Appendix E

Preliminary Geotechnical Investigation

PRELIMINARY GEOTECHNICAL STUDY
PROPOSED WALPERT STREET CONDOMINIUM PROJECT
SE OF WALPERT AND 2ND STREETS
HAYWARD, CALIFORNIA

FOR

AMG & ASSOCIATES, LLC

Project No. GA-109/G319-01

JULY 11, 2014

PRA Group
CONSULTING ENGINEERS

No. GA-109/G319-01
July 11, 2014

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SUBJECT: **PRELIMINARY GEOTECHNICAL STUDY**
Proposed Walpert Street Condominium Development
SE Walpert and 2nd Streets
Hayward, California

Mr. Broussard:

In accordance with your request, we have completed our Preliminary Geotechnical Study for the above subject site located southeast of the intersection of Walpert and 2nd Streets, in Hayward, California (See Figure 1, Site Location Map). It is our understanding that it is proposed to develop a condominium complex on approximately 34.6 acres for development at the subject site (Figure 3, Site Plan). Access for this development will be via Walpert Street at the north and a new road that will be constructed through the site that will connect with an existing court off 2nd Street at the south end of the site.

The purpose of this study is to provide a preliminary evaluation of geotechnical and soil engineering conditions at the subject site associated with the proposed development. Geotechnical issues reviewed at this site include undocumented fill placement, erosion, expansive soils, soil creep, potential presence of naturally occurring asbestos, and slope stability from cut and fill slopes to be constructed as part of the proposed development. Based upon this preliminary review, it would appear that these geotechnical conditions can be mitigated through proper planning and engineering, with preliminary recommendations for site development provided for initial planning purposes. Due to the extensive grading proposed for this project, and the potential for encountering naturally occurring asbestos, it is recommended that a Phase 2 Geotechnical Study be performed for this site, that includes exploratory borings located in cut and fill zones.

We refer you to the text of this report for a detailed discussion of our preliminary geotechnical evaluation of the subject property based upon our investigations to date. If you have any questions or if we may be of further service, please contact the undersigned.

Very truly yours,
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G31901.1

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PURPOSE

This report provides an evaluation of potential geologic hazards to the site and preliminary information regarding the geotechnical hazards and soil conditions that may impact the proposed development. Based upon the site conditions encountered in this preliminary geotechnical investigation, a supplemental subsurface investigation and engineering analysis will be required based upon the site specific development plan. The recommendations section of this report provides preliminary soil engineering and foundations recommendations appropriate for initial site design planning purposes.

SCOPE

The scope of this investigation entailed a review of the available literature, including soil and geologic maps and reports, aerial photographic analysis, a site reconnaissance including field mapping, telephone conversations with City of Hayward personnel from the planning and public works departments, and the excavation of 11 exploratory test pits. Soil samples were obtained for laboratory testing and classification purposes.

SITE LOCATION

The project site is located southeast of the intersection of Walpert Street and 2nd Street in Hayward, California (see Figure 1, Site Location Map). The site is bordered by Walpert Street along the northwest site limits and 2nd Street along the northeastern site limits. Residential units that also front 2nd Street are adjacent to the site along the northeastern side. Two municipal water tanks are adjacent to the site just southwest of the northwest corner, and Ward Creek borders the site along the sites' southern limits.

SITE DESCRIPTION

The site is an irregularly shaped parcel, with topography of the site generally hilly with slopes ranging from slight to moderate for the majority of the site, to very steep along the Ward Creek embankment following the southern limits of the property (see Figure 2, Site Aerial Photo and Test Pit Locations, and Figure 3, Site Plan). Access to the site is presently available from 2nd Street. Based upon preliminary grading plans submitted to this office, it is proposed to construct a new access road through the site connecting Walpert Street at the north to an existing court leading to 2nd Street at the south.

EXISTING SITE CONDITIONS

At the time of our initial field investigation, the majority of the site was undeveloped, save for an existing single-family structure fronting Walpert Street at the northwest corner of the property. The structure is indicated with an **H** on Figure 4 City of Hayward Web Site Photo, and is indicated on the City of Hayward web site as being a historic structure. In review of a 1946 aerial photograph, this structure was one of several that were formerly located in this northwest corner area. A 1980 aerial photograph still showed those structures, but a 1987 aerial photograph only shows the single structure that currently exists.

Additional features noted during our field investigation were:

1. A single, vertical, blue-green colored PVC pipe just downslope of the top of slope just south of the southern-most water tank off Walpert Street at the northwest corner area. This pipe may be related to the drainage discharge from the water tank area.

2. An existing water line traverses the site from the southern water tank to 2nd Street. See Figure 2 and Figure 4 for the approximate location of this line.

3. A sewer man hole cover for the existing sanitary sewer line that traverses the top of bank area along the southern portion of the site. See Figure 4, Hayward Web Site Photo, for approximate location of this line.

4. At the southeastern portion of the site, there is an area that had been excavated to remove the surface colluvial material and expose the underlying bedrock. In review of a 1968 aerial photograph, it is apparent that grading has occurred both in this area, and to the west. The approximate limits of this grading is indicated on Figure 2. The purpose of this grading is unknown. In the area of Test Pit 6 on Figure 2, the area appears to be graded to create a pad with boulders of very hard rock on the perimeter of this pad. The test pit indicates a shallow fill cover overlying a hard bedrock material. Topographically, this area is still a drainage swale, and fill may have been placed in the swale to create this level pad. It was also noted during our field reconnaissance that down slope of this pad area there is concrete rubble and rock boulders placed on the slope. There is a small drainage chute that continues down slope from this debris fill area to the alluvial plain of Ward Creek.

FIELD EXPLORATION

Eleven exploratory test pits were excavated at the subject parcel on May 28, 2014, at the locations shown on Figure 2. The test pits were excavated with a track-mounted Bobcat-excavator, using an 18-inch wide bucket. The logs of tests pits 1 through 11 are presented in Figures 9 through 19.

The exploratory backhoe pits and trenches were excavated and logged by a representative of this office, in order to visually evaluate and sample the subsurface soils and bedrock at this site. Field classification of soils and rock units were verified in the laboratory after further examination of the samples.

Soil samples were obtained by manually driving a 2.5-inch diameter portable sampler with repeated blows of a slide hammer. Soil samples were logged in the field, labeled, and submitted to the laboratory for testing.

LABORATORY TESTING

Laboratory testing was conducted on selected samples to obtain data on density, moisture content, unconfined compressive strength, Atterberg Limits, and classification of the soil. Test results are shown on the Exploratory Test Pit Logs. One bulk sample was obtained from Test Pit 3 of the surface soils for the purpose of testing for corrosion potential. This sample was submitted to Cerco Analytical for the determination of pH, minimum resistivity, chlorides and sulfate concentration. The results of the corrosion testing are presented with the Cerco report in Appendix A of this report.

GENERAL GEOLOGY

The subject site is located within the Front Hills of Robinson (1956). This series of hills is bounded on the east by the East Chabot fault and on the west by the Hayward fault. This mile-wide belt of Jurassic, Cretaceous and Quaternary deposits dominate the site. In the regional area of the site, the Robinson mapped Jurassic rocks that include an intrusive gabbro and serpentine, and the Knoxville Formation consisting of marine sedimentary material, and in localized areas, talc-chlorite schist and glaucophane bearing rocks. The Cretaceous rocks include Oakland conglomerate terrestrial alluvial materials and Chico Formation marine sedimentary material. The Quaternary deposits include Leona rhyolite and undifferentiated alluvial and colluvial deposits.

The Knoxville Formation and unnamed gabbro and serpentine rocks in the area of the site have been strongly deformed into a series of northwest-trending lithic belts which are subparallel to the Hayward and East Chabot faults (see Figure 5, Robinson Geology Map).

At the site area, the bedrock units are overlain by an old alluvial cover of Pleistocene age consisting of low-dipping beds of poorly consolidated gravels that contain fragments of older bedrock material. These gravel deposits occurs in thin patches on hilltops and on vaguely defined benches and are deeply eroded. At this site, the rounded gravels are intermixed within a dark yellow brown silty clay matrix. A sample of the silty clay was tested for Atterberg Limits and determined to have a Liquid Limit of 65 and a Plasticity Index of 45, which would be considered highly expansive.

Three different geological workers mapped the regional area. The mapping in the site area from these three workers is presented in Figure 5:Robinson (1956); Figure 6: Dibblee (1980); and Figure 7: Graymer and others (1995). These three maps are generally consistent of the type of bedrock units present in the site area. Robinson (Figure 5) shows a reduced amount of the gravel cover, and has the gabbro and serpentine unit in fault contact with the Knoxville Formation traversing the general middle of the site. The fault contact is described as the West Chabot fault. The fault contact is presented in a different location, farther northeastward in the mapping of Dibblee (Figure 6) and Graymer et al (1995). The Dibblee map shows the fault contact as perhaps traversing the eastern and southeastern portion of the site, while Graymer et al shows the fault contact as not crossing the site. Seismically, the West Chabot fault is not considered active by the California Geological Survey. A trace of the West Chabot fault (included within what was described as the Carlos Bee fault zone) was studied for the South Reservoir site in Castro Valley. Based upon bedrock outcrops found in the South Reservoir study, the fault zone exhibited both reverse or normal offset with an unknown amount of strike-slip offset, and because the fault zone occurs entirely within Jurassic and early Cretaceous bedrock, the sense of offset and constraints on timing of deformation are poor (ESA Consultants/William Lettis & Associates, 1996). The South Reservoir study stated, "...unfaulted middle to late Pleistocene gravel deposits extend across the coalescent fault zone in the hills south of San Lorenzo Creek" (the subject site), and concluded, based upon their studies that the

Carlos Bee fault zone has not moved during the past 35,000 years and is inactive according to Division of Safety of Dams.

The Hayward fault zone is located approximately 1,000 feet southwest of the site, and is the nearest fault considered active by the State of California. The site is outside of the Special Studies Zone designated for this fault, which is comprised of a set of northwest-trending fault traces along the western front of the East Bay hills and is part of the San Andreas fault system. The Holocene active Hayward fault zone extends approximately 51 miles from San Pablo Bay in the north to the hills southeast of San Jose, where it joins the Calaveras fault zone. The Hayward fault is a right-lateral, strike-slip fault distinguished by active creep and strong geomorphic expression, including off-set streams, sag ponds, and other fault-produced topographic features (Lienkaemper, 1992).

The Hayward fault has documented Holocene activity based on geomorphic, geologic and seismologic (microseismicity) evidence (Ellsworth and others, 1982), historic surface rupture (Lawson, 1908), and fault creep (Lienkaemper, 1992). The Hayward fault produced large historic earthquakes in 1836(?) and 1868 and is currently considered to be the most probable source of a major earthquake in the San Francisco Bay area (WGCEP,2008).

The fault traces within the Hayward fault zone are designated as Special Studies Zones faults, with the fault zone indicated in yellow on Figure 8, Earthquake Zones of Required Investigation. This same figure shows that the site's southern embankment adjacent to Ward Creek is within a zone designated as having a potential for earthquake-induced landslides. Because of this designation, supplemental subsurface investigations will be needed once the final plan and building layout is completed in order to evaluate the potential for earthquake-induced landslides.

A second type of fault movement called "seismic creep" is taking place continuously in intermittent pulses along the Hayward fault zone at the present time (Radbruch and others, 1966). This movement has been measured at rates of approximately 0.2 to 0.3 inch per year (Lienkaeper, 1992). The cumulative effect of seismic creep can cause major structural distress to buildings, streets and utilities located across the fault creep zone.

