of ground movement tolerable by the pipeline. Pacific Connector would consider, evaluate, and implement the best mitigation options for specific conditions during the final detailed design in coordination with the FERC.

Liquefaction and Lateral Spreading Potential

The potential for soil liquefaction from an earthquake is a function of the intensity or strength of the earthquake shaking (high PGA), the duration of strong earthquake shaking, the nature of the soil (it must generally be loose to medium dense and granular such as silt or sand), and groundwater conditions (the soil must be saturated with a shallow groundwater table). In general, liquefaction that results in permanent ground deformation or buoyant displacement of buried pipelines has the potential to result in pipeline damage (O'Rourke and Liu 1999). Pipeline damage associated with liquefaction typically occurs where a sharp transition exists between liquefiable and non-liquefiable materials. Shear or bending movements at such sharp transitions can damage pipelines. In addition, liquefaction can change the buoyancy forces such that the pipeline may float if not mitigated during design. The evaluation of liquefaction potential is complex and depends on numerous site parameters, including soil grain size, soil density, age of soil deposit, depth of the water table, site geometry, static stresses, and design accelerations.

In addition to settlement or pipeline buoyancy, the possibility exists that liquefaction could result in lateral spreading. Lateral spreading involves lateral displacement of surficial blocks of non-liquefied soil as the underlying soil layer liquefies. Lateral spreading generally develops in areas where sloping ground is present, such as along the banks of rivers, sloughs, canals, or lakes. Because lateral spreading is associated with liquefaction of soils, the potential for lateral spreading along the pipeline alignment was evaluated based on the same criteria as liquefaction potential.

The potential for liquefaction along the Pacific Connector pipeline was evaluated based on topography and soil conditions obtained from geological maps, NRCS soil surveys, and, at some sites, limited geotechnical boring data. Areas along the proposed pipeline that are subject to being under water-saturated soils within the pipeline depth are generally limited to valley floors. The groundwater table is not expected to be encountered within the trench depth along mountainous terrain. Excavation depths within the gently sloping valley floors crossed by the pipeline would be limited to the pipeline trench. The pipeline trench backfill is not considered to be of sufficient volume to liquefy during an earthquake. Additionally, trench breakers would be installed in the pipeline trench at regular intervals to prevent the trench from capturing and conveying near surface groundwater.

Liquefaction potential was identified for portions of the proposed route that would be expected to encounter loose to medium dense sandy soils (generally occurring in alluvial valleys or near rivers, streams, sloughs, lakes or other waterbodies). The characteristics were incorporated by Pacific Connector into a numerical liquefaction analysis used to characterize the potential risk of liquefaction. Based on an initial numerical analyses, sites that were underlain by strata with a safety factor against liquefaction of less than 1 are shown as having a "High" risk for potential liquefaction. Geotechnical borings were completed at areas of high risk to obtain data necessary for further evaluation of liquefaction hazards in these areas. These areas are listed in table 4.1.2.3-2 as having potential for liquefaction and/or lateral spreading. Those listed as low potential include sites with subsurface conditions of fine-grained soils that are not susceptible to liquefaction or soils that are not expected to be saturated. Those listed as high potential include sites that are underlain by potentially saturated loose to medium dense granular soils. The unknown potential site is an area of private property where no site-specific subsurface information is available due to lack of access.

TABLE 4.1.2.3-2

Summary of Potential Liquefaction and Lateral Spreading Hazards

From MP	To MP	Feature	Liquefaction Potential/ Lateral Spreading Potential	Ownership
1.4R	3.0R	Coos Bay	High/Low	Private, State
3.00R	6.50R	Kentuck Inlet	High/High	Private, State
8.26R	8.47R	Willanch Slough	High/High	Private, State
11.0R	11.3R	Coos River	High a/	Private, State
10.10	10.40	Stock Slough	Low/Low	Private
10.80	11.40	Catching Slough	Low/Low	Private, State
15.72	15.77	Boone Creek	Low/Low	Private
22.60	23.10	North Fork Coquille River	Low/Low	Private
27.00	27.15	Park Creek (aka Middle Creek)	Low/Low	BLM, Private
29.41	30.20	East Fork Coquille River	Low/Low	Private
48.02	48.40	Deep Creek	Low/Low	County, Private, BLM
49.70	50.45	Middle Fork Coquille River	Low/Low	Private
55.80	56.60	Alluvial Valley	Low/Low	Private
56.90	59.00	Olalla Creek	Low/Low	Private
66.85	67.05	Willis Creek	High/High	Private
68.95	69.80	South Umpqua River #1	High a/	ODOT
88.20	88.65	Days Creek	Low/Low	Private
94.55	94.80	South Umpqua River #2	High a/	Private
122.55	122.75	Rogue River	High a/	Private, State
128.50	128.70	Indian Creek	Unknown b/	Private
131.80	132.00	Neil Creek	Low/Low	Private
191.60	199.00	Klamath Valley	High/Low	Private
199.00	201.00	Klamath River	High a/	Private, State, Reclamation
201.00	214.00	Lost River Valley	Low/Low	Private, State, Reclamation
217.10	218.33	Alluvial valley	Low/Low	Private
221.80	224.40	Alluvial valley	Moderate/Low	Private

a/ A potential for occurrence may exist, but hazard would be mitigated.
b/ Landowner permission to evaluate site was not granted.

Pipeline segments were further evaluated in a third phase analysis including Kentuck Slough, Willanch Slough, and Coos River Valley. The third phase liquefaction and lateral spreading analysis for all but the Coos Bay crossing is described in the *Liquefaction and Lateral Spreading Hazard Evaluation*.[66] The Pacific Connector design requirements used to evaluate the pipeline under liquefaction hazard conditions are consistent with 49 CFR 192 and the underlying ASME performance requirements. This performance requirement focuses on maintaining pipe integrity and allows that inspection and repairs would likely be necessary after a major earthquake. Pipelines in natural gas service that are regulated under 49 CFR 192 can be designed for stresses and strains that exceed 100 percent specified minimum yield stress (SMYS) provided that certain conditions are met. Although there is no uniform design standard for the evaluation of pipeline stresses caused by large permanent ground deformations induced by soil liquefaction, the general practice has been to complete numerical modeling that incorporates the dynamic response of the

[66] Dated July 29, 2016, Appendix L to Appendix A.6 of Resource Report 6 in Pacific Connector's September 2017 filing with the FERC.

potentially liquefiable soils and the soil-pipe interaction effects to estimate the pipe stresses after a design earthquake event.

In the third phase of evaluation, site-specific seismic hazard analyses were completed to define the design earthquake magnitude and PGA for each site and to refine the liquefaction and lateral spreading hazard potential at each site. The design earthquake used for the liquefaction analysis in this case was an earthquake with a mean return period of 2,475 years per ASCE 7-10. It is noted that this return period is greater than the pipeline standard design requirement for the 475-year return period, but was used to address concerns regarding a large magnitude CSZ earthquake. The 2008 probabilistic seismic hazard model developed by the USGS was used in defining the design earthquake event, which indicated that magnitude 8 to 9 CSZ earthquakes dominate the seismic hazard at the subject sites. The MCE at the Coos Bay, Kentuck Slough, Willanch Slough, Willis Creek, and Neil Creek sites are associated with a large Cascadia-type subduction earthquake. The MCE for the remaining sites was based on local faults of the Klamath Graben Fault System. Based on the results of the evaluation, the following sites were determined to a have high liquefaction hazard: Kentuck Slough and Coos River. The analysis results indicated that the liquefaction-induced permanent ground deformations at the Willanch Slough site is low and would not likely overstress the pipeline.

Additional analyses of areas of high liquefaction hazard were performed to obtain pipe stress estimates that might result from seismic events. A pipe's stress limit is its failure envelope under combined stresses, and this analysis takes into account the fact that as a pipe is stressed in combined axial and bending mode, it can withstand total stresses greater than the yield stress before rupturing. Two analysis calculation methods were used to estimate the pipe stresses caused by the large liquefaction-induced permanent ground deformations. The effect of liquefaction and lateral spreading on the pipeline was calculated for each of the selected sites using the currently specified pipeline carrier pipe specifications of 36-inch-diameter, 0.762-inch wall thickness, API-5L X-70 Steel Pipe. The results show that the maximum pipe stresses at Kentuck Slough were estimated to be lower than the SMYS, hence the strains should be lower than about 0.2 percent to 0.5 percent and well within the acceptance criteria of 2 percent pipe strain under seismic conditions. However, the results indicated that the maximum pipe stresses at the Coos River crossing are estimated to be greater than the yield stress.

A limit stress analysis was therefore completed for the Coos River crossing to determine the likelihood of pipeline rupture due to liquefaction. The results indicate that although the pipe stresses at Coos River exceed the SMYS, they are still estimated to be below the combined stress limit (ultimate failure envelope); and the liquefaction- and lateral-induced pipe strain is less than the 2 percent strain limit per ASME B31.8 code and the Pacific Connector design guidance.

A seismic hazard evaluation of the Coos Bay pipeline crossing was performed by GeoEngineers in June 2018 (GeoEngineers 2018a). Pacific Connector proposes to use HDD methods to traverse Coos Bay and depths of the HDD crossing would be located in deeper dense sands that have no liquefaction potential. However, although the entry and exit areas of the HDD crossing would be located beyond the area of the most severe liquefaction and lateral spreading areas, they would still be located in sand materials more susceptible to potential liquefaction. Evaluation of the pipeline liquefaction strain for these areas indicates that liquefaction could cause a 0.2 percent strain in the pipe. This calculated strain is less than the 2 percent strain limit, and therefore would meet the ASME design code.

Mitigation for liquefaction conditions can include avoidance by routing around or under the potentially liquefiable materials, by reinforcing the pipe with thicker walls, and/or by weighting the pipe with a concrete coating. Potential ground improvement measures would also be considered including vibroflotation,[67] stone columns, compaction grouting, and deep dynamic compaction. Primary geotechnical factors involved in selecting the type of mitigation include: the depth of liquefiable soils, fines content, groundwater depth, the potential for obstructions (i.e., buried logs), and the density of overburden soils over the liquefiable soils.

At the time the analysis was completed, the Pacific Connector design basis specification was established as the design basis and performance expectation under seismic loading. Under Code Requirements Section 4.6.2.9, pipelines designed for seismic loadings for natural gas service regulated under 49 CFR 192 can be designed for stresses and strains that exceed 100 percent SMYS provided that certain conditions are met. More specifically, the Code refers to ASME B31.8 Section 833 Design for Stresses Greater than Yield, stating, "(a) The limits in paragraphs 833.3 and 833.4 (combined stresses for restrained pipe) may be exceeded where due consideration is given to ductility and strain capacity of seam welds, girth weld, and pipe body materials; and to the avoidance of buckles, swelling, or coating damage; and (b) The maximum permitted strain is limited to 2%." These seismic design criteria are generally consistent with those recommended by American Lifelines Alliance and Pipeline Research Council International guidelines. The pipeline would be designed to meet ASME B31.8 Section 833 as required by the pipeline operator's design basis specifications during final design of the Project in order to make appropriate considerations for ductility and strain capacity of seam welds, girth weld, and pipe body materials.

Pacific Connector proposes to cross four river crossings (Coos River, Rogue River, Klamath River, and South Umpqua River) using trenchless crossing methods including HDD and DP technologies in order to reduce the environmental impacts of construction and to install the pipeline below zones of potentially liquefiable soil. Regardless of the performance standard that is established Kentuck Slough and Coos River sites would be constructed with special backfill placed around the pipeline in areas where the pipeline transitions from rock to soil to alleviate potential stress resulting from differential movement in accordance with the pipeline operator's design basis specifications. For the pipeline segments that transition from the alluvial soils to rock, the special backfill would extend approximately 40 feet into the rock from the soil/rock interface. The special backfill material would consist of clean, imported, processed sand of alluvial origin (crushed materials would not be used). The special backfill material would completely surround the pipe, with a minimum of 1 foot of sand backfill covering the crown of the pipe. This backfill would help to alleviate stresses induced by differential settlement between the rock and the alluvial soils. The pad of special sand backfill beneath the pipe and the sand backfill adjacent to and above the pipe would be placed in lifts not greater than 12 inches in loose thickness and lightly tamped with hand-operated vibratory equipment; and the native backfill above the imported sand would be lightly compacted with mechanical equipment.

4.1.2.4 Landslide Hazards and Slope Stability

Many types of landslides occur that can affect property and public safety. However, most landslides can be placed in two general categories: (1) shallow-rapid landslides (debris

[67] Vibroflotation is a technique for improving the strength and bearing capacity of unsaturated, granular soils.

slides/flows) and (2) deep-seated landslides. Shallow-rapid, or rapidly moving, landslides generally originate on very steep slopes, often where no prior indications of movement are present. In the Coast Range, especially in the Tyee formation, recurring debris flows produce debris chutes. These are evident by narrow concave gullies containing activity indicators such as bare rock, soil generation, and vegetation stratification. Fans and coalescing fans (from multiple chute discharges) form plains. Mass-movement of rapid-shallow landslides is typically triggered by large, infrequent storm events.

Deep-seated landslide movement can occur where no previous movement is evident, but commonly occurs where topographic and vegetative indications of past or chronic slope movements are present. Deep-seated landslides range in depth from tens to hundreds of feet and can occur anywhere on a hill slope. The larger deep-seated landslide complexes may occupy several square miles of terrain. These features can usually be identified on topographic maps or aerial photos based on distinctive contour or vegetative patterns. Slope movement can vary from rapid to nearly imperceptible and may entail small to large displacements. The greatest risk of deep-seated landslide movement arises from existing (dormant) features that can reactivate in response to land management practices, seismic activity, stream erosion and/or prolonged periods of precipitation. Movement can be complex, ranging from slow to rapid, and may include small to large slope displacements.

Risk is greatest where the direction of slide movement is across (perpendicular to) the pipeline alignment. This typically occurs where the pipeline crosses a slope instead of descending straight down the fall line. Although the greatest risk is where a pipeline crosses a landslide, headward (upslope) expansion of the slide could eventually involve a pipeline located upslope of an active landslide. Strain within a pipeline can develop slowly from a deep-seated landslide as a result of long-term slow movement, or it can develop quickly as a result of a single movement event. Shallow-rapid landslides are unlikely to induce long-term strain to a pipeline, but rather more likely to expose the pipe and result in a loss of support where it crosses a debris slide source area. Once mobilized into a debris flow, shallow-rapid landslides often have tremendous erosional potential. Debris flows that originate upslope of the pipeline also have the potential to scour, expose, and damage the pipeline by debris impact; however, as discussed in the following sections, moderate and high-risk landslide areas have been avoided during routing of the pipeline.

Construction alongside slopes can also result in instability during construction, restoration, and operation, and could be a source of debris flows. Construction factors that may increase the potential for slope failure and debris flow could include trenching along slopes and the burden of construction equipment on unstable surfaces. Cut slopes and fill slopes along the pipeline right-of-way could be a source of debris flow in the Project area triggered by intense and/or prolonged rainfall events. A typical debris flow pathway consists of an upper initiation site or source area, a main path down a slope and then into and down a stream channel, and then a lower depositional area or run out zone on an alluvial fan at the base of the mountain. Fill slopes, especially inadequately constructed and maintained fill slopes, are a potential source of debris flows. Fill slope failures could become debris flows that damage not only the pipeline corridor but also the slopes, stream channels, or other resources hundreds or thousands of feet downslope from the corridor. Cut slope or fill slope failures pose a risk to pipeline construction workers, the public, and natural resources. As a result, the cut-and-fill slopes would be designed for slope stability by taking into account slope percent and other engineering geology and geotechnical engineering factors such as the orientation of the bedrock surface as well as geologic structure. The ODF has developed guidelines for the identification of high risk areas for rapidly moving landslides (including debris flows) that have a substantial risk to public safety (ODF 2000). Additional discussion of public safety concerns related to potential landslide hazards is provided in section 4.13 (i.e., the Reliability and Safety section).

An initial landslide hazards evaluation was conducted in three phases: initial office review, aerial reconnaissance, and surface reconnaissance. The purpose of the first phase study was to identify existing landslides as well as areas susceptible to landslides within one-quarter mile of the initial alignment by reviewing published maps and digital data (Burns et al. 2011a, 2011b), aerial photographs and LiDAR-generated hillshade models. The purpose of following two phases was to further evaluate only those landslide hazard sites that represent potentially moderate or high risk to the pipeline, based on the results of the previous phase of evaluation. These initial evaluation phases are described in greater detail below. No landslide hazards were identified at the aboveground facility locations.

Rapidly Moving Landslide Risk Assessment

An assessment of rapidly moving landslides (RMLs) was conducted based on available detailing mapping, risk assessment methods, and on follow-up site reconnaissance in areas of concern. DOGAMI, in cooperation with other agencies, produced a map of Potential Rapidly Moving Landslide Hazards in Western Oregon (Hofmeister et al. 2002). This map was limited to western Oregon because the vast majority of historical RML occurrence has been within that portion of the state. Pacific Connector has provided geologic hazards maps in Appendix F of the *Geologic Hazards and Minerals Resources Report* (GeoEngineers 2017a) that show the slopes in and around the pipeline alignment in western Oregon that have been mapped as potential RML hazards. Creation of the map involved the use of GIS modeling, checking and calibration with limited field evaluations, and making comparisons with historical landslide inventories. The intent was to identify areas that have some potential to be affected by RMLs so that they would be considered and evaluated appropriately.

The portion of the route in the Blue Ridge region was identified and evaluated after the RML mapping by DOGAMI had been discontinued and is no longer being used to evaluate RML hazard risk. Other methods were used to evaluate RML hazards (such as LiDAR hillshade and aerial photograph interpretation). No RML hazards were identified along the portion of the route in the Blue Ridge region that pose a threat to the proposed pipeline alignment.

The portion of the pipeline alignment that crosses the Coast Range physiographic province has the greatest risk of being affected by rapidly moving landslides because of rugged terrain composed of relatively weak sedimentary bedrock and relatively high precipitation rates. In particular, studies indicate that the Tyee Core Area within this province has a higher susceptibility to rapidly moving landslides than other areas of the pipeline (Robinson et al. 1999).

The potential for rapidly moving landslides to occur east of MP 166 (east of the Cascade Range) generally is considered to be relatively low based on geological conditions, relatively little rainfall, and statistically fewer past historical rapidly moving landslide occurrences (Hofmeister et al. 2002). Climate change models predict a drier climate east of the Cascade Range, including less snowpack (and snowmelt), more rain instead of snow in low elevation basins, lower summer and early fall streamflows, and decreased soil moisture (University of Oregon 2008). These conditions are not likely to increase the potential for rapidly moving landslides in this region. Slopes east of MP 166 were reviewed to identify high-risk sites based on general guidelines of the ODF (ODF 2000). Based on available topographic mapping, no slopes along the pipeline alignment east of MP 166 exceed 65 percent or appear to be at high risk of rapidly moving landslide occurrence.

Pacific Connector conducted an initial risk assessment to evaluate the potential risk (high, moderate, and low) where the pipeline alignment crosses the mapped hazard areas using some of the input parameters used for the DOGAMI model (Hofmeister et al. 2002). Using LiDAR where available, 10-meter digital elevation model, and aerial photography, Pacific Connector identified moderate and high risk RML sites along the proposed route. Pacific Connector then conducted a surface reconnaissance of these sites to further evaluate potential risk. In general, the risk of landslide occurrence and mobilization increases with slope gradient and with the degree of convergence (concavity).

A total of 304 pipeline segments were initially identified within rapidly moving landslide hazard areas. Based on the risk assessment, approximately 128 of these sites were considered to be a potentially moderate or high risk and were selected for further study. Site-specific reconnaissance was conducted in certain areas with the potential for shallow-rapid landslide hazards, as documented on Tables B-3a and B-3b of Appendix B in GeoEngineers (2017a).

Deep-seated Landslide Risk Assessment

Larger, deep-seated landslides can usually be identified from topographic maps (including LiDAR) and aerial photographs. Areas susceptible to deep-seated landslide movement were identified from existing geological maps and from topographic or photographic indications of historical or ancient landslide movement.

Table B-2 from GeoEngineers (2017a) lists the identified deep-seated landslides, the data source, and the initial risk to the pipeline. High hazard landslides were identified where the alignment crosses landslide mass or is located on the slope such that the slide could move or expand to involve the pipeline. Surficial, geomorphic, and vegetative features suggest that the landslide is active or dormant historic (past movement less than 100 years ago) (Keaton and DeGraff 1996). Moderate hazard landslides were identified where the alignment crosses landslide mass or is located on the slope such that the slide could move or expand to involve the pipeline, and where surficial, geomorphic and vegetative features suggest that the landslide is dormant-young (last movement 100 to 5,000 years ago) (Keaton and DeGraff 1996). Fifteen of the landslides were judged to pose a moderate to high potential risk to the pipeline. In these instances, Pacific Connector either rerouted the pipeline route to avoid the hazard or assessed the feature further through aerial reconnaissance and risk assessment. The subsequent aerial reconnaissance of the deep-seated landslides identified as moderate to high risk included assessments of geomorphic and vegetative conditions. These data were incorporated into a model of potential risk related to each deep-seated landslide. Six landslides were identified as posing a moderate to high potential risk and were evaluated further in the field. One of the landslides (at MPs 14.70-14.8) was eliminated as posing a moderate potential risk based on field observations. The remaining five landslides are located in Coos County within the Coast Range physiographic province (at MPs 14.30BR-14.38BR, 23.8BR-24.23BR, 24.40BR-24.60BR, 65.25-65.50, 65.3-65.50, and 72.70-72.9).

Upon receiving site access permission, Pacific Connector's geotechnical consultant would perform a reconnaissance of the five potentially moderate to high risk landslides identified along the pipeline alignment. The geotechnical consultant would characterize the potential age, activity level, and potential risk posed to the proposed pipeline based on visual interpretation of the geomorphic and vegetative conditions. If ground-truthing reveals that these landslides are still considered as moderate to high risk, additional geotechnical investigation, including exploratory borings, may be warranted and appropriate mitigation would be proposed. If mitigation is deemed necessary, pipeline rerouting to avoid the landslide hazard is the preferred method, but stabilization and monitoring would also be considered.

DOGAMI has indicated that more detailed landslide studies are available for Coos County and that more detailed LiDAR mapping has become available. It is also noted that the first level of the landslide screening process done by Pacific Connector did not include review of the recent LiDAR data, and that LiDAR was only reviewed in secondary screening for landslides along the pipeline corridor. Therefore, **we recommend that:**

- **<u>Prior to construction</u>, Pacific Connector should file an updated landslide identification study with the Secretary, for review and written approval by the Director of the OEP, that includes:**

  a. results of a review of any available DOGAMI landslide studies that were not previously used for landslide identification;

  b. results of a review of the latest available DOGAMI LiDAR data for identification of landslides along the entire pipeline route;

  c. specific mitigation that would be implemented for any previously unidentified moderate or high-risk landslide areas of concern; and

  d. the final monitoring protocols and/or mitigation measures for all landslide areas that were not accessible during previous studies.

Seismically Induced Landslides and Rockfalls

Strong ground shaking associated with an earthquake may induce landslide failures at great distances from the earthquake source (Keefer 1984). The potential exists, at least locally along portions of the proposed route, for ground shaking to induce rockfalls, landslides, or soil slumps (USGS 2010, 2002). Potential areas of seismically induced landslides include the mapped existing landslides summarized in Table B-2 of GeoEngineers (2017a) Geologic Hazards and Mineral Resources Report from Pacific Connector's application to the FERC.

Areas of potential ground shaking of sufficient intensity to initiate landslides or rockfalls include the areas of greatest seismic activity: the Klamath Falls region (with relatively recent events of magnitudes 5.9 and 6.0) and the Coos Bay region (with the potential for very large, long recurrence interval, Cascadia megathrust events). It is noted that the entire pipeline route is located in an area mapped by the USGS from high to moderate earthquake hazard based on ground motion predictions.

Landslide Hazards Avoidance and Minimization of Adverse Effects

For the purposes of landslide hazard evaluation in this report, a distinction is made between the hazard associated with a landslide and the risk associated with that hazard. In the following discussions, statements of risk apply to the potential for damage or failure of the pipeline from earth movements. It is recognized that the consequences of a pipeline failure may be catastrophic and involve fire and/or explosion. However, those consequences are location-specific and are not considered in the following evaluations of risk to the pipeline. Pacific Connector has worked to avoid landslides along the proposed route. Ridgetops are generally considered to be stable and, therefore, an attempt has been made to route the vast majority of the pipeline along ridgetops.

Risks associated with landslides include both the risk that installation of the pipeline may adversely affect slope stability, and that post-construction land movements could damage the pipeline. Pacific Connector selected its proposed route to avoid existing landslides and areas susceptible to landslides (i.e., unstable slopes where construction-induced landslides could occur). In addition, the potential for construction-induced landslides would be avoided through appropriate construction techniques and BMPs included in the ECRP. Appendix B, Table B-2 from GeoEngineers (2017a) identifies where Pacific Connector's initial proposed route was changed to avoid identified landslides and landslide hazard areas.

Table B-2 from the GeoEngineers (2017a) indicates where reroutes were completed to avoid identified landslides. Tables B-3a and B-3b from the same report indicate where reroutes were incorporated into the proposed route to avoid moderate- and high-hazard RML hazard areas. All of the moderate- and high-hazard deep-seated landslides identified along the alignment were avoided where feasible during final route selection.

At this time, no known hazardous landslides thought to pose a risk to the pipeline have been identified along the current route (through the use of LiDAR interpretation, helicopter-based reconnaissance, and ground-based reconnaissance) as requiring additional monitoring beyond the standard monitoring protocols for the entire pipeline. Pacific Connector would develop monitoring protocols and/or mitigation measures prior to construction if warranted based on findings from the ground-based reconnaissance. There are two primary ways in which pipeline construction has the potential to adversely impact slope stability: (1) deep excavation into and across the slope where the pipeline is oriented in the "side-slope" direction; and (2) capturing, concentrating and conveying surface or near surface water along the pipeline right-of-way surface or within the pipeline trench and routing it to potentially unstable slopes. The current proposed pipeline alignment generally avoids traversing steep slopes perpendicular to slope direction (side-hill) to the extent practicable.

GeoEngineers identified segments along the proposed pipeline centerline that are oriented at an angle of 45 degrees or less from contour and where slope gradients are greater than 30 percent. The slope gradients were analyzed using GIS software and a combination of LiDAR-based digital elevation model (DEM) and publicly available 10-meter DEM. Following Pacific Connector's proposed BMPs described in the ECRP would limit potential adverse impacts on slope stability for those side slopes segments that are less than 30 percent gradient. In general, these BMPs include using well-drained structural fill placed in lifts and compacted for the side slope sites with gradients of 30 percent or greater oriented perpendicular to the pipeline. At sites where import of large volumes of structural fill is not practical, alternative methods would be implemented to construct the fill slopes with native soils. For example, perforated drain pipes can be installed within the inside edge of the construction right-of-way prior to placement of the fill to improve drainage of the native soils. Perforated drains would be surrounded by 12 inches of drain rock, all of which would be wrapped in a geotextile filter fabric. After drains are installed, the fills would be placed in horizontal lifts and compacted.

Pacific Connector would further identify steep side slope pipeline construction segments during the final design phase. Fill slope construction details and specifications would be designed for all identified pipeline segments that traverse steep side slopes (30 percent or greater).

Pipeline Construction BMPs for Landslides and Slope Stability

Pacific Connector has prepared and would implement the ECRP included in its POD to avoid and reduce impacts from pipeline construction, including reducing the potential for construction to adversely affect slope stability. Because the pipeline would cross extensive areas of rugged terrain, there is potential for previously unidentified landslides or new landslides to affect the pipeline after it is installed. Monitoring higher-risk areas along the pipeline can aid in detecting landslide occurrence and movement so that action can be taken to prevent damage to the pipeline. Monitoring can range from visual surface observations from the air or ground to the use of strain gauges and subsurface instrumentation, such as inclinometers, to detect and measure slope movements (typically, these instrumentation methods are used only on pipeline segments affected by active slope movement). Monitoring is further described in the section below.

Pacific Connector's ECRP includes several BMPs that are intended to reduce the potential for pipeline construction to change or alter natural stormwater runoff and/or near surface groundwater. The following summarizes these BMPs:

1. Trench breakers would be installed in the pipeline trench on slopes prior to backfilling to prevent water from flowing along the pipeline and eroding trench backfill materials (see ECRP, Section 4.2.1). Spacing of trench breakers would be based on slope gradient. Slopes greater than 30 percent in mountainous terrain would receive trench breakers spaced at least every 100 feet. Pacific Connector would utilize sandbags (foam trench breakers may be used if approved by the State of Oregon) for trench breaker construction (see Section 4.2.1 of the ECRP for additional trench breaker details).
2. Pacific Connector would install temporary slope breakers to reduce runoff velocity, concentrated flow and to divert water off the construction right-of-way to avoid excessive erosion. Temporary slope breakers may be constructed of materials such as soil, silt fence, staked straw bales, straw wattles, or sand bags. The outfall of each temporary slope breaker would be to a stable, well-vegetated area or to an energy dissipating device at the end of the slope breaker and off the construction right-of-way. Pacific Connector would install temporary slope breakers on all slopes greater than 5 percent according to the spacing in Table 4.1-1 of the ECRP, unless the EI determines that a closer spacing is required.
3. Permanent slope breakers (waterbars) would be installed across the right-of-way on slopes. The purpose of these structures is to reduce erosion by reducing runoff velocities, by shortening slope lengths, preventing concentrated water flow, and by diverting water off the construction right-of-way. Slope breakers would be constructed with a 2 to 8 percent outslope so that water does not pool or erode behind the breaker. Outflow would be

diverted to a stable area off the right-of-way consistent with FERC's Plan. Slope breakers would be installed along the right-of-way based on slope gradient and soil characteristics (see Table 4.2-2 of the ECRP.) All slopes greater than 30 percent gradient would receive slope breakers spaced at least every 50 feet.

4. Project-wide, slash from timber clearing would be stockpiled at the edge of the right-of-way and scattered/redistributed across the right-of-way during final cleanup and reclamation according to the BLM and Forest Service fuel loading specifications to reduce fire hazard risks. However, much of the slash generated during timber-clearing operations would remain on the ground and in place to provide cover to reduce erosion over the winter following construction. Pacific Connector has designated UCSAs that would not be cleared of trees along the route. Generally, slash would not be stored in UCSA in riparian reserves on federal lands. Minimizing overall disturbance would reduce the potential for erosion, especially on steep slopes.

Pipeline Monitoring

Pacific Connector would implement landslide and pipeline easement monitoring that consists of weekly air patrol, annual helicopter survey, and quarterly class location. Class location consists of land patrol (including leak detection), semi-annual class 1 and class 2 location land patrol, and annual cathodic protection survey. All the identified ancient landslides crossed by the proposed pipeline fall within class 1 or 2 areas. Observed areas of active third-party activities such as logging or development and areas affected by unusual events such as landslides, severe storms, flooding, earthquake or tsunami may require additional inspection and monitoring determined on an individual basis.

The purpose of the monitoring would be to detect potential movement or pipe strain before it compromised the structural integrity of the pipeline. If movement were detected, immediate action would be taken to reduce the risk to the pipeline. Every landslide is unique, and there are no standard methods for reducing or eliminating landslide-related risks to buried pipelines. However, in concept, initial response actions generally include measures to reduce the stresses in the pipeline caused by slide movements. Secondary response actions are directed at improving the stability of the slide so that movements in the vicinity of pipeline are halted or the impacts on the pipeline are minimized. Tertiary response actions involve rerouting the pipeline to avoid landslide hazards by relocating the pipeline to a safer location.

Although the pipeline route does not cross active or recently active landslides, if any landslides do occur or become reactivated after the pipeline is installed, Pacific Connector would monitor the slide movement so that mitigation can be identified and implemented prior to damage occurring to the pipeline. The frequency of landslide monitoring would be based on the activity level (rate of movement) of each landslide and also includes consideration of precipitation. High-risk landslides (active or dormant-young) that pose a hazard to a pipeline would be instrumented so that movement can be measured. Instrumentation typically includes installation of slope inclinometer casing to measure landslide movement, and installation of strain gages on the pipeline to measure strain induced by slope movement.

Response Actions

Exposure of the pipe by excavation is the initial response action typically taken to reduce stresses in the pipe. By exposing the pipe on both sides, the pipe is allowed to rebound to a position where it carries little residual stress.

Improvements in surface drainage also are important initial response measures. Typical drainage improvement measures include: (1) placement of impermeable liners over the ground surface to limit infiltration of precipitation and erosion; (2) ditching to divert surface water around landslide areas; and 3) routing surface flows across slide areas within tightline drain pipes. If surface drainage improvements would impact jurisdictional resources under Section 404 of the CWA these impacts would need to be permitted as appropriate. See section 4.3 of this EIS.

Once the landslide area is initially stabilized, a decision of permanent action must be made. Permanent mitigation can include repairs and stabilization of the landslide area. Permanent repairs can include drainage improvements, loading and/or stabilization of the toe of the slope, decreasing the load at the head of the slope, or retaining structures at the base or within the slope. If the landslide is large and complex and stabilization is not a reasonable option, rerouting the pipeline around the slide may be the preferred mitigation.

Specialized trench backfill is utilized where pipelines cross landslides or fault zones where differential movement or shearing across the pipeline is expected. For steep slopes, trench breakers and water bars are utilized to reduce the potential for erosion or mass wasting of trench backfill. Section 11.0 of the ECRP provides special backfill and compaction criteria for restoring site grades on slopes greater than 3H:1V. Specifications include use of structural fill, benching slopes to receive fill, and compaction of fill in lifts.

Because the geological and other natural hazards are important considerations for the design, construction, and operation of the facility, information on the final mitigation measures and monitoring protocols of the pipeline in areas which were not accessible during previous studies are required to evaluate slope stability conditions. See our recommendation above, requiring that additional monitoring and mitigation be done for these areas.

4.1.2.5 Rock Sources and Permanent Disposal Sites

Pacific Connector has identified 20 potential rock source and permanent disposal sites that total approximately 86 acres along the proposed route. Of these 20 rock source/disposal sites, all of the sites (5 of which are temporary extra work areas [TEWAs]) are existing quarries/gravel pits. These sites are listed in table 4.1.2.5-1. The table lists the rock source and disposal sites, their sizes, approximate mileposts in relation to the pipeline, jurisdiction, and existing land use. Only the disposal sites (and not the TEWAs) listed in table 4.1.2.5-1 are being proposed for use as permanent disposal sites.

TABLE 4.1.2.5-1

Rock Source and/or Permanent Disposal Sites

Site	Size (acres)	Milepost	Land Use	Jurisdiction
Coos County				
TEWA 38.90-W/ Sandy Creek Quarry	4.50	38.90	Strip mines, quarries, and gravel pits, clearcut forest land, regenerating evergreen forest land, transportation, communication, utilities corridors	Private
Douglas County				
Signal Tree Road Quarry – Sec. 3	1.22	45.86	Quarries	BLM Roseburg District
Signal Tree Road Quarry – Sec. 35	1.09	47	Quarries	BLM-Coos Bay District
Weaver Road Quarry Site 1	1.62	47	Quarries	BLM-Coos Bay District
Weaver Road Quarry Site 2	1.30	47	Quarries	BLM-Coos Bay District
Private Quarry Benedict Road	1.49	56.75	Quarries	Private
Roth – Existing Quarry #1	0.77	72.61	Quarries	Private
Roth – Existing Quarry #2	0.34	72.76	Quarries	Private
TEWA 79.85-N (BLM Quarry Site)	3.61	79.85	Quarries, transportation, communication, utilities corridors, regenerating evergreen forest land	BLM-Roseburg District
Hatchet Quarry MP 102.30	2.00	102.30	Strip mines, quarries, gravel pit, transportation, communication, utilities corridors	FS-Umpqua
Rock Disposal MP 104.12	3.36	104.12	Mines, quarries, and gravel pits, transportation, communication, utilities corridors, regenerating forest land	FS-Umpqua
Jackson County				
TEWA 110.73 (Peavine Quarry)	15.87	110.54	Mines, quarries, gravel pit and evergreen forest	FS-Umpqua
TEWA 150.31-W (Heppsie Mountain Quarry)	5.56	150.31	Mines, quarries, and gravel pits, mixed rangeland, evergreen forest land, mixed forest land, transportation, communication, utilities corridors, regenerating evergreen forest land, clearcut forest land,	Private and BLM-Medford District
Rum Rye MP 160.41	4.91	160.41	Strip mines, quarries, and gravel pits	FS-Rogue River-Siskiyou
TEWA 160.54-W (Big Elk Cinder Pit) (Ichabod Rock Quarry)	15.26	160.54	Mines, quarries and gravel pits, transportation, communication, utilities corridors, evergreen forest land	FS-Rogue River-Siskiyou
Klamath County				
Rock Source and Disposal MP 180.56	7.76	180.56	Mines, quarries, gravel pit, transportation communication and utilities corridors, and regenerating forest land	Private
Rock Source and Disposal MP 180.71	2.95	180.71	Mines, quarries, gravel pits, Clearcut forest land	Private
Rock Source and Disposal MP 182.40	5.66	182.40	Quarries, gravel pits	Private
Rock Source and Disposal MP 201.61	4.96	201.61	Transitional areas, cropland and pasture, transportation communication and utilities corridors	Private
TEWA (5) Total			**44.80**	
TEWAs associated with existing quarries (5)			**44.80**	
Existing quarries and rock source and disposal sites—Total			**41.18**	
TOTAL			**85.98**	

Source: Pacific Connector's Resource Report 1, Table 1.2-3, filed with the FERC September 2017.

Rock source sites may contain useable mineral deposits that may be extracted and/or purchased for use during construction. Disposal sites were identified for final placement of unusable, non-merchantable materials. These sites are typically exhausted areas within active quarries or abandoned quarries and may include commercial sites. Other permanent storage sites, including some TEWAs, were identified for permanent storage of excavated material. The material disposed of in these areas would be properly graded, drained (if necessary), and revegetated. The sites identified are not proposed for expansion beyond their proposed permitted or authorized boundaries. Use of any site would be permitted as required by the appropriate jurisdiction or landowner, and Pacific Connector would comply with applicable permits/stipulations. The disposal of mineral material to Pacific Connector from rock sources proposed to be utilized on BLM lands would follow regulations in 43 CFR 3600.

If Pacific Connector acquired rock from these sources or permanently disposed of excavated material, all available topsoil would be salvaged. The salvaged topsoil would be used to restore the site as required by landowner stipulations. Rock resource areas managed and developed by Pacific Connector would need quarry Operation and Reclamation Plans, to the extent required by DOGAMI's regulatory authority (OAR 632-030-0005 through 0070 and ORS 517.750 through 990). Appropriate BMPs would be implemented, such as those in Norman et al. (1998). No impacts are anticipated from the rock sources and permanent disposal sites.

4.1.2.6 Blasting During Trench Excavation

Blasting could be required for pipeline trench excavation in areas where hard, non-rippable bedrock occurs. The bedrock units where blasting could be necessary would consist primarily of volcanic and metavolcanic rocks in the Klamath Mountains and volcanic rocks in the Cascade Range as well as along the ridges in the Basin and Range physiographic province. In addition, local areas of well-lithified sedimentary rock may need to be blasted in the Coast Range.

Pacific Connector identified areas where blasting may be necessary by reviewing the NRCS soils maps and descriptions to identify soil units that typically contain bedrock within 5 feet of the ground surface. Soils data, geological maps, and topographic relief were used to rank the qualitative likelihood for blasting along the pipeline as follows:

- No Potential – Areas containing deep soils and alluvial, fluvial, lacustrine, and estuarine sediments that could be readily excavated. General occurrence: the coastal and Klamath basin lowlands and the major valleys and floodplains in all of the physiographic provinces.
- Low Potential – Areas containing soft sedimentary rock and tuff that can typically be excavated without ripping. General occurrence: Coast Range, and local areas of the Klamath Mountains, Cascade Range, and the Basin and Range physiographic provinces.
- Moderate Potential – Areas containing fractured, faulted, or weathered metamorphic or volcanic rocks that generally can be excavated with ripping, but that could require local blasting. General occurrence: local areas in the Klamath Mountains, Cascade Range, and the Basin and Range physiographic provinces.
- High Potential – Areas containing hard or fresh plutonic (for example, granitic) and volcanic rocks that could not be excavated without blasting. General occurrence: local areas of the Klamath Mountains physiographic province, portions of the Cascade Range physiographic province, and local areas in the Basin and Range physiographic province.

Table 4.1.2.6-1 provides a summary of the blasting potential along the pipeline. Blasting is less likely to be required to construct the first 78 miles of the pipeline because the materials are expected to consist of soil, sediments, and rippable sedimentary rocks. Although the blasting potential is classified as high for about 100 miles of the proposed route, this distance estimate includes local areas as much as 0.9 mile in length that contain valley fill, thick soils, and soft volcanic rocks (such as tuffs) that would not need to be blasted. In addition, some of the proposed route classified as having a high or moderate potential for blasting may contain weathered rock that could instead be ripped by conventional excavation equipment.

TABLE 4.1.2.6-1

Summary of Blasting Potential Along the Proposed Pacific Connector Pipeline a/

From MP	To MP	Blasting Potential	Material	Ownership (Federal Lands)
0.00	19.7BR	None to Low	Soil, sediments, sedimentary rocks and valley fill	BLM – Coos Bay
19.7BR	19.9BR	Moderate	Volcanic	BLM – Coos Bay
19.9BR	21.5BR	None	Sediments	BLM – Coos Bay
21.5BR	21.6BR	Moderate	Volcanic rocks	BLM – Coos Bay
21.6BR	21.9BR	None	Sediments	BLM – Coos Bay
21.9BR	22BR	None to Moderate	Sediments, volcanic rocks	BLM – Coos Bay
22BR	22.1BR	Moderate	Volcanic rocks	BLM – Coos Bay
22.1BR	22.3BR	None	Sediments	BLM – Coos Bay
22.3BR	23.6BR	Moderate	Volcanic rocks	BLM – Coos Bay
23.6BR	45.9	None to Low	Marine sedimentary rocks, sediments	BLM – Coos Bay
45.9	48.2	Moderate	Marine sedimentary rocks (hard)	BLM-Roseburg
48.2	59.2	None to Low	Marine sedimentary rocks, sediments, mélange rocks with valley floor sediments	BLM-Roseburg
59.2	59.3	Moderate	Mélange rocks	BLM-Roseburg
59.3	59.4	None	Sediments	BLM-Roseburg
59.4	59.5	Moderate	Mélange rocks	BLM-Roseburg
59.5	59.9	None	Sediments	BLM-Roseburg
59.9	63.9	Moderate	Mélange rocks	BLM-Roseburg
63.9	64	None	Sediments	BLM-Roseburg
64	65.6	Moderate	Mélange rocks	BLM-Roseburg
65.6	67	None	Sediments, mélange rocks	BLM-Roseburg
67	69.3	Moderate	Mélange rocks	BLM-Roseburg
69.3	70.4	None	Mélange rocks with valley floor sediments	BLM-Roseburg
70.4	71.1	moderate	Metamorphic rocks, sediments	BLM-Roseburg
71.1	71.3	High	Metamorphic rocks, sediments	BLM-Roseburg
71.3	75.1	moderate	Metamorphic rocks	BLM-Roseburg
75.1	78.5	None to Low	Marine sedimentary rocks, sediments	BLM-Roseburg
78.5	79	High	Volcanic rocks, intrusive rocks	BLM-Roseburg
79	79.2	none	Sediments	BLM-Roseburg
79.2	81.1	High	Intrusive rocks, volcanic rocks	BLM-Roseburg
81.1	81.6	None	Sediments	BLM-Roseburg
81.6	87.7	High	Volcanic rocks, intrusive rocks	BLM-Roseburg
87.7	88.3	Low	Marine sedimentary rocks	BLM-Roseburg
88.3	88.8	High	Volcanic rocks, intrusive rocks	BLM-Roseburg
88.8	89	Low	Marine sedimentary rocks	BLM-Roseburg
89	89.5	High	Volcanic rocks	BLM-Roseburg
89.5	89.9	Moderate	Marine sedimentary rocks	BLM-Roseburg
89.9	91.3	Low	Marine sedimentary rocks	BLM-Roseburg
91.3	94.5	Moderate	Marine sedimentary rocks, volcaniclastic rocks	BLM-Roseburg
94.5	95.3	None	Sediments	BLM-Roseburg

TABLE 4.1.2.6-1 (continued) **Summary of Blasting Potential Along the Proposed Pacific Connector Pipeline**				
From MP	**To MP**	**Blasting Potential**	**Material**	**Ownership (Federal Lands)**
95.3	95.5	High	Intrusive rocks	BLM-Roseburg
95.5	97	Low	Marine sedimentary rocks	BLM-Roseburg
97	108.9	High	Intrusive rocks, metamorphic rocks, mélange rocks	BLM-Roseburg / Umpqua NF
108.9	109.4	None	Sediments	Umpqua NF
109.4	111	High	Volcaniclastic rocks, volcanic rocks	Umpqua NF
111	113.3	Low	Volcaniclastic rocks	Umpqua NF
113.3	113.6	High	Volcaniclastic rocks, volcanic rocks	-
113.6	113.7	Low	Volcaniclastic rocks	-
113.7	116.9	High	Volcaniclastic rocks, volcanic rocks, intrusive rocks	BLM-Medford
116.9	118.2	Low	Volcaniclastic rocks	BLM-Medford
118.2	119.5	High	Volcanic rocks	BLM-Medford
119.5	119.6	Low	Volcaniclastic rocks	BLM-Medford
119.6	119.8	High	Volcanic rocks	BLM-Medford
119.8	120.2	Low	Volcaniclastic rocks	BLM-Medford
120.2	120.4	High	Volcanic rocks	BLM-Medford
120.4	121.7	Low	Volcaniclastic rocks	BLM-Medford
121.7	122.1	High	Volcanic rocks	BLM-Medford
122.1	122.4	Low	Volcaniclastic rocks	BLM-Medford
122.4	122.6	High	Volcanic rocks	BLM-Medford
122.6	123.1	none	Sediments	BLM-Medford
123.1	126	High	Volcanic rocks	BLM-Medford
126	126.7	Low	Volcaniclastic rocks	BLM-Medford
126.7	133.6	High	Volcanic rocks	BLM-Medford
133.6	134.1	Low	Volcaniclastic rocks	BLM-Medford
134.1	134.7	High	Volcanic rocks	BLM-Medford
134.7	140.2	None to Low	Volcaniclastic rocks, sediments	BLM-Medford
140.2	141.7	High	Volcanic rocks	BLM-Medford
141.7	141.9	Low	Volcaniclastic rocks	BLM-Medford
141.9	143.5	High	Volcanic rocks	-
143.5	143.9	None to Low	Volcaniclastic rocks, sediments	-
143.9	144.8	High	Volcanic rocks	-
144.8	145.2	Low	Volcaniclastic rocks	-
145.2	145.7	High	Volcanic rocks	-
145.7	145.7	None	Sediments	-
145.7	146.8	High	Volcanic rocks	-
146.8	147	Low	Volcaniclastic rocks	-
147	148.2	High	Volcanic rocks	-
148.2	148.3	Low	Volcaniclastic rocks	BLM-Medford
148.3	148.3	High	Volcanic rocks	BLM-Medford
148.3	148.4	Low	Volcaniclastic rocks	BLM-Medford
148.4	172	High	Volcanic rocks, vent and pyroclastic rocks	BLM-Medford / Rogue River-Siskiyou NF / Fremont-Winema NF
172	175.4	None	Volcanic rocks with overlying thick soil	Fremont-Winema NF
175.4	186.6	High	Volcanic rocks	BLM-Lakeview
186.6	186.7	None	Sediments	BLM-Lakeview
186.7	190.8	High	Volcanic rocks	BLM-Lakeview
190.8	212.6	None	Terrestrial sedimentary rocks, sediments	BLM-Lakeview
212.6	214.8	Moderate	Terrestrial sedimentary rocks	BLM-Lakeview
214.8	215	High	Volcanic rocks	BLM-Lakeview

TABLE 4.1.2.6-1 (continued)

Summary of Blasting Potential Along the Proposed Pacific Connector Pipeline

From MP	To MP	Blasting Potential	Material	Ownership (Federal Lands)
215	215.2	None	Sediments	BLM-Lakeview
215.2	215.6	High	Volcanic rocks	BLM-Lakeview
215.6	216.4	None	Sediments	BLM-Lakeview
216.4	216.5	Moderate	Terrestrial sedimentary rocks	BLM-Lakeview
216.5	217.1	High	Volcanic rocks	BLM-Lakeview
217.1	217.5	Moderate	Terrestrial sedimentary rocks	-
217.5	217.9	None	Sediments	-
217.9	218.5	Moderate	Terrestrial sedimentary rocks	-
218.5	218.9	None	Sediments	-
218.9	218.9	Moderate	Terrestrial sedimentary rocks	-
218.9	222.1	High	Volcaniclastic rocks, volcanic rocks	-
222.1	222.5	Moderate	Terrestrial sedimentary rocks	-
222.5	223.9	High	Volcaniclastic rocks, volcanic rocks	-
223.9	224.9	Moderate	Terrestrial sedimentary rocks	-
224.9	225.8	None	Sediments	-
225.8	227	Moderate	Terrestrial sedimentary rocks	-
227	227.7	None	Sediments	-
227.7	228.8	High	Volcanic rocks	-

a/ Information in this table is intended to provide estimates of potential blasting required along the pipeline route. More detailed evaluations of blasting specifications would be included in the required site-specific Blasting Plans.

Pacific Connector would conduct all blasting in accordance with all federal, state, and local regulations and Pacific Connector Construction Specifications. Pacific Connector would include specifications in any blasting contract to control adverse impacts, including measures to reduce vibrations and flyrock, measures for safe blasting practices near active pipelines, and seasonal restrictions to protect wildlife, as needed. Pacific Connector would have blasting inspectors present to ensure that all specifications were met and to perform pre- and post-blast inspections of nearby structures and wells.

Drilling and blasting would be done with the Pacific Connector inspector present and with the inspector's approval to proceed prior to each blast. Blasting operations would be conducted by or under the direct and constant supervision of experienced personnel legally licensed and certified to perform such activity in the jurisdiction where blasting occurs. Pacific Connector would require their contractor to provide site-specific Blasting Plans at least 5 working days prior to any proposed blasting-related activity, and the contractor would be required to obtain Pacific Connector approval in writing prior to starting work. The Blasting Plan would include the following information:

- explosive type, product name and size, weight per unit, density, and equivalent energy release ratio (N) (the blasting agent Ammonium Nitrate and Fuel Oil [ANFO] would not be allowed);
- delay type, sequence, and delay (milliseconds);
- initiation method (detonating cord, blasting cap, or safety fuse);
- stemming material and tamping method;
- hole depth, diameter, and pattern;
- explosive depth, distribution, and maximum weight per delay;
- number of holes per delay;

- distance and orientation to nearest aboveground structure;
- distance and orientation to nearest underground structure, including pipeline;
- procedures for storing, handling, transporting, loading, and firing explosives, fire prevention, inspections after each blast, misfires, fly rock and noise prevention, stray current accidental-detonation prevention, signs and flagmen, warning signals prior to each blast, notification prior to blasting, and disposal of waste blasting material;
- seismograph company, personnel, equipment, and sensor location, if required;
- copies of all required federal, state, and local permits;
- blaster's name, company, copy of license, and statement of qualifications;
- magazine type and locations for explosives and detonating caps; and
- typical rock type and geology structure (solid, layered, or fractured).

Pre-blast inspections would be completed for structures and wells that are within the influence zone of the blasting. The pre-blast inspections would include but not be limited to an inventory of existing structural integrity and signs of structural distress such as cracks. Post-blasting inspections would include an inspection and comparison of the same elements observed for the pre-blast inspection. If blast related damage is identified by Pacific Connector inspectors and confirmed to be a result of the blasting activities, then damaged structures or wells would be returned to pre-construction conditions or better.

Blasting for grade or trench excavation would be utilized only after all other reasonable means of excavation have been used and are unsuccessful in achieving the required results. Pacific Connector may specify locations (foreign line crossings, near-by structures, etc.) where consolidated rock would be removed by approved mechanical equipment such as rock-trenching machines, rock saws, hydraulic rams, or jack hammers in lieu of blasting.

