- Proposed amendment UNF-1 would allow removal of effective shade on perennial streams. This amendment would not prevent attainment of ACS objectives because a site-specific temperature assessment (NSR 2009, 2015, Stantec 2019) showed that any temperature increase resulting from removal of effective shade would be minor and limited to the point of maximum impact at the site of construction.
- Proposed amendment UNF-3 would allow the Project to exceed detrimental soil conditions within the construction corridor. This would not prevent attainment of ACS objectives because soil decompaction and remediation required in Riparian Reserves is expected to effectively moderate detrimental soil conditions. Implementation of measures in the ECRP is expected to effectively control surface erosion and restore native vegetation (see section 4.3.4 of this EIS).
- Proposed amendment UNF-4 would reallocate approximately 588 acres from the matrix land allocation to the LSR allocation. This would benefit aquatic habitats because this area would be managed for late-successional stand conditions that provide additional aquatic protections.
- Proposed amendment of the Umatilla National Forest LRMP to waive protection measures for Survey and Manage species would not prevent attainment of ACS objectives because the Project does not threaten the persistence of any riparian-dependent species (see appendix F.5).

The routing of the Project through NFS lands, coupled with the relatively small area of NFS land affected by Project construction (73.74 acres or 0.31 percent of the NFS lands in the fifth-field watershed – appendix F.4, table 2-23), makes it highly improbable that Project impacts could affect watershed conditions. Although there are project-level impacts (e.g., short-term sediment and a long-term change in vegetative condition at stream crossings), these would be minor in scale and largely limited to the boundaries of the Project area (appendix F.4, section 1.4.1.2).

No Project-related impacts that would prevent attainment of ACS objectives have been identified (table 4.7.3.5-7 or appendix F.4, table 2-35). All relevant Project impacts are within the range of natural variability for watersheds in the Western Cascades and Klamath Provinces, although some of these processes have been altered from their natural condition (appendix F.4).

Rogue River Basin, Trail Creek Fifth-Field Watershed HUC 1710030706, Umpqua National Forest

Discussions of watershed analysis recommendations, natural disturbances, range of variability and other elements of the ACS are found in appendix F.4. Table 4.7.3.5-8 (table 2-44 in appendix F.4) compares the Project impacts on the objectives of the ACS for the Trail Creek watershed. The Project would not affect any Riparian Reserves in the watershed (appendix F.4, table 2-3, 2-38). National Forest System lands where the ACS applies comprise about 12 percent of the Trail Creek watershed (appendix F.4). Watershed conditions and recommendations are found in the Trail Creek watershed assessment (BLM 1999) and described in detail in appendix F.4. In the Trail Creek watershed, timber harvest and removal of LWD from creek channels has reduced structural complexity of the aquatic habitat and its ability to retain sediments. Chronic, fine-grained sediment, most recently related to roads and timber harvest, has negatively affected aquatic habitats by adding large volumes of sediment. The presence of roads has segregated some stream reaches from upslope habitats that are needed for replenishment of LWD.

TABLE 4.7.3.5-8 **Compliance of the Pacific Connector Pipeline Project with ACS Objectives, Trail Creek Watershed**	
ACS Objective	**Project Impacts**
Maintain and restore the distribution, diversity, and complexity of watershed and landscape-scale features to ensure protection of the aquatic systems to which species, populations, and communities are uniquely adapted.	Riparian Reserves are watershed landscape-scale features that would be affected by the Project. No Riparian Reserves are affected in the Trail Creek watershed (table 2-41). On NFS lands subject to the ACS, the Project ROW is located primarily in early or mid-seral forests (table 2-41). There are no river or stream crossings on NFS lands, and the Project ROW is located largely on or near ridge tops to minimize impacts on aquatic habitats. No wetlands or streams are crossed or clipped in the watershed. Use of native vegetation and the anticipated rapid revegetation of disturbed areas would likely further reduce Project impacts. Off-site mitigation measures including road stormproofing and decommissioning are expected to improve watershed conditions in the Trail Creek watershed (see appendix F.4).
Maintain and restore spatial and temporal connectivity within and between watersheds. Lateral, longitudinal, and drainage network connections include floodplains, wetlands, upslope areas, headwater tributaries, and intact refugia. These network connections must provide chemically and physically unobstructed routes to areas critical for fulfilling life-history requirements of aquatic and riparian-dependent species.	The Project is not expected to affect spatial or temporal connectivity in the Trail Creek watershed because no wetlands or waterbodies are crossed. No rivers or streams would be crossed on NFS lands.
Maintain and restore the physical integrity of the aquatic system, including shorelines, banks, and bottom configurations.	No stream channels are crossed on NFS lands where the ACS applies so the physical integrity of banks and stream bottoms would not be affected.
Maintain and restore water quality necessary to support healthy riparian, aquatic, and wetland ecosystems. Water quality must remain within the range that maintains the biological, physical, and chemical integrity of the system and benefits survival, growth, reproduction, and migration of individuals composing aquatic and riparian communities.	No wetlands or streams are crossed on NFS lands in the Trail Creek watershed. No long-term impacts on water quality are expected because of application of the ECRP, including maintenance of effective ground cover and BMPs during construction (see section 1.4.1 of appendix F.4).
Maintain and restore the sediment regime under which aquatic ecosystems evolved. Elements of the sediment regime include the timing, volume, rate, and character of sediment input, storage, and transport.	The Trail Creek watershed was historically characterized by pulse-type depositions of coarser sediments from landslides and surface erosion following major disturbances such as fires and high-intensity winter storms (BLM 1999, Everest and Reeves 2007). Chronic erosion and deposition of fine sediments, primarily from roads and to a lesser degree from land use, have replaced these pulse-type disturbances in the watershed. Project construction and operation are not likely to alter sediment erosion and deposition in the watershed nor are they likely to exacerbate these conditions. Proposed mitigation projects would contribute to a reduction of adverse sediment scouring and depositing and restoration of aquatic functions (see appendix F.4, table 2-42).
Maintain and restore instream flows sufficient to create and sustain riparian, aquatic, and wetland habitats and to retain patterns of sediment, nutrient, and wood routing. The timing, magnitude, duration, and spatial distribution of peak, high, and low flows must be protected.	The Project is not likely to affect peak flows in the Trail Creek watershed because of its predominately ridge top location, the relatively small area of the watershed affected (less than 1%), the absence of stream crossings, and the relative lack of connectivity to aquatic systems. The Trail Creek watershed assessment noted that increases in peak flows are a low risk in all the subwatersheds and in the watershed as a whole.

TABLE 4.7.3.5-8 (continued)	
Compliance of the Pacific Connector Pipeline Project with ACS Objectives, Trail Creek Watershed	
ACS Objective	**Project Impacts**
Maintain and restore the timing, variability, and duration of floodplain inundation and water table elevation in meadows and wetlands.	The Project would not cross any meadows or wetlands in the Trail Creek watershed on NFS lands, so there would be no impact from the Project on water tables or seasonal inundation of these areas
Maintain and restore the species composition and structural diversity of plant communities in riparian areas and wetlands to provide adequate summer and winter thermal regulation; nutrient filtering; and appropriate rates of surface erosion, bank erosion, and channel migration and to supply amounts and distributions of coarse woody debris sufficient to sustain physical complexity and stability.	The Project would not affect Riparian Reserves in the Trail Creek watershed (table 2-39). Following construction, replanting with native species would facilitate reestablishment of vegetation communities.
Maintain and restore habitat to support well-distributed populations of native plant, invertebrate and vertebrate riparian-dependent species.	The Project would not affect any Riparian Reserves in the Trail Creek watershed (table 2-39). Consistent with the requirements of the POD, LWD and boulders removed from the corridor during construction would be replaced to restore and stabilize channel crossings. Revegetation would be accomplished using native riparian species. The Project would waive application of Management Recommendations for Survey and Manage species in the watershed but would not threaten the persistence of riparian-dependent Survey and Manage species or prevent attainment of the ACS objectives (see appendix F.5).

Source: Appendix F.4, table 2-44

Given the ridgetop location of the pipeline corridor on NFS lands, the lack of intersects with waterbodies, and lack of impacts on Riparian Reserves it is highly unlikely that Project construction and operation would prevent attainment of ACS objectives on NFS land in the Trail Creek watershed.

The high clay-content soils in the watershed (BLM 1999:1-4) presents a potential issue with respect to possible compaction and sediment that could be mobilized by overland flow. Subsoil ripping (including the use of hydraulic excavators) is a proven method to reduce soil compaction. Measures in the ECRP including soil remediation with organic materials, rapid revegetation and maintenance of effective ground cover are likely to successfully control surface erosion. The Forest Service may require additional erosion control measures if needed.

Off-site mitigation measures, identified by the Forest Service, would supplement onsite minimization, mitigation, and restoration actions. These proposed offsite mitigation measures are responsive to recommendations in the Trail Creek watershed assessment and would contribute to improving terrestrial and aquatic conditions within the watershed (see appendix F.4; table 2-42).

A site-specific amendment of the Umatilla National Forest LRMP to waive limitation on detrimental soil compaction is proposed to make a provision for the Project. This proposed amendment is minor in scope and is not expected to prevent attainment of ACS objectives because of implementation of the ECRP and the fact that there are no stream intersects on NFS lands in the Trail Creek watershed. The proposed amendment of the Umatilla National Forest LRMP to waive protection measures for Survey and Manage species would not prevent attainment of ACS objectives because species viability would be maintained (see appendix F5).

The relatively small area of NFS land affected by Project construction (50.27 acres or 1.15 percent of NFS lands in the watershed), makes it highly improbable that Project impacts could affect watershed conditions beyond the site scale. Although there are project-level impacts such as short-term surface erosion these would be minor and limited to the boundaries of the Project area (see appendix F.4, section 1.4.1).

No Project-related impacts that would retard or prevent attainment of ACS objectives have been identified (appendix F.4, table 2-44). Impacts, as they relate to relevant ecological processes, are within the range of natural variability for watersheds in the Western Cascade and Klamath-Siskiyou Provinces, although some of these processes have been altered from their natural condition (appendix F.4; table 2-40).

Rogue River Basin, Little Butte Creek Fifth Field Watershed, HUC 1710030708, Rogue-Siskiyou National Forest

Discussions of watershed analysis recommendations, natural disturbances, range of variability are found in appendix F.4. Table 4.7.3.5-9 (table 2-62 in appendix F.4) compares the Project impacts on the objectives of the ACS for the Little Butte Creek watershed. National Forest System lands where the ACS applies comprise approximately 59,900.38 acres or 25.10 percent of the Little Butte Creek watershed (appendix F.4, table 2-45). Riparian Reserves comprise approximately 8,096.50 acres (about 3.39 percent of the entire watershed [appendix F.4, table 2-45]) on NFS lands. Watershed conditions and recommendations are found in the Little Butte Creek watershed assessment (BLM and Forest Service 1997). A total of 10.22 acres or 0.13 percent of the Riparian Reserves in the watershed would be affected of which 7.66 acres are cleared and 2.56 acres (appendix F.4, table 2-47) are modified on:

- One perennial stream channel crossing
- One intermittent stream channel crossing
- One intermittent stream and one wetland where Riparian Reserves are clipped, but the associated waterbodies are not crossed by the Project.

The Project would cross an additional perennial stream at MP 167.67. The method of stream crossing at this location would be a conventional boring method which would route the pipeline underneath the stream therefore, not clearing any Riparian Reserves or crossing the actual channel.

TABLE 4.7.3.5-9

Compliance of the Pacific Connector Pipeline Project with ACS Objectives, Little Butte Creek Watershed

ACS Objective	Project Impacts
Maintain and restore the distribution, diversity, and complexity of watershed and landscape-scale features to ensure protection of the aquatic systems to which species, populations, and communities are uniquely adapted.	Riparian Reserves are watershed-scale features. The project would affect about 10.22- acres or about 0.13% of Riparian Reserves on NFS lands in the Little Butte Creek watershed (appendix F.4, table 2-47). There is one intermittent and one perennial stream channel crossed in the Little Butte Creek watershed on NFS lands. Impacts on aquatic systems are expected to be short-term and minor and limited to the project scale because of application of BMPs and erosion control measures (see appendix F.4, section and 1.4.1). Large woody debris cleared in construction of the project would be used to stabilize and restore stream crossings. Off-site mitigation measures on NFS lands include 57.5 miles of road decommissioning, approximately 1.5 -miles of instream projects, snag creation and coarse woody debris placement are expected to improve watershed conditions in the Little Butte Creek watershed (see appendix F.4, tables 2-57, 2-58, 2-59, 2-60). Off-site mitigation could also take place on BLM lands. BLM administered lands are not subject to ACS requirements as a result of the August 2016 RODs for two new RMPs (BLM 2016a and 2016b) that supersede the RMPs amended by the 1994 NWFP ROD. The project proponent has offered voluntary mitigation that could be implemented on BLM lands within this watershed; these mitigation efforts would benefit ACS objectives within the watershed. Off-site mitigation proposed by the Applicant on BLM lands include approximately 8.6 miles of instream projects, 2.4 miles of road decommissioning and an additional 23.2 miles of other road sediment reduction projects. While there are long-term changes in vegetation in Riparian Reserves from construction clearing of the project right-of-way, these would be minor in scale and well within the range of natural variability given the disturbance history of the watershed (see appendix F.4, table 2-40).
Maintain and restore spatial and temporal connectivity within and between watersheds. Lateral, longitudinal, and drainage network connections include floodplains, wetlands, upslope areas, headwater tributaries, and intact refugia. These network connections must provide chemically and physically unobstructed routes to areas critical for fulfilling life-history requirements of aquatic and riparian-dependent species.	The Project is not expected to affect spatial or temporal connectivity in the Little Butte Creek watershed because the pipeline would be buried in all aquatic habitats crossed, consistent with the requirements of the exhibits specified in the Wetland and Waterbody Crossing Plan. At each crossing, bed and bank disturbances from equipment crossing and trenching are small (<15 -feet -wide). After construction, all disturbed areas would be returned to their approximate preconstruction contours and drainage patterns. The temporary construction ROW would be restored and revegetated with native grasses, forbs, conifers, and shrubs, as outlined in the ECRP. After construction, key habitat components such as LWD and boulders would be restored onsite and the bed and banks would be returned to preconstruction conditions. By implementing these measures, lateral and longitudinal connectivity at the site scale would be maintained, although in the short-term during construction, connectivity may be disrupted. Except for a few days during the construction of the crossings, access to areas necessary for life-histories of aquatic and riparian dependent species would not be obstructed. By restricting stream crossing operations to the ODFW in-stream work window, possible impacts on sensitive life stages of aquatic biota would be minimized. Road decommissioning that occurs within Riparian Reserves (approximately 18-acres) would contribute to restoration of aquatic connectivity. The residual levels of disturbance are anticipated to be well within the range of natural variability in the Klamath-Siskiyou Province and the High Cascades Province. (appendix F.4, table 2-54)
Maintain and restore the physical integrity of the aquatic system, including shorelines, banks, and bottom configurations.	Impacts on the bed and banks of aquatic features would be minor and limited to the site of construction because the pipeline would be buried, and the actual area of bank and stream bottom disturbance is small at each crossing (<15-feet -wide). This level of disturbance is comparable to a bank slough (see appendix F.4, section 1.4.1.) or a culvert installation and well within the range of natural variability that for watersheds of the Klamath-Siskiyou Province and the High Cascades Province (see (appendix F.4, table 2-54). After construction, key habitat components such as LWD and boulders would be restored onsite and the bed and banks would be returned to preconstruction conditions, consistent with the exhibits to the POD. By implementing these measures, the physical integrity of the aquatic system at the site scale would be maintained.

TABLE 4.7.3.5-9 (continued)

Compliance of the Pacific Connector Pipeline Project with ACS Objectives, Little Butte Creek

ACS Objective	Project Impacts
Maintain and restore water quality necessary to support healthy riparian, aquatic, and wetland ecosystems. Water quality must remain within the range that maintains the biological, physical, and chemical integrity of the system and benefits survival, growth, reproduction, and migration of individuals composing aquatic and riparian communities.	Minor amounts of sediment would be mobilized during construction. These impacts are expected to be short-term and limited to the general area of construction (see appendix F.4, section 1.4.1). No long-term impacts on water quality are expected because of application of the ECRP that includes maintenance of effective ground cover and BMPs during construction (see appendix F.4, section 1.4.1.1). Effective shade would be removed at the crossing of the South Fork Little Butte Creek at MP 162.45. A site-specific shade analysis (NSR 2009) found no temperature impacts at the site or at the stream network scale at this crossing.
Maintain and restore the sediment regime under which aquatic ecosystems evolved. Elements of the sediment regime include the timing, volume, rate, and character of sediment input, storage, and transport.	The Little Butte Creek watershed sediment regime was historically characterized by pulse-type depositions of coarser sediments from landslides and surface erosion following major disturbances such as fires and high-intensity winter storms (BLM and Forest Service 1997). The current sediment regime in the watershed has replaced these pulse-type disturbances with more chronic erosion and deposition of fine sediments primarily from urban and agricultural land use, timber harvest and roads. Project construction and operation is not likely to alter this sediment pattern nor is it likely to exacerbate these conditions because of implementation of measures in the ECRP (see section 1.4.1) including maintenance of effective ground cover, water bars to dissipate overland flows and maintenance of sediment barriers until revegetation is successful. Sediment impacts from construction are expected to be like those described in appendix F.4, section 1.4.1.2. A pulse of sediment could be observed following the first seasonal rain, but that this is likely to dissipate within a few hundred feet and would be indistinguishable from background levels. Any sediment impacts are expected to be well within the range of natural variability for the Klamath-Siskiyou Province and the High Cascades Province (see appendix F.4, table 2-54). Proposed mitigation projects including road decommissioning would contribute to reduction of sediments and restoration of aquatic functions at the watershed scale (see appendix F.4, table 2-57).
Maintain and restore instream flows sufficient to create and sustain riparian, aquatic, and wetland habitats and to retain patterns of sediment, nutrient, and wood routing. The timing, magnitude, duration, and spatial distribution of peak, high, and low flows must be protected.	The Project is unlikely to affect peak flows in the Little Butte Creek watershed because of the dispersed nature of impacts, the current hydrologically recovered conditions in the watershed, the relatively small proportion of the watershed affected (0.25%), and the relative lack of connectivity to aquatic systems (see appendix F.4, table 2-54). Decommissioning roads on NFS lands (57.5 miles) as part of the offsite mitigation plan would contribute substantively the restoration of flow patterns by restoring hydrologic connectivity at stream crossings that are decommissioned (see appendix F.4, table 2-57).
Maintain and restore the timing, variability, and duration of floodplain inundation and water table elevation in meadows and wetlands.	The Project clips one small wetland on NFS land but does not cross it. Application of the ECRP including maintenance of effective ground cover and BMPs during construction will be applied (see appendix F.4, section 1.4.1.1). In addition, decommissioning 57.5 miles of roads, 18- acres of which are in Riparian Reserves (see appendix F.4, table 2-57) would contribute substantially to restoring floodplain functions where these projects occur.
Maintain and restore the species composition and structural diversity of plant communities in riparian areas and wetlands to provide adequate summer and winter thermal regulation; nutrient filtering; and appropriate rates of surface erosion, bank erosion, and channel migration and to supply amounts and distributions of coarse, woody debris sufficient to sustain physical complexity and stability.	The Project impacts on riparian vegetation in the Little Butte Creek watershed would be minor. Approximately 10.22 acres or 0.13% of the Riparian Reserves in the watershed are potentially affected by the Project (appendix F.4, table 2-48). Existing herbaceous and brush cover would be maintained in Riparian Reserves to the extent practicable. Following construction, replanting with native species would facilitate reestablishment of vegetation communities. Large woody debris and boulders from the Project ROW would be returned to disturbed riparian areas. Coarse woody debris placement and snag creation on 126- acres in Riparian Reserves, along with revegetation on 18 acres of Riparian Reserves in roads that would be decommissioned would help to reestablish species composition and structural diversity of plant communities in Riparian Reserves (see appendix F.4, table 2-57).

TABLE 4.7.3.5-9 (continued) **Compliance of the Pacific Connector Pipeline Project with ACS Objectives, Little Butte Creek**	
ACS Objective	**Project Impacts**
Maintain and restore habitat to support well-distributed populations of native plant, invertebrate and vertebrate riparian-dependent species.	The Project impacts on riparian vegetation in the Little Butte Creek watershed would be minor. Approximately 10.22 acres or 0.13% of the Riparian Reserves in the watershed are potentially affected by the Project. Following construction, replanting with native species would facilitate reestablishment of vegetation communities. Large woody debris and boulders from the Project ROW would be returned to disturbed riparian areas. Coarse wood placement and snag creation on 126 acres in Riparian Reserves, along with revegetation on 18 acres of Riparian Reserves in roads that would be decommissioned would help to reestablish species composition and structural diversity of plant communities in Riparian Reserves. The Project would waive application of Management Recommendations for Survey and Manage species in the watershed but would not prevent attainment of the ACS objectives because the viability of riparian-dependent Survey and Manage species would not be threatened. (see appendix F.5).

Source: Appendix F.4, table 2-62

The Little Butte Creek watershed is the largest, and in some ways, the most complex watershed crossed by the Project. With 13.87 miles of corridor, and 209.32 acres of clearing on NFS lands, this watershed has the most NFS land area affected of all watersheds crossed by the Project. The watershed is geologically complex with both Klamath-Siskiyou Province and the High Cascades Province landscapes. It is ecologically diverse and important, providing some of the most productive coho salmon streams in the Upper Rogue Basin. Little Butte Creek watershed is a Tier 1 Key Watershed above the confluence of the North and South Forks of Little Butte Creek (appendix F.4, table 1-2), and roughly 88 percent of the NFS lands in the watershed are managed as LSR (appendix F.4, table 1-1). Against this backdrop, compliance with the ACS is an important measure of Project impacts.

Pacific Connector has modified the Project to respond to the ACS objectives and has incorporated measures consistent with the Riparian Reserve Standards and Guidelines into the ECRP and other elements of their plan of development (e.g., Wetlands and Water Body Crossing Plan). The assessment in appendix F.4 demonstrates that short-term impacts associated with the Project would occur to streambanks, and substrates at the site scale. Change in vegetative condition from clearing of forest within the Project right-of-way is a long-term impact. These impacts, however, are well within the range of natural variability given the disturbance processes that function in the watershed (see appendix F.4, table 2-54). This is especially apparent when considering the total amount of Riparian Reserves that are located within the Little Butte Creek watershed (8,096.50 acres) and the amount of clearing (10.22 acres) in Riparian Reserves (0.13 percent of the Riparian Reserves in the watershed) (appendix F.4, table 2-47). Also, because of the linear characteristic of the pipeline, the Riparian Reserve crossings would be spread out across the landscape.

Off-site mitigation measures including approximately 60 miles of road decommissioning (57.5 miles are within Key Watershed), approximately 10 miles of LWD instream projects, identified by the Forest Service and proposed by the Applicant on BLM lands, would supplement onsite minimization, mitigation, and restoration actions. These proposed offsite mitigation measures are responsive to recommendations in the Little Butte Creek watershed assessment (1997) and the South Cascades Late-Successional Reserve Assessment (1998). Mitigations measures encompassed with the Project description described in section 2 of this EIS are responsive to watershed assessment recommendations and would improve watershed conditions where they are applied (see appendix F.4, table 2-57, 2-58).

To make provisions for the Project, three site-specific amendments of the Rogue River National Forest LRMP related to the ACS are proposed (see appendix F.4).

- Proposed amendment RRNF-5 would allow the Project to cross the MA-26 Restricted Riparian land allocation at one location on the South Fork of Little Butte Creek a perennial stream. This amendment would not prevent attainment of ACS objectives because a site-specific temperature assessment (NSR 2009) showed there would be no temperature increase from shade removal at this location, effective ground cover and sediment barriers would be maintained and implementation of the ECRP is expected to control surface erosion and reestablish native vegetation.
- Proposed amendment RRNF-6 would allow the Project to exceed detrimental soil conditions within the construction corridor. This would not prevent attainment of ACS objectives because the Project would require soil remediation as needed with organic materials in areas with potential revegetation difficulty, soil decompaction, maintenance of effective ground cover, application of BMPs, and application of offsite mitigations. Therefore, any sediment impacts from detrimental soil conditions are expected to be minor and short term and the methods described above would be expected to effectively moderate detrimental soil conditions. Implementation of measures in the ECRP is expected to effectively control surface erosion and restore native vegetation (see section 4.3.4 in this EIS).
- Proposed amendment of the Rogue River National Forest LRMP to waive protection measures for Survey and Manage species would not prevent attainment of ACS objectives because the persistence of riparian dependent survey and manage species would not be threatened (see appendix F.5).

The Project is otherwise consistent with Standards and Guidelines for activities in Riparian Reserves for the Rogue River National Forest.

The routing of the pipeline through NFS lands, coupled with the relatively small area of NFS land affected by Project construction (0.67 percent of NFS lands in the fifth-field watershed), makes it highly improbable that Project impacts could affect watershed conditions. The relative lack of intersections with aquatic systems serves to further minimize possible impacts. Although there are project-level impacts from short-term sediment and long-term change in vegetative condition at stream crossings, these would be minor in scale (appendix F.4, table 2-62).

No Project-related impacts that would prevent attainment of ACS objectives have been identified (appendix F.4, section 1.4.1, table 2-62). All relevant Project impacts are within the range of natural variability for watersheds in the Klamath-Siskiyou and High Cascades Provinces, although some of these processes have been altered from their natural condition (appendix F.4).

Klamath River Basin, Spencer Creek Fifth Field Watershed, HUC 180102206, Winema National Forest

Discussions of watershed analysis recommendations, natural disturbances, range of variability etc. are found in appendix F.4. Table 4.7.3.5-10 (table 2-77 in appendix F.4) and this section compares the Project impacts on the objectives of the ACS for the Spencer Creek watershed. National Forest System lands where the ACS applies comprise approximately 41 percent of the Spencer Creek watershed (appendix F.4, table 1-1). Watershed conditions and recommendations are found in the Spencer Creek watershed analysis (BLM et al. 1995). The Project would include approximately 6.05 miles on NFS lands. A total of 9.98 acres of Riparian Reserves or 0.60 percent of the Riparian Reserves in the watershed (appendix F.4, table 2-65) would be affected of which 8.63 acres are cleared and 1.35 acres (appendix F.4, table 2-3) are modified on:

- Four intermittent stream channels and two wetlands crossed by the Project.
- Four intermittent streams and two wetlands where Riparian Reserves are clipped but the associated stream channel or wetland is not crossed.

TABLE 4.7.3.5-10

Compliance of the Pacific Connector Pipeline Project with ACS Objectives, Spencer Creek Watershed

ACS Objective	Project Impacts
Maintain and restore the distribution, diversity, and complexity of watershed and landscape-scale features to ensure protection of the aquatic systems to which species, populations, and communities are uniquely adapted.	Riparian Reserves are watershed-scale features. The project would clear about 8.63-acres or about 0.52% of Riparian Reserves on NFS lands in the Spencer Creek watershed (appendix F.4, table 2-67). There are four intermittent stream channels crossed in the Spencer Creek Watershed. No perennial streams are crossed. Riparian Reserves associated with two forested wetlands and four intermittent streams are clipped. Impacts on aquatic systems are expected to be short-term or minor and limited to the project scale because of application of BMPs and erosion control measures (see appendix F.4, section 1.4.1.). Clearing of 4.58 acres of LSOG vegetation in Riparian Reserves is a long-term change in condition, but is minor in scale, and within the range of natural variability given the disturbance processes in Spencer Creek (appendix F.4). Spencer Creek watershed remains above the 15% threshold on federal lands for LSOG vegetation established in the NWFP (appendix F.4). Large woody debris cleared in construction of the project right-of-way would be used to stabilize and restore stream crossings. Off-site mitigation measures including 29.2 miles of road decommissioning, one mile of instream projects, fencing and riparian planting projects are expected to improve watershed conditions in the Spencer Creek watershed on NFS lands. Off-site mitigation could also take place on BLM lands. BLM administered lands are not subject to ACS requirements as a result of the August 2016 RODs for two new RMPs (BLM 2016a and 2016b) that supersede the RMPs amended by the 1994 NWFP ROD. The project proponent has offered voluntary mitigation that could be implemented on BLM lands within this watershed; these mitigation efforts would benefit ACS objectives within the watershed. Applicant proposed off-site mitigation on BLM lands include improvement road drainage at 16 sites and road closure at 12 sites. While there are long-term changes in vegetation in Riparian Reserves from construction clearing of the project right-of-way, these would be minor in scale and well within the range of natural variability given the disturbance history of the watershed (see appendix F.4).

TABLE 4.7.3.5-10 (continued)

Compliance of the Pacific Connector Pipeline Project with ACS Objectives, Spencer Creek Watershed

ACS Objective	Project Impacts
Maintain and restore spatial and temporal connectivity within and between watersheds. Lateral, longitudinal, and drainage network connections include floodplains, wetlands, upslope areas, headwater tributaries, and intact refugia. These network connections must provide chemically and physically unobstructed routes to areas critical for fulfilling life-history requirements of aquatic and riparian-dependent species.	The Project is not expected to affect spatial or temporal connectivity in the Spencer Creek watershed because the pipeline would be buried in all aquatic habitats crossed, consistent with the requirements of the exhibits specified in the POD (i.e., Wetland and Waterbody Crossing Plan). Additionally, all the channels crossed in Spencer Creek are intermittent and are likely to be dry at the time of crossing. In the short-term, during construction, connectivity could be disrupted for 1-5 days. At each crossing, bed and bank disturbances are small (<15 feet wide). After construction all disturbed areas would be returned to their approximate preconstruction contours and drainage patterns. The temporary Project ROW would be restored and revegetated with native grasses, forbs, conifers, and shrubs, as outlined in the ECRP. After construction, key habitat components such as LWD and boulders would be restored onsite and the bed and banks would be returned to preconstruction conditions. By implementing these measures, lateral and longitudinal connectivity at the site scale would be maintained, although in the short-term, during construction, connectivity may be disrupted. Except for a few days during the construction of the crossing, access to areas necessary for life-histories of aquatic and riparian dependent species would not be obstructed. By restricting stream crossing operations to the ODFW in-stream work window, possible impacts on sensitive life stages of aquatic biota would be minimized. Road decommissioning that occurs within Riparian Reserves (approximately 9.63- acres) would contribute to restoration of aquatic connectivity (see appendix F.4). The residual levels of disturbance are anticipated to be well within the range of natural variability in the High Cascades Province (see appendix F.4).
Maintain and restore the physical integrity of the aquatic system, including shorelines, banks, and bottom configurations.	Impacts on the stream bed and banks would be minor and limited to the site of construction because the pipeline would be buried, and the actual area of bank and stream bottom disturbance is small at each crossing (<15- feet -wide). This level of disturbance is comparable to a bank failure (see appendix F.4, section 1.4.1) and well within the range of natural variability for watersheds in the High Cascades Province. After construction, key habitat components such as LWD and boulders would be restored onsite and the bed and banks would be returned to preconstruction conditions, consistent with the exhibits to the POD (i.e., Wetland and Waterbody Crossing Plan). By implementing these measures, the fluvial integrity of the aquatic system at the site-scale would be maintained. Offsite mitigation measures (see section 2.6.3.6) would substantively improve watershed conditions by decommissioning 29.22 miles of roads (50- acres total of which 12.6- acres are in Riparian Reserves), replanting willows along 0.5 -miles of perennial streams and restoring LWD in 1 mile of Spencer Creek (appendix F.4, table 2-74).
Maintain and restore water quality necessary to support healthy riparian, aquatic, and wetland ecosystems. Water quality must remain within the range that maintains the biological, physical, and chemical integrity of the system and benefits survival, growth, reproduction, and migration of individuals composing aquatic and riparian communities.	Spencer Creek is 303(d) listed by the State of Oregon for biological criteria, sedimentation, and temperature (ODEQ 2010 database). Project stream crossings in the Spencer Creek watershed are expected to occur when intermittent stream channels are dry. Minor amounts of sediment would be generated during construction that may be mobilized during the onset of seasonal precipitation in the fall. These impacts are expected to be short -term and limited to the general area of construction (see appendix F.4, section 1.4.1). No long-term impacts on water quality are expected because of application of the ECRP including maintenance of effective ground cover (see appendix F.4, section 1.4.1) and BMPs during construction (see section 1.4.1.1) Offsite mitigation measures (see appendix F.4, table 2-73) address key issues identified in the watershed assessment and are expected to substantially improve watershed conditions.
Maintain and restore the sediment regime under which aquatic ecosystems evolved. Elements of this sediment regime include the timing, volume, rate, and character of sediment input, storage, and transport.	The Spencer Creek watershed sediment regime was historically characterized by pulse-type depositions of coarser sediments from streambank erosion following major disturbances such as fires and high-intensity winter storms. More chronic erosion and deposition of fine-grained sediments primarily from roads, and to a lesser degree from land use has replaced these pulse-type disturbances in the current sediment regime in the watershed. The Project construction and operation are not likely to alter this sediment pattern nor is it likely to exacerbate these conditions. Sediment impacts from construction are expected to be like those described in section 1.4.1.2 of appendix F.4. Proposed mitigation would contribute to reduction of sediments and restoration of aquatic functions at the watershed scale. Any sediment impacts are expected to be well within the range of natural variability given the disturbance history of the Spencer Creek watershed (see appendix F.4).

TABLE 4.7.3.5-10 (continued) Compliance of the Pacific Connector Pipeline Project with ACS Objectives, Spencer Creek Watershed	
ACS Objective	**Project Impacts**
Maintain and restore instream flows sufficient to create and sustain riparian, aquatic, and wetland habitats and to retain patterns of sediment, nutrient, and wood routing. The timing, magnitude, duration, and spatial distribution of peak, high, and low flows must be protected.	The Project is unlikely to affect flow patterns in the Spencer Creek watershed because of the dispersed nature of impacts, high infiltration rates and the relatively small proportion of the watershed affected (0.41%) (appendix F.4, table 2-64). Decommissioning roads (29.5 miles) as part of the offsite mitigation plan would contribute substantively the restoration of flow patterns by restoring hydrologic connectivity at stream crossings that are decommissioned (see appendix F.4, table 2-73).
Maintain and restore the timing, variability, and duration of floodplain inundation and water table elevation in meadows and wetlands.	The Project crosses two small wetland areas and clips the Riparian Reserve of another two forested wetlands. Trench plugs would be installed on each side of these wetlands as needed to block subsurface flows and maintain shallow, unconfined aquifer water table elevations, as required by FERC's *Procedures*. By restricting crossings to the dry season (July 1 to Sept. 15), possible impacts on shallow ground water tables of these wetland areas are expected to be minor and short-term.
Maintain and restore the species composition and structural diversity of plant communities in riparian areas and wetlands to provide adequate summer and winter thermal regulation; nutrient filtering; and appropriate rates of surface erosion, bank erosion, and channel migration and to supply amounts and distributions of coarse, woody debris sufficient to sustain physical complexity and stability.	The Project impacts on riparian vegetation in the Spencer Creek watershed would be minor. Approximately 9.98 or 0.60% of the Riparian Reserves in the watershed are potentially affected by the Project (appendix F.4, table 2-65). Existing herbaceous and brush cover would be maintained in Riparian Reserves to the extent practicable. Following construction, replanting with native species would facilitate reestablishment of vegetation communities. Large woody debris and boulders from the Project ROW would be returned to disturbed riparian areas. Revegetation of 12.6 acres of Riparian Reserves in roads that would be decommissioned would help to reestablish species composition and structural diversity of plant communities in Riparian Reserves (appendix F.4, table 2-74).
Maintain and restore habitat to support well-distributed populations of native plant, invertebrate and vertebrate riparian-dependent species.	The Project impacts on riparian vegetation in the Spencer Creek watershed would be minor. Approximately 9.98 acres or 0.60% of the Riparian Reserves in the watershed are potentially affected by the Project (appendix F.4, table 2-65). Following construction, replanting with native species would facilitate reestablishment of vegetation communities. Large woody debris and boulders from the Project ROW would be returned to disturbed riparian areas. Revegetation on 12.6 acres of Riparian Reserves in roads that would be decommissioned would help to reestablish species composition and structural diversity of plant communities in Riparian Reserves. The Project would waive application of Management Recommendations for Survey and Manage species in the watershed but would not prevent attainment of the ACS objectives because the viability of riparian-dependent survey and manage species would not be not threatened. (see appendix F.5).

Source: Appendix F.4, table 2-77

The Spencer Creek watershed is the easternmost and driest watershed where the ACS applies that is crossed by the Project in the High Cascades Province. It is also a Tier 1 Key Watershed in the NWFP. Stream densities are much lower than watersheds west of the Cascade crest. Precipitation patterns show a strong declining gradient from 40 inches a year on the crest of the Cascades to less than 12 inches where Spencer Creek flows into the Klamath River. The pumice soils in the watershed have high infiltration rates and rarely exhibit overland flows and mass wasting events that influence riparian and aquatic resources in other watersheds crossed by the Project. By locating the Project adjacent to the Clover Creek Road for much of its length, impacts on wetlands and stream channels have been minimized when compared to the impacts of creating a new corridor.

There are two areas of concern related to the effects of the project in the Spencer Creek watershed based on the Spencer Creek watershed analysis including whether those effects would be outside the range of natural variability for affected resources in the watershed. The two areas of concern are sediment and temperature. These effects on the four intermittent streams that would be crossed on NFS lands are summarized below; additional information is provided in section 2.2.3.3 of appendix F.4 of this EIS.

A stream crossing turbidity, construction risk and site response analysis was used to evaluate stream crossing risk for all waterbodies in the Spencer Creek watershed (see section 4.3 of this EIS and appendix F.4, table 2-67). BMPs that would be applied at each crossing, grouped by "blue" (low risk) and "yellow" (moderate risk) construction impact risk ratings are shown in appendix F.4, table 2-68. All of the crossings in Spencer Creek are rated as "blue" or low risk for construction impacts.

All stream crossings on NFS lands in the Spencer Creek watershed are intermittent (non-fish bearing), snow-melt driven streams. BMPs from the "Blue" category in appendix F.4, table 2-68 would be applied at these channel crossings. The upper three crossings (MP 171.06, 171.57, 172.48) drain into wetland features directly below the Spencer Creek road, or into the large Buck Lake complex of channels. The lower crossing (MP 173.74) is an intermittent tributary of Spencer Creek.

If the project is constructed, sediment impacts are expected to be minor, short -term and consistent with the evaluation in section 4.3 of the EIS and compliant with the POD, specifically the ECRP and *Wetland and Waterbody Crossing Plan* described in section 2.1.4 of the EIS. Long-term adverse consequences to water quality from soil erosion and channel sedimentation are not expected to occur due to effective ground cover, implementation of the ECRP which includes revegetation of disturbed areas, and installation of waterbars to disperse water.

While on-site erosion control measures are expected to be effective, the presence of wetland features below three of the crossings (MP 171.06, 171.57, and 172.48) provide additional backup for filtering of any fine sediment that may enter stream systems from these crossings.

There are four crossings of intermittent channels on NFS lands in the Spencer Creek watershed where vegetation within a Riparian Reserve would be cleared. Crossings of these intermittent channels are not expected to affect water temperatures because these streams would likely be dry or become discontinuous by the time that warmer water temperatures become an issue in late summer (see appendix F.4, section 1.4.1.1).

Consistent with the previous efforts supporting FERC's 2015 Final EIS, Pacific Connector used predictive modeling on a representative cross-section of perennial crossings along the project route, spanning the ecoregions, HUCs, width classes, and aspect classes present from Coos Bay to Malin, Oregon, including stream crossings on NFS lands. Model results show a maximum predicted increase of 0.16°Cover one 75-foot clearing. Thermal recovery analysis shows that temperatures return to ambient within a maximum distance of 25 feet downstream of the Project right-of-way, based on removal of existing riparian vegetation over a cleared right-of-way width of 75- feet. These findings are consistent with the reports prepared for the Forest Service and BLM in support of their assessment of amendments to RMPs (NSR 2009, 2014; Stantec 2019). Pacific Connector also assessed the cumulative impact of right-of-way clearing on stream temperatures. The project cumulative effects to the thermal regime in the Coos, Coquille, South Umpqua, Rogue, Klamath, and Lost River basins is expected to be exceptionally minor and well below detection in the field given that mitigation for loss of effective shade would occur, and that predictive modeling using SSTEMP shows that the local impacts are small in magnitude and spatially limited (GeoEngineers 2013f: 26).

Pacific Connector has modified the Project to respond to the ACS objectives and has incorporated measures consistent with the Riparian Reserve Standards and Guidelines. The assessment provided in appendix F.4, table 2-70 demonstrates that short-term impacts would occur to streambanks, and substrates at the site scale. Change in vegetative condition from clearing the Project right-of-way is a long-term impact that would occur on 8.63 acres of Riparian Reserves. These impacts, however, are well within the range of natural variability given the disturbance processes that function in the watershed (see appendix F.4, table 2-70). Also, because of the linear characteristic of the Project, the Riparian Reserve crossings would be spread out across the landscape.

Off-site mitigation measures, identified by the Forest Service, would supplement on-site minimization, mitigation, and restoration actions. These proposed off-site mitigation measures are responsive to recommendations in the Spencer Creek Watershed Assessment (BLM et al. 1995) and would improve watershed conditions where they are applied (appendix F.4, table 2-73).

Three site-specific amendments of the Winema National Forest LRMP that have a nexus with the ACS are proposed to make provision for the Project (see appendix F.4).

- Proposed amendments WNF-4 and WNF-5 would allow the Project to exceed detrimental soil conditions within the Project right-of-way. This would not prevent attainment of ACS objectives because soil decompaction and remediation required in Riparian Reserves is expected to effectively moderate detrimental soil conditions. Implementation of measures in the ECRP is expected to effectively control surface erosion and restore native vegetation (see section 4.3.4 of this EIS).
- Proposed amendment of the Winema National Forest LRMP to waive protection measures for Survey and Manage species would not prevent attainment of ACS objectives because the Project does not threaten the persistence of any riparian-dependent species (see appendix F.5).

The Project is otherwise consistent with Standards and Guidelines for activities in Riparian Reserves for the Winema National Forest.

The routing of the Project through NFS lands, coupled with the relatively small area of NFS land affected (0.41 percent of NFS in the fifth-field watershed), makes it highly improbable that the Project impacts could affect watershed conditions. Although there are project-level impacts (e.g., short-term sediment and long-term a change in vegetative condition at stream crossings), these would be minor in scale (see appendix F.4, table 2-77).

No Project-related impacts that would prevent attainment of ACS objectives have been identified. All relevant impacts are within the range of natural variability given the disturbance patterns and fire history of watersheds in the High Cascades Province (see appendix F.4, table 2-70).

4.7.3.6 Resource Values and Conditions on Federal Lands: The Late Successional Reserve (LSR) System on National Forest System Lands

This section summarizes appendix F.3 (LSR Technical Report), which contains the full text of the independent Forest Service analysis. Reviewers who seek additional information should review the applicable section in appendix F.3. Section numbers that refer to sections in the appendix are so noted.

The LSR Network

The NWFP allocated a network of LSRs to conserve species of concern within the existing configuration of land ownership and the location of remaining LSOG forests within the range of the NSO (see appendix F.3 section 1.2).[177] The reserve network is embedded in a matrix of "working" forests and was designed to maintain LSOG forests in a well-distributed pattern across these federal lands (Moeur et al. 2011).

The LSR network is composed primarily of areas of large (mapped) reserves, but also includes smaller areas of "unmapped" reserves that are composed of sites occupied by MAMUs or are known NSO activity centers (KOAC). As presently configured the Pacific Connector pipeline would not cross any "unmapped reserves."[178] The LSR standards and guidelines are designed to guide management activities occurring within these LSRs to protect and enhance the conditions of the LSOG forest ecosystems contained therein (Forest Service and BLM 1994b). The proposed Pacific Connector pipeline route would cross two mapped LSRs (LSR 223 on the Umpqua National Forest, and LSR 227 on the Rogue River National Forest).

LSR Standards and Guidelines

The standards and guidelines for LSRs are contained in Attachment A (pages C-9 through C-21) of the NWFP ROD. They are designed to protect and enhance conditions of LSOG forest ecosystems that serve as habitat for LSOG species. They are written to apply to specific management actions such as silviculture, range management, mining, new developments, etc., and should be interpreted in that context. The standards and guidelines that apply to new developments such as pipelines are addressed on page C-17 of the NWFP standards and guidelines. The standard on page C-17states:

> *Developments of new facilities that may adversely affect Late-Successional Reserves should not be permitted. New development proposals that address public needs or provide significant public benefits, such as powerlines, pipelines, reservoirs, recreation sites, or other public works projects would be reviewed on a case-by-case basis and may be approved when adverse impacts can be minimized and mitigated. These would be planned to have the least possible adverse impacts*

[177] Originally the NWFP covered federal lands managed by the BLM and Forest Service within the range of the NSO. However, in August 2016, the BLM issued new Resource Management Plans that replaced the management direction for BLM lands. Therefore, the management direction in the NWFP no longer applies to BLM lands.

[178] Table 4.7.3.3-2 in the draft EIS listed an estimated one acre of unmapped LSR that may be impacted by road improvements on an existing road on the Rogue River National Forest. However, that road improvement is located within LSR 227 and is therefore not in an unmapped LSR. This table has been corrected in the Final EIS.

on Late-Successional Reserves. Developments would be located to avoid degradation of habitat and adverse impacts on identified late-successional species.

On January 3, 2001 the Regional Interagency Executive Committee for the NWFP issued Instruction Memorandum No, OR-2001-016 titled "Interpretation of the Northwest Forest Plan Standards and Guidelines Regarding New Developments in Late-Successional Reserves" (USDA and USDI 2001 Memorandum). This guidance was followed including the guidance for determining conditions neutral or beneficial to the creation and maintenance of late-successional habitat.[179]

The LSR standards and guidelines provide the framework upon which the proposed LSR mitigation actions and related plan amendments for the Pacific Connector pipeline are evaluated (see section 1.3.3 of appendix F.3). To meet this direction, the Forest Service has provided input to the Applicant regarding project design. First, in routing the proposed project, LSRs have been avoided where possible. Second, where impacts on LSRs are unavoidable, on-site "Design Features" or "Project Requirements" have been developed to minimize the impacts. Third, in order to ensure that the objectives would continue to be achievable in these LSRs, land reallocations are being proposed as part of a compensatory mitigation plan. These proposed land reallocations would take non-LSR (i.e., matrix) lands and designate them as LSRs. The reallocations will require amendments of the LRMPs for the Umpqua National Forest and Rogue River National Forest. Fourth, off-site compensatory mitigation actions have been proposed to aid in off-setting unavoidable adverse impacts.

The Commission will consider the need and public benefit of this Project when making its decision on whether or not to authorize it, as documented in the Project Order. The cooperating agencies will consider public benefit within the context of each agency's respective authorities. Each cooperating agency will document its decision in the applicable permit, approval, concurrence, or determination.

Project Impacts on LSRs on NFS Lands

The proposed pipeline would cross three national forests (Rogue River, Umpqua, and Winema) for a total of approximately 31 miles. The proposed project would affect mapped LSRs on the Rogue River and Umpqua National Forests. As presently configured, the proposed Pacific Connector project would not cross any LSRs on the Winema National Forest. Table 4.7.3.6-1 and figure 4.7-5 provide an overview of the number of acres that would be directly affected by the Project within LSRs on each affected unit of the Forest Service. The mapped LSR that would be crossed on the Umpqua National Forest is depicted in figure 4.7-5, and the mapped LSR that would be crossed on the Rogue River National Forest is depicted in figure 4.7-5.

[179] The introduction to the Standards and Guidelines for Multiple-Use Activities Other Than Silviculture states; "As a general guideline nonsilvicultural activities located inside Late-Successional Reserves that are neutral or beneficial to the creation and maintenance late-successional habitat are allowed" (NWFP page C-16). The 2001 memorandum provides the detailed guidance for considering new developments in LSR including the "neutral or beneficial" standard.

TABLE 4.7.3.6-1

Direct Effects (a/) of the Proposed Project on Mapped LSRs (acres)

Forest	Cleared	Modified	Total Direct Effects
Umpqua National Forest	68	19	87
Rogue River National Forest	210	71	281
Total	**278**	**90**	**368**

a/ Direct effects include Pipeline corridor clearing, TEWAs, and UCSAs
Data source: Forest Service, GIS layers

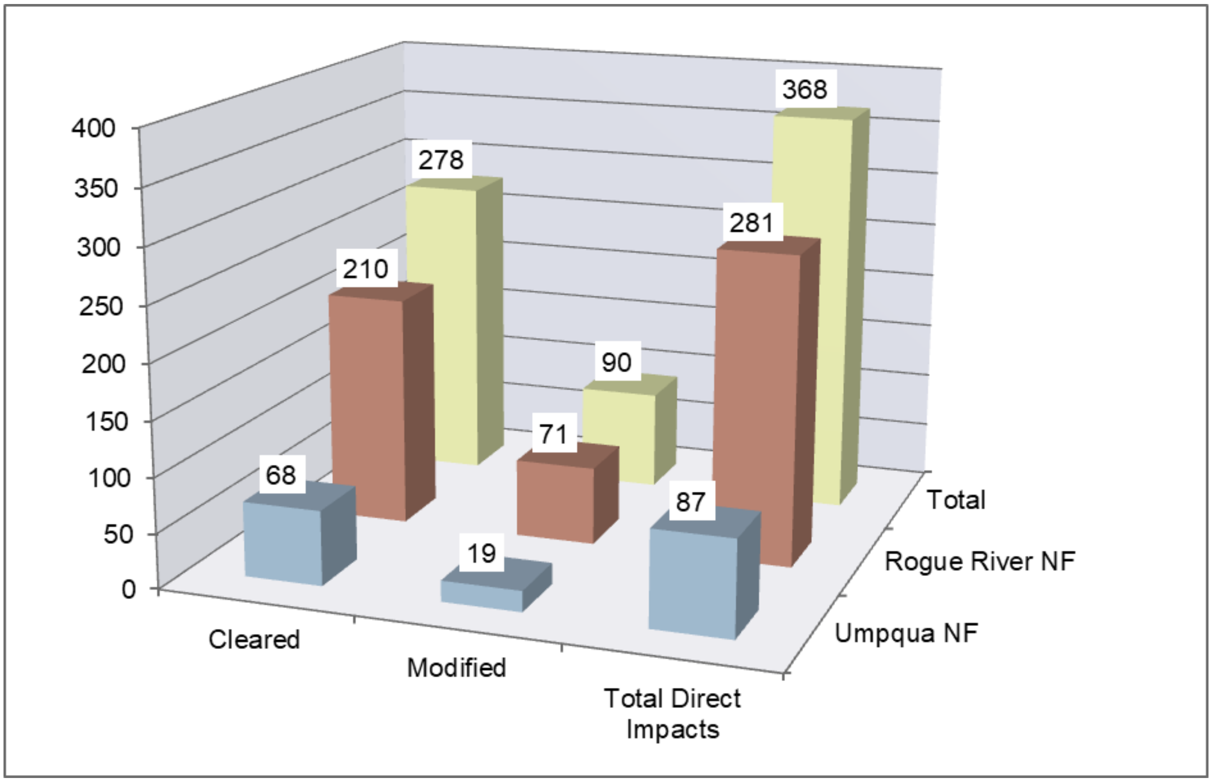

Figure 4.7-5. Direct Effects of the Proposed Project on Mapped LSRs (acres)

Direct effects would occur in the areas that would be cleared (i.e., forest vegetation would be removed) for the pipeline right-of-way and the TEWAs. Direct effects would also occur on acres that would be "modified" by the pipeline project. These acres include UCSAs that would not be cleared of trees during construction. These areas would be used to store forest slash, stumps, and dead and downed log materials that would be scattered across the right-of-way after construction, which would be considered temporary habitat modifications.

Indirect effects from construction of the pipeline are also expected within LSRs that have interior forest that the NSO rely on for nesting habitat. The conversion of large tracts of LSOG forest to small, isolated forest patches with large edge areas can create changes in microclimate, vegetation species, and predator-prey dynamics. Such edge effects–the magnitude of changes over distance from the edge to forest interior–would depend on the general orientation to the sun. Two main physical factors affecting and creating an edge microclimate are sun and wind (Forman 1995; Chen et al. 1995; Harper et al. 2005). Together, sun and wind: 1) desiccate leaves by increasing evapotranspiration; 2) influence which plant species survive and thrive along the edge, usually favoring shade-intolerant species; and 3) impact the soil, insects, and other animals along the edge. Compared to the forest interior, areas near edges receive more direct solar radiation during the day, lose more long-wave radiation at night, have lower humidity, and receive less short-wave radiation. However, such effects are dependent on such local conditions as orientation of an edge: the magnitudes of change in humidity with distance from an edge are most extreme with south-facing edges compared to east- and west-facing edges (Chen et al. 1995). These effects would vary along the pipeline route as a function of route orientation and the facing direction of each edge. Because the Pacific Connector pipeline generally trends from northwest to southeast, edge effects would be most pronounced on the southwest-facing edges and weakest along the northeast-facing edges. Fundamental changes in the microclimate (moisture, temperature, solar radiation) of a stand have been recorded greater than 700 feet from the forest edge (Chen et al. 1995).

Using recommendations from the ESA Sub-Task Group and Habitat Quality Subtask Group, indirect effects are considered to extend for 100 meters from the created edge in LSOG forest. In making their recommendation, the sub-task groups considered the study done by Karen A. Harper et al., which looked at edge influence on forest structure in fragmented landscapes (Harper et al. 2005). The study reviewed the effects caused by forest edges on multiple response variables, including: 1) forest processes of tree mortality/damage, recruitment, growth rate, canopy foliage, understory foliage, and seedling mortality, 2) forest structure by canopy trees, canopy cover, snags and logs, understory tree density, herbaceous cover, and shrub cover, and 3) stand composition by species, exotics, individual species, and species diversity. The study found that the mean distance of edge influence on any single response variable did not exceed 300 feet (100 meters). Therefore, indirect effects for the project are estimated to extend for 100 meters beyond the cleared area on each side of the corridor in LSOG forest habitat. There is no corresponding research for edge effects in younger forest stands (less than 80 years old). There is, however, research that indicates indirect effects extend out approximately two times the average tree height (Morrison et al. 2002). Based on this research, an estimate of 30 meters is used in non-LSOG forest habitat. In non-forested areas, no indirect effects are estimated since no new edge would be created. Table 4.7.3.6-2 and figure 4.7-6 provide a summary of the total number of LSR acres that would be directly and indirectly affected on Forest Service lands by the pipeline project.

The construction, operation, and maintenance of the proposed pipeline project would affect LSRs on Forest Service lands in several ways. It would remove and fragment LSOG forest habitat that some vertebrate and invertebrate species depend on. It would directly affect individuals of species listed as threatened under the ESA through removal of suitable nesting, roosting, and foraging habitat for the NSO. The indirect effects discussed above would result in the loss of some interior LSOG forest habitat and increased predation (see also section 4.6 of this EIS for additional discussion).

Although there would be some impacts on interior forests, these impacts have been minimized in LSR through the routing of the pipeline. The Forest Service worked closely with the Applicant to avoid interior forest by routing the pipeline where feasible on or near existing roads and timber harvest areas (see section1.3.3 of appendix F.3 for additional information).

TABLE 4.3.7.6-2

Summary of Total LSR Acres Directly and Indirectly (a/) Affected by the Proposed Project

Forest	Direct Effects	Indirect Effects	Total Effects
Umpqua	87	240	327
Rogue River	281	539	820
Total Forest Service	**368**	**779**	**1,147**

Data source: Forest Service GIS data layers

a/ Direct effects include cleared acres (corridor and TEWAs) and modified acres (UCSAs). Indirect effects include 100 meters on each side of the cleared corridor edge in LSOG, and 30 meters on each side of the cleared corridor edge in non-LSOG.

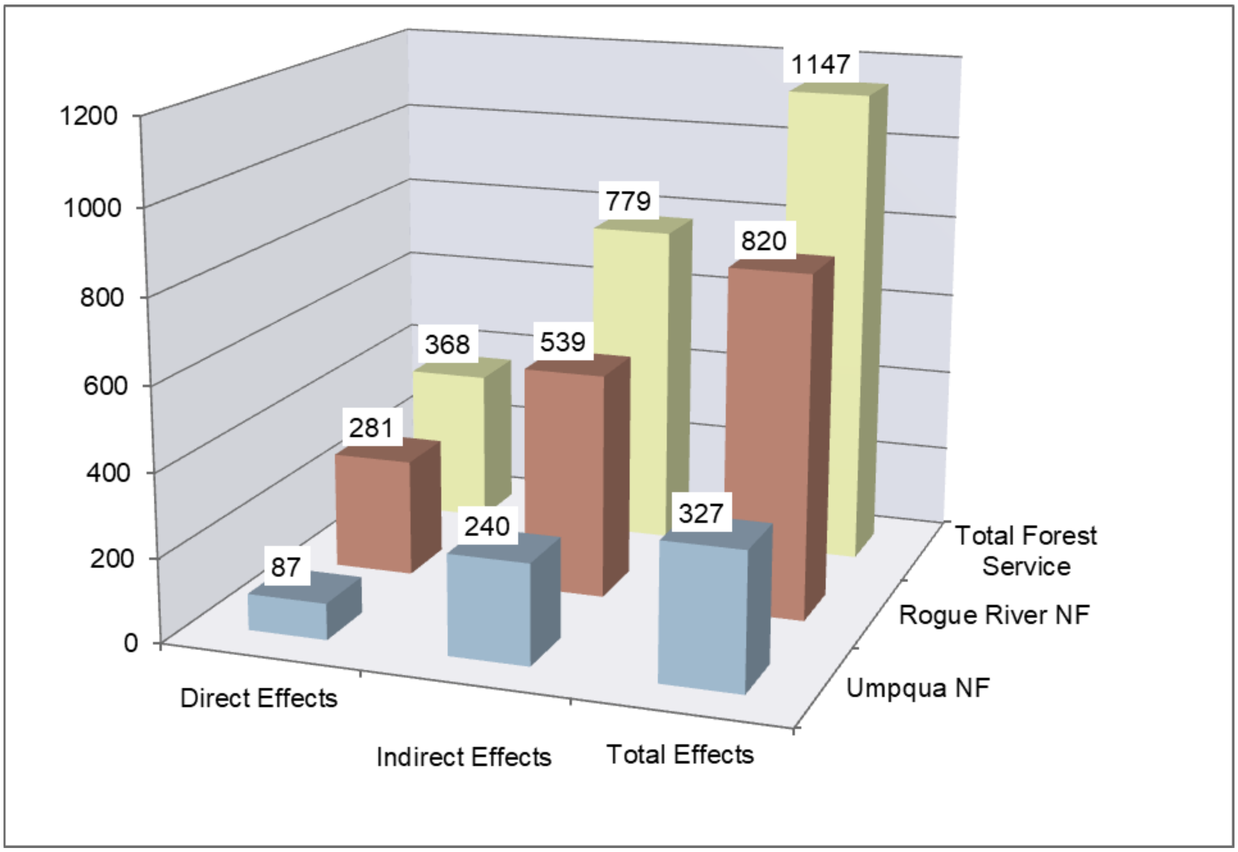

Figure 4.7-6. Summary of Total LSR Acres Directly and Indirectly Affected

The primary mitigation action for the effects of the proposed pipeline on LSRs would add acres to the LSRs. The Forest Service is proposing to accomplish this through reallocation of matrix lands to LSR. Reallocating these acres will require amendments to the Umpqua and Rogue River National Forest LRMPs.[180] Table 4.7.3.6-3 and figure 4.7-7 display a summary comparison

[180] Evaluations of these proposed amendments and how they relate to the planning requirements in the Forest Service planning rule at 36 CFR 219 (2012 Version) is discussed in section 4.7.3.4 of the EIS and in appendix F.2.

between the LSR acres that would be cleared by the construction of the project and the proposed reallocation of matrix lands to LSR.

TABLE 4.7.3.6-3

Comparison of Total LSR Acres Cleared (a/) by the Project and the Acres of Matrix Reallocated to LSR

	LSR Habitat Affected by Project Construction Clearing			LSR Mitigation
Forest	**LSOG Habitat**	**Non-LSOG Habitat**	**Total LSR Clearing**	**Matrix to LSR Reallocations**
Umpqua National Forest	20	48	68	585
Rogue River National Forest	52	158	210	522
Total	**72**	**206**	**278**	**1,107**

Data source: Forest Service GIS data layers
a/ Clearing includes acres in the project corridor and the TEWAs.

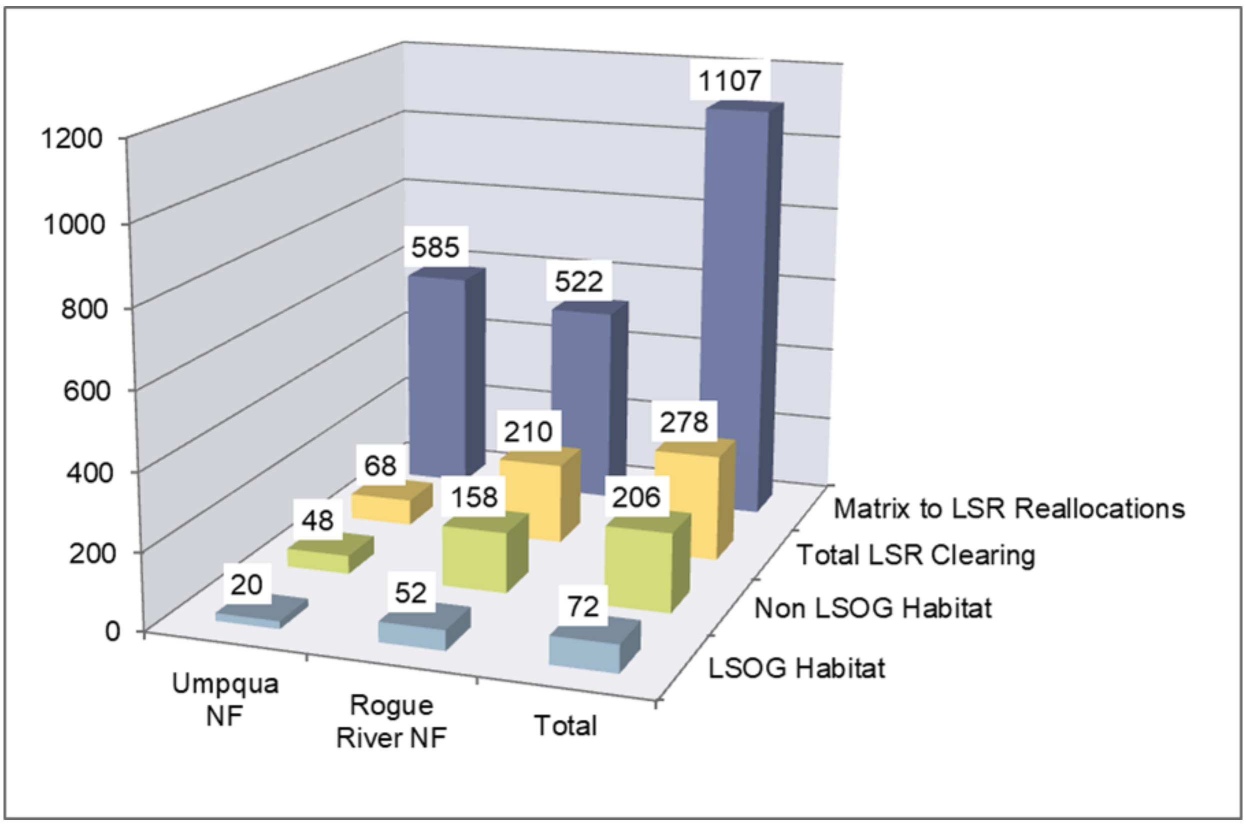

Figure 4.7-7. Comparison of Total LSR Acres Cleared by the Project and Total Acres of Matrix Reallocated to LSR

In addition to the reallocation of matrix lands to LSR, off-site mitigation would also be necessary to ensure that unavoidable adverse impacts are mitigated to meet the requirement that the overall impact would be either neutral or beneficial to the creation and maintenance of late-successional habitat in LSRs (USDA and USDI Memorandum 2001). A CMP on Forest Service lands has been developed by the agency for the Project. A portion of the CMP was developed specifically to compensate for the unavoidable adverse impacts of the project on LSRs, to achieve a neutral or beneficial condition within affected LSRs, and to maintain the long-term integrity of the Forest Service land use plans for LSRs. Under the CMP, unavoidable impacts on LSOG forest habitats within LSRs on Forest Service lands would be compensated for by a combination of reallocation of matrix lands to LSR and a set of off-site mitigation projects. These projects are discussed in the sections below (see also appendix F.3 sections 2.1 and 2.2, appendix F.2, and section 4.7.3.4 of this EIS).

Umpqua National Forest LSR 223

The proposed Pacific Connector project would cross approximately 5.0 miles of LSR 223 on the Umpqua National Forest and the construction of the Project would directly affect (acres cleared plus acres modified) approximately 87 acres of LSR 223. A map of the proposed project and LSRs in the Umpqua National Forest is displayed in figure 4.7-8.

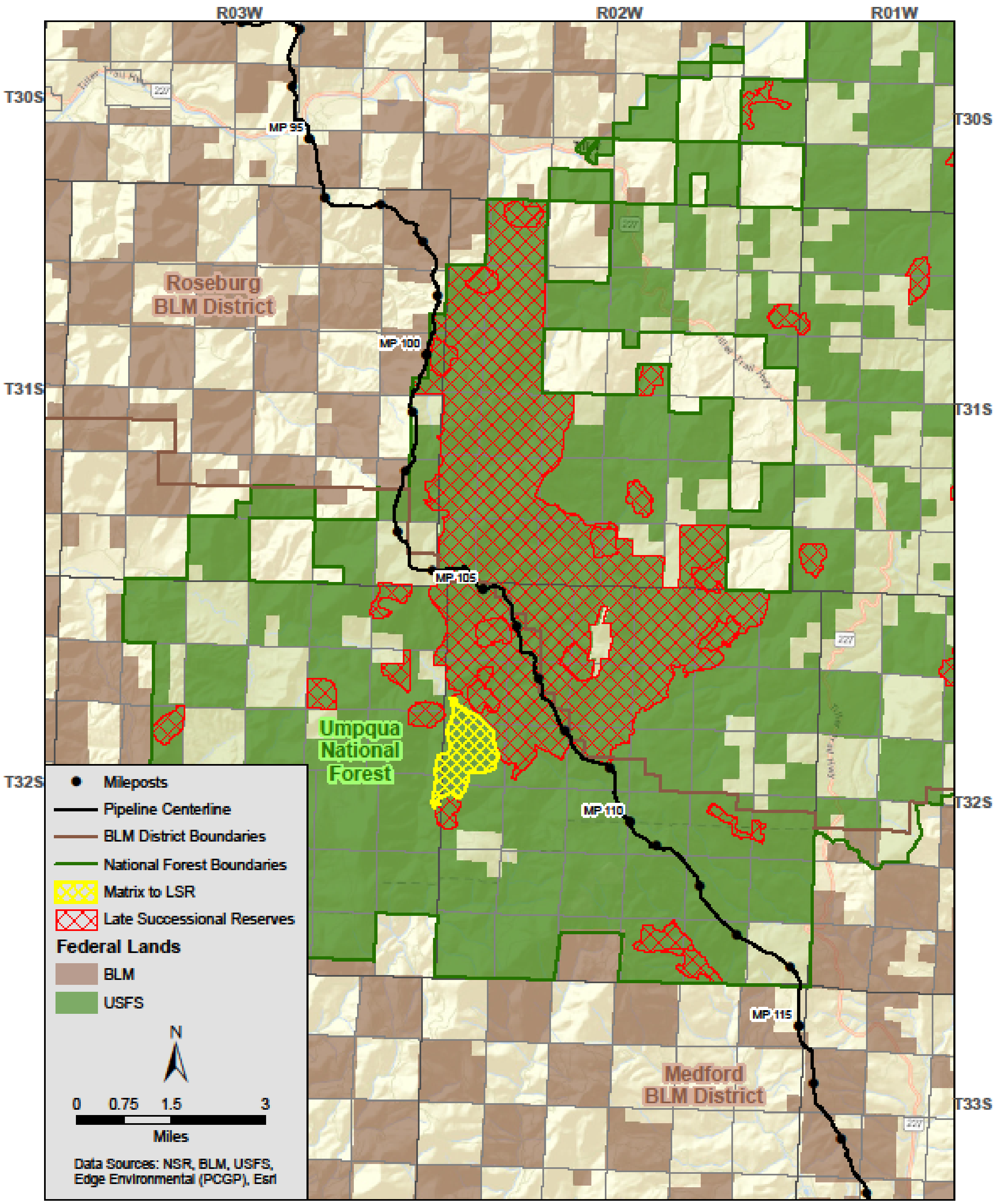

Figure 4.7-8. Map of Proposed Project and LSRs in the Umpqua National Forest

Amendment UNF-4, Reallocation of Matrix Lands to Late Successional Reserves

The Umpqua National Forest LRMP would be amended to change the designation of approximately 585 acres from the matrix land allocation to the LSR land allocation in Sections 7, 18, and 19, T.32 S., R. 2 W., Oregon; and Sections 13 and 24, T. 32 S., R. 3 W., W. M., Oregon (see figure 4.7-8). This change in land allocation is proposed to partially mitigate for the potential adverse impact of the project on LSR 223 in the Umpqua National Forest. This amendment would change future management direction for the lands reallocated from matrix to LSR.

Mitigation Actions

A compensatory mitigation plan has been developed by the Forest Service and submitted to the project Applicant to ensure that the goals and objectives of the LRMP related to LSR 223 would be achieved.[181] Mitigation actions include:

- Creation of snags on 190 acres that are below desired snag densities for LSRs.
- Placing coarse woody debris (CWD) on 164 acres in units that are currently below desired levels for CWD.
- Decommissioning 5 miles of roads to reduce fragmentation and develop interior stand habitat over time.
- Thinning approximately 247 acres of overstocked stands to reduce fire risk and accelerate development of LSR characteristics.
- Integrated stand density and fuel break treatments on 898 acres in LSR 233 to restore stand density, species diversity, structural diversity and control the spread and intensity of wildfire within forested stands prone to fire activity.
- Other proposed mitigation actions in LSR 223 include 80 acres of meadow restoration, 301 acres of off-site pine removal, 6 miles of noxious weed treatments, fish passage improvement at two sites, 5 miles of road stormproofing and one water source improvement.

The off-site mitigation actions proposed are consistent with the recommendations in the LSRA for LSR 223. These off-site mitigation actions would accelerate the development of LSOG forest habitat elements to further offset the effects of the project on LSR 223 in the long term. The additional off-site mitigation actions would also increase the effectiveness of the additional LSOG forest habitat added to LSR 223 by improving the quantity, quality, and distribution of high-quality habitat. Figure 4.7-9 displays a map of the proposed mitigation actions.

[181] This mitigation plan has been revised from the previous version based on the changed conditions in LSR 223 as a result of the 2015 Stouts Creek Fire (see Attachment 1 to appendix F.3).

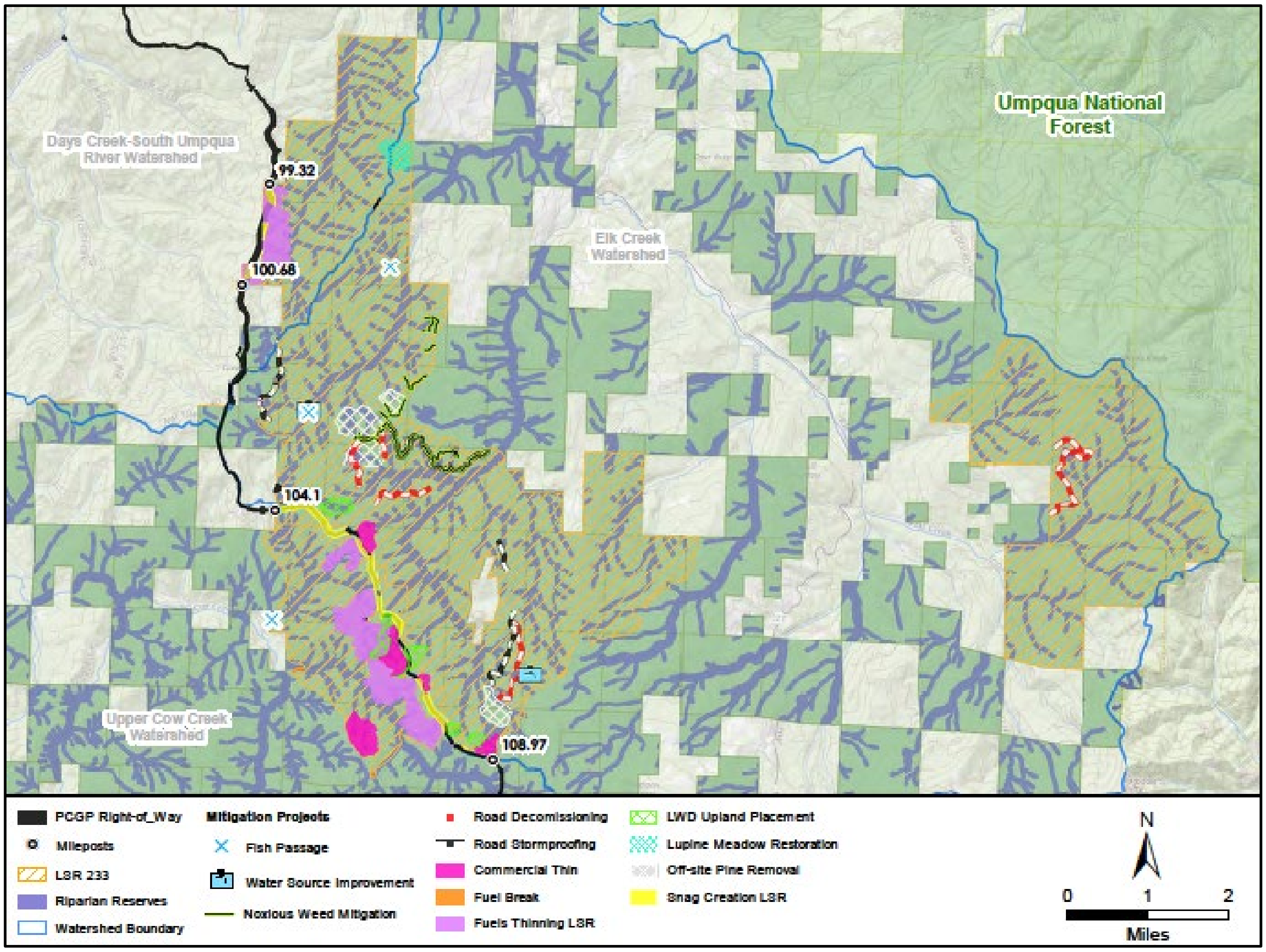

Figure 4.7-9. Proposed Off-Site Mitigation Actions in LSR 223

Assessment of Proposed Amendments and Mitigation Actions Relevant to LSR 223

The Project would clear approximately 68 acres in LSR 223, of which approximately 20 acres are LSOG forest. The area proposed to be reallocated to LSR 223 is approximately 585 acres of matrix lands, of which approximately 296 acres are LSOG forest. This change in land allocation is proposed to partially mitigate for the potential adverse impact of the Project on LSR 223 in the Umpqua National Forest. When acres reallocated from matrix lands to LSR are compared to the acres of LSR that would be cleared by the Project, the proposed amendment would reallocate over eight times more acres to LSR than would be cleared for the Project corridor. A comparison of the total acres affected in LSR 223 and the acres of reallocation are displayed in table 4.7.3.6-4 and figure 4.7-10 below.

TABLE 4.7.3.6-4

Comparison of LSR 223 Acres Affected (a/) by the Project and Acres of Matrix Reallocated to LSR

Umpqua NF LSR 223	Direct Effects: Cleared	Direct Effects: Modified	Indirect Effects	Total Effects	Matrix to LSR Reallocation
LSOG	20	7	166	193	296
Non- LSOG	48	12	74	134	289
Non-Forest	0	0	0	0	0
Total	**68**	**19**	**240**	**327**	**585**

a/ Total effects include cleared acres (corridor and TEWAs), modified acres (UCSAs), and indirect effect acres (100 meters on each side of the cleared corridor edge in LSOG and 30 meters on each side of the cleared corridor edge in non-LSOG).
Data source: Forest Service GIS Data Layers

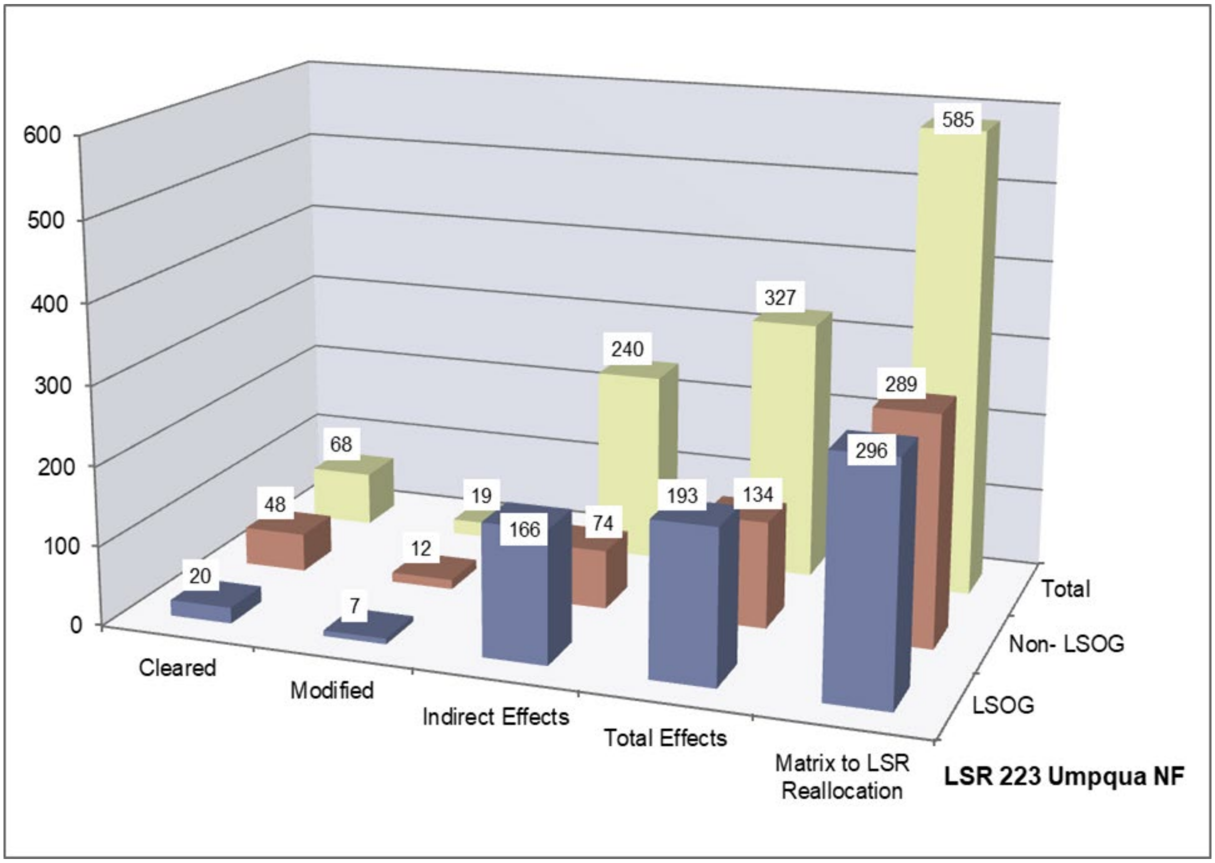

Figure 4.7-10. Comparison of Total LSR 223 Acres Affected by the Project and Acres of Matrix Reallocated to LSR

In addition to the Project impacts on LSR 223 in the Umpqua National Forest there are also potential impacts on LSR 223 from road improvements that may be necessary to accommodate the trucks that would construct the pipeline. These trucks are longer than typical trucks that use forest roads and some road widening and curve realignment may be necessary to safely allow for this truck traffic. However, in LSR 223 on the Umpqua National Forest, it is estimated that only 0.01 acre of road improvements widening would occur. Although road improvements would occur to the extent possible within the existing clearing limits, it is possible that some additional clearing of forest vegetation would be necessary to accommodate the road improvements (see the TMP, Appendix Y of the POD, for additional details).

Assessment of Functionality of LSR 223 on the Umpqua National Forest and Consistency with LSR Standards and Guidelines

The functionality of LSR 223 relates directly to the goals and objectives for LSRs (see section 1.2 of appendix F.3) and can be measured by the quantity, quality, and distribution of LSOG forest habitat in the LSR and how the proposed project would impact these characteristics.

- Quantity: The overall quantity of LSOG habitat within LSR 223 on the Umpqua National Forest would increase with the proposed LRMP amendment. The project would remove approximately 20 acres of LSOG habitat but the reallocation would add 296 acres of LSOG habitat, for a net increase of 276 acres.
- Quality: The area proposed for reallocation to LSR 223 contains some large blocks of LSOG habitat and it would also be located immediately adjacent to two KOACs, providing further consolidation of LSOG habitat and increased protection of NSO habitat. With the reallocation of matrix to LSR and the consolidating of larger blocks of LSOG habitat, the quality of the LSOG habitat within LSR 223 would be slightly improved. There is also the benefit of the 289 acres of younger (less than 80 years old) stands in the reallocated acres being managed for future LSOG habitat, which would provide the potential for larger blocks of LSOG habitat.
- Distribution: The distribution of LSOG habitat within LSR 223 would remain largely unchanged with the proposed project and the reallocation of matrix to LSR LRMP amendment. To the extent there are minor changes, they would be beneficial due to the location of the proposed reallocation. The reallocation would occur on the southwest edge of the LSR, providing for some additional connectivity with the nearest LSRs to the south and west.
- The off-site mitigation actions would improve the quantity, quality, and distribution of LSOG habitat in LSR 223 by accelerating the development of constituent elements of late-successional habitat, reducing the risk of stand-replacement fire and reducing fragmentation through road decommissioning and stand-density management.

The project design features, the reallocations of matrix to LSR, and the off-site mitigation actions for LSR 223 in the Umpqua National Forest have been designed with the goal of making the overall impact of the Pacific Connector pipeline project either neutral or beneficial to the creation and maintenance of late-successional habitat. These actions combined would maintain or improve the functionality of LSR 223.

Rogue River National Forest LSR 227

The proposed Project would cross approximately 13.9 miles of the Rogue River National Forest and, if constructed, would directly affect (corridor plus TEWAs and UCSAs) approximately 281 acres of LSR 227. The proposed pipeline and LSR 227 in the Rogue River National Forest are displayed on figure 4.7-11.[182]

[182] The miles and acreage are slightly different from the draft EIS due to the pipeline reroute for the Pacific Crest Trail crossing (see section 3.4.2.9 of this EIS for a description of the reroute). Although there are three more acres of direct impact the new route would directly impact three less acres of LSOG habitat.

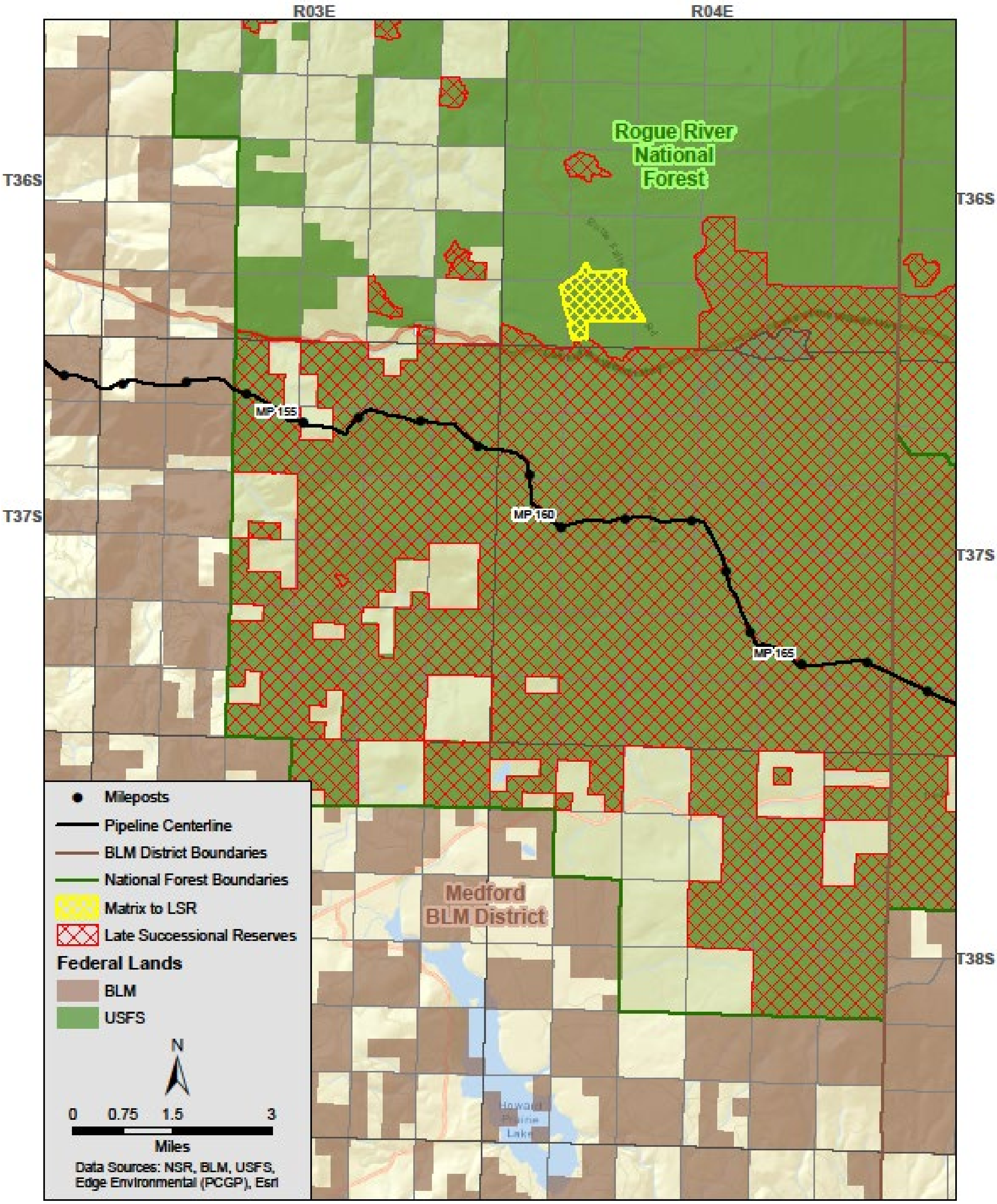

Figure 4.7-11. Map of Proposed Project and LSR in the Rogue River National Forest

Amendment RRNF-7, Reallocation of Matrix Lands to Late Successional Reserves

The Rogue River National Forest LRMP would be amended to change the designation of approximately 522 acres from the matrix land allocation to the LSR land allocation in Section 32, T.36 S., R. 4 E., W. M., Oregon (see figure 4.7-11). This change in land allocation is proposed to partially mitigate for the potential adverse impact of the project on LSR 227 in the Rogue River National Forest. The amendment would change future management direction for the lands reallocated from matrix to LSR.

Mitigation Actions

A compensatory mitigation plan has been developed by the Forest Service and submitted to the project Applicant to ensure that the goals and objectives of the LRMP related to LSR 227 would be achieved (see appendix F.3, section 2.2). The lands in the Rogue River National Forest that would be affected by the proposed project are all within LSR 227. The primary objectives for the off-site mitigation actions are to accelerate the development of LSOG forest habitat in LSR 227. Mitigation actions include:

- Creation of snags on 622 acres that are below desired snag densities for LSRs.
- Placing CWD on 511 acres in units that are currently below desired levels for CWD.
- Decommissioning 57 miles of roads to reduce fragmentation and develop interior stand habitat over time.
- Thinning approximately 618 acres of overstocked stands to reduce fire risk and accelerate development of LSR characteristics.
- Other proposed mitigation actions in LSR 227 include placing large woody debris in approximately 1.4 miles of streams to improve fish habitat.

The off-site mitigation actions proposed are consistent with the recommendations in the LSRA for LSR 227. These off-site mitigation actions would accelerate the development of LSOG forest habitat elements to further offset the effects of the project on LSR 227 in the long term. The additional off-site mitigation actions would also increase the effectiveness of the additional LSOG forest habitat added to LSR 227 by improving the quantity, quality, and distribution of high-quality habitat. The proposed mitigation actions are displayed in figure 4.7-12.

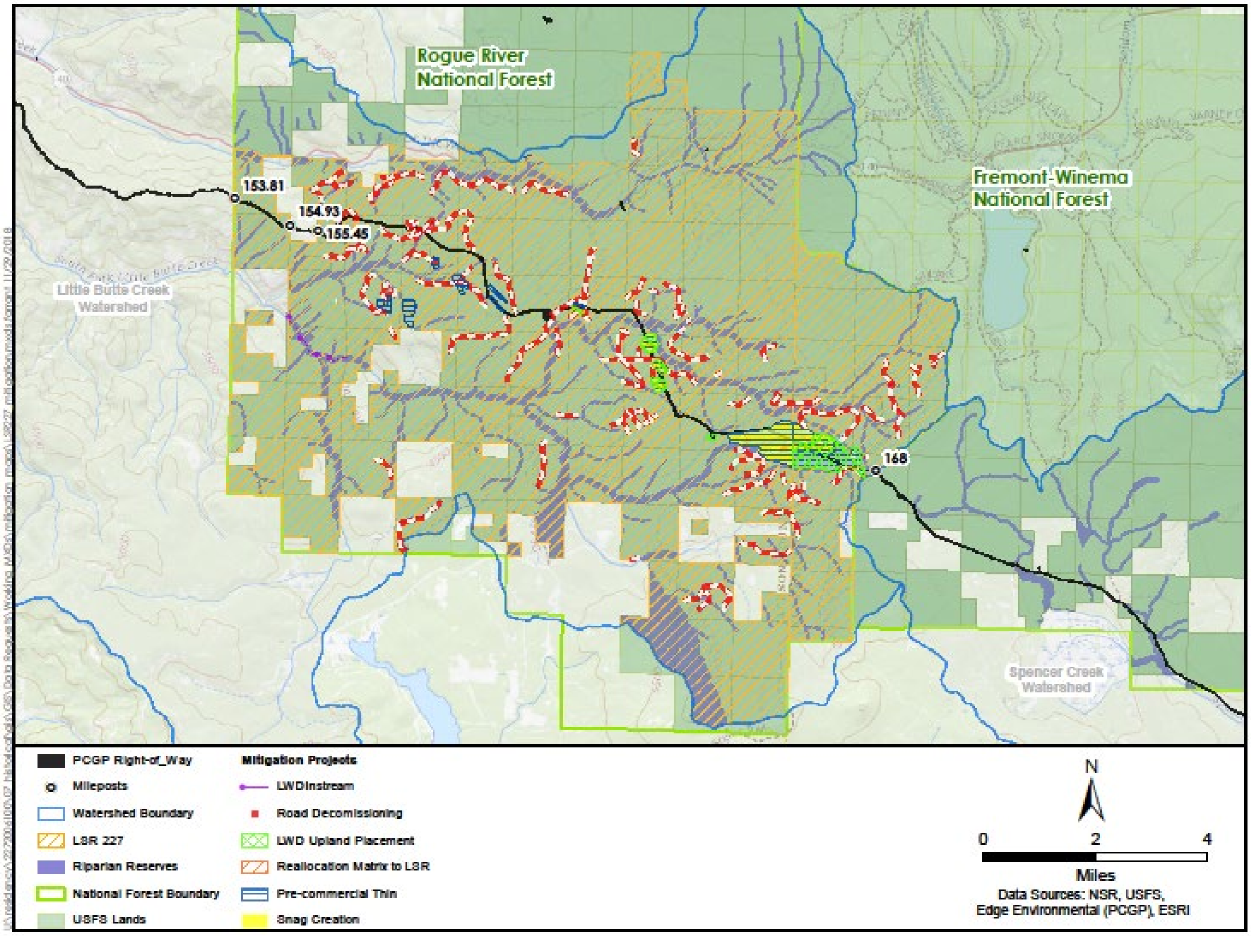

Figure 4.7-12. Proposed Off-Site Mitigation Actions in the Rogue River National Forest

Assessment of Proposed Amendments and Mitigation Actions Relevant to LSR 227

In the Rogue River National Forest, the proposed project would lie entirely within LSR 227. If constructed, the portion of the project on the Rogue River National Forest would be about 13.9 miles long and would clear approximately 210 acres of forest vegetation in LSR 227, of which approximately 52 acres are LSOG forest. The matrix area proposed for reallocation to LSR is approximately 522 acres, of which approximately 237 acres are LSOG forest (see figure 4.7-13). This change in land allocation is proposed to partially mitigate for the potential adverse impact of the project on LSR 227 in the Rogue River National Forest. When acres reallocated from matrix to LSR are compared to the acres of LSR that would be cleared by the project, the proposed amendment would reallocate about 2-1/2 times more acres to LSR than would be cleared in the project corridor. When comparing acres of LSOG habitat, the proposed amendment would reallocate over 4 times more acres of LSOG habitat than would be cleared by the project. A comparison of the total acres affected in LSR 227 and the acres that would be reallocated are displayed in table 4.7.3.6-5 and figure 4.7-13 below.

TABLE 4.7.3.6-5

Comparison of Total LSR Acres Affected (a/) by the Project and Acres of Matrix Reallocated to LSR

Rogue River National Forest LSR 227	Direct Effects: Cleared	Direct Effects: Modified	Indirect Effects	Total Effects	Matrix to LSR Reallocation
LSOG	52	21	349	422	237
Non- LSOG	149	50	190	389	284
Non-Forest	9	0	0	9	1
Total	**210**	**71**	**539**	**820**	**522**

a/ Total effects include cleared acres (corridor and TEWAs), modified acres (UCSAs), and indirect effect acres (100 meters on each side of the cleared corridor edge in LSOG and 30 meters on each side of the cleared corridor edge in non-LSOG).
Data source: Forest Service GIS Data Layers

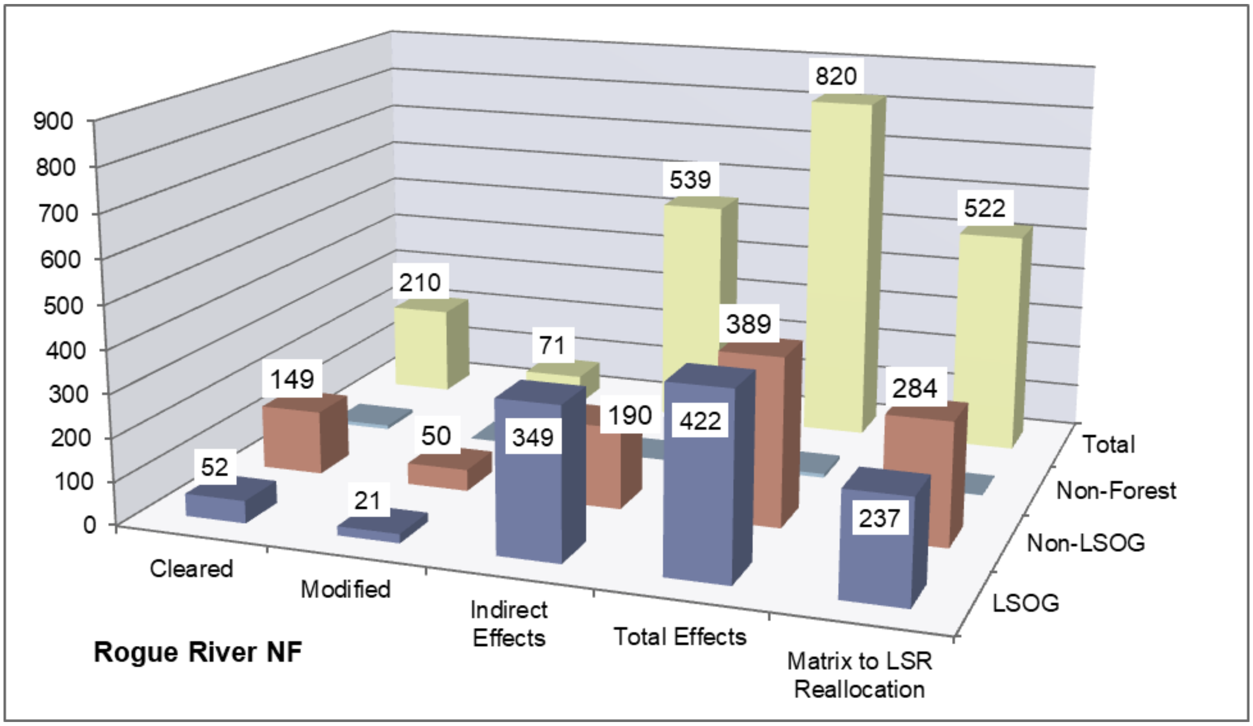

Figure 4.7-13. Comparison of Total LSR Acres Affected by the Project and Acres of Matrix Reallocated to LSR

In addition to the impacts of the pipeline corridor, there are also potential impacts on LSR 227 from road improvements that may be necessary to accommodate the trucks that would construct the pipeline. These trucks are longer than typical trucks that use forest roads, and some road widening and curve realignment may be necessary to safely allow for this truck traffic. It is estimated that only one acre of road improvements would occur within LSR 227. Although this road widening would occur to the extent possible within the existing clearing limits, it is possible that some additional clearing of forest vegetation would be necessary to accommodate the road improvements (see the TMP, Appendix Y of the POD, for additional details).

Assessment of Functionality of LSR 227 on the Rogue River National Forest and Consistency with LSR Standards and Guidelines

The functionality of LSR 227 relates directly to the goals and objectives for LSRs (see section 1.2 of appendix F.3) and can be measured by the quantity, quality, and distribution of LSOG forest habitat in the LSR and how the proposed project would impact these characteristics.

- Quantity: The overall quantity of LSOG habitat within LSR 227 on the Rogue River National Forest would increase with the proposed LRMP amendment. The project would remove approximately 52 acres of LSOG habitat but the reallocation would add 237 acres of LSOG habitat for a net increase of 185 acres.
- Quality: The area proposed for reallocation to LSR 227 contains some large blocks of LSOG habitat. With the reallocation of matrix to LSR and the consolidating of larger blocks of LSOG habitat, the quality of the LSOG habitat within LSR 227 would be slightly improved. There is also the benefit of the 284 acres of younger (less than 80 years old) stands in the reallocated acres being managed for future LSOG habitat that would provide the potential for larger blocks of LSOG habitat.
- Distribution: The distribution of LSOG habitat within LSR 227 would remain largely unchanged with the proposed project and the reallocation of matrix to LSR LRMP amendment. To the extent there are minor changes, they would be beneficial due to the location of the proposed reallocation. The reallocation would occur on the north end of the LSR, providing for some additional connectivity with the nearest LSRs to the north.
- The off-site mitigation would improve the quantity, quality, and distribution of LSOG habitat in LSR 227 by accelerating the development of constituent elements of late-successional habitat, reducing the risk of stand-replacing fire, and reducing fragmentation through road decommissioning and stand-density management.

The Project design features, the reallocation of matrix to LSR, and the off-site mitigation actions for LSR 227 in the Rogue River National Forest have been designed with the goal that the overall impact of the Pacific Connector pipeline project would be either neutral or beneficial to the creation and maintenance of late-successional habitat. These actions combined would maintain or improve the functionality of LSR 227.

4.7.4 Conclusion

Constructing and operating the Project would have both temporary and permanent effects on land use. Some land uses would be permanently converted to industrial use, others (such as affected orchards, vineyards, and forests) would no longer be permitted directly over the pipeline. Other land uses would be converted to more natural conditions than they are currently (as part of the proposed Project-related mitigation sites). Based on the proposed mitigation and minimization measures the Project would not significantly affect land use.

4.8 RECREATION AND VISUAL RESOURCES

4.8.1 Recreation and Public Use Areas

4.8.1.1 Jordan Cove LNG Project

Parks and Other Recreational Use Areas

Land on the North Spit is managed and owned by several public agencies, including the COE, BLM, Forest Service, State of Oregon, and the Port, as well as private entities such as Roseburg Forest Products, D.B. Western, and Southport. The COE manages 245 acres on the Spit, including the North Jetty at the mouth of Coos Bay.

The Jordan Cove LNG Project would be located on the North Spit of Coos Bay, on private land. No recreational activities would be allowed within the facility boundaries. Parks and recreational areas in the general vicinity of the Project site are shown on figure 4.8-1 and discussed in the following sections.

<u>BLM Coos Bay/North Spit Shorelands</u>

The North Spit of Coos Bay is a strip of land between the Pacific Ocean and the waters of Coos Bay. This peninsula area contains both industrial and semi-wild areas. The BLM administers 1,864 acres on the Spit, with 709 acres classified as an Area of Critical Environmental Concern (ACEC) and the remainder designated as Recreation Management Areas (RMAs). BLM (2016a) designated four RMAs within the Coos Bay/North Spit area as part of the Northwestern and Coastal Oregon Record of Decision and Approved Resource Management Plan. The four RMAs are: Bastendorff Beach (a 53-acre Special Recreation Management Area [SRMA]), Coos Head (an approximately 11-acre SRMA), North Spit Boat Ramp (a 5-acre SRMA), and the North Spit Trail System (a 1,505-acre Extensive Recreation Management Area [ERMA]).[183] These SRMA and ERMA areas provide non-motorized and motorized recreation opportunities along the Pacific Coast and in the greater Coos Bay area for use by the local community and regional visitors.

The closest of these RMAs to the Jordan Cove LNG Project is the North Spit Trail System, which is approximately 300 feet from the Trans-Pacific Parkway. The BLM boat launch facility and courtesy dock, which provides access to the Coos Bay estuary and is also part of the SRMA, is approximately 0.16 mile southwest of the LNG terminal site. These four areas include designated roads and trails for OHV use. These roads are also available to hikers and equestrians. The BLM estimated that in a typical year about 2,460 OHVs and approximately 6,150 people traveled on the sand road to the North Jetty. According to the BLM, about 13,100 vehicles visited the boat dock in a single year, and about 420 boats were launched (BLM 2006b). Cross country areas in the Bastendorff Beach, Coos Head, and North Spit Trail System RMAs are available for non-motorized use only.

[183] SRMAs are defined by the BLM as administrative units where recreation opportunities and setting characteristics are recognized for their unique value, importance, and/or distinctiveness, especially as compared to other recreation areas. ERMAs are administrative units that require specific management consideration to address recreation use, demand, and/or related investments (BLM 2016a).

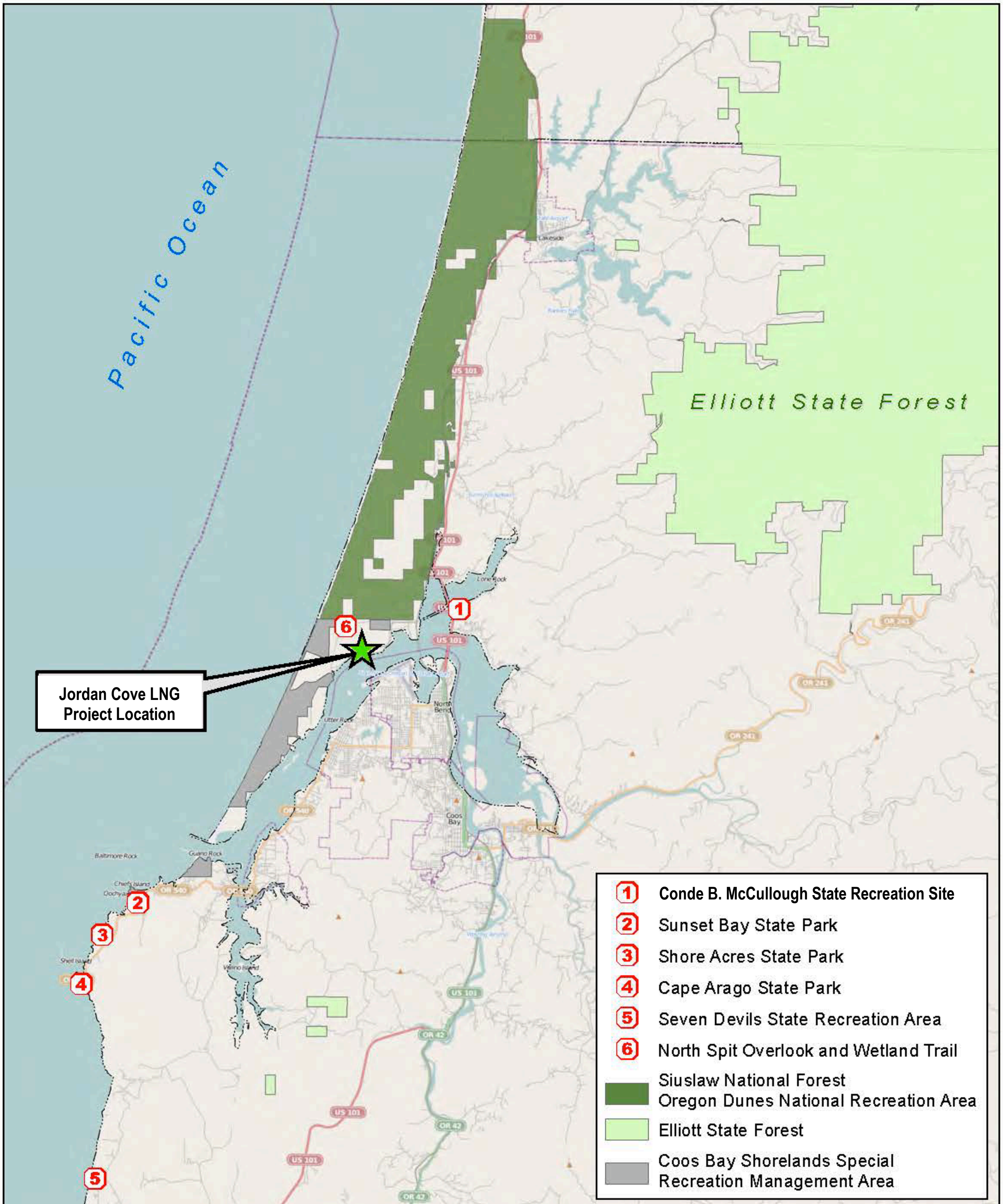

Figure 4.8-1

Recreation Areas in the Vicinity of the Jordan Cove LNG Project

Oregon Dunes National Recreation Area

The Forest Service manages the ODNRA within the Siuslaw National Forest at the north end of the Spit. The ODNRA extends approximately 45 miles along the Oregon Coast from Coos Bay north to Florence. The southern boundary of the ODNRA is about 100 feet north of the Jordan Cove LNG terminal site, across the Trans-Pacific Parkway. The Horsfall Campground is located about 0.5 mile northeast of the LNG terminal site.

The ODNRA contains the largest expanse of coastal sand dunes in North America, as well as a coastal forest and over 30 lakes and ponds. Recreational opportunities at the ODNRA include OHV use, hiking, camping, horseback riding, angling, canoeing, sailing, waterskiing, and swimming. There are approximately 34 miles of designated OHV routes open to all classes of OHVs, and roughly 135 miles of unofficial user-developed routes that are technically closed (Forest Service 2012b). The ODNRA south of Horsfall Road is closed to OHV travel, except along the beach. Day use and overnight camping facilities within the ODNRA are visited by approximately 1.0 to 1.5 million people each year (Forest Service 2009, 2012c). The Forest Service identified 1.6 million visits to the Siuslaw National Forest, including the ODNRA, in 2011, with 23.6 percent of visitors engaging in OHV use, including 18.2 percent of visitors who identified OHV use as their main activity and spent an average of 6.6 hours participating in OHV use per visit (Forest Service 2012c).

National Wildlife Refuges

Two NWRs are located near the North Bank upland wildlife habitat mitigation site (North Bank mitigation site). The 889-acre Bandon Marsh NWR is located adjacent to the North Bank mitigation site, near the mouth of the Coquille River. The lower Coquille River estuary provides important habitat for juvenile and adult anadromous fish species, including coho and Chinook salmon, steelhead, and cutthroat trout (FWS 2018d). The Oregon Islands NWR includes 1,853 rocks, reefs, and islands and extends from Tillamook, Oregon to the Oregon/California border. The refuge also protects two headlands: Coquille Point and Crook Point. Coquille Point, located approximately 5 miles from the North Bank mitigation site, provides a buffer zone between mainland development and the islands, and provides opportunities to watch seabirds and harbor seals, as well as a paved trail and interpretive panels (FWS 2018e).

State of Oregon

Pacific Ocean Beaches

The OPRD controls the Pacific Ocean beaches below the high tide mark on the west side of the Spit, while the ODSL possesses the beach land below mean low tide, including submerged lands (BLM 2005). A survey conducted on behalf of the OPRD found that the 15-mile stretch of beach along the ocean from Ten Mile Creek to the mouth of Coos Bay was visited by an average of 38 people on a weekday, and 60 people on a weekend day (Shelby and Tokarczyk 2002). The main activities of beach visitors in this area include OHV use (54 percent), relaxing (21 percent), walking (16 percent), and recreational activities with dogs (4 percent). Surfing is also a recreational activity in the ocean along the North Spit.

Oregon State Parks and Recreation Areas

Four state parks and two state recreation areas are located within 15 miles of the Project. The closest of these is the Conde B. McCullough State Recreation Site, located approximately 2.4 miles northeast across Highway 101 from the Jordan Cove LNG Project. Located along the southern shore of Haynes Inlet, this narrow shoreline recreation site is largely forested, with a small parking lot near a boat ramp at its eastern end. Only day-use recreation is permitted. The remaining five sites—the William M. Tugman, Sunset Bay, Shore Acres, and Cape Arago State Parks, and the Seven Devils State Recreation Site—are all located more than 8 miles from the Jordan Cove LNG Project. In addition, two state parks are located near the North Bank mitigation site. Bullards Beach State Park is located approximately 0.75 mile west of the North Bank mitigation site. Park facilities include campsites, a horse camp, a hiker/biker camp, and a boat ramp, and also provides access to the historic Coquille River Lighthouse (Oregon State Parks 2018). Face Rock State Scenic Viewpoint is located about 0.2 mile from the North Bank mitigation site. Amenities include picnic tables, restrooms, a viewing scope, and a stairway and trail to the beach.

Oregon State Forests

Elliott State Forest, located in the Coast Range approximately 7.8 miles to the northeast, is the closest state forest to the Jordan Cove LNG Project. Elliott State Forest is a contiguous block of land about 18 miles long (north to south), and about 16 miles wide (west to east) that encompasses approximately 93,000 acres, primarily in Coos and Douglas Counties. Although Elliott State Forest is managed primarily for timber production, recreation uses on the forest include dispersed camping, fishing, OHV use on forest roads and designated trails, horseback riding, hunting, and low amounts of hiking and mountain biking.

North Spit Overlook

The North Spit Overlook and nature trail are located about 0.5 mile west of the Jordan Cove LNG Project, on the north side of the Trans-Pacific Parkway. These facilities are maintained by Weyerhaeuser, a forest products company, to provide the public an opportunity to observe wildlife and birds in the vicinity of its former wastewater lagoon on the North Spit. Typically open to the public for nature studies, birding, walking, and photography, the gate providing access to the overlook and trails has been closed in recent years.

Coos Bay Estuary

Coos Bay estuary spreads nearly 20 square miles, offering many recreational opportunities including boating, fishing, clamming, and crabbing. The Coos Regional Trails Partnership (2004), a loose consortium of federal land management agencies and local economic development entities, developed a brochure that maps Coos Bay's water trails where canoeists and kayakers can enjoy the sloughs, bay islands, and rivers draining into the bay. The water trails closest to the LNG terminal site are approximately one mile northeast in North Slough and Haynes Inlet east of the Central Oregon and Pacific Railroad Bridge that crosses Coos Bay. A separate water trail is identified for Coos Bay east of the Highway 101 bridge. The section of Coos Bay south of the LNG terminal site is not identified as part of the water trail system (Coos Regional Trails Partnership 2004).

Oregon Coast Trail

The Oregon Coast Trail passes within 0.5 mile of the Jordan Cove LNG Project and the meteorological station site, where the trail follows Horsfall Beach Road and joins the Trans-Pacific Parkway. The Oregon Coastal Trail is a 360-mile-long hiking trail that extends south from the Columbia River to the California border. The trail was created by the Oregon Recreation Trails Advisory Council and is managed by the OPRD as part of the state park system. The trail crosses beaches, follows roads, passes through forests, and hugs coastal headlands. The majority of the trail is on the beach, but approximately 1.25 miles north of the Jordan Cove LNG Project, the trail leaves the beach at Horsfall Beach Access Road and becomes an inland trail. After heading east along Horsfall Beach Access Road, the inland trail turns east along the Trans-Pacific Parkway, and then south on U.S. Highway 101 heading into the city of North Bend. The inland trail continues through North Bend on city streets and then continues south to Charleston and then out to Sunset Bay State Park.

Oregon Coast Bike Route

The Oregon Coast Bike Route is a 370-mile-long signed bicycle route that primarily follows U.S. 101 as a shoulder bikeway and passes near the terminal, following U.S. Highway 101 through the Trans-Pacific Parkway/U.S. 101 intersection. In several areas, the route departs from the main highway and follows county roads and city streets. This occurs in North Bend, where bicyclists follow the North Bend Bypass and avoid heavy commercial and truck traffic on U.S. 101 through North Bend and Coos Bay. The bypass passes south of Pony Slough on Virginia Avenue and then turns south on Broadway Street, approximately 1.7 miles south of the Jordan Cove LNG Project. At Newmark Avenue (Cape Arago Highway), the bypass turns west and continues to South Empire Boulevard, where it continues south to Charleston, crossing the South Slough Bridge. Leaving Charleston, the bypass turns south on Seven Devils Road. In Bandon, near the North Bank mitigation site, the route runs along Riverside Drive, Ocean Drive, and Beach Loop Road through historic Old Town.

City of North Bend Parks

There are eight existing parks, one planned park, and a boat ramp in the city of North Bend. Three of these parks and the boat ramp are within 3 miles of the Jordan Cove LNG Project. Simpson Park, located approximately 1.9 miles to the southeast, is mostly forested land for day-use, low intensity recreation. Ferry Road Park, located approximately 1.9 miles to the southeast, across U.S. Highway 101 from Simpson Park and the terminal, is a developed recreation site, with a baseball diamond, a pavilion available for rent from the North Bend Parks Department, and restrooms. Winsor Park, also located approximately 1.9 miles to the southeast, on the east side of U.S. 101, is mostly forested, with an open field for recreational activities. All three parks are located close to the APCO laydown site. The California Street Boat Ramp is located approximately 2.5 miles southeast across the bay from the Jordan Cove LNG Project.

City of Coos Bay Parks

Parks operated by the City of Coos Bay Parks Department include John Topits Park, Hollering Place Wayside, Mingus Park, and a series of neighborhood pocket parks. Hollering Place Wayside and Ed Lund Park, one of the neighborhood pocket parks, are the closest of these facilities to the Jordan Cove LNG Project; both are located about 2 miles to the south. Hollering Place Wayside was the location of a pre-European village and also the site of the first European settlement in what would become Coos County. Today, the location offers water views and a place for a picnic. Ed Lund Park includes a children's play area, a large lawn, horseshoe pits, picnic tables and benches, and is the site of many community activities, including the annual Empire Clamboree.

City of Bandon Parks

Three city parks (i.e., Bandon City Park, Kronenberg County Park, and Weber's Pier) are located approximately 3 miles southwest of the North Bank mitigation site. In addition, private recreation facilities in the vicinity of the North Bank mitigation site include three golf courses north of Bullards Beach State Park, a youth center, and an RV park.

Impacts on Parks and Other Recreational Use Areas

Increased Demand from Construction Workers

The temporary influx of non-local construction workers could potentially increase demand for recreational activities at the parks and other recreational use areas located near the Jordan Cove LNG Project. An estimated average of 802 non-local workers are expected to be employed over the 53-month-long construction phase, with the number of non-local workers expected to peak at 1,568 workers during month 30. Assuming that a portion of the workforce temporarily relocating to the area would be accompanied by family members, temporary increases in population would range from the equivalent of 3.4 percent to 6.6 percent of the combined populations of Coos Bay and North Bend in 2018 (section 4.9). A share of these workers and family members may seek recreational opportunities near the Jordan Cove LNG Project. Demand would primarily be limited to periods when workers are not employed, primarily weekend days, and would be temporary and short term. Given the large amount of public lands in the region and the relatively low levels of current use, this potential short-term increase in demand is not expected to result in significant effects on parks and other recreational areas.

Noise

Construction and operation of the Jordan Cove LNG Project could result in increases in the ambient sound environment for people recreating in the immediate vicinity, including users of the North Spit Overlook, coastal beaches, BLM RMAs, ODNRA, and the Siuslaw National Forest. Noise modeling (discussed in more detail in section 4.12 of this EIS) indicates that expected Project general construction noise levels at the closest noise sensitive area (REC 1, which is located about 0.7 mile from the LNG terminal and is representative of the closest areas of federally managed lands on the North Spit) would temporarily result in a significant increase in noise levels compared to ambient levels (see section 4.12). This increase in noise levels at recreational areas through the Coos Bay area (see section 4.12 for details on the extent and magnitude of impacts) could adversely affect an individual's recreational experience in these areas and may result in some individuals choosing not to recreate during times when active pile driving is occurring.

Pile-driving activities required to install foundations and sheet piling would be the loudest construction activities associated with the LNG terminal and are expected to last 20 hours a day for 2 years. We have determined that pile driving would result in significant impacts on the Coos Bay area (see figure 4.12-3 in section 4.12) due to the expected noise levels, as well as the extended duration (i.e., 20 hours a day for 2 years) that these impacts would occur (see section 4.12.2.3). Impacts are expected to be greatest during the nighttime and, in the absence of additional mitigation, would affect the recreation experience of visitors to the Horsfall campground (i.e., NSA 3; see section 4.12).

During the day, OHVs that are allowed on the beach and dune trails contribute to the ambient noise levels on the North Spit. The noise limit for OHVs in the ODNRA is 93 dBA at 20 inches from the exhaust outlet (Forest Service 2013). For OHV riders and other people in close proximity, OHV sound levels would exceed the predicted Project's construction and operational noise levels. Distance, topography, coastal winds, and vegetation would help to reduce Project construction and operational noise in the portions of the ODNRA where OHVs are not allowed (between the Trans-Pacific Parkway and Horsfall Beach Access Road).

Recreation Access and Driving for Pleasure:

There may be some conflicts between recreational drivers on the Trans-Pacific Parkway and construction traffic traveling to and from the Jordan Cove LNG Project. Recreational drivers in this context could include recreationists using the Trans-Pacific Parkway to access recreation sites, including the ODNRA, as well as people recreating by driving for pleasure. These types of conflict could also occur with Tribal members who use the Trans-Pacific Parkway to access the North Spit area to gather culturally significant plants, collect shellfish, and hunt.

The potential for conflict would increase during major annual recreation events such as the annual UTV Takeover on Boxcar Hill, which brings large numbers of utility task vehicle (UTV) enthusiasts to the North Spit area for several days each summer. In 2019, the UTV Takeover was held from Wednesday June 26 through Sunday June 30 (Johnson 2019). We recommend that Jordan Cove and the Forest Service coordinate closely during periods of unusually high recreation use to reduce potential conflicts to the extent possible. Note also that the Boxcar Hill Campground is proposed as a laydown area (see figure 4.7-1a). Use of the campground as a laydown area would preclude its use as a campground and affect recreation use of the property, including off-road special events, such as the UTV Takeover.

Traffic counts conducted in support of the Traffic Impact Analysis prepared on behalf of Jordan Cove (David Evans & Associates, Inc. [DEA] 2017b) counted a total of 232 vehicles passing through the intersection of the Trans-Pacific Parkway and Horsfall Beach Road from 4:30 p.m. to 6:30 p.m. on a Friday afternoon in August 2015. DEA (2017b) estimates that the number of vehicles traveling to and from the Jordan Cove LNG Project would peak in 2021, with 945 workers driving to the site in two staggered shifts each day, and 140 long haul truck trips each day to and from U.S. 101 via the Trans-Pacific Parkway to the site/north laydown yard, and 2 long haul trips each day to and from U.S. 101 via Ferry Road to the south laydown yard. DEA (2017b) assumed that the truck trips would occur throughout the day. Although the number of construction workers employed on-site would be higher in 2022, the number of passenger vehicles traveling to and from the terminal site would decrease with the addition of the temporary workforce housing facility on South Dunes, and external park and ride lots.

The addition of construction-related traffic could cause potential delays at key intersections as discussed in section 4.10 during peak PM hours (Monday to Friday). Mitigation measures, also discussed in section 4.10, are expected to reduce potential effects, and recreationists and others could avoid delays by traveling outside of peak commuting hours.[184] Mitigation would likely include staggered work shifts, construction of a dedicated eastbound left-turn lane at the intersection of U.S. 101 at the Trans-Pacific Parkway, and implementation of a temporary signal at the intersection for the duration of construction activities (see section 4.10).

[184] Peak commuting hours identified in DEA (2017b) analysis are as follows:

- Midweek AM (6:30 to 7:30 AM)
- Midweek PM (5:00 to 6:00 PM)
- Friday PM (5:30 to 6:30 PM)
- Saturday midday (11:30 AM to 12:30 PM)

In addition, as discussed in section 4.10, during the second construction phase (when the Park and Ride lots would be in operation), DEA (2017b) found that workers leaving the Myrtlewood Off-site Park and Ride in the afternoon would cause estimated traffic volumes to exceed capacity at the intersection of Hauser Depot Road with U.S. 101 resulting in traffic congestion and delays. Hauser Depot Road is a popular OHV access point to the ODNRA. Mitigation for traffic impacts in this area would likely include manual flagging during afternoon peak hours (see section 4.10).

Hunting

Hunting activities are managed by the ODFW. Big game, waterfowl, and fur-bearing animals are hunted in the public areas of the North Spit and within the Siuslaw National Forest during hunting seasons. The influx of Jordan Cove workers to the area could add to the number of people who would hunt on public lands in the region during hunting seasons. However, this potential increase would be temporary and short term. The total construction period would be about 53 months and most construction jobs would last for less than two years. As noted with respect to overall project-related demand for recreation, workers temporarily relocating to the area would have limited time available to hunt, primarily weekend days.

Clamming and Crabbing in Coos Bay

Recreational clamming and crabbing activities occur in Coos Bay near the Jordan Cove LNG Project. Coos Bay was the third most productive clamming estuary in Oregon as of 2008 and an annual average of 15,000 crabbing trips took place between 2008 and 2011 (Ainsworth and Vance 2009; Ainsworth et al. 2012). Sites for clamming include the mud flats on the bay side of the North Spit, the northern reaches of South Slough, in Haynes Inlet and the eastern side of the bay north of the McCullough Bridge. Crabbing takes place from the docks in Charleston and Empire, from boats, and on the bay side of the North Spit.

Dredging in the bay to create the access channel for the Jordan Cove LNG Project could potentially affect recreational clamming and crabbing. Potential effects related to dredging are assessed in section 4.3.2.1 of this EIS, which concludes that dredging of the access channel would only have temporary effects on bay water quality, and increased sedimentation from dredging would be limited in extent. The limited time and extent of dredging siltation is not expected to result in long-term or population wide effects on clams and crabs near the Jordan Cove LNG Project. Marine fish and shellfish species could be entrained during the dredging process. Section 4.5.2.2 notes that while much of the available evidence suggests that entrainment from dredging is not a substantial problem for many species, some studies have found that Dungeness crab are highly susceptible to entrainment. Section 4.5.2.2 concludes that entrainment would not have a substantial effect on the local marine resources, but some important fish and shellfish may be reduced in abundance locally. Further, as mitigation for wetland effects, Jordan Cove would create new eelgrass beds in Coos Bay that could serve as nursery habitat for crabs and Jordan Cove would also create new wetlands at Kentuck Slough.

Wakes from LNG carriers in the Federal Navigation Channel are not expected to cause major shoreline erosion beyond natural waves. Further, due to the relatively low transit speed and the required minimum underkeel clearance distance, propeller wash from LNG carriers is not expected to greatly disturb the channel bottom or affect clam and crab harvest in Coos Bay (see section 4.3.2.1).

Recreational clamming and crabbing that takes place outside the navigation channel would not be directly affected by LNG carrier traffic transiting the waterway to and from the LNG terminal. Effects would be similar to those presently experienced during the passage of other deep-draft ships. However, if crabbing or clamming activities were to occur within the established security zones, those activities may be required to cease, with attending vessels required to temporarily move out of the security zone while the LNG carrier in transit moves by. The requirement for any commercial or recreational boat operating within the security zone near the channel, but not impeding the safe navigation of the LNG carrier in the channel, to move and vacate the security zone area would be up to the Coast Guard on-scene commander and decided on a case-by-case basis. The Coast Guard has informed Jordan Cove that the degree of security zone enforcement would be based on the threat level in effect at the time and the specific perceived threat of any vessel in the security zone. Crab pots outside of the navigation channel should not be affected by LNG carrier traffic in the waterway. Passive equipment, such as crab pots, would be permitted to remain within the security zone while an LNG carrier is present.

Boating, Fishing, and Other Water-Based Activities

Data collected by the Oregon State Marine Board (OSMB) identified approximately 105,000 boat-use days in Coos County in 2013 (Lesser et al. 2014). The data did not identify the share of these trips that originated in Coos Bay, but information collected as part of a similar survey in 2007 indicated that recreational boaters took a total of 31,552 boat trips in Coos Bay for a total of 35,950 activity days. Fishing accounted for 91 percent of these days, sailing for 8 percent, and recreational cruising for 1 percent (OSMB 2008). Sixty-eight percent of the boating activities in Coos Bay in 2007 originated from the Charleston Marina and the Empire ramp, 19 percent at the California Street boat ramp, and 4 percent at the North Spit ramps. Charleston Marina, the Empire ramp, and North Spit ramp are located approximately 7.3 miles, 3.3 miles, and 2.1 miles southwest of the Jordan Cove LNG Project; the California Street boat ramp is about 2.5 miles southeast.

Boating activities in Coos Bay include both motorized and non-motorized boating. Non-motorized activities include canoeing, kayaking, and stand-up paddling. Other water-based recreational activities in the bay include diving and surfing. Diving locations in the bay include, from south to north, the North Jetty, Buoy #7, the jetty off Buoy #1, and the Empire Boat Ramp. The lower bay on the inside of the North Jetty has been identified as a popular surfing spot.

Popular fish species caught by recreational anglers out of Coos Bay include Coho and Chinook salmon. Other recreational catch species include various species of perch, rockfish, flatfish, sturgeon, Pacific herring, and California halibut. Much of the recreational angling for salmon in Coos Bay occurs in late summer and fall. Bank angler access on the North Spit is limited. Boat angling occurs throughout the bay, but angling is limited in some areas at times by exposure to winds.

Jordan Cove proposes to construct the slip and LNG carrier berth structures while the slip is kept isolated from Coos Bay by an earthen berm. The excavation and dredging of the slip would occur in isolation from the bay, with no restrictions placed on recreational boating in the construction site area. Recreational boating would, however, be discouraged around the construction area during the final phase in the slip construction, which would involve removing the earthen berm and connecting the excavated/dredged slip area to the bay. Recreational boating would also be discouraged during excavation of the access channel. Construction would also involve dredging within Coos Bay and would include the excavation of the four submerged areas adjacent to the existing Federal Navigation Channel as part of the Navigation Reliability Improvements. Excavation and dredging activities are expected to occur during the in-water work period from October through February 15. Excavation of the berm and the four submerged areas as part of the marine waterway modifications would occur during four in-water work periods. Dredging of the access channel is expected to occur over two in-water work periods.

The Coast Guard and OSMB would provide Notice to Mariners to avoid the affected areas during the construction period. In addition, Jordan Cove would post signs on the shoreline, at the boat ramps and marinas, and on buoys or fixed navigation aids in the bay to notify boaters of the planned construction activity and the duration of the activity. All floating and submerged dredging equipment operating in the bay would be clearly marked with day signals and light signals at night in accordance with the U.S. Inland Rules of the Road. If the signage and notices are not sufficient to prevent recreational boaters from avoiding the construction areas, some form of physical barrier, such as a continuous string of highly visible soft material floats, could be extended across the mouth of the slip or around the construction area. Construction safety inspectors would also be responsible for warning any recreational boaters who enter the construction area.

Potential effects on recreational boaters during construction of the slip, access channel, and the four Navigation Reliability Improvement areas would be temporary and affect a limited area. Coos Bay is extensive (20 square miles or 12,800 acres) and recreational boating opportunities would continue to be available in other portions of the bay during construction, with existing boat ramps remaining open during construction. The construction dredging areas are limited in size and boaters could avoid these areas by moving to the south and east side of the bay.

