
IV.D. GEOLOGY AND SOILS

The following section is a summary of several geotechnical reports conducted for the proposed project site. These reports were prepared by two different consultants and are listed below. Copies of these reports can be found in Appendix I. Additional information was obtained from the Los Angeles City Planning Department Environmental and Public Facilities Maps (1996).

1. Geotechnical Considerations Proposed Property Purchase Ocean Woods Terrace Apartment Complex 17331-17333 Tramonto Drive Pacific Palisades, California, Law Crandall (December 31, 1998).
2. Geologic and Soils Engineering Exploration Proposed Landslide Repair and Multi Unit Condo and Townhome Buildings Tentative Tract 52928, 17331-17333 Tramonto Drive, Pacific Palisades, California, J. Byer Group Inc. (August 16, 2000).
3. Addendum Geologic and Soil Engineering Exploration Report Proposed Landslide Repair and Multi-Unit Condominium and Town Home Buildings Tentative Tract 52928, 17331-17333 Tramonto Drive Pacific Palisades, California, J. Byer Group Inc. (November 29, 2000).
4. Addendum Geologic and Soils Engineering Exploration Report #2, Proposed Landslide Repair and Multi-Unit Condominium and Town Home Buildings Tentative Tract 52928, 17331-17333 Tramonto Drive, Pacific Palisades, California, J. Byer Group Inc. (June 29, 2001).
5. Letter from David T. Hsu, Chief of Grading Section, City of Los Angeles Department of Building and Safety to Emily Gabel-Luddy, Deputy Advisory Agency, Los Angeles Department of City Planning, regarding Tentative Tract 52928, December 5, 2001.

ENVIRONMENTAL SETTING

The proposed project site consists of a partially graded and developed parcel that contains approximately 3.8 acres of hillside terrain. The study area is on the eastern edge of Castellammare Mesa approximately 400 feet west of the intersection of Castellammare Drive and Sunset Boulevard. The western boundary of the project site includes the central portion of the active Revello Drive Landslide. Elevations at the project site range from approximately 85 to 200 feet. Surface drainage within the slide on the proposed project site is uncontrolled and generally flows down the contours of the land toward Castellammare Drive. Depressions¹ within the eastern, more active portion of the

¹ *A closed contour, inside of which the ground or geologic structure is at a lower elevation than the surrounding area.*

property is moderately to poorly controlled. Numerous terrace drains, paved swales, and drainage pipes are present on the slopes below the existing on-site apartment buildings.

Exploration was conducted near the toe of the Revello Drive Landslide between March 31 and April 2, 1997 and March 1 through 24, 2000. Exploration included grading an access road to the northwestern portion of the property and drilling five borings. These borings were dug to between 43 and 65 feet below ground surface with the aid of a hillside drill rig. An additional boring was conducted on October 24, 2000. This boring was drilled to 60 feet with a limited access, bucket-auger drill rig.²

Groundwater

Perched groundwater zones and seeps were encountered during exploration. Moderate to heavy seeps were encountered within the slide mass. In general, the water is perched on top of the clayey gouge³ along the base of the upper and lower slides. Outside of the slide to the east, a slight seep was encountered in Crandall Boring 2 at 25 feet, while Boring 3 was dry to 22 feet. Seasonal fluctuations in groundwater levels may occur due to variations in climate, irrigation and other factors not evident at the time of exploration. Fluctuations in groundwater levels may also occur across the site. Rising groundwater can saturate earth materials, causing instability of slopes.

Geologic Conditions

The bedrock underlying the project site is common to this area of the Pacific Palisades near the base of the south flank of the Santa Monica Mountains. Bedding mapped on- and off-site is warped and folded. The majority of bedding planes mapped strike to the northwest and dip moderately to steeply to the northeast. Faults were not encountered during exploration; however, bedding plane shears were observed in the bedrock below the slide, which likely formed during regional folding of the bedrock.

Bedrock underlying the project site and encountered in the borings below the landslide debris consists of siltstone, sandstone, and occasional basalt and conglomerate. Previous geotechnical consultants have mapped the bedrock beneath the site as part of the Martinez Formation of the Eocene age. Based on the presence of Middle Miocene micro-fossils located near the project site, the bedrock has been mapped as part of the Topanga Formation. In general, the siltstone and sandstone bedrock is thinly to thickly bedded, moderately hard, contorted and sheared. Cemented conglomerate that is blue-grey to light-grey, massive, and slightly weathered was encountered in Boring 3. Where exposed near the

² Borings have been conducted at the project site by a number of geotechnical firms. Individual borings are referred to in text by the name of the company, followed by the number of the boring.

³ A thin layer of soft, earthy pulverized claylike material along the wall of a vein, which can be readily removed.

ground surface the bedrock is oxidized to a light tan to gray-brown color. Below the slide plane, the bedrock is dark gray to blue-gray with little oxidation. Hard basalt was encountered in Crandall Boring 3.

Natural residual soil and colluvium⁴ likely blanket the bedrock on the natural slopes east of the landslide. The residual soil likely consists of dark brown sandy clay that is approximately three feet thick. Colluvium may be present in the swale below the access drive on the eastern portion of the study area. Alluvial terrace caps the bedrock on the eastern portion of the site. In general, the terrace consists of sand and sandy gravel with cobbles that are tan to brown, dense, and structureless. These soils can be seen in Figure IV.D-1, Geologic Map.

Revello Drive Landslide

The Revello Drive Landslide is located on the western portion of the project site (See Figure IV.D-2, Revello Landslide). In the spring of 1965 a landslide occurred after a 1:1 to 1 ½:1 cut slope was created below the westernmost Ocean Woods Terrance apartment building located on the project site. The slope failed onto and bulldozed over a level pad at 17325 Castellammare Drive. Over the years, additional movement of the original slide mass and secondary failures have caused the slide to enlarge and affect the street and 17321 Castellammare Drive.

The western portion of the project site is mantled by landslide debris of varying thickness. Offsite to the south, landslide debris ranges from 25 feet at Boring 3 to 48 feet at Boring 4. The base of the slide within the project site and upslope were defined by recent and older boring logs. There are clearly two main slides planes: upper and lower. It is believed that the upper plane failed onto the 1965 pad cut on the adjacent downslope property. Over time, the slide enlarged in size and depth to include the lower slide plane.