Every precaution would be taken to prevent damage to aboveground and underground structures during blasting operations; and every precaution would be taken to prevent injuries and damage to persons or inconvenience to the general public. Blasting mats or padding would be used on all shots where necessary to prevent scattering of loose rock onto adjacent property and to prevent damage to nearby structures and overhead utilities. Blasting would not begin until occupants of nearby buildings, residences, places of business, places of public gathering, and farmers have been notified sufficiently in advance to allow for protection of personnel, property, and livestock. Maximum ground motion velocities of 2 inches/second specified at the locations of structures would be required for any structures identified within 200 feet of the pipeline construction area.

Blasting for trench excavation could result in impacts on wells, wetlands, slopes, structures, and other adjacent buried utilities, as described below. The use of Pacific Connector's proposed monitoring and mitigation measures would avoid or reduce the likelihood of local failures of unstable rock and soil, and damage to structures or utilities from blasting vibrations.

Water Wells and Springs

Blasting could affect groundwater quality by temporarily increasing groundwater turbidity near the construction right-of-way. In addition, turbidity and blasting agent by-products could possibly temporarily degrade groundwater quality and potentially have temporary effects on wells in the immediate proximity of the blasting. In general, vibration effects on wells would be expected to be limited to the immediate proximity of the blasting. A common measurement unit for vibration is the peak particle velocity (PPV) of blasting-induced ground motion in inches per second.

Siskind (1999) summarizes information on four blasting studies conducted to evaluate vibration effects on wells. One study showed, "There were no physical vibration effects on the wells even as close as 300 feet." The maximum velocities for this testing ranged from 0.84 to 5.44 inches per second, with four of the five sites exceeding 2 inches per second. In another study, a well was tested for casing cement bond damage. The study indicated initial bond losses occurred at 4.7 inches per second. A third study indicated that wells outside the blast pattern were exposed to as much as 8.7 inches per second at a distance of 31 feet and no damage occurred; however, the construction details for these wells are not described in the Siskind (1999) report.

A discussion of water supply wells within 150 feet of the construction right-of-way and measures proposed by Pacific Connector to avoid or reduce impacts on wells, including from blasting, is included in section 4.3. Pacific Connector would employ measures in the Blasting Plan including development of site-specific blasting operation and monitoring plans to address site variables (soil and rock types, etc.), which would incorporate known locations of existing groundwater wells or springs and seeps. Maximum ground motion velocities (or PPV) of 2 inches/second would be set for blast locations within 150 feet of water wells and springs.

Pacific Connector would request authorization from landowners to test and document the baseline condition, yield, and water quality of any private wells located within 200 feet of the pipeline construction right-of-way. This testing would occur before the pipeline construction starts in the nearby area, and the testing results would be shared with the property owner, if requested. Similar information would be gathered for any public water wells located within 400 feet of the pipeline construction right-of-way. Based on testing results, if it is determined after construction that there has been an impact on groundwater supply (either yield or quality), Pacific Connector would work with the landowner to ensure a temporary supply of water, and, if determined necessary by the landowner, Pacific Connector would provide a permanent water supply. Mitigation measures would be coordinated with the individual landowner in order to meet the landowner's specific needs. Mitigation measures for groundwater wells, springs, and seeps would be specific to each property and would be determined during landowner negotiations.

Wetlands

Blasting could potentially redirect surface water and groundwater flows to and from wetlands. In addition, turbidity and blasting agent by-products could possibly temporarily degrade surface water and groundwater quality.

Any turbidity resulting from blasting is expected to be temporary and to dissipate shortly after blasting. Water quality impacts on wetlands from blasting agents, if any, would be expected to be temporary and localized because only small amounts of blasting agents generally would be needed for trenching. Specific blasting agents would be listed in the *Blasting Plan*[68] prior to the initiation of any blasting. The use of ANFO would not be allowed.

Slopes

Unstable rock and soil slopes could locally fail as a result of blasting vibrations. Pacific Connector would complete a reconnaissance of slopes in the vicinity of the blasting, including measuring slope inclinations and observing areas adjacent to planned blasting locations for potential

68 The *Blasting Plan* was included in Pacific Connector's January 2018 application to the FERC as Appendix C of the POD.

indicators of unstable slopes. Identified slope areas that could be impacted by blasting would be monitored and evaluated for hazards to people and property during the blasting operations.

Structures

Blasting vibrations and flying debris could potentially damage aboveground structures. If structures were present in areas where blasting was necessary, Pacific Connector would request authorization from landowners to inspect structures located within 200 feet of the pipeline construction right-of-way before and after blasting. Blasting mats or padding also would be used when blasting near structures to limit potential damage from flying rocks. To limit potential damage to structures, maximum ground motion velocities (or PPV) of 2 inches/second would be specified at the locations of structures, which is consistent with the language of the *Blasting Plan*.

As an additional precaution, Pacific Connector would require the contractor conducting blasting to limit the size of charges in accordance with the scaled distance factor (SD) guidelines developed by the Office of Surface Mining Reclamation and Enforcement (OSMRE). The SD is equal to the distance from the blast to an aboveground structure divided by the square root of the charge (pound per delay). For distances less than 300 feet, OSMRE states that the SD shall exceed 50 feet, which specifies a maximum blasting charge of 1.0 pound/delay.

Adjacent Pipelines and Buried Utilities

Blasting vibrations could potentially damage adjacent underground pipelines and utilities. In general, blasting would not be allowed within 10 feet of an existing pipeline or buried utility. In cases where blasting near an existing utility was necessary, the pipeline or utility owner would be notified in advance of the blasting, and measures would be taken to reduce the potential for utility damage (as outlined in the *Blasting Plan*).

4.1.2.7 Paleontological Resources

There are no known paleontological resources along the pipeline route.

4.1.3 Environmental Consequences on Federal Lands

4.1.3.1 Geologic Hazards on Federal Lands

The seismic hazard evaluation included surface rupture from faulting, liquefaction potential, and lateral spreading as discussed in section 4.1.2.3 above. In general, seismic hazard risks are low for the proposed pipeline. In addition, liquefaction potential and scour would be avoided by employing HDD construction of the pipeline across streams. The potential exists locally along portions of the proposed route on federal lands for seismically induced ground shaking to induce rockfalls, landslides, or soil slumps. Pacific Connector selected its proposed route to avoid existing landslides and areas susceptible to landslides to the extent practicable.

The pipeline would cross the BLM-Coos Bay District from MP 13.0BR to MP 27.5; and from MP 28.4 to MP 45.7. The western portion of this area is within the outer limit of the Cascadia event impact area. Evaluation of hazards for the design earthquake indicate that the pipeline (designed to standards) would not be susceptible to risks from seismic events. One landslide site located near MP 36.92 on land managed by the BLM Coos District could not be avoided. Additional investigation of this site resulted in a final risk determination of low (GeoEngineers 2017a). The landslide risk at this site is not considered hazardous enough to require additional mitigation or rerouting.

The pipeline would cross the BLM-Roseburg District from MP 46.9 to MP 102.3. Recent faults are not present in this area; and steep slopes and landslides have been avoided in this section of the pipeline route. The pipeline would cross the Umpqua National Forest from MP 99.3 to MP 113.2. Recent faults are not present in this section of the pipeline route; and steep slopes and landslides have been avoided in this section of the pipeline route. The pipeline would cross the BLM Medford District from MP 115.1 to MP 141.9; and from MP 148.3 to MP 153.8. Recent faults are not present in this section of the pipeline route. Steep slopes and landslides have been avoided in this section of the pipeline route. The pipeline would cross the Rogue River-Siskiyou NF from MP 153.8 to MP 168. Recent faults are not present in this section of the pipeline route. Steep slopes and landslides have been avoided in this section of the pipeline route.

The pipeline would cross the Fremont-Winema National Forest from MP 168 to MP 175.4. The Quaternary-age Sky Lakes fault zone is located from MP 172 to MP 182. Some areas of this route section have a high potential for blasting during construction. Steep slopes and landslides have been avoided in this section of the pipeline route. The pipeline would cross the BLM Lakeview District from MP 176.2 to MP 216.8. The Quaternary-age Sky Lakes fault zone is located from MP 172 to MP 182; the Klamath Lake fault is located near MP 187; the Lower Klamath Lake fault system is located near MP 204 to MP 206; and the Stukel Mountain fault is located near MP 212 to MP 213. Some areas of this route section have a high potential for blasting during construction. Steep slopes and landslides have been avoided in this section of the pipeline route.

Mitigation for pipeline sections that cross recent faults has been discussed in section 4.1.2.3. During construction, Pacific Connector would have the pipeline trench carefully examined by a qualified professional for evidence of stratigraphic offsets potentially related to ground rupture. If such features are observed, Pacific Connector would implement additional mitigation measures, with the specific mitigation developed at that time. Such measures could include burying the pipe in a wide trench that was backfilled with loose gravel or sand, which would allow for relatively unrestrained movement of the buried pipe within the zone of fault movement.

Because the pipeline would cross a predominance of rugged terrain within BLM and NFS lands, there is potential for previously unidentified landslides or new landslides to affect the pipeline after it is installed. To reduce landslide risk, Pacific Connector would implement its ECRP during pipeline construction, which would reduce the potential for construction to adversely affect slope stability. As described in the ECRP, temporary construction BMPs would include sediment barriers, slope breakers, and application of mulch prior to seeding; permanent measures would include installation of permanent slope breakers and revegetation. In addition, as part of its pipeline operation, Pacific Connector would conduct regular monitoring of the pipeline right-of-way, which would aid in detecting landslide occurrence or slope movement. On federal lands, Forest Service and BLM representatives would conduct monitoring with Pacific Connector personnel. Mitigation could include the use of shutoff valves. If movement is detected, immediate action would be taken to reduce the risk to the pipeline. Actions would include initial response to reduce the stresses on the pipeline, and follow-up actions to stabilize the slide. If the slide is large and complex enough such that stabilization would not be feasible, the pipeline could be relocated around the slide area.

Pacific Connector intends to implement a level of landslide and pipeline easement monitoring like that currently performed on existing pipeline facilities in southwestern Oregon. Monitoring would consist of weekly air patrol, annual helicopter survey, and quarterly class location. Class location consists of land patrol (including leak detection), semi-annual class 1 and class 2 location land patrol, and annual cathodic protection survey. Observed areas of active third-party activities such as logging or development and areas affected by unusual events such as landslides, severe storms, flooding, earthquake or tsunami may require additional inspection and monitoring determined on an individual basis.

4.1.3.2 Mineral Resources on Federal Lands

Pacific Connector identified mineral resources and mining claims that would be intersected or fall within the immediate proximity of the pipeline route. It is noted that all of the oil and gas areas (BLM oil and gas leases) and all of the mining claims were identified as having a "closed" status. The BLM would review and verify the validity of an updated LR2000 database query by Pacific Connector during their right-of-way permit review. Pacific Connector, not BLM, would be responsible for all cost burdens associated with the permit that have not been included explicitly, including but not limited to realty and other associated aspects (GIS/data management, etc.) of this project that will have cost burdens.

Sixteen oil and gas areas are located between MP 10.4R and 45.7, and two mining claims between MPs 0 and 1.4 in Coos County on BLM land (GeoEngineers 2017a). Seven oil and gas areas, two placer mining claims, one mine, two lode mining claims, and a chromite resource are located in the vicinity of the pipeline alignment between MPs 46.9 and 97 in Douglas County on BLM land. Two load mining claims and a quarry are located in the vicinity of the pipeline alignment between MPs 101.8 and 110 in Douglas County on NFS land. Nine oil and gas areas and two lode mining claims are located in the vicinity of the pipeline alignment between MPs 115.4 and 154.9 in Jackson County on BLM land. One oil and gas area is located in the vicinity of the pipeline alignment between MPs 155.4 and 166.4 and one between MPs 205.2 and 205.7 in Jackson County on NFS land. One lode mining claim in the vicinity of the pipeline alignment is located between MPs 170.1 and 171.1 in Klamath County on NFS land. Two geothermal resources areas are located in the vicinity of the pipeline alignment between MPs 192.7 and 216.8 in Klamath County on BLM land.

The Green Butte Quarry was identified at MP 101.8 within the Umpqua National Forest. However, GeoEngineers (2017a) indicated that this quarry was never opened and there are no plans for its future development. The proposed route between MPs 108.6 and 110.9 avoids the Peavine Quarry within the Umpqua National Forest. The pipeline alignment at MP 150.5 is within approximately 100 feet northeast of the Heppsie Mountain quarry on BLM land and parallels the length of the quarry. The Heppsie quarry is a regional hard rock quarry and to utilize this rock quarry it is necessary to blast the rock. It was determined by the BLM and Pacific Connector that due to the proximity of the pipeline to the quarry and the incompatibility of production blasting the rock quarry near the pipeline, that 70,000 cubic yards of rock will be blasted at the expense of Pacific Connector and left on site. The BLM is requiring this blasting because the BLM will not assume unknown risk associated with complications, limitations, or liability associated with utilizing this quarry in the future. The BLM assumes that a portion (15,000 to 20,000 cubic yards) of this blasted rock would be reserved for BLM use and the remainder would be available for purchase through the 43 CFR 3600 regulations.

POD attachments include the *Blasting Plan, ROW Clearing Plan,* and *ROW Marking Plan,* all of which would serve to ensure the avoidance of quarries.

Near MP 109, the pipeline would be about 0.3 mile and 0.5 mile east of the Nivinson and Red Cloud mercury mines, respectively. These mines are located within NFS lands. Construction and operation of the pipeline would not affect these mines. The proposed route would cross areas mapped as volcanic and volcanogenic rocks at the current crossings of the East Fork Cow Creek. These bedrock units have not been identified as a substantial source of naturally occurring mercury. Naturally occurring mercury in this area typically is associated with metamorphic bedrock units such as amphibolite.

The Forest Service reports that naturally occurring mercury exists in the vicinity of the Mars Prospect located near MP 108.7 (Broeker 2010). Broeker concluded that naturally occurring mercury is present in the disrupted soil regolith and underlying bedrock strata throughout the upper reaches of the East Fork Cow Creek watershed. Although localized, mercury values are sufficiently high enough to have warranted exploration, development and minor production between the 1930s and 1960s. Geochemical analysis of six soil samples collected along a 2,000-foot section of Pacific Connector's previously proposed route in this area that crossed partly through the historic Thomason mining claims near the East Fork Cow Creek determined the area to have very low concentrations of naturally occurring mercury mineralization. Pacific Connector subsequently rerouted its proposed route in this area approximately 2,500 feet from where the samples were taken.

Based on the analytical results, mapped bedrock at the proposed route, and the distribution/location of mercury mines, it is unlikely that the soils underlying the currently proposed crossing of the East Fork Cow Creek would have concentrations of naturally occurring mercury exceeding those measured in samples obtained from the previous crossing location and most likely would have lower levels. Additional details on the literature research, field observations and soil sampling and analysis completed for the prospects and mines located near MPs 108 to 110 are provided in GeoEngineers (2017a). Soil sampling and analysis results also support that mercury specific health and safety protocols would not be needed for the construction activities. It is expected that the planned erosion and sediment control measures described in the Pacific Connector's ECRP would protect the ecological health of upland and in-stream areas from the naturally occurring mercury concentrations.

The pipeline could potentially interfere with future mining and reclamation activities on lands adjacent to and within the right-of-way. Future expansions of surface mines immediately adjacent to the right-of-way potentially could be limited or precluded in some cases because mineral resources could not be extracted from immediately up or downslope of the pipeline right-of-way or from beneath the pipeline. Similarly, the presence of the pipeline could limit or preclude the stockpiling of mineral resources or development of a processing area adjacent to up or downslope areas of the pipeline. These considerations also could limit or preclude reclamation activities at mine claims near the pipeline because of the potential to disturb the slopes above and below the pipeline and right-of-way. Any impact would be site-specific and would depend on topography, drainage, and subsurface conditions in that area. The BLM has indicated that if a mining claimant determines that the pipeline potentially interferes with their mining claim, any costs associated this potential interference and related settlements would be borne by Pacific Connector.

4.1.3.3 Rock Sources and Permanent Disposal Sites on Federal Lands

Rock source sites may contain useable mineral deposits that may be extracted and/or purchased for use during construction. Disposal sites were identified for final placement of unusable, non-merchantable materials. These sites are typically exhausted areas within active quarries or abandoned quarries and may include commercial sites. Other permanent storage sites, including some TEWAs, were identified for permanent storage of excavated material. The material disposed of in these areas would be properly graded, drained (if necessary), and revegetated. The sites identified are not proposed for expansion beyond their proposed permitted or authorized boundaries. Use of any site would be permitted as required by the appropriate jurisdiction or landowner, and Pacific Connector would comply with applicable permits/stipulations. The disposal of mineral material to Pacific Connector from rock sources proposed to be utilized on BLM lands would follow regulations in 43 CFR 3600.

Pacific Connector has identified 20 potential rock source and permanent disposal sites that total approximately 86 acres along the pipeline route. Of these 20 rock source/disposal sites, 12 are located within federal lands as shown in table 4.1.2.5-1. All of these sites have been previously used and disturbed by quarry operations and/or strip mining. Most of these sites continue to have ongoing quarry operations. Only the disposal sites (and not the TEWAs) listed in table 4.1.2.5-1 are being proposed for use as permanent disposal sites.

Pacific Connector does not intend to expand these sites beyond the existing or previously disturbed footprints. If Pacific Connector acquired rock from these sources or permanently disposed of excavated material, all available topsoil would be salvaged. The salvaged topsoil would be used to restore the site as required by landowner stipulations. Rock resource areas managed and developed by Pacific Connector would need quarry Operation and Reclamation Plans, to the extent required by DOGAMI's regulatory authority (OAR 632-030-0005 through 0070 and ORS 517.750 through 990). Appropriate BMPs would be implemented, such as those in Norman et al. (1998). No impacts are anticipated from the rock sources and permanent disposal sites.

4.1.3.4 Blasting During Trench Excavation on Federal Lands

Pacific Connector identified areas where blasting may be necessary by reviewing the NRCS soils maps and descriptions to identify soil units that typically contain bedrock within 5 feet of the ground surface. Soils data, geological maps, and topographic relief were used to rank the qualitative likelihood for blasting along the pipeline.

Table 4.1.2.6-1 provides a summary of the blasting potential along the pipeline including BLM and NFS areas that would be crossed. Although the blasting potential is classified as high for about 100 miles of the proposed route, this distance estimate includes local areas as much as 0.9 mile in length that contain valley fill, thick soils, and soft volcanic rocks (such as tuffs) that would not need to be blasted. In addition, some of the proposed route classified as having a high or moderate potential for blasting may contain weathered rock that could instead be ripped by conventional excavation equipment.

The BLM-Coos Bay District portion of the pipeline alignment has a low potential for blasting during construction. The pipeline route within the BLM-Roseburg District has low to moderate potential for blasting during construction. Portions of the pipeline route within the Umpqua National Forest, the BLM Medford District, the Rogue River-Siskiyou National Forest, the Fremont-Winema National Forest, and the BLM Lakeview District have a high potential for blasting during construction.

Blasting for grade or trench excavation would be utilized only after all other reasonable means of excavation have been used and are unsuccessful in achieving the required results. Pacific

Connector may specify locations (foreign line crossings, near-by structures, etc.) where consolidated rock would be removed by approved mechanical equipment such as rock-trenching machines, rock saws, hydraulic rams, or jack hammers in lieu of blasting.

Pacific Connector would conduct all blasting in accordance with all federal, state, and local regulations and Pacific Connector Construction Specifications. Pacific Connector would include specifications in any blasting contract to control adverse impacts, including measures to reduce vibrations and flyrock, measures for safe blasting practices near active pipelines, and seasonal restrictions to protect wildlife, as needed. Pacific Connector would have blasting inspectors present to ensure that all specifications were met and to perform pre- and post-blast inspections of nearby structures and wells.

Drilling and blasting would be done with the Pacific Connector inspector present and with inspector's approval to proceed prior to each blast. Blasting operations would be conducted by or under the direct and constant supervision of experienced personnel legally licensed and certified to perform such activity in the jurisdiction where blasting occurs. Pacific Connector would require their contractor to provide a Blasting Plan at least five working days prior to any blasting-related activity, or two weeks prior to blasting on federal lands, and the contractor would be required to obtain Pacific Connector approval in writing prior to starting work.

4.1.3.5 Paleontological Resources on Federal Lands

Paleontological resources on federal lands are regulated, as outlined in 36 CFR Ch. 11 261.9 (i). Pacific Connector consulted with federal land management agencies for information on potential paleontological resources crossed by or within the pipeline right-of-way. Based on the consultation, the BLM required an assessment of the potential for paleontological resources on the portion of the right-of-way located on the lands it manages. The assessment indicates that there is a limited potential for encountering paleontological resources on BLM lands and only localized monitoring would need to occur during pipeline construction. The following sections summarize the findings from the paleontological resource assessment. The full assessment report is contained in *Final Paleontology Assessment, Pacific Connector Gas Pipeline Project, Coos Bay to Malin, Oregon* (GeoEngineers 2017c).[69]

Potential Paleontological Resources on NFS Lands

Pacific Connector states that consultation with staff of the Real Estate and Mineral Resources Section of the Umpqua National Forest reported that there were no known paleontological resources on the portions of the pipeline right-of-way located within the boundaries of the Umpqua, Rogue River, and Winema National Forests. According to Paleontology Associates, only the Umpqua and Rogue River National Forests bear potentially favorable lithologic units for fossil content along the pipeline corridor. These units occur in:

- Umpqua National Forest MPs 106 to 109—Fisher formation-volcanic ash and lacustrine siltstone;
- Umpqua National Forest MPs 109.5 to 115.5—Little Butte and Colestin formations-tuffaceous sediments;
- Rogue River National Forest MPs 120 to 121—Colestin formation-tuffaceous sediments; and

[69] Appendix M to Appendix A-6 of Resource Report 2 in Pacific Connector's September 2017 filing with the FERC.

- Rogue River National Forest MPs 155 to 158—No formal formation designation-tuffaceous sediments, lahars, waterlaid tuffs.

Based on the information provided regarding the lack of identified paleontological resources within the pipeline right-of-way on NFS lands, no measures appear necessary for the avoidance and minimization of adverse effects on paleontological resources on NFS lands. Pacific Connector does not plan to monitor for lithologic units on NFS lands.

Potential Paleontological Resources on BLM Lands

The BLM required an assessment of the potential for paleontological resources on the portion of the right-of-way located on the lands it manages. Pacific Connector completed an assessment that indicates there is a limited potential for encountering paleontological resources on BLM lands and only localized monitoring would need to occur during pipeline construction. The following sections summarize the findings from the paleontological resource assessment. The full assessment report is contained in the *Final Paleontology Assessment, Pacific Connector Gas Pipeline Project, Coos Bay to Malin, Oregon* (GeoEngineers 2017c).

A formal analysis of existing paleontological data was completed for the portions of the pipeline right-of-way on BLM lands. The analysis, completed by Dr. William Orr, who is recognized by the BLM as a qualified paleontologist, was conducted in general accordance with BLM Manual H-8270-1 (BLM 1998).

Fossil-bearing rock formations along the portions of the right-of-way located on BLM lands range in age from the Jurassic period (almost 200 million years old) to the Pleistocene Epoch (about 12,000 years before present). Between MPs 17 and 54, the right-of-way on BLM lands almost entirely traverses Eocene units of the southern Coast Range. The units span the entire epoch, with a wide variety of clastics ranging from coarse conglomerates to very fine-grained deep water silts and shales. Paleocene Epoch intervals in the lower Roseburg Formation could potentially contain plants, invertebrates, reptiles (turtles) and odontocete cetacea (primitive toothed whales). In addition, Pleistocene intervals in localized swamp boggy areas of the Roseburg Formation could potentially yield bones of large Ice Age mammals.

The portion of the BLM lands in the Klamath Mountain interval between MPs 54 and 97 has some of the oldest and most complex rocks in Oregon. Because most of the Klamath rocks are mapped as tectonic accretionary terranes, even the most fragmentary fossils discovered would be an important find.

BLM lands would be crossed between MPs 110 and 123, MPs 128 and 137, and MPs 167 and 172 in the Cascade Range. Two formations in this region, the Colestin and Little Butte, have a potential for producing plant fossils. Both of these formations were deposited in nonmarine, continental settings with volcanogenic ash, tuff and silts mixed with extrusive volcanics of basalt, basaltic andesite and related igneous rocks. Despite the wide range of ages and environments, the floral lists at any given site for either formation are limited. As a result, any new taxa recorded or salvaged in the course of the construction activities would add to the knowledge of the Cascade geologic history.

Between MPs 216 and 217, the pipeline right-of-way crosses BLM lands in the Basin and Range province. Lake sediments of Cascade ash dating between 5 million to 11,000 years ago in this area bear a limited, but stratigraphically important fauna.

Paleontology Field Monitoring Protocols for BLM Lands

Pacific Connector conducted a field survey of the above-referenced portions of the pipeline right-of-way that occur on BLM lands. The locations observed during the survey were selected using the results of the formal analysis of the existing data and a mile-by-mile evaluation of the geologic formations along the right-of-way.

The field survey results were used to classify the potential for encountering paleontological resources on BLM lands during construction. The classifications used for the project were consistent with classes 1 through 5 in the BLM Potential Fossil Yield Classification procedure (revised H-8270-1).

All but 1 mile of the right-of-way on BLM lands has been classified as meeting Class 3a or 3b, based on the formal analysis and the field survey. An approximately 0.25-mile segment from MP 216.5 to 216.75 is classified as Class 4a. For approximately 25 miles of the Class 3a or 3b lands, the BLM would require limited spot monitoring during pipeline construction because the potential presence of fossils cannot be completely eliminated. The 1-mile-long area not classified as Class 3 is divided into two approximately 0.5-mile-long areas classified as Class 1 and Class 2. To satisfy BLM requirements, Pacific Connector would continuously monitor both of these segments for the potential presence of paleontological resources during pipeline construction. The spot or continuous monitoring during construction would be conducted by a field paleontologist working under the supervision of the lead paleontologist.

Procedures for Recovering Significant Discoveries of Vertebrate or Invertebrate Fossil Remains on BLM Lands

Although the likelihood of discovering paleontologically significant fossils on BLM lands is considered remote, such a discovery could potentially occur during the proposed surveys, brush clearing, or construction activities. The field inspector or field paleontologist identifying a fossil of potential interest would be responsible for notifying the lead paleontologist immediately of the discovery. The lead paleontologist would, in turn, evaluate the significance of the finding relative to the salvage parameters. If the fossil was considered salvageable material, it would be recovered under the direction of the lead paleontologist and Pacific Connector. Pacific Connector proposes to designate the University of Oregon Museum of Natural and Cultural History as the repository for any salvageable material recovered from the portion of the pipeline right-of-way located on BLM lands.

4.1.4 Conclusion

Much of the Project is located in the CSZ tectonic area (an area of potential earthquake and tsunami activity). Based on documentation of existing mineral resources and mine claims, the Project would not significantly affect these resources. Although untapped mineral resources are present along the Project and the potential for future mining and mine claims is possible, the Project would not significantly affect future mining development. Based on the documentation provided; Jordan Cove and Pacific Connector's proposed construction and operations procedures, methods, and plans to appropriately design for geologic hazards; and their implementation of minimization and mitigation measures, we conclude that constructing and operating the Project would not significantly affect geology and would not be significantly affected by geologic hazards.

4.2 SOILS AND SEDIMENTS

4.2.1 Jordan Cove LNG Project

Soils at the proposed LNG terminal and the South Dunes site have been previously disturbed by the operations of the Menasha and Weyerhaeuser companies and from the placement of fill material derived from COE dredging of the Coos Bay Federal Navigation Channel in the 1970s. This fill material (composed predominantly of sand with a small percentage of silt) overlies much of the LNG terminal tract and is more than 10 feet deep in some areas. Recent testing and grading to support a 2014 geotechnical exploration program in a 2-acre area of the LNG terminal revealed the presence of ash-amended soils from 12 to 60 inches (SHN 2015).

Jordan Cove performed geotechnical investigations in the area of the proposed LNG storage tanks and process area in April through May 2013 (GRI 2013) as further described in sections 4.1.1.1 and 4.13.1.5. The subsurface data revealed that surficial material in this area is generally fine-grained sand with traces of silt that is underlain by a silt-sand unit at approximately elevation -110 to -140 feet. In the South Dunes portion of the site, above elevation 30 feet, the conditions vary mainly because of variation in the sands and the presence or absence of peat/organics. Another geotechnical investigation was performed in April 2012 (GRI 2012) in the South Dunes portion of the site. Based on geotechnical borings, the sands in the access and utility corridor are composed of areas of fill and native material. Organics and peat were encountered only in the western end of the access and utility corridor at depths of approximately 11 feet below grade. Below elevation -30 feet, the conditions for the access and utility corridor are similar to those described for the LNG terminal site. Geotechnical explorations at the proposed Kentuck project site found that surface fill is 1 to 2 feet deep, underlain by native sand and silt to a depth of about 35 feet, and silt to depths of about 70 to 100 feet.

The *Geotechnical Data Report – 2018 Subsurface Investigation Program* (Jordan Cove LNG 2019a) includes data for 47 soil borings drilled at the LNG terminal. The data includes additional stratigraphy information, cone penetrometer testing, and numerous laboratory tests.

4.2.1.1 General Impacts

Soil types and characteristics in the Jordan Cove LNG Project area were assessed using the NRCS Soil Survey geographic database (NRCS 2017). Construction of the Jordan Cove LNG Project would disturb several soil types, as shown in table 4.2.1.1-1.

The following discussion addresses the soil type characteristics that would be affected in order from highest total impact to lowest, as listed in table 4.2.1.1-1. Soil characteristics for soils that cover 1 percent or less of the total area are not discussed or described in detail.

Dune Land is mapped within approximately 23 percent (140 acres) of the Jordan Cove LNG Project area. It consists of fine and medium textured sands on hills and ridges, formed from aeolian deposits. Permeability is very rapid, and runoff is slow. This soil is severely susceptible to wind erosion and slightly susceptible to water erosion.

Waldport Fine Sand comprises approximately 22 percent (136 acres) of the Jordan Cove LNG Project area. The Waldport Fine Sand is a deep, excessively drained soil occurring on stabilized sand dunes. It is formed from aeolian deposits. Permeability of the Waldport soil is very rapid, but runoff is slow. This soil is severely susceptible to wind and water erosion.

TABLE 4.2.1.1-1

Acres of Impacts at the Jordan Cove LNG Terminal, by Soil Type

Soil Type / Map Unit	Acres a/	Percent (subtotal)
Permanent Operation Areas		
Dune land / 16	29.3	17%
Heceta Fine Sand	43.8	26%
Heceta Waldport Fine Sand	1.4	<1%
Waldport Fine Sand / 59D	1.0	<1%
Waldport Fine Sand / 59E	82.7	48%
Waldport-Dune land complex	0.14	<1%
Waldport-Heceta Fine Sand / 61D	12.8	8%
Subtotal	**171.1**	**100.0%**
Temporary Construction Areas		
Brallier mucky peat / 7	5.8	1%
Chetco silty clay loam	0.3	<1%
Coquille silt loam / 12	76.9	17%
Dune Land	110.8	25%
Waldport Fine Sand / 59D	11.5	3%
Waldport Fine Sand / 59E	40.1	9%
Heceta Fine Sand	19.3	4%
Heceta Waldport Fine Sand	0.5	<1%
Nestucca silt loam	29.8	7%
Salander silt loam	7.7	2%
Templeton silt loam / 54D	7.9	2%
Templeton silt loam / 54E	4.9	1%
Waldport-Heceta Fine Sand	86.8	19%
Udorthents, level (57)	45.9	10%
Subtotal	**448.2**	**100.0%**
Totals (temporary and permanent)		
Brallier mucky peat / 7	5.8	<1%
Chetco silty clay loam	0.3	<1%
Coquille silt loam / 12	76.9	12%
Dune Land	140.0	23%
Waldport Fine Sand / 59D	12.5	2%
Waldport Fine Sand / 59E	122.8	20%
Heceta Fine Sand	63.1	10%
Heceta Waldport Fine Sand	1.9	<1%
Nestucca silt loam	29.8	5%
Salander silt loam	7.7	1%
Templeton silt loam / 54D	7.8	1%
Templeton silt loam / 54E	4.8	<1%
Waldport-Heceta Fine Sand	99.6	16%
Udorthents, level (57)	45.9	7%
Waldport-Dune land complex	0.1	<1%
Project Total	**619.0**	**100.0%**

a/ Column may not add correctly due to rounding. Acres rounded to nearest tenth acre, percentage rounded to nearest whole value (values below 1 are shown as "<1").

b/ Although soils mapping included "water" as a category, it is acknowledged that water is not a soil and therefore, water is not included in this table.

c/ The North Point Workforce Housing Complex adds an additional 2 acres to the temporary construction areas subtotal and project total that is not reflected in the table (see chapter 2). Soils in the housing project area are primarily Udorthents. This modification does not change the overall conclusions regarding soils impacts.

Waldport-Heceta Fine Sands comprise approximately 16 percent (100 acres) of the Jordan Cove LNG Project area. This soil is composed of 50 percent Waldport Fine Sand and 50 percent Heceta Fine Sand (both described herein). This soil is severely susceptible to wind erosion and moderately susceptible to water erosion.

Coquille silt loam comprises 12 percent (77 acres) of the Jordan Cove LNG Project area. The Coquille silt loam is a deep, very poorly drained soil that is formed in alluvium on floodplains. Permeability of this Coquille soil is slow. This soil type is slightly susceptible to wind and water erosion.

Heceta Fine Sand comprises 10 percent (63 acres) of the Jordan Cove LNG Project area. This is a deep, poorly drained soil found in deflation basins and depression areas between dunes. It is formed on aeolian materials. Permeability of this soil is rapid, and runoff is ponded. This soil is severely susceptible to wind erosion and slightly susceptible to water erosion.

Udorthents soils comprise 7 percent (46 acres) of the Jordan Cove LNG Project area. They occur on floodplains, marshes, and tidal flats and in areas that have been filled and leveled for commercial and industrial uses. Areas on floodplains are made up of sandy, silty, or clayey material; and areas on marsh and tidal flats are made up of dredging spoil, dune sand, and wood chips.

Nestucca silt loam comprises 5 percent (30 acres) of the Jordan Cove LNG Project area. This is a deep, somewhat poorly drained soil formed in alluvium on floodplains. Permeability is moderately slow, and runoff is very slow. This soil is slightly susceptible to wind and water erosion.

4.2.1.2 Project-Specific Soil Limitations

Prime Farmland

The NRCS defines prime farmland as land that has the best combination of physical and chemical characteristics for growing food, feed, forage, fiber, and oilseed crops. Prime farmland can include land that possesses these characteristics but is being used currently to produce livestock and timber. Urbanized land and open water are excluded from prime farmland. Prime farmland typically contains few or no rocks, is permeable to water and air, and is not excessively erodible or saturated with water for long periods. Unique farmland is land that is used for production of specific high-value food and fiber crops. In addition, soils may be considered of statewide or local importance if those soils are capable of producing a high yield of crops when managed according to accepted farming methods.

There are no soils at the Jordan Cove LNG Project site that are classified as prime or unique farmland soils. However, Coquille silt loam, Heceta Fine Sands Chetco silty clay loam, Waldport-Heceta Fine Sand and Nestucca silt loam are classified as farmland of statewide importance. These areas comprise a total of approximately 240 acres (39 percent) of the Jordan Cove LNG Project area. This classification includes areas of soils that nearly meet the requirements for prime farmland and that economically produce high yields of crops when treated and managed according to acceptable farming methods. The criteria for defining and delineating farmland of statewide importance are determined by the appropriate state agencies. Farmland of statewide importance may include tracts of land that have been designated for agriculture by state law (NRCS 2006). No areas within the Jordan Cove LNG Project area are currently being used for cropland, and much of the Project area has been previously modified by industrial activities and the placement of dredged material. Therefore, no farmland of statewide importance would be taken out of production by construction and operation of the Jordan Cove LNG Project.

Erosion Potential

Erosion is a continuing natural process that can be accelerated by human disturbances. Factors that influence soil erosion include soil texture, structure, length and percent of slope, vegetative cover, and rainfall or wind intensity. Soils most susceptible to erosion by wind or water are typified by bare or sparse vegetative cover, non-cohesive soil particles with low infiltration rates, and moderate to steep slopes. The soils at the LNG terminal site occur within an area of high wind intensity and are in wind erodibility groups 1 (extreme) and 2 (high), which are the most susceptible to wind erosion.

Soils with severe wind erosion potential include Chetco silty loam, Dune Land, and Waldport Fine Sand. Approximately 276 acres (44 percent) of the total area is characterized by the potential for severe wind erosion. Soils with moderate to high potential for water erosion include Chetco silty clay loam, Waldport fine sand, and Waldport-Dune complex. Approximately 136 acres (22 percent) of the total area is characterized with the potential for moderate to high water erosion.

To reduce potential for soil loss due to erosion, temporary erosion controls would be installed and maintained in accordance with Jordan Cove's *Plan*. Permanent erosion control measures would be installed, as necessary, and in compliance with county and state BMPs. Permanent erosion control measures may include vegetation, vegetated swales, infiltration or settling basins, stormwater runoff diversion and control through ditches, check dams, or other velocity dissipaters. For portions of the storm surge/tsunami barrier and terminal areas above +14 feet in elevation, which are not expected to normally be subjected to severe wind or water conditions (but may be affected by storm surge or tsunami events), alternative erosion control would be used. Alternative erosion control for protection from potential tsunami runups in slope areas would include using concrete cellular mattresses, grout injected geotextile fabric mattresses, or other suitable means as determined during detailed design. The design of the slope protection against waves would be developed through consultation with DOGAMI. Erosion of the engineered slopes within the marine slip is not anticipated under normal wave, tide, and marine vessel traffic conditions. The proposed pile dike rock apron along the access channel side slope would be implemented in coordination with the COE to arrest slope migration and prevent effects on Pile Dike 7.3. The erosion control measures would be designed in accordance with the ODOT Erosion Control Manual. By implementing these erosion control measures, construction and operation of the Project would not result in significant soil erosion by water or wind.

Compaction Potential

Soil compaction is the process by which air spaces in the soil are reduced in size because of physical pressure exerted on the soil surface. Compaction results in soil conditions that reduce infiltration, permeability, and gaseous and nutrient exchange rates. Fine-textured soils with poor internal drainage are the most susceptible to compaction. Compaction can result from construction equipment traveling over wet soils, and could further disrupt soil structure, reduce pore space, increase runoff potential, and cause rutting.

Previous activities at the Roseburg tract and the LNG terminal site have already compacted soils. Jordan Cove would test engineered fill for compaction at regular intervals in areas disturbed by construction activities; and would implement BMPs—especially in areas that have not been historically disturbed by industrial land use—as described in Jordan Cove's ECRP. Such BMPs would include limiting construction in wet weather conditions and application of soil amendments to facilitate plant establishment.

Potentially Contaminated Soils and Groundwater

The site of the LNG terminal was a livestock ranch until 1958. After it was acquired as part of the mill complex, the tract was occasionally used for log-sorting activities. In 1972/1973, the COE spread materials dredged during maintenance of the Coos Bay navigation channel on the site. From the late 1970s through the early 1980s, sand, boiler ash, and wood debris from milling operations were placed on the majority of what is defined as the LNG terminal site. Weyerhaeuser, which acquired the mill in 1981, spread decant solids from its wastewater treatment facility at the LNG terminal site between 1985 and 1994. The South Dunes site was originally developed as a sulfite pulp and paper mill by the Menasha Wood Ware Corporation in 1961. It was acquired by Weyerhaeuser in 1981 and converted to a recycle paper mill in 1995. The mill was closed in 2003. Between 1981 and 1992, Weyerhaeuser leased the southern portion of the property adjacent to the geographic Jordan Cove portion of Coos Bay to a fish hatchery operation. The buildings for both the mill and the fish hatchery have been removed.

Jordan Cove conducted multiple Phase I and Phase II Environmental Site Assessments at the terminal tract to assess for environmental contamination. Phase I protocols consist of record searches, inventories, site visits, and other non-intrusive information gathering. Phase II protocols consist of intrusive environmental media sampling. Phase II Environmental Site Assessments were conducted to address the findings of the Phase I Environmental Site Assessments (CH2M Hill 1996; Thiel Engineering 2004; GRI 2005; PES Environmental 2006; GRI 2007b; GSI Water Solutions 2012; GRI 2017b; SHN 2017; SHN 2018). The details of these investigations are all included in FERC filings for the Project and are only generally summarized in the following section.

A Phase I Environmental Site Assessment of the APCO site conducted by SHN in 2013 (SHN 2013a) identified dredge spoils that may have been affected by historical industrial activities upstream of the site as a recognized environmental condition.[70] The existing Boxcar Hill site is being used as a recreational facility with all-terrain vehicle rentals, riding trails, and camping. A Phase I Environmental Site Assessment of the Boxcar Hill site did not identify any recognized environmental conditions in connection with the site (SHN 2017). A limited (specifically for the Port Laydown area and not entire property parcels) Phase I Environmental Site Assessment was conducted for the Port Laydown site in February 2018 (SHN 2018) which identified numerous concerns including a potential off-site source of contamination (D.B. Western facility cited for violations including illegal disposal of solid and hazardous waste), potentially contaminated dredge material, burn piles within the site, and the potential for lead in soil from target shooting activities. Contaminants identified as both soil and groundwater concerns include: tributyl tin, heavy metals (arsenic, barium, lead, cadmium, chromium, mercury, selenium and silver), copper, polychlorinated biphenyls (PCB), polycyclic aromatic hydrocarbons (PAH), semivolatile organic compounds (SVOC), VOCs, total petroleum hydrocarbons (TPH), dioxins and furans, and

[70] The presence or likely presence of any hazardous substances or petroleum products in, on, or at a property: (1) due to release to the environment; (2) under conditions indicative of a release to the environment; or (3) under conditions that pose a material threat of a future release to the environment.

formaldehyde. A Phase II Environmental Site Assessment to assess for soil and groundwater contamination is planned for this site.

The following Phase II Environmental Site Assessment investigations were conducted at the proposed LNG terminal site to determine if contaminated soils and/or groundwater are present:

- In 1996, Weyerhaeuser conducted Phase II Environmental Site Assessment investigations which found that VOCs, SVOCs, metals, petroleum hydrocarbons, and PCBs (analytes tested) in the fill were below levels that would necessitate cleanup work (CH2M Hill 1996). With the exception of arsenic and PCB, material present at the site is below the current (1996) Oregon residential soil cleanup standards. PCB in one ash discrete sample exceeded the residential standard, but was well below the industrial soil standard. Arsenic detected at the site is within typical background concentration levels for the western United States and, therefore, does not represent any substantial environmental issue.
- Phase II Environmental Site Assessment investigations were conducted by PES Environmental, Inc. (PES) in April 2006 (PES 2006). These investigations focused on the South Dunes site (inclusive of the portions of this site to be used for the LNG terminal) as well as the Ingram Yard site.
- Another Phase II Environmental Site Assessment investigation was completed at the LNG terminal site by GRI in October 2006 (GRI 2007b). The assessment was conducted at test pits in the area of the former Ingram Yard and along a wastewater pipeline.
- GRI performed a Phase II Environmental Site Assessment investigation in 2005 of the Roseburg property (GRI 2005), which has been used for wood-processing activities since 1968.
- GRI conducted a Phase II Environmental Site Assessment in July 2017 (GRI 2017b) of the APCO site.

Grading for the north access road and the ground improvement geotechnical test site required excavation of between 12 inches and 60 inches of soil from a 2-acre area from April 7 through April 15, 2014. During the grading activities, ash-amended soils were encountered, with a total of 5,600 cy of ash/soil mixture excavated and stockpiled in the area of the north access road in berms as indicated in the 1200C permit. On May 8, 2014, the ODEQ determined that these actions, while not prohibited, required a solid waste letter of authorization before commencement of grading activities. The ODEQ required Jordan Cove to obtain a solid waste authorization letter; on July 16, 2014, a solid waste authorization letter was submitted to the ODEQ. Jordan Cove would be required by the ODEQ to provide prior notice to the ODEQ should any grading or ground disturbance activities be planned to occur on the LNG terminal site. Provisions for long-term disposal of disturbed LNG terminal site soils and any other specific mitigation measures would be specified in detail in the final engineering design.

The results of Phase II environmental sampling activities at the LNG terminal site identified contaminants in soil at levels below or slightly exceeding the applicable ODEQ risk-based concentrations (RBC) and EPA screening levels at several locations. Analytical results from samples collected from the LNG terminal site found low concentrations of PAHs, TPH, metals, VOCs, SVOCs, PCBs, dioxins, furans, and butyltin compounds in soil samples. It is noted that regulatory updates to toxicity values for some compounds have changed the screening levels used in preliminary risk assessments since the preparation of these environmental site assessment reports. Table 4.2.1.2-1 presents a subset of chemicals detected at the site and represents contaminants that either exceed or approach current ODEQ and EPA regulatory screening levels or were present in multiple sample locations at both the South Dunes site and LNG terminal site. Table 4.2.1.2-1 includes applicable ODEQ RBCs for the soil ingestion, dermal contact, and inhalation exposure pathway under the occupational and construction worker scenarios (ODEQ 2015) and the EPA regional screening levels for industrial soils (EPA 2018b). Table 4.2.1.2-1 also includes ODEQ-established natural background concentrations for naturally occurring metals in soil. The maximum detected concentrations for selected compounds generally encountered in on-site soils, as summarized by previous environmental investigations, are also included in table 4.2.1.2-1 (CH2M Hill 1996; GRI 2005; PES 2006; GRI 2007b). As a part of the investigations, a screening-level human and ecological risk assessment of residual contamination was conducted and concluded that residual contaminants did not exceed ODEQ's screening levels for the occupational and construction worker exposure scenarios (PES 2006). Based on the findings of previous environmental investigations, the ODEQ issued a "No Further Action" determination for the former Weyerhaeuser mill and the LNG terminal site. A copy of this determination letter is provided in Jordan Cove's September 2017 application to the FERC.[71] A "Condition" of the No Further Action determination states that "While surface soils at the LNG terminal site meet human health and ecological screening criteria, they contain low levels of potentially bio-accumulating chemicals and must not be placed in waters of the state." Implementation of erosion controls for runoff during construction and operation, as well as revegetation plans would prevent the low-level contamination from entering surface waters. Jordan Cove's ECRP lists the specific measures to be used for erosion and sediment control practices, wind erosion and dust control, and clearing and grading. Peripheral erosion and sediment control would be provided along the site perimeter, and at all operational drain inlets and outlets at all times during construction. Sediment basins would be employed if necessary.

TABLE 4.2.1.2-1

Summary of Applicable ODEQ and EPA Screening Levels Concentrations (in parts per million [ppm])

			ODEQ			EPA
Compound	**Max. Detected Concentration**	**Data Source a/**	**Occupational**	**Construction Worker**	**Natural Background**	**Screening Value**
Petroleum Hydrocarbons						
Diesel	11,000	2	14000	4600	Not Applicable	Not Established
Gasoline	4,150	2	20000	9700	Not Applicable	Not Established
Metals						
Arsenic	28.5	3	1.9	15	12	3
Cadmium	0.799	3	9,000	220,000	0.54	98
Chromium (VI)	56	3	6.3	49	241	6.3
Lead	62	1	800	800	34	800
Mercury	0.34	3	350	110	0.11	4.6
PAHs						
Fluoranthene	62.3	3	30,000	10,000	Not Applicable	3,000
Fluorene	1.29	2	47,000	14,000	Not Applicable	3,000
Pyrene	52	3	23,000	7,500	Not Applicable	2,300
Naphthalene	70	3	23	580	Not Applicable	17

[71] Included in Resource Report 7, Appendix G.7, as part of Jordan Cove's September 2017 application to the FERC.

TABLE 4.2.1.2-1 (continued)

Summary of Applicable ODEQ and EPA Screening Levels Concentrations (in parts per million [ppm])

			ODEQ			EPA
Compound	Max. Detected Concentration	Data Source a/	Occupational	Construction Worker	Natural Background	Screening Value
PCBs (Total PCBs)	0.64	1	0.74	8.4	Not Applicable	0.97
2,3,7,8-TCDD (dioxin) equivalents	0.000019	3	0.000016	0.00017	Not Applicable	0.000022

a/ Data Sources:
1. CH2M Hill 1996
2. PES 2006
3. GRI 2007b

Jordan Cove continues to work with the ODEQ toward the determination of appropriate regulatory requirements for the handling of contaminated soil and sediment. The ODEQ approved Jordan Cove's *Revised Work Plan for Joint Regulatory Closure Settling Basins, Petroleum-Contaminated Soil, Asbestos Waste, and Mill Waste Former Weyerhaeuser Mill Site and Ingram Yard Properties (LNG terminal site)* on July 22, 2013. The plan describes redevelopment of the South Dunes site that would involve increasing existing site grades a minimum of 3 feet with clean structural fill consisting of sand from the new slip to be excavated on the LNG terminal site (Ingram Yard property). Development over the existing mill wastewater system settling basins would require over-excavation of geotechnically unsuitable (highly organic) sludge in the basins and replacement with clean, compacted structural fill. Any wastewater treatment sludges that are removed would be properly disposed of in accordance with ODEQ's Solid Waste Rules. A qualified contractor familiar with handling potentially contaminated materials would be mobilized, and a dredge would be used to remove the basin sludge to a dewatering system. Potentially contaminated material would be transported off-site to an approved ODEQ-regulated facility that would be identified prior to construction. In addition, landfill materials would be removed and handled according to the overall *Mill Site Closure Plan* that was approved by the ODEQ on July 22, 2013.

A disposal plan for contaminated soil would be developed by Jordan Cove once the Project engineering design is finalized. The disposal plan will be submitted to the ODEQ for pre-approval prior to the work. Additional details on the management and regulatory requirements of existing contaminants are provided in Jordan Cove's *Framework Contaminated Media Management Plan.*[72]

Jordan Cove completed a data gap investigation in 2018 to delineate existing petroleum and other contaminants at the former mill site in compliance with the terms and conditions of the No Further Action determination granted by ODEQ in 2006. Based on the analytical results from the data gap investigation, concentrations of PAHs, metals, and/or petroleum hydrocarbons exceeded RBCs for deep soil (i.e., deeper than 10 feet) is not anticipated to be encountered by workers. Specific contaminants that exceeded RBCs include naphthalene (46.8 and 92 mg/kg); oil (6,130, 6,190, 14,000, and 61,500 mg/kg); benzo(a)pyrene (2.27 mg/kg); diesel (27,660 mg/kg); and chromium (743 mg/kg). Such remedial action(s) would comply with the requirements and recommendations of the No Further Action determination and ODEQ review and approval. Jordan Cove is in the process of consulting with the ODEQ regarding potential required subsequent remedial mitigation

[72] Included in Resource Report 7, Appendix O.7, as part of Jordan Cove's September 2017 application to the FERC.

efforts to reduce the concentration of contaminants in soil or reduce exposure pathways in relation to the Project if deep excavation work (deeper than 10 feet) is required. ODEQ would require preparation of a health and safety plan to limit worker exposures and ensure workers are aware of the presence or possible presence of contamination, and steps to take if contamination is encountered. In addition, Jordan Cove is preparing a Remedial Action Plan (RAP) for ODEQ approval that would provide an approach for future confirmation sampling that considers construction/excavation worker exposure pathways. The RAP will also include specific methods for the management of asbestos-containing materials. These plans would be subject to the State's approval.

Soils and/or sediments containing residual contamination must be managed and/or disposed in accordance with ODEQ rules. Per guidance from the ODEQ, Jordan Cove would provide prior notice to the ODEQ when grading or ground disturbance activities are planned to occur on the LNG terminal site. In addition, a permanent disposal plan for the boiler ash material would be prepared by Jordan Cove and submitted to the ODEQ for approval prior to site development activities.

Jordan Cove has prepared a *Framework Contaminated Media Management Plan* that includes general measures to be implemented in the event that unanticipated soil contamination is discovered during construction of the Jordan Cove LNG Project but does not include specific monitoring and sampling protocols for handling potential or suspected contamination that might be encountered. If Jordan Cove's Environmental, Health and Safety Division determines that additional action is necessary, Jordan Cove would implement the following measures:

- contact a qualified consultant and/or testing laboratory to assist with the determination of the extent and nature of the contamination;
- devise a plan for additional site-specific investigations as necessary;
- conduct site-specific testing and/or laboratory analysis to determine the extent and nature of contamination;
- notify all applicable environmental authorities as required by law, including the ODEQ;
- devise a site-specific plan depending on the nature and extent of the contamination encountered for continuation of construction, which may involve evaluation avoidance options as necessary to support the construction of the proposed facilities;
- devise a strategy or plan for handling wastes in an appropriate manner including waste characterization, hauling, manifesting, and disposal necessary to support continuing construction;
- devise a plan for site stabilization and backfilling; and
- complete all required and necessary agency follow-ups and reporting.