SEISMICITY

The following description of the San Andreas fault system is derived from William Cotton and Associates (April, 1985), and applies to the Hayward and Calaveras fault systems as well:

> Movement along faults of the San Andreas fault system is generated by global forces shearing the eastern margin of the Pacific plate along the western margin of the North American plate. Movement between these two very large crustal plates has been going on in this region of California for about 5 million years, and appears to be averaging, at present, about two inches per year. In the Bay Area, this crustal movement does not proceed as uniform annual displacement along the faults, but instead the forces driving the plates elastically deform the rocks adjacent to the faults until the rocks finally rupture and produce fault displacements. The largest historic displacement was measured to be 20 feet in length in Marin County after the great earthquake of 1906. The sudden release of elastic strain energy that accompanies fault rupture is what causes the ground to shake....

The subject property, like all properties in the San Francisco Bay Area, is situated in a very seismically active region. The following statements summarize the potential impacts of the seismic setting upon development of the subject property.

Based on an analysis of the historic earthquake records of the active faults, published and unpublished data on potentially active faults and the geographic relationship between the subject property and the faults of the San Francisco Bay region, it is reasonable to conclude that the major Bay area fault systems have the greatest potential for adversely

impacting the proposed development. A list of pertinent active faults, their distance, expected moment magnitude, and estimated peak ground acceleration (PGA*) is provided below:

Fault	Maximum Moment Magnitude	Distance, miles	PGA*
Hayward	6.5	0.12	0.33
Calaveras	6.9	7.8	0.21
Concord - Green Valley	6.7	16.0	0.11
San Andreas	7.2	18.5	0.13
Greenville	6.9	18.6	0.11
Monte Vista-Shannon	6.8	18.7	0.11
San Gregorio	7.4	25.5	0.11
Rodgers Creek	7.0	32.5	0.07
W. Napa	6.5	35.5	0.06

*PGA is the peak horizontal ground acceleration as a fraction of gravity, determined from the Shake2000 program using the attenuation method of Boore, Joyner, and Fumal (1997).

A coalition of scientists from the U. S. Geological Survey, Southern California Earthquake Center, and the California Geological Survey prepared the Uniform California Earthquake Rupture Forecast (2008). Data presented by this group estimates the chance of one or more large earthquakes (Magnitude 6.7 or greater) in the San Francisco Bay region within the 30 year time period between 2007 and 2036 to be approximately 63 percent. In that same time period, the chance for a magnitude 6.7 or greater earthquake on the Concord-Green Valley, Rodgers Creek - Hayward, and San Andreas faults is 3, 31, and 21 percent, respectively.

Ground Shaking

The effects of seismically-induced ground shaking at the subject property resulting from a large magnitude (6.0 or greater) earthquake on any major fault within the San Francisco

Bay region can be estimated from accounts of the effects which were described shortly after the 1906 earthquake, magnitude 8.3 with an epicenter located between San Francisco and Marin Counties. Studies by Lawson (1908) and Borcherdt, et al (1975) indicate that the highest ground shaking intensities (i.e., very violent) occur within 1500 to 2000 feet of the master trace of the San Andreas fault, and that violent ground shaking generally occurs at sites that are within 1 mile of the master trace. Furthermore, sites situated between 1 and 3 miles of the master trace would likely experience very strong ground shaking intensities. In the event of a large magnitude earthquake on the Hayward fault zone, it is reasonable to assume that the subject property will experience very violent to very strong levels of ground shaking. It should be emphasized that this estimate is based on a small number of field observations in a region that was sparsely populated in 1906.

Since these are estimates, and they are based on a small amount of data, they should be used as a general guide to reflect future ground shaking intensities. Nevertheless, we believe that it is reasonable to conclude that any structures constructed on the subject property should be expected to experience very violent to very strong ground shaking.

The California Division of Mines and Geology prepared an earthquake planning scenario for a magnitude 7.5 earthquake on the Hayward fault (CDMG, 1987). The scenario was postulated on a 7.5 magnitude earthquake simultaneously rupturing the entire 62 mile length of the Hayward fault with ground shaking lasting for 25-35 seconds duration, with the zone of faulting varying between a few meters and 100 meters (330 feet). Total right lateral displacement along the fault was postulated as reaching a maximum of 10 feet, with the average displacement about 5 feet. The offset would likely be distributed over more than one shear plane, in a fault zone 10 to 20 feet wide. Vertical displacements along the fault would be expected to be minor and of limited extent. The postulated scenario was

set to occur during the Spring when saturated ground conditions increase the propensity for ground failures, notably seismically induced landslides.

The seismic intensity distribution for the above CDMG scenario indicated for the northwestern site area,

> "Damage considerable in structures (masonry) built especially to withstand earthquakes: threw out of plumb some wood-frame houses built especially to withstand earthquakes; great in substantial (masonry) buildings, some collapse in large part; or wholly shifted frame buildings off foundations, racked frames, underground pipes sometimes broken."

and for the majority of the site,

> "Damage negligible in buildings of good design and construction, slight to moderate in well-built ordinary buildings, considerable in poorly built or badly designed buildings...."

The scenario maps do not map the Ward Creek embankment as an, "area subject to seismically induced landsliding." The local building codes and current CBC recommendations reflect the design parameters for mitigation of earthquake conditions. The appropriate code should be utilized for minimum design standards based upon the particular features of the structure and the recommended minimum seismic load factors.

Ground Failure

Numerous large and small landslides were noted after the 1906 earthquake along the steep mountainous terrain within the Santa Cruz Mountains. Similar landslide activity has occurred all over the Bay area mountains in association with large magnitude earthquakes. Seismically-induced slope failure is considered to be a potential hazard for both natural and engineered slopes. Very strong seismic shaking within the regional area should be considered as a hazard in the form of a potential triggering mechanism for slope failure, ground subsidence and lateral spreading. These slope failures were described as "earth-

avalanches" (Lawson, 1908) which suggested that their mode of failure was rapid and most likely down steep slopes. It is anticipated that any potential for seismically-induced ground failures at the site will be confined to the steeper slope areas, such as the Ward Creek embankment. It should be noted that the Hayward Area Recreation District has a paved hiking trail on the south bank of Ward Creek, opposite from the subject site. This trail has extensive cut slopes within the bedrock units that are near vertical to heights of 15 to 20 feet.

The U.S. Geological Survey prepared a regional study for "Relative Slope Stability and Land-Use Planning", for the San Francisco Bay Region (USGS, 1989). Plate 3 of that study indicates a region that coincides with the steep Ward Creek embankment as within Category 4, "Moderately Unstable", in "Areas of greater than 15 percent slope that are underlain by bedrock units susceptible to landsliding but not underlain by landslide deposits.

A 2000 study by Sebastian Roberts and others based upon the air photo interpretation of T. H. Nilsen does not map any landslides at the site area. A study by the California Geological Survey (Majmundar, 1996) indicates the presence of an earthflow in the drainage swale at the southwestern portion of the site up slope of Ward Creek. As can be seen in Figure 8A, Area Landslide Map, this mapped earthflow extends into the previously described anomalous flat area that may have resulted from grading.

Slope Stability Issues

Due to the grading proposed for this site, the two primary slope stability issues are related to the stability of the main cut-slope adjacent to the existing residences fronting 2nd Street, and fill-slope stability of the fill that is proposed to be placed above the Ward Creek embankment. Based upon the present findings of this study, it is not known what bedrock

unit will be exposed within the proposed cut slopes at the eastern portion of the site. There is even a possibility that the cut slope will expose the fault contact between the gabbro and diabase units and the sedimentary units of the Knoxville Formation.

There are no existing cut-slopes that would expose bedding structure, and intrusive diabase-gabbro bedrock at this site varies considerably in color variation, texture and strength. Some sections of these rocks may be extremely hard and difficult to excavate, while other sections may be intensely fractured and friable. Seepage has often been associated with these fractured ultramafic rocks, which also creates increased potential for slope stability problems, where seepage is not controlled by subdrains.

Therefore, a Certified Engineering Geologist of this office must be present during grading operations to observe all cut-slopes and keyway excavations. Supplemental recommendations may be required, including over-excavation, removal and replacement with an engineered buttress fill.

Fill slopes will require a keyway to support the proposed fill. In the event adverse soil and/or bedrock conditions are encountered, a deeper and wider keyway may be required to provide sufficient strength to resist the fill slope movement. The diabase-gabbro bedrock that will be encountered in the keyway for the fill construction at the southwestern portion of the property may need a wider than a typical keyway width to provide a stable base for fill support.

AERIAL PHOTOGRAPH REVIEW

The website, NETR Online was reviewed for historic aerial photographs to review past site conditions. The oldest aerial photograph available for on-line review at this site was 1946. This photo showed the northwest corner of the site was developed with what appears to

be several single-family residences. This photograph also shows that an orchard was presented between the dwellings along Walpert Street and the water tank closest to Walpert Street. This photo also shows a few of the residential dwellings fronting 2nd Street at the central eastern portion of the site, and that an extensive orchard had existed downslope of these residences upon the subject site.

A 1958 aerial photograph shows that the majority of the orchards were no longer present at the site. As previously mentioned in this report, a 1968 aerial photograph shows an area of ground disturbed by grading at the southeastern portion of the property. In all of the years reviewed, the area of the Ward Creek embankment along the site area was not viewable due to the extensive vegetation present.

SUBSURFACE SOIL CONDITIONS

The information obtained from our exploratory test pits and field mapping determined that the site is covered by an old alluvial layer, and underlain at shallow depth by a diabase bedrock. All of the test pits encountered the old alluvium layer, but not all of the test pits penetrated into the underlying bedrock. The alluvial layer consisted of predominantly of a combination of sand and silt with some interbeds of clay, and intermixed with rounded clasts of rock. In some locations, the test pits were excavated to a depth of approximately 8.5 feet below existing grade without encountering the underlying bedrock. Soil samples obtained from the test pits determined this alluvial zone had a dry density of 90 to 100 pounds per cubic foot (pcf) and an in-place moisture content ranging from 10 to 20 percent. A sample of the clay encountered in the test pit T-3 was tested for Atterberg Limits and determined a Liquid Limit of 65 and a Plasticity Index of 45, which would be considered in high to very high in expansion potential. In general, this stiff to very stiff alluvial layer had pocket penetrometer tests of 4.5+ tons per square foot.

Based upon published maps, field mapping and exposures in the test pit excavations, the predominant bedrock type expected beneath the alluvial layer is a diabase bedrock. This material is considered an ultrabasic rock and as such considered as having a potential for naturally occurring asbestos. Supplemental subsurface investigations and sampling will be needed to obtain samples of this bedrock material for testing for potential asbestos content. Outcrops of the diabase bedrock are present at the southeastern portion of the site in the area of past grading, and along the Ward Creek embankment.

Published mapping indicates that the diabase bedrock found at this site is in fault contact with sandstone, siltstone and shale of the Knoxville Formation. The fault contact is along the West Chabot fault, which is variously mapped by others as either crossing through the site, or lying northeastward of the site. None of the test pits encountered in the locations excavated, sedimentary rock of the Knoxville Formation.

For further description of the materials encountered in the test pits, please refer to the logs of test pits 1 through 11 found in Figures 9 through 19. The laboratory test results are also provided with the logs of test pits.