During construction of the Project, Jordan Cove would have large pieces of equipment brought in via water transport, using the existing Federal Navigation Channel. Jordan Cove anticipates that the terminal would receive approximately 70 water deliveries over a 2-year period. Deliveries would be via a mix of ocean-going vessels and barges. In addition, during construction of the access channel about two barges per day would transport dredged materials from Ingram Yard to the Kentuck project site. The addition of these vessels is not expected to have adverse effects on other bay users, including recreational boaters.

During operation of the Project, recreational boaters would have to avoid LNG carriers in transit within the waterway. Jordan Cove anticipates that up to 120 LNG carriers would visit the LNG terminal each year. Recreational boaters using the bay at the same time that an LNG carrier is in transit within the waterway may encounter delays due to the moving security zone requirements around an LNG carrier, as specified in Jordan Cove's Waterway Suitability Assessment (WSA) and the Coast Guard's WSR and LOR. Jordan Cove estimated that it may take an LNG carrier up to 90 minutes to transit the waterway from the buoy to the terminal at speeds between 4 and 10 knots. The Coast Guard and OSMB would continue to remind boaters of their obligation not to impede deep draft ships, regardless of the cargo. LNG carriers may take up to 30 minutes to pass resulting in limited potential delays to recreational boaters.[185] Potential impacts on both motorized and non-motorized recreational boaters would be temporary and similar to those associated with existing deep-draft vessels calling at the Port. This would also be the case for other water-oriented recreation in the bay, such as diving and surfing.

[185] Based on an estimated 120 LNG carriers visiting the terminal each year, there would be an average of just over two vessels per week.

Other Public and Special Use Areas:

The LNG terminal would be approximately 0.9 mile from the Southwest Oregon Regional Airport. Potential effects of the LNG terminal on the airport are addressed in section 4.10.

4.8.1.2 Pacific Connector Pipeline Project

Parks and Recreational Areas or Facilities on Non-Federal Lands

The pipeline route does not cross any non-federal park lands or developed recreational facilities, and construction and operation of the pipeline should not adversely affect park users. However, construction-related activities would temporarily increase traffic on local roads used to access parks, and park users may be able to hear construction noise while workers and equipment move through the area to install the pipeline. In addition, the pipeline route would cross a water trail (i.e., the Haynes Inlet Water Trail) as discussed below. The following sections discuss parks and recreational areas or facilities in the vicinity of the pipeline project.

Oregon State Lands

Oregon Coast Trail

The Oregon Coast Trail is discussed above in section 4.8.1.1. The pipeline route would be within one-quarter mile of the trail where it follows Horsfall Beach road and joins the Trans-Pacific Parkway. Recreational users of the Oregon Coast Trail would be exposed to pipeline construction traffic along the Trans-Pacific Parkway, which is the only access road to the North Spit area and the Jordan Cove Meter Station. Pacific Connector proposes to reduce effects on local traffic by following the measures outlined in its TMP (see section 4.10.2). Pipeline construction activities and related traffic could be visible and audible to hikers on the Oregon Coast Trail where it joins with the Trans-Pacific Parkway, but these effects would be temporary, lasting only the duration of pipeline installation in this area. Further, this area is adjacent to a large-scale industrial facility (Roseburg Forest Products), a railroad, and a road. As a result, pipeline construction is not expected to significantly affect trail use or trail user experience.

Coos Bay Estuary

Coos Bay is used for recreational boating, canoeing, kayaking, angling, clamming, and crabbing. As noted above, the Coos Regional Trails Partnership, a consortium of land management agencies and economic development groups, have mapped Coos Bay's water trails for kayakers and other paddlers (Coos Regional Trails Partnership 2004). Portions of one water trail – the Coos Bay Trail – would be crossed by the pipeline alignment. The Coos Bay Trail begins at the California Avenue Boat Ramp, near the south end of the McCullough Bridge (i.e., U.S. Highway 101). The trail heads south through Coos Bay, along the western banks. The pipeline would cross this water trail using trenchless HDD crossing methods at about MP 1.50, with the proposed HDD continuing up into Kentuck Inlet to approximately MP 3.0, where it would end in uplands.

Potential effects on boaters using these areas during or after construction would be limited due to the use of HDD as boating in the vicinity of the HDD path would be allowed to continue during the drilling. HDD operations and pipe stringing would occur in uplands for both the Jordan Cove to North Point HDD, and for the HDD crossing from North Point to Kentuck Inlet. The HDD pipe string would be staged in uplands north of Jordan Cove for the Jordan Cove to North Point HDD, and the pipe string for the North Point to Kentuck Inlet crossing would be staged east of Kentuck Inlet and pulled to the west underneath the bay. Use of HDD would avoid impacts on boaters.

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 (also referred to as a frac-out). To prevent a frac-out or address impacts should one occur, Pacific Connector developed its *Drilling Fluid Contingency Plan for Horizontal Directional Drilling Operations*.[186] If a frac-out were to occur, recreational boaters could be temporarily affected during implementation of the contingency plan, which could involve deploying containment structures, if feasible, and monitoring locations downstream of the HDD.

Klamath Wildlife Area

The Klamath Wildlife Area is managed by ODFW to provide habitat for wintering and nesting waterfowl, upland game birds, and a variety of other wildlife. Bald eagles, white pelicans, and ospreys are among the bird species that are present in this area during certain times of the year. The Miller Island Unit, along the Klamath River south of West Klamath, also serves as a recreation spot for fishing, hunting, and boating (ODFW 2017i). The pipeline right-of-way passes within 0.1 mile along the north side of the Miller Island Unit near MP 199.15, but is separated from the Unit by the Klamath River and other industrial areas. Construction in this area would be limited to the ODFW-recommended work period of July 1 through January 31 to avoid affecting wildlife populations supported by the area.

State Parks

There are no Oregon State Parks within 1 mile of the pipeline. Some USGS maps show Camas Mountain State Park near MP 51.7 in Douglas County. However, OPRD records do not show that there is, or historically has been, a state park or any state land ownership at this location (Teal 2006).

<u>County Lands</u>

There are nine county parks located near the pipeline route. Five of these parks are located in Coos County and include three parks accessed by the Coos Bay Wagon Road: Middle Creek Park, Ham Bunch-Cherry Creek Park, and Frona County Park. Middle Creek Park lies approximately 0.5 mile west of the pipeline alignment at about MP 27.5. Middle Creek is an unimproved, day use park. Ham Bunch-Cherry Creek Park, with about eight primitive campsites and fishing on Cherry Creek, is located about 1 mile northwest of the pipeline alignment at MP 28.5. Frona County Park, which offers a primitive group campground and fishing area along the East Fork of the Coquille River, is less than 0.5 mile northwest of the pipeline alignment at MP 29.9 (Coos Bay Net 2006; Coos County Park and Recreation 2006).

The other two parks in Coos County are Rock Prairie County Park and Laverne County Park. Rock Prairie County Park is an unimproved, day use park, located approximately 1.5 miles southwest of the pipeline, near MP 23.26. Laverne County Park is a 350-acre park located approximately 2.5 miles southeast of MP 22. Located on the North Fork Coquille River, Laverne County Park includes 76 campsites (46 RV sites and 30 tent sites), as well as a picnic area, large group area, softball field, playground, and other amenities. Construction is not anticipated to affect park use or associated recreational opportunities.

[186] See Appendix 2.H of Resource Report 2, in Pacific Connector's September 2017 application to the FERC.

There are three county parks near the pipeline route in Douglas County: Ben Irving Reservoir, North Myrtle Park, and the Carl C. Hill Wayside. Ben Irving Reservoir, located about 1.5 miles south of the pipeline alignment near the town of Tenmile and State Highway 42 (near MP 55.8), is a large man-made water body used for fishing, boating, and other water related recreation. The day use park has a picnic site and boat launch. The reservoir could be a source of water for pipeline hydrostatic testing (see section 4.3). Project water use would be allowed by the reservoir owner and is not expected to significantly draw down the reservoir or affect boating or other day-use activities. North Myrtle Park is located approximately 1.5 miles north of MP 79 on County Road 15 (North Myrtle Road). This park is a day use park, with a ball field and picnic area. The pipeline would cross the access road to this park. Near Milo, the Carl C. Hill Wayside provides a picnic area and fishing along the South Umpqua River. This day use area is approximately 0.7 mile southwest of the pipeline alignment at MP 94.7, where the pipeline route crosses the South Umpqua River.

In Jackson County, Rogue Elk Country Park provides camping, hiking, and picnicking opportunities. This park is located west on State Highway (SH) 62 (Crater Lake Highway), approximately 2 miles west of the town of Trail. The park, at its closest point, is approximately 0.64 mile from the pipeline. No construction traffic or other related indirect effects are anticipated for park visitors because construction access to the pipeline would be via other roadways.

Although construction-related activities would temporarily increase traffic on local roads used to access the above parks, the five relatively remote county parks (Middle Creek, Ham Bunch-Cherry Creek, Frona, Ben Irving Reservoir, North Myrtle, and Rogue Elk Country) would not be directly affected by construction and operation. The Carl C. Hill Wayside picnic area may experience increased construction traffic and noise due to its proximity to SH 227 and the presence of a large pipe laydown and staging yard. Park visitors would also be able to hear construction activities upriver. The proposed diverted open cut of the South Umpqua River is, however, scheduled to coincide with the low water season of late summer/early fall to reduce effects on boaters and anglers in the area.

Other Non-Federal Public Recreation Areas

Keno Recreation Area

Pacific Power's Keno Recreation Area consists of a developed campground, boat launch, and picnic area along the Keno Reservoir of the Klamath River. Fishing and water sports are common activities at this recreation site near the town of Keno. The pipeline alignment passes less than 0.5 mile north of the reservoir where it would be adjacent to an existing powerline corridor. Recreation and access to the Keno Recreation Area would not be affected by construction and operation activities. While the Keno Reservoir could be a source of water for pipeline hydrostatic testing, this potential use is not expected to significantly draw down the reservoir or affect boating or other day-use activities. Hydrostatic testing is more fully discussed in section 4.3.2.

OHV Controls and Limited Access to the Right-of-Way

Comments received during public scoping expressed concern with the potential for an increase in OHV use where the pipeline right-of-way could create new access points. There was also concern about the effectiveness of control methods proposed by Pacific Connector. The pipeline right-of-way could increase unauthorized OHV, snowmobile, and dispersed motorized access and associated resource access. Pacific Connector's *Recreation Management Plan*[187] describes measures to be employed on both public and private lands to control unauthorized OHV use. Pacific Connector's plan indicates that they would assess the need for OHV control measures primarily where the pipeline right-of-way would intersect roads, OHV trails, or other trails. Various natural and constructed control measures would be installed at appropriate locations in coordination with the appropriate land management agencies or landowner. Potential locations identified by Pacific Connector include the PCT area, the Blue Ridge Trail System ERMA area, the Camel Hump and Obenchain Road areas, Dead Indian Memorial Highway, Forest Road 700, and Clover Creek Road. OHV control measures could include:

- dirt or rock berms, sometimes coupled with erosion control devices;
- strategically placed non-merchantable logs, slash, or tree stumps;
- large rocks or boulders partly buried along the right-of-way;
- signs;
- fencing and locked gates; and
- vegetative screening to disguise the existence of the right-of-way.

Where necessary, OHV control structures would extend out beyond the right-of-way to prevent "drive-around" and would be built at an appropriate height to prevent passage.

Pacific Connector would coordinate with landowners during construction and restoration to finalize site-specific OHV control measures. In addition, following construction, the effectiveness of the site-specific measures would be assessed on a periodic basis, generally in conjunction with revegetation monitoring and in response to identified problems. Pacific Connector would be responsible for monitoring and managing unauthorized OHV use during the full life of the pipeline project and would implement additional measures as necessary.

Federal Parks, Recreation Areas, and Other National Designations

As discussed throughout this EIS, portions of the Pacific Connector pipeline route would cross through parts of three National Forests (Umpqua, Rogue River-Siskiyou, and Fremont-Winema) and four BLM Districts (Coos Bay, Roseburg, Medford, and Lakeview). The proposed route for the Pacific Connector pipeline would not cross any national parks, national monuments, national landmarks, wilderness areas, wildlife preserves, wild and scenic river segments, or reservoirs. The route would, however, cross several federally designated scenic byways, rivers on the national inventory, and national trails, as discussed below. The route would also cross two ERMAs, also discussed below.

<u>National Parks and Monuments</u>

The closest national park to the Pacific Connector pipeline is Crater Lake National Park, located approximately 26 miles northeast of MP 132. The Cascade-Siskiyou National Monument is the closest monument to the pipeline at approximately 10 miles southwest of MP 175. Because of their distance from the pipeline route, no national parks or monuments would be directly affected by the Pacific Connector Pipeline Project. However, indirect effects may include air quality effects on Class I areas (see section 4.12.1), and construction traffic on roads leading to the parks and monuments.

[187] Appendix S to Pacific Connector's POD filed with the FERC in January 2018.

National Scenic Byways

Three National Scenic Byways would be crossed by the Pacific Connector pipeline: the Pacific Coast Scenic Byway (U.S. Highway 101); the Rogue-Umpqua Scenic Byway (State Highway 62); and the Volcanic Legacy Scenic Byway (U.S. Highway 97). Generally, installation of a pipeline across a road may have direct effects through a temporary halt to traffic, and removal of vegetation which may affect visual quality. However, in the case of these three National Scenic Byways, as discussed below, the highways would remain open during pipeline construction and no vegetation would be removed in the vicinity of the crossings.

Following Highway 101 south from Astoria to Brookings, many locations along the Pacific Coast Scenic Byway offer views of the Oregon coast. The pipeline would be installed by conventional construction methods underneath U.S. Highway 101 (at Conde B. McCullough Memorial Bridge) between approximately MPs 1.22 and 1.23 because the highway is elevated at this location. Pipeline construction activities would be staged within existing construction storage yards on both the west and east sides of the highway and would be visible on either side from the highway. There would be no surface disturbance to the highway. Construction access to the staging areas would be via surface streets at Pittum Loop and Chappell Parkway. Temporary short-term traffic interruptions may occur at the intersection of Highway 1 and Ferry Road (approximately 0.23 mile south of construction), when supplies, crews, and heavy equipment traffic are required. Potential effects would be temporary, and once completed, the pipeline would be undetectable to those traveling on U.S. Highway 101, but the right-of-way may be visible in the existing construction storage yard and an old lumber storage yard to the west of Highway 101. Given the current land use of these areas, the right-of-way feature would not be expected to be especially noticeable to those travelling the Pacific Coast Scenic Byway.

Following State Routes 138, 62, and 234, the Rogue-Umpqua Scenic Byway forms a semi-circle route through the Umpqua and Rogue National Forests between the cities of Roseburg and Gold Hill. The pipeline would cross the Rogue-Umpqua Scenic Byway approximately 0.2 mile south of the town of Trail (MP 122.6) on State Highway 62. An HDD would be used to cross under State Highway 62 and the adjacent Rogue River, from MP 122.24 to 122.67; therefore, the pipeline is not expected to affect the Rogue-Umpqua Scenic Byway. A temporary extra work area would be located immediately adjacent to the Scenic Byway, in between the highway and the Rogue River. Temporary short-term traffic interruptions may occur at the intersection of State Highway 62 when supplies, crews, and heavy equipment traffic would be required to service the HDD operations. Pacific Connector would implement traffic control measures while the HDD activities are occurring to ensure safety for the public and construction personnel. The pipeline would not be visible to travelers along the Rogue-Umpqua Scenic Byway following the completion of construction.

The Volcanic Legacy Scenic Byway provides a touring route of south-central Oregon and northeastern California. The Oregon portion of the Volcanic Legacy Scenic Byway begins on U.S. Highway 97, north of Crater Lake, circles Crater Lake, and then continues south on State Routes 62 and 140 through Klamath Falls and into California. The Pacific Connector pipeline would cross the Volcanic Legacy Scenic Byway just south of Klamath Falls (MP 199.6) near where it crosses the Klamath River. Pacific Connector proposes to use an HDD to cross under Highway 97 and the Klamath River between MPs 199 and 200. Effects would be temporary, as travelers on Highway 97 may be able to briefly glimpse pipeline construction activities off in the distance. The HDD under Highway 97 and the Klamath River would be completed within a two-month period. The Pacific Connector Pipeline Project would have no direct effects on the Volcanic Legacy Scenic Byway, and the highway would be kept open to traffic during construction. Following installation, the pipeline would not be visible to travelers using the Volcanic Legacy Scenic Byway and is, therefore, not expected to affect the scenic qualities of this byway.

National Wild and Scenic Rivers and Nationwide Rivers Inventory

Wild and Scenic Rivers

The Rogue River, which the pipeline would cross near the community of Trail, is a designated Wild and Scenic River[188] from the Crater Lake National Park boundary downstream to Prospect, approximately 20 miles north of the pipeline crossing. In addition, an 84-mile section of the Rogue River is designated as Wild and Scenic starting about 7 miles west of the city of Grants Pass and proceeding west toward the town of Gold Beach (NPS 2005). Neither of the designated Wild and Scenic River segments would be crossed or otherwise affected by the pipeline.

Indirect effects could occur if the pipeline crossing were to cause sedimentation that could run downstream and affect water quality of the federally designated Wild and Scenic River portion of the Rogue River. However, the pipeline would cross the Rogue River using an HDD, which would avoid direct effects on this river. Also, while this segment of the Rogue River was found suitable for Wild and Scenic designation in the 2015 suitability studies conducted in support of the Southwestern Oregon RMP (BLM 2016b), its river-related values are only protected on BLM-managed lands (approximately one mile from the pipeline crossing). The pipeline would not cross any protected segments of the Rogue River on BLM-managed lands. The values for which the river was found eligible are not expected to be affected by the pipeline construction and operation.

National Wildlife Refuges, Natural Landmarks, and Wilderness Areas

Sky Lakes Wilderness and Mountain Lakes Wilderness

There are several federally designated Wilderness Areas in the Umpqua, Rogue River, and Fremont-Winema National Forests, but none of them would be crossed by the Pacific Connector pipeline. The pipeline does, however, pass in the general vicinity of two Wilderness Areas: the Sky Lakes Wilderness (113,590 acres), which is located in both the Fremont-Winema and Rogue River National Forests; and the Mountain Lakes Wilderness (23,071 acres), in the Fremont-Winema National Forest. The pipeline would pass approximately 3.7 miles south of the Sky Lakes Wilderness and 1.3 miles south of the Mountain Lakes Wilderness. These wildernesses would not be affected by pipeline construction or operation because of these distances and the intervening forested landscapes.

Round Top Butte National Natural Landmark

Between MPs 134.7 and 137.1 the Pacific Connector pipeline route would pass in close proximity to the east side of the Round Top Butte National Natural Landmark (NNL), which was designated an NNL on June 15, 2011. Geologically, the NNL includes a basaltic butte and volcanic plains. Biologically, the NNL encompasses a unique mixture of grasslands, ponderosa pine, white oak, and buck brush vegetation. The NNL is administered as two parcels: 747 acres managed by the

[188] Wild and scenic rivers are designated for preservation under the Wild and Scenic Rivers Act of 1968 (Public Law 90-542), which was enacted by the U.S. Congress to preserve certain rivers with outstanding natural, cultural, and/or recreational values in a free-flowing condition for the enjoyment of present and future generations.

BLM as a Research Natural Area (RNA), and a private preserve managed by The Nature Conservancy.

At its closest point, the pipeline would be about 0.25 mile away from the BLM boundary to the NNL. Where the pipeline would be closest to the NNL boundary, near MP 135.6, it would be located on private land through previously harvested and thinned forest. The pipeline route does not cross the NNL and would have no direct effects on it. Pacific Connector would reduce the spread of weeds by following its ECRP and its *Integrated Pest Management Plan*.

Klamath Basin National Wildlife Refuges

The Klamath Basin hosts a complex of six NWRs in the Klamath Falls region of Southern Oregon and Northern California. These refuges, managed by the FWS, consist of a variety of habitats including freshwater marshes, lakes, meadows, coniferous forests, sagebrush and juniper grasslands, agricultural lands, and rocky cliffs and slopes. These habitats support diverse and abundant populations of resident and migratory wildlife, with 433 species having been observed on or near the refuges. Each year the refuges serve as a migratory stopover for about 75 percent of the Pacific Flyway waterfowl, with peak fall concentrations of more than 1 million birds. The Pacific Flyway is one of four major migratory routes (Pacific, Central, Mississippi, and Atlantic flyways) used by migratory birds in North America.

The pipeline would pass approximately 3.5 miles north of the Bear Valley NWR, and approximately 3.7 miles north of the Lower Klamath NWR. Between MPs 196 and 199, the pipeline wraps around on the north side of the Klamath River. On the south side of the river, the FWS owns two small 80-acre “out parcels,” which are surrounded by State of Oregon lands managed by the ODFW. The two parcels are approximately 0.8 mile to 1.2 miles south of the pipeline. Some USGS topographic maps show old Lower Klamath Refuge boundaries on lands that were withdrawn from consideration in the 1920s (Coles 2006). Pacific Connector confirmed with the FWS in June 2006 that the pipeline would not affect any lands within the Klamath Basin Refuge boundaries.

Construction and operation of the Pacific Connector Pipeline Project should have no direct effects on the Wilderness Areas, Natural Landmarks, and NWRs discussed above because the pipeline would not cross any of these areas.

Inventoried Roadless Areas

The pipeline route and related facilities would not be located in any Inventoried Roadless Areas (IRAs). The nearest IRA is the Brown Mountain IRA, located on the Rogue River National Forest approximately 0.6 mile north of the pipeline route at MP 162.0. On the Fremont-Winema National Forest, the West Boundary IRA is about 2.2 miles northeast of MP 172.25. Construction and operation of the Pacific Connector Pipeline Project would have no direct effects on these IRAs.

National Recreational Areas and Trails

BLM Coos Bay/North Spit RMAs and Forest Service ODNRA

The Pacific Connector pipeline would have no direct effects on the Coos Bay/North Spit RMAs or the ODNRA because it does not cross those areas. From MP 0.00, the pipeline would be installed using an HDD underneath Coos Bay to the southeast, away from the RMAs and ODNRA. During the HDD process, supplies, equipment and crews would need to access the LNG terminal area and the north end of the HDD area. There would be increased traffic volumes on the Trans-Pacific Parkway, which provides access to the North Spit. Travelers may experience increased traffic congestion and short delays, but these effects would be temporary and short term, and access or use of the RMA or ODNRA areas would not be precluded.

Recreational users of the Coos Bay/North Spit RMAs and the ODNRA may also be exposed to noise from pipeline construction, as well as from construction of Pacific Connector's Jordan Cove Meter Station. Potential noise effects would be temporary and short-term, and mitigated in part by distance, topography, vegetation, and ambient noise levels from other sources, including non-project related traffic on the Trans-Pacific Parkway, OHVs, and other industries on the North Spit. Noise is more fully discussed in section 4.12.2.

Pacific Crest National Scenic Trail

The PCT is a 2,650-mile-long hiking and equestrian trail stretching from the Canadian border in Washington to the Mexican border in California. With the passage of the National Trails System Act of 1968, as amended, Congress designated the PCT as one of the first scenic trails in the nation (Forest Service 1982). Thousands of hikers, horse riders, cross-country skiers, and snowshoers use the trail each year. Approximately 430 miles of the PCT runs through the Cascade Mountain Range in Oregon. The pipeline route crosses the PCT at approximately MP 167.8.

Trail users can access the trail in several locations near the pipeline route area, including a registered trailhead on the Dead Indian Memorial Highway (County Road 533). This trailhead is about 1.3 miles west of where the pipeline would cross Dead Indian Memorial Highway. The trail can also be accessed using Forest Road 3720-700, or by using the Brown Mountain trail accessed by Forest Road 3705.

Installation of the pipeline would affect PCT users for a short duration of time. Pacific Connector proposes to use a conventional boring technique to bore underneath the PCT at the trail crossing location to reduce effects to trail users. Construction of the bore crossing would take approximately one to two weeks, and it is not expected that PCT closures or detours would be required. There would be no surface disturbance or vegetation removal on the PCT or immediately adjacent areas. For public safety, temporary construction fencing would be installed around construction work areas that could potentially be accessed from the PCT. This fencing would be dark green, dark brown, or black in color to reduce visual effects.

Pacific Connector has also identified site-specific mitigation measures to reduce potential effects on the PCT in its *Recreation Management Plan.* These measures include the following:

- provide advance notice of construction to the Forest Service and PCT Association;
- notify the Forest Service District Ranger 48 hours in advance if any anticipated delays for PCT users would exceed 1 hour;
- provide at least 7 days advance notice if the PCT needs to be detoured;
- obtain Forest Service approval and install temporary construction notification signs on the PCT, 0.25 mile north and south of the bore crossing, and remove signs immediately post-construction;
- obtain Forest Service approval and install detailed detour route signs (if needed);
- plan, if practicable, for PCT disruption outside of the trail's busiest hiking season (mid-July to early August);

- obtain Forest Service approval and install temporary dark green, dark brown, or black construction fencing where necessary for public safety, and remove fencing immediately post-construction;
- complete construction and all associated activities (clearing, grading, pipeline installation, and restoration) within one season;
- confine construction activities to normal daylight working hours, use no artificial lighting;
- install standard Nordic ski trail markers as needed post-construction;
- revegetate the right-of-way using native trees, shrubs, and plants; and
- use a combination of rocks, logs, and slash to deter motorized vehicles and OHVs from gaining access to the PCT, in such a manner as not to adversely affect the area's visual resource qualities, to the extent practicable.

Pacific Connector intends to use a "dog-leg" segment to avoid a perpendicular crossing of the trail and thereby reduce the visibility of the pipeline corridor to trail users (see section 4.8.2.3 for an assessment of visual resources on federal lands). To further reduce potential effects on the PCT and its users, Pacific Connector has "necked down" the construction right-of-way width from the standard 95 feet to 75 feet for approximately 300 feet on either side of the trail.

Pacific Connector intends to retain existing trees along Forest Service Road 3720-700 to the east of the crossing to reduce the visibility of the pipeline corridor to trail users (see section 4.8.2.3 for an assessment of visual resources on federal lands). To further reduce potential effects on the PCT and its users, Pacific Connector would "neck down" the construction right-of-way width from the standard 95 feet to 75 feet in the visible immediate foreground from the trail crossing, and has adjusted the pipeline right-of-way to abut and parallel the existing road where visible from the PCT. With the proposed mitigation in place, the proposed action would not affect PCT access or restrict PCT recreational use. Effects to recreational users would be short-term, lasting during construction activities when hikers would be subject to sights and sounds of signage, construction fencing, and construction activities in the immediate vicinity of the bore crossing.

South Brown Mountain Shelter

The South Brown Mountain Shelter is a small, fully enclosed log cabin about 200 yards off the PCT in Section 32, T.37S, R.5E. The shelter, located in the Rogue River-Siskiyou National Forest near its boundary with the Fremont-Winema National Forest, is used year-round by hikers, cross-country skiers, snowmobilers, and others. The cabin contains a wood stove, primitive storage facilities, and counter spaces. Potable well water is available using a hand pump that is operational from mid-May to late October.

The South Brown Mountain Shelter is approximately 600 feet north of the pipeline route near MP 167.7; and would not be directly affected by construction or operation of the pipeline. Temporary noise from pipeline construction may be audible at the shelter, but visitors would not be able to see the pipeline or related construction activities because of the existing vegetation screening that is located between the shelter and the right-of-way. Distance, topography, and vegetation would reduce pipeline construction noise at the shelter. The effects from pipeline construction noise would be temporary and should not adversely affect users of the shelter.

Brown Mountain Trail

The Brown Mountain Trail is a path for non-motorized users on the Fremont-Winema and Rogue River-Siskiyou National Forests. The trail is linked by two short sections of forest roads and circles Brown Mountain. One access point is near the pipeline at a trailhead on Forest Road 3705, near South Fork Little Butte Creek about a mile north of MP 165.0. In addition to summer recreational activities, cross-country skiing and snowmobiling are popular winter sports along the Brown Mountain multi-use trail system between about MPs 160 and 170. The Brown Mountain Trail and access on Forest Road 3705 are not expected to be affected by pipeline construction or operation.

Other Extensive Recreation Management Areas

Blue Ridge Trail System ERMA.

The Blue Ridge Trail System ERMA is located within the Coos Bay District. Designated for hiking, biking, equestrian, and motorcycle trails, this 1,405-acre ERMA currently supports approximately 12 miles of trails, which connect with a larger network of logging roads that can also be utilized. Timber harvest and management operations have occurred in this area, with road closures occurring intermittently for logging operations. The pipeline would cross this ERMA from MP 19.92 to MP 22.11 (approximately 2.19 miles) and cross three of the Blue Ridge trails. In addition, Pacific Connector would utilize several existing roads in this ERMA for construction access. Similar to when logging activities have occurred in the area, these trail segments would need to be closed during pipeline construction. Construction would also result in increased traffic volumes on existing roads and other users may experience traffic congestion and delays, with access to some trails temporarily affected. Potential construction traffic-related impacts are discussed in Pacific Connector's TMP (Appendix Y of the POD). Recreational users may also be exposed to noise during pipeline construction. Potential noise effects would be temporary and short-term, and partially mitigated in some locations by distance, topography, vegetation, and ambient noise levels from other sources, including single-track OHVs. Noise is more fully discussed in section 4.12.2.

Pacific Connector has identified the following measures to reduce potential effects to trail users:

- provide advance notice of construction dates to the BLM, Coos Bay District;
- establish a roughed-in trail tread within 24 hours of crossing completion, with temporary directional signs posted at each end of the crossing;
- restore the trail to full design standards within 2 weeks of completing the trail crossing (weather permitting); and
- install standard trail route markers as needed post-construction where the trail location is not evident.

In addition, Pacific Connector is proposing to use an existing communications tower located on the top of Blue Ridge, within the ERMA. Pacific Connector would use the tower during operations and Pacific Connector staff and contractors may need to access this existing location intermittently to maintain communications equipment. Impacts on other users are expected to be limited.

Buck Berry Rock ERMA

The Buck Berry Rock ERMA is located within the Medford District. Designated for non-motorized trail systems in a remote setting, this ERMA encompasses 6,504 acres, located north of the community of Trail. This ERMA is approximately 0.5 mile from the pipeline at its closest point, near MP 121 and separated from the proposed route by private lands and SH 227. Construction is not anticipated to have any impacts on this ERMA.

Green Top Mountain ERMA

The Green Top Mountain ERMA consists of 5,316 acres located within the Medford District. Designated for non-motorized trail systems, this ERMA is not located in proximity to any larger communities. This ERMA is approximately 0.3 mile from the Pipeline at its closest point, near MP 138.5. Construction is not anticipated to have any impacts on this ERMA.

Surveyor Mountain ERMA

The Surveyor Mountain ERMA consists of 17,376 acres located within the Lakeview District. This ERMA is a short distance from Klamath Falls and frequented by big game hunters, OHV users, and snowmobilers. From MPs 172 to 178, the pipeline is within one mile of the ERMA, and between MPs 176.1 and 177, the pipeline crosses the ERMA. In this area, the proposed pipeline right-of-way is co-located immediately adjacent to Clover Creek Road (County Road 603), and no new impacts are expected.

Stukel Mountain ERMA

The Stukel Mountain ERMA consists of 9,622 acres located within the Lakeview District. Located close to Klamath Falls, this ERMA attracts OHV users, hikers, and mountain bikers. The Pipeline is approximately 0.4 mile from the ERMA, near MP 212.5, and separated from the ERMA by private lands. Pipeline construction is not expected to have any impacts on this ERMA. Pacific Connector's proposed Stukel Mountain Communication Site is located at an existing communication tower complex on BLM-managed lands within the ERMA. Construction activities at or adjacent to the existing complex would be temporary and short-term lasting a few months with a small crew requiring limited equipment. Communication-related construction and operation activities would be similar to existing activities and operations at the complex with limited impacts on recreation users.

Bryant Mountain ERMA

The Bryant Mountain ERMA consists of 9,093 acres located within the Lakeview District. The Bryant Mountain ERMA has potential for an OHV trail system. The site is close to Klamath Falls and is mostly a contiguous block of BLM land. The Pipeline is approximately 0.4 mile from the ERMA, near MP 228, and separated from the ERMA by private lands. Construction is not anticipated to have any impacts on this ERMA.

Federal Recreational Lakes and Reservoirs

Fish Lake

Fish Lake is located on the Rogue River National Forest near the crest of the Cascades about 2.5 miles away from the pipeline route at about MP 161. The Fish Lake Recreation Area includes Forest Service campgrounds, picnic areas, and a boat ramp, as well as a privately-operated resort with cabins, a trailer park, additional camp sites, food service, and a marina. During the summer the lake supports water related activities, including fishing and boating. During the winter, ice-fishing, cross-country skiing, and snowmobiling are popular in the area. Pacific Connector has identified Fish Lake as a potential source for water that would be used for hydrostatic testing of the pipeline. Water would be potentially withdrawn from two places: one location at the lower end of the lake near the dam; and the other at the upper end of the lake in the vicinity of the Fish Lake Campground and boat ramp. No roads or recreational facilities would be closed because of the hydrostatic test water withdrawals from the lake; however, water trucks would use Forest Service Roads 2800700, 2800706, and 2800800. Use of these roads is addressed in Pacific

Connector's TMP (Appendix Y of the POD). Pacific Connector has indicated that after it has selected a construction contractor for the pipeline, it would submit a water withdrawal plan to the Forest Service that would outline measures to reduce effects on recreational users and encumbrances at the lake.

John C. Boyle Reservoir

The John C. Boyle Reservoir is operated by PacifiCorp as part of a FERC-licensed hydropower project. Boat launches and the Topsy Recreation site, operated by the BLM, provide camping, picnicking, fishing, boating and swimming for visitors to this section of the Klamath River approximately 8 miles south of MP 184.31. Recreation and access to the reservoir and recreation site would not be directly affected by construction activities, although construction could cause some temporary delays on Keno Access Road (also known as State Highway 66). Pacific Connector has identified the reservoir as a potential source of water for hydrostatic testing. Use of the reservoir for this purpose would not be expected to significantly or noticeably draw down the reservoir or affect recreational activities. The John C. Boyle Dam is one of four dams on the Klamath River that is planned to be removed as part of the Klamath Economic Restoration Act.

ACECs

North Spit ACEC

The North Spit ACEC is located about 3.5 miles southwest of the Jordan Cove Meter Station, where the pipeline would terminate. The North Spit ACEC would not be directly affected by construction or operation of the Pacific Connector Pipeline Project. Indirect effects could occur as a result of the increased traffic on the Trans-Pacific Parkway that would occur during construction. These potential increases have the potential to cause traffic congestion and short delays but are not expected to preclude access to or use of the ACEC.

Upper Rock Creek ACEC

The BLM's Coos Bay District designated 364 acres in Section 5, T.29S., R.9W., Douglas County, Oregon as the Upper Rock Creek ACEC. The purpose of this ACEC is to maintain, protect, and restore the area's natural systems and botanical values, which include western red cedar and western hemlock, and skunk cabbage, as well as sedge-dominated wetlands. The area also supports the Oregon Natural Heritage Program Coast Range Ecological Cell 108 and provides habitat for marbled murrelet and northern spotted owl. At its closest point, the construction right-of-way is approximately 115 feet south of this ACEC at MP 43.2 and would not directly conflict with the management of the ACEC. Pacific Connector proposes to use North Rock Creek Road, a paved public road located approximately 50 feet from the ACEC, for construction access in this area. Potential effects on wildlife are assessed in section 4.5.1.

4.8.1.3 Environmental Consequences on Federal Lands

Forest Service Potential Wilderness Evaluation

Wilderness Areas, Inventoried Roadless Areas (IRA), and Potential Wilderness Areas (PWA) are discussed together here because they share a set of terminology and interrelated history. A wide range of terms and references have been used by respondents, the courts, and the Forest Service when referring to these topics such as roadless, unroaded, uninventoried roadless, undeveloped areas, and roadless expanse. The terms and definitions as stated below are used in this site-specific analysis. They are based on current law, regulation, agency policy, and the LRMPs, as amended, for the Umpqua, Rogue River, and Winema National Forests.

Wilderness

A Wilderness Area is designated by congressional action under the Wilderness Act of 1964 and other wilderness acts. The Wilderness Act of 1964, Section 2(c) defines wilderness, in part, as:

> *[A]n area of undeveloped Federal land retaining its primeval character and influence, without permanent improvements of human habitation, which is protected and managed so as to preserve its natural conditions and which (1) generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable; (2) has outstanding opportunities for solitude or a primitive and unconfined type of recreation; …*

Two Wilderness Areas are in proximity to the pipeline alignment: Sky Lakes Wilderness (113,590 acres) is in both the Winema and Rogue River National Forests and its southern tip is approximately 3.7 miles north of the pipeline alignment at MP 162, and Mountain Lakes Wilderness (23,071 acres), in the Winema National Forest, is approximately 1.3 miles north of MP 172.

No Project activities would occur within or adjacent to a wilderness area. There would be no effects on designated wilderness or wilderness characteristics because the closest wilderness (Mountain Lakes) is over a mile away. Because of this distance, project activities would typically not be seen or heard by anyone recreating in the wilderness. The exceptions could be short duration views of smoke during burning activities. Smoke management mitigation measures would reduce the risk of smoke drifting into the wilderness.

Inventoried Roadless Areas

IRAs were identified in the 2001 Roadless Area Conservation Rule in a set of inventoried roadless area maps, contained in Forest Service Roadless Area Conservation Final Environmental Impact Statement, volume 2, dated November 2000, which are held at the National headquarters office of the Forest Service, or any subsequent update or revision of those maps (36 CFR 294.11). These areas were set aside through administrative rulemaking and have provisions, within the context of multiple use management, for the protection of inventoried roadless areas.

The nearest IRA is the Brown Mountain IRA, located on the Rogue River National Forest approximately 0.6 mile north of MP 162. On the Winema National Forest, the West Boundary IRA is about 2.2 miles northeast of MP 172. No activities associated with the Pacific Connector Pipeline Project would occur within or adjacent to an IRA; therefore, there would be no project-related effects on IRAs.

Potential Wilderness Areas

This is not an official inventory. Official inventories of potential wilderness areas are completed during forest planning. This analysis considers PWAs only for purposes of assessing potential effects of the Pacific Connector pipeline activities on wilderness characteristics. PWAs are not a land designation decision (e.g., does not change current land management allocations), they do not imply or impart any particular level of management direction or protection, they are not an evaluation of potential wilderness (Forest Service Handbook [FSH] 1909.12, Chapter 72), and they are not preliminary administrative recommendations for wilderness designation (FSH 1909.12, Chapter 73). The inventory of PWAs does not change the administrative boundary of any IRA or any congressionally designated wilderness. The original designated management area (*e.g.*, Matrix) would remain the land designation even if areas in the project planning area meet the handbook criteria for PWAs. PWAs are evaluated (regarding making recommendations to Congress for inclusion in the National Wilderness Preservation System) during the development or revision of land management plans, in other words at the forest planning level and not at the project planning level.

PWAs qualify for placement on the inventory if they meet the following criteria (FSH 1909.12, Chapter 71):

1. The area contains 5,000 acres or more.
2. Areas contain less than 5,000 acres, but can meet one or more of the following criteria:
    a. Area can be preserved due to physical terrain and natural conditions.
    b. Areas are self-contained ecosystems, such as an island, that can be effectively managed as a separate unit of the National Wilderness Preservation System.
    c. Areas are contiguous to existing wilderness, primitive areas, Administration endorsed wilderness, or potential wilderness in other Federal ownership, regardless of their size.
3. Areas do not contain forest roads (36 CFR 212.1) or other permanently authorized roads, except as permitted in areas east of the 100th meridian.

Areas may meet either criteria 1 and 3, or criteria 2 and 3. If the criteria in section 71.1 of the FSH are met, criteria in section 71.11 of the FSH (criteria for including improvements) must also be met. This analysis used the following project-specific criteria to delineate areas characterized as undeveloped and roadless, yet included improvements:

- Roads (as defined in 36 CFR 212.1) were excluded per FSH 1909.12, section 71.1. Mapped areas were at least 300 feet from NFS roads. This distance was selected because tree harvest is commonly permitted within 300 feet of open forest roads for personal-use firewood. In addition, danger tree removal occurs at various distances from open forest roads depending on tree height, topographic slope, and other factors.
- Timber harvest areas where logging, as evidenced by stumps, and prior skid trails or roads are substantially unrecognizable, or areas where clearcuts have regenerated to the degree that canopy closure is similar to surrounding uncut areas per FSH 1909.12, section 71.11.

No undeveloped areas greater than 5,000 acres would be crossed by the Pacific Connector pipeline route. All of the undeveloped areas crossed by the pipeline are less than 5,000 acres in size, are not contiguous to existing Wilderness or IRAs, and do not meet the PWA criteria for areas less than 5,000 acres. As a result, the Project would not affect any PWAs.

<u>Other Undeveloped Areas</u>

Other undeveloped areas refer to those areas that do not meet inventory criteria as PWAs, and are not an IRA or designated Wilderness area. There are no forest-wide or management area standards and guidelines specific to other undeveloped areas in the Umpqua, Rogue River, and Winema National Forest LRMPs. All lands, including undeveloped areas, are managed consistent with forest-wide standards and guidelines and by designated LRMP management area allocations. Other undeveloped areas are identified because they may contain special resource values that warrant an evaluation differently than other parts of the project area.

There are approximately 3,747 acres of other undeveloped lands not meeting PWA criteria that would be crossed by the pipeline on NFS lands. Approximately 1,792 acres of these areas are within the Umpqua National Forest[189], and approximately 1,955 acres are within the Rogue River National Forest (see appendix F8 for maps and additional information). The portion of the pipeline route within the Winema National Forest is on or adjacent to existing roads and would not impact "other undeveloped areas." Other undeveloped areas may have intrinsic ecological and social values because they do not contain roads (or the roads are no longer system roads) or evidence of past timber harvest. These values can include intrinsic physical and biological resources (e.g., soil, water, wildlife, recreation, fisheries, etc.), and intrinsic social values (e.g., apparent naturalness, solitude, remoteness).

Human influences have had limited impact on long-term ecological processes within these other undeveloped areas. Disturbances by insects and fire have likely been the factors with the most potential to have affected the area. Opportunities for primitive recreation include camping, hiking, hunting, wildlife watching, and photography. Opportunities for a feeling of solitude, the spirit of adventure and awareness, serenity, and self-reliance are limited by the size and shape of the areas, as well as by distance to roads and topographic screening. The size of the area necessary to feel a sense of solitude varies by individual; however, areas that are long and narrow offer less opportunity for solitude due to less distance from noise at their midpoint. Nearby sounds of roads, timber harvest, and other management activities can often be heard and the activities sometimes seen from within these undeveloped areas because they are all within approximately 1 mile or less of the nearest road from their midpoints.

The Pacific Connector Pipeline Project would directly impact approximately 8 acres of other undeveloped areas on the Umpqua National Forest and approximately 22 acres on the Rogue River National Forest. These impacts include the areas cleared by the right-of-way construction, the TEWAs, and the acres used as UCSAs.

For these other undeveloped areas within the pipeline project area where construction and operation would occur the impacts on soil; water quality; air quality; forage; plant and animal communities; habitat for threatened, endangered, and sensitive species; developed recreation; noxious weeds; and cultural resources are essentially the same as disclosed above for recreation and in other sections of section 4 of this EIS and are not reiterated here.

The Pacific Connector Pipeline Project would impact the apparent naturalness and solitude within these areas. Pipeline construction would alter the apparent naturalness on approximately 30 acres of these areas. The increase in the number of visible stumps, and the linear nature of the pipeline corridor clearing would be the most apparent visual change resulting from implementation. The linear nature of the cleared corridor would likely adversely affect the visual recreational experience

[189] This area burned in the 2015 Stouts Creek Fire and as a result there are additional alterations in this area from fire suppression efforts. In addition to the changed vegetation conditions the surrounding landscape has also changed as a result of salvage logging on industrial forest lands immediately to the west of this area.

of anyone using these areas for dispersed recreation. This impact would be long term due to a portion of the right-of-way being maintained as a low vegetation area for the life of the pipeline project. Although the pipeline construction and operation would adversely affect visual resources in these areas, they would not be inconsistent with the standards and guidelines for visual quality in the respective LRMPs.

Activities associated with the construction of the pipeline in and adjacent to these other undeveloped areas would reduce the sense of solitude and remoteness during construction activities. Other sights and sounds of ongoing and previously approved activities in areas adjacent to these other undeveloped areas would continue to have short-term effects on opportunities for solitude and remoteness. Overall, there would be little change to the current availability of solitude or primitive recreation within these areas because only a very small portion (approximately 0.8 percent) would be affected by the Pacific Connector Pipeline Project.

BLM Lands with Wilderness Character

In the fall of 2012, the BLM updated its inventory of lands with wilderness character. These updates were part of the Analysis of the Management Situation process associated with the new RMPs for western Oregon that were approved in August of 2016. The inventory covered BLM lands in the Salem, Eugene, Roseburg, Coos Bay, and Medford Districts, as well as the Klamath Falls Resource Area of the Lakeview District. The results of this most recent inventory were compared to the proposed route, and no areas of overlap were discovered. The proposed pipeline would not impact BLM land with wilderness character.

4.8.1.4 Conclusions

Constructing and operating the Jordan Cove LNG Project would not have direct adverse effects on nearby recreational areas, including the ODNRA and BLM RMAs, but may have indirect effects. As described in the preceding sections, temporary indirect impacts during construction would include construction-related noise and short-term delays to recreationists using the Trans-Pacific Parkway to access recreation sites, including the ODNRA. Indirect impacts during operation include short-term delays for recreational boaters required to avoid LNG carriers in transit within the waterway. Constructing and operating the Pacific Connector Pipeline Project would result in impacts on recreation resources as described in the preceding sections. Based on the proposed construction, mitigation, and operation procedures the Project would not significantly affect recreation resources or areas.

4.8.2 Visual Resources

Procedures for describing the existing visual condition of the landscape and assessing the visual effects of the Project are similar to and generally consistent with methodologies developed by the BLM (1986), Forest Service (1973, 1995b), the FHWA (2015), and the COE (Smardon et al. 1988). This section documents the visual assessment conducted for the Jordan Cove LNG Project and the Pacific Connector pipeline, based primarily on the potential visibility of the Project facilities and their expected visual effects on the landscape.

4.8.2.1 Jordan Cove LNG Project

The Jordan Cove LNG Project would be located almost entirely on privately owned, mostly open, industrial-zoned land on the bay side of the North Spit of Coos Bay. Ingram Yard is generally bordered to the north by the Coos Bay Rail Link and the Trans-Pacific Parkway; to the west are open lands of Henderson Marsh, which is owned by the Port; to the east is the existing industrial Roseburg Forest Products wood chip facility; and to the south are the open waters of the Coos Bay estuary. About 3,000 feet northwest of the LNG terminal is the beach and Pacific Ocean. Topography on the westernmost portion of Ingram Yard is relatively flat where fill material has been covered by brush and grasses. Forested sand dune ridges reaching elevations that exceed 100 feet above mean sea level (AMSL) cover the eastern portion of Ingram Yard.

North of the access and utility corridor is the Coos Bay Rail Link and the Trans-Pacific Parkway, beyond which are federal lands managed by the BLM and Forest Service. Those federal lands contain forested sand dunes. South of the corridor is the existing industrial Roseburg Forest Products facility.

The South Dunes area is relatively flat open lands that were formerly the location of the Menasha-Weyerhaeuser mill complex and a fish hatchery. Most of the buildings of those facilities have been removed, and what remains is a mixture of roads, railroad tracks, parking lots, grasslands, dunes, and wetlands. The South Dunes area is surrounded on the south and east by the open waters of the Coos Bay estuary, including geographic Jordan Cove on the south and Hayes Inlet on the east. To the west is the Roseburg Forest Products facility. To the north is the ODNRA.

The Roseburg Forest Products facility is mostly paved, with roads and railroad tracks, and includes a dock for mooring ships, a 190-foot-tall loading tower, wood chip piles, two large buildings, two water towers, and several small outbuildings.

Beyond 0.5 mile from the Jordan Cove LNG Project, the existing landscape on the North Spit is characterized by a mix of industrial land uses and open space. Industrial facilities on the north side of Coos Bay on the North Spit include the Southport Forest Products lumber mill, approximately 1 mile southwest of the Jordan Cove LNG Project. The International Marine Contractors and the D.B. Western manufacturing plant facilities are also located on the North Spit approximately 2 miles southwest of the Jordan Cove LNG Project (specifically the terminal site). Undeveloped land separates the Project from these facilities. Most of the rest of the North Spit southwest from the Project consists of the open lands and dunes of the BLM RMAs.

Southward, across Coos Bay from the Jordan Cove LNG Project, are the cities of North Bend and Coos Bay. The smaller community of Glasgow is located on the east side of Haynes Inlet and north side of the Coos Bay estuary, about 4,000 feet northeast of South Dunes. The Kentuck project site proposed for wetland mitigation (see section 4.4) is located approximately 1.5 miles southeast of Glasgow and inland from Kentuck Inlet on Upper Coos Bay. The closest residential developments to the terminal site are approximately 1 mile south, on the opposite side of the bay. The Southwest Oregon Regional Airport is directly across Coos Bay, about 1 mile south of the terminal site.

Once constructed, the largest aboveground structures within the Jordan Cove terminal would be the two LNG storage tanks, which would each be approximately 267 feet wide and 180 feet tall. Dredge materials from the marine waterway modifications project would be deposited at the APCO site located on the south side of the Bay, between the Coos Bay Railroad Bridge and the Oregon Coast Highway (also known as U.S. Highway 101).

Viewpoint Selection

A visual assessment was conducted to determine the potential effects on visual resources associated with the Jordan Cove LNG Project. Representative viewing points (also referred to as key observation points [KOPs]) were identified within the terminal viewshed (i.e., the area from which facilities at the terminal would be potentially visible). Generally, visual details become apparent to the viewer when they are seen in the foreground, at a distance of one-half mile or less, but may affect viewers when they are present in the middleground (up to 4 miles from the viewer) depending on the extent of landscape modification noticeable and other visual factors. It is anticipated, however, that views of the Project would be partially or fully screened by existing vegetation, topography, or infrastructure for much of the Project viewshed, and from most areas beyond 2 miles away. Therefore, the visual assessment applies to a viewshed for the Jordan Cove LNG Project that extends to a distance of approximately 2 miles from the LNG terminal in all directions, which was defined using aerial and ground photography, local planning documents, computer modeling, and field reconnaissance. Site visits to document existing visual conditions in the terminal area and to identify potentially affected sensitive viewing locations were conducted in April 2006, May 2013, and August 2017.

Representative viewpoints for use in the assessment were selected based on potential visibility of the proposed Jordan Cove LNG Project site from various distances, the sensitivity of viewing locations, and input from land management agencies (primarily the BLM and Forest Service). The viewpoints consist of locations with concentrations of viewers, such as major roadways or housing developments; visually sensitive land uses, such as parks and recreation areas; culturally sensitive locations, such as historic sites; and places designated as having scenic importance, such as highways and overlooks. Figure 4.8-2 indicates the locations of the 11 viewpoints used for visual assessment of the Jordan Cove LNG Project, and the location of the most prominent features there. The viewpoints are identified as follows:

- Viewpoint-1 North Spit Overlook and Wetland Trailhead
- Viewpoint-2 Trans-Pacific Parkway at Jordan Cove Project Site Entrance
- Viewpoint-3 Horsfall Beach Campground and Day Use Area
- Viewpoint-4 U.S. Highway 101 and Trans Pacific Parkway Intersection
- Viewpoint-5 U.S. Highway 101 on the north side of McCullough Bridge
- Viewpoint-6 U.S. Highway 101 at the southern end of McCullough Bridge
- Viewpoint-7 North Bend, intersection of Meade Avenue and Florida Avenue
- Viewpoint-8 North Bend, intersection of Meade Avenue and Vermont Avenue
- Viewpoint-9 North Bend, Open Space near Washington Avenue
- Viewpoint-10 North Bend, Bike Trail south of the Airport
- Viewpoint-11 BLM North Spit Boat Launch Area

Figure 4.8-2

Key Observation Point Locations for the Jordan Cove LNG Project

Visual Simulations

Computer-generated visual simulations were prepared for 9 of the 11 viewpoints. Visual simulations were not prepared for Viewpoint 4 and Viewpoint 7 because the LNG terminal would be, at most, minimally visible from those locations. Figures K-1 through K-11 in appendix K show the existing conditions (or "before" view) for each viewpoint, and a visual simulation (or "after" view) illustrating the expected appearance of built portions of the Project. The visual impact assessment was based on evaluation of the landscape changes that would result from completed construction and during the operation phase of the proposed facilities.

The visual simulations are the result of an objective analytical and computer modeling process and are accurate within the constraints of available site data, such as site topography, the proposed LNG terminal design, and photography obtained in the field. Existing GIS, a digital elevation model, engineering data, and digital aerial photographs provided the basis for developing three-dimensional digital models of the LNG storage tanks using a real-world coordinate system.

Viewpoint Analyses

The visual assessment for the Jordan Cove LNG Project is based on evaluation of the expected visual effects at the individual representative viewpoints. Because the LNG storage tanks would be the most visible feature of the LNG export terminal, the evaluation for each viewpoint focused on the visibility of the storage tanks.

Viewpoint-1 North Spit Overlook and Wetland Trailhead—Viewpoint-1 represents views to the southeast experienced by recreational visitors from the North Spit Overlook and Wetland Trailhead, which are located on private land on the northwest side of the Trans-Pacific Highway approximately 0.4 mile west of the LNG terminal site boundary. As shown in the simulation in figure K-1 in appendix K, there would be an unobstructed view of the LNG terminal from this location. Once the forested sand dune is removed, the LNG storage tanks, ground flares, and surrounding concrete perimeter walls would dominate the view.

Viewpoint-2 Trans-Pacific Parkway at Jordan Cove Project Site Entrance—Viewpoint-2 represents views to the southwest for travelers along the Trans Pacific Parkway to the north of the terminal site. The viewpoint is located approximately 0.25 mile northeast of the northern boundary of the LNG terminal site, and approximately 0.5 mile northeast of the LNG storage tanks. As shown in figure K-2 in appendix K, with the forested sand dune removed, parkway travelers at this location would have an unobstructed view of the ground flares, gas processing area and concrete perimeter walls, and a partially screened view of the LNG storage tanks. Similar conditions would occur at other locations along the Trans-Pacific Parkway where views to the south were not obscured by vegetation.

Viewpoint-3 Horsfall Beach Campground and Day Use Area—Viewpoint-3 represents views to the south-southeast experienced by visitors to the sand dune public overlook above the Horsfall Beach Campground/Parking/Staging Area in the ODNRA. The Oregon Coast Trail also passes through this location as it transitions from the beach to Horsfall Beach Road. The viewpoint is located approximately 1.25 mile north of the LNG terminal site boundary, and approximately 1.6 miles northwest of the LNG storage tanks. The simulation indicates that views of the proposed facilities would be partially obstructed, and that the domes of the LNG storage tanks, the ground flares, and the surrounding concrete perimeter walls would be partially visible above the existing tree line (figure K-3 in appendix K). Because of their light color, viewers would be most likely to notice the tops of the LNG storage tanks. Along the Oregon Coast Trail, the LNG terminal would likely be partially visible from 0.5 mile to the east of the intersection of Horsfall Beach Road and the Trans-Pacific Parkway.

Viewpoint-4 U.S. Highway 101 and Trans-Pacific Parkway Intersection—Viewpoint-4 represents views to the west for travelers along U.S. 101 approximately 2.2 miles east of the LNG terminal site boundary, near the intersection with the Trans-Pacific Parkway and less than 0.5 mile east of the Conde B. McCullough State Recreation Site (figure K-4 in appendix K). The Oregon Coast Trail is also located along the Trans-Pacific Parkway and U.S. Highway 101 south of the Trans-Pacific Parkway Intersection in this area. Looking southwest, the Trans-Pacific Parkway can be seen in the middleground and the 190-foot-high loading tower at the Roseburg Forest Products chip export facility is barely visible above the trees beyond. The LNG terminal site, which would be obstructed by intervening landform and vegetation, would be located behind and to the right of the loading tower. Figure K-4 is an existing view from this viewpoint. A simulation was not completed because the proposed facilities would be obscured by topography and vegetation from this viewpoint. The Trans-Pacific Parkway/U.S. 101 widening would be visible in the foreground. The LNG terminal would likely be partially visible from the Conde B. McCullough State Recreation Site, located 2.4 miles to the northeast of the LNG terminal, but would be mostly obscured by vegetation and intervening topography. The LNG terminal would be visible along U.S. Highway 101 South in this area, but would be partially obscured by vegetation and intervening topography.

Viewpoint-5 U.S. Highway 101 on the north side of McCullough Bridge—Viewpoint-5 represents views to the west as seen by travelers along U.S. 101 on the north side of McCullough Bridge, and is located approximately 2 miles east of the LNG terminal site boundary. The Oregon Coast Trail is also located along this section of U.S. Highway 101.

In the existing view, the forested sand dune located on the LNG terminal site is visible behind the Coos Bay Rail Link Bridge and the Roseburg Forest Products facility (figure K-5 in appendix K). The simulation shows that the forested sand dune would be removed, and that the LNG tanks and concrete perimeter wall would be visible above the treeline. Views of the LNG terminal facilities would be partially obscured by the existing Roseburg Forest Products facilities.

Viewpoint-6 U.S. Highway 101 at the Southern end of McCullough Bridge—Viewpoint-6 represents views to the northwest from the south side of McCullough Bridge, approximately 2 miles southeast of the LNG terminal site boundary and approximately 0.1 to 0.3 mile east of the APCO Dredge Disposal Site. Simpson Park, owned by the City of North Bend Parks, is located adjacent to the viewpoint location to the south. As shown in the simulation (figure K-6 in appendix K), the LNG storage tanks would be visible in the background above the APCO Site dredge material deposits, which are visible in the foreground. APCO Site 1 (approximately 0.1 mile west of the viewpoint location) would be approximately 36 feet tall, and APCO Site 2 (approximately 0.3 mile west of the viewpoint location) would be 48 feet tall. Initially, the dredge deposit areas would appear as an exposed sand dune. After vegetation is established, ground cover on the dredge deposit areas would appear visually similar to the surrounding landscape.

Viewpoint-7 North Bend, intersection of Meade Avenue and Florida Avenue—Viewpoint-7 represents views to the northwest from urbanized areas within North Bend, approximately 2 miles southeast of the LNG terminal site boundary. The Roseburg Forest Products facility is visible between and over the residential buildings and vegetation, across Pony Slough and Coos Bay (figure K-7 in appendix K). The forested sand dune that currently exists on the LNG terminal site is visible as a dark green line of vegetation behind the Roseburg Forest Products facility in the background. The view of the proposed facilities from this viewpoint was not simulated, because visibility of the facilities would be limited by the vegetation, residences, and other development. The LNG storage tanks would mostly be obstructed by intervening landforms, vegetation, and the existing Roseburg Forest Products facility.

Viewpoint-8 North Bend, intersection of Meade Avenue and Vermont Avenue—Viewpoint-8 represents views to the northwest from an urbanized area within North Bend that is higher in elevation compared to Viewpoint-7. The viewpoint is located approximately 2.25 miles southeast of the LNG terminal site boundary. In the existing view, Pony Slough, the Southwest Oregon Regional Airport, the Coos Bay Rail Link, and Coos Bay are visible between the viewpoint location and the proposed terminal location. The forested sand dune that currently exists on the LNG terminal site is visible as the dark green line of vegetation in the distance (figure K-8 in appendix K). As shown in the simulation, the forested sand dune would be removed and the LNG storage tanks, marine slip, concrete perimeter walls, and LNG vessel (when in port) would be visible from this viewpoint.

Viewpoint-9 North Bend, Open Space Near Washington Avenue—Viewpoint-9 represents views to the north from an open space in an urbanized area within the western part of North Bend. A single-family development is proposed (but not approved) for this location along Washington Avenue, which is located just south and uphill from the Church of Jesus Christ of Latter-day Saints, approximately 1.4 miles from the LNG terminal site boundary. As shown in figure K-9 in appendix K, the LNG storage tanks, marine slip, and concrete perimeter walls would be visible above the tree line.

Viewpoint-10 North Bend, Bike Trail South of the Airport—Viewpoint-10 represents views from Airport Lane and a bike trail that is located south and uphill from of the North Bend Waste Water Treatment Plant and the Southwest Oregon Regional Airport, near the intersection of Colorado Avenue and Arthur Street. The viewpoint is located approximately 1 mile south of the LNG terminal site boundary. In the existing view, treatment plant and airport structures are present in the foreground and the Roseburg Forest Products facility is visible in the middleground, as is the forested dune on the LNG terminal site (figure K-10 in appendix K). The simulation shows that the LNG storage tanks, marine slip and associated sheet pile walls, and LNG vessel (when in port) would be visible and prominent from this viewpoint.

Viewpoint-11 BLM North Spit Boat Launch Area—Viewpoint-11 (figure K-11 in appendix K) represents views to the northeast from the interpretive overlook at the BLM North Spit Boat Launch parking lot, and is approximately 0.75 mile southwest of the LNG terminal site boundary. The topography at this site is flat with low-growing vegetation, allowing views of the existing forested sand dune located on the LNG terminal site to the left of the Roseburg Forest Products facility. The simulation shows that the LNG storage tanks, marine slip, concrete perimeter walls, and the LNG carrier (when in port) would be visible in the near middleground.

Visual Impacts

Short-Term Visual Impacts

Construction of the Jordan Cove LNG Project would be noticeable to recreational users on Coos Bay, in portions of the ODNRA, in portions of the North Spit Overlook, and at the boat launch and other locations within the BLM Coos Bay/North Spit RMA. Some residences in both the cities of

North Bend and Coos Bay would also have views across the bay to the terminal, although for other residences such views would be obstructed by terrain, vegetation, or intervening development. Construction activities would also be noticeable to motorists using the Trans-Pacific Parkway and the Pacific Coast Scenic Byway (U.S. Highway 101). Visual effects from construction activities near the terminal site that are likely to be noticeable would include dust plumes, exposed surfaces resulting from clearing and grading, and the presence of construction equipment and personnel activity on the LNG terminal site. Wetland restoration activity at the Kentuck project site might be evident to motorists using local roads and rural residences in the immediate vicinity of the site. Facilities associated with ancillary elements of LNG terminal construction, such as submerged pipelines to convey dredged material, may be visible in selected locations near shoreline areas but are not likely to create noticeable additional visual contrast. These visual effects from construction activity would be temporary and limited to the construction period.

Short-term visual effects during construction of the LNG terminal would include the presence of the workforce housing facility within the South Dunes that would include pre-fabricated housing units and basic utility structures, which would visually resemble a small, dense residential community. The workforce housing facility would be dismantled and all structural elements removed from the site following completion of construction activities, and therefore visual effects resulting from the housing facility would be short term.

Long-Term Visual Effects

Based on the visual simulations, the Jordan Cove LNG Project would be visible to the public and would alter the existing visual character and scenic quality of the site. In addition to installation of the LNG tanks and related facilities, another permanent effect includes the removal of portions of a forested dune located on the eastern portion of the terminal site. This dune is a noticeable topographic feature of the existing landscape, and its removal was incorporated in the simulations whenever applicable.

Based on the visual changes indicated by the simulations for the set of representative viewpoints, the Jordan Cove LNG Project would have a moderate to high visual effect on residential communities in Coos Bay and North Bend to the south of the site. This effect would occur because of proposed landform modifications, including removal of the forested sand dune on the LNG terminal site, and the visibility of proposed industrial facilities on a previously undeveloped site. Moderate visual impacts are anticipated for viewers from hillside residences that would have views of the LNG terminal site that are not screened by topography, vegetation, or intervening development. These viewers would see the proposed development in the context of existing residential, commercial, transportation, and industrial uses in North Bend and Coos Bay that would be visible in foreground to middleground distances. Residences located along the shoreline of Coos Bay south of the regional airport (along Maxwell Road, Seagate Avenue, and Fenwick Street, for example) with unobstructed views of the site would experience a stronger visual effects and reduced scenic quality than would hillside residences, because the proposed facilities would primarily be viewed in the context of a shoreline landscape that currently has sparser development and higher scenic quality than the interior urban areas.

Twenty-four-hour facility lighting would be required for security and personnel safety during operation of the LNG terminal. Review comments on the draft EIS noted that LNG facilities are known to have extensive and bright lighting. Lights associated with the LNG terminal site are not anticipated to create a substantial new source of light or glare that would adversely affect daytime views. Existing nighttime views in the area include lights associated with the airport, the industrial facilities on the North Spit, and other urban uses. The addition of lights associated with the Jordan Cove LNG Project would create a noticeable increase to the extent and intensity of night lighting in the Coos Bay area. Nevertheless, depending on the viewing location, this change would represent a low to moderate incremental impact in context of the extent and intensity of current lighting in the area.

The Jordan Cove LNG Project would be visible to recreational users on Coos Bay, in portions of the ODNRA, from the North Spit Overlook, and in portions of the BLM Coos Bay/North Spit RMAs, including the BLM boat launch. Recreational users with views of the Jordan Cove terminal would notice moderate visual contrast in most locations, but high contrast when the Project is viewed in the foreground (within approximately 0.5 mile of the proposed facilities). The reduction of scenic quality in these areas where the Project creates a high contrast in the foreground would reduce the recreation experience from those viewpoints for some viewers who are sensitive to those changes. When viewed from greater distances, the reduction of scenic quality would generally be less pronounced because the Project would be viewed in the context of the surrounding landscape, which is characterized by other industrial, residential, and commercial developments.

The CTCLUSI considers the North Spit and surrounding areas to be a Traditional Cultural Property (TCP), and has noted that the viewshed is considered as a contributing factor in the TCP nomination for this area. Long-term adverse effects experienced by the CTCLUSI within the viewshed of the North Spit and surrounding area would be similar to the effects discussed above for recreational users of the area.

The Project would be noticeable to motorists using the Trans-Pacific Parkway and the Pacific Coast Scenic Byway (also known as U.S. Highway 101). Visual effects on travelers on these roadways would be low to moderate. Intervening landforms and vegetation obstructs views toward the LNG terminal site from many locations along U.S. 101 and the Trans-Pacific Parkway. Travelers on these roadways would potentially experience low to moderate visual effects, because these viewers tend to have lower sensitivity and a shorter duration of view, and because the facilities would be viewed in the context of the surrounding landscape.

Wetland restoration would alter the long-term appearance of the 140-acre Kentuck project site. The site is the location of the former Kentuck Golf and Country Club, an 18-hole golf course that opened for play in the mid-1960s and closed in 2009. Aerial imagery indicates the site is no longer actively maintained and has a vegetative cover of grasses and other low-growing species, with trees and shrubs in some areas around the southern periphery and some visible evidence of remnant golf course features. The Kentuck project site is similar in character to adjacent open pasture areas located in the flat valley bottom land along Kentuck Slough, which is a narrow, linear waterway parallel to Kentuck Lane. Over time, most of the open, grassy area of the site would take on the appearance of freshwater and estuarine wetlands, including some areas of open water. The long-term visual effect of the proposed mitigation action would be to create a more natural-appearing landscape at the Kentuck site, and the change would be relatively subtle. Because the Kentuck project site is in a narrow tributary valley, this visual change would only be evident within the immediate local area, primarily including segments of East Bay Road and Kentuck Lane and a small number of rural residences located in the valley. The long-term landscape change at the Kentuck site is likely to be perceived as a minor, positive visual effect.

A related visual element of the LNG terminal would be the introduction of LNG carriers to the viewshed of the Coos Bay area communities. Traveling between 4 and 10 knots per hour, an LNG carrier would cross through the field of view for shoreline viewers in a few minutes. While LNG carriers are very large vessels, they are relatively close in size to cargo ships that currently transit the bay for the purpose of transporting wood products, which average around 600 feet in length. Because ships of this scale are already a regular occurrence in the waterway, the presence of LNG carriers would not be a new type of visual feature on the waterway.

Proposed Mitigation Measures

Jordan Cove has proposed several measures that would mitigate long-term visual effects of the Project. Jordan Cove has taken measures to reduce impacts on wetlands and estuaries in the siting of the Project, thereby retaining some of the visual characteristics of the site. The LNG terminal location was selected to avoid disturbance of Jordan Lake, which would help to reduce visual effects by preserving an existing, distinctive waterbody in the landscape. However, the size and location of the proposed LNG terminal and associated facilities would cause visual effects from many viewpoints that cannot be effectively mitigated.

The exterior of the LNG storage tanks would be constructed of untreated concrete of a light grey color for cryogenic purposes. While a darker color would help reduce the visibility of the tanks from a distance, such treatment is not generally considered feasible, as dark colors absorb heat, which would increase the temperature of the tank exterior and become problematic for LNG storage control. Jordan Cove evaluated various tank profiles and locations to reduce visual effects, and concluded that the proposed size, profile, and location would be the optimum considering other environmental factors, safety, and reliability. The final landscape design for the site would include provisions to contour and stabilize landforms not affected by construction and to provide some level of screening around the facilities. The use of native plants for restoration and stabilization of the landforms would also be incorporated into the final planting design to the extent practical. Building facades would incorporate the architectural design of existing buildings in the area. The final lighting plan would include hooded or cut-off lighting to reduce light spillage onto adjacent areas. Only lighting required for operation and maintenance, site safety and security, and to meet FAA requirements would be used on the LNG storage tanks and, whenever possible, the light would be localized to reduce off-site effects.

4.8.2.2 Pacific Connector Pipeline

Visual resources along the pipeline alignment vary greatly. The natural landscape features include sandy treed dunes, expansive bay views and temperate rain forest in the Coos Bay area, and rolling steep conifer-forested hillsides in the Coast and Cascade ranges and foothills. Open oak savanna, pasturelands, and rolling hills are common in the viewsheds near Roseburg and east of Medford, with views transitioning to dramatic conifer mountain and volcanic landscapes in the Cascade Mountains. Croplands, pasturelands, rolling sagebrush rangeland, and pine-juniper forests punctuated by westerly views of the Cascades compose a unique scenic landscape in the Klamath Basin at the eastern end of the pipeline.

Culturally modified landscapes include farm and rangelands, meadow habitats in forest breaks created by Native Americans through use of fire, small towns, and forest management activities including clearcut timber harvesting. Forested viewsheds are characterized by various aged forest stands that are in various stages of harvest, regeneration, or mature forests. Several viewsheds along the western portion of the pipeline route have very low scenic integrity, including hillsides altered by clearcuts and traversed by logging roads. A few forested areas also include existing utility corridors. Where the pipeline crosses NFS lands within the Umpqua, Rogue River-Siskiyou, and Fremont-Winema National Forests, the forested viewsheds are characterized as ranging from low to high scenic integrity, varying with stages of forest maturity and harvest regeneration. Other forest landscapes and views have been modified by recent wildfires, such as the Stouts Creek Fire in the Umpqua National Forest in 2015.

On BLM and NFS lands, visual resources are managed according to visual resource management guidelines. Most of the pipeline alignment would pass through viewsheds which allow moderate change, as evidenced by active timber management activities. These are areas where alterations of the existing landscape would not significantly alter the existing characteristics of the viewshed. In a few locations, the pipeline would cross federally managed public lands that are designated as having high visual resource sensitivity under the agencies' visual management system. These areas are discussed in detail later in this section.

KOP Selection

A visual assessment was conducted to determine the potential effects on visual resources associated with the pipeline. Representative viewpoint points (also referred to as KOPs) were identified within the viewshed for the pipeline, defined as the area from which the pipeline would be potentially visible. The pipeline viewshed extends to a distance of 5 miles on either side of the pipeline. This distance was defined using aerial and ground photography, local planning documents, computer modeling, and field reconnaissance. The 5-mile viewshed extent represents the foreground/middleground distance zone as described in the BLM Visual Resource Management (VRM) system, and corresponds to the potential viewing range within which visible aspects of the Project (primarily the cleared right-of-way) are most likely to be noticeable to the casual observer. Site visits were conducted in April 2006 and updated in May 2013 to document visual conditions along the pipeline route and to identify potentially affected sensitive viewing locations along the proposed route. Based on these site visits, it is anticipated that views of much of the pipeline from within the 5-mile viewshed would be partially or fully screened by existing trees, landforms, or intervening development. Figures 4.8-3 to 4.8-5 show the proposed route as it moves through the various BLM VRM classifications and Forest Service VQO classes[190] as well as the KOP locations along the route.[191]

A supplemental visual impact assessment was conducted to determine the potential effects on visual resources associated with the pipeline as it crosses the PCT. The viewshed for the PCT at this crossing is quite limited because of the old-growth forest, dense brush and understory trees, and the pedestrian scale of the characteristic landscape. A detailed visual analysis was undertaken for the PCT crossing site. Several site visits were conducted in the spring of 2015 to document existing visual conditions of the PCT at the pipeline crossing. The Forest Service determined that two new KOPs would be required to accurately simulate the expected future visual conditions as

[190] The VRM system has four management classes, with objectives ranging from preserving the existing landscape character (Class I) to providing for management activities that require major modification of the existing landscape character (Class IV). The VQO system has five classes, ranging from Preservation (where most management activities are prohibited) to Maximum Modification (where management activities may dominate the landscape). See Section 4.8.2.3 for additional discussion.

[191] The VRM class boundaries shown on figure 4.8-4 are incorrect near KOP-P2. They are based on GIS data which is being corrected at the time of publication. The VRM class near the Trail Post Office KOP is VRM-II.

seen from the PCT. Forest Service personnel and the visual analysts established two new KOPs in this pedestrian landscape.

For this supplemental analysis, the new KOPs are numbered sequentially as KOP-P8 and KOP-P9, as shown on figure 4.8-5 (MP 155 to 228). The VQO for the affected landscape along the PCT is Foreground Partial Retention, indicating that human activities should remain visually subordinate to the characteristic landscape. Activities may repeat form, line, color, and texture common to the characteristic landscape, but changes in their qualities of size, amount, intensity, direction, pattern, etc. should remain visually subordinate to the characteristic landscape.

A supplemental visual impact assessment was also conducted for the crossing of the Coos Bay Wagon Road corridor in 2013, to support an analysis of the Modified Blue Ridge Route Alternative, which has been incorporated into the Proposed Route. As a result, KOP-P10 was added to the visual resource analysis, as shown on figure 4.8-3.

As a result of the original and supplemental visual assessments, the complete list of KOPs for the Pacific Connector Pipeline Project is summarized as follows:

- **KOP-P1 ODNRA**, west of MP 0, Horsfall Beach Campground and Day Use Area
- **KOP-P10 Coos Bay Wagon Road**, MP 24.37, Sumner-Fairview Road northwest of Fairview
- **KOP-P2 Trail Post Office**, MP 123.0, Town of Trail adjacent to Highway 62
- **KOP-P3 Highway 140**, MP 145.6 near Little Butte Creek
- **KOP-P4 Big Elk Road** (Forest Road 37), MP 161.4, west of Lake of the Woods
- **KOP-P5 Clover Creek Road**, MP 172.2, north of Buck Lake
- **KOP-P6 Clover Creek Road**, MP 176.8, east of Buck Lake and west of Aspen Lake
- **KOP-P7 Clover Creek Road**, MP 170.1, northwest of Buck lake
- **KOP-P8 Pacific Crest Trail**, MP 167.7-167.84, south of Brown Mountain
- **KOP-P9 Pacific Crest Trail**, MP 167.7-167.84, south of Brown Mountain

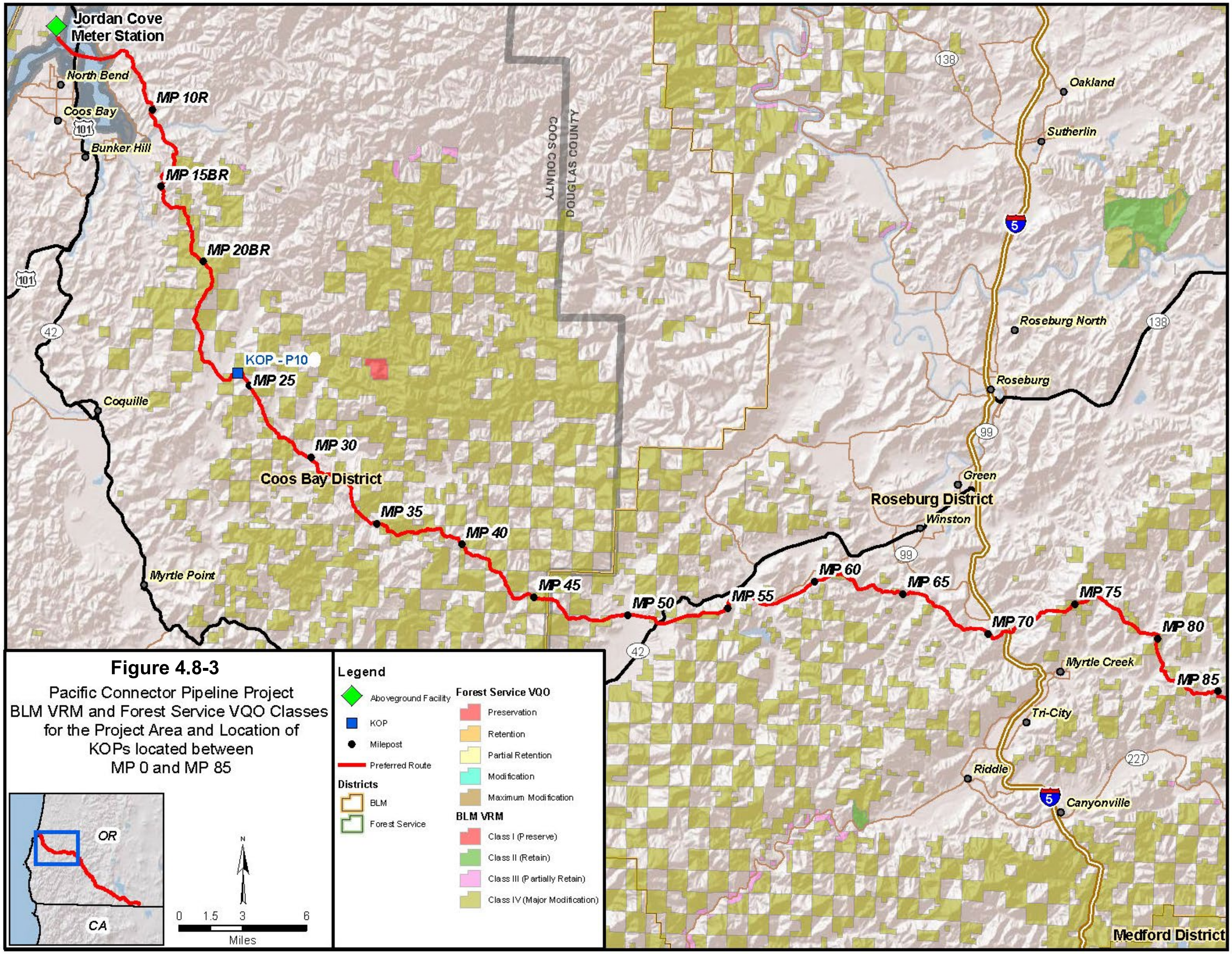

Figure 4.8-3
Pacific Connector Pipeline Project
BLM VRM and Forest Service VQO Classes
for the Project Area and Location of
KOPs located between
MP 0 and MP 85

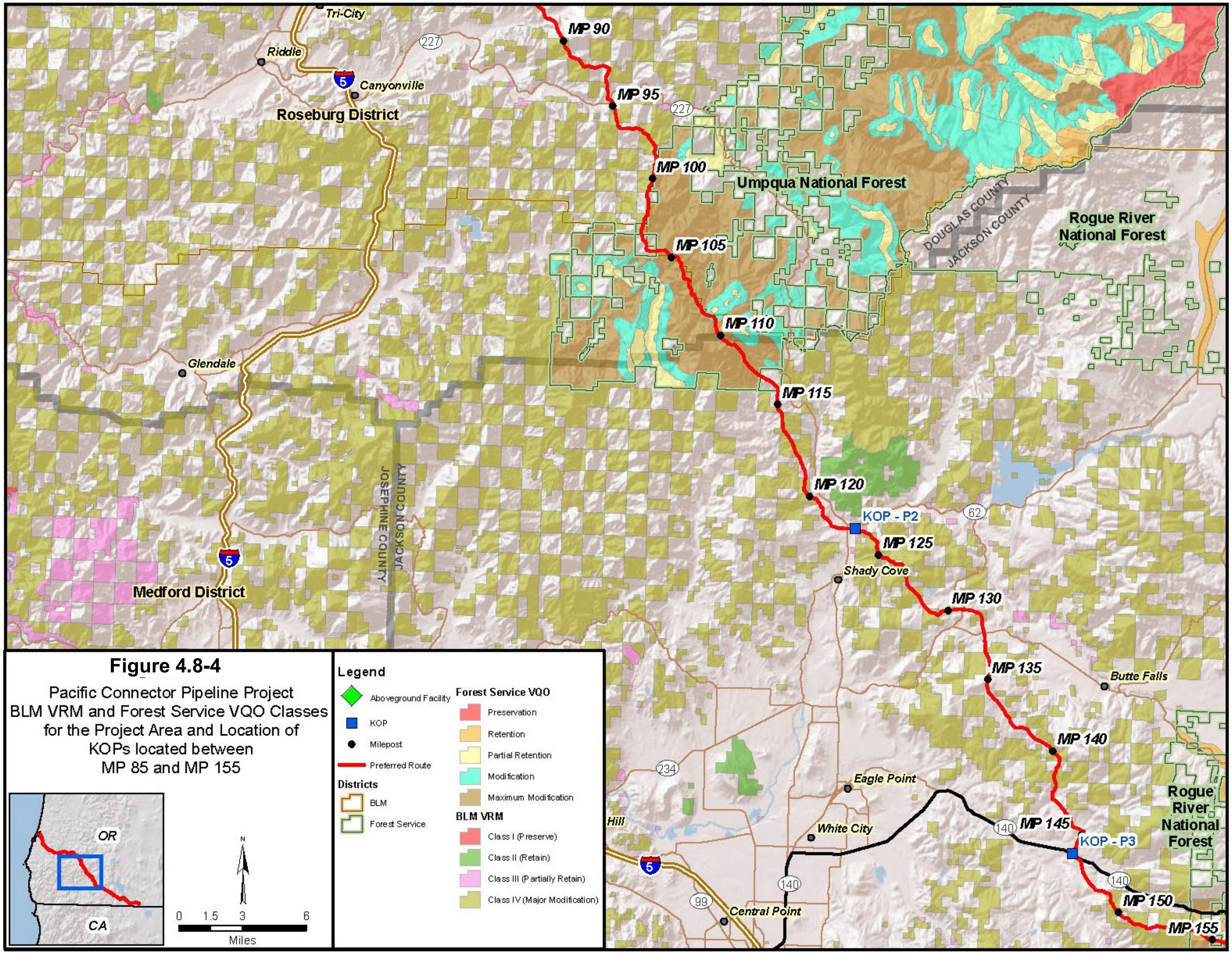
Figure 4.8-4
Pacific Connector Pipeline Project
BLM VRM and Forest Service VQO Classes
for the Project Area and Location of
KOPs located between
MP 85 and MP 155
Legend
Aboveground Facility
KOP
Milepost
Preferred Route
Districts
BLM
Forest Service
Forest Service VQO
Preservation
Retention
Partial Retention
Modification
Maximum Modification
BLM VRM
Class I (Preserve)
Class II (Retain)
Class III (Partially Retain)
Class IV (Major Modification)
Miles
0 1.5 3 6
OR
CA
Roseburg District
Medford District
Umpqua National Forest
Rogue River National Forest
Tri-City
Riddle
Canyonville
Glendale
Shady Cove
Butte Falls
Eagle Point
White City
Central Point
Hill
DOUGLAS COUNTY
JACKSON COUNTY
JOSEPHINE COUNTY
KOP - P2
KOP - P3
MP 90
MP 95
MP 100
MP 105
MP 110
MP 115
MP 120
MP 125
MP 130
MP 135
MP 140
MP 145
MP 150
MP 155

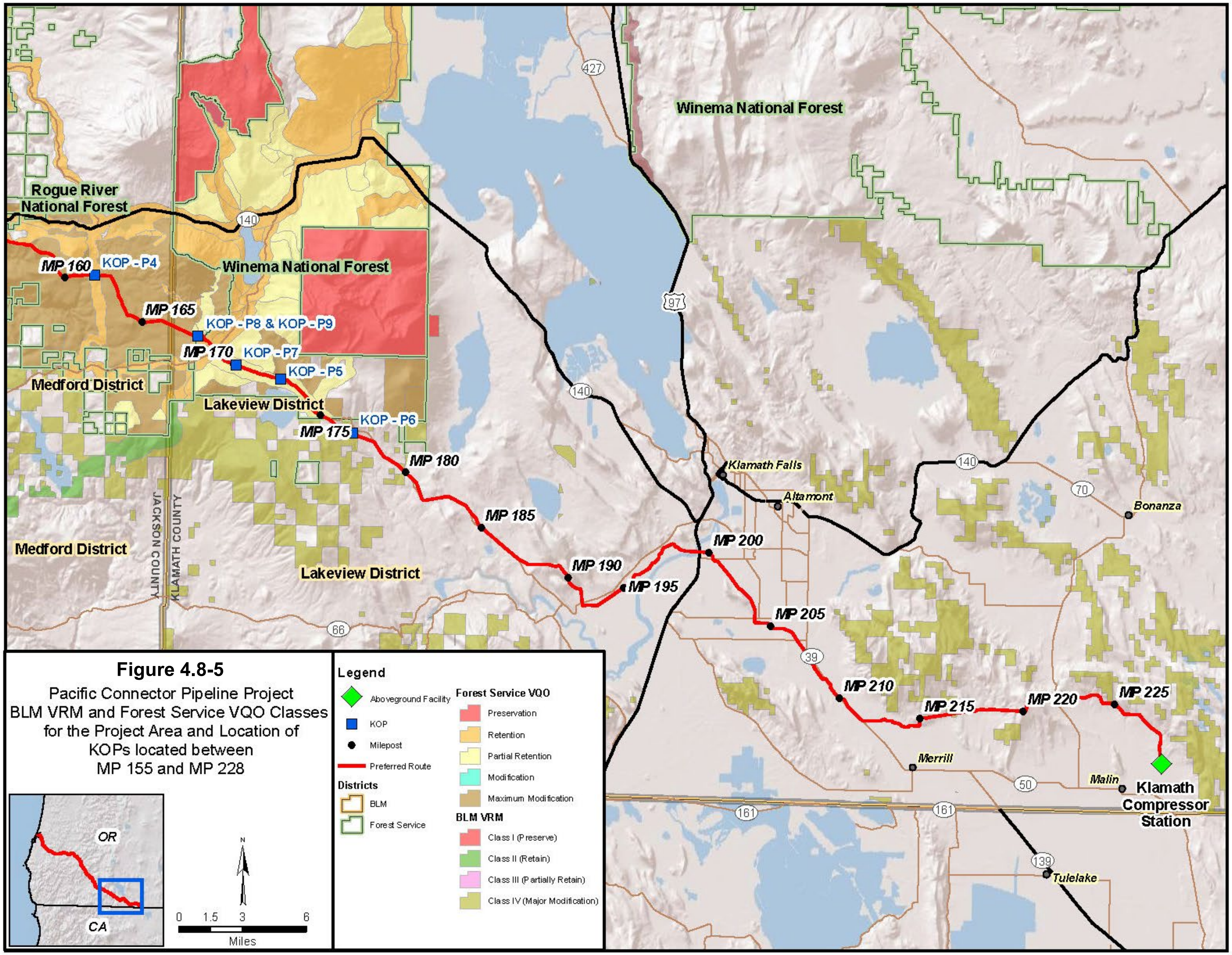

Figure 4.8-5
Pacific Connector Pipeline Project
BLM VRM and Forest Service VQO Classes
for the Project Area and Location of
KOPs located between
MP 155 and MP 228

Visual Simulations

Photographs of existing visual conditions were used in preparing computerized visual simulations for each KOP. Because the appearance of the pipeline right-of-way would change with time, a series of simulations were prepared to illustrate how the pipeline right-of-way would look at different timeframes following construction. The KOP photo sets are presented sequentially in appendix K as follows:

- Existing Conditions: How the landscape appeared at the time site photography was conducted.
- Post-Construction (Year 0): The pipeline is in place and backfilled. Soils have been re-contoured, water bars constructed, and cull logs, root wads, and boulders have been scattered across the right-of-way. Seedlings of native trees (Douglas-fir and ponderosa pine) have been planted among the woody debris and boulders, except for a 30-foot-wide corridor directly above the pipeline.
- Post-Construction, Site Repair, and Replanting (Year 5): Douglas-fir and ponderosa pine saplings are starting to show among the woody debris, boulders, and water bars. Grasses are growing across the entire right-of-way. There are no trees growing in a 30-foot-wide corridor directly above the pipeline.
- Year 25: Young Douglas-fir and ponderosa pine trees are growing throughout the right-of-way, except for the 30-foot-wide corridor directly above the pipeline, and some of the woody debris (cull logs and root wads) is beginning to deteriorate. The boulders and water bars remain, and maintenance has occurred to keep only low-growing shrubs and grasses in the 30-foot-wide corridor centered directly over the pipeline.

KOP Analyses

Pacific Connector, with guidance from the Forest Service and BLM, initially selected nine points from which to assess visual and aesthetic impacts. Five points were selected based on their proximity to federal lands with high scenic qualities and associated visual management objectives. A tenth KOP was added later to reflect potential visual impacts at the pipeline crossing of the former Coos Bay Wagon Road, a feature of historic interest. These KOPs would also serve as monitoring points for mitigation. Each KOP is described below.

<u>KOP-P1 ODNRA</u>

KOP-P1 represents views experienced by recreational users at the ODNRA, Horsfall Beach Campground and Day Use Area. KOP-P1 is geographically similar to Viewpoint-3 at and is located north of pipeline MP 0.00 with views of both the LNG terminal and pipeline construction areas (figure 4.8-2). From KOP-P1, visual effects associated with the pipeline would be subordinate to concurrent construction at the proposed LNG terminal, as well as activities associated with nearby industrial areas, air and sea port traffic, and urban development in the Coos Bay region. Visual effects of the pipeline from this KOP are therefore negligible overall. No further visual impact assessment is necessary at this location due to complete visual screening of the pipeline alignment by intervening topography. For this reason, there is no photograph/simulation set for KOP-P1 in the figures that follow.

KOP-P10 Coos Bay Wagon Road

The pipeline would cross the route of the historic Coos Bay Wagon Road on private lands at MP 24.37, about 15 miles southeast of Coos Bay and 2 miles northwest of the community of Fairview. The Coos Bay Wagon Road was a historic backcountry route built in the 1870s to connect Coos Bay and Roseburg, Oregon for freight transportation. The Wagon Road fell into disuse after OR 42 was built in the Coquille River valley during the early twentieth century. Local roads developed along the original road alignment continue to be used as an alternative travel route. KOP-P10 is located where the pipeline would cross the Wagon Road route, which is now a two-lane paved road identified locally as the Sumner-Fairview Road. The KOP represents foreground/middle ground views of the pipeline that would be experienced by travelers on the former Wagon Road route.

Figure K-12a in appendix K provides the existing view from the just outside the proposed pipeline right-of-way, and figures K-12a through K-12c show visual simulations for different stages of construction and restoration (note that for this KOP the set of simulations also includes a view of conditions at Year 10 as requested by the BLM). In Year 0, clearing associated with the pipeline would be visible to road users for approximately 0.25 mile, or approximately one-eighth of a mile on either side of the pipeline crossing. While the pipeline clearing might be visible from locations beyond this area, it is not likely to dominate views or affect landscape character. By Year 10, the right-of-way might not be noticeable to most road users because planted vegetation would mask the corridor unless the viewer is directly adjacent to the 30-foot permanently cleared area.

KOP-P2 Trail Post Office

KOP-P2 is located on private land at the U.S. Post Office in the town of Trail, near MP 123.0 and is representative of the view from Crater Lake Highway (State Highway 62). Simulations show the views to the southeast where the pipeline route crosses private land southwest of the Rogue River HDD crossing. Approximately halfway up the hill, the pipeline would leave private land and cross BLM land designated as VRM Class IV. Existing vegetation depicted in the view from KOP-P2 at the pipeline right-of-way consists of a dense evergreen forest of Douglas-fir and ponderosa pine. There are patches of scrub-oak and manzanita at the right-of-way, and a bare patch of soil north (left) of the right-of-way (figures K-13a and K-13b in appendix K). After pipeline construction, the removed vegetation and exposed earth within the cleared right-of-way would create a moderate to high level of contrast in the short term, until vegetation is re-established. After vegetation is established, the level of contrast would be low to moderate (figure K-13b and K-13c).

KOP-P3 Highway 140 near Little Butte Creek

KOP-P3 is located at MP 145.6, at the point where the pipeline would cross under State Highway 140 near Little Butte Creek on private lands, and represents views to the southeast experienced by travelers along Highway 140 (figures K-14a and K-14b in appendix K). This KOP provides a middle ground/background view of BLM lands classified as VRM Class IV located approximately 2.5 miles southeast of KOP-P3. The pipeline right-of-way would be visible in the foreground where it is located adjacent to Highway 140, and then in the middleground/background where it would be located on a hill on BLM land. Initially, contrast levels would be moderate to high, depending upon the angle of view. Contrast would be reduced over time as vegetation is re-established within the right-of-way.

KOP-P4 Big Elk Road (Forest Road 37)

KOP-P4 represents views to the north experienced by travelers along Big Elk Road (Forest Road 37) at MP 161.4 This road provides access for snowmobilers, anglers, hikers, and others travelling to Lake of the Woods. The pipeline crossing location is located in the Rogue River-Siskiyou National Forest in an area designated with a VQO of Foreground Retention. The pipeline would cross the road at this location in a perpendicular manner, and viewers would experience both foreground and middleground views of the cleared pipeline right-of-way when they are adjacent to or near the road crossing. Simulations show the moderate long-term visual effects of the permanently cleared 30-foot-wide right-of-way that would be visible to passing motorists (figures K-15a and K-15b in appendix K).

KOP-P5, KOP-P6, and KOP-P7 Clover Creek Road

The pipeline would generally parallel Clover Creek Road for approximately 18.2 miles between MP 169.5 and MP 187.7. The Forest Service VQO for MPs 170 and 175 is Partial Retention. The series of three simulations in figure K-16 shows the typical visual effects that would occur in timbered landscapes along this segment of Clover Creek Road.

Simulations prepared for KOP-P5 represent a long-distance view of the right-of-way near MP 172.2 from the perspective of motorists along Clover Creek Road. The simulations show that clearing associated with the pipeline right-of-way would be visible in the immediate foreground, foreground, and middleground from this perspective (figures K-16a and K-16b in appendix K). Contrast created by the clearing of the right-of-way would be reduced over time after restoration, which would involve recontouring, reseeding, scattering of slash across the right-of-way, and replanting.

KOP-P6 represents a second view from the perspective of motorists on Clover Creek Road, near Spencer Creek at about MP 176.8 along the pipeline route, on BLM lands, looking uphill. In this location, the pipeline right-of-way would be immediately adjacent to the road, as shown in figures K-16a and K-16b for KOP-P5 and figures K-17a and K-17b for KOP-P6. The clearing would create a "widening" effect. Contrast created by the clearing of the right-of-way would be reduced over time after restoration, which would involve recontouring, reseeding, scattering of slash across the right-of-way, and replanting.

KOP-P7 represents a third view from the perspective of motorists along Clover Creek Road. KOP-P7 is located at MP 170.1, facing due east and downhill from a motorists' perspective. There is an existing partial-cut timber harvest area on the north (left) side of the road. Simulations for KOP-P7 show an additional long-distance view of the pipeline right-of-way from along Clover Creek Road. As shown on the post-construction simulation, woody debris (cull logs, slash, and root wads) would be left on the right-of-way to discourage OHV use, which would create visual contrasts. The Year 25 simulation shows pine reforestation on the right-of-way, and in this view, the permanently cleared and maintained area directly over the pipeline would be partially to completely screened from view of the road. This simulation shows the extent of high visual effects of the pipeline, over time, in the immediate foreground, foreground, and middleground of Clover Creek Road (figures K-18a and K-18b in appendix K).

KOP-P8 and KOP-P9, Pacific Crest Trail Crossing (MP 167.7-167.84)

The pipeline would intersect the PCT at approximately MP 167.8, in the Rogue River-Siskiyou National Forest. At this location, two VQOs apply. The area to the south and west of the crossing site has a VQO of Foreground Partial Retention, while the area to the north and east has a VQO of Foreground Retention. Both of these VQOs are intended to protect the existing visual quality of the foreground for PCT users. Because the pedestrian landscape has very limited sight distance, only immediate foreground (0 to 300 feet) views are possible.

The following site-specific mitigation measures would be implemented in the visible foreground to reduce visual impacts:

- construct/install scenery mitigation measures under the guidance of a scenery specialist to be on-site during time of construction;
- retain a screen of existing vegetation east of the PCT crossing site along Forest Road 3720-700 to screen views of the bore site and cleared right-of-way;
- chip slash and mulch the right-of-way to manage slash, reduce soil erosion, and retain soil moisture to increase revegetation success;
- hydro mulch seed with colorant-dark brownish green to reduce soil color contrast;
- scallop edges by removing trees in designated uncleared storage areas to reduce the straight linear edge and to vary shadow-cast patterns;
- place logs irregularly across the cleared area to break up linear patterns and to provide naturalistic barriers to unauthorized OHV use;
- flush-cut all stumps in the immediate foreground to less than 6-inch height;
- use a tree spade to transplant trees of 15- to 20-foot height into the right-of-way in clusters to immediately break up the linear edges and the barren swath, and plant clusters a minimum of 30 feet apart;
- remove, store, and transplant on-site shrubs and ground cover plants back into the cleared area, ditch zone, and bore area post-construction;
- cut undergrowth outside of the 10-foot ditch zone and the bore area to 6-inch height rather than stripping to bare soil;
- bury any root wads or boulders in the right-of-way to at least 1/3 the height of the boulder or root wad in order to maintain natural appearance;
- subsoil all areas not immediately over the pipeline to reduce soil compaction and improve re-vegetation success;
- plant 1- to 2-gallon size shrubs to decrease the amount of time needed to address soil color contrast and the single plane of the open forest floor; and
- monitor revegetation treatments on an annual basis to evaluate success and to determine if VQOs are being achieved or if additional efforts are needed. Continue monitoring efforts until the VQO of Foreground Partial Retention is achieved.

The visual simulations presented in figures K-19 and K-20 in appendix K show the anticipated visible impacts of the pipeline right-of-way and construction work space immediately following construction. Figure K-19 also shows anticipated visual impacts 5 and 25 years following implementation.

The pipeline would widen the existing linear opening of Forest Road 3720-700 through old-growth forest. Because of that widening, the right-of-way alignment along the road, and the curvature of the road in combination with retained existing vegetation, hikers and equestrians would have immediate foreground (0 to 300 feet) views from the PCT crossing.

Figure K-19, KOP P8

In the post-construction (year 0) simulation, the pipeline is in place and the trench is backfilled. Because the pipeline was bored underneath the existing road and trail, no vegetation has been cleared for approximately 115 feet either side of the PCT. Viewing northwest from the crossing (Figure K-19a), the pipeline right-of-way parallels Forest Road 3720-700, and vegetation clearing is evident in the immediate foreground from the end of the bore until the road curves out of view approximately 300 feet from the viewer. The entire area visible from this location is within the immediate foreground. This simulation assumes that all the avoidance, minimization, and mitigation measures described above would be implemented.

On-site shrubs and ground cover plants were dug from the 10-foot-wide ditch zone and bore area, and heeled-in root balls for transplantation back into the trench zone. On-site 15- to 20-foot trees were likewise removed from the right-of-way with a tree spade and stored for transplantation. The entire 75-foot-wide right-of-way within the visible immediate foreground has been seeded with native grasses and forbs. Trees, including Douglas-fir seedlings, Shasta red fir seedlings, and the transplanted 15- to-20-footers were planted in masses outside of the 30-foot-wide mowed area and irrigated. Pacific Connector would provide adequate irrigation at Forest Service direction, and replace plantings if mortality exceeds 30 percent. The tree groupings were planted in irregular patterns, with a minimum spacing between groupings of 30 feet, in order to reduce the contrast of the 30-foot permanent right-of-way with the surrounding landscape. Logs were placed in the right-of-way to further reduce the linear pattern and to provide naturalistic barriers preventing unauthorized OHV access.

At Year 5 (Figure K-19b), planted seedlings, transplanted trees, and transplanted shrubs are growing larger, and grasses and forbs are growing across the entire right-of-way. Differing growth rates between individuals and species have begun to add irregularity and texture to the scene, as have the patterns of shrubs, grasses, and forbs. The irregular, wide spacing of vegetative groupings has reduced the contrast of the 30-foot cleared right-of-way, giving the area a meadow-like appearance.

At Year 25 (Figure K-19b), planted and transplanted vegetation is growing larger and some of the logs are beginning to lose their bark. Irregularities in spacing, species, and individual survival have combined to increase the texture of the scene, which is transitioning from meadow-like to forested glade. Maintenance has occurred to keep only low-growing shrubs, forbs, and grasses in the 30-foot-wide corridor centered directly over the pipeline, as well as to reduce undergrowth throughout the right-of-way in order to maintain the reduced visual contrast of the 30-foot-wide corridor.

KOP-P8 represents a hiker's perspective walking northbound on the PCT, looking northwest (left) along Forest Road 3720-700 and the 75-foot-wide cleared right-of-way from the intersection of the PCT and Forest Road 3720-700. For a typical hiker or equestrian, the duration of view would be short, lasting the time it takes to cross the 30-foot open area of the road and road-shoulders. The right-of-way would create an opening that would allow more sunlight into this area, and have the effect of widening the existing opening for Forest Road 3720-700.

To achieve a Foreground Partial Retention VQO, management activities may introduce form, line, color, or texture that are found infrequently or not at all in the characteristic landscape, but they should remain subordinate to the visual strength of the characteristic landscape or become so within two years of project completion. The overall visual effect as seen from KOP P8 would achieve the Foreground Partial Retention VQO, provided that the described mitigation and revegetation techniques are successful. If any of the revegetation strategies are unsuccessful or minimally successful, VQO attainment could be compromised. Annual monitoring would analyze revegetation success and VQO attainment, and determine if additional measures are required to meet the Foreground Partial Retention VQO. Monitoring results would be reported immediately to the Forest Service for action, and monitoring would continue until VQO achievement.

Figure K-20, KOP P9

KOP-P9 is a northbound hiker's perspective, looking east from the PCT just prior to crossing Forest Road 3720-700 (Figure K-20). The VQO is Foreground Retention. The bore site and pipeline right-of-way clearing would be behind a screen of retained existing vegetation along Forest Road 3720-700 and the east side of the PCT. Duration of view from this vantage point would be the same as for KOP-P8. The screen of thick vegetation would prevent any direct views into the cleared bore site or pipeline right-of-way. Project activities would create openings behind the screen of vegetation that would allow more light into the view from the crossing, and a sense of more-open forest behind the seen vegetation, but would not be directly visible from the PCT or the crossing site.

To achieve a Foreground Retention VQO, project activities may only repeat form, line, color, and texture frequently found in the surrounding landscape. Changes in their qualities of size, amount, intensity, direction, or pattern should not be visually evident to the casual forest visitor within one year after the completion of project activities. Because of the effective visual screening offered by the retained vegetation, Project activities east of the PCT crossing would not be visually evident to the casual observer, and would therefore meet the Foreground Retention VQO immediately post-construction.

Visual Impacts

<u>Short-Term Visual Impacts</u>

Construction impacts on visual resources would result from the presence of equipment, materials, and workers along the pipeline right-of-way, at TEWAs and staging areas, and along access roads. Visual effects would also result from the alteration of landforms and vegetation along the right-of-way during construction. Excavation for the pipeline would expose sub-grade soils that would contrast with the color of the existing land surface and the forest canopy. Visual contrast in color, line, and texture between the disturbed, vegetated ground and the adjacent vegetation would be most noticeable in the short term (0-5 years after construction) while the right-of-way is in the process of revegetating. Vehicles, heavy equipment, helicopters, pipeline components, and workers would be visible during site clearing, grading, trenching, pipeline transport, welding, laying in, backfilling, and site/right-of-way cleanup and restoration. Construction equipment and activities would be seen by various viewers close to the sites and pipeline corridor, including adjacent and nearby residents, recreationists on trails and roads, motorists on public roadways and, in some cases, pedestrians. Much of the Pacific Connector pipeline route is in remote locations seldom visited by the public, although visitors in such remote areas may be relatively sensitive to changes in visual quality. Where visible, view durations would vary from brief to extended periods. Construction activities would be most visible for those elements of the pipeline in close proximity to residential neighborhoods and adjacent to major travel corridors, including highways and the PCT; however, these effects would be temporary and would be limited to the construction period. Revegetation and restoration efforts, including placement of slash on the right-of-way in forested areas, would serve to mitigate the visual contrast in color, line, and texture.

Amendments to the Rogue River-Siskiyou and Fremont-Winema National Forest LMPs would be necessary to address consistency with specific standards and guidelines related to VQOs. These amendments would acknowledge the short-term visual effects that would occur that would be inconsistent with current management direction. They would allow for an extended period of time for the areas to recover and meet the VQOs in a reasonable amount of time.

Long-Term Visual Impacts

Pipeline

The landscape setting along the pipeline route is varied, ranging from flat valley floors and agricultural fields, to rolling hillsides covered with oak and madrone woodlands, to steep mountainsides and sharp ridgelines covered with mixed conifer forests. On flat terrain in agricultural settings, the right-of-way would be restored following construction and ranchers/farmers would be allowed to grow shallow-rooted crops over the pipeline. Construction work areas would normally be difficult to distinguish from surrounding areas. Therefore, no long-term visual effects would result from installation of the pipeline in agricultural areas.

In the mountainous terrain, many of the existing landscapes that would be traversed by the pipeline have already been affected by timber harvests, including large clear-cuts. Existing scenic integrity in these areas is low, and the introduction of the pipeline should not create long-term visual contrasts in these settings.

The greatest long-term visual effects would occur where the new right-of-way would create new clearings through forestlands not characterized by large-scale timber harvests. The clearing of the right-of-way would create a sharp-edged linear feature across contiguously forested landscape. The appearance of the corridor would be similar to transmission line corridors. Revegetation and restoration, including replacement of slash in the right-of-way, would be initiated following construction and would mitigate the visual contrast in color, line, and texture. Contrast might also be increased where surface rock or stumps would be scattered across the right-of-way or placed in piles at road crossings to create OHV barriers or habitat features. Over time, contrast would decrease as the right-of-way is revegetated, narrows in width because of revegetation, and becomes more similar in texture and color to the surrounding forest lands. After successful restoration, the cleared area around the right-of-way would be reduced to the 30-foot permanently cleared area, further reducing contrast with the surrounding forested area.

The right-of-way might be noticeable to the casual observer depending on the distance, line-of-sight, topographic, and vegetation conditions at the viewpoint as well as the conditions along the Pipeline right-of-way. The corridor would be most apparent when viewed from a location in-line with the right-of-way, and might not be visible when viewed from a perpendicular location due to vegetative screening. Where it crosses ridges, the cleared right-of-way might be visible as a "notch" in the treeline from perpendicular or near-perpendicular viewpoints. Many forested areas crossed by the pipeline are away or visually screened from roads, trails, and populated areas, and therefore are not immediately visible to viewers.

Aboveground Facilities

The aboveground facilities proposed by Pacific Connector would be long-term structural features on the landscape. A detailed description of the aboveground facilities is provided in section 2. The MLV sites are all located within the pipeline right-of-way, and consist of a 50-foot x 75-foot (0.9 acre) site that would be enclosed by a 7-foot-high, chain-link fence. Five of the MLVs would require a 40-foot-tall tower to be installed within the site. Pacific Connector has attempted to locate MLVs adjacent to existing roads to facilitate access and reduce the length of new access roads, and to set mainline block valves back from crossings in sensitive viewsheds. Where not screened by topography or vegetation, the MLV sites would be visible to roadway travelers. On federal lands, all aboveground piping would be painted with a color approved by the managing federal agency in order to meet visual quality objectives and visual screening would be implemented. The MLVs would all be located within the pipeline right-of-way and therefore, with the mitigation measures applied to federal lands, would have low effects on visual quality of the surrounding area. MLV 13 was previously located adjacent to the Dead Indian Memorial Highway, but has been relocated back from Clover Creek Road and accessed from an existing private road to screen the mainline block valve from view.

The Klamath Compressor Station (MP 228.1) would have visual effects on nearby residents and travelers along Malin Loop Road and Morelock Road (figure 4.8-6). The location is on private land in a rural area that is relatively flat and is currently covered by grasses, sage, and juniper. To reduce visual contrast, the buildings at the compressor station would be painted a color selected to blend as well as possible with the surrounding landscape, and portions of the outward facing sides of the station would be landscaped to reduce potential visual effects on area residences. The station would be surrounded by a 7-foot-tall chain-link fence with screening slats. The station would include exterior lighting to be used only when operations personnel are actively performing nighttime work at the station. Pacific Connector has stated that during operation of the station nighttime work or maintenance activities would generally not be scheduled; therefore, these lights would only be used periodically and possibly for short periods during the winter when daylight working hours are shorter. Pacific Connector has not identified specific lighting arrangements, although standard practice is for outside lights at infrastructure facilities such as compressor stations to be shrouded to direct light to the specific work areas within the station.

Pacific Connector anticipates that communications towers would be required at the compressor meter stations, several automated MLVs, and at leased space on existing communication towers (see section 2 for location descriptions). The towers at the meter stations, compressor station, and automated MLVs would be located within the fenced facility sites. The Communication Facilities Plan[192] describes the construction, modification, operation, and maintenance of communication facilities on lands managed by the BLM and the Forest Service.

The proposed communication facilities are not expected to significantly alter or impair the visual setting. Pacific Connector would co-locate communications towers with existing facilities whenever possible, if leased space is available within existing facility sites at the time of construction. If construction of new facilities is required, Pacific Connector would seek to obtain

[192] Appendix D of Pacific Connector's POD filed with the FERC in January 2018.

an approximate 100-foot by 100-foot (0.23 acre) area for each of the new tower installations in the immediate vicinity of the existing communication tower facilities. A variance would be needed to allow installation of any new tower under such conditions. Because additional towers are anticipated to be co-located with existing tower facilities, they are not expected to impair the existing visual setting.

Proposed Mitigation Measures

Pacific Connector produced an *Aesthetics Management Plan*[193] that outlined measures to reduce visual impacts along its pipeline route. Generally, these measures include:

- reducing the width of the right-of-way and elimination of TEWAs at sites with high visual sensitivity;
- strategic alignment of the right-of-way where it crosses roads or trails to reduce the visible extent of the corridor (for example, crossing roads or trails at right angles);
- strategic placement of construction debris (slash, stumps, and boulders) in visually sensitive areas;
- place natural barriers where the right-of-way opening is adjacent to trails and roads to prevent potential unauthorized OHV use;
- clear additional timber outside the right-of-way in selected locations to scallop and feather the edges of the clearing, to reduce the hard line of forested lands adjacent to the right-of-way;
- revegetation of the right-of-way after pipeline installation, including planting trees in TEWAs that were cleared of forest or woods and strategic placement of trees to help reduce contrast between the cleared right-of-way and surrounding forest lands;
- planting rows or clusters of trees and shrubs across the right-of-way (outside of the 30-foor permanently cleared corridor) to provide visual screens at specific sensitive trail or road crossings, using native species whenever possible; and
- painting aboveground facilities in color schemes that would blend into the background landscape.

It should be noted that some visual mitigation measures are not shown in the visual simulations. These include opportunities for revegetation with large-sized trees (tree-spade efforts), forest edge scalloping, and/or feathering treatments to decrease stand density contrasts at the right-of-way edges. Therefore, these simulations represent a worst-case scenario at each KOP.

4.8.2.3 Environmental Consequences on Federal Lands

Visual Resources on Federal Lands

Regulatory Setting and Visual/Scenic Management Systems

The responsibility of protecting visual resources on lands owned or under the jurisdiction of the federal government is established by FLPMA, which places emphasis on the protection of scenic resources on public land, and the Forestland and Rangeland Renewable Resources Planning Act (1974) which empowers the Forest Service to manage scenery resources. The National Forest Management Act (1976) required the completion of Forest Plans that established VQOs for the National Forests.

[193] Appendix A to Pacific Connector's POD filed with the FERC in January 2018.

NFS Lands

The Forest Service seeks to manage NFS lands to attain the highest possible quality of landscape aesthetics and scenery commensurate with other appropriate public uses, costs, and benefits. Scenic integrity is defined as "*a measure of the degree to which a landscape is visually perceived to be "complete.*" The highest scenic integrity ratings are given to those landscapes that have little or no deviation from the character valued by constituents for its aesthetic appeal. Scenic integrity is used to describe an existing situation, standard for management, or desired future condition" (Forest Service 1995b).

National Forests use a Visual Management System (VMS) to manage visual resources on NFS lands and to analyze visual effects of proposed projects. The VMS has a rating system known as VQO to establish standards for scenery resource management. The VMS was outlined in FSH 462, published in 1974. Since then, scenery management on NFS lands has been updated by Handbook 701, which introduced the Landscape Aesthetics, Scenery Management System (SMS). The SMS utilizes a rating system similar to VMS to evaluate project impacts on visual quality. The SMS is based on the relative scenic quality of each portion of the landscape and its sensitivity based on the visibility from, and uses in, the surrounding areas. The SMS uses Scenic Integrity Objectives to establish the desired conditions for management of an area.

Under the former VMS system, management prescriptions and related VQOs were developed for all NFS lands. VQOs for each national forest crossed by the pipeline are identified in their respective LRMPs. VQOs are management standards that identify five degrees of alteration to the natural landscape based on a landscape's diversity of natural features and the public's concern for scenic quality. Because the aforementioned forest plans have not been amended to use the SMS, both VMS and SMS are used in this EIS section. A crosswalk between the two systems is described in *Landscape Aesthetics: a Handbook for Scenery Management* (Forest Service 1995b), and summarized in table 4.8.2.3-1.

TABLE 4.8.2.3-1

Forest Service Crosswalk Between Visual Quality Objectives, Scenic Integrity Objectives, and Scenic Integrity Levels a/

Visual Management System (VMS) 1973 Direction **Visual Quality Objective (VQO)**	**Scenery Management System (SMS) 1995 Direction** **Scenic Integrity Objective (SIO)**	**Definition of Scenic Integrity Levels**
Preservation	Very High	*Unaltered*: Valued landscape character "is" intact with only minute if any visual deviations. The existing landscape character is expressed at the highest possible level.
Retention	High SIO	*Appears unaltered*: Landscapes where the valued landscape character "appears" intact. Visual deviations (human-made structures or activities) may be present but must repeat the form, line, color, texture, and pattern common to the landscape character so completely and at such a scale that they are not evident.
Partial Retention	Moderate SIO	*Appears slightly altered*: Noticeable deviations must remain visually subordinate to the landscape character being viewed.
Modification	Low SIO	*Appears Moderately Altered*: Visual deviations (human-made structures or activities) begin to dominate the valued landscape character being viewed but they borrow valued attributes such as size, shape, edge effect and pattern of natural openings, vegetative type changes or architectural styles outside the landscape being viewed. They should not only appear as valued character outside the landscape being viewed but compatible or complimentary to the character within.
Maximum Modification	Very Low SIO	*Appears Heavily Altered*: Visual deviations (human-made structures or activities) may strongly dominate the valued landscape character. They may not borrow from valued attributes such as size, shape, edge effect and pattern of natural openings, vegetative type changes or architectural styles within or outside the landscape being viewed. However deviations must be shaped and blended with the natural terrain (landforms) so that elements such as unnatural edges, roads, landings, and structures do not dominate the composition.
For Inventory and Scenic Effect Prediction Purposes Only		
Unacceptable Modification UM	Unacceptably Low	*Extremely altered*: Landscapes where the valued landscape character being viewed appears extremely altered. Visual deviations (human-made structures or activities) are extremely dominant and borrow little if any form, line, color, texture pattern or scale from the landscape character. Landscapes of this level of integrity need rehabilitation. This level should only be used to inventory existing integrity. It must not be used as a management objective.

a/ Scenic Integrity Objectives establish desired conditions for management (equivalent to purpose of Visual Quality Objectives under former VMS); Scenic Integrity Levels describe the current condition of the scenic resource.

BLM Lands

The BLM has a VRM system that is comparable to the Forest Service VMS. Based on a matrix of three factors (scenic quality, sensitivity level, and distance), BLM lands are placed into one of four visual resource inventory classes (table 4.8.2.3-2). These classes represent the relative value of the visual resources, Class I (Preserve Character) and Class II (Retain Character) being the most restrictive, Class III (Partially Retain Character) relatively less restrictive, and Class IV (Major Modification of Character) being least respective. The class objectives describe the different degrees of modification, or contrast, allowed to the basic visual elements of the landscape in each class. VRM management classes are then established through the RMP process and adjusted as necessary to reflect the resource allocation decisions made in RMPs.

TABLE 4.8.2.3-2

BLM Visual Resource Management Classes

VRM Class	Definition
Class I Preserve Landscape Character	Manage Visual Resource Management Class I areas in accordance with natural ecological changes. Prohibit activities that would lower the Visual Resources Inventory class of Visual Resource Management Class I areas. The level of change to the characteristic landscape will be very low and will not attract attention. Changes will repeat the basic elements of form, line, color, texture, and scale found in the predominant natural features of the characteristic landscape.
Class II Retain Landscape Character	Manage Visual Resource Management Class II areas for low levels of change to the characteristic landscape. Management activities will be seen but will not attract the attention of the casual observer. Changes will repeat the basic elements of form, line, color, texture, and scale found in the predominant natural features of the characteristic landscape.
Class III Partially Retain Landscape Character	Manage Visual Resource Management Class II areas for low levels of change to the characteristic landscape. Management activities will be seen but will not attract the attention of the casual observer. Changes will repeat the basic elements of form, line, color, texture, and scale found in the predominant natural features of the characteristic landscape.
Class IV Major Modification of Landscape Character	Visual Resource Management Class IV includes all lands that are not designated as Visual Resource Management Classes I, II, or III. Manage Visual Resource Management Class IV areas for high levels of change to the characteristic landscape. Management activities may dominate the view and will be the major focus of viewer attention.

The Pacific Connector pipeline route would cross 46.9 miles of BLM lands that are classified as VRM Class IV in the 2016 Southwestern Oregon and Northwestern and Coastal Oregon ROD/RMPs. VRM Class IV areas allow high levels of change from projects to the characteristic landscape. Management activities may dominate the view and will be the major focus of viewer attention. The construction, operation, and maintenance of the pipeline would be consistent with the objectives of this class.

Sensitive Viewsheds on Federal Lands

The federal land managing agencies identified areas they consider possessing sensitive viewsheds along the pipeline route and, as appropriate, developed site-specific amendments to LMPs to ensure compliance with the LMPs if the Project were authorized. Pacific Connector outlined measures it would implement to reduce visual impacts at those areas in its *Aesthetic Management Plan for Federal Lands* (Appendix A to the POD). Table 4.8.2.3-3 lists the sensitive viewsheds on federal land, their visual objective classes, and proposed mitigation measures.

TABLE 4.8.2.3-3

Sensitive Viewsheds on Federal Lands and Proposed Mitigation Measures

MPs	**Viewshed Area**	**Agency/Unit**	**Visual Class or Objective**	**Sensitivity Level**	**Mitigation Methods a/**
161.07-161.64	Big Elk Road (FS Road 37) – South Fork Little Butte Valley	Forest Service – Rogue River National Forest	VQO – Foreground Retention	High	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 13
167.7-167.84	PCT	Forest Service – Rogue River National Forest	VQO – Foreground Partial Retention and Foreground Retention	High	1, 2, 4, 5, 6, 7, 10, 13, 14
168.14-168.18	Dead Indian Memorial Highway	Forest Service – Winema National Forest	Middleground Partial retention	Moderate	1, 6
156.3 to 156.8 and 157.2 to 157.5	Little Butte Creek	Forest Service – Rogue River National Forest	Middleground Partial Retention	Moderate	1, 2, 6, 12, 13
168.40-169.00	Dead Indian Memorial Highway	Forest Service – Winema National Forest	VQO – Foreground Retention	High	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13
169.00-174.40 176.15-176.45; 176.60-177.04	Clover Creek Road	Forest Service – Winema National Forest	VQO - Foreground Partial Retention	Moderate-High	1, 2, 3, 4, 5, 6, 7, 8, 10

a/ 1 – Mulch right-of-way and use colorant of dark brownish green for hydro-mulch;
2 – Scallop and feather edges of the right-of-way by removing or cutting some tall trees as directed by land manager;
3 – Transplant trees 15-20 feet tall in clusters spaced 660 feet apart;
4 – Transplant trees in clusters in TEWAs and combine with partly buried boulders;
5 – Bury root wads and boulders in foreground along right-of-way;
6 – Reduce soil compaction according to the ECRP;
7 - Plant 1-2 gallon-sized shrubs and protect them with plant guards;
8 – Construct a berm with boulders to discourage OHV access;
9 – Screen corridor from viewer by leaving trees near roadway and transplanting trees 15-20 feet tall in foreground;
10 – Plant deciduous trees and shrubs such as willow, ceanothus, ribes, huckleberry and chinquapin;
11 – Recontour cut bank to discourage OHV access;
12 – Fund Forest Service tree thinning activities
13 – Necking-down, or narrowing, construction corridor.
14 – Bore Trail Crossing

Visual Resources Specific to Consistency with Federal LMPs

BLM Lands

BLM lands crossed by the Pacific Connector Pipeline Project are VRM Class IV where high levels of change in the landscape character are permitted. The Pacific Connector Pipeline would meet the VRM Class IV standards on all BLM lands.

NFS Lands

Umpqua National Forest

The VQO for all lands crossed by the Pacific Connector Pipeline Project on the Umpqua National Forest is Maximum Modification. The pipeline would be within the VQO standards of Maximum Modification upon completion of corridor restoration and revegetation.

Rogue River National Forest

The Pacific Connector pipeline would meet the VQOs of the Rogue River National Forest LRMP with the following three exceptions:

(1). At the crossing of the Big Elk Road at Pacific Connector pipeline MP 161.4 in Section 16, T. 37 S., R. 4 E., W. M., Oregon.

This location has a VQO of Foreground Retention (Management Strategy 6, Rogue River National Forest LRMP, page 4-72). Standards and guidelines for Foreground Retention where the Pacific Connector pipeline route crosses the Big Elk Road require that VQOs be met within one year after completion of the Project and that management activities not be visually evident. The pipeline project would not meet that standard at that location. Amendment RRNF-2 of the Rogue River National Forest LRMP is proposed at this location to make provision for the Pacific Connector pipeline. This proposed amendment would change the VQO at this location to Foreground Partial Retention (Management Strategy 7, LRMP page 4-86) and allow 10 to 15 years for the amended VQOs to be attained. The Big Elk Road in the vicinity of the Pacific Connector pipeline crossing would be affected by this proposed amendment. This is a site-specific amendment that would apply only to the Pacific Connector pipeline. It does not change VQOs for any other project.

Temporal and Spatial Boundaries of Impacts

This proposed change would affect about 5 acres in the year of construction and approximately 2 acres after 10 years. The 5 acres represents the 75-foot-wide construction right-of-way as seen from Big Elk Road. The 2 acres represents the area seen from Big Elk Road associated with the 30-foot-wide operational permanent easement for the pipeline that would be kept clear of tall trees (more than 15 feet tall) 10 years after right-of-way restoration and revegetation. This would not achieve the Forest Plan goals and objectives of a natural appearing forest at that location one year after construction. Drivers passing the corridor would be able to see it for approximately 15 to 20 seconds. This change would affect only recreation and VQOs in the vicinity of the Big Elk Road–Pacific Connector pipeline intersection. No other LRMP goals and objectives would be affected by this change.

(2). Along the ridgetop south of State Highway 140 between Pacific Connector pipeline MPs 156.3 to 156.8 and 157.2 to 157.5 in Sections 11 and 12, T. 37 S., R. 3 E., W. M., Oregon

This location has a VQO of Middleground Partial Retention. Standards and guidelines for Middleground Partial Retention (Management Strategy 9, Rogue River National Forest LRMP Page 4– 112) require that VQOs for a given location be achieved within 3 years of completion of the Project. The Pacific Connector pipeline would not meet this standard at that location. Amendment RRNF-4 of the Rogue River National Forest LRMP is proposed at this location to make provision for the pipeline project. This proposed amendment would allow 10 to 15 years to meet the Middleground Partial Retention standard at this location. Approximately 0.8 mile or 9 acres of the Pacific Connector right-of-way in the Middleground Partial Retention VQO visible at distances of 0.8 to 5 miles from State Highway 140 would be affected by this proposed amendment. This is a site-specific amendment that would apply only to the Pacific Connector pipeline. It does not change VQOs for any other project.

Temporal and Spatial Boundaries of Impacts

This proposed change would affect approximately 9 acres or about 0.8 mile of the pipeline corridor as seen from Highway 140 in the year of construction. For the next 10 to 15 years, the pipeline corridor would remain visually dominant to the surrounding landscape but would become less evident each year. Vegetation growth and mitigation measures would allow the area to meet the assigned VQO of Middleground Partial Retention after 10 to 15 years.

This proposed amendment would not change VQOs, but instead allow more time to meet the VQO of Middleground Partial Retention as seen from Highway 140. To the degree that travelers look up as they are headed west on Highway 140, this location would be visible from a distance of 0.8 to 5 miles for a few minutes. Duration would depend on travel speed but would likely be less than 10 minutes, and would likely not be continuous because of the height of roadside trees and line of sight from the highway. This location would not be visible from other key observation points or travel routes such as the Big Elk Road.

Winema National Forest

The Pacific Connector pipeline would meet the VQO of the Winema National Forest LRMP with the following exceptions:

(1). Where the Pacific Connector right-of-way crosses the Dead Indian Memorial Highway at approximately pipeline MP 168.8 in Section 33, T. 37 S., R. 5 E., W. M., Oregon

This location has visual standard of Foreground Retention. Standards and guidelines for Scenic Management, foreground retention (Winema National Forest [WNF] LRMP 4–103, Management Area 3A, Foreground Retention) requires visual standards for a given location be achieved within one year of completion of the Project. The Pacific Connector pipeline would not meet that standard at that location. Amendment WNF-2 is proposed to allow 10 to 15 years to meet the specified visual standard at this location. This is a site-specific amendment that would apply only to the Pacific Connector pipeline in the vicinity of the Dead Indian Memorial Highway and would not change future management direction for any other project.

Temporal and Spatial Boundaries of Impacts

This proposed amendment would affect about 3 acres of Management Area 3A initially, but over a period of 10 to 15 years, the affected area would decrease to around one-quarter of an acre because of the growth of vegetation at the highway crossing. Installing the pipeline across Dead Indian Memorial Highway would create a corridor that would be visible for about 10 to 15 seconds for travelers along the highway. The area affected by pipeline construction at the crossing would be much less than one percent of Management Area 3A. This is a project-specific amendment that would affect only and recreational experiences in a limited area. This proposed amendment would not change visual standards, but instead allows more time to meet the visual standards of foreground retention as seen the Dead Indian Memorial Highway.

(2). Where the Pacific Connector right-of-way is adjacent to the Clover Creek Road from approximately pipeline MP 170 to 175 in Sections 2, 3, 4, 11, and 12, T. 38 S., R. 5 E., and Sections 7 and 18, T. 38 S., R. 6 E., W. M., Oregon

This location has a visual standard of Foreground, Partial Retention. Standards and guidelines for Foreground Partial Retention (LRMP, page 4–107, Management Area 3B) require that visual standards be met within three years of completion of a project. The Pacific Connector pipeline cannot meet that standard at that location in three years after construction. Amendment WNF-3 is proposed to allow 10 to 15 years to meet the standard of Foreground, Partial Retention at this location. This is a site-specific amendment that would apply only to the Pacific Connector pipeline in the vicinity of the Clover Creek Road and would not change future management direction for any other project.

Temporal and Spatial Boundaries of Impacts

The Winema National Forest LRMP would be amended to allow 10 to 15 years to meet the VQO for Scenic Management, Foreground Partial Retention from MPs 170 to 175. This change would potentially affect approximately 50 acres and 6 miles of corridor as seen from the Clover Creek Road. This is a site-specific amendment that would apply only to the Pacific Connector pipeline in the vicinity of Clover Creek Road and would not change future management direction for any other project. Over a period of 10 to 15 years, the affected area would decrease to about 29 acres because of changes in vegetation. Initially, the affected area would be visually evident for the entire 5 miles on NFS lands adjacent to the Clover Creek road. Over time, this would become less visually evident because of the ingrowth of vegetation and mitigation measures adopted by the Pacific Connector pipeline. At an average speed of 40 mph, the 5-mile-long area affected by this amendment would be visible for approximately 10 to 12 minutes.