Spills or leaks of fuels, lubricants, or coolant from construction equipment could contaminate soils. The soil and sand on the Project site have high infiltration capacity, and comprise a shallow groundwater (10 feet or less) system with high aquifer transmissivity. A spill, if it occurred, would spread quickly; however, the effects of contamination would typically be minor because of the low frequency of spills and leaks. During construction, Jordan Cove would implement its water quality management plan that includes a SPCC Plan. This plan describes spill prevention practices, spill handling and emergency notification procedures, and training requirements that would be implemented during construction of the Project. The SPCC Plan addresses the unique soil and subsurface conditions of the Project site, including the high permeability, shallow groundwater, and rapid transmissivity. With the implementation of the SPCC Plan and ODEQ requirements, construction of the Project is not anticipated to spread existing contamination or cause additional soil contamination.

4.2.1.3 LNG-Specific Topics

Potentially Contaminated Bay Sediments

The Port developed a sampling and analysis program (SAP; SHN 2006a) that details the sediment collection and testing program conducted on the material that would be dredged during construction of the access channel. The sediment sampling and analysis program followed the Dredged Material Evaluation Framework (DMEF) Tier IIB approach for physical and chemical evaluation of the proposed dredged material and only included physical analysis of materials. As described below, chemical analyses were not required based on grain size. In addition, Jordan Cove prepared an *LNG Terminal Dredging Pollution Control Plan* in April 2019 (Jordan Cove LNG 2019b) that describes dredging activities, dredge material transport and disposal, and spill response procedures.

The results of the grain size distribution based on COE-approved methods (COE et al. 1998) indicated the average percent of sand in sediment samples was over 99 percent. The results of the total volatile solids (TVS) analysis indicated that the average percent TVS in the sediments was approximately 0.7 percent. DMEF Tier IIA states, "If the results of grain size analysis are at least 80 percent sand and TVS is less than 5 percent, the proposed dredging material qualifies for unconfined, aquatic disposal based on exclusionary status." Therefore, the Port's report concluded that further characterization was not considered necessary.

In addition to the access channel, proposed dredging would take place at four locations along/adjacent to the Coos Bay Navigation Channel (i.e., dredge areas 1, 2, 3, and 4). For dredge areas 1 through 4, historical boring logs from the Federal Navigation Channel were evaluated to provide a dredged sediment characterization. Subsurface exploration within the Federal Navigation Channel was performed by GRI in 2005 and 2007 (GRI 2005 and 2007b). More recently, geotechnical site investigations were carried out by GRI in 2011 and 2017. Additional analyses for submittal to the Portland Sediment Evaluation Team (PSET) are underway. A detailed discussion of dredging and material disposal methods is provided in the *Dredged Material Management Plan.*[73]

Waterway enhancements associated with the dredge areas are summarized in section 2.1.1.6 and generally provide for the widening of the channel in these areas. Operational maintenance dredging is discussed in section 2.1.1.8. The total area dredged for the channel enhancements includes a 25-foot-wide buffer that would extend into rock substrate, which will be superimposed by a sloped sandy substrate. (Jordan Cove LNG 2019c). The extent of the final constructed sand side slope (after dredging and equilibration of slopes) would be dependent on local shoreline characterizes. Dredge areas are expected to equilibrate over a 6-year period. Some side slope equilibration would occur at all dredged areas, with NRI Area 4 experiencing the largest slope

[73] Included in Resource Report 7, Appendix N.7, as part of Jordan Cove's September 2017 application to the FERC.

adjustment of approximately 700 feet horizontally for a vertical equilibration adjustment requirement of -4 feet (see section 4.5 for more details).

Jordan Cove has conducted extensive investigations regarding soil contaminants in close coordination with the Portland Sediment Evaluation Team (PSET) at the west portion of the Kentuck mitigation site beginning in 2010. Jordan Cove has submitted four SAPs and three sediment characterization reports for the western portion of the site to the COE from September 2010 to November 2014. These studies document that chemical analysis of samples for VOCs, SVOCs, PAHs, PCBs, metals, dioxins, furans, and butyltin compounds did not detect any contaminants above applicable screening levels and that the material is suitable for its intended use in the Kentuck project site without restriction, with the exception of the golf course irrigation pond. According to the sampling results documented in the November 13, 2014 sediment characterization report, mercury is present at levels above clean fill screening criteria in sediments contained in the golf course irrigation pond. Although oil-range hydrocarbons are also present at this location, these were not detected above applicable screening levels. Affected soil in the Kentuck project site would be excavated and removed to a permitted disposal facility in accordance with an ODEQ work plan that would be approved prior to the removal action.

Jordan Cove prepared a sediment characterization report (GRI 2018) for the east portion of the Kentuck site to characterize material at the former Kentuck Golf Course that would be partially excavated and/or partially overlain by imported material to create a wetlands mitigation site. Sampling and analyses were performed for this portion of the Kentuck site in November 2017. Soil/sediment samples were collected from 10 locations within the intertidal channel and floodplain and analyzed for metals, VOCs, PAHs, SVOCs, PCBs (e.g., Aroclors), and pesticides. With the exception of the detection of the pesticide aldrin above the marine screening level in one area (sample S-27), the sampling and analyses completed show the proposed plan for Kentuck to be consistent with regulatory guidance and applicable screening levels. To address the S-27 area, Jordan Cove proposes to excavate 6 inches below the proposed final grade and replace to design grade with clean imported sand. This excavation would be completed laterally beyond S-27 to a point halfway to the nearest adjacent sample points. The excavated material from the S-27 area would be incorporated into an on-site constructed bermed area with a clean imported sand cap or transported offsite to an approved permitted disposal facility. As previously noted, Jordan Cove's *Dredging Pollution Control Plan (Navigation Reliability Improvements, Kentuck, APCO)* describes dredging activities, dredge material transport and disposal, and spill response procedures.

Shoreline along the Waterway for LNG Carrier Marine Traffic

Jordan Cove conducted two studies to evaluate shoreline impacts during the transit of LNG vessels in the waterway to and from the LNG terminal (Moffatt & Nichol 2017a, 2017b). The *Vessel Wakes Impacts Memo* (Moffat & Nichol 2017a) evaluates shoreline erosion within Coos Bay resulting from vessel transit. The study concluded that the proposed LNG terminal combined with the associated changes in the size and speed of vessels expected to utilize the proposed channels would not result in increased shoreline impacts (such as increased erosion) due to ship-generated waves. A rock apron has been proposed to arrest slope migration, or equilibration, before it can progress to a condition that could potentially negatively impact Pile Dike 7.3. Construction of the Pile Dike rock apron is expected to produce a localized, temporary increase in turbidity; however, the long-term effect of the rock apron would improve shoreline stability including accounting for the effects of marine traffic. The *Propeller Wash Analysis Memo* (Moffat & Nichol 2017b) evaluates potential impacts of propeller wash on scour in the slip, access channel, MOF, and at the pile dike areas. An area of potential scour due to propeller wash is located along the eastern side of the slip and access channel, where the maximum bottom propeller wash scour depth is estimated to be nearly 0.5 foot. Jordan Cove would provide slope protection (i.e., armor rip rap as described in section 2.4.1.5) for the west and north sides of the slip, and scour protection would be provided at the base/toe of the bulkhead walls. These measures would provide adequate slope and bulkhead protection to prevent associated scour.

4.2.2 Pacific Connector Pipeline Project

4.2.2.1 General Impacts

Soils along the proposed pipeline route were identified using NRCS surveys for Coos, Douglas, Jackson, and Klamath Counties (NRCS 2004; SCS 1985, 1989, 1993); and NRCS State Soil Geographic Database (STATSGO) and Soil Survey Geographic Database (SSURGO) soil classifications (NRCS 2017). The Forest Service soil resource inventories of the Umpqua, Rogue River, and Winema National Forests were used to assess soil resources in the National Forests (Forest Service 1976, 1977, and 1979). Information in the Forest Service surveys was supplemented by STATSGO and SSURGO data where available.

According to the NRCS Land Resource Regions and Major Land Resource Areas (MLRAs) (NRCS 2006), the pipeline route would cross four MLRAs:

- the Sitka Spruce Belt including the Pacific Coast and Coos Bay area in Coos County;
- the North Pacific Coast Range, Foothills, and Valleys including Coos County and portions of Douglas County;
- the Siskiyou-Trinity Area including portions of Douglas and Jackson Counties, the Umpqua National Forest, and portions of the Rogue River-Siskiyou National Forest; and
- the Klamath and Shasta Valleys and Basins in the southern part of Klamath County.

Soil associations crossed by the pipeline are shown in table G-1 in appendix G by MP, including the mileage percentage of the entire pipeline length. The Medco-McNull-McMullun and Vermisa-Vannoy-Josephine-Beekman soil associations are crossed by 15.7 and 12.9 percent of the pipeline length, respectively. The remaining soil associations are crossed by less than 10 percent of the pipeline length.

Detailed descriptions of all soil associations crossed by the Project and their characteristics are provided in appendix G of this EIS. The remainder of this discussion focuses on the sensitive soils characteristics present along the pipeline route as shown in table G-3 in appendix G. It is noted that the soil characteristics studies for the Pacific Connector pipeline and the Jordan Cove LNG Project are different in approach. Pacific Connector primarily relies on soils data available from the NRCS databases; and Jordan Cove uses preliminary geotechnical study data as well as NRCS data.

To provide the highest level of detail in quantifying the soil properties and impacts, analysis was based on the characteristics of the individual soil mapping units crossed within each soil association. Major soil characteristics and limitations for the pipeline and aboveground facilities are discussed below. Table G-3 in appendix G provides a summary of soil limitations that could be encountered by the pipeline route.

4.2.2.2 Project-Specific Soil Limitations

Prime Farmland

The pipeline alignment crosses approximately 68 miles (30 percent of the pipeline) of soils where the dominant map unit in the MLRA is classified on either the NRCS state or county list of prime farmland or "farmland of statewide importance."[74] These designations were previously described in section 4.2. Permanent impacts on prime farmland soils from the proposed pipeline would be associated with the aboveground facilities, as discussed in section 4.2.2.3 below. Pacific Connector would implement mitigation measures in areas where existing agricultural land uses would be affected (approximated 43 miles of the pipeline route) to reduce impacts on prime farmland and crop yields, such as topsoil salvaging, scarification, and subsequent testing to ensure that potential compaction is remediated. Topsoil salvage is achieved by mechanically segregating topsoil from subsoil to an approved depth and width along the pipeline right-of-way. Topsoil segregation would be performed over the trench line and spoil storage areas in croplands, hayfields, pastures, and areas specified by landowners. Areas where topsoil salvaging and segregation would occur are shown by MP in table 4.2.2.2-1 to reduce potential impact on soil and agricultural productivity.

TABLE 4.2.2.2-1

Areas Where Topsoil Would be Salvaged Along the Pacific Connector Pipeline

Area/Land Use	From (MP)	To (MP)	Mileage
Coos County			
Wetlands/Pasture	3.06	6.45R	3.39
Pasture	8.28R	8.45R	0.17
Wetland/Pasture	10.96R	11.06R	0.1
Wetland/Pasture	11.19R	12.11BR	0.92
Pasture	14.67BR	15.32BR	0.65
Pasture/Hayfield	22.59	23.04	0.45
Pasture/Hayfield	29.49	29.83	0.34
Pasture/Hayfield	29.87	30.14	0.27
Douglas County			
Croplands/Pasture	49.50	50.25	0.75
Croplands/Pasture	50.30	50.55	0.25
Pasture/Residential	50.72	50.82	0.1
Pasture	51.31	51.55	0.24
Pasture	51.58	51.78	0.2
Pasture/Wetlands/Residential	55.83	56.56	0.73
Pasture/Wetlands/Residential	56.77	57.10	0.33
Pasture/Wetlands/Residential	57.12	57.59	0.47
Wetlands/Pasture/Hayfield	57.61	58.53	0.32
Wetlands/Pasture/Hayfield	58.65	58.73	0.08
Wetlands/Pasture/Hayfield	58.79	59.60	0.81
Wetlands/Pasture/Hayfield	59.66	60.08	0.42
Pasture Pasture/Hayfield	60.15	60.24	0.09
Pasture Pasture/Hayfield	60.45	60.57	0.12
Pasture/Hayfield	60.58	60.66	0.08
Pasture/Hayfield	65.58	65.73	0.15
Pasture	66.88	66.94	0.06
Pasture	66.97	67.08	0.11
Pasture	69.03	69.49	0.27
Pasture	71.36	71.54	0.18
Croplands/Pasture	76.36	76.37	0.01
Pasture	76.41	76.47	0.06
Pasture	77.82	78.05	0.23

[74] It is noted that some area mapped as prime farmland or farmland of statewide importance have previously been affected by development activities that have precluded their use for agricultural activities.

TABLE 4.2.2.2-1 (continued)

Areas Where Topsoil Would be Salvaged Along the Pacific Connector Pipeline

Area/Land Use	From (MP)	To (MP)	Mileage
Pasture	79.00	79.03	0.03
Hayfield/Pasture	81.20	81.65	0.45
Pasture	88.29	88.50	0.21
Pasture	88.53	88.57	0.04
Pasture	88.61	88.70	0.09
Pasture/Wetlands	94.35	94.56	0.21
Pasture/Wetlands	94.87	95.07	0.2
Jackson County			
Pasture	118.84	118.91	0.07
Pasture	120.70	120.82	0.12
Pasture/Residential	120.84	120.90	0.06
Pasture/Hayfield	121.90	122.20	0.3
Pasture/Wetlands	128.47	128.69	0.22
Pasture	132.03	132.12	0.09
Pasture/Wetlands	132.16	132.18	0.15
Pasture/Wetlands	132.22	132.51	0.29
Pasture/Wetlands	132.53	132.57	0.04
Pasture/Wetlands	142.26	142.56	0.3
Pasture/Wetlands	142.58	142.66	0.08
Pasture	144.31	144.49	0.18
Pasture	144.58	144.69	0.11
Pasture/Wetlands	145.05	145.95	0.9
Pasture	146.12	146.87	0.75
Klamath County			
Pasture/Hayfield/Wetlands	190.63	197.69	7.06
Pasture/Hayfield/Wetlands	197.74	198.21	0.47
Pasture/Croplands/Wetlands	199.60	214.42	14.87
Pasture	217.30	217.54	0.24
Pasture/Croplands	217.55	217.92	0.37
Pasture/Croplands	221.31	221.85	0.54
Pasture/Croplands	221.95	222.25	0.3
Pasture/Croplands	223.25	223.38	0.13
Pasture/Croplands	224.23	225.65	1.42
Pasture/Croplands	226.03	226.86	0.83
Pasture/Croplands	227.78	227.94	0.16
Pasture	228.35	228.81	0.46
TOTAL			**44.09**

Note: For a description of topsoil segregation and effects on wetlands, see section 4.3. (Up to the top 12 inches of topsoil would be segregated from the area disturbed by trenching in wetlands, except in areas where standing water or saturated soils are present.) Topsoil would not be segregated on federal lands as discussed in section 4.2.3.

Erosion Potential

The pipeline route would cross approximately 94 miles (41 percent of pipeline length) of soils with a high or severe water erosion potential and 14 miles (6 percent of the pipeline length) of soils with a high wind erosion potential (NRCS wind erodibility groups 1 and 2).

Impacts on soils from erosion would be minimized by following the Pacific Connector's *Plan* and *Procedures* and their Project-specific ECRP. Pacific Connector would implement specific water erosion prevention measures such as covering temporary storage piles; covering, seeding and mulching of soil and vegetation piles; and installation of sediment barriers, interceptor ditches or berms, or other measures where necessary, to filter water and divert flow away from sensitive areas. With these measures, significant water erosion would not occur. Pacific Connector would implement reseeding efforts, apply mulch, and water for dust control to reduce potential erosion by wind on the disturbed soils during construction. In addition, as described in section 4.1 of this EIS, an extensive geotechnical review was conducted to ensure that the route avoided known or potential areas of mass soil movement. This effort required minor reroutes in numerous areas along the alignment to ensure the safety and integrity of the pipeline.

Temporary erosion control measures would be installed immediately after clearing and prior to grading (i.e., the initial soil disturbance). Near waterbodies and wetlands, the EIs would determine in the field the extent of temporary erosion control measures (i.e., sediment barriers) that would need to be installed prior to clearing activities to reduce the potential for runoff to enter a wetland or waterbody. All erosion control devices would be routinely inspected and any damaged or temporarily removed structures would be replaced at the end of each working day. Temporary erosion control measures would be maintained until successful revegetation has been achieved.

Sediment barriers would be used to confine sediment to the construction right-of-way and would be constructed of either silt fence or straw bales. Sediment barriers would generally be placed as follows:

- at the base of slopes adjacent to road, wetland and waterbody crossings where sediment could flow from the construction right-of-way onto the road surface or into the wetland or waterbody;
- adjacent to wetland and waterbody crossings, as necessary, to prevent sediment flow in the wetland or waterbody consistent with the requirements of the FERC's *Procedures* (which Pacific Connector's *Procedures* were based upon); and
- on the downslope side of the right-of-way where it traverses steep side slopes (greater than or equal to 30 percent).

Pacific Connector would install temporary slope breakers to reduce runoff velocity, concentrate flow, and to divert water off the construction right-of-way to avoid excessive erosion. Temporary slope breakers may be constructed of materials such as soil, silt fence, staked straw bales, straw wattles, or sand bags. If it becomes necessary to delay final cleanup, including final grading and installation of permanent erosion control measures, beyond 20 days (10 days in residential areas) after the trench is backfilled in a specific area, Pacific Connector would apply mulch on all disturbed slopes before seeding.

Trench breakers would be installed in the trench and keyed into trench walls on slopes prior to backfilling to slow the flow of subsurface water along the trench to prevent erosion of trench backfill materials. A permanent slope breaker and a trench breaker would be installed at the base of slopes near the boundary between the wetland and adjacent upland areas.

Waterbody crossings would be stabilized and temporary sediment barriers installed within 24 hours of completion of backfilling in accordance with Pacific Connector's *Procedures*. Pacific Connector would install erosion control fabric (such as jute or excelsior) on streambanks and steep slopes at the time of recontouring. The erosion control fabric would be designed for the proposed use and would be approved by the EI, and authorized agency representative on federal lands.

Permanent slope breakers (waterbars) would be installed across the right-of-way on steep slopes based on soil erosion potential as specified in table 2.4.2.1-1. The purpose of these structures is to reduce erosion by reducing runoff velocities, by shortening slope lengths, preventing concentrated flow, and by diverting water off the construction right-of-way. Slope breakers are also intended to prevent sediment deposition into sensitive resources.

Compaction Potential

The proposed pipeline alignment would cross a total of 174 miles (76 percent of the total pipeline length) of soils that are highly susceptible to compaction. Soils in this sensitive group were determined based on the NRCS rating of high or severe for the Haul Roads, Log Landings, and Soil Rutting categories. Soils in this group are rated based on Unified soil texture classification, rock fragments on or below the surface depth to a restrictive layer, depth to a water table and slope. However, most soils are susceptible to compaction depending on the number of passes of heavy equipment and the moisture content of the soils at the time of construction. Unmitigated soil compaction can result in long-term reductions of soil productivity and increased erosion from increased surface runoff.

Pacific Connector would reduce soil compaction, rutting, and structural damage to wet soils and soils with poor drainage by employing BMPs such as the use of low-ground-weight construction equipment, or operating normal equipment on timber riprap, prefabricated equipment mats, or terra mats. In addition, Pacific Connector would not conduct construction activities during extremely wet weather conditions as would be determined in the field by the EI as specified in the FERC's *Plan*. During forest clearing activities, the potential for soil compaction would be minimized where cable and helicopter logging methods are used. Where log skidding occurs, several practices would be employed as described in Section 2.3 of Pacific Connector's *Right-of-Way Clearing Plan for Federal Lands,*[75] where feasible, to reduce the potential for soil compaction.

As described in Pacific Connector's ECRP, regrading, recontouring, scarifying, and final cleanup activities after pipeline construction would mitigate potential soil compaction in all areas of pipeline construction. However, these measures alone would not be sufficient to entirely address soil compaction, and additional measures including subsoil ripping and decompaction with hydraulic excavators would also be necessary to fully address soil compaction. Mitigating compaction promotes infiltration, reduces surface water runoff, minimizes erosion, and enhances revegetation efforts. Pacific Connector would test for soil compaction in agricultural areas (e.g., active croplands, hayfields, and pastures), residential areas, and on NFS and BLM lands. Soil compaction mitigation on federal lands is more specifically discussed in section 4.3.2.

Potentially Contaminated Soils and Groundwater

A review of the ODEQ's Environmental Cleanup Site Information (ECSI) database (ODEQ 2017a, 2017b, 2017c, and 2017d) and EPA's (2017) EnviroMapper - Facility Detail Report revealed that there are 116 sites with either cleaned-up, potential, or confirmed soil and/or groundwater contamination within 0.25 mile of the pipeline route as listed in table G-2 in appendix G. Based on a review of these sites, the sites listed in appendix G were determined to have the potential to encounter contaminated soil or groundwater during construction. During the review of these sites, the following issues were considered: sites that are closed might have residual contamination and contaminated soils might be carried by the wind to adjacent areas.

[75] This plan was included in Pacific Connector's application to the FERC as Appendix U to the POD.

In order to further evaluate the potential to encounter contamination during construction of the Pacific Connector Pipeline Project, Pacific Connector consulted with ODEQ via a letter request dated May 28, 2019 (included in appendix G). the proposed work will not encounter contamination or have the potential to spread the remaining contamination

The ODEQ agreed with the conclusions of the May 28, 2019 letter in a letter dated June 12, 2019, and filed with the Commission on June 17, 2019. The ODEQ agreed that the proposed work will not encounter contamination or have the potential to spread the remaining contamination. If soils containing previously unknown residual contamination are discovered during construction activities, these would be managed and/or disposed in accordance with ODEQ rules. Pacific Connector would dispose of any contaminated soils in accordance with ODEQ's solid waste rules.

During construction, contamination from accidental spills or leaks of fuels, lubricants, and coolant from construction equipment could adversely impact soils. To reduce impacts, Pacific Connector would implement measures contained in its SPCC Plan, which specifies cleanup procedures in the event of inadvertent spills during Project construction. Pacific Connector has developed a *Contaminated Substances Discovery Plan* (Appendix E to the POD [appendix F.10 of this EIS]) that specifies the measures that would be implemented if unanticipated contaminated soil or groundwater are encountered during construction. Some of the measures outlined in that plan specify that all construction work in the immediate vicinity of areas where hazardous or unknown wastes are encountered would be halted; that all construction, oversight, and observing personnel would be evacuated to a road or other accessible up-wind location until the types and levels of potential contamination can be verified, and that if an immediate or imminent threat to human health or the environment exists, one of Pacific Connector's emergency response contractors identified in the SPCC Plan or the National Response Team would be notified and mobilized. Pacific Connector would update the *Contaminated Substances Discovery Plan* to be consistent with the latest information regarding contaminated sites in proximity to the pipeline alignment prior to construction.

4.2.2.3 Pipeline-Specific Topics

Soil Limitations

<u>Reclamation Sensitivity</u>

The pipeline alignment would cross a total of 146 miles (63 percent of the pipeline length) of soils that are rated as having reclamation sensitivity or poor revegetation potential (NSR 2014a). These soils may have a combination of characteristics that could require additional measures or BMPs to reduce erosion and sedimentation potential. Restoration of these soils may require adaptive seed mixtures and implementation of revegetation practices (i.e., fertilization, mulching, monitoring) to enhance revegetation success. Section 10.0 of Pacific Connector's ECRP includes a detailed description of soil restoration procedures and requirements. Pacific Connector would implement revegetation procedures, such as topsoil segregation, recontouring, scarification, soil replacement, seedbed preparation, fertilization, seed mixtures, seeding timing, seeding methods, and supplemental plantings to ensure revegetation success. Information contained in the BLM/Forest Service *Technical Memorandum Soil Risk and Sensitivity Assessment on BLM and National Forest System Lands* (NSR 2015a) would be used to identify and treat areas on BLM and Forest Service lands where specific and focused soils remediation measures may be required to reduce potential erosion and accomplish vegetation objectives (see section 4.2.3).

Pacific Connector would work with individual landowners to address restoration of active agricultural and residential landscaping, if affected by pipeline construction. In active agricultural areas, Pacific Connector would restore the lands in compliance with the *Plan* and *Procedures*, and would also compensate the landowner for any additional restoration measures (e.g., replanting crops) that the landowner preforms. In residential areas, Pacific Connector would use contractors familiar with local horticultural and lawn establishment procedures for reclamation work or would compensate the landowner if the landowner conducts that restoration work; Pacific Connector would still be responsible for ensuring the restoration efforts are successful.

Seedbed preparation would be conducted, where necessary, immediately prior to seeding to prepare a firm seedbed conducive to proper seed placement and moisture retention. Seedbed preparation would also be performed to break up surface crusts and to reduce the extent of weeds which may have developed between initial reclamation and seeding. A seedbed would be prepared in disturbed areas, where necessary, to a depth of up to four inches using appropriate equipment to provide a seedbed that is firm, yet rough. A rough seedbed is conducive to capturing or lodging seed when broadcasted or hydroseeded, and it reduces runoff and erosion potential. The rough seedbed would retain soil moisture for seedling germination and establishment.

In most areas, final right-of-way cleanup procedures are sufficient because they leave a surface smooth enough to accommodate a drill seeder pulled by a farm tractor and rough enough to catch broadcasted seed and trap moisture and runoff. Where residential and cropland areas are disturbed, more intensive ground and seedbed preparations may be required including rock collection, grading, and soil preparation/amending. The EI would be responsible for determining where seedbed preparation measures are required prior to seeding.

Pacific Connector has consulted with the NRCS and land management agencies regarding recommended seed mixtures for the Project area. The seed mixtures developed for the Pacific Connector Pipeline Project are based on these agency recommendations and are provided in the ECRP. During right-of-way negotiations, private landowners may also request other seed mixtures than those proposed in the ECRP. These specific landowner requested/specified seed mixtures would be documented in landowner right-of-way agreements.

Disturbed areas would be seeded within six working days of final grading, weather and soil conditions permitting. If final grading occurs more than 20 days after pipe installation and backfilling, Pacific Connector would apply mulch on all disturbed areas prior to seeding. Seeding would proceed in accordance with the ECRP.

Restrictive Layer

Soils that are rated as having a restrictive layer are shallow soils that have a lithic, paralithic, or other restrictive soil layer within 60 inches of the soil surface. The pipeline alignment would cross a total of about 139 miles (61 percent of the pipeline length) of soils with a restrictive layer. These soils have thin profiles, restrictive root zones and hold less available water for plant growth. Shallow and hard bedrock can also restrict trenching, requiring special equipment (rock hammers/saws) or blasting in some areas to efficiently excavate the trench to required design depths. Excavation of bedrock or cemented layers may require additional measures to provide suitable pipe bedding materials. Soils in this group are also included in the soils that have reclamation sensitivity. Section 4.1 of this EIS discusses shallow soils, rock lithology, potential blasting locations, rock removal, and disposal.

Large Stones

Soils with more than 25 percent cobbles and stones in the soil profile can present problems with surface reclamation because they hold less available water for plant growth and generally require broadcast seeding methods. Further, the introduction of stones or rocks from subsoils to surface soil layers during trenching or blasting can adversely affect agricultural productivity and agricultural equipment operation.

The pipeline route would cross a total of 70 miles (31 percent of the pipeline length) of soils containing cobbles and stones. Pacific Connector has developed measures that would reduce impacts on restoration and revegetation caused by rocks, cobbles, and stones near the soil surface. In agricultural and residential areas, topsoil would be segregated except on federal lands as discussed in section 4.2.3. A rock picker would be used to remove large fragments.

Rocks excavated from the trench would be kept separate from topsoil during construction and during surface preparation as part of restoration. Pacific Connector has identified rock disposal sites. These sites are listed in table 4.1.2.5-1. Large rocks and boulders would also be used as OHV barriers along the right-of-way and at road crossings to control unauthorized OHV access to the right-of-way both during construction and operation. Additionally, large rocks and boulders would be piled in upland areas along the right-of-way to create habitat diversity features where approved by the EI or Pacific Connector's authorized representative and the landowner or land management agency.

Aboveground Facilities

Pacific Connector's aboveground facilities would be located within or immediately adjacent to the pipeline construction right-of-way. Each facility would be fenced and graveled immediately after construction. Permanent impacts on soils would occur at aboveground facilities that would be graded and graveled or where facilities would be constructed. Soil limiting characteristics at aboveground facilities are listed on table 4.2.2.3-1. Soils at specific aboveground facilities are described below. Section 10.0 of Pacific Connector's ECRP includes a detailed description of erosion control and soil reclamation procedures and requirements.

TABLE 4.2.2.3-1

Summary of Soils Limitations – Pacific Connector Pipeline Aboveground Facilities

Proposed Facility	Area (ac) a/	Soil Mapping Unit (STATSGO)	High Erosion Potential b/	Steep Slopes c/	Large Stones d/	Restrictive Layer e/	High Compaction Potential f/	Poor Revegetation Potential g/	Prime Farmland h/
Jordan Cove Receipt MS, BVA #1, Receiver Site	1.72	S6398 (61D)	N/A i/	N/A i/	N/A i/	N/A i/	N/A i/	N/A i/	N/A i/
MLV #2 (Boone Creek Road) /	<1	S6399 (54F)	Water	Yes	No	No	Yes	Yes	No
MLV #3 (Myrtle Point Sitkum Rd)	<1	S6402 (47B)	No	No	No	No	Yes	No	No
MLV #4 (Deep Creek Rd)	<1	S6408 (262E)	No	No	No	Yes	Yes	Yes	No
MLV #5 (S. of Ollala Creek)	<1	S6360 (14C)	No	No	No	No	Yes	No	Yes
MLV #6 Launcher/ Receiver & CT	<1	S6385 (189F)	Water	Yes	Yes	Yes	No	Yes	No
MLV #7 (Pack Saddle Rd)	<1	S6360 (270F)	Water	Yes	No	No	Yes	Yes	No
MLV #8 (Hwy 227)	<1	S6360 (183B)	No	No	No	No	Yes	Yes	Yes
MLV #9 (BLM Rd 33-2-12) /	<1	S6381 (69E)	No	Yes	Yes	Yes	No	Yes	No
MLV #10 (Shady Cove)	<1	S6380 (122E)	Water	Yes	Yes	Yes	Yes	Yes	No
MLV #11 (Butte Falls & Launcher/Receiver Site) /	<1	S6380 (125C)	No	No	Yes	Yes	Yes	Yes	No
MLV #12 (Heppsie Mtn Quarry)	<1	S6380 (111G)	Wind	Yes	Yes	Yes	Yes	Yes	No
MLV #13 (Clover Creek Rd)	<1	S6387 (R6)	No	No	No	No	Yes	No	No
MLV #14 & Launcher/ Receiver Site	<1	S656 (129B)	No	No	Yes	Yes	No	Yes	No
MLV #15 Klamath River /	<1	S1150 (40)	No	No	No	No	Yes	No	Yes
MLV #16 (Hill Road)	<1	S6356 (58A)	No	No	No	Yes	Yes	No	Yes
Klamath Compressor Station, Klamath-Beaver and Klamath-Eagle Meter Stations, MLV #17, Launcher/Receiver & CT	21.30	S542 (19C)	Wind	No	No	No	Yes	No	Yes

TABLE 4.2.2.3-1 (continued)

Summary of Soils Limitations – Pacific Connector Pipeline Aboveground Facilities

Proposed Facility	**Area (ac) a/**	**Soil Mapping Unit (STATSGO)**	**High Erosion Potential b/**	**Steep Slopes c/**	**Large Stones d/**	**Restrictive Layer e/**	**High Compaction Potential f/**	**Poor Revegetation Potential g/**	**Prime Farmland h/**
Blue Ridge Communication Site	<1	S6396 (4D)	Water	No	No	No	Yes	Yes	No
Signal Tree Communication Site	<1	S6395 (50D)	No	No	Yes	Yes	Yes	Yes	No
Sheep Hill Communication Site	<1	S6395 (50D)	No	No	Yes	Yes	Yes	Yes	No
Harness Mountain Communication Site (Existing)	0.0	S6396 (122E)	No	No	Yes	No	No	No	No
Starveout Communication Site	<1	S6361 (89E)	Water	No	Yes	Yes	No	Yes	No
Flounce Rock Communication Site	<1	S6380 (113G)	Water	Yes	No	Yes	Yes	Yes	No
Robinson Butte	<1	S6388 (0038)	No	Yes	Yes	No	No	No	No
Stukel Mountain Communication Site	<1	S6388 (16E)	No	Yes	Yes	No	No	Yes	No

MS = meter station, MLV = mainline block valve, CT = communication tower. Soil data from NRCS (2004); SCS (1985, 1989, 1993); Forest Service (1976, 1977, and 1979). NRCS State Soil Geographic Database (STATSGO and SSURGO) soil classifications (NRCS 2017).

a/ Area of pipeline construction and operation ROW disturbance. Acreages rounded to nearest whole acre; values less than 1 are reported as <1.

b/ Soils with NRCS water erosion rating of high or severe; and/or soils with NRCS wind erodibility groups 1 and 2.

c/ Soils with slopes greater than 30 percent.

d/ Soils with greater than 25 percent cobbles and/or stones within pipeline trench depth.

e/ Soils with a restrictive soil layer (bedrock or cemented layer) within 60 inches of the soil surface.

f/ Soils with an NRCS rating of high or severe for the Haul Roads, Log Landings, and Soil Rutting category.

g/ Combined rating for soils with high or severe erosion potential, steep slopes, large stones, shallow soils, saline/sodic conditions, clayey soils (greater than 40 percent), and soil map units with dominant amounts of rock outcrop. The Reclamation/Sensitivity type does not include data related to the revegetation sensitivity studies on federally managed lands (NSR 2015).

h/ Soils with dominant map unit included on either the state or county list of farmland of importance (includes prime farmland, unique farmland, and farmland of statewide or local importance).

i/ These aboveground facilities would be located entirely within the proposed Jordan Cove LNG terminal. This soil association has been previously disturbed and would be graded and built up during construction of the Jordan Cove LNG terminal prior to construction of the Pacific Connector pipeline.

Jordan Cove Meter Station

The Jordan Cove Meter Station (at MP 0.0) would be within the South Dunes site, on the North Spit, in Coos County. This area was formerly the location of the Menasha-Weyerhaeuser mill (operated between 1961 and 2003), which is now dismantled. Petroleum hydrocarbons (e.g., fuel, fuel oil, lubricants, solvents, and hydraulic oil constituents) are present in subsurface soils and groundwater from past mill operations/practices in the area of the South Dunes site. In addition, transite/asbestos siding and other debris from the Weyerhaeuser Company mill demolition are present in surficial soils. The meter station would occupy approximately 1 acre on the Bullards-Nehalem-Dune Land soil association. There are no known soil limitations that would affect the construction and use of this parcel for a meter station. The meter station site would be graded and its elevation built up by Jordan Cove from soils excavated and dredged from the LNG terminal access channel and marine slip. The Jordan Cove Meter Station would also contain MLV #1, a receiver, and a communication tower.

The Jordan Cove Meter Station location and pipeline alignment are in the general area of potential debris/fill; however, the TEWA usage has been reduced in size, and the debris/fill material would not be disturbed as the TEWA would be used only for staging equipment or materials. To protect human health and ensure worker safety, Pacific Connector or qualified contractor personnel would collect representative samples of the debris/fill in the excavation zone prior to construction for the meter station and pipeline alignment and surrounding materials for laboratory analysis for contaminants of concern listed above. Based on the results of laboratory analysis, any contaminated material would be removed and properly disposed of in accordance with appropriate federal and state regulations. Where the removed fill must be stockpiled pending characterization and ODEQ approval, Pacific Connector would take precautions to avoid mitigation of existing contamination (e.g., appropriate liner for storage area, berms). This approach is consistent with ODEQ recommendations for this general area (ODEQ - No Further Action Determination Letter, Former Weyerhaeuser Containerboard Mill North Bend, Coos County, Oregon Tax Lots #25S-13W-4-100, 25S-13W-3-200, and the LNG terminal [Ingram Yard portion of 25S-13W-0-200 ECSI Site ID No. 1083]).[76] Clean backfill would be utilized to backfill excavations. Lastly, Pacific Connector would mandate pipeline contractor training that would include this site's status and history, and instruct that site excavation and disturbance is to be limited. Documentation of all analytical results and disposal records would be filed with the FERC following construction of the meter station.

Klamath Compressor Station

The Klamath Compressor Station would be located at MP 228.8 in Klamath County. The site would also include the Klamath-Beaver and Klamath-Eagle meter stations, MLV #17, a launcher/receiver, and a communication tower. The compressor station would occupy a 21.4-acre site within the Fordney-Calimus Poman soil association. The two dominant mapped soil units (i.e., Fordney loamy fine sand and Calimus loam) are considered prime farmland if irrigated; however, the site is not irrigated or otherwise in agricultural use. Fordney loamy fine sand has a high wind erosion hazard; therefore, periodic watering may be necessary to reduce fugitive dust during construction clearing and grading activities until the site has been stabilized with gravel.

[76] Included in Jordan Cove's Resource Report 7, Appendix G.7, in their September 2017 application to the FERC.

Gas Control Communication Towers

Pacific Connector would install a series of communication towers for gas control and system monitoring at 8 locations. As discussed above, one new communication tower would be erected within the Klamath Compressor Station and the Jordan Cove Meter Station. No soils would be disturbed where an existing tower would be utilized. Pacific Connector expects to erect new communication towers adjacent to existing facilities at three locations: Flounce Rock, Robinson Butte, and Stukel Mountain. Construction of the new towers would disturb about 0.2 acre at each location. Information on the soil characteristics for the new tower locations is provided in table 4.2.2.3-1. Pacific Connector would reduce erosion by following its ECRP. Because the communication towers are industrial facilities, the presence of stones, restrictive layers, and poor revegetation potential would not be environmentally adverse factors in the construction and operation of the towers.

Launchers/Receivers and Mainline Block Valves

Seventeen MLVs would be installed along the pipeline according to USDOT spacing requirements (49 CFR Part 192 Section 192.179). Potential impacts from the MLVs are accounted for within the proposed pipeline because these facilities would be located entirely within the construction right-of-way. However, because these small (less than a tenth of an acre) sites would contain aboveground facilities, they would permanently affect soils. Six of the MLV locations would be on soils designated as prime farmland, with five of these locations (MLVs 5, 8, 15, 16, and 17) within existing cropland/pastures rangeland. Construction and operation of the launchers/receivers and MLVs would take a total of about one-third of an acre out of agricultural production, excluding acres that were already discussed under the meter stations. Loss of agricultural production would be a factor considered in compensation to landowners negotiated by Pacific Connector while obtaining easement agreements.

Temporary Storage Yards

Pacific Connector has identified 36 potential, privately-owned contractor and pipe storage yards in the general area of the proposed route. These yards would be used for pipe offloading, office trailers, fabrication, equipment storage, material staging and employee parking. Although it is unlikely that all 36 yards would be utilized, numerous sites are identified and evaluated given that some sites could become unavailable at the time of construction. Most (28) of the yards are located in existing industrial areas or sites that have been previously disturbed by filling, grading, and gravelling activities, and therefore the soils resources at these locations have been substantially altered from natural conditions. Of the remaining storage yards, two have been partially disturbed (i.e., Coquille Park and Rogue Aggregates). Only six storage yards have not been disturbed previously. These include four storage yards that are currently used for agriculture (i.e., Roth, Riddle Pasture, Klamath Falls North of Cross Road East, and Klamath Falls North of Cross Road West). The remaining undisturbed storage yards (i.e., Klamath Amuchastegui Building, and Klamath Falls Industrial Oil) are undeveloped land in industrial parks.

Soil associations, mapping units, and sensitive soil characteristics are listed for each of the storage yards in table 4.2.2.3-2.

TABLE 4.2.2.3-2

Contractor and Pipe Storage Yards with Sensitive Soil Characteristics (Pastures, Fields and Vacant Lots)

Name	County	Section, Township, Range	Acres a/	Description	Soil Association – Soil Mapping Units and Sensitive Soil Characteristics b/
Coquille Park	Coos	Section 35, T. 27 S., R. 13 W.	3.3	Sturdivant Park, adjacent to rail siding	Soil Association: Waldport (OR0797) Soil Mapping Units: (Coos County): 40 & 41 Sensitive Soil Characteristics: 1, 3, 5
Roth	Douglas	Section 29, T. 28 S., R 5 W.	3.8	Pasture, adjacent to rail siding, connect to Pipeline ROW	Soil Association: Ruch-Medford-Takilma (OR059) Soil Mapping Units: (Douglas County): 81A & 189F Sensitive Soil Characteristics: Philomath-Dixonville complex soil: 3, 6 Foehlin soil: 1, 3
Riddle Pasture	Douglas	Section 45, T. 30 S., R. 6 W.	7.3	Vacant field adjacent to industrial sites and rail siding	Soil Association: Ruch-Medford-Takilma (OR058) Soil Mapping Units (Douglas County): 14A &14C Sensitive Soil Characteristics: 1, 3, 5
Rogue Aggregates	Jackson	Section 20, T. 36 S., R. 2 W.	38.9	Pasture/undevel-oped land within active aggregate quarry and processing facility and undeveloped land includes rail siding	Soil Association: Ruch-Medford-Takilma (OR059) Soil Mapping Units (Jackson County): 10B, 31A, 55A, 133A Sensitive Soil Characteristics: 1, 3
Klamath Amuchastegui Building	Klamath	Section 10, T. 39 S., R. 9 E.	25.5	Existing commercial site and undeveloped industrial lots adjacent to rail siding	Soil Association: Fordney-Calimus-Poman (OR059) Soil Mapping Units (Klamath): 19A, 90 Sensitive Soil Characteristics: 19A - 1, 3; 90 – 1, 4, 5
Klamath Falls Industrial Oil	Klamath	Sections 8, 9 & 10, T.39 S., R. 9 E.	39.5	Undeveloped Industrial Lots adjacent to highway, rail and rail sidings	Soil Association: Malin-Laki-Henley (OR008) Soil Mapping Units (Klamath): 7C, 18A, 74D Sensitive Soil Characteristics: 1, 3, 4, 7
Klamath Falls North of Cross Road East	Klamath	Section 1, T. 40 S., R.9 E.	7.0	Farmland, adjacent to rail siding	Soil Association: Fordney-Calimus-Poman (OR059) Soil Mapping Units (Klamath): 58A Sensitive Soil Characteristics: 1, 3, 4
Klamath Falls North of Cross Road West	Klamath	Section 1, T. 40 S., R.9 E.	37.0	Agricultural Field	Soil Association: Fordney-Calimus-Poman (OR059) Soil Mapping Units (Klamath): 58A Sensitive Soil Characteristics: 1, 3, 4

a/ Acreages are rounded to nearest tenth acre.
b/ Sensitive Soil Characteristics:
1 – All soils within this mapping unit (based on SSURGO geographic databases) are considered prime farmland soil or farmland of statewide importance.
2 – These soils are positioned on floodplains and stream terraces and have soil components within the mapping unit that may be poorly drained and have either seasonal high water tables at or near the surface and have surface soils that are susceptible to compaction impacts and some that are susceptible to occasional or rare flooding.
3 – These soils have low strength and are susceptible to compaction especially if wet.
4 – Shallow to bedrock or duripan
5 – Seasonal high water table
6 – Combined rating for soils with high or severe erosion potential, steep slopes, large stones, shallow soils, saline/sodic conditions, clayey soils (greater than 40 percent), and soil map units with dominant amounts of rock outcrop. The Reclamation/Sensitivity type does not include data related to the revegetation sensitivity studies on federally managed lands (NSR 2015a).
7 – Susceptible to high risk of wind or water erosion.

Pacific Connector would use appropriate erosion control measures to reduce potential impacts at the yards. After the pipeline is constructed, the temporary yards would be restored to their previous condition and use.

The Coquille Yard is identified as a TEWA intended for use as a contractor yard for staging pipe, equipment, or other construction supplies and materials. Based on historical information, contaminated soil at the site was removed and treated in a soil treatment area and the site was encapsulated with fill dirt from ODOT in 1995. In 1998, the ODEQ recommended no further action for the site. Pacific Connector has identified this yard for staging of pipe, equipment or other construction supplies and materials and the use would be surface use only. Minor surface grading would be limited to pushing berms as needed to support pipe joints. This limited use of the site is not expected to result in effects on the encapsulated area or in potential effects on human health, worker safety, or the environment. However, Pacific Connector would consult with the ODEQ prior to use of the site to confirm that the intended use is consistent with the protections required for this property. In addition, Pacific Connector would include pipeline contractor training regarding this site's status and history and would require that site excavation and disturbance be limited.

Access Roads

Most access roads for the pipeline would be existing federal (BLM and Forest Service), state, county, and private roads that intersect the proposed pipeline alignment. Where needed, Pacific Connector proposes to modify existing roads and construct new roads to ensure construction and operation access. Approximately 3.8 acres of soils would be disturbed to construct 10 TARs, and approximately 2.16 acres of soils would be permanently affected to construct or reconstruct 15 PARs. The TARs would be constructed using appropriate BMPs to reduce potential impacts and would be designed and constructed for their intended use. All TARs would be reclaimed (i.e., regraded, scarified, and replanted) upon completion of construction according to the landowner or agency requirements. Soils along PARs would be permanently compacted and unvegetated.

4.2.3 Environmental Consequences on Federal Lands

The causes and extent of environmental effects on soil resources from the proposed Project are described above. The Forest Service has determined that these effects will, in some areas and for some activities will exceed allowable thresholds for detrimental soil conditions established by the applicable forest plans. Therefore, the Forest Service has proposed plan amendments and compensatory mitigation actions to make provision for the proposed project.

The BLM has not established detrimental soil condition thresholds within the applicable Resource Management Plans and therefore has not proposed similar plan amendments.

4.2.3.1 Environmental Consequences on National Forest Lands

The Project would cause soil mixing, displacement, and compaction on the backfilled trench and the spoils side of the corridor, steep slopes in some locations, and rocky soils where subsoil ripping would not effectively restore soils to a condition with less than 15 percent increase in bulk density. Additionally, these soil impacts would occur on more than just the backfilled trench and spoils side of the corridor. They would occur across the entire construction right-of-way, particularly where heavy equipment is operating (refer to figure 2.3-1 of typical pipeline right-of-way cross sections). These conditions (soil mixing, displacement, and compaction) would also occur on new TEWAs and new TARs. As a result, an estimated 30 to 70 percent of the Project area would likely have detrimental soil conditions from mixing, displacement, or compaction. Complete rehabilitation would also require recovery of the soil biology, which requires restoration of the soil organic matter and time. Some surface erosion is likely to occur; however, 85 to 95 percent of surface erosion can be prevented or trapped on-site by application of measures in the ECRP. Any surface erosion that does occur is expected to be minor, and within the range of natural variability for watersheds in southwest Oregon (see appendix F.4).

The Project may cause sediment transport from construction clearing and use of roads by the project. As part of the Project mitigation, road sediment reduction projects are aimed at reducing the chronic contributions of fine-grained sediment from road surfaces and fill failures to stream systems. As described in section 2, table 2.1.5-1, mitigation activities include decommissioning of 93.9 miles of Forest Service roads. Table 2.1.4.1-1 also indicates the Applicant's voluntary proposal to decommission about 5 miles of road on BLM lands. Proposed road decommissioning would increase infiltration of precipitation, reduce surface runoff, and reduce sediment production from road-related surface erosion in the watershed where the impacts from the Project occur. Sediment reduction would also include closure of about 1.2 miles of Forest Service roads, reducing fine-grained sediments by eliminating traffic impacts and storm-proofing 11.2 miles to reduce road-related sedimentation and improve drainage. In its proposed *Comprehensive Mitigation Plan*, the Applicant has also proposed voluntary mitigation to reduce road-related sedimentation and improve drainage on about 70 miles of roads on BLM lands (see table 2.1.4.1-1).

LRMPs for the Umpqua, Rogue River, and Winema National Forests have standards and guidelines that establish thresholds for detrimental soils conditions as shown in table 4.2.3.1-1.

TABLE 4.2.3.1-1

Thresholds for Detrimental Soil Conditions on NFS Lands

Watershed	Total Project Acres a/	Cleared Acres b/	Threshold Acres Allowed c/	Minimum Projected Acres in Detrimental Condition d/	Maximum Projected Acres in Detrimental Condition	Minimum Acres Over Threshold	Maximum Acres Over Threshold
Umpqua National Forest							
Days Creek- South Umpqua	53	21	11	6	15	-5	4
Elk Creek-South Umpqua	30	29	6	9	20		14
Upper Cow Creek	74	74	16	22	52	6	36
Trail Creek	50	41	12	12	29	0	17
Total Umpqua NF	***207***	***165***	***45***	***49***	***116***	***8***	***71***
Rogue River National Forest							
Little Butte Creek	277	207	28	62	145	34	117
Winema National Forest							
Spencer Creek, All Land Allocations other than Management Area 8	85	73	17	22	51	5	34
Spencer Creek Riparian Areas (Management Area 8)	7	7	1	2	5	<1	4
Total Winema NF	***92***	***80***	***18***	***24***	***56***	***5***	***38***
Total Cumulative Direct Effect, All NFS Lands	**576**	**452**	**91**	**135**	**317**	**47**	**226**

Rows and columns may not add correctly due to rounding. Acres rounded to nearest whole acre (values below 1 are shown as "<1").

a/ Total Project Acres is all acres within the ROW. This includes cleared and uncleared areas.

b/ Cleared Acres are the construction corridor and TEWAs.

c/ Threshold Acres Allowed is the threshold from the standards and guidelines times the Total Project Acres.

d/ Projected Acres in Detrimental Conditions is estimated at 30 percent (minimum) to 70 percent (maximum) of the Cleared Acres.

Detrimental soil conditions are measured upon completion of a project after restoration and rehabilitation work is completed. Detrimental soil conditions are defined in each national forest LRMP, but generally include:

- compaction, which is defined as an increase in bulk density of 15 percent when compared to adjacent undisturbed soils for all soils except volcanic ash or pumice. For volcanic ash soils, compaction is defined as a 20 percent increase in bulk density when compared to adjacent undisturbed soils;
- displacement or mixing, which is the horizontal removal by mechanical means of 50 percent or more of the topsoil or "A" horizons, or mixing of these layers with less fertile subsurface mineral layers such that the continuity of the horizons is lost; and
- detrimental puddling, which is the physical change to soil structure that results when traffic ruts and molds a soil to a depth of 6 inches or more.

Precise estimates of detrimental soil conditions likely to exist at completion of a project are impossible to make. For the purposes of this assessment, 30-70 percent of the pipeline project area may be in a detrimental soil condition upon completion of all soil restoration and rehabilitation efforts. Table 4.3.2.2-1 provides an estimate of predicted detrimental soil conditions. Where projected acres exceed the threshold, an amendment of the affected LRMP is necessary to make provision for the Pacific Connector Pipeline Project.

The impacts of detrimental soil conditions include:

- a possible reduction in soil productivity from mixing or displacement of nutrient-bearing soil layers; and
- a potential increase in runoff and erosion from decreased infiltration of compacted soils.

See section 4.3.4 for measures that would be applied on federal lands to address these issues.

Amendments of Forest Plans Related to Thresholds for Detrimental Soil Conditions

Where detrimental soil conditions exceed the threshold established in an LRMP, an amendment of the LRMP is necessary for the Project to proceed. The following amendments of National Forest LRMPs are proposed to waive limitations on detrimental soil condition thresholds to make provision for the Project. Additional discussion of forest-specific management direction related to soil conditions is provided in section 4.7.3.

<u>UNF-3. Project-Specific Amendment to Waive Limitations on Detrimental Soil Conditions Within the Pacific Connector Right-of-Way in All Management Areas</u>[77]

For planning purposes, soil impacts are considered long term. Soil compaction and displacement would be confined to the project area, but predicting how much would be affected is an estimate based on professional judgment and the nature of corridor construction. See section 4.3.2.3 for a discussion of environmental consequences.