NATURALLY OCCURRING ASBESTOS

In 1986, the Air Resources Board (ARB) identified asbestos as a toxic air contaminant (TAC) based on its classification as a known cancer causing pollutant. Regulations were promulgated that related to the demolition or renovation of structures that contained asbestos containing materials. Subsequently, Regulation 11, Rule 14 was adopted by the Bay Area Air Quality Management District (BAAQMD) to control emissions of naturally-occurring asbestos from unpaved road surfaces and other surfacing operations. The ARB amended these regulations by issuance of an Asbestos Airborne Toxic Control Measure (ATCM) for Surfacing Applications (Section 93106, effective date 11/13/01). A

Implementation Guidance Document for the Asbestos Airborne Toxic Control Measure for Surfacing Applications was published in July 2002. These regulations reduced the allowable asbestos content in materials used for surfacing applications from 5 percent to 0.25 percent. Additionally, this section provides for reporting and record-keeping requirements with respect to those that sell, supply or offer to sell and supply restricted material. A restricted material by this regulation is either material extracted from a property where any portion of the property is located in a geographic ultramafic rock unit as mapped by the Department of Conservation, Division of Mines; or material not in a geographically mapped ultramafic rock unit, but determined to be an ultramafic rock unit or tested to have an asbestos content equal to or greater than 0.25 percent.

The California Air Resources Board identifies asbestos in the form of chrysotile, crocidolite, amosite, fibrous tremolite, fibrous actinolite and fibrous anthophyllite as toxic air contaminant. No safe asbestos exposure limit has been established for residential areas by CalEPA or the Bay Area Air Quality Management Division (BAAQMD). BAAQMD requires mitigation for any material found to exceed 0.25%, as outlined in CCR Title 17, Section 93106. CCR Title 17, Section 93105 describes measures to mitigate airborne asbestos dust required by sites found to contain naturally occurring asbestos

There are also regulations and ATCM for Construction, Grading, Quarrying, and Surface Mining Operations (Section 93105). These regulations apply to construction, grading, quarrying, and surface mining operations in areas identified as geographic ultramafic rock units on maps developed by the Department of Conservation (DOC), Division of Mines and Geology. The regulation promotes statewide consistency in control requirements and compliance. Large construction projects (over 1 acre disturbed area) will be required to prepare a dust mitigation plan and receive approval from the local district prior to the start of the project. The plan must specify measures that will be taken to ensure that no visible dust crosses the property line and must address control of emissions from: track-out,

disturbed surface areas, storage piles, on-site vehicle traffic, off-site transport of material, and earthmoving activities. The plan must also address post-construction stabilization and air monitoring (if required by the district). Table 1 shows control options for the topics to be addressed in the asbestos dust mitigation plan for large construction projects. Many of these requirements would already be carried out by such projects to minimize nuisance dust complaints and protect water quality.

Table 1 Dust Mitigation Options for Large Construction Projects

Emission Sources	**Dust Mitigation Options**
Track-out	• Gravel pad • Grizzly • Wheel wash system • Wet sweeping • HEPA filter system
Disturbed surface areas and inactive storage piles	• Apply water • Maintain a crust • Apply dust suppressants or chemical stabilizers • Cover with tarps or vegetative cover • Install wind barriers
Traffic on unpaved on-site roads	• Restrict vehicles to 15 MPH or less • Keep roads adequately wetted • Apply dust suppressants • Cover with non-asbestos gravel
Active storage piles	• Keep wet • Cover with tarps
Earthmoving activities	• Pre-wet to depth of cuts • Suspend grading when winds are high • Apply water
Off-site transport of material	• Ensure trucks are maintained such that no spillage can occur from holes or other openings in cargo compartments • Ensure that loads are wet and tarped or wet and loaded with 6 inches of freeboard

Post-construction disturbed areas	• Establish and maintain a vegetative cover • Cover with at least 3 inches of non-asbestos material • Pave

The site area has been mapped as having ultrabasic rock and the bedrock exposures were determined to be diabase, a form of ultrabasic rock. Laboratory testing of soil and rock samples will be needed to determine if naturally-occurring asbestos is present in excess of 0.25 percent. Select grading would be needed to locate ultramafic rocks if found to contain naturally-occurring asbestos materials at a minimum of 12 inches below top of road subgrade and a minimum of 3 feet below building pad grade. An asbestos dust mitigation plan may be needed for submittal to the local air district for approval prior to the commencement of grading activities. A disclosure form for notification of prospective home buyers of the potential for the presence of naturally-occurring asbestos may also be required.

DISCUSSION

The field mapping, subsurface exploration and geotechnical explorations of adjoining sites show that the geology of the site region is complicated by the geologically historic movements of the proto-Hayward fault system and intrusive nature of the diabase/gabbro. The majority of the site is underlain by a diabase-gabbro bedrock. In contact with this diabase-gabbro is the sedimentary Knoxville formation. In many cases, the diabase-gabbro bedrock appears to form intrusive relationships with surrounding rock units. These bedrock fault contacts likely represent pre-Hayward fault movements, such as those related to the Chabot fault system of faults.

The diabase-gabbro bedrock is a highly variable rock type in its degree of hardness and is susceptible to seepage zones and slope instability. The proposed conceptual grading plan is in development, but generally indicates it is proposed to perform grading that will result in large (30 foot) cuts on the uphill northeastern portions of the property and on the order of 30 foot fills placed at the southwestern portion of the site adjacent to the steep Ward Creek embankment. Areas of cut within this bedrock type will likely require subexcavation and replacement with compacted engineered fill. Fill areas to be located within this bedrock must be evaluated by both the Geotechnical Engineer and the Certified Engineering Geologist of PRAG in order to determine the extent of subexcavation and the depth of keyways to support the proposed fill areas.

Due to the intrusive nature of the bedrock, geologic relationships that have previously not been identified may become known that will require significant modification of the development plan. Heretofore unrecognized fault relationships may become exposed that require supplemental investigations that may result in new building restriction zones. Significant buttress fills and subsurface drainage facilities will likely be required to prepare the site for development, dependent upon the final plan.

A representative of this office must review final grading plans and foundation designs in order to supplement the general geotechnical recommendations of this preliminary report, and the required subsequent supplemental geotechnical study.

During site grading, a representative of this office must observe all grading operations in order to verify site operations, perform field density compaction tests as needed, and to provide supplemental recommendations as subsurface conditions are encountered. During grading operations, a Certified Engineering Geologist must be present to observe all keyways and cut-slopes for evaluation of exposed geologic conditions.

While the site is not underlain by a mapped active trace of the Hayward fault zone, its close proximity means the site could be subject to severe ground shaking in the event of a near-source earthquake. The southern limits of the site that include the steep Ward Creek embankment is within a State zone requiring an evaluation for the potential for earthquake-induced landslides. This study will require a supplemental geotechnical investigation that will obtain subsurface samples of the soil and bedrock for laboratory testing to determine shear strength parameters for consideration in slope stability review.

The presence of ultrabasic rock at this site indicates the potential for naturally occurring asbestos. The grading of sites containing NOA is regulated by the Bay Area Air Quality Board. A supplemental investigation will be required to obtain samples of soil and rock for testing of asbestos content. Borings will be needed to obtain samples from the depth of anticipated cut slopes.

CONCLUSIONS

The following conclusions are based on the results of this preliminary review of subsurface conditions.

1. It is our opinion that based upon the information obtained to date, the development of the project site for the proposed condominium complex is feasible from a geotechnical engineering standpoint, provided that the recommendations of this report and the required supplemental geotechnical study are incorporated into the planning, design and construction of the project.

2. The site is not within a State zone for potentially active faults. Seismically induced ground shaking with minor to moderate structural damage may occur within the economic life of the development. The Ward Creek embankment along the southern limits of the site lies within a State mapped zone requiring supplemental investigation to determine the potential for earthquake-induced slope movement.

3. Our preliminary subsurface exploration and observations indicate that the surface soils at this site are variable in expansion potential with some clay soil tested as having a high to very high expansion potential.

4. Due to the variable nature and the potential for differential expansive soil encountered at the site, it is our opinion that the finished lots will be inspected by a Geotechnical Engineer to classify each lot as to the expansive condition of the soils within the foundation area of the structure. For lots classified as expansive, we conclude that the proposed structures must be supported on a structural mat slab foundation system.

5. Due to the presence of shallow bedrock, it is our opinion that no liquefaction hazard exists at the project site

6. Creep movement of soil on steep slopes will occur due to the natural tendency of the soil to shrink and swell with seasonal moisture changes. This hazard can be reduced by following prudent building practices and strictly implementing geotechnical recommendations to be provided by this office.

7. The site is underlain by fractured, and highly weathered diabase bedrock that would be expected to vary in strength from extremely hard to soft and clay-like. The intrusive nature of the bedrock type precludes determination of bedding attitude, but the bedrock may be intensely fractured in localized areas. Due to the geologic history of the area, bedrock conditions may change over a short distance. An Engineering Geologist must evaluate all cut slopes and keyway excavations in order to observe exposed subsurface conditions and to provide supplemental recommendations as needed.

8. Based on observation of subsurface conditions made to date, the site will need extensive subsurface drainage controls in an attempt to reduce seepage within soils and bedrock and to install buttress keyways and engineered fills to provide support to the hillside slopes.

9. Due to the presence of ultramafic rocks (diabase) the site will require supplemental sampling of soil and bedrock for determination of asbestos content and may be subject to regulations pertaining to naturally-occurring asbestos materials.

PRELIMINARY RECOMMENDATIONS

The following recommendations are provided for preliminary planning purposes. Supplemental subsurface investigations that include test borings, laboratory testing and engineering analyses will be required based upon the final grading and building layout scheme. The following preliminary recommendations are to be used for planning purposes and may be modified as subsurface conditions are exposed during the supplemental investigation and during grading operations at the time of site development.

Geotechnical Hazards

Risk of geotechnical hazards will always exist due to uncertainties of geologic conditions and the unpredictability of seismic activity in the Bay Area. However, in our opinion, based on available data reviewed to date, there are no indications of geotechnical hazards that would preclude use of the site for the proposed development, provided the recommendations provided in this report and the required supplemental geologic and geotechnical evaluations prior to site development are incorporated into the planning, design and construction of the project. We reserve the right to modify our opinions based upon new or additional information obtained the required supplemental subsurface investigation or observations made during grading operations for site development.

CBC Seismic Parameters

We have reviewed the California Building Code (CBC) and our files to provide seismic shaking criteria for your structural engineer's consideration in the foundation design of the proposed development.

SEISMIC CRITERIA	VALUE
Site Class	C
Peak Ground Acceleration (2% probability in 50 years)	1.1989g
S_s Short Period 0.2-second Spectral Acceleration	2.477g
S_1 1.0 Second Spectral Acceleration	1.030g
Site Coefficient F_a	1.0
Site Coefficient F_v	1.3
Max. Short Period Spectral Response Acceleration $SM_s = F_a \times S_s$	2.477g
Max. Spectral Response Acceleration 1-second period $SM_1 = F_v \times S_1$	1.339g
Damped Design Spectral Response - Short Period $SD_s = 2/3 \times SM_s$	1.651g
Damped Design Spectral Response - 1-second Period $SD_1 = 2/3 \times SM_1$	0.893g

Grading

Preliminary conceptual grading plans were provided this office during preparation of this report, we provide the following recommendations for consideration in the design of the site development plans. We recommend that final grading plans and building layout be reviewed by our office in order to plan the required supplemental investigation. All grading must conform to Appendix B, Preliminary Grading Specifications; however, the specifications are general and would be expected to vary with site and soil conditions encountered during development.

Exploratory test pits were excavated for our geologic exploration and backfilled to less than 90% relative compaction. We recommend that a surveyor and a representative of our company locate the test pits and trenches prior to grading to decide whether these explorations will be removed during grading. These test pits may be located in an area that involves a minimum amount of grading. If located within a planned improvement area, the test pits should be re-excavated and backfilled with compacted fill.

All grading must be observed by a representative of our firm. It is especially important that our representative be present during the stripping and scarification process to observe whether undesirable materials are encountered.

The following general recommendations should be incorporated into site grading.