4.8.2.4 Conclusion

Constructing and operating the Jordan Cove LNG Project would result in substantial short-term and long-term changes to the existing landscape within the viewshed of the Project. As described in the preceding sections, the LNG tanks and related facilities at the terminal would be visible from a range of viewpoints within the surrounding area and the visual effects were assessed to be low to high dependent on the user and viewpoint location. Jordan Cove attempted to optimize design factors for the LNG tanks and has adopted various measures to mitigate for the visibility of the Project facilities, including use of landform contouring and stabilization, vegetative screening, architectural treatments, and use of hooded lighting. However, based on the size and location of the proposed LNG facilities we conclude that the Jordan Cove LNG portion of the Project would significantly affect visual resources for some views and viewing locations.

Constructing and operating the Pacific Connector Pipeline Project would result in short-term and long-term visual effects as described in the preceding sections. However, Pacific Connector's proposed procedures and mitigation measures are expected to result in reduction of the long-term visual contrast in color, as well as line and texture created by clearing of the pipeline right-of-way. Measures such as structure co-location, painting, landscaping, and screening are expected to limit the visual effects of the associated aboveground Project facilities. Based on the proposed construction, operation, and minimization measures, the Project, excluding the LNG facility, would not significantly affect visual resources.

Although this visual impact conclusion is consistent with federal regulatory guidance regarding consideration of context and intensity in evaluation of impact significance, the FERC recognizes that some identifiable affected interests will have a different perspective on the level of visual impact. In particular, people who live near the pipeline right-of-way or travel near it frequently may place a high value on the character of the existing landscape and may consider Project-related changes to that landscape to be significant visual impacts.

4.9 SOCIOECONOMICS

This section addresses the potential effects of Project construction and operation on the following components of the social and economic environment: population, housing, the local economy and employment, infrastructure and public services, recreation and tourism, other commercial activities, and environmental justice. The following discussion is divided into two main sections that address the Jordan Cove LNG Project and Pacific Connector Pipeline Project separately. Both projects would involve construction and operation activities in Coos County. Potential impacts on Coos County are discussed separately by Project, with the combined impacts of both Projects discussed in section 4.9.2.

4.9.1 Jordan Cove LNG Project

4.9.1.1 Population

The closest cities to the Jordan Cove LNG Project are North Bend and Coos Bay. These two cities had estimated 2018 populations of 9,815 and 16,680, respectively (see table 4.9.1.1-1). The total estimated population of Coos County in 2018 was 63,275.

TABLE 4.9.1.1-1

Population by State, County, and Community

				2010 to 2018	
State/County/Community	**2000**	**2010**	**2018**	**Net Change**	**Percent Change**
Oregon	3,421,399	3,831,074	4,195,300	364,226	9.5%
Coos County	62,779	63,043	63,275	232	0.4%
City of Coos Bay	15,374	15,967	16,680	713	4.5%
City of North Bend	9,544	9,695	9,815	120	1.2%

Source: Portland State University 2012, 2018

As described previously, Jordan Cove estimates that construction of the Jordan Cove LNG Project and associated facilities would take place over a roughly 5-year period. Following an initial 9-month period of site clearing, construction of the Jordan Cove LNG Project would occur over a 53-month construction period. Jordan Cove's estimated construction workforce would average 1,023 workers over the 53-month construction period, with projected employment expected to peak in year 3 with an estimated 1,996 workers employed on site (ECONorthwest 2017a). Construction would require workers in highly skilled crafts, such as pipefitters, ironworkers, electricians, carpenters, and management staff, including safety specialists. Jordan Cove anticipates that the workers hired will already have these skills, having gained experience in other related industries, including the oil and gas and power industries.

Jordan Cove estimates that an average of 221 workers would commute daily from their normal place of residence to the Project site, leaving an estimated average of 802 workers temporarily relocating to the Project vicinity from elsewhere. A portion of this workforce would be accompanied by family members, resulting in the total estimated addition of an average of 901 people (workers and family members) to the Project vicinity. The addition of 901 people would be equivalent to approximately 3.4 percent of the combined populations in the cities of Coos Bay and North Bend in 2018 (26,495), and approximately 1.4 percent of the total county population (63,275) (table 4.9.1.1-1).

At the peak of LNG terminal construction, an estimated total of 1,752 people would temporarily relocate to live near the Project vicinity (ECONorthwest 2017a). This temporary increase would be equivalent to about 6.6 percent of the combined populations of Coos Bay and North Bend and 2.8 percent of the county total (table 4.9.1.1-1). These estimated peak population increases would be temporary and short term. Very few, if any, of the temporary construction workers relocating to the Project area are expected to stay permanently. Impacts associated with construction-related population increases are discussed throughout this section.

In the first full year of operations, Jordan Cove would directly employ 200 workers in Oregon, 180 at the Jordan Cove LNG Project and 20 at the company office in Portland. Unlike construction, once the Project is operating, the employees would live permanently near their workplaces. Workers would either be hired locally or permanently relocate to the area. ECONorthwest (2017a) estimated that about 40 percent of the operating workforce at the Jordan Cove LNG Project would be hired locally, with the remaining 60 percent relocating to Coos County from out-of-state or elsewhere in Oregon. Assuming an average household size of 2.74, this would result in the addition of 296 new residents, which would be equivalent to about 1.1 percent of the combined populations in the cities of Coos Bay and North Bend in 2018.

Crime

We received numerous comments on the Project that expressed concern that the temporary influx of construction workers and the development of workforce housing units or “man-camps” would result in increases in crime, particularly prostitution, human trafficking, and domestic violence. Native American tribal members also expressed concern about the potential for increased crime to disproportionally affect their communities and suggested that staff consider the impacts of natural resource development projects on crime in North Dakota and Wyoming. Based on this concern and to assess the Project’s potential impact on crime rates, we reviewed existing published literature that considers the link between crime and natural resource development, as well as the potential for disproportionate impacts on tribal communities. Most of the research into the link between natural resource development and crime focuses on “boomtowns,” where large-scale resource development, especially oil and gas extraction, has resulted in rapid population growth that has weakened existing social ties in the affected communities (O’Connor 2017). Some might consider the introduction of a workforce to construct the Project as analogous to a “boomtown.” However, the number of individuals who are expected to temporarily migrate to the Project area would, as described above, result in a relatively minor increase in the local population.

Based on official crime statistics and interviews with law enforcement officers, studies in North Dakota and Wyoming found that the crimes that increased the most during boom periods included traffic-related incidents, assault, disorderly conduct, drug-related crimes, thefts, burglaries, and domestic violence (Archbold 2015; Archbold et al. 2014; Jacquet 2005; Jayasundara et al. 2016). Police officers in North Dakota attributed the increase in domestic violence calls to housing shortages and cramped living quarters and stated that violent crimes in their jurisdictions were not increasing to the extent that local, regional, and national media outlets have reported (Archbold 2015).

A comparison of crime statistics for “natural gas boom counties” in Pennsylvania, with similar counties in New York where fracking is banned, found that the natural gas boom counties experienced higher overall violent crime rates than the comparison counties (Komarek 2018). This comparison did not establish cause and effect relationship for the variables considered or report what percentage of the crimes were committed by workers brought in to support natural gas production. Komarek (2018) also noted that caution should be taken in extrapolating these results to other locations or industries or phases of technology development, with differences in local characteristics potentially resulting in different experiences with criminal activity.

A number of newspaper and magazine reports have focused on the Bakken Oil Field in North Dakota, near the Fort Berthold Indian Reservation (Harvard 2015; Adler and Hillstrom 2015; Gillette 2016; Briody 2017; Deer and Nagle 2017; Nienaber 2017). These reports focus on links between semi-permanent worker camps and negative impacts on female Native American populations. According to this reporting, the influx of large numbers of well-paid male oil workers at the North Dakota camps coincided with increases in sex trafficking, sexual assaults, and physical violence. Other studies found inconclusive links between crime and increased oil and gas activity or only minor increases in crime (Ruddell et al. 2014; Kowalski and Zajac 2012; Luthra et al. 2007; Price et al. 2014). A recent study in North Dakota found few significant relationships linking increased drilling to increases in crime and concluded that the effect of drilling is localized, with different counties experiencing different levels and types of crime-related impacts (O'Connor 2017).

In summary, some studies and articles have identified increases in crime potentially related to large influxes of temporary workers. Other studies found inconclusive links between crime and increased oil and gas activity or only minor increases in crime. Studies have also concluded that impacts are localized, with different oil field counties experiencing different levels and types of crime-related impacts. As a result, attempts to use this information to estimate related potential increases in crime from LNG terminal construction would be speculative. This would also be the case with attempts to estimate the likelihood that Native American populations would be disproportionately affected by increases in crime.

4.9.1.2 Housing

In 2017, Coos County had an estimated total of 30,870 housing units,[194] with a rental vacancy rate of 5.6 percent and 557 housing units available for rent. In addition, an estimated 1,582 units were identified for seasonal, recreational, or occasional use. In the cities of North Bend and Coos Bay, an estimated 79 and 103 housing units, respectively, were available for rent, with an additional 59 and 163 units identified for seasonal, recreational, or occasional use (U.S. Census Bureau 2019a, 2019b).

A housing analysis and action plan completed for Coos County in 2018 (czbLLC 2018) found limited affordable housing units available for rent or purchase in Coos County, with very little new construction over the past decade and existing units being converted to vacation and seasonal use. The study concluded that there is a shortage of quality rental units for households earning less than $35,000 annually, and a shortage of affordable home ownership options for households with annual incomes below $75,000. In addition, the study noted that anecdotal examples exist of newcomers being unable to find quality housing at a reasonable price (czbLLC 2018).

ECONorthwest (2017b) identified 23 hotels and motels in Coos County, with a combined total of 1,442 rooms. More than half of these rooms (776 or 54 percent) were located in the cities of Coos

[194] The Census Bureau defines a housing unit as a house, apartment, mobile home or trailer, group of rooms, or single room occupied or intended to be occupied as separate living quarters. Data are 5-year estimates (2013 to 2017) from the U.S. Census American Community Survey. Estimates are annual totals based on 5 years of data (U.S. Census Bureau 2019a, 2019b).

Bay and North Bend, with a further 34 percent (496 rooms) located in Bandon, about 30 miles south of the site. There were also at least 26 smaller lodging establishments (less than 15 rooms) in Coos County, with an estimated total of 214 rooms (ECONorthwest 2017b). The number of rooms available for rent by construction workers would vary by season. Average occupancy data for Coos County compiled from January 2011 through July 2017 indicate that average monthly occupancy rates range from about 38 percent in January to 78 percent in July and 80 percent in August (ECONorthwest 2017a). Applying these percentages to the estimated total supply of hotel, motel, and inn rooms in Coos County (1,656) suggests that on average 1,025 rooms would likely be available for rent in January, with 330 rooms potentially available in August. It should also be noted that occupancy rates vary during the week, and tend to be higher during weekends.

Jordan Cove identified 39 recreational vehicle (RV) parks and campgrounds in Coos County, with a combined total of approximately 2,200 managed spaces (ECONorthwest 2017b).[195] As with hotels, demand for RV spaces is highly seasonal and the highest demand is usually on weekends.

As described previously, Jordan Cove proposes to build a workforce housing facility at the South Dunes site to address concern that demand for rental housing by construction workers will have a negative impact on the availability and cost of rental housing for local residents. Workforce housing units would be added in phases beginning with approximately 200 units in the fall of year 2, and peaking at up to 700 units (depending on demand) in early year 3, with the number of units on-site gradually reduced starting in the latter half of year 4.

In addition to rental housing (houses, apartments, and mobile homes), the workforce housing facility, and short-term housing accommodations, including hotels and motels, and RV parks and campgrounds, construction workers commonly rent extra bedrooms in existing owner- or renter-occupied homes.

ECONorthwest (2017a) estimated that during an average month 147 workers would seek rental housing, 337 workers would seek hotel and motel rooms, RV or campground spaces, or individual room rentals; with 311 workers expected to reside at the workforce housing facility. During peak construction, they estimated that 274 workers would seek rental housing, 588 workers would seek hotel and motel rooms, RV or campground spaces, or individual room rentals; and 693 workers would be expected to reside at the workforce housing facility.[196]

For rental housing, the estimated average demand for 147 units and peak demand for 274 units would be equivalent to approximately 26 percent and 49 percent of the total 557 units estimated to be available for rent in Coos County. However, as noted above, potential shortages of rental housing have been identified in Coos County (czbLLC 2018). Average and peak demand for other types of housing units (337 and 588 units, respectively) would exceed the estimated available

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[195] These totals represent an inventory of private and public RV parks and campgrounds in Coos County (ECONorthwest 2017b). Privately-owned sites account for approximately 60 percent (1,300 spaces) of the total estimated spaces. Camping is typically limited to 14 consecutive days at publicly managed sites and the Forest Service has indicated that Forest Service-managed campgrounds would not be available for use by construction workers. Forest Service-managed campgrounds account for about 11 percent (250 spaces) of the estimated total.

[196] These estimates developed on behalf of Jordan Cove are "likely housing choices based on information provided by contractors, union PLA documents, comparable Oregon projects, JCEP, and estimates by ECONorthwest" (ECONorthwest 2017a, p. 16). In addition to the above, they assumed that a handful of non-local construction workers (7 to 13) would seek to purchase housing.

supply of hotel and motel rooms in Coos County in August (330 rooms). However, a share of this demand would also likely be met by RV and campground spaces and individual room rentals in existing owner- or renter-occupied housing. Construction-related demand would result in lower vacancy rates and upward pressure on rental/room rates. Other visitors seeking temporary accommodation near the terminal site may be temporarily displaced during peak season, especially on summer weekends. These estimates also assume, as described above, that more than one-third of the workers temporarily relocating to the area would be housed at the workforce housing facility, thereby reducing demand for other types of housing in the Project vicinity (during both average and peak periods). Construction workers associated with the Pacific Connector pipeline would also be seeking temporary housing in Coos County. The combined impact of housing demand from LNG terminal and pipeline workers is discussed below in section 4.9.2.2.

In the first full year of operations, Jordan Cove would directly employ 180 workers in Coos County. ECONorthwest (2017a) estimated that about 40 percent of the operating workforce (72 workers) at the LNG terminal would be hired locally, with the remaining 60 percent (108 workers) relocating to Coos County from out-of-state or elsewhere in Oregon. Many of the relocating workers would likely buy homes, while others would choose to rent. Estimates from the U.S. Census Bureau's American Community Survey indicate that Coos County's existing housing for sale (360 units) and for rent (557 units) currently exceeds this potential demand (U.S. Census Bureau 2019b).[197] However, as noted above, the 2018 Coos County housing analysis and action plan identified potential shortages of rental housing, as well as anecdotal evidence of newcomers to the area being unable to find quality housing at a reasonable price (czbLLC 2018).

4.9.1.3 Property Values

Numerous people commenting on the Project expressed concern about impacts on property values. The proposed site would be located near other industrial uses including the Roseburg Forest Products facility and the Southwest Oregon Regional Airport. The Project is expected to have a moderate to high long-term visual effect on residential communities in Coos Bay and North Bend, located more than a mile to the south of the terminal site. Moderate visual impacts are anticipated for viewers from hillsides with relatively unobstructed views of the LNG Terminal site, with residences located along the shoreline of Coos Bay south of the regional airport expected to experience high visual impacts (see section 4.8.2.1).

Real estate property values are dependent on a number of factors, including, but not limited to, location, property size and condition, proximity to public services and infrastructure, market trends, and buyer preference. Staff has repeatedly attempted to address property value concerns; however, due to the lack of specific, independently prepared, peer-reviewed studies regarding natural gas export terminal facility impacts on property values, we are not able to determine what, if any, impact the Project would have on property values. A property's value is ultimately determined by the amount a purchaser is willing to pay, and we are not aware of any conclusive evidence linking natural gas terminal infrastructure to a decrease in property value.

[197] The American Community Survey is a nationwide survey that produces demographic, social, housing and economic estimates in the form of 1-year, 3-year and 5-year estimates based on population thresholds. Data are based on a survey of the population, not a full census of all households and the resulting numbers are estimates, rather than actual counts. The data reported here and elsewhere in this section are 5-year estimates, which are annual totals based on 5 years of data.

Specific studies that assess the impact of LNG export terminals on property values are unavailable. However, a study conducted by the Argonne National Laboratory (Clark and Nieves 1994) examined the economic impacts of eight types of "noxious" facilities on local wages and property values. The study examined the effects of 262 facilities, 11 of which were LNG facilities. The study concluded that the presence of five of the eight types of "noxious" facilities has a substantial negative effect on property values and a positive effect on wages. LNG facilities were not one of these five types of facilities. Furthermore, the study concluded that the presence of an LNG facility did not have a substantial positive or negative effect on either wages or property values (Clark and Nieves 1994). More recently, Davis (2011) assessed the impact of 92 large power plants that opened in the U.S. between 1993 and 2000. Using the hedonic price method, Davis estimated impacts on housing values and rents within 2 miles of each new facility and found "modest declines" of 4 to 7 percent, with somewhat larger decreases within 1 mile. To address concerns for this Project, ECONorthwest (2006) reviewed property values within 1 mile of existing LNG "peak storage" facilities in Newport and Portland, Oregon. Using data from the Lincoln County Tax Assessors Office, ECONorthwest found that property values around the Newport LNG plant were not depressed and 25 homes within 0.5 mile and overlooking the facility had above average market values. They also argue that the presence of many other industrial and commercial properties around the Portland LNG facility, including the second-largest industrial employer in the city, suggest that the presence of this facility has not discouraged other businesses from locating in the area (ECONorthwest 2006).

Based on the above review, the limited available studies that specifically address LNG facilities have found no impacts on property values (Clark and Nieves 1994; ECONorthwest 2006), while a more recent study of large power plants found modest declines in property values within 2 miles, with somewhat larger decreases within 1 mile (Davis 2011). There are no residences within 1 mile of the LNG Terminal site, but moderate to high long-term visual impacts are anticipated for residential communities in Coos Bay and North Bend, more than a mile south of the terminal site. While it is not possible to ascertain from the limited available literature if property values would be affected by the Project, effects were they to occur would likely coincide with residential areas expected to experience visual impacts.

4.9.1.4 Economy and Employment

Coos County had a total estimated civilian labor force of 26,460 in 2018 (Oregon Employment Department 2019). The average annual unemployment rate in Coos County in 2016 was higher than the statewide average, 5.4 percent versus 4.2 percent. State and local government and health care and social assistance were the two largest economic sectors in the county in 2017 based on employment (U.S. Bureau of Economic Analysis 2018). Median household income in Coos County ($42,464) was lower than the statewide median of $60,123 in 2017 (U.S. Census Bureau 2018).

Jordan Cove estimates that construction of the Jordan Cove LNG Project would cost about $7.3 billion over the 53-month construction period, with an estimated $2.99 billion expected to be spent in Oregon (ECONorthwest 2017c).

Using Impact Analysis for Planning (IMPLAN) economic modeling software, ECONorthwest (2017c) estimated the total (direct, indirect, and induced) regional economic impacts of Project construction (table 4.9.1.4-1). Direct impacts are those that happen at the initial source of the economic activity, in this case the project construction sites. Indirect impacts are generated by the expenditures on goods and services by suppliers who provide goods and services to the construction project. Indirect effects are often referred to as "supply-chain" impacts because they involve interactions among businesses. Induced impacts are generated by the spending of households associated either directly or indirectly with the Project. Workers employed during construction, for example, will use their income to purchase groceries and other household goods and services. Workers at businesses that supply the facility during construction or operation will do the same. Induced effects are sometimes referred to as "consumption-driven" impacts. Spending associated with the Project produces multiplier spending effects for other sectors of the state economy as businesses respond to supply-chain and consumption-driven demands for goods and services.

TABLE 4.9.1.4-1

Regional Economic Impacts of Construction of the Jordan Cove Project in Oregon

Impact Type	Output b/	Value Added b/	Labor Income b/	FTE Jobs b/	Average Number of Jobs per Year c/
Total Direct Impacts	$7,300	na	$1,235	4,527	1,023
Local Impacts (State of Oregon) a/					
Direct	$2,990	$1,027	$967	3,531	798
Indirect	$1,743	$992	$776	14,107	3,194
Induced	$1,725	$982	$571	13,435	3,042
Total d/	**$6,458**	**$3,001**	**$2,314**	**31,073**	**7,034**

Notes:
FTE = full-time equivalent; na = not applicable
a/ Local impacts in this context are impacts that would occur within the state of Oregon. Direct impacts are the share of the total direct impacts expected to occur in Oregon.
b/ Impacts are presented for the entire 53-month construction period. Output, value added, and labor income are expressed in millions of dollars.
c/ Average number of jobs per year based on 53 months of construction.
d/ Totals may not sum due to rounding.
Source: ECONorthwest 2017c

Total impacts are estimated in terms of economic output, value added, labor income, full-time equivalent (FTE) jobs, and average jobs per year. Economic output represents the dollar value of goods and services produced. Value added represents the net contribution of industries to the local economy and consists of revenues less intermediate inputs. Labor income is the sum of employee compensation and proprietary (self-employed) income. FTE jobs represent employment for 2,080 hours per year; FTE jobs do not necessarily translate into the number of affected workers. Two jobs that last 6 months each, for example, count as one FTE job.

As stated in section 4.9.1.1, Jordan Cove estimated that they would employ an annual average of 1,023 workers over the 53-month-long construction period, with a peak of 1,996 employees during month 30. Total direct employment over the 53-month construction period was estimated to be equivalent to 4,527 FTE jobs, with the equivalent of 3,531 FTE jobs expected to be filled by Oregon workers. Construction of the Jordan Cove LNG Project would be a union project, with Jordan Cove requiring the major contractor to sign a project labor agreement with the key signatory unions to the National Construction Agreement. Union locals have reportedly indicated that they believe the majority of skilled crafts workers can be supplied from within Oregon (ECONorthwest 2017a). ECONorthwest (2017a), in an analysis prepared on behalf of Jordan Cove, assumed that almost four-fifths of all construction workers, managers, and staff for the Jordan Cove LNG

Project would come from Oregon. In addition, ECONorthwest (2017a) estimated that Project construction would support a total of 14,107 indirect and 13,435 induced FTE jobs in Oregon over the life of the construction period (table 4.9.1.4-1).

Based on the share of workers expected to commute daily to and from the LNG terminal work site, an estimated 372 of the 1,023 annual average direct FTE jobs would be filled by local workers (i.e., workers typically residing in Coos County or nearby) (ECONorthwest 2019). ECONorthwest (2019) estimated that construction employees (including resident, itinerant, and commuting employees) for the LNG terminal and pipeline would together spend an annual average of $51.9 million in Coos County and support annual average business sales of $70.3 million and 642 local jobs.

During the first full year of operations, Jordan Cove would directly employ 200 workers in Oregon, 180 for the LNG terminal, and 20 for the company office in Portland, with total labor compensation (including benefits and payroll taxes) expected to exceed $44.8 million. This direct employment in conjunction with facility expenditures on Oregon sourced goods and services would support additional economic activity in Coos County and elsewhere in Oregon. Using expenditure data provided by Jordan Cove, ECONorthwest (2017d) estimated that annual Project operation would support total (direct, indirect, and induced) employment of 1,602 FTE jobs in Oregon in the first full year of operations, with total associated labor compensation of approximately $132.3 million. Viewed in 2017 dollars, total compensation would be about $111.3 million or $69,477 per FTE job (ECONorthwest 2017d).

All of the full-time LNG terminal employees would likely reside in Coos County or nearby. ECONorthwest (2019) estimated that operation employees for the LNG terminal (180 FTEs) and pipeline (15 FTEs) would together spend an annual average of $12.2 million in Coos County and support annual average local business sales of $29.5 million and 120 local jobs.

Indirect and induced impact estimates developed by ECONorthwest (2017c, 2017d) are based on the share of construction and operation expenditures that Jordan Cove estimates would occur in Oregon. Changes in actual levels of in-state spending would result in changes to the indirect and induced impact estimates.

No commercial enterprises would be displaced by the Project, and construction and operation of the terminal would not result in the loss of local business revenues or taxes.

4.9.1.5 Tax Revenues

Total revenues for Coos County were approximately $58.9 million in fiscal year 2018. Tax revenues accounted for $12.5 million of this total, with 87 percent of tax revenues generated by property taxes (Coos County 2019). Other sources of revenue included intergovernmental transfers (state and federal funds); licenses, fees, and permits; charges for services; and timber sales on county forestlands (table 4.9.2.5-1). The LNG terminal would contribute to the fiscal health of local communities through a local Community Enhancement Plan in Coos County. Construction and operation of the Jordan Cove LNG Project would also generate state and local tax revenues, including revenues from payroll taxes.

4.9.1.6 Public Services

Law Enforcement and Fire Protection

Coos County is served by one sheriff's office, seven police departments, and 17 fire departments. To reduce potential impacts, Jordan Cove would reimburse Coos County to cover any costs associated with public safety during construction and operation. Jordan Cove has also committed to building and funding the SORSC within the Jordan Cove LNG Project site. In addition, a continuously manned Jordan Cove Fire Station would be located on-site and Jordan Cove would be responsible for funding additional security measures to protect LNG carrier marine traffic.

Jordan Cove would also be responsible for funding additional security measures outlined in the Coast Guard's WSR and LOR to protect LNG carrier marine traffic to and from the terminal within the waterway; this would include escort boats operated by the County Sheriff's department.

Medical Facilities

Coos County is served by three hospitals. The Southern Coos Hospital is designated a critical access hospital as well as a full-service, general acute care hospital. It is ranked as a Level 4 Trauma Center (Southern Coos Hospital & Health Center 2017). The Coquille Valley Hospital in Coquille is ranked as a Level 4 Trauma Center (Coquille Valley Hospital 2017). The Bay Area Hospital in the city of Coos Bay is the closest to the Jordan Cove LNG Project site, approximately 6 miles away. This facility is rated a Level 3 Trauma Center (Bay Area Hospital 2017). In addition, North Bend Medical Center is a regional health care cooperative with five locations and more than 70 providers in the Coos Bay area (North Bend Medical Center 2017).

During construction, Jordan Cove would provide on-site medical facilities and personnel to provide care for the project workforce both at the site and at the Workforce Housing Facility. Care would include first aid, emergency response, and treatment of common illnesses. Potential construction injuries requiring treatment could range from scrapes and bruises through broken bones and injured limbs, concussion, and wounds requiring stitches, with injured parties requiring off-site treatment for more severe injuries should they occur.

During plant operation, Jordan Cove would have a licensed nurse practitioner on staff with offices located in the Operations Building. The primary functions for the nurse practitioner would be to assess routine employee needs, manage employee wellness programs to reduce the need for emergency visits, and handle triage of any job-related injuries that might occur within the Project site. Additionally, to address public concern, Jordan Cove signed an MOU with the State of Oregon that requires it to equip the Bay Area Hospital according to State policies for all hospitals in treating burns.[198] Other potential injuries that might occur are expected to be similar to those already treated at the hospital and by the North Bend Medical Center.

Schools

Coos County has six school districts, with total enrollment of 10,051 in the 2016-17 school year (Oregon Department of Education 2017). The Coos Bay School District operates five schools, serving about 3,100 students (Oregon Department of Education 2017). The North Bend School

[198] Memorandum of Understanding and Agreement No. 14-008 By and Between Jordan Cove Energy Project and the State of Oregon for LNG Emergency Preparedness. Filed July 1, 2014, in FERC Docket No. CP13-483.

District operates four schools serving about 4,400 students (Oregon Department of Education 2017). In addition, there are four private schools in North Bend serving approximately 250 students (ECONorthwest 2017a). The Bandon School District #54 has three schools, serving about 697 students (Bandon School District 2018).

As described previously, numerous non-local workers are expected to temporarily relocate to the Project area during construction, but very few are expected to be accompanied by family members. ECONorthwest (2017a) estimated that 57 households would temporarily relocate to the Project area during Project construction. Assuming an average household size of approximately 2.74 persons, including 0.55 school-aged children, would result in the addition of an estimated 31 students to Coos County schools. This addition would be equivalent to 0.3 percent of total county enrollment in 2016-17, or 0.4 percent of the combined enrollment in the Coos Bay and North Bend School Districts.

Assuming the same average household size as above, Project operation would result in the potential addition of 59 students to Coos County schools. This addition would be equivalent to 0.6 percent of total county enrollment in 2016-17, or 0.8 percent of the combined enrollment in the Coos Bay and North Bend School Districts.

Utilities

Constructing and operating the terminal facilities would require connection to and use of public electric, water, waste disposal, and communications systems/utilities. Jordan Cove has indicated that there is sufficient electric power on the North Spit to serve existing customers and meet Project needs during construction. Liquefaction operations would be powered directly by gas-fired combustion turbines and would not require externally sourced electric power from the grid. The SORSC and low load remote instrumentation would be connected to the local grid.

Solid waste generated during Jordan Cove LNG Project's construction would be collected on-site and items that cannot be reused or recycled would be hauled to licensed landfills by authorized waste haulers and disposal companies. Sanitary waste generated during construction would either be collected and taken off-site for disposal by a licensed contractor, or treated prior to discharge to the IWWP, and any solid waste would be disposed of off-site by a licensed contractor. All waste generated by the workforce housing facility would be handled in a similar manner.

During operation of the terminal, sanitary waste water would be treated on-site and effluent sent to the IWWP. Solid waste would either be recycled or hauled from the site and disposed of by private licensed waste disposal companies without the need for city or county resources.

4.9.1.7 Recreation, Tourism, and Subsistence

Recreation and Tourism

Approximately 1 million people visited Coos County in 2018, staying on average 2.4 nights (Dean Runyan Associates 2019). An estimated 42 percent of these nights were spent in hotels or motels, with visitors who stayed in hotels or motels accounting for approximately 69 percent of visitor spending. Travel-related spending in Coos County in 2018 totaled about $265.1 million, and supported an estimated 3,330 jobs (approximately 10.5 percent of total county employment), $84.5 million in earnings, and an estimated $9.7 million in local and state tax revenue.

Recreation and tourism activities are discussed in detail in section 4.8.1. Important recreation activities near the LNG terminal site include recreational boating, fishing, clamming and crabbing, and hunting (see section 4.8.1.1). In 2008, travel-generated spending related to shellfishing, fishing, hunting, and wildlife viewing in Coos County totaled $33.4 million, approximately 18.3 percent of total estimated travel-related spending in Coos County in that year ($183 million) (Dean Runyan Associates 2009). In addition, local recreation-generated spending on these activities totaled and estimated $6.2 million. Travel-related spending on shellfishing in Coos County accounted for 15 percent of the statewide total. Local recreation-spending on shellfishing accounted for 21 percent of the statewide total (Dean Runyan Associates 2009). Assuming that travel generated spending on shellfishing, fishing, hunting, and wildlife viewing in Coos County continued to account for a similar share of total travel-related spending (18.3 percent) in 2018 suggests that visitors engaging in these activities spent about $48.5 million in Coos County in 2018 and potentially supporting around 600 jobs.

Commenters during public scoping expressed concern that the Project could negatively affect the local economy by harming the recreation and tourism sectors. Potential effects on tourism could also occur during the summer when construction workers would likely compete with visitors to Coos County for accommodations. Potential combined demand for hotel and motel rooms, RV or campground spaces, and individual room rentals would exceed the estimated available supply of hotel and motel rooms in Coos County in August, even with the workers camp in place. However, as discussed in section 4.9.1.2, a share of this demand would also likely be met by RV and campground spaces and individual room rentals in existing owner- or renter-occupied housing. Construction-related demand would result in lower vacancy rates and upward pressure on rental/room rates. Other visitors seeking temporary accommodation near the terminal site may be temporarily displaced during peak season, especially on summer weekends. This could result in reduced demand for some recreation outfitter/guide services, as potential clients seek recreation opportunities elsewhere.

As discussed in section 4.8.1.1, dredging in the bay to create the access channel for the Jordan Cove LNG Project could potentially affect recreational clamming and crabbing through increased sedimentation and entrainment. However, the limited time and extent of dredging siltation is not expected to result in long-term effects on clams and crabs near the Jordan Cove LNG Project. Further, entrainment is not expected to have a substantial effect on the local marine resources, but some important fish and shellfish may be reduced in abundance locally.

Subsistence

Tribes providing input through the scoping process and the FERC's government-to-government consultations have indicated that hunting, fishing, and gathering (commonly referred to as subsistence) could be adversely affected by the Project. The CTCLUSI has specifically expressed concern that traditional activities practiced by its members including the gathering of traditional plants, harvesting of shell fish, fishing, and hunting may be restricted by the Jordan Cove LNG Project. Tribal consultation and potential impacts on traditional resources are discussed in detail in section 4.11.

We were unable to locate information on subsistence practices in Oregon (e.g., harvest types and amounts), and no documentation has been entered into the Commission's administrative records regarding subsistence. However, our understanding of the Project area is that supplemental subsistence is common and Tribal members in the area supplement their diets and incomes through subsistence practices.

Supplemental subsistence users, especially those accessing Coos Bay and its resources, could be affected by the Project. Anglers would be subject to waterway restrictions pertaining to LNG carrier passage (similar to existing restriction for deep-draft ships). Subsistence hunters using areas near the LNG terminal site during construction could experience delays and disturbances due to construction activities, particularly traffic and noise (e.g., Project noise could affect wildlife behavior; see section 4.5). In addition, the influx of temporary workers to the area could add to the number of people hunting on public lands in the region and increase competition for resources. Therefore, we conclude that supplemental subsistence activities could be affected by the Project; however, this impact would be temporary and not significant.

4.9.1.8 Other Commercial Activities

Commercial Fishing

In 2018, Coos Bay accounted for about 10 percent of total catch by volume in Oregon and 23 percent of catch by value. Pacific shrimp constituted 40 percent (12.0 million pounds) of the Coos Bay catch in volume and 23 percent ($9.3 million) of its catch in value. Dungeness crab made up about 20 percent (6.0 million pounds) of the Coos Bay catch in volume, but almost half the value (49 percent; $19.7 million). Viewed as a share of the state total, the Dungeness crab catch in Coos Bay accounted for 26 percent of both the total volume and value (Pacific Fisheries Information Network 2019). An estimated total of $54.7 million in total personal income was generated by the fishing industry in the Coos Bay area in 2014, including income from both landed fish and revenue returned from distant water fisheries (The Research Group 2015).

Almost 200 commercial fishing vessels operate in Coos Bay on average per month from March to October, with just over 100 based in Coos Bay for the entire year (ECONorthwest 2017b). The actual number of commercial fishing vessels traveling through Coos Bay might be greater due to some transient travel to deliver products, buy ice, or seek other services. A fisherman's market cooperative and a small commercial fishing fleet are located in Charleston (located a few miles south of the Project area near the mouth of the bay). The Charleston Marina provides infrastructure and services to locally-based and visiting commercial fishing vessels (Oregon International Port of Coos Bay 2018a).

As described previously, numerous cargo ships (vessels and barges) would deliver materials to the terminal site during construction and, once in operation, the site would be called upon by up to 120 LNG carriers per year. Fishing boats would avoid cargo ships and barges similar to how they currently deal with commercial deep-draft ship and barge traffic into and out of the Port.

During LNG carrier transit in the waterway to the terminal, an exclusionary Coast Guard safety and security zone would be implemented. Non-LNG vessels would be allowed to transit through the safety zone and would also be allowed in the safety zone during passage provided that these other vessels do not impede the safe navigation of the LNG carriers in the restricted channel, and that the other vessels do not pose a security threat or concern to the LNG carriers in transit. The timing and constraints associated with LNG carrier transit through the channel entrance bar area would be similar to existing constraints on chip ships and log carriers calling at the port. Note that the LNG marine traffic would overlap with the portion of the navigation channel used by the ocean-going fishing fleet from Charleston for about 2 miles. There may be slight delays resulting from meeting situations between an LNG carrier and a commercial fishing vessel, because of the security and safety zones or other conditions imposed by the Coast Guard. Jordan Cove has indicated that the impact on boats at any point in the channel would last about 20 to 30 minutes, the same as when other deep-draft vessels use the channel.

We received comments expressing concern that dredging in the bay to create the access channel would have detrimental effects on Dungeness crab and the crabbing industry in Coos Bay, which relies heavily on crab for its profits. Potential impacts on crabs could occur as a result of increased sedimentation and/or entrainment; however, as discussed in section 4.5.2.2, increased sedimentation from dredging is not expected to result in long-term or population-wide effects on crabs, and entrainment is not expected to have a substantial effect on the local marine resources, although some important fish and shellfish may be reduced in abundance locally.

Commercial Ship Traffic

According to the Oregon International Port of Coos Bay (2018b), the Port is a major deep-draft coastal harbor moving more than 1.5 million tons of cargo each year. In 2017, 47 deep-draft vessels and 34 tugs and barges docked at Coos Bay port facilities.

The existing Coos Bay channel is wide enough to accommodate only one deep-draft ship in one direction. The Coast Guard, as part of its Waterway Suitability Report (WSR) and LOR, requires Jordan Cove to develop a Transit Management Plan to outline how conflicts with other commercial vessels would be avoided.

Ships associated with the construction and operation of the terminal could be affected by or affect other commercial ship traffic. Because the navigation channel can only accommodate one deep-draft transit, Project-related vessels may need to wait for the channel to clear. Conversely, other commercial ship traffic may need to wait for Project-related vessels to clear the channel, resulting in delays in transit. These potential impacts would be temporary and similar to those associated with existing deep-draft vessels calling at the Port.

Other Industries

There are several industrial enterprises located in proximity to the terminal site including the Southwest Regional Airport, Roseburg Forest Products, the Southport Lumber Company (Southport Lumber), and D.B. Western, a manufacturing company. The Southwest Oregon Regional Airport is addressed in section 4.10. Jordan Cove would temporarily lease land from Roseburg Forest Products for a staging area (i.e., a “laydown area”) during construction of the Jordan Cove LNG Project. Also, two warehouses located on the Roseburg Forest Products site and a small shed on the Boxcar Hill site would be removed during site preparation.

Southport Lumber operates a sawmill about a mile southwest of the terminal site. This facility includes a barge slip at about NCM 6.3 and a rail spur. The D.B. Western factory and berth is located at NCM 5.6, about 2 miles south of the terminal site. Based on the distances to the terminal site, impacts on these facilities are not expected. However, access to these facilities, as well as the Roseburg Forest Products facility, by road and water could be affected by Project-related vehicle traffic on the Trans-Pacific Parkway and vessel traffic in the navigation channel. Project-related effects on the Trans-Pacific Parkway and related mitigation plans are further discussed in section

4.10. Mitigation would likely include staggered work shifts, construction of a dedicated eastbound left-turn lane at the intersection of U.S. 101 at the Trans-Pacific Parkway, and implementation of a temporary signal at the intersection for the duration of construction activities (see section 4.10). Impacts on commercial ship traffic are discussed in the preceding section.

4.9.1.9 Environmental Justice

EO 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, requires federal agencies to consider if impacts on human health or the environment (including social and economic aspects) would be disproportionately high and adverse for minority and low-income populations and appreciably exceed impacts on the general population or other comparison group.[199]

Guidelines provided by the CEQ (1997a) and EPA (1998) indicate that a minority community may be defined as one where the minority population comprises more than 50 percent of the total population or comprises a meaningfully greater share of total population than the share in the general population of an appropriate benchmark region used for comparison.[200] Minority populations may consist of a group of individuals living in geographic proximity to one another, or a geographically dispersed set of individuals who experience common conditions of environmental effect. Further, a minority population exists if there is "more than one minority group present and the minority percentage, as calculated by aggregating all minority persons, meets one of the above-stated thresholds" (CEQ 1997a, p. 26).[201]

The CEQ and EPA guidelines indicate that low income populations should be identified based on the annual statistical poverty thresholds established by the U.S. Census Bureau. Like minority populations, low income populations may consist of individuals living in geographic proximity to one another, or a geographically dispersed set of individuals who would be similarly affected by the proposed action or program.

In comments provided on the draft resource reports prepared for this Project, the EPA requested that the FERC conduct appropriate public outreach to ensure that the public and Native American tribes are informed about the Project and the possible impacts on their communities and trust resources. The EPA also stated that it considers children, the disabled, the elderly, and those with limited English proficiency to be potential environmental justice populations due to their unique vulnerabilities.

In several different filings with the FERC, the CTCLUSI and Klamath Tribes raised issues about the potential for the Project to have impacts on Indian tribes as Environmental Justice populations. Both the CTCLUSI and Klamath Tribes believe that "man-camps" associated with construction of the Projects may result in crime, drug use, sex trafficking, sexual assaults, and physical violence against Native American women. The CTCLUSI stated that Projects would have disproportionate

[199] EO 12898 applies to agencies that are part of the Executive Branch of the federal government. Although the FERC is an independent regulatory agency and not part of the Executive Branch, we carry out our programs in the spirit of EO 12898 and this EIS addresses the potential environmental justice impacts of the Project.

[200] The benchmark region used for comparison is also referred to as the "reference community" (Federal Interagency Working Group on Environmental Justice & NEPA Committee [Federal Interagency Working Group] 2016).

[201] Minority populations identified by the U.S. Census include Black or African American, American Indian and Alaska Native, Asian, Native Hawaiian and Other Pacific Islander, and Other Race, which are considered races, and persons of Hispanic or Latino origin, which is considered an ethnicity.

impacts on Native Americans by creating a housing shortage for low income communities, limiting traditional practices and access to resources important to tribes, contaminating waterbodies that contain aquatic species collected or fished by Native people, and exposing tribal members to noise and air pollution.

Review Methodology

Based on guidelines provided by the CEQ (1997a) and EPA (1998), we used a two-step approach to conduct our review. These steps were:

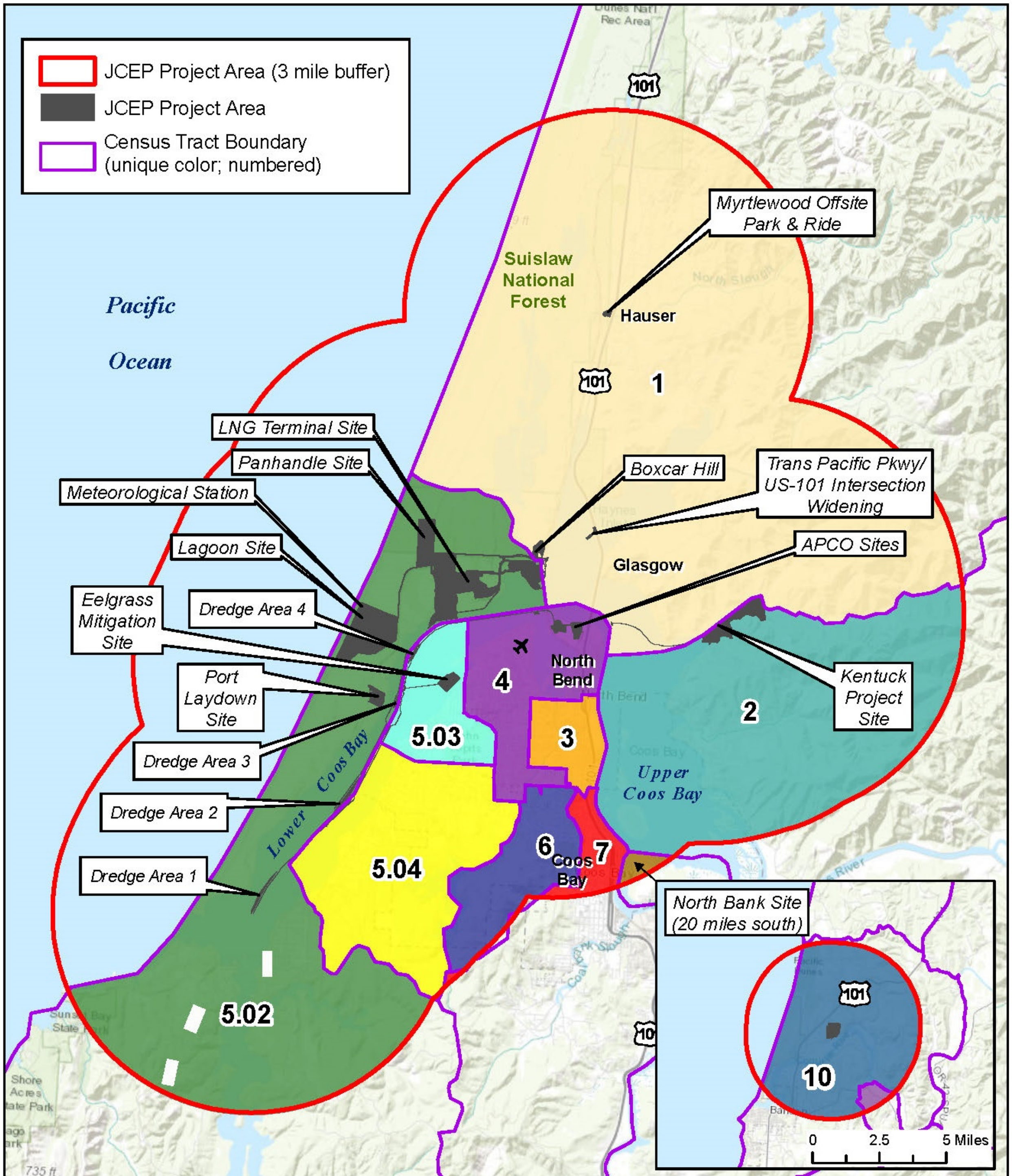
1. Identify the presence of minority and/or low-income populations.
2. Identify whether impacts on human health or the environment would be disproportionately high and adverse for minority and low-income populations and appreciably exceed impacts on the general population or other comparison group.[202]

We used the EPA's Environmental Justice Mapping and Screening Tool (EJSCREEN) to assess the potential presence of environmental justice populations in the vicinity of the LNG terminal site. In accordance with EO 12898, EJSCREEN provides information on low income and minority populations. The tool also provides summary information for four other factors – less than high school education; linguistic isolation; individuals under age 5; and individuals over age 64 – which are considered potential indicators of vulnerable populations.

The area of analysis for the LNG terminal consists of the area within 3 miles of the LNG terminal site. This area of analysis was selected to identify potential minority and low-income populations that could be affected by geographic proximity to the Project. Data were compiled for the area within a 3-mile radius of the center of the LNG Terminal site using the EJSCREEN buffer tool, which aggregates Census data to develop estimates for the population within the buffered area.

Larger and more populated geographic areas may have the effect of "masking" or "diluting" the presence of concentrations of minority and/or low-income populations (CEQ 1997a; EPA 1998). Data were, therefore, also reviewed separately at the census tract level for the 10 census tracts that are fully or partially located within 3 miles of the areas that would be disturbed during construction of the LNG terminal (figure 4.9-1).[203],[204]

[202] A "comparison group" in this context may be used (as appropriate) as part of the disproportionately high and adverse impact analysis and is distinct from the "reference community", which, as noted earlier, is used to identify the potential presence of minority and/or low-income populations (Federal Interagency Working Group 2016).
[203] The buffer shown in figure 4.9-1 shows a 3-mile distance from the areas that would be disturbed during construction of the LNG Terminal. This differs from the 3-mile radius used in the initial EJSCREEN analysis, which represents the area within a 3-mile radius from the center of the LNG Terminal site.
[204] Census tracts are small, relatively permanent statistical subdivisions of a county. Census tract boundaries normally follow visible features, but may follow legal geography boundaries and other non-visible features in some instances. Census tracts ideally contain about 4,000 people and 1,600 housing units (U.S. Census Bureau 2019c).



N

1 in = 2 miles

0 1 2 Miles

Date Source: U.S. Census, 2010

Figure 4.9-1

2010 Census Tracts in the Jordan Cove Project Area

Environmental Justice and Vulnerable Populations

In accordance with the guidelines provided by the CEQ (1997a) and EPA (1998), the following criteria were used to identify the potential presence of minority and low-income populations within the area of analysis.

A potential minority population exists when:

- The minority population comprises more than 50 percent of the total population; and/or
- The minority population comprises a meaningfully greater share of total population than the share in the reference community.[205, 206]

A potential low-income population exists when:

- the percent of the population in households where the household income is less than or equal to twice the federal poverty level is greater than the percent in the reference community; and/or
- the area meets the U.S. Census Bureau's definition of a poverty area.[207]

Data for the six demographic variables assessed in EJSCREEN are presented in table 4.9.1.9-1. Data are provided for a 3-mile radius centered on the terminal site (the analysis area) and the state of Oregon (the reference community), with data also presented for the cities of North Bend and Coos Bay, Coos County, and the United States for additional context.[208] Review of EJSCREEN indicated that there are no residents within 1 mile of the Jordan Cove LNG Project site.

[205] According to the Federal Interagency Working Group (2016, p. 25), the "*Meaningfully Greater* analysis requires use of a reasonable, subjective threshold (e.g., ten or twenty percent greater than the reference community)." For this analysis, a minority population is considered "meaningfully greater" if it is 20 percent greater than the corresponding statewide average.

[206] The reference community for this analysis is the state of Oregon because alternate locations for the Project would likely be outside Coos County.

[207] The U.S. Census Bureau defines a poverty area as a census tract or other area where at least 20 percent of residents are below the poverty level (U.S. Census Bureau 2019c). Note this measure is not compiled by EJSCREEN and is, therefore, not included in the data summarized in table 4.9.1.9-1.

[208] Data for the 3-mile radius were compiled using the EJSCREEN buffer tool, which estimates the fraction of each Census block group that is within the buffer by using block-level population counts from the 2010 Census.

TABLE 4.9.1.9-1

Demographic Indicators

Selected Variables a/	3-Mile Radius	North Bend	Coos Bay	Coos County	Oregon	United States
Total Population	12,209	9,675	15,787	62,944	3,982,267	318,558,162
Percent of Total						
Minority Population b/	20%	19%	18%	14%	23%	38%
Low Income Population c/	39%	33%	44%	44%	35%	34%
Linguistically Isolated Population	1%	1%	1%	1%	3%	4%
Population with Less Than High School Education	10%	7%	11%	11%	10%	13%
Population under Age 5	6%	6%	6%	5%	6%	6%
Population over Age 64	19%	22%	21%	24%	16%	14%

a/ Data are originally from the American Community Survey 2012-2016 five-year estimates compiled by the U.S. Census Bureau.
b/ Minority Population: The percent of individuals in each geographic area who list their racial status as a race other than White alone and/or list their ethnicity as Hispanic or Latino.
c/ Low-Income Population: The percent of geographic area's population in households where the household income is less than or equal to twice the federal poverty level.
Source: EPA 2019

The data presented in table 4.9.1.9-1 indicate that the minority share of the population within the 3-mile radius is less than 50 percent and lower than the statewide average (the reference community) and, therefore, does not meet the definition of a minority population. This is also the case with the cities of North Bend and Coos Bay and for Coos County as a whole (table 4.9.1.9-1). Review of the data in table 4.9.1.9-1 indicates that the share of the population considered low income by EJSCREEN is greater than the corresponding statewide share within the 3-mile radius, as well as in the city of Coos Bay, and Coos County. This suggests the potential presence of low-income populations within the analysis area.

The area within the 3-mile radius has a higher percentage of Native Americans (approximately 3 percent) than the state of Oregon (0.9 percent) as a whole. This is also the case with the cities of Coos Bay and North Bend, where Native Americans constitute 2.5 percent and 1.9 percent of the total population, respectively (U.S. Census Bureau 2019f). While Native Americans comprise a small share of the local population, as a result of their unique relationship with the surrounding environment, for this analysis, Tribal populations are considered an environmental justice population with the potential to be disproportionately affected by construction and operation of the LNG terminal.

Data were also reviewed at the census tract level to identify the potential existence of minority and/or low-income populations within 3 miles of the LNG terminal site and related facilities (figure 4.9-1). The minority share for these census tracts ranged from 8 percent to 27 percent, substantially lower than the 50 percent measure identified in CEQ (1997a) and EPA (1998) guidelines, and equal to or less than the state average (23 percent) in all but one case (census tract 5.04) (table 4.9.1.9-2). The total minority share of census tract 5.04 was 27 percent, which is below the "meaningfully greater" threshold of 20 percent identified for this analysis.

TABLE 4.9.1.9-2 **Potential Minority and Low-Income Populations by Census Tract**						
Census Tract	**Total Population a/**	**Minority Population (Percent) a/**	**Compared to the Reference Community**	**Low Income Population (Percent) a/**	**Compared to the Reference Community**	**Households below the Poverty Level (Percent) b/**
01	5,417	10	0.43	35	1.00	16
02	2,485	9	0.39	38	1.09	14
03	3,062	23	1.00	32	0.91	15
04	6,664	17	0.74	33	0.94	15
05.02	2,738	8	0.35	38	1.09	17
05.03	2,685	16	0.70	43	1.23	24
05.04	6,491	27	1.17	55	1.57	26
06	2,589	13	0.57	38	1.09	17
07	6,852	18	0.78	45	1.29	17
08	3,203	10	0.43	34	0.97	10
Oregon (Reference Community)	**3,982,267**	**23**	**1.00**	**35**	**1.00**	**14**

a/ Data are from EJSCREEN and originally based on data from the ACS 2012-2016 five-year estimates compiled by the U.S. Census Bureau (EPA 2019).
b/ Data are from the ACS 2013-2017 five-year estimates (U.S. Census Bureau 2019d).

Using the EJSCREEN low income measure, 6 of the 10 census tracts within 3 miles had low income populations that exceeded the state average of 35 percent. In addition, for two of the tracts (5.03 and 5.04) more than 20 percent of the population was below the poverty level (table 4.9.1.9-2).

The share of total population with less than a high school education was higher than the state average in 5 of the 10 census tracts. Almost all of the census tracts (9 out of 10) had larger shares of their population over age 64 than the state average, and three tracts also had larger shares of total population below age 5. The share of the population identified as linguistically isolated was below the state average in 9 of the 10 census tracts (EPA 2019).

High and Adverse Impacts

The impacts of constructing and operating the proposed LNG terminal on the natural and human environments are identified and discussed throughout the environmental analysis section of this document. As described in the numerous environmental resource-specific discussions, we conclude that the Project would not significantly impact the environment or have high and adverse effects on human health or the environment, with the following exceptions:

- Based on the size and location of the proposed LNG facilities, we conclude that the Jordan Cove LNG portion of the Project would significantly affect visual resources for some views and viewing locations (see section 4.8.2).
- During construction, pile-driving operations at the LNG Terminal site as currently proposed would occur for 20 hours a day for 2 years and exceed the FERC's noise criterion (see section 4.12.2.3). The FERC has provided recommendations to address these associated impacts.
- When the combined effects of the Jordan Cove LNG Project and Pacific Connector Pipeline Project are taken into consideration together, construction of the Project has the

potential to cause significant effects to short-term housing in Coos County (see section 4.9.2.2).

Disproportionate Impacts on Environmental Justice Populations

Low-income populations are present within 3 miles of the LNG terminal site. However, as noted above, none of the potential low-income populations are located within 1 mile of the LNG terminal site (there are no residents within 1 mile of the site) and the potential for these populations to be disproportionately affected relative to other populations within 3 miles of the site is low. The high and adverse effects identified in the preceding section and their potential to disproportionately affect the low-income populations within 3 miles of the site are discussed below.

- The Jordan Cove LNG Project is expected to have a moderate to high long-term visual effect on residential communities in Coos Bay and North Bend, more than a mile to the south of the terminal site. Moderate visual impacts are anticipated for viewers from hillsides with relatively unobstructed views of the LNG terminal site, with residences located along the shoreline of Coos Bay south of the regional airport expected to experience high visual impacts (see section 4.8.2.1). Affected residences are located in census tracts 4 and 5.03, with high effects expected to occur along the shoreline in census tract 5.03, which has been identified as a potential low-income population. Visual impacts on low-income populations in these areas would not be disproportionately high and adverse when compared to other affected residents. Further, the low-income population in the portion of census tract 5.03 that would be affected is below the state average of 35 percent and does not meet the definition of a low-income population. This is also the case for the portion of census tract 4 south of the airport that would be affected. The part of census tract 4 east of Pony Slough does, however, meet the definition of a low-income population. Impacts where they occur in this area would be moderate.[209]
- Pile-driving activities during construction of the LNG Terminal could result in significant noise impacts on residents who live across Coos Bay to the south and east of the site, with impacts expected to be greatest within approximately 2 miles of the site (see section 4.12.2.3). Viewed by census tract, the potentially affected area includes parts of census tracts 5.02, 5.03, and 4. The majority of affected residents would be those in census tracts 5.03 and 4 near the site. Noise impacts on low-income populations in these areas would not be disproportionately high and adverse when compared to other affected residents. Further, as noted above with respect to visual impacts, the portions of the tracts near the shorelines do not meet the definition of a low-income population.[210]
- Non-local construction workers are expected to seek a range of temporary housing options including rental housing (houses, apartments, and mobile homes), hotel and motel rooms, and RV parks and campgrounds. A recent study found limited affordable housing units available for rent in Coos County (czbLLC 2018) and increased demand for rental housing during construction is anticipated to result in lower vacancy rates and upward pressure in rental rates. Increased demand for rental housing would affect the market as a whole, but

[209] This discussion is based on the census block groups in these areas. A census block group is a statistical subdivision of a census tract. Census block groups typically contain between 600 and 3,000 people and 240 and 1,200 housing units (U.S. Census Bureau 2019e). The block groups reviewed here were: census tract 5.03, block group 1; census tract 4, block group 2; and census tract 4, block group 1.

[210] The portions of the tracts in these areas are census tract 5.03, block group 1 and census tract 4, block group 2.

would likely be more acutely felt by low-income households who are spending a large share of their income on housing. In section 4.9.2.2, we recommend that Jordan Cove and Pacific Connector designate a Construction Housing Coordinator to addresses construction contractor housing needs and potential impacts in each county affected by the Project, including Coos County.

Tribal populations are considered an environmental justice population with the potential to be disproportionately affected by construction and operation of the terminal as a result of their unique relationship with the surrounding environment. The potential for Tribal populations to be disproportionately affected by the high and adverse effects identified in the preceding section would be similar to that described above for low-income populations. We discuss consultations with Indian tribes and potential project-related impacts on cultural and other resources that may be important to tribes in section 4.11. In addition, the recommended cultural resources environmental condition described in section 4.11 includes the recommendation that a revised Ethnographic Report be filed prior to construction, for the review of the FERC staff, SHPO, cooperating federal land-managing agencies, and interested Indian tribes. We expect that study to identify Historic Properties of Religious and Cultural Significance (HPRCS) to Indian tribes, and address what traditionally gathered plants, fisheries, and hunted species may still exist in the Project area.

4.9.2 Pacific Connector Pipeline Project

4.9.2.1 Population

Population data for the four counties that would be crossed by the pipeline are summarized in table 4.9.2.1-1. The pipeline route mainly passes through sparsely populated rural areas, with population densities in 2018 ranging from 11.3 people per square mile in Klamath County to 76.8 people per square mile in Jackson County. Estimated population in the affected counties in 2018 ranged from 63,275 in Coos County to 219,200 in Jackson County.

TABLE 4.9.2.1-1

Population by State and County

State/County	Population 2000	2010	2018	Percent Change in Population 2010-2018	Persons per Square Mile 2018
Oregon	**3,421,399**	**3,831,074**	**4,195,300**	**9.5%**	**42.5**
Coos County	62,779	63,043	63,275	0.4%	39.6
Douglas County	100,399	107,667	111,735	3.8%	21.9
Jackson County	181,269	203,206	219,200	7.9%	76.8
Klamath County	63,775	66,380	67,960	2.4%	11.3
Total a/	**408,222**	**440,296**	**462,170**	**5.0%**	**29.6**

a/ This row is the sum of the four counties that would be crossed by the pipeline.
Sources: Portland State University 2012, 2018; U.S. Census Bureau 2017

As described previously, Pacific Connector estimates that construction of the pipeline would occur over a 4-year period, with an average monthly workforce of 885 people over this period. The pipeline construction workforce is expected to peak at approximately 4,242 workers in June of Year 3, dropping to 4,027 the following month. The pipeline construction workforce would be distributed over seven construction spreads.

Based on Pacific Connector's initial estimates, monthly employment for pipeline construction is estimated to average 241 workers in Coos County, 194 workers in Douglas County, 361 workers in Jackson County, and 89 workers in Klamath County. ECONorthwest (2017a) assumed that approximately 64 percent of the average pipeline workforce would temporarily relocate to the affected counties for the duration of their employment, with about 5 percent of the total expected to be accompanied by their families. Assuming an average household size of 2.74 persons, estimated temporary increases in population would range from 0.1 percent (Douglas, Jackson, and Klamath Counties) to 0.3 percent (Coos County) of their respective county populations in 2018.

Peak pipeline construction workforces would include an estimated 1,002 workers in Coos County, 1,350 workers in Douglas County, 1,524 workers in Jackson County, and 366 workers in Klamath County. ECONorthwest (2017a) assumed that approximately 78 percent of the peak workforce would temporarily relocate to the affected counties, with 1 to 2 percent of workers expected to be accompanied by their families. Assuming an average household size of 2.74 persons, estimated temporary increases in population would range from 0.4 percent (Klamath County) to 1.3 percent (Coos County) of their respective county populations in 2018. These estimated population increases and associated impacts would be temporary and short term, with very few if any of the temporary construction workers relocating to the project area expected to stay permanently. Impacts associated with construction-related population increases are discussed throughout this section.

Construction of the Pacific Connector pipeline in Coos County would coincide with Jordan Cove LNG Project construction. Based on the above analyses, the combined temporary increase in population (workers and family members) associated with both projects would average 1,069 workers over the life of the Project. Assuming that LNG terminal and pipeline construction activities in Coos County were to peak at the same time, the combined influx of construction workers would result in a temporary increase in population of approximately 2,561 workers. These potential additions would be equivalent to approximately 1.7 percent (average) and 4.0 percent (peak) of the total estimated population in Coos County in 2018. Note that construction activities for the LNG terminal and pipeline in Coos County are not expected to peak at the same time. The combined peak increase identified here represents a worst-case scenario for the purposes of analysis.

Operating the pipeline would require an estimated permanent staff of 15 employees, consisting of six operations technicians in Coos Bay, Coos County, five employees in the Medford pipeline office in Jackson County, and four employees at the compressor station near Malin in Klamath County. Employees are expected to live within driving distance of their work location and are not expected to affect population levels or trends in the counties along the pipeline route.

Crime

We received numerous comments expressing concern that a temporary influx of construction workers would result in increases in crime, particularly prostitution, human trafficking, and domestic violence. In addition, commenters have expressed concern that impromptu or informal worker camps may occur along the pipeline's length and result in negative impacts on surrounding areas. Informal camps could potentially occur if a landowner allows workers to use their property or workers park RVs in business parking lots that allow RV camping. These types of camps, were they to occur, are considered "informal" or "unsanctioned" because, unlike the workforce housing facility proposed for the LNG terminal site, they are not proposed by the Applicant.

Newspapers have reported concerns related to pipeline workers and increases in crime, but we are unaware of any studies that have investigated this relationship. Potential increases in crime related to large influxes of temporary workers are discussed in section 4.9.1.1. Pipeline construction-related population increases would be much lower than those associated with LNG terminal construction, as discussed above. In addition, pipeline construction workers typically relocate as work proceeds along the pipeline, reducing the amount of time workers are likely to reside in any one location. As a result, attempts to use the information in section 4.9.1.1 to estimate related potential increases in crime from pipeline construction are not appropriate.

Public Protest

We received comments on the draft EIS from several individuals and entities including the Klamath Tribes expressing concern that construction of the Project would result in public protest(s) that would adversely affect the environment and nearby communities. The commenters suggested that public protests could range in size from an individual camping out in a tree or chaining themselves to a piece of equipment to a large encampment, similar to the protest that occurred near the Standing Rock Sioux Reservation in North Dakota for the Keystone XL oil pipeline. These comments also suggested that the EIS consider the impacts on the environment resulting from protests.

FERC-regulated projects under construction have experienced a variety of protests; however, determining the likelihood, location, scale, and duration of a protest is not feasible. A public protest would affect human and natural environments. In responding to a protest, community services including police, fire, medical, government, and judicial resources would be affected. These services would be diverted from other uses and would result in additional costs to the associated communities. A protest could increase individual and perhaps community-wide anxiety and stress. In addition to impacts on the human environment, impacts on the natural environment would also occur. Protest activities, including vehicle use and camping, would affect soils, vegetation, and other natural resources. Improvised and unregulated infrastructure supporting protesters including housing, water, power, sanitation, and transportation would further affect the environment. However, as stated previously, it is not feasible to quantitatively assess an impact on the environment due to protest activities.

4.9.2.2 Housing

In 2017, the four counties that would be crossed by the pipeline had an estimated total of 207,714 housing units, with almost half of this total (93,704 units) located in Jackson County. An estimated 3,179 of these units were identified as vacant and available for rent. Available rental units ranged from 557 in Coos County to 1,017 in Jackson County. In addition, an estimated 7,786 units were identified for seasonal, recreational, or occasional use, ranging from 1,376 units in Douglas County to 2,634 units in Klamath County. ECONorthwest (2017b) also identified an estimated total of 9,640 hotel, motel, and small inn rooms in the four counties, along with an estimated 8,800 sites in managed RV parks and campgrounds (table 4.9.2.2-1).

TABLE 4.9.2.2-1

Housing

Geographic Area	Housing Units 2013-2017 a/ Total Housing Units	Rental Vacancy Rate	Units Available for Rent	For Seasonal, Recreational, or Occasional Use c/	Hotels and Motels b/ Number of Facilities	Number of Rooms	Managed RV Parks and Campgrounds Number of Sites d/
Coos County	30,870	5.6%	557	1,582	49	1,656	2,200
Douglas County	49,838	4.4%	666	1,376	40	1,990	2,800
Jackson County	93,704	3.1%	1,017	2,194	91	4,457	2,100
Klamath County	33,302	9.0%	939	2,634	37	1,537	1,700
Project Area Total e/	**207,714**	**4.7%**	**3,179**	**7,786**	**217**	**9,640**	**8,800**

a/ Data are from the U.S. Census American Community Survey.
b/ Hotel and motels include commercial hotels, inns, and motels, as well as smaller inns and bed and breakfast establishments (B&Bs), with data obtained from STR, Inc. (commercial hotels, inns, and motels) and internet searches (smaller inns and B&Bs) (ECONorthwest 2017b).
c/ Housing units for seasonal, recreational, or occasional use are generally considered to be vacation homes. They are not included in the estimated number of housing units available for rent.
d/ Estimated totals are based on an inventory of private and public RV parks and campgrounds in each county (ECONorthwest 2017b). Privately-owned sites account for approximately half (4,400 spaces) of the total identified spaces. Camping is typically limited to 14 consecutive days at publicly managed sites and the Forest Service has indicated that Forest Service-managed campgrounds would not be available for use by construction workers. Forest Service-managed spaces account for about 23 percent (2,300 spaces) of the identified total.
e/ Estimated totals are rounded to the closest 100.
Source: ECONorthwest 2017b, U.S. Census Bureau 2019a, 2019b

Hotel and motel occupancy rates in the Project area follow a seasonal trend, with occupancy rates tending to be higher in the summer (June through September) and lower in the winter (November through February). During peak tourist season (July and August), average hotel and motel occupancy rates are around 80 percent in Coos, Jackson, and Klamath Counties and close to 75 percent in Douglas County (ECONorthwest 2017b). Occupancy rates for RV parks and campgrounds in the pipeline project area are not published, but tend to be more seasonal than those of hotels and motels (ECONorthwest 2017b).

Estimated average and peak housing demand by non-local construction workers is shown by housing type and county in table 4.9.2.2-2. Estimated average and peak demand is compared with estimated supply by housing type and county in table 4.9.2.2-3. Viewed as a portion of available rental housing, peak demand for rental housing would range from 6 percent (Klamath County) to 28 percent (Coos County) of estimated available units. As discussed in section 4.9.2.1, the 2018 Coos County housing analysis and action plan identified a shortage of affordable rental housing (czbLLC 2018).

TABLE 4.9.2.2-2

Estimated Housing Demand by Pacific Connector Construction Workers

	Rental Housing (Apartments, Houses, Mobile Homes) a/,b/		Hotels and Motels, RV and Campground Spaces, and Individual Room Rentals a/	
Geographic Area	**Average**	**Peak**	**Average**	**Peak**
Coos County	59	157	92	624
Douglas County	48	207	74	845
Jackson County	88	239	138	949
Klamath County	22	57	34	228

a/ Estimated demand by housing type is based on ratios estimated by ECONorthwest (2017a) adjusted to account for subsequent changes in Pacific Connector's construction schedule and workforce estimates.
b/ Assumes that 10 percent of individual workers would share a rental unit with another construction worker.

TABLE 4.9.2.2-3

Estimated Housing Demand by Pacific Connector Construction Workers as a Share of Estimated Supply

	Rental Housing (Apartments, Houses, Mobile Homes)		Hotel and Motel Rooms a/	
Geographic Area	**Average**	**Peak**	**Average**	**Peak**
Coos County	11%	28%	6%	38%
Douglas County	7%	31%	4%	42%
Jackson County	9%	24%	3%	21%
Klamath County	2%	6%	2%	15%

a/ Percentages represent estimated demand as a share of the total estimated supply of hotel and motel rooms, not the share that would normally be available for rent. Percentages do not include RV parks and campgrounds or special living situations, such as bedrooms in single-family homes that home owners may rent to construction workers

Peak demand for hotels and motels, RV and campground spaces, and individual room rentals would range from about 15 percent of the total supply of hotel and motel rooms in Klamath County to 42 percent of the total in Douglas County. Total supply in this context refers to the total number of units and is not adjusted to account for seasonal occupancy rates. During peak season (July and August), peak demand would exceed the normally available supply of hotel and motel rooms in Coos (330 rooms), Douglas (511 rooms), and Jackson (833 rooms) Counties. A share of this demand would, however, also likely be met by RV and campground spaces and individual room rentals in existing owner- or renter-occupied housing.

Increased demand for temporary housing from construction workers is unlikely to result in the construction of new hotels, apartments, or houses because building takes time and the increase in demand would only be temporary (for 4 years or less). Local areas could, however, potentially accommodate additional RVs and campers, and homeowners could make spare bedrooms available for rent (ECONorthwest 2017b).

During peak tourist season (July and August), short-term accommodations in some communities, especially those in Coos, Douglas, and Jackson Counties, would experience lower vacancy rates and upward pressure on rental rates. The availability of short-term housing, especially at hotels, motels, and RV parks, could become limited in the immediate pipeline vicinity, and workers and others seeking temporary accommodation in those areas may pay higher rental rates for rooms or RV sites or have to commute farther than desired. Additionally, during the period of peak demand for short-term housing by construction workers, tourists would likely be displaced, particularly during summer weekends. Visitors seeking outdoor recreational opportunities do, however, have a wide range of destination choices in southern Oregon and could potentially recreate elsewhere in the region if they were interrupted by pipeline construction at a particular location.

The Klamath Tribes have expressed concern that impromptu or informal worker camps may occur along the pipeline's length and result in negative impacts on surrounding areas. Informal camps could potentially occur if a landowner allows workers to use their property or workers park RVs in business parking lots that allow RV camping. The Jordan Cove workforce housing facility is the only workforce housing development that has been proposed by Jordan Cove and Pacific Connector. Construction workers not residing at the proposed facility are expected to seek other temporary living situations as discussed above.

These potential issues would be exacerbated in Coos County, where the Pacific Connector Pipeline Project construction would coincide with Jordan Cove LNG Project construction, resulting in higher levels of demand for temporary housing. The following discussion addresses the combined demand from both projects and assumes that housing demand would peak for both projects during the same month. Combined, estimated average and peak demand for hotel and motel rooms, RV or campground spaces, or individual room rentals would be for 429 and 1,212 units, respectively, equivalent to 31 percent and 73 percent of the total supply of hotel and motel rooms in Coos County. While a share of this demand would be met by RV and campground spaces and individual room rentals, peak levels of demand would likely exceed the share of hotel and motel rooms that are usually vacant and available for rent during the summer, resulting in increased competition for temporary housing among workers, as well as the potential displacement of tourists and other visitors who would be unable to find temporary accommodation in Coos County.

For rental housing, the combined estimated average and peak demand would be for 207 and 432 units, respectively, equivalent to approximately 37 percent and 78 percent of the total 557 units estimated to be available for rent in Coos County. As noted in section 4.9.2.1, potential shortages of rental housing have been identified in Coos County (czbLLC 2018). Increased demand from Project-related construction workers would likely reduce vacancy rates and place upward pressure on rental rates, resulting in the potential displacement of other existing or potential residents seeking rental accommodation.

Operation of the pipeline would require 15 permanent employees and would have no noticeable effect on the local housing markets.

We received a number of comments on the draft EIS that expressed concern about potential impacts on housing during construction. These included concerns from the Oregon Department of Energy, which requested that the FERC, as a condition of the certificate, require the Applicant to provide a comprehensive workforce housing plan that addresses the potential impact of the construction workforce on housing resources in Coos County. Based on the potential impacts discussed above and comments on the draft EIS, in order to address and reduce impacts on housing during construction, **we recommend that**:

- **<u>Prior to construction</u>, Jordan Cove and Pacific Connector should file with the Secretary a statement affirming the designation of a Construction Housing Coordinator who would coordinate with contractors and the community to address**

housing concerns. Additionally, Jordan Cove and Pacific Connector should describe the measures it would implement to inform affected communities about the Construction Housing Coordinator.

4.9.2.3 Property Values

We received numerous comments concerning the potential effect of the pipeline on property values. These comments included concerns that the pipeline would negatively affect sales prices and result in an inability to sell one's property. Concern was also expressed that a decrease in property values would result in reduced property tax revenues for the affected counties.

A number of studies have sought to determine whether the presence of a pipeline affects property values using a range of statistical techniques including paired sales and other sales comparisons, linear regression and hedonic price modeling, and descriptive statistics. These studies include two national case studies conducted by the Interstate Natural Gas Association of America (Allen, Williford & Seale, Inc. 2001; Integra Realty Resources 2016), two case studies that evaluated the effects of the South Mist Pipeline Extension in Clackamas and Washington Counties, Oregon (Fruits 2008; Palmer 2008), and studies from Arizona and Nevada (Diskin et al. 2011; Wilde et al. 2014). These studies suggest that natural gas pipelines do not necessarily negatively affect the value of that property. The effect a pipeline may have on a property's value depends on many factors, including the size of the tract, the values of adjacent properties, the presence of other utilities, the current value of the land, and the current land use. Subjective valuation is generally not considered in appraisals, but may affect individual decisions when a property is offered for sale. Purchase decisions are often based on the purchaser's plans for the property, such as occupancy, use for agriculture, future residential development, or commercial/industrial development. If the presence of a pipeline interferes with a purchaser's plans, the potential buyer may decide against acquiring the property. However, each potential purchaser has different criteria and differing capabilities to purchase land. Therefore, based on our review of available studies and our understanding of property valuation, we conclude that the likelihood of the pipeline resulting in a long-term decline in property values and a related decrease in property tax revenues is low.

Public comments expressed concern that placement of the pipeline on private property would either prevent or make it more difficult for a potential purchaser to obtain a mortgage loan or insurance. There are no documented cases or verifiable information in the FERC administrative record for this Project supporting the assertion that insurance rates and access to home loans would be adversely affected by construction and operation of the Project.

4.9.2.4 Economy and Employment

The four counties that would be crossed by the pipeline had a total combined estimated labor force of 207,096 in 2018. Labor force estimates by county ranged from 26,460 in Coos County to 104,763 in Jackson County (table 4.9.2.4-1). Annual unemployment rates in 2018 ranged from 4.8 percent in Jackson County to 5.4 percent in Coos and Douglas Counties and were higher than the state average (4.2 percent) in all four counties. Table 4.9.2.4-1 also presents average per capita income and median household income by county, and identifies the two largest economic sectors based on total employment data compiled by the U.S. Bureau of Economic Analysis (2018). Average per capita income in 2017 (the most recent year available) was lower than the state average ($48,137) in all of the affected counties. Median household income was also below the state median ($60,123) in 2017 in all four counties.

TABLE 4.9.2.4-1

Employment and Labor Statistics for the Pacific Connector Pipeline Project Area

State/ County	Civilian Labor Force 2018 a/	Unemployment Rate (%) 2018 a/	Per Capita Income ($) 2017	Median Household Income ($) 2017	Two Largest Economic Sectors 2017 (By Percent of Employment) b/
Oregon	2,104,156	4.2	$48,137	$60,123	Health Care and Social Assistance (12%); Retail (10%)
Coos	26,460	5.4	$41,802	$42,464	State and Local Government (16%); Health Care and Social Assistance (12%)
Douglas	46,374	5.4	$38,752	$47,157	Health Care and Social Assistance (12%); State and Local Government l (11%)
Jackson	104,763	4.8	$44,360	$51,364	Health Care and Social Assistance (15%); Retail Trade (14%)
Klamath	29,499	6.4	$38,446	$41,875	Health Care and Social Assistance (14%); State and Local Government (12%)

a/ Labor force and unemployment data are annual averages.
b/ Employment by economic sector is summarized in more detail in table 4.9.2.4-2.
Sources: Oregon Employment Department 2019; U.S. Bureau of Economic Analysis 2018, 2019; U.S. Census Bureau 2018

All four counties were identified as distressed on Business Oregon's Temporary Distressed List for 2019 (Business Oregon 2019). A county is considered distressed by Business Oregon based on an index calculated from four composite factors (unemployment rates, per capita personal income, changes in covered payroll by worker, and changes in employment). Twenty-five of Oregon's 36 counties were identified as distressed in 2019.

Similar to the analysis prepared for the Jordan Cove LNG Project (see section 4.9.1.4, above), ECONorthwest (2017c) used IMPLAN to estimate the total (direct, indirect, and induced) regional economic impacts of pipeline construction and operation. Pacific Connector estimates that constructing the pipeline and related facilities would cost about $2.46 billion, with an estimated $1.4 billion expected to be spent in Oregon (ECONorthwest 2017c). ECONorthwest (2017c) estimated that total direct employment over the 24-month construction period would be equivalent to 2,854 FTE jobs, with the equivalent of 1,712 FTE jobs expected to be filled by Oregon workers.[211] Total direct labor income during pipeline construction would be approximately $926 million; with $544 million of this total expected to be paid to Oregon workers (table 4.9.2.4-2).

Constructing the pipeline would also support an estimated total of 4,102 indirect and 6,344 induced FTE jobs. In addition, pipeline construction would support total (direct, indirect, and induced) output, value added, and labor income of $2.8 billion, $1.3 billion, and $1.1 billion, respectively (table 4.9.2.4-2).

211 Pacific Connector revised its construction workforce estimates in a November 2018 filing with the FERC, increasing the length of the construction period and the total number of FTE workers. These changes would likely result in an increase in direct impacts in Oregon, as well as potential increases in indirect and induced impacts.

TABLE 4.9.2.4-2

Regional Economic Impacts of Construction of the Pacific Connector Pipeline Project in Oregon

Impact Type a/	Output b/	Value Added b/	Labor Income b/	FTE Jobs b/
Total Direct Impacts	$2,460	na	$926	2,854
Local Impacts (State of Oregon) c/				
Direct	$1,400	$578	$544	1,712
Indirect	$591	$313	$241	4,102
Induced	$820	$467	$272	6,344
Total d/	**$2,811**	**$1,359**	**$1,056**	**12,159**

Notes:
na = not applicable.
a/ Pacific Connector revised its construction workforce estimates in a November 2018 filing with the FERC, increasing the length of the construction period and the total number of FTE workers. These changes would likely result in an increase in direct impacts in Oregon, as well as potential increases in indirect and induced impacts.
b/ Impacts are presented for the entire construction period. Output, value added, and labor income are expressed in millions of dollars.
c/ Local impacts in this context are impacts that would occur within the state of Oregon. Direct impacts are the share of the total direct impacts expected to occur in Oregon.
d/ Totals may not sum due to rounding.
Source: ECONorthwest 2017c

Based on the share of workers expected to commute daily to and from pipeline work sites, an estimated 489 of 685 annual average direct FTE jobs would be filled by local workers (i.e., workers typically residing in or near the county where the work would take place) (ECONorthwest 2019). ECONorthwest (2019) estimated that construction employees (including resident, itinerant, and commuting employees) for the LNG terminal and pipeline would together spend an annual average of $51.9 million in Coos County and support annual average local business sales of $70.3 million and 642 local jobs. Pipeline construction workers alone would spend from $5.6 million (Klamath County) to $24.6 million (Jackson County) in the other three counties, supporting from $7.8 million to $38.4 million in local business sales and from 68 to 327 local jobs (table 4.9.2.4-3).

TABLE 4.9.2.4-3

Local Economic Impacts of Construction of the Pacific Connector Pipeline Project by County

County	Annual Average FTEs by Place of Residence a/	Construction Employee Spending a/	Local Business Sales a/	Local Jobs Supported (FTEs) a/
Coos b/	132	$51.9	$70.3	642
Douglas	107	$13.5	$18.7	159
Jackson	202	$24.6	$38.4	327
Klamath	48	$5.6	$7.8	68
Itinerant and Commuters	196	na	na	na
Total c/	**685**	**$95.7**	**$135.2**	**1,196**

Notes:
na = not applicable.
a/ Impacts are estimated annual average impacts. Employee spending and local business sales are expressed in millions of dollars.
b/ Estimated construction employee spending, local business sales, and local jobs for Coos County include the impacts of spending by LNG terminal workers, as well as pipeline workers.
c/ Totals may not sum due to rounding.
Source: ECONorthwest 2019

In the first full year of operations, Pacific Connector would directly employ 15 workers in Oregon, with total labor compensation (including benefits and payroll taxes) of approximately $3.1 million.

This direct employment in conjunction with facility expenditures on Oregon sourced goods and services would support additional economic activity in Coos, Douglas, Jackson, and Klamath Counties and elsewhere in Oregon. Annual pipeline operation is estimated to support total (direct, indirect, and induced) employment of 180 FTE jobs in Oregon in the first full year of operations, with total associated labor compensation of approximately $11.3 million. Viewed in 2017 dollars, total compensation would be about $9.5 million or $53,200 per FTE job (ECONorthwest 2017d).

All of the pipeline operations workforce would likely reside in or near one of the four counties crossed by the pipeline, with pipeline-related expenditures also expected to occur locally (i.e., in the four counties). ECONorthwest (2019) estimated that operation employees for the LNG terminal (180 FTEs) and pipeline (15 FTEs) would together spend an annual average of $12.2 million in Coos County and support annual average local business sales of $29.5 million and 120 local jobs, with the most of these impacts associated with operation of the LNG terminal. Pipeline operations in the other three counties crossed by the pipeline would support a combined total of approximately $2.9 million in business sales and 25 local jobs (ECONorthwest 2019).

As noted with respect to the Jordan Cove LNG Project, indirect and induced impact estimates developed by ECONorthwest (2017c, 2017d) are based on the share of construction expenditures that Pacific Connector estimates would occur in Oregon. Changes in actual levels of in-state spending would result in changes to the indirect and induced impact estimates.

4.9.2.5 Tax Revenues

The Pacific Connector pipeline would generate federal, state, and local tax revenues during both the construction and operation phases of the Project. Federal tax revenues would be generated from federal income tax on Project-related earnings. There is no sales and use tax in Oregon, but state tax revenues would be generated through income and lodging taxes. Local tax revenues would be generated from property taxes and city lodging taxes.

Federal lands generate revenues for local counties through 25 percent fund/Secure Rural Schools payments and Payment in Lieu of Taxes (PILT) payments. Secure Rural Schools payments are discussed below in section 4.9.3.2. The PILT program is designed to compensate local governments for lost property tax revenue associated with federal lands. Annual PILT payments to the four affected counties in Fiscal Year 2018 ranged from $649,640 in Coos County to $1,864,853 in Jackson County (U.S. Department of the Interior 2018).

Total revenues for the four counties that would be crossed by the pipeline in fiscal year 2018 ranged from $53.7 million in Klamath County to $136.7 million in Jackson County (table 4.9.2.5-1). The intergovernmental revenue category identified in table 4.9.2.5-1 includes payments from the federal and state governments to the counties. These revenues include PILT payments, which help local governments maintain public services such as firefighting and police protection, public schools and roads, and search-and-rescue operations.

TABLE 4.9.2.5-1 **Revenues for the Counties Crossed by the Pacific Connector Pipeline, FY 2016**				
Revenue Type	**Coos County**	**Douglas County**	**Jackson County**	**Klamath County**
Property Taxes	$10,885,634	$10,381,257	$44,526,574	$14,880,953
Other Taxes	$1,616,943	NR	NR	$2,286,584
Intergovernmental Revenues a/	$32,605,736	$45,356,806	$67,917,316	$28,943,974
Licenses, Fees, and Permits	$4,364,063	$1,503,781	$4,438,819	$1,625,383
Charges for Services	$3,213,907	$13,873,162	$18,419,704	$4,614,330
Timber Sales	$5,008,006	NR	NR	NR
Interest on Investments	$635,942	$1,075,756	$1,228,411	$998,495
Other Revenue	$588,448	$4,074,216	$143,402	$356,811
Total	**$58,918,679**	**$76,264,978**	**$136,674,226**	**$53,706,530**

NR = not reported
Sources: Coos County 2019; Douglas County 2018; Jackson County 2018; Klamath County 2019

During construction, Pacific Connector estimates that the pipeline would generate approximately $91 million in federal income tax based on an estimated construction payroll of $537 million and an average federal income tax rate of 17 percent. The estimated construction payroll would also generate approximately $40.1 million in state income tax, assuming an average state income tax rate of 9 percent. Temporary workers associated with pipeline construction would generate approximately $374,000 in state lodging taxes, as well as an estimated $1.9 million in local lodging taxes that would be distributed across the four counties. Pacific Connector also estimates that personal property taxes on approximately $728 million worth of equipment and materials either purchased in or brought into Oregon would generate about $10.9 million in tax revenues.

During operation, Pacific Connector estimates that the pipeline would generate approximately $518,000 in annual federal taxes based on estimated labor income during the first year of operation, as well as an estimated $233,000 in annual state income taxes. Pacific Connector would also pay property taxes based on the value of the installed pipeline and associated aboveground facilities and the number of pipeline miles in each county. ECONorthwest estimated pipeline property taxes based on 2016 tax rates and the number of pipeline miles in all taxing jurisdictions crossed by the pipeline. Over the initial 20 years of operations, the pipeline is expected to generate approximately $4.7 million in average annual property taxes in Coos and Douglas Counties and approximately $5.3 million in average annual property taxes in Jackson and Klamath Counties (ECONorthwest 2017d). Property tax payments would vary over time due to pipeline depreciation and changing tax rates.

The Pacific Connector pipeline would not involve federal land disposal, acquisition, or exchange and is, therefore, not expected to affect existing PILT or 25 percent fund/Secure Rural Schools payments to the affected counties.

4.9.2.6 Public Services

Law Enforcement and Fire Protection

The pipeline route crosses four counties, each with its own Sheriff's office, employing a combined total of almost 400 officers. In addition, 23 municipalities have their own police departments, with a combined total of more than 350 officers. There are more than 30 municipal fire departments and approximately 40 Rural Fire Protection Districts in the four counties that would be crossed by the pipeline, with a combined total of approximately 1,750 firefighters. As discussed in section 4.9.2.1, estimated temporary increases in population during peak construction would range from 0.4 percent of the existing total in Klamath County to 1.3 percent in Coos County. This relatively minor and short-term influx of non-local workers and their families during the peak construction period is not expected to adversely affect existing law enforcement or fire-fighting capabilities.

The USDOT is mandated to provide pipeline safety, and the USDOT pipeline standards are published in 49 CFR Parts 190-199. Part 192 of 49 CFR specifically addresses natural gas pipeline safety issues. Part 192 requires that each operator must establish and maintain liaison with appropriate fire, police, and public officials to learn the resources and responsibilities of each organization that may respond to a natural gas pipeline emergency and to coordinate mutual assistance. The operator must also establish a continuing education program to enable customers, the public, government officials, and those engaged in excavation activities to recognize a gas pipeline emergency and report it to appropriate public officials. Pacific Connector would provide the appropriate training to local emergency service personnel before the pipeline is placed in service. No additional specialized local fire protection equipment is expected be required to handle pipeline emergencies. Pipeline safety is discussed further in section 4.13 of this EIS.

Pacific Connector has developed an *Emergency Response Plan Concept Paper*, a *Fire Prevention and Suppression Plan*, and a *Safety and Security Plan.*[212] Pacific Connector would be responsible for the cost of implementing these plans. Pacific Connector does not anticipate that implementation of these plans would require additional medical or other public service personnel (including additional police or fire fighting capabilities).

Pacific Connector has indicated that in the event of a pipeline accident, the party deemed responsible for the accident would ultimately be responsible for paying all costs for emergency response, containment, damages, remediation, and repairs for the public and private property affected. In the event of an accident, Pacific Connector would provide emergency support to completely respond to the accident.

Medical Facilities

There are nine hospitals in the four counties that would be crossed by the Pacific Connector pipeline, with a combined total of almost 900 beds (table 4.9.2.6-2). These include four Level III Trauma System Hospitals that can receive helicopter transport and three level IV Trauma Hospitals (table 4.9.2.6-1).

[212] Pacific Connector's Emergency Response Plan Concept Paper, a Fire Prevention and Suppression Plan, and a Safety and Security Plan are included as Appendices H, K, and V, respectively, in its POD filed with the FERC on January 23, 2018 (see appendix F.10 of this EIS).

TABLE 4.9.2.6-1

Hospitals in the Counties Crossed by the Pacific Connector Pipeline

County	Hospital	Town	Trauma Level a/	Staffed Beds	Occupancy Rate 2016
Coos	Bay Area Hospital	Coos Bay	III	129	50.1
Coos	Coquille Valley Hospital	Coquille	IV	17	36.1
Coos	Southern Coos Hospital and Health Center	Bandon	IV	19	6.7
Douglas	Lower Umpqua Hospital	Reedsport	NA	16	18.0
Douglas	Mercy Medical Center	Roseburg	III	129	60.1
Jackson	Asante Ashland Community Hospital	Ashland	IV	37	33.9
Jackson	Providence Medford Medical Center	Medford	III	138	54.5
Jackson	Asante Rogue Medical Center	Medford	III	307	74.5
Klamath	Sky Lakes Medical Center	Klamath Falls	NA	100	52.8

a/ Trauma hospitals differ from other hospitals in that they guarantee the immediate availability of surgeons, anesthesiologists, physician specialists, nurses, ancillary services, and resuscitation life-support equipment 24 hours a day and are dedicated to the care of trauma patients. Trauma facilities in Oregon are designated as Level I, II, III, or IV, with Level I and II centers offering the highest level of care (Oregon Health Authority 2018).
Source: Oregon Association of Hospitals and Health Systems 2018

As discussed above, estimated temporary increases in population during peak construction are expected to be short-term and range from 0.4 percent of the existing total in Klamath County to 1.3 percent in Coos County. If construction employment for the terminal and pipeline were to peak in Coos County at the same time, the combined temporary increase in population would be equivalent to about 4.0 percent of the existing total. Existing medical facilities are expected to be adequate to handle issues resulting from the temporary influx of non-local employees working on pipeline construction. Therefore, we conclude that constructing and operating the pipeline is not expected to have significant adverse effects on emergency services or regional hospitals.

Schools

There are 33 school districts within the four counties that would be crossed by the Pacific Connector pipeline, with a total combined enrollment of almost 64,000 students. Enrollment by county in the 2016-2017 school year ranged from about 9,500 students in Klamath County to almost 30,000 students in Jackson County.

As discussed in section 4.9.2.1, Pacific Connector anticipates that approximately 5 percent of the average workforce relocating to the potentially affected counties would be accompanied by family members, with just 1 to 2 percent of the peak non-local workforce expected to be accompanied by family. Assuming an average household size of approximately 2.74 persons, including 0.55 school-aged children, the temporary relocation of these households would result in the addition of 2 (Klamath County) to 10 students (Jackson County) to county schools. These additions would be equivalent to 0.1 percent of current enrollment or less for all counties and are not expected to noticeably affect existing school facilities and programs. Construction of the pipeline would coincide with terminal construction, resulting in a combined (pipeline and terminal) addition of an estimated 38 students to Coos County schools, which would be equivalent to about 0.4 percent of total county enrollment in 2016-2017.

Operation of the pipeline would require an estimated permanent staff of 15 employees, consisting of 6 operations technicians in Coos Bay (Coos County), 5 employees in Medford (Jackson County), and 4 employees near Malin (Klamath County). Assuming that these employees would all be hired from elsewhere, their permanent relocation along with their families to the area would not be expected to noticeably affect enrollment in local public schools.

Utilities

All four counties crossed by the Pacific Connector pipeline route have existing public utilities already in place, including water, sewers and sanitation, electricity, natural gas and propane, telephone, and cable. Some of those services are provided by county governments or municipalities, and some by private companies.

Construction of the pipeline would have only minor, temporary effects on local community utilities, services, and infrastructure. Pacific Connector would need to hook up to local utilities, including electric power and telephone lines, at its compressor station, three meter station locations, and new communications towers and buildings. Pacific Connector would also use electric power and telephone lines at its contractor yards, where existing power and telephone lines are available. Other than water required for pipeline hydrostatic testing and dust control during construction, Pacific Connector has stated that its Project would not require public water or sewer services. The pipeline would not require wastewater treatment or the construction or expansion of wastewater facilities and existing stormwater drainage systems.

Pacific Connector developed an *Overburden and Excess Material Disposal Plan* and a S*anitation and Waste Management Plan* as part of its POD.[213] During construction, trash and food waste would be collected on a daily basis and removed from the pipeline right-of-way. Excess rocks, overburden, large slash, and timber would be removed to established disposal areas. Following construction, all construction-related debris, including mats, skids, rope, and excess padding, would be removed by qualified solid waste disposal companies to appropriate licensed landfills or recycling facilities.

4.9.2.7 Recreation, Tourism, and Subsistence

Recreation

A recent report by the Outdoor Industry Association (2017) estimated that outdoor recreation and related expenditures in Oregon generated an estimated $16.4 billion in consumer spending and $749 million in state and local tax revenues, supporting 172,000 jobs and $5.1 billion in wages and salaries (Outdoor Industry Association 2017). This included money spent on gear, vehicles, trips, and travel-related expenses.

Concern was expressed by commenters that the proposed pipeline crossing of the Rogue River would affect recreation-related businesses in the nearby community of Trail in Jackson County. The Rogue River is well known for its salmon and steelhead fishery, and this section of the river is popular for recreational floating using rafts and inflatable kayaks. Visitors spend money on outfitter and guide services, bait, and equipment rentals, as well as lodging, restaurants, transportation, and other local goods and services. Pacific Connector proposes to cross the Rogue River using HDD technology, which would avoid direct effects on the river and its fisheries (see chapter 2 and section 4.3) and reduce potential direct effects on recreationists.

[213] Pacific Connector's *Overburden and Excess Material Disposal Plan* and a S*anitation and Waste Management Plan* are included as Appendices Q and W, respectively, in its POD filed with the FERC on January 23, 2018.

Concern was expressed during public scoping that the pipeline would have negative effects on the communities of Shady Cove and Trail by disrupting traffic along SH 62, which parallels the Rogue River and connects these communities to Crater Lake. Viewed as a share of current traffic, the average expected increase in vehicles would range from 1.1 percent to 2.4 percent of estimated totals, with the peak estimated increase ranging from 2.4 percent to 5.0 percent (table 4.9.2.7-1). Pacific Connector developed a Transportation Management Plan to reduce conflicts between construction traffic and recreational users of local roads (see Appendix Y to Pacific Connector's POD [appendix F.10 of this EIS]). Transportation issues related to pipeline construction are more fully addressed in section 4.10.2.

TABLE 4.9.2.7-1

Estimated Construction Traffic Impacts on SH62 near Shady Cove and Trail

SH 62 Location Description	Milepost	2015 AADT	Estimated Increase in AADT	
			Average a/	Peak b/
1.83 miles north of SH 234	15.46	7,900	1.1%	2.4%
0.05 mile south of Brophy Way	18.35	5,500	1.6%	3.4%
0.03 mile north of Indian Creek Road in Shady Cove	19.81	6,200	1.4%	3.0%
0.02 mile north of Rogue River Drive in Shady Cove	20.11	6,400	1.4%	2.9%
Northern city limits of Shady Cove	21.10	4,200	2.1%	4.4%
0.05 mile south of Tiller-Trail Highway (SH 227)	22.37	3,700	2.4%	5.0%

a/ Based on an estimated average of 89 construction-related vehicle round trips per day.
b/ Based on an estimated peak of 187 construction-related vehicle round trips per day.
AADT – average annual daily traffic
Source: Oregon Department of Transportation 2017.

Tourism

Travel spending in the four potentially affected counties in 2018 was approximately $1,151 million, ranging from $146 million in Klamath County to $511 million in Jackson County (table 4.9.2.7-2). Travel spending generated earnings of approximately $377 million and supported approximately 14,420 jobs in the four-county area in 2018. Travel-related employment as a share of total county employment ranged from 4.6 percent (Jackson County) to 10.5 percent (Coos County) (Dean Runyan Associates 2019).

TABLE 4.9.2.7-2

Travel Spending, Earnings, and Employment, 2018

State/County	Travel Spending ($ million)	Earnings ($ million)	Employment	
			Jobs	Percent of County Total (2017) a/
Oregon	12,300	3,600	115,000	Na
Coos	265.1	84.5	3,330	10.5
Douglas	228.7	72.6	3,140	6.1
Jackson	511.3	163.3	5,760	4.6
Klamath	146.0	56.3	2,190	6.7
Project Area Total	**1,151.1**	**376.7**	**14,420**	**Na**

a/ This percentage represents travel-related employment for 2017 as a percent of total employment.
Source: Dean Runyan Associates 2019

As discussed in section 4.9.2.2, during periods of peak demand by pipeline workers and tourists (July to September), short-term housing accommodations in some communities, especially those in Coos, Douglas, and Jackson Counties, would experience lower vacancy rates and upward pressure on rental rates. At peak demand for lodging by construction workers has the potential to temporarily displace tourists at some locations, particularly during weekends of the summer season. As noted in section 4.9.2.2, visitors seeking outdoor recreational opportunities have a wide range of destination choices in southern Oregon and may choose to recreate elsewhere if they were interrupted by pipeline construction at a particular location. However, this temporary displacement could result in reduced demand for some recreation outfitter/guide services, as potential clients seek recreation opportunities elsewhere.

Subsistence

As noted in section 4.9.1.7, Indian tribes have indicated that subsistence users may be adversely affected by the Project. Subsistence has been identified as important to the tribes and their ability to carry on long-standing traditional activities (as well as the basis for their economies, in some instances), with the ability to continue these practices closely tied to tribal health and well-being. Specific concerns identified by the tribes are described in section 4.11 and include the following:

- The Grand Ronde Tribes have indicated that salmon and lamprey, which they believe could potentially be affected by the Project, have particular cultural significance to the Tribes. They have also expressed concern about potential impacts on other aquatic resources, including ESA federally listed bull trout and the Oregon Conservation Strategy species of rainbow trout, cutthroat trout, and Umpqua chub.
- The Klamath Tribes have expressed concern about water quality, the pipeline route crossings of the Rogue and Klamath Rivers, and the potential for the Project to impact fish species that are important to the Tribes.
- The Yurok Tribe has expressed concern that Pacific Connector's proposed crossing of the Klamath River could have potential impacts on tribal trust fish species, including ESA-listed coho salmon, Chinook salmon, steelhead, green sturgeon, and Pacific lamprey. They have also indicated that the potential disruption of fish habitat may have negative impacts on the Yurok Tribal economy that depends, in part, on a commercial salmon fishery.

As described in this EIS, constructing the pipeline would temporarily affect waterbodies that provide habitat for fish, and therefore would result in short-term effects on subsistence fishing in those waterbodies. During construction of the Pacific Connector pipeline, the potential would exist for short-term, localized effects on subsistence hunting, with effects limited to the duration of construction activities in the affected area or areas.

4.9.2.8 Other Commercial Activities

Commercial Fishing

Commercial and recreational fisheries are discussed in section 4.5 of this EIS and section 4.9.1.8 discusses the commercial fishing industry in Coos Bay. There are no commercial fisheries for vertebrate fish species in the Coos Bay Estuary.

Fish are not harvested commercially in the rivers and streams crossed by the pipeline. However, fish such as salmon and steelhead that spawn in affected rivers are commercially harvested in coastal areas off Oregon, Washington, and California, as well as British Columbia and Alaska. A 2009 study estimated that Rogue River salmon commercially harvested off the Northwest coast support annual economic benefits of approximately $1.36 million (ECONorthwest 2009). Constructing the pipeline would affect waterbodies that provide habitat for aquatic resources that are commercially harvested. However, short-term construction-related effects on streams and rivers are not expected to adversely affect the spawning of fish that are commercially harvested from the ocean; as effects such as sedimentation and turbidity would be reduced through the use of erosion control devices. Potential effects resulting from the pipeline crossing waterbodies and mitigation of those effects are discussed in section 4.3, and effects on aquatic resources in stream habitats are evaluated in section 4.5 of this EIS.

Commercial Oyster Farms

Commercial oyster beds are located in South Slough, Haynes Inlet, and Upper Coos Bay, including two commercial oyster operations in the northern portion of Coos Bay near the pipeline crossing: Clausen Oysters and Coos Bay/North Bend Oyster Company. Both companies lease land from the Port of Coos Bay and Coos County and cultivate non-native Pacific and Kumamoto oysters and native Olympia oysters (DeKrey 2017). A study conducted for Pacific Connector estimated that Clausen Oysters had an annual yield of 10 to 13 million oysters, with the potential for gross wholesale revenues of about $2.25 million annually. The same study estimated that Coos Bay/North Bend Oyster Company had an annual yield of 7 to 8 million oysters, with the potential for gross wholesale revenues of about $1.25 million annually. Annual operational costs for both companies were estimated to be approximately 50 percent of gross sales (HDR 2015).

The pipeline would be installed via HDD beneath an active oyster lease area operated by Clausen Oysters. The use of an HDD would generally avoid impacts on Haynes Inlet and this oyster lease area. Appendix I.2 to Resource Report 2 (i.e., the *Drilling Fluid Contingency Plan*) outlines the measures that would be used during construction to avoid or reduce potential disturbance to oyster populations during construction. However, commercial oyster beds could be affected by an inadvertent release of HDD drilling fluids in the immediate vicinity. Contingency plans would be implemented that would reduce the chance of a frac-out spill being substantial and also result in timely clean up, if needed. This is discussed further in section 4.5 of this EIS.

Other Industries

The pipeline would cross mostly rural areas, avoiding densely populated or urban areas, and not result in the displacement of any businesses. Constructing and operating the pipeline would, however, temporarily and permanently affect forested and agricultural lands and associated businesses. The pipeline would cross about 82.8 miles of mature forested lands and 58.8 miles of recently harvested forested lands. Land ownership of forested lands includes privately-owned timberland, state lands, NFS lands, and BLM lands. Approximately 1,050 million board feet (MMBF) of timber was harvested in the four affected counties in 2016, with an annual average harvest from 2011 to 2016 of 1,047 MMBF (ODF 2017b). During Project scoping, private timber companies expressed concern about impacts on their operations. The Seneca Jones Timber Company identified a number of concerns, including potential competition between Pacific Connector and private timber companies for the use of ridge tops for access and equipment placement; possible restrictions related to forest yarding or the hauling of heavy equipment over the installed pipeline; and potential increases in the cost of local aggregate materials. Timber harvesting and the mitigation of effects related to the pipeline are discussed in more detail in section 4.7.

Pacific Connector has indicated that it will require a total of approximately 650,00 cubic yards of aggregate to construct the pipeline and associated facilities spread over 2 years, with an estimated 325,000 cubic yards required each year. Using information from DOGAMI, Pacific Connector estimates that this annual demand would be equivalent to approximately 8 percent of the suitable aggregate produced in the four potentially affected counties. In their assessment, they assume that half of the total aggregate (8 million cubic yards) produced in the four counties would be suitable for use in pipeline construction. Therefore, we conclude that pipeline construction is unlikely to result in a measurable decrease in the availability of aggregate or a substantial price increase.

Pipeline construction would affect agricultural land. The majority of the potentially affected land is pasture and cropland used for livestock forage and to grow hay, alfalfa, and food crops. A very small portion of the construction right-of-way would cross land in orchards, groves, vineyards, and nurseries. Following construction, a smaller area of agricultural land would be retained within permanent easements or acquired for pipeline operation. This area would include the permanent pipeline corridor, surface facilities, and maintenance right-of-way. The vast majority of these lands could be restored and returned to their original condition and use after the pipeline is installed. Therefore, although impacts could last for several years, most potential effects on agricultural operations would be temporary and short-term in nature. One exception is deep-rooted crops, such as orchards and vineyards, which could not be planted directly over the pipeline. Owners of orchards crossed by the pipeline would lose a percentage of their trees and potential future income. Potential impacts on agriculture are discussed further in section 4.7.

For both temporary and permanent effects, Pacific Connector would negotiate with landowners and provide compensation for timber/crop losses or land taken out of use as a result of pipeline construction.

4.9.2.9 Environmental Justice

Review Methodology

The methodology used for the terminal environmental justice assessment is summarized in section 4.9.1.9. The same general methodology was used for the following pipeline assessment. The analysis area for the pipeline analysis consists of the 19 census tracts that would be crossed by the pipeline route, and one other census tract that is within one mile of the route. The reference community is the state of Oregon, which was selected to provide a consistent benchmark for analysis.

Environmental Justice and Vulnerable Populations

The Pacific Connector pipeline would cross a mostly rural region. The population in all four counties is predominantly White, with persons of Hispanic or Latino origin making up the largest share of the non-White population in all four counties, and statewide (table 4.9.2.9-1).

TABLE 4.9.2.9-1

Race and Ethnicity in Counties Crossed by the Pacific Connector Pipeline a/

Geographic Area	Total	Percent of Total						
		White b/	Hispanic or Latino	Black or African American b/	American Indian and Alaska Native b/	Asian b/	Other Race b/, c/	Two or more races b/
Coos County	62,921	85.6	6.3	0.6	2.0	1.1	0.3	4.3
Douglas County	107,576	88.4	5.5	0.4	1.0	0.9	0.1	3.7
Jackson County	212,070	81.7	12.2	0.6	0.6	1.2	0.5	3.3
Klamath County	66,018	78.7	12.3	0.7	3.2	1.0	0.2	3.8
Oregon	4,025,127	76.5	12.7	1.8	0.9	4.1	0.5	3.6

a/ Data are American Community Survey 2013-2017 five-year estimates compiled by the U.S. Census Bureau.
b/ Non-Hispanic only. The federal government considers race and Hispanic/Latino origin to be two separate and distinct concepts. People identifying Hispanic or Latino origin may be of any race. The data summarized in this table present Hispanic/Latino as a separate category.
c/ The "Other Race" category presented here includes census respondents identifying as "Native Hawaiian and Other Pacific Islander" or "Some Other Race."
Source: U.S. Census Bureau 2019f

Approximately 2.0 percent of the population of Coos County is Native American. The Coquille Tribe and the CTCLUSI are headquartered in the cities of North Bend and Coos Bay, respectively. Native Americans comprise 1.0 percent of the population in Douglas County. The Cow Creek Tribe is headquartered in Roseburg and operates a hotel and casino in nearby Canyonville. Native Americans account for 3.2 percent of the population in Klamath County. The Klamath Tribes are headquartered at Chiloquin.

Data for the six demographic variables assessed in EJSCREEN are presented by county in table 4.9.2.9-2. These variables include low-income and minority populations, along with four other indicators considered by EJSCREEN to be potential indicators of vulnerable populations. These data indicate that the share of the population considered low income by EJSCREEN is higher than the statewide average in all four counties. The data also indicate that the share of the population over age 64 exceeds the state average in all four counties (table 4.9.2.9-2).

TABLE 4.9.2.9-2

Demographic Indicators

Selected Variables a/	Coos County	Douglas County	Jackson County	Klamath County	Oregon
Total Population a/	62,944	107,375	210,916	65,946	3,982,267
Percent of Total					
Minority Population	14	11	18	21	23
Low Income Population	44	42	40	44	35
Linguistically Isolated Population	1	0	2	1	3
Population with Less Than High School Education	11	11	11	12	10
Population under Age 5	5	5	6	6	6
Population over Age 64	24	24	20	19	16

a/ Data are originally from the American Community Survey 2012-2016 five-year estimates compiled by the U.S. Census Bureau.
Source: EPA 2019

Data were also reviewed using EJSCREEN for the 20 census tracts that comprise the analysis area (table 4.9.2.9-3). The share of the population considered minority by EJSCREEN is lower than the state average (23 percent) in all four counties, ranging from 11 percent to 21 percent (table 4.9.2.9-

2). None of the census tracts in Coos, Douglas, or Jackson Counties had minority populations that exceeded the state average. Three census tracts in Klamath County had minority populations that exceeded the state average and were above the "meaningfully greater" threshold of 20 percent identified for this analysis (table 4.9.2.9-3). The Klamath Compressor Station would be located in one of these tracts (9706).

Native Americans ranged from 0 percent to 3.3 percent of total population in the census tracts that would be crossed by or within 1 mile of the Pipeline Project route (U.S. Census Bureau 2019f).

TABLE 4.9.2.9-3

Potential Minority and Low-Income Populations by Census Tract

County/Census Tract	Total Population a/	Total Minority Population (Percent) a/	Compared to the Reference Community	Low Income Population (Percent) a/	Compared to the Reference Community	Households below the Poverty Level (Percent) b/
Coos County	**62,944**	**14**	**0.61**	**44**	**1.26**	**18**
01	5,417	10	0.43	35	1.00	16
02	2,485	9	0.39	38	1.09	14
05.02	2,738	8	0.35	38	1.09	17
08	3,203	10	0.43	34	0.97	10
09	7,371	8	0.35	50	1.43	15
11	5,850	13	0.57	51	1.46	24
Douglas County	**107,375**	**11**	**0.48**	**42**	**1.20**	**15**
1600	8,008	16	0.70	53	1.51	19
1700	3,582	9	0.39	33	0.94	14
1800	4,236	16	0.70	40	1.14	18
2100	4,315	8	0.35	36	1.03	20
Jackson County	**210,916**	**18**	**0.78**	**40**	**1.14**	**15**
25	2,540	6	0.26	28	0.80	8
26	2,732	9	0.39	37	1.06	19
27	6,768	9	0.39	45	1.29	13
Klamath County	**65,946**	**21**	**0.91**	**44**	**1.26**	**18**
9703	3,107	15	0.65	34	0.97	15
9705	1,435	13	0.57	40	1.14	20
9706	1,671	46	2.00	52	1.49	8
9707	1,915	32	1.39	40	1.14	10
9708	2,354	10	0.43	32	0.91	13
9709	4,250	11	0.48	34	0.97	13
9715	4,100	28	1.22	52	1.49	23
Oregon (Reference Community)	**3,982,267**	**23**	**1.00**	**35**	**1.00**	**14**

a/ Data are from EJSCREEN and originally based on data from the American Community Survey 2012-2016 five-year estimates compiled by the U.S. Census Bureau (EPA 2019).
b/ Data are from the American Community Survey 2013-2017 five-year estimates (U.S. Census Bureau 2019d).

The share of the population considered low income by EJSCREEN is higher than the state average (35 percent) in more than half (13 out of 20) of the census tracts that would be crossed by or are within 1 mile of the pipeline. However, only four of the census tracts (Coos County – 11; Douglas County – 2100; and Klamath County – 9705 and 9715) had 20 percent or more of their populations below the poverty level (table 4.9.2.9-3).

The share of the population considered linguistically isolated by EJSCREEN is lower than the state average (3 percent) in all four counties (table 4.9.2.9-2). Two census tracts, both in Klamath County, had linguistically isolated populations that exceeded the state average, with linguistically isolated populations of 6 percent (9707) and 14 percent (9706) versus the statewide average of 3 percent. The share of the population with less than high school education was slightly higher than the state average (10 percent) in all four counties, ranging from 11 percent to 12 percent (table 4.9.2.9-2), with the shares in 13 of the 20 census block groups also exceeding the state average. The populations in the census tracts crossed by the Pacific Connector pipeline tend to be older than the state average, as suggested by the county averages (table 4.9.2.9-2), with the share of the population over 64 exceeding the state average in all 20 census tracts. Only three of the census tracts crossed by or within 1 mile of the pipeline route had a population below age 5 that exceeded the state average.

High and Adverse Impacts

The impacts of constructing and operating the Pipeline Project on the natural and human environments are identified and discussed throughout the environmental analysis section of this document. As described in the numerous environmental resource-specific discussions, we conclude that the Project would not significantly affect the environment or have high and adverse effects on human health or the environment. While no significant impacts were identified, adverse construction-related impacts would likely include emissions from construction equipment, increases in dust and noise, and increases in local traffic that could result in temporary delays at some highway crossings. These impacts would be temporary and localized and with mitigation in place are not expected to be high, as discussed in sections 4.12.1 (Air Quality), 4.12.2 (Noise and Vibration), and section 4.10.2 (Transportation). This includes impacts related to the Klamath Compressor Station, which would be located in census tract 9706 in Klamath County (table 4.9.2.9-3).

Disproportionate Impacts on Environmental Justice Populations

The Pacific Connector pipeline route mostly crosses rural regions with low population densities, and avoids towns and cities. Pacific Connector has indicated that they sought to find the shortest, buildable route between Coos Bay and Malin, Oregon, where the pipeline would originate. Along the way, the pipeline route mostly follows ridges through the mountains. Unlike discrete facilities whose impacts are generally concentrated in one location, a pipeline establishes or expands a narrow corridor often over long distances passing near populations with a variety of social and economic characteristics. The preceding review suggests the presence of potential environmental justice or vulnerable populations in several of the census block groups that would be crossed by the Pacific Connector pipeline. Construction and operation of the pipeline is not expected to result in high and adverse human health or environmental effects on any nearby communities and the likelihood that these potential environmental justice and vulnerable populations will be disproportionately affected relative to other populations in the census tracts crossed by the pipeline is low.

Tribal populations are considered an environmental justice population with the potential to be disproportionately affected by construction and operation of the pipeline as a result of their unique relationship with the surrounding environment. As discussed above, the likelihood that environmental justice and vulnerable populations (including tribal populations) would be disproportionately affected relative to other populations in the census tracts crossed by the pipeline is low. We discuss consultations with Indian tribes and potential Project-related impacts on cultural and other resources that may be important to tribes in section 4.11. In addition, as noted with respect to the LNG terminal in section 4.9.1.9, the recommended cultural resources environmental condition described in section 4.11 includes the recommendation that a revised Ethnographic Report be filed prior to construction, for the review of the FERC staff, SHPO, cooperating federal land-managing agencies, and interested Indian tribes.

4.9.3 Environmental Consequences on Federal Lands

Potential socioeconomic effects of the pipeline on federal lands would be primarily related to timber harvesting, recreation, and transportation. These are discussed in sections 4.7, 4.8, and 4.10, respectively. In addition, the Siuslaw National Forest, which manages lands north of the LNG terminal site, including the ODNRA, has expressed concerns about increases in crime on NFS lands as a result of dispersed camping and increased use by construction workers, as well as increased crime at the Myrtlewood Off-site Park and Ride, with worker vehicles providing opportunities for vehicle break-ins. The Siuslaw National Forest has indicated that camping for purposes other than recreation is not allowed on the NFS lands they manage (Pavoni 2019).

4.9.3.1 Financial Efficiency Analysis

The Forest Service directs that projects involving timber sales include a financial efficiency analysis that compares the anticipated costs and revenues that are part of Forest Service monetary transactions (Forest Service 2002). Pacific Connector prepared a financial efficiency analysis that assesses the net present value of costs and benefits that would accrue to the federal government as a result of construction and operation of the pipeline project. This analysis was prepared in general accordance with direction contained within the Forest Service Handbook.

The analysis is limited to those costs and revenues that would result from the direct use of federal assets (land, timber, and roads) and can be directly quantified based on existing fee schedules. The analysis does not include government administrative revenues that would be generated from the fees charged to process the project application and monitor the right-of-way. In addition, the analysis does not include non-market economic costs or benefits that are not part of federal monetary transactions.

Costs and benefits were projected over a 50-year time period, where appropriate, and discounted using a real discount rate of 4 percent. The analysis identifies two sources of direct government revenue: (1) Pacific Connector's payment for timber that would need to be cut, and (2) Pacific Connector's rental payments for construction access and the pipeline right-of-way. The analysis also identifies three sources of government costs: (1) the value of lost timber productivity along the new right-of-way, (2) the value of non-merchantable trees that would need to be cut prematurely (lost timber growth), and (3) the incremental cost of future maintenance for existing roads that Pacific Connector may upgrade above their existing federal maintenance level (Levy 2008). The present values of these projected revenues and costs are summarized in table 4.9.3.1-1. The projected net present value of the Pacific Connector Pipeline Project based on this analysis is $7.77 million in 2015 dollars (table 4.9.3.1-1).

This analysis does not, however, as noted above, account for other costs and benefits that are not assigned monetary values by the federal government. Other potential impacts (not valued) to federal lands include impacts on recreation, the PCT, grazing, LSRs, and Riparian Reserves (Levy 2008). While no monetary value is assigned to these potential impacts, they are considered in detail elsewhere in this document.

TABLE 4.9.3.1-1

Financial Efficiency Analysis of the Pacific Connector Pipeline Project

Category	Timing	Present Value in 2015 (2010$ millions)
Revenues		
Timber Revenue a/	Year 1 to Year 2	5.25
Temporary Use Permit and Right-of-Way Revenue b/	Year 1 to Year 52	2.67
Costs		
Lost Timber Productivity c/	Year 1	-0.004
Lost Timber Growth d/	Year 1	-0.058
Incremental Road Maintenance e/	Year 3 to Year 52	-0.083
Net Present Value		7.77

a/ Timber revenue was calculated based on the pond value of the estimated timber volume, less the costs of logging and hauling the timber to the mill, slash disposal, and road work. Timber volumes and other values used in this estimate are based on preliminary estimates prepared by Pacific Connector.
b/ This analysis assumes that Temporary Use Permits would be required for construction for 2 years and the right-of-way (ROW) would be required for 50 years. Revenues are estimated based on the federal 2020-2023 Linear ROW Rental Schedule values per acre for the affected counties. The analysis assumes that Pacific Connector would make a one-time payment, rather than make annual payments over the life of the project.
c/ Lost timber productivity was estimated based on the soil expectation value of the lands that would be permanently lost to timber production and is based on an average soil expectation value of $14.30 per acre.
d/ Lost timber growth accounts for the value of non-merchantable trees that would be cleared in the ROW. This value is based on the projected value of these trees at merchantable age. Premature harvest of these trees represents foregone revenue for the federal government and is, therefore, counted as a cost here.
e/ Non-design improvements, such as turn-outs, widening, or blading/grading, to existing roads on NFS and BLM lands would likely be necessary as part of this project and may change the maintenance level of the existing road (by, for example, adding base and gravel to an existing road surface of native materials) and, as a result, impose an incremental maintenance cost on the government. This analysis assumes that all roads on federal lands used by Pacific Connector for construction access would be upgraded from native materials to gravel and, therefore, result in costs at the upper end of the range of possible outcomes. Incremental cost increases are assumed to be $343 per mile per year.
Source: Levy 2008

4.9.3.2 Secure Rural Schools and Community Self-Determination Act

Prior to 2000, in states with national forests and certain BLM lands, 25 percent of the returns to the U.S. Treasury from revenue-producing activities, such as timber sales, were returned to each state for distribution back to counties having acreage within a national forest. Those payments were called the "25 percent fund payments" and were dedicated by law to roads and schools. In October 2000, the *Secure Rural Schools and Community Self Determination Act of 2000* was enacted to stabilize federal payments to states in response to declining federal receipts. The legislation was authorized for implementation for fiscal years 2001 through 2006, and has subsequently been reauthorized, most recently in May 2018 (Forest Service 2018). As mentioned above, the Pacific Connector pipeline would not involve federal land disposal, acquisition, or exchange and is, therefore, not expected to affect existing 25 percent fund/Secure Rural Schools payments to the affected counties.

4.9.3.3 Mitigation of Impacts on Federal Lands

No mitigation of impacts on federal lands specifically related to socioeconomics is currently being considered.

4.9.4 Conclusion

Construction and operation of the Project would result in impacts on socioeconomic resources as described in the preceding sections. Temporary impacts during construction would include increased demand for law enforcement and fire protection, and medical services. These potential construction-related impacts would be temporary and short term. In addition, Project construction would provide direct employment for local workers, support jobs and income elsewhere in the local and state economies, and generate tax revenues for local, state, and federal agencies. However, when the combined effects of the Jordan Cove LNG Project and Pacific Connector Pipeline Project are taken into consideration collectively, construction of the Project has the potential to cause significant effects to short-term housing in Coos County. These impacts could include potential displacement of existing and potential residents, as well as tourists and other visitors. Tourists and other visitors could also be displaced during peak construction in Douglas and Jackson counties as Project-related demand for hotel and motel rooms would likely exceed the normally available supply. With the Applicant's proposed construction and operations procedures and mitigation measures in place, construction and operation of the LNG terminal and pipeline facilities are not expected to result in significant impacts on socioeconomic resources or services, with the exception of housing availability. With respect to housing, we recommend in section 4.9.2.2 that Jordan Cove and Pacific Connector designate a Construction Housing Coordinator to addresses construction contractor housing needs in the four affected counties (Coos, Douglas, Jackson, and Klamath).

4.10 TRANSPORTATION

4.10.1 Jordan Cove LNG Project

4.10.1.1 Marine Traffic

Marine traffic in Coos Bay includes deep-draft cargo ships that call at the Port; tugs and barges; and commercial and private fishing and recreational boats. In 2015, 42 deep-draft cargo ships called at the Port, down from about 200 calls per year in the mid-1990s. Nearly 200 commercial fishing vessels operate in Coos Bay from March to October, with just over 100 based in Coos Bay year-round. There is also some transient travel from other commercial vessels through Coos Bay delivering products, buying ice, or seeking other services. Barges, commercial fishing boats, and recreational boats are all shallow-draft vessels that can move out of the navigation channel to avoid deep-draft cargo ships when necessary. All deep-draft cargo ships servicing Coos Bay use the existing navigation channel. They enter and exit the Port under the control of a Coos Bay Pilot.

The LNG terminal would receive approximately 70 water deliveries over a 2-year period. Deliveries would be via a mix of ocean-going vessels and barges. During construction, Jordan Cove would also use barges to transport dredge materials from the LNG terminal access channel and slip for fill at the Kentuck project site, resulting in an estimated 225 barge deliveries over a 4- to 5-month period. The addition of these vessels, about 25 trips per month, would not adversely impact other bay users, such as other commercial ship traffic, fishing vessels, or recreational boaters. Transits would be scheduled with the pilots and follow normal procedures in use for commercial vessel traffic. Jordan Cove would consult with the COE regarding scheduled operation and maintenance activities and other requirements related to dredges and equipment using the navigation channel. Jordan Cove would consult with the Coast Guard regarding other requirements for construction equipment ships and barges (see appendix B).

As described in section 2, Jordan Cove anticipates that LNG carriers would call on the terminal up to 120 times per year. Travel time from the offshore buoy at the beginning of the navigation channel to the terminal is estimated to be about 90 minutes at typical speeds of 4 to 10 knots. Coos Bay pilots would not pilot an LNG carrier through the Federal Navigation Channel under severe weather conditions, or when the volume of other ship traffic in the channel is so heavy that transit to the LNG terminal could be unsafe.

The Federal Navigation Channel can accommodate only one-way deep-draft vessel traffic (i.e., only one vessel at a time; see section 2). An LNG carrier would be unable to use the channel when another deep-draft commercial ship is in transit in Coos Bay, and would instead be held either at the buoy outside the bay or in the marine slip at the Jordan Cove LNG terminal until the other deep-draft ship has completed its transit.

Impacts on fishing and recreational boats in Coos Bay resulting from Project-related ship traffic would be similar to those from current deep-draft cargo ship traffic in the Federal Navigation Channel. In general, as a deep-draft vessel enters the channel, other boats move out of its way, and boats in the ocean near the mouth of the channel defer entering the channel until the larger ships have passed. The escort boats accompanying each LNG carrier would facilitate moving other boats out of the way in a timely manner. As they currently do for other commercial cargo ship traffic, the Coast Guard and OSMB would remind recreational boaters of their obligation to not impede deep-draft vessels transiting in the Federal Navigation Channel. Interactions between deep-draft cargo ships and other boats rarely occur in Coos Bay. The likelihood of a collision between an LNG carrier and another boat would be extremely low because of the mitigation measures imposed by the Coast Guard's WSR, including the implementation of a TMP, and a security zone around LNG carriers in the waterway (typically around 500 yards in size). While an LNG carrier is moored at berth at the terminal, a security zone would be established around the slip. This security zone would not extend as far as the Federal Navigation Channel and would not affect vessels transiting through the channel.

The addition of approximately 70 water deliveries via a mix of ocean-going vessels and barges during the two-year construction period and 120 LNG carriers per year transiting to and from the Jordan Cove LNG terminal during its operation would increase the total number of deep-draft vessels calling at Coos Bay. This increase in marine traffic combined with current deep-draft vessel traffic would be less than historic ship traffic through the channel. The number of calls at the Port of Coos Bay by deep-draft vessels has declined from more than 300 calls per year in the late 1980s, to about 200 calls per year in the late 2000s, to just over 40 in 2015. Therefore, based on this historic capacity, current traffic practices in the bay, and the implementation of Coast Guard shipping measures, we conclude that some marine traffic might be temporarily inconvenienced, but the passage of LNG carriers and other Project-related marine traffic through the channel would not significantly affect other boats in Coos Bay.

4.10.1.2 Motor Vehicle Traffic

As described in section 2, the construction work force would use public roads and highways (U.S. Highway 101 and the Trans-Pacific Parkway) to deliver supplies and access LNG terminal site workspaces.

On behalf of Jordan Cove, DEA prepared a *Traffic Impact Analysis* for the Jordan Cove LNG Project (DEA 2017b) based on a Project study area established by ODOT, Coos County, and the City of North Bend.[214] The 14 intersections that comprise the study area are governed by operational targets or standards established by the applicable jurisdiction (City of North Bend, Coos County, and/or ODOT). The existing conditions (August 2017) analysis performed by DEA found that all study area intersections met the applicable mobility targets during both midweek AM and PM analysis hours. All intersections but one also met the applicable LOS mobility targets during both Friday PM and midday Saturday analysis hours.[215] The exception, the westbound left turn from Ferry Road to U.S. 101, was identified as operating at level of service (LOS) E and, therefore, exceeding the applicable "LOS D" mobility target established by the City of North Bend).[216]

The DEA analysis assessed impacts for four analysis hours, which coincide with peak workforce shift changes. The DEA construction phase analysis assumed two work shifts, with start times staggered by one hour, with only one shift occurring during peak analysis hours. The analysis, therefore, looked at only half the proposed workforce, with the other half of the workforce assumed

[214] This report was filed as part of Jordan Cove's response to FERC's January 3, 2018 Environmental Information Request.

[215] LOS is measured as a function of control delay at intersections, with six established targets ranging from LOS A, where there is little or no delay, to LOS F, where there is delay of more than 50 seconds at unsignalized intersection, or more than 80 seconds at signalized intersections.

[216] Project construction and operation would not add any traffic to the westbound left turn from Ferry Road to U.S. 101 and, therefore, this intersection is not discussed further.

to travel outside of peak analysis hours. The use of two staggered work shifts is intended to reduce construction impacts and assumed to be in place in all the construction-related analyses.

The DEA study analyzed impacts for two construction phases—(1) just before the proposed workforce housing and Park and Ride lots are active; and (2) when the construction workforce would be at its peak with the proposed housing and Park and Ride lots also at peak usage—and the first year of operations.

For the first construction phase, the study found that the intersection of U.S. 101 at the Trans-Pacific Parkway would fail to meet operational targets during the midweek PM and Friday PM analysis hours if no mitigation were provided, with construction-related traffic resulting in vehicle queuing and delays. To address this failure, Jordan Cove would construct a dedicated eastbound left-turn lane (approximately 600 feet in length) and implement a temporary signal at the intersection for the duration of construction activities.

This intersection would also fail to meet operational targets during the second construction phase evaluated in the DEA study. In addition, U.S. 101 at Hauser Depot Road was predicted to fail to meet operational targets during the midweek PM and Friday PM analysis hours, with estimated traffic volumes exceeding intersection capacity resulting in traffic congestion and delays. Jordan Cove would mitigate this impact by implementing manual flagging of the intersection during the PM hours when the construction workforce would be leaving the Myrtlewood Off-site Park and Ride lot.

The DEA analysis of the first year of operation found that all intersections meet the applicable mobility targets.[217]

In summary, the DEA (2017b) study indicates that Project-generated trips during peak construction would result in operational impacts at two study area intersections if no other mitigation were provided. In addition to staggered work shifts (assumed in the analysis), the *Traffic Impact Analysis* recommended the following strategies and mitigation measures:

- U.S. 101 at Trans-Pacific Parkway – construct a dedicated eastbound left-turn lane and employ temporary signalization of the intersection.
- Hauser Depot Road at U.S. 101 – employ manual flagging at the intersection during the PM hours when the workforce is leaving the Myrtlewood Off-site Park and Ride lot.
- Use Park and Ride lots to bus workers not residing at the North Spit housing facility to the Project site.