The Project would likely result in a detrimental soil condition on 30 to 70 percent of the project area on the Umpqua National Forest (165 acres) due to displacement and compaction. Approximately 11

[77] Forest-Wide Soils Standard and Guideline #1 (Umpqua LRMP IV-67).

of those acres would likely be in Riparian Reserves. Compaction can largely be addressed by subsoil ripping, but displacement would be unavoidable because of the nature of the Project. Existing LRMP standards and guidelines allow up to 20 percent of the project corridor (about 33 acres of the corridor on the Umpqua National Forest) to be in a degraded soil condition upon completion of a project. The Pacific Connector Pipeline Project would exceed these thresholds by about 8 to 71 acres on the Umpqua National Forest. These impacts would be spread over four separate fifth-field watersheds. See section 4.7.3 and appendix F.4, Aquatic Conservation Strategy Assessment, for a watershed-specific evaluation. Amendment of the Umpqua National Forest LRMP to waive limitations on detrimental soil conditions is not expected to prevent attainment of Aquatic Conservation Strategy objectives (section 4.7.3 and appendix F.4). See section 4.7.3 for a discussion of this amendment in the context of the Umpqua National Forest LRMP.

RRNF–6. Project-Specific Amendment to Waive Limitations on Detrimental Soil Conditions Within the Pacific Connector Right-of-Way in All Management Areas[78]

The Pacific Connector Pipeline Project would likely result in a degraded soil condition on an estimated 30 to 70 percent of the pipeline right-of-way on NFS lands in the Rogue River National Forest (all in the Little Butte Creek Watershed) due to displacement and compaction (Orton 2009). Compaction can largely be addressed by subsoil ripping, but displacement would be unavoidable because of the nature of the project. Existing LRMP standards and guidelines allow up to 10 percent or 28 acres of the pipeline corridor to be in a degraded soil condition on completion of a project. Thus, the Project would likely exceed this threshold by about 34 to 117 additional acres or 0.07 to 0.2 percent of the 57,234 acres (NFS lands only) within the Little Butte Creek Watershed upon completion. About 2 to 6 acres of degraded soil conditions above LRMP thresholds may be in Riparian Reserves. See section 4.7.3 and appendix F.4, Aquatic Conservation Strategy, for a watershed-specific evaluation of consequences. Amendment of the Rogue River National Forest LRMP to waive limitations on detrimental soil conditions is not expected to prevent attainment of Aquatic Conservation Strategy objectives (section 4.7.3 and appendix F.4). See section 4.7.3 for a discussion of this amendment in the context of the Rogue River National Forest LRMP.

WNF-4 and WNF-5: Project-Specific Amendment to Waive Limitations on Detrimental Soil Conditions within the Pacific Connector Right-of-Way in All Management Areas[79]

These standards and guidelines of the Winema National Forest LRMP restrict the amount of an area that may be in a degraded soil condition as a result of a management activity. They are considered together here because the assessment is the same for both standards.

The Pacific Connector Pipeline Project would likely result in a degraded soil condition on an estimated 30 to 70 percent project right-of-way on NFS lands in the Winema National Forest (all in the Spencer Creek Watershed) due to displacement and compaction (Orton 2009). Compaction can largely be addressed by subsoil ripping, but displacement would be unavoidable because of the nature of the project. Existing LRMP standards and guidelines allow up to 10 percent (1.5 acres) of the project corridor in Management Area 8 Riparian Areas or 20 percent (17 acres) in the pipeline corridor outside of Management Area 8 to be in a degraded soil condition on completion of a project. Thus, the pipeline project would likely exceed this threshold by an estimated 5 to 38

[78] Standards and guidelines in the Rogue River National Forest LRMP (pp. 4-41, 4-83, 4-97, 4-123, 4-177, 4-307)
[79] Winema National Forest LRMP Management Direction for Riparian Areas page 4-73 (WNF-4) and 4-137 (WNF-5).

additional acres or 0.03 to 0.16 percent within the Spencer Creek watershed upon completion. See section 4.7.3 and appendix F.4, for a watershed-specific evaluation of consequences. Amendment of the Winema National Forest LRMP to waive limitations on detrimental soil conditions is not expected to prevent attainment of Aquatic Conservation Strategy objectives (section 4.7.3 and appendix F.4). See section 4.7.3 for a discussion of this amendment in the context of the Winema National Forest LRMP.

Cumulative Impacts, All Units

Cumulatively, on the Umpqua, Rogue River, and Winema National Forests, detrimental soil conditions within the pipeline project area are expected to range between about 135 and 317 acres (table 4.3.3.3-1), or about 47 to 226 acres over the combined LRMP threshold for the pipeline project of 91 acres. Assuming an even distribution over the 30.6-mile NFS part of the pipeline project area, this equals about 2 to 8 acres of detrimental soil conditions above the LRMP thresholds for each mile of pipeline, spread over six separate fifth-field watersheds.

Mitigation also includes storm-proofing of 11.4 miles of Forest Service roads would reduce sediment from roads by increasing the resistance of a road to failure during high-intensity rainfall events. Storm-proofing strategies include improving drainage, reducing diversion potential at culverts, outsloping road surfaces and replacing culverts with hardened low water fords. Road sediment reduction activities would result in approximately 207 total acres (assuming a typical 16-foot wide roadway) of long-term sediment mitigation on federal lands.

Road stabilization and culvert replacement of 11 sites on NFS lands would reduce road-related sediment by stabilizing or removing failing cut and fill slopes. Culvert replacement reduces sediment by replacing undersized or failing culverts with culverts that are appropriate to pass debris at higher flows. This reduces the probability of fill failure associated with plugged culverts.

The locations of the road sediment reduction activities are listed in table 4.2.3.1-2.

TABLE 4.2.3.1-2

Mitigation Projects to Address LMP Amendments on NFS Lands

Unit	Watershed	Mitigation Group	Project Type	Project Name	Quantity	Unit
Umpqua National Forest	Elk Creek - South Umpqua	Road sediment reduction	Road Storm-proofing	Elk Creek Road Storm-proofing	9.2	miles
	Elk Creek - South Umpqua	Aquatic and Riparian Habitat	Fish Passage	Elk Creek Fish Passage Culverts	5	sites
	Elk Creek - South Umpqua	Road sediment reduction	Road Decommissioning	Elk Creek Road Decommissioning	5.9	miles
	Trail Creek	Road sediment reduction	Road Decommissioning	Trail Creek Road Decommissioning	0.3	miles
	Trail Creek	Road sediment reduction	Road Storm-proofing	Trail Creek Storm-proofing	2.2	miles
	Upper Cow Creek	Road sediment reduction	Road Closure	Upper Cow Creek Road Closure	1.2	miles
	Upper Cow Creek	Road sediment reduction	Road Decommissioning	Upper Cow Creek Road Decommissioning	1.0	miles
	Upper Cow Creek	Aquatic and Riparian Habitat	Fish Passage	Upper Cow Creek Fish Passage Culverts	6	sites
Rogue River NF	Little Butte Creek	Road sediment reduction	Road Decommissioning	Little Butte Creek Road Decommissioning	57.5	miles
Winema NF	Spencer Creek	Road sediment reduction	Road Decommissioning	Spencer Creek Road Decommissioning	29.2	miles

a/ Mileages are rounded to nearest tenth of a mile.

4.2.3.2 Soil Risk and Sensitivity Assessment

At the request of the BLM and Forest Service, Pacific Connector identified areas on BLM and NFS lands along the proposed Project where there is a low vegetation recovery potential. These soils included combined characteristics including high or severe erosion potential, steep slopes, large stones, shallow soils, saline/sodic conditions, clayey soils (greater than 40 percent), and soil map units with dominant amounts of rock outcrop. Certain types of disturbed soils where residual soil compaction exists in subsurface soil layers, topsoil has eroded, soil horizons have been mixed, and/or topsoil has been removed, can lead to conditions where revegetation can be very difficult, no matter what mitigation methods are employed.

In order to specifically identify areas of revegetation concern where more rigorous mitigation might be required, a Soil Risk and Sensitivity Assessment was performed for the BLM and Forest Service in 2015 that included the TEWAs and UCSAs. The new temporary and permanent access roads necessary for Project construction and/or operation were not included in this analysis due to the small number of acres associated with these on BLM and NFS lands. The intent of the assessment was to identify the areas where additional soil decompaction, erosion control, or other types of site-specific and focused remediation measures may be required on BLM and NFS lands to reduce erosion potential and/or accomplish agency revegetation objectives. Soil risk and sensitivity factors were identified by a BLM/Forest Service team including four criteria in the assessment of the risk element; plant mortality, soil erosion, slope rating and aspect; and three levels of sensitivity, primarily based on qualitative values related to management objectives.

As depicted in table 4.2.3.2-1, approximately 83 percent of the Project area, or about 1,143 acres, is rated as Level 1 – very low or Level 2 – low for combined risk and sensitivity. These are locations where revegetation measures are expected to be successful with decompaction and other standard methods described in the ECRP. Approximately 18 percent of the Project area, or about 237 acres, is rated as Level 3 – moderate or Level 4 – high for combined risk and sensitivity where more aggressive erosion controls and/or soil remediation are likely to be needed.

TABLE 4.2.3.2-1

Risk/Sensitivity Ratings by Administrative Unit by Watershed (Acres)

Unit	Watershed	Risk Sensitivity Rank 1 (very low)	2 (low)	3 (moderate)	4 (high)	5 (very high)
Coos Bay BLM	East Fork Coquille River	13	26	4	32	0
	Coquille River	0	<1	<1	<1	0
	North Fork Coquille River	5	22	8	8	0
	Middle Fork Coquille River	9	58	6	9	<1
	Coos Bay-Frontal Pacific Ocean	<1	2	<1	<1	0
	Subtotal	**27**	**108**	**20**	**19**	**<1**
Roseburg BLM	Clark Branch South Umpqua	2	7	1	0	0
	Olalla-Looking Glass	10	10	5	0	0
	Days Creek -South Umpqua	13	146	16	3	0
	Middle Fork Coquille River	6	17	3	<1	0
	Myrtle Creek	2	65	24	<1	0
	Elk Creek	<1	2	<1	<1	0
	Subtotal	**33**	**247**	**50**	**4**	**0**
Medford BLM	Big Butte Creek	3	<1	1	7	0
	Little Butte Creek	35	63	12	3	0
	Shady Cove RR	10	49	13	3	0
	Trail Creek	28	41	5	0	0
	Subtotal	**76**	**153**	**32**	**13**	**0**

TABLE 4.2.3.2-1 (continued)

Risk/Sensitivity Ratings by Administrative Unit by Watershed (Acres)

Unit	Watershed	Risk Sensitivity Rank 1 (very low)	2 (low)	3 (moderate)	4 (high)	5 (very high)
Lakeview BLM	Spencer Creek	**2**	**<1**	**12**	**<1**	**0**
Umpqua National Forest	Days Creek - South Umpqua	0	40	15	0	0
	Elk Creek - South Umpqua	<1	31	<1	0	0
	Trail Creek	15	24	0	0	0
	Upper Cow Creek	7	39	15	9	<1
	Subtotal	**22**	**134**	**30**	**9**	**<1**
Rogue River NF	Little Butte Creek	**158**	**119**	**14**	**3**	**0**
Winema NF	Spencer Creek	**12**	**52**	**25**	**3**	**0**
	Total	**328**	**814**	**183**	**54**	**<1**

Note: Rows and columns may not sum correctly due to rounding. Acres rounded to nearest whole acre (values below 1 are shown as "<1").

Areas rated as Level 3 – moderate (about 183 acres or 13 percent of the Project) had either high risk or high sensitivity but not both, or were ranked as moderate for both criteria. Areas that ranked as Level 4 – high (about 54 acres or 4 percent of the Project) had both high sensitivity and high risk and would be considered high priority areas for aggressive soil remediation. Less than one acre was ranked Level 5 – very high and considered to have a very high priority for aggressive restoration measures.

Areas ranked a Level 3 – moderate to 5 – very high (237 acres total) would be recommended for more site-specific validation of the risk criteria used in this assessment to confirm that specific locations merit consideration of the more aggressive soil remediation measures listed below:

- a 2- to 3-inch organic mulch surface application (80 percent coverage) of woodchips, logging slash, and/or straw;
- adaptive seed mixes and vegetation to better fit site conditions;
- deep subsoil decompaction with hydraulic excavators that leave constructed corridor mounded and rough with maximum water infiltration so that water cannot flow downhill for any appreciable distance;
- more aggressive use of constructed surface water runoff dispersion structures such as closely placed and more pronounced slope dips and water bars, etc.;
- more aggressive use of constructed surface runoff entrapments such as silt fencing, sediment settling basins, or straw bale structures, etc.;
- more aggressive placement (100 percent coverage) and depth (3 to 4 inches) of ground cover using woodchips, logging slash, straw bales, wattles, etc.; and
- priority monitoring of results as needed to measure success or make future recommendations.

4.2.4 Conclusion

Constructing the Project would result in both short-term and long-term permanent impacts on soils, including soils characterized for reclamation sensitivity. However, based on the Applicants' proposed construction and operations procedures, methods, and plans to address known and unanticipated soil contamination, and the implementation of impact minimization and mitigation measures, we conclude that constructing and operating the Project would not significantly affect soils.

4.3 WATER RESOURCES AND WETLANDS

4.3.1 Groundwater

4.3.1.1 Jordan Cove LNG Project

The Jordan Cove LNG Project area is underlain by the unconfined Dune-Sand Aquifer. This aquifer is located within unconsolidated deposits of sand and gravel, which may also contain variable quantities of silt and clay (USGS 2009b). The Dune-Sand Aquifer is generally 100 feet thick (USGS 1992). The aquifer extends to a depth of 160 feet below sea level. Groundwater has been found within about 8 to 10 feet depth at the terminal and fluctuates with the tides and seasonal precipitation. Because the terminal site is bordered on three sides by saltwater bodies, saltwater intrudes into the aquifer and influences groundwater quality (GSI 2017). Iron concentration is also an existing groundwater concern in the area.

High concentrations of iron in shallow groundwater arise from leaching that occurs as rainfall percolates through vegetative litter (such as leaves and pine needles) and into the underlying dunal sands (GSI 2017). Once the percolating water reaches the water table, the iron remains dissolved in the shallow groundwater and can migrate deeper into the aquifer at and near the CBNBWB production wells, which are all screened at depths of 50 feet and greater. Historically, the CBNBWB has observed higher iron concentrations in water from some of its production wells at the northern end of the west wellfield. As part of its wellfield management plan, pumping from these wells was terminated indefinitely to reduce the downward migration of high-iron groundwater from the shallow portion of the aquifer in that area. CBNBWB would not use those wells to meet the Jordan Cove LNG Project's water supply needs.

Information maintained by the OWRD indicates that there are four groundwater wells permitted for industrial use and fire protection by Roseburg Forest Products located within or near the disturbance area. Additionally, the CBNBWB maintains 18 non-potable, groundwater withdrawal wells north of the terminal site. The closest CBNBWB well is about 3,500 feet north of the terminal site.

The CBNBWB well field system is currently capable of producing up to 4 million gallons per day (mgd) of water during normal precipitation years (CBNBWB 2012). Past studies indicate the aquifer system itself is capable of safely yielding up to 5 mgd without adverse impacts on the aquifer from saltwater intrusion and without adverse impacts on overlying surface water resources (CH2M Hill 1995 as cited in GSI 2017).

A review of EPA's sole source aquifer (SSA) mapping revealed that the closest SSA is approximately 40 miles north-northeast of the Jordan Cove LNG Project.[80] Additionally, a review of ODEQ data showed that the site would not overlie any Groundwater Management Areas where groundwater contamination from non-point source activities warrants state intervention.

[80] EPA defines an SSA area as one that supplies at least 50 percent of the drinking water consumed in the area overlying the aquifer. EPA guidelines also stipulate that these areas can have no alternative drinking water source(s) that could physically, legally, and economically supply all those who depend upon the aquifer from drinking water (EPA 2013).

Impacts and Mitigation

Jordan Cove would obtain water from the CBNBWB to construct and operate the Jordan Cove LNG Project. As shown in table 4.3.1.1-1, Jordan Cove estimates that it would need a total of about 667 million gallons of water for construction and operation of the Jordan Cove LNG Project.

TABLE 4.3.1.1-1

Projected Water Usage for the Proposed Jordan Cove LNG Project

Activity	Total (million gallons)	Peak Use (thousand gallons per month)	Potable (Y/N)
Construction			
General Construction Activities	11.3	382.0	N
Grading Activities	488.4	21,861.0	N
LNG Tank Hydro	60.0	30,000.0	N
Drinking Water	1.7	57.0	Y
Concrete Batch Plant	7.2	275.0	Y
Workforce Housing	26.9	1,102.0	Y
TOTAL	**595.5**		
Operation			
Source of Operation- Phase Water Demand	**Annual Water Demand (million gallons)**	**Average Instantaneous Flowrate (gallons per minute)**	**Potable (Y/N)**
Process Water Makeup	36.3	69	Y
Quench Water	15.8	30	Y
Plant Water	15.8	30	Y
Buildings	3.7	7	Y
TOTAL	**71.5**		

Constructing and operating the Jordan Cove LNG Project could affect groundwater, because of the shallow depth to groundwater and the permeability of the overlying sands and gravels across the site and through groundwater use. Site stabilization, excavation, pile driving, and the installation of permanent aboveground facilities could all affect groundwater. In addition to the permanent modification of site topography which could affect underlying groundwater characteristics (quantity, flow, and quality); an inadvertent release of equipment-related fluids, such as lubricating oil, gasoline, and diesel fuel, could affect groundwater. Installing piles to support the Jordan Cove LNG Project could create vertical conduits further affecting underlying groundwater characteristics. Additionally, these conduits could also transmit contaminants.

Three of four Roseburg Forest Products wells would be buried to create a construction staging area and would be permanently abandoned in accordance with state regulations. Jordan Cove has indicated that Roseburg Forest Products would drill new wells to the east to replace the buried wells. The fourth well would remain in place. We conclude that neither construction nor operation of the Project would impact the CBNBWB wells to the north due to the distance of the wells from the Project (the closest CBNBWB well is about 3,500 feet north of the terminal).

Although past studies indicate that the wells can yield up to 5 mgd without adverse impacts on overlying surface water resources, we examined whether sourcing of water from the CBNBWB wells for construction and operation of the LNG Terminal might temporarily lower groundwater levels near the wells, which could result in a drawdown in overlying lakes and wetlands. Modeling conducted for the Project showed a small drawdown effect to the overlying lakes and wetlands of no more than 6 inches and typically less (GSI 2017) could occur during the construction period.

Drawdowns of the water table in the shallow aquifer would be similar during the 0.6-mgd construction pumping period and the two short-term 3.8-mgd pumping periods associated with the LNG tank testing. These pumping rates are both below the capacity of the CBNBWB well field.

The excavation and grading required to create the marine slip could cause local groundwater elevations to shift as a result of the change in topography; however, this change would be minor and localized. Creating the marine slip would also shift the seawater interface inland, but it would not affect the water supply wells.

Use of the upland APCO sites for disposal of material dredged from Coos Bay could potentially affect groundwater due to infiltration of saline water from the dredged materials. However, both of these sites have been previously used for dredged material placement and there are no known groundwater uses. Further, the APCO sites are largely surrounded by saltwater, which likely already affects the groundwater chemistry. Thus, we do not anticipate saltwater infiltration to result in a significant effect at the APCO sites.

Based on the depth to groundwater, dewatering would be required during construction of the marine slip. The anticipated method for dewatering is the use of well-points, which consist of a closely spaced series of small-diameter shallow wells connected to a dewatering pump via a common headermain (i.e., a pipe that context to the dewatering pump). The contractor would determine the most appropriate method for dewatering excavations and obtain appropriate permits prior to construction. All water associated with dewatering would be allowed to infiltrate elsewhere onsite and return to the groundwater table. Water associated with construction dewatering would not be directly discharged to waterbodies until either filtered or directed to a treatment system approved by the ODEQ before discharge, in accordance with Jordan Cove's ESCP and their *Plan* and *Procedures*. A monitoring program would be conducted prior to, during, and after construction to monitor potential impacts on ground and surface waters. Dewatering would have temporary, localized effects on groundwater movement, but flow patterns would return to normal soon after construction.

An inadvertent equipment-related fluid spill could adversely affect groundwater quality. The scope and magnitude of the effect would vary depending on fluid, quantity spilled, and location of the spill. To prevent and reduce the potential of a spill and the resulting impact on groundwater, Jordan Cove would implement measures as described in its SPCC Plan.[81] These measures include refueling procedures; spill response procedures, spill response materials, and training; countermeasures/contingency plan; and hazardous liquids storage, and disposal. Spill-related impacts during operation of the Jordan Cove LNG Project would mainly be associated with fuel storage, facilities use, equipment refueling, and equipment maintenance, which would be prevented or reduced with the implementation of Jordan Cove's SPCC Plan.

The terminal site would have a system of curbs, drains, and basins to collect and contain any spills of LNG during operation. In the unlikely event that LNG is spilled, the cryogenic liquid would vaporize rapidly upon contact with the warm air and water. Because LNG is not soluble in water

[81] The preliminary SPCC Plan was included in Jordan Cove's September 2017 application to the FERC as Appendix F.2 to Resource Report 2. The preliminary SPCC Plan provides general content but would be updated prior to the start of construction to final detail.

and would completely vaporize shortly after being spilled, the LNG could not mix with or contaminate groundwater.

During operation, the LNG terminal would cover about 100 acres with impervious surface materials, such as asphalt, concrete, and compacted gravel. The conversion of pervious surface to impervious surface can typically cause a decrease in the local recharge of shallow groundwater (by converting infiltration to runoff); however, Jordan Cove would capture most runoff for infiltration into the ground on-site with only high flows expected to run off directly to the bay. Additionally, in comparison to the total 12,480-acre area of the Dune-Sand Aquifer, this 0.8 percent area reduction would not likely result in an adverse effect on the level of groundwater in the area. Through use of the measures discussed above, we conclude that impacts on groundwater resources at the Jordan Cove LNG Project would be reduced to the extent practicable and would not be significant.

Five domestic supply wells in the vicinity of the Kentuck project were evaluated for their vulnerability to saltwater intrusion caused by inundation of the former golf course area as part of the Project wetland mitigation. Of the five wells, two were determined to be moderately to highly vulnerable to Project impacts, and a third was found to have low to moderate vulnerability. Jordan Cove has initiated discussions with the landowners regarding mitigation strategies to offset potential effects on these wells, including well replacement, and other means of settlement.

4.3.1.2 Pacific Connector Pipeline Project

The Pacific Connector pipeline (and associated facilities) would be located above four general aquifer types: unconsolidated-deposit; pre-Miocene rock; volcanic and sedimentary rock; and Pliocene and younger basaltic rock.

Unconsolidated-deposit Aquifers – The pipeline would overlie unconsolidated-deposit aquifers for approximately 7.6 miles in and around Coos Bay (between MPs 3.0 and 23.4), 3.1 miles in Douglas County between MPs 55.3 and 69.7, and 23.0 miles in the Klamath Basin between MPs 191.9 and 214.9. These aquifers consist primarily of sand and gravel and are the most productive and widespread aquifers in Oregon. These unconsolidated-deposit aquifers typically provide freshwater for most public-supply, domestic, commercial, and industrial purposes (USGS 1994).

Pre-Miocene Rock Aquifers – The majority of the pipeline route between MPs 23.5 and 155.8 would overlie aquifers in pre-Miocene rocks. These aquifers consist of undifferentiated volcanic rocks, undifferentiated consolidated sedimentary rocks, and undifferentiated igneous and metamorphic rocks principally in the mountainous areas crossed by the pipeline. Within and west of the Cascade Range, the consolidated sedimentary rocks are of marine origin and commonly yield salt water. At depth, the salt water can contaminate overlying freshwater aquifers. Permeability of the aquifers varies greatly. Water from wells completed in these aquifers is used mostly for domestic and agricultural (livestock watering) supplies (USGS 1994).

Volcanic and Sedimentary Rock Aquifers – Northeast of Medford, the pipeline route enters a groundwater area of volcanic and sedimentary rock aquifers for about 8.2 miles between MPs 134.2 and 156.9. These aquifers consist of a variety of volcanic and sedimentary rocks that generally yield fresh water but locally can yield salt water. About 30 percent of the fresh groundwater withdrawals are used for public supply, about 20 percent are used for domestic and commercial, and about 50 percent are used for agricultural (primarily irrigation) purposes (USGS 1994).

Pliocene and Younger Basaltic-rock Aquifers – In the Klamath Basin, between MPs 191.9 and 228.8, the pipeline route passes through an area of Pliocene and younger basaltic-rock aquifers for about 51 miles while also passing in and out of unconsolidated deposit aquifers. Pliocene and younger basaltic-rock aquifers yield fresh water that is used mostly for agricultural (primarily irrigation) purposes (USGS 1994).

Depth to groundwater varies throughout the Project area. Approximately 26 miles (or 13 percent) of the pipeline route would cross areas of shallow groundwater where the water table ranges from zero to 6 feet bgs. Approximately 16 of those 26 pipeline miles would be in areas that have seasonally high groundwater (fall through spring) and the remaining 10 pipeline miles, primarily in the Klamath Basin, would be located in areas with shallow groundwater year-round.

Groundwater-fed springs and seeps were identified along the pipeline route during wetland surveys and by review of aerial photos. Additional springs and seeps may be identified by landowners during easement negotiations and through contact with adjacent property owners. The owners would be asked to identify springs and seeps and their uses. For springs and seeps located within 200 feet of the construction disturbance, Pacific Connector would implement its *Groundwater Supply Monitoring and Mitigation Plan*.[82]

No EPA-designated SSAs would be crossed by the Pacific Connector pipeline. The nearest EPA-designated SSA is located approximately 40 miles to the north.

The 1996 federal Safe Drinking Water Act (SDWA) requires Source Water Assessments for all public water systems that have at least 15 hookups, or serve more than 25 people year-round. About 80 percent of Oregonians get their drinking water from public water systems. The Oregon Health Authority and the ODEQ Drinking Water Protection Program jointly manage the SDWA assessment requirements. ODEQ maintains the Drinking Water Protection database[83], which includes public drinking water source areas for groundwater and surface water, as well as the locations of public water system intakes and public groundwater wells. ODEQ has identified and established wellhead protection areas (WHPAs) to protect public drinking water sources. The SDWA defines a WHPA within the recharge area of a well as the surface and subsurface area surrounding a water well or well field, supplying a public water system, through which contaminants are reasonably likely to move toward and reach such a water well or well field. The pipeline would cross six WHPAs as shown in table 4.3.1.2-1 (ODEQ 2017e). One pipe yard is located within the Klamath Auction Cafeteria WHPA, and one rock source and disposal site (Rum Rye/MP 160.41) is located within the Medford Water Commission WHPA.

[82] Included in Pacific Connector's application to the FERC as Appendix F.2 of Resource Report 2.
[83] According to the ODEQ water quality mapping and GIS data page, for security reasons, the agency restricts access to the GIS layers with latitude/longitude readings of wells, springs and intakes (ODEQ 2017e).

TABLE 4.3.1.2-1

Wellhead Protection Areas Crossed by the Pacific Connector Pipeline Project

Starting Milepost	Ending Milepost	County	Public Groundwater Source Area	Public Drinking Water System ID
3.41R	6.79R	Coos	Kentuck Golf Course	4190858
195.13	196.15	Klamath	Production Metal Forming, Inc	4195058
197.43	197.77	Klamath	Timber Resource Services	4193994
198.45	199.62	Klamath	Collins Products LLC	4193995
199.21	199.70	Klamath	Columbia Plywood Corp	4194403
200.53	200.65	Klamath	Crossroads Mobile Home Park	4100446

There are also numerous private wells located along the pipeline route that are exempt from water rights permitting and the locations are not known. To identify these unmapped wells, Pacific Connector would ask the property owners to identify their wells and the water use. For wells located within 200 feet of the construction disturbance, Pacific Connector would implement its *Groundwater Supply Monitoring and Mitigation Plan*. Table 4.3.1.2-2 lists the seven private wells within 200 feet of the construction work area for which location information was available (OWRD 2017).

TABLE 4.3.1.2-2

Private Wells Within 200 Feet of Construction Work Space for the Pacific Connector Pipeline Project

Milepost	Permit Number	Use	Distance to Construction Area (feet)
190.8	10354	Irrigation	85
201.1	15997	Supplemental Irrigation	116 a/
202.5	15120	Irrigation	175
203.8	15818	Irrigation	31
205.7	15134	Irrigation	118
217.3	3957	Irrigation	62
NA	15245	Industrial	55 b/

a/ Well located 50 feet of a temporary extra work space
b/ Well located 55 feet from Millington 1 Yard

Impacts and Mitigation

Construction activities such as; grading, trenching, dewatering, and backfilling could cause minor fluctuations in shallow groundwater levels, increase turbidity within shallow groundwater and alter the flow path of springs and seeps.

As described previously, approximately 26 miles of the pipeline route would cross areas where groundwater can be found at or very near the surface. In areas with a high groundwater table where standard dewatering may be insufficient, Pacific Connector may use “push-pull” or “float” techniques to install the pipeline. While the installation of trench breakers and trench dewatering by pumps to an upland area may be feasible for small areas of seasonally high groundwater, we note that some of these shallow groundwater areas could extend over 1.6 miles (see table H-4 in appendix H). For longer stretches of the pipeline route, trench dewatering through a well point pumping system with a groundwater treatment plan (such as controlled discharging to a straw bale structure or filter bag) may be required. Dewatering may locally lower the groundwater table and alter flow paths; however, these impacts would be temporary, and the dewatering typically occurs over a few days. If there are wells, seeps, or springs near the dewatering activities, they would be monitored for effects in accordance with Pacific Connector's *Groundwater Supply Monitoring and Mitigation Plan* (described below).

Near-surface soil compaction caused by heavy construction vehicles could reduce a soil's ability to absorb water, which would affect infiltration/groundwater recharge rates and could affect underlying groundwater flow and quality. To reduce these impacts excavated topsoil and subsoils would be segregated within wetlands, agricultural areas, and at the request of landowners, and returned as closely as practical to their original soil horizon and slope position. Following construction, restoration of compacted soils would include regrading, recontouring, scarifying (or ripping), and final cleanup activities. Decompacting soils would restore water infiltration, reduce surface water runoff, reduce erosion, and support revegetation efforts.

There are 116 sites with cleaned-up, potential, or confirmed soil and/or groundwater contamination within 0.25 mile of the pipeline route where there is the potential to encounter contaminated soil or groundwater during construction. The potential to encounter previously contaminated soils and groundwater is evaluated and discussed in the Contaminated Soils and Groundwater section under section 4.2.2.3.

A spill or inadvertent release of equipment-related fluids could adversely affect underlying groundwater quality and use. To reduce the potential for a spill or inadvertent release, Pacific Connector would implement numerous measures as described in its SPCC Plan.[84] These measures include, but are not limited to:

- regular inspection of containers and tanks;
- use of secondary containment of fuel storage tanks and hazardous materials containers 55-gallons or greater;
- implementation of emergency response procedures, including spill reporting procedures; and
- use of standard procedures for excavation and off-site disposal of any soils contaminated by spillage.

Prior to construction, Pacific Connector would include in the SPCC Plan the types and quantities of hazardous materials that would be stored or used during construction. Project personnel would be trained and prepared to demonstrate their ability to implement the SPCC Plan to federal, state, or local inspectors.

In addition to the SPCC Plan, Pacific Connector would implement the measures described in its *Contaminated Substances Discovery Plan* (Appendix E to the POD [appendix F.10 of this EIS]) to address an unanticipated discovery of contaminants during construction. As described previously, this plan outlines practices to protect human health and worker safety and measures that would be taken to prevent further contamination.

As described in section 4.1, Pacific Connector has identified numerous locations where blasting may be required for pipeline installation. Blasting could temporarily increase turbidity in groundwater. Pacific Connector has developed a *Blasting Plan* (Appendix C of the POD [appendix

[84] The SPCC Plan was included in Pacific Connector's September 2017 application to the FERC as Appendix B.2 to Resource Report 2.

F.10 of this EIS]) to reduce potential adverse impacts on the environment, nearby water sources, structures, or utilities. As stated in the *Blasting Plan*, licensed blasting contractors would conduct the blasting activities in accordance with all applicable federal, state, and local regulations. Pacific Connector would obtain all necessary permits if blasting is required.

Constructing the Project could affect springs, seeps, and wells. Depending on the location of a well, spring or seep relative to the pipeline, the flow of the feature could be temporarily or permanently affected. These resources could be redirected and experience changes in quantity and quality. To reduce potential impacts, prior to construction, Pacific Connector would implement the measures described in its *Groundwater Supply Monitoring and Mitigation Plan.* Landowners would be supplied with documentation that explains the proposed pipeline construction methods, and outlines the pre-construction field investigation for the identification and monitoring of groundwater supplies. Pre-construction surveys would be conducted to confirm the presence and locations of all groundwater supplies for landowners within and adjacent to construction workspace. In addition, during easement negotiations, the landowner can work with Pacific Connector on siting the alignment to increase the distance between the pipeline and any springs or wells. Pacific Connector would conduct post-construction sampling if requested by the landowner or in disputed situations to determine the effects of construction, if any, on the groundwater supply. The landowner would be provided with a point of contact with Pacific Connector to report potential problems with wells, springs, and seeps believed to be the result of construction. If a groundwater supply is affected by the Project, Pacific Connector would work with the landowner to provide a temporary supply of water; if determined necessary, Pacific Connector would provide a permanent water supply to replace affected groundwater supplies (restore, repair, or replace). Mitigation measures would be coordinated with the individual landowner to meet the landowner's specific needs and be specific to each property.

Operation of the aboveground pipeline facilities would include connections to fixed belowground pipes. Pacific Connector would conduct monitoring in accordance with the DOT requirements during operations to reduce the potential of corrosion and leaks that could affect groundwater. Additionally, Pacific Connector would implement BMPs as detailed in the ECRP and SPCC Plan to avoid, reduce, and mitigate the spill of any hazardous substances that could affect shallow groundwater and/or unconsolidated aquifers.

4.3.1.3 Conclusion

The effects of the Project on groundwater would primarily be temporary. However, based on the characteristics of underlying groundwater, the Applicants' proposed construction and operations procedures and methods, and their implementation of impact minimization and mitigation measures, we conclude that constructing and operating the Project would not significantly affect groundwater resources.

4.3.2 Surface Water

The surface waters in the Project area include marine waters along the shipping route within 3 nautical miles of the coast, Coos Bay, and adjoining surface waters, and streams crossed by or near Project facilities extending from Coos Bay about 229 miles to the connecting point of the proposed pipeline in Klamath County in eastern Oregon. State and federal laws and regulations that will affect Project actions related to surface waters are discussed in section 1. Waters having special status relative to some of these laws and regulations are discussed below. The discussion is separated into two sections, the first dealing with effects on waters from actions relating to the development and operation of the Jordan Cove LNG Project and the second addressing actions related to the development and operation of the Pacific Connector pipeline.

4.3.2.1 Jordan Cove LNG Project

The Jordan Cove LNG Project would be located in Coos Bay, Oregon. Coos Bay is a major coastal estuary with a surface area of about 12,380 acres at mean high water. Coos Bay is fed by about 30 tributaries, including the Coos River, Millicoma River, Catching Slough, Isthmus Slough, Pony Slough, South Slough, North Slough, Kentuck Slough, and Haynes Inlet. The estimated average annual discharge at the mouth of Coos Bay is 2.2 million acre-feet of fresh water (Roye 1979). The Coos Bay watershed covers an area of approximately 739 square miles of Oregon's southern coastal range and is included in the larger South Coast Watershed Basin (ODEQ 2012b).

The existing Federal Navigational Channel is used by recreational, fishing, and major transport vessels to access multiple locations within Coos Bay from the open ocean and coastal marine waters. Four areas adjacent to the Federal Navigation Channel would be modified (see section 2 of this EIS) and used by LNG carriers transiting to the Jordan Cove LNG Project. Between the existing navigation channel and the terminal marine slip, Jordan Cove would create a new access channel. The Oregon Institute of Marine Biology (OIMB) sampled physical oceanographic data in Coos Bay, near the proposed location of the terminal access channel, from August 2009 through December 2010 (Shanks et al. 2010, 2011). The OIMB data set included salinity, temperature, and Chlorophyll a. The OIMB data show there is little variation exhibited in salinity during the tidal cycle, but slightly lower salinity levels occur during low tides and slightly higher salinity levels during high tides. In contrast, temperatures are markedly higher during low tides than high tides. In effect, the results of the OIMB sampling program indicate that there is a great amount of seasonal, but only moderate daily, variability in the physical oceanographic data of the waters of Coos Bay near the Jordan Cove LNG Project.

Impact and Mitigation

The potential impacts and mitigation associated with the construction of the Jordan Cove LNG Project and LNG carrier traffic are related primarily to Project-related dredging, stormwater management, carrier travel, and carrier water use. The effects are related to increases in turbidity, suspended and deposited sediment, bottom and shoreline erosion, toxic substance releases, and water temperature changes.

Jordan Cove would not use surface water sources during construction[85] or operation of the terminal, and all waters discharged from the site would be treated prior to release, including decant water[86] returning from on-land dredge deposits. Permits would be obtained for all wastewater discharges as required by ODEQ. A more detailed presentation of water supply needs for both construction and operation is provided in section 4.3.1.1 and table 4.3.1.1-1.

[85] Water from Coos Bay would be included with estuarine dredged bottom sediment transported to land storage areas; no reduction in Coos Bay water volume would occur from this water use.

[86] Water that is included with dredge bottom material from the bay that goes to on-land deposition areas will be held until sediment settles before it is returned to the access slip or adjacent bay areas. ESCP procedures will be implemented to meet turbidity discharge standards.

There are no process water discharges anticipated from the liquefaction process. There would be some wastewater discharges from the oil-water separators that would be directed to the IWWP. There are no anticipated changes to water quality in Coos Bay from the release of wastewater from the Jordan Cove LNG Project.

The ODEQ's Integrated Report includes Coos Bay on the Section 303(d) list of waterbodies not meeting the criteria for shellfish growing since 2004, due to elevated fecal coliform measurements. Coos Bay is listed as Category 5, water quality limited, and a Total Maximum Daily Load (TMDL) is needed (ODEQ 2012c). Wastewater generated during construction and operation of the Jordan Cove LNG Project would be treated by the City of North Bend's wastewater treatment system via a new industrial wastewater sewer line, and therefore the Project is not likely to add fecal coliform to Coos Bay.

Turbidity and Sedimentation

Dredging and construction activities at the Jordan Cove LNG Project would result in temporary increases in turbidity and sedimentation in Coos Bay. Details on marine facility construction, including dredging activities, are provided in section 2 of this EIS. Dredging activity, primarily associated with slip, access channel, temporary material barge berth, MOF, and marine waterway modifications would be the major sources of turbidity and suspended sediment in Coos Bay. The construction of the marine slip would have most of the slip dredging separated from the bay by an earthen berm and would not affect bay turbidity. Other sources of turbidity would include a dike rock pile apron, Trans-Pacific Parkway/U.S. 101 intersection widening, Kentuck Slough development, and various construction-related tailing lines placements.

All work in the bay would be done during the ODFW recommended in-water window between October 1 to February 15[87]. Within the access channel, dredging would be conducted using a preferred hydraulic (e.g., suction) dredge with a cutterhead or secondary method of mechanical (e.g., clamshell) dredge. The Applicant has indicated that the hydraulic cutter suction dredge is their preferred dredging method (due to the lower turbidity that would be generated) and would be used as the primary method; however, the mechanical dredge would need to be used in certain locations due to the presence of buried woody debris or other materials in the substrates that could not be removed using hydraulic methods (e.g., the mechanical dredging methods would be used in parts of the access channel near the shoreline and along the proposed modifications to the marine waterway). Dredged material from the access channel would consist of dense sand, some gravel, and traces of silt. The navigation channel bottom area to be dredged consists primarily of sand and, depending on location, some siltstone and sandstone below surface sand (see *Dredged Material Management Plan*[88]).

Jordan Cove commissioned modeling efforts to estimate the range of turbidity and suspended sediment that would result from Project-related dredging (Moffatt and Nichol 2006, 2017c). The models were developed based on a sediment analysis conducted at the site of the dredging and took into consideration wind, tidal currents, and seasonal flows and were developed without inclusion of potential turbidity control measures that could be implemented such as those described in dredging pollution control plans (Jordan Cove LNG 2019b, 2019d). Moffatt & Nichol (2006)

[87] Based on their draft EIS comments of July 3, 2019, ODFW will require that the in-water work window in the slip area be changed to October 1 to January 31 to accommodate unlikely eulachon spawning.
[88] Included as Appendix N.7 of Resource Report 7 as part of Jordan Cove's September 2017 application to the FERC.

indicated that constructing the access channel via mechanical dredging would result in a maximum concentration of turbidity of 600 to 6,000 mg/l depending on tidal velocity, decreasing substantially farther away from the site. The latest model (i.e., Moffat & Nichol 2017c) addresses suspended sediment concentrations from the proposed dredging operations. Constructing the slip and access channel would result in suspended sediment that would exceed about 20 mg/l over background levels within about 0.2 to 0.3 mile of the dredging site and exceed about 400 mg/l within about 0.1 mile with either dredging method (clamshell or cutter suction dredge) (Moffat & Nichol 2017c). Moffat & Nichol (2006) model estimates found that, depending on current velocity, peak suspended sediment concentrations with clamshell dredging ranged from about 500 to 6,000 mg/l at the dredge site, decreasing to less than 50 mg/l within about 0.1 mile. Hydraulic dredging would result in lower values ranging from about 250 to 500 mg/l at the dredging site, decreasing to less than 14 mg/l in less than 0.1 mile.

Moffat & Nichol (2006) noted maximum concentrations outside of the specific dredge location would only occur for about 2 hours or less over the daily tidal cycle with the plume moving upstream or downstream of the dredge site on flood or ebb tide, respectively. Moffatt & Nichol (2006) indicated that due to this limited period of elevated suspended sediment in any site-specific area of the plume, other than the actual dredge area, average daily turbidity levels would remain near background values for the mechanical dredge at the slip during active dredging.

Turbidity models for both construction and maintenance of the four Marine Waterway Modifications areas were developed using the three possible dredging methods. Generally, suspended sediment levels would be similar to those modeled for the access channel, but distribution of sediment plumes would be more extensive. The cutter suction dredge would generally have lower concentrations of sediment than other options, but the overall maximum distribution of areas over background suspended sediment (about 20 mg/l) would be similar, averaging about 1.2 miles[89] from the specific active dredging site of the four channel expansion areas with any dredging methods. Turbidity levels and distribution would be similar for both construction or maintenance dredging. Overall levels of peak concentration dependent on method used, with cutter suction the lowest and hopper dredge the highest. Areas of high concentrations, over about 500 mg/l based on averages of the four main channel dredged areas, would generally extend about 0.1 mile from the dredge site for cutter suction and clamshell dredges and less than about 1.0 mile for hopper dredge, based on figures of elevated turbidity distribution presented in Moffat & Nichol (2017c). Based on the Moffat & Nichol (2006) model of the access channel dredging, it would be expected that these peak levels would be short lived at any specific location. Given that, as noted above, tides would move the location of the sediment plume, higher concentrations in any location, other than near actual dredge location, would only last about 2 hours.

The model of the Eelgrass Mitigation site (Moffat & Nichol 2017c) assumed an excavator would be used, which would result in a confined area of elevated suspended sediment extending less than 0.1 mile from point of dredging, and would be less if the preferred hydraulic dredge is used. The more limited effect of tidal flow over the area would help confine the distribution of the elevated sediment plume. These elevated levels would be short term and highly localized to the nearshore area, likely returning to background levels in less than a day after dredging stopped.

[89] Plume distance noted includes total spread both upstream and downstream of dredge site.

As noted above, sedimentation and turbidity would be higher during clamshell dredging than during hydraulic dredging operation. Clamshell dredging is also proposed for maintenance dredging of the slip and access channel, and potential effects are discussed below. Construction and maintenance dredging at the four marine waterway modification areas would be done via hydraulic dredging (cutter suction or hopper) or clamshell dredging, or a combination of these. Hydraulic placement of materials at the upland sites (e.g., APCO Sites 1 and 2, and Kentuck project site) is the preferred method for dredging including material transport with temporary subtidal dredge material transport pipelines (see *Dredged Material Management Plan).*

In addition to several structural actions taken to reduce turbidity, like dredging behind a berm and allowing settling of decant return water to state-required levels before return to the bay, the Applicant has indicated several operational controls that may be implemented as needed to reduce the chance of elevated turbidity exceeding state considered unacceptable levels. These controls include:

- decreasing cutter head speed, decreasing suction flow rate, using different size or type of dredge, lowering crest elevation, and/or avoiding stockpiling during peak ebb conditions;
- scheduling or phasing work activities and duration;
- preventing resuspension of sediment;
- no dumping of partially full buckets in the bay;
- adjusting volume or speed of loading or suction where applicable; and
- limiting the number and location of bay access events with equipment.

As discussed above, the modeling conducted by Moffatt and Nichol (2017d) was done to determine the potential effects of all proposed actions including slip and access channel excavation, marine waterway modifications, and Eelgrass Mitigation site dredging on flow hydraulics in the bay. Construction in these areas would produce no or negligible impacts on overall tidal flow, tidal range, current velocity, and circulation in Coos Bay. Additionally, the result of the tidal flow circulation modeling and analysis predicts that there would be localized velocity reduction as well as localized small increases in velocity in portions of the bay. These would include slight velocity increases near the pile dikes at the western corner of the access channel. The planned construction of the new pile dike rock apron is intended to moderate local velocity changes that may affect erosion. The deepening of the channel near the mouth of the bay (NRI 1 channel deepening area) at the entrance turn also appears to have resulted in locally increased currents to the north in Log-Spiral Bay. However, the model did not include effects of ocean waves that influence current velocity in this outer region of Coos Bay. Overall the effects of Project actions on the Coos Bay tidal prism were unsubstantial, and effects on tidal current velocity changes were also negligible except for a few localized areas.

Using available information on Coos Bay characteristics and the output from the hydrodynamic model, the MIKE-21 sediment transport simulation model was used to determine Project channel modification effects on the rate of sedimentation in the bay (Moffat and Nichols 2017e). The model found that overall sedimentation shoaling rates in the navigation channel within the bay would not change, although there were some local changes associated with project-related actions including a slight increase in deposition by the constructed MOF and some erosion sedimentation on the western side of the slip. While some changes in sedimentation were predicted near the two northernmost pile dikes, the projected changes in this area and rest of the bay from the Project actions were within the natural range of sedimentation rate variability.

Based on the turbidity modeling conducted for both construction and maintenance dredging, without consideration of potential turbidity control methods being implemented, the effects of maintenance dredging and disposal are predicted to be localized and relatively short term, likely lasting less than a day after dredging stops. Effects of maintenance dredging on suspended sediment concentrations and distribution in the slip, access channel, and Federal Navigation Channel would be similar to those discussed for the respective type of dredging methods used (Moffat & Nichol 2017c). However, the duration would be shorter for maintenance as less material would be removed than during construction.

Propeller wash from LNG carriers and tug boats associated with the Project, as well as ship wakes (waves) breaking on shore, could increase erosion along the shoreline and resuspend loose sediment along the shallow shoreline area, resulting in temporary increases of turbidity and sedimentation in the bay, both of which would affect water quality. The effects of these actions relating to sediment, bottom disturbance, and wave actions on marine aquatic resources are discussed in section 4.5 of this EIS.

Jordan Cove developed two models to assess propeller wash effect along the channel (Moffat & Nichol 2008; Coast and Harbor Engineering [CHE] 2011). The Moffat & Nichol (2008) model indicated propeller wash–induced bottom velocity along most of the main channel would be similar to the maximum velocity of peak tides (about 4 feet per second [fps]) whereas the CHE (2011) model indicated higher bottom velocities (13 fps) but in a very narrow range (about 80 feet wide). Both models, however, indicated that along most of the route, because the bottom of the channel consists of coarse materials (sand and sandstone), bottom material suspension would be limited and would settle rapidly, and elevated turbidity would be unlikely to occur. Moffat & Nichol (2008) estimated that near the docking location (about 0.5 mile), estimated bottom velocity would increase to about 7 to 8 fps. Some increased bottom scour and locally elevated turbidity may occur in this area, but the effects would be limited in dimension. This disturbance would occur below the intertidal area. CHE (2011) also modeled likely bottom disturbance from existing large vessel transit (assumed 106 round trips [212 channel passages] annually) in the bay and found that bottom velocity from these would be slightly greater than that of the LNG carriers (projected 120 round trips [240 channel passages] annually) so LNG effects on disturbance would be less than existing vessel traffic.

An additional model by Moffat and Nichol (2017g) estimated potential for scour and elevated turbidity while carriers are berthing and unberthing at the access channel and slip. The model assumed the LNG carrier engines and propeller would be used in addition to that of tugs for this action. While berthing had low potential for scour, unberthing, with the use of LNG carrier propeller engagement, could cause high potential for scour in the access channel and slip area. They estimate that maximum bottom velocity could be about 13.6 fps during unberthing, but less than 5.4 fps during berthing in the slip and access channel. They estimated that scour depth, with a substrate consisting of mostly medium size sand, could be up to 0.46 foot in the eastern portion of the access channel. Overall, about 12 acres of bottom could be scoured to a depth over 0.2 foot in general on a periodic basis. The bank areas of the slip would be armored, which would prevent scour there. Likely plumes of turbidity could occur briefly near the slip and access channel primarily near the bottom during the period of unberthing. The turbidity increase would be local and settle once the propellers stopped.

Jordan Cove modeled the likely effects of LNG carrier traffic on shoreline waves (Moffatt and Nichol 2017f). Wave height effects were evaluated from the access channel and slip to the mouth of the navigation channel. Moffat & Nichol estimated that the existing large bulk carriers would cause shoreline wave heights of about 0.3-0.6 foot under existing conditions. The LNG carrier transit wave height would be less under proposed channel changes, about 0.2 to 0.3 foot. These vessels' induced waves would likely occur for about 106 bulk carrier and 120 LNG carrier round trips a year CHE (2011). Tug vessels traveling at the same speed as LNG carriers would have similar wave height, but when tug vessels depart Coos Bay to bring in large vessels they may travel at about 10 knots, resulting in shoreline wave heights of about 0.5 to 0.8 foot. Day-to-day natural wave heights near the more protected bay area near the slip entrance are about 0.3 to 0.4 foot, while under windy conditions, much of Coos Bay's shoreline would have shoreline waves of 0.8 to 0.9 foot, and under severe storms even the area near the slip entrance would have wave height of about 2 feet (CHE 2011). Wave actions could also affect local turbidity. CHE (2011) estimated that, considering the annual frequency of LNG carriers, shoreline sediment transport potential may increase by 5 to 8 percent and, considering natural range of variable wave energy, would be unmeasurable. Considering these waves would be mostly in the range of natural conditions and the shoreline is a naturally high energy area, changes to turbidity would likely be minor as well. This model assessment did not, however, consider higher speed tug transit. The tug vessel trips at these higher speeds would be about equal to LNG carrier entries (about 120 channel round trips) but may not all be made at speeds as high as 10 knots. Each vessel passage would generate some form of wave for about 15 minutes (CHE 2011), with the peak wave period much less in duration. This compares to a natural wave frequency that would last much longer (e.g., hours or days). The induced waves from these additional vessels, with the possible exception of outgoing tugs, would have an unsubstantial effect on shoreline erosion and local elevation of turbidity as they are well within the naturally occurring, wind-generated wave heights (CHE 2011). The NMFS has concerns that higher vessel speeds may adversely increase shoreline erosion and fish stranding, potentially adversely affecting marine habitat. The NMFS recommended that vessel speeds not exceeding 8 knots within Coos Bay would be more protective. The FERC does not have the regulatory ability to dictate operational speeds of LNG carriers or tugs; however, the independent carrier operators would be required to follow all Coast Guard requirements regarding the operation of LNG carriers, including carrier speeds.

Spills or Leaks of Hazardous Materials

Project-related fluids that enter Coos Bay could affect state water quality standards. During construction of the Jordan Cove LNG Project, stormwater runoff could transport sediment and hazardous materials into Coos Bay. The introduction of sediment into Coos Bay would increase turbidity and sedimentation as discussed above and the introduction of hazardous materials would affect local water quality. To reduce stormwater runoff, construction activities would be conducted in compliance with the State of Oregon's General NPDES permit (1200-C). Additionally, stormwater runoff would be managed in accordance with a site-specific SPCC Plan. Stormwater collected in areas that have no potential for contamination would be allowed to flow or be pumped to ditches that ultimately drain to the slip or Coos Bay. Stormwater collected in areas that are potentially contaminated with oil or grease would be pumped or would flow to the oily water collection sumps. Collected stormwater from these sumps would flow to the oil-water separator packages before discharge to the IWWP. Jordan Cove would apply for a new NPDES permit for this discharge prior to Project initiation. No untreated stormwater collected in areas that are potentially contaminated with oil or grease would be allowed to enter federal or state surface waters.