Cut Slopes

Generally, exposed slopes cut into firm native soil and rock should not be steeper than two horizontal to one vertical (2H:1V), and flatter slopes may be required in localized areas. The uninterrupted height of the slope must not exceed 25 feet in elevation between 6-foot wide drained benches. The stability of cut slopes is often affected by adverse bedding, the character of the rock exposed and/or by the inclination of weak zones within the bedrock rather than the general strength of the rock being cut. The nature of the bedrock observed at this site and the regional geologic history indicates a variety of bedrock types and structural orientations may vary significantly over a short distance.

In areas where adverse orientations may exist, an engineering geologist must evaluate these cut slopes during grading. If adverse conditions are observed, we will provide recommendations regarding removal of unstable soil, keyway locations, and buttress filling or retaining wall construction for cut slope stability.

Fill Slopes

Generally, fill placed on slopes shall have a finish slope of no steeper than 2 horizontal to 1 vertical. We recommend that a keyway be excavated at least 5 feet into the underlying competent bearing soil or bedrock at the toe of the proposed fill. The bottom of the keyway should have a minimum width of 20 feet and should be sloped a minimum of 2 percent downward into the keyway heel

for drainage into a subdrain system installed to collect migrating water. Due to the variable nature of the bedrock at this site, keyways will likely be deeper and wider than standard dimensions. The total depth of the keyway and the extent of the fill slope configuration should be decided in the field during grading by the geotechnical engineer or the engineer's representative.

The subdrain should consist of CalTrans Class 2 permeable material with a perforated 6-inch-diameter ABS SDR 23.5 or equivalent pipe installed on a bed of approximately 3 inches of drain rock. Perforations should be placed downward. Drainage of the system will be accomplished with unperforated pipe extending from the subdrain pipe to an acceptable storm drain system. All subdrain and drain pipe should be placed to fall at least 1 percent toward the outlet side for flow.

Compacted fill placed within the keyway should be compacted to at least 95 percent relative compaction. Compacted fill placed above the keyway or in benched areas should be compacted to at least 90 percent of the maximum dry density. Relative compaction should be based on ASTM D 1557 test methods. On-site soil may be used as fill provided that it is moisture-conditioned to a minimum of 3 percent above the optimum moisture content.

The gradient of the exposed outboard surface of the fill slope should not exceed 2H:1V (horizontal to vertical), and the uninterrupted height of the slope must not exceed 25 feet in elevation between the 6-foot-wide drained benches. Fill from cuts on adjacent portions of the site may be used provided that our firm's representative confirms suitability. The compacted fill should continue up the slope with additional drained benches excavated into bedrock or acceptable soil as recommended by our geotechnical engineer or the engineer's representative.

Surface water runoff above the compacted fill slope must be intercepted by a concrete lined V-ditch installed on the upslope portion of the compacted fill slope and discharged to an appropriate outlet. Additional recommendations may be made for fill slope construction depending upon the soil conditions. The project civil engineer should be contacted to design the V-ditch and determine the appropriate outlet for drainage.

On-site soil generated by site grading may be used as fill provided that the soil is free of deleterious and organic materials and that it has been approved for use as fill by our geotechnical engineer or the engineer's representative. Organic strippings must not be placed within the structural fills. Samples of any proposed import fill planned for use on this project should be submitted to our geotechnical engineer or the engineer's representative for approval and appropriate testing no less than 4 working days before the expected delivery to the jobsite.

All fill to be placed at depths greater than 4 feet below final grade must be placed at a minimum of 90 percent relative compaction (i.e., 90 percent of the maximum dry density based on ASTM D 1557 test methods) and moisture-conditioned to a minimum of three 3 percent over the optimum moisture content. Fills that contain moderately expansive clay should have special preparation in the event removal is not feasible. Special preparations would include compaction to a minimum of 85 and to a maximum of 90 percent relative compaction and moisture-conditioned to a minimum of 5 percent over the optimum moisture content. Fill characterized as moderately expansive soil is generally defined as having a plasticity index (PI) greater than 20. A representative sample of the fill should be tested for the expansiveness of the soil and approved by the geotechnical engineer or the engineer's representative. The upper 4 feet of fill constructed of nonexpansive to slightly expansive soil should be compacted to a

minimum of 90 percent relative compaction and moisture-conditioned to a minimum of 3 percent over the optimum moisture content.

Expansion of near-surface soils can be greatly reduced by taking appropriate measures during grading. Selective grading to remove expansive soils and replace with low or non-expansive soils during the mass grading process is highly recommended. In areas where expansive silty clay will receive fill, we recommend scarifying the upper 12 inches, moisture-conditioning the soil to above the optimum moisture content by at least 5 percent, and recompacting the soil to a relative compaction between 85 and 90 percent. In areas where the expansive silty clay is at or near final grade, we recommend subexcavating 3 feet and replacing it with one of the following: (1) with import fill that is nonexpansive or has a low expansion potential and the approval of our geotechnical engineer, or (2) with on-site select material approved by our geotechnical engineer or the engineer's representative.

Identification of expansion potential is subject to confirmation by appropriate expansion, swell, or other tests as selected by the geotechnical engineer or the engineer's representative. Selective grading may be used to place material with a high expansion potential at depth or wasting and to place material with a lower expansion potential at or near the surface. This method lessens the effects of soil expansion or shrinkage.

After rough grading is completed, we recommend our representative sample the surface soil conditions of all cut and transition lots and classify the expansion potential of the surface soil as low, moderate, or high. Occasionally, samples should be collected for Atterberg Limits testing in the laboratory to check the field evaluations. The following requirements should apply to cut lots and transition lots.

Cut Lots

Lots entirely in cut and in material with a moderate to high expansion potential should be subexcavated a minimum of 3 feet. The exposed subgrade should be scarified to a minimum depth of 12 inches and recompacted at 85 to 90 percent relative compaction and a minimum of 5 percent over optimum moisture content. Soil with a low expansion potential should be recompacted to at least 90 percent relative compaction and at least 3 percent over optimum moisture content.

Transition Lots

Transition lots are defined as those partially in cut and partially in fill with the transition occurring within the building pad or near it. Lots with a small cut section outside the building pad should be treated as fill lots described above. Transition lots should be subexcavated a minimum depth of 3 feet and scarified to a minimum depth of 12 inches. Both the scarified material and the subexcavated material should be recompacted at 85 to 90 percent relative compaction and a minimum of 5 percent over optimum moisture content for moderately to highly expansive soil. Soil with a low expansion potential should be recompacted to at least 90 percent relative compaction and at least 3 percent over optimum moisture content.

Additional topsoil will be needed for landscaping lots cut entirely in bedrock. We recommend stockpiling the topsoil and near-surface material generated from stripping swales and low-lying areas. This material should be used for landscaping where topsoil is limited.

Permeable soil may be encountered at final cut pad elevations that could collect and direct percolated water into bedded areas and cause seepage on the lower slope. If this occurs, the pad must be over-excavated of the upper 2 feet of permeable zone and replaced with a compacted clayey soil cap (excluding highly expansive soil) to reduce infiltration of water. Compaction of the clayey soil cap should be in accordance with the compaction requirements discussed earlier in this report.

Subsurface drains should be provided where any potential seepage zones are encountered during grading. The subsurface drains would provide drainage for these areas and would increase the stability of the cut and fill areas where excessive moisture is found. We recommend that all subsurface drains be installed according to Section 9 of Appendix B.

We recommend that all finished pads be graded a minimum of 1 percent sloping downward and toward the proposed street elevation.

After mass grading is completed, it is imperative that exposed moderately to highly expansive soil be kept moist by occasional sprinkling. If the soil dries out, we recommend that the upper 12 inches be scarified, moisture-conditioned, and recompacted in accordance with the recommendations given above. Additional subexcavation and recompaction may be required by the geotechnical engineer or the engineer's representative based on observed conditions.

Foundations

Based upon preliminary subsurface information obtained during this study, it is recommended that the proposed structures be supported on a structural mat slab foundation system. Upon completion of mass grading operations, the Geotechnical Engineer will perform a lot-by-lot inventory of site conditions in order to determine if

alternative foundation systems, such as conventional spread footings, may be allowable.

If a foundation system other than those recommended is desired, this office should be called for supplemental recommendations. Such recommendations will be presented as an addendum to this report.

We presently anticipate that the proposed structures will consist of one to two-stories in height, and of wood-frame construction. Structural loads are expected to be light to moderate. Based upon the results of our study we have provided recommendations for a structural mat foundation system. Geotechnical design criteria should be implemented at the discretion of the Structural Engineer based upon his review and designed in conformance with current industry standards and the geotechnical recommendations of this report. If a foundation system other than that recommended is desired, this office should be called for supplemental recommendations. Such recommendations would be presented as an addendum to this report. The following foundation recommendations are based on the anticipated soil conditions underlying the project site. If unanticipated soil conditions are encountered at the time of grading, the design criteria may be altered at the discretion of the Geotechnical Engineer.

Slab-On-Grade Foundation System

We recommend the following Geotechnical design criteria in Table I be used by the Structural Engineer for design of the structural mat foundation system.

TABLE I STRUCTURAL MAT FOUNDATION RECOMMENDATIONS		
	Design Factor	
1	Pad Moisture Conditioning, Top 12-inches	Required
2	Max. Allowable bearing pressure, psf; DL&LL	2000
3	Subgrade Modulus (K) - pci	150
4	External Cantilever - ft. (Random 10' length)	5
5	Interior span - ft.	12
6	Max. Deflection - any 10' span inches	1/4
7	Edge uplift pressure - psf to 0 at 10'	250
8	External Thickened Edge - in.	12 x 14 i.e., an additional 2-inches of slab thickness)
9a	Visqueen - 10 mil. minimum	Required
9b	Min. Visqueen cover; sand - in.	2
10	Min. Slab Thickness - in.	12

The above values are based upon the average soil conditions expected within the soil materials located within the top 3 feet of pad grade. A capillary break may be utilized if deemed beneficial by the Structural Engineer. Surface drainage will be required; gutters should be tied to tight lines discharging to the site's storm sewer system. Swales with drop inlet facilities are desirable in order to facilitate the rapid removal of all surface storm or irrigation water.

Concrete slabs-on-grade where moisture passage would be a problem, should be underlain by a 4-inch-thick capillary break of pea gravel or clean crushed rock (no fines). We recommend that Class 2 base rock not be used as the capillary break, and that a membrane of 10 mil minimum thickness be placed on the crushed rock and overlain by 2 inches of clean sand to assist in the proper curing of the slab. The length of overlap for the membrane should conform to the manufacturer's specification or a minimum of 12 inches, whichever is greater. Furthermore, at no time should the membrane be punctured during the construction of the concrete slab-on-grade. Improper placement of the membrane may result in adverse moisture conditions that could contribute to cracking or heaving of the slab. Excess moisture could also pass through the slab into the residence. It should be understand that the above membrane is considered a moisture retarder and not a barrier. Membranes that achieve the designation of a moisture barrier are considered 15 mil membranes manufactured by Stego Wrap and equivalent.

Studies have shown that trees planted within half of their mature height from the edge of the foundation have caused differential foundation movements. These will require more water in periods of extreme drought and in some cases a root injection system may be required to maintain moisture equilibrium.

The setback for structures from the top or bottom of cut or fill slopes is a minimum 10 feet, and where fill slopes exceed 30 feet, the California Building Code setback of 1/3 the height of slope for structures from the top of slope, unless evaluated by the Geotechnical Engineer to provide supplemental recommendations. Some sloughage or debris resulting from possible downhill soil erosion of cut slopes should be expected and would require removal. An alternative protective measure would consist of constructing a low retaining wall along the base of the cut slope. This wall should have a subdrain installed behind it, parallel to the base of the slope, and at a minimum

1 percent gradient to provide gravity drainage to an approved outlet. A swale above the wall should be provided to control slope wash runoff. If retaining walls are to be constructed, they must be designed by a structural engineer, and a geotechnical engineer must review the proposed design.