The slide debris consists of a mixture of siltstone and sandstone with a silty sand matrix that is gray-brown, tan and slightly moist to moist. The deeper slide debris consists of contorted and discontinuous siltstone and sandstone that is orange-brown, gray-brown, tan, slightly moist to saturated, medium dense to dense, highly oxidized, and has a chaotic structure. The base of the slides are marked by a one to 24 inch thick zone of clay gouge and intensely sheared siltstone that is dark gray-brown to blue-

⁴ *A general term applied to loose and incoherent deposits, usually at the foot of a slope or cliff and brought there chiefly by gravity.*

Figure IV.D-1, Geologic Map

Figure IV.D-2, Revello Landslide

gray, plastic, moist to saturated and contains slicks. The base of the slide acts as an aquiclude⁵ and has perched groundwater above.

Seismic Conditions

The entire southern California area is considered a seismically active region. The region has numerous active, potentially active, and inactive faults. Active faults are defined as a fault that has had surface displacement within Holocene times (about the last 11,000 years). A potentially active fault is a fault that has demonstrated surface displacement of Quaternary age deposits (within the last 1.6 million years).

There are no known faults on the proposed project site. Based upon the “Maps of Known Active Fault, Near Source Zones in California and Adjacent Portions of Nevada”, dated February 1988 (part of the 1997 Uniform Building Code); the site is located within one mile of the Malibu Coast Fault. In addition, the project site is also located near the Santa Monica Fault. These faults make up a portion of the Santa Monica Fault System. A more detailed description of these faults follows. Figure IV.D-3, Fault Map, depicts the major faults in the vicinity of the project site.

Malibu Coast Fault

The Malibu Coast fault zone is a series of east-west trending, north-dipping reverse faults extending westward from Santa Monica to offshore of Point Mugu. Fault trenching conducted in 1985 and 1986 on south Winter Mesa in the Malibu area of Los Angeles County exposed several faults offsetting Tertiary and Pleistocene age units, and one fault offsetting colluvial deposits estimated to be 6,000 years old. The observed fault, named the Winter Mesa Fault, is believed to be a splay of the Malibu Coast fault zone; accordingly, the Holocene faulting on the Winter Mesa fault is considered representative of active faulting along the Malibu Coast fault zone.

Santa Monica Fault

The Santa Monica fault is the western segment of the Santa Monica-Hollywood fault zone which trends east-west from the Santa Monica coastline on the west to the Hollywood area on the east. In the Santa Monica area, the Santa Monica fault splays into two segments, the North Branch and the South Branch. Several investigators have indicated that the fault is active, based on geomorphic evidence and fault trenching studies. Recent studies indicate that the Santa Monica Fault does not extend east of the northerly extension of the Newport-Inglewood fault zone or the West Beverly Hills Lineament of Dolan

⁵ *A body of rock that will absorb water slowly, but will not transmit it fast enough to supply a well or spring. (Dictionary of Geology Terms, American Geological Institute, 1984, 3rd Edition).*

Figure IV.D-3, Fault Map

and Sieh (1992). The Santa Monica fault has not been zoned as active under the Alquist-Priolo Earthquake Fault Zoning Act because of the absence of well-defined fault traces. However, the Santa Monica Fault is considered active by the State Geologist.

Liquefaction

Liquefaction is the process in which loose granular soils below the groundwater table temporarily lose strength during strong ground shaking as a consequence of increased pore pressure and thereby, reduced effective stress. The vast majority of liquefaction hazards are associated with sandy soils and silty soils of low plasticity. Potentially liquefiable soils (based on composition) must be saturated or nearly saturated to be susceptible to liquefaction (California Division of Mines and Geology, 1997).

Significant factors that affect liquefaction include water level, soil type, particle size and gradation, relative density, confining pressure, intensity of shaking, and duration of shaking. Liquefaction potential has been found to be the greatest where the groundwater level is shallow and submerged loose, fine sands occur within a depth of about 50 feet or less. Liquefaction potential decreases with increasing grain size and clay and gravel content, but increases as the ground acceleration and duration of shaking increase. According to the Los Angeles City Planning Department Citywide Division Environmental and Public Facilities Maps, the project site is not in an area that is classified as liquefiable or potentially liquefiable.⁶

Ground Subsidence

Subsidence is the downward settling of the earth's surface with little or no horizontal motion. One cause of land subsidence is the withdrawal of fluids from deep geologic formations leaving void spaces. Unless these voids are refilled by re-pressurization techniques, they may collapse, causing subsidence in the shallower earth layers. Land subsidence can result in varying degrees of distress to foundations and other engineered structures built above or within these subsiding earth layers caused by settling of the earth. The proposed project site is not located in an area that is susceptible to subsidence and is not located in an oil field or oil drilling area.⁷

⁶ Los Angeles City Planning Department Citywide Division, *Environmental and Public Facilities Maps: Areas Susceptible to Liquefaction*, September 1, 1996 and *State of California Seismic Hazard Zones* at http://gmw.consrv.ca.gov/shmp/download/paf/ozn_malib.pdf.

⁷ Los Angeles City Planning Department Citywide Division, *Environmental and Public Facilities Maps: Oil Field & Oil Drilling Areas*, September 1, 1996.

Other Geologic Issues

Tsunamis

Tsunamis are produced by significant undersea disturbances, such as earthquakes. Most major Pacific Ocean tsunamis are generated by large earthquakes off the coasts of South America, Central America, Alaska, and Japan. Modeled heights of potential tsunamis for the nearby Getty Villa estimated potential wave heights to be four and seven feet above mean sea level (msl) for 100- and 500-year, respectively. The project site ranges in elevation from 85 to 200 feet msl and therefore would not be affected by tsunamis.

Seiches

A seiche involves the oscillation of a body of water in an enclosed basin, such as a reservoir, storage tank, or lake. There is no such body of water on or near the project site; therefore, the site is not subject to seiche hazards.