The Traffic Impact Analysis recommends that Jordan Cove enter into development agreements with ODOT, Coos County, and the City of North Bend to allow the various entities to work through different scenarios should they occur during construction. Such development agreements would provide the framework to allow for timely identification and development of response actions or

[217] The one exception would be the westbound turn from Ferry Road to U.S. 101, which currently fails to meet operational targets. As noted above, operation of the project would not add any traffic to this intersection.

mitigation for unforeseen scenarios that develop during construction. We concur with these findings. Therefore, **we recommend that:**

- **<u>Prior to construction</u>, Jordan Cove should file documentation that it has entered into a cooperative improvement agreement with ODOT and traffic development agreements with Coos County and the City of North Bend, as recommended in the Traffic Impact Analysis report.**

The COE has expressed concern that traffic congestion could impair their ability to transport material to the North Spit for North Jetty Major Maintenance. The results of the above analysis indicate that during terminal construction the intersection of U.S. 101 at the Trans-Pacific Parkway would fail to meet operational targets during the midweek PM and Friday PM analysis hours if no mitigation were provided. The intersection would continue to meet operational targets in the AM analysis hours and throughout the day when deliveries to the North Jetty would be expected to occur. Further, mitigation is recommended to address the anticipated traffic congestion during midweek PM and Friday PM analysis hours. As a result, the potential for traffic congestion-related impacts on the COE North Jetty Major Maintenance is anticipated to be low.

During construction of the LNG terminal slip, excavated material would be transported by truck to upland sites. The excavated material truck haul route would be on Jordan Cove or Roseburg Forest Products owned land and would not cross the Trans-Pacific Parkway. The haul trucks and other equipment using the haul road would consist of large off-road vehicles common for large civil infrastructure or mining projects. The only potential conflict would be with Roseburg chip truck traffic, when the Jordan Cove excavated material trucks cross Jordan Cove Road. This potential impact would be mitigated by construction of a temporary traffic overpass that would segregate traffic traveling to and from the Roseburg Forest Products facility from large, off-road haul trucks and equipment.

4.10.1.3 Railroad Traffic

The existing Coos Bay rail line would be used for the delivery of sheet piling. Over the first year 16 deliveries of sheet piling would occur. However, Jordan Cove has indicated that pending further analysis, additional use of the rail line may be necessary. All rail shipments would be off-loaded at an existing rail spur at the Roseburg Forest Products yard, which runs into the construction laydown area. No new rail construction is anticipated for the purpose of transporting materials and equipment to the site. Rail deliveries would be coordinated with Roseburg Forest Products and Coos Bay Rail Link to reduce impacts on their operations.

4.10.1.4 Air Traffic

The Southwest Oregon Regional Airport is located in the city of North Bend, directly across Coos Bay and less than 1 mile from the LNG terminal site. The airport is owned and operated by the Coos County Airport District and provides commercial passenger services. United Airlines currently provides daily flights to and from San Francisco. United Airlines also provides seasonal twice-a-week flights to and from Denver. Federal Express and Ameriflight operate cargo services out of the airport. The Coast Guard has five helicopters based at the airport. The number of fixed wing aircraft based at the Southwest Oregon Regional Airport has ranged from 51 to 68 for the past 20 years, with 51 aircraft based at the airport in 2010.

Because construction would occur near an airport, Jordan Cove is required by 14 CFR 77 to file notice with the FAA. Based on the information provided in the notice, the FAA would determine if the construction would result in an obstruction to air navigation, navigational aids, or navigational facilities. If the FAA determines that the construction is an obstruction, it will presume that this construction is a hazard to air navigation and will advise all known interested persons, unless further aeronautical study concludes that the construction is not a hazard.

On May 7, 2018, the FAA determined that the LNG marine vessels (at multiple locations during transit), LNG storage tanks, Amine regenerator column, and the thermal oxidizer stack are obstructions and would be presumed hazards to air navigation. However, the FAA's Notices of Presumed Hazard are not final determinations and states that if the maximum heights of the structures that exceed obstruction standards were reduced to 167 feet AMSL, 155 feet above ground level, they would not create a substantial adverse effect and a favorable determination could subsequently be issued. Jordan Cove has indicated that it would continue to meet with the FAA to address the presumed hazards to air navigation.

Based on the FAA's determination that multiple Project components would be presumed hazards to air navigation, we expect that takeoffs and landings, and runway operations could be affected by operation of the terminal. Changes to takeoffs and landings could affect flight times. Jordan Cove estimates that flights could be delayed up to 13 minutes if an LNG carrier is in transit in the vicinity of the airport. Also, changes to takeoffs and landings, departures and approaches, could affect the amount of noise experienced by adjacent communities including residences, recreation sites, and natural areas. Lastly, any change to runway operations could affect commercial and cargo flight services. Given these impacts, we conclude that operating the LNG terminal could significantly impact Southwest Oregon Regional Airport operations.

In comments on the draft EIS, concern was expressed regarding the impact of thermal plumes on flight operations. In response to multiple inquiries about this issue, the FAA in 2015 issued a memorandum to staff concerning a technical guidance and assessment tool for evaluation of thermal exhaust plume impacts on airport operations. In this memorandum, the FAA determined that thermal exhaust plumes in the vicinity of airports may pose a unique hazard to aircraft in critical phases of flight are therefore incompatible with airport operations. Based on our review of the Project, we have determined that thermal plumes emanating from the terminal could adversely affect takeoffs and landings. The FAA encourages airport sponsors and land use planning and permitting agencies to evaluate and take into account potential flight impacts from existing and planned development that produce plumes.

4.10.2 Pacific Connector Pipeline Project

4.10.2.1 Access Roads

Pacific Connector would use a variety of vehicles including standard pick-up trucks, earth-moving equipment, tractor trailers, and pipe-stringing (and other materials/equipment) trucks to construct the pipeline. These vehicles would traverse Project-area roadways and access workspaces via existing and new construction access roads. Equipment and materials would be transported from various laydown areas and storage yards to the pipeline right-of-way and associated construction workspaces. Most construction equipment would remain on the right-of-way during construction.

As described previously, existing roads, including federal and state highways, as well as local, private, and BLM and Forest Service roads, would be used to access workspaces and move construction equipment, materials, and personnel (see table D-2 in appendix D).

Major federal, state, and county highways that would be affected by the pipeline include:

- U.S. Highway 101 (MP 1.2) and State Highway 42 (MP 51.5) in Coos County;[218]
- I-5 (MP 71.2) and Highway 227 (MP 94.7) in Douglas County;
- State Highway 62 (MP 122.6), Butte Falls Highway (132.5), and State Highway 140 (MP 145.6) in Jackson County; and
- State Highway 66 (MP 191.5), U.S. Highway 97 (MP 199.6), and State Highway 39 (MP 208.8) in Klamath County.

The pipeline would be installed in Coos Bay under U.S. Highway 101. State Highways 42, 140, 66, and 39 would be crossed with conventional road bores. Pacific Connector proposes to use direct pipe technology to cross under I-5. State Highway 62 and U.S. 97 would be crossed with HDDs. Highway 227 and the Butte Falls Highway would be crossed with open cuts. Smaller roads would also typically be crossed with open cuts. ODOT does not allow open cut crossings on the State Highway System, including interstate highways.

Constructing the pipeline would temporarily impact Project-area roads and their users. Temporary impacts include increased road traffic, traffic delays, and road wear. To facilitate construction of the pipeline, some existing roads would be improved. Improvements would generally occur on smaller roads and would include widening, base improvement (gravel), and the installation of pullout/passing spaces. Minor improvements (i.e., filling potholes, grading to remove ruts, and/or limbing to remove overgrowth) would be needed in some areas to accommodate oversized and heavy construction equipment. In other cases, roadway improvements would require reconstruction to make the roads usable for access to the construction right-of-way. Pipeline-stringing trucks would haul 40- to 80-foot lengths (joints) of pipe, which would often require travel outside an existing road footprint. Widening access roads would be necessary to accommodate the potential for the stringing trucks to “walk” outside of the existing road footprint. In some circumstances, it may also be necessary for oncoming traffic to pull off of the existing road footprint to pass.

To reduce impacts on affected roads and users, Pacific Connector would implement the measures described in its TMP (Appendix Y to the POD [see appendix F.10 of this EIS). These measures include:

- Obtain all necessary permits from ODOT, BLM, Forest Service, and the counties to cross and/or use roads, and implement all permit stipulations.
- Notify landowners or managers 7 days in advance of planned road work. In cases where there are unforeseen changes to the schedule, provide a minimum 48-hour notice.
- Use flaggers, signs, lights, barriers, and other common traffic control measures.
- Maintain at least one lane of traffic with detours around the construction by plating over the open portion of the trench or by other suitable methods. Where road closures are

[218] Milepost numbers referred to in this section pertain to pipeline mileposts, not highway mileposts. Pipeline MPs are shown on figure 1.1-1 and the pipeline route maps in appendix C.

necessary, limit closures to 24 hours, post signs in advance, provide access for emergency vehicles, and evaluate alternate access for local residents.

- Keep roads free of mud and other debris that may be deposited by construction equipment. Ensure track-driven equipment crosses roads on tires or construction pads to reduce road damage. Repair any roadways damaged by construction activities.

In addition to its use of public roads, Pacific Connector would construct 11 new TARs and 15 new PARs (table 4.10.2.1-1). Almost all of the TARs and 12 of the PARs would be located on non-federal land. After the pipeline is installed, unless specifically requested by the landowner, the TARs would be removed, and the land restored to its original use. Most of the new PARs would be located within Pacific Connector's permanent pipeline easement and would provide access during construction as well as for operations and maintenance activities while the Pacific Connector pipeline is in service.

TABLE 4.10.2.1-1

Proposed New Temporary and Permanent Construction Access Roads

Access Road (TAR/PAR-MP)	Width (feet)	Length (feet) a/	Jurisdiction	County
TAR-3.06	20	1,396	Private	Coos
TAR-12.08	20	468	Private	Coos
TAR-29.53	20	85	Private	Coos
TAR-29.92	16	2,249	Private	Coos
TAR-88.69	20	416	Private	Douglas
TAR-94.81	20	114	Private	Douglas
TAR-101.70	25	1,517	Private/NFS	Jackson
TAR-141.10	25	471	Private	Jackson
TAR-143.19	20	146	Private	Jackson
TAR-145.60	20	391	Private	Klamath
TAR-208.72	20	281	Private	Klamath
TAR-215.72	14	728	Private	Klamath
Total TAR		**7,534**		
PAR-22.16	20	293	Private	Coos
PAR-32.50	20	376	Private	Coos
PAR-51.59	20	118	Private	Douglas
PAR-59.58	25	195	Private	Douglas
PAR-71.46	25	1,466	Private	Douglas
PAR-80.03	25	92	BLM	Douglas
PAR-94.66	25	501	Private	Douglas
PAR-113.66	25	73	Private	Jackson
PAR-122.18	25	181	Private	Jackson
PAR-132.46	25	271	Private	Jackson
PAR-150.70	25	282	BLM	Jackson
PAR-169.48	25	342	Private	Klamath
PAR-187.46	25	438	Private	Klamath
PAR-196.63	20	5	Private	Klamath
PAR-211.58	25	72	Private	Klamath
Total PAR		**4,705**		

TAR = Temporary Access Road; PAR = Permanent Access Road; MP = milepost
a/ All or portions of the PARs are located within the permanent pipeline easement. Estimated total disturbance from TAR = 3.7 acres, total disturbance from PAR = 2.2 acres.

4.10.2.2 Additional Traffic on Local Roads

Pacific Connector assumes that approximately 80 percent of workers would travel each morning to a construction yard, and then make the return trip in the evening. These workers would then be transported from the contractor yard to and from construction workspaces on crew buses. The remaining 20 percent of the workforce would drive their own vehicles to construction workspaces using local roads and highways, with 30 percent of this total expected to carpool with approximately two workers per vehicle. The 20 percent of the workforce using their own vehicles would make two to three daily trips from the contractor yards to various construction locations.

Pacific Connector estimates that between three and four pipe-stringing trucks would make approximately two roundtrips per day between the pipe storage yards and pipeline work sites for the duration of project construction. Three water trucks and three dump trucks would make up to six roundtrips per day to deliver materials and equipment to the right-of-way and control fugitive dust. Another five fuel/lube/maintenance trucks and five equipment trucks would make approximately one roundtrip per day between the storage yards and work sites. Based on these assumptions, average heavy truck traffic during mainline construction is estimated to include 53 vehicle round trips per day along each construction spread. The routes taken by these vehicles would vary depending on the location of construction activities.

Based on these assumptions, construction-related peak vehicle round trips per day would range from 461 to 1,657, including crew buses and heavy vehicle trips (table 4.10.2.2-1).[219]

TABLE 4.10.2.2-1

Estimated Peak Vehicle Round Trips per Day by Pipeline Spread

Vehicle Type/Journey	Spread a/,b/ 1	2	3	4	5
Personal vehicles from place of residence to work sites c/	413	589	284	171	150
Personal vehicles from place of residence to contractor yards	661	942	455	274	239
Worker vans and trucks from contractor yards to work sites d/	52	74	36	21	19
Heavy Vehicle Trips e/	53	53	53	53	53
Total Traffic f/	**1,179**	**1,657**	**828**	**520**	**461**

a/ The spreads initially identified by Pacific Connector are as follows:
Spread 1: Coos Bay (Coos County) to Camas Valley (Douglas County)
Spread 2: Camas Valley to Milo (Douglas County)
Spread 3: Milo (Douglas County) to Shady Cove (Jackson County)
Spread 4: Shady Cove (Jackson County) to Keno (Klamath County)
Spread 5: Keno to Malin (Klamath County)
b/ Pacific Connector has indicated they now plan to use eight construction spreads, which would reduce the number of workers traveling to any one location.
c/ Personal vehicles are assumed to make between two and three trips per day between work sites and contractor yards.
d/ Worker vans are assumed to be 15-passenger crew vans.
e/ Heavy vehicle traffic includes pipe-stringing, water, dump, material, and fuel/lube/maintenance trucks making between one and six trips per day between work sites and contractor yards.
f/ Totals may not sum due to rounding.

Other trips not included in the estimates in table 4.10.2.2-1 include workers building the aboveground facilities, inspectors, and surveyors traveling to and from various work sites.

4.10.2.2 Operations

Operating the pipeline would require a permanent staff of about 15 employees. Project-related traffic during operations would be minimal, occurring on a sporadic rather than regular basis, and would have negligible effects on traffic volumes on roads in the Project area.

[219] These estimates are based on five construction spreads as initially identified by Pacific Connector. Pacific Connector has since indicated that they would use eight construction spreads. Increases in the number of spreads would reduce the number of workers traveling to any one location.

4.10.2.3 Off-Highway Vehicles

Commenters raised concerns during public scoping that the pipeline right-of-way could be used to increase unauthorized OHV, snowmobile, and dispersed motorized access to adjacent lands. OHV use is discussed in section 4.8, Recreation and Visual Resources.

4.10.3 Environmental Consequences on Federal Lands

4.10.3.1 Roads Crossed

The pipeline would cross multiple roads on BLM and NFS lands. Some roads would be crossed at more than one location. The pipeline would be placed within the right-of-way of a number of roads. Open cuts would be used to cross all of the roads on BLM and NFS lands.

4.10.3.2 Roads Used for Access

Pipeline construction would require the use of many miles of existing roads on federal lands, or existing private roads on which federal land-managing agencies hold an easement. The BLM and NFS roads are of varying conditions, and some roads would require improvements to surfacing, brushing, drainage maintenance, and other work to accommodate oversized and heavy construction equipment. In most cases, the potentially affected roads are single-lane forest roads designed and built primarily for the removal of timber using conventional log trucks. Pacific Connector's pipe-stringing trucks would be hauling 40- to 80-foot-long sections of pipe to the right-of-way. These vehicles would be approximately 100 feet long. Because of the size of these and other vehicles that would use these access roads, some minor improvements (straightening, widening, cut and fill, and/or culvert improvements) may be required. In some circumstances, it may also be necessary to construct turnouts for oncoming traffic to "pull out" of the existing road footprint for passing purposes. All road maintenance, reconstruction, and improvements undertaken by Pacific Connector and their contractors would conform to BLM and Forest Service requirements. No maintenance or improvements would be allowed on any road not authorized for use and approved for improvements.

Pacific Connector would construct one new TAR on BLM land. This road would be approximately 0.3-mile-long and would disturb less than approximately 1 acre of land. One TAR would be constructed on NFS lands. This road would also be approximately 0.3-mile-long and disturb less than approximately 1 acre of land (table 4.10.2.1-1). These roads would provide access during construction and would be restored to preconstruction conditions following completion of construction; which would result in a short-term impact.

Pacific Connector would construct three new PARs on BLM land, totaling about 600 feet (see table 4.10.2.1-1). Construction of these new roads would permanently impact approximately one-third of an acre. These roads would provide access during construction and for operations and maintenance activities while the Project is in service. No new PARs would be built on NFS land.

Construction activities at proposed federal road crossings would also affect public access, as well as use by permittees, contractors, and cost share users. Pacific Connector's TMP identifies the roads on federal lands that would be used during Project-related timber extraction activities, and pipeline construction and operations, and specifies the standards that would be utilized where improvements on federal roads are necessary.

As discussed in section 4.10.2.3, Pacific Connector's TMP outlines measures Pacific Connector would implement to maintain public access on roads used for construction access or crossed by the construction right-of-way during pipeline construction.

4.10.3.3 OHV Use on Federal Lands

Federal land managers have raised concerns that the pipeline right-of-way could be used to increase unauthorized OHV, snowmobile, and dispersed motorized access to federal lands. Locations where unauthorized access could be exacerbated by the pipeline right-of-way include the area around the PCT; the Camel Hump area; the Obenchain area; along the Clover Creek Road (on NFS land); and various points on BLM lands. In the Obenchain area, four-wheel-drive vehicles have caused extensive resource damage. The Camel Hump and Obenchain areas are located within the Jackson Access and Cooperative Travel Management Area, which encompasses both private and BLM lands, and is generally closed to motorized use from mid-October through April. In the area along the Clover Creek Road, the pipeline would closely parallel the road for 18 miles (on public and private lands); thus, the pipeline right-of-way could potentially turn into an OHV thoroughfare without appropriate barriers and mitigation.

OHV controls were addressed in Pacific Connector's *Recreation Management Plan* (Appendix S of their POD [appendix F.10 of this EIS]). The general measures Pacific Connector would use to limit OHV access to its right-of-way on federal lands would be the same as those discussed for non-federal lands above.

4.10.4 Conclusion

Constructing and operating the Project would not significantly affect marine or railroad traffic. With the proposed mitigation measures mentioned in previous sections in place, the Project would also not significantly affect motor vehicle traffic. However, we have concluded that the Project could significantly impact Southwest Oregon Regional Airport operations.

4.11 CULTURAL RESOURCES

According to the FERC's Office of Energy Projects' "Guidelines for Reporting on Cultural Resources Investigations for National Gas Projects," cultural resources include any pre-contact or historic archaeological site, district, object, cultural feature, building or structure, cultural landscape, or TCP. Generally, cultural resources are considered to be historic properties[220] under the NHPA if they are at least 50 years old and meet the criteria for listing on the NRHP (36 CFR Part 60.4). It should be noted that consulted Indian tribes[221] have pointed out that their definition of cultural resources is more expansive than that above and may include natural resources or features.[222] As discussed in subsection 4.11.1.3 below, while resources and issues of concern to Indian tribes that do not meet the above definition of cultural resources are described in this section, the reader is referred to the corresponding section of this EIS for a more detailed discussion.

The regulations for implementing Section 106 of the NHPA, at 36 CFR 800.9, encourage the integration of the Section 106 compliance process with the NEPA process; and we have done this as described herein. This section is broken into several subsections that mirror the Section 106 compliance process. The steps of the process, as outlined in 36 CFR 800 are: 1) consultations; 2) identification of historic properties; 3) assessment of effects; and, 4) the resolution of adverse effects. Our first subsection below is a summary of consultations initiated by the FERC staff, and communications the Applicants had with various consulting parties, including other federal agencies, the Oregon SHPO,[223] and interested Indian tribes. Next, we define the area of potential effects (APE), and summarize the results of literature reviews and site file searches, and the results of cultural resources inventories conducted by the Applicants' consultants. Then we discuss the Unanticipated Discovery Plan (UDP) produced by the Applicants for the Project, and reviews by consulting parties. Lastly, we reach conclusions about the status of our compliance with the NHPA. Appendix L includes a cultural context for the Project, a brief summary of archaeological research in southern Oregon, detailed listings of consultations with the Oregon SHPO and interested Indian tribes, and detailed listings of identified cultural resources in the APE of the terminal and pipeline, anticipated impacts on those resources, and proposed methods to address those effects.

Section 101(d)(6) of the NHPA states that properties of traditional religious and cultural importance to Indian tribes may be determined eligible for the NRHP. In carrying out our responsibilities under Section 106 of the NHPA, the FERC staff consulted with Indian tribes that

[220] Historic properties include any pre-contact or historic district, site, building, structure, or object, and properties of traditional religious or cultural importance to Indian tribes listed on or eligible for listing on the NRHP, as defined in 36 CFR 800.16(l).

[221] 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."

[222] Although "cultural resources" are not defined in 36 CFR 800, it is a "term-of-art" in the field of historic preservation and archaeological research. Some Indian tribes believe that cultural resources could include natural resources, such as plants and animals of traditional importance to tribes, and topographic features, such as mountains and rivers, and viewsheds that may be sacred. See, for example, the July 2, 2019 letter from the Cow Creek Band to the FERC commenting on our March 29, 2019 draft EIS (accession number 20190711-0021)

[223] In all cases, the SHPO refers to the staff of the Oregon State Historic Preservation Office within the Oregon State Parks and Recreation Department, including the State Archaeologist.

may attach religious and cultural importance to properties in the APE. On behalf of all the federal cooperating agencies, as the lead federal agency, the FERC staff conducted government-to-government consultations with Indian tribes that may be interested in the Project, and may have concerns about potential impacts on cultural resources and historic properties, including traditional religious and cultural properties. Consultations with Indian tribes are detailed below.

As the lead federal agency under Section 106 of the NHPA, the FERC is required to take into account the effect of its undertakings[224] (including authorizations under Sections 3 and 7 of the NGA) on historic properties and afford the Advisory Council on Historic Preservation (ACHP) an opportunity to comment. Jordan Cove and Pacific Connector, as non-federal applicants, are assisting the FERC in meeting its obligations under Section 106 by providing data, analyses, and recommendations in accordance with 36 CFR 800.2(a)(3) and the FERC's regulations at 18 CFR 380.12(f). The Applicants are using the services of a consulting firm (Historical Research Associates, Inc. [HRA]) to gather cultural resources data. The FERC remains responsible for all findings and determinations under the NHPA.

As the lead federal agency for the Project, the FERC will address compliance with Section 106 on behalf of all the federal cooperating agencies in this EIS.[225] However, the federal land-managing agencies still have separate obligations regarding cultural resource management under other federal laws and regulations, including, but not limited to, the Antiquities Act of 1906, Section 110 of the NHPA, Archaeological and Historic Preservation Act of 1974, Archaeological Resources Protection Act of 1979, FLPMA, and the Native American Graves Protection and Repatriation Act.

4.11.1 Consultations

In accordance with Section 106, the FERC staff, on behalf of all of the federal cooperating agencies, identified historic properties potentially affected by the Project in consultation with the Oregon SHPO, interested Indian tribes, and other consulting parties prior to making our determinations of NRHP eligibility and Project effects. We also consulted with the SHPO, interested Indian tribes, and other consulting parties to determine the resolution of adverse effects on historic properties that cannot be avoided. All correspondence related to these consultations can be found in the Commission's administrative record. A detailed listing of communications and comments received from the Oregon SHPO and interested Indian tribes are included in appendix L.

Consultations for the current Project began with the issuance of the NOI on June 9, 2017. The NOI was sent to a wide range of stakeholders, including other federal agencies such as the ACHP, U.S. Department of the Interior Bureau of Indian Affairs (BIA), BLM, COE, Forest Service, Reclamation, and NPS; state and local government agencies, such as the Oregon SHPO; affected landowners; regional environmental groups and non-governmental organizations; and Indian

[224] "Undertaking means a project activity, or program funded in whole or in part under the direct or indirect jurisdiction of a Federal agency, including those carried out by or on behalf of a Federal agency; those carried out with Federal financial assistance; those requiring a Federal permit, license or approval; and those subject to state or local regulation administered pursuant to a delegation or approval by a Federal agency," as defined in 36 CFR 800.16(y).

[225] Pursuant to 36 CFR 800.2(a)(2), the EPAct, and the May 2002 Interagency Agreement on Early Coordination of Required Environmental and Historic Preservation Reviews.

tribes that may have an interest in the Project area. The NOI contained Section 106-specific text initiating consultations with the SHPO and soliciting their views and those of other government agencies, interested Indian tribes, and the public on the Project's potential effects on historic properties.

4.11.1.1 Consultations with the SHPO

FERC Staff Consultations

Consultations between the FERC staff and the Oregon SHPO about the Jordan Cove LNG terminal and Pacific Connector pipeline, including meetings and correspondence, date back to 2006. Consultations between the FERC and the SHPO from 2006 to 2009 were summarized in section 4.10.1.1 of the final EIS we produced in May 2009 for the Jordan Cove LNG import terminal and original Pacific Connector sendout pipeline in Docket Nos. CP07-441-000 and CP07-444-000. Consultations with the SHPO between May 2009 and September 2015 were documented in section 4.11.1.1 of the final EIS we issued in September 2015 for Docket Nos. CP13-483-000 and CP13-492-000. Consultations between the FERC and the SHPO after September 2015, related to Docket Nos. CP17-494-000 and CP17-495-000, are summarized in table L-1 in appendix L.

Communications by the Applicants with the SHPO

Communications between the SHPO and the Applicants after September 2015 are summarized in tables L-2 and L-3 in appendix L.

4.11.1.2 Consultations with Indian Tribes

The unique and distinctive political relationship between the United States government and Indian tribes is defined by treaties, statutes, executive orders, judicial decisions, and agreements. These have resulted in differentiating tribes from other entities that deal with, or are affected by, the federal government. This relationship has given rise to a special federal trust responsibility, involving the legal obligations of the United States government toward Indian tribes and the application of fiduciary standards of due care with respect to Indian lands, tribal trust resources, and the exercise of tribal rights.

The FERC acknowledges that it has trust responsibilities to Indian tribes. The FERC issued a "Policy Statement on Consultations with Indian Tribes in Commission Proceedings" in Order 635 on July 23, 2003, which was supplemented in an October 17, 2019 policy statement. [226] The supplemented policy includes the following key objectives:

- the Commission will endeavor to work with Indian tribes on a government-to-government basis, and will seek to address the effects of proposed project on tribal rights and resources though consultations;
- the Commission will ensure that tribal resources and interests are considered whenever the Commission's actions or decisions have the potential to adversely affect Indian tribes or Indian trust resources;
- the Commission will set forth in its environmental documents and orders how tribal input resulting from consultations is considered in agency decisions for infrastructure projects; and

[226] 169 FERC ¶ 61,063, Docket No. PL20-1-000, Order 863.

- the Commission will consider the effect of its actions on Indian treaty rights in its NEPA and decision documents.

This EIS, below and in appendix L, discusses treaties and consultations with interested Indian tribes.

The FERC contacted Indian tribes that may attach religious or cultural significance to sites in the region or may be interested in potential Project impacts on cultural resources. We identified Indian tribes that historically used or occupied the Project area through standard ethno-historical sources, such as the *Handbook of North American Indians* (Suttles 1990), communications with the SHPO and the Oregon Legislative Commission on Indian Services, input from federal cooperating agencies, information provided by the Applicants, and scoping responses to our June 9, 2017 NOI, including letters from interested Indian tribes.

Indian tribes identified in the region are the Burns Paiute Tribe, Confederated Tribes of the Lower Umpqua, Coos, and Siuslaw Indians (CTCLUSI), Coquille Indian Tribe (Coquille Tribe), Cow Creek Band of Umpqua Tribe of Indians (Cow Creek Tribe), Fort Bidwell Paiute Tribe, Confederated Tribes of the Grand Ronde Community of Oregon (Grand Ronde Tribes), Hoopa Valley Tribe, Karuk Tribe, Klamath Tribes, Modoc Tribe of Oklahoma, Pit River Tribe, Confederated Tribes of Siletz Indians (Siletz Tribes), Tolowa Dee-ni' Nation (formerly Smith River Rancheria), and Yurok Tribe.

A context that identifies Indian tribes that historically used or occupied the area affected by the Project, as well as details of the FERC consultations and the Applicants' communications with Indian tribes, can be found in appendix L.

FERC Staff Consultations with Indian Tribes

Consultations between the FERC and Indian tribes after September 2015, related to Docket Nos. CP17-494-000 and CP17-495-000, are listed in table L-4 in appendix L. Some Indian tribes have questioned the nature of our consultations.[227] Consultations between FERC staff and Indian tribes are still ongoing. Tribal consultation efforts were initiated with an e-mail sent on May 9, 2017 to tribes inviting them to participate in a telephone conference call about the Project. This was followed by the NOI issued by the FERC on June 9, 2017, requesting comments about the Project. On April 5, 2018, the FERC staff sent letters to individual Indian tribal leaders. In response to those letters, the CTCLUSI, Coquille Tribe, Grand Ronde Tribes, Karuk Tribe, and Yurok Tribe requested meetings with FERC staff. FERC staff met in-person with representatives of the CTCLUSI in Coos Bay, Oregon on March 22 and June 28, 2017, July 17, 2018, and June 25, 2019; with the Coquille Tribe in North Bend, Oregon on July 16, 2018 and June 12, 2019; with the Cow Creek Tribe in Roseburg, Oregon on June 28, 2017 and June 12, 2019; with the Grand Ronde Tribes at Grand Ronde, Oregon on June 11, 2019; with the Karuk Tribe in Happy Camp, California on July 18, 2018; with the Klamath Tribes in Chiloquin, Oregon on June 29, 2017 and June 13, 2019; and with the Yurok Tribe in Klamath, California on July 18, 2018. Additional emails and telephone conference calls have occurred between the FERC staff and some of the above tribes to discuss specific concerns about the Project (see appendix L).

[227] For example, the CTCLUSI, in their July 5, 2019 letter (accession number 20190708-5040) to FERC commenting on our draft EIS issued March 29, 2019, made a distinction between "staff-to-staff" consultations and consultations among decision-makers.

Comments from Native American Individuals

In addition to government-to-government consultations between the FERC staff and leaders of interested Indian tribes, various other tribal members and individual Native Americans commented about the Project in response to our notice of applications, during scoping, and in comments on our March 29, 2019 draft EIS. Communications between Native American individuals and organizations and the FERC are listed in table L-5 in appendix L. Of these communications, 28 were letters from Native American individuals or organizations submitted as motions to intervene.

In addition to the above letters, several individuals identifying themselves as Native Americans spoke at our public scoping sessions for the Project. Gary Jackson, who identified himself as a member of the Cow Creek Tribe, spoke at the public scoping session held on June 28, 2017 in Roseburg. Dale Ann Frye Sherman Yaqui and Margaret Robbins, who identified themselves as members of the Yurok Tribe, spoke at the public scoping session held on June 29, 2017 in Klamath Falls. Also at the Klamath Falls session, Monique Sonoquie identified herself as Chumash and Apache residing at the Yurok reservation in California; Mirinda Hart identified herself as Wylocki-Wintu from the Round Valley Confederation of Tribes in California; Anna Powell identified herself as a member of the Hoopa Valley Tribe in California; and Della Sanchez and Taylor Tupper identified themselves as members of the Klamath Tribes. Concerns voiced during the scoping meetings were similar to those identified in the letters from tribal members and Native American individuals listed in table L-5 in appendix L.

A number of Native American individuals provided comments at the public sessions for taking comments on the draft EIS held by the FERC in southern Oregon the week of June 24-27, 2019.

Applicants' Communications with Indian Tribes

Contacts between the Applicants and Indian tribes are listed in tables L-6 and L-7 in appendix L of this EIS.[228] Specific interested Indian tribes were provided the opportunity by the Applicants to review research designs and cultural resources investigations reports. Some tribal representatives also participated in surveys and monitored subsurface testing.

4.11.1.3 Issues Raised by Indian Tribes

This section summarizes the comments received from consulted Indian tribes. Tribes raised a wide variety of topics, not necessarily limited to historic properties considered under Section 106. In general, issues of concern, outside of the NHPA process, raised by Indian tribes included:

- Indian trust assets;
- traditional lifeways;
- water quality;
- aquatic species/fisheries;
- wildlife;
- forestry and wildfires;
- air quality and climate change;
- aesthetics;
- geologic hazards and general safety of the Project;
- environmental justice and socioeconomics; and
- cumulative impacts of the Project.

[228] These communications were documented in Jordan Cove's and Pacific Connector's September 2017 applications to the FERC and their subsequent responses to staff's multiple environmental information request since January 2018.

We summarize tribal concerns, raised prior to the issuance of our draft EIS on March 29, 2019,[229] in consultations with the FERC, below, by individual tribe. However, where a tribal concern for a natural resource not considered under Section 106 was discussed, the reader is referred to the corresponding section of this EIS for a more detailed description of those resources, and where applicable, the impacts of the Project on those resources under NEPA.

Confederated Tribes of Coos, Lower Umpqua, and Siuslaw Indians

In several different filings with the FERC, the CTCLUSI indicated that they consider the geographic area of the Coos Bay estuary to be a TCP Historic District, known as "*Q'alay ta Kukwis schichdii me*" (Jordan Cove and the Bay of Coos People). The CTCLUSI have issued two resolutions (Resolution No. 2006-097 and Resolution No. 2015-049) mentioning the TCP. The CTCLUSI also began the process of nominating the District to the NRHP. There are no federal laws that would prevent a project from crossing a TCP. However, there are regulations (36 CFR 800) and an NPS bulletin (Parker and King 1998) that provide guidance about evaluation of significance, assessing impacts, and mitigating effects on TCPs.

The CTCLUSI are concerned that Project-related activities at the terminal (Ingram Yard) and South Dunes area, such as drilling, grading, dredging, and vibro-compaction, may impact buried village sites and Indian graves documented in the Tribes' database of cultural resources. In its January 29, 2018 letter to the FERC staff, the CTCLUSI stated that a pre-contact shell midden deposit was found deeply buried in Coos Bay during geotechnical testing conducted for the Pacific Connector pipeline HDD. A report that provided the results of monitoring of geotechnical borings (Derr et al. 2018) did not identify any deeply buried shell middens or cultural resources in Coos Bay, as described by CTCLUSI.

Jordan Cove's consultants have recommended monitoring of construction by professional archaeologists and tribal representatives. Any cultural resources or human remains uncovered during monitoring would be handled according to the Project's UDP. In addition, Jordan Cove has executed a Cultural Resources Protection Agreement (CRPA) with the CTCLUSI that provides for tribal monitoring of construction activities. As articulated in its July 10, 2017 letter to the FERC, the CTCLUSI are concerned that traditional activities of its members in the Project area, including the gathering of plants, harvesting of shell fish, fishing, and hunting, may be restricted by the proposed Project. In this EIS, we address Project-related impacts on upland vegetation and timber in section 4.4, terrestrial wildlife in section 4.5.1, and aquatic resources in section 4.5.2. Some tribal concerns in regard to species gathered, fished, or hunted are addressed in those sections. It should be noted that Jordan Cove's proposed LNG terminal upland facilities would be located on private lands where tribal access has been limited since the Luse family sold its ranch on the North Spit in 1883.[230] Likewise, about 64.4 percent of the Pacific Connector pipeline route would be located on private lands where tribal access may be prohibited.

[229] Comments from Indian tribes on our draft EIS are addressed elsewhere in this EIS.

[230] William Luse, the son of H.H. Luse, who established a sawmill at Empire in 1855, was once married to a Coos woman, and was involved in the Indian community at Jordan Cove. The Luses acquired the properties of the Henderson, Barnett, Crawford, and Jordan families, which included Coos members. The lands were consolidated into a large ranch on the North Spit. As long as the Luses owned this land, Indian occupation of the North Spit would have been allowed, but this changed once the property was sold to the Oregon Southern Improvement Company.

The CTCLUSI indicated that they would be funding their own independent ethnographic study of the Coos Bay area. However, more recently, Jordan Cove convened a Cultural Resources Working Group that included interested Indian tribes as participants,[231] and offered individual tribes financial support for them to produce their own ethnographic studies of the Project area. As discussed below in section 4.11.3.1 of this EIS, we are recommending that the Commission Order contain an environmental condition requiring Jordan Cove and Pacific Connector to produce a revised ethnographic study. We expect that study to identify HPRCS to Indian tribes, and address what traditionally gathered plants, fisheries, and hunted species may still exist in the Project area.

The CTCLUSI also expressed concerns about crime, sexual exploitation of women, and negative impacts on the native communities of the Coos Bay area as a result of the operation of a "man-camp" (South Dunes Temporary Workers Housing Complex) during terminal construction; similar to the impacts of "man-camps" of the Bakken oil fields of North Dakota (see Harvard 2015; Adler and Hillstrom 2015; Gillette 2016; Briody 2017; Deer and Nagle 2017; Nienaber 2017; Finn et al. 2016). This issue is discussed in section 4.9, Socioeconomics.

In its July 10, 2017 letter to the FERC, the CTCLUSI requested to be a cooperating agency in the preparation of our EIS. However, on October 25, 2017, the CTCLUSI filed a motion to intervene in the proceeding. It is Commission policy that intervenors cannot also be cooperating agencies. As such, the CTCLUSI's request to be a cooperating agency cannot be granted.

Also in its July 10, 2017 letter, the CTCLUSI requested a meeting between FERC staff and the Tribal Council as part of our government-to-government consultations. Tribal leaders met directly with the Chair of the Commission at FERC headquarters in Washington, D.C., and representatives of the CTCLUSI met face-to-face with Commission staff in Oregon on March 22 and June 28, 2017, July 17, 2018, and June 25, 2019. We consider those meetings, our NOI, our letters to the CTCLUSI, and letters from the Tribes to the Commission to constitute government-to-government consultations.

The CTCLUSI believe that the Project may have negative impacts on Coos Bay's tourism and fishing industries. Effects on fisheries are addressed in section 4.5.2 of the EIS, and we discuss impacts on the tourism industry in section 4.9.

The CTCLUSI are also concerned about potential safety risks that may be caused by earthquakes related to seismic movements along the CSZ, and that an earthquake-triggered tsunami could hit the North Spit. Potential impacts from earthquakes and a tsunami, and LNG terminal safety are discussed in section 4.13 of the EIS.

The CTCLUSI would like an assessment of potential health impacts on tribal members and the general community of Coos Bay. This includes Project-related impacts on water quality and air quality. Jordan Cove will arrange for on-site medical professionals to provide basic care for terminal construction workers, reducing the potential influx of patients to the local medical facilities. Further, Jordan Cove signed a MOU with the State of Oregon that requires Jordan Cove to equip the Bay Area Hospital according to state policies for all hospitals in treating burns. The

[231] While the Working Group also included the Forest Service, BLM, and COE, the FERC was specifically excluded from the Group by the Applicants (probably for *ex parte* reasons).

EIS addresses water quality effects in sections 4.3.1 and 4.3.2, while air quality effects are discussed in section 4.12.1.

The CTCLUSI raise concerns about the clearing of forest, and the potential for Project-caused wildfires. Effects on forested lands and the potential for wildfires are discussed in in section 4.4.

In a letter to the FERC dated January 22, 2018, the CTCLUSI stated that Jordan Cove was not providing advance notification of geotechnical investigations in a timely manner and did not provide the Tribes with detailed work plans. Jordan Cove responded to these issues in a letter to the FERC dated January 25, 2018, detailing the geotechnical investigation work plan and notifications provided to the Tribes. In addition, the CRPA contains procedures for notifications to the CTCLUSI concerning future geotechnical investigations proposed by Jordan Cove.

According to their January 29, 2018 letter to the FERC, the CTCLUSI would like to be engaged in the discussion of impacts on the Project's viewshed. This section discusses indirect impacts on cultural resources through visual and audible intrusions. Section 4.8.2 of the EIS includes a visual assessment. The CTCLUSI also requested that the cumulative impact assessment in the EIS include the Coos Bay, Oregon Section 408/204(f) Channel Modification, which it does (in section 4.14).

Coquille Indian Tribe

On November 8, 2017, the Coquille Tribe requested to be a cooperator in the production of this EIS. We accepted that request in a letter to the Tribe dated April 4, 2018. On July 16, 2018 and June 12, 2019, the FERC staff met in-person with the Coquille Tribe in North Bend, Oregon.

The Coquille Tribe requested that this EIS address potential indirect impacts on Indian trust assets, such as the Coquille Forest. Although Jordan Cove has stated that there are no Indian trust assets "directly adjacent to the APE," the pipeline route is in close proximity to three parcels of the Coquille Forest which are held in trust by the BIA and managed by the Coquille Tribe. There should be no direct impacts on lands held in trust by the Coquille Tribe. The proposed pipeline right-of-way would be as close as 65 feet upslope of the three parcels of the Coquille Forest. Indirect impacts on the Coquille Forest would be similar to other forested lands, which are discussed in section 4.4 of this EIS.

In a February 26, 2019 e-mail to FERC staff, the Coquille Tribe provided a list of important traditional-cultural plant and animal species. The Tribe noted that plant species provided much of the sustenance, shelter, and safety for their ancestors. The upland vegetation in the Project area and wetlands are discussed in sections 4.4 and 4.3 of this EIS, respectively. Plants traditionally used by the Coquille Tribe are identified in section 4.4.1.5. Some traditionally used plants are also considered special status species, and are discussed in section 4.6.

The Coquille Tribe noted that animals (including fish and birds) provided food and raw materials for shelter, technologies, economies, and ceremonial purposes. The Tribe provided a list of some of the animal species that are culturally important to them. Wildlife and aquatic species are discussed in section 4.5 of this EIS. As with the culturally significant plant species listed above, some traditionally important animals are also considered special status species and are discussed in section 4.6.

Cow Creek Band of Umpqua Tribe of Indians

In a letter to the FERC dated October 20, 2017, the Cow Creek Tribe stated that the Pacific Connector pipeline route would cross about 122 miles of the Tribe's aboriginal territory or ceded lands. The Tribe is concerned about potential Project-related impacts on cultural resources, and is also concerned about river and stream crossings and impacts on water quality and aquatic resources. Proposed waterbody crossings of the Pacific Connector pipeline route are listed by milepost in table H-3 of appendix H of this EIS. This EIS addresses impacts on waterbodies in section 4.3.2 and impacts on aquatic species in section 4.5.2.

As of September 2018, Pacific Connector has identified 79 archaeological sites along the pipeline route within the historic aboriginal territory or ceded lands of the Cow Creek Tribe, from about MP 42 to MP 168. The FERC has determined that 59 of those sites are listed or eligible for the NRHP or are unevaluated; the remaining 20 sites were found not eligible for listing on the NRHP.

The Cow Creek Tribe has reviewed previously filed cultural resources inventory and evaluation reports, and treatment plans. The Tribe also monitored previous archaeological investigations in their ancestral territory. There is additional cultural resource work to be done for the Project, including additional investigatory work and consultations. However, we expect that Pacific Connector should execute an agreement with the Cow Creek Tribe, similar to the CRPA with the CTCLUSI described above, to continue tribal monitoring of future archaeological investigations. In addition, the FERC will require Pacific Connector to provide future reports of cultural resources investigations, and new treatment plans, to the Cow Creek Tribe for review.

Confederated Tribes of the Grand Ronde Community

In its motion to intervene, filed with the FERC on November 15, 2017, the Grand Ronde Tribes stated that they have maintained a deep connection to the resources and sacred places of their treaty homelands. The Tribes are interested in protecting, enhancing, and restoring tribal culture and natural resources affected by the Project. The Tribes listed specific upland wildlife and aquatic species of special concern. This EIS discusses aquatic species in section 4.5.2, upland wildlife in section 4.5.1, and ESA protected and other special status species in section 4.6.

The Grand Ronde Tribes stated that their ancestors once occupied the region between about MPs 50 and 175 along the Pacific Connector pipeline route. As of 2015, Pacific Connector's consultants recorded 81 archaeological sites along that segment of the proposed pipeline route. Of those, 42 sites were either found to be eligible for the NRHP or are unevaluated; the remaining 39 sites were found not eligible for listing on the NRHP. In a January 16, 2018 letter to the FERC commenting on Pacific Connector's Resource Report 4, the Grand Ronde Tribes requested a reassessment of isolated finds, which do not "accurately reflect the historic land use of the landscape, but is a consequence of many years of cultural resource surveys being undertaken in a piecemeal fashion." The identification of archaeological sites and isolated finds is a matter of survey and recordation methodologies, and we note that Pacific Connector's contractor's methods were confirmed with the Oregon SHPO's acceptance research designs, resource forms, and survey reports. In addition, the Grand Ronde Tribes suggested revisions to Pacific Connector's UDP. Pacific Connector has provided the Grand Ronde Tribes with copies of cultural resources investigations reports for their review.

In its May 4, 2018 letter to the FERC, the Grand Ronde Tribes re-asserted their deep connections with the resources and sacred places of their ancestral homelands in southern Oregon, including Usual and Accustomed areas ceded by treaties with the U.S. government. Pacific Connector has convened a Cultural Resources Working Group and offered individual tribes financial support for them to produce their own ethnographic studies. The Grand Ronde Tribes object to the limited funds and expedited time frame for such studies to be conducted by tribal staff.

On July 20, 2018, the FERC staff held a telephone conference call with representatives of the Grand Ronde Tribes. That call discussed the FERC's NEPA process, and our process for complying with the NHPA.

On September 19, 2018 the Grand Ronde Tribes provided the FERC staff with a comment letter regarding the cultural resource studies completed to date and the Cultural Resources Working Group put together by the Applicants. The Tribes noted they were, to date, yet to receive complete materials documenting cultural resource surveys from the Applicant for the Tribes' review. Concerns were expressed for a lack of consideration of historic properties of religious and cultural significance to Indian tribes. The Grand Ronde Tribes have apprehensions about the Applicant-driven Cultural Resources Working Group.

As discussed below in section 4.11.3.1 of this EIS, we are recommending that the Commission Order contain an environmental condition requiring the Applicants to produce a revised ethnographic study. We expect that study to identify HPRCS to the Tribes, and address what traditionally gathered plants, fisheries, and hunted species may still exist in the Project area.

In a letter to FERC dated October 5, 2018, the Grand Ronde Tribes requested an in-person government-to-government meeting. Staff held a face-to-face meeting with representatives of the Grand Ronde Community at the Grand Ronde Reservation on June 11, 2019.

Karuk Tribe

The Karuk Tribe, in comments to the FERC dated July 5, 2017, raised concerns about potential Project-related impacts on water quality and the salmon fishery in the Klamath River. Since the U.S. government never executed a treaty with the Karuk Tribe, and did not set aside an officially designated reservation for the Tribe, the Karuk Tribe does not have special fishing or hunting privileges on ceded lands that are federally protected as treaty rights.

The Karuk Tribe believes that the Pacific Connector pipeline may contribute sediment to and increase the water temperature of streams crossed. We address impacts on waterbodies in section 4.3.2 of this EIS. Likewise, this EIS discusses aquatic resources in section 4.5.2.

The Karuk Tribe also claims that in the case of a break of the Pacific Connector pipeline, waterbodies would be polluted. However, the pipeline would transport natural gas in gaseous form (not liquid) and, in the unlikely event of an incident and release, natural gas, which is lighter than air, would dissipate into the atmosphere and would not contaminate waterbodies. The Karuk Tribe believes that the Jordan Cove export terminal would include a 420-megawatt power plant. This is not so, as the current proposal has eliminated the power plant.

In their May 3, 2018 letter to the FERC, the Karuk Tribe requested a meeting with staff to discuss the Project. Again, the Tribe mentioned its concerns about the pipeline crossing of the Klamath

River, and its potential impacts on the salmon fishery and the lifeways of the Tribe. The FERC staff met in-person with representatives of the Karuk Tribe in Happy Camp, California, on July 18, 2018.

Klamath Tribes

The Klamath Tribes provided comments about the Project to the FERC in filings on June 7 and 26, September 1, and October 20, 2017, and May 3, 2018. The Klamath Tribes assert that the Pacific Connector pipeline route would cross ceded lands that contain cultural resources of importance to the Tribes, and that former villages and graves may be impacted by construction of the pipeline.

As of 2015, Pacific Connector's consultants have identified 10 pre-contact archaeological sites along the pipeline route in Klamath County. Eight of those sites were evaluated as eligible for the NRHP or are unevaluated. Members of the Klamath Tribes participated in Pacific Connector's cultural resources surveys. Pacific Connector has provided the Klamath Tribes with copies of all previous cultural resource reports, for their review. If the terminal and pipeline are authorized by the FERC, and any unanticipated sites or human remains are found during construction, Pacific Connector would follow the procedures outlined in its UDP, that was previously reviewed by the Klamath Tribes.

The Klamath Tribes requested the opportunity to assist in the drafting of a revision of Pacific Connector's Historic Properties Management Plan (HPMP). A draft HPMP was filed with the FERC by Pacific Connector on October 5, 2018. As part of the previous applications, the FERC staff had recommended that Pacific Connector negotiate an agreement with the Klamath Tribes. We expect that Pacific Connector should execute such an agreement with the Klamath Tribes, similar to the CRPA with the CTCLUSI described above.

The Klamath Tribes are also concerned about water quality, the pipeline route crossings of the Rogue and Klamath River, and the potential for the Project to impact fish species that are important to the Tribes. The 1864 treaty with the Klamath Tribes stated that the Tribes hold "…*the exclusive right of taking fish in the streams and lakes, included in said reservation, and of gathering edible roots, seeds, and berries within its limits*…." However, the Pacific Connector pipeline route does not cross the Klamath Reservation. Pacific Connector proposes to cross under the Rogue River and Klamath River using HDDs, to avoid impacts on those rivers and their associated fisheries. The pipeline would also cross 17 streams or creeks that form part of the Klamath River headwaters in Klamath County. Pacific Connector would use dry methods (flumes or dams) to cross other streams. Erosion controls that would be implemented at stream crossings would limit turbidity and sedimentation. These stream crossings would not result in significant long-term impacts on the fishery resources associated with the Klamath River system. See sections 4.3.2 and 4.5.2 in this EIS for more details about impacts on waterbodies and aquatic resources, respectively, and proposed mitigation measures.

The Klamath Tribes raised concerns about impacts on regional air quality, and the Project's potential contributions to global warming. Air quality is discussed in section 4.12.1 of this EIS.

The Klamath Tribes are also concerned about the potential for the Project's facilities to be impacted by earthquakes and landslides. Earthquakes and landslides along the pipeline route are discussed in section 4.1 of this EIS.

The issue of "man camps" and tribal community safety in those settings has also been raised by the Klamath Tribes. There are no proposed worker housing camps along the Pacific Connector pipeline route. Instead, workers would be dispersed along spreads and find housing in RV camps, rental houses and apartments, and hotels, as discussed in the socioeconomics section (4.9) of this EIS.

The Klamath Tribes cite EO 12898 as requiring the study of impacts of the Project on Environmental Justice communities, including Indian tribes. Although the FERC is an independent regulatory agency excluded from compliance with Executive Orders, in order to address this tribal and general public concern, we analyze in section 4.9 of this EIS whether the Project would have disproportional environmental impacts on minority and low-income populations.

The Klamath Tribes are also concerned that the Project may create opportunities for the looting of cultural remains and historical sights. Information related to the location of these resources is considered confidential and privileged, and are not provided to the public. As a result, the risk of the Project and our analysis resulting in looting of these resources is low.

Tolowa Dee-Ni' Nation

The Tolowa Dee-Ni' Nation, in its letter dated December 6, 2018 to the FERC, described the Nation's "strong opposition [to] and concern" regarding the proposed Project. The Nation noted they cannot support the Project based on the proximity of the pipeline to the headwaters of the Rogue River and the perceived potential for pipeline leaks to impact the waters of the river. As noted elsewhere in this section, the pipeline would transport natural gas in gaseous form which, in the event of a release, would dissipate into the atmosphere and would not contaminate waterbodies. The pipeline would cross under the Rogue River with an HDD, and Pacific Connector would use dry methods to cross other headwater streams. Those techniques, as explained in section 4.3 of this EIS, would reduce impacts on waterbodies and their associated fisheries.

Yurok Tribe

The Yurok Tribe, in its letter dated July 6, 2017 to the FERC, and in its motion to intervene filed October 26, 2017, stated that Pacific Connector's proposed crossing of the Klamath River could have potential impacts on tribal trust fish species. Disruption of fish habitat may have negative impacts on the Yurok tribal economy that depends in part on a commercial salmon fishery. Project-related impacts on aquatic species are discussed in sections 4.5 and 4.6 of this EIS.

When the Klamath Reservation in California was created in 1855 for the Yurok and Hupa people, their rights to fish in the rivers running through the reservation were federally protected. In a 1993 opinion issued by the Solicitor for the U.S. Department of the Interior, it was stated that the entitlement of the Yurok and Hoopa Valley Tribes was limited to 50 percent of the harvest of Klamath-Trinity Basin salmon (Leshy 1993). The Pacific Connector pipeline route does not cross through the Klamath-Trinity Basin of California. The pipeline route would cross the Klamath River in Klamath County, Oregon, within the traditional territory of the Klamath Tribes, where Pacific Connector would use an HDD. The HDD would limit impacts on the Klamath River and its fishery resources.

In addition, the Tribe states that the Klamath Riverscape is a district listed on the Yurok Tribe Register of Historic Properties. Pacific Connector's consultants should review the Klamath Riverscape to determine what effects, if any, the Project would have on it. In their May 4, 2018 letter to the FERC, the Yurok Tribe requested a meeting with staff to discuss the Project. On July 18, 2018, the FERC staff met in-person with representatives of the Yurok Tribe in Klamath, California.

4.11.1.4 Communications with Other Agencies

The BLM, Forest Service, Reclamation, COE, EPA, FWS, and NMFS are federal cooperating agencies in the production of this EIS, and consulting parties with regard to the Section 106 compliance process. The federal land-managing agencies previously provided the FERC with their opinions on NRHP eligibility and pipeline effects for sites on federal land. Comments related to cultural resources received by the FERC from other federal agencies between 2012 and 2015 for Docket Nos. CP13-483-000 and CP13-492-000 are discussed in section 4.11.1.3 of our September 2015 final EIS for those projects. Communications between the FERC and other federal agencies related to cultural resources issues for Docket Nos. CP17-494-000 and CP17-494-000 are discussed below.

In response to our June 9, 2017 NOI for the Project, the EPA filed comments, dated July 10, 2017. One of its comments was that the EIS should discuss compliance with the NHPA, including consultations with the SHPO. In addition, the document should discuss Project-related impacts on tribal, cultural, or other treaty resources. We address EPA's issues in this section.

The ACHP wrote a letter to the FERC dated January 25, 2018, in response to the January 22, 2018 letter from the CTCLUSI to the FERC about geotechnical testing. The ACHP stated that, in general, their agency has "interpreted geotechnical testing as part of project planning for undertakings and not, in and of itself, subject to review by federal agencies under Section 106." They requested that the FERC respond to the Tribes and clarify the purpose of the geotechnical investigations and the place of those investigations in the FERC's Section 106 compliance process. The FERC staff agrees with the ACHP position that geotechnical investigations are considered part of the pre-planning process and not subject to Section 106 compliance. It is FERC practice that pre-construction geotechnical investigations be conducted without FERC review or approval and are not considered to be cultural resource studies or part of the Section 106 process (see FERC 2017). As such, the Applicants do not need permission from the FERC to conduct pre-planning geotechnical work, and these activities do not constitute part of the FERC's undertaking. However, the Applicants may need permits from other federal agencies, such as the COE, for those activities.

Jordan Cove's Communications with Other Agencies

Jordan Cove sent email communications to the COE, SHPO, ODEQ, and ODE on May 19 and November 16, 2017, providing a context for the geotechnical work proposed at the APCO site and about sampling at Kentuck Slough, respectively. Project Activity Updates were also provided to the same agencies via email on September 3, 2017 for September 2017; October 2, 2017 for activities scheduled in October; October 13 and 27 and November 9, 2017 for activities in November; December 1, 2017 for activities scheduled for December 2017; and December 14 and 20, 2017 for activities scheduled for January and February 2018. Details of these communications can be found in appendix L.

Pacific Connector's Communications with Other Agencies

On February 24, 2017, Pacific Connector sent an email to the BLM requesting a review of the list of cultural resource sites located along the pipeline route on BLM lands. On February 29, 2017, the Forest Service called HRA to discuss heritage properties on NFS lands that may be affected by the Pacific Connector Project. On May 26, 2017, Pacific Connector sent an email to the COE, ODE, and ODEQ regarding geotechnical testing to support the proposed HDD under Coos Bay. We detail Pacific Connector's communications since 2015 with other federal and state agencies in appendix L.

4.11.2 Area of Potential Effect

As stated in our NOI, we define the direct APE as all areas subject to ground disturbance, including the construction right-of-way, TEWAs, contractor/pipe storage yards, disposal areas, aboveground facilities, and new or to-be-improved access roads. An indirect APE was also established by the Applicants for each project based on each viewshed.

4.11.2.1 Jordan Cove LNG Project

In the case of the Jordan Cove Project, the direct APE includes the footprint of all potential ground-disturbing actions. Specifically, this includes the South Dunes Site, Ingram Yard, Access and Utility Corridor, Meteorological Station, IWWP, Trans-Pacific Parkway/U.S. 101 Intersection, the planned mitigation sites (Kentuck, Eelgrass, Lagoon, Panhandle, and North Bank), Boxcar Hill laydown and parking area, Roseburg Forest Products and Port laydown sites, APCO Sites 1 and 2, Myrtlewood Off-site Park and Ride, and hydraulic dredge slurry pipelines in Coos Bay. In total, construction of the Jordan Cove LNG terminal facilities would impact about 1,355 acres. We agree with the definition of the direct APE, provided in Jordan Cove's application to the FERC. The Jordan Cove Project facilities are described in more detail in section 2 of this EIS.

The indirect APE is defined to include all areas potentially subjected to the introduction of visual, atmospheric, or audible elements that diminish the integrity of a historic property's significant historic features. Jordan Cove's consultants conducted a windshield survey for a 2-mile radius around the proposed LNG terminal. The existing Boxcar Hill Campground and RV Park was noted in this area. Also found in the indirect APE was a house in the Shorewood area at the northern mouth of Haynes Inlet, the Hilltop House restaurant and Bay Bridge Motel on the north side of the McCullough Bridge, and residential neighborhoods in the city of North Bend (Bowden et al. 2017). The consultants concluded that no historic properties would have a view of the aboveground components of the LNG terminal. As such, the indirect APE was recommended to be the same as the direct APE. However, the consultants did not address visual impacts on the NRHP-listed McCullough Bridge.

The indirect APE would overlap with a portion of the CTCLUSI-nominated *Q'aly ta Kukwis schihdii me* TCP historic district that covers most of the Coos Bay estuary and which Jordan Cove's consultants did not take into consideration because the nomination form was filed after their analysis was conducted. In accordance with the Memorandum of Agreement (MOA) for this Project, the FERC staff will assess if the Project could have an adverse effect on the TCP historic district, in consultations with the SHPO and interested Indian tribes.

The direct APE, which is the same as the indirect APE for the Jordan Cove Project, is depicted in Figure 1-1 of the 2017 survey report (Bowden et al. 2017) filed with Jordan Cove's application to the FERC.

4.11.2.2 Pacific Connector Pipeline Project

Pacific Connector defined the direct APE as all geographic areas that will potentially experience ground disturbances from the construction, operation, and maintenance of the pipeline. This includes a 400-foot-wide survey corridor along the 229-mile-long pipeline route; and areas related to the Project outside that corridor, including TEWAs, USCAs, contractor and pipe storage yards, rock source and disposal sites, hydrostatic discharge sites, new and improved access roads, cathodic protection beds, and aboveground facilities, including communication towers. Pacific Connector's cultural resources contractor estimated that the direct APE covers about 17,037 acres (Derr et al. 2018). We agree with this definition of the direct APE. The Pacific Connector Project facilities are described in more detail in section 2 of this EIS.

Pacific Connector defined the indirect APE to include all geographic areas that would potentially experience visual intrusions or changes as a result of the construction, operation, and maintenance of the pipeline. The pipeline will not produce sufficient noise or odors to warrant consideration of audible or atmospheric/olfactory indirect effects in establishing the indirect APE. Section 4.12.2 of this EIS discusses noise impacts related to the construction and operation of Pacific Connector's facilities. Since the pipeline will be buried, the aboveground components of the project will be related to the associated aboveground facilities and the permanent easement itself, which will be maintained as a 50-foot-wide cleared corridor on the landscape. To identify the indirect APE, Pacific Connector's consultants reviewed the pipeline route for instances where the cleared easement may be noticeably visible, considering 1) current heavily vegetated landscapes with adjacent significant topographical differences and 2) landscapes that are relatively unencumbered by modern intrusions. This analysis determined that locations where the indirect effects APE diverges from the direct APE are limited to locations where the permanent easement traverses a steep, heavily vegetated area, then turns sharply so that the permanent easement could be seen directly from a location outside of the direct APE. The SHPO, in a letter to Pacific Connector's consultants dated January 22, 2016, concurred with the methodology for defining the indirect APE. We agree. Section 4.8.2 of this EIS includes a visual impact assessment of the proposed pipeline right-of-way.

Appendix A of the 2017 pipeline addendum survey report (Derr et al. 2017), filed with Pacific Connector's application with the FERC, contains maps that depict the direct and indirect APEs.

4.11.3 Results of Investigations

Archaeological, historical, and ethnographic contexts of the Project area can be found in the numerous survey reports completed for the Project since 2005. A brief context for Native American tribal occupations of the Project area and a historical summary of archaeological studies in the region can be found in appendix L. Studies conducted specifically for the Project are described and listed below.

4.11.3.1 Jordan Cove LNG Project

Jordan Cove has sponsored cultural resources investigations of its proposed LNG terminal since 2005. Table 4.11.3.2-1 lists the surveys and archaeological testing that cover Jordan Cove's proposed facilities. More detailed summary descriptions of Jordan Cove's cultural resources investigations are provided in appendix L of this EIS.

TABLE 4.11.3.1-1

Cultural Resources Surveys and Testing at Jordan Cove's Proposed LNG Terminal Facilities

Facility or Use Area a/	Survey Reports	Inventory Status
Access Channel (Coos Bay)	Byram 2006a, 2006b; Punke, et al.2018b; Rose et al. 2014	Survey complete
Ingram Yard – Marine Slip including LNG Vessel Berth, Tug Berth, and Emergency Lay Berth	Byram 2006a, 2006b; Punke 2018a; Punke et al. 2018a and 2018b; Rose et al. 2014; Simmons 1983; Stubbs 1975	Survey complete
Rock Apron (Coos Bay)	Hulse 2018 (in Bowden 2018)	Survey not complete
Ingram Yard – Material Offloading Berth	Byram 2006a and 2006b; Punke 2018a; Punke et al. 2018a and 2018b; Rose et al. 2014; Simmons 1983	Survey complete
Ingram Yard – Haul Road	Bowden et al. 2017; Byram 2006a and 2006b; Punke 2018a; Punke et al. 2018a and 2018b; Rose et al. 2014; Simmons 1983	Survey complete
Ingram Yard – LNG Loading Platform and Transfer Pipeline	Byram 2006a and 2006b; Punke 2018a; Punke et al. 2018 and 2018b; Rose et al. 2014; Simmons 1983	Survey complete
Ingram Yard – LNG Storage Tanks	Byram 2006a and 2006b, Punke 2018a; Punke et al. 2018a and 2018b; Simmons 1983	Survey complete
Ingram Yard – Liquefaction Processing Area	Bowden et al. 2017; Byram 2006a and 2006b; Punke 2018a; Punke et al. 2018a and 2018b; Simmons 1983	Survey complete
Ingram Yard – Refrigerant Storage Area	Byram 2006a and 2006b; Punke 2018a; Punke et al. 2018a and 2018b; Simmons 1983	Survey complete
Ingram Yard – Gas Processing Area	Byram 2006a and 2006b; Punke 2018a; Punke et al. 2018a and 2018b; Simmons 1983	Survey complete
Ingram Yard – Utilities	Punke 2018a; Punke et al. 2018a and 2018b; Simmons 1983	Survey complete
Ingram Yard – Flare Area	Punke 2018a; Punke et al. 2018a and 2018b; Simmons 1983	Survey complete
Ingram Yard – Secondary Terminal Entrance	Punke 2018a; Punke et al. 2018a and 2018b; Simmons 1983	Survey complete
Ingram Yard – Laydown Area	Byram 2006a and 2006b; Punke 2018a; Punke et al. 2018a and 2018b; Simmons 1983	Survey complete
Ingram Yard – Other	Macfarlane and Skinner 2013 (in Bowden et al. 2017: Appendix C); Punke 2018a; Punke et al. 2018a and 2018b	Survey complete
Fire Station and Ancillary Buildings at west end of Access and Utility Corridor (north of Roseburg Forest Products)	Byram 2006a and 2006b; Byram and Shindruk 2012; Punke 2018a; Punke et al. 2018a and 2018b	Survey complete
Access and Utility Corridor (Between Roseburg Forest Products and South Dunes)	Barner 1978; Byram 2006a and 2006b; Byram 2008; Byram and Purdy 2007; Byram and Shindruk 2012; Punke 2018a; Punke et al. 2018a and 2018b; Rose and Davis 2013 (in Bowden et al. 2017:Appendix C); Simmons 1983	Survey complete
Laydown Areas (Roseburg Forest Products)	Bowden et al. 2009 and 2017; Byram 2006a and 2006b; Punke et al. 2018a	Survey complete
Temporary Dredge Slurry and Water Return Pipelines (Roseburg Forest Products & South Dunes)	Barner 1978; Bowden et al. 2009; Byram 2006a and 2006b; Byram 2008; Byram and Purdy 2007; Byram and Shindruk 2012; Punke 2018a; Punke et al. 2018a and 2018b	Survey complete

TABLE 4.11.3.1-1 (continued)

Cultural Resources Surveys of Jordan Cove's Proposed LNG Terminal Facilities

Facility or Use Area a/	Survey Reports	Inventory Status
Laydown Area and Temporary Workforce Housing Complex (South Dunes)	Barner 1978; Bowden et al. 2009 and 2017; Byram 2008; Byram and Purdy 2007; Hamilton and Ragsdale 2018; Olander et al. 2009; Punke 2018a and 2018b; Punke et al. 2018a and 2018b; Rose et al. 2014	Survey complete
SORSC (South Dunes)	Bowden et al. 2009 and 2017; Byram and Purdy 2007; Punke 2018a and 2018b; Punke et al. 2018a and 2018b	Survey complete
Administration Building (South Dunes)	Bowden et al. 2009 and 2017; Byram and Purdy 2007; Punke 2018a and 2018b; Punke et al. 2018a and 2018b	Survey complete
Industrial Wastewater Pipeline Replacement and new Water Line (Trans-Pacific Parkway)	Rose and Johnson 2014; Simmons 1984	Survey complete
Port Laydown Site (North Spit – south of Southport facility)	Byram and Purdy 2008; Darby 2005 (in Bowden et al. 2017); Hulse 2018	Survey complete
Boxcar Hill Laydown Area (North Spit – east side of Causeway)	Byram 2009; Derr et al. 2017; Punke et al. 2018b	Survey complete
Meteorological Station and Access Road (Lagoon Mitigation Site)	Bowden et al. 2017; Dinwiddie and Bowden 2018	Survey complete
Channel Improvement Areas 1-4 (Coos Bay)	Hulse 2018	Survey complete
Temporary Dredge Line from Channel Improvement Areas to APCO sites (Coos Bay)	Bowden 2018	Survey complete
Temporary Dredge Line to Eel Grass Mitigation Site (Coos Bay)	Bowden 2018	Survey complete
Eel Grass Mitigation Site (Coos Bay)	Bowden 2018	Survey complete
Temporary Dredge Line to Kentuck Slough Mitigation Area (Coos Bay)	Bowden 2018	Survey complete
Trans-Pacific Parkway Causeway and U.S. Highway 101 Intersection Improvements (north of McCullough Bridge)	Bowden et al. 2017; Byram 2006a and 2006b; Byram 2009; Simmons 1984	Survey complete
APCO Sites 1 and 2 (North Point)	Derr and Punke 2019; Punke and Bowden 2018	Survey complete
Kentuck Slough Wetland Mitigation Area (Kentuck Slough)	Bowden et al. 2009; Bowden et al. 2017; Byram and Walker 2010, Derr et al. 2017; Punke 2018b; Ragsdale et al. 2013	Survey complete
Myrtlewood RV Park Off-Site Parking Lot (Hauser)	Bowden et al. 2017	Survey complete
Lagoon Habitat Mitigation Site	Bowden et al. 2009; Dinwiddie and Bowden 2018	Survey not complete
Panhandle Habitat Mitigation Site	Bowden et al. 2009; Dinwiddie and Bowden 2018	Survey not complete
North Bank Habitat Mitigation Site	Bowden et al. 2009; Dinwiddie and Bowden 2018	Survey not complete

a/ Facilities derived from Table 1.4-1 and Figure 1.1-1 of Resource Report 1 attached to Jordan Cove's application to the FERC, and Table 4.2-2 filed November 2, 2018.

Areas that still require additional survey include the Lagoon, Panhandle, and North Bank habitat mitigation sites. Additionally, the Rock Apron area has only been partially surveyed.

Geoarchaeological deep testing and shovel probing have been conducted in Ingram Yard, the Access and Utility Corridor, and the South Dunes area (Punke et al. 2018; Punke 2018a and

2018b), as well as at both APCO sites (Punke and Bowden 2018; Derr and Punke 2019). A piece of bone was found in a shovel probe at the South Dunes area that was identified as "non-human." No other archaeological evidence was uncovered by the geoarchaeological studies. However, buried surfaces suitable for human habitation were identified beneath the fill layers at tested areas.

Appendix L summarizes the identified and reported resources that are within or adjacent to the direct APE for the Jordan Cove Project. We agree with all recommendations of NRHP eligibilities and effects that have been provided thus far by Jordan Cove's consultants. However, not all of these eligibility determinations have received concurrence from the SHPO yet. For those resources where SHPO concurrence has not yet been requested (pending additional investigations) or is pending, the recommended NRHP eligibilities and effects assessments made by Jordan Cove's consultants are preliminarily used for this analysis.

To date (November 2019), eight pre-contact fish weir sites (35CS261, 35CS263, 35CS324, 35CS326, 35CS327, 35CS328, 35CS342, and 35CS343) were identified along one of the proposed dredge slurry pipeline routes in Coos Bay and were evaluated as eligible for the NRHP (Punke et al. December 2018). In a letter to Jordan Cove, dated July 22, 2019, the SHPO concurred that fish weir sites 35CS261, 35CS263, 35CS342, and 35CS343 are eligible for the NRHP. We asked Jordan Cove to file with the FERC avoidance or treatment plans for those historic properties.[232]

In a letter to the FERC staff, dated July 19, 2019, the Oregon SHPO provided its determination that the TCP "*Q'alay ta Kukwis schichdii me"* Historic District is eligible for nomination to the NRHP.[233] However, the Oregon SHPO also found that "*Q'alay ta Kukwis schichdii me*" should not be listed on the NRHP because of objections from landowners (as the District overlaps portions of the cities of Coos Bay and North Bend). The SHPO forwarded the nomination to the NPS on May 23, 2019, who returned it on July 2, 2019 because of process and documentation deficiencies. However, because the SHPO found the TCP to be eligible, we will treat it as an historic property. We will continue to consult with the Oregon SHPO and interested Indian tribes about an assessment of effects and possible future treatment to avoid, reduce, or mitigate impacts on this TCP.

4.11.3.2 Pacific Connector Pipeline Project

Since 2006, Pacific Connector has hired professional cultural resources management consultants Byram Archaeological Consulting, Southern Oregon University Laboratory of Archaeology, and HRA to conduct surveys and testing investigations in the APE. Table 4.11.3.2-1 lists the reports documenting the archaeological and historical investigations of the proposed Pacific Connector facilities.

[232] See FERC Environmental Information Request dated July 22, 2019, Question 13.

[233] The Coquille Tribe, in a letter to FERC staff dated September 4, 2019, objected to the SHPO's determination for the "*Q'alay ta Kukwis schichdii me*" TCP, claiming the SHPO exceeded its jurisdiction, since a portion of the historic district would cross Coquille lands.

TABLE 4.11.3.2-1

Cultural Resources Surveys and Testing Conducted for the Pacific Connector Project

Title	Reference	Type of Study	Subsurface Investigations	Project Component(s) Surveyed or Tested
Pacific Connector Gas Pipeline Project Cultural Resources Survey, Coos, Douglas, Jackson, and Klamath Counties, Oregon	Bowden et al. 2009	Pedestrian and subsurface	Shovel probe, test units	Portion of pipeline corridor, some TEWAs, some UCSAs, some quarries, some laydown areas, some and access roads.
Cultural Resources Survey for the Pacific Connector Gas Pipeline Project, Addendum Report	Olander et al. 2009 (in Bowden et al. 2017)	Pedestrian and subsurface	Shovel probe	Portion of pipeline corridor and alternatives.
Pacific Connector Gas Pipeline Project Cultural Resources Investigations, Coos, Douglas, Jackson, and Klamath Counties, Oregon, Final Phase II Evaluations	Bowden et al. 2010	Subsurface	Test units	Portion of pipeline corridor.
Pacific Connector Gas Pipeline Project Cultural Resources Survey, Coos, Douglas, Jackson, and Klamath Counties, Oregon, Survey Report Addendum for December 2009 FERC Data Request	Knutson et al. 2010	Pedestrian, intertidal/boat	NA	Portion of pipeline corridor and some laydown areas.
Archaeological Survey of the Oregon Gateway Marine Terminal Slip and Access Channel Mitigation Site at Kentuck Slough	Byram and Walker 2010	Pedestrian and subsurface	Shovel probes and auger probes	Portion of pipeline corridor.
Pacific Connector Gas Pipeline Project Cultural Resources Survey, Coos, Douglas, Jackson, and Klamath Counties, Oregon: 2013 Cultural Resources Addendum	Bowden et al. 2013	Pedestrian and subsurface	Shovel probe	Portions of pipeline corridor, Klamath Falls Compressor Station, and some TEWAs.
Pacific Connector Gas Pipeline Project Cultural Resources Survey: 2013 Cultural Resources Addendum #2	Ragsdale et al. 2013	Pedestrian and subsurface	Shovel probe, deep testing, test units	Portion of pipeline corridor and some TEWAs.
Pacific Connector Gas Pipeline Project Cultural Resources Survey: Phase II Evaluation of Site 35DO1284	Willis et al. 2013	Subsurface	Test units	Portion of pipeline corridor and one TEWA.
Pacific Connector Gas Pipeline Project Cultural Resources Survey, Coos, Douglas, Jackson, and Klamath Counties, Oregon. 2014-2015 Cultural Resources Addendum	Derr et al. 2015	Pedestrian and subsurface	Shovel probes, deep testing	Portion of pipeline corridor, some TEWAs, and one laydown area.
Jordan Cove Energy Project LNG Terminal Cultural Resources Survey, Overview, and Evaluation Report	Bowden et al. 2017	Pedestrian, subsurface, and architecture.	Shovel probes and auger probes	Portion of pipeline corridor.
Pacific Connector Gas Pipeline Project Cultural Resources Survey, Coos, Douglas, Jackson, and Klamath Counties, Oregon. 2017 Cultural Resources Addendum.	Derr et al. 2017	Pedestrian, intertidal/boat, windshield, and subsurface	Test units and shovel probes	Portion of pipeline corridor, some TEWAs, and some access roads.

TABLE 4.11.3.2-1 (continued)

Cultural Resources Surveys and Testing Conducted for the Pacific Connector Project

Title	Reference	Type of Study	Subsurface Investigations	Project Component(s) Surveyed or Tested
Phase II Evaluation of Site 35DO1495	Davis et al. 2018a	Pedestrian survey and testing	Test units and shovel probes	Portion of pipeline corridor.
Phase II Evaluation of Site 35KL4330	Davis et al. 2018b	Pedestrian survey and testing	Test units and shovel probes	Portion of pipeline corridor.
Pacific Connector Gas Pipeline Project Cultural Resources Survey, Coos County, Oregon: 2018 Cultural Resource Addendum 1	Derr et al. 2018a	Pedestrian and subsurface	Shovel probes	Portion of pipeline corridor and some TEWAs and access roads outside the pipeline corridor.
Pacific Connector Gas Pipeline Project Cultural Resources Survey, Coos, Douglas, Jackson, and Klamath Counties, Oregon: 2018 Cultural Resource Addendum 2	Derr et al. 2018b	Pedestrian and subsurface	Deep geoarchaeological testing and shovel probes	Portion of pipeline corridor, some workspaces, and some access roads. Monitoring of geotechnical borings
Archaeological Investigations at North Point, North Bend, Oregon	Derr and Punke 2019	Pedestrian and subsurface	Shovel probes, coring and trenching	Portion of pipeline corridor within APCO sites.

Pacific Connector's contractor indicated that, as of December 31, 2018, approximately 209 miles of the pipeline route (91 percent) and 609 miles of access roads were covered by cultural resources surveys (Derr et al. 2018). As of April 2018, a total of 1,557 work spaces (97 percent) have been surveyed. Surveys were completed for 26 pipe yards and 16 rock source and disposal sites. In September 2018, it was estimated that Pacific Connector had inventoried a total of about 560 acres combined for all the extra workspaces and yards surveyed off the pipeline centerline.[234] All 35 hydrostatic test water discharge sites have been surveyed. Inventories have also been completed covering most of the proposed aboveground facilities except for two MLVs and one communication tower (discussed below in section 4.11.5). Geotechnical borings were excavated in Coos Bay for the proposed HDD under the bay; at the upland western approach to the crossing of Kentuck Slough, at the lowland western side of the proposed crossing of the South Umpqua River near Milo, at the crossing of the Southern Pacific Railroad and Reclamation Drain 5-A in the Klamath Basin, and the west side of the Lost River (Derr et al. 2018); and geoarchaeological deep testing was performed at the North Point of North Bend (Derr and Punke 2019) and the Klamath River crossing (Derr et al. 2015). The geotechnical borings were monitored by professional archaeologists and tribal representatives, and no cultural resources were identified.

Inventories for the Pacific Connector Project have identified 179 recorded and reported archaeological and historic architectural sites (see table L-14 in appendix L). Eighty-nine are aboriginal pre-contact archaeological sites; 46 are historic archaeological sites; 11 are historic sites (built environment); 2 are historic cemeteries; 28 are multicomponent, with both pre-contact and historic remains; and 3 are of undetermined time period. Eighty-five are along a pipeline route; 48 are along access roads; 1 is within a TEWA; 7 are within yards; 35 are along a pipeline route and an access road; and 3 are at the Klamath Compressor Station. Forty-eight of these sites are

[234] Pacific Connector filing with the FERC on March 21, 2019.

located on federal lands (see appendix L); the remainder are on non-federal lands. In addition, 152 isolated finds (IFs) were recorded during surveys for the Project. Two of the IFs, HRA-724i and HRA-727i, require additional investigations to confirm their isolated nature. Both are pre-contact IFs on private lands and are considered unevaluated for NRHP eligibility. After consulting with the SHPO through HRA, we determined that the remaining IFs are not eligible for the NRHP and require no further work. However, some tribes have expressed concern that consideration was not given to the importance of some of these IFs (see table L-4 in appendix L).

Of the 134 sites on non-federal lands, 76 require no further work either because they have been evaluated as not eligible for the NRHP, have been avoided, or anticipated effects would not be adverse (two of these has dual landownership with a federal agency). Two additional sites on non-federal lands are unevaluated and NRHP-eligible and can be avoided, but require consultation or additional survey to confirm. Thirty-nine sites on non-federal lands are unevaluated or considered NRHP-eligible and cannot be avoided, so they need additional investigations, either survey or testing (one of these has dual landownership with a federal agency). Avoidance plans for sites that can be avoided can be found in the draft HPMP filed with the FERC on October 5, 2018. The HPMP is subject to revision based on ongoing consultations between Pacific Connector, Indian tribes, SHPO, and federal land-managing agencies. However, not all unevaluated, potentially NRHP-eligible, and NRHP-listed sites that can be avoided by the Project have avoidance plans; therefore, the draft HPMP still needs further revision.

Twenty sites have been determined to be eligible for or listed on the NRHP and cannot be avoided (see table L-12 in appendix L). In most cases, the Applicants prepared treatment plans for these historic properties, which were reviewed by appropriate interested Indian tribes, federal land management agencies, the Oregon SHPO, and the FERC staff.

4.11.3.3 Federal Lands

The industrial wastewater line replacement at the Jordan Cove LNG terminal would cross a piece of land administered by the BLM. The COE has an easement on a portion of the Jordan Cove LNG terminal. No cultural resources were identified on federal lands associated with the Jordan Cove LNG Project.

The proposed Pacific Connector pipeline route would cross about 71 miles of federal lands administered by the BLM, Forest Service, and Reclamation. In total, 46 sites were identified on federal lands or are otherwise managed by one of these federal agencies (three have dual landownership with private landowners). Thirty-six sites are on BLM lands, 9 are on Forest Service lands, and 1 is managed by Reclamation.

Of the 36 sites on BLM lands, 12 are not eligible for the NRHP and require no further work. Eleven of the BLM sites can be avoided (this includes one site with dual private landownership). Seven of the sites on BLM lands are unevaluated for NRHP eligibility and require additional work, either additional survey or testing, prior to their evaluation for eligibility to the NRHP (this includes one site with dual private landownership). An additional three sites are being treated as NRHP-eligible (this includes one site with dual private landownership). Pacific Connector has proposed conducting testing to confirm eligibility of these sites. Five BLM sites (35DO1104, 35DO1105, 35DO1106, 35DO1110, and 35DO1117) have been determined eligible for the NRHP and cannot be avoided by the Project. Pacific Connector's consultants have recommended that data recovery investigations be conducted to mitigate adverse effects at the unavoidable eligible sites.

Of the nine sites on Forest Service lands, two were evaluated as not eligible for the NRHP, and require no further work. Five Forest Service sites are unevaluated and need additional surveys and evaluations. One Forest Service site can be avoided. One site (35DO1107) on NFS lands is eligible for the NRHP and cannot be avoided. Pacific Connector produced a treatment plan to mitigate adverse effects at 35DO1107, which the Forest Service found acceptable.

The Klamath Project, managed by Reclamation, is eligible for the NRHP. The Pacific Connector pipeline route would cross 16 irrigation features associated with the Klamath Project. Pacific Connector proposes to bore under the Klamath Project canals. However, neither Reclamation nor the SHPO have commented to date on this method of reducing impacts on the canals.

4.11.4 Unanticipated Discovery Plans

Jordan Cove included a draft UDP (August 2017) as Appendix B.4 in Resource Report 4 of its September 2017 application to the FERC in Docket No. CP17-495-000. Jordan Cove has stated that it developed its UDP in communications with certain Indian tribes (see appendix L). The Oregon SHPO, as well as the CTCLUSI, Coquille Tribe, Grand Ronde Tribes, and Klamath Tribes, provided Jordan Cove with comments on the plan, and Jordan Cove indicated that it would address those comments.

Pacific Connector included a copy of its August 2017 draft UDP as Appendix B.4 of Resource Report 4, attached to its September 2017 application to the FERC and as an appendix to the draft HPMP submitted in October 2018 in response to a request by the FERC staff. Pacific Connector has indicated that the CTCLUSI, Coquille Tribe, and the Klamath Tribes commented on the draft UDP. Review of the draft UDP by the SHPO has not yet been completed.

A May 7, 2019 version of the UDP was filed by Jordon Cove and Pacific Connector with the FERC on September 18, 2019.[235] Jordan Cove and Pacific Connector continue to solicit feedback from tribes and cooperating agencies on an individual basis and through the Cultural Resources Working Group. We cannot find the UDPs acceptable until we see final versions that address comments from Indian tribes, cooperating federal agencies, and the SHPO.

4.11.5 Compliance with the NHPA

We have not yet completed the process of complying with the NHPA. Additional consultations, investigations, and/or plans remain necessary.

On April 4, 2018, the Applicants filed a first draft Ethnographic Report (Deur 2018). The FERC staff, in environmental information requests dated May 4 and October 23, 2018, requested that the Applicants revise the Ethnographic Report to provide additional information about TCPs, HPRCS, and traditional resources and use areas within the APE. In a filing on November 2, 2018, the Applicants declined to revise the Ethnographic Report, claiming that it is not required for purposes of compliance with Section 106 of the NHPA. The regulations for implementing Section 106 at 36 CFR 800.2(c)(2)(ii) require consultations with Indian tribes to identify sites of religious and

[235] As part of the revised POD.

cultural importance to tribes, in keeping with Section 101(d)(6) of the NHPA. Further, section 6.1 (8) of the FERC staff's guidelines (FERC 2017) directs applicants to produce and file an "ethnographic analysis to identify any living Native American groups or other groups with ties to the project area to identify properties of traditional, religious, or cultural importance to Tribes and other groups." In addition, several interested Indian tribes requested the additional data we asked for in the ethnographic study revision. Below, we have included in our recommended cultural resources environmental condition that a revised Ethnographic Report be filed prior to construction, for the review of the FERC staff, SHPO, cooperating federal land-managing agencies, and interested Indian tribes. The ethnographic study has also been included as a stipulation of the MOA.

For the Jordan Cove LNG Project, the planned Lagoon, Panhandle, and North Bank habitat mitigation sites, and the Rock Apron in Coos Bay still require surveys. Additional geoarchaeological deep testing may be conducted in high probably areas at the terminal. Jordan Cove indicated it would conduct archaeological testing at site 35CS227. Jordan Cove's consultants recommended that construction be monitored by qualified professional archaeologists in the vicinity of sites 35CS221 and 35CS227 at the Ingram Yard and South Dune areas, respectively; and at site BAC-2014-1 near the intersection of Highway 101 with the North Spit Causeway. Monitoring of construction was also recommended at the Boxcar Hill staging area, Roseburg Forest Products staging area, and Port Laydown Site; the crossing of Jordan Cove Road; and APCO sites.

For the Pacific Connector Pipeline Project, as of December 2018, about 20 miles of pipeline route (totaling about 796 acres), 41 workspaces (totaling about 28 acres), 17 yards, and rock source and disposal sites (totaling about 211 acres), and about 148 access roads (totaling about 83 miles) remain unsurveyed. Surveys have not yet been conducted at the following five locations in the indirect APE: 1) east of Haynes Inlet (MP 5.5R); 2) west side of Kentuck Slough (MP 6.3R); 3) 13674 Sitkum Lane, Myrtle Point (MP 29.5); 4) near Dora Cemetery (MP 29.5): and 5) 2378 Upper Camas Road, Camas Valley (MP 49.5). Aboveground facilities that have not yet been surveyed are MLV #2, MLV #9, and the Harness Mountain Communication Tower. Where access has been denied, Pacific Connector would need a Certificate from the Commission in order to use eminent domain to conduct remaining surveys and other investigations. Additional deep testing remains to be conducted at the pipeline crossings of the Coos River, South Umpqua/I-5, and Rogue River.

Fifty-four unevaluated sites along the Pacific Connector Project pipeline route were recommended for additional work, either survey and/or testing, prior to our being able to determine their eligibility for the NRHP (see table L-12 in appendix L). We and the SHPO agree that 20 sites along the pipeline route are eligible for the NRHP and require treatment because they cannot be avoided (see table L-12 in appendix L).

To resolve adverse effects at affected historic properties, the FERC staff is producing a MOA for the current undertaking, to be circulated among the consulting parties. The MOA will stipulate that the treatment plans should be implemented, with the written permission of the FERC and federal land-managing agencies, as applicable. It will also allow for phased surveys and testing investigations.

To ensure that the Commission's responsibilities under the NHPA and its implementing regulations are met, **we recommend that:**

Jordan Cove and Pacific Connector should <u>not begin construction of facilities and/or use</u> any staging, storage, or temporary work areas and new or to-be-improved access roads <u>until</u>:

a. Jordan Cove and Pacific Connector each file with the Secretary:

1. remaining cultural resources inventory reports for areas not previously surveyed;

2. site evaluations and monitoring reports, as necessary;

3. a revised Ethnographic Study Report that addresses the items outlined in staff's May 4 and October 23, 2018 environmental information requests;

4. final HPMPs for both Projects with avoidance plans;

5. final UDP; and

6. comments on the cultural resources reports, studies, and plans from the SHPO, applicable federal land managing agencies, and interested Indian tribes.

b. FERC staff produces an MOA and affords the ACHP an opportunity to comment on the undertaking; and

c. FERC staff reviews and the Director of OEP approves all cultural resources reports, studies, and plans and notifies Jordan Cove and Pacific Connector in writing that treatment plans may be implemented and/or construction may proceed.

All materials filed with the Commission containing location, character, and ownership information about cultural resources must have the cover and any relevant pages therein clearly labeled in bold lettering: "<u>CUI//PRIV - DO NOT RELEASE</u>."

4.11.6 Conclusion

We have not yet completed the process of complying with the NHPA. Additional cultural resource inventories, evaluations, and associated reports are to be completed, as well as a final ethnographic study, HPMP, and UDP. Consultations with tribes, SHPO, and applicable federal land-managing agencies have also not been concluded. Constructing and operating the Project would have adverse effects on historic properties under Section 106 of the NHPA. However, an MOA is being developed with the goal of resolving adverse effects on historic properties. The execution of an MOA and the implementation of associated treatment plans would take into account the effects of the undertaking and conclude the Section 106 process.

4.12 AIR QUALITY AND NOISE

4.12.1 Air Quality

Construction and operation of the proposed Project would affect local and regional air quality. The term "air quality" refers to relative concentrations of pollutants in the ambient air. The subsections below summarize applicable federal and state air quality regulations and describe well-established air quality concepts that are applied to characterize air quality and to determine the significance of increases in air pollution. This includes metrics for specific air pollutants known as ambient air quality standards (AAQS), regional designations to manage air quality known as Air Quality Control Regions (AQCRs), and efforts to monitor ambient air concentrations.

Air quality impacts are spatially dependent, and therefore, this section is divided into subsections as follows:

- Impacts in the Coos Bay area associated with the Jordan Cove LNG Project and marine vessels on the waterway are discussed in section 4.12.1.3.
- Impacts associated with the Pacific Connector pipeline—for which the key air pollution sources are emissions from construction and operation of the compressor station in Klamath County—are discussed in section 4.12.1.4.
- Environmental consequences on federal lands are summarized in section 4.12.1.5.

4.12.1.1 Regulatory Setting

Regulatory requirements for air quality—aside from the requirement that the overall project not contribute to a degradation in air quality that results in an exceedance of the NAAQS—depend upon the equipment that is proposed to be constructed and the associated emissions. Sources of air pollution at the Jordan Cove LNG Project and in the associated waterway include the following:

- five direct-drive combined cycle combustion turbines, each rated at 524.1 million Btu per hour (MMBtu/hr), to power refrigeration compressors;
- one thermal oxidizer, rated at 110 MMBtu/hr for the gas conditioning system;
- one auxiliary boiler rated at 296.2 MMBtu/hr;
- one enclosed marine flare rated at 0.74 MMBtu/hr;
- one multipoint ground flare rated at 2.13 MMBtu/hr;
- two diesel black-start engines each rated at 4,376 hp;
- two backup engines each rated at 1,073 hp;
- three fire water pump engines each rated at 700 hp;
- two 160,000 cubic meters (m3) capacity LNG storage tanks;
- fugitive emission sources (valves, flanges, and other equipment); and
- LNG carriers and support vessels.

Regulatory requirements for air quality applicable to the Pacific Connector Pipeline Project depend in part upon the equipment that is proposed to be installed at the compressor station and the associated emissions. Sources of air pollution at the compressor station would include:

- three General Electric PGT25/DLE 1.5 natural gas–fired combustion turbines, each with a maximum site rating of 28,290 hp, and a maximum heat input rate of 194.7 MMBtu/hr at 0°F (the air permit would limit operation to only two turbines at a time; the third is solely for reliability to maintain maximum throughput for the pipeline at times when one of the two operating units is offline for maintenance);

- one 6.28 MMBtu/hr gas-fired hot water boiler;
- one 1,090 kilowatt (kW) natural gas–fired spark-ignition standby generator, limited to no more than 100 hours per year of operation; and
- ancillary activities (fugitive venting, blowdowns, and condensate tank).

Air emission sources for the Jordan Cove LNG Project and the Pacific Connector Pipeline Project are regulated at the federal and state level. Applicable federal and state air quality regulations are summarized below.

Federal and International Air Quality Requirements

Applicable and potentially applicable federal air quality regulations include:

- New Source Review (NSR)/Prevention of Significant Deterioration (PSD) preconstruction permit requirements;
- General Conformity;
- Title V Operating Permit requirements;
- New Source Performance Standards;
- National Emissions Standards for Hazardous Air Pollutants (HAP);
- Chemical Accident Prevention; and
- Mobile Source Regulations.

<u>NSR/PSD Preconstruction Permit Requirements</u>

The federal NSR preconstruction permit program is administered by ODEQ under OAR 340-224 and includes two components: Nonattainment NSR (NNSR), which applies to "major" stationary sources located in nonattainment areas, and NSR/PSD, which applies to "major" stationary sources located in attainment or unclassifiable areas. Because existing air quality is classified as "attainment" or "unclassifiable" for all NAAQS pollutants, only NSR/PSD regulations are applicable to the Jordan Cove LNG Project. The Jordan Cove LNG Project as originally designed was considered a "major" PSD source, and a PSD permit application was submitted to ODEQ in March 2013. However, the current Project design no longer includes the previously proposed South Dunes Power Plant facility, and as a result it no longer qualifies as a major PSD source. A Type B state-only NSR application was submitted to ODEQ in September 2017 for the Jordan Cove LNG Project and in May 2015 for the Pacific Connector Pipeline Klamath Compressor Station.

Criteria pollutant emissions from the Pacific Connector Pipeline Project compressor station would be well below major source thresholds. Although GHGs are above previously identified major source thresholds, the Supreme Court made a ruling on June 23, 2014 (*Utility Air Regulatory Group [UARG] v. EPA [No. 12-1146])* that effectively disallowed the triggering of NSR/PSD based on the significance of GHG emissions alone. Therefore, the Pacific Connector Pipeline Project is not expected to trigger the federal reporting requirements of NSR/PSD.

General Conformity

For proposed activities that are not covered by NSR/PSD permits—such as construction activities—General Conformity requirements can apply in areas designated as "nonattainment" or "maintenance" with respect to the NAAQS. However, because there are no such areas within the vicinity of the Jordan Cove LNG Project or along construction routes, these requirements do not apply.

Approximately 325 feet of the Pacific Connector pipeline in construction spread 5, between MPs 199 and 200, would be located within the particulate matter with a diameter of less than 10 microns (PM_{10}) maintenance area. Federal regulations at 40 CFR 93 Subpart B require a General Conformity analysis for PM_{10} maintenance areas when emissions of PM_{10} exceed 100 tons per year (TPY). Estimated emissions for this 325-foot length of construction in the PM_{10} maintenance area are presented in table 4.12.1.1-1 and are far below the General Conformity applicability threshold; therefore, the General Conformity requirements do not apply to the Pacific Connector Pipeline Project.

TABLE 4.12.1.1-1

Estimated Construction PM_{10} Emissions in Klamath Falls PM_{10} Maintenance Area (tons) from the Pacific Connector Pipeline Project

Pollutant	PM_{10}
Total Spread 5 nonroad engine emissions (42.5 miles)	2.48
Total Spread 5 fugitive dust emissions (42.5 miles)	26.573
Total Spread 5 PM_{10} emissions	29.053
PM_{10} maintenance area total emissions (300 feet)	**0.039**

Title V Operating Permit

Facilities that have the potential to emit at least 100 TPY of any criteria pollutant, 10 TPY of any individual HAP, or 25 TPY of any combination of HAPs are required to obtain Title V Operating Permits, which are implemented by ODEQ under OAR 340-218. Because the Jordan Cove LNG Project's emissions of oxides of nitrogen (NO_x), carbon monoxide (CO), PM_{10}, and particulate matter with a diameter of less than 2.5 microns ($PM_{2.5}$) would each exceed that threshold for criteria pollutants, it will be required to apply for a Title V Operating Permit. For new sources (such as the ones proposed here), applications for these permits are due one year after the source commences operation. Oregon requires Title V facilities to obtain a Standard ACDP permit prior to construction; see the discussion of state air permitting requirements below.

Facilities that trigger PSD permitting, such as this one, are required to obtain Title V Operating Permits, which are implemented by ODEQ under OAR 340-218. The Pacific Connector Pipeline Project would therefore be required to apply for a Title V Operating Permit. For new sources (such as the ones proposed here), applications for these permits are due one year after the source commences operation.

The Title V Operating Permit will help ensure that the facility continues to comply with all applicable air regulations after it is built. These permits require periodic monitoring to ensure compliance with the permit, annual certification of compliance with all applicable air pollution regulatory requirements, and public comment on permit issuance/renewal and on significant modifications to the permit.

New Source Performance Standards

All new sources of air pollution in specific source categories are required to comply with applicable New Source Performance Standards (NSPS) regulations (40 CFR 60), which establish maximum emission limits for criteria pollutants (and their precursors) and also incorporate monitoring, reporting, and recordkeeping requirements. NSPS regulations that are applicable to the Project are discussed below.

The natural gas–fired turbines at the Jordan Cove LNG Project are subject to NSPS Subpart KKKK, which limits emissions of NO_x from the turbines.

The auxiliary boiler is subject to NSPS Subpart Db, which applies to steam-generating units rated at greater than 100 MMBtu/hr heat input. The auxiliary boiler would be subject to the Subpart Db emission limit for NO_x but would be exempt from the Subpart Db emission limits for sulfur dioxide (SO_2) and particulate matter because it would burn only natural gas.

The two diesel black-start generators, two diesel backup generators, and three diesel fire pump engines are subject to NSPS Subpart IIII, which requires that new or modified stationary engines meet the same emissions standards that manufacturers of comparable nonroad engines are required to comply with. Jordan Cove has proposed to install engines that meet EPA Tier 2 emission standards for the diesel generators, and EPA Tier 3 emission standards for the diesel fire pump engines.

New large storage tanks containing liquids that can emit significant amounts of volatile organic compounds (VOCs)—i.e., where the equilibrium partial pressure exerted by the VOC exceeds 3.5 kilopascals (kPa)—are subject to NSPS Subpart Kb. However, the two largest constituents in LNG that exert partial pressure are methane and ethane (both of which are negligibly photochemically reactive and therefore exempt from the definition of VOC). The remaining VOC constituents in LNG, such as butane, propane, and heavier compounds, have an equilibrium partial pressure of less than 3.5 kPa at the storage temperature, and therefore, the LNG storage tanks are not subject to NSPS Subpart Kb.

Certain equipment at crude oil and natural gas production facilities can be subject to NSPS Subpart OOOOa. However, Jordan Cove has determined that none of its proposed facilities or equipment would qualify as affected sources under Subpart OOOOa.

With respect to the Pacific Connector Pipeline Project, the gas-fired combustion turbines located at the Klamath Compressor Station would be new and subject to NSPS Subpart KKKK (and are therefore specifically exempted from NSPS Subpart GG for stationary combustion turbines, as per 40 CFR 60.4305(b)). They would be required to meet an NO_x emission standard of 25 ppm by volume, dry basis, corrected to 15 percent oxygen (ppmvd @ 15 percent O_2) or approximately 1.2 pounds NO_x per megawatt hour generated.

The potential spark-ignition emergency generator at the compressor station would be manufactured after June 12, 2006, and therefore would be subject to NSPS Subpart JJJJ, which requires that NOx emissions be no higher than 2.0 grams per horsepower per hour (g/hp-hr) = 160 ppmvd @ 15 percent O2, and that CO emissions be no higher than 4.0 g/hp-hr = 540 ppmvd @ 15 percent O2.

New large storage tanks containing liquids that can emit significant amounts of VOCs—i.e., where the equilibrium partial pressure exerted by the VOC exceeds 3.5 kPa—are subject to NSPS Subpart Kb. While the design of the Klamath Compressor Station has not been finalized, a condensate storage tank is likely to be installed. The potential applicability of NSPS Subpart Kb will be determined once the final storage tank specifications are known.

Certain equipment at crude oil and natural gas production facilities can be subject to NSPS Subpart OOOOa. The fugitive emissions at the Klamath Compressor Station would qualify as an "affected facility" under Subpart OOOOa, and the centrifugal compressors may be subject as well if they are equipped with wet seals. If any pneumatic controllers are installed, they may also be subject to Subpart OOOOa if they have a natural gas bleed rate of greater than 6 standard cubic feet per hour. Storage tanks may be subject to Subpart OOOOa if they have potential VOC emissions of 6 TPY or more; however, the condensate storage tank is unlikely to have potential emissions meeting this threshold. The extent to which NSPS Subpart OOOOa is applicable will be determined once the design of the Klamath Compressor Station is finalized.

National Emissions Standards for Hazardous Air Pollutants

New and existing sources of air pollution are required to comply with applicable National Emissions Standards for Hazardous Air Pollutants (NESHAP), many of which are also incorporated by reference into Oregon's regulations at OAR 340-244-0220. NESHAPs exist for the following source types included at the Jordan Cove LNG Project terminal:

- Stationary Combustion Turbines (40 CFR 63, Subpart YYYY); Stationary Reciprocating Internal Combustion Engines (40 CFR 63, Subpart ZZZZ); and
- Industrial, Commercial, and Institutional Boilers at Area Sources (40 CFR 63, Subpart JJJJJJ).

For natural gas–fired turbines, the requirements of Subpart YYYY were stayed per 40 CFR 63.6095(d), and therefore, there are no applicable requirements. For the engines, compliance with NSPS Subpart IIII satisfies the requirements of 40 CFR 63 Subpart ZZZZ, and therefore, there are no additional applicable requirements. For the auxiliary boiler, the requirements of Subpart JJJJJJ do not apply because it would burn only natural gas.

NESHAPs exist for the following source types included at the Pacific Connector compressor station:

- Stationary Combustion Turbines (40 CFR 63, Subpart YYYY); and
- Stationary Reciprocating Internal Combustion Engines (40 CFR 63, Subpart ZZZZ).

For natural gas–fired turbines, the requirements of Subpart YYYY were stayed per 40 CFR 63.6095(d), and therefore there are no applicable requirements. For the engines, compliance with NSPS Subpart JJJJ satisfies the requirements of 40 CFR 63 Subpart ZZZZ, and therefore there are no additional applicable requirements.

Chemical Accident Prevention Provisions

LNG facilities are subject to safety regulations developed by the USDOT (49 CFR 193) and the U.S. Department of Homeland Security (33 CFR 127). The EPA's Chemical Accident Prevention Provisions (40 CFR 68, which were developed in accordance with Section 112(r) of the CAA and referenced by Oregon regulations at OAR 340-244-0230) can also apply to owners or operators of stationary sources producing, processing, handling, or storing toxic or flammable substances. However, the EPA's General Counsel has clarified that Section 112(r) and the associated regulations do not apply to LNG stored at terminals because the material is either being transported or stored incident to transportation (EPA 2006).

Aside from LNG, which would be stored incident to transportation, the Project would not be storing hazardous or flammable substances in excess of any thresholds identified in 40 CFR 68, and therefore, those regulations do not apply. However, with regard to the storage of any small quantities of hazardous substances that are not being transported or stored incident to transportation, the 112(r)(1) general duty clause does apply:

> *The owners and operators of stationary sources producing, processing, handling or storing [hazardous] substances have a general duty in the same manner and to the same extent as section 654, title 29 of the United States Code, to identify hazards which may result from [accidental] releases using appropriate hazard assessment techniques, to design and maintain a safe facility taking such steps as are necessary to prevent releases, and to minimize the consequences of accidental releases which do occur.*

Mobile Source Regulations

International Maritime Organization (IMO) Standards for Ships – The IMO has officially designated waters off North American coasts as "Emission Control Areas" (ECAs) under Annex VI, which means that stringent international emission standards will apply to ships operating in these areas. Effective in 2015, the sulfur content in marine fuels used in these waters is required to contain no more than 0.1 percent sulfur (or else vessels can install control equipment to reduce emissions from fuels with higher sulfur contents to equivalent levels). In November 2011, IMO's Marine Environment Protection Committee adopted amendments that exempted boiler-propelled vessels "that were not originally designed for continued operation on marine distillate fuel or natural gas" (such as LNG carriers) from the fuel sulfur requirements until at least 2020 (IMO 2011). However, Jordan Cove has indicated that they would require vessels calling on the LNG terminal to meet the fuel sulfur requirements. In addition, diesel engines installed on vessels manufactured in 2016 or later are required to control NO_x emissions to levels that are approximately 80 percent lower than currently allowable levels ("Tier 1") when operating in ECAs (which in most cases will mean that NO_x control equipment will need to be installed). The IMO regulations also include requirements pertaining to emissions from shipboard incinerators.

EPA Requirements for Marine Diesel Engines – All marine diesels larger than 37 kW that have been manufactured in the United States since January 1, 2004, are required to meet federal emissions standards identified in 40 CFR 94 or 40 CFR 1042; the newest engines are subject to the most stringent requirements ("Tier 4"). Although most engines on existing LNG carriers were not manufactured in the United States, some of the newer engines installed on tugs and other local support vessels may be subject to these regulations, and the Project's emissions calculations reflect the use of "Tier 4" diesel engines in the tugboats.

EPA Requirements for Land-Based Engines and Vehicles – The EPA has promulgated extensive regulations reducing emissions from new on-road vehicles and construction equipment, which has resulted in substantial emissions reductions over time in spite of increased equipment/vehicle populations and usage.

EPA Regulations on Fuels – Any diesel oil or gasoline sold in the United States that is used in or intended for use in marine engines or land-based engines is subject to federal regulations (40 CFR 80). Non-road, locomotive, and marine diesel sold in the United States must have a sulfur content no greater than 15 ppm (0.0015 percent) by weight. Although these requirements do not apply to diesel fuel (or boiler fuel) obtained by LNG carriers outside the United States, diesel fuel used by tugboats, support vessels, and construction equipment would need to meet these criteria. Gasoline is required to have a sulfur content of no more than 80 ppm per gallon, or more than 30 ppm on average for any given refinery or importer.

State Air Quality Requirements

In addition to the rules identified above, ODEQ has state-specific air quality requirements. Those that would be directly applicable to the Jordan Cove LNG Project and/or the Pacific Connector Pipeline Project, and those that may potentially be applicable are discussed below.

Oregon Construction Permit

Oregon requires that facilities subject to Title V Operating Permits obtain a Standard ACDP in accordance with OAR 340-216 prior to construction. As part of this permit, Plant Site Emission Limits are required to be obtained for all regulated pollutants, as per OAR 340-222-0020, and an air quality impact analysis must be conducted in accordance with OAR 340-216. Since the Jordan Cove LNG Project terminal is subject to the Title V Operating Permit regulations, an ACDP is required. Oregon also requires that facilities subject to NSPS regulations with emissions greater than 10 TPY obtain an ACDP, including Plant Site Emission Limits and an air quality impact analysis. The Pacific Connector Pipeline Project is subject to this requirement.

A Standard ACDP identifies all applicable requirements, identifies plant site emission limits (PSELs), and includes testing, recordkeeping, and reporting requirements sufficient to determine compliance with the PSEL. A Type B state-only NSR application for a Standard ACDP was submitted to ODEQ in September 2017.

Air Quality Impact Analysis

Oregon's ACDP regulations cross-reference air quality analysis regulations in OAR 340-225-0050(1) and (2) and OAR 340-225-0060. These regulations are therefore applicable. With respect to the requirement for projects to demonstrate compliance with the NAAQS and PSD increments, ODEQ allows projects to show that their own impacts are below significant impact levels. Projects that cannot demonstrate impacts less than the significant impact levels must show that (a) modeled impacts from the proposed source and other PSD increment-consuming sources are less than PSD increments, and (b) those impacts plus background concentrations are less than the NAAQS. The Project's ACDP permit application demonstrates that the applicable requirements of these regulations are met. More details about the air quality impact analysis are provided under the "Operational Air Impacts and Mitigation" subheadings below.

General Emission Standards

Under OAR 340-226, sources that are not already subject to NSPS requirements (as identified above) or other new source standard and have the potential to emit at least 1 TPY of any criteria pollutant must meet the requirements for Typically Achievable Control Technologies (TACT). Emission limits that meet TACT would be typical of the emission rates achieved by other recently installed emission units of a similar type and size. The use of dry low emission technology and good combustion practices in the Pacific Connector compressor turbines would meet or exceed TACT for gas-fired turbines of this size.

Visible Emission and Nuisance Requirements

State visible emissions and nuisance abatement regulations are codified in OAR 340-208. Both construction and operation phases of the Project would be subject to visible emission limits stated in terms of opacity. Either Project may not emit contaminants causing opacity to equal or exceed 20 percent in any period or periods aggregating more than 3 minutes in any hour. In addition, no person may create an observable deposition of particulate matter on another person's property (OAR 340-208-540).

This regulation prohibits nuisances and requires that reasonable precautions be taken to minimize fugitive dust emissions in Special Control Areas (which include areas within 3 miles of the corporate limits of any city having a population of 4,000 or more). The LNG Project site is within 3 miles of Coos Bay, Oregon, which has a population of approximately 16,000; and within 3 miles of North Bend, Oregon, which has a population of approximately 10,000.

Given that visible emissions from the combustion of gaseous fuels are typically far below 20 percent opacity and that the only fugitive dust emissions are likely to be those associated with construction, the Jordan Cove LNG Project is anticipated to meet these regulations.

4.12.1.2 Existing Conditions

Climate

Jordan Cove LNG Project

Climatic conditions, such as ambient temperature, cloud cover, and wind, can significantly change how emissions of pollutants impact local air quality. The State of Oregon is divided into nine climate zones as established by the National Climatic Data Center (NCDC). The Jordan Cove LNG Project and the waterway used by the LNG marine traffic lies in the southern part of Zone 1–The Oregon Coast. The climate of the Project area is characterized by wet winters, relatively dry summers, and mild temperatures year-round. Terrain features include the coastal plain, which extends from less than a mile to a few tens of miles in width, numerous coastal valleys, and the Coast Range, whose peaks range from 2,000 to 5,500 feet above sea level. The National Weather Service (NWS) maintains a climate station at the Southwest Oregon Regional Airport in Coos County, located across Coos Bay approximately 1 mile south of the Project site. Climate data from this station should be representative of conditions in the area of the Jordan Cove LNG Project.

The heaviest precipitation in this zone occurs mainly during the winter months when moist air masses move off the Pacific Ocean onto land. Normal annual precipitation (as measured at the Southwest Oregon Regional Airport) is approximately 65 inches, with normal annual snowfall of approximately 1 inch. The highest monthly precipitation values occur during the months of November, December, and January.

The mean maximum temperature in North Bend/Coos Bay is approximately 60°F, the mean minimum temperature is approximately 46°F, and the mean temperature is approximately 53°F. Temperatures of 90°F or higher occur less than once per year, on average, and freezing temperatures are infrequent, with killing frosts being even less frequent. The growing season (period between minimum temperature occurrences of 28°F) averages approximately 303 days.

Strong winds occur occasionally, usually in advance of winter storms. These winds can exceed hurricane force and have been known to cause significant damage to structures and vegetation. Such events, however, are typically short-lived and last less than one day. Partly cloudy skies are prevalent during the summer. Winter skies are likely to be cloudy. As a result of the persistent cloudiness, total solar radiation is relatively low in this zone.

Pacific Connector Pipeline Project

As identified above, the State of Oregon is divided into nine climate zones as established by the NCDC. The pipeline runs from Zone 1 (the Oregon Coast; as described in section 4.12.1.1) through Zone 3 (Oregon Southwestern Valleys) to Zone 7 (the South Central Oregon climate region; NCDC 1994). The primary source of air pollutants associated with Project operation is the proposed Klamath Compressor Station, which lies in Zone 7. The region surrounding the Klamath Compressor Station receives an annual average of 14.2 inches of precipitation per year.[236] Average daily temperature is 50.4°F from the same station and reporting period. The prevailing wind direction is from the west at an average daily speed of 6.3 miles per hour (mph).[237]

The air temperature extreme in Klamath Falls ranges from -10°F to 100°F. For the period 1997 to 2008, an air temperature below 0°F was recorded on average 1.3 days per year (WRCC 2012). Hourly meteorological data for Klamath Falls were obtained from the NCDC for the most recent 5-year period (2008 to 2012) (NCDC 2013). During the 2008–2012 period, ambient air temperature at or below 0°F occurred for 84 hours for an average of approximately 17 hours (0.7 day) per year.

Existing Air Quality

Existing air quality is typically characterized relative to EPA's NAAQS, which exist for seven pollutants:

- oxides of sulfur (measured as SO_2)
- CO
- oxides of nitrogen (measured as nitrogen dioxide, NO_2)
- ozone
- PM_{10}
- $PM_{2.5}$
- lead and its compounds (measured as lead)

These pollutants are referred to as "criteria pollutants" because EPA is required to periodically identify air quality criteria which reflect the latest scientific knowledge (including knowledge regarding the health impacts on children, asthmatics, and the elderly), and revise the NAAQS accordingly. The CAA requires EPA to set both primary NAAQS (which are established to be protective of human health, allowing an adequate margin of safety) and secondary NAAQS

[236] Based on data from the Western Regional Climatic Center at the Klamath Falls 2 SSW weather station for the period January 1981 through December 2010.
[237] As recorded at the Klamath Falls Airport Weather Station, from November 1997 to December 2008.

(established to be protective of public welfare, which includes effects on wildlife, crops, vegetation, and buildings). Emissions of other non-criteria pollutants are also regulated by EPA and state/local environmental agencies, even though NAAQS are not developed for them.

The EPA, and state and local agencies, have established a network of ambient air quality monitoring stations to measure concentrations of criteria pollutants across the United States. All areas of the United States are classified as being "attainment," "unclassified," or "nonattainment" with respect to the NAAQS. "Nonattainment" areas, where criteria pollutant concentrations exceed the NAAQS, are required to develop plans to meet the standards by specified deadlines, and after meeting the standards are classified as "maintenance areas" (a subcategory of attainment areas, for areas previously designated as nonattainment). Coos County is part of the Southwest Oregon Interstate AQCR and is designated as "attainment" (criteria pollutant concentrations are below the NAAQS) or "unclassifiable" for all of the NAAQS. The NAAQS and the ambient concentrations of criteria pollutants at the nearest ambient air monitoring stations are shown in table 4.12.1.2-1. The monitoring stations selected (Portland for SO_2, CO, and NO_2; Eugene for PM_{10}; and Cottage Grove for ozone and $PM_{2.5}$) are located between approximately 65 and 165 miles from the Jordan Cove LNG Project. These were the closest available stations for each respective pollutant.

In addition to the NAAQS identified in table 4.12.1.2-1, states are allowed to set more stringent ambient air quality standards. While Oregon has adopted state AAQS that match the NAAQS in most cases, it has set more stringent AAQS for SO_2, as shown in table 4.12.1.2-1.

TABLE 4.12.1.2-1

Existing Air Quality Concentrations for Criteria Air Pollutants Near the Jordan Cove LNG Project

Air Pollutant	Averaging Period	Primary NAAQS	Secondary NAAQS	State AAQS	Nearest Ambient Monitoring Site(s)	Monitor Value g/	Background as Fraction of NAAQS
SO_2 (µg/m^3)	1-Hour a/	197	NA	197	Portland	10.5	0.05
	3-Hour b/	NA	1,300	1,300		21.0	0.02
	24-Hour b/	365	NA	260		5.3	0.02
	Annual	80	NA	52		0	0.00
CO (µg/m^3)	1-Hour b/	40,000	NA	40,000	Portland	2,740	0.07
	8-Hour b/	10,000	NA	10,000		2,100	0.21
NO_2 (µg/m^3)	1-Hour c/	188	NA	188	Portland	54.5	0.29
	Annual	100	100	100		17	0.17
Ozone (ppm)	8-Hour d/	0.070	0.070	0.070	Cottage Grove	0.061	0.87
PM_{10} (µg/m^3)	24-Hour b/	150	150	150	Eugene	53	0.35
$PM_{2.5}$ (µg/m^3)	24-Hour e/	35	35	35	Cottage Grove	22	0.63
	Annual f/	12.0	12.0	12		8.2	0.68

a/ NAAQS applies to the 3-year average of the annual (99th percentile) of the daily max.1-hour avg. concentration.
b/ NAAQS is not to be exceeded more than once per calendar year.
c/ NAAQS applies to the 3-year average of the annual (98th percentile) of the daily max. 1-hour avg. concentration.
d/ NAAQS applies to the 3-year average of the annual 4th highest daily max. 8-hour avg. concentration.
e/ NAAQS applies to the 3-year average of the annual 98th percentile 24-hour concentration.
f/ NAAQS applies to the 3-year average of annual concentrations.
g/ For 1-hr SO_2, 1-hr NO_2 ,8-hr ozone, and 24-hour $PM_{2.5}$ the values in this column are the 3-year (2013–2015) averages that the NAAQS applies to. For other pollutants the annual values shown in this column represent the maximum concentrations seen in 2013-2015 and the shorter-term values are high second-high concentrations.

Each of the criteria pollutants in table 4.12.1.2-1, except ozone, are emitted directly; ozone can also be emitted directly by a few sources but is predominantly a result of reactions between NO_x—predominantly NO_2 and nitrogen oxide (NO)—and VOCs in the air, particularly in the warmer months. For this reason, emissions inventories often refer to NO_x and VOCs as criteria pollutants as well.

In addition to the criteria pollutants, other types of air pollutants include "air toxics" (as defined by ODEQ 340-246)—which include but are not limited to chemicals designated as HAPs by EPA. Air toxics are a set of chemicals and chemical classes that often have carcinogenic, mutagenic, or other especially hazardous properties; most are subsets of criteria pollutants (i.e., several air toxics exist in the form of particulate matter and/or can be classified as VOCs). Ambient air quality standards do not typically exist for these pollutants; ODEQ regulations identify "ambient benchmarks" for some, but not all, and existing monitoring stations do not monitor all of these chemicals either. Aggregate impacts of air toxics are often assessed in terms of the lifetime cancer risk and respiratory hazard index, which are calculated based on conservatively determined cancer risk factors and reference exposure levels. EPA's latest National Air Toxics Assessment (for calendar year 2014) shows that regionally, the lifetime cancer risk associated with ambient air toxics concentrations in Coos Bay and the surrounding area is 30 in a million or less, and the respiratory hazard index is approximately 0.50 or less (EPA 2018c). A respiratory hazard index of less than 1 means that ambient air toxics are unlikely to cause adverse respiratory health effects over a lifetime of exposure.

The term "greenhouse gases" (GHG) refers to the gases and aerosols that occur in the atmosphere both naturally and as a result of human activities, such as the burning of fossil fuels. The primary GHGs are CO_2, methane, and nitrous oxide. GHGs are non-toxic and non-hazardous at normal ambient concentrations, and there are no applicable ambient standards or emission limits for GHG. However, unlike criteria pollutants and air toxics, GHG concentrations have been increasing over time and are continuing to increase. Elevated levels of GHGs are the primary cause of warming of the climatic system.

Emissions of GHGs are typically quantified and regulated in units of CO_2e. The CO_2e takes into account the global warming potential (GWP) of each GHG. The GWP is the measure of a particular GHG's ability to absorb solar radiation as well as its residence time within the atmosphere. The GWP allows comparison of global warming impacts between different gases; the higher the GWP, the more that gas contributes to climate change in comparison to CO_2. Thus, CO_2 has a GWP of 1, methane has a GWP of 25, and nitrous oxide has a GWP of 298.[238]

The Pacific Connector pipeline would pass through rural areas in Coos, Douglas, Jackson, and Klamath Counties. The Klamath Compressor Station would be located within an unclassified area approximately 1.8 miles northeast of Malin in Klamath County, and approximately 14 miles to the southeast of the southeast corner of the Klamath Falls nonattainment area for the 2006 24-hour $PM_{2.5}$ standard. The areas through which the pipeline would pass and in which the compressor station would be located all attain all ambient air quality standards (see section 4.12.1.1), with the exception that approximately 325 feet of pipeline in construction spread 5, between MPs 199 and 200, would be

[238] These GWPs are based on a 100-year time period. We have selected their use over other published GWPs for other timeframes because these are the GWPs the EPA has established for reporting of GHG emissions and air permitting requirements. This allows for a consistent comparison with these regulatory requirements.

located within the Klamath Falls PM_{10} maintenance area (i.e., an area that currently attains the PM_{10} standard, but was formerly designated as a nonattainment area). An additional 4.3 miles of pipeline would be located within the Klamath Falls nonattainment area for the 2006 24-hour $PM_{2.5}$ standard. However, the 2006 $PM_{2.5}$ standard was superseded by the 2012 $PM_{2.5}$ standard, for which the entire pipeline route is in attainment.

Background air quality data near the compressor station are presented in table 4.12.1.2-2. For SO_2, CO, and NO_2, the nearest active monitors are located in Boise, Idaho for SO_2 and CO (280 miles to the northeast), and in Eureka, California for NO_x (165 miles to the southwest). Because of these significant distances, the nearest monitors are not considered to be representative of the ambient air quality near the compressor station location. Therefore, background concentrations are based on values predicted by NW AIRQUEST (2018) Criteria Pollutant Design Value maps and lookup tables. The background concentrations shown for PM_{10} and $PM_{2.5}$ represent the worst-case values recorded by monitors in Klamath, Jackson, and Lane Counties, which respectively are closest to the eastern, central, and western portions of the pipeline. Wildfires in 2014-2015 caused elevated $PM_{2.5}$ near Klamath Falls, resulting in an exceedance of the 24-hour 98th percentile 3-year average for 2013-2015. The ODEQ submitted an exceptional event demonstration in April 2017 requesting that the EPA exclude $PM_{2.5}$ data affected by the wildfire events. The EPA has concurred that a portion of the August 2015 data was affected by an exceptional event, but no formal regulatory action has been taken to exclude the data.

TABLE 4.12.1.2-2

Existing Air Quality Near Proposed Klamath Compressor Station

Air Pollutant	Averaging Period	Most Stringent AAQS	Background Concentration	Background Based On
SO_2 (μg/m^3)	1-Hour a/	197	1.0	Design values for 2009-2011 estimated using NW AIRQUEST (2018)
	3-Hour b/	1,300	1.0	
	24-Hour b/	260	0.8	
	Annual	52	0.5	
CO (μg/m^3)	1-Hour b/	40,000	942	Design values for 2009-2011 estimated using NW AIRQUEST (2018)
	8-Hour b/	10,000	708	
NO_2 (μg/m^3)	1-Hour c/	188	8.1	Design values for 2009-2011 estimated using NW AIRQUEST (2018)
	Annual	100	1.3	
Ozone (ppm)	8-Hour d/	0.070	0.065	Data from Jackson County (Medford) for 2013-2015
PM_{10} (μg/m^3)	24-Hour b/	150	71	Data from Jackson County (Medford) for 2013
	Annual	50	-	(no record)
$PM_{2.5}$ (μg/m^3)	24-Hour e/	35	40 g/	Data from Jackson County (Medford) for 2013-2015
	Annual f/	12.0	11 g/	

μg/m^3 = microgram per cubic meter
a/ AAQS applies to the 3-year average of the annual (99th percentile) of the daily max.1-hour avg. concentration.
b/ AAQS is not to be exceeded more than once per calendar year.
c/ AAQS applies to the 3-year average of the annual (98th percentile) of the daily max. 1-hour avg. concentration.
d/ AAQS applies to the 3-year average of the annual 4th highest daily max. 8-hour avg. concentration.
e/ AAQS applies to the 3-year average of the annual 98th percentile 24-hour concentration.
f/ AAQS applies to the 3-year average of annual concentrations.
g/ May include data deemed part of the "exceptional event" due to wildfires in the region during 2014 and 2015.

4.12.1.3 Jordan Cove LNG Project Impacts

Construction Air Quality Impacts

During construction, a temporary reduction in ambient air quality may result from emissions and fugitive dust generated by construction equipment. Fugitive dust emission levels would vary in relation to moisture content, composition, and volume of soils disturbed. Fugitive dust and other emissions from construction activities generally do not result in a significant increase in regional pollutant levels, although local pollutant levels could increase temporarily.

Construction air pollutant emissions include exhaust and crankcase emissions from construction equipment, vehicles that transport workers and materials, and vessels that transport equipment and construction materials. Emissions of criteria pollutants from construction activities by year are shown in table 4.12.1.3-1. Emissions would occur over the duration of construction activity, which is anticipated to last 5 years. The construction emission totals reported during year 5 include emissions from commissioning and startup of the LNG Project facilities.

Construction tasks for which emissions were estimated include the following broad categories of activity:

- **Site Preparation:** Includes demolition, clearing, and removal of vegetation or existing structures on site; construction of an MOF and TMBB for delivery of construction materials; topsoil removal, cut/fill, and grading of the site; dredge spoil placement; soil improvement to stabilize it against settling and seismic events;
- **Underground Structures:** Includes installation of pilings for the LNG Project structures and marine slip; laying storm drains, utility lines, fire water piping, process piping, and duct banks; construction of all foundations, including the LNG storage tanks, process equipment, and pipe racks; and site restoration, road paving, and landscaping;
- **Marine Facilities:** Includes derrick barges for dredging of the slip basin and access channel; land-based construction equipment to construct the slip face and install armoring; installation of a sheet pile retaining wall; installation of pilings for marine structures, and installation of LNG carrier loading facilities;
- **Marine Waterway Modification:** Includes excavation of submerged areas adjacent to the shipping channel;
- **LNG Storage Tank Construction:** Includes construction of outer concrete foundation, walls, and roof; construction of interior steel plate floor, walls, and roof; hydrostatic pressure testing of the inner tank and pneumatic testing of the outer tank; and installation of insulation, including expanded perlite between the wall liner and inner tank wall;
- **Aboveground Structures:** Includes installation of all process facilities, including both pre-fabricated modules and structures built onsite; installation of aboveground piping; and installation of electrical wiring and instrumentation; and
- **Miscellaneous Construction:** Includes various construction tasks not listed above, including the operation of an on-site concrete batch plant.

TABLE 4.12.1.3-1

Estimated Emissions from Terminal Construction Activities, By Year (tons)

Year	CO	NO_x	SO_2	VOC	PM_{10}	$PM_{2.5}$	HAP	GHG (as CO_2e)
Year 1	120	351	0.35	23	268	39	7.4	53,397
Year 2	184	404	0.43	32	310	100	11.0	66,708
Year 3	199	269	0.33	31	192	87	11.3	52,768
Year 4	81	43	0.08	10	18	17	3.7	13,615
Year 5 (plus commissioning emissions)	85	72	20.94	71	209	68	4.1	925,856
Total	**669**	**1,139**	**22.13**	**167**	**997**	**311**	**37.5**	**1,112,344**

To mitigate construction-related emissions, all construction equipment would be maintained in accordance with manufacturers' recommendations and engine idling time would be minimized. As required by federal regulations, construction equipment would combust diesel fuel with no more than 0.0015 percent sulfur, and vessels would combust fuel that complies with International Convention for the Prevention of Pollution from Ships and EPA standards for sulfur content. Additionally, Jordan Cove would implement the following measures to mitigate construction emissions from mobile and temporary stationary sources:

- reduce use, trips, and unnecessary idling of heavy equipment.
- maintain and tune engines per manufacturer's specifications to perform EPA certification levels, where applicable, and to perform at verified standards applicable to retrofit technologies. Employ periodic, unscheduled inspections to limit unnecessary idling and to ensure that construction equipment is properly maintained, tuned, and modified consistent with established specifications.
- prohibit any tampering with engines and require continuing adherence to manufacturer's recommendations.
- use construction equipment engines that incorporate modern pollution control technology. If practicable, lease new, clean equipment meeting the most stringent of applicable federal or state standards.

To mitigate fugitive dust emissions during construction, Jordan Cove would spray water or use dust suppressants on disturbed soil and access roads. The frequency and methodology of dust suppression would depend on the specific construction activities, terrain, soil conditions, and weather conditions. Additionally, Jordan Cove would implement the following measures to mitigate construction emissions due to fugitive dust:

- use of large off-road equipment for excavation and hauling operations to complete the work in the shortest time and least number of trips;
- stabilization of open storage piles and disturbed areas by covering and/or applying water or chemical/organic dust palliative where appropriate. This applies to both inactive and active sites, during workdays, weekends, holidays, and windy conditions. Installing wind fencing, and phase grading operations, where appropriate, and operate water trucks for stabilization of surfaces under windy conditions;
- pre-wetting of material before excavation in selected areas;
- use of wheel-washing stations to prevent track out of materials onto public roads;

- use of street sweepers to clean any materials inadvertently tracked onto public roads near the project site; and
- when hauling material and operating non-earthmoving equipment, prevent spillage by covering loads, limiting fill height in trucks, and training operators in the proper hauling and loading of material.