An inadvertent release of construction equipment–related fluids (fuel storage, equipment refueling, and equipment maintenance) could adversely affect water quality in Coos Bay. As described previously, Jordan Cove has prepared a site-specific SPCC Plan. The purpose of this SPCC Plan is to reduce the potential for accidental releases of hazardous materials and to establish proper protocols for minimization, containment, remediation, and reporting of any releases that might occur. Jordan Cove's proposed measures to reduce the risk of hazardous material spills and reduce impacts should a spill occur (which apply Project-wide, including along the pipeline) include, but are not limited to:

- establishing training requirements for all employees handling fuels and other hazardous substances;
- providing storage location requirements for all hazardous substances, including chemicals, oils, and fuels, of a minimum of 150 feet from a waterbody or wetland boundary;
- requiring overnight equipment parking or any refueling operations to be located a minimum of 150 feet from a waterbody or a wetland boundary;
- requiring containment or diversionary devices for any container with a capacity of 55 gallons or larger, and providing discharge prevention measures like dikes, retaining walls, curbing, weirs, booms, diversion ponds, retention ponds, and absorbent materials;
- stipulating all secondary containment systems be capable of containing a volume equivalent to the largest container plus sufficient freeboard for precipitation (i.e., 110 percent); and
- providing for inspections to ensure no visible sheen is present on accumulated stormwater in containment systems, and the condition documented, prior to discharge.

While a hazardous material spill has the potential for adverse environmental impacts, adherence to the SPCC Plan would greatly reduce the likelihood of such impacts, as well as reduce the resulting impacts should a spill occur. As such, significant adverse impacts on surface water due to contamination from hazardous material spills or releases are not expected to occur.

Numerous commenters expressed concern about the impacts of an LNG spill into Coos Bay. If LNG spilled or leaked, it would turn to vapor when exposed to the warmer atmosphere, and these vapors would rise as they would be lighter than air. LNG is not soluble, would not mix with water, and would not contaminate surface water. Spills or releases of fuel or other oils into surface waters from LNG carriers are more likely to occur during fueling or bunkering at the dock when the materials are being transferred onto the carrier.

In compliance with guidelines outlined by the International Maritime Organization (IMO) under the Marine Environmental Protection Committee, vessels with 400 gross tonnage and above, like LNG carriers, are also required to develop and implement a Shipboard Oil Pollution Emergency Plan, which includes measures to be taken when an oil pollution incident has occurred or a ship is at risk of one. With the implementation each LNG carrier's shipboard oil pollution emergency plan, impacts resulting from the spill of fuel, or oil, or other hazardous liquids would be reduced.

Temperature, Chemical, and Biological Effects

While berthed, LNG carriers would release ballast water and engine cooling water into the marine slip. No wastewater would be discharged from the LNG carriers into the slip. The LNG carriers may arrange with licensed private entities for refueling, provisioning, and collection of sanitary and other waste waters contained within the carrier. The licensed private entities would transport the waste to a permitted treatment facility. Discharges from vessels are subject to regulation by EPA. EPA currently regulates these discharges via the Vessel General Permit.

Once arriving in Coos Bay, LNG carriers at the terminal slip would discharge ballast concurrently with the LNG cargo loading. The amount of ballast water discharged must, at a minimum, be adequate to maintain the LNG carrier in a condition of positive stability and with an adequate operating draft while the LNG cargo is loaded. Each LNG carrier would discharge approximately 9.2 million gallons of ballast water during the loading cycle to compensate for 50 percent of the mass of LNG cargo loaded.[90]

The LNG loading rate is designed to be 10,000 m^3/hr (with a peak capacity of 12,000 m^3/hr), or 4,600 metric tons per hour (t/hr) (5,520 t/hr peak); consequently, the ballast water discharge rate would be approximately 20,250 gallons per minute (gpm). The typical ballast water discharge port is approximately 3.5 to 4.2 square meters covered by a screen with 4.5 mm bars, spaced every 20 to 25 mm.

LNG carriers and marine barges utilized for this Project must meet the requirements of the EPA and Coast Guard regulations. Coast Guard regulations (33 CFR 151, subpart D and 46 CFR 162.060 on "Standards for Living Organisms in Ships' Ballast Water Discharged in U.S. Waters; Final Rule" [77 FR 17254 (Mar. 23, 2012)] and Navigation and Vessel Inspection Circular 01 18) provide guidance to the maritime industry and Coast Guard personnel relative to the implementation of Ballast Water Management (BWM) system requirements. These governing regulations apply to all vessels that enter or operate within U.S. waters and are equipped with a ballast water system that has been approved by the Coast Guard and meets the applicable ballast water discharge standards.

The Coast Guard regulations require the same discharge standards as the IMO regulations, but the Coast Guard regulations also contain some requirements pertaining to a ship's operational procedures that are additional to the IMO's regulations (DNV GL 2018). These include the following:

- ballast tanks must be cleaned regularly to remove sediments;
- when retrieved, anchors and chains must be rinsed;
- fouling must be removed from the hull, piping, and tanks on a regular basis;
- a BWM Plan that includes the above in addition to BWM must be maintained (however, there is no requirement that the BWM Plan be approved);

[90] One cubic meter of LNG is 0.46 metric tons (t), which for the maximum size of LNG carrier authorized to call on the LNG terminal (148,000 m^3) would be 68,080 t of LNG per ship. Assuming 1 t of seawater is 1.027 m^3, the amount of seawater ballast discharged (50 percent of the weight of the LNG loaded) would be approximately 34,959 m^3 (approximately 9.2 million gallons).

- records of ballast and fouling management must be maintained; and
- a report form must be submitted 24 hours before calling at a U.S. port.

The EPA has additional requirements for periodic sampling, including calibration of sensors, sampling of biological indicators, and sampling of residual biocides.

The Coast Guard requires that vessels equipped with ballast tanks and bound for ports or places in the United States (except for the Great Lakes), regardless of whether the vessel operated outside the Exclusive Economic Zone (EEZ), submit the ships' BWM information to the Coast Guard no later than 6 hours after arrival at the port or place of destination, or prior to departure from that port or place of destination, whichever is earlier.

In 2017, the International Convention for the Control and Management of Ships' Ballast Water and Sediments developed measures that must be implemented to reduce the potential for introduction of non-native species through ballast water. These measures have since been adopted by the IMO and are required to be implemented in all ships engaged in international trade. While the open sea exchange of ballast water has been used in the past and reduces the potential for non-native species introductions, on-board ballast water treatment systems are more effective at removing potential non-native species from ballast water. There are two different standards that ships must meet. All new ships must meet the "D-2" performance standard, which establishes the maximum number of viable organisms allowed to be discharged in ballast water. Conformity with the D-2 standard requires ships to utilize on-board ballast water treatment systems. Existing ships that do not currently have on-board ballast water treatment systems must continue to, at a minimum, conduct open sea exchanges of ballast water ("D-1" standard). Eventually, all ships will be required to conform with the D-2 standard. The timetable for conformity with the D-2 standard for existing ships is based on the date of the ship's International Oil Pollution Prevention Certificate renewal survey, which occurs every five years (IMO 2017). Therefore, most ships calling on the Project, estimated to begin in 2023 at the earliest, would be expected to have conformed to D-2 standards.

Any discharge of a pollutant into the navigable waters of the United States requires authorization under the CWA. Although discharges of ballast waters were historically excluded from the CWA, in 2013 the EPA issued a NPDES permit, the General Permit for Discharges Incidental to the Normal Operation of Vessels (VGP). The VGP, effective December 19, 2013, sets numeric effluent limits for ballast water discharges from certain large commercial vessels under a staggered implementation schedule. The standard is expressed as the maximum concentrations of living organisms in ballast water. The permit also includes maximum discharge limitations for biocides and residues.

Coast Guard regulations (46 CFR 162.060) were enacted in June 2012 in an effort to phase out ballast water exchange practices. The ballast water discharge standard (33 CFR 151.2030(a)) requires vessels calling at all U.S. ports to be equipped with a Coast Guard-approved BWM system. This applies to all new ships constructed on or after December 2013. All vessels over 300 gross tons or that have the capacity to discharge 2,113 gallons of ballast water must submit a notice of intent to the EPA requesting authorization under the 2013 VGP.

Discharging ballast water would not substantially affect water quality in Coos Bay. At the point of discharge, the interface with Coos Bay would experience temporary changes in salinity, temperature, pH, and dissolved oxygen. However, these changes to water quality would be highly localized and would quickly dissipate. While open ocean water has generally higher salinity (e.g., 35 practical salinity units [psu]) than typically occurs in Coos Bay (range 16 to 33 psu; Shanks et al. 2010, 2011) due to the high volume of water passing by the loading area, the contribution of ballast water would be only about 0.3 percent of the water passing by the terminal. Therefore, no measurable changes in salinity, other than directly at the discharge port, would occur.

Water temperatures are also unlikely to be significantly altered from release of ballast water. The temperature of the water in Coos Bay undergoes both seasonal and diurnal fluctuations. In December and March, the ocean and fresh water entering the estuary had similar temperatures, around 50°F. In summer, low stream flows results in a rise of temperatures in the bay, to above 60°F in September at NCM 8 (Roye 1979). Based on LNG carrier design, a substantial difference in temperature between ballast water and ambient waters is not anticipated. LNG carriers are constructed with double hulls, which increases the structural integrity of the hull system and provides protection for the cargo tanks in case of an incident. The space between the inner and outer hulls is used for water ballast. Because ballast water is stored in the ship's outer hull below the waterline, discharged water temperatures would not be expected to deviate significantly from ambient water temperatures; rather, it is anticipated that the ballast water would be equilibrated to the surrounding water temperature before being discharged. Therefore, thermal impacts from LNG carrier ballast water discharge would not be anticipated. The pH of the ballast water (reflective of open ocean conditions) may be slightly higher as compared to that of freshwater estuaries; however, this slight variation is not expected to have any impacts on existing marine organisms.

Dissolved oxygen levels are a critical component for the respiration of aquatic organisms. Among other factors, dissolved oxygen levels in water can be influenced by water temperature, water depth, phytoplankton, wind, and current. Typical water column profiles indicate a decrease in dissolved oxygen with an increase in depth. Some factors that often influence this stratification include sunlight attenuation for photosynthetic organisms that can produce oxygen, wind, wave, and current that results in mixing. Water that is collected within the ballast tanks of a ship would lack many of these important influences and could suppress dissolved oxygen levels. However, ballast water that is discharged is not expected to be anoxic (i.e., lacking all oxygen), just lower than what levels would likely be at the surface. In addition, ballast water would be discharged near the bottom of the slip where dissolved oxygen levels may already be lower due to natural stratification. Therefore, no significant impacts are likely to occur as a result of discharging ocean water with potentially suppressed dissolved oxygen levels.

Cooling water flows while at the berth are approximately 11,000 cubic meters per hour (m^3/hr; 2.91 million gallons per hour or 48,000 gpm). For a 148,000 m^3 vessel, this would total approximately 69.7 million gallons while at berth (for 24 hours). Although LNG carriers vary in design, generally the intake port for this engine cooling water is approximately the same size and at the same location as the ballast water intake port and approximately 32 feet below the water line, or 5.6 feet from the keel of the LNG carrier. The size may vary but it is generally 3.5 to 4.2 square meters covered by a screen with 4.5 mm bars, spaced every 25 mm. The engines would be running to provide power for standard hoteling activities as well as running the ballast water pumps.

Using the numerical thermal plume dispersal model from EPA (2003) in combination with the Coos Bay hydrodynamic model (Moffat & Nichol 2017d), Jordan Cove modeled possible slip temperature changes resulting from the discharge of engine cooling water by an LNG carrier. The model assessed the temperature effects of eight different combinations of vessel type, ambient temperature, volume discharged, temperature, and velocity of discharge water were run (Moffat & Nichol 2017h). The modeling results showed that for typical ambient flow conditions the estimated water temperature of the discharged water would be up to about 2 to 3 degrees Celsius (°C; 3.6 to 5.4°F) warmer at the discharge port than ambient water. At about 40 to 80 feet from the discharge port (LNG carrier sea chest), temperatures would not exceed 0.3°C (0.54°F) above the ambient temperature (CHE 2011; Moffat & Nichol 2017h). The model results for the steam turbine power vessels typically were in the upper portion of these distance ranges. This temperature difference would decrease further with distance from the point of discharge. The average water temperature increases for the total slip volume for one day when an LNG carrier using the larger volume (steam turbine vessel) is at dock would range from 0.03 to 0.06°F. Tidal mixing would also decrease maximum slip temperature.

Potential effects of temperature increase from elevated cooling water releases would be further reduced from the cold LNG temperature entering the LNG carrier while at the terminal berth. Because of the extreme differential of the temperature of the cargo in the LNG carrier (-260°F) and that of the surrounding bay water (nominally 50°F), there is a constant uptake of heat by the LNG carrier while loading. This heat uptake is affected by LNG cargo that changes states from liquid to vapor daily. The typical LNG carrier sees 0.25 percent of its liquid cargo converted to the gaseous state each 24 hours, which requires heat uptake from the surrounding environment. It is reasonable to assume that 50 percent or more of the heat uptake by the carrier is extracted from the water during the full 24 hours of stay. Considering the volume of water in the Jordan Cove marine slip (an estimated 384 million gallons), tidal mixing in Coos Bay, and vessel hull cooling from the gas, the release of heated water from LNG carrier engine cooling operations would not substantially increase ambient bay water temperatures. In addition, ballast water discharged from the LNG carrier would also comprise some portion of the water withdrawn for cooling and affected by its discharge. The predicted temperature increases from the release of engine cooling water at the edge of the mixing zone (about 40 to 80 feet from the vessel) is only about 0.5°F above ambient temperature and that increase would be reduced farther away from the LNG carrier. We conclude that the thermal effect of LNG carrier operations at the berth would have very minimal impact on background water temperatures.

Salinity and dissolved oxygen changes from channel morphology modification would not result in substantial change in these parameters in Coos Bay. As discussed above, changes in tidal levels and current velocities in the bay would not occur except in a very limited area by the access channel. Thus, tidal exchange rates, which are a main factor affecting these parameters in the bay, would remain substantially unchanged. In addition, recent models of these parameters by the COE (Port of Coos Bay and COE 2019 [unpublished]) of a much greater main channel dredging activity than the proposed Project in the bay (in regards to scope of dredging) found only slight differences in bay areas (less than 0.7 psu salinity, and less than 0.2 mg/l dissolved oxygen). All dissolved oxygen levels, even during periods of lowest levels, would remain over 7.7 mg/l. Because the scope of Project dredging would be less, we would expect less changes than these model results.

During construction and operation, sanitary wastewater would either be directed to a holding tank and disposed of by a sanitary waste contractor as necessary, or would be treated by a packaged treatment system and directed to an existing IWWP. Discharges of any type would be regulated through NPDES permits. The result is that no hazardous substances, including fecal bacteria, would be discharged to Coos Bay, thus having no effect on bacterial load to the bay.

4.3.2.2 Pacific Connector Pipeline Project

The pipeline, associated workspace, and equipment bridges would be located across 19 Hydrologic Unit Code (HUC) level-5 watersheds (see table 4.3.2.2-1). An additional 5 watersheds would be crossed by the proposed access roads.

TABLE 4.3.2.2-1

Subbasins and Watersheds Crossed by Proposed Pacific Connector Pipeline

	Level 5 Watershed		
Subbasin	**Watershed Name**	**HUC a/**	**Miles Crossed b/**
Coos	Coos Bay- Frontal Pacific Ocean	1710030403	15.3
	South Fork Coos River c/	1710030401	2.1
Coquille	North Fork Coquille River	1710030504	11.5
	East Fork Coquille River	1710030503	9.6
	Middle Fork Coquille River	1710030501	15.9
South Umpqua	Olalla Creek-Lookingglass Creek	1710030212	8.8
	Clark Branch - South Umpqua River	1710030211	13.0
	Myrtle Creek	1710030210	8.9
	Days Creek - South Umpqua River	1710030205	19.2
	Elk Creek c/	1710030204	3.2
	Upper Cow Creek	1710030206	5.3
Upper Rogue	Trail Creek	1710030706	10.7
	Shady Cove - Rogue River	1710030707	8.1
	Big Butte Creek	1710030704	5.1
	Little Butte Creek	1710030708	33.0
Upper Klamath	Spencer Creek	1801020601	15.1
	John C. Boyle Reservoir - Klamath River-	1801020602	5.4
Lost River	Lake Ewauna-Upper Klamath River	1801020412	16.2
	Mills Creek - Lost River	1801020409	23.0
		Total	**229.4**

a/ Hydrologic Unit Code (USGS 1987).
b/ Total miles of watershed area crossed by the pipeline in each HUC, rounded to nearest tenth of a mile.
c/ There are no waterbodies crossed in these watersheds.

The pipeline would be constructed across or near 337 waterbodies. Of the 337 waterbodies, only about 20 percent (68) are identified as perennial streams[91]. Of the remaining affected waterbodies, 257 are intermittent streams (which includes 87 intermittent ditches[92]), 8 are perennial ponds (including stock ponds, an industrial pond, and excavated depressions), and 4 are estuaries. In Coos County, the Project would affect 52 waterbodies, in Douglas County 89 waterbodies, in Jackson County 92 waterbodies, and in Klamath County 105 waterbodies. A table of waterbody crossings, including the proposed crossing method, is included in appendix H (table H-3).

Pacific Connector proposes to use several different methods to install the pipeline across waterbodies depending on site-specific conditions (see section 2). Many of the waterbodies crossed by the pipeline are minor intermittent streams or ditches that are expected to be dry or non-flowing at the time of construction. For all waterbodies without flow at the time of construction, Pacific Connector would utilize standard upland, cross-country construction methods identified in

[91] Perennial streams have flow in some parts all year; intermittent streams carry flow some of the year but cease flowing occasionally or seasonally.
[92] "Ditches" include irrigation canals and laterals, roadside ditches, and pasture ditches.

Pacific Connector's ECRP. Waterbody crossing methods are characterized as dry open cut, wet open cut, diverted open cut, direct pipe, bore, and HDD. Most streams would be crossed with dry open-cut methods using dam-and-pump or flume methods which generally allow trenching across streams in the dry, minimizing potential turbidity. HDD crossings are primarily used on the largest streams and estuarine crossings in the Project area (see table 4.3.2.2-2). Only one diverted open-cut crossing would be done (South Umpqua River, table 4.3.2.2-2). No planned wet open-cut crossing, where pipeline trenching occurs with flowing water present, is planned. However, a wet open-cut crossing method may be required if all other crossing methods are attempted and fail. If a wet open-cut crossing method is required, then additional permitting and impact analysis may be required.

TABLE 4.3.2.2-2

FERC Designated Major Waterbodies Crossed by Pacific Connector Pipeline by County and Fifth-Field Watershed a/

County - Fifth-Field Watershed (Fifth-Field HUC)	Major Waterbody	Approximate Milepost	Water Type	Length of Crossing (feet)	Crossing Type
Coos County - Coos Bay Frontal (1710030403)	Coos Bay	0.28-1.00	Estuarine	3,751	HDD
	Coos Bay	1.46-3.02	Estuarine	8,170	HDD
	Coos River	11.13R	Estuarine	516	HDD
Douglas County - Clark Branch-South Umpqua River (1710030211)	South Umpqua River	71.27	Perennial	200	Direct Pipe
Douglas County - Days Cr. South Umpqua River (1710030205)	South Umpqua River	94.73	Perennial	123	Diverted Open Cut
Jackson County - Rogue River-Shady Cove (1710030707)	Rough River	122.65	Perennial	143	HDD
Lake Ewauna-Upper Klamath (1801020412)	Klamath River	199.38	Perennial	973	HDD

a/ FERC designated major waterbodies are those greater than 100 feet wide at the water's edge at the time of construction.

Oregon Water Quality Regulations and Standards

Section 303(c) of the CWA requires states to establish, review, and revise water quality standards for all surface waters. To comply with these standards, the ODEQ has developed a classification system to describe the highest beneficial use(s) and associated minimum water quality standards of identified surface waterbodies within the state. The Oregon Water Quality Standards include beneficial use(s), fish use designations, narrative and numeric criteria to support the beneficial use(s), and anti-degradation policies. The purpose of the Anti-degradation Policy is to guide decisions that affect water quality such that unnecessary further degradation from new or increased point and nonpoint sources of pollution is prevented, and to protect, maintain, and enhance existing surface water quality to ensure the full protection of all existing beneficial uses. The state-designated beneficial use classifications for the basins crossed by the proposed Pacific Connector pipeline are similar among the basins. They include beneficial uses such as domestic and irrigation and livestock water use (excluding Coos Bay waters), industrial water, fishing and boating, wildlife and hunting, fish and aquatic life, and in some basins navigation and transportation (e.g., Coos Bay), as well as varied other uses.

Each state is required, under Section 305(b) of the CWA, to submit a report to the EPA describing the status of surface waters in the state biennially. Waterbodies are assessed to determine if their use is "fully supported," "fully supported but threatened," "partially supported," or "not supported" in accordance with the water quality standards. A use is said to be "impaired" when it is not supported or only partially supported. A list of waters that are impaired is required by Section 303(d) of the CWA, and it is provided in the 305(b) report (ODEQ 2016). To restore a waterbody to its use classification, a state may elect to impose restrictions more stringent than those normally required by the NPDES or other permitting programs, or even deny a permit for activities that could adversely affect an "impaired" waterbody.

States are also required to develop TMDLs for the impaired waterbodies. TMDLs describe the amount of each pollutant a waterbody can receive and not violate water quality standards. To comply with EPA requirements, the State of Oregon produced a combined report entitled Oregon's 2012 Integrated Report on Water Quality (Integrated Report).

The GIS coverage for the 2010 Integrated Report was reviewed to determine the locations of the water quality limited waters for Water Quality Assessment Categories 4 and 5 to determine if they are in the vicinity of Project components. Based on the ODEQ 2012 Integrated Report GIS coverage, 31 Category 4 and 5 water quality impaired waterbodies would be crossed by the pipeline and are listed in table H-5 in appendix H (ODEQ 2012c).

- TMDLs for the South Umpqua subbasin were completed in October 2006.
- TMDLs for the Upper Rogue subbasin were completed in December 2008.
- TMDLs for the Upper Klamath River, and Lost River subbasins were approved in December 2010.
- TMDLs for the Coos and Coquille Subbasins are currently in progress.

Pacific Connector proposes to cross 26 impaired waterbodies using dry/diverted open-cut crossing techniques. Conventional boring, DP, or HDD methods would be used to cross 5 of the impaired waterbodies.

Contaminated Surface Water or Sediments

As discussed in section 2 as well as sections 4.2 and 4.4 of this EIS, Pacific Connector has BMPs and plans in place to control runoff of any potential hazardous material found at all Project areas including TEWAs, pipe storage sites, hydrostatic test discharge sites, and right-of-way clearing areas. These procedures are intended to prevent unacceptable quantities of material (sediment, toxic substances, oils, concrete water) from entering surface waters. Additionally, sites along the pipeline project route were assessed for their potential to contain hazardous substances.

As discussed in section 4.2, a review of ODEQ's ECSI database and EPA's EnviroMapper - Facility Detail Report indicated there are numerous locations within 0.25 mile of the route (see table G-2 in appendix G) primarily considered pipeline storage sites with either cleaned-up, potential, or confirmed soil and/or groundwater contamination. As noted in section 4.2, many of these sites have the potential to encounter contaminated soil or groundwater during construction. This includes about 12 considered pipe storage sites and three near (but not on) the pipeline route. The FERC has made recommendations that Pacific Connector consult with the ODEQ regarding existing soil and groundwater contamination at these sites (see section 4.2 for the complete list of sites).

Pacific Connector's SPCC Plan is intended to prevent contamination from pipeline activities. Pacific Connector has developed a *Contaminated Substances Discovery Plan* that specifies the measures that would be implemented if unanticipated contaminated soil, surface water, or groundwater are encountered during construction. Some of the measures outlined in that plan include that all construction work in the immediate vicinity of areas where hazardous or unknown wastes are encountered would be halted. The procedures would greatly reduce the risk of hazardous substance entering water bodies along the route.

Additionally, a site with elevated natural mercury levels was found on the originally proposed pipeline route crossing East Fork Cow Creek (MP 109), and concern was expressed that disturbed soil from the crossing could cause human health risk or enter the adjacent stream. Thomason mining claims near East Fork Cow Creek have been determined to have very low concentrations of naturally occurring mercury mineralization (GeoEngineers 2017k). The pipeline route subsequently was rerouted approximately 2,500 feet from where the elevated mercury samples were taken. GeoEngineers (2017k) stated that the soils underlying the currently proposed crossing of East Fork Cow Creek would likely avoid the elevated mercury areas. The ECRP has a number of temporary and permanent erosion control and equipment-cleaning measures to reduce the potential for sediment or contaminated substances to enter wetlands or waterbodies, further reducing potential mercury contamination concerns at this crossing. Additionally, Pacific Connector would implement various site-specific actions at this crossing as recommended by the Forest Service, including:

- Provide 100 percent post-construction ground cover on all disturbed areas. Wood fiber is the preferred material. In addition, construct water bars at 50-foot intervals.
- Ensure that erosion control measures are in place before the fall rains and monitor for rilling, gullying, and other forms of active erosion and issues to improve erosion control measures to preclude sedimentation.
- Inspect the construction corridor for sedimentation after each substantial storm event and, if erosion issues are found, correct them

Drinking Water Source Areas and Public Intakes

As identified in table 4.3.2.2-3, the pipeline would cross or be adjacent to 12 public drinking water source areas (DWSAs) (ODEQ 2012e). In some locations, the pipeline would be located within a particular source area for several miles, but in other locations the pipeline would be located along ridgelines meandering in and out of source areas.

TABLE 4.3.2.2-3

Surface Water Public DWSAs Crossed by the Proposed Pacific Connector Pipeline

Starting Milepost	Ending Milepost	County	Drinking Water Source Area a/	Public Drinking Water System ID	Source Water
20.06BR	35.81	Coos	City of Myrtle Point	4100551	N. F. Coquille River
35.81	41.69	Coos	City of Coquille City of Myrtle Point	4100213 4100551	Coquille River Coquille River
41.69	53.21	Coos	City of Coquille	4100213	N.F. Coquille River
53.21	64.71	Douglas	Winston-Dillard Water District	4100957	S. Umpqua River
64.71 73.37	70.51 74.31	Douglas	Roseburg Forest Products-Dillard	4194300	S. Umpqua River
70.51 74.31	73.37 82.94	Douglas	Clarks Branch Water Association	4100548	S. Umpqua River
82.94	95.41	Douglas	Tri-City Water District	4100549	S. Umpqua River
95.41	102.74	Douglas	Milo Academy Tri-City Water District	4100250 4100549	S. Umpqua River S. Umpqua River
102.74	110.52	Douglas	Milo Academy City of Glendale	4100250 4100323	S. Umpqua River Cow Creek
110.52	124.63	Jackson	Country View Mountain Home Estates	4100808	Rogue River
124.63	124.98	Jackson	Country View Mountain Home Estates Anglers Cove	4100808 4101483	Rogue River Rogue River
124.98	130.07	Jackson	Country View Mountain Home Estates Hiland WC – Shady Cove	4100808 4101520	Rogue River Rogue River
130.07	135.04	Jackson	Country View Mountain Home Estates	4100808	Rogue River
135.04	168.02	Jackson	Medford Water Commission	4100513	Rogue River

a/ The proposed route meanders in and out of Surface Water DWSAs where there are two DWSAs listed.

Table 4.3.2.2-4 lists the public water systems with surface water intakes within 3 miles downstream of waterbodies that would be crossed by the pipeline (ODEQ 2013a).

TABLE 4.3.2.2-4

Surface Water Intakes for Potable Drinking Water Supply

Intake	Public Water System	Source Water for Intake	Waterbody Crossing	Intake Distance Downstream a/	County
4194300	Roseburg Forest Products – Dillard	S. Umpqua River	Rice Creek – MP 65.76 Tributary to S. Umpqua River	0.8 mile	Douglas
4194300	Roseburg Forest Products – Dillard	S. Umpqua River	Willis Creek MP 66.95 Tributary to S. Umpqua River	1.8 miles	Douglas
4100808	Country View Mountain Home Estates	Rogue River	Rogue River MP 122.65	1.4 miles	Jackson
4101483	Anglers Cove Subdivision	Rogue River	Rogue River MP 122.65	Approx. 3 miles	Jackson

Note: All intakes located within 3 miles downstream of proposed waterbody crossings for the Pacific Connector pipeline.
a/ Location of intake downstream from proposed waterbody crossing.

Points of Diversion

Surface water diversions for irrigation, livestock watering, and industry are located within 150 feet of 44 waterbody crossings (see table 4.3.2.2-5).

TABLE 4.3.2.2-5

Points of Diversion within 150 feet of Pacific Connector Construction Work Area

Water Right Type	Water Right Owner	County	Nearest Milepost	Permit/ Certificate Number	Type of Diversion	Diversion Source	Usage Description	Distance to Construction Work Area (feet)	Type of Construction Work Area Containing Points of Diversion a/	Number of Water Rights
Storage	Private	Douglas	60.73	44288	Stream	Perron Creek	Livestock	35.90	-	1
			65.35	T 6708	Stream	South Umpqua River/Reservoir 1	Industrial/manufacturing uses	0.00	Pipe Yards	1
			67.12	R 14589	Stream	Unnamed Stream	Multiple purpose	108.39	-	2
			74.20	69536	Winter Runoff	Runoff/Reservoir 13	Fire protection	0.00	Construction Right-of-Way	1
			74.20	69536	Winter Runoff	Runoff/Reservoir 13	Livestock	0.00	Construction Right-of-Way	1
			75.49	17241	Stream	Sutherlin Creek	Industrial/manufacturing uses	0.00	Pipe Yards	1
			75.49	30362	Stream	Sutherlin Creek	Industrial/manufacturing uses	0.00	Pipe Yards	1
									Storage Total	***8***
Surface Water	Private	Coos	12.07	53679	Stream	Unnamed Stream	Domestic including Lawn and Garden	79.83	-	1
			13.80	36042	Spring	A spring	Domestic	0.00	Construction Right-of-Way	1
			29.48	S 44450	Stream	Stemmler Creek	Domestic including Lawn and Garden	134.81	-	1
			29.48	S 44450	Stream	Stemmler Creek	Livestock	134.81	-	1
			29.86	60877	Stream	East Fork Coquille River	Irrigation	56.92	-	1
			30.00	39940	Stream	East Fork Coquille River	Irrigation	0.00	Construction Right-of-Way	1
		Douglas	49.53	44065	Stream	Lang Creek	Irrigation	109.26	-	1
			58.64	S 54735	Stream	Olalla Creek	Domestic Expanded	117.96	-	1
			67.19	15423	Stream	South Umpqua River	Irrigation	132.51	-	1
			67.19	22390	Stream	South Umpqua River	Irrigation	67.80	-	1
			67.19	23826	Stream	South Umpqua River	Industrial/Manufacturing Uses	0.00	Pipe Yards	1
			70.36	29340	Stream	South Umpqua River	Irrigation	120.06	-	1
			70.36	65231	Stream	South Umpqua River	Irrigation	64.53	-	1
			70.36	68634	Stream	South Umpqua River	Irrigation	64.53	-	1
			75.49	15598	Stream	Sutherlin Creek	Industrial/Manufacturing Uses	0.00	Pipe Yards	2
			75.49	17292	Stream	Camas Swale/Log Pond	Industrial/Manufacturing Uses	0.00	Pipe Yards	1
			75.49	30363	Stream	Sutherlin Cr/Pond	Industrial/Manufacturing Uses	0.00	Pipe Yards	1
			81.23	55163	Stream	South Myrtle Creek	Irrigation	67.96	-	1
			82.27	80544	Stream	South Umpqua River	Irrigation	0.00	Pipe Yards	1
			88.16	43561	Stream	Fate Creek	Irrigation	90.46	-	1
			88.16	52977	Stream	Fate Creek	Irrigation	90.46	-	1
			88.52	56872	Stream	Fate Creek	Irrigation	147.03	-	1

TABLE 4.3.2.2-5 (continued)

Points of Diversion within 150 feet of Pacific Connector Construction Work Area

Water Right Type	Water Right Owner	County	Nearest Milepost	Permit/ Certificate Number	Type of Diversion	Diversion Source	Usage Description	Distance to Construction Work Area (feet)	Type of Construction Work Area Containing Points of Diversion a/	Number of Water Rights
Surface Water (cont.)		Jackson	122.67	34473	Stream	Rogue River	Irrigation	132.95	-	1
			122.83	65482	Stream	Rogue River	Irrigation	22.39	-	1
			145.77	2170	Stream	Little Butte Creek	Irrigation	100.10	-	1
			145.77	2470	Stream	Little Butte Creek	Irrigation	129.80	-	1
			145.77	57753	Stream	North Fork Little Butte Creek	Irrigation	129.80	-	1
			145.82	17215	Stream	North Fork Little Butte Creek	Irrigation	103.16	-	1
		Klamath	199.96	67512	Stream	Klamath River	Fire Protection	23.69	-	1
	State	Coos	22.30	9712	Spring	A spring	Domestic	119.11	-	1
			27.20	60812	Stream	Middle Creek	Irrigation	127.86	-	1
		Douglas	67.19	S 51632	Stream	South Umpqua River/Con 18714	Primary and Supplemental Irrigation	0.00	Pipe Yards	1
			67.30	S 51924	Reservoir	South Umpqua/Galesville	Supplemental Irrigation	0.00	Pipe Yards	1
			70.36	S 52930	Stream	South Umpqua River	Primary and Supplemental Irrigation	0.00	Pipe Yards	1
			71.31	S 51924	Stream	South Umpqua River	Irrigation	0.00	Temporary Extra Work Space	1
		Jackson	128.61	73043	Stream	Indian Creek	Anadromous and Resident Fish Rearing	9.87	-	12
			135.65	41308	Reservoir	Reservoir	Wildlife	100.42	-	1
									Surface Water Total	***49***
									Grand Total	**57**

a/ Dash indicated a facility (e.g., pipe yard, ROW, TEWA) that does not intersect a water right location.

Floodplains

EO 11988 (10 CFR 1022) requires federal agencies to avoid to the extent possible the long- and short-term adverse impacts associated with the occupancy and modification of floodplains and to avoid direct and indirect support of floodplain development wherever there is a practicable alternative. Potential effects of the project located within a floodplain should be evaluated and project design should consider flood hazards and floodplain management. It is reasonable to assume that all watercourses that convey natural flows, whether mapped as floodplains, flood hazard areas, or not, present some level of flood hazard. The flood hazard is not limited to inundation; bank erosion and bed scour (a lowering or destabilization of the channel bed during a flow event) are also hazards that can occur due to flooding.

Portions of the pipeline would be located within floodplains. However, because the pipeline would occupy a very limited space within the floodplain, it would not result in a discernable reduction in flood storage capacity. With the exception of the terminal (which would permanently occupy about 200 acers of floodplain; see section 2) there are no permanent facilities in floodplains and PARs would not substantially impact floodplains. Therefore, the Project is not likely to substantially impact flood attenuation and dispersal in each watershed as a result of the small footprint of the Project within each watershed floodplain.

Nationwide Rivers Inventory

The Nationwide Rivers Inventory lists more than 3,400 free-flowing river segments in the United States characterized as possessing one or more “outstandingly remarkable” natural or cultural values judged to be of more than local or regional significance. The proposed pipeline would cross three rivers that are listed on the Nationwide Rivers Inventory (NPS 2013):

- The **North Fork of the Coquille River** listing includes its headwaters in Section 16, T.26S., R.10W. and extends to the confluence with the South Fork Coquille River in Section 5, T.29S., R.12W. This segment was added to the list in 1993 for outstandingly remarkable fish, wildlife, and cultural (prehistoric Indian sites) values. The pipeline would cross this river segment at MP 23.1.
- The **East Fork of the Coquille River** listing extends from its headwaters in Section 18, T.28S., R.8W. to the confluence with the North Fork of the Coquille River in Section 36, T.28S., R.12W. It was added to the list in 1993 for outstandingly remarkable fish, wildlife, boating and fishing. The pipeline would cross this river at MP 29.9.
- The **South Umpqua River** listing includes the reach from Tiller (Section 33, T.30S., R.2W.) downstream to the confluence with the North Umpqua River at River Forks (Sections 31 and 32, T.26S., R.6W.). This reach was added to the list in 1993 for outstanding and remarkable fish and historical values. The pipeline would cross this section of river in two locations, MP 71.3 and MP 94.7.

Impacts and Mitigation

Impacts resulting from the pipeline’s construction (see section 2 for a description of the pipeline’s construction techniques) would be temporary and would affect crossed waterbodies. Construction actions may affect the following parameters:

- turbidity and sedimentation;
- channel and streambank integrity and stability

- in-stream flow
- risk of hazardous material spills and
- waterbody status and water use related to:
  - Oregon Water Quality Regulations and Standards effects
  - contaminated surface water or sediment effects
  - drinking water sources areas and public intakes effects
  - point of diversion effects
  - National Rivers Inventory effects

To reduce potential adverse impacts along the construction right-of-way and at waterbody crossings, Pacific Connector would implement its ECRP during construction, restoration, and operation of its proposed facilities. This would include installing temporary equipment bridges across perennial or intermittent waterbodies flowing at the time of construction to prevent sedimentation caused by construction and vehicular traffic. The ECRP outlines the erosion control procedures that Pacific Connector would utilize.

Trench spoil excavated from within the waterbody would be placed at least 10 feet from the water's edge or in a TEWA if possible (i.e., if the TEWA can adequately support and store the spoil). Staging areas and additional spoil storage areas would be located at least 50 feet from waterbody boundaries, where topographic conditions and other site-specific conditions allow. Where topographic conditions do not allow a 50-foot setback, spoil storage areas would be located at least 10 feet from the water's edge. Sediment control devices, such as silt fences and straw bales, would be placed around the spoil piles to prevent spoil flow back into the waterbody. Pacific Connector would utilize BMPs as necessary, as discussed in the ECRP, to prevent sedimentation entering into waterbodies or wetlands. Mulch would also be used to apply effective ground cover to reduce erosion potential. "Effective ground cover" is considered to be the amount of cover necessary for maintaining a disturbed site in a low hazard category for erosion. The on-site EI would be responsible for ensuring that designated erosion control measured are properly implemented for the site-specific conditions.

Project-specific stream crossing evaluations have been conducted and crossing procedures and mitigative actions would also be implemented. Pacific Connector conducted an initial assessment of crossing conditions of all streams suitable for this analysis (GeoEngineers 2017d, 2018b, 2018c). GeoEngineers (2017d) applied the FWS's Stream Crossing Screening Matrix to all stream crossings that display fluvial characteristics. This assessment was intended to determine where stream crossings may pose a substantial risk of increasing streambank erosion and streambed instability. GeoEngineers, using a combination of field and GIS data, rated the 173 fluvial pipeline stream crossings based on the matrix (GeoEngineers 2018b). Some streams could not be accessed, and evaluation was based on desktop analysis for those streams. The matrix has two axes rating the crossing based on the potential Project effects on the crossing and the relative stream response at the crossing. Each crossing was rated as low, medium, or high for each of the two axes (all stream crossings were placed into one of nine categories, such as Low–Low, Low–Medium, or Medium–High). Category ratings were based on summing numeric ranking (1=lowest risk to 5=highest risk) for multiple metrics for each of the two axes (see GeoEngineers 2017d for details).

No crossing was rated as having both high risk of Project impact potential (i.e., high risk of Project impacts) and high risk of site response potential (high risk of stream and site response). If any crossing had been in this category, Pacific Connector indicated that a site-specific crossing plan would be developed. Should later assessment of the crossings (see below) find that a crossing is in this category, a site-specific plan would be developed prior to construction and reviewed and approved by FERC.

GeoEngineers (2017d, 2018c) grouped the nine risk categories into five categories based on generally similar risk of streams being affected and labeled these as color management categories (Blue, Green, Yellow, Orange, and Red). The assessments included an initial survey and follow-up surveys that resulted in the current assessment of streams into these categories.

After the follow-up surveys, stream crossings with the lowest stream response potential and a low or moderate project impact potential (94 total) were designated as the Blue category and would be crossed using project-typical BMPs. These project-typical BMPs would be applied to all streams while additional BMPs would be applied to the other crossings depending on their rated category of risk. The remaining stream crossings (79) included 68 Yellow and 11 Orange crossings with some greater risk potential at the crossings than Blue crossings. These two categories would have specific additional BMPs applied in addition to the project typical BMPs with the purpose of protecting stream and bank processes following pipeline installation at sites with this category of potential risks. The details of these category specific actions are described in GeoEngineers (2017d, 2018c). After follow-up survey some additional BMPs were added to some of these streams including seven surveyed Orange category crossings (Middle Creek [MP 27.04], Elk Creek [MP 32.40], Tributary to Big Creek [MP 37.35], Upper Rock Creek [MP 44.21], East Fork Cow Creek [MP 109.47], West Fork Trail Creek [MP 118.89], and South Fork Little Butte Creek [MP 162.45]), and had specific crossing plans developed that designate the types of bed and bank restoration that would occur at each of these sites GeoEngineers (2017b, 2018b). Additional specific actions would occur at some streams on federal lands (see section 4.7 and appendix F).

Substrate characteristics and physical habitat features have been or would be determined through pre-construction surveys[93], and the upper 1 foot of existing substrate would be replaced, and other physical conditions matched during reconstruction after pipe installation. Clean spawning gravel would be top dressed as appropriate, and composition would be based on pebble counts or other appropriate methods on a site-specific basis; this would require review and approval by agency staff prior to implementation. Many of these actions would be determined prior to construction based on results of the pre-construction survey (see below) and determined by a qualified EI specifically trained to determine proper restoration actions to implement based on river channel processes or a suitably trained professional. On non-federal lands, this person would have the authority to select appropriate additional BMP construction methods, bank stability actions, revegetation types and methods to help reduce the risk of instability of the crossing and potential for future erosion (GeoEngineers 2017d, 2018b).

A pre-construction survey[94] would be conducted by a technically qualified team on all stream crossings to confirm and clarify conditions developed in the aforementioned matrix analysis. This would include surveys of sites currently not accessible due to property ownership issues. Following these surveys, if significant changes were to occur to parameters of the risk matrix for

[93] Some stream crossings were not accessible and would be surveyed prior to construction once approval and land owner access agreements are obtained.

[94] Some stream crossing were not accessible and will be surveyed prior to construction once approval and land owner access agreements are obtained

a crossing, changes would be made to risk level and appropriate final methods of crossing and BMPs made at each stream crossing. If any crossing is moved into the "high" project impact and "high" stream response risk matrix category, a site-specific crossing design would be developed for that site. Following the final surveys, special additional BMPs, as described in GeoEngineers (2017d, 2018b), would be implemented depending on individual site conditions and may include such actions as changes in bank material and bank angle modifications, specific substrate composition used, plants used on the bank, artificial stabilizing bank material, rootwad enhancement, type of bed and bank restoration structure, and various other actions.

The approach described above, which would include more site-specific information and possibly more site-specific designs based on the pre-construction survey, is expected to be suitable for the protection of aquatic resources at waterbody crossings. The final procedures would ultimately need to obtain other permit-process approval (e.g., Section 401 water quality certification) before construction is conducted at specific sites.

As a measure to help ensure crossing actions would not adversely affect stream bank and channel structure, Pacific Connector, as part of their pipeline integrity monitoring, would observe all stream crossings, regardless of risk rating category, annually for the life of the Project and note any obvious signs of channel erosion, pipeline exposure, or major shifts in restoration elements. Where any problems were noted during this annual assessment, a follow-up visit by geo-professionals would occur (GeoEngineers 2018b). On a quarterly basis, over two years after construction at all perennial crossings on federal lands as well as the highest risk sites identified on non-federal lands (Orange category), monitoring of vegetation success, stability of restoration elements, fish passage status, channel migration, erosion, head cutting, and other channel characteristics would be conducted. Additional forms of monitoring (e.g., vegetation, animal browse, and continued channel/restoration status) would occur at varied sites over varied intermittent periods over a 10-year period, with the highest frequency and intensity of monitoring effort at those sites of greatest risk of channel and bank instability. Frequency and type of monitoring may be adjusted based on site-specific conditions. In addition, flow and rainfall events would be recorded to understand the response of sites to flow events. Additional monitoring would occur on streams on federal lands. Remediation of adverse conditions with channel stability or habitat found during the monitoring would occur. Reports of the monitoring would be developed for years 1, 2, 3, 5, 7, and 10 after construction describing observations made and any remedial actions taken.

<u>Construction of New TARs, New PARs, Existing Access Roads (EAR), and TEWAs</u>

Construction of roads and facilities have the potential to contribute sediment to streams. Of the existing roads that would be used for construction that would need improvements, approximately 56 road segments would be within 100 feet of streams, with 47 of these directly crossing waterbodies. The total road area that would be within 100 feet of streams and that would be expanded (e.g., widened or turnouts added) include 5.6, 0.15, and 0.68 acres for EARs, TARs, and PARs, respectively.[95] A portion of these areas are within regions with the greatest potential to contribute sediment to streams (see below). All access roads would use the existing crossing facility (e.g., bridge, culvert, ford), except for one that would use a temporary bridge and another with a temporary culvert. It is possible that other crossings may need to be improved or replaced,

[95] Total acres on the road segments that would be widened, not just the area within 100 feet of streams (see Pacific Connector Resource Report 2, Appendix Table A.2-6).

once final plans are developed prior to construction. These crossings would have to be reviewed and approved by the applicable agencies prior to their implementation.

Currently, there are 8 TARs and 11 PARs that would be built in the range of coho salmon–bearing watersheds along the proposed route. Of these, 2 PARs would directly cross streams and 4 TARs and 3 PARs would be within 200 feet of streams in these watersheds. There would be about 23 EAR segments that would be improved (e.g., by widening, resurfacing, or brush removal) that are within 200 feet of coho salmon-bearing streams, 7 of which would directly cross streams. Potential sediment delivery to streams would occur from gravel and dirt roads, either newly built or improved ones. Dube et al. (2004) provided a summary table of distance categories for sediment delivery. The table indicated that where roads directly cross streams all sediment (100 percent) that runs off the road at the crossing would be considered to enter the streams, while potential sediment delivery to streams from road runoff decreases exponentially by distance from a stream. Dube et al. (2004) indicated that, from about 1 to 100 feet from a stream, 35 percent of road runoff would reach a stream; between 100 and 200 feet about 10 percent; and beyond 200 feet, no runoff would be considered to reach a stream. Given the locations of these roads, a total of 4 TARs, 3 PARs, and 21 EAR road segments related to the Project could potentially deliver sediment to coho salmon streams, either from directly crossing streams or being with 200 feet upslope of stream channels. There are likely other road areas outside of the 200-foot area that, depending on road ditching, road surface, and whether the hillslope would be channelized between road and streams, could also contribute some sediment to streams from construction or use. Additional streams other than coho salmon streams could also have some road-induced sediment delivery from construction and use. Such sediment delivery could increase turbidity and fine sediment deposits to streams, especially if BMPs were not properly instituted in these areas.

Several actions would be taken to reduce sediment runoff from roads, right-of-way clearing, and stream crossing structures. Where road improvements would be required, Pacific Connector would ensure that existing drainage features (e.g., culverts, ditches, dips, and grade sags) continue to function properly or they would employ suitable substitute measures to ensure that drainage is controlled to prevent off-site erosion or other resource damage. Surfaces of all new PARs would be graveled, thereby decreasing their erosion potential. Further, PARs and TARs would meet land-managing agencies' engineering design and road management standards consistent with the intended use of the road, and all applicable agency BMPs for erosion control would be implemented. All TARs would also be restored to preconstruction conditions following completion of construction.

TEWAs, which are common along the route, many near streams, represent another potential source of elevated sediment runoff. To reduce the chance of sediment entry to streams from TEWAs, Pacific Connector would install BMPs according to their ECRP for all related construction actions. BMPs may include silt fence/straw bale, sediment barriers, temporary slope breakers, or prefabricated construction mats to prevent rutting/compaction impacts and mulch, dust control, and permanent erosion control measures that would further reduce sediment discharges from a site after construction is complete including right-of-way areas. In forested areas, slash-filter windrows may be constructed on the downhill edge of the construction right-of-way and TEWAs, as directed by the EI.

While some additional sediment would enter streams, several factors would reduce these occurrences:

- the relatively small area that would be disturbed from these actions;
- the provisions in the TMP that would be followed, which include meeting local, state, and federal road construction and maintenance procedures as appropriate;
- the ECRP and BMPs that would be implemented for Project roads, right-of-way clearing, and TEWAs;
- inspection of erosion control measures at least daily during active construction and weekly in non-active construction areas and within a day of intensive rain (more than 0.5 inches rain);
- active maintenance of temporary erosion control measures until permanent vegetation is established; and
- inspection, when possible, of erosion control measures prior to forecast storms and taking of corrective actions as needed.

The result would be that noticeable adverse effects on stream sediment or water quality are unlikely to occur.

<u>Turbidity and Sedimentation</u>

Turbidity and sedimentation affect water clarity and future substrate characteristics. Increases in both can be detrimental to drinking water quality and adversely affect aquatic organisms by impeding light penetration, benthic organism survival, and quality of substrate for invertebrate production and fish spawning success (see section 4.5). Turbidity in streams is often regulated, and levels allowed are usually designated in state water quality certification permits. To reduce increases in turbidity and suspended sediment at waterbody crossings, Pacific Connector would utilize the dry crossing methods (i.e., flume and dam-and-pump) for most of the flowing waterbodies crossed by the pipeline (as discussed above). The remainder would be crossed by conventional bore, diverted open-cut, HDD, and DP. Turbidity and sedimentation resulting from dry open-cut methods are generally minor and temporary and are associated with (1) installation and removal of the upstream and downstream dams used to isolate the construction area; (2) water leaking through the upstream dam and collecting sediments as it flows across the work area and continues through the downstream dam; (3) movement of in-stream rocks and boulders to allow proper alignment and installation of the flume and dams; and (4) when streamflow is returned to the construction work area after the crossing is complete and the dams and flume are removed. Dry methods have been reported to produce one-seventh the suspended sediment in streams than "wet" methods (Reid et al. 2002). According to Pacific Connector, during construction of Williams Northwest Pipeline's Capacity Replacement Project in Washington State (completed in 2006), a total of 67 waterbodies were crossed using dry open-cut crossing methods (fluming and/or dam and pump). During these crossings, there was only one event where state water quality turbidity limits were exceeded. The exceedance occurred through a failure of the pumps during the night when a monitor was not on site to restart the pump.

Some turbidity would result during instream activities and when the water is diverted to the backfilled areas. GeoEngineers (2017e) evaluated the potential risk of turbidity during construction across waterbodies and assigned waterbodies a score from 1 (low) to 5 (high). Of

299 waterbodies evaluated[96], 110 were scored with a low risk (score of 1 or 2) of turbidity increase over a 24-hour period and 189 were scored with a moderate risk (score of 3 or 4), generally due to soil erosion potential, presence of clay or mud, and/or the presence of steep slope or an incised channel that would require construction of a deep trench.

Monitoring studies of varied dry stream crossing pipeline activities have found moderately elevated suspended sediment near these crossings sites. Reid et al. (2004) measured suspended sediment downstream from 12 flumed pipeline crossings and 23 dam-and-pump crossings in North American streams. The study estimated that suspended sediment concentrations averaged 99 mg/l for flumed crossings and 23 mg/l at the dam-and-pump crossings. Reid et al. (2002) found that below four separate dam-and-pump crossings, mean suspended sediment was less than 20 mg/l within 30 meters (100 feet) downstream.

For Project area streams, average watershed suspended sediment values within 50 meters downstream of the stream crossings were modeled.[97] During a standard crossing using dam-and-pump or flumed crossing methods, when water diversion and sediment control methods are in place, values would range from 27 to 153 mg/l for flumed crossing and 7 to 35 mg/l with dam-and-pump crossings for the affected watersheds. These values are similar to those found by Reid et al. (2004) noted above. However, values would be much higher should the crossing sediment control method fail, with modeled suspended sediment values ranging from 712 to 4,102 mg/l if wet open cut methods were used during crossing failure. Duration of elevated values from failure would likely be short, less than about 2 to 4 hours for small streams and possibly up to about 6 hours for large stream crossings. While failures of diversion control systems during crossings are uncommon (Reid et al. 2004), they would likely occur at some crossings during construction. Suspended sediment concentrations from any crossing method would decrease to background levels (about 2 mg/l) within about 0.6 to 19 km (approximately 0.4 to 11.8 miles) downstream of a crossing, among the 14 watersheds.