ENVIRONMENTAL IMPACTS

Thresholds of Significance

Appendix G of the CEQA Guidelines indicates that a project could have a potentially significant geology and soils impact if it were to cause one or more of the following conditions:

1. Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving:
 - Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map or based on other substantial evidence of a known fault?
 - Strong seismic ground shaking?
 - Seismic-related ground failure, including liquefaction?
 - Landslides?
 - Result in substantial soil erosion or the loss of topsoil?
 - Be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction, or collapse?

- Be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994), creating substantial risks to life or property?

Based on the City of Los Angeles CEQA Thresholds Guide, the proposed project would also result in a significant geotechnical impact if it exceeds any of the following thresholds. Where applicable, the thresholds from the City's CEQA Thresholds Guide are provided in the EIR because they address potential environmental impacts that are not entirely addressed by Appendix G of the CEQA Guidelines.

- A project would normally have a significant geologic hazard impact if it would cause or accelerate geologic hazards which would result in substantial damage to structures or infrastructure, or expose people to substantial risk of injury.
- A project would normally have a significant impact on landform alteration if one or more distinct and prominent geologic or topographic features would be destroyed, permanently covered or materially and adversely modified. Such features may include, but are not limited to, hilltops, ridges, hillslopes, canyons, ravines, rock outcrops, water bodies, streambeds and wetlands.

Proposed Project

The proposed project involves the demolition of the existing apartment buildings and all other structures and the construction of an 82-unit condominium complex. In addition, the 1965 Revello Drive Landslide that is located on the project site would be removed and the area recompacted to provide permanent slope stabilization for the proposed project. Table IV.D-1 shows the amount of cut and fill required for the proposed project and the landslide repair. The proposed landslide repair and redevelopment of the site with multi-unit condominium and townhome buildings is feasible from a geologic and soils engineering standpoint provided the recommendations provided by the consulting geologists and City of Los Angeles Department of Building and Safety are included in the plans and are implemented during construction.⁸ In a letter dated December 5, 2001 from the City of Los Angeles Department of Building and Safety the following is stated:

“A favorable report has been received from the Geotechnical Engineering Division of the Bureau of Engineering. Tentative Tract 52928 is approved subject to the following conditions:”

⁸ *The J. Byer Group, Inc., Geologic and Soils Engineering Exploration Proposed Landslide Repair and Multi Unit Condo and Townhome Buildings Tentative Tract 52928, 17331-17333 Tramonto Drive, Pacific Palisades, California, August 16, 2000.*

These conditions can be found as part of the mitigation measures recommended below or can be found in Appendix I of this report.

**Table IV.D-1
Cut and Fill Requirements**

Use	Cubic Yards
Cut	30,000 cubic yards
Fill	5,000 cubic yards
Export	100,000 cubic yards
Import (for landslide repair)	75,000 cubic yards
Landslide Removal and Recompact	75,000 cubic yards

Project Impacts

Revello Drive Landslide

Repair of the existing landslide would help to stabilize the site for the construction of the proposed project. In order to repair the landslide, the landslide debris would be removed down to bedrock. Removal depths could potentially be up to 60 feet. Once the landslide debris is removed, compacted fill would be placed on the bedrock up to the planned grades for Buildings 1 and 2. This compacted fill would be used as primary structural fill to support the proposed buildings.

Soldier piles would be required in order to support vertical excavations along the north, west, and south sides of the removal. These piles would be embedded into the bedrock below the base of the landslide. Additional piles along the upslope property line may also be required to support temporary vertical excavations to construct the required rear yard retaining walls. The location of these soldier piles can be seen in Figure IV.D-1 and Figures IV.D-4 through IV.D-10.

The owner of the downslope property (17325 Castellammare Drive) has received City approval to develop a 21-unit condominium complex and also plans to permanently stabilize and develop the toe of the Revello Drive Landslide. Soldier piles along the common property line would be required prior to either project proceeding. Permanent soldier piles designed for an equivalent fluid pressure of 65 pounds per cubic foot will be required to support the compacted fill placed within the landslide removal void. Building 2, which is located upslope from these piles, should be founded in approved compacted fill below a 1:1 plane projected up from the downhill base of the slide removal. Deepened foundations consisting of friction piles tied with grade-beams will be required to support portions of Building 2.

Figure IV.D-4, Section A-A

Figure IV.D-5, Section B-B

Figure IV.D-6, Section C-C

Figure IV.D-7, Section D-D

Figure IV.D-8, Section E-E

Figure IV.D-9, Section F-F

Figure IV.D-10, Section G-G

Portions of Buildings 1 and 2 will transition across the limits of the slide into the area of the temporary 1:1 back-cut. The portions of the proposed building located on bedrock outside the limits of the slide will be over-excavated 10 feet below the bottom of the footings and replaced with compacted fill.

Subdrains will be required at the base of the landslide repair. These subdrains should discharge to the atmosphere via gravity. As discussed above, significant geotechnical impacts from the Revello Drive Landslide would be mitigated to less than significant levels provided the mitigation measures listed below are implemented.

Seismic Hazards

The principal seismic hazard to the proposed project is strong ground shaking from earthquakes produced by local faults. Modern, well-constructed buildings are designed to resist ground shaking through the use of shear walls and reinforcements. The proposed construction would be consistent with all applicable provisions of the city of Los Angeles Building Code, as well as the seismic design criteria contained within the Uniform Building Code. Additional precautions may be taken to protect personal property and reduce the chance of injury including strapping water heaters and securing furniture. It is likely that the project site will be shaken by future earthquakes produced in southern California. However, with the incorporation of mitigation measures listed below, these impacts would be less than significant.

Liquefaction

The proposed project site is not located in an area that is classified as liquefiable or potentially liquefiable. Therefore, liquefaction impacts would be less than significant.

Subsidence

The proposed project site is not located in an area that is susceptible to subsidence and is not located in an oil field or oil drilling area. Therefore, impacts to the proposed project due to subsidence would be less than significant.

Tsunamis

The project site ranges in elevation from 85 to 200 feet msl. The site is above the elevations (four to seven feet above mean sea level) that would be impacted by tsunamis. Therefore, impacts to the project site from tsunamis would be less than significant.