The effect of construction emissions on ambient air quality would vary with time due to the construction schedule, the mobility of the sources, and the variety of emission sources. Fugitive dust and other emissions due to construction activities generally do not pose a significant increase in regional pollutant levels; however, local pollutant levels would increase during the construction period. Based on the duration and scope of construction activities, we determine that construction of the Project would impact local air quality. However, construction emissions would not have a long-term, permanent effect on air quality in the area.

Operational Air Quality Impacts

Operational emissions from the Project include those from the Jordan Cove LNG Project sources, fugitive emissions from evaporative losses, and emissions from the LNG carriers and tugboats (including emissions in the waterway). These emissions are summarized in table 4.12.1.3-2 for routine operation. Commissioning emissions are included in year 5 of the construction emissions in table 4.12.1.3-2.

TABLE 4.12.1.3-2

Estimated Emissions During Operation of the Jordan Cove LNG Project (tons per year)

Source	CO	NO_x	SO_2	VOC	PM_{10}	$PM_{2.5}$	HAP	GHG (as CO_2e)
Combustion Turbines	97.82	81.99	35.19	32.72	112.26	112.26	5.06	1,292,706
Combustion Turbines Startup/Shutdown	0.73	0.23	4.4E-03	0.10	0.11	0.11	6.2E-04	188
Thermal Oxidizer	38.50	63.25	19.84	1.08	3.85	3.85	0.96	622,154
Auxiliary Boiler	1.16	0.96	0.36	0.67	1.3	1.3	0.24	15,193
Firewater Pump Engines	0.80	1.59	2.1E-03	4.5E-02	9.0E-02	9.0E-02	3.6E-03	241
Backup Generator Engines	0.28	3.33	2.5E-03	0.04	0.04	0.04	4.1E-03	278
Black Start Generator Engines	0.21	1.49	8.8E-03	0.09	0.05	0.05	1.5E-02	1,002
Flares	3.90	0.86	3.9E-02	8.31	0.38	0.38	4.3E-02	2,177
Gas-Up	9.5	2.09	0.16	17.53	1.12	1.12	3.8E-02	4,351
Fugitive Emissions	0	0	0	7.98	0	0	1.77	13,116
Aggregate Insignificant Emissions	1.0	1.0	1.0	1.0	1.0	1.0	--	--
LNG Carriers a/	37.33	52.75	10.05	9.84	3.50	3.50	--	16,479
Tugs	17.68	9.51	2.6	1.00	0.32	0.32	--	3,736
Total	**208.91**	**219.05**	**69.26**	**80.41**	**124.02**	**124.02**	**8.13**	**1,971,621**

a/ Values are based on 120 vessel calls per year, assuming worst-case emissions (i.e., vessel type with the highest emissions) for each pollutant. Emissions estimated at the state seaward boundary (i.e. 3.0 nautical miles from the Oregon coastline).

Commissioning and Start-Up Emissions: Commissioning of the Jordan Cove LNG Project is planned to occur during year 5 of construction. Table 4.12.1.3-2 includes estimated commissioning and operating emissions from all of the terminal stationary sources in year 5, including compressor turbines and duct burners, startup/shutdown emissions, auxiliary boiler, thermal oxidizer, flares, emergency engines, and fugitive emissions.

Routine Operation: The following sources are expected to operate continuously during routine operation:

- five combustion turbines for the refrigeration compressors;
- one thermal oxidizer;
- flare pilot flames for the enclosed marine flare and multipoint ground flare;
- two LNG storage tanks; and
- fugitive emission sources (valves, flanges, and other equipment).

Intermittent Operation: The following sources or activities would only operate intermittently. The auxiliary boiler would provide high-pressure steam if none of the LNG trains are operating, and the other intermittent sources would only operate during startup or shutdown events, planned maintenance, process upsets, readiness testing, or emergency situations:

- combustion turbine startup and shutdown events;
- one auxiliary boiler;
- one enclosed marine flare;
- one multipoint ground flare;
- two diesel black-start engines;
- two backup engines;
- three fire water pump engines; and
- up to 120 LNG carriers per year, with one tugboat attending each carrier.

The Jordan Cove LNG Project would remain below PSD major source thresholds for emissions of all criteria pollutants, HAP, and GHG, but would be a Title V major source for emissions of NO_x, CO, PM_{10}, and $PM_{2.5}$. As described above, a Type B state-only NSR application was submitted to ODEQ in September 2017.

For the criteria pollutants, dispersion modeling of the combined impacts of the terminal and LNG carriers/tugs was conducted using version 16216r of EPA's preferred dispersion model (AERMOD). Secondary formation of PM was also accounted for in accordance with EPA guidance, by adding the expected secondary formation of $PM_{2.5}$ from NO_x and SO_2 emissions to the modeled result for direct $PM_{2.5}$ impacts. For the permitting of just the stationary sources, regulations state that if worst-case impacts from worst-case project emissions are below the "significant" levels identified in OAR 240-200-0020 Table 1 (which are well below the NAAQS standards in table 4.12.1.2-1 and the PSD increments in 4.12.1.3-2), there is no need to quantitatively model impacts from other nearby sources as well. The ACDP permit application showed that 1-hour SO_2 impacts, as well as short-term and annual impacts for NO_2, $PM_{2.5}$, and PM_{10}, were above "significant" levels. Therefore, multisource modeling was conducted which incorporated emissions from eight other nearby facilities (Roseburg Forest Products, Westrum Funeral Services, Bandon Concrete, Southport Forest Products, Allweather Wood, LTM Incorporated, Coastal Cremation and Funeral Services, and Georgia-Pacific Wood Products). The multisource modeling also included emissions from LNG carriers/tugs. Results are shown in table 4.12.1.3-3.

TABLE 4.12.1.3-3

Maximum Combined Impacts of Jordan Cove LNG Project, Marine Vessels, and Nearby Major Sources

Air Pollutant	Averaging Period	Maximum Cumulative Impact a/	Class II Increment	Maximum Cumulative Impact + Background	AAQS
SO_2 (μg/m³)	1-Hour	30.1	NA	33.2	196
NO_2 (μg/m³)	1-Hour	132.3	NA	148.3	188
	Annual	4.1	25.0	6.0	100
PM_{10} (μg/m³)	24-Hour	9.3	30.0	44.3	150
	Annual	1.4	17.0	NA	NA
$PM_{2.5}$ (μg/m³)	24-Hour	8.3	9.0	18.2	35.0
	Annual	1.7	4.0	8.4	12.0

μg/m³ = microgram per cubic meter
a/ The maximum cumulative impact shown is the highest of the results modeled from either the AAQS or PSD increment analyses for each indicated pollutant and averaging period.

For all pollutants, the combined impacts at the points of highest concentration are below the applicable NAAQS and the PSD increments. Impacts on the distant Class I areas[239] are discussed in section 4.12.1.5. Therefore, we conclude that based on the maximum predicted impacts of the LNG terminal and LNG carriers, in addition to nearby major sources, there would be no significant impacts on regional air quality.

4.12.1.4 Pacific Connector Pipeline Project Impacts

Construction Air Quality Impacts

Construction of the pipeline and compressor station would result in a temporary increase in emissions due to the combustion of fuel in vehicles and equipment, dust generated from soil disturbance, and general construction activities (e.g., painting and welding). Pipeline construction spread activities would occur in sequence or in assembly-line fashion along the right-of-way with one crew following the next from clearing until final cleanup. Emissions from any given stage of construction would therefore be spread out along the construction corridor due to the sequence/assembly-line nature of the work, rather than being concentrated in a specific stationary location. As work proceeds, there are often small periods between job tasks when work at a specific location on the right-of-way is delayed such as between trenching and pipe stringing or pipe stringing and welding. As the work crews move along the corridor, the construction equipment would produce emissions and these emission sources would move along the corridor as work progresses. Local residents nearby to construction may notice a localized increase in dust (i.e., directly around the Project area) from construction activities; however, Pacific Connector would spray water on the right-of-way, and may use Dustlock® in addition to water, for dust control. Pipeline construction crews would move quickly down the right-of-way in a linear fashion, and few locations would see sustained construction for significant lengths of time.

Pacific Connector estimated total pollutant emissions from the entire duration of construction activities, as detailed in table 4.12.1.4-1. Helicopters may be used during logging for right-of-way clearance; however, their use is uncertain and, due to the limited scope and duration of the activity, the associated emissions were not quantified.

[239] Areas designated as "Class I" include international parks and various national wilderness areas and parks above specified sizes.

TABLE 4.12.1.4-1

Estimated Emissions from Construction of the Klamath Compressor Station and Pacific Connector Pipeline (tons)

Source	CO	NO_x	SO_2	VOC	PM_{10}	$PM_{2.5}$	HAP	GHG (as CO_2e)
Compressor Station – Fugitive Dust on Unpaved Roads	0	0	0	0	4.67	0.47	0	0
Compressor Station – Fugitive Dust from Materials Handling	0	0	0	0	2.04	2.04	0	0
Compressor Station – Construction Equipment Exhaust	1.48	1.52	0.07	0.29	0.21	0.20	0.22	378
Pipeline – Fugitive Dust from Materials Handling	0	0	0	0	146.32	146.32	0	0
Pipeline – Fugitive Dust from Roads	0	0	0	0	123.45	12.55	0	0
Timber Removal – Fugitive Dust from Roads	0	0	0	0	30.92	3.22	0	0
Pipeline (Spread 1) – Construction Equipment Exhaust	12.96	35.39	2.39	4.40	4.36	4.23	3.66	14,342
Pipeline (Spread 2) – Construction Equipment Exhaust	12.60	32.82	2.18	4.06	3.99	3.87	3.37	13,099
Pipeline (Spread 3) – Construction Equipment Exhaust	10.58	25.77	1.64	3.10	3.02	2.93	2.56	9,784
Pipeline (Spread 4) – Construction Equipment Exhaust	9.10	23.56	1.52	2.79	2.82	2.73	2.34	9,082
Pipeline (Spread 5) – Construction Equipment Exhaust	8.06	20.11	1.33	2.50	2.46	2.39	2.09	8,003
Total	**54.78**	**139.17**	**9.13**	**17.14**	**324.26**	**180.95**	**14.24**	**54,688**

Emissions from construction equipment have been reduced over time as a result of the federal regulations for mobile engines and fuels, and measures would be taken by Pacific Connector to minimize fugitive dust. The predominant source of PM is fugitive dust (for which emissions estimation procedures have typically largely over-predicted emissions compared to what is seen in ambient measurements) (Watson and Chow 2000; Countess Environmental 2001). Pacific Connector would implement the following measures to mitigate the air emissions during pipeline construction:

Fugitive Dust Source Controls:

- Limit drop heights of soil excavation activities.
- Water the right-of-way, laydown areas, and temporary roads at least daily in areas of active construction, if necessary.
- Control project-related traffic speeds on dirt access roads and on linear facility rights-of-way.
- Ensure that speeds on the construction right-of-way would not exceed 15 mph where fugitive dust can be generated.
- Water gravel or dirt access roads in areas of heavy traffic, as determined necessary to control fugitive dust.
- Decrease speed limits when excessive winds prevail and where sensitive areas such as public roads may be adjacent to access roads or the right-of-way.
- Maintain speed limit signs for the duration of the construction activities and place them where access roads intersect the construction right-of-way.
- Water temporarily stockpiled soils to create a semi-hard protective layer to minimize wind erosion, if necessary.

- Ensure that wind erosion BMPs will be in place during forecasted high wind (greater than 25 mph) weather advisories (see the ECRP).

Mobile and Stationary Source Controls:

- Reduce use, trips, and unnecessary idling of heavy equipment.
- Maintain and tune engines per manufacturer's specifications to perform EPA certification levels, where applicable, and to perform at verified standards applicable to retrofit technologies. Employ periodic, unscheduled inspections to limit unnecessary idling and to ensure that construction equipment is properly maintained, tuned, and modified consistent with established specifications.
- Prohibit any tampering with engines and require continuing adherence to manufacturer's recommendations.
- Use construction equipment engines that incorporate modern pollution control technology. If practicable, lease new, clean equipment meeting the most stringent of applicable federal or state standards.

Finally, as identified in its *Fugitive Dust Control Plan*, construction of the Pacific Connector pipeline would pass through up to 8.9 miles of geologic formations that may contain naturally occurring asbestos in the form of serpentinite rocks or soils, or other types of ultramafic rocks. Pacific Connector would implement the following additional BMPs and mitigation measures in areas identified as potentially containing naturally occurring asbestos:

- identify areas with potential naturally occurring asbestos with signs at all access points;
- reduce grading or excavation speeds;
- limit grading activities when winds are high or keep wetted;
- limit speeds of construction vehicles and equipment to 15 mph or less;
- inform operators and construction personnel to keep equipment and vehicle windows and doors closed during construction or on windy days in areas of naturally occurring asbestos;
- clean equipment before moving it offsite of the naturally occurring asbestos area;
- locate and design equipment cleaning stations in coordination with a federal land representative such that contaminated water is not carried offsite; and
- stabilize all disturbed areas with vegetation post-construction.

The impacts on ambient air quality from construction of the Klamath Compressor Station and Pacific Connector pipeline would vary with time due to the construction schedule, the mobility of the sources, and the variety of emission sources. Fugitive dust and other emissions due to construction activities generally do not pose a significant increase in regional pollutant levels; however, local pollutant levels would increase during the construction period. Based on the duration and scope of construction activities, we conclude that construction of the Project would impact local air quality. However, construction emissions would not have a long-term, permanent effect on air quality in areas adjacent to the construction corridor. In addition, emissions from pipeline construction would be distributed along the entire 229-mile-long construction corridor, greatly reducing localized impacts.

Operation Air Quality Impacts

Emissions of criteria pollutants from operation of the compressor station and pipeline are shown in table 4.12.1.4-2. Most of the emissions result from fuel combustion in the compressor station turbines, boiler, and standby generator. Fugitive emissions result from the normal leakage of small amounts of methane, VOC, and HAP compounds from valves, flanges, and other components in the compressor station piping, as well as meter stations or valve sites along the pipeline. Venting emissions result from infrequent process upsets and planned maintenance activities.

TABLE 4.12.1.4-2

Criteria Pollutant Emissions from Operation of Klamath Compressor Station and Pacific Connector Pipeline (tons per year)

Source	CO	NO_x	SO_2	VOC	PM_{10}	$PM_{2.5}$	HAPs	GHGs (as CO_2e)
Compressor Station Turbines a/	146.4	144.6	8.7	9.9	17.1	17.1	2.88	379,251
Compressor Station Fugitive Emissions	0	0	0	7.3	0	0	0.27	10,307
Boiler a/	2.7	1.6	0.02	0.18	0.25	0.25	0.06	3,912
Generator	0.6	0.3	0.00	0.2	0.01	0.00	0.04	88
Pipeline Fugitive and Venting Emissions	0	0	0	1.01	0	0	--	162
Total	**149.7**	**146.5**	**8.72**	**18.59**	**17.36**	**17.35**	**3.25**	**393,720**

a/ Based on maximum potential emissions for all three turbines and boiler operating continuously at their rated capacities, with the exception that turbine operation at temperatures below 0 degrees Fahrenheit is excluded. This value corresponds to the potential-to-emit (PTE) for the Project based on the permitted number of turbines.

Routine Operation: The following compressor station and pipeline sources are expected to operate continuously during routine operation:

- three combustion turbines for the compressor drives;
- one boiler;
- compressor station fugitive emission sources (condensate tank, valves, flanges, and other equipment); and
- pipeline fugitive emission sources (valves, flanges, and other equipment at three meter and regulator stations).

Intermittent Operation: The following sources or activities would only operate intermittently, during startup or shutdown events, planned maintenance, process upsets, readiness testing, or emergency situations:

- one standby generator engine; and
- periodic venting and blowdown events, estimated at three major blowdown events per year.

The compressor station would remain below PSD major source thresholds for emissions of all criteria pollutants, HAP, and GHG, but would be a Title V major source for emissions of NO_x and CO. Pacific Connector submitted a standard ACDP initial application to ODEQ in May 2015 and submitted a modification to its standard ACDP application in September 2017.

Potential emissions of HAP from the turbines, boiler, and generator are estimated to be just 1.3 TPY. Potential emissions of four pollutants at the Klamath Compressor Station (NO_x, CO, PM_{10}, and $PM_{2.5}$) exceed the Significant Emission Rate threshold at OAR 340-200-0020 and require a dispersion modeling analysis. Potential emissions of SO_2 are below the Significant Emission Rate, but modeling of SO_2 was also performed as requested by the FERC. A screening model (AERSCREEN) was used for all pollutants and averaging periods with the exception of 1-hour NO_2 and 24-hour $PM_{2.5}$, which were modeled twice, first with AERSCREEN and then with AERMOD. AERMOD is a more refined model that allows the use of hourly meteorological data and produces a less conservative result than AERSCREEN. Modeling results are presented in table 4.12.1.4-3. Pacific Connector filed an ACDP air permit application with ODEQ in 2015, and the modeling was performed in accordance with the modeling protocol that was approved by ODEQ at that time. ODEQ may request updates to that modeling protocol as part of the state air permitting process.

Based on the results of the screening analysis using AERSCREEN, and the refined AERMOD analysis for 1-hour NO_2 and 24-hour $PM_{2.5}$, we conclude that the Project would not have a significant impact on regional air quality.

TABLE 4.12.1.4-3

Screening-Level CO and NO_2 Impacts from Compressor Station Turbines

Air Pollutant	Averaging Period	Model	Maximum Impact	Background a/	Maximum Impact + Background	AAQS
NO_2 (μg/m^3)	1-Hour	AERMOD	96.4 b/	10.0	106.4	188
	Annual	AERSCREEN	29.6 b/	2.1	31.7	100
CO (μg/m^3)	1-Hour	AERSCREEN	433	993	1,426	40,000
	8-Hour	AERSCREEN	390	748	1,138	10,000
PM_{10} (μg/m^3)	24-Hour	AERSCREEN	32	32	64	150
$PM_{2.5}$ (μg/m^3)	24-Hour	AERMOD	4.2	17	21.2	35
	Annual	AERSCREEN	5.3	5.3	10.6	12
SO_2 (μg/m^3)	1-Hour	AERSCREEN	26.5	1.3	27.8	196
	3-Hour	AERSCREEN	26.5	1.3	27.8	1,300
	24-Hour	AERSCREEN	23.9	0.8	24.7	NA
	Annual	AERSCREEN	2.65	0.5	3.1	NA

a/ Background concentrations based on design values for 2009-2011 estimated using NW AIRQUEST.
b/ Based on an assumed in-stack NO_2 to NO_X ratio of 0.19.

4.12.1.5 Environmental Consequences on Federal Lands

A quantitative analysis of air quality impacts from potential stationary emissions sources at the Jordan Cove LNG Project (but not the marine vessels or other major sources that obtained permits since the baseline dates) was conducted for Class I areas within 200 kilometers (km) of the Project site. First, AERMOD was used to evaluate impacts at receptors placed at a radius of 50 km from the Project site (the farthest distance for which AERMOD is recommended for use). If modeled impacts at all of the 50 km receptors were below the Class I significant impact level (SIL) for a given pollutant and averaging period, then it was presumed that impacts would also be below the SIL at each Class I area (ranging in distance from 110 to 178 km from the Project site).

However, if modeled impacts at 50 km were above a SIL, then further analysis was conducted to simulate what impacts would be at the nearest boundary of each Class I area. This simulation was performed by selecting the receptor along the 50-km radius that had the highest modeled concentration (i.e., impact) when averaged over 5 years, and then comparing that impact at 50 km to the 5-year average impact at a receptor located just 1 km from the Project site, in the direction of the maximum-impact 50-km receptor. The results at the 1-km and 50-km receptors were then extrapolated (using an exponential decay function) to evaluate impacts at the distance of each Class I area.

The results of this analysis are shown in table 4.12.1.5-1 and indicate that impacts from the Jordan Cove LNG Project at all Class I areas would be well below the SILs.

TABLE 4.12.1.5-1

Maximum Impacts of Jordan Cove LNG Project at Class I Areas

Air Pollutant	Averaging Period	Maximum Impact at 50 km	Maximum Impact at Class I Area Boundary	Class I SIL a/
SO_2 (μg/m^3)	3-Hour	1.33	0.24	1.0
	24-Hour	0.35	0.023	0.2
	Annual	0.012	N/A	0.1
NO_2 (μg/m^3)	Annual	0.032	N/A	0.1
PM_{10} (μg/m^3)	24-Hour	0.854	0.061	0.3
	Annual	0.026	N/A	0.2
$PM_{2.5}$ (μg/m^3)	24-Hour	0.854	0.061	0.07
	Annual	0.026	N/A	0.06

a/ SILs are based on the first highest concentration at any one location.
μg/m^3 = microgram per cubic meter

In addition to the modeling analysis described above, a screening test was also performed for Air Quality Related Values (AQRV) at Class I areas. This screening test is used by federal land managers to determine whether a source more than 50 km from a Class I area is likely to have any adverse impact on an AQRV, such as visibility impairment. If the ratio of emissions in tons per year (Q) divided by the distance to a Class I area in km (D) is less than 10, then a source is considered not to cause or contribute to a visibility impairment. This screening calculation showed that the Q/D ratio for combined annual emissions of NO_x, SO_2, and PM from stationary sources at the Jordan Cove LNG Project was less than or equal to 10, indicating that no further Class I AQRV impact analyses are required.

Air pollution regulations treat other (Class II) federal lands in the same manner as non-federal Class II lands. The nearest federal lands in the vicinity of the Jordan Cove LNG Project include the ODNRA immediately north, and COE and BLM land on the North Spit. The pipeline route would cross various parcels of Class II areas administered by the BLM, Forest Service, and Reclamation. Dispersion modeling of terminal operations illustrated that impacts at the locations nearest the terminal would be less than the maximum Class II impacts identified above in section 4.12.1.3.

The closest Class I area to the Klamath Compressor Station is Lava Beds National Monument in California. This Class I area is approximately 37 km (about 23 miles) to the southwest of the compressor station site. A Class I AQRV screening analysis for potential impacts from compressor station operational emissions on Lava Beds National Monument shows that the Q/D ratio is much less than 10, indicating that no further Class AQRV impact analyses are required.

The pipeline route would pass closest to the Mountain Lakes Wilderness Class I area. The shortest distance between the Mountain Lakes Wilderness boundary and the pipeline is 4.5 miles (7.3 km), located at about MP 172.5. Pipeline construction spread 5 would operate between MPs 169.5 and 228.8, a total distance of 59.3 miles (95.4 km). Thus, emission sources for construction spread 5 would vary in distance from Mountain Lakes as the spread moves along the right-of-way. The potential air quality impact on Mountain Lakes would decrease as the distance between construction spread activity and Mountain Lakes increases (as the spread moves away from the closest point to Mountain Lakes). Pipeline construction would generally occur at a steady pace; therefore, it is reasonable to expect that these construction emissions for spread 5 would be evenly distributed throughout the spread 5 construction corridor (except for in areas where terrain or other factors slow the rate of construction). For the pollutants of highest concern, emissions expected per kilometer of pipeline route would only be 0.21 ton/km of NO_x, 0.01 ton/km of SO_2, and 1.56 ton/km of PM_{10}. Applying the Class I AQRV screening analysis mentioned above to these emissions again results in impacts far below the screening criteria.

Pacific Connector would consult with the federal land managers of Class I areas during the air permit process. For the Class II federal lands areas that are crossed by the pipeline, construction sources would have only a temporary impact on air quality and there are no operational sources of emissions located in those areas (i.e., the terminal and compressor station are not located on or near federal lands).

Terminal sources are distant from federal lands. The nearest Class I area is more than 100 km (about 62.1 miles) away, and a quantitative air quality impact analysis, as summarized in table 4.12.1.5-1, shows that impacts from the Jordan Cove LNG Project would not be significant on federal lands. About 71 miles of pipeline route would cross federal lands. Emissions associated with pipeline construction activities are very low, and these activities would be temporary and transient as crews move in a linear fashion along the right-of-way. Therefore, based on the analysis presented above, Pacific Connector's commitment to consult with federal land managers of Class I areas, and the temporary nature of construction emissions on Class II areas, we conclude that the Project would not adversely affect air quality on federal lands.

4.12.1.6 Conclusion

Constructing and operating the Project would result in short- and long-term impacts on air quality. However, based on the implementation of the required BMPs, the Project would not significantly affect air quality.

4.12.2 Noise and Vibration

Noise would affect the local environment during both the construction and operation of the Project. At any location, both the magnitude and frequency of environmental noise may vary considerably over the course of the day and throughout the week. For construction activities, this variation in noise levels is caused primarily by changes in equipment operations and activity locations. During operation, this variation is caused in part by changes in operational activities, weather conditions, and the effects of seasonal vegetative cover. In this section of the EIS, potential noise impacts on human receptors are discussed, while noise impacts on wildlife are addressed in sections 4.5 and 4.6.

Noise can be measured and quantified using many different metrics. Some of the most common metrics used by federal agencies and presented in subsequent sections of this EIS are the equivalent sound level (L_{eq}), day-night sound level (L_{dn}), and the maximum sound level (L_{max}). Conventionally expressed in dBA, the L_{eq} is the energy-averaged, A-weighted sound level for the complete time period. It is defined as the steady, continuous sound level over a specified time, which has the same total sound energy as the actual varying sound levels over the specified period.

Effectively, the variations in noise over the time period are averaged. The L_{dn} measures the 24-hour average noise level at a given location. This metric was adopted by the EPA for developing criteria for the evaluation of community noise exposure and also by the FERC when assessing noise. The L_{dn} is calculated by averaging the 24-hour hourly L_{eq} levels at a given location after adding 10 dB to the nighttime period (10:00 p.m. to 7:00 a.m.) to account for the increased sensitivity of people to noises that occur at night. The L_{max} sound level is used to quantify the maximum instantaneous sound pressure level by source (such as noise from a car backfiring, or firecrackers) over a given specified measurement period. Table 4.12.2-1 lists relative dBA noise levels of common sounds measured in the environment and industry. The human ear's threshold of perception for noise change is considered to be 3 dBA; 6 dBA is clearly noticeable to the human ear, and 10 dBA is perceived as a doubling of noise (Bies and Hansen 1988).

TABLE 4.12.2-1

Sound Pressure Levels and Relative Loudness of Typical Noise Sources and Soundscapes

Noise Source or Activity	Sound Level (dBA)	Subjective Impression
Jet aircraft takeoff from carrier (50 feet)	140	Threshold of pain
50-hp siren (100 feet)	130	
Loud rock concert near stage or jet takeoff (200 feet)	120	Uncomfortably loud
Float plane takeoff (100 feet)	110	
Jet takeoff (2,000 feet)	100	Very loud
Heavy truck or motorcycle (25 feet)	90	
Garbage disposal, food blender (2 feet), or pneumatic drill (50 feet)	80	Loud
Vacuum cleaner (10 feet)	70	
Passenger car at 65 mph (25 feet)	65	Moderate
Large store air-conditioning unit (20 feet)	60	
Light auto traffic (100 feet)	50	Quiet
Quiet rural residential area with no activity	45	
Bedroom or quiet living room, or bird calls	40	Faint
Typical wilderness area	35	
Quiet library, soft whisper (15 feet)	30	Very quiet
Wilderness with no wind or animal activity	25	Extremely quiet
High-quality recording studio	20	
Acoustic test chamber	10	Just audible
	0	Threshold of hearing

Note: Adapted from Beranek (1988) and EPA (1974)

In response to the draft EIS, we received comments expressing concern about potential adverse health effects on humans due to Project-related noise. In 2011, the World Health Organization (WHO) produced a publication summarizing the results of studies analyzing the relationship between environmental noise and potential health effects including cardiovascular disease, cognitive impairment, sleep disturbance and tinnitus (WHO and JRC 2011). As described further below, we use the EPA-recommended noise criterion to protect the public.

4.12.2.1 Regulatory Requirements for Noise

Federal Noise and Vibration Criteria

In 1974, the EPA published *Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety* (EPA 1974). This publication evaluates the effects of environmental noise with respect to health and safety. The document provides information for state and local governments to use in developing their own ambient noise standards. The EPA has determined that in order to protect the public from activity interference and annoyance outdoors in residential areas, noise levels should not exceed an L_{dn} of 55 dBA. The FERC has adopted this criterion for new compression and associated pipeline facilities, and it is used here to evaluate noise emissions from operation of the Project. An L_{dn} of 55 dBA is equivalent to a continuous noise level of 48.6 dBA L_{eq} for facilities that operate at a constant level of noise. Therefore, a constant sound level of less than 48.6 dBA L_{eq} would ensure compliance with the FERC requirement limiting the L_{dn} at the nearest NSAs to less than or equal to 55 dBA.

The Commission has regulations in 18 CFR 380.12k(4)(v)(B) that address perceived vibration from new or modified facilities. In addition, the American National Standards Institute (ANSI) published ANSI S12.2-2008 that identifies criteria for sound pressure levels that should not be exceeded to avoid moderately perceptible vibration and rattle inside a room. These criteria are 65 dB and 70 dB in the 31.5 hertz (Hz) and 63 Hz octave bands, respectively, and are used to assess vibration levels.

State Noise and Vibration Standards

The State of Oregon has established statewide noise limits for industrial and commercial noise sources (OAR Chapter 340, Division 35). No statewide vibration limits have been established. The specified noise limits apply to either the property line location closest to the noise source or to locations 25 feet toward the noise source from the noise-sensitive building, whichever distance from the noise source is greater. Noise-sensitive property includes residences and other facilities normally used for sleeping, schools, churches, hospitals, and public libraries. The primary noise limits set by the Oregon regulations are based on the statistical distribution of varying noise levels during daytime and nighttime hours. Noise limits are specified in terms of three percentile levels: L_{50}, the noise level exceeded 50 percent of the time; L_{10}, the noise level exceeded 10 percent of the time, and L_{01}, the noise level exceeded 1 percent of the time. In addition to noise limits for noise-sensitive properties, Oregon noise regulations establish additional noise limits for industrial and commercial noise sources in or near designated quiet areas. Quiet areas are defined as land or facilities where the qualities of serenity, tranquility, and quiet are of extraordinary importance and serve a public need. The State of Oregon has not designated any quiet areas, but some local noise ordinances have done so (Beyer 2007). Noise limits established by the Oregon noise control regulations are summarized in table 4.12.2.1-1.

TABLE 4.12.2.1-1

Oregon Noise Limits For Industrial and Commercial Noise Sources

Percentile Noise Level In Any One Hour	Noise-Sensitive Properties Located Outside Designated Quiet Areas		Within Designated Quiet Areas at a Point 400 Feet or More from the Noise Source	
	7 a.m. – 10 p.m.	10 p.m. – 7 a.m.	7 a.m. – 10 p.m.	10 p.m. – 7 a.m.
L_{50}	55 dBA	50 dBA	50 dBA	45 dBA
L_{10}	60 dBA	55 dBA	55 dBA	50 dBA
L_{01}	75 dBA	60 dBA	60 dBA	55 dBA

Notes: The noise limits in this table do not apply to noise from construction sites, agricultural or forestry operations, vehicle traffic, rail traffic, aircraft operations, and various other exempt sources.
Source: OAR 340-035-0035(1)(a), 340-035-0035(1)(b), and 340-035-0035(1)(c).

In addition to the overall dBA limits summarized in table 4.12.2.1-1, the Oregon noise regulations establish additional limits for discrete tones from industrial and commercial noise sources. These octave band noise limits are summarized in table 4.12.2.1-2.

TABLE 4.12.2.1-2

Octave Band Noise Limits For Industrial and Commercial Noise Sources

Center Frequency of Octave Band (Hertz)	Median Sound Pressure Level Limit a/	
	7 a.m. – 10 p.m.	10 p.m. – 7 a.m.
31.5 Hz	68 dB	65 dB
63 Hz	65 dB	62 dB
125 Hz	61 dB	56 dB
250 Hz	55 dB	50 dB
500 Hz	52 dB	46 dB
1,000 Hz	49 dB	43 dB
2,000 Hz	46 dB	40 dB
4,000 Hz	43 dB	37 dB
8,000 Hz	40 dB	34 dB

a/ The noise limits in this table do not apply to noise from construction sites, agricultural or forestry operations, vehicle traffic, rail traffic, aircraft operations, and various other exempt sources.
The noise limits in this table apply to either the property line location closest to the noise source or to locations 25 feet toward the noise source from the noise-sensitive building, whichever distance from the noise source is greater.
If noise levels for any 1/3 octave band exceeds the encompassing octave band limit by more than 10 dB, additional limitations may apply.

Source: OAR 340-035-0035(1)(f).

Oregon noise regulations also establish a numerical noise level increase standard for new industrial or commercial noise sources located on a previously unused site. The regulations limit the increase in hourly L_{10} and L_{50} noise levels as measured at noise-sensitive properties to 10 dBA above the ambient background L_{10} and L_{50} noise levels (OAR 340-035-0035(1)(b)(B)(i)). The 10 dBA operational noise increment standard does not apply to noise from construction activities, agricultural or forestry operations, vehicle traffic, rail traffic, aircraft operations, or various other exempt sources.

Local Noise Standards

The City of North Bend has a noise ordinance that prohibits the making of "unnecessary noise," but the ordinance does not establish specific numerical noise limits (North Bend City Code, Section 9.04.030). Daytime construction activity between the hours of 7 a.m. and 6 p.m. is exempt from the City of North Bend noise ordinance. The counties of Coos, Douglas, and Jackson, Oregon, do not have local noise ordinances. Klamath County cites compliance to occur when federal and/or state noise regulations are met (Klamath County 2010, Policy 5).

Underwater Noise Criteria

Potential underwater noise impacts on marine mammals and fish were also evaluated as part of the Project assessment. Applicable criteria are prescribed by NMFS and are provided in section 4.5.2.

Noise Levels

Existing noise levels are variable depending on location relative to the Project. Therefore, the existing sound environment is broken down by the Project area near the Jordan Cove LNG Project and areas near the Pacific Connector pipeline.

4.12.2.2 Existing Conditions

Jordan Cove LNG Project

The major existing anthropogenic noise sources in the vicinity of the Jordan Cove LNG Project include vehicle traffic on the Trans-Pacific Parkway and U.S. Highway 101, OHV/ATV use in the ODNRA, the Roseburg wood chip facility on the North Spit, and boat traffic on Coos Bay. Aircraft operations at the Southwest Oregon Regional Airport in North Bend are an additional intermittent anthropogenic noise source. Wind, birds, and insects contribute to natural background noise levels. There are no noise sensitive areas (NSAs)[240] within 1 mile of the LNG terminal site.

Jordan Cove has conducted several baseline sound surveys in the vicinity of the Project including one in 2005, 2013, and one most recently in 2017. These surveys collected data for approximately 30 minutes per measurement over a 3-day period. All NSAs and distances to the LNG terminal are shown in figure M-1 in appendix M and are described below. The overall facility site plan is shown in figures 2.1-1 and 2.1-3 in section 2. Figure 4.12-1 presents the LNG Terminal site (shaded purple) as well as NSAs including:

- NSA 1: consists of approximately 180 single-family homes in a residential subdivision located about 1.3 miles south of the LNG terminal noise-producing equipment in the city of North Bend along the south side of the bay adjacent to the airport.
- NSA 2: a group of approximately 50 single-family homes, located approximately 2.2 miles east of the LNG terminal noise producing equipment on Russell Point. Highway traffic located along the Oregon Coast Highway contributes to ambient noise levels at this location.
- NSA 3: the Horsfall campground, the closest campground to the Jordan Cove LNG Project, located approximately 1.2 miles northeast of the LNG terminal noise producing equipment.
- REC 1: the recreation area located to the west and northwest of the LNG terminal noise-producing equipment. This recreation area does not include campground facilities.
- Western Snowy Plover NSA: the critical wildlife habitat for the western snowy plover. It is located along the coast of the Pacific Ocean about 3 to 6 miles southwest of the LNG terminal noise-producing equipment (not identified on map).

[240] NSA distances are measured from the acoustical center of the facility and not the edge of the property.

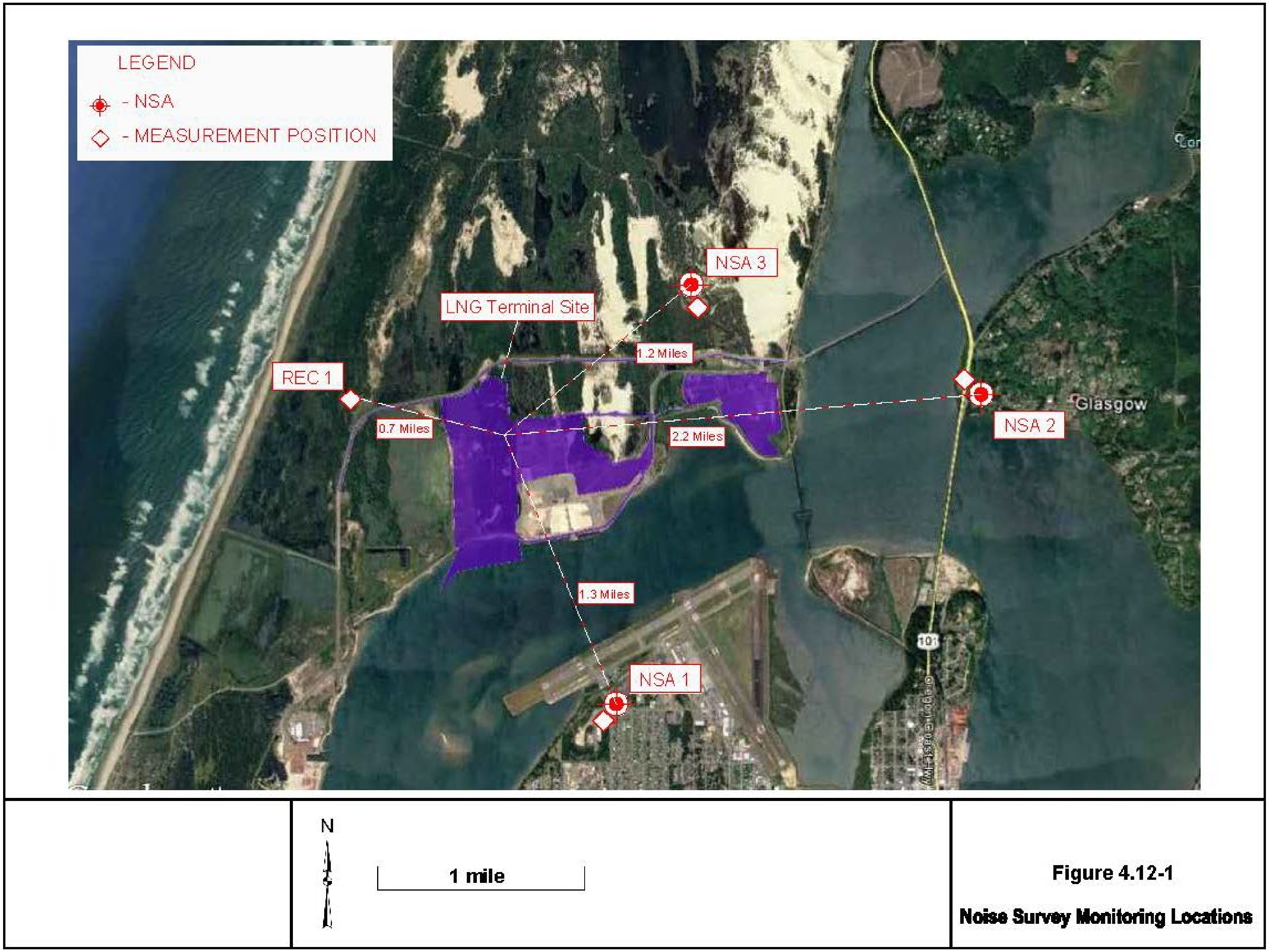


Figure 4.12-1

Noise Survey Monitoring Locations

Jordan Cove monitored the ambient noise levels at those NSAs over a period of approximately 72 hours; the results are presented in table 4.12.2.2-1.

TABLE 4.12.2.2-1

Ambient Noise Levels for the Jordan Cove LNG Terminal Measured at Nearby NSAs a/

Receptor	Distance from LNG Terminal to Receptor (miles)	Direction	Daytime L_{eq}, dBA	Nighttime L_{eq}, dBA	Ambient L_{dn}, dBA b/
NSA 1	1.3	South	52	44	53
NSA 2	2.2	East	63	58	65
NSA 3	1.3	Northeast	58	40	56
REC 1	0.7	West	51	48	55

a/ Data collected during the 2017 sound survey
b/ The L_{dn} is calculated by averaging the actual daytime noise levels with the nighttime levels plus 10 dBA.

Ambient underwater sound levels were also considered. Ambient underwater noise levels range from about 74 dB to 100 dB re 1 µPa in the open ocean with no ship traffic nearby, to about 115 dB to 135 dB re 1 µPa in large marine inlets with some recreational boat traffic (CaDOT 2009). Since Coos Bay is fairly active with existing shipping traffic, ambient underwater noise levels are expected to correspond to the latter range in the presence of shipping but may be lower at times corresponding to reduced boat traffic activity.

Pacific Connector Pipeline Project

For the Pacific Connector pipeline, ambient sound level data were collected in the vicinity of the proposed Klamath Compressor Station in 2012. Background sound levels obtained in the 2012 survey are appropriate for continued use in this analysis because there have been no changes to the surrounding land uses and no development that would increase background noise levels since the 2012 survey. The GTN and Ruby meter facilities, farm animals and equipment, traffic on local roads, and occasional aircraft overhead are the existing noise sources that were captured in the background noise monitoring study. The area around the Klamath Compressor Station is rural; however, an existing Pacific Gas Transmission Company facility is located nearby. All NSAs and distances to the Klamath Compressor Station are shown on figure M-2 in appendix M and are described as follows:

- NSA 1: 34545 Malin Loop Road (Subsequent to the 2012 noise survey, Pacific Connector purchased this property);
- NSA 2: 33909 Malin Loop Road (Subsequent to the 2012 noise survey, Pacific Connector purchased this property);
- NSA 3: 20933 Morelock Road;
- NSA 4: 33535 Malin Loop Road;
- NSA 5: 33770 Malin Loop Road;
- NSA 6: 34631 Malin Loop Road; and
- NSA 7: residence 1,230 feet north of station location.

Pacific Connector monitored the ambient noise levels at those NSAs, the results are presented in table 4.12.2.2-2.

TABLE 4.12.2.2-2

Ambient Noise Levels for the Klamath Compressor Station Measured at Nearby NSAs

Receptor	Distance from Compressor Station, feet	Direction	Daytime L_{eq} dBA	Nighttime L_{eq} dBA	Ambient L_{dn} dBA b/
NSA 1	Property owned by Pacific Connector				
NSA 2	Property owned by Pacific Connector				
NSA 3	1,839	Northwest	35	32	39
NSA 4	2,820	Southwest	32	30	37
NSA 5	2,275	Southwest	54	36	52
NSA 6	1,500	Southeast	41	39	46
NSA 7 a/	1,230	North	39	37	43

a/ Residence to be built. Existing noise level based on level measured at NSA 1.
b/ The L_{dn} is calculated by averaging the actual daytime noise levels with the nighttime levels plus 10 dBA.

4.12.2.3 Jordan Cove LNG Project Impacts

Construction Noise Impacts

As proposed, construction of the Jordan Cove LNG Project would occur over a period of about four years. During site grading and preparation activities, equipment may be operated on two 10-hour shifts, six days per week, with the potential to increase to a 24/7 schedule if required. Pile-driving activities would occur 20 hours per day over a two-year period. No blasting is anticipated to be required for construction because the entire site area consists of sand.

Received sound levels at NSAs from construction would depend on the type of equipment used, the mode of operation of the equipment, the length of time the equipment is in use, the amount of equipment used simultaneously, and the distance between the sound source and the NSA. These factors would be constantly changing throughout the construction period. Construction noise was estimated by Jordan Cove using the Federal Highway Administration's Roadway Construction Noise Model. Table M-1 in appendix M shows a schedule of the equipment expected to potentially be in simultaneous operation, along with the maximum sound level, L_{max}, at 50 feet, the usage percentage, and the expected L_{eq} at 50 feet considering the usage percentage. Noise levels from the construction equipment, excluding pile-driving activities, are expected to range from 68 dBA L_{eq} to 81 dBA L_{eq} at 50 feet.

Jordan Cove conducted noise modeling with the commercially available computer-aided noise abatement (CadnaA) noise prediction model. The software is standards based, and the International Organization for Standardization (ISO) 9613 Part 2 standard was used for air absorption and other noise propagation calculations. Standard atmospheric conditions were selected, and all receptor locations were modeled with all sound sources assumed to be in operation simultaneously. The ground absorption coefficient for all water surfaces was set to highly acoustically reflective with the remaining surfaces set to partially acoustically absorptive.

Table 4.12.2.3-1 presents the predicted daytime and nighttime sound levels at NSAs associated with general construction activities based on planned equipment usage for the currently planned equipment allocation for each year of construction. Figure 4.12-2 depicts the sound generated during general construction activities throughout the Project area in the form of color-coded sound contours.

TABLE 4.12.2.3-1

Predicted Construction Noise Levels at NSAs (dBA)

Receptor	Ambient L_{dn}	Construction Noise Level, Daytime, L_d	Construction Noise Level, Nighttime, L_n	Construction Noise Level, L_{dn}	Future Combined Level, L_{dn}	Increase over Ambient, L_{dn}
NSA 1	53	49	44	52	56	3
NSA 2	65	39	34	41	65	<1
NSA 3	56	42	37	45	57	<1
REC 1	55	49	44	52	57	2

The loudest construction activity at the LNG Terminal site would be pile driving. Pile driving would be required to install the deep foundation piles and sheet piling needed to create the marine bulkheads and retaining walls. Jordan Cove has indicated that up to 14 concurrent diesel impact pile hammers and 6 vibratory hammers would be used during construction of the facility to drive approximately 3,700 pipe piles ranging from 24-inch- to 72-inch-diameter in width.

To reduce the noise impacts from pile-driving activities, we recommended in the draft EIS that these activities be limited to daytime hours. In comments on the draft EIS, Jordan Cove indicated that limiting pile-driving activities in this manner would double the expected time to complete them, from 2 to 4 years.

Subsequently, Jordan Cove, in response to an environmental information request concerning pile-driving noise, provided an analysis of the noise impacts on the North Bend and Coos Bay areas. A summary of Jordan Cove's pile-driving analysis can be found at the end of appendix M.

During our review of Jordan Cove's pile-driving noise analysis, we were unable to confirm its findings. Specifically, Jordan Cove's use of the L_{eq} and L_{dn} sound metrics to characterize pile-driving noise levels, which may underestimate the worst-case instantaneous L_{max} noise impacts experienced by NSAs, is concerning. Our review of the setting and proposal indicates that pile-driving noise impacts are best assessed using L_{max} rather than L_{eq} and L_{dn}. Additionally, Jordan Cove's assertion of privilege regarding the details of the pile-driving analysis did not permit a complete public disclosure of the analysis. Therefore, to ensure that potential noise impacts on nearby communities are assessed in a comprehensive and appropriate manner, we determined that further analysis was necessary, and as such, independently conducted our own analysis using L_{max} as the primary sound metric.

DataKustic GmbH's CadnaA, the computer-aided noise abatement program (2019 MR1), was used for our acoustic modeling analysis. Additional detailed information about the model assumptions can be found at the beginning of noise appendix M. Generally, we assumed the same number and type of piles that were used by Jordan Cove in their analysis. We also used the same pile locations and impact hammer types that would be used by Jordan Cove, as indicated in its filings.

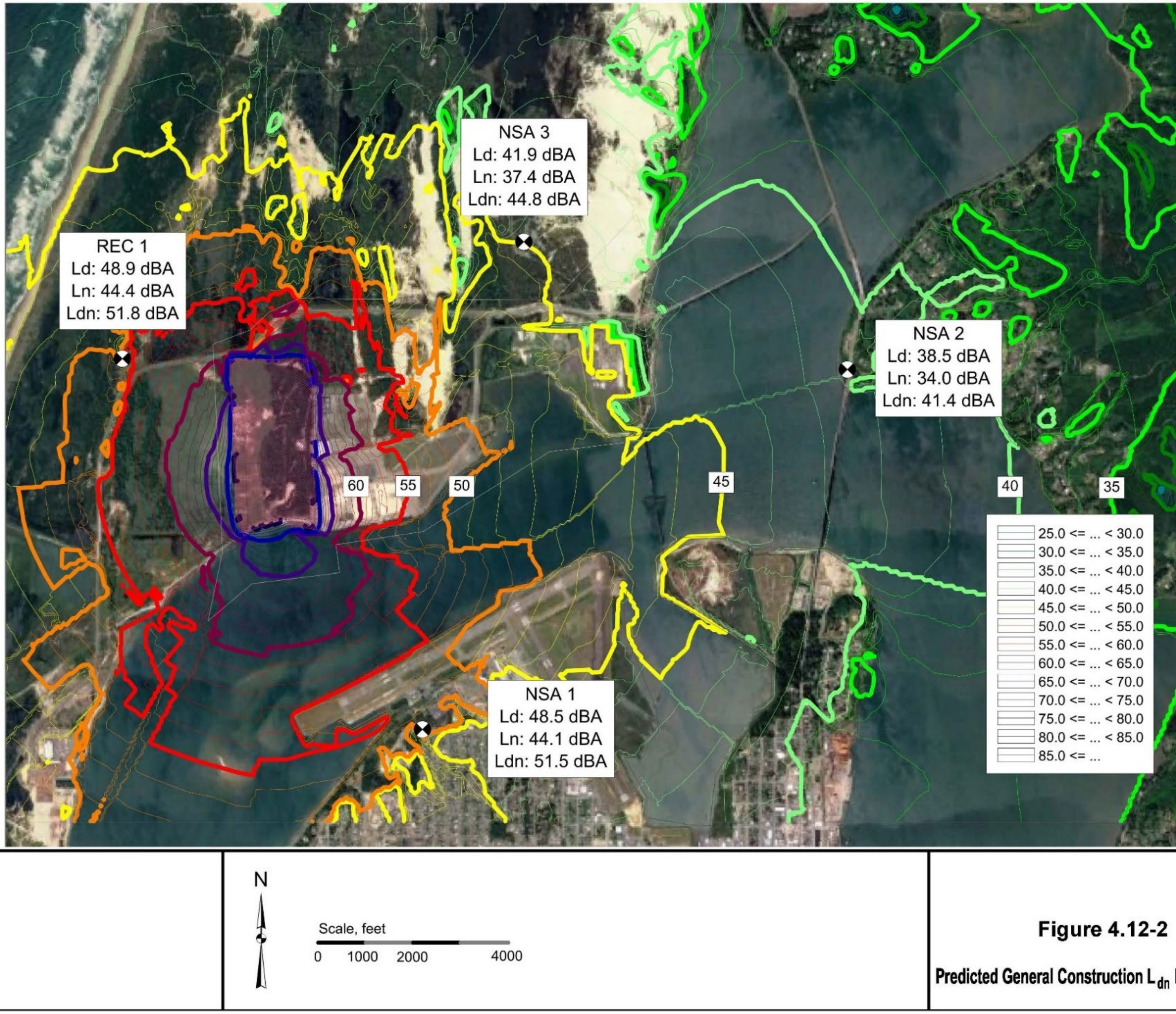


Figure 4.12-2

Predicted General Construction L_{dn} Levels (dBA)

Our analysis, as demonstrated in table 4.12.2.3-2 and depicted on figure 4.12-3, finds extremely high L_{max} noise levels resulting from the proposed pile-driving activities in a large envelope around the LNG Terminal site, severely impacting adjacent recreation areas and thousands of homes in North Bend, Coos Bay, and Glasgow. Furthermore, we have determined that 20 hours per day of elevated noise would adversely affect these communities, especially during sensitive nighttime hours. For these reasons, we conclude that pile-driving activities would temporarily, but significantly, impact noise receptors in the Coos Bay area. We should note that this analysis is conservative, as L_{max} does not indicate the peak noise level and it does not assume any other activities that could occur concurrently (e.g., general construction, earth movement, dredging) and could potentially increase the noise impact.

TABLE 4.12.2.3-2

Predicted Pile Driving Noise Levels at NSAs – No Mitigation (dBA)

	Ambient Sound Level			**Potential Combined Sound Level**		**Increase over Ambient**	
Receptor	**Daytime L_d**	**Nighttime L_n**	**Pile Driving Sound Level L_{max}**	**Daytime**	**Nighttime**	**Daytime**	**Nighttime**
NSA 1	52	44	78	78	78	26	34
NSA 2	63	58	63	66	64	3	7
NSA 3	58	40	71	71	71	13	31
REC 1	51	48	81	81	81	30	33
PLV	51	48	59 a/	60	59	9	11

a/ Impacts on the western snowy plover critical habitat were calculated at the closest point. The habitat is several miles in length and impacts would decrease at points farther from the LNG Terminal site.

To reduce noise impacts, we requested Jordan Cove assess potential noise reduction devices and measures. Jordan Cove determined that all noise mitigation efforts would result in a lengthening of the Project's construction schedule. However, Jordan Cove did not specify the length of time that the construction schedule would be extended. As proposed, noise impacts would occur 20 hours a day, six days a week for two years. Implementing noise reduction devices and measures including reducing the amount of time Jordan Cove could conduct pile driving activities each day could result in noise impacts extending beyond two years. If the construction schedule were to be extended, impacts on other resources could increase. If additional equipment and contractors were added in an attempt to maintain the two-year schedule or reduce the lengthening of the schedule as a result of the implementation of noise reduction measures, the frequency of pile-driver hammer blows would likely increase and could perceptibly increase noise and time-averaged L_{eq} noise levels at NSAs. Also, impacts on other resources including socioeconomics could increase if additional construction workforce were added. However, we have determined that the extremely high nighttime L_{max} levels, as well as the L_{max} increase over ambient levels would result in a severe impact on thousands of residents at night. Therefore, we have concluded it is necessary to reduce this nighttime impact.

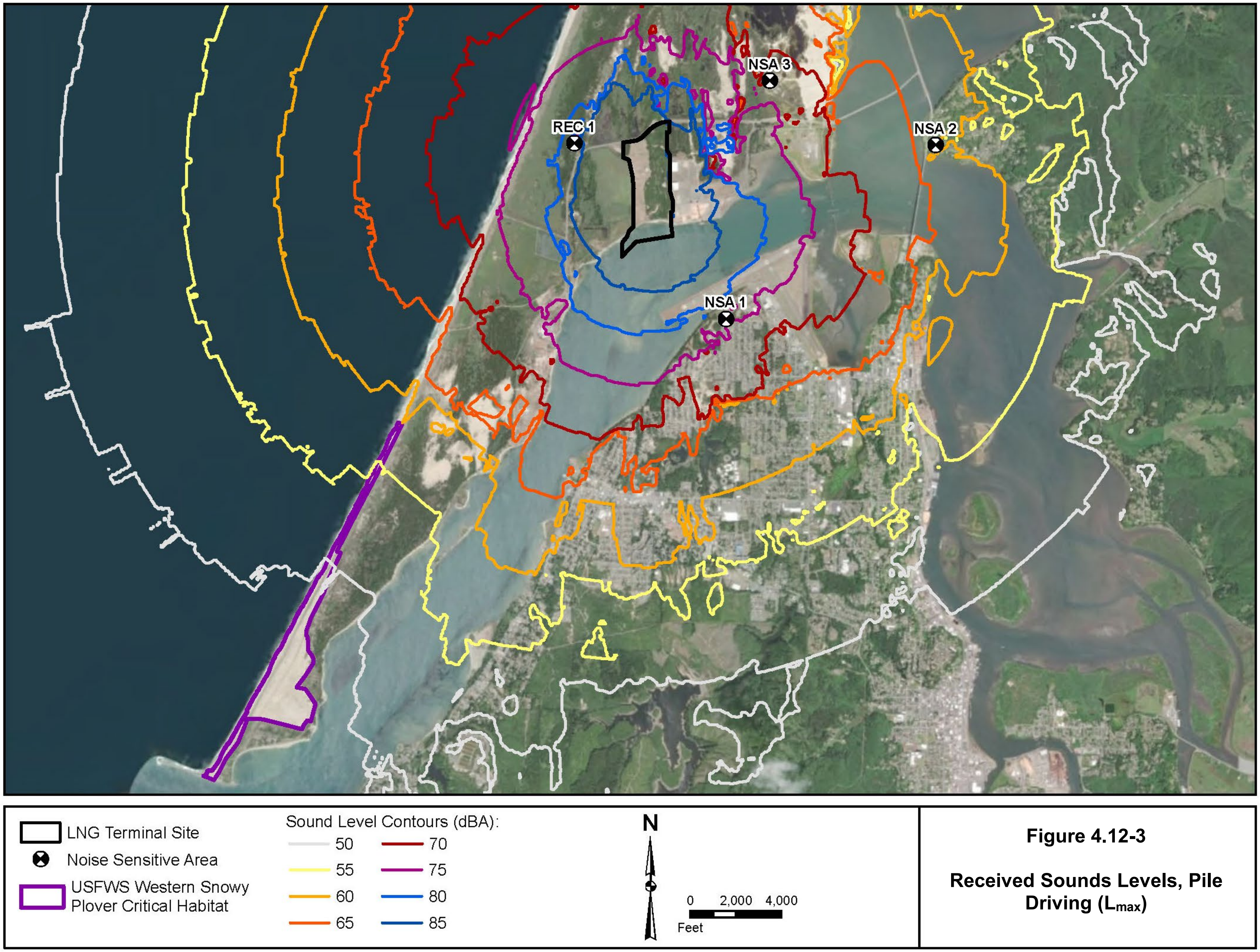


Figure 4.12-3

Received Sounds Levels, Pile Driving (L_{max})

We conducted an additional review of the noise reduction measures considered by Jordan Cove. Of these, wooden pile cushion/caps appear to be a feasible option. Consequently, we modeled noise impacts with and without wooden pile cushion/caps. The noise contours displaying the impact levels can be seen in figures 4.12-3 and 4.12-4. Although the resulting noise levels with the wooden cushion/caps would still be significant, it would result in lower impact levels for many thousands of residences (see table 4.12.2.3-3). As described previously, the use of a noise impact reduction device may extend the construction period, and attendant impacts. To provide a comparison of potential noise impacts during the unmitigated and mitigated pile-driving scenarios, the number of residences within each sound contour level range was approximated based on a review of parcel and structure data via aerial imagery. The number of residences impacted by each sound contour level range both with and without the wooden pile cushions/caps is shown in table 4.12.2.3-3. The results of the comparison clearly show that potential noise impacts at residences would decrease with the implementation of the wooden pile cushion/cap. As shown in table 4.12.2.3-3, no residents are anticipated to experience sound levels greater than 70 dBA when the pile cap/cushions are used during impact pile-driving activities.

TABLE 4.12.2.3-3

Noise Impacts from Pile Driving on Residences in Coos Bay, North Bend, and Glasgow, Oregon

Decibel Range (L_{max}) (dBA)	Estimated Number of Residences, No Pile-Driving Caps	Estimated Number of Residences, Pile-Driving Caps
55-60	2,311	1,929
60-65	2,073	871
65-70	760	55
70-75	718	0
75-80	37	0

Based on the predicted severe and significant noise impacts on Coos Bay, North Bend, and Glasgow residents as well as adjacent recreational areas, and to reduce noise impacts during sensitive nighttime hours, **we recommend that:**

- **During construction of the LNG terminal facilities and other activities requiring the use of vibratory and impact pile-driving, Jordan Cove should:**
  - **a. limit all active pile driving to between the hours of 7:00 a.m. and 10:00 p.m.; and**
  - **b. utilize wooden pile cushion/caps when conducting impact pile-driving work.**

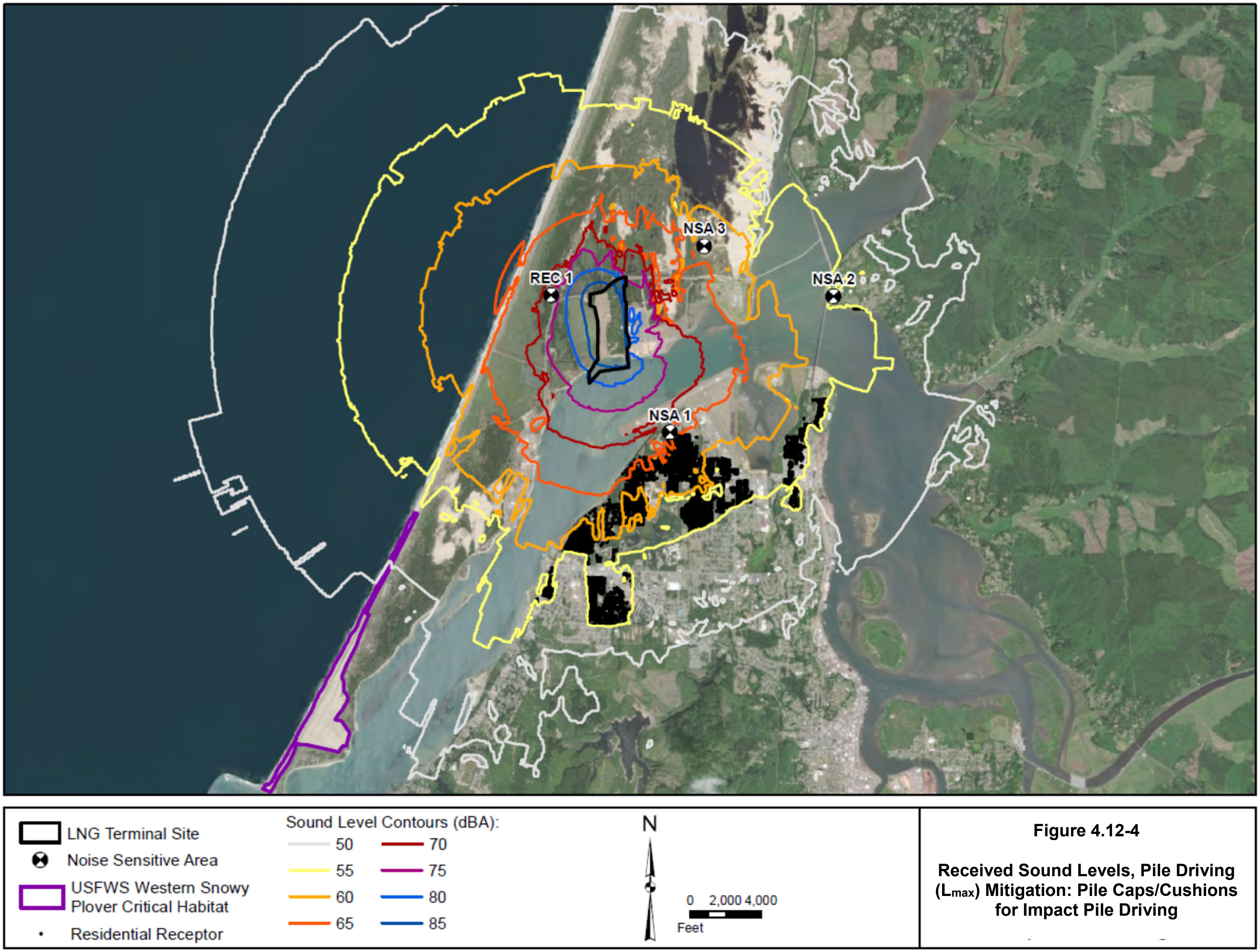


Figure 4.12-4

Received Sound Levels, Pile Driving (L_{max}) Mitigation: Pile Caps/Cushions for Impact Pile Driving

Dredging would also take place during the first three years of the Project. Dredging is anticipated to occur on a 24-hour basis during construction, and its sound level is estimated to be 59 dBA at a distance of 500 feet. Open water dredging activities would occur in five separate work areas, with four work areas along the Federal Navigation Channel and one in the slip area of the Project. Sound was conservatively modeled assuming dredging would take place concurrently at each of the five separate work areas, with all equipment operating simultaneously. Table 4.12.2.3-4 presents the predicted sound levels at NSAs associated with dredging activities. An additional NSA, labeled NSA D1, was included in the dredging evaluation because it is the closest residential area to the Federal Navigation Channel dredging area. Figure 4.12-5 visually displays the sound generated during dredging throughout the Project area in the form of color-coded sound contours. These noise impacts, although moderate in magnitude, would be 24 hours per day and would impact thousands of homes in Coos Bay.

TABLE 4.12.2.3-4

Predicted Dredging Noise Levels at NSAs (dBA)

Receptor	Ambient L_{dn}	Predicted Sound Level, L_{eq}	Predicted Sound Level, L_{dn}	Future Combined Level, L_{dn}	Increase over Ambient, L_{dn}
NSA 1	53	35.8	42.2	53	<1
NSA 2	65	24.6	31.0	65	<1
NSA 3	56	22.0	28.4	56	<1
REC 1	55	28.0	34.4	55	<1
NSA D1 a/	53	44.7	51.1	55	2

a/ Ambient sound levels at NSA D1 are assumed to be the same as at NSA 1, a residence in the same neighborhood, and the same distance from the bay and ocean as NSA D1

Noise from a cutter suction dredge varies with the capacity of the dredger and the type of material being dredged. A smaller dredge with an anticipated sound power level of 157 dB would be used for the Project; however, a larger dredg was also considered to assess worst-case noise impacts. Noise associated with dredging is largely related to ship traffic. It is not anticipated that dredging noise would cause more severe effects on marine mammals or fish than behavioral disturbance (see section 4.5). The noise from dredging and vessel movements would be similar to existing noise levels due to existing dredging and vessel activity in the Coos Bay channel and are not expected to result in significant effects on NSAs in Coos Bay and North Bend.

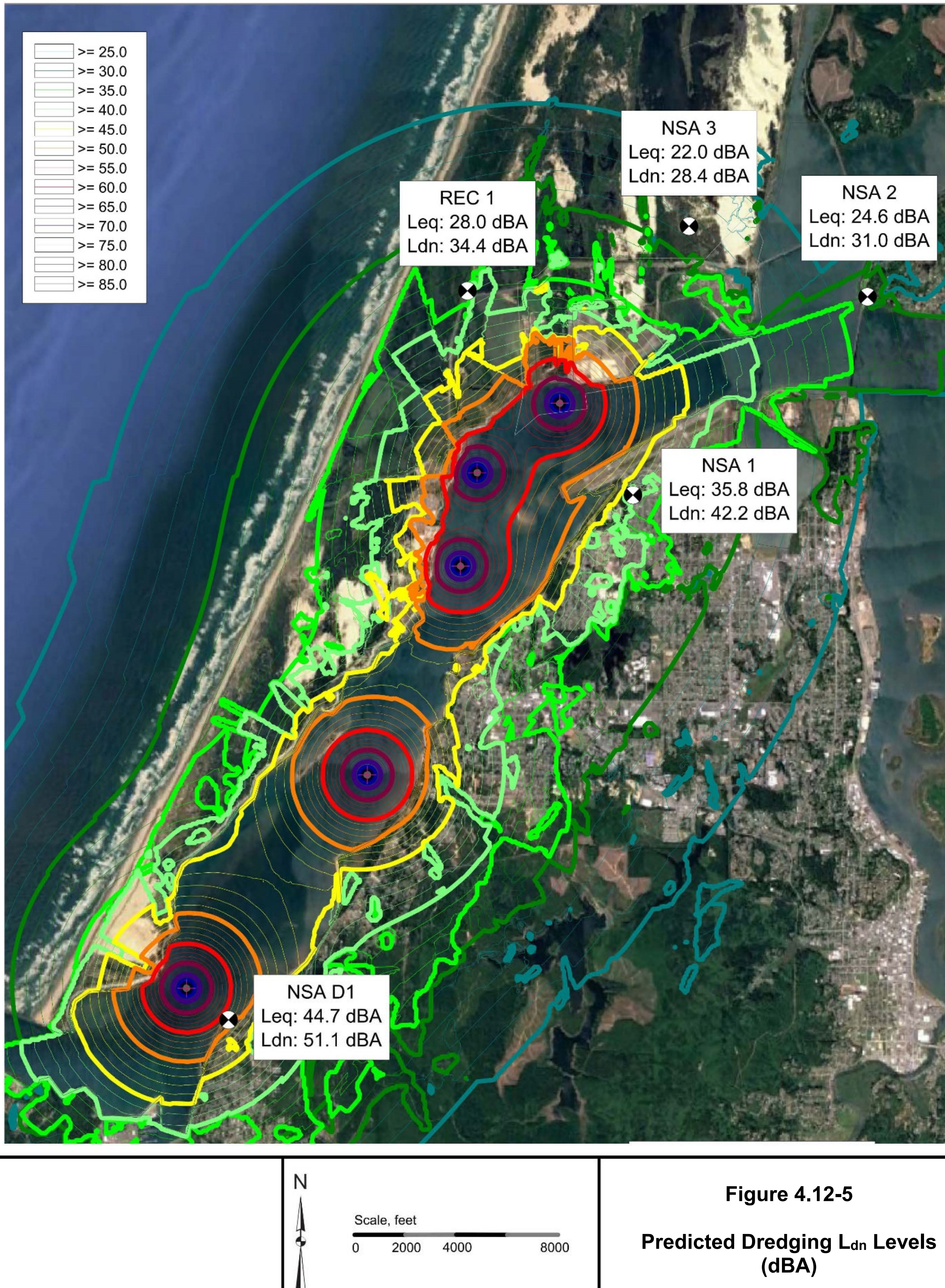


Figure 4.12-5

Predicted Dredging L_{dn} Levels (dBA)

Operational Noise Impacts

Operational noise associated with the Jordan Cove Project was modeled using noise prediction software (CadnaA version 2017) in accordance with ISO 9613. The following major noise-producing equipment would normally be in operation at the Jordan Cove LNG Project and were included in the acoustic modeling analysis:

- Five refrigerant compressors, combustion turbines, heat recovery steam generators, and associated piping;
- Refrigerant compressor interstage and discharge aerial coolers;
- Three steam turbines and their associated air-cooled condensers;
- Two boil-off gas (BOG) compressors with interstage and discharge aerial coolers; and
- Various other smaller condensers, coolers, pumps and valves.

The model simulates the outdoor propagation of sound from each noise source and accounted for sound wave divergence, atmospheric and ground absorption, sound directivity, and shielding due to interceding barriers and terrain. A database was developed that specified the location, octave-band sound levels, and sound directivity of each noise source. The model calculates the A-weighted sound pressure levels from the Project at the NSA locations. Noise modeling was based on normal operation, which excludes intermittent activities such as startup, shutdown, and any other abnormal or upset operating conditions. The results of the analysis (table 4.12.2.3-5) indicate that the predicted NSA sound levels are below the 55 dBA L_{dn} FERC noise criterion.

TABLE 4.12.2.3-5

Predicted Project Noise Emissions at NSAs compared to Regulatory Limits for Jordan Cove LNG Project (dBA)

Receptor	Predicted Project Sound Level (L_{eq})	2017 Nighttime Measured 1-hour (L_{eq}/L_{50})	Increase Over Existing Ambient (L_{eq}) a/	Predicted Project Sound Level (L_{dn})	Existing Ambient (L_{dn})	Future Level (L_{dn}) (Project + Ambient)	Increase Over Existing Ambient
NSA 1	45	44	4	51	53	55	2
NSA 2	37	58	0	43	65	65	<1
NSA 3	43	40	5	49	56	57	1
REC 1	49	48	4	55	55	58	3

a/ The values presented represent the increase in L_{eq} sound level (dBA) above the 2017 measured nighttime ambient L_{eq} as a result of Project operations.

As currently designed, Jordan Cove would not install additional noise mitigation measures such as acoustical enclosures, acoustical barriers, or custom silencers beyond mitigation inherent to the specified equipment analyzed.

As far as ground-borne and low frequency air-borne vibration, facility equipment is designed and balanced to minimize extraneous vibration to preserve and extend the service life of the equipment. Ground-borne and low-frequency airborne vibration resulting from the Jordan Cove LNG Project equipment is not expected at the NSAs.

In terms of environmental noise, an increase to the ambient sound level of 3 dBA is generally considered barely detectable by the human ear. The expected increases in L_{dn} noise levels at the nearest NSAs due to normal operation are less than 3 dBA; however, to ensure that the noise from operation of the Jordan Cove LNG Project would not be significant, **we recommend that:**

- **Jordan Cove should file a full power load noise survey with the Secretary no later than 60 days after placing the entire LNG terminal into service. If a full load noise survey is not possible, Jordan Cove should file an interim survey at the maximum possible horsepower load within 60 days of placing the LNG terminal into service and file the full operational surveys within 6 months. If the noise attributable to the operation of all the equipment of the LNG terminal exceeds 55 dBA L_{dn} at any nearby NSAs, under interim or full load conditions, Jordan Cove should file a report on what changes are needed and install additional noise controls to meet the level within 1 year of the in-service date. Jordan Cove should confirm compliance with this requirement by filing a second full power noise survey with the Secretary no later than 60 days after it installs the additional noise controls.**

Jordan Cove also indicated that they would not phase in operation of the liquefaction trains and would instead bring the facility into operation at one time. Therefore, we modified our recommendation to reflect Jordan Cove's commitment.

Flaring would generate noise; however, since it would occur very infrequently, it is not considered part of typical operations. Cold process flaring is expected to occur five times a year and last for approximately 30 minutes, and warm process flaring is expected to take place once every 3 years and last for approximately 2 hours. The marine flare is expected to be used four times a year and could last approximately 14 hours per event.

Noise associated with flaring was modeled using measurement data from another similar flare and/or engineering references, as appropriate. Table 4.12.2.3-6 presents the predicted sound levels at NSAs associated with flaring. Since flaring lasts for fewer than 24 hours, the predictions were adjusted to reflect actual operation time. Compliance with the FERC noise criterion and State of Oregon noise requirements was successfully demonstrated for all flaring scenarios. Figure M-1 in appendix M also visually displays the sound generated during flaring throughout the Project area in the form of color-coded sound contours. Though process and marine flaring are not expected to take place simultaneously, they were also modeled together to be conservative. As shown in table 4.12.2.3-6, process flaring is substantially louder than marine flaring and therefore dominates the combined case.

TABLE 4.12.2.3-6 Predicted Process and Marine Flare Noise Levels at NSAs (dBA)								
Receptor	Predicted Flaring Sound Level, L_{eq}	Predicted Flaring Sound Level (Adjusted for Event Duration), 1-hour L_{eq}	2017 Nighttime Measured 1-hour L_{eq}/L_{50}	Increase Over Existing Ambient, 1-hour L_{eq}	Predicted Flaring Sound Level (Adjusted for Event Duration), L_{dn}	Ambient L_{dn}	Future Combined Level, L_{dn}	Increase over Ambient, L_{dn}
Cold Process Flare (30 minutes per event)								
NSA 1	44	41	44	2	34	53	53	<1
NSA 2	37	34	58	<1	27	65	65	<1
NSA 3	43	40	40	3	33	56	56	<1
REC 1	57	54	48	7	47	55	56	1
Warm Process Flare (2 hours per event)								
NSA 1	44	44	44	3	43	53	53	<1
NSA 2	37	37	58	<1	36	65	65	<1
NSA 3	43	43	40	5	42	56	56	<1
REC 1	57	57	48	10	56	55	59	4
Marine Flare (14 hours per event)								
NSA 1	25	25	44	<1	31	53	53	<1
NSA 2	16	16	58	<1	22	65	65	<1
NSA 3	12	12	40	<1	18	56	56	<1
REC 1	28	28	48	<1	34	55	55	<1
Combined Process and Marine Flares								
NSA 1	47	46	44	4	44	53	53	<1
NSA 2	40	39	58	<1	37	65	65	<1
NSA 3	46	45	40	6	43	56	57	<1
REC 1	47	59	48	11	44	55	53	1

During operation of the Jordan Cove LNG Project, the primary underwater sound sources would consist of LNG ships and tug boats. The Jordan Cove LNG Project would add about 110 to 120 LNG carriers on an annual basis to the existing 50 deep draft vessels per year operating in the area.

Noise from large vessels can range up to 188 dB re 1 μPa at 1 meter. Noise from vessels varies depending on size, power, propulsion system loading, and vessel speed. Typical transit speed for vessels within Coos Bay navigation channel is 7 knots. JASCO Research (2006) states that broadband noise from LNG carriers at half speed is expected to be around 175 re 1 μPa at 1 meter. Noise from tug boats is less speed dependent and, in fact, tugs under load can be noisier than larger vessels.

In accordance with the NMFS (2016c) technical guidance, a cumulative assessment was conducted for vessel-related noise. The results showed that the noise from transiting vessels and tugs does not represent a potential risk of PTS to any of the identified marine mammal species. When tugs are operating semi-stationary under full power near the facility, individual harbor porpoises would need to remain within about 1 mile of the tug for 1 hour for there to be a potential for PTS. Killer whales would need to remain within about 100 feet of the tug for 1 hour for there to be potential for PTS.

4.12.2.4 Pacific Connector Pipeline Project Impacts

Construction Noise Impacts

Construction activities at the Klamath Compressor Station are expected to last between 12 and 18 months and would involve clearing and grading, placement of fill, excavation for foundations for the compressor unit packages, other equipment settings, ancillary equipment, associated unit housing, piping, and structures. Table M-2 in appendix M presents typical noise emission levels at various distances for the noise-producing equipment that would be operating during the construction of the station.

Construction of the Klamath Compressor Station would cause temporary increases in ambient noise levels in the immediate vicinity of the construction site. Pacific Connector's standard construction operating hours are 7:00 a.m. to 7:00 p.m., Monday through Saturday. OAR 340-035-0035(5)(g) provides an exemption for construction noise from compliance with noise standards.

During construction of the Pacific Connector pipeline, construction noise would be audible to NSAs near the construction right-of-way. Some of the land crossed by the pipeline is categorized for residential, commercial, or industrial use. Over 100 structures are within 150 feet of the pipeline right-of-way or TEWAs, and several residences are within 50 feet of the pipeline construction right-of-way or TEWAs. See section 4.7 of this EIS for more information on land use. Due to the assembly-line nature of pipeline construction, activities in any area could occur intermittently over a period lasting from several weeks to a few months.

Additionally, the area where the pipeline construction right-of-way crosses the PCT is classified as a quiet area. Construction in this area may impact PCT trail users during the 7 to 14 days of estimated construction near the PCT. Pacific Connector has adopted site-specific mitigation measures to reduce potential noise impacts on PCT trail users during construction. In addition, the Forest Service recommends that Pacific Connector install noise barriers at specific locations identified by Forest Service personnel prior to construction in those areas to minimize noise impacts (see section 4.8 for additional details).

Construction equipment would be operated on an as-needed basis. Phase 6 of construction may include rock blasting. Blasting would only occur in areas where bedrock is found within the pipeline trench depth and where other methods such as rock saws, ripping, and/or hydraulic hammers were found to be ineffective. A blasting plan has been prepared within the POD (see appendix F.10 of this EIS) that details mitigation measures for blasting activities.

Blasting is a short-duration event compared to rock removal methods, such as using track rig drills, rock breakers, jack hammers, rotary percussion drills, core barrels, and/or rotary rock drills. Blasting techniques include the electronically controlled ignition of multiple small-explosive charges in an area of rock 8/1,000th of a second apart, resulting in a total event duration of approximately 3/10th of a second. The detonations are timed so the energy from individual detonations destructively interferes with each other, referred to as wave canceling. As a result, very little of the kinetic energy generated during the detonations is wasted as audible noise. For this phase, sound levels at 50 feet are predicted to be 95 dBA L_{eq} and would attenuate to 87 dBA L_{eq} and 74 dBA L_{eq} at 100 feet and 300 feet, respectively. Noise would diminish rapidly as the distance from the noise source increases.

Access roads would be used by construction equipment to reach the right-of-way. There may be areas where access roads are limited in width, grade, or availability. Helicopters may be used during logging for right-of-way clearance; however, in general and as stated in section 2.4.2.1, ground-based skidding and cable (where feasible) logging methods would likely be the standard method. Helicopters that may be used for the Project are assumed to be at most 115 dBA at 50 feet (Michael Minor & Associates 2008), 112 dBA at 100 feet, and 98 dBA at 300 feet. The primary sources of wideband acoustic energy from helicopters are the main and tail rotor. Helicopters generally fly at low altitudes; therefore, potential temporary increases to ambient sound levels would occur in the area where helicopters are operating as well as along their flight path.

In addition to temporary disturbance near residences or other noise-sensitive land uses, construction noise would have localized but temporary effects on wildlife. In general, temporary noise from construction activities would result in some wildlife movements away from the pipeline corridor. See additional discussion of potential pipeline construction noise effects on wildlife in sections 4.5 and 4.6 of this EIS.

The majority of pipeline construction would occur during daytime hours only, with the exception of HDD operations. Other activities often conducted at night include operation of pumps at dry-ditch waterbody crossings; hydrostatic testing; and tie-ins. Pacific Connector may opt to perform these additional construction activities at night. The following mitigation measures would be implemented, as necessary, during construction of the pipeline and/or the Klamath Compressor Station:

- ensure that all equipment has sound control devices no less effective than those provided by the manufacturer;
- ensure that equipment would have muffled exhausts; and
- to the extent feasible, the construction site would be configured in a manner that keeps noisier equipment and activities as far as possible from noise sensitive locations.

If necessary, for greater noise reduction, moveable paneled noise shields, barriers, or enclosures adjacent to or around noisy equipment would be installed where required to meet applicable Project noise limits. If properly installed, temporary barriers can result in a noise reduction of up to 10 dBA at the receptor.

Horizontal Directional Drilling and Direct Pipe Crossings

Pacific Connector proposes to use HDD technology to cross under six waterbodies and a powerline/steep slope location at six sites. Some portions of HDD operations would occur as 12-hour work shifts, while other activities would normally occur as 24-hour-per-day operations. The overall duration of HDD operations is site-specific and would be determined by the drilling contractor. HDD/DP operation durations are dependent upon HDD length and geology, among other factors. For Pacific Connector, HDD/DP duration ranges from 30 days to 130 days.

The equipment would consist of an HDD drilling rig and auxiliary support equipment including electric mud pumps, a crane, mud mixing and cleaning equipment, and a shale shaker. Most significant noise sources would be at the entry and noise levels from the exit locations would be less than the entry noise levels. Table M-4 in appendix M provides sound power level data for the proposed HDD equipment by octave band.

Using a methodology consistent with ambient data collection for other portions of the Project, a measurement survey was conducted near each HDD crossing. The results of that survey are presented in table 4.12.2.4-1.

TABLE 4.12.2.4-1

Ambient Noise Levels for the Pacific Connector HDD Sites Measured at Nearby NSAs

Crossing	Measurement Location	Daytime L_{eq}, dBA	Nighttime L_{eq}, dBA	Ambient L_{dn}, dBA
Coos Bay East and West Entry	Measurement Site #1	63	46	61
	Measurement Site #2	65	46	63
MP25 (BPA Powerline Corridor)	NSA #1	54	49	56
	NSA #2	43	45	51
Coos River	NSA #1	65	35	63
	NSA #2	65	38	63
	NSA #3	60	41	58
	NSA #4	60	37	58
South Umpqua	NSA #1	53	50	57
	NSA #2	63	59	66
	NSA #3	57	51	59
	NSA #4	62	53	63
Rogue River	NSA #1	46	35	46
	NSA #2	46	35	46
	NSA #3	46	35	46
	NSA #4	46	35	46
	NSA #5	54	35	52
	NSA #6	36	35	42
	NSA #7	45	35	45
Klamath River	NSA #1	62	46	61
	NSA #2	57	47	57
	NSA #3	53	43	53

Sound levels at the NSAs due to HDD construction were modeled assuming two scenarios: no noise mitigation, and with noise mitigation, if necessary. The noise mitigation options considered were a barrier wall and two types of acoustic tents. The 20-foot-high barrier wall would wrap around the entire HDD site. The tents include a vinyl acoustic tent installed over the entire drilling site. The tent would be approximately 190 feet long by 90 feet wide by 35 feet high and would contain all equipment on the site and an additional special fabric acoustic tent installed over the entire drilling site. Table 4.12.2.4-2 shows the existing ambient sound level, expected drilling noise including mitigation (if necessary), future combined sound level and net increase in sound level above ambient, presented in terms of L_{eq} sound levels. In most cases, the HDD noise produced adheres to the FERC noise criterion of 55 dBA L_{dn} (or 48.6 dBA L_{eq}); however, there are a few instances where exceedances are predicted at the Coos Bay West and East crossings. At the Coos Bay West crossing, NSA#1 is expected to experience received sound levels above 48.6 dBA L_{eq}; however, during daytime hours, existing ambient sound levels are such that the increase in sound level due to HDD would be negligible. During nighttime hours, HDD activity would result in a net increase in sound level of approximately 7 dBA above nighttime ambient sound levels. At the Coos Bay East crossing, NSA #2 would experience an exceedance of the FERC noise criterion during nighttime hours and HDD activity would result in a net increase in sound level of approximately 7 dBA above nighttime ambient sound levels. We conclude that the noise from the HDD operations, especially during nighttime operations, should be mitigated. Therefore, **we recommend that:**

- **Prior to drilling activities at HDD sites, Pacific Connector should file a site-specific nighttime noise mitigation plan with the Secretary for review and written approval by the Director of OEP. During any drilling operations, Pacific Connector should implement the approved plan, monitor noise levels, and file in its biweekly reports documentation that the noise levels attributable to the drilling operations at NSAs does not exceed 55 L_{dn} dBA.**

Figures M-3 through M-9 in appendix M depict the HDD locations, predicted sound levels for HDD activity, and the location of the nearest NSAs.

The DP method is another trenchless construction method that would be used to cross some waterbodies by Pacific Connector (see section 2), which is similar to HDD but is also combined with the process of microtunneling. Compared to HDD, a much larger cutterhead is used, eliminating the reaming process. Excavation and hole boring are performed with a microtunneling machine and cutterhead. Generally, completing a DP crossing takes less time than an HDD crossing and is considered less noisy since the majority of equipment is located at the crossing entry point, as opposed to both entry and exit points. Therefore, it is expected that the assessment of potential noise impacts using HDD technology is a conservative approach in comparison to use of the DP method.

TABLE 4.12.2.4-2

Summary of HDD Acoustic Modeling Results

Crossing	NSA	Distance (ft) / Direction from HDD a/	Ambient Sound Level L_{dn}, dBA	HDD Noise, L_{dn}, dBA	Future Combined Sound Level, L_{dn}, dBA	Net Increase, dBA
Coos Bay West (20' Barrier Wall)	NSA #1	1,469 / South	61	51	61	<1
	NSA #2	1,652 / Southeast	61	46	61	<1
	NSA #3	4,493 / North	61	39	61	<1
	NSA #4	2,058 / Southeast	61	45	61	<1
Coos Bay East (20' Barrier Wall)	NSA #1	1,193 / Southwest	61	41	61	<1
	NSA #2	490 / South	61	51	61	<1
	NSA #3	4,431 / North	61	40	61	<1
	NSA #4	873 / Southeast	61	44	61	<1
MP25 - BPA Powerline Corridor (No Mitigation)	NSA #1	9,842 / Northwest	56	37	56	<1
	NSA #2	4,104 / Southeast	51	48	53	2
Coos River (20' Barrier Wall)	NSA #1	1,232 / South	63	38	63	<1
	NSA #2	1,258 / South	63	36	63	<1
	NSA #3	479 / Southeast	58	51	59	1
	NSA #4	375 / Southwest	58	53	59	1
South Umpqua (20' Barrier Wall)	NSA #1	2,025 / South	57	33	57	<1
	NSA #2	818 / East	66	46	66	<1
	NSA #3	1,325 / Northeast	59	50	60	1
	NSA #4	2,345 / Southeast	63	50	63	<1
Rogue River East Entry (Special Acoustic Tent)	NSA #1	464 / North	46	51	52	6
	NSA #2	1,000 / East	46	43	48	2
	NSA #3	800 / South	46	47	50	4
	NSA #4	490 / Southwest	46	52	53	7
Rogue River East Entry (20' Barrier Wall)	NSA #5	1,300 / West	52	48	53	1
	NSA #6	>1,300 b/	42	55	55	13
	NSA #7	>1,300 b/	45	45	48	3
Klamath River East Entry (Special Acoustic Tent)	NSA #1	650 / Northeast	61	53	62	1
	NSA #2	>1,500 b/	57	43	57	<1
	NSA #3	1,500 / South	53	44	54	1
Klamath River East Entry (20' Barrier Wall)	NSA #1	650 / Northeast	61	51	61	<1
	NSA #2	>1,500 b/	57	51	58	1
	NSA #3	1,500 / South	53	53	56	3

a/ Distances and direction were estimated from the figures in appendix M.
b/ NSA was not shown in the figures. It is assumed that these NSAs are at a greater distance from the HDD than the NSA shown on the figure.

Operational Noise Impacts

Compressor Station Operation

Operational noise associated with the Klamath Compressor Station was evaluated using manufacturers' noise emission data for the anticipated compressors, associated noise producing equipment, and typical noise control applications. The Klamath Compressor Station detailed design has not been completed; therefore, estimates of compressor station operational noise levels are based on best available information. Primary noise sources from equipment at the compressor station, along with corresponding estimated noise emission data and noise control equipment reduction values, were derived from measurements of similar equipment at other similar facilities (see table M-5 in appendix M).

Operational noise levels for the Klamath Compressor Station were estimated using CadnaA, as previously discussed, and noise prediction techniques consistent with ISO 9613 for sound propagation outdoors. These techniques take into account the noise generation of individual equipment items, shielding by buildings and barriers, spreading losses, ground and atmospheric effects, and reflections from surfaces. The modeling conservatively predicted the noise contribution during the operation of all three compressor units operating under full load conditions. The modeling included effects of the hillside excavated to form a partial noise barrier to the east.

During development of the detailed design, best practices applicable to noise reduction would be incorporated. Best design practices routinely incorporated in gas turbine stations are low noise air intakes; exhaust silencers; blow down silencers; gas cooler fans; and sound insulated buildings, housings, and piping. In rare cases, if necessary for compliance with noise limits, noise barriers may be installed. Insertion loss values of the noise mitigation measures incorporated into the acoustic modeling analysis are presented in table M-6 in appendix M.

The results of the operational acoustic modeling analysis are shown in table 4.12.2.4-3. FERC regulations require that during operation, compressor station noise increments not exceed an L_{dn} of 55 dBA (equivalent to a continuous noise level of 48.6 dBA L_{eq}) at the nearest NSA. Oregon noise regulations require that operational noise from new commercial or industrial facilities must not increase ambient L_{50} noise levels by more than 10 dBA. For a facility that operates continuously at a steady level, the L_{50} is often very similar to the L_{eq} level; therefore, predictions of compressor station sound levels are in L_{eq} but are comparable to L_{50} baseline sound levels. The results indicate that, having incorporated the indicated noise mitigation measures, the received sound levels at NSAs would be in compliance with the 55 dBA L_{dn} FERC noise criterion and the Oregon noise regulations. In addition, figure M-10 in appendix M shows the sound contours associated with the operation of the Klamath Compressor Station.

TABLE 4.12.2.4-3

Predicted Operational Noise Levels of the Klamath Compressor Station

Receptor Location	Distance (feet) and Direction	Existing L_{50} (dBA)	Predicted L_{eq} (dBA)	Predicted Increase Over Existing L_{50} (dBA)	Existing L_{dn} (dBA)	Predicted L_{dn} (dBA)	Combined Existing plus Predicted L_{dn}, dBA	Predicted Increase Over Existing L_{dn} (dBA)
NSA 1	Property Purchased by Pacific Connector							
NSA 2	Property Purchased by Pacific Connector							
NSA 3	1,839/Northwest	32	40	9	39	46	47	8
NSA 4	2,820/Southwest	30	35	6	37	41	43	6
NSA 5	2,275/Southwest	36	37	4	52	43	53	1
NSA 6	1,500/Southeast	39	41	4	49	47	51	2
NSA 7	1,230/North	37	43	7	43	50	51	8

Pacific Connector has committed to implementing the following noise mitigation measures for the facility:

- The turbine intake and/or exhaust systems should be equipped with silencers having greater insertion losses than the standard silencers in order to reduce the noise contribution at the nearest NSA (NSA 1) to a level below L_{dn} 55 dBA.
- The turbine exhaust duct located between the compressor building wall and the silencer should be acoustically insulated.
- The turbine lube oil coolers should have noise levels approximately equal to Solar’s 85 dBA cooler. The cooler noise level at a horizontal distance of 50 feet from the center of each cooler would be about 54 dBA.
- The gas after-coolers should be designed so that the noise levels at a horizontal distance of 50 feet from the center of each cooler would be about 60 dBA.
- Outdoor aboveground gas piping should be inserted underground soon after exiting the compressor building.
- The compressor building should be acoustically insulated with 6 inches of 8 pounds/cubic feet density mineral wool insulation. The building shell should have 22-gauge metal outer sheeting in the walls and roof and a 26-gauge perforated metal liner.
- The compressor building roll-up door should have a minimum noise reduction rating of STC-28 through the door (this may require a double door).
- Personnel doors should be standard insulated doors with an STC-26 noise reduction rating.
- The compressor building ventilation system has not yet been designed. The building ventilation openings should be acoustically designed so that they are compatible with the silencing in the rest of the station.
- The compressor impeller wheels have not yet been selected and the unit piping noise levels could not be evaluated. It is expected that the unit piping would require acoustic insulation.

As shown in table 4.12.2.4-3, operation of the Klamath Compressor Station would result in clearly noticeable increases in noise levels at three of the five NSAs. However, the station’s contribution would be less than the FERC requirement of L_{dn} 55 dBA. Although the Klamath Compressor

Station is anticipated to operate in compliance with the applicable noise requirements to ensure that actual operational noise is at or below the FERC-recommended limits, and that there would be no significant effects on noise quality at the nearest NSAs to the compressor station, **we recommend that:**

- **Pacific Connector should file a noise survey with the Secretary no later than 60 days after placing the Klamath Compressor Station in service. If a full load condition noise survey is not possible, Pacific Connector should provide an interim survey at the maximum possible horsepower load and provide the full load survey within 6 months. If the noise attributable to the operation of all of the equipment at the Klamath Compressor Station under interim or full horsepower load conditions exceeds an L_{dn} of 55 dBA at any nearby NSAs, Pacific Connector should file a report on what changes are needed and should install the additional noise controls to meet the level within 1 year of the in-service date. Pacific Connector should confirm compliance with the above requirement by filing a second noise survey with the Secretary no later than 60 days after it installs the additional noise controls.**

Venting/Blowdown Events

These short-term events are a venting of gas for safety purposes to relieve pressure in a pipeline component or at a compressor station prior to performing maintenance work (anticipated to occur on an annual basis). A venting or blowdown event at individual MLV locations is a rare and infrequent event. Blowdowns are expected to occur no more than five times a year over a short time frame (approximately 1 to 5 minutes). The sound levels associated with high pressure gas venting are a function of initial blowdown pressure, the diameter and type of blowdown valve, and the diameter and arrangement of the downstream vent piping. Blowdown sound levels are loudest at the beginning of the blowdown event and decrease as the blowdown pressure decreases. A blowdown vent with a silencer results in a sound power level of approximately 83 dBA. Noise levels at various distances based on that sound power level expected for routine blowdown events are given in table 4.12.2.4-4.

TABLE 4.12.2.4-4

Blowdown Valve Sound Pressure Level at Various Distances

	Distance (feet)/ Received Sound Level, L_{eq} (dBA)			
Sound Source	**50**	**100**	**300**	**1,000**
Blowdown Valve with Silencer	48	42	33	22

Acoustic modeling was conducted to determine received sound levels associated with routine blowdowns at the closest NSAs to the mainline block valve locations (table 4.12.2.4-5). Modeling results indicate compliance with applicable noise requirements prescribed by the FERC and the State of Oregon.

TABLE 4.12.2.4-5 **Summary of Blowdown Acoustic Modeling Results**				
Receptor	**County**	**Distance (Feet)**	**Sound Pressure Level, L_{eq} (dBA)**	**Sound Pressure Level, L_{dn} (dBA)**
02 - AGF 15.69 (BVA #2)	Coos	727	25	31
05 - AGF 59.58 (BVA #5)	Douglas	1,114	21	27
06 - AGF 71.46 (BVA #6)	Douglas	1,096	21	27
08 - AGF 94.66 (BVA #8)	Douglas	205	36	42
10 - AGF 122.18 (BVA #10)	Jackson	896	23	29
15 - AGF 197.77 (BVA #15)	Klamath	1,092	21	27
16 - AGF 214.28 (BVA #16)	Klamath	604	27	33
17 - AGF 228.13 (Klamath Compressor Station, BVA #17)	Klamath	743	25	31

MLV blowdowns, if scheduled for maintenance activities during the life of the pipeline, would be communicated to the surrounding landowners in writing (e.g., letters and "door-hangers") in advance of the event. These events are conducted during daylight hours only. Such transient events are of very short duration and do not represent continuous or routine noise or disturbance to NSAs. Based on the infrequent and short duration of blowdowns, these events would not have significant adverse noise impacts on nearby NSAs.

Metering Station Noise

One meter station would be located very close to the Jordan Cove LNG terminal (at the gas gate), and two meter stations would be located within the Klamath Compressor Station fence line. Noise may be generated by gas flow in the pipe used for measurement at the meter stations. However, noise generated by operation of the Jordan Cove LNG Project would dominate over the meter station near the terminal; similarly, noise generated by operation of the compressor station would dominate over the meter stations at the compressor station. Noise would not be expected to be audible beyond the edge of the meter station sites or pipeline right-of-way. Additionally, our recommendation that Pacific Connector and Jordan Cove complete noise surveys at both the compressor station and the LNG terminal would be inclusive of noise generated by the meter stations in and near these respective facilities; therefore, we conclude that noise impacts due to operation of the meter stations would result in significant impacts on nearby NSAs.

4.12.2.5 Environmental Consequences on Federal Lands

The southern boundary of the ODNRA is less than 0.7 mile northwest of the Jordan Cove LNG Project. As shown on the noise contour maps on figure 4.12-2, estimated noise from general Jordan Cove LNG Project construction is expected to remain below an L_{dn} of 55 dBA (i.e., the noise level used by the EPA and FERC to protect the public from activity interference and annoyance outdoors in residential areas); however, during pile driving for installation of berth facilities at the Jordan Cove marine slip, predicted noise levels at the ODNRA are expected to exceed the FERC noise criterion (figure 4.12-3). In addition, predicted noise levels at the BLM boat ramp located about 1 mile southwest of the terminal site would exceed 55 dBA (figure 4.12-3). Noise from pile driving would be noticeable to users of the ODNRA and BLM boat ramp during construction. This impact would be a temporary annoyance to users of the ODNRA and boat ramp. Due to the noise-generating activities associated with the ODNRA and BLM boat ramp, these locations are not considered to be an NSA.

During operation and flaring, predicted noise generated from the Jordan Cove LNG Project may also exceed the 55 dBA L_{dn} FERC noise criterion at the ODNRA and BLM boat ramp. During operation of the Jordan Cove LNG Project, BLM and COE lands near the Coos Bay navigation channel would receive limited noise impacts from LNG carriers arriving at and departing from the terminal. An estimated 110 to 120 ships per year would call on the Jordan Cove LNG Project. Noise levels during ship movements are estimated to be about 63 dBA at a distance of 300 feet during each pass-by event, which would be similar to noise generated from deep-draft cargo ships that currently traverse the Coos Bay navigation channel. Because the Coast Guard may impose a moving safety zone around LNG carriers (see section 4.10 for more details), only one large vessel would likely be traversing any one location along the channel at any point in time. Current ship traffic at the Port is about 50 deep-draft commercial ship calls per year. The increase in the number of vessel calls at the Port resulting from operation of the Jordan Cove LNG Project would be less than one ship movement per day. Noise from LNG carriers would not be expected to create a noticeable change in overall noise levels at BLM and COE lands along the Coos Bay navigation channel.

During construction of the Pacific Connector pipeline, there would be temporary noise impacts on federal lands crossed by the pipeline or crossed by construction access roads. Construction noise could have localized and temporary effects on recreational users and wildlife on federal lands. Pipeline construction would proceed in a linear fashion along the right-of-way, and equipment would be operated on an as-needed basis; therefore, exact noise at a particular point cannot be determined. However, we can estimate noise levels as a function of the distance of the receptor from the equipment. Table M-3 in appendix M provides predicted construction noise levels at 50 feet, 100 feet, and 300 feet for pipeline construction. Noise would diminish rapidly as the distance from the noise source increases.

During operation of the pipeline, there would be no noise generated from the buried pipeline. Aboveground MLVs would be located within BLM lands. During operation, sound is sometimes detectable within several feet of MLVs; however, any noise impact during operation of the MLVs, with the exception of blowdown events discussed previously, would not be humanly perceptible beyond the operational right-of-way for the pipeline. The main source of noise from operation of the Pacific Connector would be from the Klamath Compressor Station, which would be located on private land, with no federal land adjacent or nearby. We conclude that construction and operation of the Pacific Connector Pipeline Project would not have significant adverse noise impacts on users of federal lands.

4.12.2.6 Conclusion

Constructing and operating the Project would result in noise-related impacts. Based on the implementation of the proposed BMPs as well as inclusion of the recommendations made in this EIS, construction and operation of the pipeline and Klamath Compressor Station would not cause significant noise-related impacts. Similarly, operation of the LNG facility, and non-pile-driving construction activities would not cause significant noise-related impacts. However, noise-related impacts resulting from pile driving at the LNG Terminal are expected to cause significant impacts over more than two years to residents in Coos Bay, North Bend, and Glasgow, Oregon.

4.13 RELIABILITY AND SAFETY

4.13.1 Jordan Cove LNG Project

4.13.1.1 LNG Facility Reliability, Safety, and Security Regulatory Oversight

LNG facilities handle flammable and sometimes toxic materials that can pose a risk to the public if not properly managed. These risks are managed by the companies owning the facilities, through selecting the site location and plant layout as well as through suitable design, engineering, construction, and operation of the LNG facilities. Multiple federal agencies share regulatory authority over the LNG facilities and the operator's approach to risk management. The safety, security, and reliability of the Jordan Cove LNG Project would be regulated by the USDOT PHMSA, the Coast Guard, and the FERC.

In February 2004, the USDOT PHMSA, the Coast Guard, and the FERC entered into an Interagency Agreement to ensure greater coordination among these three agencies in addressing the full range of safety and security issues at LNG terminals and LNG marine vessel operations, and maximizing the exchange of information related to the safety and security aspects of LNG facilities and related marine operations. Under the Interagency Agreement, the FERC is the lead federal agency responsible for the preparation of the analysis required under NEPA for impacts associated with terminal construction and operation. The USDOT PHMSA and the Coast Guard participate as cooperating agencies but remain responsible for enforcing their regulations covering LNG facility siting, design, construction, operation, and maintenance. All three agencies have some oversight and responsibility for the inspection and compliance during the LNG facility's operation.

The USDOT PHMSA establishes and has the authority to enforce the federal safety standards for the location, design, installation, construction, inspection, testing, operation, and maintenance of onshore LNG facilities under the Natural Gas Pipeline Safety Act (49 U.S.C. 1671 et seq.). The USDOT PHMSA's LNG safety regulations are codified in 49 CFR 193, which prescribes safety standards for LNG facilities used in the transportation of gas by pipeline that are subject to federal pipeline safety laws (49 U.S.C. 60101 et seq.), and 49 CFR 192. On August 31, 2018, USDOT PHMSA and FERC signed a memorandum of understanding (MOU) regarding methods to improve coordination throughout the LNG permit application process for FERC jurisdictional LNG facilities. In the MOU, USDOT PHMSA agreed to issue a Letter of Determination (LOD) stating whether a proposed LNG facility would be capable of complying with location criteria and design standards contained in Subpart B of Part 193. The Commission committed to rely upon the USDOT PHMSA's determination in conducting its review of whether the facilities would be consistent in the public interest. The issuance of the LOD does not abrogate the USDOT PHMSA's continuing authority and responsibility over a proposed project's compliance with Part 193 during construction and future operation of the facility. The USDOT PHMSA's conclusion on the siting and hazard analysis required by Part 193 is based on preliminary design information which may be revised as the engineering design progresses to final design. The USDOT PHMSA regulations also contain requirements for the design, construction, installation, inspection, testing, operation, maintenance, qualifications and training of personnel, fire protection, and security for LNG facilities as defined in 49 CFR 193, which would be completed during later stages of the Project. If the Project is authorized, constructed, and operated, LNG facilities as defined in 49

CFR 193, would be subject to the USDOT PHMSA's inspection and enforcement programs to ensure compliance with the requirements of 49 CFR 193.

The Coast Guard has authority over the safety of an LNG terminal's marine transfer area and LNG marine vessel traffic, as well as over security plans for the waterfront facilities handling LNG and LNG marine vessel traffic. The Coast Guard regulations for waterfront facilities handling LNG are codified in 33 CFR 105 and 33 CFR 127. As a cooperating agency, the Coast Guard assists the FERC staff in evaluating whether an applicant's proposed waterway would be suitable for LNG marine vessel traffic and whether the waterfront facilities handling LNG would be operated in accordance with 33 CFR 105 and 33 CFR 127. If the facilities are constructed and become operational, the facilities would be subject to the Coast Guard inspection program to ensure compliance with the requirements of 33 CFR 105 and 33 CFR 127.

The FERC authorizes the siting and construction of LNG terminals under the NGA and delegated authority from the DOE. The FERC requires standard information to be submitted to perform safety and reliability engineering reviews. FERC's filing regulations are codified in 18 CFR §380.12 (m) and (o), and requires each Applicant to identify how its proposed design would comply with the USDOT PHMSA's siting requirements of 49 CFR 193 Subpart B. The level of detail necessary for this submittal requires the Applicant to perform substantial front-end engineering of the complete project. The design information is required to be site-specific and developed to the extent that further detailed design would not result in significant changes to the siting considerations, basis of design, operating conditions, major equipment selections, equipment design conditions, or safety system designs. As part of the review required for a FERC order, we use this information from the Applicant to assess whether the proposed facilities would have a public safety impact and to suggest additional mitigation measures for the Commission to consider for incorporation as conditions in the order. If the facilities are approved and the suggested mitigation measures are incorporated into the order as conditions, FERC staff would review material filed to satisfy the conditions of the order and conduct periodic inspections throughout construction and operation.

In addition, the Energy Policy Act of 2005 requires FERC to coordinate and consult with the Department of Defense (DOD) on the siting, construction, expansion, and operation of LNG terminals that would affect the military. On November 21, 2007, the FERC and the DOD entered into a MOU formalizing this process.[241] On January 29, 2019, the FERC received a response letter from the DOD Siting Clearinghouse stating that Jordan Cove LNG Project would have a minimal impact on military training and operations conducted in the area.

4.13.1.2 USDOT PHMSA Siting Requirements and 49 CFR Part 193 Subpart B Determination

Siting LNG facilities, as defined in 49 CFR 193, with regard to ensuring that the proposed site selection and location would not pose an unacceptable level or risk to public safety is required by the USDOT PHMSA's regulations in 49 CFR 193 Subpart B. The Commission's regulations under 18 CFR §380.12 (o) (14) require Jordan Cove to identify how the proposed design complies with the siting requirements in the USDOT PHMSA's regulations under 49 CFR 193 Subpart B.

[241] http://www.ferc.gov/legal/mou/mou-dod.pdf

The scope of the USDOT PHMSA's siting authority under 49 CFR 193 applies to LNG facilities used in the transportation of gas by pipeline subject to the federal pipeline safety laws and 49 CFR 192.[242]

The regulations in 49 CFR 193 Subpart B require the establishment of an exclusion zone surrounding an LNG facility in which an operator or government agency must exercise legal control over the activities where specified levels of thermal radiation and flammable vapors may occur in the event of a release for as long the facility is in operation. Approved mathematical models must be used to calculate the dimensions of these exclusion zones. The siting requirements specified in NFPA 59A (2001), an industry consensus standard for LNG facilities, are incorporated into 49 CFR 193 Subpart B by reference, with regulatory preemption in the event of conflict. The following sections of 49 CFR 193 Subpart B specifically address siting requirements:

- Section 193.2051, Scope, states that each LNG facility designed, replaced, relocated or significantly altered after March 31, 2000, must be provided with siting requirements in accordance with Subpart B and NFPA 59A (2001). In the event of a conflict with NFPA 59A (2001), the regulatory requirements in Part 193 prevail.
- Section 193.2057, Thermal radiation protection, requires that each LNG container and LNG transfer system have thermal exclusion zones in accordance with section 2.2.3.2 of NFPA 59A (2001).
- Section 193.2059, Flammable vapor-gas dispersion protection, requires that each LNG container and LNG transfer system have a dispersion exclusion zone in accordance with sections 2.2.3.3 and 2.2.3.4 of NFPA 59A (2001).
- Section 193.2067, Wind forces, requires that shop fabricated containers of LNG or other hazardous fluids less than 70,000 gallons must be designed to withstand wind forces based on the applicable wind load data in American Society of Civil Engineers (ASCE) 7 (2005). All other LNG facilities must be designed for a sustained wind velocity of not less than 150 mph unless the USDOT PHMSA Administrator finds a lower wind speed is justified or the most critical combination of wind velocity and duration for a 10,000-year mean return interval.

As stated in 49 CFR §193.2051, under Subpart B, LNG facilities must meet the siting requirements of NFPA 59A (2001), Chapter 2, and include but may not be limited to:

- NFPA 59A (2001) section 2.1.1 (c) requires consideration of protection against forces of nature.
- NFPA 59A (2001) section 2.1.1 (d) requires that other factors applicable to the specific site that have a bearing on the safety of plant personnel and surrounding public be considered, including an evaluation of potential incidents and safety measures incorporated in the design or operation of the facility.
- NFPA 59A (2001) section 2.2.3.2 requires provisions to minimize the damaging effects of fire from reaching beyond a property line, and requires provisions to prevent a radiant heat flux level of 1,600 British thermal units per square foot per hour (Btu/ft^2-hr) from reaching

[242] 49 CFR §193.2001 (b) (3), Scope of part, excludes any matter other than siting provisions pertaining to marine cargo transfer systems between the LNG marine vessel and the last manifold (or in the absence of a manifold, the last valve) located immediately before a storage tank.

beyond a property line that can be built upon. The distance to this flux level is to be calculated with LNGFIRE3 or with models that have been validated by experimental test data appropriate for the hazard to be evaluated and that have been approved by the USDOT PHMSA.

- NFPA 59A (2001) section 2.2.3.4 requires provisions to minimize the possibility of any flammable mixture of vapors from a design spill from reaching a property line that can be built upon and that would result in a distinct hazard. Determination of the distance that the flammable vapors extend is to be determined with DEGADIS or approved alternative models that take into account physical factors influencing LNG vapor dispersion.[243]

Taken together, 49 CFR 193 Subpart B, and NFPA 59A (2001) require that flammable LNG vapors from design spills do not extend beyond areas in which the operator or a government agency legally controls all activities. Furthermore, consideration of other hazards which may affect the public or plant personnel must be evaluated as prescribed in NFPA 59A (2001), section 2.1.1 (d).

Title 49 CFR 193 Subpart B, and NFPA 59A (2001) also specify three radiant heat flux levels which must be considered for LNG storage tank spills for as long as the facility is in operation:

- 1,600 Btu/ft^2-hr - This level can extend beyond the plant property line that can be built upon but cannot include areas that are used for outdoor assembly by groups of 50 or more persons;[244]
- 3,000 Btu/ft^2-hr - This level can extend beyond the plant property line that can be built upon but cannot include areas that contain assembly, educational, health care, detention or residential buildings or structures;[245] and
- 10,000 Btu/ft^2-hr - This level cannot extend beyond the plant property line that can be built upon.[246]

The requirements for design spills from process or transfer areas are more stringent. For LNG spills, the 1,600 Btu/ft^2-hr flux level cannot extend beyond the plant property line onto a property that can be built upon. In addition, section 2.1.1 of NFPA 59A (2001) requires that factors

[243] USDOT has approved two additional models for the determination of vapor dispersion exclusion zones in accordance with 49 CFR §193.2059: FLACS 9.1 Release 2 (Oct. 7, 2011) and PHAST-UDM Version 6.6 and 6.7 (Oct. 7, 2011).

[244] The 1,600 Btu/ft^2-hr flux level is associated with producing pain in less than 15 seconds, first degree burns in 20 seconds, second degree burns in approximately 30 to 40 seconds, 1 percent mortality in approximately 120 seconds, and 100 percent mortality in approximately 400 seconds, assuming no shielding from the heat, and is typically the maximum allowable intensity for emergency operations with appropriate clothing based on average 10 minute exposure.

[245] The 3,000 Btu/ft^2-hr flux level is associated with producing pain in less than 5 seconds, first degree burns in 5 seconds, second degree burns in approximately 10 to 15 seconds, 1 percent mortality in approximately 50 seconds, and 100 percent mortality in approximately 180 seconds, assuming no shielding from the heat, and is typically the critical heat flux for piloted ignition of common building materials (e.g., wood, PVC, fiberglass, etc.) with prolonged exposures.

[246] The 10,000 Btu/ft^2-hr flux level is associated with producing pain in less than 1 seconds, first degree burns in 1 seconds, second degree burns in approximately 3 seconds, 1 percent mortality in approximately 10 seconds, and 100 percent mortality in approximately 35 seconds, assuming no shielding from the heat, and is typically the critical heat flux for unpiloted ignition of common building materials (e.g., wood, PVC, fiberglass) and degradation of unprotected process equipment after approximate 10 minute exposure and to reinforced concrete after prolonged exposure.

applicable to the specific site with a bearing on the safety of plant personnel and the surrounding public must be considered, including an evaluation of potential incidents and safety measures incorporated into the design or operation of the facility. The USDOT PHMSA has indicated that potential incidents, such as vapor cloud explosions and toxic releases should be considered to comply with Part 193 Subpart B.[247]

In accordance with the August 31, 2018 MOU, the USDOT PHMSA issued a LOD to the Commission on the 49 CFR 193 Subpart B regulatory requirements.[248] The LOD provides USDOT PHMSA's analysis and conclusions regarding 49 CFR 193 Subpart B regulatory requirements for the Commission to consider in its decision to authorize, with or without modification or conditions, or deny an application.

4.13.1.3 Coast Guard Safety Regulatory Requirements and Letter of Recommendation

LNG Marine Vessel Historical Record

Since 1959, marine vessels have transported LNG without a major release of cargo or a major accident involving an LNG marine vessel. There are more than 370 LNG marine vessels in operation routinely transporting LNG between more than 100 import/export terminals currently in operation worldwide. Since U.S. LNG terminals first began operating under FERC jurisdiction in the 1970s, there have been thousands of individual LNG marine vessel arrivals at terminals in the U.S. For more than 40 years, LNG shipping operations have been safely conducted in U.S. ports and waterways.

A review of the history of LNG maritime transportation indicates that there has not been a serious accident at sea or in a port which resulted in a spill due to rupturing of the cargo tanks. However, insurance records, industry sources, and public websites identify a number of incidents involving LNG marine vessels, including minor collisions with other marine vessels of all sizes, groundings, minor LNG releases during cargo unloading operations, and mechanical/equipment failures typical of large vessels. Some of the more significant occurrences, representing the range of incidents experienced by the worldwide LNG marine vessel fleet, are described below:

- **El Paso Paul Kayser** grounded on a rock in June 1979 in the Straits of Gibraltar during a loaded voyage from Algeria to the United States. Extensive bottom damage to the ballast tanks resulted; however, no cargo was released because no damage was done to the cargo tanks. The entire cargo of LNG was subsequently transferred to another LNG marine vessel and delivered to its U.S. destination.
- **Tellier** was blown by severe winds from its docking berth at Skikda, Algeria in February 1989 causing damage to the loading arms and the LNG marine vessel and shore piping. The cargo loading had been secured just before the wind struck, but the loading arms had not been drained. Consequently, the LNG remaining in the loading arms spilled onto the deck, causing fracture of some plating.

[247] The USDOT PHMSA's "LNG Plant Requirements: Frequently Asked Questions" item H1, https://www.phmsa.dot.gov/pipeline/liquified-natural-gas/lng-plant-requirements-frequently-asked-questions, accessed Aug. 2018.

[248] September 11, 2019 letter "Re: Jordan Cove Energy Project L.P., Docket No. CP17-495-000, 49 CFR Part 193, Subpart B, Siting – Letter of Determination" from Massoud Tahamtani to Rich McGuire. Filed in Docket Number CP17-495-000 on September 24, 2019. FERC eLibrary accession number 20190924-3018.

- **Mostefa Ben Boulaid** had an electrical fire in the engine control room during unloading at Everett, Massachusetts on February 5, 1996. The LNG marine vessel crew extinguished the fire and the ship completed unloading.
- **Khannur** had a cargo tank overfill into the LNG marine vessel's vapor handling system on September 10, 2001, during unloading at Everett, Massachusetts. Approximately 100 gallons of LNG were vented and sprayed onto the protective decking over the cargo tank dome, resulting in several cracks. After inspection by the Coast Guard, the Khannur was allowed to discharge its LNG cargo.
- **Mostefa Ben Boulaid** had LNG spill onto its deck during loading operations in Algeria in 2002. The spill, which is believed to have been caused by overflow rather than a mechanical failure, caused significant brittle fracturing of the steelwork. The LNG marine vessel was required to discharge its cargo, after which it proceeded to dock for repair.
- **Norman Lady** was struck by the USS Oklahoma City nuclear submarine while the submarine was rising to periscope depth near the Strait of Gibraltar in November 2002. The 87,000 m^3 LNG marine vessel, which had just unloaded its cargo at Barcelona, Spain, sustained only minor damage to the outer layer of its double hull but no damage to its cargo tanks.
- **Tenaga Lima** grounded on rocks while proceeding to open sea east of Mopko, South Korea due to strong current in November 2004. The shell plating was torn open and fractured over an approximate area of 20 by 80 feet, and internal breaches allowed water to enter the insulation space between the primary and secondary membranes. The LNG marine vessel was refloated, repaired, and returned to service.
- **Golar Freeze** moved away from its docking berth during unloading on March 14, 2006, in Savannah, Georgia. The powered emergency release couplings on the unloading arms activated as designed, and transfer operations were shut down.
- **Catalunya Spirit** lost propulsion and became adrift 35 miles east of Chatham, Massachusetts on February 11, 2008. Four tugs towed the LNG marine vessel to a safe anchorage for repairs. The Catalunya Spirit was repaired and taken to port to discharge its cargo.
- **Al Gharrafa** collided with a container ship, Hanjin Italy, in the Malacca Strait off Singapore on December 19, 2013. The bow of the Al Gharrafa and the middle of the starboard side of the Hanjin were damaged. Both ships were safely anchored after the incident. No loss of LNG was reported.
- **Al Oraiq** collided with a freight carrier, Flinterstar, near Zeebrugge, Belgium on October 6, 2015. The freight carrier sank, but the Al Oraiq was reported to have sustained only minor damage to its bow and no damage to the LNG cargo tanks. According to reports, the Al Oraiq took on a little water but was towed to the Zeebrugge LNG terminal where its cargo was unloaded using normal procedures. No loss of LNG was reported.
- **Al Khattiya** suffered damage after a collision with an oil tanker off the Port of Fujairah on February 23, 2017. Al Khattiya had discharged its cargo and was anchored at the time of the incident. A small amount of LNG was retained within the LNG marine vessel to keep the cargo tanks cool. The collision damaged the hull and two ballast tanks on the Al Khattiya, but did not cause any injury or water pollution. No loss of LNG was reported.

- **Assem** collided with a very large crude carrier (VLCC) Shinyo Ocean off the Port of Fujairah on March 26, 2019. The VLCC suffered severe portside hull height breach and the Assem had damage to its bow. Both marine vessels were unloaded at the time of the collision and subsequently no LNG or oil was released. Aseem was moved to port for anchorage and Shinyo Ocean was relocated to another point of anchorage.

LNG Marine Vessel Safety Regulatory Oversight

The Coast Guard exercises regulatory authority over LNG marine vessels under 46 CFR 154, which contains the United States safety standards for self-propelled LNG marine vessels transporting bulk liquefied gases. The LNG marine vessels visiting the proposed facility would also be constructed and operated in accordance with the IMO *Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk and the International Convention for the Safety of Life at Sea*. All LNG marine vessels entering U.S. waters are required to possess a valid IMO Certificate of Fitness and either a Coast Guard Certificate of Inspection (for U.S. flag vessels) or a Coast Guard Certificate of Compliance (for foreign flag vessels). These documents certify that the LNG marine vessel is designed and operating in accordance with both international standards and the U.S. regulations for bulk LNG marine vessels under 46 CFR 154.

The LNG marine vessels that would deliver or receive LNG to or from the proposed facility would also need to comply with various U.S. and international security requirements. The IMO adopted the *International Ship and Port Facility Security Code* in 2002. This code requires both ships and ports to conduct vulnerability assessments and to develop security plans. The purpose of the code is to prevent and suppress terrorism against ships; improve security aboard ships and ashore; and reduce the risk to passengers, crew, and port personnel on board ships and in port areas. All LNG marine vessels, as well as other cargo vessels (e.g., 500 gross tons and larger), and ports servicing those regulated vessels, must adhere to the IMO standards. Some of the IMO requirements for ships are as follows:

- marine vessels must develop security plans and have a Vessel Security Officer;
- marine vessels must have a ship security alert system to transmit ship-to-shore security alerts identifying the ship, its location, and indication that the security of the ship is under threat or has been compromised;
- marine vessels must have a comprehensive security plan for international port facilities, focusing on areas having direct contact with ships; and
- marine vessels may have equipment onboard to help maintain or enhance the physical security of the ship.

In 2002, the Maritime Transportation Security Act (MTSA) was enacted by the U.S. Congress and aligned domestic regulations with the maritime security standards of the *International Ship and Port Facility Security Code and the Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk and the International Convention for the Safety of Life at Sea*. The Coast Guard's regulations in 33 CFR 104 require marine vessels to conduct a vessel security assessment and develop a vessel security plan that addresses each vulnerability identified in the vessel security assessments. All LNG marine vessels servicing the facility would have to comply with the MTSA requirements and associated regulations while in U.S. waters.

The Coast Guard also exercises regulatory authority over LNG facilities that affect the safety and security of port areas and navigable waterways under EO 10173; the Magnuson Act (50 U.S.C. section 191); the Ports and Waterways Safety Act of 1972, as amended (33 U.S.C. section 1221, et seq.); and the MTSA of 2002 (46 U.S.C. section 701). The Coast Guard is responsible for matters related to navigation safety, LNG marine vessel engineering and safety standards, and all matters pertaining to the safety of facilities or equipment located in or adjacent to navigable waters up to the last valve immediately before the receiving tanks. The Coast Guard also has authority for LNG facility security plan review, approval, and compliance verification as provided in 33 CFR 105.

The Coast Guard regulations in 33 CFR 127 apply to the marine transfer area of waterfront facilities between the LNG marine vessel and the last manifold or valve immediately before the receiving tanks. Title 33 CFR 127 applies to the marine transfer area for LNG of each new waterfront facility handling LNG and to new construction in the marine transfer areas for LNG of each existing waterfront facility handling LNG. The scope of the regulations includes the design, construction, equipment, operations, inspections, maintenance, testing, personnel training, firefighting, and security of the marine transfer area of LNG waterfront facilities. The safety systems, including communications, emergency shutdown, gas detection, and fire protection, must comply with the regulations in 33 CFR 127. Under 33 CFR §127.019, Jordan Cove would be required to submit two copies of its Operations and Emergency Manuals to the Coast Guard Captain of the Port (COTP) for examination.

Both the Coast Guard regulations under 33 CFR 127 and FERC regulations under 18 CFR §157.21, require an applicant who intends to build an LNG terminal to submit a Letter of Intent (LOI) to the Coast Guard no later than the date that the owner/operator initiates pre-filing with FERC, but, in all cases, at least 1 year prior to the start of construction. In addition, the Applicant must submit a Preliminary WSA to the COTP with the LOI.

The Preliminary WSA provides an initial explanation of the port community and the proposed facility and transit routes. It provides an overview of the expected impacts LNG operations may have on the port and the waterway. Generally, the Preliminary WSA does not contain detailed studies or conclusions. This document is used by the COTP to begin his or her evaluation of the suitability of the waterway for LNG marine traffic. The Preliminary WSA must provide an initial explanation of the following:

- port characterization;
- characterization of the LNG facility and the LNG marine vessel route;
- risk assessment for maritime safety and security;
- risk management strategies; and
- resource needs for maritime safety, security, and response.

A Follow-On WSA must be provided no later than the date the owner/operator files an application with FERC, but in all cases at least 180 days prior to transferring LNG. The Follow-on WSA must provide a detailed and accurate characterization of the waterfront facilities handling LNG, the LNG marine vessel route, and the port area. The Follow-on WSA provides a complete analysis of the topics outlined in the Preliminary WSA. It should identify credible security threats and navigational safety hazards for the LNG marine vessel traffic, along with appropriate risk management measures and the resources (i.e., federal, state, local, and private sector) needed to carry out those measures. Until a facility begins operation, Applicants must also annually review their WSAs and submit a report to the COTP as to whether changes are required. This document is reviewed and validated by the Coast Guard and forms the basis for the agency's Letter of Recommendation (LOR) to the FERC.

In order to provide the Coast Guard 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, the Coast Guard has published a Navigation and Vessel Inspection Circular – *Guidance on Assessing the Suitability of a Waterway for Liquefied Natural Gas (LNG) Marine Traffic* (NVIC 01-11).

NVIC 01-11 directs the use of the three concentric Zones of Concern, based on LNG marine vessels with a cargo carrying capacity up to 265,000 m^3, used to assess the maritime safety and security risks of LNG marine traffic. The Zones of Concern are:

- Zone 1 – impacts on structures and organisms are expected to be significant within 500 meters (1,640 feet). The outer perimeter of Zone 1 is approximately the distance to thermal hazards of 37.5 kilowatts per square meter (kW/m^2) (12,000 Btu/ft^2-hr) from a pool fire.
- Zone 2 – impacts would be significant but reduced, and damage from radiant heat levels are expected to transition from severe to minimal between 500 and 1,600 meters (1,640 and 5,250 feet). The outer perimeter of Zone 2 is approximately the distance to thermal hazards of 5 kW/m^2 (1,600 Btu/ft^2-hr) from a pool fire.
- Zone 3 – impacts on people and property from a pool fire or an un-ignited LNG spill are expected to be minimal between 1,600 meters (5,250 feet) and a conservative maximum distance of 3,500 meters (11,500 feet or 2.2 miles). The outer perimeter of Zone 3 should be considered the vapor cloud dispersion distance to the lower flammability limit from a worst case un-ignited release. Impacts on people and property could be significant if the vapor cloud reaches an ignition source and burns back to the source.

Once the Applicant submits a complete Follow-On WSA, the Coast Guard reviews the document to determine if it presents a realistic and credible analysis of the public safety and security implications from LNG marine traffic both in the waterway and when in port. As required by its regulations (33 CFR §127.009), the Coast Guard is responsible for issuing a LOR to the FERC regarding the suitability of the waterway for LNG marine traffic with respect to the following items:

- physical location and description of the facility;
- the LNG marine vessel's characteristics and the frequency of LNG shipments to or from the facility;
- waterway channels and commercial, industrial, environmentally sensitive, and residential areas in and adjacent to the waterway used by LNG marine vessels en route to the facility, within 25 kilometers (15.5 miles) of the facility;
- density and character of marine traffic in the waterway;
- locks, bridges, or other manmade obstructions in the waterway;

- depth of water;
- tidal range;
- protection from high seas;
- natural hazards, including reefs, rocks, and sandbars;
- underwater pipes and cables; and
- distance of berthed LNG marine vessels from the channel and the width of the channel.

The Coast Guard may also prepare an LOR Analysis, which serves as a record of review of the LOR and contains detailed information along with the rationale used in assessing the suitability of the waterway for LNG marine traffic.

Jordan Cove LNG Project's Waterway Suitability Assessment

On January 9, 2017, Jordan Cove submitted a LOI and a Preliminary WSA to the COTP, Sector Colombia River, to notify the Coast Guard that it proposed to construct an LNG export terminal. The Preliminary WSA was based on a WSA dated April 10, 2006 that was previously submitted to the Coast Guard and was updated on December 29, 2012 for export operations. In addition, Jordan Cove has submitted annual WSA updates to the Coast Guard since the 2012 WSA update. 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.

LNG Marine Vessel Routes and Hazard Analysis

An LNG marine vessel's transit to the terminal would begin when it reaches the entrance of Coos Bay from the Pacific Ocean. Once inside the entrance, the marine vessel would turn north at the City of Charleston, Oregon and would transit to the Jordan Cove LNG Project marine berth. After reaching the turning basin near the Project site, the LNG marine vessel would turn to the right and back into the eastern side of the marine slip. The total inbound transit distance to the Jordan Cove LNG Project marine berth would be approximately 8.0 miles from the entrance of Coos Bay. The route would be reversed for outbound LNG marine vessel transits.

