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RICHMOND
PLANNING DEPARTMENT

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August 15, 2005
Job No. 527

Mr. James J. Santurro
Land Research and Management
673 James Drive
Placerville, Ca 95667

RE: Conceptual Description of Landslide Mitigation Measures
Forest Green Estates
Richmond, California

Gentlemen:

The following is a description of the landslide mitigation measures for which you have contracted with Drill Tech Drilling & Shoring, Inc. to provide structural design services and eventually, construction services. There are two separate landslides being mitigated by two different schemes. The first is the La Colina landslide to the west of the site. This landslide is to be supported and isolated from the development with a soldier pile and tieback wall. The second potential landslide being mitigated is the large landslide to the south of the site. This slide is to be stabilized by draining it so that groundwater cannot build up within the slide mass to a point where it becomes unstable. Each of the two landslide mitigation measures are discussed in further detail below.

Soldier Pile and Tieback Wall Along West Property Boundary

Terrasearch has provided load magnitudes (inclined at 37.6 degrees from horizontal) against the proposed soldier pile wall of 400 kips per foot and 77 kips per foot for portions of the wall perpendicular and parallel to the slide, respectively. These design loads are then used for a structural analysis of the beams and tiebacks.

Based on preliminary analysis, the soldier piles resisting the 400 kips per foot driving force will be double W27x102 beams encased in concrete in 48-inch diameter drilled holes. The soldier piles will be spaced 8 feet on center and will be embedded 15 feet below the base of the landslide. The double steel beams will be supported by 5 rows of relatively high capacity tiebacks (up to 750 kip design load per tieback) extending up to 130 feet in length.

Also based on preliminary analysis, the soldier piles resisting the 77 kips per foot driving force will consist of heavy rebar cages encased in concrete in 36-inch diameter drilled holes. These soldier piles will be spaced 8 feet on center and will also be embedded 15 feet below

the base of the landslide. These soldier piles will be supported by 2 rows of tiebacks (with around 250 kips design load per tieback) extending up to 120 feet in length.

The construction of the soldier pile and tieback wall will be performed with conventional drilling equipment likely consisting of a track mounted hydraulic pile drill and a Klemm type tieback drill. These drills will be supported by a concrete pump, crane, forklift and other equipment commonly associated with this type of heavy construction work.

Large Dewatering Shafts Stabilizing the Slope South of Development

Due to the depth of the potential slide within the slope to the south of the Forest Green Development, large diameter dewatering shafts are proposed to mitigate the potential for landslides. The potential sliding to the south of the development could occur at depths in excess of 100 feet along the south slope. A structural fix is not economically viable for this depth of sliding. The most effective way to stabilize deep slides that are driven by large groundwater forces is to remove the water

Groundwater removal from slides is very commonly performed with the installation of horizontal drains (typically 1-1/2 inch inside diameter Schedule 80 slotted pipe installed in a 4-inch or greater diameter hole). Given that the point of discharge of the required horizontal drains on this project is deeper than the existing ground surface, it is necessary to drill the horizontal drains from a point well beneath the ground surface. The most practical means of accomplishing both the drilling of the horizontal drains and the extraction of the groundwater is to drill the horizontal drains from inside a deep shaft. Upon the completion of the horizontal drain installation, these shafts become large sumps from which the groundwater is pumped and discharged.

The design of the circular dewatering shafts is relatively straightforward. The locations of the shafts are determined by the project geotechnical engineer based on the locations of groundwater needing removal. The depth of the shafts is also determined in this manner based on the desired depth of groundwater drawdown. We understand that Terrasearch has selected a shaft depth of 120 for this project. The location, quantity, direction, and inclination of the horizontal drains radiating from the shaft are similarly determined by the geotechnical engineer based on the anticipated groundwater locations and drawdown requirements. The shaft diameter will be based on the space requirements of the equipment drilling the horizontal drains. This has not yet been finalized, but the required inside diameter is at this time anticipated be between 20 and 25 feet. The structural design of the shafts will be performed by Drill Tech Drilling & Shoring, Inc. and will consist of approximately 12 inches of shotcrete reinforced with rock bolts and either rebar or bent sections of steel beams (ring steel). The discharge piping and pumps will be determined based on anticipated flow rates and the distance and head being pumped. We understand that the discharged water will flow into detention basins currently shown as a part of the planned development. Excavated material generated from the shaft construction would be incorporated to the planned fills associated with the mass grading at the site.

Construction of the dewatering shafts is anticipated to be performed with conventional mining techniques using equipment such as cranes, excavators, mini-excavators, shotcrete pumps, etc. Based on the available geotechnical information, blasting is not anticipated. The horizontal drains would be drilled a rotary wash drill rig. All work would be performed in conformance with the requirements of the Cal Osha Division of Mining and Tunneling.

We trust that this letter meets your needs at this time. If you have any questions, please do not hesitate to contact me.

Respectfully submitted,

A handwritten signature in black ink, appearing to read "Brett K. Mainer". The signature is written in a cursive, flowing style.

Brett K. Mainer, P.E., G.E.
Engineering Manager

cc. Simon Makdessi - Terrasearch
Sean Kennings - LAK and Associates