Seiches

A seiche involves the oscillation of a body of water in an enclosed basin. There are no enclosed bodies of water located on or near the project site. Therefore, no impacts to the project site from seiches would occur.

CUMULATIVE IMPACTS

Development of the proposed project in conjunction with the related projects listed in Section II.B would result in further development of the Pacific Palisades area in the City of Los Angeles. Geotechnical hazards are site-specific and there is little, if any, cumulative relationship between development of the proposed project and the related projects (with the exception of Related Project #4). Related Project #4 is a proposed 21-unit condominium complex at 17325 Castellammare Drive that has been approved for construction by the City of Los Angeles. This related project is located at the toe of the Revello Drive Landslide, downslope of the proposed project site. Related Project #4 is required to permanently stabilize the toe of the landslide, and has received approval from the City of Los Angeles Department of Building and Safety for its proposed slope stabilization program. In the event that Related Project #4 is not constructed, the stabilization measures for the proposed project would be adequate to stabilize the portion of the landslide located on the project site as the required slope stabilization improvements for each project are not co-dependent. Therefore, provided the proposed project and Related Project #4 implement all of the slope stabilization techniques approved by the Department of Building and Safety, cumulative geology and soils impacts would be less than significant.

MITIGATION MEASURES

The following mitigation measures are required to reduce geology and soils impacts to less than significant levels:

Seismic

1. The design and construction of the project shall conform to the Uniform Building Code seismic standards as approved by the Department of Building and Safety.

Site Preparation

Grading Specifications

2. The areas to receive compacted fill shall be prepared by removing all vegetation, debris, existing fill, soil, colluvium and slide debris. The exposed excavated area shall be observed by

the soils engineer or geologist prior to placing compacted fill. The exposed grade shall be scarified to a depth of six inches, moistened to optimum moisture content, and recompact to 90 percent of the maximum density.

3. The proposed building site for buildings 1 and 2 shall be excavated to a minimum depth of 10 feet below the bottom of all footings. The excavation shall extend a minimum of 10 feet beyond the building footprint. The excavated areas shall be observed by the soils engineer or geologist prior to placing compacted fill.
4. Fill, consisting of soil approved by the soils engineer, shall be placed in horizontal lifts and compacted in six-inch layers with suitable compaction equipment. The excavated on-site materials are considered satisfactory for reuse in the controlled fills. Any imported fill shall be observed by the soils engineer prior to use in fill areas. Rocks larger than six inches in diameter shall not be used in the fill.
5. The fill shall be compacted to at least 90 percent of the maximum laboratory density for the material used. The maximum density shall be determined by ASTM D 1557-91 or equivalent.
6. Field observation and testing shall be performed by the soils engineer during grading to assist the contractor in obtaining the required degree of compaction and the proper moisture content. Where compaction is less than required, additional compactive effort shall be made with adjustment of the moisture content, as necessary, until 90 percent compaction is obtained. One compaction test is required for each 500 cubic yards or two vertical feet of fill placed.

Fill Slopes

7. Compacted fill slopes may be constructed at a 2:1 gradient and shall be keyed and benched into bedrock or supported laterally with retaining walls or soldier piles.

Subdrain

8. A subdrain system is recommended at the back of the proposed repair. The subdrain shall consist of an eight inch perforated pipe surrounded by five cubic feet of gravel per foot of subdrain. Gravel 'chimney' drains are recommended along the uphill sides of the repair. The gravel chimney drains shall consist of a 12 inch wide strip of 34 inch gravel placed between the compacted fill and the shored excavation. The chimney drains shall have hydraulic connectivity to the main subdrain.

Excavation Characteristics

9. In the event a hard cemented layer is encountered during foundation excavation, coring or the use of jackhammers may be necessary. Groundwater and caving zones may also be encountered in soldier pile excavations. Casing and/or drilling muds may be required shall caving zones be encountered.

Foundation Design***Spread Footings***

10. Continuous and/or pad footings may be used to support the proposed buildings and garage retaining walls provided they are founded in bedrock, approved compacted fill (buildings 1 and 2) or alluvial terrace. Continuous footings shall be a minimum of 12 inches in width. Pad footings shall be a minimum of 24 inches square. Table IV.D-2 depicts the recommended design parameters.

**Table IV.D-2
Design Parameters**

Bearing Material	Minimum Embedment Depth of Footing	Vertical Bearing (psf)	Coefficient of Friction	Passive Earth Pressure (pcf)	Maximum Earth Pressure (psf)
Bedrock	12 inches	4,000	0.35	500	6,000
Alluvial Terrace	12 inches	1,500	0.3	300	3,000
Future Compacted Fill	18 inches	1,500	0.3	300	3,000

11. Increases in the bearing values of the compacted fill, terrace and bedrock are allowable at a rate of 20 percent for each additional foot of footing width or depth to a maximum of 3,000 pounds per square foot for the fill and terrace and 6,000 pounds per square foot for the bedrock. For bearing calculations, the weight of the concrete in the footing may be neglected.
12. The bearing values shown above are for the total of dead and frequently applied live loads and may be increased by one third for short duration loading, which includes the effects of wind or seismic forces. When combining passive and friction for lateral resistance, the passive component shall be reduced by one third.
13. All continuous footings shall be reinforced with a minimum of four #4 steel bars; two placed near the top and two near the bottom of the footings. Footings shall be cleaned of all loose

soil, moistened, free of shrinkage cracks and approved by the geologist prior to placing forms, steel or concrete.

Deepened Foundations - Friction Piles

14. Drilled, cast in place concrete friction piles are recommended to support portions of the proposed buildings located over deep fill and adjacent to slopes to achieve the required slope setbacks. Also, piles are recommended to support the southern portion of Building 2 below the 1:1 setback plane. Piles shall be a minimum of 24 inches in diameter and a minimum of eight feet into bedrock or eight feet into fill below the setback plane. Piles may be assumed fixed at three feet into bedrock or three feet into fill below the setback plane. The piles may be designed for a skin friction of 700 and 500 pounds per square foot for that portion of pile in contact with the bedrock and compacted fill, respectively. All piles shall be tied in two horizontal directions with grade beams.