Pilotage is compulsory for foreign marine vessels and U.S. marine vessels under registry in foreign trade when in U.S. waters. All deep draft marine vessels currently entering the shared waterway would employ a U.S. pilot. The National Vessel Movement Center in the U.S. would require a 96-hour advance notice of arrival for deep draft marine vessels calling on U.S. ports. During transit, LNG marine vessels would be required to maintain voice contact with controllers and check in on designated frequencies at established way points.

NVIC 01-11 references the "Zones of Concern" for assisting in a risk assessment of the waterway. As LNG marine vessels proceed along the intended transit route, the estimated zones of concern would extend over resources such as residential and industrial areas, military installations, and also non-residential areas accessible to the public such as parks. Hazard Zone 1 would remain almost entirely over the water and would encompass coastal areas in Charleston and Coos Bay. Commercial vessels, recreational vessels, fishing vessels, Cape Arago Dock, I.C.I. Marine Industrial Park, North Bay Marine Industrial Park, and Roseburg Forest Products Facility would also fall within Zone 1. Zone 2 would cover a wider swath of coastal areas along Charleston, Coos Bay, Barview, and North Bend and would include multiple residential buildings, commercial buildings, industrial buildings, numerous Recreational Vehicle hook-up Parks, numerous recreational areas and boat launch ramps, Marine Research Center, Charleston Marina, South Slough Bridge, Coast Guard Sector Charleston, Charleston Fire District Stations 1 and 3, Madison Elementary School, Sunset Middle School, Coos Bay Fire Department Station 2, and the Southwestern Oregon Regional Airport. Zone 3 would span larger portions of Charleston, Coos Bay, Barview, and North Bend and would include Coast Guard Group North Bend, Railroad Bridge, Oregon Dunes Recreational Park, Southwestern Oregon Community College.

The areas impacted by the three different hazard zones are illustrated for accidental and intentional events in figures 4.13-1 and 4.13-2, respectively.

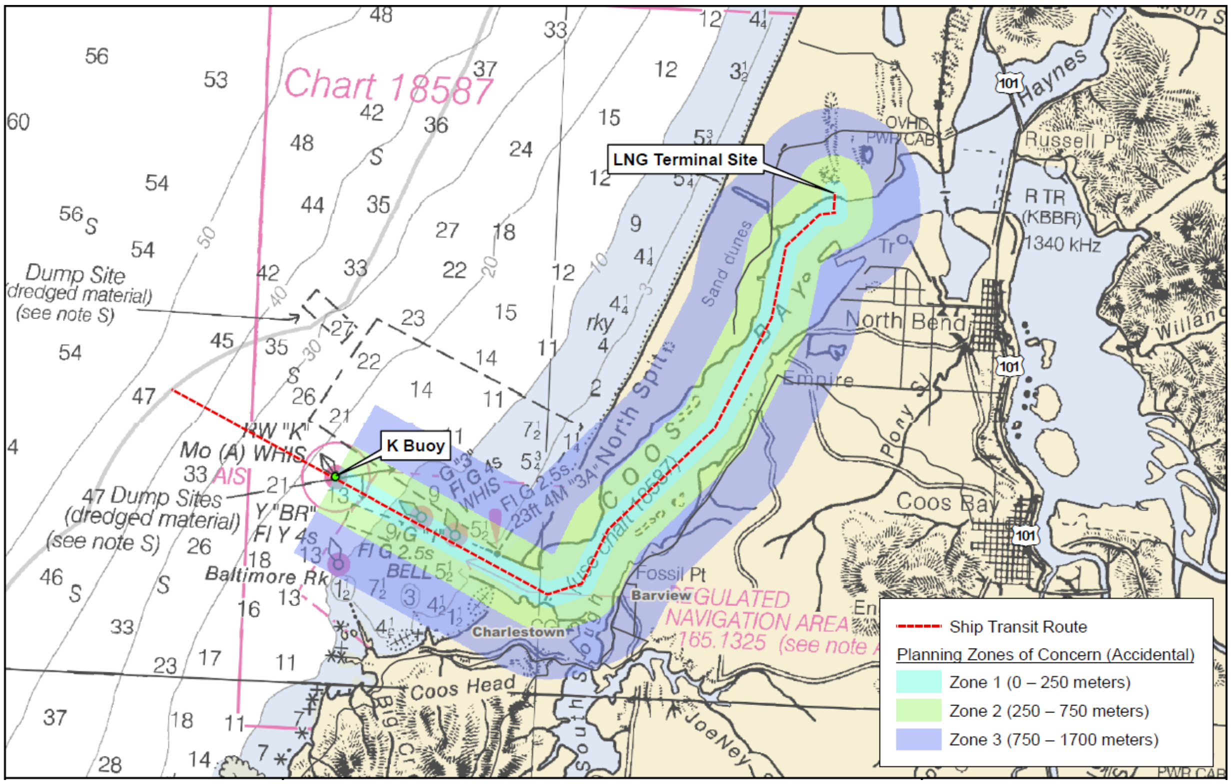


Figure 4.13-1 Accidental Hazard Zones along LNG Marine Vessel Route

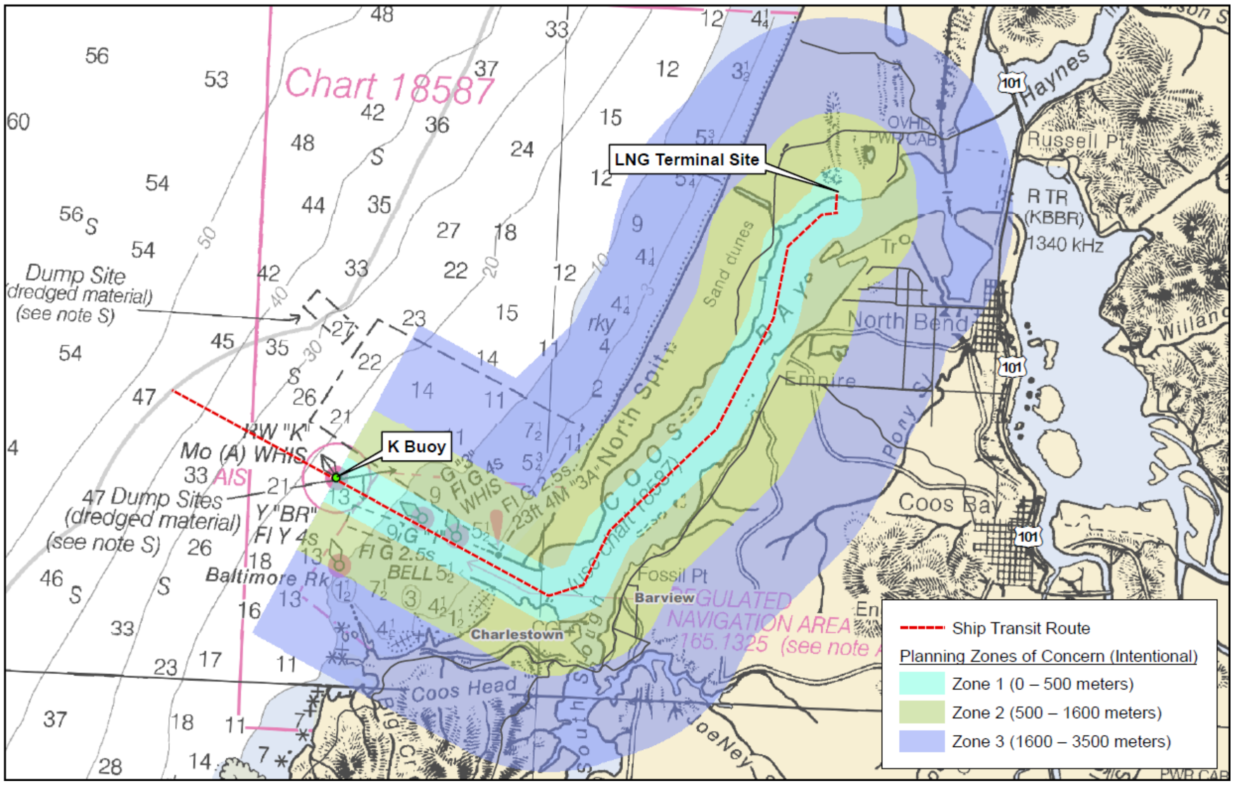


Figure 4.13-2. Intentional Hazard Zones along LNG Marine Vessel Route

U.S. Coast Guard Letter of Recommendation and Analysis

In a letter dated May 10, 2018, the Coast Guard issued an LOR and LOR Analysis to FERC stating that the Coos Bay Channel would be considered suitable for accommodating the type and frequency of LNG marine traffic associated with this Project. As part of its assessment of the safety and security aspects of this Project, the COTP Sector Columbia River consulted a variety of stakeholders including the Area Maritime Security Committees, Harbor Safety Committees, state representatives, pilot organizations, and local emergency responders. The LOR was based on full implementation of the strategies and risk management measures identified by the Coast Guard to Jordan Cove in its WSA.

Although Jordan Cove has suggested mitigation measures for responsibly managing the maritime safety and security risks associated with LNG marine traffic, the necessary vessel traffic and/or facility control measures may change depending on changes in conditions along the waterway. The Coast Guard regulations in 33 CFR 127 require that Applicants annually review WSAs until a facility begins operation and submit a report to the Coast Guard identifying any changes in conditions, such as changes to the port environment, the LNG facility, or the LNG marine vessel route, that would affect the suitability of the waterway for LNG marine traffic.

The Coast Guard's LOR is a recommendation, regarding the current status of the waterway, to the FERC, the lead agency responsible for siting the on-shore LNG facility. Neither the Coast Guard nor the FERC has authority to require waterway resources of anyone other than the Applicant under any statutory authority or under the Emergency Response Plan (ERP) or the Cost Sharing Plan. As stated in the LOR, the Coast Guard would assess each transit on a case by case basis to identify what, if any, safety and security measures would be necessary to safeguard the public health and welfare, critical infrastructure and key resources, the port, the marine environment, and the LNG marine vessel.

Under the Ports and Waterways Safety Act, the Magnuson Act, the MTSA, and the Security and Accountability For Every (SAFE) Port Act, the COTP has the authority to prohibit LNG transfer or LNG marine vessel movements within his or her area of responsibility if he or she determines that such action is necessary to protect the waterway, port, or marine environment. If this Project is approved and if appropriate resources are not in place prior to LNG marine vessel movement along the waterway, then the COTP would consider at that time what, if any, vessel traffic and/or facility control measures would be appropriate to adequately address navigational safety and maritime security considerations.

4.13.1.4 LNG Facility Security Regulatory Requirements

The security requirements for the proposed project are governed by 33 CFR 105, 33 CFR 127, and 49 CFR 193 Subpart J - Security. Title 33 CFR 105, as authorized by the MTSA, requires all terminal owners and operators to submit a Facility Security Assessment (FSA) and a Facility Security Plan (FSP) to the Coast Guard for review and approval before commencement of operations of the proposed Project facilities. Jordan Cove would also be required to control and restrict access, patrol and monitor the plant, detect unauthorized access, and respond to security threats or breaches under 33 CFR 105. Some of the responsibilities of the Applicant include, but are not limited to:

- designating a Facility Security Officer with a general knowledge of current security threats and patterns, security assessment methodology, vessel and facility operations, conditions, security measures, emergency preparedness, response, and contingency plans, who would be responsible for implementing the FSA and FSP and performing an annual audit for the life of the Project;
- conducting an FSA to identify site vulnerabilities, possible security threats and consequences of an attack, and facility protective measures; developing a FSP based on the FSA, with procedures for: responding to transportation security incidents; notification and coordination with federal, state, and local authorities; prevention of unauthorized access; measures to prevent or deter entrance with dangerous substances or devices; training; and evacuation;
- defining the security organizational structure with facility personnel with knowledge or training in current security threats and patterns; recognition and detection of dangerous substances and devices, recognition of characteristics and behavioral patterns of persons who are likely to threaten security; techniques to circumvent security measures; emergency procedures and contingency plans; operation, testing, calibration, and maintenance of security equipment; and inspection, control, monitoring, and screening techniques;
- implementing scalable security measures to provide increasing levels of security at increasing maritime security levels for facility access control, restricted areas, cargo handling, LNG marine vessel stores and bunkers, and monitoring; ensuring that the Transportation Worker Identification Credential (TWIC) program is properly implemented;

- ensuring coordination of shore leave for LNG marine vessel personnel or crew change out as well as access through the facility for visitors to the LNG marine vessel;
- conducting drills and exercises to test the proficiency of security and facility personnel on a quarterly and annual basis; and
- reporting all breaches of security and transportation security incidents to the National Response Center.

Title 33 CFR 127 has requirements for access controls, lighting, security systems, security personnel, protective enclosures, communications, and emergency power. In addition, an LNG facility regulated under 33 CFR 105 and 33 CFR 127 would be subject to the TWIC Reader Requirements Rule issued by the Coast Guard on August 23, 2016. This rule requires owners and operators of certain vessels and facilities regulated by the Coast Guard to conduct electronic inspections of TWICs (e.g., readers with biometric fingerprint authentication) as an access control measure. The final rule would also include recordkeeping requirements and security plan amendments that would incorporate these TWIC requirements. The implementation of the rule was first proposed to be in effect August 23, 2018. In a subsequent notice issued on June 22, 2018, the Coast Guard indicated delaying the effective date for certain facilities by three years, until August 23, 2021. On August 2, 2018, the President of the United States signed into law the Transportation Worker Identification Credential Accountability Act of 2018 (H.R. 5729). This law prohibits the Coast Guard from implementing the rule requiring electronic inspections of TWICs until after the Department of Homeland Security (DHS) has submitted a report to the Congress. Although the implementation of this rule has been postponed for certain facilities, the company should to consider the rule when developing access control and security plan provisions for the facility.

Title 49 CFR 193 Subpart J also specifies security requirements for the onshore components of LNG facilities, as defined in 49 CFR 193, including requirements for conducting security inspections and patrols, liaison with local law enforcement officials, design and construction of protective enclosures, lighting, monitoring, alternative power sources, and warning signs. If the Project is authorized, constructed, and operated, compliance with the security requirements of 33 CFR 105, 33 CFR 127, and 49 CFR 193 Subpart J would be subject to the respective Coast Guard and USDOT PHMSA inspection and enforcement programs.

Jordan Cove provided preliminary information as well as data request responses on these security features and indicated additional details would be completed in the final design. Jordan Cove would install an impervious vapor barrier of heights ranging from 20 feet to 100 feet around portions of the property boundary. However, details of intrusion detection on the barriers would not be finalized until final design. We recommend in section 4.13.1.6 that Jordan Cove provide final design details on these security features for review and approval, including: lighting coverage drawings that illustrate photometric analyses demonstrating the lux levels at the interior of the terminal are in accordance with API 540, and other federal regulations for lighting along the perimeter fence line and along paths/roads of access and egress; camera coverage drawings that illustrate coverage areas of each camera such that the entire perimeter of the plant is covered with redundancy and the interior of plant is covered, including a camera be provided at the top of each LNG storage tank, within pretreatment areas, within liquefaction areas, within truck transfer areas, within marine transfer areas, and buildings; fencing drawings that demonstrate a fence would deter or mitigate entry along the perimeter of the entire facility and is set back from exterior structures and vegetation, and from interior hazardous piping and equipment by at least 10 feet; vehicle barrier and controlled access point drawings that demonstrate crash-rated barriers are provided to prevent uncontrolled access, inadvertent entry, and impacts on components containing hazardous fluids from vehicles. Furthermore, in accordance with the February 2004 Interagency Agreement among FERC, USDOT PHMSA, and Coast Guard, FERC staff would collaborate with the Coast Guard and USDOT PHMSA on the Project's security features.

4.13.1.5 FERC Engineering and Technical Review of the Preliminary Engineering Designs

LNG Facility Historical Record

The operating history of the U.S. LNG industry has been free of safety-related incidents resulting in adverse effects on the public or the environment with the exception of the October 20, 1944, failure at an LNG plant in Cleveland, Ohio. The 1944 incident in Cleveland led to a fire that killed 128 people and injured 200 to 400 more people.[249] The failure of the LNG storage tank was due to the use of materials not suited for cryogenic temperatures. LNG migrated through streets and into underground sewers due to inadequate spill impoundments at the site. Current regulatory requirements ensure that proper materials suited for cryogenic temperatures are used in the design and that spill impoundments are designed and constructed properly to contain a spill at the site. To ensure that this potential hazard would be addressed for proposed LNG facilities, we evaluate the preliminary and final specifications for suitable materials of construction and for the design of spill containment systems that would properly contain a spill at the site.

Another operational accident occurred in 1979 at the Cove Point LNG plant in Lusby, Maryland. A pump electrical seal located on a submerged electrical motor LNG pump leaked causing flammable gas vapors to enter an electrical conduit and settle in a confined space. When a worker switched off a circuit breaker, the flammable gas ignited, causing severe damage to the building and a worker fatality. With the participation of the FERC, lessons learned from the 1979 Cove Point accident led to changes in the national fire codes to better ensure that the situation would not occur again. To ensure that this potential hazard would be addressed for proposed facilities that have electrical seal interfaces, we evaluated the preliminary designs and recommend in section 4.13.1.6 that Jordan Cove provide, for review and approval, the final design details of the electrical seal design at the interface between flammable fluids and the electrical conduit or wiring system, details of the electrical seal leak detection system, and the details of a downstream physical break (i.e. air gap) in the electrical conduit to prevent the migration of flammable vapors.

On January 19, 2004, a blast occurred at Sonatrach's Skikda, Algeria, LNG liquefaction plant that killed 27 and injured 56 workers. No members of the public were injured. Findings of the accident investigation suggested that a cold hydrocarbon leak occurred at Liquefaction Train 40 and was introduced into a high-pressure steam boiler by the combustion air fan. An explosion developed inside the boiler firebox, which subsequently triggered a larger explosion of the hydrocarbon vapors in the immediate vicinity. The resulting fire damaged the adjacent liquefaction process and liquid petroleum gas separation equipment of Train 40, and spread to Trains 20 and 30. Although Trains 10, 20, and 30 had been modernized in 1998 and 1999, Train 40 had been operating with

[249] For a description of the incident and the findings of the investigation, see "U.S. Bureau of Mines, Report on the Investigation of the Fire at the Liquefaction, Storage, and Regasification Plant of the East Ohio Gas Co., Cleveland, Ohio, October 20, 1944," dated February 1946.

its original equipment since start-up in 1981. To ensure that this potential hazard would be addressed for proposed facilities, we evaluated the preliminary design for mitigation of flammable vapor dispersion and ignition in buildings and combustion equipment to ensure they would be adequately covered by hazard detection equipment that could isolate and deactivate any combustion equipment whose continued operation could add to or sustain an emergency. We also recommend in section 4.13.1.6 that Jordan Cove provide, for review and approval, the final design details of hazard detection equipment, including the location and elevation of all detection equipment, instrument tag numbers, type and location, alarm indication locations, and shutdown functions of the hazard detection equipment.

On March 31, 2014, a detonation occurred within a gas heater at Northwest Pipeline Corporation's LNG peak-shaving plant in Plymouth, Washington.[250] This internal detonation subsequently caused the failure of pressurized equipment, resulting in high velocity projectiles. The plant was immediately shut down, and emergency procedures were activated, which included notifying local authorities and evacuating all plant personnel. No members of the public were injured, but one worker was sent to the hospital for injuries. As a result of the incident, the liquefaction trains and a compressor station located onsite were rendered inoperable. Projectiles from the incident also damaged the control building that was located near pre-treatment facilities and penetrated the outer shell of one of the LNG storage tanks. All damaged facilities were ultimately taken out of service for repair. The accident investigation showed that an inadequate purge after maintenance activities resulted in a fuel-air mixture remaining in the system. The fuel-air mixture auto-ignited during startup after it passed through the gas heater at full operating pressure and temperature. To ensure that this potential hazard would be addressed for proposed facilities, we recommend in section 4.13.1.6 that Jordan Cove provide a plan for purging, for review and approval, which addresses the requirements of the American Gas Association Purging Principles and Practice and to provide justification if not using an inert or non-flammable gas for purging. In evaluating such plans, we would assess whether the purging could be done safely based on review of other plans and lessons learned from this and other past incidents. If a plan proposes the use of flammable mediums for cleaning, dry-out or other activities, we would evaluate the plans against other recommended and generally accepted good engineering practices, such as NFPA 56, *Standard for Fire and Explosion Prevention during Cleaning and Purging of Flammable Gas Piping Systems*.

We also recommend in section 4.13.1.6 that Jordan Cove provide, for review and approval, operating and maintenance plans, including safety procedures, prior to commissioning. In evaluating such plans, we would assess whether the plans cover all standard operations, including purging activities associated with startup and shutdown. Also, in order to prevent other sources of projectiles from affecting occupied buildings and storage tanks, we recommend in section 4.13.1.6 that Jordan Cove incorporate mitigation into their final design with supportive information, for review and approval, that demonstrates it would mitigate the risk of a pressure vessel burst or boiling liquid expanding vapor explosion (BLEVE) from occurring.

FERC Preliminary Engineering Review

FERC requires an applicant to provide safety, reliability, and engineering design information as part of its application, including hazard identification studies and front-end-engineering-design (FEED) information for its proposed Project. FERC staff evaluates this information with a focus

[250] For a description of the incident and the findings of the investigation, see Root Cause Failure Analysis, Plymouth LNG Plant Incident Investigation under CP14-515.

on potential hazards from within and nearby the site, including external events, which may have the potential to cause damage or failure to the Project facilities, and the engineering design and safety and reliability concepts of the various protection layers to mitigate the risks of potential hazards.

The primary concerns are those events that could lead to a hazardous release of sufficient magnitude to create an offsite hazard or interruption of service. Furthermore, the potential hazards are dictated by the site location and the engineering details. In general, FERC staff considers an acceptable design to include various layers of protection or safeguards to reduce the risk of a potentially hazardous scenario from developing into an event that could impact the offsite public. These layers of protection are generally independent of one another so that any one layer would perform its function regardless of the initiating event or failure of any other protection layer. Such design features and safeguards typically include:

- a facility design that prevents hazardous events, including the use of inherently safer designs; suitable materials of construction; adequate design margins from operating limits for process piping, process vessels, and storage tanks; adequate design for wind, flood, seismic, and other outside hazards;
- control systems, including monitoring systems and process alarms, remotely-operated control and isolation valves, and operating procedures to ensure that the facility stays within the established operating and design limits;
- safety instrumented prevention systems, such as safety control valves and emergency shutdown systems, to prevent a release if operating and design limits are exceeded;
- physical protection systems, such as appropriate electrical area classification, proper equipment and building spacing, pressure relief valves, spill containment, and cryogenic, overpressure, and fire structural protection, to prevent escalation to a more severe event;
- site security measures for controlling access to the plant, including security inspections and patrols, response procedures to any breach of security, and liaison with local law enforcement officials; and
- onsite and offsite emergency response, including hazard detection and control equipment, firewater systems, and coordination with local first responders, to mitigate the consequences of a release and prevent it from escalating to an event that could impact the public.

The inclusion of such protection systems or safeguards in a plant design can minimize the potential for an initiating event to develop into an incident that could impact the safety of the offsite public. The review of the engineering design for these layers of protection are initiated in the application process and carried through to the next phase of the proposed project in final design if authorization is granted by the Commission.

The reliability of these layers of protection is informed by occurrence and likelihood of root causes and the potential severity of consequences based on past incidents and validated hazard modeling. As a result of the continuous engineering review, we recommend mitigation measures and continuous oversight to the Commission for consideration to include as conditions in the order. If a facility is authorized and recommendations are adopted as conditions to the order, FERC staff would continue its engineering review through final design, construction, commissioning, and operation.

Process Design

In order to liquefy natural gas, most liquefaction technologies require that the feed gas stream be pre-treated to remove components that could freeze out and clog the liquefaction equipment or would otherwise be incompatible with the liquefaction process or equipment, including mercury, hydrogen sulfide, CO_2, water, and heavy hydrocarbons. For example, mercury is typically limited to concentrations of less than 0.01 micrograms per normal cubic meter because it can induce embrittlement and corrosion resulting in a catastrophic failure of equipment.

The inlet gas would be conditioned to remove solids and water droplets prior to entering feed gas pretreatment processes. Once the inlet gas is conditioned, the feed gas would enter the mercury removal system to reduce the mercury concentration in the feed gas. After mercury removal, the feed gas would contact an amine-based solvent solution in the amine contactor column to remove the hydrogen sulfide and CO_2 (i.e., acid gas) present in the feed gas. Once the acid gas components accumulate in the amine solution, the amine solution is routed to an amine regenerator column that utilizes a reboiler. Contact with the reboiler discharge would regenerate the amine solution by using heat to release the acid gas. The regenerated amine solution would be recycled back to the amine contactor column and the removed acid gas would be sent through a sulfur removal unit to remove hydrogen sulfide. The acid gas stream is then routed to a thermal oxidizer, where CO_2, trace amounts of hydrogen sulfide not removed in the sulfur removal unit, and trace amounts of hydrocarbons would be incinerated. The feed gas exiting the amine contactor column enters a knock out drum where bulk water would be recovered and recycled back to the amine contactor column. After the knock out drum, any remaining water in the feed gas would be removed using regenerative molecular sieve beds. During the mole sieve bed regeneration process, heated regeneration gas would release water from the molecular sieve beds. Water collected during the molecular sieve regeneration process would be routed back to the amine contactor column. After water removal, the treated dry gas would flow to the liquefaction unit.

Heavy hydrocarbon removal would be integrated into the liquefaction process. The first pass through the refrigeration process would be used to remove heavy hydrocarbons at intermediate temperatures. The feed gas would flow into deethanizer to extract the heavy hydrocarbon liquids. The vapor portion would reenter the refrigeration process and would be sub-cooled into LNG. The liquid portion from the deethanizer would flow into the deethanizer reboiler to further separate the heavier hydrocarbons from the lighter hydrocarbons. The heavier hydrocarbons exiting the deethanizer reboiler would be sent to the fuel gas system and the lighter hydrocarbons would be returned to the deethanizer for further processing. The LNG exiting the refrigeration process would flow to an LNG expander to reduce pressure, then into an LNG flash vessel before being pumped to two full containment LNG storage tanks.

In order to achieve the cryogenic temperatures needed to liquefy the natural gas stream in the above process, the gas would be cooled by a thermal exchange process driven by a closed loop refrigeration system using mixed refrigerants comprised of a mixture of nitrogen, methane, ethylene, propane, and isopentane. Methane would be provided from the treated dry feed gas stream entering the refrigeration process and the other refrigerants required for the liquefaction process would be delivered by truck and stored onsite for initial filling and use, as needed, for make-up. Truck unloading facilities would be provided to unload make-up refrigerants.

During export operations, LNG stored within the LNG storage tanks would be sent out through multiple in-tank pumps (the pump discharge piping would penetrate through the roof and is an inherently safer design when compared to penetrating the side of an LNG storage tank) and would be routed through a marine transfer line and multiple liquid marine transfer arms connected to an LNG marine vessel. In order to keep the marine transfer line cold between LNG export cargoes, an LNG recirculation line would keep the marine transfer line cold and avoid cool down prior to every LNG marine vessel loading operation. The LNG transferred to the LNG marine vessel would displace vapors from the marine vessel, which would be sent back through a vapor marine transfer arm, a vapor return line, and into the boil-off gas (BOG) header. Once loaded, the LNG marine vessel would be disconnected and leave for export. Low pressure BOG generated from stored LNG (LNG is continuously boiling), vapors returned during LNG marine vessel filling operations, and flash gas from the LNG flash vessel would be compressed and would be routed to the fuel gas system. The closed BOG system would prevent the release of BOG to the atmosphere and would be in accordance with NFPA 59A. This would be an inherently safer design when compared to allowing the BOG to vent to the atmosphere.

The Project would include many utilities and associated auxiliary equipment. The major auxiliary systems required for the operation of the liquefaction facility include BOG, fuel gas, flares, instrument and utility air supply, water supply, demineralized water, steam, aqueous ammonia, nitrogen, diesel, and backup power. Three flare systems would be designed to handle and control the vent gases from the process areas. The warm and cold flare would be routed to a common ground flare and the marine flare would be routed to a dedicated enclosed cylindrical ground flare. High pressure steam created using refrigerant compressor driver exhaust gas waste heat would generate electricity for the facility via the Steam Turbine Generators and would also supply heat to the Regeneration Gas Heater. Low pressure steam would provide heat to the Feed Inlet Heater, Amine Reboiler, Sulfur Scavenger Inlet Heater, Fuel Gas Superheater, and the Defrost Heater. An auxiliary steam boiler would be provided to generate steam when the refrigerant compressors are not in operation. A diesel storage tank would be provided to supply three diesel firewater pumps. Black start power supply would be provided from the offsite power grid and Jordan Cove would consider installing a black start power generator in final design. If included in final design, the diesel storage tank would also supply the black start power generator. Trucks would fill a liquid nitrogen storage tank and vaporizers would supply gaseous nitrogen for refrigerant make-up. Site generated nitrogen would be used for compressor seals, purging activities, and utility stations as well as for pre-commissioning and start-up activities. In addition, aqueous ammonia would be used for pH adjustment in the steam system and to reduce nitrogen oxide emissions from the refrigerant compressor drivers.

The failure of process equipment could pose potential harm if not properly safeguarded through the use of appropriate engineering controls and operation. Jordan Cove would install process control valves and instrumentation to safely operate and monitor the facilities. Alarms would have visual and audible notification in the control room to warn operators that process conditions may be approaching design limits. Jordan Cove would design their control systems and human machine interfaces to the International Society for Automation (ISA) Standards 5.3, 5.5, 60.1, 60.3, 60.4, and 60.6, and other standards and recommended practices. Jordan Cove indicates that an alarm management program in accordance with ISA Standard 18.2 would be in place to ensure the effectiveness of the alarms. We recommend in section 4.13.1.6 that Jordan Cove develop and implement the alarm management program prior to introduction of hazardous fluids.

Operators would have the capability to take action from the control room to mitigate an upset. Jordan Cove would develop facility operation procedures after completion of the final design; this timing is fully consistent with accepted industry practice. We recommend in section 4.13.1.6 that Jordan Cove provide more information, for review and approval, on the operating and maintenance procedures, including safety procedures, hot work procedures and permits, abnormal operating conditions procedures, and personnel training prior to commissioning. We would evaluate these procedures to ensure that an operator can operate and maintain all systems safely, based on benchmarking against other operating and maintenance plans and comparing against recommended and generally accepted good engineering practices, such as American Institute of Chemical Engineers (AIChE) Center for Chemical Process Safety (CCPS), *Guidelines for Writing Effective Operating and Maintenance Procedures*, AIChE CCPS, *Guidelines for Management of Change for Process Safety*, AIChE CCPS, *Guidelines for Effective Pre-Startup Safety Reviews, AGA, Purging Principles and Practices*, and NFPA 51B, *Standards for Fire Prevention During Welding, Cutting, and Other Hot Work*. In addition, we recommend in section 4.13.1.6 that Jordan Cove tag and label instrumentation and valves, piping, and equipment and provide car-seals/locks to address human factor considerations and improve facility safety and prevent incidents.

In the event of a process deviation, emergency shutdown (ESD) valves and instrumentation would be installed to monitor, alarm, shutdown, and isolate equipment and piping during process upsets or emergency conditions. The Project would also have a plant-wide emergency shutdown system to initiate closure of valves and shutdown of the process during emergency situations as well as the ability to shutdown specific areas to address local emergency conditions. Safety-instrumented systems would comply with ISA Standard 84.00.01 and other recommended and generally accepted good engineering practices. We also recommend in section 4.13.1.6 that Jordan Cove file information, for review and approval, on the final design, installation, and commissioning of instrumentation and emergency shutdown equipment to ensure appropriate cause-and-effect alarm or shutdown logic and enhanced representation of the emergency shutdown system in the plant control room and throughout the plant.

In developing the FEED, Jordan Cove conducted a Hazard Identification (HAZID) review project's preliminary design based on the proposed process flow diagrams and the plot plans. In addition, the Jordan Cove performed two Hazard and Operability and Layer of Protection Analysis (Hazard and Operability Review [HAZOP] and Layer of Protection Analysis [LOPA]) Studies. Each HAZOP was used to identify and analyze the potential hazards within the design that might pose an unacceptable risk to people, the environment, and assets and was based on the piping and instrumentation diagrams. Each LOPA was used to analyze selected scenarios of high risk to personnel, the environment, or assets, as identified in the HAZOP, to assure the appropriate risk level reduction, based on risk reduction factors for the hazard.

A more detailed HAZOP analysis would be performed by Jordan Cove during the final design to identify the major process hazards that may occur during the operation of the facilities. The HAZOP study would be intended to address hazards of the process, engineering, and administrative controls and would provide a qualitative evaluation of a range of possible safety, health, and environmental consequences that may result from the process hazard, and identify whether there are adequate safeguards (e.g., engineering and administrative controls) to prevent or mitigate the risk from such events. Where insufficient engineering or administrative controls were identified, recommendations to prevent or minimize these hazards would be generated from the results of the HAZOP review. We recommend in section 4.13.1.6 that Jordan Cove file the

HAZOP study on the completed final design for review and approval. We would evaluate the HAZOP to ensure all systems and process deviations are addressed appropriately based on likelihood, severity, and risk values with commensurate layers of protection in accordance with recommended and generally accepted good engineering practices, such as American Institute of Chemical Engineers, Guidelines for Hazard Evaluation Procedures. We also recommend in section 4.13.1.6 that Jordan Cove file the resolutions of the recommendations generated by the HAZOP review be provided for review and approval by FERC staff. Once the design has been subjected to a HAZOP review, the design development team would track, manage, and keep records of changes in the facility design, construction, operations, documentation, and personnel. Jordan Cove would evaluate these changes to ensure that the safety, health, and environmental risks arising from these changes are addressed and controlled based on its management of change procedures. If our recommendations are adopted into the order, resolutions of the recommendations generated by the HAZOP review would be monitored by FERC staff. We also recommend in section 4.13.1.6 that Jordan Cove file all changes to their FEED for review and approval by FERC staff. However, major modifications could require an amendment or new proceeding.

If the Project is authorized and constructed, Jordan Cove would install equipment in accordance with its design. We recommend in section 4.13.1.6 that Project facilities be subject to construction inspections and that Jordan Cove provide, for review and approval, commissioning plans, procedures and commissioning demonstration tests that would verify the performance of equipment. In addition, we recommend in section 4.13.1.6 that Jordan Cove provide semi-annual reports that include abnormal operating conditions and planned facility modifications. Furthermore, we recommend in section 4.13.1.6 that the Project facilities be subject to regular inspections throughout the life of the facilities to verify that equipment is being properly maintained and to verify basis of design conditions, such as feed gas and sendout conditions, do not exceed the original basis of design.

Mechanical Design

Jordan Cove provided codes and standards for the design, fabrication, construction, and installation of piping and equipment and specifications for the facility. The design specifies materials of construction and ratings suited to the pressure and temperature conditions of the process design. Piping would be designed, fabricated, assembled, erected, inspected, examined, and tested in accordance with the American Society of Mechanical Engineers (ASME) Standards B31.3, B36.10, and B36.19. Valves and fittings would be designed to standards and recommended practices such as API Standards 594, 598, 600, 602, 603, 607, 608, 609, and 623; ASME Standards B16.5, B16.9, B16.10, B16.20, B16.21, B16.25, B16.34, B16.36 and B16.47; and ISA Standards 75.01.01, 75.05.01, 75.08.01, and 75.08.05. Portions of the facility regulated under 33 CFR 127 for the marine transfer system, including piping, hoses, and loading arms should also be tested in accordance with 33 CFR §127.407.

Pressure vessels must be designed, fabricated, inspected, examined, and tested in accordance with ASME Boiler and Pressure Vessel Code (BPVC) Section VIII and per 49 CFR 193 Subparts C, D, and E and NFPA 59A (2001). LNG storage tanks must be designed, fabricated, tested, and inspected in accordance with 49 CFR 193 Subpart D, NFPA 59A (2001 and 2006), and API Standard 620. In addition, Jordan Cove would design, fabricate, test, and inspect the LNG storage tanks in accordance with API Standard 625 and American Concrete Institute (ACI) 376. Other low-pressure storage tanks such as the amine storage tank would be designed, inspected, and maintained in accordance with the API Standards 650 and 653. All LNG storage tanks would also include boil-off gas compression to prevent the release of boil-off to the atmosphere in accordance with NFPA 59A (2001) for an inherently safer design. The Heat exchangers would be designed to ASME BPVC Section VIII standards; API Standards 660 and 661; the Tubular Exchanger Manufacturers Association (TEMA) standards; and Aluminum Plate-Fin Heat Exchanger Manufacturer's Association (ALPEMA) guidelines. Rotating equipment would be designed to standards and recommended practices, such as API Standards 610, 613, 614, 617, 618, 619, 670, 672, 674, 675, 676, and 682; and ASME Standards B73.1 and B73.2. Fired heaters would be specified and designed to standards and recommended practices, such as API Standards 530, 556 and 560, and NFPA 85.

Pressure and vacuum safety relief valves, a vent stack, and flares would be installed to protect the storage containers, pressure vessels, process equipment, and piping from an unexpected or uncontrolled pressure excursion. The safety relief valves would be designed to handle process upsets and thermal expansion within piping, per NFPA 59A (2001) and ASME Section VIII; and would be designed in accordance with API Standards 520, 521, 526, 527, 537, and 2000; ASME Standards B31.3; and other recommended and generally accepted good engineering practices. In addition, the operator should verify the set pressure of the pressure relief valves meet the requirements in 33 CFR §127.407. We recommend in section 4.13.1.6 Jordan Cove provide final design information on pressure and vacuum relief devices, vent stack, and flares, for review and approval, to ensure that the final sizing, design, and installation of these components are adequate and in accordance with the standards reference and other recommended and generally accepted good engineering practices.

Although many of the codes and standards were listed as ones the project would meet, Jordan Cove did not make reference to all codes and standards required by regulations or are recommended and generally accepted good engineering practices. Therefore, we recommend in section 4.13.1.6 that Jordan Cove provide the final specifications for all equipment and a summarized list of all referenced codes and standards for review and approval. If the Project is authorized and constructed, Jordan Cove would install equipment in accordance with its specifications and design, and FERC staff would verify equipment nameplates to ensure equipment is being installed based on approved design. In addition, FERC staff would conduct construction inspections including reviewing quality assurance and quality control plans to ensure construction work is being performed according to proposed Project specifications, procedures, codes, and standards. We recommend in section 4.13.1.6 Jordan Cove provide semi-annual reports that include equipment malfunctions and abnormal maintenance activities. In addition, we recommend in section 4.13.1.6 that the Project facilities be subject to inspections to verify that the equipment is being properly maintained during the life of the facility.

Hazard Mitigation Design

If operational control of the facilities were lost and operational controls and emergency shutdown systems failed to maintain the Project within the design limits of the piping, containers, and safety relief valves, a release could potentially occur. FERC regulations under 18 CFR §380.12 (o) (1) through (4) require applicants to provide information on spill containment, spacing and plant layout, hazard detection, hazard control, and firewater systems. In addition, 18 CFR §380.12 (o) (7) require applicants to provide engineering studies on the design approach and 18 CFR §380.12

(o) (14) requires applicants to demonstrate how they comply with 49 CFR 193 and NFPA 59A. As required by 49 CFR 193 Subpart I and by incorporation section 9.1.2 of NFPA 59A (2001), fire protection must be provided for all USDOT PHMSA regulated LNG facilities based on an evaluation of sound fire protection engineering principles, analysis of local conditions, hazards within the facility, and exposure to or from other property. NFPA 59A (2001) also requires the evaluation on the type, quantity, and location of hazard detection and hazard control, passive fire protection, emergency shutdown and depressurizing systems, and emergency response equipment, training, and qualifications. If authorized, constructed, and operated, LNG facilities as defined in 49 CFR 193, must comply with the requirements of 49 CFR 193 Subpart I and would be subject to USDOT PHMSA's inspection and enforcement programs. However, NFPA 59A (2001) also indicates the wide range in size, design, and location of LNG facilities precludes the inclusion of detailed fire protection provisions that apply to all facilities comprehensively and includes subjective performance-based language on where ESD systems and hazard control are required and does not provide any additional guidance on placement or selection of hazard detection equipment and provides minimal requirements on firewater. Also, the project marine facilities would be subject to 33 CFR 127, which incorporates sections of NFPA 59A (1994), which have similar performance-based guidance. Therefore, FERC staff evaluated the proposed spill containment and spacing, hazard detection, emergency shutdown and depressurization systems, hazard control, firewater coverage, structural protection, and onsite and offsite emergency response to ensure they would provide adequate protection of the LNG facilities as described below.

Jordan Cove performed a preliminary fire protection evaluation to ensure that adequate mitigation would be in place, including spill containment and spacing, hazard detection, emergency shutdown and depressurization systems, hazard control, firewater coverage, structural protection, and onsite and offsite emergency response. We recommend in section 4.13.1.6 that Jordan Cove provide a final fire protection evaluation that evaluates the type, quantity, and location of hazard detection and hazard control, passive fire protection, emergency shutdown and depressurizing systems, and emergency response equipment, training, and qualifications in accordance with NFPA 59A (2001), and to provide more information on the final design, installation, and commissioning of spill containment, hazard detection, hazard control, firewater systems, structural fire protection, and onsite and offsite emergency response procedures for review and approval.

Spill Containment

In the event of a release, sloped areas at the base of storage and process facilities would direct a spill away from equipment and into the impoundment system. This arrangement would minimize the dispersion of flammable vapors into confined, occupied, or public areas and minimize the potential for heat from a fire to impact adjacent equipment, occupied buildings, or public areas if ignition were to occur.

Title 49 CFR §193.2181, under Subpart C specifies that each impounding system serving an LNG storage tank must have a minimum volumetric liquid capacity of 110 percent of the LNG tank's maximum design liquid capacity for an impoundment serving a single tank, unless surge is accounted for in the impoundment design. If authorized, constructed, and operated, LNG facilities as defined in 49 CFR 193, must comply with the requirements of 49 CFR 193 Subpart C and would be subject to USDOT PHMSA's inspection and enforcement programs. For full containment LNG tanks, we also consider it prudent to provide a barrier to prevent liquid from flowing to an unintended area (i.e., outside the plant property). The purpose of the barrier is to prevent liquid from flowing off the plant property and does not define containment or an impounding area for thermal radiation or flammable vapor exclusion zone calculations or other code requirements already met by sumps and impoundments throughout the site. Jordan Cove proposes two full-containment LNG storage tanks for which the outer tank wall would serve as the impoundment system. FERC staff verified that the LNG storage tank's outer concrete wall would have a liquid capacity of at least 110 percent of the inner LNG tank's maximum liquid capacity. In addition, Jordan Cove would also install a berm around the LNG storage tank area to prevent liquid in the storage tank area from flowing off-site in the event of an outer tank impoundment failure.

Jordan Cove proposes to install curbing, paving, and trenches to direct potential LNG, refrigerant, and heavy hydrocarbon liquid releases to the Process/Tank Impoundment Basin. LNG releases from ship loading piping would be directed to either the Process/Tank Impoundment Basin or the Marine Impoundment Basin. Releases in the refrigerant storage area or from refrigerant delivery trucks would be collected in curbed areas and directed via a trench to the Refrigerant Storage Impoundment Basin. This basin would be sized to be greater than the largest refrigerant storage tank. Jordan Cove would also include local containment walls around the Amine Make-up Storage Tank, Liquid Nitrogen Storage Tank, Ammonia Storage Tank, and Diesel Storage Tank which would have a volumetric capacity of greater than 110 percent of the maximum liquid volume in each storage tank. The design would also include curbed areas in the acid gas removal area to contain amine releases. However, Jordan Cove did not propose a spill containment system to collect liquid releases from the Warm Flare Knockout Drum. Therefore we recommend in section 4.13.1.6 that Jordan Cove specify a spill containment system around the Warm Flare Knockout Drum.

Under NFPA 59A (2001), section 2.2.2.2, the capacity of impounding areas for vaporization, process, or LNG transfer areas must equal the greatest volume that can be discharged from any single accidental leakage source during a 10-minute period or during a shorter time period based upon demonstrable surveillance and shutdown provisions acceptable to the USDOT PHMSA. If authorized, constructed, and operated, LNG facilities as defined in 49 CFR 193, must comply with the requirements of 49 CFR 193 Subpart C and would be subject to USDOT PHMSA's inspection and enforcement programs. The impoundment system design for the marine facilities would be subject to the Coast Guard's 33 CFR 127, which does not specify a spill or duration for impoundment sizing. However, we evaluate whether all hazardous liquids are provided with spill containment based on the largest flow capacity from a single pipe for 10 minutes accounting for de-inventory or the liquid capacity of the largest vessel (or total of impounded vessels) served, whichever is greater and whether providing spill containment reduces consequences from a release. We recommend in section 4.13.1.6 that Jordan Cove provide additional information on the final design of the impoundment systems for review and approval.

Jordan Cove indicated that all piping, hoses, and equipment that could produce a hazardous liquid spill would be provided with spill collection and/or spill conveyance systems. Furthermore, Jordan Cove indicates that the stormwater pumps would be automatically operated by level control and interlocked using redundant low temperature detectors to prevent pumps from operating if LNG is present within the LNG spill basins. Although stormwater removal pumps would be proposed for the large impoundment basins, Jordan Cove proposes to install normally-closed valves on local curbed areas and within bund walls to allow analysis of stormwater prior to routing it to the drainage channels. Jordan Cove is consulting with USDOT PHMSA on the use of normally-closed valves instead of stormwater removal pumps required in 49 CFR 193 Subpart C. Therefore, we recommend in section 4.13.1.6 that Jordan Cove provide correspondence from USDOT PHMSA on the use of normally closed valves to remove stormwater from curbed areas. In addition, low temperature detectors would not stop the stormwater removal pumps from operating in the event a relatively warm heavy hydrocarbon release reaches the impoundment basins. Therefore, Jordan Cove indicated that gas detectors would be provided to prevent the stormwater removal pumps from operating if warm refrigerant or heavy hydrocarbon releases could reach an impoundment basin. If authorized, constructed, and operated, final compliance with the requirements of 49 CFR 193 Subpart C, would be subject to USDOT PHMSA's inspection and enforcement programs.

If a project is authorized and constructed, Jordan Cove would install spill impoundments in accordance with its design and FERC staff would verify during construction inspections that the spill containment system including dimensions, and slopes of curbing and trenches, and volumetric capacity matches final design information. In addition, we recommend in section 4.13.1.6 that Project facilities be subject to regular inspections throughout the life of the facility to verify that impoundments are being properly maintained.

Spacing and Plant Layout

The spacing of vessels and equipment between each other, from ignition sources, and to the property line must meet the requirements of 49 CFR 193 Subparts C, D, and E, which incorporate NFPA 59A (2001). NFPA 59A (2001) includes spacing and plant layout requirements and further references NFPA 30, NFPA 58, and NFPA 59 for additional spacing and plant layout requirements. If authorized, constructed, and operated, LNG facilities as defined in 49 CFR 193, must comply with the requirements of 49 CFR 193 and would be subject to USDOT PHMSA's inspection and enforcement programs.

In addition, FERC staff evaluated the spacing to determine if there could be cascading damage and to inform what fire protection measures may be necessary to reduce the risk of cascading damage. If spacing to mitigate the potential for cascading damage was not practical, we evaluated whether other mitigation measures were in place and evaluated those systems in further detail as discussed in subsequent sections in section 4.13.1.5. We evaluated the spacing of buildings in line with AIChE CCPS *Guidelines for Evaluating Process Plant Buildings for External Explosions and Fires* and API 752, which provide guidance on identifying and evaluating explosion and fire impacts on plant buildings and occupants resulting from events external to the buildings. Jordan Cove submitted a building siting analysis based on API 752 and also indicated it would meet ASCE 59 to determine explosion impacts on plant buildings. In addition, FERC staff evaluated other hazards associated with releases and whether any damage would likely occur at buildings or would result in cascading damage.

To minimize the risk of cryogenic spills causing structural supports and equipment from cooling below their minimum design metal temperature, Jordan Cove would generally locate cryogenic equipment away from process areas and would have spill containment systems for cryogenic spills that would direct them to a remote impoundment. In addition, Jordan Cove would protect equipment and structural steel against cold shocks through selection of suitable materials of construction or by the application of cold spill protection. We recommend in section 4.13.1.6 that Jordan Cove file drawings and specifications for structural passive protection systems to protect equipment and supports that could be exposed to cryogenic releases.

To minimize risk for flammable or toxic vapor ingress into buildings and from reaching areas that could result in cascading damage from explosions, Jordan Cove would generally locate buildings away from process areas and would locate fired equipment and ignition sources away from process areas. In addition, the LNG storage tanks are generally located away from process equipment and process facilities are relatively unconfined and uncongested. Therefore, we recommend in section 4.13.1.6 that Jordan Cove conduct a technical review of facility, for review and approval, identifying all combustion/ventilation air intake equipment and the distances to any possible flammable gas or toxic release; and verify that these areas would be adequately covered by hazard detection devices that would isolate or shut down any combustion or heating ventilation and air conditioning equipment whose continued operation could add to or sustain an emergency. In addition, we recommend in section 4.13.1.6 that Jordan Cove demonstrate adequate ventilation and detection in the battery rooms to mitigate hydrogen build up from battery off-gas. We also recommend in section 4.13.1.6 that Project facilities be subject to periodic inspections during construction to verify flammable/toxic gas detection equipment is installed in heating, ventilation, and air condition intakes of buildings at appropriate locations. In addition, we recommend in section 4.13.1.6 that Project facilities be subject to regular inspections throughout the life of the facilities to continue to verify that flammable/toxic gas detection equipment installed in building air intakes function as designed and are being maintained and calibrated.

To minimize overpressures from vapor cloud explosions, we evaluated how flammable vapors would be prevented from accumulating within confined areas. Jordan Cove would design for overpressures in accordance with API RP 752, API RP 753, ASCE 41088, and other recommended and generally accepted good engineering practices. In addition, explosions in process areas were evaluated and demonstrated to produce less than 1 psi side on overpressure at the LNG storage tanks. However, vapor dispersion could disperse underneath the LNG storage tanks. Therefore, we recommend in section 4.13.1.6 that Jordan Cove file an analysis for review and approval that demonstrates the flammable vapor dispersion from design spills would be prevented from dispersing underneath the elevated LNG storage tanks or detail how the LNG storage tanks would be able to withstand an overpressure due to ignition of the flammable vapors that disperse underneath the elevated LNG storage tanks.

To minimize the risk of pool fires from causing cascading damage, Jordan Cove located the spill impoundments such that the radiant heats would have a minimal impact on most areas of the plant. Fires within the process impoundments would be spaced such that there would not be high radiant heats on any equipment. A fire from the LNG storage tank outer containment walls would result in radiant heats over 10,000 Btu/ft^2-hr at the adjacent LNG storage tank. Therefore, we recommend in section 4.13.1.6 that Jordan Cove file an analysis for review and approval demonstrating the tanks can withstand the radiant heat from adjacent LNG storage tank fires. In addition, thermal radiation levels from an LNG tank roof top fire could potentially impact process equipment, process vessels, and pipe racks. Specifically, radiant heats over 10,000 Btu/ft^2-hr from an LNG tank roof top fire could extend over the LNG Flash Drum and the Auxiliary Boiler Package and radiant heats over 4,000 Btu/ft^2-hr could extend over portions of the liquefaction process areas, pretreatment area, refrigerant tanks, steam turbine generators, tugs dock, and multiple powerhouses. Jordan Cove would install fixed water spray systems that would cover the LNG Flash Drum and Auxiliary Boiler. In addition, the LNG Flash Drum would have cryogenic insulation that would also shield the vessel from radiant heats above 10,000 Btu/ft^2-hr. For radiant heats over 4,000 Btu/ft^2-hr, Jordan Cove would install fixed water spray systems and would provide cryogenic and fire insulation for process equipment not housed in a shelter. In addition, Jordan Cove would install a firewall to shield the refrigerant tanks from excessive radiant heats. Cryogenic and fire proofing would also shield structural steel from the radiant heat. However protection of this equipment was not specified and design details would be done in final design. Therefore, we recommend in section 4.13.1.6 that Jordan Cove file final design drawings and specifications of the passive structural fire protection for review and approval for structural supports and equipment.

To minimize the risk of jet fires from causing cascading damage that could exacerbate the initial hazard, Jordan Cove would shroud the LNG transfer piping and LNG product header and would locate flammable and combustible containing piping and equipment away from buildings and process areas that do not handle flammable and combustible materials. Jordan Cove would also install emergency shutdown systems that would limit the duration of a jet fire event, depressurization systems that would reduce the pressure in equipment, and would install firewater systems to cool equipment and structures as described in subsequent sections in section 4.13.1.5. In addition, we recommend in section 4.13.1.6 that Jordan Cove file drawings of the passive structural fire protection for review and approval for structural supports and equipment.

In addition, FERC staff evaluated the spacing to determine if there could be cascading damage and to inform what fire protection measures may be necessary to reduce the risk of cascading damage. Thermal radiation levels from an LNG tank roof top fire and other impoundments could potentially impact process equipment, process vessels, and piperacks located within the pretreatment area, liquefaction trains, BOG compressor area, the utility area, and at the Marine Flare. To mitigate against a LNG tank roof top fire, impoundment fires, and jet fires within the plant, Jordan Cove proposes thermal radiation mitigation measures to prevent cascading events in the design, including thermal protection insulation, fire-retardant insulation materials, emergency depressurization, flame, combustible gas and low temperature detectors, fire proofing of structural steel columns supporting critical equipment, fixed automatic firewater spray system, high expansion foam system, and firewater monitors and hydrants. However, details of these systems would be done in final design. Therefore, we recommend in section 4.13.1.6 that Jordan Cove provide the final design of these thermal mitigation measures, for review and approval, to demonstrate cascading events would be mitigated.

If the project is authorized, Jordan Cove would finalize the plot plan, and we recommend in section 4.13.1.6 that Jordan Cove provide any changes for review and approval to ensure capacities and setbacks are maintained. If the facilities are constructed, Jordan Cove would install equipment in accordance with the spacing indicated on the plot plans. In addition, we recommend in section 4.13.1.6 that Project facilities be subject to periodic inspections during construction to verify equipment is installed in appropriate locations and the spacing is met in the field. We also recommend in section 4.13.1.6 that Project facilities be subject to regular inspections throughout the life of the facilities to continue to verify that equipment setbacks from other equipment and ignition sources are being maintained during operations.

Ignition Controls

Jordan Cove LNG Project's plant areas would be designated with a hazardous electrical classification and process seals commensurate with the risk of the hazardous fluids being handled in accordance with NFPA 59A (2001), 70, 497, and API RP 500. If authorized, constructed, and operated, LNG facilities as defined in 49 CFR 193, must comply with the requirements of 49 CFR 193 and would be subject to USDOT PHMSA's inspection and enforcement programs, which require compliance, by incorporation by reference, with NFPA 59A (2001). NFPA 59A (2001) subsequently references NFPA 70 (1999) for installation of electrical equipment and wiring. The marine facilities must comply with similar electrical area classification requirements of NFPA 59A (1994) and NFPA 70 (1993), which are incorporated by reference into the Coast Guard regulations in 33 CFR 127. Depending on the risk level, these areas would either be unclassified or classified as Class 1 Division 1, or Class 1 Division 2. Electrical equipment located in these areas would be designed such that in the event a flammable vapor is present, the equipment would have a minimal risk of igniting the vapor. We evaluated Jordan Cove's electrical area classification drawings to determine whether Jordan Cove would meet these electrical area classification requirements and good engineering practices in NFPA 59A, 70, 497, and API RP 500. We recognize that Jordan Cove appears to meet NFPA 59A (1994 and 2001), NFPA 70 (1993 and 1999), and most of NFPA 497 and API 500, and recommend in section 4.13.1.6 that Jordan Cove provide final electrical area classification drawings for review and approval.

If the project is authorized, Jordan Cove would finalize the electrical area classification drawings and would describe changes made from the FEED design. We recommend in section 4.13.1.6 that Jordan Cove file the final design of the electrical area classification drawings for review and approval. If facilities are constructed, Jordan Cove would install appropriately classed electrical equipment, and we recommend in section 4.13.1.6 that Project facilities be subject to periodic inspections during construction for FERC staff to spot check electrical equipment and verify equipment is installed per classification and are properly bonded or grounded in accordance with NFPA 70. In addition, we recommend in section 4.13.1.6 that Project facilities be subject to regular inspections throughout the life of the facility to ensure electrical equipment is maintained (e.g., bolts on explosion proof equipment properly installed and maintained, panels provided with purge, etc.), and electrical equipment are appropriately de-energized and locked out and tagged out when being serviced.

In addition, submerged pumps and instrumentation must be equipped with electrical process seals, and instrumentation in accordance with NFPA 59A (2001) and NFPA 70. We recommend in section 4.13.1.6 that Jordan Cove provide, for review and approval, final design drawings showing process seals installed at the interface between a flammable fluid system and an electrical conduit or wiring system that meet the requirements of NFPA 59A (2001) and NFPA 70. In addition, we recommend in section 4.13.1.6 that Jordan Cove file, for review and approval, details of an air gap or vent equipped with a leak detection device that should continuously monitor for the presence of a flammable fluid, alarm the hazardous condition, and shut down the appropriate systems. In addition, we recommend in section 4.13.1.6 that Project facilities be subject to regular inspections throughout the life of the facility to ensure electrical process seals for submerged pumps continue to conform to NFPA 59A and NFPA 70 and that air gaps are being properly maintained.

<u>Hazard Detection, Emergency Shutdown, and Depressurization Systems</u>

Jordan Cove would also install hazard detection systems to detect cryogenic spills, flammable and toxic vapors, and fires. The hazard detection systems would alarm and notify personnel in the area and control room to initiate an emergency shutdown, depressurization, or initiate appropriate procedures, and would meet NFPA 72, ISA Standard 12.13, and other recommended and generally accepted good engineering practices. In addition, we recommend in section 4.13.1.6 that Jordan Cove provide specifications, for review and approval, for the final design of fire safety specifications, including hazard detection, hazard control, and firewater systems.

FERC staff also evaluated the adequacy of the general hazard detection type, location, and layout to ensure adequate coverage to detect cryogenic spills, flammable and toxic vapors, and fires near potential release sources (i.e., pumps, compressors, sumps, trenches, flanges, and instrument and valve connections). We recommend in section 4.13.1.6 that Jordan Cove file a hazard detection study to evaluate the effectiveness of their flammable and combustible gas detection and flame and heat detection systems in accordance with ISA 84.00.07 or equivalent methodologies. This evaluation would need to demonstrate that 90 percent or more of releases (unignited and ignited) that could result in an off-site or cascading impact would be detected by two or more detectors and result in isolation and de-inventory within 10 minutes. The analysis should take into account the set points, voting logic, wind speeds, and wind directions. FERC staff also reviewed the fire and gas cause and effect matrices to evaluate the detectors that would initiate an alarm, shutdown, depressurization, or other action based on the FEED. Jordan Cove did not provide the fire and gas system cause and effect matrices that indicate how each detector would initiate an alarm, shutdown, depressurization, or conduct other action. Therefore, we recommend in section 4.13.1.6 that Jordan Cove provide, for review and approval, the cause and effect matrices for process instrumentation, fire and gas detection system, and emergency shutdown system.

In addition, Jordan Cove specified low oxygen detectors at the liquid nitrogen storage tanks, but did not denote the location of the low oxygen detectors in the Project drawings. Therefore, we recommend in section 4.13.1.6 that Jordan Cove provide additional information, for review and approval, on the final design of all hazard detection systems (e.g., manufacturer and model, elevations, etc.) and hazard detection layout drawings. If the project is authorized, constructed, and operated, Jordan Cove would install hazard detectors according to its final specifications and drawings, and we recommend in section 4.13.1.6 that Project facilities be subject to periodic inspections during construction to verify hazard detectors and ESD pushbuttons are appropriately installed per approved design and functional based on cause and effect matrixes prior to introduction of hazardous fluids. In addition, we recommend in section 4.13.1.6 that Project facilities be subject to regular inspections throughout the life of the facility to verify hazard detector coverage and functionality is being maintained and are not being bypassed without appropriate precautions.

Hazard Control

If ignition of flammable vapors occurred, hazard control devices would be installed to extinguish or control incipient fires and releases, and would meet NFPA 59A; NFPA 10, 12, 17, and 2001; API Standard 2510A; and other recommended and generally accepted good engineering practices. We evaluated the adequacy of the number and availability of handheld, wheeled, and fixed fire extinguishing devices throughout the site based on the FEED. FERC staff also evaluated whether the spacing of the fire extinguishers would meet NFPA 10 and agent type and capacities meet NFPA 59A (2009 and later editions). The hazard control plans appeared to meet NFPA 10 travel distances to most components containing flammable or combustible fluids (Class B) for handheld fire extinguishers (30 to 50 feet) and wheeled extinguishers (100 feet) and NFPA 10 travel distance to most other components that could pose an ordinary combustible hazard (Class A) or associated electrical (Class C) hazard for handheld extinguishers (75 feet). Buildings also appear to be provided with handheld extinguishers that appear to satisfy NFPA 10 requirements, including placement at each entry/exit. The agent type (potassium bicarbonate) and agent storage capacities for wheeled (minimum 125 pounds [lb]) and for handheld extinguishers (minimum 20 lb) also appear to meet NFPA 59A requirements. In addition, travel distances, installation heights, visibility, flow rate capacities, and other requirements should be confirmed in final design and in the field where design details, such as manufacturer, obstructions, and elevations, would be better known. Therefore, we recommend in section 4.13.1.6 that Jordan Cove files the final design of these systems, for review and approval, where details are yet to be determined (e.g., manufacturer and model, elevations, flowrate, capacities, etc.) and where the final design could change as a result of these details or other changes in the final design of the Project.

In addition, we evaluated whether clean agent systems would be installed in all instrumentation buildings in accordance with NFPA 2001. Jordan Cove would install clean agent fire suppression systems in accordance with NFPA 2001 in buildings that house electrical and control equipment such as the Control Room, power distribution equipment rooms, and power generation houses. Jordan Cove also indicated that CO2 extinguishers as well as dry chemical extinguishers would be provided in the electrical powerhouses. In addition, Jordan Cove would provide a carbon dioxide extinguishing system for the refrigerant compressors turbines in accordance with NFPA 12.

If the Project is authorized, constructed, and operated, Jordan Cove would install hazard control equipment, and we recommend in section 4.13.1.6 that Project facilities be subject to periodic inspections during construction to verify hazard control equipment is installed in the field and functional prior to introduction of hazardous fluids. In addition, we recommend in section 4.13.1.6 that Project facilities be subject to regular inspections throughout the life of the facility to verify in the field that hazard control coverage and is being properly maintained and inspected.

Passive Cryogenic and Fire Protection

If cryogenic releases or fires could not be mitigated from impacting facility components to insignificant levels, passive protection (e.g., fireproofing structural steel, cryogenic protection, etc.) should be provided to prevent failure of structural supports of equipment and pipe racks. The structural fire protection would comply with NFPA 59A (2001) and other recommended and generally accepted good engineering practices. NFPA 59A (2001) section 6.4.1 requires pipe supports, including any insulation systems used to support pipe whose stability is essential to plant safety, to be resistant to or protected against fire exposure, escaping cold liquid, or both, if they are subject to such exposure. However, NFPA 59A (2001) does not provide the criteria for determining if they are subject to such exposure or the level of protection needed to protect the pipe supports against such exposures. In addition, NFPA 59A does not address cryogenic or structural protection of pressure vessels or other equipment.

Therefore, FERC staff evaluated whether passive cryogenic and fire protection would be applied to pressure vessels and structural supports to facilities that could be exposed to cryogenic liquids or radiant heats of 4,000 Btu/ft^2-hr or greater from fires with durations that could result in failures[251] and that they are specified in accordance with recommended and generally accepted good engineering practices with a fire protection rating commensurate to the exposure. The structural fire protection would comply with NFPA 59A (2001); API RP 2218; Association of the Wall and Ceiling Industry Technical Paper 12-A; International Organization for Standardization

[251] Pool fires from impoundments are generally mitigated through use of emergency shutdowns, depressurization systems, structural fire protection, and firewater, while jet fires are primarily mitigated through the use of emergency shutdowns, depressurization systems, and firewater with or without structural fire protection.

(ISO) 12944 and 22899; Underwriters Laboratories (UL) 1709; and other recommended and generally accepted good engineering practices.

To minimize the risk of cryogenic spills causing structural supports and equipment from cooling below their minimum design metal temperature, Jordan Cove would protect equipment and structural steel against cold shocks through selection of suitable materials of construction or by the application of coldproofing. In addition, Jordan Cove would have spill containment systems surrounding cryogenic equipment and would generally locate cryogenic equipment away from process areas that do not handle cryogenic materials. Cryogenic protection would comply with NFPA 59A (2001), ISO 20088, and other recommended and generally accepted good engineering practices. In addition, Jordan Cove would install a firewall between the refrigerant storage tanks and the Refrigerant Storage Impoundment Basin to prevent cascading damage from radiant heats in excess of 4,000 Btu/ft^2-hr. We recommend in section 4.13.1.6 that Jordan Cove file drawings and specifications of the final design, for review and approval, for the structural passive protection systems to protect equipment and supports from cryogenic releases.

To minimize the risk of a pool or jet fire from causing cascading damage, Jordan Cove would generally locate flammable and combustible containing piping, equipment, and impoundments away from buildings and other process areas that do not handle flammable and combustible materials. Jordan Cove demonstrated that the radiant heats from pool fires from the LNG storage tank outer containment walls and impoundments would have a minimal impact on most areas of the plant with the exceptions described in the Spacing and Plant Layout section above. Fires within the other impoundments would be spaced such that there would be less than 4,000 Btu/ft^2-hr on any equipment.

In addition, we recommend in section 4.13.1.6 that Jordan Cove demonstrate that passive protection is provided in areas where jet fires may result in failure of structural supports. Jordan Cove would need to file drawings of the passive structural fire protection for review and approval for structural supports and equipment that could result in a failure when exposed to a jet fire. In addition, we recommend in section 4.13.1.6 that Jordan Cove provide additional information on final design of these systems, for review and approval, where details are yet to be determined (e.g., calculation of structural fire protection materials, thicknesses, etc.) and where the final design could change as a result of these details or other changes in the final design of the Project.

We also note that it was unclear whether Jordan Cove would install fire walls in transformer areas, which would be required for certain transformers. Therefore, we recommend in section 4.13.1.6 that Jordan Cove separate or provide fire walls for transformer in accordance with NFPA 850 or equivalent that would prevent cascading damage.

If the Project is authorized, constructed, and operated, Jordan Cove would install structural cryogenic and fire protection according to its design, and we recommend in section 4.13.1.6 that Project facilities be subject to periodic inspections during construction to verify structural cryogenic and fire protection is properly installed in the field as designed prior to introduction of hazardous fluids. In addition, we recommend in section 4.13.1.6 that Project facilities be subject to regular inspections throughout the life of the facility to continue to verify that passive protection is being properly maintained.

Firewater Systems

Jordan Cove would also provide firewater systems, including remotely operated firewater monitors, sprinkler systems, fixed water spray systems, and firewater hydrants and hoses for use during an emergency to cool the surface of storage vessels, piping, and equipment exposed to heat from a fire. These firewater systems would be designed, tested, and maintained to meet NFPA 59A (2001), 13, 14, 15, 20, 22, 24, and 25 requirements. Jordan Cove would also provide high expansion foam for each LNG spill impoundment basin to reduce vaporization rates from LNG pools and would meet NFPA 59A (2001) and NFPA 11. FERC staff evaluated the adequacy of the general firewater or foam system coverage and verified the appropriateness of the associated firewater demands of those systems and worst-case fire scenarios to size the firewater and foam systems. Jordan Cove provided firewater coverage drawings for the firewater monitors and fire hydrants, however, where coverage circles intersect pipe racks, large vessels or process equipment, the firewater coverage could be blocked, and the coverage circles should be modified to account for obstructions during the final design. Additionally, not all areas of the gas pretreatment are adequately covered. We recommended in section 4.13.1.6 that Jordan Cove provide adequate firewater coverage for all of the pretreatment equipment. We recommend in section 4.13.1.6 that Jordan Cove file additional information on the final design of these systems, for review and approval, where details are yet to be determined (e.g., manufacturer and model, nozzle types, etc.) and where the final design could change as a result of these details or other changes in the final design of the Project.

FERC staff also assessed whether the reliability of the firewater pumps, firewater source, and onsite storage volume would be appropriate. Jordan Cove would provide a primary and backup firewater pump with different drivers per NFPA 20. Jordan Cove also states that the firewater tanks would meet NFPA 22 and API Standard 650. However, the firewater tank data sheet denotes that the firewater tanks would be designed to API Standard 650 and does not make reference to NFPA 22. Therefore, we recommend in section 4.13.1.6 that Jordan Cove design the firewater tanks in accordance with NFPA 22 or justify how API Standard 650 provides an equivalent or better level of safety. Furthermore, Jordan Cove would provide a fully staffed fire department adjacent to the firewater tanks that would meet NFPA 600.

We also recommend in section 4.13.1.6 that Jordan Cove should specify that the firewater flow test meter is equipped with a transmitter and that a pressure transmitter is installed upstream of the flow transmitter, which should both be connected to the DCS and recorded to keep a history of flow test data. In addition, we recommend in section 4.13.1.6 that the largest firewater pump or component be able to be removed for maintenance from the firewater pump shelter. If the Project is authorized, constructed, and operated, Jordan Cove would install the firewater and foam systems as designed, and we recommend in section 4.13.1.6 that Project facilities be subject to periodic inspections during construction and that companies provide results of commissioning tests to verify the firewater and foam systems are installed and functional as designed prior to introduction of hazardous fluids. In addition, we recommend in section 4.13.1.6 that Project facilities be subject to regular inspections throughout the life of the facility to ensure firewater and foam systems are being properly maintained and tested.

Geotechnical and Structural Design

Jordan Cove provided geotechnical and structural design information for its facilities to demonstrate the site preparation and foundation designs would be appropriate for the underlying soil characteristics and to ensure the structural design of the Project facilities would be in accordance with federal regulations, standards, and recommended and generally accepted good engineering practices. The application focuses on the resilience of the Project facilities against natural hazards, including extreme geological, meteorological, and hydrological events, such as earthquakes, tsunamis, seiche, hurricanes, tornadoes, floods, rain, ice, snow, regional subsidence, sea level rise, landslides, wildfires, volcanic activity, and geomagnetism

Geotechnical Evaluation

FERC regulations under 18 CFR §380.12 (h) (3) require geotechnical investigations to be provided. In addition, FERC regulations under 18 CFR §380.12 (o) (14) require an applicant to demonstrate compliance with regulations under 49 CFR 193 and NFPA 59A. If authorized, constructed, and operated, LNG facilities as defined in 49 CFR 193, must comply with the requirements of 49 CFR 193 and would be subject to USDOT PHMSA's inspection and enforcement programs. USDOT PHMSA regulations incorporate by reference NFPA 59A (2001). NFPA 59A (2001) section 2.1.4 requires soil and general investigations of the site to determine the design basis for the facility. However, no additional requirements are set out in 49 CFR 193 or NFPA 59A on minimum requirements for evaluating existing soil site conditions or evaluating the adequacy of the foundations, therefore FERC staff evaluated the existing site conditions, geotechnical report, and proposed foundations to ensure they are adequate for the LNG facilities as described below.

The Project would be 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 Epoch Coos Bay dune sheet (Peterson et al. 2006). The Project would be located near the eastern edge of the Cascadia Subduction Zone (CSZ), where the North American Plate is overriding the Explorer, Juan de Fuca, and Gorda tectonic plates (Wells et al. 2016). The converging tectonic plates have resulted in the accumulation of marine deltaic sediments and volcanic seamounts, referred to as the Siletzia Terrance, along the western edge of the North American tectonic plate (Heller and Ryberg 1983). The plates have also created a deformation zone along the western edge of the accumulation wedge complex, strike-slip and thrust/reverse faulting in the North American tectonic place, and a zone of bedrock folding extending from the coast eastward. The major tectonic elements associated with the subduction zone include the accumulation wedge complex, a deformed forearc basin consisting of the Coast Range and Willamette Valley, a volcanic arc complex consisting of the Cascade Mountain Range, and a backarc in eastern Oregon and Washington. The Project would be located at the junction of the accumulation wedge complex and the forearc basin. Local bedrock structures reflect east-west compressional deformation resulting from ongoing oblique subduction of the CSZ that has occurred since the late-middle Miocene Epoch (Wells and Peck 1961), and includes the megathrust itself, north-south trending folds, north-south trending reverse and thrust faults, and west-northwest trending oblique strike-slip faults (Black and Madin 1995; Madin et al. 1995; Goldfinger et al. 1992). The location and extent of fold and fault structures have been inferred from stratigraphic, geomorphic, and geophysical evidence. Geologic structures south of the site include the South Slough Syncline, the Westport Arc (anticline), and the eastern and the western forks on the Westport Arc (Allen and Baldwin 1944).

Jordan Cove contracted KBJ (a joint venture consisting of Kiewit, Black & Veatch, and JGC) and its subconsultants to conduct geotechnical investigations and report to evaluate existing soil site conditions and proposed foundation design for the Project. During the investigation, the facility was subdivided into three primary areas: Ingram Yard area, Access and Utility Corridor area and South Dunes area. The LNG liquefaction trains, LNG storage tanks, and marine facilities would be located in the Ingram Yard area. The average elevation of the existing grade in Ingram Yard area ranged from +20 to +125 feet North American Vertical Datum 1988 (NAVD 88), the Access and Utility Corridor area ranged from +20 to +135 feet NAVD 88, and the South Dune area was less variable and was approximately +15 feet NAVD 88. KBJ indicated that the geologic profile consists primarily of sand overlying sand and silt, and then overlies clayey silt. Below elevation −30 feet NAVD 88, the subsurface material shows low variation and is generally dense.

Above elevation −30 feet, the material is more variable, with organics, clay, and fill present in the upper near surface profile in portions of the Project site. The Project site would be demolished, cleared, relocated, grubbed, and prepared using standard earthmoving and compaction equipment. Site preparation would result in a final grade elevation from +46 to +70 feet NAVD 88 with varying amounts of fill/cut that cross the site. Exceptions include the LNG storage tanks and water-dependent facilities such as the marine terminal and the Material Offloading Facility (MOF). The LNG storage tank basins would have an elevation of approximately +27 feet NAVD 88 that would be surrounded by a tertiary protective berm with a crest elevation of no less than +46 feet NAVD 88. Jordan Cove indicated that the parts of the marine facilities that would be normally occupied or operational would typically be at an elevation of +34.5 feet or greater, whereas normally unoccupied/non-operational parts of the marine facilities may be at a lower elevation.

Based on the test borings conducted, a number of design profiles were developed for the Project site. At Ingram Yard area, the subsurface conditions are relatively consistent below EL −30 feet. The existing sands above EL −30 feet consist of either existing sand fill or native dune or estuary sand deposits. In the area of the dune on the eastern portion of the Ingram Yard area, the sands are native starting at the ground surface. Below EL −30 feet, the native sands is predominantly fine-grained, with occasional shells and silt zones. A sand-silt unit is present beneath the native sand at elevations ranging from −110 feet to −140 feet. Investigation borings completed near the south LNG storage tank in the Ingram Yard area encountered hard clayey silt that was classified as poorly indurated silty shale at a depth of approximately −252 feet. Another boring drilled about 480 feet north, did not encounter the poorly indurated silty shale when terminated at a depth of about −280 feet. At the Access and Utility Corridor area, the subsurface conditions are generally similar to Ingram Yard. Below EL −30 feet, the conditions are similar to the Ingram Yard area. Above EL −30 feet, the soil consists primarily of sand with both fill and native sand encountered. Organics and peat were encountered only in the western end of the Access and Utility Corridor between EL −11 feet and EL −10.5 feet. At the South Dune area, as at Ingram Yard and along the Access Utility Corridor, the subsurface conditions at the South Dunes area are relatively constant below EL −30 feet. The conditions above EL −30 feet vary mainly because of variation in the sands and the presence or absence of peat/organics. Peat/organics were encountered in several areas of the South Dunes area at elevations ranging from 4 to 9 feet. The existing sand above EL −30 feet consists of fill, and native dune and estuary sand deposits. In the northeast quadrant of the South Dunes a layer of clay was encountered from EL 6 to 3.5 feet. The clay thickness varies from 0.3 foot to 2.5 feet and the material is very soft to soft with high plasticity. In the east central portion of the South Dunes, the driftwood was estimated to extend not more than 10 feet below ground surface. Below elevation −30 feet, the South Dunes subsurface conditions are fairly consistent. The native sand is predominantly fine grained, with occasional shells and silt zones. A deep boring at the South Dunes indicates that the native sand extends to elevation −151 feet.

Below EL −151 feet, dark gray, very stiff to very hard, moist, and high plasticity clayey silt with sand and cementation was encountered that extended to an elevation of at least −223 feet.

KBJ conducted further subsurface investigations including: mud-rotary borings with standard penetration tests (SPTs); cone penetration test (CPT) soundings; test pits, electrical resistivity testing; measurement of shear and compression wave velocities; pressure meter testing; infiltrometer testing, pump testing; geophysical surveys, and laboratory testing. The borings and shear wave velocity logging on the project site were completed to depths of approximately 300 feet. Geotechnical laboratory testing was completed on representative samples of the soil obtained from the explorations for the purpose of determining its physical characteristics and engineering properties. Approximately 132 borings to depths ranging from 14 to 300 feet below existing grade, approximately 90 cone penetration tests (CPTs) to depths ranging from 16 to 80 feet (or to refusal) below existing grade, 21 temporary piezometers to measure groundwater levels, and over 5 different tests on recovered soil samples, including classification tests (water content, Atterberg liquid and plastic limits, sieve tests), compression tests, corrosion potential tests (pH, sulfate, chloride, electrical resistivity) in general accordance with pertinent American Society for Testing and Materials (ASTM) standards.

Based on the results of analytical laboratory testing, the exposure of concrete and steel to the soil would not require special considerations. The results for sulfate in the groundwater tested indicate that no special considerations would be required to protect the concrete for the existing groundwater conditions. In contrast, the electrical resistivity test results indicate a corrosion specialist should be consulted. In addition, Coos Bay is a salt water environment, and salt is known to degrade concrete. Therefore, materials in contact with the surface water in Coos Bay or in the immediate vicinity of Coos Bay should be protected from exposure to salt water. Currently the groundwater below the site is fresh water; however, if the marine slip is authorized and dredged, it is unclear how much water from Coos Bay would infiltrate into the dredged sands and increase the chloride content. Therefore, it is standard practice that the chloride content of the dredged sand be tested as dredging is performed. If the chloride contents are observed to increase during dredging, then any necessary corrosion protection should be implemented.

The subsurface data from geotechnical soil borings and CPT soundings indicate that the subsurface conditions on the west side of Ingram Yard are relatively consistent with sand fill from the ground surface near EL 20 feet to EL 9.5 feet. Near approximately EL 9.5 feet, an up to 2 feet thick layer of organic rich soil or peat is present in many locations below the fill, with native sands below. Beneath the peat layer is medium dense, native sand that extends to EL −30 feet. The medium dense, native sand would be improved by vibro-compaction and excavation with backfill to mitigate potentially liquefiable soils prior to construction of the LNG storage tanks. The peat layer would be removed and replaced prior to the ground improvement for soil liquefaction mitigation. Below EL −30 feet is dense to very dense, native sand that extends to about EL −135 feet. From EL −135 feet to below EL −260 feet a sand-silt. A clayey silt material identified as poorly indurated silty shale was found below about EL −235 feet.

FERC staff evaluated the geotechnical investigation to ensure the adequacy in the number, coverage, and types of the geotechnical borings, CPTs, SCPTs, and other tests, and found them to adequately cover major facilities, including the marine facilities, liquefaction areas, pretreatment areas, flare system, buildings, power generation, storage tanks, and berms at the site. Jordan Cove states that additional investigation would be performed to support final design, including borings, CPTs, PMTs, and geophysical testing. FERC staff will continue its review of the results of the geotechnical investigation to ensure foundation designs are appropriate prior to construction of final design and throughout the life of the facilities.

Measured groundwater elevations have varied from a high of approximately 18 feet to -1 foot NAVD 88. Groundwater elevations increase with distance to the north away from Coos Bay. Considering the subsurface conditions for the LNG facility, Jordan Cove is proposing to support the LNG storage tanks and most of the facility structures on shallow isolated foundations, raft foundations, or deep foundations placed on improved ground. The recommended deep foundations to support large loads proposed would be either drilled piers or open-ended steel pipe piles. KBJ indicated the estimated depth of frost penetration for the site is approximately 1 foot below ground surface, therefore, the bottom of the foundations should be located at minimum depth of 1 foot below finished grade. The subsurface conditions at the site require soil improvement before any structures can be built for the LNG facilities. These conditions include peat, clay, buried driftwood, and liquefiable soil. KBJ provided considerations for ground improvement techniques including vibro-compaction; sand compaction; dry excavation and removal; wet excavation and removal and soil mixing. In areas where ground improvement would be utilized, Jordan Cove proposes to utilize vibro-compaction and deep soil mixing ranging in depth from the groundwater table to a maximum of approximately EL −30 feet NAVD 88, depending on the foundation loading and soil suitability for ground improvement, to bring foundations capacities and settlements within acceptable limits. Deep soil mixing would consist of installing overlapping (secant) soil mixed columns to create shear walls that reinforce the liquefiable soil mass. The deep soil mixed shear walls would be installed. KBJ performed settlement analysis for the Project site.

This project design assumes the potential for seismically-induced and post-seismic (flow) liquefaction. At Ingram Yard, the settlement due to liquefaction was estimated to be none to approximately 11.5 inches. Along the Access and Utility Corridor, the potential total settlement due to liquefaction was estimated to be approximately 0.8 to 9.5 inches. At the South Dunes, settlement due to liquefaction was estimated to be approximately 0.5 inch up to 7 inches. KBJ stated that it would employ ground improvement methods such as vibro compaction and excavation with backfill to reduce the potential settlement following a liquefaction event to 3 inch or less. KBJ stated that the preliminary estimates of LNG storage tank settlement based on the available ground investigation data and proposed ground improvement indicate that differential settlements would be in line with the requirements of ACI 376. The influence of soil structure interaction on local settlement gradients near the LNG storage tank edge would be evaluated with more detailed analysis and models in the detailed design phase, together with the limits that can be absorbed by the tank components. Due to the wide range of settlement values, we recommend in section 4.13.1.6 that Jordan Cove file an upper limit for total settlement for large flexible foundations and the maximum total edge settlement for equipment and structures consistent with applicable codes, including but not limited to API 620, API 625, API 653, and ACI 376.

Dredging would be required for the LNG marine vessels to traverse to the terminal as well as for the construction of the marine facilities. The existing shoreline would be excavated, dredged, and sloped during construction. To prevent slumping of the dredged slope, maintain the berthing line position, and provide structural integrity support to the landside facilities by reducing erosion, the excavated shoreline would be protected from scour and erosion using stone or cement based rip-rap armoring. The Project basin shoreline would be protected from scour and erosion using stone or a cement based rip rap. The northern slope of the marine slip would be protected against scour from the toe to above the water line. Above the waterline, alternative scour (and wind/rain erosion) protection systems for less frequent events would be provided using any number of potential techniques including; concrete cellular mattresses, grout-injected geotextile fabric mattresses (fabriform) and/or geotextile reinforced vegetative planting. The proposed rip-rap armoring would minimize the potential for erosion where the shoreline would be excavated.

The results of Jordan Cove's geotechnical investigation at the Project site indicate that subsurface conditions are suitable for the proposed facilities, if proposed site preparation, foundation design, and construction methods are implemented in addition to the satisfaction of proposed recommendations.

Structural and Natural Hazard Evaluation

FERC regulations under 18 CFR §380.12 (m) require applicants address the potential hazard to the public from failure of facility components resulting from accidents or natural catastrophes, evaluate how these events would affect reliability, and describe what design features and procedures that would be used to reduce potential hazards. In addition, 18 CFR §380.12 (o) (14) require an applicant to demonstrate how they would comply with 49 CFR 193 and NFPA 59A. USDOT PHMSA regulations under 49 CFR 193 have some specific requirements on designs to withstand certain loads from natural hazards and also incorporates by reference NFPA 59A (2001 and 2006) and ASCE 7-05 and ASCE 7-93 via NFPA 59A (2001). NFPA 59A (2001) section 2.1.1 (c) also requires that Jordan Cove consider the plant site location in the design of the Project, with respect to the proposed facilities being protected, within the limits of practicality, against natural hazards, such as from the effects of flooding, storm surge, and seismic activities. This would be covered in USDOT PHMSA's LOD on 49 CFR 193 Subpart B. However, with the exception of wind loads, which are covered in 49 CFR §193.2067, under Subpart B, the LOD would not cover whether the facility is designed appropriately against these other hazards, which would be part of 49 CFR 193 Subpart C. If authorized, constructed, and operated, LNG facilities as defined in 49 CFR 193, must comply with the requirements of 49 CFR 193 and would be subject to USDOT PHMSA's inspection and enforcement programs. The marine facilities would be subject to 33 CFR 127, which requires if the waterfront facility handling LNG is in a region subject to earthquakes the piers and wharves must be designed to resist earthquake forces. In addition, Coast Guard regulations under 33 CFR 127 incorporates by reference certain portions of NFPA 59A (1994) and ASCE 7-88 via NFPA 59A (1994). However, Coast Guard regulations do not provide criteria for a region subject to earthquakes or the earthquake forces the piers and wharves are to withstand and NFPA 59A (1994) section referenced in 33 CFR 127 is for seismic design only and is applicable to stationary LNG containers, which would not be under 33 CFR 127. Therefore, we evaluated the basis of design for all facilities for all natural hazards under FERC jurisdiction, including those under USDOT PHMSA and Coast Guard jurisdiction.

Jordan Cove states that FERC and NFPA 59A requirements to design in accordance with ASCE 7-05 conflict with local building code requirements in the Oregon Structural Specialty Code (OSSC) of 2014. Specifically, OSSC 2014 is based on ASCE 7-10. To resolve this conflict, Jordan Cove indicated that they would conform to both ASCE 7-05 and ASCE 7-10 in parallel, with the final design the more conservative design requirements of the two. Jordan Cove also indicated that in case of conflict, the more stringent requirement would govern. Thus, the final design would be intended to satisfy the FERC, NFPA 59A, ASCE 7-05, and ASCE 7-10 requirements. Jordan Cove states the facilities would also be constructed to the requirements in the 2006 International Building Code (IBC) and the 2014 Oregon State Specialty Code. These standards require various structural loads to be applied to the design of the facilities, including live (i.e., dynamic) loads, dead (i.e., static) loads, and environmental loads. FERC staff also evaluated potential engineering design to withstand impacts from natural hazards, such as earthquakes, tsunamis, seiche, hurricanes, tornadoes, floods, rain, ice, snow, regional subsidence, sea level rise, landslides, wildfires, volcanic activity, and geomagnetism. We recommend in section 4.13.1.6 that Jordan Cove file final design information (e.g., Civil/Structural drawings, specifications, and calculations) and associated quality assurance and control procedures with the documents reviewed, approved, and stamped and sealed by the professional engineer of record in Oregon.

If a project is authorized, constructed, and operated, the company would install equipment in accordance with its final design. In addition, we recommend in section 4.13.1.6 that Jordan Cove file, for review and approval, settlement results during hydrostatic tests of the LNG storage containers and periodically thereafter to verify settlement is as expected and does not exceed the applicable criteria in API Standards 620, 625, 653, and ACI 376.

Earthquakes, Tsunamis, and Seiche

FERC regulations under 18 CFR §380.12 (h) (5) requires evaluation of earthquake hazards based on whether there is potential seismicity, surface faulting, or liquefaction. Earthquakes and tsunamis have the potential to cause damage from shaking ground motion and fault ruptures. Earthquakes and tsunamis often result from dynamic activity in the earth's crust. The damage that could occur as a result of seismic ground motions is affected by the type/direction and severity of the fault activity and the distance and type of soils the seismic waves must travel from the hypocenter (or point below the epicenter where seismic activity occurs). To assess the potential impact from earthquakes and tsunamis, Jordan Cove evaluated historic earthquakes along fault locations and their resultant ground motions.

The USGS maintains a database containing information on surface and subsurface faults and folds in the United States that are believed to be sources of earthquakes of greater than 6.0 magnitude occurring during the past 1.6 million years (Quaternary Period).[252] KBJ performed a site-specific fault and seismic analysis for the Project, involving field investigations and subsequent data evaluation. The project site is covered by more than 100 feet of unconsolidated sand that prevents direct inspection of the bedrock, faults within 5 miles of the Project site have been identified from existing geologic maps. A total of 12 active and potentially active faults were identified within 100 miles of the Project site, but only the Barview fault is within 5 miles of the site. The Barview fault is a south dipping thrust fault that has offset the Miocene Epoch (23 to 5.3 million years ago) Empire Formation and Pleistocene Epoch (2.6 million to 11.7 thousand years ago) marine terrace platforms by about 3 feet. The mapped length of the Barview fault is less than 2 miles and extends from Coos Bay to the east-southeast north of Barview, Oregon (Madin et al., 1995). Based on the distance of the Barview fault from the Project site and its west-northwest strike, the Barview fault would not create a potential for fault offset at or near the ground surface at or near the Project site. KBJ indicated that neither fault is identified to potentially fault material younger than the Eocene Epoch. While the location and extent of both faults is uncertain, they are considered unlikely to potentially create fault offset at or near the ground surface at the Project site. The Barview fault

[252] USGS, Earthquake Hazards Program, Quaternary Fault and Fold Database of the United States, https://earthquake.usgs.gov/hazards/qfaults/, accessed Aug 2018.

is included with South Slough thrust and reverse faults in the USGS Quaternary Fault and Fold database. Ground motions that Barview fault could potentially generate at the site would be evaluated in the Deterministic Seismic Hazard Analysis (DSHA). The Barview Fault and the South Slough thrust and reverse faults are both incorporate into the Probabilistic Seismic Hazard Analysis (PSHA) as part of the gridded seismic sources and are not explicitly modeled as individual faults. Additionally, Jordan Cove states that there is no historically reported earthquakes have been associated with faults within 5 miles of the site. Because the subsurface investigations at the site have not identified seismic fault ruptures, there is no potential to affect faulting on the site.

The Jordan Cove LNG Project is in a region that has exhibited moderate to low seismic activity during the historic record, within the last 170 years. The region has been subject to numerous earthquakes of moment magnitude (MW) 4 or greater; however, the regional rate of seismicity is lower than in California and Washington. Earthquake records dating back to 1900 indicate there is only one record or an earthquake with a magnitude greater than 3 within a 50 km radius of the site. Near-fault effects such as rupture directivity and velocity or displacement pulses are typical for faults within 15 to 30 km of the site (National Earthquake Hazards Reduction [NEHRP], 2009; 2015). Directivity pulses are reasonably likely at 10 to 20 km from a site and polarization of seismic waves in the fault-normal and fault-parallel directions typically extends about 3 to 5 km from the fault (NEHRP 2015). The rupture directivity and pulses are considered for the Project site while fault-normal and fault-parallel directions of grounds motion are not considered. KBJ stated the Project site would not be located up-dip from the fault plane and significant directivity or pulses are unlikely. Based on the geological record, large magnitude earthquakes with moment magnitudes of 9 have occurred on the CSZ during the past 11,000 years with the last occurring in the year 1700. The CSZ is the dominate earthquake ground motion hazard source for the site. Onshore directivity is not expected for the CSZ because of the anticipated rupture geometry (Baker et al. 2012). Jordan Cove stated that the subsurface investigations at the Project site have not identified fault ruptures, and identified active faults in the region do not have a potential to create faulting at the proposed site, and growth faults are not present. While the presence of major tectonic faults and growth faults can require special consideration, the presence or lack of major tectonic faults identified near the site does not define whether earthquake ground motions can impact the site because ground motions can be felt large distances away from an earthquake hypocenter depending on number of factors. Jordan Cove stated that ground motions at the facility would be monitored by three sets of seismometers. An open-field seismometer located in a clear area away from other equipment would provide a baseline ground movement reference for any event. Two seismometers located on the top and bottom of each LNG storage tank. If any of the three sets of seismometers exceeds safe limits, an alarm would sound in the control room where operators could shut down operations.

To address the potential ground motions at the site, USDOT PHMSA regulations in 49 CFR §193.2101, under Subpart C require that field-fabricated LNG tanks must comply with section 7.2.2 of NFPA 59A (2006) for seismic design. NFPA 59A (2006) requires LNG storage tanks be designed to continue safely operating with earthquake ground motions at the ground surface at the site that have a 10 percent probability of being exceeded in 50 years (475 year mean return interval), termed the operating basis earthquake (OBE). In addition, section 7.2.2 of NFPA 59A (2006) incorporated by reference in 49 CFR §193.2101, under Subpart C, require that LNG tanks and its impounding system be designed to have the ability to safely shutdown when subjected to earthquake ground motions which have a 2 percent probability of being exceeded in 50 years

(2,475 year mean return interval), termed the safe shutdown earthquake (SSE). USDOT PHMSA regulations in 49 CFR §193.2101, under Subpart C also incorporate by reference NFPA 59A (2001) Chapter 6, which require piping systems conveying flammable liquids and flammable gases with service temperatures below −20°F, be designed as required for seismic ground motions. If authorized, constructed, and operated, LNG facilities as defined in 49 CFR 193, would be subject to the USDOT PHMSA's inspection and enforcement programs.

In addition, FERC staff recognizes Jordan Cove would also need to address hazardous fluid piping with service temperatures at −20°F and higher and equipment other than piping, and LNG storage (shop built and field fabricated) containers. We also recognize the current FERC regulations under 18 CFR §380.12 (h) (5) continue to incorporate National Bureau of Standards Information Report (NBSIR) 84-2833. NBSIR 84-2833 provides guidance on classifying stationary storage containers and related safety equipment as Category I and classifying the remainder of the LNG project structures, systems, and components as either Category II or Category III, but does not provide specific guidance for the seismic design requirements for them. Absent any other regulatory requirements, this guidance recommends that other LNG project structures classified as Seismic Category II or Category III be seismically designed to satisfy the Design Earthquake (DE) and seismic requirements of the ASCE 7-05 in order to demonstrate there is not a significant impact on the safety of the public. ASCE 7-05 is recommended as it is a complete American National Standards Institute (ANSI) consensus design standard, its seismic requirements are based directly on the National Earthquake Hazards Reduction Program (NEHRP) Recommended Provisions, and it is referenced directly by the IBC. Having a link directly to the IBC and ASCE 7 is important to accommodate seals by the engineer of record because the IBC is directly linked to state professional licensing laws while the NEHRP Recommended Provisions are not.

The geotechnical investigations of the existing site performed by KBJ indicate the site class was determined in accordance with ASCE 7-05, ASCE 7-10, and the 2014 edition of the OSSC (Oregon Structural Special Specialty Code) in the Geotechnical Report (KBJ, 2017) using the shear wave velocity measurements form the downhole P-S suspension logging and cross hole seismic logging. The average shearwave velocity in the upper 100 feet (30 meters), VS30 of 697.5 to 783 feet per second, at two of the three locations at the LNG storage tanks. The shear wave velocity measurement at the one location indicated Seismic Site Class E (VS30 of 480.9 feet per second); however, all the locations would be Seismic Site Class D after ground improvement to mitigate liquefiable soils. Seismic Site Class D is valid once liquefiable soils at the site have been mitigated to eliminate Seismic Site Class F conditions (KBJ, 2017). This is in accordance with ASCE 7-05, which is incorporated directly into 49 CFR 193 for shop fabricated containers less than 70,000 gallons and via NFPA 59A (2006) for field fabricated containers.[253] This is also in accordance with IBC (2006). Sites with soil conditions of this type would experience significant amplifications of surface earthquake ground motions at longer periods. Due to the presence of the CSZ (dips under the site) the seismic risk to the site is considered high. As a result of the high seismic risk and in accordance with NBSIR 84-2833, we recommend a special inspector be

[253] There are six different site classes in ASCE 7-05, A through F, that are representative of different soil conditions that impact the ground motions and potential hazard ranging from Hard Rock (Site Class A), Rock (Site Class B), Very dense soil and soft rock (Site Class C), Stiff Soil (Site Class D), Soft Clay Soil (Site Class E), to soils vulnerable to potential failure or collapse, such as liquefiable soils, quick and highly sensitive clays, and collapsible weakly cemented soils (Site Class F).

provided to inspect construction of the Project facilities and that reports on the construction and inspection of the Project be generated and submitted to FERC for review.

NFPA 59A (2006) section 7.2.2.1, incorporated by reference in 49 CFR §193.2101(b), under Subpart C, requires a site-specific investigation for all installations, except shop-built containers, to determine the characteristics of seismic ground motion and associated response spectra. KBJ performed a site-specific seismic hazard study for the site. The study concluded that the site would have a Horizontal Operating Basis Earthquake (OBE) peak spectral ground acceleration at 0.2 s-period of 0.857 g, and a Horizontal Safe Shutdown Earthquake (SSE) peak spectral ground acceleration at 0.2 s-period of 1.537 g based on improved site conditions. The OBE has a 10% probability of being exceed in 50 years (475 year mean return interval) while the SSE has a 2% chance of being exceeded in 50 years (2,475 year mean return interval). The study also provided the site-specific Design Earthquake (DE) values S_{DS} and S_{D1} of 1.025 g and 1.002 g, respectively. KBJ also developed the Vertical response spectra using the horizontal response spectra and vertical-to-horizontal (V/H) ratios and indicated the V/H ratios are not less than ½ for the Project. FERC staff independently evaluated the OBE PGA, SSE PGA, 0.2-second design spectral acceleration, and 1.0-second design spectral accelerations for the site using the Applied Technology Council (ATC) and USGS Earthquake Hazards Program Seismic Design Maps[254] and Unified Hazard[255] tools for all occupancy categories (I through IV). Based on the ATC and USGS tools, FERC found the OBE and SSE peak spectral accelerations at 0.2 s-period for the site based on Site Class D to equal 0.722 g and 1.694 g, respectively. The OBE and SSE that Jordan Cove provided are about 80 percent of the values from the ATC/USGS websites which would be acceptable for site specific values.

ASCE 7-05 also requires determination of the Seismic Design Category based on the Occupancy Category (or Risk Category in ASCE 7-10 and 7-16) and severity of the earthquake design motion. The Occupancy Category (or Risk Category) is based on the importance of the facility and the risk it poses to the public.[256] FERC staff has identified the Project as a Seismic Design Category E based on the ground motions for the site for Occupancy Category (or Risk Category) of I, II or III structures, and Seismic Design Category F for Occupancy Category IV structures. This seismic design categorization would be consistent with the IBC (2006) and ASCE 7-05 (and ASCE 7-10).

Seismic events can also result in soil liquefaction in which saturated, non-cohesive soils temporarily lose their strength/cohesion and liquefy (i.e., behave like viscous liquid) as a result of

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[254] USGS, Changes to U.S. Seismic Design Maps Web Tools, https://earthquake.usgs.gov/designmaps/us/application.php, accessed December 2018.

[255] USGS, Unified Hazards Tool, https://earthquake.usgs.gov/hazards/interactive/, accessed Dec 2018.

[256] ASCE 7-05 defines Occupancy Categories I, II, III, and IV. Occupancy Category I represents facilities with a low hazard to human life in even of failure, such as agricultural facilities; Occupancy Category III represents facilities with a substantial hazard to human life in the event of failure or with a substantial economic impact or disruption of day to day civilian life in the event of failure, such as buildings where more than 300 people aggregate, daycare facilities with facilities greater than 150, schools with capacities greater than 250 for elementary and secondary and greater than 500 for colleges, health care facilities with 50 or more patients, jails and detention facilities, power generating stations, water treatment facilities, telecommunication centers, hazardous facilities that could impact public; Occupancy Category IV represents essential facilities, such as hospitals, fire, rescue, and police stations, emergency shelters, power generating stations and utilities needed in an emergency, aviation control towers, water storage and pump structures for fire suppression, national defense facilities, and hazardous facilities that could substantially impact public; and Occupancy Category II represents all other facilities. ASCE 7-10 changed the term to Risk Categories I, II, III, and IV with some modification.

increased pore pressure and reduced effective stress when subjected to dynamic forces such as intense and prolonged ground shaking. Areas susceptible to liquefaction may include saturated soils that are generally sandy or silty. Typically, these soils are located along rivers, streams, lakes, and shorelines or in areas with shallow groundwater. The site-specific seismic study indicates liquefiable soils are present throughout the Project site, and their depths vary with the location. The liquefiable soils at Ingram Yards area and the Access and Utility Corridor have a maximum of approximately EL −30 feet NAVD 88. At the LNG terminal and the Access and Utility Corridor, the liquefiable layers are predicted to extend below the dunes present on the site. At the South Dunes Area, liquefaction is estimated in a soil zone that starts at the groundwater table and extends to variable depths from EL 0 feet to approximately EL −25 feet NAVD 88. Jordan Cove indicated that a detailed review of the potential methods of soil improvement has been undertaken, and a number of these proven methods could be employed for the Project, depending on the results of the final site investigations planned. Those methods are: vibro-compaction; sand compaction; dry excavation and removal; wet excavation and removal and soil mixing. Jordan Cove has indicated that the LNG facilities at the site would be constructed on either a site improved with deep soil mixing or in some cases deep foundations, which would mitigate any potential impacts of soil liquefaction to minimize or eliminate any effects soil liquefaction. Also to counteract associated lateral spreading effects at the marine facilities, Jordan Cove has elected to install a permanent sheet pile wall in combination with improved soils for the LNG marine vessel berth.

Seismic events in waterbodies can also cause tsunamis or seiches by sudden displacement of the sea floors in the ocean or standing water. Tsunamis and seiche may also be generated from volcanic eruptions or landslides. Tsunami wave action can cause extensive damage to coastal regions and facilities. The west coast of the United States has historically been subject to minor inundation from tsunamis generated by distant earthquakes in South America, Alaska, and Japan. Kelsey et al. (2005) note that tsunamis generated from these distant subduction zone earthquakes have minor inundation effects because of the long diagonal approach of tsunami waves to the west coast form these sources. In addition, northern California, Oregon, and Washington have been subjected to large tsunamis from CSZ megathrust earthquakes, with the last one occurring approximately in the year 1700. Jordan Cove conducted hydrodynamic and tsunami modeling studies for the Project site and indicated a tsunami generated by a megathrust earthquake on the CSZ would present the greatest tsunami inundation risk at the project site and the maximum design tsunami run-up elevation for the project site is no greater than 34.5 feet NAVD 88 including co-seismic subsidence and sea level rise effects. Jordan Cove proposes to construct most structures above the elevation +46 feet NAVD 88, which would minimize impacts associated with potential storm surges and tsunamis. The co-seismic subsidence information indicates that the largest coastal subsidence, of 3 to 6 feet, occurred in northern Oregon and southern Washington, with subsidence ranging from 0 to 3 feet elsewhere. Leonard et al. (2004) estimated an average of 2 feet of co-seismic subsidence occurred in the Coos Bay area during the 1700 earthquake. For the Project site and in accordance with more recent tsunami modeling completed for the Southern Oregon Coast (Witter et al. 2011), the estimated subsidence would be on the order of 7.6 feet. Jordan Cove indicated that the Project would be designed to mitigate inundation due to the design tsunami and the design tsunami run-up elevations are established including an allowance for subsidence. In addition, Jordan Cove indicated the design tsunami run-up elevations have been determined in conjunction with a mean high water tide. Jordan Cove also indicated that furthermore tsunami protection berms, safety critical elements of the facility, point of support elevations, invert levels and underside of essential equipment, would be at least 1 foot above the estimated maximum run-up elevation and most will be far above that elevation. The criteria used to evaluate tsunami wave heights it based on new requirements provided in ASCE 7-16 which indicates that Maximum Considered Tsunami (MCT) events should use the same maximum earthquake criteria as used to determine Maximum Consider Ground Motions (and SSE ground motions). FERC staff worked with NOAA who helped developed Tsunami maps for ASCE 7-16 and NOAA determined that inundation elevations from the MCT event for the Jordan Cove LNG Project site were consistent with those determined by Jordan Cove. Therefore, FERC staff agrees that the tsunami elevations that Jordan Cove provided are suitable for the Project site.

Hurricanes, Tornadoes, and other Meteorological Events

Hurricanes, tornadoes, and other meteorological events have the potential to cause damage or failure of facilities due to high winds and floods, including failures from flying or floating debris. To assess the potential impact from hurricanes, tornadoes, and other meteorological events, Jordan Cove evaluated such events historically. The severity of these events are often determined on the probability that they occur and are sometimes referred to as the average number years that the event is expected to re-occur, or in terms of its mean return/recurrence interval.

Because of its location, the Project site would not likely be subject to hurricane force winds during the life of the Project, however, strong extratropical cyclones (baroclinic, cold core systems are common in the region. These storms are capable of producing winds of hurricane force, and as such, Jordan Cove has indicated that the project site would be designed to withstand strong wind events. However, because wind speeds at the Project location are considerably less than those that occur in the Gulf Coast east region and the east coast of the US, Jordan Cove stated that the wind load combinations specified in Chapter 2 of ASCE 7-10 should be used. Jordan Cove stated that the design wind speed using ASCE 7-10 Load and Resistance Factor Design (LRFD) and Allowable Stress Design (ASD) for LNG facilities and hazardous structures, which would be categorized as Risk Category III and IV (Occupancy Category in ASCE 7-05).

Jordan Cove hired Cermak Peterka Peterson (CPP) to perform a site specific wind speed assessment for this Project. CPP determined 127 mph 3-second gust as the Design Wind Speed (3-second gust, 33 feet, Exposure category C). The 127 mph 3-second gust was determined based on the criteria specified in 49 CFR §193.2067(b)(2)(ii), under Subpart B and ASCE 7 based on a 10,000 year mean return interval, or a 0.5 percent probability of occurrence within a 50-year period for the site. CPP stated that the 127 mph wind speed is a strength level speed corresponding directly to the mean recurrence interval (MRI) criteria. The 127 mph 3-second gust converts to a sustained wind speed of approximately 102 mph. When using this wind speed with ASCE 7-05 load combinations, the value should be reduced by a factor of square root of 1.6 or the design wind pressure reduced by a factor of 1.6 in order to achieve the desired 10,000-year MRI. When using the 127 mph wind speed with ASCE 7-10 load combinations, no additional factors are required. In both cases, the wind importance factor is not applicable due to the wind speed directly corresponding with the required return period. The 127 mph 3-second gust equates to a strong Category 2 Hurricane using the Saffir-Simpson scale (96 to 110 mph sustained winds, 117 to 140 mph 3-second gusts). FERC staff found that when reviewing Figure 6-1A of ASCE 7-05, the Project location would be closest to the 90 mph 3-second gust isocontour in the special wind region area. Because the Project site is located within a special wind region, FERC staff did not utilize the ATC hazard tool, but instead utilized the ASCE 7 hazard tool, which provides the 3-second gust at a height of 33 feet above ground level and Exposure Category C. For the Project site, the

ASCE 7-10 3-second gust wind speed at 33 feet above ground for Exposure C is observed to be 115 mph, also, it is basic wind speed for Occupancy Category III and IV building and other structures, which corresponds to a 1,700 mean recurrence interval and 3 percent probability of exceedance in 50 years. Using a 50 MRI, a 10,000-year MRI can be extrapolated to equal approximately 127 mph 3-second gust. Jordan Cove confirmed that all facilities, including those containing LNG or other hazardous fluids (and associated safety systems), would be designed for wind loads specified in Chapters 26 through 31 of ASCE 7-10 using the wind speed in accordance with 49 CFR §193.2067 (b)(2)(ii). For consistency and simplicity, Jordan Cove confirmed to use a single conservative Exposure Category D for all wind design regardless of physical location within the facility. Jordan Cove's final wind speed design 127 mph 3-second gust, at 33 feet above ground, Exposure Category D is more conservative than CPP suggested 127 mph 3-second gust, at 33 feet above ground, Exposure Category C.

Jordan Cove must meet 49 CFR §193.2067, under Subpart B for wind load requirements for LNG facilities. In accordance with the MOU, the USDOT PHMSA evaluated in its LOD whether the Applicant's proposed Project meets the USDOT PHMSA requirements under Subpart B. However, in response to a draft EIS recommendation, USDOT PHMSA has indicated that structures that do not fall under the definition of LNG facilities in 49 CFR 193 would not be subject to the design wind speed requirements in 49 CFR §193.2067, under Subpart B. As a result, we recommend in section 4.13.1.6 that Jordan Cove specify facilities that are not covered by USDOT PHMSA's LOD to be designed to withstand basic wind speeds in accordance with ASCE 7-16 based on the appropriate Risk Category. If the Project is authorized, constructed, and operated, the facilities would be subject to the USDOT PHMSA's inspection and enforcement programs. Final determination of whether the facilities are in compliance with the requirements of 49 CFR 193 Subpart B would be made by the USDOT PHMSA staff.

In addition, as noted in the limitation of ASCE 7-05 section 6.5.4.3 and ASCE 7-10 section 26.5.4, tornadoes were not considered in developing basic wind speed distributions. This leaves a potential gap in potential impacts from tornadoes. Therefore, FERC staff evaluated the potential for tornadoes. Appendix C of ASCE 7-05 makes reference to American Nuclear Society 2.3 (1983 edition), *Standard for Estimating Tornado and Extreme Wind Characteristics at Nuclear Power Sites*. This document has since been revised in 2011 and reaffirmed in 2016 and is consistent with NUREG/CR-4461, *Tornado Climatology of the Contiguous U.S.*, Rev. 2 (NUREG 2007). These documents provide maps of a 100,000 mean year return period for tornadoes using 2 degree latitude and longitude boxes in the region to estimate a tornado impacting a structure with a 200 foot characteristic length. Figures 5-8 and 8-1 from NUREG/CR-4461 indicate a 100,000 year maximum tornado wind speeds would be less than 65 mph 3-second gusts for the Project site location. Later editions of ASCE 7 (ASCE 7-10 and ASCE 7-16) make reference to International Code Council (ICC) 500, *Standard for Design and Construction of Storm Shelters*, for 10,000 year tornadoes. However, the ICC 500 maps were conservatively developed based on tornadoes striking regions and indicate a 130 mph 3-second gust for a 10,000 year event, which is higher than the 65 mph 3-second gust in American Nuclear Society 2.3 and NUREG/CR-4461. As a result, we conclude the use of an equivalent 127 mph 3-second gust, at 33 feet above ground, Exposure Category D, is adequate for the LNG storage tanks and conservative from a risk standpoint for the other LNG and hazardous facilities. USDOT PHMSA provided a LOD on the Project's compliance with 49 CFR 193 Subpart B in regard to wind speed. This determination was provided to the Commission as further consideration to the Commission on its decision to authorize or deny the Project.

The USDOT PHMSA regulations in 49 CFR §193.2067, under Subpart B would require the impounding system for the LNG storage tanks to withstand impact forces from wind borne missiles. ASCE 7 also recognizes the facility would be in a wind borne debris region. Wind borne debris has the potential to perforate equipment and the LNG storage tanks if not properly designed to withstand such impacts. The potential impact is dependent on the equivalent projectile wind speed, characteristics of projectile, and methodology or model used to determine whether penetration or perforation would occur. However, no criteria are provided in 49 CFR 193 or ASCE 7 for these specific parameters. NFPA 59A (2016) recommends Comite Euro-International du Beton (CEB) 187 be used to determine projectile perforation depths. In order to address the potential impact, we recommend in section 4.13.1.6 that Jordan Cove provide a projectile analysis for review and approval to demonstrate that the outer concrete impoundment wall of a full-containment LNG tank could withstand wind borne projectiles prior to construction of the final design. The analysis should detail the projectile speeds and characteristics and method used to determine penetration or perforation depths. FERC staff would compare the analysis and specified projectiles and speeds using established methods, such as CEB 187, and DOE and Nuclear Regulatory Commission (NRC) guidance.

In addition, FERC staff evaluated historical tropical storm, hurricane, and tornado tracks in the vicinity of the project facilities using data from the Department of Homeland Security (DHS) Homeland Infrastructure Foundation Level Data (HILFD) and NOAA Historical Hurricane Tracker.[257,258] Since 1900, there is no historical storm or hurricane that has been reported within 65 nautical miles of the LNG terminal site. Hurricanes do not occur near the LNG terminal site as the environment does not support these barotropic, warm core systems. Since 1950, there is no historical tornado event that has been reported within 10 nautical miles of the LNG terminal site. Although tropical cyclones do not occur at the Project site, extreme storms offshore sometimes cause the water level along the coastline to raise significantly beyond the normal tide levels. This phenomenon is referred to as storm surge. Jordan Cove performed a study in accordance with the FEMA flood insurance studies and indicated the flooding at the project site for the 500-year event including storm surge to be +12.6 feet NAVD 88 at Ingram Yard and +12.8 feet NAVD 88 at South Dunes. The LNG Terminal site elevations of all above ground facilities are higher than the maximum coastal flooding elevations estimated. FERC staff agrees that storm surge and tsunami would not need to be considered simultaneously.

Potential flood levels may also be informed from the FEMA Flood Insurance Rate Maps, which identify Special Flood Hazard Areas (base flood) that have a 1 percent probability of exceedance in 1 year to flood (or a 100 year mean return interval) and moderate flood hazard areas that have a 0.2 percent probability of exceedance in 1 year to flood (or a 500 year mean return interval). According to the FEMA National Flood Hazard Layer, portions of the Project would be located in the 100-year floodplain. In addition, according to FEMA flood hazard maps (2018), the 100-year flood elevation at the site is between +12.2 feet to +12.8 feet NAVD 88 and the 500-year flood elevation is between +12.4 feet to +13 feet NAVD 88. We recognize that a 500 year flood event has been recommended as the basis of design for critical infrastructure in publications, including ASCE 24, Flood Resistant Design and Construction. Therefore, it is our opinion that it is good

257 DHS, Homeland Infrastructure Foundation Level Data, https://hifld-geoplatform.opendata.arcgis.com/, August 2018.

258 NOAA, Historical Hurricane Tracker, https://coast.noaa.gov/hurricanes/, August 2018.

practice to design critical energy infrastructure to withstand 500-year event from a safety and reliability standpoint for the still water elevation (SWEL) with a 500-year wave crests and relative sea level rise and subsidence. Furthermore, we determined the use of intermediate values from NOAA for sea level rise and subsidence is more appropriate for design and higher projections are more appropriate for planning in accordance with NOAA (2017)[259] which recommends defining a central estimate or mid-range scenario as baseline for shorter-term planning, such as setting initial adaptation plans for the next two decades and defining upper bound scenarios as a guide for long-term adaptation strategies and a general planning envelope.

Jordan Cove proposes to construct most structures above the elevation +46 feet NAVD 88 which would minimize impacts associated with potential storm surges. Exceptions include the LNG storage tanks and water-dependent facilities such as the marine terminal and Material Offloading Facility (MOF). The LNG storage tank base would have an elevation of approximately +27 feet NAVD 88 would be surrounded by a tertiary protective berm with a crest elevation of no less than +46 feet NAVD 88. Jordan Cove indicated that the parts of the marine facilities that are normally occupied or operational would typically be at an elevation of +34.5 feet or greater, whereas normally unoccupied/non-operational parts of the marine facilities may be at a lower elevation. The Project site elevations of all aboveground facilities are higher than the maximum coastal flooding elevations estimated. Also, FERC staff evaluated the controlling wave height 4.12 feet for the project site in accordance with FEMA report (2018). In addition, we would expect an intermediate projected sea level rise and subsidence of 0.66 feet between 2020 and 2050 as provided by NOAA (2017). Adding the 500-year SWEL (13 feet), wave height (8.5 feet), relative sea level rise (0.66 feet), and subsidence results in a total elevation of 22.16 feet. As a result, we conclude that the facility would be able to withstand storm surge without damage during a 500-year storm event.

Shoreline erosion could occur at the Project site and along the opposite shoreline as a result of waves, currents, and vessel wakes. Jordan Cove stated that the Project basin shoreline would be protected from scour and erosion using stone or a cement based rip rap. Even though shoreline erosion is a concern at the site, the proposed mitigation measures would minimize erosion and scour impacts.

FERC staff evaluated the basis of design for the Project relating to withstanding rain, ice, and snow events. To handle the rain the area receives, Jordan Cove stated that the roofs of permanent structures to be located onsite would be designed to preclude instability resulting from ponding effects by ensuring adequate primary and secondary drainage systems, slope, and member stiffness. Jordan Cove discussed the ice load design for the Project and stated the ice load is not applicable for the Project site and design ice thickness is 0 inches in accordance with ASCE 7-10 and climatological studies. The coastal location of this Project also impacts the amount of snow the area receives. Jordan Cove states that the snow design for this Project was based on ASCE 7-10 design maps and the 2014 OSSC. Jordan Cove indicated the snow load design bases for this Project are 5 pounds per square foot (psf) for ground snow load and 20 psf for the roof snow load.

[259] Global And Regional Sea Level Rise Scenarios for the United States, U.S. Department Of Commerce, National Ocean and Atmospheric Administration, National Ocean Service Center for Operational Oceanographic Products and Services, January 2017.

Landslides and other Natural Hazards

Landslides in the United States occur in all 50 states. The primary regions of landslide occurrence and potential are the coastal and mountainous areas of California, Oregon, and Washington, the states comprising the intermountain west, and the mountainous and hilly regions of the eastern United States. Jordan Cove evaluated the type and occurrence of landslides in the vicinity of the Project site and indicated that no landslide deposits were identified within the Project area. There is a moderate to high landslide susceptibility hazard on the dune ridges at the Project site; however, active landslides have not been identified on the sand dunes. The high susceptibility at the Project site is primarily based on the steep slopes of the dune deposits. Jordan Cove states that they would regrade the steep dunes thereby eliminating potential landslide hazards related to dune sand stability. The potential for tsunamis associated with submarine landslides is more likely a source in the CSZ. Jordan Cove evaluated the type and occurrence of landslides for the Project area and indicated that no landslides deposits were identified with the Project site. A moderate to high landslide susceptibility hazard is mapped on the dune ridges at the Project site; however, active landslides have not been identified on the sand dunes. The high susceptibility indicated at the Project site is primarily based on the steep slopes of the dune deposits. Jordan Cove would regrade the steep dunes thereby eliminating potential landslide hazards related to dune sand stability.

Volcanic activity is primarily a concern along plate boundaries on the West Coast and Alaska and also Hawaii. Based on FERC staff review of maps from USGS[260] and DHS[261] and Jordan Cove report: the Cascade Mountain Range is the volcanic arc complex of the CSZ and is located approximately 100 miles east of the Project site. Volcanoes of the Cascade Mountains are found from northern California to British Columbia. The nearest Cascade Volcano is the Crater Lake caldera that was formed during the eruption and collapse of Mount Mazama approximately 7,700 years ago. The Project site would not be directly affected by the various types of volcanic eruption hazards due to the distance of the hazards, the upwind location of the Project site from the volcanic hazard, and the low likelihood of both substantial and proximal volcanic events during the lifetime of the Project.

The west coast is often associated with the potential for wildfires. According to the Oregon Department of Forestry (ODF), have been a number of fires that have occurred within 100 miles of the Jordan Cove site, however, none of these fires occurred in the immediate proximity of Coos Bay. In addition, Jordan Cove site is surrounded by water on the southern and eastern side, separating the site from the more forested areas to the east of the site. As such, it is unlikely that a wildfire would occur at the Project site. Additionally, Jordan Cove indicated that the plans for how to handle fires are provided in the Emergency Response Plan that has been developed for the site.

Geomagnetic disturbances (GMDs) may occur due to solar flares or other natural events with varying frequencies that can cause geomagnetically induced currents, which can disrupt the operation of transformers and other electrical equipment. USGS provides a map of GMD

[260] United States Geological Survey, U.S. Volcanoes and Current Activity Alerts, https://volcanoes.usgs.gov/index.html, accessed Aug 2018.
[261] Department of Homeland Security, Homeland Infrastructure, Foundation-Level data (HIFLD), Natural Hazards, hifld-geoplatform.opendata.arcgis.com, accessed Aug 2018

intensities with an estimated 100 year mean return interval.[262] The map indicates the Jordan Cove site could experience GMD intensities of 400 nano-Tesla (nT) with a 100 year mean return interval. However, Jordan Cove would be designed such that if a loss of power were to occur the valves would move into a fail-safe position. In addition, Jordan Cove is an export facility that does not serve any U.S. customers.

External Impact Review

To assess the potential impact from external events, FERC staff conducted a series of reviews to evaluate transportation routes, land use, and activities within the facility and surrounding the LNG terminal site, and the safeguards in place to mitigate the risk from events, where warranted. FERC staff coordinated the results of the reviews with other federal agencies to assess potential impacts from vehicles and rail; aircraft impacts on and from nearby airports and heliports; pipeline impacts from nearby pipelines; impacts on and from adjacent facilities that handle hazardous materials under the EPA's Risk Management Plan regulations and power plants, including nuclear facilities under the Nuclear Regulatory Commission's regulations. Specific mitigation of impacts from use of external roadways, rail, helipads, airstrips, or pipelines are also considered as part of the engineering review done in conjunction with the NEPA review.

FERC staff uses a risk-based approach to assess the potential impact of the external events and the adequacy of the mitigation measures. The risk-based approach uses data based on the frequency of events that could lead to an impact and the potential severity of consequences posed to the LNG terminal site and the resulting consequences to the public beyond the initiating events. The frequency data is based on past incidents and the consequences are based on past incidents and/or hazard modeling of potential failures.

Road

FERC staff reviewed whether any truck operations would be associated with the project and whether any existing roads would be located near the site. FERC staff uses this information to evaluate whether the project and any associated truck operations could increase the risk along the roadways and subsequently to the public and whether any pre-existing unassociated vehicular traffic could adversely increase the risk to a project site and subsequently increase the risk to the public. In addition, if authorized, constructed, and operated, LNG facilities as defined in 49 CFR 193, must comply with the requirements of 49 CFR 193 and would be subject to the USDOT PHMSA's inspection and enforcement programs. USDOT PHMSA regulations under 49 CFR §193.2155 (a) (5) (ii), under Subpart C require that structural members of an impoundment system must be designed and constructed to prevent impairment of the system's performance reliability and structural integrity as a result of a collision by or explosion of a tank truck that could reasonably be expected to cause the most severe loading if the liquefaction facility adjoins the right-of-way of any highway. Similarly, NFPA 59A (2001), section 8.5.4, requires transfer piping, pumps, and compressors to be located or protected by barriers so that they are safe from damage by rail or vehicle movements. However, the USDOT PHMSA regulations and NFPA 59A (2001) requirements do not indicate what collision(s) or explosion(s) could reasonably be expected to

[262] United States Geological Survey, Magnetic Anomaly Maps and Data for North America, https://mrdata.usgs.gov/magnetic/map-us.html#home, accessed Aug 2018.

cause the most severe loading. FERC staff evaluated consequence and frequency data from these events to evaluate these potential impacts.

FERC staff evaluated the risk of the truck operations based on the consequences from a release, incident data from the USDOT Federal Highway Administration (FHWA)[263], USDOT National Highway Traffic Safety Administration (NHTSA)[264], USDOT PHMSA[265], EPA, NOAA[266], and other reports[267,268,269], and frequency of trucks and proposed mitigation to prevent or reduce the impacts of a vehicular incident.

Incident data from USDOT FHWA, USDOT NHTSA, and USDOT PHMSA indicate hazardous material incidents are very infrequent (4e-3 incidents per lane mile per year) and nearly 75 to 80 percent of hazardous material vehicular incidents occur during unloading and loading operations while the other 20 to 25 percent occur while in transit or in transit storage. In addition, approximately 99 percent of releases are 1,000 gallons or less and catastrophic events that would spill 10,000 gallons or more make up less than 0.1 percent of releases. In addition, less than 1 percent of all reportable hazardous material incidents with spillage result in injuries and less than 0.1 percent of all reportable hazardous material incidents with spillage result in fatalities.

The EPA and NOAA report that 80 percent of fires that lead to container ruptures results in projectiles and that 80 percent of projectiles from liquefied petroleum gas (LPG) incidents, which constitute the largest product involved in BLEVEs, travel less than 660 feet. The EPA also reports that on average container ruptures would result in less than four projectiles for cylindrical containers and 8.3 for spherical vessels. FERC staff evaluated other reports that affirmed the EPA estimates based on data for approximately 150 experimental and accidental pressure vessel bursts (PVBs) and BLEVEs with approximately 683 total projectiles (4.6 average fragments per incident) that showed approximately 80 percent of fragments traveled 490 to 820 feet and within 6.25 times the estimated or observed fireball radius. The data also showed projectiles have traveled up to 3,900 feet for large LPG vessels and 1,200 feet for LPG rail cars. In all the documented cases, the projectiles traveled less than 15 times the fireball diameter, but one of the reports indicated up to 30 times the fireball diameter is possible albeit very rare.

Unmitigated consequences under average ambient conditions from releases of 1,000 gallons through a 1-inch hole would result in distances ranging from 25 to 200 feet for flammable vapor dispersion, and 75 to 175 feet for jet fires. Unmitigated consequences under worst case weather conditions from catastrophic failures of trucks proposed at the site generally can range from 200 to 2,000 feet for flammable vapor dispersion, 275 to 350 feet for radiant heat of 5 kW/m^2 from jet

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263 USDOT FHWA, Office of Highway Policy Information, *Highway Statistics 2016*, https://www.fhwa.dot.gov/policyinformation/statistics/2016/, accessed March 2019.

264 USDOT NHTSA, *Traffic Safety Facts Annual Report Tables*, https://cdan.nhtsa.gov/tsftables/tsfar.htm, accessed March 2019.

265 USDOT PHMSA, Office of Hazardous Material Safety, *Incident Reports Database Search*, https://hazmatonline.phmsa.dot.gov/IncidentReportsSearch/Welcome.aspx, accessed March 2019.

266 U.S. Environmental Protection Agency and National Oceanic and Atmospheric Administration, ALOHA®: User's Manual, The CAMEO® Software System, February 2007.

267 Birk, A.M., BLEVE Response and Prevention Technical Documentation, 1995.

268 American Institute of Chemical Engineers, Center for Chemical Process Safety, Guidelines for Vapor Cloud Explosion, Pressure Vessel Burst, BLEVE, and Flash Fire Hazards, Second Edition, 2010.

269 Lees, F.P, Lees' Loss Prevention in the Process Industries: Hazard Identification, Assessment, and Control, Volume 2, Second Edition, 1996.

fires, 800 to 1,050 feet to a 1 psi overpressure from a BLEVE, 850 to 1,500 feet for a heat dose equivalent to a radiant heat of 5 kW/m^2 over 40 seconds from 250 to 325 feet radii fireballs burning for 5 to 15 seconds from a BLEVE, and projectiles from BLEVEs possibly extending farther. Based on distribution function of the projectile distances, FERC staff estimate approximately 90 percent of all projectiles for a 10,000-gallon tanker truck would be within 0.5 mile and there is approximately a 1 percent probability they would extend beyond 1 mile and less than 0.1 percent probability they would extend 30 times the fireball diameter. These values are also close to the distances provided by the USDOT FHWA for designating hazardous material trucking routes (0.5 mile for flammable gases for potential impact distance) and USDOT PHMSA for emergency response (0.5 to 1 mile for initial evacuation and 1 mile for potential BLEVEs for flammable gases).

During startup and operation of the project, Jordan Cove estimates 22 refrigerant make-up trucks, 8 amine trucks, 4 nitrogen trucks, 160 aqueous ammonia trucks, and 28 diesel trucks would be needed at the site annually. The most frequent truck deliveries would occur during commissioning and startup activity at the site and would deliver refrigerants to load the liquefaction trains. Between 15 and 20 trucks are expected over an approximately 2 week timeframe to load each liquefaction train. The refrigerant deliveries would be repeated for the startup of each subsequent liquefaction train. Jordan Cove does not plan to utilize any trucks to deliver LNG. The Transpacific Parkway, which connects to State Highway (SH) 101 is located directly to the north of the facility property and would be used to access the Jordan Cove Project site. The Transpacific Parkway is a two lane bi-directional route with a 45 mph speed limit. Jordan Cove provided a Road Safety and Reliability Impact Study (RSRIS). The RSRIS addresses potential safety and reliability impacts of proposed tanker trucks loaded or unloaded at the LNG terminal, and from commercial and recreational roadway traffic along the Transpacific Parkway. The separation distance between the Transpacific Parkway and the Project facilities that would contain hazardous fluids would be greater than 300 feet which would exceed the distances estimated for flammable vapor dispersion and radiant heat from an LNG truck 1-inch hole release. In addition, the Project would install an 80-feet tall impervious barrier that would separate the Transpacific Parkway and the process equipment located in the Ingram Yards area. FERC staff did not identify any other major highways or roads within close proximity to piping or equipment containing hazardous materials at the site that would not be protected by this separation distance and 80-feet tall barrier to raise concerns of direct impacts from a vehicle impacting the site.

