7.3. Lateral Spreading

Lateral spreading is described as the lateral movement of the soil on a gentle sloping ground due to soil liquefaction. Based on the liquefiable potential of the upper soil layer of the project site and nearby shoreline, lateral spreading may occur in an event of a strong earthquake. Documented events are likely on mild slopes of 0.3 to 5%. Horizontal displacement and vertical displacement (settlement and heaving) due to lateral spreading has caused considerable damage to infrastructures and especially underground / utility lines.

In-situ ground solidification technique, such as the deep cement mixing (DCM), is known for mitigation of earthquake-induced lateral spreading. DCM is installed by inserting columns of soil-concrete mixture in the project site. The installation creates a grid of soil-cement columns that produces a stiffer strength to support in-situ soil to reduce lateral spreading. The popularity of this method is indisputable in Japan, followed by the United States and Scandinavia.

7.4. Geotechnical Concerns

The main geotechnical concern of a buried tank below high water table (about a meter from the existing ground) will be the uplift or buoyant force. The uplift force will be exacerbated should liquefaction occur (arising from the excess high pore water pressure) during a strong ground motion (Major earthquake).

A second concern would be the stability of the envisioned vertical cut. Retaining structure is necessary to contain the envisioned 6m vertical cut, and will have to be designed for a) active earth pressure, b) the full hydrostatic forces assuming water level at the ground surface, c) earthquake forces, d) effects of surcharge loads arising from nearby structures or roadways.

Another concern would be the ground subsidence in the surrounding area during excavation works, especially when dewatering (water table is lowered by pumping). Ground subsidence is reasonably expected as the retaining wall moves (or rotates) towards the excavation for the active earth pressure (minimum lateral resistance) to act. Dewatering works in the area will exacerbate ground subsidence unless soil improvement is first provided.

7.5. Foundation Schemes

Based on the above findings, the proposed structure(s) may be supported on deep or piled foundations. In addition to the required compressional load, the piles will have to provide tensile resistance to resist the buoyant forces of the buried tank (i.e., when empty).

Driven piles or bored piles may be considered for this purpose.