We recommend periodic moistening of the building pad subgrade and foundation excavations to prevent drying of the subgrade soil. A representative of our firm must check moisture conditions in the subgrade soil and foundation excavations 48 hours prior to placing concrete. If site conditions require additional moisture conditioning, the building pad subgrade must be soaked with water for a minimum of 48 hours prior to placing concrete in the excavations or prior to placing gravel for the capillary break in slab areas.

Retaining Walls

Retaining walls should be supported on firm bedrock either through a footing, or be supported by piers that extend into and derive support from firm bedrock. The following recommendations are for a retaining wall founded in firm bedrock. The retaining wall should be designed for a fully-drained condition. The proposed design should be reviewed by our firm to confirm that the retaining wall configuration is compatible with the assumed parameters. Table 1 presents our preliminary design criteria for general retaining wall construction. Preliminary design pressures are expressed as equivalent fluid pressures. Specific criteria based upon a supplemental geotechnical study is required for retaining wall recommendations for a specific site design layout. This office should be contacted for supplemental recommendations where piers are required to achieve embedment into non-yielding bedrock.

TABLE 1

RETAINING WALL DESIGN CRITERIA

Pressures: Gradient of Backfill	Active Pressure (pcf)	Passive Pressure* (pcf)
Level	55	400
2:1 (maximum)	65	400

*Commences a minimum of 1 foot below lowest adjacent grade, except that passive pressure excludes colluvial soil over bedrock.

Walls restrained at the top should be designed with a 100 psf uniform lateral surcharge load in addition to the lateral earth pressures given above. Any wall structurally connected to a structure must be considered a restrained wall.

The design criteria are applicable for walls which have fully-drained conditions and are no greater than 10 feet in height. To provide fully-drained conditions, a gravel drainage system should be constructed behind the walls and have a minimum width of 12 inches. We recommend that the drainage system commence behind and at the bottom of the retaining structure's heel and extend up the retaining wall to 1 foot below grade. The drainage system should consist of Cal Trans Class II permeable material or alternate approved by our geotechnical engineer or the engineer's representative. A 4-inch diameter, perforated rigid drainpipe should be installed at the bottom of the drainage system and below the cold joint with holes facing down. The pipe should be sloped at a minimum of 1 percent and discharged to a suitable drainage facility away from all structural improvements. The area immediately behind the retaining wall should be graded so as to prevent surface water from ponding adjacent to the wall.

For backfill behind retaining structures, the zone between the structure's drainage system and the limits of excavation may be backfilled with on-site soil; however, granular material is recommended for lower lateral earth pressures. Should on-site soils be used in the zone between the structure's drainage system and the limits of excavation, the backfill materials should be compacted to 90 percent of the maximum dry density at 2 to 4 percent above optimum moisture content as determined by American Society of Testing Materials (ASTM) D 1557-91 test methods. Over-compaction behind retaining structures tends to increase the lateral pressure against the structures and, therefore, should be avoided.

Where retaining walls are used adjacent to living areas and to reduce the potential for moisture transmission through the walls, we recommend that (1) the exterior face be hot-mopped in accordance with the manufacturer's specifications and (2) an impermeable membrane be placed over the hot-mopped surface to protect the surface from damage during rock placement. It is important that surface drainage controls also be installed to reduce the potential for moisture transmission.

Miscellaneous Concrete Slabs-on-Grade

We recommend that the slab-on-grade be a minimum thickness of 4 inches for walkways and patios. Due to the expansive nature of the near-surface soil and rock, we recommend reinforcing the concrete slab-on-grade floor either (1) with No. 3 reinforcing bars spaced at 18 inches on center, or (2) with an alternate reinforcement system as required by the project structural engineer. We also recommend that exterior flatwork be structurally independent of the mat foundation system to provide freedom of movement due to potential changes in soil volume. In general, the reinforcement should be draped or supported by concrete dobies to attain its greatest efficiency in minimizing the cracking of the slabs. Crack control joints must be located as directed by the structural engineer.

Prospective homeowners should expect some vertical displacement of exterior flatwork, sidewalks, driveways, pavements, and garage slabs. To reduce vertical displacement, we recommend presoaking all exterior flatwork areas, maintaining proper site drainage, and controlling irrigation of landscaping.

Utility Trenches

Utility trenches that parallel the sides of the buildings must be placed so that they do not extend below a line sloped down and away at a slope of 2H:1V (horizontal to vertical) from the bottom outside edge of the perimeter foundations (i.e., the base of the grade beam systems).

All trenches must be backfilled with native materials compacted uniformly to the relative compaction specified in Appendix B. If local building codes require use of sand as the trench backfill, all utility trenches entering the building must be provided with an impervious seal of either cohesive soil or lean concrete where the trench passes under the building perimeter. The impervious plug must extend 4 feet into, and out of, the building perimeter. Jetting of trench backfill is not recommended as it may result in an unsatisfactory degree of compaction.

Drainage

Surface water must not be allowed to pond adjacent to building foundations. To preclude drainage problems, we recommend continuous roof gutters for the proposed residences. It will be necessary to direct all water collected from roof downspouts into closed conduits that lead to acceptable discharge points away from the structures.

A positive slope gradient of 2 percent down and away from the building perimeter must be applied to the finished subgrade (inclusive of topsoil). This slope must extend no

less than 5 feet away from the outside building perimeter. Drainage swales with drop inlet facilities should be provided to remove runoff from around the structures.

Plants must not be placed immediately adjacent to the structures. If vegetation must be planted adjacent to the buildings, drought-resistant plants that require very little moisture and drip-irrigation systems should be used. Sprinkler heads must not be placed where they could saturate foundation soil.

The landscape architect, licensed landscapers, and prospective owners should be informed of the grading and surface drainage requirements. They should also be aware that moistening of the subgrade soils should be systematic and uniform for all sides of each structure. In the areas adjacent to the foundation or concrete slabs-on-grade, the soil should be protected from over-irrigation and from excessive drying. Shade trees or shrubs requiring large amounts of moisture from the soil should be set away from the foundations so that their roots do not influence the soil adjacent to the foundations.

Soil adjacent to foundations and the slabs-on-grade will need to be monitored by home buyers during hot and dry summer periods. Relatively constant moisture should be maintained in the soil adjacent to the foundation to keep the soil uniform and stable. If adequate moisture is not maintained in the soil adjacent to the foundations, then the soil may either dry and separate from the foundations or the soil may become wet and expand against the foundations causing adverse movements.

Pavement Section

We recommend determining the pavement section after the completion of mass grading and the subgrade conditions are known and the approved traffic indices are supplied by the municipal engineer. It is recommended that selective grading be

planned so that relatively higher R-value material, such as granular soils be placed in the upper two feet of subgrade level. Regardless of the design section, to perform to its greatest efficiency, the pavement section requires the following construction criteria:

a. Remove organic and deleterious materials from all pavement subgrade.

b. Moisture-condition the upper 6 inches of subgrade soil and compact it to a minimum relative compaction of 95 percent and to a moisture content of 2 to 4 percent over the optimum moisture content. All pavement subgrade should be stable with no "pumping" at the time the base rock is placed.

c. Use only good quality materials of the type and minimum thickness specified. All base rock should meet the *Standard Specifications* of the State of California for Class 2 baserock and should be angular in shape.

d. Compact the baserock uniformly to a minimum relative compaction of 95 percent.

e. Place the asphalt concrete only during periods of fair weather when the free air temperature is within the prescribed limits as set forth by the Asphalt Concrete Institute.

f. Compact all trench backfill under the pavement to reduce fill settlement and minimize pavement damage that may result from such settlement. Mechanical compaction is recommended because material placed by jetting or ponding will probably not attain satisfactory densities.

g. Provide adequate drainage or V-ditch systems to prevent surface water from migrating into the subgrade pavement soil from behind curb-and-gutter sections. For areas where pavement abuts landscaping, we recommend extending the concrete curb to the bottom of the base rock layer to form a cut-off wall to prevent water from migrating into the base rock.

Swimming Pools

Investigations for swimming pools were not part of this study. We recommend conducting supplemental investigations for proposed swimming pools on a site-specific basis.

Construction During Fall and Winter Seasons

Wet weather may raise the moisture content of the soil well above optimum conditions and earthwork construction may be difficult or impossible. Supplemental recommendations will be provided by our geotechnical engineer or the engineer's representative in the field, if appropriate.

Miscellaneous

Our exploration did not reveal the presence of buried items such as leaching fields, wells, storage tanks, etc. It is possible, however, that such items may be present, particularly in light of prior residential construction that was present at the northwest corner area of the property If such items are encountered during grading or during excavations of foundations, our firm should be notified immediately to provide recommendations for proper procedures. Also, this study did not include investigations for toxic substances or groundwater contamination of any type. If such conditions are encountered during site development, additional studies will be required.

Plan Review

Before submitting design drawings and construction documents to the appropriate local agency for approval, copies of the documents must be reviewed by our firm to ensure that the recommendations in this report have been effectively incorporated.

Construction Observations

A representative of this firm must be present during grading and foundation subgrade preparation to observe that the work performed is in conformance with specifications and recommendations provided here. We will also perform testing as necessary to evaluate the quality of the materials and their relative compaction. Records will be maintained of our site visits and test results.

A Certified Engineering Geologist of PRA must observe all cut slopes and keyway excavations during the mass grading of the project.

Subexcavation of transition lots should be checked prior to backfilling to confirm that the excavation is at the necessary depth and that no adverse conditions are observed.

At the completion of site grading and foundation excavation, we will submit a summary of our observation and test results along with any necessary supplemental recommendations.

To assure that our personnel are at the site when needed, we require that you notify us at least 2 working days before the task begins.

LIMITATIONS

This report has been prepared for the exclusive use of AMG & Associates Incorporated, and their consultants for specific application to the proposed development. If changes occur in the nature, design location, or configuration of the proposed development, the conclusions and recommendations contained here shall not be considered valid. Changes must be reviewed by our firm.

The analysis, opinions, conclusions and recommendations submitted in this report are based in part on the referenced materials, site visit and evaluation, and subsurface exploration. The nature and extent of variation among exploratory test pits and trenches may not become evident until construction. The geologic nature of the site region is highly variable and subsurface conditions encountered during mass grading may require supplemental recommendations that may alter the proposed development scheme. If variations appear, it will be necessary to re-evaluate or revise recommendations made in this report.

The recommendations in this report are contingent on PRA Group conducting an adequate testing and monitoring program during construction of the proposed development. Unless the construction monitoring and testing program is provided by or coordinated with our firm, PRAG will not be held responsible for compliance with design recommendations presented in this report and other supplemental reports.

Our services have been provided in accordance with generally accepted geotechnical engineering practices. No warranties are made, express or implied, as to the professional opinions or advice provided. Recommendations contained in this report are valid for a period of 1 year; after 1 year they must be reviewed by this firm to determine whether or not they still apply.

References

Bay Area Air Quality Management District, Regulation 11 Hazardous Pollutants, Rule 14, Asbestos-Containing Serpentine, July 17, 1991.

Borcherdt, R. D., Gibbs, J. F., and Lajoie, K. R., 1975, Maps Showing Maximum Earthquake Intensity Predicted in the Southern San Francisco Bay Region, California for Large Earthquakes on the San Andreas and Hayward Faults: U.S. Geological Survey Misc. Field Studies Map MF-709.

California Air Resources Board, Staff Report: Initial Statement of Reasons for the Proposed Asbestos Airborne Toxic Control Measure for Construction, Grading, Quarrying, and Surface Mining Operations, Executive Summary.

California Air Resources Board, Final Regulation Order, Asbestos Airborne Toxic Control Measure for Surfacing Applications, Section 93106, effective date November 13, 2001.