Therefore, we conclude that the Project would not pose a significant risk or significant increase in risk to the public due to vehicle impacts as a result of the potential consequences, incident data, frequency of trucks, proposed mitigation by Jordan Cove, and additional mitigation measures proposed by FERC staff.

Rail

FERC staff reviewed whether any rail operations would be associated with the Project and whether any existing rail lines would be located near the site. FERC staff uses this information to evaluate whether the Project and any associated rail operations could increase the risk along the rail line and subsequently to the public and whether any pre-existing unassociated rail operations could adversely increase the risk to the Jordan Cove site and subsequently increase the risk to the public. In addition, if authorized, constructed, and operated, LNG facilities as defined in 49 CFR 193, must comply with the requirements of 49 CFR 193 and would be subject to the USDOT PHMSA's inspection and enforcement programs. The USDOT PHMSA regulations under 49 CFR §193.2155 (a) (5) (ii), under Subpart C state that if the LNG facility adjoins the right-of-way of any railroad, the structural members of an impoundment system must be designed and constructed to prevent impairment of the system's performance reliability and structural integrity as a result of a collision by or explosion of a train or tank car that could reasonably be expected to cause the most severe loading.

Section 8.5.4 of NFPA 59A (2001), incorporated by reference in 49 CFR 193, requires transfer piping, pumps, and compressors to be located or protected by barriers so that they are safe from damage by rail or vehicle movements. However, the USDOT PHMSA regulations and NFPA 59A (2001) requirements do not indicate what collision(s) or explosion(s) could reasonably be expected to cause the most severe loading. Therefore, FERC staff evaluated consequence and frequency data from these events to evaluate these potential impacts. FERC staff evaluated the risk of the rail operations based on the consequences from a release, incident data from the Federal Rail Administration (FRA) and PHMSA, and frequency of rail operations nearby Jordan Cove.

FERC staff evaluated the risk of the rail operations based on the consequences from a release, incident data from the USDOT Federal Railroad Administration (FRA) and USDOT PHMSA, and frequency of rail operations near the LNG Terminal site. Incident data from USDOT FRA and USDOT PHMSA indicates hazardous material incidents are very infrequent (6e-3 incidents per rail mile per year). In addition, approximately 95 percent of releases are 1,000 gallons or less, and catastrophic events that would spill 30,000 gallons or more make up less than 1 percent of releases. In addition, less than 1 percent of hazardous material incidents result in injuries and less than 0.1 percent of hazardous material incidents result in fatalities.

As previously discussed, the EPA and NOAA report that 80 percent of fires that lead to container ruptures results in projectiles and that 80 percent of projectiles from LPG incidents, which constitute the largest product involved in BLEVEs, travel less than 660 feet. The EPA also reports that on average container ruptures would result in less than four projectiles for cylindrical containers and 8.3 for spherical vessels. FERC staff evaluated other reports that affirmed the EPA estimates based on data for approximately 150 experimental and accidental PVBs and BLEVEs with approximately 683 total projectiles (4.6 average fragments per incident) that showed approximately 80 percent of fragments traveled 490 to 820 feet and within 6.25 times the estimated or observed fireball radius. The data also showed projectiles have traveled up to 3,900 feet for large LPG vessels and 1,200 feet for LPG rail cars. In all the documented cases, the projectiles traveled less than 15 times the fireball diameter, but one of the reports indicated up to 30 times the fireball diameter is possible albeit very rare.

Unmitigated consequences under average ambient conditions from releases of 1,000 gallons through a 1-inch hole would result in distances ranging from 25 to 200 feet for flammable vapor dispersion, and 75 to 175 feet for jet fires. Unmitigated consequences under worst-case weather conditions from catastrophic failures of rail cars containing various flammable products generally can range from 300 to 3,000 feet for flammable vapor dispersion, 450 to 575 feet for radiant heat of 5 kW/m^2 from jet fires, 1,225 to 1,500 feet to a 1 psi overpressure from a BLEVE, 1,250 to 2,100 feet for a heat dose equivalent to a radiant heat of 5 kW/m^2 over 40 seconds from 350 to 450 feet radii fireballs burning for 7 to 20 seconds from a BLEVE, and projectiles from BLEVEs possibly extending farther. Based on distribution function of the projectile distances, FERC staff estimate approximately 80 percent of all projectiles for a 30,000-gallon rail car would be within

0.5 mile and there is approximately a 5 percent probability they would extend beyond 1 mile and less than 0.1 percent probability they would extend 30 times the fireball diameter. These values are also close to the distances provided by USDOT PHMSA for emergency response (0.5 to 1 mile for initial evacuation and 1 mile for potential BLEVEs for flammable gases).

The closest rail line would be the Coos Bay Rail Line (CBRL) located directly to the north of the Project site. The CBRL is a single line railroad that provides delivery of forestry products (e.g., wood products, fertilizer, organic dairy feed) to the nearby Roseburg Forest Products Plant. The Project would install an 80-feet tall impervious barrier that would separate the CBRL and the process equipment. BakerRisk, Inc. performed a rail risk safety analysis and security risk assessment for Jordan Cove that evaluated the potential safety, security, and reliability impacts from the CBRL.

The closest Project facilities would be the ground flare approximately 60 feet from the rail line separated by a retaining wall, the closest auxiliary power generators and pretreatment facilities approximately 400 to 450 feet from the rail line, the closest LNG storage tank approximately 1,150 feet from the rail line, and the closest liquefaction train approximately 1,200 feet from the rail line. However the rail line would not transport pressurized or flammable hazard fluids. Therefore the rail road would not pose a vapor dispersion, fireball, jet fire, pool fire, BLEVE, or projectile hazard to the Project. In addition, Jordan Cove would coordinate with local emergency responders with regard to potential rail incidents. Due to the extremely low likelihood and mitigating actions, we conclude the Project would not pose a significant increase in risk to the public as a result of the proximity of the Project to the rail lines

In addition Jordan Cove would install a railroad construction spur within the plant boundaries that would be located approximately 750 feet east of the process equipment and anticipates to utilize the construction spur approximately 2 times every 3 years for maintenance. The Project would install a 100-feet tall impervious barrier that would separate the construction spur and the process equipment. If the Project is authorized, Jordan Cove would keep the construction spur in place to provide delivery of maintenance equipment, spare parts, and other oversized equipment that would be suited for rail transport. Based on the potential consequences, incident data, distance, and location of the CBRL as well as the anticipated frequency of railroad delivery via the construction spur, we conclude that the Project would not pose a significant increase in risk to the public as a result of the proximity of the Project to the rail lines.

Air

FERC staff reviewed whether the Project would require the use of any aircraft and whether any existing aircraft operations would be located near the LNG terminal site. FERC staff uses this information to evaluate whether the Project and any associated aircraft operations could increase the risk to the public, and whether any pre-existing unassociated aircraft operations could adversely increase the risk to the Project and subsequently increase the risk to the public. In addition, if authorized, constructed, and operated, LNG facilities as defined in 49 CFR 193, must comply with the requirements of 49 CFR 193 and would be subject to the USDOT PHMSA's inspection and enforcement programs. USDOT PHMSA regulations under 49 CFR §193.2155 (b), under Subpart C, require a LNG storage tank must not be located within a horizontal distance of one mile from the ends, or 0.25 miles from the nearest point of a runway, whichever is longer. In addition, the height of LNG structures in the vicinity of an airport must comply with USDOT

FAA requirements. In addition, FERC staff evaluated the risk of an aircraft impact from nearby airports.

Two mixed use aviation airports, Southwest Oregon Regional Airport and Lakeside Municipal Airport, would be located 0.7 mile southeast and 10.9 miles northeast of the LNG terminal site, respectively. The one general aviation airport is the Sunnyhill- North Bend Airport located 4.7 miles northeast of the LNG terminal site. The LNG storage tanks are located 1.19-1.29 miles away from the end of the closest runway and 1.08-1.19 miles from the nearest point of the closest runway, and therefore appears to satisfy part of the USDOT PHMSA regulations. The LNG marine vessels may approach closer to the runways, but are not subject to the USDOT PHMSA requirements.

USDOT PHMSA regulations also require compliance with USDOT FAA requirements. USDOT FAA regulations in 14 CFR 77 require Jordan Cove to provide a notice to the FAA of its proposed construction. This notification should identify all equipment that are more than 200 feet above ground level or lesser heights if the facilities are within 20,000 feet of an airport with its longest runway more than 3,200 feet (at 100:1 ratio) or within 10,000 feet of an airport with its longest runway no more than 3,200 feet (at 50:1 ratio) depending on length of runway) or within 5,000 feet of a helipad (at 25:1 ratio). In addition, mobile objects, including the LNG marine vessel that would be above the height of the highest mobile object that would normally traverse it would require notification to FAA.

The Project would include permanent structures that would be as close as approximately 4,400 feet to the nearest airport with a runway that exceeds 3,200 feet. given the proximity to the airport is within 20,000 feet, equipment taller than 44 feet (100:1 ratio) would exceed the height requirements200 feet. In addition, the LNG marine vessels along the transit route would be of a potential significant height relative to its proximity to the airport runways. Therefore, in accordance with the USDOT FAA regulations in 14 CFR 77, Jordan Cove submitted notice to the FAA. See section 4.10 for additional discussion regarding impacts to air navigation.

As discussed in the Jordan Cove Energy Project Final EIS under Docket Number CP13-483-000, two options were identified for mitigating the presumed hazards. One option would maintain the existing flight pattern and require additional lighting and markings on the LNG storage tanks and amine columns. Raising the altitude of planes would provide another level of safety. The other option would “flip” the flight patterns for Runway 04 from their current alignment as a left-handed pattern to the north of the airport that would fly over the Project site, to a right-handed pattern south of the airport that would avoid the terminal. However, the Southwest Oregon Regional Airport did not support the concept of flipping the flight patterns at Runway 04 because that would place aircraft over a populated area. Instead, the Southwest Oregon Regional Airport preferred marking the tanks and towers and stated that the Jordan Cove LNG terminal would not represent a substantial hazard to aircraft because:

- the existing floor of the airport’s traffic pattern is 1,000 feet AMSL and no aircraft flying in the pattern would have to change course or altitude to avoid any of the proposed structures;
- the amine towers are lower than surrounding structures, terrain, and surveyed trees. The LNG storage tanks are taller than the trees, but still lower than the McCullough Bridge located within the flight pattern area at 268 feet AMSL; and

- marked obstacles (including both structures and trees) are higher than the airport's elevation and require aircraft to operate at altitudes more than 500 feet above the amine towers and the LNG tanks and no current visual flight rules would have to change course or altitude to avoid the proposed structures.

However, since the USDOT FAA has not issued the final determination, the Project could significantly impact the operations of the Southwest Oregon Regional Airport.

Comments from the public indicated potential impacts on aircraft from the Project's proposed combustion equipment should be considered. Specifically, the hot exhaust generated in the gas combustion turbines would be emitted to the atmosphere via exhaust stacks and would result in a thermal plume above the proposed equipment. As this hot thermal plume rises into the atmosphere, it could encroach into an aircraft's flight path.

In addition, FERC staff used DOE Standard 3014, Accident Analysis for Aircraft Crash into Hazardous Facilities, which utilizes a 22-mile threshold radius around the hazardous facility for consideration of hazards posed by airport and heliport operations to the Project facilities. There are two mixed use airports (commercial, military, and general aviation), and one general aviation airport within the 22-mile radius. Per the DOE standard 3014, heliports need only be considered if there are local overflights associated with facility operations and/or area operations. The Project site does have a facility associated heliport in the South Dunes area that would be located approximately 1.2 miles east of processing areas. The heliport would support the Southwest Oregon Regional Safety Center and would generally be used for emergency response and annual exercises. In addition, the Project would install a 100-feet tall impervious barrier that would be located between the process equipment and the heliport. Based on the potential separation distance between the process equipment and the heliport as well as the anticipated limited use of the heliport, we conclude the impact risk due to heliport operations would not be significant.

Comments from the public and feedback from FAA indicated potential impacts on and from the Project and the nearby Southwest Oregon Regional Airport. FERC staff conducted internal analyses, and requested information from the Applicant on the likelihood and consequences from a potential aircraft impacting the Project and determined that the potential impact on the facility would be above the initial 3e-5 per year screening threshold identified for the process areas and the LNG storage tanks. The potential consequences of such an incident at the tank roof or in the process areas would likely result in a release and fire that would be within the existing hazard footprints already evaluated for a complete tank roof fire and full impoundment fire that is sized for the largest spill in the process area. However, depending on the location of impact and extent of damage, the potential fire hazard could extend beyond those evaluated from the LNG storage tank roof fire and the impoundment basin fires. Therefore, FERC staff evaluated whether the full containment walls would withstand aircraft impacts using established methods, such as CEB 187 and other publications. Based on this analysis, FERC staff determined that the full containment LNG storage tanks could withstand general aviation impacts without perforation of the outer tank wall from aircraft impacts that exceed frequencies of 3e-5 per year. However, FERC staff also determined that the LNG storage tanks may not withstand commercial aviation impacts without perforation of the outer tank wall from aircraft impacts. FERC staff calculated the frequency of an accident involving a commercial jet to be below the credible event threshold of 3e-5 per year, however, the calculation for the frequency is based on generic crash frequencies that do not take into account specific hazards to air navigation, such as those identified by the USDOT FAA aeronautical studies that presume a hazard to aircraft.

As discussed above, potential fire hazard distances from aircraft impacts on the LNG storage tank could extend beyond the property lines, however, these fire hazards would not impact the public. Therefore, we conclude that the Project would not pose a significant risk or increase risk to the public from aircraft impacts on either the LNG storage tanks or the process areas due to the potential consequences, incident data, and the distance and position of aircraft operations relative to the populated areas in the North Bend community.

Pipelines

FERC staff reviewed whether any pipeline operations would be associated with the Project and whether any existing pipelines would be located near the site. FERC staff uses this information to evaluate whether the Project and any associated pipeline operations could increase the risk to the pipeline facilities and subsequently to the public and whether any pre-existing unassociated pipeline operations could adversely increase the risk to the Project site and subsequently increase the risk to the public. In addition, pipelines associated with this Project must meet the USDOT PHMSA regulations under 49 CFR 192 and are discussed in section 4.13.3. If authorized, constructed, and operated, LNG facilities as defined in 49 CFR 193, must comply with the requirements of 49 CFR 192 and 49 CFR 193 and would be subject to the USDOT PHMSA's inspection and enforcement programs. FERC staff evaluated the risk of a pipeline incident impacting the Project and the potential of cascading damage increasing the risk to the public based on the consequences from a release, incident data from the USDOT PHMSA, and proposed mitigation to prevent or reduce the impacts of a pipeline incident from Jordan Cove.

For existing pipelines, FERC staff identified an existing natural gas pipeline located approximately 1.75 miles southwest of the site. FERC staff evaluated the potential risk from an incident from the pipeline and its potential impacts by considering the design and operating conditions and location of the pipeline. This pipeline would be located too far to impact the Project site in the event of an incident.

In addition, based on the potential likelihood of pipeline incidents and potential consequences from a pipeline incident, we conclude that the Project would not significantly increase the risk to the public beyond existing risk levels that would be present from a pipeline leak or pipeline rupture worst-case event near the Project site.

Hazardous Material Facilities and Power Plants

FERC staff reviewed whether any EPA Risk Management Plan regulated facilities handling hazardous materials and power plants were located near the site to evaluate whether the facilities could adversely increase the risk to the Project site and whether the Project site could increase the risk to the EPA Risk Management Plan facilities and power plants and subsequently increase the risk to the public.

There were no facilities handling hazardous materials or power plants identified adjacent to the site. The closest EPA Risk Management Plan regulated facilities handling hazardous materials would be the City of North Bend Wastewater Treatment Plant located approximately 1.03 miles away, and the Pony Creek Water Treatment Plant located approximately 3.50 miles away. The EPA Risk Management Plan regulations require certain hazard distances to be calculated and a risk management plan to be developed commensurate with those consequences. In addition, the closet power plant identified would be the Douglas County Forest Products Biomass Plant approximately 46 miles away and the closest nuclear plant would be the Columbia Generating Station located over 300 miles away.

Given the distances, locations, and risk management plan requirements of the facilities relative to the populated areas of the North Bend communities, we conclude that the Project would not pose a significant increase in risk to the public or that the hazardous material facilities and power plants would not pose a significant risk to the Project and subsequently to the public.

Onsite and Offsite Emergency Response Plans

As part of its application, Jordan Cove indicated that the Project would develop a comprehensive ERP with local, state, and federal agencies and emergency response officials to discuss the Facilities. Jordan Cove would continue these collaborative efforts during the development, design, and construction of the Project. The emergency procedures would provide for the protection of personnel and the public as well as the prevention of property damage that may occur as a result of incidents at the Project facilities. The facility would also provide appropriate personnel protective equipment to enable operations personnel and first responder access to the area.

As required by 49 CFR §193.2509, under Subpart F, Jordan Cove would need to prepare emergency procedures manuals that provide for: a) responding to controllable emergencies and recognizing an uncontrollable emergency; b) taking action to minimize harm to the public including the possible need to evacuate the public; and c) coordination and cooperation with appropriate local officials. Specifically, 49 CFR §193.2509 (b) (3) requires "Coordinating with appropriate local officials in preparation of an emergency evacuation plan…," which sets forth the steps required to protect the public in the event of an emergency, including catastrophic failure of an LNG storage tank. USDOT PHMSA regulations under 49 CFR §193.2905, under Subpart J also require at least two access points in each protective enclosure to be located to minimize the escape distance in the event of emergency.

Title 33 CFR §127.307 also requires the development of emergency manual that incorporates additional material, including LNG release response and emergency shutdown procedures, a description of fire equipment, emergency lighting, and power systems, telephone contacts, shelters, and first aid procedures. In addition, 33 CFR §127.207 establishes requirements for warning alarm systems. Specifically, 33 CFR §127.207 (a) requires that the LNG marine transfer area to be equipped with a rotating or flashing amber light with a minimum effective flash intensity, in the horizontal plane, of 5000 candelas with at least 50 percent of the required effective flash intensity in all directions from 1.0 degree above to 1.0 degree below the horizontal plane. Furthermore, 33 CFR §127.207 (b) requires the marine transfer area for LNG to have a siren with a minimum 1⁄3- octave band sound pressure level at l meter of 125 decibels referenced to 0.0002 microbars. The siren must be located so that the sound signal produced is audible over 360 degrees in a horizontal plane. Lastly, 33 CFR §127.207 (c) requires that each light and siren must be located so that the warning alarm is not obstructed for a distance of 1.6 km (1 mile) in all directions. The warning alarms would be required to be tested in order to meet 33 CFR 127. Jordan Cove would be required to meet the warning alarms requirements specified in 33 CFR §127.207.

In accordance with the EPAct 2005, FERC must also approve an ERP covering the terminal and ship transit prior to construction. Section 3A (e) of the NGA, added by section 311 of the EPAct

2005, stipulates that in any order authorizing an LNG terminal, the Commission must require the LNG terminal operator to develop an ERP in consultation with the Coast Guard and state and local agencies. The final ERP would need to be evaluated by appropriate emergency response personnel and officials. Section 3A (e) of the NGA (as amended by EPAct 2005) specifies that the ERP must include a Cost-Sharing Plan that contains a description of any direct cost reimbursements the Applicant agrees to provide to any state and local agencies with responsibility for security and safety at the LNG terminal and in proximity to LNG marine vessels that serve the facility. The Cost-Sharing Plan must specify what the LNG terminal operator would provide to cover the cost of the state and local resources required to manage the security of the LNG terminal and LNG marine vessel, and the state and local resources required for safety and emergency management, including:

- direct reimbursement for any per-transit security and/or emergency management costs (for example, overtime for police or fire department personnel);
- capital costs associated with security/emergency management equipment and personnel base (for example, patrol boats, firefighting equipment); and
- annual costs for providing specialized training for local fire departments, mutual aid departments, and emergency response personnel; and for conducting exercises.

The cost-sharing plan must include the LNG terminal operator's letter of commitment with agency acknowledgement for each state and local agency designated to receive resources.

Jordan Cove submitted a draft ERP to address emergency events and potential release scenarios in the Application. The ERP would include public notification, protection, and evacuation. As part of the FEED review, FERC staff evaluated the initial draft of the emergency response procedures to assure that it covers the hazards associated with the Project. In addition, we recommend in section 4.13.1.6 that Jordan Cove provide additional information, for review and approval, on development of updated emergency response plans prior to initial site preparation. We also recommend in section 4.13.1.6 that Jordan Cove file three dimensional drawings, for review and approval, that demonstrate there is a sufficient number of access and egress locations. If this Project is authorized, constructed, and operated, Jordan Cove would coordinate with local, state, and federal agencies on the development of an emergency response plan and cost sharing plan. We recommend in section 4.13.1.6 that Jordan Cove provide periodic updates on the development of these plans for review and approval, and ensure they are in place prior to introduction of hazardous fluids. In addition, we recommend in section 4.13.1.6 that Project facilities be subject to regular inspections throughout the life of the facility and would continue to require companies to file updates to the ERP.

4.13.1.6 Recommendations from FERC Preliminary Engineering and Technical Review

Based on our preliminary engineering and technical review of the reliability and safety of the Jordan Cove LNG Project, we recommend the following mitigation measures as conditions to any order authorizing the Project. These recommendations would be implemented prior to initial site preparation, prior to construction of final design, prior to commissioning, prior to introduction of hazardous fluids, prior to commencement of service, and throughout the life of the facility to enhance the reliability and safety of the facility and to mitigate the risk of impact on the public.

- **<u>Prior to initial site preparation</u>, Jordan Cove should file with the Secretary documentation of consultation with the USDOT PHMSA that the final design safety features demonstrates compliance with 49 CFR §193.2051 and NFPA 59A 2.1.1(d).**

- **<u>Prior to construction of final design,</u> Jordan Cove should file with the Secretary documentation of consultation with USDOT PHMSA staff as to whether the use of normally closed valves to remove stormwater from curbed areas would meet USDOT PHMSA requirements.**

- **<u>Prior to construction of final design</u>, Jordan Cove should file with the Secretary the following information, stamped and sealed by the professional engineer-of-record, registered in Oregon:**

  a. site preparation drawings and specifications;

  b. LNG terminal structures, LNG storage tank, and foundation design drawings and calculations (including prefabricated and field constructed structures);

  c. seismic specifications for procured Seismic Category I equipment prior to the issuing of request for quotations;

  d. quality control procedures to be used for civil/structural design and construction; and

  e. a determination of whether soil improvement is necessary to counteract soil liquefaction.

  In addition, Jordan Cove should file, in its Implementation Plan, the schedule for producing this information.

- **Jordan Cove should employ a special inspector during construction and a copy of the inspection reports should be included in the monthly status reports filed with the Secretary. The special inspector should be responsible for:**

  a. observing the construction of the liquefaction facility to be certain it conforms to the design drawings and specifications;

  b. furnishing inspection reports to the engineer- or architect-of-record, and other designated persons. All discrepancies should be brought to the immediate attention of the contractor for correction, then if uncorrected, to the engineer- or architect-of-record; and

  c. submitting a final signed report stating whether the work requiring special inspection was, to the best of his/her knowledge, in conformance with approved plans and specifications and the applicable workmanship provisions.

- **<u>Prior to commencement of service</u>, Jordan Cove should file with the Secretary a monitoring and maintenance plan, stamped and sealed by the professional engineer-**

of-record registered in Oregon, which ensures the facilities are protected for the life of the LNG terminal considering settlement, subsidence, and sea level rise.

Information pertaining to the following specific recommendations should be filed with the Secretary for review and written approval by the Director of OEP, or the Director's designee, within the timeframe indicated by each recommendation. Specific engineering, vulnerability, or detailed design information meeting the criteria specified in Order No. 833 (Docket No. RM16-15-000), including security information, should be submitted as critical energy infrastructure information pursuant to 18 CFR §388.113. See Critical Electric Infrastructure Security and Amending Critical Energy Infrastructure Information, Order No. 833, 81 Fed. Reg. 93,732 (December 21, 2016), FERC Stats. & Regs. 31,389 (2016). Information pertaining to items such as offsite emergency response, procedures for public notification and evacuation, and construction and operating reporting requirements would be subject to public disclosure. All information should be filed **a minimum of 30 days** before approval to proceed is requested.

- **Prior to initial site preparation, Jordan Cove should file an overall Project schedule, which includes the proposed stages of the commissioning plan.**
- **Prior to initial site preparation, Jordan Cove should file procedures for controlling access during construction.**
- **Prior to initial site preparation, Jordan Cove should file quality assurance and quality control procedures for construction activities.**
- **Prior to initial site preparation, Jordan Cove should file its design wind speed criteria for all other facilities not covered by USDOT PHMSA's Letter of Determination to be designed to withstand wind speeds commensurate with the risk and reliability associated with the facilities in accordance with ASCE 7-16 or equivalent.**
- **Prior to initial site preparation, Jordan Cove should specify a spill containment system around the Warm Flare Knockout Drum.**
- **Prior to initial site preparation, Jordan Cove should develop an ERP (including evacuation) and coordinate procedures with the Coast Guard; state, county, and local emergency planning groups; fire departments; state and local law enforcement; and appropriate federal agencies. This plan should include at a minimum:**

  a. **designated contacts with state and local emergency response agencies;**

  b. **scalable procedures for the prompt notification of appropriate local officials and emergency response agencies based on the level and severity of potential incidents;**

  c. **procedures for notifying residents and recreational users within areas of potential hazard;**

  d. **evacuation routes/methods for residents and public use areas that are within any transient hazard areas along the route of the LNG marine transit;**

  e. **locations of permanent sirens and other warning devices; and**

f. an "emergency coordinator" on each LNG marine vessel to activate sirens and other warning devices.

Jordan Cove should notify the FERC staff of all planning meetings in advance and should report progress on the development of its ERP at 3‑month intervals.

- **Prior to initial site preparation, Jordan Cove should file a Cost-Sharing Plan identifying the mechanisms for funding all Project-specific security/emergency management costs that would be imposed on state and local agencies. This comprehensive plan should include funding mechanisms for the capital costs associated with any necessary security/emergency management equipment and personnel base. Jordan Cove should notify FERC staff of all planning meetings in advance and should report progress on the development of its Cost Sharing Plan at 3-month intervals.**

- **Prior to construction of final design, Jordan Cove should file change logs that list and explain any changes made from the FEED provided in Jordan Cove LNG Project's application and filings. A list of all changes with an explanation for the design alteration should be provided and all changes should be clearly indicated on all diagrams and drawings.**

- **Prior to construction of final design, Jordan Cove should file information/revisions pertaining to Jordan Cove's response numbers 8c, 13, 15, 21, 22, 23, 24, 26, 27, 28, and 31 of its December 20, 2018 filing and 6, 9, 10, 11, 17, 19, 32, 34, and 36 of its February 6, 2019 filing which indicated features to be included or considered in the final design.**

- **Prior to construction of final design, Jordan Cove should file drawings and specifications for crash rated vehicle barriers at each facility entrance for access control.**

- **Prior to construction of final design, Jordan Cove should file drawings of the security fence. The fencing drawings should provide details of fencing that demonstrates it would restrict and deter access around the entire facility and has a setback from exterior features (e.g., power lines, trees, etc.) and from interior features (e.g., piping, equipment, buildings, etc.) that does not allow the fence to be overcome.**

- **Prior to construction of final design, Jordan Cove should file drawings of internal road vehicle protections, such as guard rails, barriers, and bollards to protect transfer piping, pumps, compressors, hydrants, monitors, etc. to ensure that they are located away from roadway or protected from inadvertent damage from vehicles.**

- **Prior to construction of final design, Jordan Cove should file security camera and intrusion detection drawings. The security camera drawings should show the locations, areas covered, and features of each camera (e.g., fixed, tilt/pan/zoom, motion detection alerts, low light, mounting height, etc.) to verify camera coverage of the entire perimeter with redundancies for cameras interior to the facility to enable rapid monitoring of the facility, including a camera at the top of each LNG storage tank, and coverage within pretreatment areas, within liquefaction areas, within truck**

transfer areas, within marine transfer areas, and buildings. The drawings should show or note the location of the intrusion detection to verify it covers the entire perimeter of the facility.

- **Prior to construction of final design, Jordan Cove should file lighting drawings. The lighting drawings should show the location, elevation, type of light fixture, and lux levels of the lighting system and should be in accordance with API 540 and provide illumination along the perimeter of the facility, process equipment, mooring points, and along paths/roads of access and egress to facilitate security monitoring and emergency response operations. This lighting plan should also be in compliance with the lighting recommendation in section 4.5.**

- **Prior to construction of final design, Jordan Cove should file a plot plan of the final design showing all major equipment, structures, buildings, and impoundment systems.**

- **Prior to construction of final design, Jordan Cove should file three-dimensional plant drawings to confirm plant layout for maintenance, access, egress, and congestion.**

- **Prior to construction of final design, Jordan Cove should file up-to-date process flow diagrams (PFDs) and piping and instrument diagrams (P&IDs) including vendor P&IDs. The PFDs should include heat and material balances. The P&IDs should include the following information:**

  a. **equipment tag number, name, size, duty, capacity, and design conditions;**

  b. **equipment insulation type and thickness;**

  c. **storage tank pipe penetration size and nozzle schedule;**

  d. **valve high pressure side and internal and external vent locations;**

  e. **piping with line number, piping class specification, size, and insulation type and thickness;**

  f. **piping specification breaks and insulation limits;**

  g. **all control and manual valves numbered;**

  h. **relief valves with size and set points; and**

  i. **drawing revision number and date.**

- **Prior to construction of final design, Jordan Cove should file P&IDs, specifications, and procedures that clearly show and specify the tie-in details required to safely connect subsequently constructed facilities with the operational facilities.**

- **Prior to construction of final design, Jordan Cove should file a car seal philosophy and a list of all car-sealed and locked valves consistent with the P&IDs.**

- **<u>Prior to construction of final design</u>, Jordan Cove should file information to demonstrate the EPC contractor has verified that all FEED HAZOP and LOPA recommendations have been addressed.**
- **<u>Prior to construction of final design</u>, Jordan Cove should file a hazard and operability review, including a list of recommendations and actions taken on the recommendations, prior to issuing the P&IDs for construction.**
- **<u>Prior to construction of final design</u>, Jordan Cove should provide a check valve upstream of the amine contractor column to prevent backflow or provide a dynamic simulation that shows that upon plant shutdown, the swan neck would be sufficient for this purpose.**
- **<u>Prior to construction of final design</u>, Jordan Cove should specify how Mole Sieve Gas Dehydrator support and sieve material would be prevented from migrating to the piping system.**
- **<u>Prior to construction of final design</u>, Jordan Cove should specify how the regeneration gas heater tube design temperature would be consistent with the higher shell side steam temperatures.**
- **<u>Prior to construction of final design</u>, Jordan Cove should specify a cold gas bypass around the defrost gas heater to prevent defrost gas heater high temperature shutdown during low flow and startup conditions.**
- **<u>Prior to construction of final design</u>, Jordan Cove should demonstrate that the differential pressure (dp) level transmitters on the LNG flash drum would not result in an excess number of false high-high-high level shutdowns.**
- **<u>Prior to construction of final design</u>, Jordan Cove should specify a means to stop LNG flows to the BOG suction drum when the BOG compressor is shutdown to prevent filling the BOG suction drum with LNG.**
- **<u>Prior to construction of final design</u>, Jordan Cove should specify a low instrument air pressure shutdown to prevent loss of control to air operated valve.**
- **<u>Prior to construction of final design</u>, Jordan Cove should evaluate and, if applicable, address the potential for cryogenic feed gas back flow in the event relief valve 30-PSV-01002A/B is open.**
- **<u>Prior to construction of final design</u>, Jordan Cove should include LNG tank fill flow measurement with high flow alarm.**
- **<u>Prior to construction of final design</u>, Jordan Cove should specify a discretionary vent valve on each LNG storage tank that is operable through the Distributed Control System (DCS). In addition, a car sealed open manual block valve should be provided upstream of the discretionary vent valve.**

- **<u>Prior to construction of final design</u>, Jordan Cove should file the safe operating limits (upper and lower), alarm and shutdown set points for all instrumentation (e.g., temperature, pressures, flows, and compositions).**

- **<u>Prior to construction of final design</u>, Jordan Cove should file cause-and-effect matrices for the process instrumentation, fire and gas detection system, and emergency shutdown system. The cause-and-effect matrices should include alarms and shutdown functions, details of the voting and shutdown logic, and set points.**

- **<u>Prior to construction of final design</u>, Jordan Cove should file an up-to-date equipment list, process and mechanical data sheets, and specifications. The specifications should include:**

  a. **building specifications (e.g., control buildings, electrical buildings, compressor buildings, storage buildings, pressurized buildings, ventilated buildings, blast resistant buildings);**

  b. **mechanical specifications (e.g., piping, valve, insulation, rotating equipment, heat exchanger, storage tank and vessel, other specialized equipment);**

  c. **electrical and instrumentation specifications (e.g., power system, control system, safety instrument system [SIS], cable, other electrical and instrumentation); and**

  d. **security and fire safety specifications (e.g., security, passive protection, hazard detection, hazard control, firewater).**

- **<u>Prior to construction of final design</u>, Jordan Cove should file a list of all codes and standards and the final specification document number where they are referenced.**

- **<u>Prior to construction of final design</u>, Jordan Cove should file a complete specifications and drawings of the proposed LNG tank design and installation.**

- **<u>Prior to construction of final design</u>, Jordan Cove should file an evaluation of emergency shutdown valve closure times. The evaluation should account for the time to detect an upset or hazardous condition, notify plant personnel, and close the emergency shutdown valve(s).**

- **<u>Prior to construction of final design</u>, Jordan Cove should file an evaluation of dynamic pressure surge effects from valve opening and closure times and pump operations that demonstrate that the surge effects do not exceed the design pressures.**

- **<u>Prior to construction of final design</u>, Jordan Cove should demonstrate that, for hazardous fluids, piping and piping nipples 2 inches or less in diameter are designed to withstand external loads, including vibrational loads in the vicinity of rotating equipment and operator live loads in areas accessible by operators.**

- **<u>Prior to construction of final design</u>, Jordan Cove should clearly specify the responsibilities of the LNG tank contractor and the EPC contractor for the piping associated with the LNG storage tank.**

- **<u>Prior to construction of final design</u>, Jordan Cove should file the sizing basis and capacity for the final design of the flares and/or vent stacks as well as the pressure and vacuum relief valves for major process equipment, vessels, and storage tanks.**

- **<u>Prior to construction of final design</u>, Jordan Cove should file an updated fire protection evaluation of the proposed facilities. A copy of the evaluation, a list of recommendations and supporting justifications, and actions taken on the recommendations should be filed. The evaluation should justify the type, quantity, and location of hazard detection and hazard control, passive fire protection, emergency shutdown and depressurizing systems, firewater, and emergency response equipment, training, and qualifications in accordance with NFPA 59A (2001). The justification for the flammable and combustible gas detection and flame and heat detection systems should be in accordance with ISA 84.00.07 or equivalent methodologies and would need to demonstrate 90 percent or more of releases (unignited and ignited) that could result in an off-site or cascading impact would be detected by two or more detectors and result in isolation and de inventory within 10 minutes. The analysis should take into account the set points, voting logic, wind speeds, and wind directions. The justification for firewater should provide calculations for all firewater demands based on design densities, surface area, and throw distance as well as specifications for the corresponding hydrant and monitors needed to reach and cool equipment.**

- **<u>Prior to construction of final design</u>, Jordan Cove should file spill containment system drawings with dimensions and slopes of curbing, trenches, impoundments, and capacity calculations considering any foundations and equipment within impoundments, as well as the sizing and design of the down-comers. The spill containment drawings should show containment for all hazardous fluids including all liquids handled above their flashpoint, from the largest flow from a single line for 10 minutes, including de-inventory, or the maximum liquid from the largest vessel (or total of impounded vessels) or otherwise demonstrate that providing spill containment would not significantly reduce the flammable vapor dispersion or radiant heat consequences of a spill.**

- **<u>Prior to construction of final design</u>, Jordan Cove should file an analysis that demonstrates the flammable vapor dispersion from design spills would be prevented from dispersing underneath the elevated LNG storage tanks, or the LNG storage tanks would be able to withstand an overpressure due to ignition of the flammable vapor that disperses underneath the elevated LNG storage tanks.**

- **<u>Prior to construction of final design</u>, Jordan Cove should file electrical area classification drawings.**

- **<u>Prior to construction of final design</u>, Jordan Cove should provide documentation demonstrating adequate ventilation, detection, and electrical area classification based on the final selection of the batteries, and associated hydrogen off-gassing rates.**

- **<u>Prior to construction of final design</u>, Jordan Cove should file drawings and details of how process seals or isolations installed at the interface between a flammable fluid**

system and an electrical conduit or wiring system meet the requirements of NFPA 59A (2001).

- **Prior to construction of final design, Jordan Cove should file details of an air gap or vent installed downstream of process seals or isolations installed at the interface between a flammable fluid system and an electrical conduit or wiring system. Each air gap should vent to a safe location and be equipped with a leak detection device that should continuously monitor for the presence of a flammable fluid, alarm the hazardous condition, and shut down the appropriate systems.**

- **Prior to construction of final design, Jordan Cove should file complete drawings and a list of the hazard detection equipment. The drawings should clearly show the location and elevation of all detection equipment. The list should include the instrument tag number, type and location, alarm indication locations, and shutdown functions of the hazard detection equipment.**

- **Prior to construction of final design, Jordan Cove should file a technical review of facility design that:**

  a. **identifies all combustion/ventilation air intake equipment and the distances to any possible flammable gas or toxic release; and**

  b. **demonstrates that these areas are adequately covered by hazard detection devices and indicates how these devices would isolate or shutdown any combustion or heating ventilation and air conditioning equipment whose continued operation could add to or sustain an emergency.**

- **Prior to construction of final design, Jordan Cove should file a design that includes hazard detection suitable to detect high temperatures and smoldering combustion products in electrical buildings and control room buildings.**

- **Prior to construction of final design, Jordan Cove should file an evaluation of the voting logic and voting degradation for hazard detectors.**

- **Prior to construction of final design, Jordan Cove should file a list of alarm and shutdown set points for all hazard detectors that account for the calibration gas of the hazard detectors when determining the lower flammable limit set points for methane, ethylene, propane, isopentane, and condensate.**

- **Prior to construction of final design, Jordan Cove should file a list of alarm and shutdown set points for all hazard detectors that account for the calibration gas of hazard detectors when determining the set points for toxic components such as condensate and hydrogen sulfide.**

- **Prior to construction of final design, Jordan Cove should file a drawing showing the location of the emergency shutdown buttons. Emergency shutdown buttons should be easily accessible, conspicuously labeled, and located in an area which would be accessible during an emergency.**

- **<u>Prior to construction of final design</u>, Jordan Cove should file facility plan drawings and a list of the fixed and wheeled dry-chemical, hand-held fire extinguishers, and other hazard control equipment. Plan drawings should clearly show the location by tag number of all fixed, wheeled, and hand-held extinguishers and should demonstrate the spacing of extinguishers meet prescribed NFPA 10 travel distances. The list should include the equipment tag number, type, capacity, equipment covered, discharge rate, and automatic and manual remote signals initiating discharge of the units and should demonstrate they meet NFPA 59A.**

- **<u>Prior to construction of final design</u>, Jordan Cove should file drawings and specifications for the structural passive protection systems to protect equipment and supports from cryogenic releases.**

- **<u>Prior to construction of final design</u>, Jordan Cove should file calculations or test results for the structural passive protection systems to protect equipment and supports from cryogenic releases.**

- **<u>Prior to construction of final design</u>, Jordan Cove should file drawings and specifications for the structural passive protection systems to protect equipment and supports from pool and jet fires.**

- **<u>Prior to construction of final design</u>, Jordan Cove should file a detailed quantitative analysis to demonstrate that adequate mitigation would be provided for each significant component within the 4,000 Btu/ft^2-hr zone from pool and jet fires that could cause failure of the component. Trucks at the truck transfer station should be included in the analysis. A combination of passive and active protection for pool fires and passive and/or active protection for jet fires should be provided and demonstrate the effectiveness and reliability. Effectiveness of passive mitigation should be supported by calculations or test results for the thickness limiting temperature rise and effectiveness of active mitigation should be justified with calculations or test results demonstrating flow rates and durations of any cooling water would mitigate the heat absorbed by the vessel.**

- **<u>Prior to construction of final design</u>, Jordan Cove should file an evaluation and associated specifications and drawings of how it would prevent cascading damage of transformers (e.g., fire walls or spacing) in accordance with NFPA 850 or equivalent.**

- **<u>Prior to construction of final design</u>, Jordan Cove should file facility plan drawings showing the proposed location of the firewater and any foam systems. Plan drawings should clearly show the location of firewater and foam piping, post indicator valves, and the location and area covered by, each monitor, hydrant, hose, water curtain, deluge system, foam system, water-mist system, and sprinkler. All areas of the pretreatment area should have adequate coverage. The drawings should also include piping and instrumentation diagrams of the firewater and foam systems.**

- **<u>Prior to construction of final design</u>, Jordan Cove should specify that the firewater pump shelter is designed to remove the largest firewater pump or other component for maintenance with an overhead or external crane.**

- **<u>Prior to construction of final design</u>, Jordan Cove should demonstrate that the firewater storage tanks are in compliance with NFPA 22 or demonstrate how API Standard 650 provides an equivalent or better level of safety.**

- **<u>Prior to construction of final design</u>, Jordan Cove should specify that the firewater flow test meter is equipped with a transmitter and that a pressure transmitter is installed upstream of the flow transmitter. The flow transmitter and pressure transmitter should be connected to the DCS and recorded.**

- **<u>Prior to construction of final design</u>, Jordan Cove should file drawings of the storage tank piping support structure and support of horizontal piping at grade including pump columns, relief valves, pipe penetrations, instrumentation, and appurtenances.**

- **<u>Prior to construction of final design</u>, Jordan Cove should file the structural analysis of the LNG storage tank and outer containment demonstrating they are designed to withstand all loads and combinations.**

- **<u>Prior to construction of final design</u>, Jordan Cove should file an analysis of the structural integrity of the outer containment of the full containment LNG storage tank demonstrating it can withstand the radiant heat from a roof tank top fire or adjacent tank roof fire.**

- **<u>Prior to construction of final design</u>, Jordan Cove should file a projectile analysis to demonstrate that the outer concrete impoundment wall of a full-containment LNG storage tank could withstand projectiles from explosions and high winds. The analysis should detail the projectile speeds and characteristics and method used to determine penetration or perforation depths.**

- **<u>Prior to commissioning</u>, Jordan Cove should file a detailed schedule for commissioning through equipment startup. The schedule should include milestones for all procedures and tests to be completed: prior to introduction of hazardous fluids and during commissioning and startup. Jordan Cove should file documentation certifying that each of these milestones has been completed before authorization to commence the next phase of commissioning and startup will be issued.**

- **<u>Prior to commissioning</u>, Jordan Cove should file detailed plans and procedures for: testing the integrity of onsite mechanical installation; functional tests; introduction of hazardous fluids; operational tests; and placing the equipment into service.**

- **<u>Prior to commissioning</u>, Jordan Cove should file settlement results from the hydrostatic tests of the LNG storage containers and should file a plan to periodically verify settlement is as expected and does not exceed the applicable criteria set forth in API 620, API 625, API 653, and ACI 376. The plan should also specify what actions would be taken after various levels of seismic events.**

- **<u>Prior to commissioning</u>, Jordan Cove should file the operation and maintenance procedures and manuals, as well as safety procedures, hot work procedures and permits, abnormal operating conditions reporting procedures, simultaneous operations procedures, and management of change procedures and forms.**

- **<u>Prior to commissioning</u>, Jordan Cove should file a plan for clean-out, dry-out, purging, and tightness testing. This plan should address the requirements of the American Gas Association's Purging Principles and Practice, and should provide justification if not using an inert or non-flammable gas for clean-out, dry-out, purging, and tightness testing.**

- **<u>Prior to commissioning</u>, Jordan Cove should tag all equipment, instrumentation, and valves in the field, including drain valves, vent valves, main valves, and car-sealed or locked valves.**

- **<u>Prior to commissioning</u>, Jordan Cove should file a plan describing how it would maintain a detailed training log to demonstrate that operating, maintenance, and emergency response staff have completed the required training.**

- **<u>Prior to commissioning</u>, Jordan Cove should file the procedures for pressure/leak tests which address the requirements of ASME BPVC Section VIII and ASME B31.3. In addition, Jordan Cove should file a line list of pneumatic and hydrostatic test pressures.**

- **<u>Prior to introduction of hazardous fluids</u>, Jordan Cove should complete and document a pre-startup safety review to ensure that installed equipment meets the design and operating intent of the facility. The pre-startup safety review should include any changes since the last hazard review, operating procedures, and operator training. A copy of the review with a list of recommendations, and actions taken on each recommendation, should be filed.**

- **<u>Prior to introduction of hazardous fluids</u>, Jordan Cove should complete and document all pertinent tests (Factory Acceptance Tests, Site Acceptance Tests, Site Integration Tests) associated with the DCS and SIS that demonstrates full functionality and operability of the system.**

- **<u>Prior to introduction of hazardous fluids</u>, Jordan Cove should develop and implement an alarm management program to reduce alarm complacency and maximize the effectiveness of operator response to alarms.**

- **<u>Prior to introduction of hazardous fluids</u>, Jordan Cove should complete and document a clean agent acceptance tests.**

- **<u>Prior to introduction of hazardous fluids</u>, Jordan Cove should complete and document a firewater pump acceptance test and firewater monitor and hydrant coverage test. The actual coverage area from each monitor and hydrant should be shown on facility plot plan(s).**

- **<u>Prior to introduction of hazardous fluids</u>, Jordan Cove should complete and document foam system and sprinkler system acceptance tests.**

- **Jordan Cove should file a request for written authorization from the Director of OEP <u>prior to unloading or loading the first LNG commissioning cargo</u>. After production of first LNG, Jordan Cove should file weekly reports on the commissioning of the**

proposed systems that detail the progress toward demonstrating the facilities can safely and reliably operate at or near the design production rate. The reports should include a summary of activities, problems encountered, and remedial actions taken. The weekly reports should also include the latest commissioning schedule, including projected and actual LNG production by each liquefaction train, LNG storage inventories in each storage tank, and the number of anticipated and actual LNG commissioning cargoes, along with the associated volumes loaded or unloaded. Further, the weekly reports should include a status and list of all planned and completed safety and reliability tests, work authorizations, and punch list items. Problems of significant magnitude should be reported to the FERC within 24 hours.

- **<u>Prior to commencement of service</u>, Jordan Cove should file a request for written authorization from the Director of OEP. Such authorization would only be granted following a determination by the Coast Guard, under its authorities under the Ports and Waterways Safety Act, the Magnuson Act, the MTSA of 2002, and the Security and Accountability For Every Port Act, that appropriate measures to ensure the safety and security of the facility and the waterway have been put into place by Jordan Cove or other appropriate parties.**

- **<u>Prior to commencement of service</u>, Jordan Cove should notify the FERC staff of any proposed revisions to the security plan and physical security of the plant.**

- **<u>Prior to commencement of service</u>, Jordan Cove should label piping with fluid service and direction of flow in the field, in addition to the pipe labeling requirements of NFPA 59A (2001).**

- **<u>Prior to commencement of service</u>, Jordan Cove should provide plans for any preventative and predictive maintenance program that performs periodic or continuous equipment condition monitoring.**

- **<u>Prior to commencement of service</u>, Jordan Cove should develop procedures for offsite contractors' responsibilities, restrictions, and limitations and for supervision of these contractors by Jordan Cove staff.**

In addition, we recommend that the following measures should apply <u>throughout the life of the Jordan Cove LNG Project</u>.

- **The facility should be subject to regular FERC staff technical reviews and site inspections on at least an <u>annual</u> basis or more frequently as circumstances indicate. Prior to each FERC staff technical review and site inspection, Jordan Cove should respond to a specific data request including information relating to possible design and operating conditions that may have been imposed by other agencies or organizations. Up-to-date detailed P&IDs reflecting facility modifications and provision of other pertinent information not included in the semi-annual reports described below, including facility events that have taken place since the previously submitted semi-annual report, should be submitted.**

- **<u>Semi-annual</u> operational reports should be filed with the Secretary to identify changes in facility design and operating conditions; abnormal operating experiences;**

activities (e.g., ship arrivals, quantity and composition of imported and exported LNG, liquefied and vaporized quantities, boil off/flash gas); and plant modifications, including future plans and progress thereof. Abnormalities should include, but not be limited to, unloading/loading/shipping problems, potential hazardous conditions from offsite vessels, storage tank stratification or rollover, geysering, storage tank pressure excursions, cold spots on the storage tank, storage tank vibrations and/or vibrations in associated cryogenic piping, storage tank settlement, significant equipment or instrumentation malfunctions or failures, non-scheduled maintenance or repair (and reasons therefore), relative movement of storage tank inner vessels, hazardous fluids releases, fires involving hazardous fluids and/or from other sources, negative pressure (vacuum) within a storage tank, and higher than predicted boil off rates. Adverse weather conditions and the effect on the facility also should be reported. Reports should be submitted within 45 days after each period ending June 30 and December 31. In addition to the above items, a section entitled "Significant Plant Modifications Proposed for the Next 12 Months (dates)" should be included in the semi-annual operational reports. Such information would provide the FERC staff with early notice of anticipated future construction/maintenance at the LNG facilities.

- **In the event the temperature of any region of the LNG storage container, including any secondary containment and imbedded pipe supports, becomes less than the minimum specified operating temperature for the material, the Commission should be notified within 24 hours and procedures for corrective action should be specified.**

- **Significant non-scheduled events, including safety-related incidents (e.g., LNG, condensate, refrigerant, or natural gas releases; fires; explosions; mechanical failures; unusual over pressurization; and major injuries) and security-related incidents (e.g., attempts to enter site, suspicious activities) should be reported to the FERC staff. In the event that an abnormality is of significant magnitude to threaten public or employee safety, cause significant property damage, or interrupt service, notification should be made immediately, without unduly interfering with any necessary or appropriate emergency repair, alarm, or other emergency procedure. In all instances, notification should be made to the FERC staff within 24 hours. This notification practice should be incorporated into the liquefaction facility's emergency plan. Examples of reportable hazardous fluids-related incidents include:**

  a. **fire;**

  b. **explosion;**

  c. **estimated property damage of $50,000 or more;**

  d. **death or personal injury necessitating in-patient hospitalization;**

  e. **release of hazardous fluids for 5 minutes or more;**

  f. **unintended movement or abnormal loading by environmental causes, such as an earthquake, landslide, or flood, that impairs the serviceability, structural integrity, or reliability of an LNG facility that contains, controls, or processes hazardous fluids;**

g. any crack or other material defect that impairs the structural integrity or reliability of an LNG facility that contains, controls, or processes hazardous fluids;

h. any malfunction or operating error that causes the pressure of a pipeline or LNG facility that contains or processes hazardous fluids to rise above its maximum allowable operating pressure (or working pressure for LNG facilities) plus the build-up allowed for operation of pressure-limiting or control devices;

i. a leak in an LNG facility that contains or processes hazardous fluids that constitutes an emergency;

j. inner tank leakage, ineffective insulation, or frost heave that impairs the structural integrity of an LNG storage tank;

k. any safety-related condition that could lead to an imminent hazard and cause (either directly or indirectly by remedial action of the operator), for purposes other than abandonment, a 20 percent reduction in operating pressure or shutdown of operation of a pipeline or an LNG facility that contains or processes hazardous fluids;

l. safety-related incidents from hazardous fluids transportation occurring at or en route to and from the LNG facility; or

m. an event that is significant in the judgment of the operator and/or management even though it did not meet the above criteria or the guidelines set forth in an LNG facility's incident management plan.

In the event of an incident, the Director of OEP has delegated authority to take whatever steps are necessary to ensure operational reliability and to protect human life, health, property, or the environment, including authority to direct the LNG facility to cease operations. Following the initial company notification, the FERC staff would determine the need for a separate follow-up report or follow up in the upcoming semi-annual operational report. All company follow-up reports should include investigation results and recommendations to minimize a reoccurrence of the incident.

4.13.2 Pacific Connector Pipeline Project

The transportation of natural gas by pipeline involves some incremental risk to the public due to the potential for accidental release of natural gas. The greatest hazard is a fire or explosion following a major pipeline rupture.

Methane, the primary component of natural gas, is colorless, odorless, and tasteless. It is not toxic, but is classified as a simple asphyxiant, possessing a slight inhalation hazard. If breathed in high concentration, oxygen deficiency can result in serious injury or death. Methane has an auto-ignition temperature of 1,000°F and is flammable at concentrations between 5.0 percent and 15.0 percent in air. An unconfined mixture of methane and air is not explosive; however, it may ignite and burn if there is an ignition source.

4.13.2.1 Safety Standards

The USDOT PHMSA is mandated to provide pipeline safety under 49 U.S.C. § 601. The USDOT PHMSA Office of Pipeline Safety administers the national regulatory program to ensure the safe transportation of natural gas and other hazardous materials by pipeline. It develops safety regulations and other approaches to risk management that ensure safety in the design, construction, testing, operation, maintenance, and emergency response of pipeline facilities. Many of the regulations are written as performance standards which set the level of safety to be attained and allow the pipeline operator to use various technologies to achieve safety. The USDOT PHMSA ensures that people and the environment are protected from the risk of pipeline incidents. This work is shared with state agency partners and others at the federal, state, and local level. Section 5(a) of the Natural Gas Pipeline Safety Act provides for a state agency to assume all aspects of the safety program for intrastate facilities by adopting and enforcing the federal standards, while section 5(b) permits a state agency that does not qualify under section 5(a) to perform certain inspection and monitoring functions. A state may also act as the USDOT PHMSA's agent to inspect interstate facilities within its boundaries; however, the USDOT is responsible for enforcement action. Most of the states have either 5(a) certifications or 5(b) agreements, while nine states act as interstate agents.

Under an MOU on natural gas transportation facilities dated January 15, 1993 between the USDOT PHMSA and the FERC, the USDOT PHMSA has the exclusive authority to promulgate federal safety standards used in the transportation of natural gas. The USDOT PHMSA pipeline standards are published in 49 CFR Parts 190-199. Title 49 CFR 192 specifically prescribes the minimum safety standards for the transportation of natural and other gas by pipeline. Title 18 CFR §157.14(a)(9)(vi) of the FERC's regulations require that an applicant certify that it will design, install, inspect, test, construct, operate, replace, and maintain the facility for which a certificate is requested in accordance with federal safety standards and plans for maintenance and inspection, or shall certify that it has been granted a waiver of the requirements of the safety standards by the USDOT PHMSA in accordance with section 3(e) of the Natural Gas Pipeline Safety Act. The FERC accepts this certification and does not impose additional safety standards other than the USDOT PHMSA standards. If the Commission becomes aware of an existing or potential safety problem, there is a provision in the MOU to promptly alert the USDOT PHMSA. The MOU also provides for referring complaints and inquiries made by state and local governments as well as the general public involving safety matters related to pipelines under the Commission's jurisdiction.

The FERC also participates as a member of the USDOT PHMSA's Technical Pipeline Safety Standards Committee, which determines if proposed safety regulations are reasonable, feasible, and practicable.

The Pacific Connector pipeline and aboveground facilities must be designed, constructed, operated, and maintained in accordance with the USDOT PHMSA regulations found in 49 CFR 192. The regulations are intended to ensure adequate protection for the public and to prevent natural gas facility accidents and failures. The USDOT specifies material selection and qualification; minimum design requirements; and protection from internal, external, and atmospheric corrosion.

The USDOT PHMSA also defines area classifications, based on population density in the vicinity of the pipeline, and specifies more rigorous safety requirements for populated areas. The class location unit is an area that extends 220 yards on either side of the centerline of any continuous 1-mile length of pipeline. The four area classifications are defined below:

- Class 1 – Location with 10 or fewer buildings intended for human occupancy;
- Class 2 – Location with more than 10 but less than 46 buildings intended for human occupancy;
- Class 3 – Location with 46 or more buildings intended for human occupancy or where the pipeline lies within 100 yards of any building, or small well-defined outside area occupied by 20 or more people on at least 5 days per week for 10 weeks in any 12-month period; and
- Class 4 – Location where buildings with four or more stories aboveground are prevalent.

Class locations representing more populated areas require higher safety factors in pipeline design, testing, and operation. Pipelines constructed on land in Class 1 locations must be installed with a minimum depth of cover of 30 inches in normal soil and 18 inches in consolidated (solid) rock. Class 2, 3, and 4 locations, as well as drainage ditches of public roads and railroad crossings, require a minimum cover of 36 inches in normal soil and 24 inches in consolidated rock.

Class locations also specify the maximum distance to a sectionalizing block valve (e.g., 10.0 miles in Class 1, 7.5 miles in Class 2, 4.0 miles in Class 3, and 2.5 miles in Class 4). Pipe wall thickness and pipeline design pressures, hydrostatic test pressures, MAOP, inspection and testing of welds, and frequency of pipeline patrols and leak surveys must also conform to higher standards in more populated areas. Class locations by MP are listed in table 4.13.2-1.

TABLE 4.13.2.1-1

USDOT Class Locations for the Proposed Pacific Connector Pipeline

Beginning MP	Ending MP	Class Location
0	1.24	1
1.24	1.33	3
1.33	2.34	1
2.34	3.11	2
3.11	3.38	1
3.38	6.47	2
6.47	21.12	1
21.12	21.25	3
21.25	22.39	1
22.39	22.74	2
22.74	22.89	1
22.89	23.26	2
23.26	50.66	1
50.66	51.14	2
51.14	51.39	1
51.39	51.59	2
51.6	55.54	1
55.54	57.76	2
57.76	94.67	1
94.68	94.89	2
94.89	121.88	1
121,88	122.15	2

TABLE 4.13.2.1-1 (continued)

USDOT Class Locations for the Proposed Pacific Connector Pipeline

Beginning MP	Ending MP	Class Location
122.15	122.18	1
122.18	122.43	2
122.43	122.45	1
122.45	123.23	2
123.23	132.46	1
132.47	169.50	1
169.51	197.65	1
197.65	198.08	3
198.08	198.17	1
198.17	198.57	2
198.57	198.61	1
198.61	198.74	3
198.74	198.96	1
198.96	199.09	3
199.09	203.79	1
199.09	203.79	1
203.79	204.13	2
204.13	204.58	2
204.58	204.90	2
204.9	228.81	1

If a subsequent increase in population density adjacent to the right-of-way indicates a change in class location for the pipeline, Pacific Connector would be required to reduce the MAOP or replace the segment with pipe of sufficient grade and wall thickness, if applicable, to comply with the USDOT PHMSA code of regulations for the new class location.

We received comments requesting that unified safety standards be applied across the entire pipeline route; however, as discussed previously, the FERC does not have the jurisdiction to require safety standards beyond those outlined by 49 CFR 192 (which are required and enforced by the USDOT PHMSA).

The USDOT PHMSA regulations require operators to develop and follow a written integrity management program that contain all the elements described in 49 CFR §192.911 and address the risks on each transmission pipeline segment. The rule establishes an integrity management program which applies to all high consequence areas (HCA).

The USDOT PHMSA has published rules that define HCAs where a gas pipeline accident could do considerable harm to people and their property and requires an integrity management program to minimize the potential for an accident. This definition satisfies, in part, the Congressional mandate for USDOT PHMSA to prescribe standards that establish criteria for identifying each gas pipeline facility in a high-density population area.

The HCAs may be defined in one of three ways. In the first method, an HCA includes:

- current Class 3 and 4 locations, or

- any area in Class 1 or 2 where the potential impact radius[270] is greater than 660 feet and there are 20 or more buildings intended for human occupancy within the potential impact circle,[271] or
- any area in Class 1 or 2 where the potential impact circle includes an identified site.[272]

In the second method, an HCA includes any area within a potential impact circle which contains:

- 20 or more buildings intended for human occupancy, or
- an identified site.

Once a pipeline operator has determined the HCAs on its pipeline, it must apply the elements of its integrity management program to those segments of the pipeline within HCAs. The USDOT PHMSA regulations specify the requirements for the integrity management plan at section 192.911. Table 4.13.2.1-2 identifies the HCAs that are crossed by or adjacent to the proposed pipeline route. The pipeline integrity management rule for HCAs requires inspection of the entire pipeline in HCAs every 7 years.

TABLE 4.13.2.1-2

USDOT Class 3 Locations and High Consequence Areas
Crossed by and Adjacent to the Proposed Pacific Connector Pipeline

Beginning MP	Ending MP	Criteria
1.24	1.33	Vicinity to ball park and commercial buildings with potential occupancy of over 20 people
21.12	21.25	Vicinity to cell tower with associated commercial buildings with potential occupancy of over 20 people
197.65	198.08	Vicinity to sawmill with potential occupancy of over 20 people
198.61	198.74	Vicinity to commercial buildings with potential occupancy of over 20 people
198.96	199.09	Vicinity to commercial buildings with potential occupancy of over 20 people

Part 192 prescribes the minimum standards for operating and maintaining pipeline facilities, including the requirement to establish a written plan governing these activities. Under 49 CFR §192.615, each pipeline operator must also establish an emergency response plan (ERP) that includes procedures to minimize the hazards in a natural gas pipeline emergency. Pacific Connector would establish written procedures, in accordance with 49 CFR §192.615, that provide the following:

- establishing and maintaining adequate means of communication with appropriate fire, police, and other public officials;
- notifying appropriate fire, police, medical and other public, local, and state official of gas pipeline emergencies and coordinating with them both planned responses and actual responses during an emergency;
- receiving, identifying, and classifying notices of events that require immediate response by the operator;

[270] The potential impact radius is calculated as the product of 0.69 and the square root of the MAOP of the pipeline in psi multiplied by the pipeline diameter in inches.
[271] The potential impact circle is a circle of radius equal to the potential impact radius.
[272] An identified site is an outside area or open structure that is occupied by 20 or more persons on at least 50 days in any 12-month period; a building that is occupied by 20 or more persons on at least 5 days per week for any 10 weeks in any 12-month period; or a facility that is occupied by persons who are confined, are of impaired mobility, or would be difficult to evacuate.

- prompt and effective response to a notice of each type of emergency (gas detection, fire, explosion, natural disaster); prescribe actions directed toward protecting people first and then property; emergency shutdown and pressure reduction in any section of the pipeline necessary to minimize hazards to life or property;
- actions required to be taken by control room personnel during an emergency in accordance with 49 CFR §192.631;
- ensuring the availability of service subcontractors, personnel, equipment, tools, and materials, as needed at the scene of any emergency;
- making safe any actual or potential hazard to life or property;
- safely restoring any service outage; and
- beginning incident investigation process as soon after the end of the emergency as possible.

Part 192 requires that each operator must establish and maintain liaison with appropriate fire, police, and public officials to learn the resources and responsibilities of each organization that may respond to a natural gas pipeline emergency, and to coordinate mutual assistance. The operator must also establish a continuing education program to enable customers, the public, government officials, and those engaged in excavation activities to recognize a gas pipeline emergency and report it to appropriate public officials. Operations personnel will attend training for emergency response procedures and plans prior to commencing pipeline operation. No additional specialized local fire protection equipment would be required to handle pipeline emergencies.

Pipeline system emergencies can include gas leaks, fire or explosion, and/or damage to the pipeline and aboveground facilities. Pacific Connector would maintain 24-hour emergency response capabilities, including an emergency-only phone number, which accepts collect charges. The number would be included in informational mail-outs, posted on all pipeline markers (installed at public road crossings), and provided to local emergency agencies in the vicinity of the pipeline and compressor station.

As part of Pacific Connector's ERP, operations personnel would attend training for emergency response procedures and plans prior to commencing pipeline operations. Pacific Connector would meet with local emergency responder groups (fire departments, police departments, land-managing agencies including the BLM, Forest Service, and Reclamation, and other public officials) to review plans and would work with these groups to communicate the specifics about the pipeline facilities in the area and the need for emergency response. Pacific Connector would also meet periodically with the groups to review the plans and revise them when necessary. If requested by local public emergency response personnel, Pacific Connector would participate in any operator-simulated emergency exercises and post-exercise critiques. Pacific Connector would use adequate local or contract resources to support the pipeline and facilities if an emergency occurs.

All of the information that Pacific Connector gathers about its system would be used to tailor its safety and integrity management activities, so that parts of the system in the greatest need of attention receive greater scrutiny, such as residential areas or areas subject to growth and development. For example, Pacific Connector would decide where and when to internally inspect the pipeline based on this information. Risk assessment of the pipeline system determines what inspection criteria are required. This may include many different types of assessment tools that provide specific types of information about the condition of the pipeline.

The Klamath Compressor Station would also be equipped with automatic emergency detection and shut down systems. For example, the station would have hazardous gas and fire detection systems, and an emergency shutdown system. These safety and emergency systems would be tested routinely to ensure they are operating properly. The emergency shutdown system would be designed to shut down and isolate elements of the compressor station in the event of a fire, before the development of a flammable mixture of gas could occur. The system would include sensors for detecting natural gas concentrations as well as ultraviolet sensors for detecting flames. Additionally, the compressor station equipment would be designed to shut down automatically if a mechanical failure poses risk to the equipment or otherwise constitutes a hazard. The compressor station would be equipped with relief valves to protect the piping from over pressurization and would be equipped with a blowdown system that can safely and rapidly depressurize part or all of the compressor station to a safe location.

Personnel would be able to respond to a compressor station emergency in 60 minutes or less during non-scheduled work hours and within a few minutes if they are at the compressor station. Personnel would be on call at all times, 24 hours a day, 365 days a year to respond to emergencies. Emergencies while the compressor station is unattended would be monitored remotely via Pacific Connector's gas control facility. Personnel living within a 30-minute travel time of the compressor station would be dispatched by the gas control facility in the event of an emergency at the compressor station.

Personnel would be Operator Qualified per USDOT PHMSA requirements for operational and emergency situations at the station. Fire protection, first aid, and safety equipment would be maintained at the compressor station, and personnel would be trained in first aid and proper equipment use.

The Pacific Connector pipeline would cross areas subject to ongoing and future land management activities on federal lands managed by BLM, Forest Service, and Reclamation. Pacific Connector would be required to prepare a POD for activities on these federal lands that also addresses other safety and reliability measures requested by the BLM, Forest Service, and Reclamation. The BLM, Forest Service, and Reclamation would review and approve draft plans to ensure all safety concerns associated with construction and operation of the proposed Pacific Connector pipeline on federally managed lands are addressed.

Pipeline Standards to Minimize Fire Risk to Forest Lands

The Pacific Connector pipeline would be in areas where forest fires could occur. Pacific Connector proposes to meet or exceed USDOT pipeline burial depth requirements (found in 49 CFR Part 192) and would install the Pacific Connector pipeline with at least 36 inches of cover in Class I locations with normal soils and at least 24 inches of cover in consolidated rock areas.

Pursuant to 49 CFR §192.615, each pipeline operator must also develop an ERP that includes procedures to minimize the hazards in the event of a natural gas pipeline emergency. The key elements of the required plan include establishing and maintaining communications with local fire officials and coordinating emergency response, emergency shutdown of the system and safe restoration of service, making personnel, equipment, tools, and materials available at the scene of an emergency, and protecting people and property from hazards. Part 192 specifically requires that each pipeline operator establish and maintain liaison with appropriate fire officials to learn the resources and responsibilities of each organization that may respond to a natural gas pipeline emergency, and must coordinate mutual assistance. The previous discussion in section 4.13.1 describes the specific emergency response capabilities of the Project.

In addition, in compliance with the federal requirements discussed above, Pacific Connector must develop an ERP for the entire system. A draft ERP was included as Appendix H to the POD.[273] The ERP requires operations personnel to attend training for emergency response procedures and requires the pipeline operators to meet with local emergency responder groups, including fire departments, to review plans and educate the responder groups on the specifics of the pipeline facilities within the relevant service area. After the initial coordination with local responders, Pacific Connector would also meet periodically with the groups to review plans and revise them when necessary. Finally, if requested by local response personnel, Pacific Connector would participate in any simulated emergency exercises and post-exercise critiques. Through these coordination activities, the fire response personnel would become familiar with the location and specific safety and fire issues associated with the pipeline. This information would significantly reduce risks to the fire response personnel responding to a fire either caused by or in the vicinity of the pipeline alignment. The majority of the training costs would be borne by Pacific Connector; therefore, the coordination requirements would not significantly increase fire suppression costs.

In the event a fire was to occur on the surface in the vicinity of the pipeline, the presence of the pipeline would not increase fire hazards. Fires on the surface are not a direct threat to underground natural gas pipelines because of the insulating effects of soil cover over the pipeline. Soil is a poor conductor of heat with thermal conductivity values ranging from 0.44 to 1.44 Btu/ft-hr-°F. The heat capacity of most soils is 0.20 to 0.25 Btu/lb-°F. Based on the proposed burial depth of 24 to 36 inches, and the insulating effects of soil cover over the pipeline, we do not believe that forest fires would affect pipeline integrity. In addition, we do not believe that additional burial depth beyond what is proposed by Pacific Connector would be necessary to protect against damage by forest fires.

When forest fires arise in the area, Pacific Connector would closely monitor and protect the pipeline from wildfires. Pacific Connector would also have facilities built along the pipeline to aid in protecting the pipeline from wildfires. Along with Pacific Connector's pipeline control there are MLV sites on the pipeline to aid in isolating which portions of the pipeline have product in them. Pacific Connector would be in communications with emergency management office and monitoring the wildfires. Pacific Connector can determine what actions need to be taken to protect the pipeline and facilities in the area of the wildfires. If a wildfire was near Pacific Connector's facility locations or an MLV site, Pacific Connector would consider shutting down and isolating those facilities until the fire risk was mitigated. After all threats to safety for the area were assessed those facilities would be inspected to ensure there was no damage from the fire before restarting. In past situations, local operation personnel have protected above ground mainline valves by burying the valves with sand and earth material. Pacific Connector remains in close

[273] Pacific Connector's POD was filed with the FERC on January 23, 2018.

communication with its operations staff at each of their locations to ensure the circumstance of the fire is tended to accordingly.

Pacific Connector has also developed a *Fire Prevention and Suppression Plan.*[274] This plan is consistent with Forest Service and BLM policies and current practices. Although designed for federal lands, it would be applicable to the entire pipeline route; regardless of landownership. The intent of the plan is to identify measures to minimize the chances of a fire starting and spreading from project facilities and to reduce the risk of wildland and structural fire.

4.13.2.2 Pipeline Accident Data

The USDOT requires all operators of natural gas transmission pipelines to notify the USDOT of any significant incident and to submit a report within 20 days. Significant incidents are defined as any leaks that:

- caused a death or personal injury requiring hospitalization; or
- involve property damage of more than $50,000 (1984 dollars[275]).

During the 20-year period from 1996 through 2015, a total of 1,310 significant incidents were reported on the more than 300,000 total miles of natural gas transmission pipelines nationwide.

Additional insight into the nature of service incidents may be found by examining the primary factors that caused the failures. Table 4.13.2.2-1 provides a distribution of the causal factors as well as the number of each incident by cause.

TABLE 4.13.2.2-1

Natural Gas Transmission Pipeline Significant Incidents by Cause (1996–2015) a/

Cause	No. of Incidents	Percentage
Corrosion	311	23.7
Excavation b/	210	16.0
Pipeline material, weld or equipment failure	354	27.0
Natural force damage c/	146	11.1
Outside force d/	84	6.4
Incorrect operation	40	3.1
All other causes e/	165	12.6
Total	**1,310**	**100**

a/ All data gathered from PHMSA Significant Transmission Pipeline Incident files. https://hip.phmsa.dot.gov/analyticsSOAP/saw.dll?Go
b/ Includes third-party damage.
c/ Natural force damage includes earth movement, heavy rain, floods, landslides, mudslides, lightning, temperature, high winds, and other natural force damage
d/ Outside force damage includes previous mechanical damage, electrical arcing, static electricity, fire/explosion, fishing/maritime activity, intentional damage, and vehicle damage (not associated with excavation
e/ Miscellaneous, unspecified, or unknown causes.

The dominant causes of pipeline incidents are corrosion and pipeline material, weld or equipment failure constituting 50.7 percent of all significant incidents. The pipelines included in the data set

[274] Included as Appendix K to Pacific Connector's 2018 POD (see appendix F.10 of this EIS).
[275] $50,000 in 1984 dollars is approximately $122,000 based on the March 2018 Consumer Price Index.

in table 4.13.2.2-1 vary widely in age, diameter, and level of corrosion control. Each variable influences the incident frequency that may be expected for a specific segment of pipeline.

The frequency of significant incidents is strongly dependent on pipeline age. Older pipelines have a higher frequency of corrosion incidents, since corrosion is a time-dependent process. The use of both an external protective coating and a cathodic protection system[276], required on all pipelines installed after July 1971, significantly reduces the corrosion rate compared to unprotected or partially protected pipe.

Outside forces are the cause in 33.5 percent of significant pipeline incidents. These result from the encroachment of mechanical equipment such as bulldozers and backhoes; earth movements due to soil settlement, washouts, or geologic hazards; weather effects such as winds, storms, and thermal strains; and willful damage.

Older pipelines have a higher frequency of outside forces incidents partly because their location may be less well known and less well marked than newer lines. In addition, the older pipelines contain a disproportionate number of smaller-diameter pipelines; which have a greater rate of outside forces incidents. Small-diameter pipelines are more easily crushed or broken by mechanical equipment or earth movement. Table 4.13.2.2-2 shows the various causes of outside force incidents.

TABLE 4.13.2.2-2

Outside Forces Significant Incidents by Cause (1996-2015) a/

Cause	No. of Incidents	Percent of all Incidents b/, c/
Third-party excavation damage	172	13.6
Operator excavation damage	25	1.9
Unspecified excavation damage/previous damage	13	1.0
Heavy rain/floods	74	5.7
Earth movement	32	2.4
Lightning/temperature/high winds	27	2.1
Natural force (unspecified and other)	13	1.0
Vehicle (not engaged with excavation)	49	3.7
Fire/explosion	9	0.7
Previous mechanical damage	6	0.5
Fishing or maritime activity	9	0.7
Intentional damage	1	0.1
Electrical arcing from other equipment/facility	1	0.1
Other outside force	9	0.7
Total	**440**	**33.5**

a/ All data gathered from PHMSA Significant Transmission Pipeline Incident files. https://hip.phmsa.dot.gov/analyticsSOAP/saw.dll?Go
b/ Percentage of all incidents was calculated as a percentage of the total number of natural gas transmission pipeline significant incidents (i.e., all causes) presented in table 4.13.9.2-1.

Since 1982, operators have been required to participate in "One Call" public utility programs in populated areas to minimize unauthorized excavation activities in the vicinity of pipelines. The "One Call" program is a service used by public utilities and some private sector companies (e.g.,

[276] Cathodic protection is a technique to reduce corrosion (rust) of the natural gas pipeline through the use of an induced current or a sacrificial anode (like zinc) that corrodes at faster rate to reduce corrosion.

oil pipelines and cable television) to provide preconstruction information to contractors or other maintenance workers on the underground location of pipes, cables, and culverts.

4.13.2.3 Impact on Public Safety

Pipeline Construction

Active pipeline construction can increase safety risks to the public generally in two ways, from an increase of traffic on roadways in the vicinity of the pipeline, and from potential exposure to construction activity itself within the construction right-of-way.

During periods of active construction, roadways in the vicinity of the pipeline project would experience an increase in small vehicle traffic from the construction work force, as well as large vehicle traffic transporting construction equipment and materials. Where the pipeline would cross roadways, access to and from the right-of-way by construction vehicles and construction activity itself at the roadway crossing could disrupt traffic and create potential safety hazards to the public. Pacific Connector has developed Transportation Plans for both private and federal lands that describe measures that it would implement to minimize public access and safety concerns as a result of construction vehicle traffic and construction activity at roadway crossings (see additional discussion in section 4.10). In addition, Pacific Connector would obtain all necessary permits for public roadway crossings and roadway use, and would comply with traffic control and public safety mitigation measures that are conditions of these permits.

During pipeline construction, the general public could be exposed to safety hazards within the pipeline construction right-of-way itself. Hazards would be typical of a construction site involving clearing, grading, and excavation, and could include timber felling, heavy equipment operation including on steep slopes, open trench, falling or rolling rock on steep slopes, and fly rock from blasting. During active construction the contractor and company personnel present on the job would limit access to the public to potentially hazardous situations such as operation of heavy equipment, or blasting for trench excavation. During construction off hours, the public could be exposed to hazards such open trench or loose rock. Locating the pipeline in non-populated areas helps to minimize the chance for unauthorized public access to the right-of-way.

Where the pipeline would be placed within residential areas, Pacific Connector would minimize impacts and potential safety hazards by ensuring that the construction proceeds quickly through such areas. Where the construction work area would be within 50 feet of a residence, Pacific Connector would install safety fence along the edge of the work area for a distance of 100 feet on either side of the residence. Fencing would be maintained, at a minimum, throughout the open trench phases of pipeline installation. Where feasible, Pacific Connector has reduced the width of the construction right-of-way near residences and placed TEWAs as far as practicable from the residences. In residential areas Pacific Connector would also limit the period of time the trench remains open prior to backfilling to 10 days. For the residences within 50 feet of the proposed right-of-way, Pacific Connector has developed site-specific plans showing the temporary and permanent rights-of-way and noting special construction techniques and mitigation measures.

The BLM, Forest Service, and Reclamation can require Pacific Connector to incorporate additional specific public safety measures into the POD as a condition of a Right-of-Way Grant for use of federal lands.

Pipeline Operation

During pipeline operation Pacific Connector would comply with the USDOT pipeline safety standards as well as regular monitoring and testing of the pipeline. While pipeline failures are rare, the potential for pipeline systems to rupture and the risk to nearby residents is discussed below.

The serious incidents data summarized in table 4.13.2.3-1 include pipeline failures of all magnitudes with widely varying consequences. Table 4.13.2.3-1 presents the average annual injuries and fatalities that occurred on natural gas transmission lines in the 5-year period between 2013 and 2017.

TABLE 4.13.2.3-1

Injuries and Fatalities – Natural Gas Transmission Pipelines

Year	Injuries	Fatalities
2013	2	0
2014	1	1
2015	16	6
2016	3	3
2017	3	3

The majority of fatalities from pipelines are due to local distribution pipelines not regulated by the FERC. These are natural gas pipelines that distribute natural gas to homes and businesses after transportation through interstate natural gas transmission pipelines. In general, these distribution lines are smaller diameter pipes and/or plastic pipes which are more susceptible to damage. Local distribution systems do not have large rights-of-way and pipeline markers common to the FERC-regulated natural gas transmission pipelines.

The nationwide totals of accidental fatalities from various anthropogenic and natural hazards are listed in table 4.13.2.3-2 to provide a relative measure of the industry-wide safety of natural gas transmission pipelines. Direct comparisons between accident categories should be made cautiously, however, because individual exposures to hazards are not uniform among all categories. The data nonetheless indicate a low risk of death due to incidents involving natural gas transmission pipelines compared to the other categories. Furthermore, the fatality rate is much lower than the fatalities from natural hazards such as lightning, tornados, or floods.

TABLE 4.13.2.3-2

Accidental Deaths by Cause

Type of Accident	Number of Fatalities a/
All injuries (unintentional)	146,571
Motor vehicle accident	37,757
Poisoning (unintentional)	47,478
Falls (unintentional)	33,381
Suffocation (unintentional)	6,917
Drowning (unintentional)	3,602
Fire/flame (unintentional)	2,646
Floods b/	84
Lightning b/	47
Natural gas distribution lines c/	11
Natural gas transmission pipelines c/	3

a/ All data, unless otherwise noted, reflect 2015 statistics from the National Vital Statistics Reports https://www.cdc.gov/nchs/data/nvsr/nvsr66/nvsr66_06.pdf
b/ NOAA National Weather Service, Office of Climate, Water and Weather Services, 30-year average (1987-2016) http://www.weather.gov/om/hazstats.shtml.
c/ PHMSA significant incident files, March 16, 2018. https://hip.phmsa.dot.gov/analyticsSOAP/saw.dll, 20-year average.

The available data show that natural gas transmission pipelines continue to be a safe, reliable means of energy transportation. From 1998 to 2017, there were an average of 68 significant incidents, 9 injuries, and 3 fatalities per year. The number of significant incidents over the more than 2.21 million miles of natural gas transmission lines in service indicates that the risk is low for an incident at any given location. The operation of the Pacific Connector pipeline would represent a slight increase in risk to the nearby public.

4.13.3 Conclusion

As part of the NEPA review and NGA determinations, Commission staff assesses the potential impact on the human environment in terms of safety and whether the proposed facilities would operate safely, reliably, and securely.

As a cooperating agency, the USDOT assists the FERC by determining whether Jordan Cove LNG Project's proposed design would meet the USDOT's 49 CFR 193 Subpart B siting requirements. On September 11, 2019, the USDOT PHMSA provided a LOD on the Project's compliance with 49 CFR 193 Subpart B. This determination is provided to the Commission as further consideration to the Commission on its decision to authorize or deny the Project. If the Project is authorized, constructed, and operated, the facility would be subject to the USDOT's inspection and enforcement program and final determination of whether a facility is in compliance with the requirements of 49 CFR 193 would be made by the USDOT staff.

As a cooperating agency, the Coast Guard also assisted the FERC staff by reviewing the proposed LNG terminal and the associated LNG marine vessel traffic. The Coast Guard reviewed a WSA submitted by Jordan Cove that focused on the navigation safety and maritime security aspects of LNG marine vessel transits along the affected waterway. On May 10, 2018, the Coast Guard issued an LOR that recommended the Coos Bay Channel be considered suitable for accommodating the type and frequency of LNG marine traffic associated with this Project based on the WSA and in accordance with the guidance in the Coast Guard's NVIC 01-11. If the Project is authorized, constructed, and operated, the facilities would be subject to the Coast Guard's inspection and enforcement program to ensure compliance with the requirements of 33 CFR 105 and 33 CFR 127.

FERC staff conducted a preliminary engineering and technical review of the Jordan Cove LNG Project design, including potential external impacts based on the site location. Based on this review, we recommend a number of mitigation measures, which would ensure continuous oversight prior to initial site preparation, prior to construction of final design, prior to commissioning, prior to introduction of hazardous fluids, prior to commencement of service, and throughout life of the facility to enhance the reliability and safety of the facility to mitigate the risk of impact on the public. With the incorporation of these mitigation measures and oversight, FERC staff concluded that the Jordan Cove LNG Project design would include acceptable layers of protection or safeguards that would reduce the risk of a potentially hazardous scenario from developing into an event that could impact the offsite public.

If authorized, the pipeline would be constructed in compliance with the USDOT PHMSA pipeline standards (as published in 49 CFR Parts 190-199). Based on the implementation of the required BMPs and adherence to the USDOT PHMSA standards, the Project would not significantly affect public safety.

4.14 CUMULATIVE IMPACTS

Coastal and southern Oregon have been affected by human activity for thousands of years and the existing environmental conditions in the Project area reflect the extensive changes to natural resources brought about by past human actions and activities. In 1850, there were about 432,808 acres of farmland in Oregon. By 1954, farmland increased to 21 million acres. In 2007, 16.4 million acres in Oregon were used for agriculture (Ballard 1959; Sorte et al. 2011). Agricultural activities have modified the environment through land clearing, water diversion for irrigation, and planting of non-native species.

Oregon has lost an estimated 38 percent of its original wetlands (Morlan 2000). Most Oregon estuaries have been significantly altered through the diking and draining of marshes in the early to mid-1900s for agricultural use and urban development. Between 1870 and 1970, tidal wetlands within the Coos Bay estuary decreased an estimated 66 percent (Oregon Progress Board 2009). According to the COE, it has been responsible for maintaining navigable waterways of the North Pacific Coast since 1871. Navigational access needs at Coos Bay and River originated from the need to provide access for ocean-going vessels to support coal, timber, and fishery industries in the mid to late 1800s. Navigational improvements over the past century beginning in 1908 have consisted of construction of Entrance Channel jetties and the deepening and widening of channels (1925, 1952, 1972, and 1988) and turning basins throughout the area to provide efficient access to vessels of increasing size and capacity.

Large-scale clearing of forests in the region began with Euro-American settlement. Initially, forests in the valley floors were cleared to make way for agriculture. Lowland areas close to population centers were logged first, followed by the less accessible areas in more mountainous terrain. Shortly after World War II, technological improvements led to increased logging in the region. There was a boom in demand for wood products during the 1950s and 1960s, with a post-war need for framing lumber and plywood for new housing. More than 70 timber mills and plywood plants opened in Oregon between 1940 and 1960, including plants in North Bend, Coos Bay, and Coquille. As timber inventories on private lands were depleted, pressure to harvest timber on federal lands increased. In 1952, western Oregon's peak year for timber production, about one-third of the 10.4 billion board feet harvested came from federal lands. By 1963, more timber was harvested on federal lands than private lands.

As a result of over a century of logging and fire suppression, the forests of the Pacific Northwest have been generally characterized by recent clearcuts, thinned stands, and young plantations interspersed with unmanaged stands. The remaining unmanaged stands range from 1,000-year-old or older forests with large trees to relatively young, even-aged stands that have regenerated following wildfires. Because wildfires and windstorms often resulted in the partial loss trees in a stand, natural stands are frequently characterized by a mixture of trees that survived a catastrophic event and younger trees that filled in the understory after the event. Where many large old trees remain in the overstory, these stands have been referred to as "old growth," "late successional," or "ancient" forests (FEMAT 1993). Where only scattered individuals or patches of large old trees remain and the majority of the stand consists of young or mature trees, stands are referred to as "mixed age" or even "young." Mixed-age stands are particularly common in some areas, such as the Oregon Coast Range, where extensive fires occurred in the 1800s. Wildlife associated with or dependent on these late-successional and old-growth forests, such as the federally listed endangered NSO and MAMU, have been negatively affected by habitat loss (see section 4.6 of this EIS).

Today, Oregon's environment reflects a mixture of natural processes and human influences across a range of conditions, from areas defined by relatively natural structures and functions to areas completely dominated by human activities (Oregon Progress Board 2000). In the past decade, large, stand-replacing wildfires have affected public lands in southwest Oregon. Since the inception of the NWFP in 1994, the majority of the NSO habitat loss in the region has been the result of stand-replacing wildfire.

Concerning past actions and activities, the CEQ issued an interpretive memorandum on June 24, 2005, stating: "agencies can conduct an adequate cumulative effects analysis by focusing on the current aggregate effects of past actions without delving into the historical details of individual past actions." The aforementioned actions and activities are included herein to provide historical context. To account for the contribution of past actions, this analysis relies on current environmental conditions as a proxy for the effects of past actions. Existing environmental conditions reflect the aggregate effects of all prior human actions and natural events. In this analysis, we generally consider the effects of past projects as part of the affected environment (environmental baseline) which was described previously. However, this analysis does consider, as applicable, the present effects of past actions. f

Furthermore, regarding past actions, this analysis is also consistent with Forest Service implementing NEPA Regulations (36 CFR 220.4(f)) (July 1, 2012), which state, in part:

> *"CEQ regulations do not require the consideration of the individual effects of all past actions to determine the present effects of past actions. Once the agency has identified those present effects of past actions that warrant consideration, the agency assesses the extent that the effects of the proposal for agency action or its alternatives will add to, modify, or mitigate those effects. The final analysis documents an agency assessment of the cumulative effects of the actions considered (including past, present, and reasonable foreseeable future actions) on the affected environment. With respect to past actions, during the scoping process and subsequent preparation of the analysis, the agency must determine what information regarding past actions is useful and relevant to the required analysis of cumulative effects. Cataloging past actions and specific information about the direct and indirect effects of their design and implementation could in some contexts be useful to predict the cumulative effects of the proposal. The CEQ regulations, however, do not require agencies to catalogue or exhaustively list and analyze all individual past actions. Simply because information about past actions may be available or obtained with reasonable effort does not mean that it is relevant and necessary to inform decision making. (40 CFR 1508.7)"*

In accordance with the NEPA, we identified other actions near the Project facilities and evaluated the potential for a cumulative effect on the environment. As defined by the CEQ, a cumulative effect is the impact on the environment resulting from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions, regardless of which agency or person undertakes such other actions. "Past" actions were addressed in the preceding discussion. "Present" actions are those currently ongoing, either being constructed or are in operation and affecting the environment in such a manner that could contribute to a cumulative impact. "Reasonably foreseeable actions" are proposed projects or developments that have applied for a permit from local, state, or federal authorities or planned projects which have been publicly announced.

Numerous commenters on the draft EIS identified Project-induced increases in North American gas production and coal use, and an increase in global natural gas use, as connected actions and reasonably foreseeable projects that should be considered in this analysis. As described further below, a project potentially contributing to a cumulative effect must affect the same resource in the same general area as the Project to have a cumulative impact on that resource. Induced production and consumption, often referred to as "upstream and downstream" impacts and often associated with "life cycle" emissions, are not regulated by the Commission and are not addressed in this analysis because their impacts would occur outside of the "geographic scopes" (see discussion below) identified for potential cumulative impacts, and therefore would not contribute to a cumulative impact. Any impacts associated with an increase in coal use (or construction of coal-fired electrical generation) would occur outside the area (geographic scope) considered for cumulative impacts and are not considered in this analysis.

We also received numerous comments on the draft EIS stating that natural disasters including tsunamis, earthquakes, wildfires, and landsides are reasonably foreseeably actions that must be considered in this analysis. The aforementioned natural disasters have occurred throughout Oregon's history resulting in significant adverse environmental impacts; however, predicting the location, magnitude, and resulting impacts of a natural disaster which can vary substantially depending on the nature of the disaster and the location is speculative.

Consistent with CEQ guidance, and cooperating agencies' regulations and recommendations, we identified and considered present and reasonably foreseeable actions within an appropriate "geographic scope". The geographic scopes considered in this analysis vary depending on the environmental resource and are identified in table 4.14-1. Actions located outside the geographic scopes are not evaluated because their potential to contribute to a cumulative impact diminishes with increasing distance from the Project.

A nearby project must affect the same resource as the Project to have a cumulative impact on that resource. As previously stated, the effects of more distant actions/projects (outside the HUC 10 or HUC 8 watersheds) are not assessed because their impacts are not expected to overlap with the Project; and therefore, would not contribute to a cumulative impact. Two examples representing opposite ends of the spectrum with regard to geographic scope are cultural resources and air quality. With exceptions, Project effects on cultural resource sites are localized in nature. A direct impact on an archaeological site would typically not affect other sites; therefore, the geographic scope for archaeological sites is limited to the area within which sites could be directly or indirectly affected by an action. In contrast, the impact of air emissions could be felt over a relatively large distance; therefore, the geographic scope for air quality is larger than for other resources. When determining the significance of a cumulative impact, 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.

As identified in table 4.14-1, we primarily consider HUC 10 (fifth-field) watersheds crossed as the geographic scope for potential cumulative impacts. The Project facilities would be located within 19 HUC 10 watersheds (figures 4.14-1a and 4.14-1b). Additionally, the COE currently considers HUC 8 (fourth-field) watershed to assess cumulative effects, therefore, we are including impacts and compensatory mitigation information provided by the COE within the larger HUC 8 watershed area for analysis of cumulative impacts on wetlands and surface waters. Project facilities would be located within six HUC 8 watersheds. Within these watersheds we have identified six general actions/project types that could contribute to a cumulative impact. These actions are: COE permits and mitigation projects, minor federal agency projects (including road/utility improvements, water flow control, weed treatments, and miscellaneous mitigation), residential and commercial development, timber harvest and forest management activities, livestock grazing, and solar power panel fields.

TABLE 4.14-1

Geographic Scope, by Resource, for Cumulative Effects Analysis

Resource	Geographic Scope	Rationale for Potential Cumulative Impact Analysis Area
Soils	HUC-10 watersheds	Projects within the HUC-10 watershed could contribute to cumulative impacts on soils within the watershed; therefore, the Project would result in additional incremental impacts on soils within the HUC-10 watersheds.
Water Resources and Wetlands	HUC-10 watersheds HUC-8 watersheds for COE wetland mitigation projects	Projects within the HUC-10 watershed could contribute to cumulative impacts on water resources and wetlands within the watershed.
Vegetation	HUC-10 watersheds	Projects within the HUC-10 watershed could contribute to cumulative impacts on vegetation within the watershed
Wildlife and Aquatic Resources	HUC-10 watersheds HUC-10 watersheds combined marine waters outside of Coos Bay	Projects within the HUC-10 watershed could contribute to cumulative impacts on wildlife and aquatic resources within the watershed; for MAMU and NSO (see text), watersheds were combined to better assess cumulative effects to these species; and projects from the mouth of Coos Bay to the outer continental shelf could contribute to impacts on listed marine species
Land Use	HUC-10 watersheds	Projects within the HUC-10 watershed could contribute to cumulative impacts on land use within the watershed
Recreation and Visual Resources	HUC-10 watersheds Viewshed from which Project construction or permanent facilities can be seen	Projects within the HUC-10 watershed could contribute to cumulative impacts on recreation; and projects within the viewshed of the Project could contribute to cumulative impacts on visual resources
Socioeconomics	Coos, Douglas, Jackson, and Klamath counties	Projects within the four counties with proposed Project facilities could contribute to cumulative impacts on socioeconomics
Environmental Justice	The census tracts directly affected by the Project	Projects within the census tracts directly affected by the proposed Project facilities could contribute to cumulative impacts on Environmental Justice communities
Transportation	Coos, Douglas, Jackson, and Klamath counties and the Coos Bay Federal Navigation Channel	Projects within the four counties with proposed Project facilities, as well as those along the Coos Bay Federal Navigation Channel could contribute to cumulative impacts on transportation
Cultural Resources	Direct and indirect Area of Potential Effect (APE)	Projects within the disturbance footprint (direct APE) or adjacent areas that could potentially experience visual, atmospheric, or audible cumulative impacts from Project construction or operation (indirect APE) could contribute to cumulative impacts on cultural resources
Air Quality	Within 0.25 mile of construction, and 50 km of LNG terminal and Klamath Compressor Station during operation	Projects within these geographic scopes could contribute to cumulative impacts on air quality during construction and operation GHGs do not have a localized geographic scope. GHG emissions from the Project would combine with emissions from projects world-wide to increase CO2, methane, and other GHG concentrations in the atmosphere.
Noise	Within 0.25 mile (daytime) and 0.5 mile (nighttime) of construction, and 1 mile of LNG terminal and Klamath Compressor Station during operation	Projects within these geographic scopes could contribute to cumulative impacts on daytime and nighttime noise during construction and operation

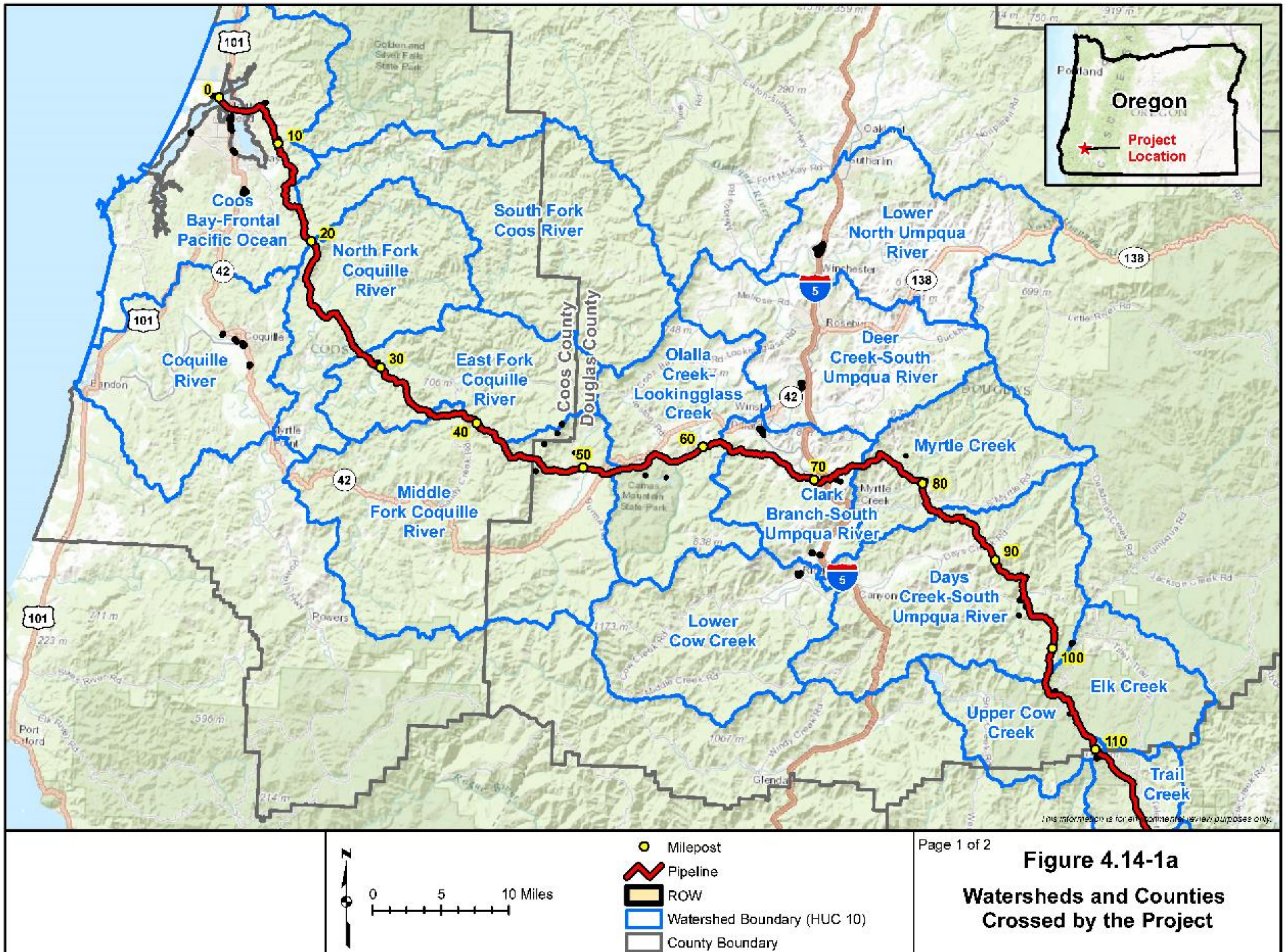

Figure 4.14-1a

Watersheds and Counties Crossed by the Project

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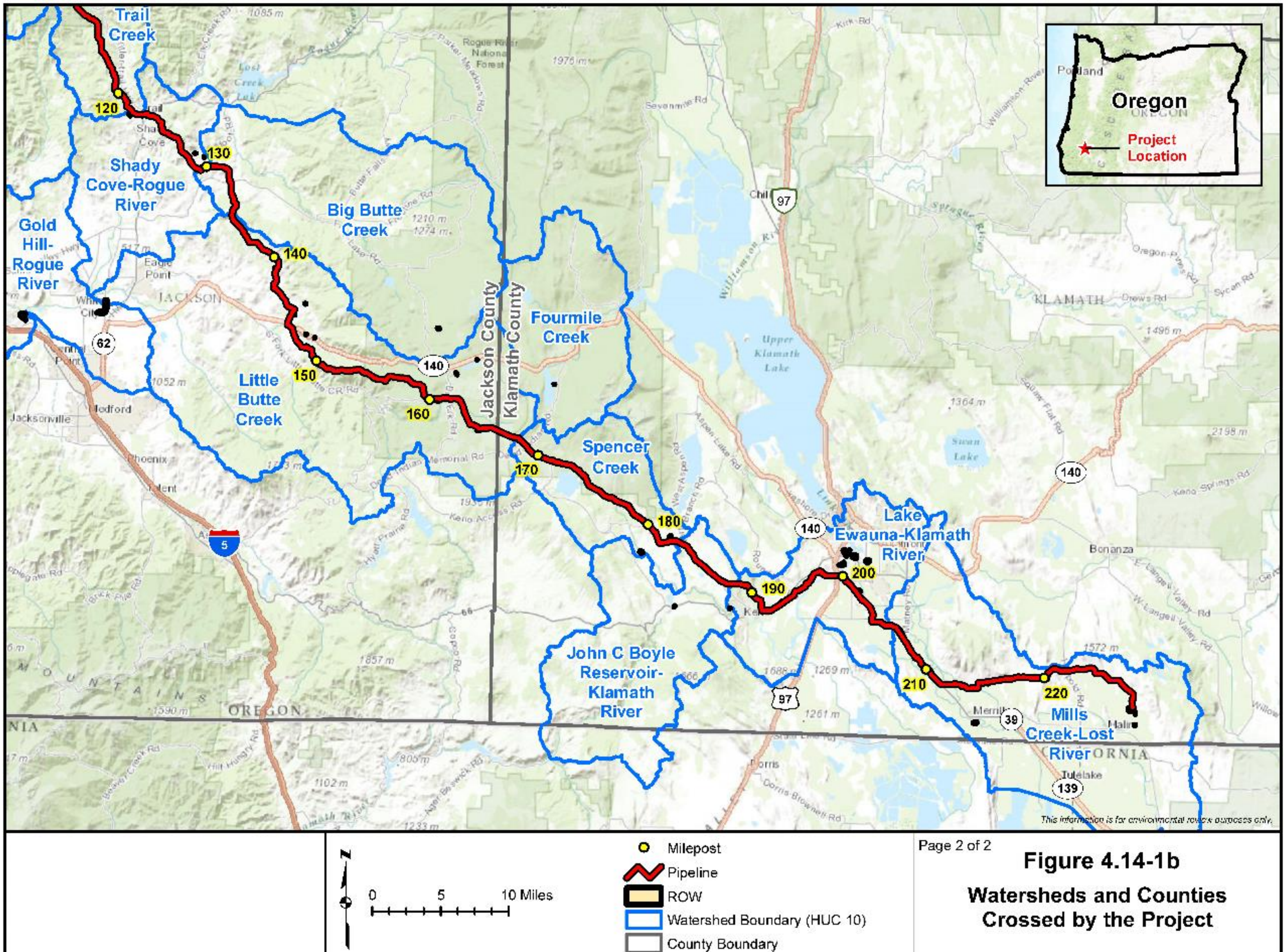

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Figure 4.14-1b

Watersheds and Counties Crossed by the Project

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Of these six project types, some additional context is necessary for livestock grazing and timber harvest and forest management activities. Livestock grazing accounts for the largest amount of affected land of any of the project types considered (approximately 292,000 acres or about 83 percent of the projects considered in our analysis). It also occupies a complex temporal niche in that grazing, having occurred for over 200 years in Oregon, is both a past, present and reasonably foreseeable activity and a large component of the affected environment. That is, the continuation of grazing is now essentially just the maintenance of the existing environment. The exception, of course, is for the addition of lands not previously open to grazing. Any additions would include an episodic and conversional set of impacts that would be cumulative with the resources also affected by the Project if they occurred during construction and restoration of the pipeline.

The continued use of grazed lands does not contribute episodic impacts, but rather ongoing perturbation that may have a set of related resource impacts, such as suppression of arboreal and natural vegetative communities that would otherwise develop. In addition, livestock grazing disrupts soil profiles, breaks down stream banks, and contributes to water quality degradation of streams. Accordingly, we characterize livestock grazing impacts as ongoing, landscape-level impacts with relatively small incremental impacts distributed over the present and future timeframe that is also affected by the Project. Consequently, livestock grazing impacts during any discrete period of time, such as the limited period that pipeline construction would occur within a given HUC-10 watershed, contributes only minor impacts on the resources also affected by the Project. For this reason, we identify ongoing livestock grazing projects in our list of projects within the geographic scope of our cumulative impacts analysis, but unless otherwise noted, we do not include them in our analysis of potential cumulative impacts on each resource.

Timber harvesting and forest management activities account for the second largest amount of affected land of the project types considered (50,950 acres or about 14 percent of the projects considered in our analysis). Timber harvesting and forest management impacts are episodic and conversional. Timber harvesting dramatically alters multiple interlaced resources including vegetative and wildlife communities, soils, water resources, and visual aesthetics. In addition to the larger scale of the impacts, there is a longer-term temporal impact. While revegetation of affected communities may be allowed to occur after harvesting, complete restoration (i.e., the point in which the affected area no longer contributes to cumulative impacts) is most often measured in decades.

Additionally, non-jurisdictional utilities at the terminal site, the use of LNG carriers, ongoing maintenance dredging, the Coos Bay, Oregon Section 408/204(f) Channel Modification, Project impact mitigation projects, and the removal of PacifiCorp dams on the Klamath River could also contribute to a cumulative impact(s). Table 4.14-2 identifies these actions by watershed, and table N-1 in appendix N lists the resources each project could affect and summarizes the area of known impacts. We generally do not include in our analysis projects such as small commercial developments, single-family homes and condominiums, and small road projects located within towns and other developed areas, because these actions have a small footprint, are consistent with surrounding land uses, and contribute only minutely to cumulative impacts on the resources evaluated in this EIS.

In addition to the geographic relationship between the Project and other projects, we also consider the temporal relationship. For the purposes of this analysis, and as noted in the preceding discussion, the temporal extent of other projects would start generally in the past[277] and extend out for the expected duration of the impacts caused by the Project.

Not all future projects and actions that have been identified or are suspected to occur within the Project area are well defined with regard to scope, location, timing, and resource footprint. Without specific information, inclusion of these projects may not be meaningful. For example, between 2010 and 2017, the populations in the counties crossed by the Project have grown by an average of about 4 percent; and along with that growth, numerous residential subdivisions, commercial developments, roads and utilities, and maintenance and upgrading of existing infrastructure have been constructed (or were proposed). If growth continues, similar future actions may occur, affecting a range of natural resources, including soils, waterbodies and wetlands, vegetation, and wildlife. There is also the potential that over time federal and state agencies and private conservation organizations may implement projects and actions that improve habitat, water quality, and air quality throughout the Project area. Most such projects would likely be mitigation projects designed to offset impacts from other regulated projects. It is not possible to quantify or assess the potential cumulative impacts or benefits that may accrue from these undefined future projects. In addition, we anticipate that at a future date the Forest Service and BLM may address the cumulative effects of currently undefined Project-related mitigation actions that these agencies may require on Forest Service-managed lands (or proactively offered by the Applicant on BLM-administered lands).

The ESA defines cumulative effects as the "effects of future state or private activities, not involving Federal activities (Federal activities are subject to project-specific, individual ESA reviews), that are reasonably certain to occur within the action area of the Federal action subject to consultation." The determinations of effect in the BA consider cumulative effects. Additionally, the Services are required to consider cumulative effects in formulating their biological opinions (50 CFR §402.14(g)(3) and (4)). In the BA, we refer the Services to this discussion to assist in their development of biological opinions.

[277] We consider only those past projects that contribute ongoing effects on resources. Generally, more recent projects contribute a greater impact.

TABLE 4.14-2

Past, Present, or Reasonably Foreseeable Actions that May Cumulatively Affect Resources a/

Project	County
Coos Bay-Frontal Pacific Ocean Watershed	
COE - Permits and Mitigation (**Coos Fourth-Field Watershed)**	Various
Non-jurisdictional facilities - LNG carriers and Utility Connections	Coos
Jordan Cove – Maintenance Dredging	Coos
Jordan Cove – Project impact mitigation	Coos
Port of Coos Bay - Coos Bay Railroad Bridge Rehabilitation	Coos
Port of Coos Bay – Maintenance Dredging	Coos
Port of Coos Bay – Coos Bay Rail Line Tunnel Rehabilitation	Coos
COE - Coos Bay Jetties Rehabilitation Project	Coos
CTCLUSI - Coos Head Area Master Plan, Hollering Place	Coos
City of North Bend – Department of Human Services Building Relocation	Coos
Port of Coos Bay - Coos Bay Section 408/204(f) Channel Modification b/	Coos
COE - Coos Bay Federal Navigation Channel Maintenance Dredging	Coos
Coos County Airport District — Southwest Oregon Regional Airport Expansion	Coos
ORDOT – McCullough Bridge Painting	Coos
Tioga Sports Park	Coos
Coos Bay Village commercial development	Coos
Forest Service — South Dunes Restoration Project	Coos, Douglas
BLM — Catching Creek Conversion Timber Sale	Coos
BLM — Other Commercial Thinning Timber Sales	Coos
South Fork Coos River	
BLM - Tioga Creek Instream Restoration Phase 1	Coos
BLM - Helipond and Pump Chance Maintenance EA	Coos
Coquille River Watershed (Fourth Field)	
COE Permits and Mitigation	Coos
Coquille River Watershed	
BLM – Calloway Creek Timber Sale	Coos
BLM – Whistle Stop Conversion Timber Sale	Coos
BLM —Wilson Creek 4 Timber Sale	Coos
BLM — West Cunningham Timber Sale	Coos
BLM – Other CT Timber Sales	Coos
North Fork Coquille River Watershed	
BLM — Manual Maintenance	Coos
BLM — Whiskey Train Timber Sale	Coos
BLM — Steele 23 CT Timber Sale	Coos
BLM — Cloud 19 CT Timber Sale	Coos
BLM — Hungry Mountain Timber Sale	Coos
BLM — Woodward 11 Timber Sale	Coos
BLM - Rock Prairie Timber Sale (Lone Pine EA)	Coos
BLM — Hidden Gem Timber Sale	Coos
BLM — Zumwalt Commercial thinning	Coos
BLM — Johns Creek Commercial thinning	Coos
BLM — Llewellyn Commercial thinning (Lone Pine EA)	Coos
BLM — Other commercial thinning and sales (Lone Pine EA)	Coos
BLM - Helipond and Pump Chance Maintenance EA	Coos
ODFW – Winter Lake Access Road Project	Coos
BLM — Steel Cherry Timber Sale	Coos
BLM — Yankee Panky Timber Sale	Coos
BLM — ERFO Road repairs	Coos
BLM — Weed Treatment	Coos
BLM — Weekly Commercial Thinning	Coos
BLM – Steel Creek Instream Restoration and Riparian Invasive Species removal/planting	Coos
BLM – Helipond and Pump Chance Maintenance EA	Coos
BLM – Scattered Skeeter Density Management Thinning	Coos
BLM – Broken Wagon Density Management Thinning	Coos

TABLE 4.14-2 (continued)

Past, Present, or Reasonably Foreseeable Actions that May Cumulatively Affect Resources a/

Project	County
Methane Energy Corp (MEC), Coos County Methane Project	Coos
BLM – Crosby Timber Sale	Coos
BLM – East Cherry Timber Sale	Coos
BLM – Wagon Road Pilot Timber Sale	Coos
BLM – Steel Trap Density Management Thinning	Coos
BLM – Weed Treatment	Coos
BLM – Brownstone Commercial thinning	Coos
BLM – My Frona Commercial thinning	Coos
BLM – Steel Cherry Commercial Thinning	Coos
Middle Fork Coquille Watershed	
BLM —Weaver Tie Timber Sale	Coos/ Douglas
BLM – Manual Maintenance	Coos/ Douglas
BLM – Weed Treatment	Coos/ Douglas
BLM – Helipond and Pump Chance Maintenance EA	Coos/ Douglas
BLM – Camas Valley Timber Sales	Coos/ Douglas
South Umpqua Watershed (Fourth Field)	
COE Permits and Mitigation	Douglas
Olalla Creek-Lookingglass Watershed	
BLM – Suicide Bar and other Commercial Thinning	Douglas
Clark Branch-South Umpqua River Watershed	
BLM – Shively-Clark Timber Sale EA	Douglas
Myrtle Creek Watershed	
BLM – Myrtle Creek REA Timber Sales	Douglas
Two Industrial Buildings	Douglas
Days Creek-South Umpqua River Watershed	
BLM – Upper Cow Late Successional Reserve Project	Douglas
BLM – Days Creek EA Timber Sales	Douglas
BLM – Shively-Clark EA Timber Sales	Douglas
Deer Creek South Umpqua River Watershed	
Grange Road Development	Douglas
Roseburg Public Works Projects	Douglas
Elk Creek Watershed	
Forest Service — Noxious Weed Treatment	Douglas
Forest Service – Livestock Grazing	Douglas
Forest Service—Tiller Aquatic Restoration Project	Douglas
Forest Service—Elk Creek Watershed Restoration Project	Douglas
Upper Cow Creek Watershed	
Forest Service—Livestock Grazing	Douglas/ Jackson
Forest Service - Upper Cow Creek Hazardous Fuels Project	Douglas/ Jackson
Forest Service –Tiller Aquatic Restoration Project	Douglas
BLM – Upper Cow Late Successional Reserve Project	Douglas
BLM – Young Stand Management	Douglas
BLM – Fuels Treatments	Douglas
Upper Rogue Watershed (Fourth Field)	
COE Permits and Mitigation	Jackson
Trail Creek Watershed	
Forest Service- Livestock Grazing	Jackson
BLM — Proposed Trail Creek Forest Management	Jackson
BLM – Proposed Trail Creek Forest Management	Jackson
BLM – Proposed Trail Creek Forest Management	Jackson
BLM – Proposed Trail Creek Forest Management	Jackson
BLM — Mouse Trail Timber Sale	Jackson
BLM – Livestock Grazing	Jackson
BLM – Elk Camel Forest Management Project	Jackson
BLM – Livestock Grazing	Jackson
Rogue River Drive Estates Subdivision	Jackson

TABLE 4.14-2 (continued)

Past, Present, or Reasonably Foreseeable Actions that May Cumulatively Affect Resources a/

Project	County
Gold-Hill Rogue River Watershed	
Saddlebrook Meadows Subdivision, Phase 2	Jackson
FB Owen Inc - Valley Meadows Estates	Jackson
Big Butte Creek Watershed	
BLM – Big Butte Forest Management Project	Jackson
BLM – Proposed Obenchain Forest Management Project	Jackson
BLM – Livestock Grazing	Jackson
BLM – Friese Camp Forest Management Project	Jackson
BLM - Double Bowen Forest Management Project	Jackson
BLM – Elk Camel Forest Management Project	Jackson
Forest Service-Livestock Grazing	Jackson
Little Butte Creek Watershed	
BLM – Proposed Obenchain Forest Management Project	Jackson/ Klamath
BLM - South Fork Little Butte Timber Sale	Jackson/ Klamath
BLM – Livestock Grazing	Jackson
Forest Service —2013 Big Elk Cinder Pit CE	Jackson/ Klamath
Forest Service- Livestock Grazing	Jackson/ Klamath
Spencer Creek Watershed	
Forest Service – Livestock Grazing	Klamath
Forest Service — Dead Indian Memorial and Clover Creek Roads Noxious Weed Treatment	Klamath
Forest Service — Lake of the Woods VVUI Project b	Klamath
Forest Service – Roadside Firewood Collection	Klamath
BLM — North Landscape Timber Sales	Klamath
BLM — Spencer Creek Thinning	Klamath
Upper Klamath Fourth-Field Watershed	
COE Permits and Mitigation	Klamath
Lost River Fourth-Field Watershed	
COE Permits and Mitigation	Klamath
John C. Boyle Reservoir-Klamath River/Lake Ewauna-Upper Klamath River/Mills Creek-Lost River Watersheds	
Oregon Department of Forestry - Bad Ham Timber Sale	Klamath
BLM — North Landscape Timber Sales	Klamath
BLM — Swan Lake Hydroelectric Pumped Storage Project	Klamath
BLM — Bryant Mountain Vegetation Treatments	Klamath
BLM – Bryant Mountain Juniper Treatment	Klamath
BLM – Stukel Juniper Treatment	Klamath
PacifiCorp. Klamath Dam Removal Project	Klamath
Turkey Hill Solar Project	Klamath
Merrill Solar Project	Klamath
BNSF Railway Crew Facility	Klamath
Klamath Irrigation District – Stukel Spill Project	Klamath
Non-jurisdictional facility – Utilities for Pacific Connector	Klamath and others

a/ Details on most future activities on private lands, such as commercial harvests, are not publicly available. These activities are expected to continue at current rates. See appendix N for acreage, status, approximate location relative to nearest Project facilities, and resources potentially affected by each project listed in this table.

b/ The Port's project is made up of several proposed actions to improve navigation efficiency, reduce shipping transportation costs, and facilitate the shipping industry's transition to larger, more efficient vessels. The Port is currently in the engineering and design phase and is coordinating with the COE since they play several roles in the area, including new long-term maintenance of the channel. The project will also require authorization from the COE and other agencies before conducting the dredging activities. The COE is preparing an EIS to analyze the potential impacts associated with the project.

The Ruby and GTN pipeline system are present in this watershed; however, as stated previously, we consider the effects of past projects as part of the affected environment

4.14.1 Cumulative Effects

Based on available information, the actions listed in table 4.14-2 would affect soils, water resources, vegetation, wildlife, fisheries and aquatic resources, socioeconomics, land use, recreation and visual resources, transportation, cultural resources, air quality, and noise; and as such, we are assessing the potential for cumulative impacts on these resources. Project impacts on geology were assessed in this EIS; however, because impacts on geology (with exceptions) are generally limited, we are not assessing cumulative impacts on geology unless specifically noted.

The acres of land affected by the projects listed in table 4.14-2 are summarized in table 4.14.1-1 by HUC-10 watershed. In this table, we also present the acres of land affected as a percentage of each watershed crossed. The acres of land affected can be used as a proxy for resources affected. The impact values of mitigation projects on federal lands are approximate and may be subject to change within or between watersheds as a result of changing conditions and agency management priorities.

TABLE 4.14.1-1

Acres Affected by Projects Included in Cumulative Effects Analysis, by Watershed

HUC-10 Watershed	Total Area Within HUC-10 Watershed (Acres)	Project Impact (Acres) a/	Other Project Impacts (Acres) b/	Combined Acres of Impacts of HUC-10 Watershed (%)
Coos Bay-Frontal Pacific	151,611	370	709	0.7
South Fork Coos River	160,146	29	11	0.0
Coquille River	111,644	36	1,029	1.0
North Fork Coquille River	98,406	189	4,802	5.1
East Fork Coquille River	85,963	172	0	0.2
Middle Fork Coquille River	197,314	272	1,097	0.7
Olalla Creek-Lookingglass	103,212	159	188	0.3
Clark’s Branch-S Umpqua R	59,577	272	441	1.2
Lower Cow Creek	102,447	16	0	0.0
Myrtle Creek	76,250	247	1,077	1.7
Days Creek-S Umpqua R	141,569	567	3,297	2.7
Deer Creek-S Umpqua R	110,072	16	30	0.0
Lower North Umpqua River	106,406	102	0	0.1
Elk Creek	54,356	40	12,248	22.6
Upper Cow Creek	47499	88	2,419	5.3
Trail Creek	35,338	217	9,597	27.8
Shady Cove-Rogue River	74,268	140	755	1.2
Gold-Hill Rogue River	136,049	106	6	0.1
Big Butte Creek	158,243	89	4,941	3.2
Little Butte Creek	238,879	633	3,770	1.8
Spencer Creek	54,247	231	4,470	8.7
John C. Boyle Reservoir-Klamath River/Lake Ewauna-Upper Klamath River/Mills Creek-Lost River	349	921	9,725	3.1
TOTAL	**2,650,575**	**4,912**	**60,612**	**2.5**

a/ Only includes watersheds with at least 1 acre of Project disturbance.
b/ Includes projects listed in table 4.14-2 and table N-1 with exception of ongoing grazing on existing allotments.

In some watersheds, the effects of other projects represent a large percentage of the total watershed area. In these cases, the significance of the cumulative impact may be only minimally altered by the contribution of the Project. For example, the Elk Creek HUC-10 watershed covers about 54,356 acres. The Project’s impacts (as described in the preceding analyses) within this watershed are inconsequential (40 acres) when compared to the total watershed area, and contribute impacts on only 0.07 percent of the watershed. However, the other projects considered have/would impact about 12,248 acres, or 22.6 percent of the watershed. In this example, whether the Project is constructed or not has no discernible effect on the cumulative impact exerted on the resources and approval and implementation of the other projects determines the significance of the cumulative impact. However, regardless of the Project's contribution to a cumulative impact, if we determine that the impacts of the Project when combined with the impacts of other projects would result in a cumulative impact, that impact is disclosed.

4.14.1.1 Soils and Sediments

Coos Bay sediments have been affected by vessel traffic and channel/port modifications for over 100 years. Additionally, these sediments are naturally disturbed by incoming and outgoing tides and are further disturbed (flushed) by freshwaters inflows into the bay. The other projects occurring in Coos Bay including the Coos Bay, Oregon Section 408/204(f) Channel Modification and the COE's North Jetty Maintenance Project would temporarily, permanently, and periodically impact Coos Bay sediments. The permanent modification of the Coos Bay Navigational Channel and the removal and disturbance of Coos Bay sediments would affect channel dynamics, water quality, adjacent sediments, fisheries and other aquatic organisms (clams and oysters), and aquatic vegetation (see sections additional discussions below). Furthermore, disrupting sediments (due to dredging and modification of adjacent upland features) impacts the naturally occurring movement of sediment and can result in atypical sediment reductions and accumulations. The impacts of other projects on sediments in Coos Bay when combined with the impacts of the Project would likely result in a cumulative impact on Coos Bay sediments. However, the magnitude of this cumulative impact would depend on the location and timing of the other projects relative to the Project.

The Coos Bay, Oregon Section 408/204(f) Channel Modification would occur, in part, adjacent to the LNG terminal site and associated marine facilities. It is possible that dredging activities associated with both the Project and the channel modification could overlap; however, the period of time when dredging activities associated with the Coos Bay, Oregon Section 408/204(f) Channel Modification may occur near the Jordan Cove LNG terminal would be limited to 3 to 4 months of the Port's three-year construction period. The total volume of material to be removed by the Port's project would be about 15.5 mcy, while the total volume to be dredged from open waters of Coos Bay for the Jordan Cove Project would be about 2.8 mcy. Near the Jordan Cove LNG Project site, RM 7 to RM 8.2, nearly 1 mcy would be removed for the Port's project. Because the Project would use upland disposal sites and other projects are expected to use marine disposal sites, no conflict would occur related to dredge disposal.

Other dredging activities in Coos Bay included in this analysis include maintenance of the Federal Navigation Channel and other slips and ports, totaling about 0.2 mcy combined. Future maintenance of the Jordan Cove terminal would result in about .054 mcy per year. Future maintenance of the modified navigation channel would result in about 1.1 mcy (0.03 mcy per year near the LNG terminal). Combined, maintenance dredging associated with the Project, the modified channel, and other activities would be about 1.16 mcy, about 95 percent would be attributed to maintenance of the navigation channel.

The North Jetty Maintenance Project would occur at the mouth of Coos Bay; however, a final construction schedule is still being developed. The North Jetty Maintenance Project would occur approximately seven river miles downstream from the LNG terminal site, but would be located less than two river miles from the nearest portion of the Project's proposed modifications to the marine waterway. Cumulatively, these projects would increase sediment redistribution and deposition. The other projects could also impact the Coos Bay shoreline. Specifically, the use of marine vessels to construct and maintain the other projects would increase wave action within Coos Bay, and when combined with the wave actions resulting from Project-related vessels (tugs, barges, and LNG carriers) could result in a cumulative impact on the Coos Bay shoreline. The Coos Bay, Oregon Section 408/204(f) Channel Modification is expected to result in vessel wakes that are small and negligible due to slower vessel speeds along most of the channel (Port of Coos Bay and COE 2019 [unpublished]). The cumulative effect of these wakes, other vessel wakes, and wakes caused by Project-related vessels on the shoreline would not be significant

Based on the location of the Project (including the Project's proposed modifications to the marine waterway), the locations of the other projects relative to the Project, and the expected timing of the other projects impacts (initial construction and maintenance), which may be concurrent with construction of the Project's marine facilities, we conclude that the cumulative impact on sediments and the Coos Bay shoreline would not be significant.

In addition to sediment and shoreline effects in Coos Bay, the Project would affect upland soils at the LNG terminal site, along the pipeline route, within additional temporary work areas, and at proposed mitigation sites. At least six timber sale projects affecting a total of over 5,000 acres of land have or would cross/overlap about six miles of pipeline construction right-of-way and workspace. It is also likely that an undeterminable amount of other timber-related activities; maintenance, commercial thinning, and management have or would cross/overlap pipeline construction right-of-way and workspace. The Project would affect about 4,500 acres of land. Cumulative impacts on soils may result from the additive loss of soil (erosion), rutting and compaction, or disturbance of the profile that may affect the revegetation potential. In general, the use of heavy equipment, and the harvesting and maintenance of timber related to timber sales and other timber-related activities would impact underlying soils in a manner similar to that described for construction of the pipeline. However, these combined impacts would not be significant because the cumulative impact on soils would be limited to the relatively narrow width of the pipeline construction right-of-way (and associated construction workspace) and because of the minimization and protection measures included in the erosion control plans for the projects. The approximately 9,500 acres of land cumulatively affected by the six timber sale projects and the proposed Project that could potentially overlap represents about 0.02 percent of the total amount of land within the watersheds crossed by the Project.

By implementing the measures discussed in section 4.1, the Project would minimize incremental impacts on soils. With the exception of the timber sale projects discussed above, other projects identified in table 4.14-2 would not overlap with the pipeline construction workspace, and therefore, we conclude that the cumulative impact on soils would not be significant.

4.14.1.2 Water Resources and Wetlands

All of the projects identified in table 4.14-2 could affect underlying groundwater. Ground-disturbing activities including aboveground facility and pipeline construction; and the use of equipment in support of those activities can affect groundwater recharge (surface water infiltration), subsurface lateral water flow, and groundwater quantity and quality. Together, the Project and the other projects would affect about 65,000 acres of land which represents about 2.5 percent of the total amount of land within the watersheds crossed by the Project. Some projects, such as the Oregon Dunes Restoration Project, would have a beneficial effect. With the exception of three watersheds, cumulative impacts on lands within an individual watershed vary between less than 0.1 percent and 5.3 percent of total land amounts. The three remaining watersheds experience a greater cumulative impact due to the presence of large timber sales, and other timber-related activities (4,470 – 12,248 acres of impact in each watershed). Withdrawal requirements from underlying groundwater associated with these projects, if any, are unknown.

As described previously, we conclude that the impacts of the Project on groundwater would not be significant. These impacts would also be temporary, relatively minor, and localized. Additionally, the ground-disturbance and subsequent effects on groundwater resulting from timber-related activities are common in the region have not been found to be individually or cumulatively significant in other federal actions. Therefore, based on the cumulative amount of land affected and that area's proportion of the overall amount of land within the affected watersheds, we conclude that the cumulative impact on groundwater would not be significant.

The COE permits and mitigation projects, including stream restoration and enhancement projects affecting a total of about 109.9 river/stream miles, would occur in the watersheds affected by the Project. Additionally, the use of the Coos Bay Navigation Channel by LNG carriers traveling to and from the terminal facilities, the proposed modification of this channel, the regular maintenance of the channel, and the removal of dams along the Klamath River would also contribute to a cumulative impact on waterbodies affected by the Project. Other projects that could contribute to a cumulative impact on waterbodies crossed by the Project include minor federal agency projects (instream and aquatic restoration projects), and timber-related activities.

Numerous concerns about cumulative impacts on water quality in Coos Bay have been expressed by the public, the CTLUSI, the CIT, and the COE. Of the projects identified as potentially contributing to a cumulative impact in Coos Bay, the Coos Bay, Oregon Section 408/204(f) Channel Modification would likely have the largest incremental contribution to cumulative impacts on Coos Bay based on the magnitude (dredging 15.5 mcy over several miles) and duration of in-water work (24 hours a day for several months a year over three years). The Coos Bay, Oregon Section 408/204(f) Channel Modification's impacts will be fully disclosed through the COE's review process. Preliminary analyses of the channel modification predict that construction and maintenance activities would have short-term turbidity effects but would meet ODEQ turbidity standards, have a small effect on salinity near the Project (-0.1 percent to +1.5 percent change in mean salinity), and some decrease in dissolved oxygen (Port of Coos Bay and COE 2019 [unpublished]).

The CTCLUSI's Hollering Place, which includes the installation of sheet piling along the shoreline of Coos Bay, is currently under construction and would not significantly contribute to a cumulative impact on water quality. As described previously, other activities and projects in Coos Bay would affect water quality and channel dynamics including channel geometry and flow. Changes to water quality would also affect fisheries and other aquatic organisms, and aquatic vegetation. These impacts when combined with the impacts of the Project could result in a cumulative impact on water resources, but this impact would also depend on the location and timing of the other projects, which would all be constrained by the ODFW in-water work window. However, preliminary planning of the Coos Bay, Oregon Section 408/204(f) Channel Modification anticipates dredging outside of this in-water work window (Port of Coos Bay and COE 2019 [unpublished]). Portions of this project that are dredged outside of the in-water work window would not overlap Project dredging. Impacts on water quality due to increased turbidity and sedimentation would be localized and temporary, returning to pre-construction conditions in a relatively short amount of time due to the dynamic and natural hydraulic regime of Coos Bay. The navigational channel improvements and the other projects, primarily the Coos Bay, Oregon Section 408/204(f) Channel Modification would contribute to a cumulative impact on channel dynamics (e.g., channel geometry and flow). This change to channel geometry and flow would be permanent; however, the Project's contribution to this change would be substantially less than the Coos Bay, Oregon Section 408/204(f) Channel Modification's contributions, which would have the largest incremental contribution to this permanent effect. Regular channel maintenance activities would not likely occur at the same time as the initial construction dredging activities associated with the Project and the Coos Bay, Oregon Section 408/204(f) Channel Modification. Project dredging is proposed to occur during the ODFW in-water work window of October 1 through February 15, while annual maintenance dredging for the navigation channel between RM 1-12 typically occurs between June 15 and October 31, to avoid inclement weather and storm conditions (Moffat & Nichol 2015). Therefore, a cumulative impact during construction is not anticipated, although a cumulative impact during operation is possible. Should channel and Project marine facility maintenance occur at or near the same time, a cumulative impact on water and aquatic resources would occur; however, again, this impact would be temporary lasting only during the active dredging. Therefore, we conclude that the cumulative impact on Coos Bay would not be significant.

