Appendix G

<u>Preliminary Geotechnical Conclusions and Recommendations for Vantage Phase 2 – Fire Station,</u>

Langan Engineering and Environmental Services Inc., October 17, 2022

17 October 2022
Revised 8 November 2022

Ms. Michele Niaki
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SUBJECT: Preliminary Geotechnical Conclusions and Recommendations
Vantage Phase 2 – Fire Station
South San Francisco, California
Langan Project No. 770675103

Dear Ms. Niaki:

This letter presents our preliminary geotechnical conclusions and recommendations for the proposed fire station that is part of Phase 2 of the Vantage development in South San Francisco, California. We prepared a geotechnical investigation report dated 17 October 2022 for Phases 2 and 3 of the Vantage development; however, it does not include our geotechnical conclusions and recommendations for the proposed fire station. We are using the data collected from the geotechnical investigation to prepare our preliminary conclusions and recommendations for the fire station, which will be finalized at a later date.

The Vantage development is southeast of the intersection of Forbes Boulevard and Eccles Avenue and is bound by Forbes Boulevard to the north, Allerton Avenue to the east, trail corridor to the south, and commercial buildings to the west. The east and west ends of the Vantage development are open lots; the east lot is currently under construction and the west lot is being used for staging and construction parking. The center of the Vantage development is currently occupied by two commercial buildings intended for demolition and paved parking. We understand the proposed fire station will be constructed at grade and is located in the northwest corner of the Vantage development.

The purpose of this letter is to provide preliminary conclusions and recommendations for the proposed fire station, regarding the following:

- subsurface conditions including groundwater levels;
- site seismicity and seismic hazards, if any;
- appropriate foundation type(s) for proposed fire station; and
- 2019/2022 California Building Code (CBC) site classification, mapped values S_S and S_1, modification factors F_a and F_v and S_{MS} and S_{M1}.

1.0 SITE AND SUBSURFACE CONDITIONS

We began our site and subsurface evaluation by reviewing available subsurface data in our database, including the following previous and current investigations performed at the project site:

- Geotechnical Investigation, Vantage Phase 2 and 3, South San Francisco, California, by Langan, dated 17 October 2022.
- Geotechnical Investigation, Forbes Research Center, 494 Forbes Boulevard, South San Francisco, California, by Langan, dated 16 January 2020.
- Preliminary Geotechnical Site Assessment, Gallo Site, South San Francisco, California, by Langan, dated 27 October 2020.
- Geotechnical Investigation, Vantage Amenity Building, South San Francisco, California, by Langan, dated 4 March 2022.

During our current geotechnical investigation, Langan drilled six supplemental borings to depths of approximately 5½ to 26 feet below ground surface (bgs) from 11 through 12 August 2022. The borings and results of the laboratory test program are presented in our design geotechnical investigation report for Phases 2 and 3 of the Vantage development. In addition, two seismic Multichannel Analysis of Surface Waves (MASW) surveys and Seismic Refraction (SR) surveys were performed by Norcal Geophysical Consultants, Inc. at the site on 8 October 2022, but the results are still pending. The results of the MASW and SR surveys will be presented in an addendum to our design geotechnical investigation report for Phases 2 and 3 of the Vantage development.

The proposed fire station is located in the northwest corner of the Vantage development and is generally underlain by several feet of sandy and gravelly fill over bedrock of the Franciscan Complex.

The previous and current investigations encountered up to about 4 feet of fill consisting of sandy clay and sand with gravel in the northwest corner of the Vantage development. Bedrock, consisting of sandstone, shale and serpentinite, which sometimes contains naturally occurring asbestos (NOA), of the Francisco Complex, was encountered beneath the fill between approximately 2½ and 4 feet bgs. The results of asbestos testing indicated concentrations of asbestos ranging from 0.25 to 3 percent. The rock is intensely fractured to crushed, plastic to friable, deeply weathered, and has soft to moderately hard hardness. Bedrock generally becomes deeper to the south and east.

The historic high groundwater level is approximately 10 feet bgs (California Geological Survey, 2021). During the previous and current investigations, groundwater was encountered at approximately 15 to 25 feet bgs during drilling. Additionally, groundwater has been observed at the top of bedrock in the vicinity of the site; this may represent a perched groundwater condition. The observed groundwater level may not represent stabilized level, and may also fluctuate due to seasonal rainfall.