The South Umpqua River diverted open-cut crossing would have similar effects on downstream sediment and turbidity, in the short term, to those from other dry crossings. These effects would mostly end once the diversion is in place as stream construction would occur in the dry. There would be short-term turbidity increases for short distances, lasting for several hours during portions of the installation and removal of the diversion structures for the proposed diverted open-cut crossing. The dominant substrate at the crossing is gravel and cobble. Local borings indicated that the upper strata is characterized as sandy gravel and cobble with some silt, while pebble counts at the crossing indicated that the surface substrate is mostly (over 16 percent) 1.6 inches or larger (i.e., small gravel or larger). While total composition of all substrate that would be trenched is not completely characterized, information suggests abundant fines are likely very low. With limited fines present, the downstream distribution of elevated fines and fine material that would settle are expected to be low from the diverted open cut. While there would be some fine material that would be suspended and travel farther downstream, it is likely to be very limited based on the available sediment assessment. The settled substrate would have limited change on existing substrate characteristics.

[96] Excludes ponds, estuaries, streams and canals crossed using trenchless methods and water bodies in right way not crossed.
[97] See Pacific Connector's response to a FERC information request related to Resource Report 2, filed May 4, 2018.

Temporary bridge installation may occasionally add turbidity to streams. Temporary stream crossings may occur outside of the fish in-water work window. Pacific Connector's crossing plans include installing temporary bridges from the bank without entering the water. These may include such items as flat-beds that are typically 30 to 40 feet long, some as long as 90 feet. If such bridges are not considered safe to install from the bank, only the equipment needed to cross the stream to install the bridge would cross the stream. Once installed, no further vehicle passage would occur in the channel. Therefore, while a small number of stream channels may be disturbed during installation causing elevated sediment levels, the limited vehicle traffic and number of such crossing locations would reduce water quality effects from turbidity in location and duration along the proposed route.

Potential effects from turbidity from construction across streams are expected to be temporary (most within days of actual construction) and minor (relatively low increase in turbidity beyond the construction area) for the following reasons:

- all but one crossing of perennial streams would be completed either using dry open-cut crossing methods or methods that avoid impacts altogether;
- crossings would be completed during ODFW and NMFS recommended in-water work periods when the flow volumes and velocities will be low;
- headwater streams are typically dominated by gravel/cobble substrates reducing the potential to generate turbidity during crossings;
- crossings (including crossings in the same watershed) would be scheduled individually, several days apart, and not completed concurrently;
- erosion control BMPs, as outlined in Pacific Connector's ECRP, would be implemented to reduce the potential for erosion and sedimentation; and
- bridge installation where vehicles enter streams would only occur in limited locations and duration, with most areas spanned by bridges without water entry, and Pacific Connector would follow BMPs and procedures approved by state and applicable federal agencies where temporary bridges would be installed.

The *Turbidity-Nutrients-Metals Water Quality Impact Analysis* (GeoEngineers 2017e) concluded that turbidity may exceed Oregon numerical water quality standards for short distances and short durations downstream from each crossing, either during and shortly after construction (in perennial waterbodies) or after fall rains begin (for intermittent and ephemeral streams). Such exceedances are allowed as part of the narrative turbidity standard if recognized in a CWA Section 401 water quality certification if every practicable means to control turbidity has been used.

Contribution of turbidity or sediment from other crossing methods, including DP, bore, and HDD, would be unlikely. DPs and bores would go under waterbodies and avoid contact with flowing streams. Start and end points would be back from the stream banks so standard BMPs for erosion control would reduce potential for sediment to enter streams from their use.

The details of the HDD crossing are described in section 2. Pacific Connector proposes to use the HDD method to cross under two spans of 0.7 and 1.6 miles of Coos Bay, and also the Coos, Rogue, and Klamath Rivers. Generally, an HDD would avoid direct effects on the bay and associated estuarine resources; stream habitat and water quality. However, an HDD requires the use of drilling mud as a lubricant during the process. This fluid is under pressure and there is a possibility of an inadvertent release of drilling mud through a substrata fracture, allowing it to rise to the surface (frac-out). The drilling fluid is typically comprised of inert muds, so an inadvertent release would likely be non-toxic to aquatic life. Drilling mud may accumulate locally and be washed downstream, temporarily increasing rates of turbidity and sedimentation. In addition, inadvertent releases most often occur near the entry and exit locations, which are often landward of the stream or estuarine channels, reducing the likelihood that drilling mud would enter surface waters. Pacific Connector prepared detailed surveys and crossing plans[98] for each of the HDD crossing sites, further reducing the chances of HDD crossing problems. To prevent an inadvertent release or address impacts should one occur, Pacific Connector developed its *Drilling Fluid Contingency Plan for Horizontal Directional Drilling Operations*[99] as discussed in section 2.

The exact composition of the drilling fluid would primarily consist of water and bentonite clay; however, additional drilling fluids additives, grout, or LCM may be necessary to control subsurface conditions encountered during drilling. Other than bentonite, Pacific Connector has not identified drilling fluid additives, grout or LCM materials or provided safety data sheets for these materials. Therefore, **we recommend that:**

- **<u>Prior to construction</u>, Pacific Connector should file with the Secretary, for review and written approval by the Director of OEP, a listing of all drilling fluid additives, grout, and LCM that may be used during HDD activities, provide safety data sheets for these materials, and indicate the ecotoxicity of each additive mixed in the drilling fluid to the identified toxicity for relevant biotic receptors.**

Based on known flow regimes within the HDD river crossings (Coos, Rouge, and Klamath Rivers), a small volume of drilling fluid released into the river would quickly dissipate. However, in the event drilling fluid is detected in a waterbody, Pacific Connector would notify the appropriate agencies, including the FERC project manager, and an assessment would be made to determine the most appropriate containment structure to be erected to reduce impacts on the waterbody (by limiting additional releases and containing the ones already in the waterbody).

In the event of a release of drilling fluids into the Coos Bay intertidal mud flats or subtidal areas, the drilling fluid may not likely mobilize as it would in a rapidly moving river. Coos Bay is relatively shallow throughout much of the HDD alignment, and the mudline becomes exposed during low tides across much of the alignment except within the dredged shipping channel. In the event of a drilling fluid release into Coos Bay, the drilling fluid would likely settle onto the bay floor.

The areas along the drill alignment and downstream of the Project site would be monitored to identify areas that may have substantial accumulations of drilling fluid. Potential accumulations would likely only occur in slow-flowing areas that allow enough time for the suspended particulates to settle out of the water column. Jordan Cove would attempt to remove drilling fluid volumes that represent substantial adverse impacts on aquatic habitat. Areas where bentonite accumulations are removed would be monitored to assess the need for additional substrate. If the

[98] See Appendix G.2 of Pacific Connector's Resource Report 2.
[99] This plan was attached as Appendix 2.H of Resource Report 2, in Pacific Connector's September 2017 application to the FERC.

areas identified lack essential substrate materials including spawning gravels, these materials may be added to mitigate the impacts of the bentonite removal activities.

Overall, drilling mud releases to any waterbody would be short term, likely less than a day, and would be diluted from large river water volumes and swift flows. We conclude that an inadvertent release of drilling mud from an HDD would have minor, short-term adverse effects on resources in estuarine channels or rivers.

Trench spoil excavated from within the waterbody would be placed at least 10 feet from the water's edge or in a TEWA and may have the potential to contribute sediment and turbidity to streams. In some waterbodies, native washed streambed boulders, cobbles, and gravels removed from the surface of the trench may be stored within the construction right-of-way in the streambed in areas isolated from streamflow (i.e., within the dammed area for flumes or dam-and-pump crossing). Storing this material in the streambed would reduce handling and help to ensure the material would be available for backfill and streambed restoration. This storage procedure requires a modification from Section V.B.4.a. of the FERC's *Procedures* (which require spoil store more than 10 feet from the edge of waterbody). This modification has been requested as part of the license application (see appendix E). Staging areas and additional spoil storage areas would be located at least 50 feet away from waterbody boundaries, where topographic conditions and other site-specific conditions allow. Where topographic conditions do not allow a 50-foot setback, spoil storage areas would be located at least 10 feet from the water's edge. Sediment control devices, such as silt fences and straw bales, would be placed around the spoil piles to prevent spoil flow back into the waterbody reducing the chance of increasing turbidity.

Channel and Stream Bank Integrity

Constructing the pipeline would modify streambanks, resulting in an increase in the rates of erosion, turbidity, and sedimentation into the crossed waterbody. An increase in soil compaction and vegetation clearing could also potentially increase runoff and subsequent streamflow or peak flows. The extent of these impacts would depend on streambank composition and vegetation stream type, velocity, and sediment particle size.

To reduce these impacts, equipment bridges and mats would be used, as necessary, to provide stable work areas and isolate equipment from waterbodies. TEWAs for spoil storage and pipe staging would be set back from the bank as discussed below, and temporary sediment barriers would be installed around disturbed areas, where necessary, in accordance with Pacific Connector's ECRP.

To restore streambanks on non-federal lands, Pacific Connector would return affected lands to preconstruction contours or shaped to a stable angle (see section 4.3.4 for a discussion of requirements on federal lands). Erosion control measures including fiber fabric or matting would be installed on slopes adjacent to streams. On some banks, depending on site-specific conditions, fiber rolls may also be installed to stabilize bank toes. The streambanks would be seeded, and woody riparian vegetation planted for stabilization according to Pacific Connector's ECRP. Pacific Connector does not anticipate that riprap would be required for streambank stabilization, but if used would be limited to the areas where flow conditions preclude effective vegetation stabilization techniques. Pacific Connector may also implement tree revetments, stream barbs/flow deflectors, toe-rock, and vegetation riprap before using hard bank protection. The

NMFS has expressed concern with the potential use of riprap or barb/flow deflectors for this Project and has requested that only bioengineered methods (such as LWD) be used for bank protection or flow control for the Project. This NMFS request may also become a condition within their BO for the Project or a requirement during the NMFS permitting process.

Fluvial erosion represents a potential hazard to the pipeline where streams can expose the pipe as a result of channel migration, avulsion, widening, and/or streambed scour. The pipeline would be designed to ensure it does not become exposed from bed scour or channel migration, which may include increasing the depth of cover to more than the 5-foot minimum to accommodate the potential for long-term channel changes. A channel migration and scour analysis was performed and rated crossings as to their risk of pipe exposure. Those sites considered to have potential risk of pipe exposure were evaluated in more detail including site-specific data and, where deemed necessary, would have additional procedures taken to ensure that likelihood of pipe exposure is substantially reduced. Ten crossings were identified as Level 2 (listed below on table 4.3.2.2-6), which have large or complex channels with a high potential for migration, avulsion, or scour, and required site-specific additional analyses. From the results of the channel migration and scour analysis, Pacific Connector would design all crossings that were assessed in detail to bury the pipe below the 100-year scour depth or into competent bedrock, whichever is shallower, and for streams likely to have channel migration, bury the pipe below the projected depth of the channel thalweg (lowest streambed elevation) within the 50-year channel migration zone. Additional analysis prior to construction would be needed for sites that were not accessible due to property rights. All crossing sites would have pre- and post-construction surveys conducted to document (by post-construction conditions monitoring) that each crossing has been restored to pre-construction conditions (or better) after project construction. A summary of the survey findings would be filed with the FERC. Crossing of various risk categories would have additional BMPs as described below.

TABLE 4.3.2.2-6

Streams Crossed by the Pacific Connector Pipeline Route That Have a High Potential for Scour or Migration

Watershed	Stream Name	MP	Maximum Scour Depth a/	Other Hazards	Mitigation Measures
Coquille	Middle Park Creek	27.0	10.5 feet	Channel widening	Dry open-cut
Coquille	Elk Creek	34.40	6.0 feet	Channel widening	Bury in bedrock
S. Umpqua	Olalla Creek	58.8	7.5 feet	Migration	Bury in bedrock
S. Umpqua	Western Crossing of the South Fork Umpqua River	71.3	unknown	unknown	DP
S. Umpqua	North Myrtle Creek	79.1	6.5 feet	Migration	Bury in bedrock
S. Umpqua	South Myrtle Creek	81.2	unknown	Migration	Bury in bedrock
S. Umpqua	Eastern Crossing of the South Fork Umpqua River	94.7	18.0 feet	unknown	Diverted open-cut
Rogue	West Fork Trail Creek	118.9	unknown	unknown	Bury in bedrock
Rogue	Rogue River	122.7	20.5 feet	Channel widening	HDD
Rogue	North Fork Little Butte Creek	145.7	unknown	unknown	Dry open-cut

a/ 100-year flood recurrence

Pacific Connector would follow the procedures described in section 2 for placement of sediment cover in streams but has requested a modification, where the existing substrate is not gravel or cobbles and site access is limited, only native materials removed from the stream be used for backfilling. Pacific Connector has provided site-specific modification to our *Procedures* (see appendix E). Any subsequent need to place fill within a stream may require a permit from the COE under Section 404 of the CWA and from the ODSL under the ORS.

In-Stream Flow

Flow changes because of Project actions can have effects on water user's access to water and physical and biological conditions of streams. Flow reductions can partially affect stream temperature as well as aquatic habitat.

Project water withdrawal from waterbodies would occur from two main activities: hydrostatic testing and water needed for project dust control. Pacific Connector estimates between 31 and 65 million gallons of water would be required to test the pipeline during hydrostatic testing (see table 4.3.2.2-7).

Water for hydrostatic testing would be primarily obtained from surface water sources, but some private supply wells or other surface water rights may be drawn upon as well (see table 4.3.2.2-7). If water for hydrostatic testing would be acquired from any source other than a municipality, including surface water sources as noted in table 4.3.2.2-7, Pacific Connector would obtain all necessary appropriations and withdrawal permits, including from the OWRD, prior to use.

Pacific Connector would apply for permission from ODEQ to discharge the hydrostatic test water. State water withdrawal permits require review by OWRD, ODEQ, and ODFW to ensure potential impacts from withdrawal do not occur. The review includes volume, timing, and duration of the withdrawal. The withdrawal permit ensures that the proposed impact on existing water rights or beneficial uses of the water body do not occur. Where test water cannot be returned to its withdrawal source, the water would be treated with a mild chlorine treatment and discharged to an upland location (at least 150 feet from streams with no direct discharge features) through a dewatering structure at a rate to prevent scour and erosion and to promote infiltration. If necessary multiple discharge locations could be used to ensure proper dissipation of discharges. The final details of chlorine concentration have not been finalized but will be developed during permitting process. Water treated with chlorine would be released according to ODEQ criteria and what is allowed in the ODEQ WPCF permit to prevent water quality or potential impacts on aquatic species. If needed this water would be treated to prevent impacts from chlorinated water on the environment (*Hydrostatic Test Plan*, Appendix M of the POD [appendix F.10 of this EIS]). Hydrostatic discharge points have been located in upland areas where feasible, and at an appropriate distance from wetlands and waterbodies to promote infiltration and to ensure that sedimentation of wetlands, waterbodies, or other sensitive areas do not occur (identified in table D-3 in appendix D). Pacific Connector's EIs would visually monitor the release of hydrostatic test water and trench dewatering activities to ensure that no erosion or sedimentation occurs. In addition, the EIs would ensure that turbid water is not discharged to waters of the state. If an EI determines that a discharge is occurring from trench dewatering, the receiving water would be visually monitored for turbidity. If a turbidity plume is observed, the trench dewatering operations would be immediately adjusted/reinstalled/maintained to ensure that the discharge of sediment to surface water is stopped and water quality standards are not exceeded. In addition, a total of 32 test header section breaks where water would be discharged are located within the construction right-of-way or TEWAs (identified in table D-3 in appendix D).

TABLE 4.3.2.2-7

Potential Hydrostatic Test Water Quantity and Source Locations

Spread	Test Sections	MP Range	Estimated Volume (gal) a/	Additional Water Required for HDD/Direct Pipe Pre-Test	Minimum + Additional Pre-Test Water b/	Source c/	Additional Potential Sources Recently Sited by Construction Management Team
			South Coast Water Basin (MP 0.00 – 53.15)				
EW.	1-2	0.00-8.35R	1,547,000	757,000	1,938,000	MP 0.00 – North Spit Pump House (Coos Bay) MP 1.31 – Fire Hydrant on Westside of Hwy 101 Bridge	–
1	3-6	8.35R-29.54	6,836,000	276,000	2,825,000	MP 11.08R – Coos River MP 29.64 – East Fork Coquille River	Steinnon Creek: North Fork of Coquille River
2	7-10	29.54-51.58	6,154,000	85,000	2,458,000	MP 29.64 – East Fork Coquille River MP 50.28 – Middle Fork Coquille River	Upper Rock Creek
			Umpqua Water Basin (MP 53.15 – 111.11)				
3	11-12	51.58-71.37	5.692.000	75,000	4,042000	MP 57.30 – Ben Irving Reservoir MP 58.79 – Ollala Creek MP 71.25 – South Umpqua River	Middle Fork Coquille
4	13-17	71.37-94.65	6,499,000	106,000	2,878,000	MP 71.25 – South Umpqua River MP 94.70 – South Umpqua River	South Myrtle Creek
5	18-20	94.65-110.23	4,350,000	–	2,535,000	MP 94.70 – South Umpqua River	South Myrtle Creek; Indian Lake
			Rogue Water Basin (MP 111.11 – 167.58)				
5	21-24	110.23-132.50	6,218,000	164,000	2,872,000	MP 122.80 – Roque River	South Myrtle Creek; Indian Lake
6	25-27	132.50-162.00	8,348,000	–	3,060,000	MP 141 .00 – Star Lake MP 133.4 – Medford Aquifer (if this is used, will have to cut in another test)	–
7	28	162.00-179.00	4,635,000	124,000	4,817,000	MP 199.2 – Klamath River MP 212.00 – Lost River	–
			Klamath Water Basin (MP 167.58–228.81)				
7	29-32	179.00-228.81	13,906,000	124,000	4,817,000	MP 199.2 – Klamath River MP 212.00 – Lost River	Lost River Anthony Blair Deep Well Gavin Rajnus Deep Well Ryan Hartmen Deep Well
Total			**64,185,000**	**1,711,000**	**32,242,000**		

a/ Total amount of water needed without any cascading of water between sections, which would not occur.
b/ Total assuming likely cascading of water between test section
c/ Currently expected sources of water but alternative or additions sources may be used as noted.
Source: Data response table based on April 12, 2018 design (Pacific Connector Response date May 24, 2018 from Attachment – FERC-PCGP-RR10-1)

To address concerns regarding water withdrawals and hydrostatic testing, Pacific Connector developed a *Hydrostatic Test Plan* (Appendix M of the POD [appendix F.10 of this EIS]). The plan would be updated in consultation with the BLM and Forest Service, as well as the Center for Lakes and Reservoirs and Aquatic Bioinvasion Research and Policy Institute (Portland State University). The plan includes measures to prevent the transfer of aquatic invasive species and pathogens from one watershed to another. Where possible, test water would be released within the same basin from which it was withdrawn. However, cascading water from one test section to another to reduce water withdrawal requirements may make it impractical to release water within the same basin where the water was withdrawn in all cases. If hydrostatic test source water cannot be returned to the same water basin from where it was withdrawn, Pacific Connector would disinfect the water that would be transferred across water basin boundaries. The hydrostatic test water treatment process would incorporate screening during water withdrawal that would meet NMFS and ODFW criteria to prevent the entrainment of small fish. Water would be discharged according to ODEQ requirements for chlorinated water discharges as noted in the *Hydrostatic Testing Plan*. All discharge locations would be monitored after construction for potential noxious weed establishment and treated if necessary.

Potential effects on stream flow associated with hydrostatic testing include reduced downstream flows, erosion and scouring at release points, and the transfer of aquatic nuisance species through the test water from one water basin to another. Estimates of potential water intake amounts from streams indicate flows below intake would be reduced by less than 10 percent of typical monthly instantaneous flow rates during the month of withdrawal for all but one (at 35 percent of flow) potential locations during withdrawal (duration about 6 to 11 days at each potential location; Ambrose 2018, see also table 4.5.2.3-6 in section 4.5 for withdrawal amounts by stream and additional recommendations by FERC). Final selection of intake rates and sites would be reviewed by ODFW and OWRD prior to testing, so that potential effects from flow reductions would be unlikely.

It is not possible to estimate the total loss of water from a basin because exact locations have not been determined for both withdrawal and discharge. Given that relatively small portions of any individual stream flow (less than 10 percent) would be used daily, the short duration at any one stream withdrawal (6 to 11 days), that some if not all of the water withdrawn would be returned to the basin where withdrawn, and that there are substantial additional streams without water withdrawal in each basin, the total loss of basin water would not be substantial. Additionally, once final plans are developed, the state permitting process for water withdrawal and discharge would ensure that substantial impacts are not allowed.

While it is not possible to know how much water would be needed for dust suppression on the pipeline construction right-of-way, during dry seasons, Pacific Connector estimates that there would be approximately five 3,000-gallon water trucks per construction spread on a given day. Pacific Connector anticipates using five construction spreads, which would total 75,000 gallons for 25 water trucks per day. While the total amount of water needed is unknown, the amount needed for each truck is relatively small. For example, if filling one truck occurred in 30 minutes of water withdrawal, the rate would be about 1.7 gallons per second or 0.2 cfs. This flow reduction would be a small portion of the flow of perennial streams or rivers that are likely to be used for water supply. Therefore, the overall change in any specific reduction in streamflow from this water use would likely be unsubstantial.

Watering trucks would spray only enough water to control the dust or to reach the optimum soil moisture content to create a surface crust. Runoff should not be generated during this operation. All appropriate permits/approvals would be obtained prior to withdrawal. Table 4.3.2.2-8 lists potential dust control water sources that have been identified by Pacific Connector.

TABLE 4.3.2.2-8

Potential Dust Control Water Sources for the Pacific Connector Pipeline

County	Nearest PM	Source
Coos	16.5	Aqueduct Lake
Coos	37.0	Brewster Lake (WI-602)
Douglas	50.2	Lang Creek Reservoir
Douglas	79.0	Big Lick Reservoir
Jackson	128.5	Indian Lake Reservoir
Jackson	133.4	Eagle Point Irrigation Canal Crossing
Jackson	141.0	Star Ranch Lake
Jackson	144.0	Unnamed Reservoir
Jackson	145.0	Gardener Reservoir
Klamath	228.5	High Line Canal
Klamath	228.7	Capek Reservoir
Klamath	229.4	Low Line Canal

Additionally, Pacific Connector has indicated it may utilize a synthetic product such as Dustlock®, in addition to water, for dust control. Dustlock is a naturally occurring byproduct of the vegetable oil refining process. Dustlock penetrates the bed of the material and bonds to make a barrier that is naturally biodegradable, ensuring that the surrounding ground and water are not contaminated, and minimizing any potential effects on fish and wildlife. However, Pacific Connector would not use Dustlock within 150 feet of riparian areas or wetlands.

For dust control water use Pacific connector would be restricted to water withdrawal from permitted waterbodies where flows would not be adversely affected as they would obtain. If water for dust control would be acquired from any source other than a municipality, including surface water sources as noted in table 4.3.2.2-8, Pacific Connector would obtain all necessary appropriations and withdrawal permits, including from the OWRD, prior to use.

According to the Forest Service, vegetation clearing and management that creates sizable canopy openings can increase water yields and subsequently, waterbody flows (Forest Service 2000). Sizeable canopy openings can result in other factors affecting watershed water storage and runoff amount, peak amount and time of runoff (Forest Service 2008). The relatively small percentage of the watersheds affected by the right-of-way and the total area of the watershed within the transient snow zone would, however, greatly limit this potential effect. Although permanent canopy removal in forested areas along the right-of-way would increase the potential for snow accumulation, the forest clearing within any of the watersheds would be so small as to not have a measurable influence on peak flows.

Surface waters could be affected due to alteration of groundwater flow where the pipeline intersects waterbodies. The hyporheic zone is a region beneath and alongside a stream bed where there is mixing of shallow groundwater and surface water. The flow dynamics and behavior in this zone is recognized to be important for surface water and groundwater interactions, as well as fish spawning, among other processes. Pacific Connector conducted a hyporheic exchange analysis on the waterbodies crossed by the pipeline (GeoEngineers 2017g). The assessment focused on determining if construction has the potential to affect the structure and function of the hyporheic zone, and if so, which stream crossing may be most sensitive to changes in hyporheic zone structure and organization. Historically, pipeline construction has not typically been considered as having a potential effect on hyporheic zone function, presumably because of the nature of the construction process having relatively limited, localized and temporary change to the subsurface conditions under streams and rivers. It is difficult to measure hyporheic exchange without detailed site-specific study, but qualitative observations of bed and bank material, stream gradient, location within a watershed, and morphological features can help indicate whether a stream has an active and functional hyporheic zone. GeoEngineers (2017g) developed weighting factors to assign criteria of high, moderate, and low sensitivity to the crossing locations. The analysis used these qualitative parameters to rank how sensitive a stream crossing may be to potential hyporheic zone alteration.

Fourteen stream crossings were categorized as having a high sensitivity to hyporheic zone alteration, which would suggest a high likelihood of a functioning hyporheic zone, mostly associated with larger waterbodies with greater floodplain widths and instream morphologic features. Two of the 'high' sensitivity crossings, including the Coos River crossing at MP 11.13R and the Rogue River crossing at MP 122.65, would be crossed by HDD rather than open trenching across the stream channel.

A "moderate" sensitivity indicates that the stream crossing displays some indicators that a hyporheic zone is active and functional; approximately 63 crossings fit this category, most of them upper to middle watershed streams. A "low" sensitivity indicates that the stream crossing does not likely support either an extensive or functional hyporheic zone; approximately 127 stream crossings fit into this category. Many of these low scoring stream crossings are bedrock-controlled, are dominated by finer-grained material, or are canals and ditches. Eleven stream crossings were not assigned any point values or ranking due to there being no channel or channel forming processes observed at the crossing location in the field.

Water quality parameters, including water temperature and intragravel dissolved oxygen, might potentially be affected at crossings where hyporheic exchange is extensive and active. Thus, streams with a "high" and "moderate" sensitivity would be the streams where water quality could potentially be compromised due to alteration of the hyporheic zone. Those crossings with a 'low' sensitivity indicate that little hyporheic exchange is currently operating in the stream, and thus would not likely impact water quality. Overall, most of the Pacific Connector pipeline crossings fall into a "low" sensitivity category, where water quality (including water temperature and intragravel dissolved oxygen) is unlikely to be significantly or measurably altered by pipeline construction.

The pipeline construction methods and BMPs described in the GeoEngineers (2017g) report, as well as the site-specific restoration plans for crossings of perennial stream on federal lands (NSR 2014) further reduce the potential for pipeline construction to adversely alter the hyporheic zone. Specifically, the BMPs which are of importance to reduce the potential impacts on the hyporheic zone include the following:

- native material that is removed from the pipeline trench during excavation across stream channels would be used to backfill once the pipe is in place to reduce potential changes to preconstruction permeability; and

- trench plugs would be installed at the base of slopes adjacent to wetlands and waterbodies and where needed to avoid draining of wetlands or affecting the original wetland or waterbody hydrology.

While the potential impact of pipeline construction on hyporheic exchange is considered to be low, Pacific Connector would implement the following measures to further reduce this potential:

- Document streambed stratigraphy prior to construction to aid in site restoration.
- As described in the *Stream Crossing Risk Analysis* and *Stream Crossing Risk Analysis Addendum* (GeoEngineers 2017d, 2018b), implement additional site-specific stream crossing restorations plans, of streams not yet field surveyed, after final pre-construction surveys.
- Segregate actively movable streambed gravels and cobbles from underlying streambed materials (including fractured bedrock; i.e., do not mix actively moveable stream bed material with that below that depth). Replace all removed material to their natural pre-construction depths, including removed gravels/cobbles.
- Below active stream gravels, replace native material in a manner to match upstream and downstream stratigraphy and permeability to the maximum extent practicable.

Blasting could alter the in-channel characteristics and hydrology of the stream, potentially decreasing flows due to increased infiltration where bedrock would be fractured. Where blasting is required in streambeds, Pacific Connector would use the dam-and-pump crossing method so that blasting activities can be completed in the dry. For further discussion on minimizing impacts related to blasting, see the *Blasting Plan* discussed in section 2.

<u>Stream Temperature</u>

Several comments received by the Commission expressed concern that the removal of vegetation near waterbodies would result in changes to waterbody temperatures. However, available information on the effects of linear pipeline crossings of streams on water temperature indicates there is little to no change. Water has a very high specific heat capacity. That is, the amount of heat needed to raise its temperature is relatively high. Typically pipeline rights-of-way are narrow, and water would flow quickly through the crossing locations, Smaller, slower moving streams have a longer exposure time, but typically do not support temperature sensitive fish species. In general, streamwater exposure to the lack of shade at pipeline crossings would be temporary and limited (see an expanded discussion in section 4.3.4.2 for federal lands).

Pacific Connector conducted research on the potential for its pipeline crossings to increase stream water temperatures (GeoEngineers 2017d). This analysis also used the Stream Segment Temperature Model (SSTEMP) by Bartholow (2002) to estimate potential temperature effects at 15 pipeline crossing locations (each was modeled using a 75-foot-wide clearing) along the whole route (table 4.3.2.2-9). The streams selected varied in size from 2 to 135 feet wide with only eight of these having less than a 10-foot flowing width. Conditions modeled were based on conditions measured during late August 2010. The average modeled temperature increase across a cleared right-of-way for these 15 streams were slight, 0.03°F, and the maximum increase among the streams was 0.3°F.

TABLE 4.3.2.2-9

Predicted Modeled Temperatures at Selected Stream Crossings Along the Pacific Connector Pipeline Route

MP	Watershed	Stream	Width (feet)	Ambient Water Temperature (°F)	Post-Construction Water Temperature (°F)	Temperature Change (°F)
10.3 a/	Coos	Stock Slough	18	56.30	56.32	0.01
17.5 a/	Coos	Catching Creek	7	56.30	56.30	<0.01
23.1	Coquille	North Fork Coquille River	44	74.30	74.23	-0.07
29.2 a/	Coquille	Tributary to East Fork Coquille River	9	58.82	58.78	-0.04
29.5 a/	Coquille	Tributary to East Fork Coquille River	6	59.72	59.72	<0.01
29.9	Coquille	East Fork Coquille River	74	64.22	64.24	0.02
32.4	Coquille	Elk Creek	7	58.46	58.47	0.01
58.8	South Umpqua	Ollalla Creek	84	58.46	58.48	0.02
73.2	South Umpqua	Tributary to South Umpqua River	2	58.46	58.59	0.13
84.2	South Umpqua	Wood Creek	7	58.46	58.5	0.04
94.7	South Umpqua	South Fork Umpqua River	135	58.46	58.49	0.03
109.5	South Umpqua	East Fork Cow Creek	6	55.40	55.44	0.04
132.8	Rogue	Quartz Creek	6	58.64	58.94	0.30
162.5	Upper Rogue	South Fork Little Butte Creek	13			0.01
212.1	Lost River	Lost Rover	73	70.70	70.68	-0.02

a/ Not crossed with current route

The total amount of riparian vegetation within one site potential tree height that would be reduced during construction and operations is discussed in section 4.5.2 of this EIS. The reduction occurs primarily from construction of the pipeline right-of-way clearing over streams but also includes right-of-way clearing that does not cross streams, and development of TARs, PARs, and TEWAs outside of the right-of-way clearing. This would include loss of about of forest during construction and operations, which would remain as non-forested habitat along the route (see table 4.5.2.3-5 in section 4.5.2 of this EIS). This cleared acreage is spread across the entire pipeline route and includes loss from all sources of construction and operations as well as vegetation that would potentially help shade streams. As discussed below, loss of this vegetation is not likely to have a marked cumulative effect on stream temperature, although some local stream increases may occur.

Potential cumulative watershed temperature increases from project riparian clearing would be unlikely. The number of crossings resulting in riparian shade area cleared in any watershed would be slight. No more than nine perennial streams would be crossed in any one of the 19 watersheds crossed by the pipeline route. Primarily perennial stream clearings are likely to have effects on temperature during the warmest part of the year, because many intermittent streams would be dry during the peak temperature periods (July–September). Thus, peak seasonal temperatures would be unlikely to affect many intermittent streams. Even considering the total number of streams crossed in watersheds, which ranges from 3 to 44 crossings per watershed, most watersheds would have less than 16 crossings (see section 4.5.2.3). The riparian area lost that could affect watershed stream temperature relative to all available riparian areas in the watershed would be slight. About

9 linear stream miles of streambank could be affected along the whole Project route (GeoEngineers 2017f; note this counts both banks separately so stream length affected would be half of this value).

To reduce the potential effects of pipeline construction on stream temperatures by the removal of riparian vegetation, Pacific Connector has incorporated the following measures into its Project design:

- narrowing the construction right-of-way at waterbody crossings to 75 feet where feasible based on site-specific topographic conditions;
- locating TEWAs 50 feet back from waterbody crossings to reduce impacts on riparian vegetation, where feasible;
- replanting the streambanks after construction to stabilize banks and to re-establish a riparian strip across the right-of-way for a minimum width of 25 feet back from the streambanks; and
- replanting riparian areas equal to 1:1 ratio to temporary riparian shading vegetation losses and 2:1 ratio for permanent riparian losses from the 30-foot operational easement clearing.

Based on these measures and the studies summarized above, we conclude that the construction and operation of the pipeline would have no discernible effect on stream temperature.

Spills of Hazardous Materials

An inadvertent release of equipment-related fluids would temporarily impact surface water quality. Equipment fluids such as gas and oil can be toxic to aquatic organisms and can affect downstream water uses including drinking water and crop irrigation. Pacific Connector has developed a SPCC Plan that describes measures to be implemented by Project personnel and contractors to prevent and, if necessary, control any inadvertent spill of hazardous materials.

Waterbody Status and Water Use

The construction and operation of the pipeline route could have effects on the status of special features including the water quality limited conditions and special uses, including water diversions and national river status. Actions described below indicate potential effects on these and Project mitigative actions implemented to aid in maintaining the current conditions and regulatory requirements relative to surface waters.

Oregon Water Quality Regulations and Standards Effects

Studies requested by ODEQ are part of a broad evaluation of potential impacts on water quality, stream channel stability, and riparian zones resulting from pipeline construction and maintenance activities. GeoEngineers conducted studies to help evaluate potential impacts including a stream crossing risk analysis, a hyporheic exchange impacts analysis, and a study of the impact on water quality from additional turbidity, nutrients, and metals caused by pipeline construction activities at stream crossings (GeoEngineers 2013a, 2013b, 2013c, and 2018b). The intent of the evaluations is to help focus management resources on those waterbody crossings to which the pipeline would present the greatest risk of impacting beneficial uses. ODEQ's regulatory authority under the CWA and OAR is provided to maintain beneficial uses through enforcement of water quality standards.

During the ODEQ CWA Section 401 process, Pacific Connector would develop a source-specific implementation plan in accordance with OAR 340-042-0080 for areas with existing TMDLs, and Pacific Connector would be identified as a new nonpoint source. The source-specific implementation plan would be reviewed and approved by ODEQ.

BMPs to reduce sedimentation during construction would be employed on all streams. However, to reduce potential stream channel impacts, including increased erosion/sedimentation, additional site-specific BMPs would be installed at sites considered to be at higher potential risk, as discussed earlier under Impacts and Mitigation based on the risk matrix analysis. These additional protections may include such items as additional upslope bank protections, hillslope drainage structures, additional wood instream or on bank, wood armoring, enhanced substrate, or reduction in bank slope to further ensure reduced erosion. The plans to keep riparian stream crossing clearing to a minimum (75 feet wide at most crossings) would also result in less removal of woody riparian vegetation and help temperature-impaired streams. Because of the water quality and stream habitat benefits, the NMFS endorses keeping near stream riparian vegetation clearing to a minimum, as is currently proposed; this NMFS request may become a condition within their BO for the Project or a requirement during the NMFS permitting process. Overall, the small reduction in shade is not likely to change stream temperatures substantially downstream of the pipeline crossing in temperature limited streams. However, removal of vegetation that once shaded the stream could cause slight local and temporary (daily) increases in temperature, in small streams with low flow discharge rates during the warm summer months. However, discernible temperature changes are very unlikely due to the limited exposure time as water passes through the 75-foot-wide clearing and the high specific heat capacity of water.

A potential new nonpoint source of nutrients and/or oxygen-demanding pollutants would be the use of fertilizer for revegetation of disturbed areas. Pacific Connector plans to apply fertilizer to disturbed areas to be reseeded, as needed. Additionally, some BLM districts along the Project route have specific recommendation for slow release fertilizer application in specific soil types in planting holes as part of any reforestation. Fertilizer would only be applied at the recommended rates of the land-managing agencies and, if applied by broadcast spreader, worked into the upper 2 inches of soil as soon as practical (see Pacific Connector's ECRP). Application would need approval by the land-managing agency or landowner. No application would occur within 100 feet of flowing water and would be avoided during heavy rain and windy conditions. Aerial broadcast spreaders would only occur with federal land-managing agency approval. Fertilizer would be added directly to hydroseeding slurry. Fertilizer would be stored away from streams and outside of federal Riparian Reserves. The NMFS has expressed concern that fertilizer application has the potential to enter waters and recommends that no application within 150 feet of waterbodies occur; this NMFS request may become a condition within their BO for the Project or a requirement during the NMFS permitting process. Any monitoring required for nutrients at locations where fertilizer is likely to contribute to run-off to waterbodies will be addressed in the state permit process and be included in a source-specific implementation plan as required by OAR 340-042-0080.

Drinking Water Sources Areas and Public Intakes Effects

Prior to construction, Pacific Connector would consult with all surface water intake operators listed in table 4.3.2.2-5 that are still active and establish a process for advanced notification of instream work. A summary of the consultations will be filed with the FERC prior to construction of the pipeline. In the event of an inadvertent spill, or a disruption of flow and/or a possible introduction of sediments into waters upstream of the intakes, Pacific Connector would notify potable water intake users of the conditions so that necessary precautions could be implemented.

Point of Diversion Effects

Pacific Connector would consult with the landowner if impacts on a water supply's point of diversion cannot be avoided, and prior to construction would work together to identify an alternate location to establish the diversion that would not violate existing state water rights for the system or cause aquatic habitat impacts. Should that landowner determined that there has been an impact on the water supply, Pacific Connector would work with the landowner to ensure a temporary supply of water. In addition, if deemed necessary, Pacific Connector would replace the affected water supply with a replacement, permanent water supply.[100] Mitigation measures would be specific to each property and would be determined during landowner negotiations. Points of diversion (both public and private) beyond 150 feet of the construction work areas are not expected to be affected by the pipeline.

National Rivers Inventory Effects

As noted earlier, the pipeline would cross three rivers that are listed on the Nationwide Rivers Inventory. Pacific Connector has developed specific plans for each of these crossing to maintain the quality of these rivers. For the North Fork of the Coquille River and East Fork of the Coquille River, Pacific Connector has developed a site-specific crossing plan for both rivers using a dry open-cut method to contain disturbed sediments. The western South Umpqua River crossing would use a DP installation process to eliminate an open-cut and reduce impacts by drilling under both the river and I-5 in a single operation. The site-specific crossing plan developed for the eastern South Umpqua River crossing would use a diverted open-cut method to limit water quality impacts by creating a "dry" working area isolated from the river. These procedures would maintain stream conditions and quality, and would not adversely affecting the streams' river status (i.e., the National River Inventory status).

4.3.2.3 Conclusion

Constructing and operating the Project would result in short-term and long-term impacts on surface water resources. However, based on Jordan Cove's proposed dredging and vessel operation methods and its impact minimization and mitigation measures (including its implementation of erosion controls, dredging procedures, construction and stormwater management procedures, and construction timing), as well as Pacific Connector's proposed waterbody crossing and restoration methods and its impact minimization and mitigation measures, we conclude that the Project would result in short-term, localized, construction-related water quality impacts, but would not significantly affect surface water resources.

4.3.3 Wetlands

Wetlands are defined by the *Corps of Engineers Wetland Delineation Manual* (Environmental Laboratory 1987) as those areas that are inundated or saturated by surface or groundwater at a

[100] *Groundwater Supply and Mitigation Plan,* which was attached as Appendix F.2 of Resource Report 2, in Pacific Connector's September 2017 application to the FERC.

frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions.

Wetlands are regulated at the federal, state, and local level. At the federal level, wetlands may be deemed Waters of the United States (33 CFR 328.3) and may be subject to regulation through Sections 401 and 404 of the CWA. Section 401 of the CWA requires that proposed dredge and fill activities under Section 404 be reviewed and certified by the designated state agency and that the project meets state water quality standards. In this case, the ODEQ has been delegated this authority and is charged with verifying that the project meets state water quality standards. For activities that are not exempt, a federal permit pursuant to Section 404 of the CWA is required to discharge dredged or fill material into waters of the United States (33 CFR 328.3). In the state of Oregon, the COE administers the CWA 404 Program and evaluates applications for the discharge of dredged or fill material into waters of the United States. In Oregon, wetlands are also regulated at the state level by the ODSL and at the local level by some city and county land-use ordinances. ODSL administers Oregon's Removal-Fill Law (ORS 196.800) to protect waterways and wetlands (see sections 1.3.6 and 1.5.1 for additional details).

Through the state's notification process, provisions for wetlands are included under the ODF's Forest Practices Act and rules will be addressed, if applicable. Details would be submitted to the ODF in either a written plan or alternate plan to include specific provisions for meeting the Forest Practices Act, including those related to wetlands.

On federally managed land, EO 11990, amended in 42 U.S.C. 4321 *et seq.*, requires the federal agencies "to avoid adverse impacts associated with the destruction or modification of wetlands wherever there is a practicable alternative" and to "include all practicable measures to reduce harm to wetlands." Further, the agencies are required to preserve and enhance the natural and beneficial values of wetlands in carrying out their responsibilities.

The *Corps of Engineers Wetlands Delineation Manual* (Environmental Laboratory 1987), the *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Western Mountains, Valleys, and Coast Region* (COE 2010) and the *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Arid West Region (Version 2.0)* (COE 2008) provide the standards for wetlands determinations. Wetland delineations for the Project were conducted in accordance with these federal regulations and methodologies.

4.3.3.1 Jordan Cove LNG Project

Wetlands and estuarine habitats, as classified using the Cowardin classification system (Cowardin et al. 1979), identified during surveys of the terminal site and associated sites between 2013 and 2017 are shown in figure 4.3-1.[101] Wetlands and estuarine habitats identified in the area include estuarine subtidal, estuarine intertidal, palustrine unconsolidated bottom, palustrine aquatic bed, palustrine emergent, palustrine scrub-shrub, and palustrine forested wetlands.

[101] The COE reviewed Jordan Cove's 2013 and 2016 wetland delineation and determinations, and provided Preliminary Jurisdictional Determinations on March 13, 2014, October 28, 2014, and March 16, 2017. Requests for Preliminary Jurisdictional Determinations for delineations conducted in 2017 have been submitted to the COE. Additionally, because it has been several years since the Preliminary Jurisdictional Determinations have been issued, Jordan Cove has requested new or revised Jurisdictional Determinations from the COE.

Estuarine intertidal wetlands are intertidal systems that are regularly flooded and have an unconsolidated shore (i.e., tidal mud/sand flats). Vegetation in tidal flats, with the exception of sea grass beds and algal mats, is generally restricted to small areas of accretion in the tidal marsh-mudflat boundary (Seliskar and Gallagher 1983). Estuarine subtidal wetlands occur below mean low tide and are adjacent to tidal mudflats. Subtidal wetlands provide important ecological functions including providing fish and invertebrate shelter during low tides, supporting sea grass communities and acting as nursery areas for some aquatic species (ODFW 2017a). Estuarine wetlands within Coos Bay are characterized by sandy, muddy, or rocky substrates that are regularly inundated by brackish water and influenced by tidal flux, resulting in cycles of saturation and exposure. Plant life is not typically abundant within these types of wetlands, though macro- and microalgae and phytoplankton can be present. Estuarine intertidal and subtidal wetlands occur throughout Coos Bay.

Palustrine unconsolidated bottom wetlands are wetlands have less than 30 percent vegetation cover and a surface with less than 25 percent of the particles smaller than stones. The closely related aquatic bed wetland class has less than 30 percent vegetation cover of plants growing on or below the water's surface for most of the growing season. These wetland types occur along the South Dunes Site and the access/utility corridor.

Palustrine emergent wetlands are freshwater wetlands dominated by erect, rooted, herbaceous wetland plants that generally persist for most of the growing season. Plant species found in emergent wetlands on the Jordan Cove LNG Project area include slough sedge (*Carex obnupta*), Hooker's willow (*Salix hookeriana*), toad rush (*Juncus bufonius*), dagger-leaved rush (*Juncus ensifolius*), tinker's penny (*Hypericum anagalloides*), devil's beggartick (*Bidens frondosa*), knotgrass (*Paspalum distichum*), Yorkshire fog (*Holcus lanatus*), creeping bent-grass (*Agrostis stolonifera*), yellow pond lily (*Nuphar lutea* ssp. *polysepala*), and floating-leaved pondweed (*Potamogeton natans*). Emergent wetlands occur in various portions of the LNG Terminal site, as well as at the Kentuck project, Panhandle, and Lagoon sites.

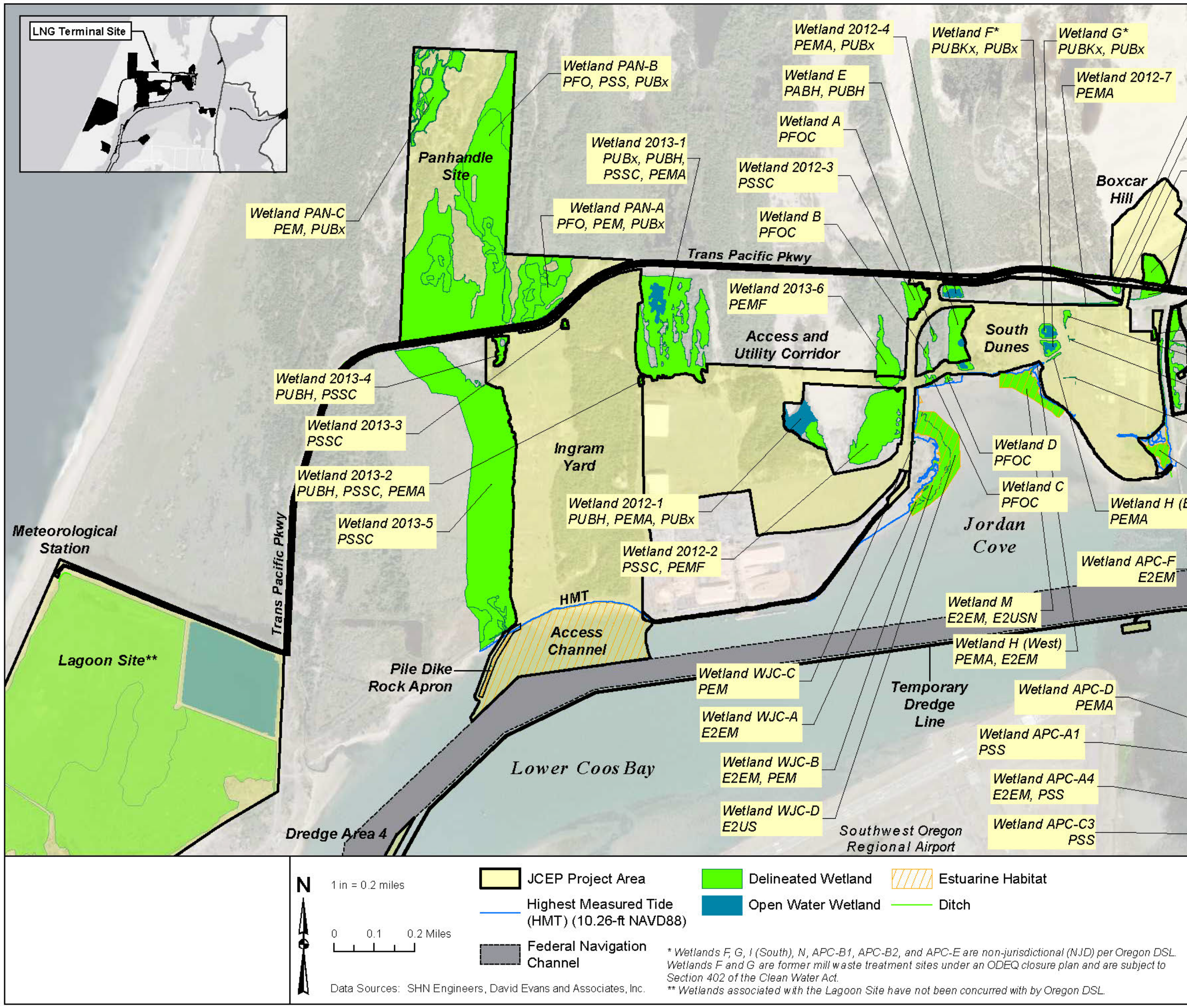
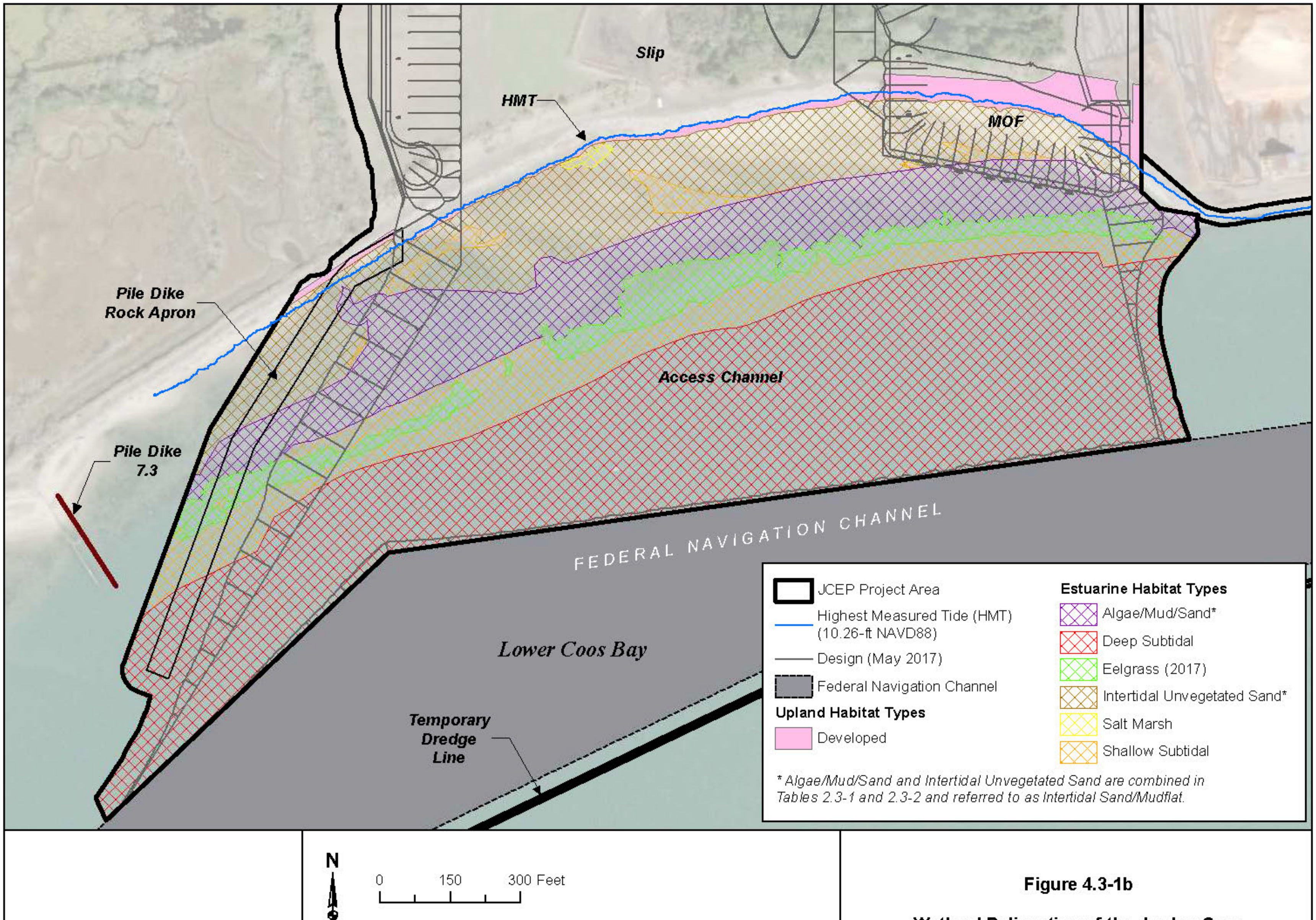


Figure 4.3-1a

Wetland Delineation of the Jordan Cove Project Area (LNG Terminal and APCO Sites)



Data Sources: SHN Engineers,
David Evans and Associates, Inc.