Lateral Design

15. The existing fill and soil on the site are subject to downhill creep. Pile shafts are subject to lateral loads due to the creep forces. Pile shafts shall be designed for a lateral load of 1,000 pounds per linear foot for each foot of shaft exposed to the existing fill and soil. Friction piles supporting the portion of Building 2 (Figure IV.D-1) within the foundation zone shall be designed for an arbitrary creep force of 5 kips, with a point of application at the ground surface.
16. The friction values are for the total of dead and frequently applied live loads and may be increased by one third for short duration loading, which includes the effects of wind or seismic forces. Resistance to lateral loading may be provided by passive earth pressure within the bedrock.
17. Passive earth pressure may be computed as an equivalent fluid having a density of 380 pounds per cubic foot. The maximum allowable earth pressure is 6,000 pounds per square foot. For design of isolated piles, the allowable passive and maximum earth pressures may be increased by 100 percent. Piles spaced more than 2½ pile diameters on center may be considered isolated.

Foundation Settlement

18. Settlement of the foundation system is expected to occur on initial application of loading. A settlement of ¼ to ½ inch may be anticipated. Differential settlement shall not exceed 1/4 inch.

Foundation Setback

19. The Building Code requires that foundations be a sufficient depth to provide horizontal setback from a descending slope steeper than 3:1. The required setback is $\frac{1}{2}$ the height of the slope with a minimum of five feet and a maximum of 40 feet measured horizontally from the base of the foundation to the slope face.

Toe of Slope Clearance

20. The Building Code requires a level yard setback between the toe of an ascending slope and the rear wall of the proposed structure of one half the slope height to a maximum 15 feet clearance for slopes steeper than 3:1. For retained slopes, the face of the retaining wall is considered the toe of the slope.

Retaining Walls***General Design***

21. Cantilevered retaining walls up to 15 feet high, supporting compacted fill with backslopes between level and 2:1 may be designed for an equivalent fluid pressure of 43 pounds per cubic foot. Cantilevered retaining walls higher than 15 feet will require specific calculations based upon the backslope and surcharge conditions. Restrained basement and parking garage walls, where wall deflection is limited, shall be designed for a pressure of 30H, where H is the height of the restrained wall in feet. Retaining walls shall be provided with a subdrain or weepholes covered with a minimum of 12 inches of 3/4 inch crushed gravel.

Backfill

22. Retaining wall backfill shall be compacted to a minimum of 90 percent of the maximum density as determined by ASTM D 1557-91, or equivalent. Where access between the retaining wall and the temporary excavation prevents the use of compaction equipment, retaining walls shall be backfilled with 3/4 inch crushed gravel to within two feet of the ground surface. Where the area between the wall and the excavation exceeds 18 inches, the gravel must be vibrated or wheel-rolled, and tested for compaction. The upper two feet of backfill above the gravel shall consist of a compacted fill blanket to the surface. Retaining wall backfill shall be capped with a paved surface drain.

Foundation Design

23. Retaining wall footings may be sized per the “Deepened” and “Spread Footings’ mitigation measures listed above.

Freeboard

24. Retaining walls surcharged by a sloping condition shall be provided freeboard for slough⁹ protection. For manufactured 2:1 slopes, a minimum of 12 inches of freeboard is recommended. For retaining walls supporting existing or natural slopes, the recommended freeboard is 18 inches. An open "V" drain shall be placed behind the wall so that all upslope flows are directed around the structure to the street or approved location.

Temporary Excavations - Soldier Piles

25. Soldier piles are recommended as part of the stabilization plan to support the compacted fill laterally and to increase the safety factor. Southeast facing vertical excavations are not recommended in the slide debris. All southeast facing excavations in the slide debris shall be trimmed to 1:1 or along other flatter planes of weakness. Non-southeast facing temporary excavations in the slide debris may be created vertically up to five feet high. Where non-southeast facing vertical excavations in the slide debris exceed five feet in height, the upper portion shall be trimmed to 1:1(45 degrees). Northeast-facing excavations in the bedrock will weaken bedding in the down-dip direction. Northeast-facing excavations shall be trimmed to 1:1, or shored.
26. Soldier piles will be required to support temporary excavations and the landslide along the uphill property line and to support offsite properties (Soldier Piles P1 through P40 on the Geologic Map). Soldier piles will also be required to support excavations along the downhill (southern) property line. Soldier piles shall be spaced a maximum of 10 feet on center. Piles may be assumed fixed at 10 feet into bedrock below the slide debris, below the 1 1/2: 1 setback plane, or below the base of the excavation, whichever is deeper.
27. The temporary load on soldier piles P1 through P10 is 170 kips per foot. From P17 to P35, the recommended design force is 145 kips per foot. Between piles P10 and P17, the design force shall decrease linearly from 170 to 145 kips per foot. The point of application is assumed to be 1/3 the retained height of the pile. Piles P1 through P35 shall be embedded in the bedrock below the base of the slide.
28. Piles P36 through 40 shall be founded below a 1½: 1 plane projected up from the base of the slide. The recommended design equivalent fluid pressure is 65 pounds per cubic foot for the portion of the pile between the ground surface and the 1½: 1 setback plane. Piles along the

⁹ *Rock material that has crumbled from the sides of a borehole.*

upslope property line may also be utilized to support temporary vertical excavations to construct the required rear yard retaining walls.

29. Due to the large forces and high retaining heights, cantilevered piles may not be feasible. Bracing, rakers, tie-back anchors, and additional row(s) of soldier piles, may be used to assist the property line retaining walls. Slopes may be trimmed offsite to reduce the heights of shored excavations with permission from the offsite property owner. The installation of tie-back anchors offsite will also require permission from the offsite property owner.

Lateral Design - Soldier Piles

30. Resistance to lateral loading may be provided by passive earth pressure within the bedrock. Passive earth pressure may be computed as an equivalent fluid having a density of 380 pounds per cubic foot. The maximum allowable earth pressure is 6,000 pounds per square foot. For design of isolated piles, the allowable passive and maximum earth pressures may be increased by 100 percent. Piles spaced more than 2½ pile diameters on center may be considered isolated.