California Air Resources Board, Proposed Regulation Order, Asbestos Airborne Toxic Control Measure for Construction, Grading, Quarrying, and Surface Mining Operations, Section 93105 (currently under revision and pending public comment).

California Code of Regulations, Title 17, Section 93106 - Final Regulation Order, Asbestos Airborne Toxic Control Measure for Construction, Grading, Quarrying, and Surface Mining Operations.

California Code of Regulations, Title 17, Section 93105 - Final Regulation Order, Asbestos Airborne Toxic Control Measure (ATCM) for Surfacing Applications.

California Division of Mines and Geology, 1990, Alquist-Priolo Special Studies Zone Maps, Hayward, 7-1/2-Minute Quadrangle, California

California Environmental Protection Agency-Air Resources Board, July 2002, Implementation Guidance Document for the Asbestos Airborne Toxic Control Measure for Surfacing Applications.

California Geological Survey, 2002, Guidelines for Geologic Investigations of Naturally Occurring Asbestos in California: Special Publication 124.

California Geological Survey, 2012, Earthquake Zones of Required Investigation Map, Hayward Quadrangle, California.

California Geological Survey, 2003, Seismic Hazard Zone Report for the Hayward 7.5-Minute Quadrangle, Alameda County, CA: Seismic Hazard Zone Report 091.

Dibblee, T. W. Jr., , 1980, Preliminary Geological Map of the Hayward Quadrangle, Alameda and Contra Costa Counties, California: U.S. Geological Survey Open File Report 80-540.

ESA Consultants/William Lettis & Associates, December 1996, Seismic Evaluation of South Reservoir Embankments for East Bay Municipal Utility District: Project No.106.9601.

Graymer, R. W., Jones, D. L., and Brabb, E. E., 1995, Geologic Map of the Hayward Fault Zone, Contra Costa, Alameda, and Santa Clara Counties, California: A Digital Database: U. S. Geological Survey Open File Report 95-597.

Greensfelder, R.W., 1974, Maximum Credible Acceleration from Earthquakes in California: CDMG Map Sheet 23.

Lawson, A.C., 1908, The California Earthquake of April 18, 1906, Report of the State Earthquake Investigation Commission: Carnegie Inst. Washington Pub. 87.

Lienkaemper, J., 1992, Map of Recently Active Traces of the Hayward Fault, Alameda and Contra Costa Counties, California: U. S. G. S. Misc. Field Studies Map MF-2196.

Majmandar, H., 1996, Landslide Hazards in the Hayward Quadrangle and Parts of the Dublin Quadrangle, Alameda and Contra Costa Counties, California: California Dept. of Mines and Geology Landslide Identification Map 37: Open File Report 95-14.

Nilsen, T.H. et al, 1979, Relative Slope Stability and Land-Use Planning in the San Francisco Bay Region, California: U.S. Geological Survey Professional Paper 944.

Nilsen, T.H., 1973, Preliminary Photointerpretation Map of Landslide and Other Surficial Deposits of the Livermore and Part of the Hayward 15-Minute Quadrangles, Alameda and Contra Costa Counties, California: U.S. Geological Survey, Misc. Field Studies Map MF-519.

Ploessel, M.R. and Slosson, J.E., 1974, Repeatable High Ground Accelerations From Earthquakes - Important Design Criteria: California Geology, September.

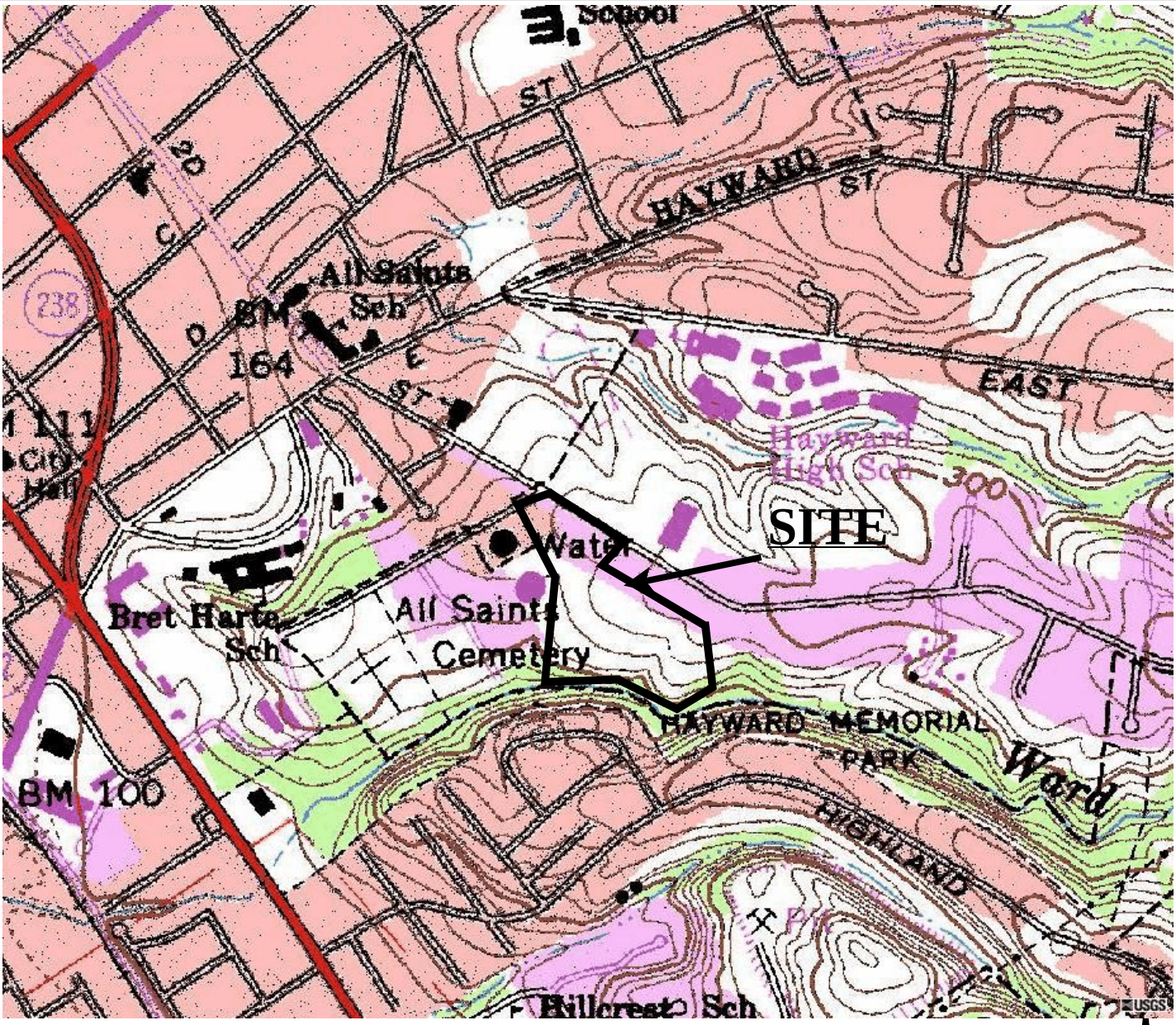
Radbruch-Hall, D.H., 1974, Map Showing Recently Active Breaks Along the Hayward Fault Zone and the Southern Part of the Calaveras Fault Zone, California, U.S. Geological Survey Misc. Investigations Series Map I-813.

Radbruch, D.H. et al, 1966, Tectonic Creep in the Hayward Fault Zone, California, U.S. Geological Survey Circ. 525.

Roberts, S. et al, 2000, Landslides in Alameda County, California: A Digital Database Extracted from Preliminary Photointerpretation Maps of Surficial Deposits by T. H. Nilsen in U. S. G. S. Open File Report 75-277: U. S. G. S. Open File Report 99-504.
Robinson, G.D., 1956, Geology of the Hayward Quadrangle, California:
U.S. Geological Survey Geologic Quadrangle GQ-88.

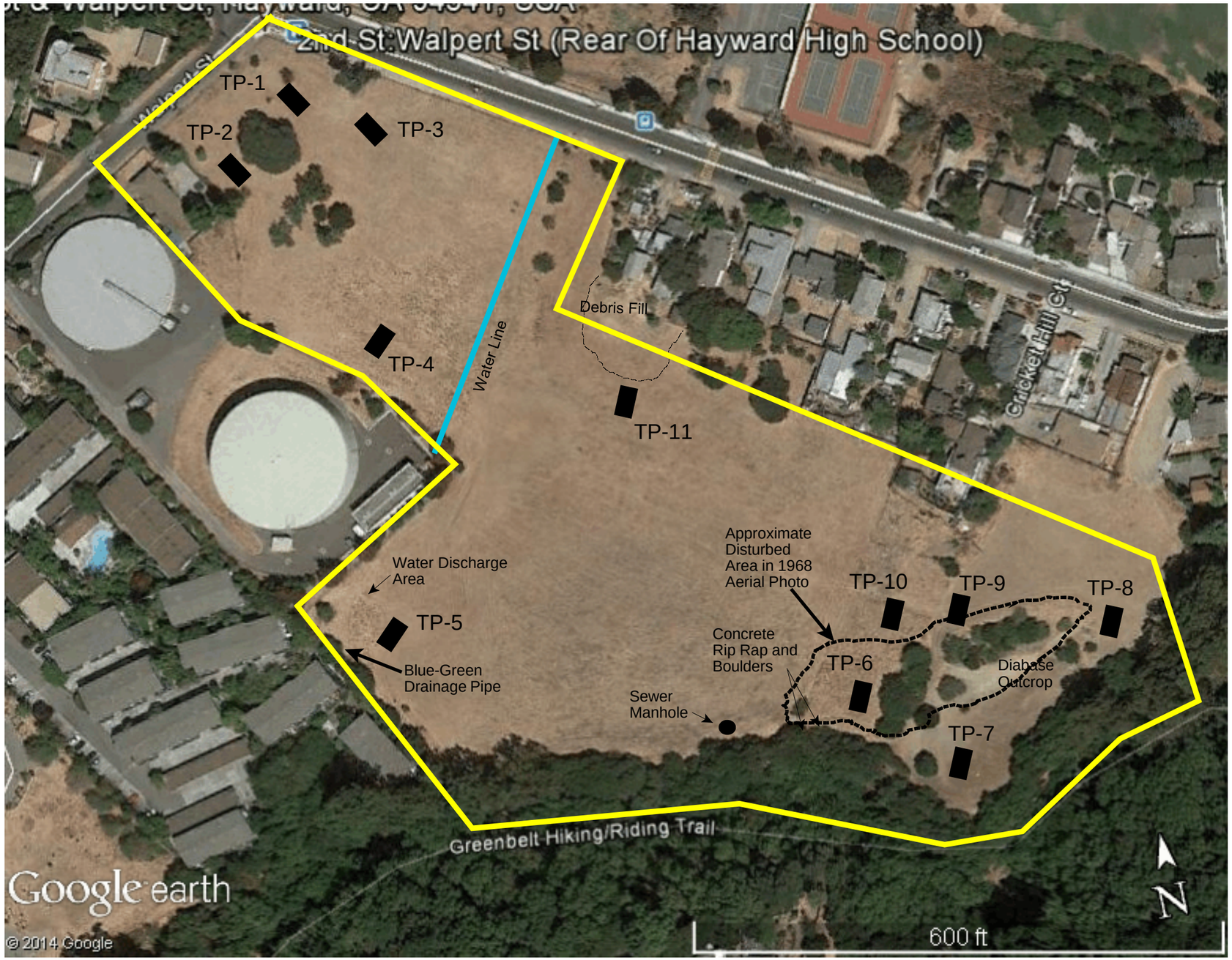
Schanabel, P.B. and Seed, H.B., 1973, Accelerations in Rock for Earthquakes in the Western United States: Seismol. Soc. Amer. Bull., v. 62, p. 501-516.