2.0 DISCUSSIONS AND PRELIMINARY RECOMMENDATIONS

The primary geotechnical issues that should be addressed during design development are adequate foundation support and settlement behavior. Our discussions and preliminary conclusions and recommendations regarding foundation options and other geotechnical aspects of the fire station are presented in the remainder of this letter. The conclusions and recommendations presented herein are preliminary and will be finalized at a later date.

2.1 Seismic Hazards

The site is in a seismically active area and will be subject to very strong shaking during a major earthquake. Strong ground shaking during an earthquake can result in ground failure such as that associated with soil liquefaction[1], lateral spreading[2], and seismic densification[3]. Each of these conditions has been preliminarily evaluated based on our review of the available subsurface data.

2.1.1 Liquefaction

The site is outside the zone designated with the potential for liquefaction, as identified on a map prepared by the California Geologic Survey titled *Earthquake Zones of Required Investigation, San Francisco South Quadrangle, Seismic Hazard Zones, Official Map,* dated 23 September 2021. Specifically, the map shows the site outside the area "where historic occurrence of liquefaction, or local geological, geotechnical and groundwater conditions indicate a potential for permanent ground displacements such that mitigation as defined in Public Resources Code Section 2693 (c) would be required." Furthermore, because bedrock is shallow and the fill is above groundwater at the site, we judge the liquefaction potential as low at the proposed fire station location.

2.1.2 Seismic Densification

Seismic densification of non-saturated, cohesionless soil following a major earthquake was analyzed using the procedure outlined by Tokimatsu and Seed (1987) and the Pradel (1998) method. At the proposed fire station location, the borings indicate top of bedrock is at approximately 2½ to 4 feet bgs. The fill above the bedrock is sufficiently dense and/or clayey. Therefore, we judge the potential for seismic densification settlement during a major earthquake at the site is low.

2.1.3 Lateral Spreading

Lateral spreading is a phenomenon in which a surficial soil displaces along a shear zone that has formed within an underlying liquefied layer. The surficial blocks are transported downslope or in

[1] Liquefaction is a transformation of soil from a solid to a liquefied state during which saturated soil temporally loses strength resulting from the buildup of excess pore water pressure, especially during earthquake-induced cyclic loading. Soil susceptible to liquefaction includes loose to medium dense sand and gravel, low-plasticity silt, and some low-plasticity clay deposits.

[2] Lateral spreading is a phenomenon in which surficial soil displaces along a shear zone that has formed within an underlying liquefied layer. Upon reaching mobilization, the surficial blocks are transported downslope or in the direction of a free face by earthquake and gravitational forces.

[3] Seismic densification is a phenomenon in which non-saturated, cohesionless soil is compacted by earthquake vibrations, causing ground surface settlement.

the direction of a free face, such as a channel, by earthquake and gravitational forces. Lateral spreading is generally the most pervasive and damaging type of liquefaction-induced ground failure generated by earthquakes. The project site is relatively flat, the soil layers are not potentially liquefiable, and the nearest free face is over a ½-mile from the site; therefore, we judge that lateral spreading at the site is low.

2.2 Settlement and Foundations

The available subsurface information indicates the location of the fire station is blanketed by about 4 feet of sandy fill which is underlain by shallow bedrock. Building loads are currently unavailable for the proposed at-grade fire station. However, based on the subsurface conditions at the site, we preliminarily conclude the fire station can be supported on a shallow foundation system such as isolated and continuous footings gaining support in the bedrock beneath the fill. If the foundation and building loads are not sufficient to resist the seismic uplift loads, tiedown anchors may be used.

Where fill is encountered, the footing excavations should be deepened to bear on bedrock, which is estimated to be about 4 feet; however localized areas could be deeper. The overexcavations can be backfilled with lean or structural concrete to the base of the footings. The bottom of the footings should be embedded at least 18 inches below the lowest adjacent soil subgrade and should be at least 18 inches wide for continuous footings and 24 inches for isolated spread footings. Footings adjacent to utility trenches (or other footings) should bear below an imaginary 1.5:1 (horizontal to vertical) plane projected upward from the bottom edge of the utility trench (or adjacent footings).

For preliminary design and the recommended minimum embedment, footings bearing on bedrock may be designed for an allowable bearing pressure of 8,000 psf for dead plus live loads, with a one-third increase for total loads, including wind and/or seismic loads. Footings designed in accordance with these recommendations should not settle more than ½ inch; differential settlement between adjacent footings, typically 20 to 30 feet apart, should be less than ½ inch.