Tie-back Anchors

31. Tie-back earth anchors may be used to assist the soldier piles in resisting the lateral loads. Either friction anchors or belied anchors may be used.
32. For design purposes, the active wedge within the slide debris is defined by the base of the slide as shown in the cross sections. For earth anchors remote to the slide, it is assumed that the active wedge adjacent to the shoring is defined by a plane drawn at 35 degrees with the vertical through the bottom of the excavation. Friction anchors shall extend at least 25 feet beyond the potential active wedge, or to a greater length if necessary to develop the desired capacities.

Testing

33. The capacities of the anchors shall be determined by testing of the initial anchors. For preliminary design purposes, it is estimated that drilled friction anchors will develop an average value of 400 pounds per square foot. Only the frictional resistance developed beyond the active wedge shall be considered in resisting lateral loads. If the anchors are spaced at least six feet on center, no reduction in the capacity of the anchors need be considered due to group action.
34. The frictional resistance between the soldier piles and the retained earth may be used in resisting a portion of the downward component of the anchor load. The coefficient of friction between the soldier piles and the retained earth may be taken as 0.35. In addition, the soldier

piles below the excavated level may be used to resist downward loads. The downward frictional resistance between the concrete soldier piles and the soils below the excavated level may be taken as equal to 700 pounds per square foot.

35. The anchors may be installed at angles of 20 to 40 degrees below the horizontal. Caving and sloughing of the anchor hole shall be anticipated and provisions made to minimize such caving and sloughing. Groundwater and seeps should be anticipated for anchors drilled within the slide debris. The anchors shall be filled with concrete placed by pumping through the auger from the tip out, and the concrete shall extend from the tip of the anchor to the active wedge. To minimize chances of caving and sloughing, that portion of the anchor shaft within the active wedge shall be backfilled with sand before testing the anchor. This portion of the shaft shall be filled tightly and flush with the face of the excavation. The sand backfill shall be placed by pumping; the sand may contain a small amount of cement to facilitate pumping.
36. A J. Byer Group representative shall select at least eight of the initial anchors for a 24-hour 200% test and eight additional anchors for quick 200% tests. The anchors shall be tested to develop twice the assumed friction value. Anchor rods of sufficient strength shall be installed in these anchors to support the 200 percent test loading. Where satisfactory tests are not achieved on the initial anchors, the anchor diameter and/or length shall be increased until satisfactory test results are obtained. The total deflection during the 24-hour 200% test shall not exceed 12 inches. During the 24-hour test, the anchor deflection shall not exceed 0.75 inch measured after the 200% test load is applied. If the anchor movement after the 200% load has been applied for 12 hours is less than 0.5 inch, and the movement over the previous four hours has been less than 0.1 inch, the 24-hour test may be terminated.
37. For the quick 200% tests, the 200% test load shall be maintained for 30 minutes. The total deflection of the anchor during the 200% quick tests shall not exceed 12 inches; the deflection after the 200% test load has been applied shall not exceed 0.25 inch during the 30-minute period.
38. All of the anchors shall be pretested to at least 150% of the design load; the total deflection during the test shall not exceed 12 inches. The rate of creep under the 150% test shall not exceed 0.1 inch over a 15-minute period for the anchor to be approved for the design loading.
39. After a satisfactory test, each anchor shall be locked-off at the design load. The locked-off load shall be verified by rechecking the load in the anchor. If the locked-off load varies by more than 10% from the design load, the load shall be resent until the anchor is locked-off within 10% of the design load.

40. The installation of the anchors and the testing of the completed anchors shall be observed by the J. Byer Group.

Lagging

41. Continuous lagging¹⁰ is anticipated for shoring piles supporting slide debris. The soldier piles shall be designed for the full anticipated lateral pressure. However, the pressure on the lagging will be less due to arching in the soils. Lagging shall be designed for the recommended earth pressure, but may be limited to a maximum value of 400 pounds per square foot.

Rakers

42. Rakers may be used to internally brace the soldier piles. The raker bracing could be supported laterally by temporary concrete footings (deadmen) or by the permanent interior footings. For design of temporary footings or deadmen, poured with the bearing surface normal to rakers inclined at 45 degrees, a bearing value of 4,000 pounds per square foot may be used, provided the shallowest point of the footing is at least one foot below the lowest adjacent grade.

Deflection

43. Some deflection of the shored embankment shall be anticipated. If excessive deflection occurs during construction, additional bracing may be necessary to minimize deflection. If desired to reduce the deflection of the shoring, a greater active pressure could be used in the shoring design. Monitoring of the performance of the shoring system is recommended. The monitoring shall consist of periodic surveying of the lateral and vertical locations of the tops of all the soldier piles. Also, some means of periodically checking the load on selected anchors may be necessary.
44. The geologist shall be present during grading to see temporary slopes. All excavations shall be stabilized within 30 days of initial excavation. Water shall not be allowed to pond on top of the excavations or to flow toward it. No vehicular surcharge shall be allowed within three feet of the top of the cut.

Floor Slabs, Decking and Paving

45. Concrete floor slabs and concrete decking shall be cast over bedrock or approved compacted fill and reinforced with a minimum of #4 bars on 16 inch centers, each way. Slabs which will be provided with a floor covering shall be protected by a polyethylene plastic vapor barrier. The

¹⁰ *Planking used especially for preventing cave-ins in earthwork or for supporting an arch during construction.*

barrier shall be covered with a thin layer of sand, about one inch, to prevent punctures and aid in the concrete cure.

- 46. Decking which caps a retaining wall shall be provided with a flexible joint to allow for the normal one to two percent deflection of the retaining wall. Decking which does not cap a retaining wall shall not be tied to the wall. The space between the wall and the deck will require periodic caulking to prevent moisture intrusion into the retaining wall backfill.
- 47. It shall be noted that cracking of concrete floor slabs is very common during curing. The cracking occurs because concrete shrinks as it dries. Crack control joints which are commonly used in exterior decking to control such cracking are normally not used in interior slabs. The reinforcement recommended above is intended to reduce cracking and its proper placement is critical to the slab's performance. The minor shrinkage cracks which often form in interior slabs generally do not present a problem when carpeting, linoleum, or wood floor coverings are used. The slab cracks can, however, lead to surface cracks in brittle floor coverings such as ceramic tile. A mortar bed or slip sheet is recommended between the slab and tile to limit, the potential for cracking.