Other deep draft vessels operating in Coos Bay would have similar effects as the LNG carriers on water quality. The impacts of LNG carriers and tug vessels traversing Coos Bay are different in nature than those of dredging projects, but would still affect water quality in the bay. LNG carrier and other deep draft vessel water withdrawals and discharges related to ballast and engine cooling operations would affect small portions of Coos Bay via potential introduction of invasive species and water quality effects (e.g., salinity, temperature, pH, and dissolved oxygen), primarily at and near the LNG marine facilities for LNG carriers (see section 4.3 and 4.5). However, given the size of Coos Bay, the frequency of LNG carries in the bay, and the current use of the bay by other marine vessels, we conclude that any cumulative effect would not be significant because the effect of each vessel would primarily be temporary and localized.

Along the pipeline route, in-water work and ground disturbing activities near waterbodies can affect water quality. The locations, scopes of work, and timing of the other projects are not all known, so we cannot quantify the specific impacts of these projects or determine if these impacts would overlap with the impacts of the Project. However, based on available information (see table 4.14.-2) and the temporary and localized impacts of the Project on surface waters as described in the preceding environmental analyses, Pacific Connector's use of HDDs to cross major waterbodies, and its implementation of erosion and sediment control measures as well as other impact minimization measures, we conclude that these impacts and the potential impacts of the other projects would result in a cumulative impact; but, this impact would not be significant.

Additionally, the Klamath, Yurok, and Karuk Tribes expressed concern that an adverse cumulative impact on the Klamath River in Klamath County and downstream into California would occur resulting from the Project and the removal of dams along the Klamath River. The tribes expressed concern about impacts on water quality and fish, especially salmon. Pacific Connector would cross the Klamath River using an HDD. Furthermore, Pacific Connector has prepared a site-specific crossing plan for the Klamath River that indicates all workspaces and measures that would be implemented to avoid and minimize impacts on the Klamath River. As described previously, the use of an HDD significantly reduces the potential for impacts on a waterbody. Should an inadvertent release of drilling fluid(s) occur into the Klamath River, water quality would be temporarily affected. The river would experience increased turbidity and sedimentation. However, these increases would subside quickly, and the resulting turbidity would also settle out quickly. The removal of dams along the Klamath River would result in a significant impact on downstream water quality; however, these significant impacts would not occur in areas where the Project's impacts would occur. Furthermore, because the Project would use an HDD to cross the river and would likely be completed before the dams are removed, the Project's incremental contributions to a cumulative impact would not be significant.

COE permits and mitigation projects would affect a total of about 101 acres of wetlands in the watersheds crossed by the Project. The extent of impacts on wetlands from the other projects identified in table 4.14.-2 (beyond the COE permits and mitigation projects in Coos Bay) are unknown, but we assume wetlands could be affected. As described previously, the Project would impact about 200 acres of wetlands, with about 45 percent of the wetlands affected by the Project associated with the LNG terminal facilities. Of the remaining 55 percent, about 110 acres of wetlands would experience temporary to short-term impacts, and about 3 acres of forested wetland would experience long-term impacts. Cumulatively, at least 250 acres of wetlands would be affected, which, based on NWI data, would represent about 0.2 percent of the estimated 130,760 acres of wetlands that occur within the watersheds included in our analysis area. This cumulative impact would not be significant given the sizes of the watersheds crossed and existing wetlands within those watersheds, relative to the extent and duration of the impacts.

4.14.1.3 Vegetation

Construction of the LNG terminal and related facilities would affect nearly 500 acres of upland vegetation (table 4.4.1.5-1). This would include impacts on forests, woodlands, shrublands, herbaceous vegetation, and disturbed land; about 168 acres would be permanently cleared. About 2.2 acres of eelgrass would be permanently affected by construction of the marine terminal and access channel. Jordan Cove has indicated that estuarine habitat values lost to the construction of the LNG terminal and related facilities would be replaced in-kind at the Eelgrass Mitigation and Kentuck project sites. Construction of the Kentuck project and Eelgrass Mitigation sites would result in an additional 127 acres of impacts on primarily wetland and aquatic vegetation.

Timber sales, commercial thinning, forest management, timber-related activities, and other projects would affect over 40,000 acres of vegetation within the watersheds crossed by the Project. These projects would primarily impact forest and herbaceous vegetation. Impacts include permanent clearing and loss, and long- and short-term disturbance (clearing and thinning). Some projects, such as the Oregon Dunes Restoration Project, would have a beneficial effect on vegetation. Many of these projects are BLM or Forest Service projects and as such have undergone an environmental review.

As described previously, the Project would affect about 4,500 acres of vegetation. Cumulatively, the Project along with the projects identified in table 4.14-2 would impact over 65,000 acres. If all 65,000 acres were vegetated, this impact would account for about 2.5 percent of the total amount of vegetation within the watersheds crossed by the Project. Considering forest vegetation, if the entire area affected by the projects considered in this analysis were forested it would account for about 4.6 percent of the total amount of forested area within the watersheds based on USGS National Land Cover Database which estimates about 1.4 million acres of forest within the watersheds. Additionally, the Project would impact 773 acres of LSOG forest. Pacific Connector would fund various projects on federal lands that would mitigate for the impacts on LSOG on federal lands to the extent required by BLM and Forest Service LRMPs. Implementation of new LRMPs and RMPs on both BLM and NFS lands in the 1990s resulted in a substantial reduction in lands available for timber harvest due to the establishment of LSRs and Riparian Reserves. Regrowth in previously harvested areas would, over time, result in more area supporting LSOG in the watersheds crossed by the Project. The clearing of LSOG by the Project would represent a loss of 0.01 percent of the remaining LSOG forest in the four physiographic provinces crossed by the Project.

Any of the projects identified in table 4.14-2 could result in the introduction or spread of invasive or noxious weeds as a result of ground disturbance and/or movement of equipment from one site to another. To avoid introducing or spreading invasive species, Jordan Cove would follow recommendations from several state and federal plans and programs including ODA, OISC, and BLM, as well as Project-specific measures (see section 4.4.1.6). It would be expected that the other projects on federal lands, or that would be subject of a federal permit review, would also implement some measures to minimize or control the spread of invasive or noxious weeds. Therefore, based on the analysis provided above, we conclude that the cumulative impact on vegetation would not be significant.

4.14.1.4 Wildlife and Aquatic Resources

All of the projects identified in table 4.14-2 could affect wildlife, including threatened and endangered species, and other species of concern. Some projects, such as the Oregon Dunes Restoration Project, would have a beneficial effect. Ground-disturbing activities; and the use of equipment in support of those activities can increase the rates of stress, injury, and mortality experienced by wildlife. Additionally, these activities can result in the temporary and permanent loss or conversion of wildlife habitats. Threatened and endangered species may be particularly vulnerable to these ground-disturbing activities and associated habitat loss. The timber harvest projects and a number of the other timber-related projects could result in the long-term loss of forested habitat which supports a variety of wildlife, including MAMU and NSO. Timber sales projects could also result in the loss of forested habitat and affect wildlife. For the purposes of this analysis, we consider timber harvest and timber sales collectively as potential impacts on mature wildlife habitat; however, we recognize that some of these projects could be beneficial for forest health and wildlife. Furthermore, some timber management activities would affect mature wildlife habitat, but would generally result in temporary impacts with a goal of promoting the long-term enhancement of mature habitat. As discussed previously, wildlife would generally avoid or be displaced by disturbance. As a result, wildlife would experience increased rates of stress, injury, and mortality. Additionally, when wildlife is displaced or behaviors change in response to disturbance and habitat loss, competition and predation pressures (from other opportunistic wildlife that move to occupy abandoned habitats or are occupying habitats that displaced wildlife is trying to use) can increase which can result in a decrease in overall fitness (including reduced rates of reproduction) for some species.

Impacts on wildlife (and threatened and endangered species) would vary depending on the amount and quality of habitat, and the duration of impacts, the fitness of an individual(s), and the concentration of individuals within affected habitats. In section 4.6, we address the Project's impacts on federally listed threatened and endangered species. Acknowledging that many federally-protected species in the Project area depend on LSOG habitat for one or more life stages and due to their particular sensitivity, we discuss further cumulative impacts on two of those species MAMU and NSO. The projects identified in table 4.14-12 include timber sales and forest management projects involving timber harvest on about 694 acres within watersheds where MAMU occur and about 10,439 acres within watersheds where NSO occur. The majority of these harvests are of regenerating stands rather than LSOG, so they are more likely to prevent forested habitat from becoming LSOG (and thus suitable for LSOG-associated species) than remove existing LSOG that is currently suitable for MAMU and NSO. As a result, the Project-related habitat loss described in section 4.6 would contribute to a cumulative impact on MAMU and NSO habitat. Furthermore, of the projects considered in this analysis, this Project would have the largest incremental impact on these species.

For other species affected, the Project and the other projects would affect about 65,000 acres of land (and associated wildlife habitats) which represents about 2.5 percent of the total amount of land within the watersheds crossed by the Project. However, some habitat types may be more sensitive to disturbance that others, such as those defined as "irreplaceable, essential, or limited" by the ODFW (see section 4.5); information on the extent of impacts that would occur to these sensitive habitat types as a result of the reasonable foreseeable projects is not available or quantifiable at this time. Therefore, we conclude that the resulting cumulative impact of the Project and the other projects would not be significant because of the total amount of land and habitat affected relative to the amounts available within the watersheds crossed and the ability of some wildlife to avoid construction activities and adapt to disturbance.

COE permits and mitigation projects, minor federal agency projects (instream and aquatic restoration projects), timber-related activities, and livestock grazing would occur in the watersheds affected by the Project and would impact aquatic resources, including threatened and endangered species and other species of concern. Additionally, LNG carriers, the Coos Bay, Oregon Section 408/204(f) Channel Modification, the regular maintenance of the channel, other projects in Coos Bay, and the removal of dams along the Klamath River would also impact aquatic resources including fish, marine mammals, and other aquatic organisms. In-water work and ground-disturbing activities associated with these projects would affect aquatic habitats, fish, marine mammals, and other aquatic organisms in a manner similar to that described for the Project (see sections 4.5 and 4.6). Aquatic habitats would be both temporarily and permanently affected; and fish and water-dependent wildlife would experience increased rates of stress, injury, and mortality.

Concerns about the importance of fish to communities affected by the Project and the potential for cumulative impacts on fish were expressed in numerous comments to the Commission. Comments provided by several tribes specifically identified Coos Bay and the Klamath River as fisheries that could be subject to adverse cumulative impacts. With the exception of the Coos Bay, Oregon Section 408/204(f) Channel Modification, the COE's North Jetty Maintenance Project, LNG carriers, and channel maintenance activities, the other projects affecting Coos Bay are temporary in nature resulting in primarily temporary impacts on aquatic habitats, fish, marine mammals and other aquatic organisms primarily from dredging activities that result in modification of habitat and increase rates of turbidity and sedimentation. The Coos Bay, Oregon Section 408/204(f) Channel Modification and the COE's North Jetty Maintenance Project would have similar construction-related temporary effects and also result in permanent, long-term alteration of channel geometries with associated permanent impacts (e.g., change in estuarine dynamics, tidal amplitude, and habitat characteristics). LNG carriers and other marine vessel traffic in Coos Bay would occur regularly; however, the disturbance caused by ships (increased wave action, underwater noise, and water withdrawal/discharge) in Coos Bay is not expected to adversely impact fish and other aquatic resources including crabbing. Channel maintenance activities would occur periodically as they currently do, and the impacts of these activities on fisheries and aquatic resources would be temporary to short-term. The impacts of these projects when combined with the impacts of the Project would not result in a significant cumulative impact on fish, marine mammals, and other aquatic organisms in Coos Bay because most impacts are localized and temporary; and long-term projects such as the Coos Bay, Oregon Section 408/204(f) Channel Modification and the COE's North Jetty Maintenance Project would be required to comply with regulations and permit requirements that minimize impacts.

Along the pipeline route, in-water work, ground-disturbing activities, and vegetation clearing related to other projects can affect aquatic habitats, fish, and water-dependent wildlife. Aquatic habitat disturbance would affect fish behavior, migration, feeding, and reproduction, and would increase rates of stress, injury, and mortality experienced by fish and other wildlife. Threatened, endangered, and other special status fish species may be particularly vulnerable to these ground-disturbing activities and the associated aquatic habitat disturbance. As described previously, the details of the other projects are not well known, so we cannot quantify the specific impacts of these projects or determine if these impacts would overlap with the impacts of the Project. Turbidity generated by the various projects along the pipeline route is generally not additive because the resulting plumes would is uncommonly synchronized and spatially overlapping. Sedimentation, however, would be additive at common settling points. Settling points within each stream are largely determined by flow dynamics within short stream segments. Consequently, the common deposition points are likely to be past and ongoing points where sediments accumulate. Additional sediment accumulation at these points is clearly an impact, but likely not a conversion of habitat type. Based on the Project's impacts on aquatic resources and the impacts of the other projects which are expected to be similar to those of the Project, we conclude that the Project would not significantly contribute to an adverse cumulative effect.

Pacific Connector would cross the Klamath River using an HDD. As described previously, the use of an HDD substantially reduces the potential for impacts on a waterbody and any aquatic resources within or dependent on that waterbody. Should an inadvertent release of drilling fluid occur into the Klamath River, aquatic habitat and fish would be temporarily affected. The removal of the four dams along the Klamath River would temporarily and permanently significantly affect fish and other aquatic resources in the river. Short-term impacts on aquatic resources would result from increases in turbidity, and long-term beneficial impacts would result from the permanent modification of (and access to) stream reaches due to changes in flow. The closest dam removal planned to the Project's crossing of the Klamath River would occur about 20 miles downstream. Because the dam is 20 miles downstream, the impacts of its removal would not be additive with the impacts of the Project; therefore, we conclude that the Project would not significantly contribute to an adverse cumulative impact.

4.14.1.5 Land Use

There are no other projects in Coos Bay whose impacts when combined with those of the LNG terminal would result in a significant cumulative impact on land use. As described previously, the Project and the other projects identified in table 4.14-2 would cumulatively affect about 65,000 acres of land (about 2.5 percent of the total amount of land within the watersheds crossed by the Project). Affected lands support a number of uses including natural forest, silviculture, residential, grazing, commercial, agricultural, and industrial activities. Timber and forest management are commonplace in the region and are not, with the exception of growth of trees and installation of permanent aboveground facilities over the pipeline, prohibited or restricted by the Project. Clearing of forested areas for construction of the Pacific Connector pipeline would amount to less than nine percent of the acreage of timberlands affected by the BLM and Forest Service vegetation management projects listed in table 4.14-2. The acreage of forested land affected by the pipeline that would not be reforested (i.e., the permanent operational right-of-way and aboveground facilities) would constitute less than two percent of the timberlands affected by the BLM and Forest Service vegetation management projects listed in table 4.14-2. Overall, the impacts of the Project when combined with the impacts of the other projects would not result in a significant cumulative impact on land use.

4.14.1.6 Visual Resources and Recreation

The only projects listed in table 4.14-2 that involve new permanent aboveground facilities within the viewshed of the LNG terminal is the City of North Bend's Department of Human Services Building and the CTCLUSI Hollering Place. The non-jurisdictional SORSC would be located within the footprint of the LNG terminal site and is considered from a visual perspective as part of the LNG terminal site. Also, although not a permanent aboveground facility, the regular use of the Federal Navigational Channel by LNG carriers and associated project-related marine vessel traffic would also constitute an impact on the visual character of Coos Bay. The Department of Human Services Building is located less than a mile from the LNG terminal and may be visible from the same vantage points (viewpoints 6-10 as shown on figure 4.8-2); however, it is located on the developed Southwest Oregon Regional Airport property and is visually consistent with the existing industrial/commercial visual character. When complete, the CTCLUSI's Hollering Place would be located just over 2 miles southwest of the LNG terminal site along the community of Empire's shoreline. The LNG carries would occur frequently in Coos Bay and would be distinguishable from other marine traffic where the navigation channel is visible from vantage points in Charleston, Barview, Empire, and North Bend. As described in section 4.8.2, we conclude that the LNG terminal would have a significant visual impact on the Coos Bay area. Therefore, because the Project's impact on Coos Bay's visual character would be significant, a significant cumulative impact would result; however, we conclude that the impacts of the Human Services building, CTCLUSI's Hollering Place, and the increased marine traffic would not contribute to a greater cumulative impact on the visual character of Coos Bay.

As described previously, at least six timber sale projects affecting a total of over 5,000 acres of land have or would cross/overlap about six miles of pipeline construction right-of-way and workspace. It is also likely that an undeterminable amount of other timber-related activities; maintenance, commercial thinning, and timber management have or would cross/overlap pipeline construction right-of-way and workspace. A cumulative impact on visual resources would occur if visible impacts of these projects and the Project are observable from one or more shared vantage points. Numerous commenters including the Klamath Indian Tribe have expressed concern about an adverse cumulative impact on the visual character of the Project area. Commenters cited the spiritual and intrinsic value of potentially affected viewsheds. Timber-related activities, sales, and forest management are common practices in Oregon and their visual impacts can be observed across the landscape. The impact of the pipeline operational easement would resemble other utilities and forest access roads, and would not generally be out of character for the region. There would, however, be locations where the pipeline route would be in less developed and managed areas and its visual impact would be less common; but because of the remote siting, the number of possible viewpoints and receptors would be small. According to the Forest Service, the majority of the timber-related activities involve thinning younger stands to speed the development of late successional old-growth habitat in LSRs and on the Matrix lands. These thinning prescriptions would generally not result in large new openings in the forest canopy. Additionally, where the pipeline would cross remote and steep topography, locations where the permanently cleared operational easement would be visible would be limited. Therefore, we conclude that a cumulative impact would occur, but that this impact would not be significant.

Two projects - the Turkey Hill Solar Project and the transmission line associated with the Swan Lake Hydroelectric Pumped Storage Project - are located in the vicinity of the proposed Klamath Compressor Station. The compressor station would be painted with a color that blends with the hues of the surrounding landscape and the grounds would be landscaped to reduce visual impacts on area residents. Given the distance to the Turkey Hill Solar Project and Swan Lake Hydroelectric Pumped Storage Project transmission line (2.2 miles and 1.9 miles, respectively), and existing topography, we conclude that the impacts of these projects would not contribute to a significant cumulative impact on visual resources.

As described in comments to the Commission about the Project, Coos Bay provides numerous recreational opportunities including boating, fishing, crabbing, hiking, bird watching, scenic viewing, and off-road vehicle trails. The cumulative impacts of the Project (as described in the preceding sections) and the other projects in Coos Bay on water quality, aquatic resources, and transportation, all of which affect recreational use of the bay would not be significant, so the cumulative impact on recreation in Coos Bay would not be significant. Some projects, such as the Oregon Dunes Restoration Project, would have a beneficial effect by restoring recreational opportunities. Project construction dredging may overlap with the Coos Bay, Oregon Section 408/204(f) Channel Modification for 3 to 4 months over the Port's 3-year construction window; however, the width of the navigation channel is sufficient to allow passage of vessels and maneuvering clearance. Overlap of these two projects is expected between mid-November and February only in years when the Jordan Cove in-water work is underway. Recreational users of Coos Bay may be inconvenienced by delays associated with the increased use of the channel by LNG carriers and other Project-related marine traffic; however, no other additional long-term marine traffic has been identified as occurring in the bay. Dredging activities associated with the other projects in Coos Bay (not including the Coos Bay, Oregon Section 408/204(f) Channel Modification) would increase vessel traffic in the channel primarily overnight, but also in daylight hours, and we conclude, based on existing ship traffic levels and expected increases, that the resulting cumulative impact, which could occur for up to three years, would not be significant. These inconveniences when added to existing marine traffic would contribute to a cumulative impact; but this impact would not significantly impair a user's ability to participate in recreation activities in the bay. As described previously, impacts on visual resources and from pile-driving noise in Coos County would be significant. Both visual character and noise can affect recreational experiences and facilities. Combined, these Project-related impacts would temporarily affect recreational opportunities near the terminal site and would likely reduce recreational enjoyment of nearby facilities for some users. However, facilities located farther away and along the 229-mile-long pipeline route would only be temporarily affected by construction. Therefore, the Project's impacts, combined with the impacts of other projects on recreation, would result in a cumulative impact; however, we conclude that this cumulative impact would not be significant.

Southern and west-central Oregon provide the public a large number of diverse recreational opportunities including camping, hiking, off-road vehicle trails, hunting, fishing, boating, and wildlife watching. Cumulative impacts along the pipeline route could occur if the Project and one or more other projects affect the same recreational resource (trail, natural area, etc.). However, none of the other projects identified along the pipeline route are expected to significantly reduce overall recreational opportunities for the public. As described previously, the Project would not significantly affect recreation. Based on the impacts of the Project and other projects, we conclude that there would not be a significant cumulative impact on recreation occurring along the pipeline route.

4.14.1.7 Socioeconomics

Constructing the Project would temporarily impact the socioeconomic character of the region as described in section 4.9. Most of the socioeconomic impacts of the Project would occur because of the introduction of a new construction workforce, which would affect total population, available housing, and tax revenue during the period of construction; and would draw on existing public services such as police, fire, and medical. Among the Project and the other activities and projects considered, the Project would require considerably more workers in highly skilled crafts, such as pipefitters, ironworkers, electricians, carpenters, and management staff, including safety specialists. Jordan Cove's estimated construction workforce would average about 1,000 workers over the 53-month construction period with a peak of about 2,000 workers. Additionally, an average of 1,400 workers per month would be required for the 24-month duration of pipeline construction. The workforce required for the Coos Bay, Oregon Section 408/204(f) Channel Modification would be about 100 to 150 workers over several months for three years. We do not anticipate that the other projects occurring in the watersheds affected by the Project would require a significant influx of non-local labor because these projects are common to the region. Therefore, we conclude that the Project's impacts on socioeconomics when added to those of the other projects would not result in a significant cumulative impact on the socioeconomic character of the region. However, as described in section 4.9, the Project would result in a significant impact on housing in Coos County during construction; therefore, a significant cumulative impact would result.

We received numerous comments on the draft EIS expressing concern about a cumulative impact on electrical power consumption and use. Jordan Cove estimates that it would require 15 to 26 MW of grid-supplied electric power annually. Using 2018 EIA data on electricity sales in the state of Oregon as a proxy for electricity use (EIA 2019), this would represent between an estimated 0.31 and 0.54 percent of total annual residential electricity use and between 0.12 and 0.22 percent of total annual overall electricity use in the state. Other projects listed in table 4.14-2 could also require grid-supplied electric power and contribute to a cumulative need for new grid-supplied power, including the CTCLUSI Coos Head Area Hollering Place, Southwest Oregon Regional

Airport Expansion, Tioga Sports Park, and Coos Bay Village commercial development in Coos County; two industrial buildings in Douglas County; and the Rogue River Drive Estates Subdivision, Saddlebrook Meadows Subdivision Phase 2, and FB Owen Inc. Valley Meadows Estates, in Jackson County. It is not known what the expected new electric power needs would be for these other projects.

4.14.1.8 Transportation

The proposed modification of the Coos Bay Federal Navigational Channel as well as other projects in Coos Bay would require the use of marine vessels. As described in section 4.10.1, constructing and operating the Project would increase the number of vessels in Coos Bay as a result of the addition of approximately 70 water deliveries via a mix of ocean-going vessels and barges during the construction period and 120 LNG carriers per year transiting to and from the Jordan Cove LNG terminal during its operation. This increase in marine traffic combined with current deep-draft vessel traffic (42 calls in 2015) would be less than historic ship traffic (about 200 calls per year in the mid-1990s) through the channel. In addition, in a Letter of Recommendation for the Project the Coast Guard considers that the Coos Bay channel to be suitable for the proposed type and frequency of LNG carriers traffic (see appendix B). Therefore, we conclude that while some marine traffic might be temporarily inconvenienced, the passage of construction-related and LNG carriers through the channel would not have significant or long-term impacts on other boats in Coos Bay. Numerous commenters have expressed concern that a modified navigational channel would induce additional marine vessel traffic. To our knowledge, additional marine vessel traffic utilizing the modified channel has not been proposed; therefore, we cannot speculate on unknown future impacts. However, the Coast Guard and other authorities would continue to regulate any future marine traffic within the channel.

Of the projects identified in table 4.14-2, timber-related activities may result in use of large, heavy equipment and log trucks on local and regional roadways. The McCullough Bridge painting project, which could overlap in time with construction of the Project, may require occasional overnight lane closures on the bridge which when considered with Project could result in a cumulative impact on local and regional road traffic; however, workforce shift changes for the construction work at the LNG Terminal are not expected to coincide with the nighttime lane closures. Other projects planned for the area are road improvements or other relatively small-scale projects not requiring a significant workforce. As described in section 4.10, the Project would contribute vehicle trips to Project-area roads during construction, and would affect these roads and their users. Together, the Project and other projects would result in a cumulative impact on Project area roads and traffic; however, we conclude that this cumulative impact would not be significant.

Operating the LNG Terminal could significantly impact Southwest Regional Airport operations. Of the projects identified in table 4.14-2, we have determined that none would impact the airport in a similar manner. However, because the Project could significantly impact the airport, we conclude that the cumulative impact on the airport could be significant.

4.14.1.9 Cultural Resources

Cumulative impacts on cultural resources would only occur if other projects were to share (and impact/disturb) the same APE (direct and indirect) as the Project. Several forest- and timber-management projects listed in table 4.14-2 would share the same direct APE as the Project and could contribute to a cumulative impact on cultural resources. Several projects listed in table 4.14-

2 in the Coos Bay area would also share the same indirect APE as the Project. Generally, a pipeline project's impacts on an indirect APE are minor. Impacts known to occur are typically off right-of-way clearing, erosion, and sedimentation. These impacts would in most cases not result in an adverse impact on cultural resources. The federal agencies managing these projects would be required to follow the regulatory requirements of 36 CFR Part 800 and/or other implementing regulations. Under these regulations, the lead federal agency, in consultation with the SHPO, would identify historic properties in the project APE, assess potential effects, and resolve adverse effects through an agreement document that outlines a treatment plan.

We received numerous and detailed comments from Indian tribes, particularly the CTCLUSI, expressing and reiterating concern about the Project's contribution to a cumulative impact on cultural resources. In their comments, the CTCLUSI state that the extensive geotechnical work (e.g., drilling and core sampling) that has occurred at the LNG terminal site over the three iterations of this Project has adversely affected cultural resources. We acknowledge that a considerable amount of geotechnical work has occurred at the LNG terminal site over the last 15 years as part of two past proposals at this site as well as work conducted in support of the existing proposal. The geotechnical work was not done for the purpose of identifying cultural resources, and we are not aware of any documented impacts on cultural resources resulting from the geotechnical work. Ingram Yard and the South Dunes areas were surveyed by archeologists and no historic properties were identified. As described previously, we consider the impacts of past projects as part of the environmental baseline, but are addressing these comments because of the sensitive nature of cultural resources and the significance attributed to them by the CTCLUSI.

We have not yet completed the process of complying with Sections 101 and 106 of the NHPA. Additional cultural resource inventories, evaluations, and associated reports are to be completed, as are a final ethnographic study, HPMP, and UDP. Consultations with tribes, SHPO, and applicable federal land-managing agencies have also not been concluded. As such, constructing and operating the Project would result in an adverse effect on historic properties under Section 106 of the NHPA. However, an MOA is under development with the goal of resolving adverse effects under Section 106. Execution of an MOA and the implementation of associated treatment plans would take into account the effect of the undertaking and conclude the section 106 process. Similarly, it is expected that other federal projects would resolve adverse effects to cultural resources, if any, through compliance with the NHPA.

4.14.1.10 Air Quality, Climate Change, and Noise

Air Quality

Constructing the Project, as well as the other projects listed in table 4.14.2, would temporarily affect air quality due to emissions from the combustion engines used to power construction equipment, vehicle emissions traveling to and from the project sites, deliveries of construction materials, and from fugitive dust emissions resulting from earth-disturbing activities and equipment movement on dirt roads. The potential for cumulative construction emissions impacts would be greatest during site preparation when fugitive dust production would likely be at its peak. Emissions from equipment engines and vehicles operating concurrently would also result in cumulative air quality impacts in the local area. Most of the reasonably foreseeable projects are located outside of the geographic scope for cumulative construction emissions. The only projects that would potentially overlap with the geographic scope for cumulative construction emissions are associated with the non-jurisdictional Project facilities, COE Coos Bay Federal Navigation

Channel Maintenance Dredging, the Coos Bay, Oregon Section 408/204(f) Channel Modification, Southwest Oregon Regional Airport Expansion, McCullough Bridge Painting Project, and various BLM and Forest Service vegetation maintenance projects.

The primary projects in the construction air emissions geographic scope of the Jordan Cove LNG Project with the potential to be constructed in a similar timeframe are the COE annual Coos Bay Navigation Channel Maintenance Dredging, the Coos Bay, Oregon Section 408/204(f) Channel Modification, the COE's North Jetty Major Maintenance, and the Southwest Oregon Regional Airport Extension. The COE Maintenance Dredging Project would result in the short-term release of criteria pollutants from the operation of hopper, hydraulic cutterhead, and mechanical dredges. These dredges are operated over about 35 days in each year that maintenance dredging occurs in the lower navigation (Moffat & Nichol 2015). Estimated emissions of criteria pollutants would not result in exceedances of the NAAQS in the Project area. Furthermore, the cumulative impact analysis conducted as part of the 2015 COE EA (which included the Southwest Oregon Regional Airport Extension and the originally proposed Jordan Cove Project) found that no substantial cumulative effects would occur. Emissions from the Coos Bay, Oregon Section 408/204(f) Channel Modification would be similar to the Project dredging and maintenance dredging because it is primarily a vessel-based dredging project. Based on this information, and the implementation of mitigation measures discussed above, cumulative air quality impacts during construction of the Jordan Cove LNG Project would not be significant.

The majority of the pipeline would be located in an attainment area for the NAAQS. However, a small portion of the pipeline would be located in a PM_{10} maintenance area and a $PM_{2.5}$ nonattainment area. Due to the de minimis construction emissions that would not exceed General Conformity thresholds, and the limited scope of Project construction in the nonattainment area, the Project is not expected to contribute discernable cumulative impacts on the nearby nonattainment areas or maintenance areas. To minimize impacts due to construction emissions during pipeline construction, Pacific Connector would implement mitigation measures to minimize construction impacts on air quality, including implementing a fugitive dust control plan, compliance with applicable EPA mobile source emission performance standards, and use of equipment manufactured to meet air quality standards.

The projects identified within the construction geographic scope of the pipeline include various BLM and Forest Service vegetation maintenance projects and the Klamath Dam Removal. While these projects would likely cause minor short-term air quality impacts, it is unlikely that they would cause significant cumulative impacts when combined with the pipeline.

Operation of the LNG facilities would have long-term effects on air quality due to operational emissions associated with the facilities. Jordan Cove would be required to obtain a Title V Operating Permit for Project operation, and would be required to comply with any operating conditions of this permit, including measures to reduce emissions.

A cumulative ambient air quality analysis was conducted that showed that operation of the LNG facilities, when considered along with existing sources and background air quality, would not result in an exceedance of the NAAQSs. The only project identified within the 50 km geographic scope for cumulative operational air quality impacts is the non-jurisdictional LNG carriers. Emissions and exhaust parameters from the LNG carriers were included in the cumulative modeling analysis starting from the process of transit, berthing, to hoteling and LNG loading, and finally to connecting the towlines and de-berthing. Based on our air quality analysis, operational cumulative impacts associated with the Jordan Cove LNG Project are expected to be minor.

Operation of the Pacific Connector Pipeline Project would have long-term effects on air quality due to emissions from the Klamath Compressor Station. The compressor station would be located in an attainment area for the NAAQS. The compressor station emissions would be below the General Conformity *de minimis* thresholds; therefore, the compressor station would not significantly impact nonattainment or maintenance areas.

Pacific Connector would require an Air Contaminant Discharge Permit from the ODEQ to construct the Klamath Compressor Station and a Title V Operating Permit to operate the compressor station. The permits for this facility would include mitigation measures and operational requirements to ensure that air emissions do not exceed the permit requirements and that the facilities would be operated in compliance with applicable air quality regulations.

Pacific Connector completed air quality modeling for the operational emissions of the Klamath Compressor Station. The results of the air quality modeling are summarized in section 4.12 and provide the estimated facility air quality impacts combined with background air quality concentrations for NO_2, CO_2, PM_{10}, $PM_{2.5}$, and SO_2, and include existing operating air emission sources. Based on this analysis, the operation of Klamath Compressor Station would not result in an exceedance of any of the NAAQS. No projects were identified within the geographic scope of the Klamath Compressor Station that would result in operational air quality impacts. Therefore, the Project would not result in cumulative impacts on air quality from the operation of the Pacific Connector Pipeline Project.

Climate Change and Greenhouse Gas Emissions

Climate change is the variation in climate (including temperature, precipitation, humidity, wind, and other meteorological variables) over time, whether due to natural variability, human activities, or a combination of both, and cannot be characterized by an individual event or anomalous weather pattern. For example, a severe drought or abnormally hot summer in a particular region is not a certain indication of climate change. However, a series of severe droughts or hot summers that statistically alter the trend in average precipitation or temperature over decades may indicate climate change. Recent research has begun to attribute certain extreme weather events to climate change (USGCRP 2018).

The leading U.S. scientific body on climate change is the U.S. Global Change Research Program (USGCRP), composed of representatives from thirteen federal departments and agencies.[278] The Global Change Research Act of 1990 requires the USGCRP to submit a report to the President and Congress no less than every four years that "1) integrates, evaluates, and interprets the findings of the Program; 2) analyzes the effects of global change on the natural environment, agriculture, energy production and use, land and water resources, transportation, human health and welfare, human social systems, and biological diversity; and 3) analyzes current trends in global change,

[278] The USGCRP member agencies are: Department of Agriculture, Department of Commerce, Department of Defense, Department of Energy, Department of Health and Human Services, Department of the Interior, Department of State, Department of Transportation, Environmental Protection Agency, National Aeronautics and Space Administration, National Science Foundation, Smithsonian Institution, and U.S. Agency for International Development.

both human induced and natural, and projects major trends for the subsequent 25 to 100 years." These reports describe the state of the science relating to climate change and the effects of climate change on different regions of the U.S. and on various societal and environmental sectors, such as water resources, agriculture, energy use, and human health.

In 2017 and 2018, the USGCRP issued its *Climate Science Special Report: Fourth National Climate Assessment*, Volumes I and II (Fourth Assessment Report) (USGCRP, 2017; and USGCRP, 2018, respectively). The Fourth Assessment Report states that climate change has resulted in a wide range of impacts across every region of the country. Those impacts extend beyond atmospheric climate change alone and include changes to water resources, transportation, agriculture, ecosystems, and human health. The U.S. and the world are warming; global sea level is rising and acidifying; and certain weather events are becoming more frequent and more severe. These changes are driven by accumulation of GHG in the atmosphere through combustion of fossil fuels (coal, petroleum, and natural gas), combined with agriculture, clearing of forests, and other natural sources. These impacts have accelerated throughout the end 20th and into the 21st century (USGCRP 2018).

GHGs were identified by the EPA as pollutants in the context of climate change. GHG emission do not cause local impacts, it is the combined concentration in the atmosphere that causes global climate and these are fundamentally global impacts that feedback to localized climate change impacts. Thus, the geographic scope for cumulative analysis of GHG emissions is global rather than local or regional. For example, a project 1 mile away emitting 1 ton of GHGs would contribute to climate change in a similar manner as a project 2,000 miles distant also emitting 1 ton of GHGs.

Climate change is a global phenomenon; however, for this analysis, we will focus on the existing and potential cumulative climate change impacts in the Project area. The USGCRP's Fourth Assessment Report notes the following observations of environmental impacts are attributed to climate change in the Northwest region (USGCRP, 2017; USGCRP, 2018):

- the region has warmed nearly 2°F since 1900;
- warmer winters have led to reductions in mountain snowpack, resulting in drought, water scarcity, and large wildfires;
- declines in dissolved oxygen in streams and lakes have caused fish kills and loss of aquatic species diversity; and
- moderate to severe spring and summer drought areas have increased 12 percent to 14 percent.

The USGCRP's Fourth Assessment Report notes the following projections of climate change impacts in the Project region with a high or very high level of confidence[279] (USGCRP, 2018):

[279] The report authors assessed current scientific understanding of climate change based on available scientific literature. Each "Key Finding" listed in the report is accompanied by a confidence statement indicating the consistency of evidence or the consistency of model projections. A high level of confidence results from "moderate evidence (several sources, some consistency, methods vary and/or documentation limited, etc.), medium consensus." A *very* high level of confidence results from "strong evidence (established theory, multiple sources, consistent results, well documented and accepted methods, etc.), high consensus." https://science2017.globalchange.gov/chapter/front-matter-guide/

- increases in stream temperature indicate a 22 percent reduction in salmon habitat by the late 20th century;
- more frequent severe winter storms, which may contribute to storm surge, large waves, coastal erosion, and flooding in low-lying coastal areas;
- the warming trend is projected to be accentuated in certain mountain areas in the Northwest in late winter and spring, further exacerbating snowpack loss and increasing the risk for insect infestations and wildfires;
- longer periods of time between rainfall events may lead to declines in recharge of groundwater and decreased water availability, and responses to decreased water availability, such as increased groundwater pumping, may lead to stress or depletion of aquifers and strain on surface water sources; and
- increases in evaporation and plant water loss rates may alter the balance of runoff and groundwater recharge, which would likely to lead to saltwater intrusion into shallow aquifers.

It should be noted that while the impacts described above taken individually may be manageable for certain communities, the impacts of compound extreme events (such as simultaneous heat and drought, wildfires associated with hot and dry conditions, or flooding associated with high precipitation on top of saturated soils) can be greater than the sum of the parts (USGCRP 2018).

The GHG emissions associated with construction and operation of the Project are identified in section 4.12.1.1 for the Jordan Cove LNG Project and section 4.12.1.2 for the Pacific Connector Klamath Compressor Station and pipeline. Both the Jordan Cove LNG Project and the Pacific Connector Klamath Compressor Station and pipeline would remain below PSD major source thresholds and are therefore not required to conduct a Best Available Control Technology analysis for mitigating GHG emissions. The construction and operation of the Project would increase the atmospheric concentration of GHGs, in combination with past, current, and future emissions from all other sources globally and contribute incrementally to future climate change impacts. Project emissions would contribute incrementally to future climate change impacts.

Currently, there is no universally accepted methodology to attribute discrete, quantifiable, physical effects on the environment to the Project's incremental contribution to GHGs. We have looked at atmospheric modeling used by the EPA, National Aeronautics and Space Administration, the Intergovernmental Panel on Climate Change, and others and we found that these models are not reasonable for project-level analysis for a number of reasons. For example, these global models are not suited to determine the incremental impact of individual projects, due to both scale and overwhelming complexity. We also reviewed simpler models and mathematical techniques to determine global physical effects caused by GHG emissions, such as increases in global atmospheric CO_2 concentrations, atmospheric forcing, or ocean CO_2 absorption. We could not identify a reliable, less complex model for this task and we are not aware of a tool to meaningfully attribute specific increases in global CO_2 concentrations, heat forcing, or similar global impacts on project-specific GHG emissions. Similarly, it is not currently possible to determine localized or regional impacts from GHG emissions from the Project. Absent such a method for relating GHG emissions to specific resource impacts, we are not able to assess potential GHG-related impacts attributable to this Project. Without the ability to determine discrete resource impacts, we are unable to determine the significance of the Project's contribution to climate change.

We have not been able to find any GHG emission reduction goals established at the federal level.[280] The State of Oregon has set GHG reduction goals with a state-wide target of 51 million metric tons of CO_2e by 2020 (a 10 percent reduction from 1990 levels), and 14 million metric tons of CO_2e by 2050 (a 75 percent reduction from 1990 levels) (Oregon Global Warming Commission 2017). The Oregon Global Warming Commission projects that Oregon will fall short of these goals without additional legislative action. Direct emissions from the Jordan Cove LNG and Pacific Connector Pipeline Projects would result in annual CO_2e emissions of about 2.14 million metric tons of CO_2e, which would represent 4.2 percent and 15.3 percent of Oregon's 2020 and 2050 GHG goals, respectively.

Noise

The Project would involve various types of equipment and activities, including pile driving, dredging, and drilling. In the Coos Bay area, these activities would temporarily and significantly increase noise levels. Projects listed in table 4.14-2 that are located within the geographic scope that could contribute to a cumulative noise impact include non-jurisdictional Project facilities, COE Coos Bay Federal Navigation Channel Maintenance Dredging, the Coos Bay, Oregon Section 408/204(f) Channel Modification (which may include blasting), the COE's North Jetty Major Maintenance, Southwest Oregon Regional Airport Expansion, McCullough Bridge Painting Project, various BLM and Forest Service vegetation maintenance projects, and the Klamath Dam Removal. Based on the schedule and proximity of the other projects, there may be some cumulative construction noise impacts. The Coos Bay, Oregon Section 408/204(f) Channel Modification could conduct dredging activities 24 hours per day over a three-year period with most work occurring overnight. The exact schedules of work and levels of noise that would occur from the projects identified in table 4.14-2 is not known. However, because noise impacts resulting from pile-driving activities at the terminal site would be significant in the Coos Bay area, we conclude that the impacts on noise resulting from construction the Project when added to the noise impacts of other projects would result in a temporary, but significant cumulative noise impact in Coos Bay. To reduce the impact of the pile-driving activities and the related cumulative impact, we are recommending additional noise minimization measures be implemented; see section 4.12.

Construction noise along the pipeline would primarily last for short periods and would vary as the equipment moves along the construction spread. The exception would be where the pipeline would be installed by HDD or DP, which would require equipment operating for up to several weeks at the HDD/DP entry and exit locations. To reduce the Project's contribution to a cumulative impact along the pipeline route, Jordan Cove would implement mitigation measures for several activities including selecting low-noise alternative equipment, restricting time of day for construction, installing temporary noise barriers, enclosing equipment, and preparing site-specific noise management plans. The HDD or DP crossing method would be used to cross under six waterbodies and a powerline/steep slope location along the BPA Powerline Corridor. Per our recommendation in section 4.12.2, Pacific Connector would be required to ensure that noise attributable to drilling operations does not exceed an 55 L_{dn} dBA.

Operation of the Jordan Cove LNG Project and Pacific Connector's Klamath Compressor Station would result in long-term increases in noise levels in the vicinity of these aboveground facilities. Noise at the Jordan Cove LNG Project would be associated with refrigerant gas

[280] The EPA's Clean Power Plan which provided national emissions reduction targets were repealed in June 2019.

turbines/compressors, boil-off gas compressors/motors, various pumps/motors, steam turbine generators, air-cooled condensers, and blow-down events. Operational noise was modeled at four NSAs near the Jordan Cove LNG terminal as discussed in section 4.12. This modeling indicated noise attributable to the LNG terminal at the NSAs would be within the FERC's limit of L_{dn} 55 dBA. Overall predicted noise increases at one of the NSAs would be noticeable but are not likely to be significant. Noise increases at the remaining three NSAs are unlikely to be perceptible. None of the other projects located within 1 mile of the Jordan Cove LNG Project are expected to have any operational noise impacts; therefore, operation of the Project would not contribute to broader cumulative noise impacts.

Underwater noise levels from large commercial ships are fairly consistent, ranging from about 177 to 188 dB re 1 μPA at 1 meter. Considering peak noise levels and cumulative sound exposure, vessel noise is not expected to exceed the NMFS guideline thresholds for the onset of permanent threshold shift for cetaceans and pinnipeds. Total underwater noise from maintenance dredging, LNG carriers, tugs, and other marine vessels would increase during operation of the Project; however, this cumulative impact would not be significantly greater than existing underwater noise levels in Coos Bay.

Noise at the Klamath Compressor Station would be associated with gas turbines, compressors, pumps, cooling fans, and blowdown events. Operational noise was modeled at five NSAs near the Klamath Compressor Station. This modeling indicated noise attributable to the compressor station at the NSAs would be within FERC's limit of L_{dn} 55 dBA. Pacific Connector would adopt the acoustic design recommendations for the Klamath Compressor Station outlined in the noise study report. Overall predicted noise increases at NSAs #5 and #6 are unlikely to be perceptible based upon the existing background noise. The predicted noise increases at the remaining NSAs would be noticeable but are not likely to be significant. None of the known existing or future projects located within 1 mile of the Klamath Compressor Station are expected to have any operational noise impacts; therefore, operation of the Pacific Connector Pipeline Project would not contribute to broader cumulative noise impacts.

4.14.2 Cumulative Impact Conclusions

The impacts of the Project when added to those of the other projects identified would result in cumulative impacts on the environment. For the federal projects, existing laws and regulations protect waterbodies and wetlands, threatened and endangered species, and historic properties, and limit impacts on air and noise. In addition, Federal land-managing agencies, such as the BLM and Forest Service, have requirements in their LRMPs and RMPs to protect resources on their lands. Given the BMPs and impact avoidance, minimization, and mitigation measures that would be implemented; and federal and state laws and regulations protecting the environment; we conclude that with the exception of significant impacts on visual resources, construction noise from pile driving during LNG terminal construction, the operation of the Southwest Regional Airport, and available housing in the Coos Bay area, cumulative impacts on the environment would not be significant.

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 CONCLUSIONS OF THE ENVIRONMENTAL ANALYSIS

The conclusions and recommendations presented below are those of the FERC's environmental staff. They were prepared in cooperation with the BLM, Forest Service, Reclamation, DOE, COE, EPA, FWS, NOAA, Coast Guard, USDOT, and Coquille Tribe. However, these agencies may present their own conclusions and recommendations in their respective and applicable records of decision. The cooperating agencies can adopt this final EIS consistent with 40 CFR §1501.3 if, after an independent review of the document, they conclude that their requirements have been satisfied. Otherwise, they may elect to conduct their own supplemental environmental analyses.

Based on our review as described in the preceding sections, we conclude that constructing and operating the Project would result in temporary, long-term, and permanent impacts on the environment and a number of significant environmental impacts; however, a majority of impacts would be less than significant due to the implementation of proposed and recommended impact avoidance, minimization, and mitigation measures. As part of our review we developed measures that would appropriately and reasonably further avoid, reduce, or mitigate environmental impacts resulting from construction and operation of the Project (see section 5.2). Therefore, we recommend that these measures be attached as conditions to any authorizations issued by the Commission.

5.1.1 Geology

The LNG terminal would be located in Coos Bay within the seismically active CSZ. Numerous comments were received by the Commission about the potential affects to the LNG terminal from a tsunami. Recognizing the concern, and as described in the LNG safety and reliability section, Jordan Cove designed the terminal facilities consistent with maximum tsunami run-up elevations and considered tsunami wave heights and inundation elevations; therefore, FERC staff agrees that the equipment elevations that Jordan Cove provided are suitable for the proposed LNG terminal site. We also conclude that the LNG terminal would be able to withstand without damage a storm surge during a 500-year storm event. Although much of the pipeline would be located in the CSZ, we conclude, based on a review of potential impacts, historical data, seismic hazard mapping, peak horizontal ground acceleration values, pipeline tolerances, and Pacific Connector's proposed impact avoidance and minimization measures, that construction and operation of the pipeline facility would not be significantly affected by potential geological hazards including ground shaking, surface ruptures, soil liquefaction and lateral spreading, landslides, and slope failures. Additionally, the pipeline would cross steep slopes and mountain ranges which increases concerns for erosion, landslides, and slope failures. However, we conclude, based on our evaluation of the pipeline facility and Pacific Connector's proposed construction methods including its implementation of erosion control devices and other impact avoidance and minimization measures, that construction and operation of the pipeline would not be significantly affected. To ensure the risk of landslides in five moderate risk areas is further reduced, we are recommending that Pacific Connector file final monitoring protocols and mitigation measures. To ensure areas of potential moderate to high-risk landslides have been fully addressed, we are also recommending that Pacific Connector conduct an additional review of the most recent LiDAR data available from DOGAMI. Furthermore, due to the absence of mining and other mineral extraction activities along the pipeline route, we conclude that these activities would also not be affected.

5.1.2 Soils and Sediments

Constructing and operating the LNG terminal would permanently impact underlying soils, including sands, fine sands, silt loams, and dune lands. Erosions control measures compliant with our Plan and Procedures would be implemented to control and reduce erosion and sedimentation. The pipeline would be located across numerous soil types including soils prone to erosion and compaction. The pipeline would also be located across about 146 miles of soils that have been rated as having reclamation sensitivity or poor revegetation potential. Impacts on soils would be reduced by Pacific Connector's implementation of erosion control measures and its use of best management practices including spill prevention and response procedures. Furthermore, Pacific Connector would install permanent erosion control measures and, if necessary, decompact soils (ripping) and implement other soil remediation measures.

To address contaminated soils at the terminal site, Jordan Cove would develop a disposal plan consistent with state requirements. An assessment of these soils conducted by Jordan Cove concluded that residual contaminants did not exceed ODEQ screening levels for worker exposure. Consultations between the Applicants and ODEQ did not result in the identification of soil and groundwater contamination along the pipeline route.

The marine loading facilities and LNG carrier berth would permanently modify the Coos Bay shoreline and access to the navigational channel. A study of vessel wakes concludes that operating the LNG terminal (and LNG carriers) would not increase shoreline impacts. The marine berth would be constructed to account for concerns about LNG carrier propeller wash affecting the operational ability of the terminal.

Based on our review, we conclude that constructing and operating the Project would temporarily and permanently impact soils; however, based on the proposed construction and operations procedures and methods and the impact avoidance, minimization, and mitigation measures that would be implemented, these impacts would not be significant.

5.1.3 Water Resources and Wetlands

5.1.3.1 Groundwater

Based on the characteristics of groundwater underlying the LNG terminal site, we have determined that the Project would not affect nearby (about 3,500 feet north of the terminal) CBNBWB water withdrawal wells. With Jordan Cove's implementation of BMPs and impact avoidance, minimization, and mitigation measures to address potential inadvertent releases of equipment related fluids, we conclude that impacts on groundwater resources at the LNG terminal site may occur, but would be reduced to the extent practicable, and would not be significant. Constructing and operating the pipeline could temporarily and/or permanently affect springs, seeps, and wells. These resources could experience changes in quantity (flow and volume) and quality (contamination due to the inadvertent release of equipment related fluids). To reduce impacts on these resources, Pacific Connector would implement measures described in its *Groundwater Supply Monitoring and Mitigation, SPCC Plan,* and *Contaminated Substances Discovery Plans.* Therefore, we conclude that constructing and operating the Project would not significantly affect groundwater resources.

5.1.3.2 Surface Water

Creating the LNG marine berth and access channel, as well as modifying the navigation channel would temporarily increase turbidity and sedimentation in Coos Bay, affecting overall water quality. The increased turbidity and sedimentation would occur as a result of initial dredging activities over varying distances depending on hydrological conditions and then again periodically in association with maintenance dredging. LNG carriers traversing the navigational channel and operating in the marine berth would not have a measurable effect on water quality other than a minor increase in turbidity along the bottom of the berth due to propeller wash. LNG carrier water withdrawals and discharges associated with ballast and normal engine operations during LNG loading would recirculate over 3 million gallons of water per hour. LNG carrier operations are not expected to significantly affect water quality (e.g., temperature, salinity, or dissolved oxygen levels) in Coos Bay.

The pipeline would be constructed across or in close proximity to 337 waterbodies; 257 intermittent streams and ditches, 68 perennial waterbodies, and several ponds and other surface water features. Pacific Connector developed a *Stream Crossing Risk Analysis* that, in conjunction with following their *Procedures*, would avoid and reduce impacts on waterbodies. Waterbodies would be crossed during low-flow periods whenever possible and within ODFW recommended in-water construction windows.

Pacific Connector would cross five major waterbodies (defined as those over 100 feet wide) including two crossings of Coos Bay and one at the Coos River using HDD methods and two locations on the South Umpqua River using DP and diverted open-cut methods. The Rogue River and Klamath River would also be crossed via HDD methods. Pacific Connector prepared an *HDD Contingency Plan and Failure Procedures* that describes measures to deal with HDD failure and contain an inadvertent release of drilling mud during the HDD process. We are also recommending that Pacific Connector provide a list of all drilling fluid additives, grout, and LCM that may be used during HDD activities.

Other than the limited number of HDD, DP, bores, and one diverted open cut, all other crossings would use dry open-cut methods (including dam-and-pump and fluming). These methods would reduce the potential for turbidity from flowing water disturbance during active flow construction. Impacts from dry crossings would be temporary and localized, with most construction occurring at a single crossing within a 48-hour period.

The pipeline would cross three rivers listed on the Nationwide Rivers Inventory: the North Fork of the Coquille River, the East Fork of the Coquille River, and the South Umpqua River. The pipeline would cross the North Fork of the Coquille River (at about MP 23) and the East Fork of the Coquille River (at about MP 30) using a dry open-cut method. Pacific Connector proposes to use a DP and diverted open cut, respectively, at the two crossings of the South Umpqua River (at about MPs 71 and 95).

During construction, Pacific Connector would use a total of about 75,000 gallons per day of water for dust control, and about 32 to 64 million gallons of water for hydrostatic testing of the pipeline. All required permits would be obtained prior to water use from both private and public water sources, which would stipulate allowable flow and flow rates of withdrawal and discharge. Based on Jordan Cove's proposed dredging and vessel operation methods, Pacific Connector's proposed waterbody crossing and restoration methods, as well as the required impact avoidance and minimization measures (including implementation of erosion controls, water management plans, hazardous substance management procedure, and construction timing), we conclude that the Project would not result in significant impacts on surface water resources.

5.1.3.3 Wetlands

Constructing and operating the LNG terminal would affect about 86.1 acres of wetlands and result in the loss of about 22.3 acres of wetlands. Constructing and operating the pipeline would temporarily affect about 114.1 acres of wetlands and result in long-term impacts on about 4.9 acres of wetlands.

Jordan Cove and Pacific Connector developed a *Compensatory Wetland Mitigation Plan* to address the COE's regulations and requirements to mitigate unavoidable impacts on wetlands. Impacts on freshwater wetland resources would be mitigated via the Kentuck project site, and impacts on estuarine wetland resources would be mitigated via the Eelgrass Mitigation site and Kentuck project site (see Jordan Cove and Pacific Connector's *Compensatory Wetland Mitigation Plan*). These mitigation plans are still being reviewed by the COE, ODSL, and applicable federal and state agencies. Approval of these mitigation plans by these agencies would be required prior to the issuance of federal and state wetland permits.

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.

5.1.4 Vegetation

Constructing and operating the Project would affect over 4,600 acres of vegetation. Over 2,850 acres of forested vegetation including about 782 acres of LSOG forest would be cleared and experience long-term and permanent impacts. However, with the exception of LSOG forest, most of the vegetation types affected by the Project are common and widespread in the region. The temporary and permanent clearing of vegetation would affect soils, wildlife, and water resources; would result in the creation of forest "edges"; and could increase the introduction and spread of exotic and invasive species. To reduce the impacts of clearing vegetation along the pipeline route, Pacific Connector would implement erosion control and numerous other measures as described in its ECRP, *Fire Prevention and Suppression Plan,* and its *Integrated Pest Management Plan.* Based on the types and amounts of vegetation that would be affected by the Project, the measures that would be implemented to avoid, reduce, and mitigate the resulting impacts, our recommendation for Pacific Connector to develop a final *Integrated Pest Management Plan*, and the abundance of similar vegetation in the affected watersheds, we conclude that constructing and operating the Project would have permanent but not significant impacts on vegetation.

5.1.5 Wildlife and Aquatic Resources

Over 600 species of terrestrial and aquatic wildlife including amphibians, reptiles, birds, fish, and mammals occur in the Project area. Constructing and operating the Project would temporarily and permanently affect these species. Wildlife would avoid and be displaced by construction activities and changes to habitat caused by the Project. Avoidance, displacement, and impacts on other behaviors as well as the loss of habitat would increase the rates of stress, injury, and mortality experienced by wildlife. Furthermore, pile-driving noise resulting from construction of the terminal facilities may adversely affect wildlife depending on their proximity to the terminal and each species' tolerance for increased noise. Similarly, we conclude that operational noise from the LNG terminal may affect terrestrial and aquatic wildlife. To further reduce impacts on wildlife and aquatic resources from terminal lighting, we are recommending that Jordan Cove develop a final lighting plan and document its consultations with the appropriate resource agencies regarding this plan. To minimize aquatic resource impacts, we are also recommending that Pacific Connector develop a *Hydrostatic Test Plan* that requires that any water withdrawal from a flowing stream does not exceed an instantaneous flow reduction of more than 10 percent of stream flow.

Regarding potential impacts on wildlife and aquatic species due to increased marine traffic (and potential fuel and/or equipment fluid releases), we conclude that impacts on wildlife including migratory birds and aquatic species would be low and not significant. We also conclude that entrainment and impingement of aquatic species from LNG carrier water intakes at the terminal would not result in substantial adverse impacts. With the exception of forested habitats and associated wildlife use and the regular traversing of Coos Bay by LNG carriers, impacts on wildlife and aquatic resources would generally be temporary.

Most impacts on aquatic species resulting from pipeline construction across streams would result from temporary water quality changes (e.g., turbidity, water temperature, pH, dissolved oxygen). To restore affected aquatic habitat, and mitigate for impacts, Pacific Connector is proposing to install LWD at selected locations and replant riparian vegetation in proportion to that initially removed, or two times greater than the final cleared right-of-way width. To reduce impacts on wildlife and aquatic resources, the Applicants would implement numerous BMPs and impact avoidance and minimization measures. In addition, terrestrial and aquatic compensatory mitigation projects proposed by the Applicants, required by the Forest Service and proposed by the Applicants on behalf of the BLM, would improve and conserve fish and wildlife habitat in proximity to the Project. Therefore, based on the implementation of these measures, the characteristics of wildlife and aquatic species in the Project area, and the Applicants' proposed construction and operation procedures and methods, we conclude that the Project would not significantly impact wildlife and aquatic resources.

5.1.6 Threatened, Endangered, and Other Special Status Species

The Project would be located across lands with habitats supporting 35 federally-listed and proposed threatened and endangered species. Based on surveys conducted by the Applicants, our assessment of these species and impacts on them resulting from construction and operation of the Project, and in consultation with the FWS and NMFS, we have determined that the Project is not likely to adversely affect 17 of the threatened and endangered species; and is likely to adversely affect 15 identified threatened and endangered species. Additionally, the Project is likely to adversely affect three species proposed for listing. The threatened species MAMU, NSO, green sturgeon (Southern DPS), Pacific eulachon (Southern DPS), coho salmon (SONCC), coho salmon (Oregon Coast ESU), vernal pool fairy shrimp, and Kincaid's lupine are likely to be adversely affected. The endangered species blue whale, fin whale, humpback whale, Lost River sucker, shortnose sucker, Applegate's milk-vetch, and Gentner's fritillary are also likely to be adversely affected. The proposed threatened Pacific marten (Coastal DPS), and Pacific fisher (West Coast DPS) and proposed endangered Franklin's bumble bee are also likely to be adversely affected. On August 30, 2019, Jordan Cove proposed measures to mitigate these impacts in their *Comprehensive Mitigation Plan*, including 1,075 acres of private LSOG habitat acquisition,

$350,000 funding of a program to reduce MAMU nest predation, and $197,400 to support barred owl management.

To ensure impacts on federally listed threatened and endangered species are sufficiently minimized, we are making several recommendations concerning noise and construction methods. Whales may be affected by construction-related noise; therefore, we are recommending that Jordan Cove prepare a *Marine Mammal Monitoring Plan* that identifies the measures that would be implemented to reduce noise impacts and to ensure compliance with NMFS underwater noise criteria pertaining to listed whales. We are also recommending that Pacific Connector adhere to FWS-recommended timing restrictions concerning MAMU stands and NSO activity centers, and conduct standard protocol surveys for these two species in all suitable habitat.

In compliance with Section 7 of the ESA, we have prepared a BA and submitted it to the FWS and the NMFS, and formal consultation with the FWS and NMFS has been initiated. In response to our BA, it is anticipated the FWS and NMFS would issue biological opinions where they will determine if the Project would likely jeopardize the continued existence of a listed species or result in the destruction or adverse modification of designated critical habitat. To ensure compliance with the ESA, we are recommending that construction not occur until consultation is complete. Concerning state-listed species and other species of concern, we conclude that constructing and operating the Project would not significantly affect these species.

5.1.7 Land Use

The Project would temporarily and permanently affect numerous land uses including managed and unmanaged forest, industrial/commercial (including utility), unmanaged (open), residential, agricultural (pasture, row crop, and other), recreational, timber, transportation (roads and highways), and range. The LNG terminal site consists of a combination of brownfield decommissioned industrial facilities, an existing landfill requiring closure, and open land. With the exception of a COE easement and BLM land crossed by the IWWP (within an existing utility corridor), no federal lands would be affected at the LNG terminal site. The nearest residence to the LNG terminal is about 1.1 miles away. The pipeline would cross a mix of private and public lands, with privately owned lands making up about two-thirds and federal lands accounting for about one-third, with some state lands also crossed. The pipeline and/or associated workspaces would be located within 50 feet of seven residences. Impacts on residences would be reduced by the implementation of residential best management practices. Following construction, some lands temporarily affected would be able to resume previous land uses. Some permanently affected lands would also be able to resume previous land uses (agriculture, unmanaged, and range), and other lands would be permanently converted to industrial/commercial use, precluding the resumption of previous land uses. Other land uses would be converted to more natural conditions than they are currently (as part of the proposed Project-related mitigation sites). Based on the impacts on land uses, we conclude that constructing and operating the Project would not significantly affect land use.

The Jordan Cove LNG Project as well as approximately 50 miles of the pipeline route would be within Oregon's Designated Coastal Zone. The Project would need to obtain a finding from the ODLCD that the Project components within the coastal zone are consistent with the CZMA. To ensure compliance with the CZMA, we are recommending that construction not occur until the Project receives a consistency determination.

5.1.8 Recreation and Visual Resources

5.1.8.1 Recreation

Constructing and operating the Project would temporarily impact recreational use of areas located near the LNG terminal. Specifically, pile-driving–related noise emanating from the terminal site would be a noticeable effect on the quality of the recreation experience at Forest Service, BLM, and Coos County–managed recreation areas including the ODNRA and BLM RMAs. Furthermore, construction-related activities could temporarily increase traffic and travel times around and near the LNG terminal site. The Project could also affect nearby recreational services including boating, fishing, and equipment vendors. Additionally, some views from nearby recreation areas would now include the LNG terminal and carriers. Visitors could also find that temporary accommodations (e.g., hotels, camp sites, and RV parks) in the Coos Bay area have lower vacancy rates than usual. Impacts due to operation of the Project would include short-term delays for recreational boaters and other water users required to avoid LNG carriers in transit within the waterway.

Constructing and operating the Pacific Connector Pipeline Project would also temporarily impact adjacent and nearby recreation resources. Recreational service providers may be affected if visitors avoid construction areas. However, impacts on specific areas would generally be time limited as pipeline work is completed in one area and activities then move onto another area. Based on the expected impacts on recreation areas and services, we conclude that constructing and operating the Project would affect recreation; however, this effect would not be significant.

5.1.8.2 Visual Resources

The LNG terminal would be visible from numerous viewpoints within the North Bend/Coos Bay area. The most visible components of the LNG terminal would be the LNG storage tanks (180 feet tall) and nighttime lighting. Although adjacent properties have been developed and are currently being used for commercial purposes, the LNG terminal would be a major industrial facility considerably different from adjacent uses, and would permanently and significantly affect the visual character of Coos Bay's northern shoreline. Constructing the pipeline (use of heavy equipment and ground disturbance) and its impact on the numerous viewsheds it would cross would be temporary. Operating the pipeline and the maintenance of an easement would permanently affect the viewshed; however, due to the remoteness of the Project area and the presence of other linear infrastructure, powerlines, highways, and roads, which have a similar impact on the viewshed, we conclude that although some individuals would find this impact to be significant, the overall impact on the Project area resulting from construction and operation of the pipeline would not be significant.

5.1.9 Socioeconomics

Constructing and operating the Project would impact socioeconomic resources. As with any large influx of people or construction workers, the Project would temporarily increase the demand for local services including law enforcement, fire protection, and health care providers. Additionally, constructing the Project would provide employment for local workers, and support other jobs and industry/service providers elsewhere in the region. Constructing both the terminal facilities and the pipeline would temporarily increase demand for housing (rental housing, hotel and motel rooms, and RV spaces) and further strain the temporary housing market in the Project area. Jordan

Cove proposes to reduce potential impacts on housing in the Coos Bay area by building a temporary housing facility for contractors. However, based on comments received concerning this issue and to further reduce potential housing issues and concerns regarding the presence of a large temporary workforce during the construction phase of the LNG terminal, we are recommending the Applicants designate a Construction Housing Coordinator to serve as a liaison between the Applicant and the communities affected by the Project during construction. In addition to receiving numerous comments on housing concerns, we also received substantial concern about potential increases in crime, particularly at-risk segments of the community including women, minorities, and Native Americans. We reviewed available literature including observational studies, media reports, and anecdotal evidence to assess how construction of the Project may impact affected communities and concluded that, although increases in crime were possible, we could not quantify the amount or location of this impact. Therefore, based on the Applicant's proposed construction and operations procedures and impact reduction measures, we conclude that constructing and operating the LNG and pipeline facilities would not result in significant impacts on socioeconomic resources or services, with the exception of housing availability in Coos County during construction.

5.1.10 Transportation

Constructing the LNG terminal would require deliveries over a 2-year period via a mix of ocean-going vessels and barges. Once construction is complete, LNG carriers would transit to and from the terminal, increasing the total number of deep-draft vessels calling at Coos Bay. The anticipated increases in marine traffic combined with current deep-draft vessel traffic would be less than historic ship traffic through the channel and are, therefore, not expected to significantly affect other marine traffic in Coos Bay. During construction of the LNG Terminal, the construction workforce would use public roads and highways. A *Traffic Impact Analysis* prepared on behalf of Jordan Cove identified a number of measures to reduce potential impacts during commuting hours including: the use of staggered work shifts; construction of a dedicated eastbound left-turn lane at the intersection of U.S. 101 and Trans-Pacific Parkway, along with the use of a temporary signal; manual flagging at the intersection of Hauser Depot Road and U.S. 101; and the use of off-site parking lots (with workers transported to the site by bus). As a result of the Project, vehicle congestion and travel times could noticeably increase. To further address traffic concerns, we are recommending that Jordan Cove enter into a cooperative improvement agreement with ODOT and traffic development agreements with Coos County and the City of North Bend, as recommended in the *Traffic Impact Analysis* report. Furthermore, pipeline construction would involve the use of existing roads, including federal and state highways, as well as local, private, and BLM and Forest Service roads, to access workspaces and move construction equipment, materials, and personnel along the Pipeline route. These roads would experience increased use and as expected would be affected by this use.

Because multiple LNG Terminal components would exceed FAA obstruction standards, operating the LNG terminal could significantly impact Southwest Oregon Regional Airport operations. Therefore, with the exception of Southwest Oregon Regional Airport operations, we conclude that with the implementation of impaction reduction measures and our recommendation that construction and operation of the Project would not result in significant impacts on transportation.

5.1.11 Cultural Resources

Cultural resource investigations for the Project are currently incomplete. Surveys that have been completed have identified sites in the vicinity that require monitoring during construction or other mitigation prior to construction. Additionally, further survey and/or testing has been recommended for some sites if avoidance cannot be achieved or confirmed by the Project.

The FERC staff and the Applicants have contacted Indian tribes that may attach religious or cultural importance to sites in the APE. We received comments from the CTCLUSI, Coquille, Cow Creek, Grand Ronde, Karuk, Klamath, Tolowa Dee-ni' Nation, Ute Indian Tribe, and Yurok Tribe. The Coquille Tribe is a cooperating agency, while the others have filed motions to intervene. A finalized ethnographic study is in the process of being completed by the Applicants.

We have not yet completed the process of complying with Sections 101 and 106 of the NHPA. Additional cultural resource inventories, evaluations, and associated reports are yet to be completed. Consultations with tribes, SHPO, and applicable federal land-managing agencies have also not been concluded and are ongoing. We are recommending that Jordan Cove and Pacific Connector not construct or use any of their proposed facilities, including related ancillary areas for staging, storage, temporary work areas, and new or to-be-improved access roads, until all studies and consultations necessary to complete compliance with the NHPA have been completed. Constructing and operating the Project would have adverse effects on historic properties under Section 106 of the NHPA. However, an MOA would be developed with the goal of resolving adverse effects on historic properties. Execution of an MOA and the implementation of associated treatment plans would take into account the effects of the undertaking and conclude the Section 106 process.

5.1.12 Air Quality and Noise

5.1.12.1 Air Quality

Air pollutants would be emitted as a result of both construction and operation of LNG marine traffic, the LNG terminal, the Pacific Connector pipeline, and aboveground facilities. During construction, a temporary reduction in ambient air quality may result from emissions and fugitive dust generated by construction equipment. Emissions from construction equipment would be temporary and would not result in a significant impact on regional air quality or result in any exceedance of applicable ambient air quality standards.

The Jordan Cove LNG Project is located in an air attainment area for federal air quality standards. In September 2017, Jordan Cove submitted an air quality permit application to the ODEQ. The Project's Type B state-only NSR permit application demonstrates that applicable requirements have been met. For all pollutants, the impacts at the points of highest concentration during operation of the Jordan Cove facilities are well below the applicable NAAQS and the PSD increments when combined with ambient air quality concentrations.

The Klamath Compressor Station and most of the pipeline route would be located in areas designated as attainment for all federal air quality standards, except for approximately 325 feet of pipeline route that would be located within the Klamath Falls PM_{10} maintenance area. Pacific Connector submitted a standard ACDP initial application to the ODEQ in May 2015, and submitted a revised application in September 2017. For all pollutants, the combined impacts at the points of highest concentration during operation of the Klamath Compressor Station are less than the applicable NAAQS.

Constructing and operating the Project would result in impacts on air quality; however, with implementation of BMPs, we conclude that these impacts would not be significant.

5.1.12.2 Noise

Noise would be generated as a result of both construction and operation of the LNG terminal and the Pacific Connector pipeline. The NSAs closest to the Jordan Cove LNG terminal are single-family homes in the city of North Bend about 1.3 miles south and directly across Coos Bay from the center of the proposed LNG terminal site, and the Horsfall campground located approximately 1.2 miles northeast of the LNG terminal. Based on the large number of residents who live across Coos Bay, the impulsive (i.e., short and intense) noise impacts associated with pile-driving activities, the predicted and perceptible noise impacts on nearby NSAs, the duration of pile-driving activities (20 hours per day for two years), as well as the lack of noise reduction measures proposed by Jordan Cove, we have concluded that pile-driving activities would significantly impact the Coos Bay area. We have determined that this impact cannot be reduced to less than significant but, to lessen the impact, we are recommending that Jordan Cove limit active pile driving to between the hours of 7:00 a.m. and 10:00 p.m., and utilize wooden pile cushion/caps when conducting impact pile-driving work.

Operational noise from operating the LNG terminal is predicted to have a sound level below the FERC requirement of 55 dBA L_{dn} at the nearest NSA. However, we are recommending that Jordan Cove document that its facilities meet our noise standards by filing the results of a noise survey during operation that shows compliance with our noise requirement.

During the construction of the Pacific Connector Project, construction noise would be audible to NSAs near the construction right-of-way. Pipeline construction activities generally would be limited to daytime hours. Due to the assembly-line nature of pipeline construction, activities in any area could occur intermittently over a period lasting from several weeks to a few months. Noise from HDD drilling activities may be above our requirement of 55 dBA L_{dn} at some NSAs without mitigation. To make certain that the mitigation measures implemented at the HDD locations reduce noise at nearby NSAs, we recommend that Pacific Connector file a noise mitigation plan, monitor noise levels, and file bi-weekly noise reports documenting compliance with our noise standard during the drilling activities.

Operation of the Klamath Compressor Station would result in noise impacts on nearby NSAs. In order to reduce these impacts, Pacific Connector would implement mitigation measures to reduce noise from the compressor station to meet our requirement of 55 dBA L_{dn} at nearby NSAs. To ensure that actual operational noise is at or below the predicted noise, and that there would be no significant impact on noise quality at the nearest NSAs, we are recommending that Pacific Connector file the results of a noise survey no later than 60 days after the compressor station is placed in service to demonstrate that noise at nearby NSAs does not exceed our standards. If that level is exceeded, Pacific Connector would need to install additional noise controls to meet that level.

Constructing and operating the Project would result in noise temporarily and permanently affecting the environment. However, most of this noise would cease once construction activities are complete and because communities and the surrounding environment would become habituate to the resulting permanent noise , we conclude that, with the exception of pile-driving noise impacts on Coos Bay, the Project would not result in significant noise impacts.

5.1.13 Reliability and Safety

As part of the NEPA review, Commission staff must assess whether the proposed facilities would be able to operate safely and securely. As a result of our technical review of the preliminary engineering design and our recommended mitigation, we believe that the facility design proposed by Jordan Cove includes acceptable layers of protection or safeguards that would reduce the risk of a potentially hazardous scenario from developing into an event that could impact the off-site public.

As a cooperating agency, the USDOT PHMSA assists the FERC by determining whether Jordan Cove's proposed design would meet the USDOT PHMSA's 49 CFR 193 Subpart B siting requirements. On September 11, 2019, the USDOT PHMSA provided a Letter of Determination on the Project's compliance with 49 CFR 193 Subpart B. This determination is provided to the Commission as further consideration to the Commission on its decision to authorize or deny the Project. If the Project is authorized, constructed, and operated, the facility would be subject to the USDOT PHMSA's inspection and enforcement program and final determination of whether a facility is in compliance with the requirements of 49 CFR 193 would be made by the USDOT PHMSA staff.

As a cooperating agency, the Coast Guard also assisted the FERC staff by reviewing the proposed LNG terminal and the associated LNG marine vessel traffic. The Coast Guard reviewed a WSA submitted by Jordan Cove that focused on the navigation safety and maritime security aspects of LNG marine vessel transits along the affected waterway. On May 10, 2018, the Coast Guard issued an LOR that recommended the Coos Bay Channel be considered suitable for accommodating the type and frequency of LNG marine traffic associated with this Project based on the WSA and in accordance with the guidance in the Coast Guard's NVIC 01-11. If the Project is authorized, constructed, and operated, the facilities would be subject to the Coast Guard's inspection and enforcement program to ensure compliance with the requirements of 33 CFR 105 and 33 CFR 127.

If authorized, Pacific Connector's pipeline would be built and inspected according to USDOT PHMSA standards published in 49 CFR 192. These regulations are intended to minimize the potential for natural gas facility accidents and protect the public and environment. The DOT specifies material selection and qualifications; minimum design requirements; and protection from internal, external, and atmospheric corrosion. We conclude that the Pipeline System would have a small increase in the risk of a pipeline accident; however, this risk would be minimized based on compliance with DOT regulations; therefore, the Pipeline System would not have a significant impact on public safety.

5.1.14 Cumulative Impacts

Construction of the Project, in addition to construction of other projects within the same geographic scopes crossed by the pipeline, would have cumulative impacts on a range of environmental resources, as discussed in section 4.14. Using available information about other projects in the area and based on some general assumptions (outlined in our analysis), we described the expected impacts of other federal projects identified in table 4.14-2. For federal projects, there are laws and regulations in place that protect waterbodies and wetlands, threatened and endangered species, and historic properties, and limit impacts from air and noise pollution. Federal land-managing agencies, such as the BLM and Forest Service, have requirements in their LMPs to protect resources on the lands they manage. We have limited information about potential or foreseeable private projects in the region. For some resources, there are also state laws and regulations that apply to private projects. While there would be cumulative impacts on resources when all of the foreseeable projects are combined, the magnitude of that impact would be minimal at the landscape scale. Given the Project BMPs and design features, mitigation measures that would be implemented, federal and state laws and regulations protecting resources, and permitting requirements, we conclude that when added to other past, present, and reasonably foreseeable future actions, the Project, with exceptions, would not result in significant cumulative impacts on the environmental. Constructing the Project would result in a temporary significant cumulative impact on housing availability in Coos County as well as a temporary significant cumulative impact on noise in Coos Bay, and would also result in a permanent significant cumulative impact on the visual character of Coos Bay. Additionally, operating the LNG Terminal could significantly impact Southwest Oregon Regional Airport operations.

5.2 FERC STAFF'S RECOMMENDED MITIGATION

If the Commission authorizes the Project, we are recommending that the following measures be included as specific conditions in the Commission's Order. These measures would further mitigate the environmental impacts associated with the construction and operation of the proposed Project. The section number in parentheses at the end of a condition corresponds to the section number in which the measure and related resource impact analysis appears in the EIS.

1. Jordan Cove and Pacific Connector shall follow the construction procedures and mitigation measures described in their respective applications and supplemental filings (including responses to staff data requests), and as identified in the EIS, unless modified by the Order. Jordan Cove and Pacific Connector must:
    a. request any modification to these procedures, measures, or conditions in a filing with the Secretary;
    b. justify each modification relative to site-specific conditions;
    c. explain how that modification provides an equal or greater level of environmental protection than the original measure; and
    d. receive approval in writing from the Director of OEP **before using that modification**.

2. For the LNG terminal, the Director of OEP, or the Director's designee, has delegated authority to address any requests for approvals or authorizations necessary to carry out the conditions of the Order, and take whatever steps are necessary to ensure the protection of life, health, property, and the environment during construction and operation of the Jordan Cove LNG Project. This authority shall include:
    a. the modification of conditions of the Order;
    b. stop-work authority and authority to cease operation; and

c. the imposition of any additional measures deemed necessary to ensure continued compliance with the intent of the conditions of the Order as well as the avoidance or mitigation of unforeseen adverse environmental impact resulting from project construction and operation.

3. For the pipeline facilities, the Director of OEP, or the Director's designee, has delegated authority to address any requests for approvals or authorizations necessary to carry out the conditions of the Order, and take whatever steps are necessary to ensure the protection of environmental resources during construction and operation of the Pacific Connector Pipeline Project. This authority shall allow:

   a. the modification of conditions of the Order;

   b. stop-work authority; and

   c. the imposition of any additional measures deemed necessary to ensure continued compliance with the intent of the conditions of the Order as well as the avoidance or mitigation of unforeseen adverse environmental impact resulting from project construction and operation activities.

4. **Prior to any construction,** Jordan Cove and Pacific Connector shall file an affirmative statement with the Secretary, certified by a senior company official, that all company personnel, EIs, and contractor personnel will be informed of the EI's authority and have been or will be trained on the implementation of the environmental mitigation measures appropriate to their jobs **before** becoming involved with construction and restoration activities.

5. The authorized facility locations shall be as shown in the EIS, as supplemented by filed site plans and alignment sheets, and shall include the route variations identified in condition 16 below. **As soon as they are available, and before the start of construction,** Jordan Cove and Pacific Connector shall file with the Secretary any revised detailed site plan drawings and survey alignment maps/sheets at a scale not smaller than 1:6,000 with station positions for all facilities approved by the Order. All requests for modifications of environmental conditions of the Order or site-specific clearances must be written and must reference locations designated on these site plan drawings.

   For the pipeline, Pacific Connector's exercise of eminent domain authority granted under NGA Section 7(h) in any condemnation proceedings related to the Order must be consistent with these authorized facilities and locations. Pacific Connector's right of eminent domain granted under NGA Section 7(h) does not authorize it to increase the size of its natural gas pipeline or facilities to accommodate future needs or to acquire a right-of-way for a pipeline to transport a commodity other than natural gas.

6. Jordan Cove and Pacific Connector shall file with the Secretary detailed site plan drawings, alignment maps/sheets, or aerial photographs at a scale not smaller than 1:6,000, identifying all route realignments, facility relocations, changes in site plan layout, staging areas, pipe storage yards, new access roads and other areas that would be used or disturbed and have not been previously identified in filings with the Secretary. Approval for each of these areas must be explicitly requested in writing. For each area, the request must include a description of the existing land use/cover type, documentation of landowner approval, whether any cultural resources or federally listed threatened or endangered species would be affected, and whether any other environmentally sensitive areas are within or abutting

the area. All areas shall be clearly identified on the maps/sheets/aerial photographs. Each area must be approved in writing by the Director of OEP **before construction in or near that area.**

This requirement does not apply to route variations required by the Order, extra workspace allowed by the Commission's *Upland Erosion Control, Revegetation, and Maintenance Plan* and/or minor field realignments per landowner needs and requirements which do not affect other landowners or sensitive environmental areas such as wetlands.

Examples of alterations requiring approval include all route realignments and facility location changes resulting from:

a. implementation of cultural resources mitigation measures;

b. implementation of endangered, threatened, or special concern species mitigation measures;

c. recommendations by state regulatory authorities; and

d. agreements with individual landowners that affect other landowners or could affect sensitive environmental areas.

7. **Within 60 days of the Order and before construction begins**, Jordan Cove and Pacific Connector shall each file an Implementation Plan with the Secretary for review and written approval by the Director of OEP. Jordan Cove and Pacific Connector must file revisions to the plan as schedules change. The plan shall identify:

   a. how Jordan Cove and Pacific Connector will implement the construction procedures and mitigation measures described in its application and supplements (including responses to staff data requests), identified in the EIS, and required by the Order;

   b. how Jordan Cove and Pacific Connector will incorporate these requirements into the contract bid documents, construction contracts (especially penalty clauses and specifications), and construction drawings so that the mitigation required at each site is clear to onsite construction and inspection personnel;

   c. the number of EIs assigned, and how the company will ensure that sufficient personnel are available to implement the environmental mitigation;

   d. company personnel, including EIs and contractors, who will receive copies of the appropriate material;

   e. the location and dates of the environmental compliance training and instructions Jordan Cove and Pacific Connector will give to all personnel involved with construction and restoration (initial and refresher training as the Project progresses and personnel change), with the opportunity for OEP staff to participate in the training session(s);

   f. the company personnel (if known) and specific portion of Jordan Cove's and Pacific Connector's organization having responsibility for compliance;

   g. the procedures (including use of contract penalties) Jordan Cove and Pacific Connector will follow if noncompliance occurs; and

h. for each discrete facility, a Gantt or PERT chart (or similar Project scheduling diagram), and dates for:

   1. the completion of all required surveys and reports;
   2. the environmental compliance training of onsite personnel;
   3. the start of construction; and
   4. the start and completion of restoration.

8. Jordan Cove shall employ at least one EI for the LNG terminal and Pacific Connector shall employ a team of EIs for the pipeline facilities (i.e., at least one per construction spread or as may be established by the Director of OEP). The EIs shall be:

   a. responsible for monitoring and ensuring compliance with all mitigation measures required by the Order and other grants, permits, certificates, or authorizing documents;
   b. responsible for evaluating the construction contractor's implementation of the environmental mitigation measures required in the contract (see condition 7 above) and any other authorizing document;
   c. empowered to order correction of acts that violate the environmental conditions of the Order, and any other authorizing document;
   d. a full-time position separate from all other activity inspectors;
   e. responsible for documenting compliance with the environmental conditions of the Order, as well as any environmental conditions/permit requirements imposed by other federal, state, or local agencies; and
   f. responsible for maintaining status reports.

9. Beginning with the filing of its Implementation Plan, Jordan Cove shall file updated status reports with the Secretary on a **monthly** basis for the LNG terminal and Pacific Connector shall file updated status reports with the Secretary on a **biweekly** basis for the pipeline facilities until all construction and restoration activities are complete. Problems of a significant magnitude shall be reported to the FERC **within 24 hours.** On request, these status reports will also be provided to other federal and state agencies with permitting responsibilities. Status reports shall include:

   a. an update on Jordan Cove's and Pacific Connector's efforts to obtain the necessary federal authorizations;
   b. Project schedule, including current construction status of the LNG terminal/each pipeline spread, work planned for the following reporting period, and any schedule changes for stream crossings or work in other environmentally-sensitive areas;
   c. a listing of all problems encountered, contractor nonconformance/deficiency logs, and each instance of noncompliance observed by the EI during the reporting period (both for the conditions imposed by the Commission and any environmental conditions/permit requirements imposed by other federal, state, or local agencies);
   d. a description of the corrective and remedial actions implemented in response to all instances of noncompliance, nonconformance, or deficiency;

e. the effectiveness of all corrective and remedial actions implemented;

f. a description of any landowner/resident complaints which may relate to compliance with the requirements of the order, and the measures taken to satisfy their concerns; and

g. copies of any correspondence received by Jordan Cove and Pacific Connector from other federal, state, or local permitting agencies concerning instances of noncompliance, and Jordan Cove's and Pacific Connector's response.

10. Pacific Connector shall develop and implement an environmental complaint resolution procedure, and file such procedure with the Secretary, for review and approval by the Director of OEP. The procedure shall provide landowners with clear and simple directions for identifying and resolving their environmental mitigation problems/concerns during construction of the Project and restoration of the right-of-way. This procedure shall be in effect throughout the construction and restoration periods and two years thereafter. Prior to construction, Pacific Connector shall mail the complaint procedures to each landowner whose property will be crossed by the Project.

    a. In its letter to affected landowners, Pacific Connector shall:

        1. provide a local contact that the landowners should call first with their concerns; the letter should indicate how soon a landowner should expect a response;

        2. instruct the landowners that if they are not satisfied with the response, they should call Pacific Connector's Hotline; the letter should indicate how soon to expect a response; and

        3. instruct the landowners that if they are still not satisfied with the response from Pacific Connector's Hotline, they should contact the Commission's Landowner Helpline at 877-337-2237 or at LandownerHelp@ferc.gov.

    b. In addition, Pacific Connector shall include in its bi-weekly status report a copy of a table that contains the following information for each problem/concern:

        1. the identity of the caller and date of the call;

        2. the location by milepost and identification number from the authorized alignment sheet(s) of the affected property;

        3. a description of the problem/concern; and

        4. an explanation of how and when the problem was resolved, will be resolved, or why it has not been resolved.

11. Jordan Cove and Pacific Connector must receive written authorization from the Director of OEP before commencing construction of any Project facilities. To obtain such authorization, Jordan Cove and Pacific Connector must file with the Secretary documentation that it has received all applicable authorizations required under federal law (or evidence of waiver thereof).

12. Jordan Cove must receive written authorization from the Director of OEP **prior to introducing hazardous fluids into the Project facilities**. Instrumentation and controls,

hazard detection, hazard control, and security components/systems necessary for the safe introduction of such fluids shall be installed and functional.

13. Jordan Cove must receive written authorization from the Director of OEP **before placing into service** the LNG terminal and other components of the Jordan Cove LNG Project. Such authorization will only be granted following a determination that the facilities have been constructed in accordance with the FERC approval, can be expected to operate safely as designed, and the rehabilitation and restoration of the areas affected by the Project are proceeding satisfactorily.

14. Pacific Connector must receive written authorization from the Director of OEP **before placing the pipeline into service.** Such authorization will only be granted following a determination that rehabilitation and restoration of the right-of-way and other areas affected by the Pacific Connector Gas Pipeline Project are proceeding satisfactorily.

15. **Within 30 days of placing the authorized facilities in service**, Jordan Cove and Pacific Connector shall each file an affirmative statement with the Secretary, certified by a senior company official:

    a. that the facilities have been constructed in compliance with all applicable conditions, and that continuing activities will be consistent with all applicable conditions; or

    b. identifying which of the conditions of the Order Jordan Cove and Pacific Connector have complied with or will comply with. This statement shall also identify any areas affected by the Project where compliance measures were not properly implemented, if not previously identified in filed status reports, and the reason for noncompliance.

16. **Prior to construction,** Pacific Connector shall 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 25. (*section 3.4.2.2*)

17. **Prior to construction,** Pacific Connector shall 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 will 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. (*section 4.1.2.4*)

18. **Prior to construction,** Pacific Connector shall 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. *(section 4.3.2.2)*

19. **Prior to construction,** Pacific Connector shall file with the Secretary a revised *Integrated Pest Management Plan*, for review and written approval by the Director of the OEP, that specifies that construction equipment will be cleaned after leaving areas of noxious weed infestations and pathogens and prior to entering BLM-managed lands regardless of contiguous land owner. The revised plan shall also address BLM and Forest Service requirements related to monitoring of invasive plant species and pathogens on federally managed lands, and documentation that the revised plan was found acceptable by the BLM and Forest Service. (*section 4.4.3.4*)

20. **Prior to construction,** Jordan Cove shall file with the Secretary, for review and written approval by the Director of OEP, its lighting plan. The plan shall include measures that will reduce lighting to the minimal levels necessary to ensure safe operation of the LNG facilities and any other measures that will be implemented to minimize lighting impacts on fish and wildlife. Along with its lighting plan, Jordan Cove shall file documentation that the plan was developed in consultation with the FWS, NMFS, and ODFW. This lighting plan shall also be in compliance with condition 53. (*section 4.5.1.1)*

21. **Prior to construction,** Pacific Connector shall file with the Secretary documentation that the final *Fish Salvage Plan* was developed in consultation with interested tribes, ODFW, FWS, and NMFS. (*section 4.5.2.3*)

22. **Prior to construction**, Pacific Connector shall file with the Secretary, for review and written approval by the Director of OEP, a revised *Hydrostatic Test Plan* that requires that any water withdrawal from a flowing stream does not exceed an instantaneous flow reduction of more than 10 percent of stream flow. (*section 4.5.2.3*)

23. **Prior to construction**, Jordan Cove shall file with the Secretary, for review and written approval by the Director of OEP, a *Marine Mammal Monitoring Plan* that identifies how the presence of listed whales will be determined during construction, and measures Jordan Cove will take to reduce potential noise effects on whales and other marine mammals, and ensure compliance with NMFS underwater noise criteria for the protection of listed whales. *(section 4.6.1.1)*

24. **Prior to construction,** Pacific Connector shall file with the Secretary its commitment to adhere to FWS-recommended timing restrictions within threshold distances of MAMU and NSO stands **during construction, operations, and maintenance** of the pipeline facilities. *(section 4.6.1.2)*

25. **Prior to construction,** Pacific Connector shall conduct standard protocol surveys of all suitable MAMU and NSO habitat that might be affected by the Project unless an alternate approach is approved by the FWS. Furthermore, Pacific Connector shall file with the Secretary the results of these surveys and documentation of its consultation with the FWS regarding the survey methods. *(section 4.6.1.2)*

26. Jordan Cove and Pacific Connector **shall not begin construction until**:
    a. the Commission staff completes formal ESA consultations with the NMFS and FWS; and
    b. Jordan Cove and Pacific Connector have received written notification from the Director of OEP that construction and/or implementation of conservation measures may begin. (*section 4.6.1.7*)

27. Jordan Cove and Pacific Connector **shall not begin construction** of the Project **until** they file with the Secretary a copy of the determination of consistency with the Coastal Zone Management Plan issued by the State of Oregon. (*section 4.7.1.2*)

28. **Prior to construction,** Jordan Cove and Pacific Connector shall file with the Secretary a statement affirming the designation of a Construction Housing Coordinator who will coordinate with contractors and the community to address housing concerns. Additionally, Jordan Cove and Pacific Connector shall describe the measures it will implement to inform affected communities about the Construction Housing Coordinator. *(section 4.9.2.2)*

29. **Prior to construction**, Jordan Cove shall file documentation that it has entered into a cooperative improvement agreement with ODOT and traffic development agreements with Coos County and the City of North Bend, as recommended in the *Traffic Impact Analysis report*. *(section 4.10.1.2)*

30. Jordan Cove and Pacific Connector shall **not begin construction of facilities and/or use** any staging, storage, or temporary work areas and new or to-be-improved access roads **until**:
    a. Jordan Cove and Pacific Connector each has filed with the Secretary:
        1. remaining cultural resources inventory reports for areas not previously surveyed;
        2. site evaluations and monitoring reports, as necessary;
        3. a revised Ethnographic Study Report that addresses the items outlined in staff's May 4 and October 23, 2018 environmental information requests;
        4. final HPMPs for both Projects with avoidance plans;
        5. final UDP; and
        6. comments on the cultural resources reports, studies, and plans from the SHPO, applicable federal land managing agencies, and interested Indian tribes.
    b. FERC staff produces an MOA and affords the ACHP an opportunity to comment on the undertaking; and
    c. FERC staff reviews and the Director of OEP approves all cultural resources reports, studies, and plans, and notifies Jordan Cove and Pacific Connector in writing that treatment plans may be implemented and/or construction may proceed.

All materials filed with the Commission containing location, character, and ownership information about cultural resources must have the cover and any relevant pages therein clearly labeled in bold lettering: "**CUI//PRIV - DO NOT RELEASE**." *(section 4.11.5*)

31. **During construction of the LNG terminal facilities and other activities requiring the use of vibratory and impact pile-driving**, Jordan Cove shall:

    a. limit all active pile driving to between the hours of 7:00 a.m. and 10:00 p.m.; and

    b. utilize wooden pile cushion/caps when conducting impact pile-driving work. (*section 4.12.2.3*)

32. Jordan Cove shall file a full power load noise survey with the Secretary **no later than 60 days after placing the entire LNG terminal into service**. If a full load noise survey is not possible, Jordan Cove shall file an interim survey at the maximum possible horsepower load **within 60 days** of placing the LNG terminal into service and file the full operational surveys **within 6 months**. If the noise attributable to the operation of all the equipment of the LNG terminal exceeds 55 dBA L_{dn} at any nearby NSAs, under interim or full load conditions, Jordan Cove shall file a report on what changes are needed and install additional noise controls to meet the level **within 1 year** of the in-service date. Jordan Cove shall confirm compliance with this requirement by filing a second full power noise survey with the Secretary **no later than 60 days** after it installs the additional noise controls. *(section 4.12.2.3)*

33. **Prior to drilling activities at HDD sites,** Pacific Connector shall file a site-specific noise mitigation plan with the Secretary, for review and written approval by the Director of OEP. During any drilling operations, Pacific Connector shall implement the approved plan, monitor noise levels, and file in its biweekly reports documentation that the noise levels attributable to the drilling operations at NSAs does not exceed 55 L_{dn} dBA. (*section 4.12.2.4*)

34. Pacific Connector shall file a noise survey with the Secretary **no later than 60 days after placing the Klamath Compressor Station in service**. If a full load condition noise survey is not possible, Pacific Connector shall provide an interim survey at the maximum possible horsepower load and provide the full load survey **within 6 months**. If the noise attributable to the operation of all of the equipment at the Klamath Compressor Station under interim or full horsepower load conditions exceeds an L_{dn} of 55 dBA at any nearby NSAs, Pacific Connector shall file a report on what changes are needed and shall install the additional noise controls to meet the level **within 1 year** of the in-service date. Pacific Connector shall confirm compliance with the above requirement by filing a second noise survey with the Secretary **no later than 60 days** after it installs the additional noise controls. *(section 4.12.2.4)*

35. **Prior to initial site preparation**, Jordan Cove shall file with the Secretary documentation of consultation with the USDOT PHMSA that the final design safety features demonstrates compliance with 49 CFR §193.2051 and NFPA 59A 2.1.1(d). *(section 4.13.1.6)*

36. **Prior to construction of final design,** Jordan Cove shall file with the Secretary documentation of consultation with USDOT PHMSA staff as to whether the use of

normally closed valves to remove stormwater from curbed areas will meet USDOT PHMSA requirements. *(section 4.13.1.6)*

37. **Prior to construction of final design**, Jordan Cove shall file with the Secretary the following information, stamped and sealed by the professional engineer-of-record, registered in Oregon:

    a. site preparation drawings and specifications;

    b. LNG terminal structures, LNG storage tank, and foundation design drawings and calculations (including prefabricated and field constructed structures);

    c. seismic specifications for procured Seismic Category I equipment prior to the issuing of request for quotations;

    d. quality control procedures to be used for civil/structural design and construction; and

    e. a determination of whether soil improvement is necessary to counteract soil liquefaction.

    In addition, Jordan Cove shall file, in its Implementation Plan, the schedule for producing this information. *(section 4.13.1.6)*

38. Jordan Cove shall employ a special inspector during construction and a copy of the inspection reports **shall be included in the monthly status reports** filed with the Secretary. The special inspector shall be responsible for:

    a. observing the construction of the liquefaction facility to be certain it conforms to the design drawings and specifications;

    b. furnishing inspection reports to the engineer- or architect-of-record, and other designated persons. All discrepancies shall be brought to the immediate attention of the contractor for correction, then if uncorrected, to the engineer- or architect-of-record; and

    c. submitting a final signed report stating whether the work requiring special inspection was, to the best of his/her knowledge, in conformance with approved plans and specifications and the applicable workmanship provisions. (section 4.13.1.6)

39. **Prior to commencement of service**, Jordan Cove shall file with the Secretary a monitoring and maintenance plan, stamped and sealed by the professional engineer-of-record registered in Oregon, which ensures the facilities are protected for the life of the LNG terminal considering settlement, subsidence, and sea level rise. *(section 4.13.1.6)*

Conditions 40 through 128 shall apply to the Jordan Cove LNG terminal. Information pertaining to these specific conditions shall be filed with the Secretary for review and written approval by the Director of OEP either: <u>prior to initial site preparation</u>; <u>prior to construction of final design</u>; <u>prior to commissioning</u>; <u>prior to introduction of hazardous fluids</u>; or <u>prior to commencement of service</u>, as indicated by each specific condition. Specific engineering, vulnerability, or detailed design information meeting the criteria specified in Order No. 683 (Docket No. RM06-24-000), including security information, shall be submitted

as critical energy infrastructure information (CEII) pursuant to 18 CFR §388.112. See CEII, Order No. 683, 71 Fed. Reg. 58,273 (October 3, 2006), FERC Stats. & Regs. ¶ 31,228 (2006). Information pertaining to items such as offsite emergency response; procedures for public notification and evacuation; and construction and operating reporting requirements will be subject to public disclosure. All information shall be filed a minimum of 30 days before approval to proceed is required.

40. **Prior to initial site preparation**, Jordan Cove shall file an overall Project schedule, which includes the proposed stages of the commissioning plan. *(section 4.13.1.6)*

41. **Prior to initial site preparation**, Jordan Cove shall file procedures for controlling access during construction. *(section 4.13.1.6)*

42. **Prior to initial site preparation**, Jordan Cove shall file quality assurance and quality control procedures for construction activities. *(section 4.13.1.6)*

43. **Prior to initial site preparation,** Jordan Cove shall file its design wind speed criteria for all other facilities not covered by USDOT PHMSA's Letter of Determination to be designed to withstand wind speeds commensurate with the risk and reliability associated with the facilities in accordance with ASCE 7-16 or equivalent. *(section 4.13.1.6)*

44. **Prior to initial site preparation**, Jordan Cove shall specify a spill containment system around the Warm Flare Knockout Drum. *(section 4.13.1.6)*

45. **Prior to initial site preparation**, Jordan Cove shall develop an ERP (including evacuation) and coordinate procedures with the Coast Guard; state, county, and local emergency planning groups; fire departments; state and local law enforcement; and appropriate federal agencies. This plan shall include at a minimum:

    a. designated contacts with state and local emergency response agencies;

    b. scalable procedures for the prompt notification of appropriate local officials and emergency response agencies based on the level and severity of potential incidents;

    c. procedures for notifying residents and recreational users within areas of potential hazard;

    d. evacuation routes/methods for residents and public use areas that are within any transient hazard areas along the route of the LNG marine transit;

    e. locations of permanent sirens and other warning devices; and

    f. an "emergency coordinator" on each LNG marine vessel to activate sirens and other warning devices.

    Jordan Cove shall notify the FERC staff of all planning meetings in advance and shall report progress on the development of its ERP **at 3-month intervals**. *(section 4.13.1.6)*

46. **Prior to initial site preparation**, Jordan Cove shall file a Cost-Sharing Plan identifying the mechanisms for funding all Project-specific security/emergency management costs that will be imposed on state and local agencies. This comprehensive plan shall include funding mechanisms for the capital costs associated with any necessary security/emergency

management equipment and personnel base. Jordan Cove shall notify FERC staff of all planning meetings in advance and shall report progress on the development of its Cost Sharing Plan at **3-month intervals**. *(section 4.13.1.6)*

47. **Prior to construction of final design**, Jordan Cove shall file change logs that list and explain any changes made from the FEED provided in Jordan Cove LNG Project's application and filings. A list of all changes with an explanation for the design alteration shall be provided and all changes shall be clearly indicated on all diagrams and drawings. *(section 4.13.1.6)*

48. **Prior to construction of final design**, Jordan Cove shall file information/revisions pertaining to Jordan Cove's response numbers 8c, 13, 15, 21, 22, 23, 24, 26, 27, 28, and 31 of its December 20, 2018 filing and 6, 9, 10, 11, 17, 19, 32, 34, and 36 of its February 6, 2019 filing which indicated features to be included or considered in the final design. *(section 4.13.1.6)*

49. **Prior to construction of final design**, Jordan Cove shall file drawings and specifications for crash rated vehicle barriers at each facility entrance for access control. *(section 4.13.1.6)*

50. **Prior to construction of final design**, Jordan Cove shall file drawings of the security fence. The fencing drawings shall provide details of fencing that demonstrates it will restrict and deter access around the entire facility and has a setback from exterior features (e.g., power lines, trees, etc.) and from interior features (e.g., piping, equipment, buildings, etc.) that does not allow the fence to be overcome. *(section 4.13.1.6)*

51. **Prior to construction of final design**, Jordan Cove shall file drawings of internal road vehicle protections, such as guard rails, barriers, and bollards to protect transfer piping, pumps, compressors, hydrants, monitors, etc. to ensure that they are located away from roadway or protected from inadvertent damage from vehicles. *(section 4.13.1.6)*

52. **Prior to construction of final design**, Jordan Cove shall file security camera and intrusion detection drawings. The security camera drawings shall show the locations, areas covered, and features of each camera (e.g., fixed, tilt/pan/zoom, motion detection alerts, low light, mounting height, etc.) to verify camera coverage of the entire perimeter with redundancies for cameras interior to the facility to enable rapid monitoring of the facility, including a camera at the top of each LNG storage tank, and coverage within pretreatment areas, within liquefaction areas, within truck transfer areas, within marine transfer areas, and buildings. The drawings shall show or note the location of the intrusion detection to verify it covers the entire perimeter of the facility. *(section 4.13.1.6)*

53. **Prior to construction of final design**, Jordan Cove shall file lighting drawings. The lighting drawings shall show the location, elevation, type of light fixture, and lux levels of the lighting system and shall be in accordance with API 540 and provide illumination along the perimeter of the facility, process equipment, mooring points, and along paths/roads of access and egress to facilitate security monitoring and emergency response operations. This lighting plan shall also be in compliance with condition 20. *(section 4.13.1.6)*

54. **Prior to construction of final design**, Jordan Cove shall file a plot plan of the final design showing all major equipment, structures, buildings, and impoundment systems. *(section 4.13.1.6)*

55. **Prior to construction of final design**, Jordan Cove shall file three-dimensional plant drawings to confirm plant layout for maintenance, access, egress, and congestion. *(section 4.13.1.6)*

56. **Prior to construction of final design**, Jordan Cove shall file up-to-date process flow diagrams (PFDs) and piping and instrument diagrams (P&IDs) including vendor P&IDs. The PFDs shall include heat and material balances. The P&IDs shall include the following information:

    a. equipment tag number, name, size, duty, capacity, and design conditions;

    b. equipment insulation type and thickness;

    c. storage tank pipe penetration size and nozzle schedule;

    d. valve high pressure side and internal and external vent locations;

    e. piping with line number, piping class specification, size, and insulation type and thickness;

    f. piping specification breaks and insulation limits;

    g. all control and manual valves numbered;

    h. relief valves with size and set points; and

    i. drawing revision number and date. *(section 4.13.1.6)*

57. **Prior to construction of final design**, Jordan Cove shall file P&IDs, specifications, and procedures that clearly show and specify the tie-in details required to safely connect subsequently constructed facilities with the operational facilities. *(section 4.13.1.6)*

58. **Prior to construction of final design**, Jordan Cove shall file a car seal philosophy and a list of all car-sealed and locked valves consistent with the P&IDs. *(section 4.13.1.6)*

59. **Prior to construction of final design**, Jordan Cove shall file information to demonstrate the EPC contractor has verified that all FEED HAZOP and LOPA recommendations have been addressed. *(section 4.13.1.6)*

60. **Prior to construction of final design**, Jordan Cove shall file a hazard and operability review, including a list of recommendations and actions taken on the recommendations, prior to issuing the P&IDs for construction. *(section 4.13.1.6)*

61. **Prior to construction of final design**, Jordan Cove shall provide a check valve upstream of the amine contractor column to prevent backflow or provide a dynamic simulation that shows that upon plant shutdown, the swan neck will be sufficient for this purpose. *(section 4.13.1.6)*

62. **Prior to construction of final design**, Jordan Cove shall specify how Mole Sieve Gas Dehydrator support and sieve material will be prevented from migrating to the piping system. *(section 4.13.1.6)*

63. **Prior to construction of final design**, Jordan Cove shall specify how the regeneration gas heater tube design temperature will be consistent with the higher shell side steam temperatures. *(section 4.13.1.6)*

64. **Prior to construction of final design**, Jordan Cove shall specify a cold gas bypass around the defrost gas heater to prevent defrost gas heater high temperature shutdown during low flow and startup conditions. *(section 4.13.1.6)*

65. **Prior to construction of final design**, Jordan Cove shall demonstrate that the differential pressure (dp) level transmitters on the LNG flash drum will not result in an excess number of false high-high-high level shutdowns. *(section 4.13.1.6)*

66. **Prior to construction of final design**, Jordan Cove shall specify a means to stop LNG flows to the BOG suction drum when the BOG compressor is shutdown to prevent filling the BOG suction drum with LNG. *(section 4.13.1.6)*

67. **Prior to construction of final design**, Jordan Cove shall specify a low instrument air pressure shutdown to prevent loss of control to air operated valves. *(section 4.13.1.6)*

68. **Prior to construction of final design**, Jordan Cove shall evaluate and, if applicable, address the potential for cryogenic feed gas back flow in the event relief valve 30-PSV-01002A/B is open. *(section 4.13.1.6)*

69. **Prior to construction of final design**, Jordan Cove shall include LNG tank fill flow measurement with high flow alarm. *(section 4.13.1.6)*

70. **Prior to construction of final design**, Jordan Cove shall specify a discretionary vent valve on each LNG storage tank that is operable through the Distributed Control System (DCS). In addition, a car sealed open manual block valve shall be provided upstream of the discretionary vent valve. *(section 4.13.1.6)*

71. **Prior to construction of final design**, Jordan Cove shall file the safe operating limits (upper and lower), alarm and shutdown set points for all instrumentation (e.g., temperature, pressures, flows, and compositions). *(section 4.13.1.6)*

72. **Prior to construction of final design**, Jordan Cove shall file cause-and-effect matrices for the process instrumentation, fire and gas detection system, and emergency shutdown system. The cause-and-effect matrices shall include alarms and shutdown functions, details of the voting and shutdown logic, and set points. *(section 4.13.1.6)*

73. **Prior to construction of final design**, Jordan Cove shall file an up-to-date equipment list, process and mechanical data sheets, and specifications. The specifications shall include:

a. building specifications (e.g., control buildings, electrical buildings, compressor buildings, storage buildings, pressurized buildings, ventilated buildings, blast resistant buildings);
b. mechanical specifications (e.g., piping, valve, insulation, rotating equipment, heat exchanger, storage tank and vessel, other specialized equipment);
c. electrical and instrumentation specifications (e.g., power system, control system, safety instrument system [SIS], cable specifications, other electrical and instrumentation); and
d. security and fire safety specifications (e.g., security, passive protection, hazard detection, hazard control, firewater). *(section 4.13.1.6)*

74. **Prior to construction of final design**, Jordan Cove shall file a list of all codes and standards and the final specification document number where they are referenced. *(section 4.13.1.6)*

75. **Prior to construction of final design**, Jordan Cove shall file complete specifications and drawings of the proposed LNG tank design and installation. *(section 4.13.1.6)*

76. **Prior to construction of final design**, Jordan Cove shall file an evaluation of emergency shutdown valve closure times. The evaluation shall account for the time to detect an upset or hazardous condition, notify plant personnel, and close the emergency shutdown valve(s). *(section 4.13.1.6)*

77. **Prior to construction of final design**, Jordan Cove shall file an evaluation of dynamic pressure surge effects from valve opening and closure times and pump operations that demonstrate that the surge effects do not exceed the design pressures. *(section 4.13.1.6)*

78. **Prior to construction of final design**, Jordan Cove shall demonstrate that, for hazardous fluids, piping and piping nipples 2 inches or less in diameter are designed to withstand external loads, including vibrational loads in the vicinity of rotating equipment and operator live loads in areas accessible by operators. *(section 4.13.1.6)*

79. **Prior to construction of final design**, Jordan Cove shall clearly specify the responsibilities of the LNG tank contractor and the EPC contractor for the piping associated with the LNG storage tank. *(section 4.13.1.6)*

80. **Prior to construction of final design**, Jordan Cove shall file the sizing basis and capacity for the final design of the flares and/or vent stacks as well as the pressure and vacuum relief valves for major process equipment, vessels, and storage tanks. *(section 4.13.1.6)*

81. **Prior to construction of final design**, Jordan Cove shall file an updated fire protection evaluation of the proposed facilities. A copy of the evaluation, a list of recommendations and supporting justifications, and actions taken on the recommendations shall be filed. The evaluation shall justify the type, quantity, and location of hazard detection and hazard control, passive fire protection, emergency shutdown and depressurizing systems, firewater, and emergency response equipment, training, and qualifications in accordance with NFPA 59A (2001). The justification for the flammable and combustible gas detection and flame and heat detection systems shall be in accordance with ISA 84.00.07 or

equivalent methodologies and would need to demonstrate 90 percent or more of releases (unignited and ignited) that could result in an off-site or cascading impact would be detected by two or more detectors and result in isolation and de inventory within 10 minutes. The analysis shall take into account the set points, voting logic, wind speeds, and wind directions. The justification for firewater shall provide calculations for all firewater demands based on design densities, surface area, and throw distance as well as specifications for the corresponding hydrant and monitors needed to reach and cool equipment. *(section 4.13.1.6)*

82. **Prior to construction of final design**, Jordan Cove shall file spill containment system drawings with dimensions and slopes of curbing, trenches, impoundments, and capacity calculations considering any foundations and equipment within impoundments, as well as the sizing and design of the down-comers. The spill containment drawings shall show containment for all hazardous fluids including all liquids handled above their flashpoint, from the largest flow from a single line for 10 minutes, including de-inventory, or the maximum liquid from the largest vessel (or total of impounded vessels) or otherwise demonstrate that providing spill containment would not significantly reduce the flammable vapor dispersion or radiant heat consequences of a spill. *(section 4.13.1.6)*

83. **Prior to construction of final design,** Jordan Cove shall file an analysis that demonstrates the flammable vapor dispersion from design spills will be prevented from dispersing underneath the elevated LNG storage tanks, or the LNG storage tanks will be able to withstand an overpressure due to ignition of the flammable vapor that disperses underneath the elevated LNG storage tanks.

84. **Prior to construction of final design**, Jordan Cove shall file electrical area classification drawings. *(section 4.13.1.6)*

85. **Prior to construction of final design**, Jordan Cove shall provide documentation demonstrating adequate ventilation, detection, and electrical area classification based on the final selection of the batteries, and associated hydrogen off-gassing rates. *(section 4.13.1.6)*

86. **Prior to construction of final design**, Jordan Cove shall file drawings and details of how process seals or isolations installed at the interface between a flammable fluid system and an electrical conduit or wiring system meet the requirements of NFPA 59A (2001). *(section 4.13.1.6)*

87. **Prior to construction of final design**, Jordan Cove shall file details of an air gap or vent installed downstream of process seals or isolations installed at the interface between a flammable fluid system and an electrical conduit or wiring system. Each air gap shall vent to a safe location and be equipped with a leak detection device that shall continuously monitor for the presence of a flammable fluid, alarm the hazardous condition, and shut down the appropriate systems. *(section 4.13.1.6)*

88. **Prior to construction of final design**, Jordan Cove shall file complete drawings and a list of the hazard detection equipment. The drawings shall clearly show the location and elevation of all detection equipment. The list shall include the instrument tag number, type

and location, alarm indication locations, and shutdown functions of the hazard detection equipment. *(section 4.13.1.6)*

89. **Prior to construction of final design**, Jordan Cove shall file a technical review of facility design that:

    a. identifies all combustion/ventilation air intake equipment and the distances to any possible flammable gas or toxic release; and

    b. demonstrates that these areas are adequately covered by hazard detection devices and indicates how these devices would isolate or shutdown any combustion or heating ventilation and air conditioning equipment whose continued operation could add to or sustain an emergency. *(section 4.13.1.6)*

90. **Prior to construction of final design**, Jordan Cove shall file a design that includes hazard detection suitable to detect high temperatures and smoldering combustion products in electrical buildings and control room buildings. *(section 4.13.1.6)*

91. **Prior to construction of final design**, Jordan Cove shall file an evaluation of the voting logic and voting degradation for hazard detectors. *(section 4.13.1.6)*

92. **Prior to construction of final design**, Jordan Cove shall file a list of alarm and shutdown set points for all hazard detectors that account for the calibration gas of the hazard detectors when determining the lower flammable limit set points for methane, ethylene, propane, isopentane, and condensate. *(section 4.13.1.6)*

93. **Prior to construction of final design**, Jordan Cove shall file a list of alarm and shutdown set points for all hazard detectors that account for the calibration gas of hazard detectors when determining the set points for toxic components such as condensate and hydrogen sulfide. *(section 4.13.1.6)*

94. **Prior to construction of final design**, Jordan Cove shall file a drawing showing the location of the emergency shutdown buttons. Emergency shutdown buttons shall be easily accessible, conspicuously labeled, and located in an area which will be accessible during an emergency. *(section 4.13.1.6)*

95. **Prior to construction of final design**, Jordan Cove shall file facility plan drawings and a list of the fixed and wheeled dry-chemical, hand-held fire extinguishers, and other hazard control equipment. Plan drawings shall clearly show the location by tag number of all fixed, wheeled, and hand-held extinguishers and shall demonstrate the spacing of extinguishers meet prescribed NFPA 10 travel distances. The list shall include the equipment tag number, type, capacity, equipment covered, discharge rate, and automatic and manual remote signals initiating discharge of the units and shall demonstrate they meet NFPA 59A. *(section 4.13.1.6)*

96. **Prior to construction of final design**, Jordan Cove shall file drawings and specifications for the structural passive protection systems to protect equipment and supports from cryogenic releases. *(section 4.13.1.6)*

97. **Prior to construction of final design**, Jordan Cove shall file calculations or test results for the structural passive protection systems to protect equipment and supports from cryogenic releases. *(section 4.13.1.6)*

98. **Prior to construction of final design**, Jordan Cove shall file drawings and specifications for the structural passive protection systems to protect equipment and supports from pool and jet fires. *(section 4.13.1.6)*

99. **Prior to construction of final design**, Jordan Cove shall file a detailed quantitative analysis to demonstrate that adequate mitigation will be provided for each significant component within the 4,000 Btu/ft^2-hr zone from pool and jet fires that could cause failure of the component. Trucks at the truck transfer station shall be included in the analysis. A combination of passive and active protection for pool fires and passive and/or active protection for jet fires shall be provided and demonstrate the effectiveness and reliability. Effectiveness of passive mitigation shall be supported by calculations or test results for the thickness limiting temperature rise and effectiveness of active mitigation shall be justified with calculations or test results demonstrating flow rates and durations of any cooling water would mitigate the heat absorbed by the vessel. *(section 4.13.1.6)*

100. **Prior to construction of final design**, Jordan Cove shall file an evaluation and associated specifications and drawings of how it would prevent cascading damage of transformers (e.g., fire walls or spacing) in accordance with NFPA 850 or equivalent. *(section 4.13.1.6)*

101. **Prior to construction of final design**, Jordan Cove shall file facility plan drawings showing the proposed location of the firewater and any foam systems. Plan drawings shall clearly show the location of firewater and foam piping, post indicator valves, and the location and area covered by, each monitor, hydrant, hose, water curtain, deluge system, foam system, water-mist system, and sprinkler. All areas of the pretreatment area shall have adequate coverage. The drawings shall also include piping and instrumentation diagrams of the firewater and foam systems. *(section 4.13.1.6)*

102. **Prior to construction of final design**, Jordan Cove shall specify that the firewater pump shelter is designed to allow removal of the largest firewater pump or other component for maintenance with an overhead or external crane. *(section 4.13.1.6)*

103. **Prior to construction of final design**, Jordan Cove shall demonstrate that the firewater storage tanks are in compliance with NFPA 22 or demonstrate how API Standard 650 provides an equivalent or better level of safety. *(section 4.13.1.6)*

104. **Prior to construction of final design**, Jordan Cove shall specify that the firewater flow test meter is equipped with a transmitter and that a pressure transmitter is installed upstream of the flow transmitter. The flow transmitter and pressure transmitter shall be connected to the DCS and recorded. *(section 4.13.1.6)*

105. **Prior to construction of final design**, Jordan Cove shall file drawings of the storage tank piping support structure and support of horizontal piping at grade including pump columns, relief valves, pipe penetrations, instrumentation, and appurtenances. *(section 4.13.1.6)*

106. **Prior to construction of final design**, Jordan Cove shall file the structural analysis of the LNG storage tank and outer containment demonstrating they are designed to withstand all loads and combinations. *(section 4.13.1.6)*

107. **Prior to construction of final design**, Jordan Cove shall file an analysis of the structural integrity of the outer containment of the full containment LNG storage tank demonstrating it can withstand the radiant heat from a roof tank top fire or adjacent tank roof fire. *(section 4.13.1.6)*

108. **Prior to construction of final design**, Jordan Cove shall file a projectile analysis to demonstrate that the outer concrete impoundment wall of a full-containment LNG storage tank could withstand projectiles from explosions and high winds. The analysis shall detail the projectile speeds and characteristics and method used to determine penetration or perforation depths. *(section 4.13.1.6)*

109. **Prior to commissioning**, Jordan Cove shall file a detailed schedule for commissioning through equipment startup. The schedule shall include milestones for all procedures and tests to be completed: prior to introduction of hazardous fluids and during commissioning and startup. Jordan Cove shall file documentation certifying that each of these milestones has been completed before authorization to commence the next phase of commissioning and startup will be issued. *(section 4.13.1.6)*

110. **Prior to commissioning**, Jordan Cove shall file detailed plans and procedures for: testing the integrity of onsite mechanical installation; functional tests; introduction of hazardous fluids; operational tests; and placing the equipment into service. *(section 4.13.1.6)*

111. **Prior to commissioning**, Jordan Cove shall file settlement results from the hydrostatic tests of the LNG storage containers and shall file a plan to periodically verify settlement is as expected and does not exceed the applicable criteria set forth in API 620, API 625, API 653, and ACI 376. The plan shall also specify what actions will be taken after various levels of seismic events. *(section 4.13.1.6)*

112. **Prior to commissioning**, Jordan Cove shall file the operation and maintenance procedures and manuals, as well as safety procedures, hot work procedures and permits, abnormal operating conditions reporting procedures, simultaneous operations procedures, and management of change procedures and forms. *(section 4.13.1.6)*

113. **Prior to commissioning**, Jordan Cove shall file a plan for clean-out, dry-out, purging, and tightness testing. This plan shall address the requirements of the American Gas Association's Purging Principles and Practice, and shall provide justification if not using an inert or non-flammable gas for clean-out, dry-out, purging, and tightness testing. *(section 4.13.1.6)*

114. **Prior to commissioning**, Jordan Cove shall tag all equipment, instrumentation, and valves in the field, including drain valves, vent valves, main valves, and car-sealed or locked valves. *(section 4.13.1.6)*

115. **Prior to commissioning**, Jordan Cove shall file a plan describing how it will maintain a detailed training log to demonstrate that operating, maintenance, and emergency response staff have completed the required training. *(section 4.13.1.6)*

116. **Prior to commissioning**, Jordan Cove shall file the procedures for pressure/leak tests which address the requirements of ASME BPVC Section VIII and ASME B31.3. In addition, Jordan Cove shall file a line list of pneumatic and hydrostatic test pressures. *(section 4.13.1.6)*

117. **Prior to introduction of hazardous fluids**, Jordan Cove shall complete and document a pre-startup safety review to ensure that installed equipment meets the design and operating intent of the facility. The pre-startup safety review shall include any changes since the last hazard review, operating procedures, and operator training. A copy of the review with a list of recommendations, and actions taken on each recommendation, shall be filed. *(section 4.13.1.6)*

118. **Prior to introduction of hazardous fluids**, Jordan Cove shall complete and document all pertinent tests (Factory Acceptance Tests, Site Acceptance Tests, Site Integration Tests) associated with the DCS and SIS that demonstrates full functionality and operability of the system. *(section 4.13.1.6)*

119. **Prior to introduction of hazardous fluids**, Jordan Cove shall develop and implement an alarm management program to reduce alarm complacency and maximize the effectiveness of operator response to alarms. *(section 4.13.1.6)*

120. **Prior to introduction of hazardous fluids**, Jordan Cove shall complete and document clean agent acceptance tests. *(section 4.13.1.6)*

121. **Prior to introduction of hazardous fluids**, Jordan Cove shall complete and document a firewater pump acceptance test and firewater monitor and hydrant coverage test. The actual coverage area from each monitor and hydrant shall be shown on facility plot plan(s). *(section 4.13.1.6)*

122. **Prior to introduction of hazardous fluids**, Jordan Cove shall complete and document foam system and sprinkler system acceptance tests. *(section 4.13.1.6)*

123. Jordan Cove shall file a request for written authorization from the Director of OEP **prior to unloading or loading the first LNG commissioning cargo**. After production of first LNG, Jordan Cove shall file weekly reports on the commissioning of the proposed systems that detail the progress toward demonstrating the facilities can safely and reliably operate at or near the design production rate. The reports shall include a summary of activities, problems encountered, and remedial actions taken. The weekly reports shall also include the latest commissioning schedule, including projected and actual LNG production by each liquefaction train, LNG storage inventories in each storage tank, and the number of anticipated and actual LNG commissioning cargoes, along with the associated volumes loaded or unloaded. Further, the weekly reports shall include a status and list of all planned and completed safety and reliability tests, work authorizations, and punch list items.

Problems of significant magnitude shall be reported to the FERC within 24 hours. *(section 4.13.1.6)*

124. **Prior to commencement of service**, Jordan Cove shall file a request for written authorization from the Director of OEP. Such authorization will only be granted following a determination by the Coast Guard, under its authorities under the Ports and Waterways Safety Act, the Magnuson Act, the MTSA of 2002, and the Security and Accountability For Every Port Act, that appropriate measures to ensure the safety and security of the facility and the waterway have been put into place by Jordan Cove or other appropriate parties. *(section 4.13.1.6)*

125. **Prior to commencement of service**, Jordan Cove shall notify the FERC staff of any proposed revisions to the security plan and physical security of the plant. *(section 4.13.1.6)*

126. **Prior to commencement of service**, Jordan Cove shall label piping with fluid service and direction of flow in the field, in addition to the pipe labeling requirements of NFPA 59A (2001). *(section 4.13.1.6)*

127. **Prior to commencement of service**, Jordan Cove shall provide plans for any preventative and predictive maintenance program that performs periodic or continuous equipment condition monitoring. *(section 4.13.1.6)*

128. **Prior to commencement of service**, Jordan Cove shall develop procedures for offsite contractors' responsibilities, restrictions, and limitations and for supervision of these contractors by Jordan Cove staff. *(section 4.13.1.6)*

In addition, conditions 129 through 132 shall apply throughout the life of the Jordan Cove LNG Project.

129. The facility shall be subject to regular FERC staff technical reviews and site inspections on at least an **annual** basis or more frequently as circumstances indicate. Prior to each FERC staff technical review and site inspection, Jordan Cove shall respond to a specific data request including information relating to possible design and operating conditions that may have been imposed by other agencies or organizations. Up-to-date detailed P&IDs reflecting facility modifications and provision of other pertinent information not included in the semi-annual reports described below, including facility events that have taken place since the previously submitted semi-annual report, shall be submitted. *(section 4.13.1.6)*

130. **Semi-annual** operational reports shall be filed with the Secretary to identify changes in facility design and operating conditions; abnormal operating experiences; activities (e.g., ship arrivals, quantity and composition of imported and exported LNG, liquefied and vaporized quantities, boil off/flash gas); and plant modifications, including future plans and progress thereof. Abnormalities shall include, but not be limited to, unloading/loading/shipping problems, potential hazardous conditions from offsite vessels, storage tank stratification or rollover, geysering, storage tank pressure excursions, cold spots on the storage tank, storage tank vibrations and/or vibrations in associated cryogenic piping, storage tank settlement, significant equipment or instrumentation malfunctions or failures, non-scheduled maintenance or repair (and reasons therefore), relative movement of storage tank inner vessels, hazardous fluids releases, fires involving hazardous fluids

and/or from other sources, negative pressure (vacuum) within a storage tank, and higher than predicted boil off rates. Adverse weather conditions and the effect on the facility also shall be reported. Reports shall be submitted **within 45 days after each period ending June 30 and December 31**. In addition to the above items, a section entitled "Significant Plant Modifications Proposed for the Next 12 Months (dates)" shall be included in the semi-annual operational reports. Such information would provide the FERC staff with early notice of anticipated future construction/maintenance at the LNG facilities. *(section 4.13.1.6)*

131. In the event the temperature of any region of the LNG storage container, including any secondary containment and imbedded pipe supports, becomes less than the minimum specified operating temperature for the material, the Commission shall be notified **within 24 hours** and procedures for corrective action shall be specified. *(section 4.13.1.6)*

132. Significant non-scheduled events, including safety-related incidents (e.g., LNG, condensate, refrigerant, or natural gas releases; fires; explosions; mechanical failures; unusual over pressurization; and major injuries) and security-related incidents (e.g., attempts to enter site, suspicious activities) shall be reported to the FERC staff. In the event that an abnormality is of significant magnitude to threaten public or employee safety, cause significant property damage, or interrupt service, notification shall be made **immediately**, without unduly interfering with any necessary or appropriate emergency repair, alarm, or other emergency procedure. In all instances, notification shall be made to the FERC staff **within 24 hours**. This notification practice shall be incorporated into the liquefaction facility's emergency plan. Examples of reportable hazardous fluids-related incidents include:

a. fire;

b. explosion;

c. estimated property damage of $50,000 or more;

d. death or personal injury necessitating in-patient hospitalization;

e. release of hazardous fluids for 5 minutes or more;

f. unintended movement or abnormal loading by environmental causes, such as an earthquake, landslide, or flood, that impairs the serviceability, structural integrity, or reliability of an LNG facility that contains, controls, or processes hazardous fluids;

g. any crack or other material defect that impairs the structural integrity or reliability of an LNG facility that contains, controls, or processes hazardous fluids;

h. any malfunction or operating error that causes the pressure of a pipeline or LNG facility that contains or processes hazardous fluids to rise above its maximum allowable operating pressure (or working pressure for LNG facilities) plus the build-up allowed for operation of pressure-limiting or control devices;

i. a leak in an LNG facility that contains or processes hazardous fluids that constitutes an emergency;

j. inner tank leakage, ineffective insulation, or frost heave that impairs the structural integrity of an LNG storage tank;

k. any safety-related condition that could lead to an imminent hazard and cause (either directly or indirectly by remedial action of the operator), for purposes other than abandonment, a 20 percent reduction in operating pressure or shutdown of operation of a pipeline or an LNG facility that contains or processes hazardous fluids;

l. safety-related incidents from hazardous fluids transportation occurring at or en route to and from the LNG facility; or

m. an event that is significant in the judgment of the operator and/or management even though it did not meet the above criteria or the guidelines set forth in an LNG facility's incident management plan.

In the event of an incident, the Director of OEP has delegated authority to take whatever steps are necessary to ensure operational reliability and to protect human life, health, property, or the environment, including authority to direct the LNG facility to cease operations. Following the initial company notification, the FERC staff would determine the need for a separate follow-up report or follow up in the upcoming semi-annual operational report. All company follow-up reports shall include investigation results and recommendations to minimize a reoccurrence of the incident. *(section 4.13.1.6)*