Lateral loads on footings can be resisted by a combination of passive resistance acting against the vertical faces of the footings and friction along the bases of the footings. Passive resistance may be calculated using lateral pressures corresponding to an equivalent fluid weight of 300 pounds per cubic foot (pcf); the upper foot of soil or bedrock should be ignored unless confined by a concrete slab or pavement. Frictional resistance should be computed using a base friction coefficient of 0.30. The passive resistance and base friction values include a factor of safety of about 1.5 and may be used in combination without reduction.

2.3 Floor Slabs

Slab-on-grades may be used for the fire station. The subgrade for the floor slab should be scarified at least 8 inches, moisture conditioned to near optimum and compacted to at least 90 percent relative compaction[4].

[4] Relative compaction refers to the in-place dry density of soil expressed as a percentage of the maximum dry density of the same material, as determined by the ASTM D1557 laboratory compaction procedure.

Moisture is likely to condense on the underside of the ground floor slabs, even though they will be above the design groundwater level. Consequently, a moisture barrier should be considered if movement of water vapor through the slabs would be detrimental to its intended use. A typical moisture barrier consists of a capillary moisture break and a water vapor retarder.

The capillary moisture break should consist of at least four inches of clean, free-draining gravel or crushed rock. The vapor retarder should meet the requirements for Class C vapor retarders stated in ASTM E1745-97. The vapor retarder should be placed in accordance with the requirements of ASTM E1643-98. These requirements include overlapping seams by six inches, taping seams, and sealing penetrations in the vapor retarder. The particle size of the gravel/crushed rock should meet the gradation requirements presented in Table 1.

TABLE 1
Gradation Requirements for Capillary Moisture Break

Sieve Size	Percentage Passing Sieve
Gravel or Crushed Rock	
1 inch	90 – 100
3/4 inch	30 – 100
1/2 inch	5 – 25
3/8 inch	0 – 6

Concrete mixes with high water/cement (w/c) ratios result in excess water in the concrete, which increases the cure time and results in excessive vapor transmission through the slab. Therefore, concrete for the floor slab should have a low w/c ratio - less than 0.45. The slab should be properly cured. Before the floor covering is placed, the contractor should check that the concrete surface and the moisture emission levels (if emission testing is required) meet the manufacturer's requirements.

2.4 Construction Considerations

Due to the presence of asbestos in the bedrock at the site, the site will be subject to the California Air Resource Board (CARB) Asbestos Airborne Toxic Control Measure (ATCM) for construction, grading, quarrying, and surface mining operations dated July 2001 during redevelopment. The CARB Asbestos ATCM is enforced locally by Bay Area Air Quality Management District (BAAQMD) and requires construction projects greater than one acre in size, in which naturally-occurring asbestos, serpentine, or ultramafic rock is present, to prepare a site-specific Asbestos Dust Monitoring Plan (ADMP) for agency approval.

The ADMP specifies dust mitigation measures that must be initiated at the start and maintained throughout the duration of the construction and grading activities per the Asbestos ATCM. Asbestos dust mitigation will be implemented every day that construction and grading activities are performed at the site. Construction and grading activities include any disturbance of surface or stockpiles conducted with powered equipment or any related activity including, but not limited to, all surface and subsurface cuts and fills, excavation, material loading, trenching, stockpiling, auger drilling, bulldozing, and landfilling.

2.5 2019/2022 CBC Mapped Values

For seismic design in accordance with the provisions of 2019/2022 California Building Code, we preliminarily recommend the following:

- Risk-Targeted Maximum Considered Earthquake (MCE_R) S_s and S_1 of 1.841g and 0.754g, respectively
- Site Class B, should be confirmed with shear wave velocity measurements from MASW survey as part of the addendum to the design geotechnical investigation report for Vantage Phase 2 and 3
- Site Coefficients F_A and F_V of 0.9 and 0.8
- Maximum Considered Earthquake (MCE) spectral response acceleration parameters at short periods, S_{MS}, and at one-second period, S_{M1}, of 1.657g and 0.603g, respectively
- Design Earthquake (DE) spectral response acceleration parameters at short period, S_{DS}, and at one-second period, S_{D1}, of 1.105g and 0.402g, respectively.

3.0 DESIGN GEOTECHNICAL REPORT

The preliminary conclusions and recommendations presented in this letter are based on subsurface information at and in the vicinity of the site. A design-level geotechnical investigation for the fire station will be prepared at a later date and should be used to develop final design drawings.

Sincerely yours,
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