

**Cascade Kelly Holdings LLC CPBR Facility
DEQ FTSS Seismic Vulnerability Assessment Forms****FORM 1 QUESTIONS FOR THE GEOTECHNICAL ASSESSMENT OF EACH FACILITY**

1. Provide a scale plan or plot drawing of the entire facility, including all tanks, berms, marine terminals, loading racks, pipelines, etc. [GEO1]

Response: See Figure 2 of Geotechnical Report

2. Provide all available soil data, boring logs and geotechnical reports developed for the site since the original design and as-built properties of the facility. [GEO2]

Response: See Appendix A of Geotechnical Report

3. Provide locations of all existing boreholes or CPTs on the plan or plot drawings. [GEO3]

Response: See Figure 2 of Geotechnical Report

4. Do the borings, CPTs and other geotechnical investigational tools meet the following criteria and conform to Oregon Structural Specialty Code 2022 ed. [GEO4]

- a. Boring or CPT depth shall be minimum 100ft (Appendix E, API 650, MOTEMS Section 3106F.2.2, ASCE7, Section 20.1).

Response: Yes, some of the existing exploration data is deeper than 100 feet.

- b. Borings are to be onshore and offshore (if any marine structures).

Response: Yes, there is boring data both onshore and offshore.

- c. Spacing of boreholes or CPTs along the berms shall not be more than 200 ft. (AASHTO, Table 10.4.2-1). For the perimeter of tank farms, 1 record at each corner would be a minimum, and if little or no differences, this may be adequate. If not, a spacing of 200 ft along the berm or perimeter is necessary if there are erratic subsurface conditions encountered (AASHTO, Table 10.4.2-1).

Response: No, exploration data is not available along the berms.

- d. If CPTs are used, a few cases of verification of results should be compared with those from adjacent borings. Relationships between the SPTs, CPTs and full borings should be provided, using the latest geotechnical references and procedures.

Response: Yes, historical boring D-6 and historical CPT P-1 are co-located

- e. Provide geologic cross sections (color) of the facility to provide stratigraphy of the site, and to establish the site classification (A-F).

Response: Yes, provided. See Figures 3 and 4 from the Geotechnical Report.

- f. If any other geotechnical data (other than CPT, SPT or borings) was available, provide details and dates.

Response: None available.

- g. Employ contemporary standards of practice for all new soil investigations.

Response: No new soil investigations were performed for the current effort.

- h. Verify compliance with items (i) through (v) of OAR 340-300-0003(6)(a).

Response: Yes, the geotechnical report complies; see the following report sections:

- (i) Section 3.4
- (ii) Sections 3.1 and 3.2
- (iii) Section 3.5
- (iv) Section 3.5, Appendix A
- (v) Section 3.5

Before proceeding to create the geotechnical design report, the borehole and CPT locations and depth (both historical and recent) for the facility, should be reviewed by DEQ.

5. The following consideration must be addressed in the geotechnical design report [GEO5]
- a. Liquefaction Potential in "Sand-Like" Soil and Cyclic Degradation in "Clay-Like" Soil. How was cyclic resistance ratio (CRR) evaluated (simplified or site-specific)?

Response: CRR was evaluated following the Idriss and Boulanger (2008) methodology.

- b. If a site-specific response analysis has been performed, was it one or two dimensional?

Response: None performed.

- c. What ground motion parameters were used?

Response: See section 4.3.1 of the Geotechnical Report.

- d. What methodology was used to calculate residual shear strength?

Response: Idriss and Boulanger (2008) methodology.

- e. What safety factor for liquefaction in sand (CRR/CSR)

Response: FS = 1. Nearly all of the soil profiles are susceptible to liquefaction even at this low FS.

- f. If using a simplified procedure, what current methodology has been used? Is the Safety Factor less than 1.4, what reduction factor has been applied to the initial shear strength of the soil?

Response: Idriss and Boulanger (2008) methodology. No reduction factor used. Soil profiles are largely liquefiable with high settlements without introducing reduction factors.

- g. If the Safety Factor is $1.0 < SF < 1.2$, how have the seismically induced ground movements been evaluated?

Response: Assuming this question is pertaining to vertical settlements, per Idriss and Boulanger (2008) methodology.

- h. If the Safety Factor $SF < 1.0$, what is the residual shear strength?

Response: Calculated per Idriss and Boulanger (2008) methodology.

6. Provide evaluations for other geotechnical hazards, if applicable. [GEO6]

- a. Slope movement

Response: See Geotechnical Report Section 4.4

- b. Lateral spreading

Response: See Geotechnical Report Section 4.4, specifically 4.4.3

- c. Ground settlement

Response: See Geotechnical Report Section 4.3.2

- d. Other surface manifestations

Response: See Geotechnical Report Section 4.3.3

7. Slope stability [GEO7]

- a. Any possibility that a slope failure that could affect any component of the facility?

Response: Yes, see Geotechnical Report Section 4.4, specifically 4.4.4

- b. If a slope failure is possible, has a stability analysis been performed?

Response: Yes, see Geotechnical Report Section 4.4.1

- c. Are seismically induced ground movements considered?

Response: Yes, see Geotechnical Report Section 4.4.1

- d. If there are ground movements considered, what methods have been used to analyze?

Response: See Geotechnical Report Section 4.4.2. Bray et al. 2018 was used in conjunction with Slide2 to estimate seismic displacements.

- e. Is the expected seismic (DE) displacement greater than 0.10 ft?

Response: Yes, see Geotechnical Report Section 4.4.2

8. Soil Structure Interaction (SSI) [GEO8]

- a. What aspects of dynamic SSI have been evaluated (e.g., piles, pipelines, tanks, earth retention systems, or other)?

Response: Very preliminary SSI considerations to date. Further exploration of SSI will be considered in the design report.

- b. What assumptions and procedures have been used to assess SSI?

Response: None

9. The geotechnical design report documents design requirements, assumptions and calculation processes and results. This document should present a complete set of information that allows for thorough review of all calculations and data analyzed to develop design recommendations and provide input into the determination of the seismic demand (Ref. 4). [GEO9]

- a. Description of the local geologic and geomorphologic setting of the facility

Response: See Geotechnical Report Section 3.1

- b. Include any and all historical geotechnical data, reports, or boring information

Response: See Geotechnical Report Appendix A

- c. Present subsurface profiles in graphical cross-sections

Response: See Geotechnical Report Figures 3 and 4

- d. Describe groundwater levels and possible artesian or sub-artesian conditions

Response: See Geotechnical Report Section 3.5.3

- e. Identify main subsurface units, based on material type, strength, and deformability

Response: See Geotechnical Report Section 3.5.2

- f. Assess lateral variability of subsurface units

Response: See Geotechnical Report Figures 3 and 4

- g. Summarize main soil and rock parameters, for each of the identified subsurface units

Response: See Geotechnical Report Section 3.5.2

- h. Describe the lateral variability to top of rock, where rock is present within the depth of concern

Response: Rock is very deep. No explorations encountered rock.

- i. Likelihood of encountering rock or cobbles that might be present within the soil matrix

Response: Not discussed in report as this is not an expected condition

- j. Provide justification for the “site classification” (A-F) for this facility.

Response: See Geotechnical Report Section 4.2.1

- k. Any additional requirements per Oregon Specialty Code, Section 1803.6?

Response: None

The determination of the site-specific seismic demand (DE) for this facility is the next step and should be a separate effort and report, based on the geotechnical report described above.