Figure 4.3-1b

Wetland Delineation of the Jordan Cove Project Area (Access Channel, MOF, and Pile Dike Rock Apron Estuarine Impacts)

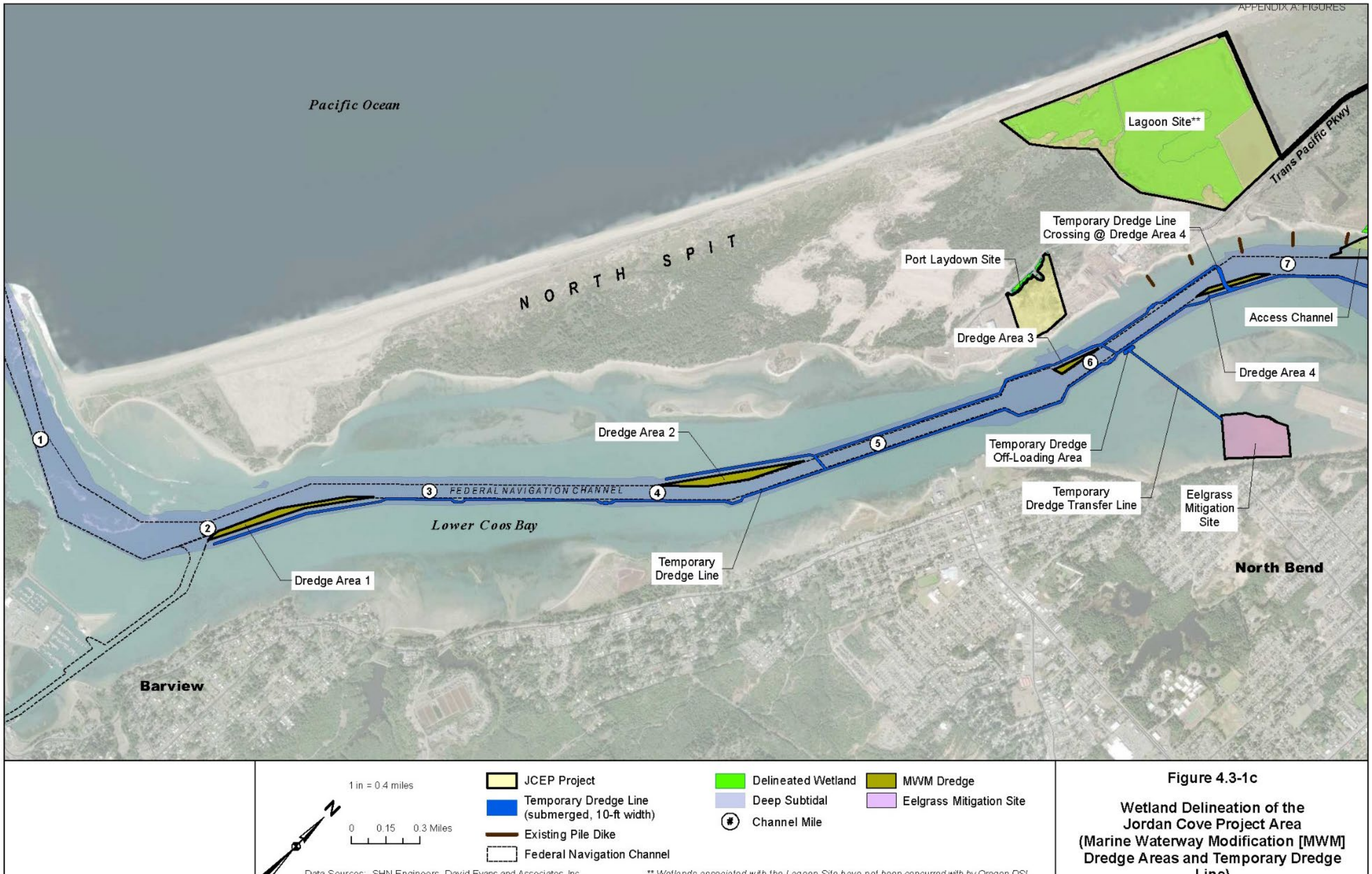
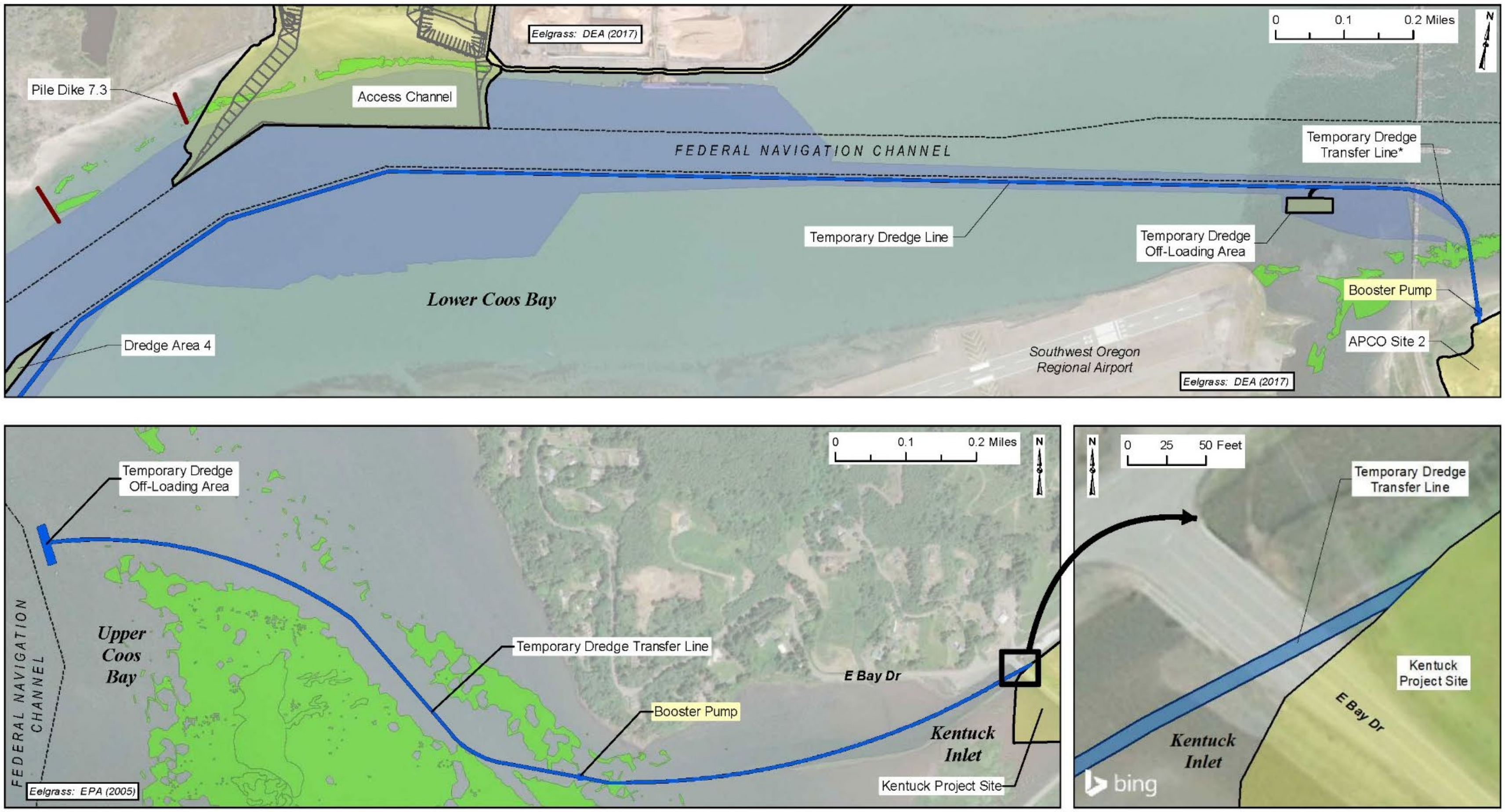


Figure 4.3-1c

Wetland Delineation of the Jordan Cove Project Area (Marine Waterway Modification [MWM] Dredge Areas and Temporary Dredge Line)



JCEP Project Area
Design (May 2017)
Temporary Dredge Line (submerged, 10-ft width)*
Existing Pile Dike
Federal Navigation Channel
Eelgrass
Deep Subtidal
Channel Mile

* Temporary Dredge Transfer Line will be suspended where it crosses the eelgrass at the entrance to APCO Site 2

Data Sources: SHN Engineers, David Evans and Associates, Inc.

Figure 4.3-1d

Wetland Delineation of the Jordan Cove Project Area (Temporary Dredge Line to APCO Site 2 and Kentuck Temporary Dredge Transfer Line)

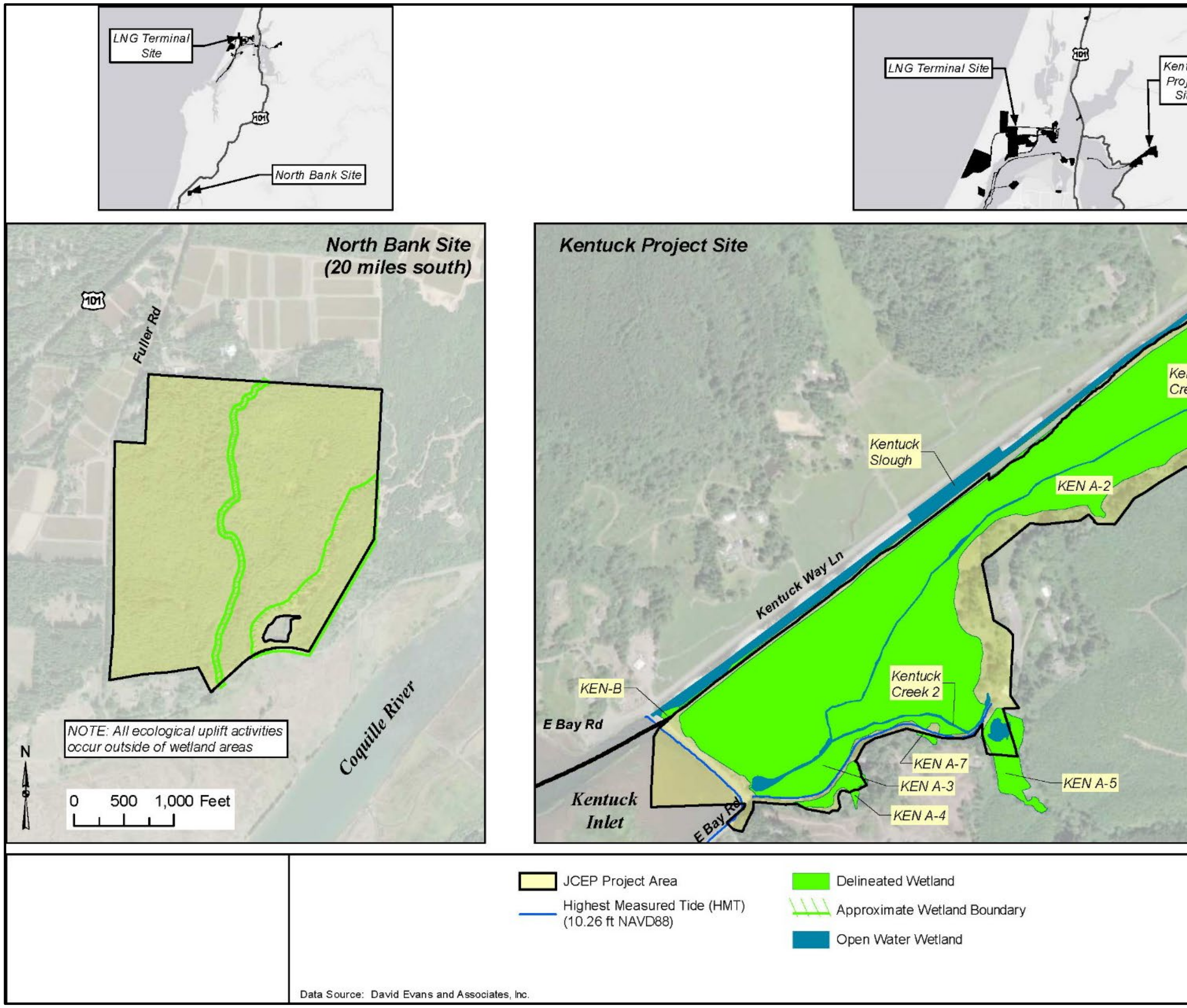
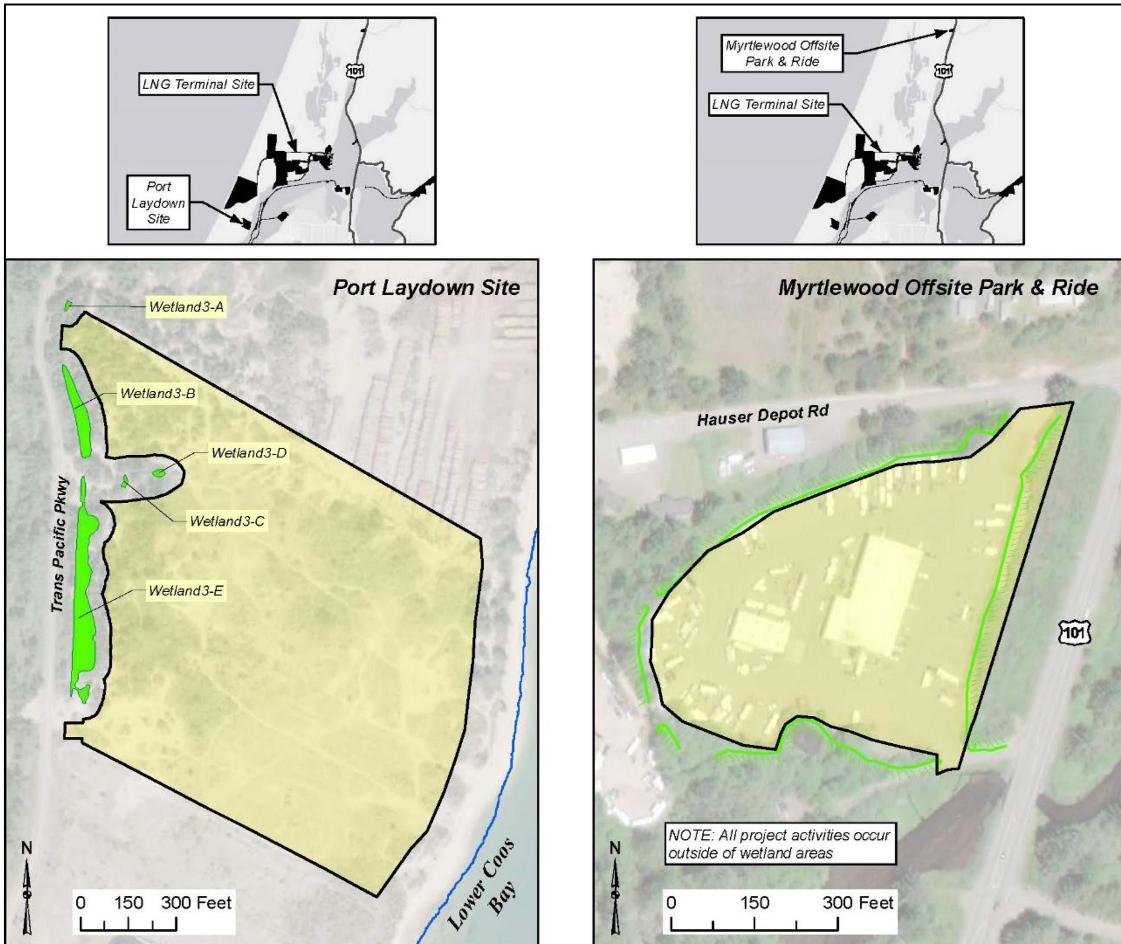


Figure 4.3-1e

Wetland Delineation of the Jordan Cove Project Area (North Bank and Kentuck Project Sites)



JCEP Project Area

Highest Measured Tide (HMT) (10.26 ft NAVD88)

Delineated Wetland

Approximate Wetland Boundary

Data Source: David Evans and Associates, Inc.

Figure 4.3-1f

Wetland Delineation of the Jordan Cove Project Area (Laydown and Park & Ride Sites)

Palustrine scrub-shrub wetlands are freshwater wetlands that include areas dominated by woody vegetation less than 20 feet tall and are vegetated with true shrubs, young trees, and trees or shrubs that are small or stunted because of environmental conditions. Species found within scrub-shrub wetlands on the LNG terminal area include Hooker's willow, Sitka willow (*Salix sitchensis*), Douglas spiraea (*Spiraea douglasii*), twinberry (*Lonicera involucrata*), slough sedge, soft rush (*Juncus effusus*), dagger-leaved rush, toad rush, western bent-grass (*Agrostis exarata*), creeping bent-grass, reed canary grass (*Phalaris arundinacea*), northern willowherb (*Epilobium ciliatum*), tall mannagrass (*Glyceria striata* [*G. elata*]), and lowland cudweed (*Gnaphalium palustre*). Scrub-shrub wetlands occur in the various portions of the LNG Terminal, Panhandle, and North Bank sites.

Palustrine forested wetlands are freshwater wetlands that contain woody vegetation that is 20 feet or taller. Coniferous species found in the forested wetlands on the LNG terminal area include shore pine (*Pinus contorta*), Douglas-fir (*Pseudotsuga menziesii*), Sitka spruce (*Picea sitchensis*), western hemlock (*Tsuga heterophylla*) and scattered Port-Orford cedar (*Chamaecyparis lawsoniana*). Shrubs within the forest wetland areas include scotch broom (*Cytisus scoparius*), coyote brush (*Baccharis pilularis*), hairy manzanita (*Arctostaphylos columbiana*), evergreen huckleberry (*Vaccinium ovatum*), salal (*Gaultheria shallon*), wax myrtle (*Morella* [*Myrica*] *californica*) and scattered rhododendron (*Rhododendron macrophyllum*). Herbaceous species include European beachgrass (*Ammophila arenaria*), silver hairgrass (*Aira caryophyllea*), little hairgrass (*A. praecox*), hairy cat's ear (*Hypochaeris radicata*), bracken fern (*Pteridium aquilinum*), sheep sorrel (*Rumex acetosella*), candy-stick (*Allotropa virgata*), and rattlesnake plantain (*Goodyera oblongifolia*). Forested wetlands occur in the north-central portion of the LNG Terminal site, near the access and utility corridor, on the eastern South Dunes area, and at the Kentuck project site.

Impacts and Mitigation

Table 4.3.3.1-1 identifies the wetlands located at Jordan Cove's terminal site and associated sites. Approximately 86.1 acres of wetlands would be affected by construction of the proposed Jordan Cove LNG Project and approximately 22.3 acres of wetlands would be permanently lost due to construction and operation of the Project (see table 4.3.3.1-1). Approximately 0.5 acre of this impact would occur to wetlands as a result on non-jurisdictional facilities (e.g., the Trans-Pacific Parkway/U.S. 101 intersection and the IWWP). The vast majority of impacts are associated with wetlands affected by construction of the ship and access channel and MOF and navigation reliability improvement dredge areas (which would impact 77.4 acres of wetlands and estuarine habitats).

TABLE 4.3.3.1-1

Wetlands and Estuarine Impacts on the LNG Project Area

Wetland or Estuarine Type	Acres Affected By Construction a/	Acres Affected By Operation
Slip and Access Channel and Material Offloading Facility (MOF)		
Estuarine b/, c/	37.3	18.3
Subtotal	**37.3**	**18.3**
Access /Utility Corridor		
Palustrine Emergent	0.8	0.6
Palustrine Scrub-Shrub	<0.1	<0.1
Subtotal	**0.9**	**0.6**
South Dunes Site		
Estuarine	0.1	0.1
Palustrine Aquatic Bed and Palustrine Unconsolidated Bottom	2.3	2.1

TABLE 4.3.3.1-1 (continued)

Wetlands and Estuarine Impacts on the LNG Project Area

Wetland or Estuarine Type	Acres Affected By Construction a/	Acres Affected By Operation
Palustrine Emergent	0.5	0.5
Palustrine Scrub-shrub	<0.1	<0.1
Palustrine Forested	0.3	0.3
Subtotal	**3.1**	**2.9**
Hydraulic Dredge Pipeline		
Estuarine	0.2	0.0
Subtotal	**0.2**	**0.0**
Industrial Wastewater Pipeline (IWWP)		
Palustrine Scrub-shrub	<0.1	0.0
Subtotal	**<0.1**	**0.0**
Trans Pacific Parkway/US-101 Intersection		
Estuarine	0.5	0.5
Subtotal	**0.5**	**0.5**
Marine Waterway Modifications – Dredge Areas 1 - 4 d/		
Estuarine c/	27.0	0.0
Subtotal	**27.0**	**0.0**
Marine Waterway Modifications – Temporary Dredge Line		
Estuarine b/, c/	13.1	0.0
Subtotal	**13.1**	**0.0**
APCO Site e/		
Estuarine	<0.1	0.0
Subtotal	**<0.1**	**0.0**
Temporary Dredge Off-loading Area at APCO Site		
Estuarine c/	0.9	0.0
Subtotal	**0.9**	**0.0**
Temporary Dredge Transfer Line and Off-loading Area at Kentuck Site f/		
Estuarine b/, c/	2.2	0.0
Subtotal	**2.2**	**0.0**
Temporary Dredge Transfer Line and Loading Area at Eelgrass Mitigation Site g/		
Estuarine b/, c/	1.1	0.0
Subtotal	**1.1**	**0.0**
Ingram Yard h/	0.0	0.0
Port Laydown Site h/	0.0	0.0
Additional Offsite Park & Ride h/	0.0	0.0
Myrtlewood Offsite Park & Ride h/	0.0	0.0
Subtotal	**0.0**	**0.0**
Total Freshwater Wetland Impacts	3.9	3.4 g/
Total Estuarine Wetland Impacts	82.2 b/	18.9
Total All Wetland Impacts	**86.1**	**22.3**

Note that values may not sum correctly due to rounding. Acreages for wetlands are rounded to the nearest tenth of an acre; values below 0.1 acre are noted as <0.1.

a/ Acres affected by construction include acres affected by operation.

b/ Acreage of eelgrass and adjacent estuarine habitats subject to change based on field mapping conducted in late August 2018, which is currently under review.

c/ Impacts on deep subtidal habitat are not expected during operation, because natural recovery of benthic communities within this habitat is expected within a relatively short time frame following construction.; therefore, impacts are recorded as construction-phase only.

d/ Additional subtidal habitat may be affected over a 6- to 8-year period from slope equilibration. Additional discussion of the effects of equilibration of subtidal habitat is provided in section 4.5.2.

e/ APCO Site wetland and estuarine construction impacts are due to temporary bridge pilings.

f/ Wetlands associated with proposed mitigation areas (Panhandle, Lagoon, North Bank upland mitigation sites; Kentuck project site and Eelgrass Mitigation site) are not included in this table. Some correlated impacts on wetlands would occur at the Kentuck project site, but they would be offset by the overall mitigation project. A full accounting of correlated impacts will be included in the 404 permit application submitted to the COE.

g/ There are no wetlands within Ingram Yard, Port Laydown site, or Myrtlewood Offsite Park & Ride.

h/ Total freshwater wetland acreage includes 0.3 acre of operational impacts on forested wetland.

To satisfy COE and state permitting, Jordan Cove assessed the function and values of wetlands permanently affected by the Jordan Cove LNG Project to determine high value wetlands. The criteria used to assess wetlands were their water quality and quantity, the value of their fish and wildlife habitat, their native plant communities and species diversity, and their value for recreation and educational purposes. Four wetlands (wetlands 2013-6, 2012-2, Wetland C, and Wetland E), totaling less than two acres, are considered high value wetlands. The COE may also require additional compensatory mitigation for impacts on Aquatic Resources of Special Concern (ARSC), which are defined as "aquatic resources that are unique, difficult to replace, and/or have high ecological function" (COE 2018). ARSCs that may be affected by the Jordan Cove LNG Project may include estuarine wetlands, rocky substrate in tidal waters, and native eelgrass (*Zostera marina*) beds. As identified above, constructing and operating the Jordan Cove LNG Project would temporarily and permanently impact wetlands. In addition to the permanent loss of wetlands, temporary impacts on wetlands include loss of vegetation, and modification of wetland hydrology and soils characteristics. Disturbed wetlands are also susceptible to the introduction of exotic and invasive plant species. Based on assessments evaluating impacts on wetland habitats from dewatering activities, it is expected that groundwater movement and levels would return to pre-disturbance conditions following construction (DEA 2015, 2018a; GSI 2017). While there may be effects to wetlands (e.g., short-term reduction in groundwater levels) these effects would be temporary and short-term. A monitoring program would be conducted prior to, during, and after construction to monitor potential impacts on ground and surface waters, as well as wetlands. In addition to impacts on wetlands listed in table 4.3.3.1-1, Henderson Marsh, which is located directly to the west of the terminal, may be affected due to changes in groundwater from construction of the slip, or from a minor reduction in water entering the marsh due to the construction of the tsunami berm on the west side of the slip.

Note that mitigation sites are not considered part of the proposed action and are proposed only as necessary compensation for unavoidable impacts.

Approximately 108.7 acres of wetland and estuarine habitats (6.0 acres of estuarine habitats and 102.7 acres of freshwater wetlands and open water) would be temporarily affected at the Kentuck project site in association with wetland restoration and mitigation activities. This includes 5.7 acres of permanent impacts (0.1 acre of estuarine habitats and 5.4 acres of freshwater wetlands). Potential impacts at the Kentuck project site include a temporary reduction in water quality due to an increase in sedimentation (e.g., resulting from import and grading of dredge material), temporary disturbances to adjacent wildlife, and a temporary impact on vegetation removed during restoration activities at the site. However, these impacts would be part of an overall long-term enhancement of the wetland habitat. Dredging for construction of the Eelgrass Mitigation site could result in approximately 10.3 acres of temporary short-term impacts on aquatic resources; potential impacts include a temporary reduction in water quality due to an increase in sedimentation during dredging activities and a temporary loss of benthic organisms. Benthic organisms could re-establish within the area once eelgrass revegetation was complete (see section 4.5 of this EIS). Additionally, eelgrass would be harvested from a nearby donor site and transplanted in the Eelgrass Mitigation site. Harvesting of eelgrass from this donor site would cause additional temporary short-term impacts on aquatic resources. Further details on the potential effects to eelgrass donor sites are discussed in section 4.5.2.

When unavoidable wetland impacts are proposed, the COE, EPA, and ODSL require that all practicable actions be taken to avoid, reduce, and then compensate for those impacts. The COE would determine the specific type and amount of compensatory mitigation that would be required to offset the loss of wetland acreage and functions that cannot be avoided or reduced as part of the

CWA Section 404 permit process and by the ODSL as part of the state Removal-Fill permit process.[102]

Prior to COE authorization, the COE must ensure aquatic resource impact avoidance and minimization have been identified, outlined, and promulgated by an applicant. The COE uses a mitigation sequence to assess the need for aquatic resource impacts. This mitigation sequence contains a primary structure centered on avoidance of aquatic resource impacts, minimization of aquatic resource impacts, restoration of aquatic resource functions and services, and compensation for the loss of aquatic resource impacts that could not be avoided. If, after outlining project aquatic resource avoidance and minimization to the degree practicable, an applicant may mitigate for subsequent aquatic resource impacts. Compensatory mitigation is typically accomplished through the following three ways: mitigation banks, in-lieu fee mitigation, and permittee-responsible mitigation. Due to limitations regarding the availability of mitigation banks and in-lieu fee options within the Project area, the Applicant is proposing permittee-responsible mitigation. The use of permittee-responsible mitigation requires the development of a project-specific compensatory mitigation plan. A compensatory mitigation plan must be developed to meet the requirements of the 2008 Compensatory Mitigation Rule as outlined in the Final Rule on Compensatory Mitigation for Losses of Aquatic Resources (73 [70] FR 19594-19705 [April 10, 2008]) and in 33 CFR Part 232.4.

A compensatory mitigation plan must replace lost aquatic functions and values, and must contain the following required components:

- goals and objectives;
- site selection criteria;
- site protection instrument;
- baseline environmental information;
- determination of credit methodology;
- mitigation work plan;
- maintenance plan;
- performance standards;
- monitoring requirements;
- long-term management plan;
- adaptive management plan; and
- financial assurances.

Jordan Cove developed a *Compensatory Wetland Mitigation Plan* to address unavoidable impacts on wetlands and other aquatic resource types.[103] Impacts on freshwater wetland resources would be mitigated via the Kentuck project site. Approximately 9.1 acres of the Kentuck project site would be enhanced and restored to mitigate for permanent impacts on freshwater wetlands (see Table 4 of Jordan Cove's *Compensatory Wetland Mitigation Plan*). Impacts on estuarine wetland and aquatic resources would be mitigated via the Eelgrass Mitigation site and Kentuck project site. Approximately 100.6 acres would be enhanced and restored at the Kentuck project site, and

[102] The Oregon International Port of Coos Bay received a removal-fill permit from the ODSL to construct the slip and access channel for development of a new terminal (DSL permit 37712-RF). A new application will be submitted to ODSL for the remaining portions of the Jordan Cove Project area not covered by ODSL permit 37712-RF. A permit application that covers the entire Jordan Cove Project area will also be submitted to the COE.

[103] See *Jordan Cove Energy Project Compensatory Wetland Mitigation Plan* filed with the FERC in January 2019.

approximately 9.3 acres would be enhanced at the Eelgrass Mitigation site for a total of approximately 109.9 acres of mitigation for permanent impacts on estuarine wetlands and aquatic resources (see Table 4 of Jordan Cove's *Compensatory Wetland Mitigation Plan*). As noted in the *Compensatory Wetland Mitigation Plan, i*n addition to the Eelgrass Mitigation site, eelgrass would be removed from the access channel prior to dredging and transplanted into the Jordan Cove embayment. The Jordan Cove embayment is a shallow, low-gradient embayment with continuous to patchy eelgrass beds, located approximately 0.5 mile east of the access channel.

The *Compensatory Wetland Mitigation Plan* is still being reviewed by the COE, ODSL, and applicable federal and state agencies. Approval of this mitigation plan by these agencies would be required prior to issuance of federal and state wetland permits. Restoration and development efforts at the Kentuck project and Eelgrass Mitigation sites required to ensure the viability of the sites would result in some short-term and permanent impacts including potential reduced local dissolved oxygen levels at the Kentuck site when initially opening the area to marine waters from potential high biological oxygen demand in existing marsh areas. However, the *Compensatory Wetland Mitigation Plan* accounts for these impacts and provides mitigation to offset these impacts. Final approval of this plan would require both state and federal permit approvals, which may impose additional specific requirements, including monitoring of adjacent off-site wetlands.

4.3.3.2 Pacific Connector Pipeline Project

Pacific Connector conducted wetland delineations of pipeline related workspaces. For areas where on-site delineation was not possible due to lack of landowner permission, Pacific Connector used USGS topographic maps, NRCS soil surveys, FWS NWI maps, and aerial photography to identify wetland type and boundaries. Wetland types identified along the proposed route included estuarine intertidal flats, estuarine subtidal channels, estuarine emergent, palustrine unconsolidated bottom, palustrine aquatic bed, palustrine emergent, palustrine scrub-shrub, palustrine forested, and riverine.

Along the proposed pipeline route, PEM wetlands, which are commonly disturbed by agricultural and grazing activities, are dominated by hydrophytic pasture grasses such as meadow foxtail (*Alopecurus pratensis*), rough bluegrass (*Poa trivialis*), and various bentgrasses (*Agrostis* spp.). Soft rush and white clover (*Trifolium repens*) are also commonly present in these disturbed wetlands. Within Douglas and Jackson Counties, pennyroyal (*Mentha pulegium*) is also a common dominant species in emergent wetlands. Emergent wetlands dominated by native species are uncommon, but when they occur (primarily within swales and irrigation canals) they generally contain cattail (*Typha latifolia*), small-fruited bulrush (*Scirpus microcarpus*), hardstem bulrush (*Schoenoplectus* [*Scirpus*] *acutus*), manna grass (*Glyceria striata* [*G. elata*]), American sloughgrass (*Beckmannia syzigachne*), and various sedges (*Carex* spp.). Vernal pool wetlands, which occur along the proposed pipeline route, are also defined as palustrine emergent wetlands.

Scrub-shrub wetland communities along the proposed pipeline route consist of two primary types: disturbed wetlands associated with grazing or development activities and relatively undisturbed wetlands. Common species within disturbed wetlands tend to support invasive species such as Himalayan blackberry (*Rubus laciniatus*) and sweetbriar rose (*Rosa rubiginosa* [*R. eglanteria*]). Common species in undisturbed wetlands include a mixture of Douglas' spirea, Pacific willow (*Salix lasiandra*), salmonberry (*Rubus spectabilis*), and Pacific ninebark (*Physocarpus capitatus*).

The majority of delineated forested wetlands along the proposed pipeline route contain Oregon ash (*Fraxinus latifolia*). Red alder (*Alnus rubra*) and black cottonwood (*Populus trichocarpa*) are more common along the western part of the pipeline route in Coos and Douglas Counties. Western red-cedar (*Thuja plicata*) and Sitka spruce are common in the coast range forested wetlands. Skunk cabbage (*Lysichiton americanum*) and salmonberry are common in the understory of coast range forested wetlands and lady fern (*Athyrium filix-femina*) and horsetails (*Equisetum* spp.) are often present in the understory in other parts of the pipeline route. Forested wetlands are uncommon along the southeastern portions of the pipeline route, but are generally in swales or depressions. They are dominated by Oregon ash with an understory of Himalayan blackberry, slough sedge, and spreading rush (*Juncus patens*).

Riverine wetlands are freshwater wetland habitats contained within a channel. The riverine wetlands along the proposed pipeline route include species similar to those found in the palustrine emergent, scrub-shrub, and forested wetlands.

Intertidal flats are the predominant estuarine wetland type crossed by the pipeline route. These wetlands are intertidal systems that are regularly flooded and have an unconsolidated shore (i.e., tidal mud/sand flats). Vegetation in estuarine tidal flats, with the exception of sea grass beds and algal mats, is generally restricted to small areas of accretion in the tidal marsh-mudflat boundary (Seliskar and Gallagher 1983). Estuarine subtidal channels occur below mean low tide and are adjacent to tidal mudflats. Subtidal channels provide important ecological functions including providing fish and invertebrate shelter during low tides, supporting sea grass communities and acting as nursery areas for some aquatic species (ODFW 2017a).

Estuarine emergent wetlands, also called estuarine marshes, occur along the outer edges of the tidal mudflats. Vegetation in these wetlands are typically erect, perennial species such as arrow grasses (*Triclochin* spp.), cordgrasses (*Spartina* spp.), bulrushes (*Scirpus* spp.), and alkali grasses (*Puccinellia* spp.).

Impacts and Mitigation

Constructing the pipeline would temporarily and permanently impact wetlands. Clearing wetland vegetation could alter several wetland functions including their ability to provide fish and wildlife habitats, sediment and nutrient trapping, and other water quality functions. Additionally, soil disturbance and removal of vegetation could temporarily affect a wetland's capacity to moderate flood flow, control sediment, or facilitate surface water flow. Removing vegetation could also increase water and soil temperatures and alter species composition within forested and shrub wetlands to a more shade intolerant composition. Digging a trench through an impervious layer of soil in a wetland would alter the hydrologic character of the wetland. Failure to segregate topsoil from the trench could result in altered biological and chemical functions in the wetland soil and could affect the re-establishment of vegetation, recruitment of native vegetation, or success of plantings. Improper operation of equipment or transport of pipe in wetlands could inadvertently rut or compact the soil and affect natural hydrologic patterns of the wetlands and may lead to inhibited seed germination or increase the potential for siltation. Improper sediment controls could lead to sediment deposition in wetlands (including those wetlands located downslope or outside of the right-of-way or construction disturbance footprint), which could lead to the release of chemical and nutrient pollutants from sediments.

The range and intensity of wetland impacts would vary depending on the type of wetland affected. In general, impacts on herbaceous wetlands would be short term, while impacts on scrub-shrub and forested wetlands would be long term. Impacts on herbaceous wetlands would be considered short term because herbaceous vegetation generally regenerates quickly. Scrub-shrub and forested wetlands may take several years to decades to reach functionality similar to pre-construction conditions, depending on the age and complexity of the system. Also, some wetlands would be permanently converted from one type to another (e.g., forested to scrub-shrub and/or herbaceous) as a result of pipeline maintenance activities.

As identified in table 4.3.3.2-1, constructing the pipeline would impact about 114 acres of wetlands. Of this 114 acres, operation of the pipeline would permanently impact approximately 4.9 acres of wetlands. This includes 4.0 acres of long-term impacts on scrub-shrub and forested wetlands and 0.9 acres of wetlands that would be permanently converted to a different wetland type. Tables H-1a and H-1b in appendix H of this EIS list the wetlands crossed by the pipeline by wetland type, ecoregion, subbasin, and fifth-field watershed, and list the acres of impacts that would occur to each of these wetlands.

TABLE 4.3.3.2-1

Summary of Wetland Impacts along the Pacific Connector Pipeline

Wetland Type	Total Acres Affected by Construction	Total Acres Affected by Operation a/, b/
Palustrine unconsolidated bottom and aquatic beds	0.6	0.0
Palustrine emergent wetlands	108.6	0.0
Palustrine forested wetlands	2.6	2.6 (0.7)
Palustrine scrub-shrub wetlands	2.3	2.3 (0.2)
Total Wetland Impact	**114.1**	**4.9 (0.9)**

Note that values may not sum correctly due to rounding. Acreages for wetlands are rounded to the nearest tenth of an acre; values below 0.1 acre are noted as <0.1.

a/ Includes palustrine forested and palustrine scrub-shrub wetlands that would be allowed to restore to preconstruction conditions (i.e., they would not be filled, nor would they be located within the permanent 10-foot-wide operational corridor); however, it could take many decades for conditions within these wetlands to restore to preconstruction conditions. Does not include impacts on palustrine emergent wetlands as these wetlands would return to preconstruction conditions relatively quickly after completion of construction.

b/ The numbers in parentheses represent the permanent conversion of forested wetlands within the 30-foot-wide maintenance corridor and scrub-shrub wetlands within the 10-foot-wide maintenance corridor; this number corresponds to the wetland effects reported in tables 4.4.2.4-2 and 4.5.1.2-6 of sections 4.4 and 4.5, respectively.

The pipeline would cross 19 (fifth-field) watersheds; however, approximately 78 percent (87.3 acres) of the pipeline's total impact on wetlands would occur in two watersheds: the Lake Ewauna Upper Klamath River watershed and the Coos Bay Frontal watershed. The remaining 24.9 acres of wetland impacts would occur primarily in small palustrine emergent wetlands and intermittent drainages where impacts would be temporary and short term. As described previously, to satisfy COE and state permitting, Pacific Connecter assessed the function and values of wetlands to determine which affected wetlands were high value wetlands. Constructing the pipeline would temporarily impact approximately 7.1 acres of high value wetlands, with the majority of these impacts (about 4.1 acres) occurring to two palustrine emergent wetlands (Wetland ID EW-33 and EW-35) associated with the floodplain of Salt Creek in Jackson County. Of the 7.1 acres of impacts on high-value wetlands, operation of the pipeline would permanently impact approximately 0.3 acre. As stated above, the COE may also require additional compensatory mitigation for impacts on ARSCs (COE 2018). ARSCs that may be affected by the proposed pipeline include alkali wetlands, mature forested wetlands, vernal pools, and Willamette Valley wet prairie wetlands.

To reduce impacts on wetlands, Pacific Connector would implement the construction and restoration measures contained in its ECRP. Section VI.A.3 of the FERC's *Procedures* requires that the construction right-of-way width be limited to 75 feet across wetlands, while Section VI.B.1.a requires that TEWAs be located at least 50 feet away from wetland boundaries. However, Pacific Connector has submitted modifications for these requirements associated with where the Applicant requested a 95-foot-wide construction right-of-way in a wetland or that TEWAs be located less than 50 feet away from a wetland (table E-1 in appendix E). Their justifications for the modifications at specific locations vary, but include reasons such as: 1) necking-down the right-of-way in emergent wetland would require use of TEWAs that would be located 50 feet back from the waterbody, which could result in these work areas being located within forested or shrub wetlands that can have a higher function and value than the disturbed emergent wetland, and 2) where the pipeline traverses disturbed emergent wetlands, such as in agricultural areas (cropland and hayfields), the typical 95-foot-wide construction footprint in uplands will be maintained because these wetlands are degraded systems that are expected to fully recover within one full growing season. Pacific Connector's proposed modifications to FERC's *Plan* and *Procedures* are provided in appendix E (also see discussion in section 2). Based on our *Procedures* and as described in its ECRP, Pacific Connector would implement the following measures in wetlands:

- the top 1 foot of topsoil would be segregated from the subsoil in the area disturbed by trenching, except where standing water is present, or soils are saturated or frozen. Immediately after backfilling, the segregated soil would be restored to its original location;
- vegetation would be cut just above ground level to leave the existing root system in place. Tree stump removal and grading would occur directly over the trenchline. Stumps would not be removed from the rest of the right-of-way unless required for safety reasons;
- construction equipment operating would be limited to that needed to clear vegetation, dig trenches, install the pipe, backfill, and restore the right-of-way. Other equipment would use upland access roads to the maximum extent possible. Travel would be restricted across wetlands where topsoil was restored;
- low ground-weight equipment would be used in saturated wetlands or the normal equipment would be operated on prefabricated equipment mats;
- slope breakers and sediment controls would be installed and maintained on slopes greater than 5 percent that are less than 50 feet from a wetland;
- erosion control devices would be installed and maintained as necessary to prevent sedimentation and runoff from entering wetlands;
- trench breakers would be installed, or the bottom of the trench would be sealed as necessary, to maintain the original wetland hydrology;
- appropriate weed-free live seed mixtures would be used for revegetation. No fertilizers would be used in wetlands;
- appropriate native trees and shrubs would be replanted during restoration of wetlands within riparian areas;
- wetlands would be monitored after revegetation for three years after construction or until the revegetation is successful. Revegetation would be considered successful when 80 percent of the type, density, and distribution of species are similar to that of adjacent

unaltered wetlands. If revegetation is not successful at the end of three years, Pacific Connector would develop and implement a remedial revegetation plan to actively revegetate the wetland and would continue revegetation efforts until wetland revegetation is successful; and

- vegetation maintenance would not be conducted over the full width of the operational right-of-way within wetlands, but limited to a 10-foot-wide corridor.[104]

The COE and ODSL may require additional mitigation (beyond what is required in this EIS) during their permitting process, which could include creating, restoring, or enhancing wetlands to replace the wetland functions and areas connectivity lost due to Project activities, or purchasing credits from a mitigation bank. ODSL administrative rules (OAR 141-085-0690) include minimum ratios for acres required for compensation that varies by type of mitigation proposed (e.g., restoration is 1 acre for each acre lost, creation is 1.5 for 1, and enhancement is 3 for 1). Pacific Connector has developed a *Compensatory Wetland Mitigation Plan* to mitigate for unavoidable impacts on wetlands affected by construction and operation of the pipeline (see section 4.3.3.1). The adequacy of wetland mitigation, including the scope and location of mitigation, would be determined by the COE.

4.3.3.3 Conclusion

In total, the Project would impact approximately 198 acres of wetlands, about 27 acres of which would be permanently lost. Based on our review of the Project and Jordan Cove and Pacific Connector's implementation of measures to reduce impacts on wetlands, we conclude that constructing and operating the Project would not significantly affect wetlands. Additionally, to mitigate wetlands impacts, Jordan Cove and Pacific Connector have prepared a Compensatory Wetland Mitigation Plan.

4.3.4 Environmental Consequences on Federal Lands

4.3.4.1 Groundwater

Shallow Groundwater

As indicated in section 4.3.1.2, the Pacific Connector Pipeline Project would cross areas where the groundwater is 0-6 feet bgs. The BLM and Forest Service may require that trench dewatering through a well point pumping system with a groundwater treatment plan be used, depending on if the groundwater is emanating from a pressurized or non-pressurized source point. On federal lands, dewatering activities would be coordinated with the BLM or Forest Service.

Springs, Seeps, and Drains

Pacific Connector surveys have identified a number of springs and seeps, as noted in appendix H of this EIS. Pacific Connector has stated that it would further verify exact locations of springs and seeps during easement negotiations with land managers. Nearby springs and seeps supplied by deeper pressurized groundwater zones would generally not be affected by the trenching activities

[104] Additionally, trees may be selectively removed if they are within 15 feet of the pipeline that could compromise the pipeline coating integrity.

or trench plugs. Spring and seeps supplied by shallow groundwater, however, may be effected by the pipeline project, particularly if the pipeline is directly up-gradient of a spring or seep location.

The BLM has disclosed that French drains, similar in function to drain tiles, were installed to stabilize Elk Creek Road, which the proposed route would cross six times between MPs 34.02 and 37.15. These crossings are all within BLM lands. Pacific Connector would ensure that any French drains damaged by the pipeline would be repaired before backfilling. If either damage or repair causes a discharge to waterways under federal jurisdiction, a water quality permit would be required under Section 404 of the CWA. All French drains crossed by the Pacific Connector pipeline would be probed prior to right-of-way restoration to check for damage, and a qualified specialist would test for damage and conduct any necessary repairs. Pacific Connector would restore any damaged drains to the same condition that existed prior to construction. In order to identify, monitor, minimize, and mitigate for potential effects to groundwater, Pacific Connector has developed a *Groundwater Supply Monitoring and Mitigation Plan*. Land managers would be supplied with documentation that explains the pipeline construction Project and outlines the pre-construction field investigation for the identification and monitoring of groundwater supplies. Pre-construction surveys would be conducted to confirm the presence and locations of all groundwater supplies within and adjacent to the pipeline right-of-way.

Soil Compaction

Near-surface soil compaction caused by heavy construction vehicles could locally reduce the soil's ability to absorb water, which would increase surface runoff and the potential for ponding. To avoid long-term changes in water table elevation and subsurface hydrology, excavated topsoil and subsoils would be segregated (on non-federal lands) within wetlands, agricultural areas, and at the request of landowners, and returned as closely as practical to their original soil horizon and slope position. Following construction, restoration of compacted soils would include regrading, recontouring, scarifying (or ripping), and final cleanup activities. Decompacting soils would restore water infiltration, reduce surface water runoff, reduce erosion, and support revegetation efforts. The EI would be responsible for conducting soil compaction testing and determining corrective measures on non-federal lands, including localized deep scarification or ripping to an average depth of up to 8 inches where feasible, utilizing appropriate winged-tipped rippers. On federal lands, remediation and corrective measures to address compaction would be consistent with specific requirements of the BLM RMP best management practices (e.g., R-91, TH-18) and Forest Service requirements (see NSR 2015a for details).

Accidental Spills of Hazardous Materials

Pipeline construction necessitates the use of heavy equipment and associated fuels, lubricants, and other potentially hazardous substances that, if spilled, could affect shallow groundwater and/or unconsolidated aquifers, throughout different aquifer layers. Accidental spills or leaks of hazardous materials associated with vehicle fueling, vehicle maintenance, and construction materials storage would present the greatest potential contamination threat to groundwater resources. Soil contamination resulting from these spills or leaks could continue to add pollutants to the groundwater long after a spill occurs. Implementation of proper storage, containment, and handling procedures would reduce the chance of such releases. Pacific Connector will follow the procedures outline in the *SPCC Plan* to reduce the potential of a spill, properly contain a spill in the event that one occurs, and to protect areas of environmental concern.

4.3.4.2 Surface Water

The Pacific Connector pipeline route would cross 19 fifth-field watersheds, and proposed access roads would cross an additional 5 watersheds. Of these, the Pacific Connector would cross NFS land in 6 fifth-field watersheds subject to ACS.

Riparian Reserves and the ACS

The 1994 NWFP set forth detailed requirements that describe how land managers should treat the forest lands within the range of the northern spotted owl (through implementation of the Standards and Guidelines – Attachment A to the 1994 NWFP ROD [Forest Service and BLM 1994a]). Some standards and guidelines apply to all lands and others to a specific land allocation. The 1994 NWFP ROD described the ACS, which was developed to restore and maintain the ecological health of watersheds and aquatic ecosystems contained within them on public lands. The strategy would protect salmon and steelhead habitat on federal lands managed by the Forest Service within the range of the NSO. In August 2016, the BLM issued two RODs for two new RMPs (BLM 2016a and 2016b). These two plans supersede the NWFP on BLM lands. BLM retained a Riparian Reserve allocation but provided new management direction, thus eliminating the ACS requirements on BLM lands. The following discussion is specific to the Forest Service.

To achieve ACS objectives in the 1994 NWFP ROD, the ACS included areas defined as Riparian Reserves and Key Watersheds, specified analytical procedures for evaluating watersheds, and defined a program for watershed restoration. While the ACS focus was primarily on the conservation of anadromous salmon and steelhead, the nine objectives listed for the ACS include maintaining and restoring aquatic systems, floodplains, wetlands, upslope habitats, and riparian zones to support invertebrate and vertebrate species dependent on those habitats.

The existing conditions and range of variability within the fifth-field watersheds that would be crossed by the Pacific Connector pipeline are provided in the watershed analyses that were prepared by the Forest Service having jurisdiction over the NFS lands within the watersheds. Watershed assessments are a necessary component of a monitoring program in order to determine what degraded or impaired areas may exist in the watershed. Table 4.3.4.2-1 lists the fifth-field watersheds subject to ACS that would be crossed by the proposed route.

TABLE 4.3.4.2-1

Fifth-Field Watersheds Crossed by the Pacific Connector Pipeline on Forest Service Lands

Jurisdiction	Watershed (Name)	Approximate Miles Crossed	Watershed Analysis Completed
Forest Service – Umpqua National Forest (NF)	Days Creek-South Umpqua River a/	1.6	2001
	Elk Creek a/	2.7	1995 a/
	Upper Cow Creek a/	4.5	1995 a/
	Trail Creek a/	2.1	1995 a/
Forest Service – Rogue River NF	Little Butte Creek	13.8	1997
Forest Service –Winema NF	Spencer Creek	6.0	1995
	Total Watersheds Crossed on NFS Lands	**30.8**	

Note that mileages may not sum correctly due to rounding. Mileages are rounded to the nearest tenth of a unit; values below 0.1 are noted as <0.1.
Source: BLM 2006; Forest Service 2006a
a/ The Elk Creek Watershed Analysis (Forest Service 1996) and the Cow Creek Watershed Analysis (Forest Service 1995a) encompass the Umpqua National Forest lands crossed by the pipeline.

The following subsection discusses acres of impacts on Key Watersheds and the mitigation measures that would be implemented on NFS land to compensate for impacts. Key Watersheds are defined as either Tier 1 or Tier 2. Tier 1 (Aquatic Conservation Emphasis) Key Watersheds contribute directly to conservation of at-risk anadromous salmonids, bull trout, and resident fish species. They also have a high potential of being restored as part of a watershed restoration program. While Tier 2 (other) Key Watersheds may not contain at-risk fish stocks, they are important sources of high-quality water. Riparian Reserves are lands along streams, wetlands, ponds, lakes, reservoirs and unstable and potentially unstable areas where special standards and guidelines direct land use on NFS lands.

Four watersheds that encompass NFS lands that would be crossed by the Pacific Connector pipeline are designated as Key Watersheds: (1) Days Creek-South Umpqua River (Tier 1); (2) Elk Creek-South Umpqua River (Tier 1); (3) Little Butte Creek; and (4) Spencer Creek (Tier 1. Key Watersheds that would be crossed by the Pacific Connector pipeline are listed in table 4.3.4.2-2.