Paving

- 48. Paving shall be placed over bedrock, terrace, or approved compacted fill. Base course shall be compacted to at least 95 percent of the maximum dry density. Trench backfill below paving shall be compacted to 90 percent of the maximum dry density. Irrigation water shall be prevented from migrating under paving. Table IV.D-3 shows the recommended pavement sections.

**Table IV.D-3
Recommended Pavement Sections**

Service	Pavement Thickness (Inches)	Base Course (inches)
Light Passenger Cars	3	4
Moderate Trucks (Storage, etc.)	4	6

Drainage

- 49. Roof gutters are recommended for the proposed structures. Pad and roof drainage shall be collected and transferred to the street or approved location in non-erosive drainage devices. Drainage shall not be allowed to pond on the pad or against any foundation or retaining wall.

Drainage shall not be allowed to flow uncontrolled over any descending slope. Planters located within retaining wall backfill shall be sealed to prevent moisture intrusion into the backfill. Planters located next to raised floor type construction shall be sealed to the depth of the footings. Drainage control devices require periodic cleaning, testing and maintenance to remain effective.

Waterproofing

50. Interior and exterior retaining walls are subject to moisture intrusion, seepage, and leakage and shall be waterproofed. Waterproofing paints, compounds, or sheeting can be effective if properly installed. Equally important is the use of a subdrain that daylight to the atmosphere. The subdrain shall be covered with 3/4 inch crushed gravel to help the collection of water. Yard areas above the wall shall be sealed or properly drained to prevent moisture contact with the wall or saturation of wall backfill.
51. Construction of raised floor buildings where the grade under the floor has been lowered for joist clearance can also lead to moisture problems. Surface moisture can seep through the footing and pond in the underfloor area. Positive drainage away from the footings, waterproofing the footings, compaction of trench backfill and subdrains can help to reduce moisture intrusion.

Plan Review

52. Formal plans ready for submittal to the Building Department shall be reviewed by The J. Byer Group. Any change in scope of the project may require additional work.

Site Observations During Construction

53. The Building Department requires that the geotechnical company provide site observations during construction. The observations include foundation excavations, tie-back excavations, shoring piles, keyways for fill, benching, and temporary slopes. All fill that is placed shall be tested for compaction and approved by the soils engineer prior to use for support of engineered structures. The City of Los Angeles requires that all retaining wall subdrains be observed by a representative of the geotechnical company and the City Inspector.
54. The J. Byer Group, Inc. shall be advised at least 24 hours prior to any required site visit. The agency approved plans and permits shall be at the jobsite and available to the J. Byer Group. The project consultant will perform the observation and post a notice at the jobsite of their visit and findings. This notice shall be given to the agency inspector.

Final Inspection

55. Final geologic and soils engineering reports shall be prepared upon completion of the grading and shall be approved by the City Department of Building and Safety.

Construction Site Maintenance

56. It is the responsibility of the contractor to maintain a safe construction site. When excavations exist on a site, the area shall be fenced and warning signs posted. All pile excavations must be properly covered and secured. Soil generated by foundation and subgrade excavations shall be either removed from the site or properly placed as a certified compacted fill. Soil must not be spilled over any descending slope. Workers shall not be allowed to enter any unshored trench excavations over five feet deep.

Department of Building and Safety, Grading Section Letter dated December 5, 2001

57. Prior to the recordation of the final map, a grading permit shall be obtained from the Department of Building and Safety.
58. Prior to issuance of a permit, the owners shall record a sworn affidavit with the Office of the County Recorder which attests to their knowledge that the western portion of the site (buildings 1 & 2) will still be bordered by active landslide on three sides after the completion of the development, and that they are aware of the potential for debris to collect behind the rear property line wall and the western property line wall, affecting the surface drain system, and that there is the potential for the landslide to remove support from the lower property line which could require the future construction of walls between the piles to provide support, and that the owner and future homeowners association agrees to assume the responsibility to keep the surface drain system behind the retaining walls clear of debris, to take responsibility for any future maintenance/repairs, and to inform all future owners of these conditions. The owner and future homeowners association shall provide proof of compliance with this mitigation measure to the Department of Building and Safety on an annual basis.
59. All existing landslide debris shall be removed and replaced as certified compacted fill, as recommended.
60. The following piles shall be designed for a minimum thrust, times pile spacing, as recommended:
- Piles P1 to P10 – 175 Kips
 - Piles P11 to P17 – decreasing from 175 to 145 Kips

- Piles P17 to P35 – 145 Kips
 - Piles P36 to P40 and all other pile supported retaining wall structures shall be designed for a minimum EFP of 65 PCF and 30 PCF, respectively, times pile spacing, as recommended.
61. Piles P1 through P40 shall be designed so that the deflection at the top of the piles is a maximum of 1 (one) inch as recommended.
 62. Pile supporting building 2 shall derive support from below the 1:1 set back plane projected up from the bottom of the fill along the southern property line. Also, the piles shall be embedded a minimum of 8 feet into bedrock or compacted fill, as recommended.
 63. The structures shall be supported entirely either on compacted fill or bedrock.
 64. Seismic design shall be based on Soil Profile Type Sc, as recommended.
 65. A shoring monitoring program shall be implemented to the satisfaction of the soils engineer.
 66. The soils engineer shall review and approve the shoring plans prior to issuance of the permit. Installation of shoring shall be performed under the continuous inspection and approval of the soils engineer.
 67. Pile shafts shall be designed for a lateral load of 1000 pounds per linear foot of shaft exposed to the existing fill, soil and weathered bedrock. Friction piles supporting the portion of building 2, shall be designed for a minimum of 5 kips creep, with a point of application at the ground surface, as recommended.
 68. The pile excavations shall be logged by the geologist to verify that the geologic conditions are not different than presented in the reports; the data shall be submitted to the Department prior to beginning the grading of the landslide.
 69. All friction pile drilling and installation shall be performed under the continuous inspection and approval of the soils engineer.
 70. The grading of the landslide shall not begin until it is verified that groundwater levels are below the bottom of the landslide. Additionally, the grading of the landslide shall not begin unless there is adequate time to complete the grading before the start of the rainy season.
 71. A minimum of ten feet of freeboard shall be provided along the northern property line, above soldier pile Nos. P17 to P29; the freeboard shall be designed for a minimum EFP of 65 pcf, as recommended. The freeboard shall also be extended along the western property line.