Steinbrugge, K.V. et al, 1987, Earthquake Planning Scenario for a Magnitude 7.5 Earthquake on the Hayward Fault in the San Francisco Bay Area:
CDMG Spec. Pub. 78.



N

NOTES SOURCE: MSR MAPS	DATE JUNE 2014 JOB NO. G319-01 DWG NO. G31901FIG1 DRAWN IDA CHK'D DJR APP'D DJR	PRA Group CONSULTING ENGINEERS **SITE LOCATION MAP** SE OF WALPERT STREET AND 2ND STREET HAYWARD, CALIFORNIA CLIENT AMG & ASSOCIATES, LLC	FIGURE NO. 1 REV. NO.



NOTES
AERIAL PHOTO FROM GOOGLE PRO

APPROXIMATE TEST PIT LOCATION

DATE	JUNE 2014
JOB NO.	G319-01
DWG NO.	G31901FIG2
DRAWN	IDA
CHK'D	DJR
APP'D	DJR

PRA Group
CONSULTING ENGINEERS

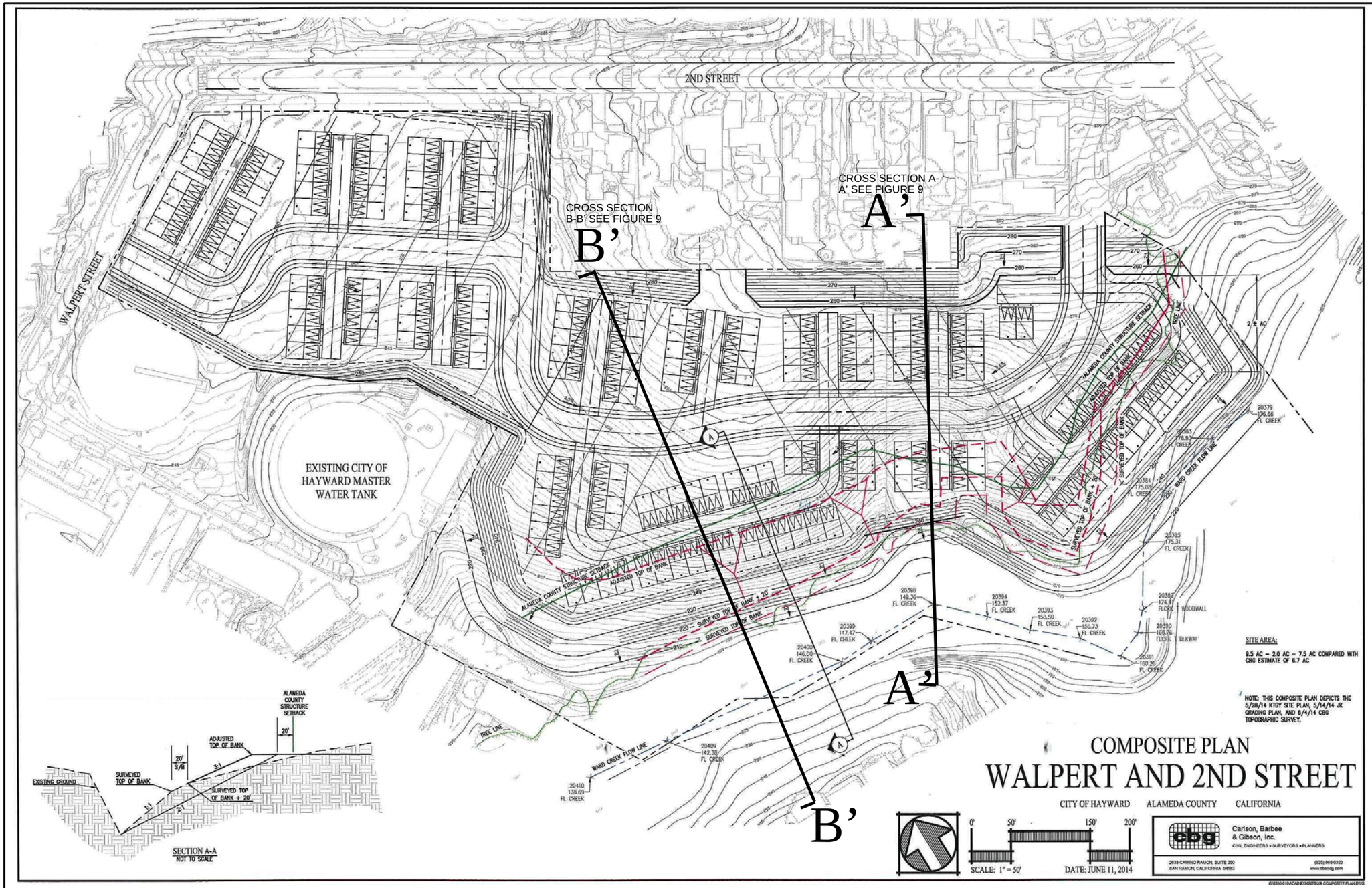
FIGURE NO.

SITE AERIAL PHOTO AND TEST PIT LOCATIONS
SE OF WALNUT STREET AND 2ND STREET
HAYWARD, CALIFORNIA

2

CLIENT AMG & ASSOCIATES

REV. NO.



NOTES

DATE	JUNE 2014
JOB NO.	G319-01
DWG NO.	G31901FIG3
DRAWN	IDA
CHK'D	DJR
APP'D	DJR

PRA Group
CONSULTING ENGINEERS

COMPOSITE SITE PLAN WITH GRADING
SE OF WALNUT STREET AND 2ND STREET
HAYWARD, CALIFORNIA

CLIENT AMG & ASSOCIATES

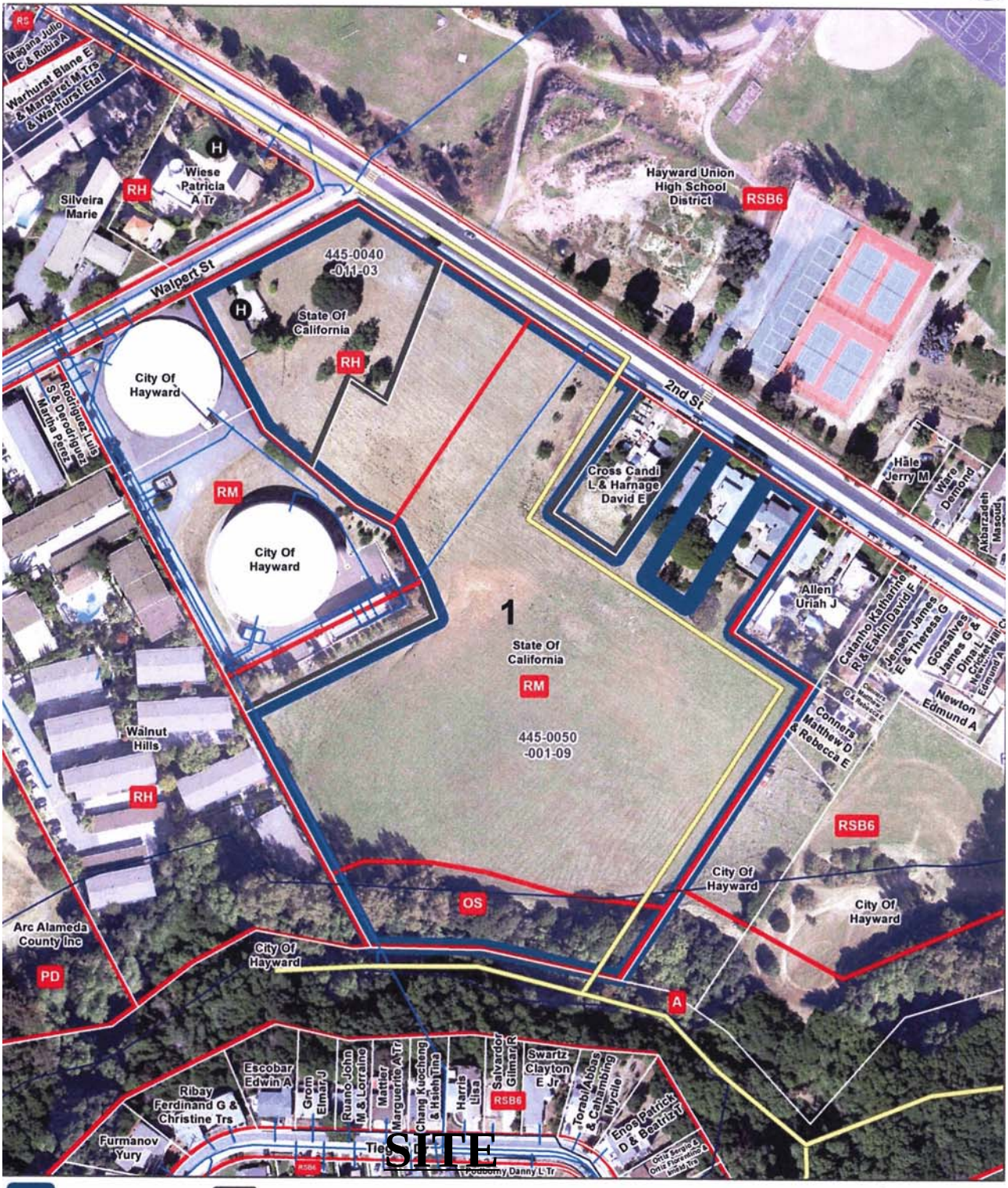
FIGURE NO.
3

REV. NO.

City of Hayward - Development Services
Highway 238 Available Property Information