TABLE 4.3.4.2-2

Key Watersheds Crossed by the Proposed Pacific Connector Pipeline

Key Watershed	Jurisdiction	Approximate Miles Crossed	Approximate Construction Disturbance (acres) a/	Approximate Operational Easement (acres) b/
Days Creek-South Umpqua River (Tier 1), MP 82.71-102.59	Umpqua National Forest	1.56	53	10
Elk Creek-South Umpqua River (Tier 1), MP 101.8-109	Umpqua National Forest	2.67	30	16
Little Butte Creek (Tier 1), MP 135.04-168	Rogue River National Forest	13.87	281	83
Spence Creek (Tier 1), MP 168-183.02	Winema National Forest	6.05	92	37
	Total	**24**	**456**	**147**

Note that values may not sum correctly due to rounding. Mileages are rounded to the nearest tenth of a unit; values below 0.1 are noted as <0.1. Acreages are rounded to the nearest whole acre; values less than 1 are noted as <1.
a/ Includes construction right-of-way, TEWAs, UCSAs, TARs, and rock source.
b/ Assumes 50-foot-wide long-term easement.

The pipeline would not cross any roadless areas and would not require any new roads to be constructed within Tier 1 Watersheds. Although the pipeline would cause temporary disturbance within Tier 1 watersheds, all disturbed areas associated with the pipeline would be restored after construction. No adverse, long-term effects are anticipated to the water resources. The 30-foot operational maintenance corridor along the pipeline centerline would create a long-term vegetation type conversion impact within forested vegetation types, but the vegetation conversion is not expected to measurably alter hydrologic functions. Restoration of all areas disturbed by the Pacific Connector pipeline would include shaping to the approximate original contour to restore drainage patterns, scarification to relieve compaction, and revegetation for stabilization and to restore habitats and land use functions. The compensatory mitigation measures outlined for LSRs and Riparian Reserves on NFS lands would benefit Key Watersheds if the mitigation projects such as road decommissioning occur within these watersheds.

On NFS lands where Riparian Reserves would be affected, up to a 100-foot riparian strip or to the edge of the existing riparian vegetation would be planted to ensure that the "maintain and restore" objectives of the ACS are accomplished for native riparian vegetation.

Impacts on Streams on Federal Lands

Temporary Equipment Crossings

For any temporary equipment crossings on any stream channel (whether intermittent or perennial, wet or dry) on federal lands, equipment crossings must be accomplished using (1) a bridge, (2) a temporary culvert with temporary road fill to be removed after work is completed, or (3) a low water ford with a rock mat. Although the FERC's *Procedures* allow clearing equipment and equipment necessary for installation of the temporary bridges to cross waterbodies prior to bridge installation, Pacific Connector would not allow clearing equipment to cross waterbodies prior to bridge placement. Furthermore, where feasible, Pacific Connector's contractor would attempt to lift, span, and set the bridges from the streambanks. Where it is not feasible to install or safely set the temporary bridges from the streambanks, only the equipment necessary to install the bridge or temporary support pier would cross the waterbody. Any equipment required to enter a waterbody to set a bridge would be inspected to ensure it is clean and free of dirt or hydrocarbons.

No waterbodies or riparian reserves on federal lands would be affected by temporary or permanent access roads.

Water Use During Pipeline Construction

Water withdrawals and releases on federal lands for dust suppression or hydrostatic testing would require site-specific approval from the agency that manages the specific water resources (federal or state). Site-specific approval by the authorized Forest Service officer on NFS lands, and similar authorizations by BLM and Reclamation would be coordinated through the development of the POD to support the Right-of-Way Grant. Withdrawals and releases of hydrostatic test water would be done in accordance with Pacific Connector's *Hydrostatic Test Plan*, included with the POD.

Potential Encounters with Contaminated Sediments

On federal land, hazardous substances, including chemicals, oils, and fuels, would not be stored within 150 feet of a waterbody or wetland boundary. As noted in the ECRP, any variance on federal lands would require prior approval by an authorized agency representative. In instances where it is not possible to maintain the 150-foot distance, the EI would request a variance that would require approval from the authorized agency representative. To reduce impacts from potential encounters with contaminated sediments, Pacific Connector would implement the measures outlined in its *Contaminated Substances Discovery Plan,* which was included as part of its SPCC Plan.

East Fork Cow Creek Crossing

The Forest Service expressed concerns about the potential for naturally occurring mercury to reach the aquatic environment during construction of the pipeline near the historic Thomason claim group (near MP 109). To address this concern, Pacific Connector conducted a mine hazard evaluation and mercury testing study for the proposed 2007 route on the Umpqua National Forest at the crossing of East Fork Cow Creek, which crossed the Thomason claim group (GeoEngineers

2007b).[105] Soil samples were collected along the proposed alignment in an area believed to be outside the zone of mineralization where mercury deposits occur, in the stream system in the vicinity of the East Fork of Cow Creek, and from mine workings in proximity to the Pacific Connector right-of-way in 2007. The samples did not contain concentrations of mercury that exceeded human health risk screening criteria.

Subsequently, Pacific Connector moved its proposed route to the east to avoid a NSO nest site. GeoEngineers (2009)[106] conducted an additional assessment of the relocated route, approximately 3,300 feet upstream and east of the original 2007 crossing to address the continued concerns of the Forest Service regarding the potential for naturally-occurring mercury within the East Fork Cow Creek drainage. That study concluded that the soils underlying the current proposed crossing of East Fork Cow Creek are unlikely to have concentrations of naturally occurring mercury exceeding those measured in samples obtained from the previous 2007 crossing location and most likely will have lower levels than those reported in GeoEngineers' (2007b) mine evaluation.

In addition to the GeoEngineers (2009) report, the Forest Service contracted with a geologist consultant (Broeker 2010)[107] to collect soil and stream sediment samples for analytical testing and reporting of mercury and other naturally occurring minerals along a 2,000-foot section of the proposed pipeline route between MP 109 and the East Fork Cow Creek. The Broeker study also concluded that construction activities along the revised pipeline route are not likely to encounter soils with elevated mercury concentrations.

In order to prevent this naturally occurring mercury from entering the aquatic environment during and after construction, additional erosion control measures and monitoring would be conducted along the pipeline route in the vicinity of the East Fork Cow Creek. If sediments containing high levels of mercury are encountered in the East Fork Cow Creek drainage during Project construction, Pacific Connector would implement the measures outlined in its *Contaminated Substances Discovery Plan*.[108]

Hyporheic Exchange at South Fork Little Butte Creek

The Forest Service has expressed concern that the crossing of South Fork Little Butte Creek would go through basalt and andesite bedrock, and therefore a site-specific crossing would need to address the potential for groundwater interception and flow at and near the crossing. A site-specific drawing for Little Butte Creek located on NFS land was included in Appendix 2E of Resource Report 2 with Pacific Connector's September 2017 application to the FERC. The crossing would need to address the potential for groundwater interception and flow at and near the crossing since it is a critical coho stream which flows through andesite and basalt. The *Stream*

[105] GeoEngineers, Inc., 23 August 2007, *Mine Hazards Evaluation and Mercury Testing at the Red Cloud, Mother Lode, Nivinson, and Elkhorn Mining Groups, Jackson and Douglas Counties, Oregon*, prepared by A. Bauer and T. Hoyles, filed as stand-alone report with Pacific Connector's June 2013 application to the FERC.
[106] GeoEngineers, Inc., 2 October 2009, *Addendum to Mine Hazards Evaluation and Mercury Testing at the Red Cloud, Mother Lode, Nivinson, and Elkhorn Mining Group,* prepared by A. Bauer and T. Hoyles, filed as stand-alone report with Pacific Connector's June 2013 application to the FERC.
[107] Broeker, L., 3 February 2010, *Potential for Natural-Occurring Mercury Mineralization to Enter the Aquatic Environment between MP 109 and East Fork Cow Creek Williams' Pacific Connector Pipeline Project*, filed as a stand-alone report with Pacific Connector's September 2017 application to the FERC.
[108] Appendix E of the POD filed as a stand-alone report in Pacific Connector's September 2017 application to the FERC.

Crossing Hyporheic Analysis (GeoEngineers 2013c, 2017g) determined that South Fork Little Butte Creek crossing had high hyporheic sensitivity. Therefore, BMPs would be implemented to mitigate for this possible effect.

Given the potential for disruption of hyporheic processes at crossings with a "high" sensitivity ranking, in addition to the pre-construction survey, a qualified geotechnical professional would be on-site to observe trenching/excavation associated with pipeline installation to document subsurface conditions, including the presence of fractured bedrock or the low probability of the presence of lava tubes. The geotechnical professional would make recommendations for backfill composition, including the use of trench plugs or other mitigation measures, to ensure that disruption to groundwater pathways are reduced. These recommendations would be pre-approved by an authorized Forest Service representative.

Stream Temperature Assessment

Project-specific temperature modeling was conducted on federal lands stream crossings. Temperature modeling, using the Stream Segment Temperature Model (SSTEMP; Bartholow 2002), was conducted at the perennial stream crossings on BLM lands at Middle Creek, Deep Creek, and Big Creek, and NFS lands at multiple crossing on the East Fork Cow Creek in 2009, 2013, and again in 2019 to reflect new pipeline alignment and lower flow conditions (NSR 2009, 2015b, 2015c; Stantec 2019). During 2013, temperature data recorders were placed at selected locations relative to each crossing during the warmest low-flow summer period to help validate the model. Flows in 2013 represented drought conditions and were about 33 percent of those modeled in 2009 at MP 109.69 in the East Fork Cow Creek. When compared to measured existing conditions, the SSTEMP model overestimated the lower flowing stream's actual existing stream temperature slightly (about 0.2 to 0.4°F) (NSR 2015b,c), indicating the inherent uncertainty in modeling stream temperatures in very small stream channels, and the potential to overestimate temperature changes in small streams. The new 2019 pipeline alignment would result in two new stream crossings in the East Fork Cow Creek fifth-field watershed that would replace two stream crossings reported in the NSR 2015 temperature assessment. During 2018, temperature data loggers were placed at select locations relative to the two new crossings, also during the warmest low-flow summer period to help validate the model. Flows in 2019 were similar to those recorded in 2013. In this case, the modeling efforts conducted on the 2018 data set also varied slightly from existing temperature conditions (about 0.1°F), which further emphasizes the inherent uncertainty in modeling stream temperatures in very small stream channels (Stantec 2019).

Model analysis of right-of-way clearing effects predicted slight temperature increases on the BLM channel crossings in Middle Creek and a small tributary to Big Creek (NSR 2014), with these limited temperature changes likely due to relatively higher flows (Middle Creek), cooler air temperatures and relative channel orientations (NSR 2015b). During the drought conditions of 2013, modeled 7-day maximum stream temperature in the multiple East Fork Cow Creek crossings showed potential temperature increases of 1.2°F to 4.2°F under the rare drought flow conditions that occurred in 2013 (NSR 2015c). Measured stream volumes ranged from 0.045 cubic feet per second to 0.115 cubic feet per second with modeled total vegetation removal in the whole 75-foot right-of-way for post-construction shade levels ranging from 1.2 to 3.7 percent. Under the drought conditions of 2013 (high temperature and low flow), modeled results suggest temperatures may exceed the TMDL thresholds (0.1°C or 0.18°F at the point of maximum impact) or ODEQ Core Cold-Water Habitat temperature criteria of 16°C (61°F) in small perennial channels in the East

Fork Cow Creek. This occurrence likely overestimates temperature changes that would most often occur, because of the drought conditions that occurred in 2013 and potential to overestimate of temperature in low-flow channels from the SSTEMP model as noted above. The 2014 analysis showed larger temperature increases than those reported in NSR (2009) primarily due to much lower flows during 2013. The 2019 stream temperature assessment focused only on the two new stream crossings (East Fork Cow Creek and an unnamed tributary to East Fork Cow Creek) associated with the portion of the pipeline alignment that would be rerouted. Stream flows measured in 2019 were also very low, similar to flows measured in 2013. Stream flow in East Fork Cow Creek during July 2019 was measured at 0.1 cfs and stream flow on the unnamed tributary to East Fork Cow Creek was estimated at 0.3 cfs. The 2019 temperature assessment suggested that complete vegetation removal of the whole right-of-way (0 percent effective shade cover) would likely result in stream temperatures exceeding the TMDL thresholds (0.1°C or 0.18°F) or ODEQ Core Cold-Water Habitat temperature criteria of 16°C (61°F) at the point of maximum impact.

Although exposure to solar radiation may cause temperature increases, temperatures downstream from limited stream-side forested clearings have often been found to cool rapidly once the stream re-enters forested regions (Zwieniecki and Newton 1999). Other studies have noted downstream cooling below timber harvest areas as well, but the extent of this cooling is not entirely clear and varies by stream (Moore et al. 2005; Poole 2001). Although there is some debate on the magnitude of cooling provided by riparian vegetation and the extent to which stream temperatures return to non-cleared temperature levels after exiting a cleared area, studies emphasize that riparian buffers assist in maintaining water temperatures (Correll 1997; Gomi et al. 2006). Generally, changes in temperature, especially in small streams, may recover quickly from cooler surrounding conditions downstream (e.g., streambed cooling, evaporation, hyporheic inflows, shade). This was validated by stream temperature data recorded on the Umpqua National Forest in 2013. The updated temperature assessment prepared for the Forest Service at this location (NSR 2014) incorporated field measurements of existing conditions on the Umpqua National Forest that showed decreasing stream temperatures of as much as -7.6°F per 100 feet with an overall average over 2,040 feet of the East Fork Cow Creek of -0.1°F per 100 feet (NSR 2015c). The presence of numerous small wetlands adjacent to the stream channel provide evidence of likely groundwater interactions. Most of this 2,040-foot reach also has substantial shade, suggesting the retention of shading structures, or at least partial shade, may greatly reduce increases in stream temperature. The 2019 Stantec assessment also supports the NSR (2009 and 2015) finding that potential temperature increases are partially offset by cooling from groundwater interactions in the stream channel.

Observations of these streams suggest that LWD and low-growing willows, huckleberries, and other brush species can provide effective shade for small, narrow channels. Blann et al. (2002) noted that riparian grasses and forbs supply as much shade as wooded buffers for streams less than 8 feet (2.5 meters) wide. In many cases during pipeline crossing construction, low-growing brush outside of the immediate crossing construction area could be retained minimizing shade loss. In the mainstem of the East Fork Cow Creek, LWD provides substantial shade that helps maintain cooler water temperatures. As described in the ECRP and waterbody crossing requirements for the Project, all LWD and boulders removed from the crossing area would be replaced during site restoration immediately (within the same year as the right-of-way clearing) following construction and low-growing brush would be retained where possible (Stantec 2019; NSR 2015b, 2015c). Many of the channels crossed by the Pacific Connector pipeline on federal lands are very small, and could easily be shaded by the placement of LWD and willow plantings. Where site-specific modeling on NFS perennial stream crossings suggests temperature increases over natural pre-project levels, a plan would be prepared to reestablish pre-crossing shade conditions using items such as willows, boulders, and LWD.

With the retention of existing shading brush on small channels, the placement of LWD, and the replanting of willows and other brush species, downstream temperatures are expected to be comparable to the existing condition and to remain below ODEQ thresholds on the East Fork Cow Creek. Additionally, any temperature increases in small streams would likely be masked by the assimilative capacity of larger streams at the stream network scale (NSR 2009).

During the ODEQ CWA Section 401 process, Pacific Connector would develop a source-specific implementation plan in accordance with OAR 340-042-0080 for areas with existing TMDLs and Pacific Connector would be identified as a new nonpoint source. For perennial stream crossings on federal lands, this plan would incorporate the requirements of the site-specific restoration plans (NSR 2015b, 2015c; Stantec 2019). The source-specific implementation plan would outline mitigation for predicted thermal impacts (GeoEngineers 2013i). This mitigation would have a goal of restoring shade along affected stream channels and nearby channels within the same fourth-field HUCs. Mitigation for construction-related impacts would occur to the extent allowed by landowners on the affected streambanks. This mitigation would incorporate riparian revegetation required by the Forest Service for impacts on riparian reserves on NFS lands. The length of channel banks planted by Pacific Connector would be determined prior to pipeline construction once a clear understanding of landowner wishes regarding streambank planting are known. Contiguous lengths of streambank planting would be preferred over planting on multiple small parcels, particularly for mitigation of permanent impacts. Mitigation ratios of 1:1 for construction-phase impacts or 2:1 for permanent impacts would be applied as outlined in ODEQ's September 2011 letter. Prior to construction, Pacific Connector would also provide the implementation plan to FERC.

Where TMDL thermal load allocations have not yet been established, ODEQ's 401 Water Quality Certification would require the development of a Water Protection Plan, consistent with the source specific implementation plan, and a mitigation plan to address project impacts on thermal loading.

On NFS lands, the Forest Service has requested that the riparian vegetation strip be extended up to 100 feet on either side of waterbodies in Riparian Reserves. Pacific Connector has agreed to implement this measure on both NFS lands and BLM lands. The riparian strip would generally be replanted with species such as willow cuttings and dogwood to provide a quick cover for shading and streambank stability. Quick cover plantings may be shorter in height than vegetation removed during constructions, thus providing less shade. Plantings/seeding would be done with native vegetation of a local source. The riparian strip would be maintained to allow an herbaceous cover 10 feet in width centered over the pipeline to facilitate corrosion and leak surveys. The remaining area of the construction right-of-way within the riparian strip would be replanted with trees that would provide greater height and stream shading over time.

Restoration

Near-surface soil compaction caused by heavy construction vehicles could locally reduce the soil's ability to absorb water, which would increase surface runoff and the potential for ponding. To avoid long-term changes in water table elevation and subsurface hydrology, excavated topsoil and subsoils would be segregated within wetlands, agricultural areas, and at the request of landowners, and returned as closely as practical to their original soil horizon and slope position. Following construction, restoration of compacted soils would include regrading, recontouring, scarifying (or ripping), and final clean-up activities. Decompacting soils would restore water infiltration, reduce surface water runoff, reduce erosion, and support revegetation efforts. Pacific Connector would test for soil compaction in agricultural (e.g., active croplands, hayfields, and pastures), residential areas, and on federal lands. The EI would be responsible for conducting soil compaction testing and determining corrective measures on non-federal lands, including localized deep scarification or ripping to an average depth of up to 8 inches where feasible, utilizing appropriate winged-tipped rippers. On federal lands, remediation and corrective measures to address compaction will be consistent with specific requirements of the BLM, Forest Service, and Reclamation (see NSR 2015a for details). In response to a Forest Service request, Pacific Connector would stabilize intermittent stream crossings (whether flowing or not) on NFS lands with temporary sediment barriers and reseed as described for other waterbodies. Streambanks and stream beds would be revegetated with native species and "armored" as needed with LWD and boulders to ensure stability. Channel breakers would be installed on each side of the trench to ensure that subsurface flows are not captured by the pipeline trench.

As discussed in section 4.3.2, Pacific Connector has requested a modification to the FERC's *Procedures* requirement that the upper 1 foot of the trench to be backfilled with clean gravel or native cobbles in all waterbodies that contain cold water fisheries. Pacific Connector has requested that for instances where the existing substrate is not gravel or cobbles, and site access is limited and would require unreasonable efforts to transport clean gravel to the waterbody, that only native materials removed from the stream be used for backfill.

For crossings of perennial streams on BLM and NFS lands, the site-specific restoration plans included as a supplement to appendix F.4 (NSR 2014a; Stantec 2019b)[109] will be used as directed by BLM and Forest Service monitors in conjunction with FERC's EIs. These restoration plans have been designed to ensure that restoration and revegetation of these crossings are consistent with ACS objectives as described in the relevant Forest Service land management plans.

All disturbed areas on federal lands would be monitored following construction to verify successful revegetation and to implement corrective action. Pacific Connector would also adhere to its mitigation plan (developed to mitigate for impacts on all riparian and upland habitats), which would be followed in areas with severe to soil erosion potential. Throughout operation of the pipeline, Pacific Connector would continue to monitor and maintain the right-of-way. The Forest Service, in consultation with Pacific Connector, has prepared a list of mitigation actions to address unavoidable impacts on NFS lands.

4.3.4.3 Wetlands

The Pacific Connector pipeline would cross approximately 0.1 mile of wetlands on federally managed land, affecting a total of approximately 0.91 acre (see table H-1a in appendix H). Permanent wetland vegetation conversion on federally managed lands would occur in

[109] These site-specific restoration plans for BLM and Forest Service stream crossings are also incorporated into the *Wetland and Waterbody Crossing Plan* that is part of the POD.

approximately 0.2 acre of wetlands as a result of vegetation management on the operational right-of-way. This 0.2 acre of permanent conversion would occur to four wetlands: palustrine forested wetland CW-10 located on lands managed by the BLM Coos Bay District, palustrine scrub-shrub/emergent wetlands GW-14/FS-HF-CWWW-111-001 (i.e., a tributary to East Fork Cow Creek), WW-111-001 managed by the Forest Service on the Umpqua National Forest, and palustrine forested/scrub-shrub wetland EW-85/WW-001-013 managed by the Forest Service on the Winema National Forest.

There would be no permanent wetland loss or wetland impacts on federally managed land due to the construction of aboveground facilities. Impacts resulting from use of existing roads would be reduced through the implementation of Pacific Connector's ECRP and the mitigation measures described above for the pipeline on all lands.

In order to prevent or limit the spread of invasive species and noxious weeds into wetlands on federally managed lands, Pacific Connector would inspect all construction equipment prior to transporting equipment to the construction right-of-way to ensure that it is clean and free of potential weed seed. Because of the contiguous pattern of NFS lands crossed by the pipeline, equipment would be inspected and cleaned at cleaning stations located at the borders of each National Forest, prior to clearing and grading activities, in addition to being cleaned at cleaning stations associated with any mapped infestation of noxious weed of priority A and T and selected B listed weeds within each National Forest (see section 4.4 for more details regarding noxious weeds). Because the BLM lands crossed by the pipeline are not contiguous but are instead spread out in a checkerboard pattern, Pacific Connector feels that is not practical to set up inspection and cleaning stations at each entry point. Instead, Pacific Connector proposed that where BLM lands are contiguous to NFS lands, the cleaning stations would be located to include the adjacent BLM lands. The location of any additional cleaning stations required in areas where BLM- or Reclamation-managed lands are not contiguous with NFS lands would be coordinated with the agency of jurisdiction. Additional measures to prevent the spread of invasive weed and wildlife species into wetlands and waterbodies are addressed within sections 4.4 and 4.5 of this EIS.

Measures to avoid or reduce impacts on wetlands that would be implemented on federally managed lands, in addition to those described above for the entire pipeline, include the following:

- Where straw is to be used on federally managed lands during seeding operations, the authorized officer for the agency of jurisdiction may inspect and approve straw material to verify that the straw is weed-free. Any gravel or rock used on federal lands would be from weed-free sources as well, and approved by the authorized representative for the agency of jurisdiction.
- Hazardous materials, fuels, and oils would not be stored in a wetland/Riparian Reserve or within 150 feet of a wetland/Riparian Reserve. Storage of hazardous materials on NFS lands would not occur without prior authorization from the BLM, Forest Service or Reclamation.
- During revegetation efforts, specific mixtures specified by the agency with jurisdiction would be used on federally managed lands. No fertilizers would be used during the revegetation of wetlands.

Based on available information, with the implementation of appropriate plans, the use of additional BMPs, and mitigation, substantial effects to waterbodies on federal lands are not expected.

4.4 UPLAND VEGETATION

Forests in the Project area support multiple interacting layers of organisms that include plants, animals, fungi, and bacteria. Old-growth forests provide vital habitat for many native species of plants and wildlife, including many federally listed threatened or endangered species, as well as providing a variety of environmental services. Old-growth trees occupied about half of the forest area in Oregon when the first comprehensive forest surveys were made in the 1930s and 1940s. By 1992, only about 20.5 percent of the forest area was old growth (Bolsinger and Waddell 1993). These resources have particular value based on their contribution to other organisms and the fact that much of this habitat has been lost.

In the following sections, we describe the vegetation communities that may be affected by construction and operation of the proposed terminal and pipeline. We also discuss the ways in which construction and operation would affect these resources.

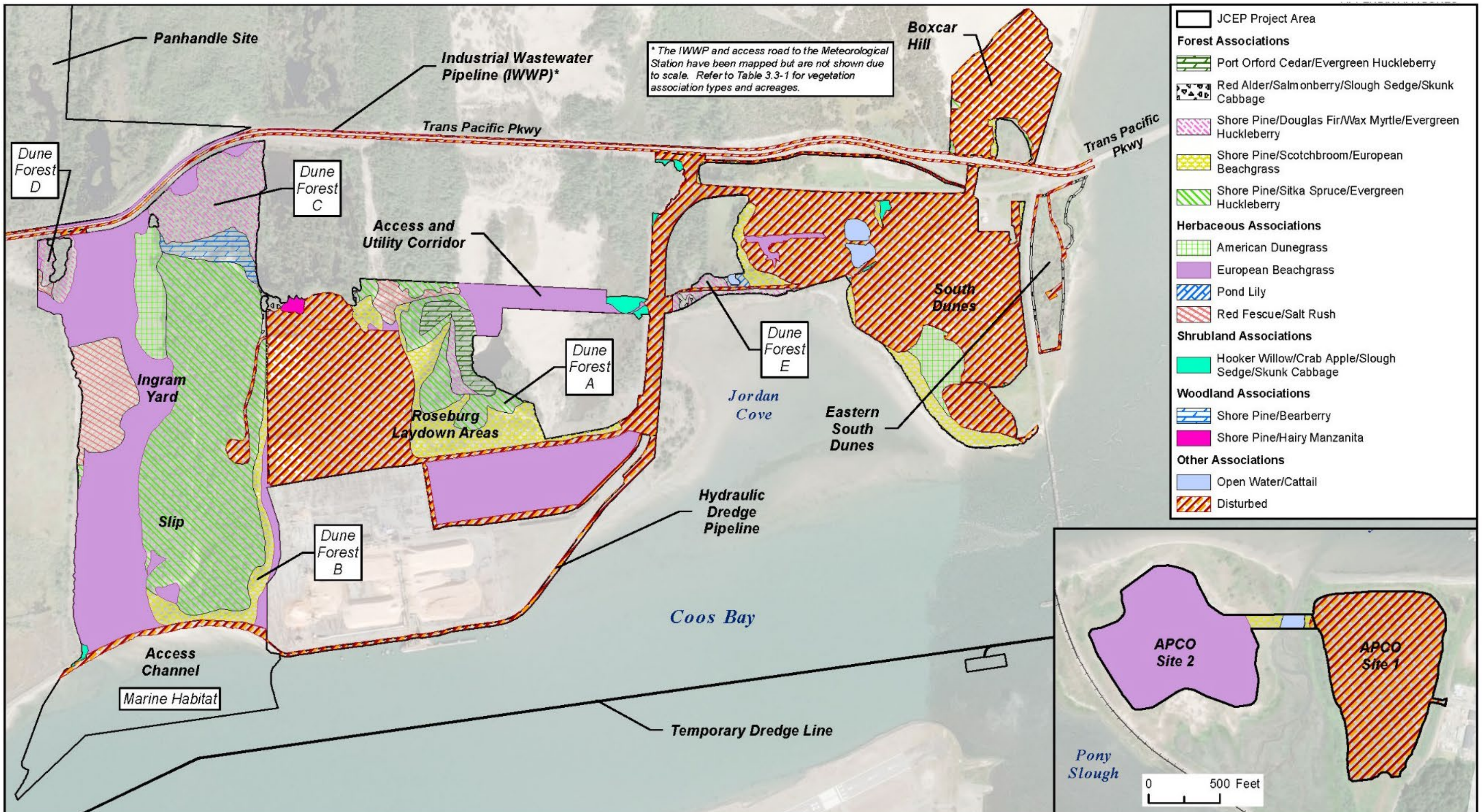
4.4.1 Jordan Cove LNG Project

As depicted in figures 4.4-1a and 4.4-1b, vegetation within the Jordan Cove LNG Project area includes forest, woodland, shrubland, and herbaceous vegetation types (as described in Christy et al. 1998). In addition, multiple areas consisting of disturbed vegetation are located within the area affected by the Project.

4.4.1.1 Forest Vegetation

Forested vegetation is defined as areas where tree species comprise at least 60 percent of the vegetation cover and canopy cover is generally 60 to 100 percent. Forested vegetation within the Jordan Cove LNG Project area varies in age and is dominated by coniferous species with scattered hardwoods. Five forested vegetation types occur within the Jordan Cove LNG Project area, as described below. Generally, the forested vegetation in this area is referred to as dune forest. Five different dune forests have been identified within the Jordan Cove LNG Project area (Dune Forest A through Dune Forest E, see figure 4.4-1a).

The Shore Pine–Douglas-Fir/Wax Myrtle-Evergreen Huckleberry vegetation type typically occurs near previously developed areas such as roads, fill sites, or industrial sites. It occurs most frequently on warm, dry ridges, and slopes on the dunes; primarily with south to west facing aspects (Christy et al. 1998). This vegetation type is characteristic of younger forest sites north of Jordan Cove and occurs in areas where dune stabilization has been achieved through recruitment of vegetation, most notably European beachgrass (*Ammophila arenaria*) and Scotch broom (*Cytisus scoparius*). This vegetation type has an open overstory dominated by shore pine (*Pinus contorta*) with scattered Douglas-fir (*Pseudotsuga menziesii*). The shrub layer is dominated by Scotch broom and coyote bush (*Baccharis pilularis*), with scattered hairy manzanita (*Arctostaphylos columbiana*), wax myrtle (*Morella* [*Myrica*] *californica*), and evergreen huckleberry (*Vaccinium ovatum*). Dominant herbaceous species include non-native species, including European beachgrass, silver hairgrass (*Aira caryophyllea*), little hairgrass (*A. praecox*), hairy cat's ear (*Hypochaeris radicata*), and sheep sorrel (*Rumex acetosella*), as well as native bracken fern (*Pteridium aquilinum*). This vegetation type can be found in portions of Dune Forests A, B, and C where adjacent landscapes have been altered by human or natural influences.



Associations used are based on the USDA Publication National Vegetation Classification System (NVCS).

Source: SHN Engineers, David Evans and Associates, Inc.

Figure 4.4-1a

Vegetation Associations

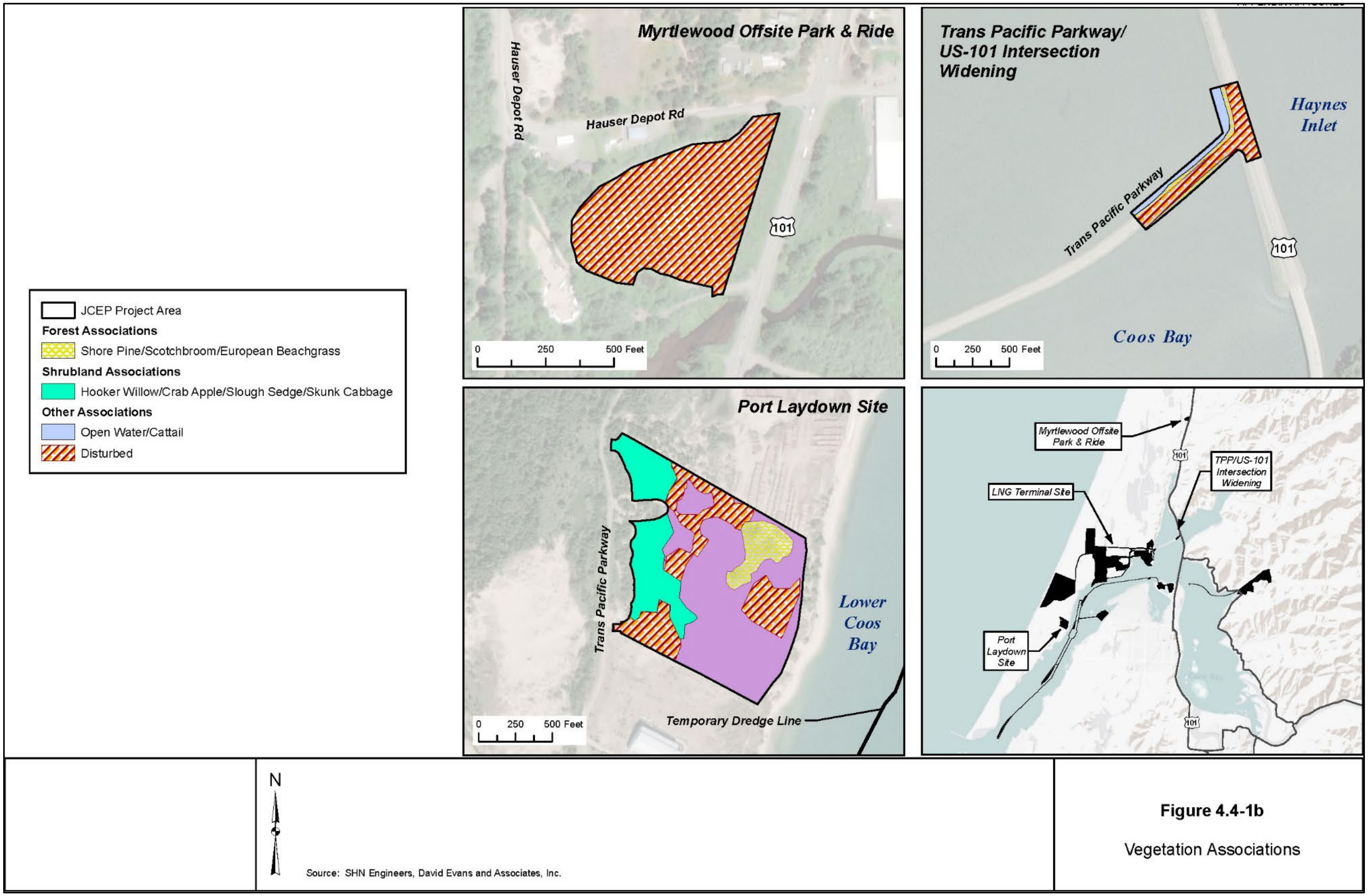


Figure 4.4-1b

Vegetation Associations

The Shore Pine-Sitka Spruce/Evergreen Huckleberry vegetation type is common in more successionally mature forests. Stands are generally dominated by shore pine and Douglas-fir, but also include Sitka spruce (*Picea sitchensis*), western hemlock (*Tsuga heterophylla*), and scattered Port Orford cedar (*Chamaecyparis lawsoniana*). The dense shrub understory in this vegetation type is dominated by evergreen huckleberry, salal (*Gaultheria shallon*), and wax myrtle, with scattered Pacific rhododendron (*Rhododendron macrophyllum*) also present. The herbaceous layer varies from sparse to moderately covered with candy-stick (*Allotropa virgata*), rattlesnake plantain (*Goodyera oblongifolia*), and bracken fern along edges or gaps in the overstory. Dune Forest B occurs in this vegetation type.

The Port Orford Cedar/Evergreen-Huckleberry vegetation type is dominated by Port Orford cedar and is considered unique because it is being decimated throughout its limited range by the Port Orford cedar root rot disease which is caused by the fungal root rot *Phytopthora lateralis* (Christy et al. 1998). A small area of well-developed Port Orford cedar/evergreen huckleberry vegetation is located upslope from the southwestern shore of Jordan Lake. Port Orford cedar observed at this location includes two trees upslope from the existing access trail that travels from the Roseburg Forest Products facility to Jordan Lake. Additionally, 23 Port Orford cedars were observed at sites located adjacent to Jordan Lake. This vegetation type can be found in portions of Dune Forest A.

The Red Alder/Salmonberry/Slough Sedge-Skunk Cabbage vegetation type occurs in wetland vegetation adjacent to upland forested vegetation, and in low flat areas adjacent to inundated wetlands. In this vegetation type, the overstory consists entirely of red alder (*Alnus rubra*) around wet areas, but transitions to shore pine in adjacent areas. Canopy cover varies from moderate (i.e., more than 50 percent canopy cover) to closed. Scattered clusters of dense shrubs, including salmonberry (*Rubus spectabilis*) and Hooker's willow (*Salix hookeriana*), are located in the understory. Herbaceous coverage is generally found in wet areas and consists almost entirely of slough sedge, with scattered skunk cabbage (*Lysichiton americanus*). This vegetation type occurs in Dune Forest E and adjacent to Dune Forest B.

Although the Shore Pine/Scotch Broom/European Beachgrass vegetation type contains shore pine, it is also described as a shrubland due to the high density of shrubby species, including Scotch broom. This vegetation type is relatively widespread throughout the Jordan Cove LNG Project site and is associated with roads and other disturbed areas. The overstory is generally open, averaging less than 50 percent cover of shore pine. Scotch broom cover varies from moderately to very dense in areas that lack a substantial canopy cover. Dominant herbaceous species include European beachgrass, red fescue (*Festuca rubra*), tall fescue (*Schedonorus arundinaceus* [*Festuca arundinacea*]), silver hairgrass, hairy cat's ear, and sheep sorrel. This vegetation type occurs west of the South Dunes site, north of the Roseburg Forest Products property, along previous road cuts for the Trans-Pacific Parkway, and along the edges of the shore pine-Sitka spruce/evergreen huckleberry community at the Port Laydown, Boxcar Hill, and APCO sites.

4.4.1.2 Woodland Vegetation

Woodland vegetation includes areas of open tree stands with cover generally varying from 25 percent to 60 percent. They occur on all aspects of dry, well drained, partially stabilized dune ridges, slopes, and flats between the sand and the forest edge (Christy et al. 1998). Two woodland vegetation types occur within the Jordan Cove LNG Project site.

The overstory of the shore pine/bearberry (*Arctostaphylos uva-ursi*) woodland vegetation type consists entirely of shore pine. The shrub layer is dominated by the low growing shrub bearberry with hairy manzanita in scattered patches. The understory is comprised almost entirely of moss and lichen species except for scattered little hairgrass, hairy cat's ear, and shrub starts. This vegetation type is restricted to a thin band adjacent to the coastline and is easily damaged by human disturbances. Shore pine/bearberry vegetation is scattered throughout the LNG terminal site, with the most substantial occurrence between Dune Forests B and C.

The overstory of the shore pine/hairy manzanita woodland vegetation type is moderately open and is dominated by shore pine with scattered Douglas-fir trees. The shrub layer varies from moderate to dense in areas where the canopy is patchy. Hairy manzanita is the dominant shrub species with scattered evergreen huckleberry and bearberry along edges. A small area of this vegetation type can be found along the eastern boundary of Dune Forest B along the access and utility corridor.

4.4.1.3 Shrubland Vegetation

Shrubland vegetation types generally consist of greater than 25 percent cover of shrubs more than 0.5 meter tall and generally less than 25 percent tree cover. A single shrubland vegetation type was identified within the Jordan Cove LNG Project area.

The overstory within the Hooker Willow/Crabapple/Slough Sedge-Skunk Cabbage vegetation type is dominated by Hooker willow, Sitka willow (*Salix sitchensis*), and Douglas spiraea (*Spiraea douglasii*), with scattered twinberry (*Lonicera involucrata*). Evergreen trees are mostly absent but may include scattered shore pine and Sitka spruce. Slough sedge is the most abundant herbaceous species. Other herbaceous species include common rush (*Juncus effusus*), dagger-leaved rush (*Juncus ensifolius*), toad rush (*J. bufonius*), western bent-grass (*Agrostis exarata*), creeping bent-grass (*A. stolonifera*), reed canarygrass (*Phalaris arundinacea),* northern willowherb (*Epilobium ciliatum*), tall mannagrass (*Glyceria striata* [*G. elata*]), and lowland cudweed (*Gnaphalium palustre*). This vegetation type occurs throughout the wetland areas west of Jordan Cove Road, in the access and utility corridor, and at the South Dunes site.

4.4.1.4 Herbaceous Vegetation

Herbaceous vegetation types are communities with less than 25 percent shrub cover and greater than 25 percent herbaceous cover. Five herbaceous vegetation types occur within the Jordan Cove LNG Project area.

Dominant species within the European beachgrass vegetation type include European beachgrass, red fescue, silver burweed (*Ambrosia chamissonis*), sand pea (*Lathyrus japonicus*), seashore lupine (*Lupinus littoralis*), beach silvertop (*Glehnia littoralis*), and beach evening primrose (*Camissonia cheiranthifolia*). This vegetation type occurs where the terminal marine slip would be located. It was also observed in patches north of Jordan Lake where the access/utility corridor is proposed and at the Port Laydown site and is the dominant vegetation type at the APCO Site 2.

The Red Fescue/Salt Rush vegetation type is generally found in grasslands on sand or fill material. Red fescue is the dominant species in this association. Scattered red fescue was observed on fill west of the South Dunes site and on sand north of the Roseburg Forest Products export facility. At the South Dunes site, in an area surrounded by scattered red fescue, a portion of a small dune was dominated by salt rush (*Juncus lesuerii*). Red fescue/salt rush was also observed at sites where sand burial by wind driven forces limits species diversity, including the western part of the LNG terminal site.

The American dunegrass vegetation type includes dune lands with the single dominant species American dunegrass (*Leymus mollis*). It can be found on beaches and in foredunes, and to a lesser extent on open deflation plains and in upper estuaries. Continual sand burial and inputs of salt spray seem necessary for American dunegrass to thrive. Scattered American dunegrass was observed west of Dune Forest B, in the LNG terminal grassland vegetation east of Henderson Marsh on previous fill deposits, and the western half of APCO Site 1.

Dominant species in the Pond Lily vegetation type include yellow pond lily (*Nuphar lutea* ssp. *polysepala),* floating water-pennywort *(Hydrocotyle ranunculoides),* floating-leaved pondweed (*Potamogeton natans*), parrotfeather (*Myriophyllum aquaticum*), water shield (*Brasenia schreberi*), and common bladderwort (*Utricularia macrorhiza*). Pond lily vegetation has been observed in deep freshwater wetlands located at the LNG terminal site.

The Common Cattail/Open-Water vegetation type includes wetland fringe sites observed adjacent to open bodies of water. Open water and areas dominated by common cattails can be found surrounding the existing sludge ponds at the South Dunes site as well as around wetlands observed south of the Trans-Pacific Parkway in the eastern portion of the LNG terminal site.

Disturbed vegetation occurs in previously human-disturbed areas, where extensive grading and gravel and dredge spoils deposition has occurred. These areas often contain non-native upland shrubs with small patches of young coastal forest dominated by shore pine, and herbaceous communities dominated by European beachgrass. Disturbed vegetation within the Jordan Cove LNG Project site typically consists of ruderal shrub, such as Scotch broom, and herbaceous vegetation. Dominant herbaceous species include silver hairgrass, hairy cat's ear, bracken fern sheep sorrel, red fescue, and seashore lupine. Disturbed vegetation is common in many areas of the Jordan Cove LNG Project site including the South Dunes site, the Port Laydown site, and the APCO Site 1.

Vegetation Important to Native Americans

The Coquille Indian Tribe indicated that some of the most important traditional cultural plant species that are found on the Coquille Forest and other Tribal lands include the bark, berries, roots, flowers, and wood of several tree and shrub species, including: Port Orford cedar, western red cedar (*Thuja plicata*), Sitka spruce, big leaf maple (*Acer macrophyllum*), wax myrtle, red alder, Pacific madrone (*Arbutus menziesii*), Pacific yew (*Taxus brevifolia*); elderberry (*Sambucus* spp.), willows (*Salix* spp), California hazelnut (*Corylus cornuta*), vine maple (*Acer circinatum*), Pacific rhododendron, azalea (*Rhododendron* spp.), manzanita (*Arctostaphylos* spp.), oceanspray (*Holodiscus discolor*), Labrador tea (*Rhododendron* (*Ledum*) *groenlandicum*), huckleberry (*Vaccinium* spp.), salal, thimbleberry (*Rubus parviflorus*), salmonberry, Oregon-grape (*Mahonia* spp.); yarrow (*Achillea millefolium*), camas (*Camassia* spp.), tiger lily (*Lilium columbianum*), columbine (*Aquilegia formosa*), various *Lomatium* and *Brodiaea* species, iris (*Iris* spp.), trailing blackberry (*Rubus ursinus*), yerba buena (*Satureja* (*Clinopodium*) *douglasii*), beargrass (*Xerophyllum tenax*), cattail (*Typha* spp.), tule (*Schoenoplectus* spp.), various sedges (*Carex* spp.) ferns, skunk cabbage, various mosses; eelgrass, giant kelp (*Macrocystis* spp.), bull kelp (*Nereocystis luetkeana*), sea lettuce (*Ulva* spp.), and surfgrass (*Phyllospadix* spp.).

4.4.1.5 General Impacts on Vegetation

Table 4.4.1.5-1 identifies the amount of vegetation affected by construction and operation of the Jordan Cove LNG Project. Constructing the Jordan Cove Project would result in 499 acres of vegetation clearing, which includes the permanent clearing of 168 acres of vegetation. Construction of the Kentuck project and Eelgrass Mitigation sites would result in an additional 127 acres of vegetation clearing not included in table 4.4.1.5-1. Areas temporarily disturbed would be revegetated following construction. Clearing of herbaceous and disturbed vegetation would be considered a short-term impact because revegetation of these areas would typically occur within three growing seasons. Clearing of forested, woodland, and shrubland areas would be considered a long-term impact because affected areas would not resemble adjacent undisturbed areas for many years to many decades.

TABLE 4.4.1.5-1

Impacts on Vegetation Type from the Jordan Cove LNG Project a/

Vegetation Type	Land Cleared during Construction (acres) b/, c/	Land Permanently Cleared due to Operations (acres) b/
Jordan Cove LNG Project Facilities		
Forested Vegetation	75	71
Woodland Vegetation	<1	<1
Shrubland Vegetation	1	<1
Herbaceous Vegetation	72	64
Disturbed Vegetation	24	21
Total Impacts from Project Facilities	***172***	***157***
Temporary Construction Areas d/		
Forested Vegetation	58	2
Woodland Vegetation	4	0
Shrubland Vegetation	8	<1
Herbaceous Vegetation	71	<1
Disturbed Vegetation	186	9
Total Impacts from Temporary Construction Areas	***327***	***11***
Grand Total for All Impacts		
Impact Grand Total	**499**	**168**

See table 2.3.1-1 in section 2 for the acreage of each individual Project component.

a/ Table does not include impacts on unvegetated upland areas or impacts on estuarine vegetation (impacts on estuarine vegetation is discussed in section 4.3).

b/ Values may not sum exactly due to rounding of significant digits. Acreages are rounded to the nearest whole acre; acreages less than 1 acre are reported as <1.

c/ Values include land permanently cleared due to operations.

d/ Temporary Construction Facilities include the Ingram Yard perimeter, North Ingram Yard, IWWP, Hydraulic Dredge Pipeline, Roseburg site laydown areas, APCO Sites, Boxcar Hill, Port Laydown site, South Dunes site, Workforce Housing Facility, parking, and Laydown area, the Trans-Pacific Parkway/U.S. Highway 101 Intersection Widening, the Additional Park & Ride site, and the Myrtlewood Off-site Park & Ride.

Additionally, as discussed in section 4.3, the use of groundwater from the CBNBWB wells for construction and operation of the Project may temporarily lower groundwater levels near the wells. This lowering of groundwater levels may temporarily affect vegetation in these areas; however, a monitoring program would be conducted prior to, during, and after construction to monitor potential impacts due to lowering of groundwater (see section 4.3.1 for more details).

Approximately 73 acres of forested vegetation, 59 acres of which consists of the shore pine-Sitka spruce/evergreen huckleberry vegetation type, would be permanently affected. All of Dune Forests A and B, the majority of Dune Forest C, and portions of Dune Forest D and E would be permanently affected. The clearing of dune forest vegetation during construction would affect the vegetation at the newly exposed edge of the coniferous forest by changing the micro-climate factors (wind, light, salt spray, organisms that prefer edges). The vegetation found within the forest interior would be exposed to the environmental elements experienced by a forest edge, which could lead to a change in species composition.

4.4.1.6 Noxious Weeds and Invasive Species

Noxious weeds and invasive plant species are non-native or introduced species that are able to exclude and out-compete desirable native species, and thereby decrease overall species diversity. Noxious weeds often invade and persist in areas after the vegetation and ground have been disturbed and can hinder restoration. Noxious weeds can adversely affect an area either when invasive plants become established or when an existing species' population size increases. Invasive or noxious plants can negatively affect native vegetation by competing for resources such as water and light, changing the community composition, eliminating or reducing native plants, or changing the vegetation structure. The changes in community composition or vegetation structure can reduce native plant populations and can also negatively affect wildlife habitat. Anticipated effects of global climate change can exacerbate the effects or likelihood of invasive species spreading or establishing in new areas (Hellmann et al. 2008). Additionally, the movement of equipment to and from construction work areas can also increase the spread of noxious weeds and invasive species. In general, grasslands, riparian areas, and relatively dry or open forests, are more susceptible to invasion than are dense, moist forests, high montane areas, and serpentine areas that have relatively closed canopy cover or have extreme climate or soils that are tolerated by fewer invasive plant species.

Noxious weeds are classified by the Oregon State Weed Board (OSWB) as any plant that is injurious to public health, agriculture, recreation, wildlife, or any public or private property. The ODA Noxious Weed Control Program and the OSWB maintain the State Noxious Weed List. There are three categories of listed noxious weeds under the ODA Noxious Weed Control Classification System (i.e., A Listed, B Listed, and List T weeds[110]). Species listed in the Noxious Weed Policy and Classification System that have been documented or could occur within the LNG terminal area are summarized in table 4.4.1.6-1.

[110] A Listed – Weeds of known economic importance which occur in small enough infestations to make eradication or containment possible; or are not known to occur in Oregon but are present in neighboring states making future occurrence in Oregon seem imminent.
B Listed – Weeds of economic importance which are regionally abundant, but which may have limited distribution in some counties in Oregon.
T List – Priority noxious weeds designated as target species that will be the focus of prevention and control by the Noxious Weed Control Program and for which the ODA will develop and implement statewide management plans. Species selected from either the "A" or "B" list.

TABLE 4.4.1.6-1

Noxious Weeds and Invasive Aquatic Species Documented or with Potential to Occur in the Jordan Cove LNG Project Area

Common Name	Scientific Name	LNG Terminal a/	Boxcar Hill	APCO Sites	Kentuck Project Site	Port Laydown
"A" List Weeds						
cordgrass (T)	*Spartina anglica, S. alterniflora, S. densiflora, S. patens*	D				
"B" List Weeds						
bull thistle	*Cirsium vulgare*	L			L	
butterfly bush	*Buddleja davidii*	L		L	L	D
Canada thistle	*Cirsium arvense*	D	D	L	D	D
English ivy	*Hedera helix*	D	D	L	L	
field bindweed (T) (morning glory)	*Convolvulus arvensis*	L		L		
French broom	*Genista monspessulana*	L		L		
gorse (T)	*Ulex europaeus*	D				
Himalayan blackberry	*Rubus armeniacus (R. discolor, R. procerus, R. fruticosa)*	D	D	D	D	
Jubata grass (Pampas grass)	*Cortaderia jubata*	D			L	
meadow knapweed	*Centaurea pratensis (C. moncktonii)*				L	
parrot feather	*Myriophyllum aquaticum*	D				
poison hemlock	*Conium maculatum*	D			D	
Scotch broom	*Cytisus scoparius*	D	D	D	D	D

"D" = indicates species has been documented at the Project site.
"L" = indicates species is likely to occur at the Project site.
"(T)" = indicates target species designated for removal and control in Oregon
Source: ODA 2018a
a/ Includes LNG terminal, access and utility corridor, South Dunes site, and Roseburg Laydown area.

To avoid introducing or spreading invasive species, Jordan Cove would follow the recommendations outlined in the Oregon Invasive Species Council (OISC) Action Plan for 2017-2019, BLM's multi-state EIS Northwest Area Noxious Weed Control Program (BLM 1985) and its supplements, the BLM's *Final Vegetation Treatments on Bureau of Land Management Lands in 17 Western States Programmatic Environmental Report* (2007), and the BLM's *Final North Spit Plan* (2005). These documents focus on detection, containment, and/or reduction of invasive plant infestations with an integrated pest management approach (e.g., chemical, mechanical, manual, and/or biological) as well as implementation of measures to avoid the introduction and spread of noxious weeds.

Jordan Cove would conduct a pre-construction survey of the Project area to identify noxious species listed by the ODA that persist despite recent and previous control efforts. Following the survey, Jordan Cove would employ standard removal practices (BLM 1985) for the weed species identified on the Project area. Methods for removal that would not aid in the dispersal of these species would be used and would include the use of integrated BMPs such as fire, mechanical or manual removal, and herbicide application, as appropriate. Treated areas would be restored by spreading seeds and planting plants.

Jordan Cove would also use herbaceous and dune seed mixes to limit germination of noxious weeds during the stabilization and restoration of the site during and following construction. Once the site is stabilized and in operation, Jordan Cove would check the site for noxious weed