72. Prior to the issuance of any permit which authorizes an excavation where the excavation is to be of a greater depth than are the walls or foundation of any adjoining building or structure and located closer to the property line than the depth of the excavation, the owner of the subject site shall provide the Department with evidence that the adjacent property owner has been given a 30-day written notice of such intent to make an excavation.
73. A registered grading deputy inspector approved by and responsible to the project geotechnical engineer shall be required to provide continuous inspection for the proposed shoring at least once a week.
74. Tie-backs are currently not proposed or approved.
75. Subdrain systems shall be installed between the soldier piles in the landslide and along the bottom of the landslide removal. A minimum of three continuous drains shall be provided beneath the proposed fill, as shown on the cross-sections in the reports and a continuous drain shall be provided at the bottom of the fill along the western property line. The water from the subdrain systems shall be conducted by gravity flow to an acceptable location at Castellammare Drive.
76. The 20-foot-wide strip of the property that extends up from Castellammare Drive shall be stabilized, as recommended in the reports.
77. All new slopes shall be no steeper than 2:1.
78. Adequate temporary erosion control devices acceptable to the Department, and if applicable the Department of Public Works, shall be provided and maintained during the rainy season.
79. All recommendations of the reports dated 08/16/00, 11/29/00, 06/29/01, 08/28/01 and 10/02/01, prepared by Jon Irvine (CEG 1691, RCE 55005) of the J. Byer Group, which are in addition or more restrictive than the conditions contained herein shall be incorporated into the plans.
80. The applicant is advised that the approval of this report does not waive the requirements for excavations contained in the State Construction Safety Orders enforced by the State Division of Industrial Safety.
81. A grading permit shall be secured and a grading bond posted.
82. A copy of the subject and appropriate referenced reports and this approval letter shall be attached to the District Office and field set of plans. Submit one copy of the above reports to the Building Department Plan Checker prior to issuance of the permit.

83. The geologist and soil engineer shall inspect all excavations to determine that conditions anticipated in the report have been encountered and to provide recommendations for the correction of hazards found during grading.
84. Any recommendations prepared by the consulting geologist and/or the soils engineer for correction of geological hazards found during grading shall be submitted to the Department for approval prior to utilization in the field.
85. All man-made fill shall be compacted to a minimum 90 percent of the maximum dry density of the fill material per the latest version of ASTM D 1557; or 95 percent where less than 15 percent fines passes 0.005mm.
86. Existing uncertified fill shall not be used for support of footings, concrete slabs or new fill.
87. All roof and pad drainage shall be conducted to the street in an acceptable manner.
88. Retaining walls shall be designed for a minimum EFP as specified on page 28 of the report dated 08/16/2000.
89. All retaining walls shall be provided with a standard surface backdrain system and all drainage shall be conducted to the street in an acceptable manner and in a non-erosive device.
90. Prior to issuance of the building permit, the design of the subdrainage system required to prevent possible hydrostatic pressure behind retaining walls shall be approved by the soils engineer and accepted by the Department. Installation of the subdrainage system shall be inspected and approved by the soils engineer and by the City grading inspector.
91. Footings adjacent to a descending slope steeper than 3:1 in gradient shall be located a distance of one-third the vertical height of the slope but need not exceed 40 feet measured horizontally from the face of the slope.
92. Buildings adjacent to ascending slopes shall be set back from the toe of the slope a level distance equal to one half the vertical height of the slope, but need not exceed 15 feet in accordance with Code Section 91.1806.5.2.
93. Pile caisson and/or isolated foundation ties are required by Code Section 91.1807.2. Exceptions and medication to this requirement are provided in Rule of General Application 662.
94. For grading involving import or export of more than 1000 cubic yards of earth materials within the grading hillside area, approval is required by the Board of Building and Safety. Application

for approval of the haul route must be filed with the Grading Section. Processing time for application is approximately 8 weeks to hearing plus 10-day appeal period.

95. Prior to the placing of compacted fill, a representative of the consulting Soils Engineer shall inspect and approve the bottom excavations. He shall post a notice on the job site for the City Grading Inspector and the Contractor stating that the soil inspected meets the conditions of the report, but that no fill shall be placed until the City Grading Inspector has also inspected and approved the bottom excavations. A written certification to this effect shall be filed with the Department upon completion of the work. The fill shall be placed under the inspection and approval of the Foundation Engineer. A compaction report shall be submitted to the Department upon completion of the compaction.
96. The consulting geologist shall periodically inspect the grading and upon completion submit a final report stating that the completed work complies with his recommendations. Geological data shall be obtained from grading exposure, particularly at back slope cuts for fills and buttress and on cut surfaces. This data shall be presented on a final geological map and as-graded plan.
97. Prior to the pouring of concrete, a representative of the consulting Soil Engineer shall inspect and approve the footing excavations. He shall post a notice on the job site for the City Building Inspector and the Contractor stating that the work so inspected meets the conditions of the report, but that no concrete shall be poured until the City Building Inspector has also inspected and approved the footing excavations. A written certification to this effect shall be filed with the Department upon completion of the work.
98. When water over 3 inches in depth is present in drilled pile holes, a concrete mix with a strength p.s.i. of 1000 over the design p.s.i. shall be tremied from the bottom up; an admixture that reduces the problem of segregation of paste/aggregates and dilution of paste shall be included.
99. The dwellings shall be connected to the public sewer system.
100. Prior to excavation, an initial inspection shall be called at which time sequence of shoring, protection fences, and dust and traffic control will be scheduled.

LEVEL OF SIGNIFICANCE AFTER MITIGATION

After incorporation of the mitigation measures listed above, impacts related to geology and soils would be less than significant.