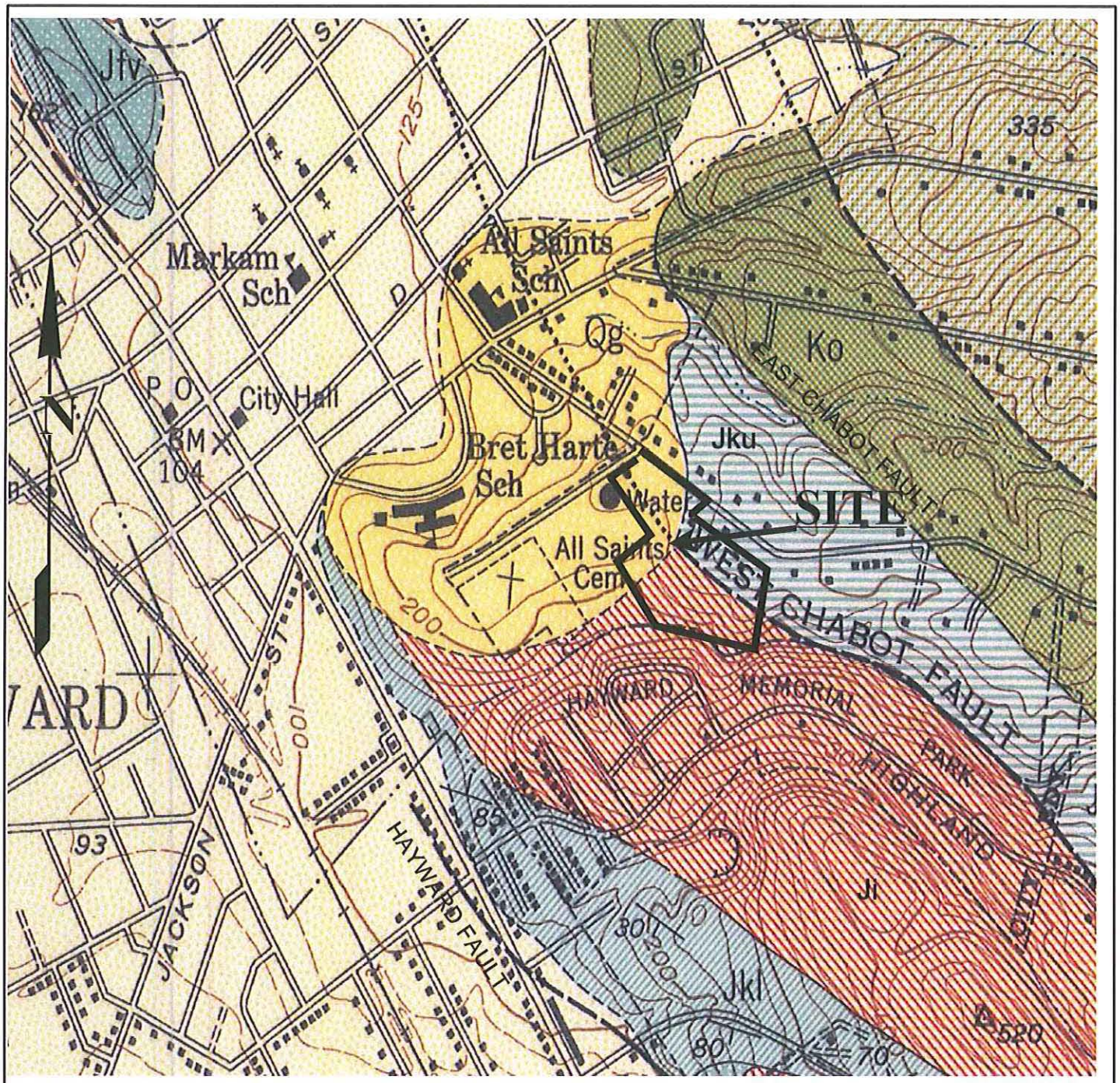
1

0 100 200 Feet



Auction property boundary
City limits
Parcels to be auctioned
Parcels (white)
238 Bypass Trail Location
Zoning boundaries
Sewer (Mains)
Sewer (Easements)
Water (Service Laterals, Laterals, Mains)
Historic Buildings

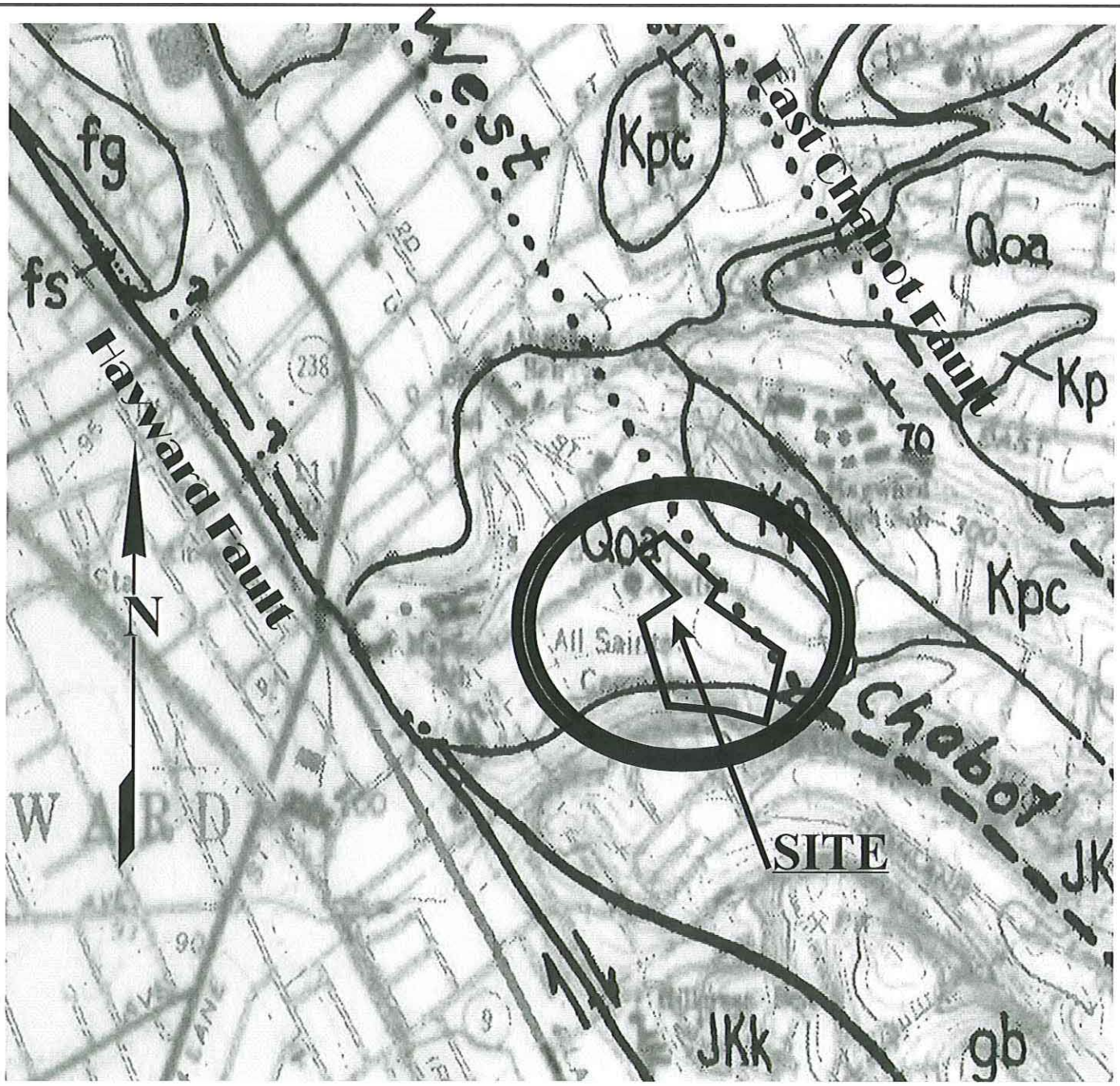
NOTES SOURCE: CITY OF HAYWARD WEB SITE	DATE JUNE 2014	PRA Group CONSULTING ENGINEERS	
	JOB NO. G319-01		
	DWG NO. G31901FIG4	**CITY OF HAYWARD WEB SITE PHOTO** SE OF WALPERT STREET AND 2ND STREET HAYWARD, CALIFORNIA	FIGURE NO. 4
	DRAWN IDA		
	CHK'D DJR		
	APP'D DJR	CLIENT AMG & ASSOCIATES, LLC	REV. NO.



KEY

- Qu — Quaternary Undifferentiated Gravels
- Qg — Quaternary Gravel
- Kc — Cretaceous Chico Formation - sandstone and shale
- Ko — Cretaceous Oakland Conglomerate - conglomerate and sandstone
- Ji — Jurassic Gabbro and Serpentine
- Jku — Jurassic Knoxville Formation - upper member shale and sandstone
- Jkl — Jurassic Knoxville Formation - lower member sandstone and pebble conglomerate

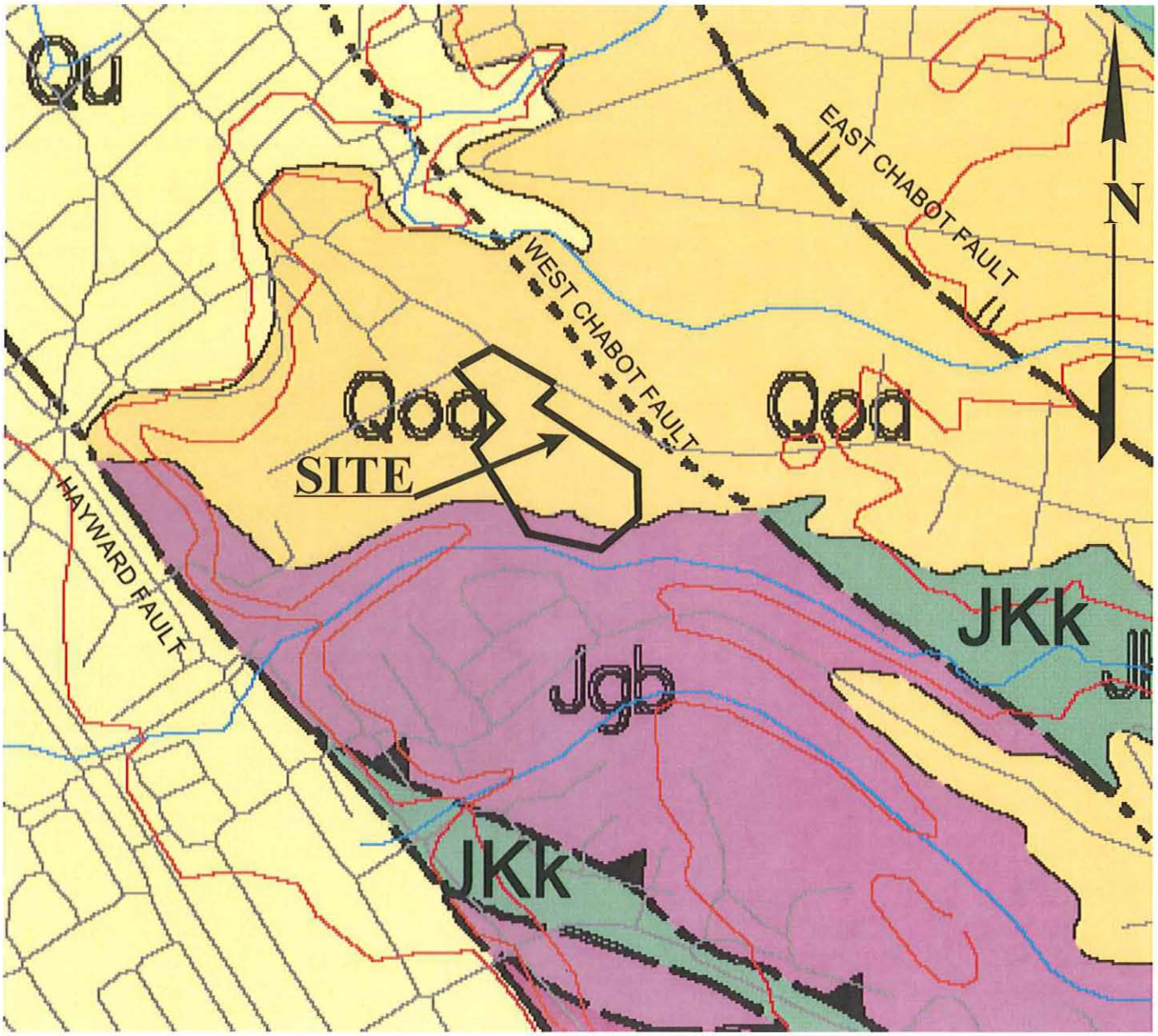
NOTES SOURCE: ROBINSON (1956)	DATE JUNE 2014 JOB NO. G319-01 DWG NO. G31901FIG5 DRAWN IDA CHK'D DJR APP'D DJR	PRA Group CONSULTING ENGINEERS **ROBINSON GEOLOGY MAP** SE OF WALPERT STREET AND 2ND STREET HAYWARD, CALIFORNIA CLIENT AMG & ASSOCIATES, LLC	FIGURE NO. 5 REV. NO.



KEY

Qa	Quaternary alluvium
Qoa	Quaternary older alluvium
Kpc	Cretaceous Panoche Formation - conglomerate
Kpp	Cretaceous Panoche Formation - clay shale
JKk	Upper Jurassic or Lower Cretaceous Knoxville Formation - shale and minor sandstone
gb	Jurassic and/or Cretaceous mafic and ultramafic rocks - gabbro and diabase, partly serpentinized

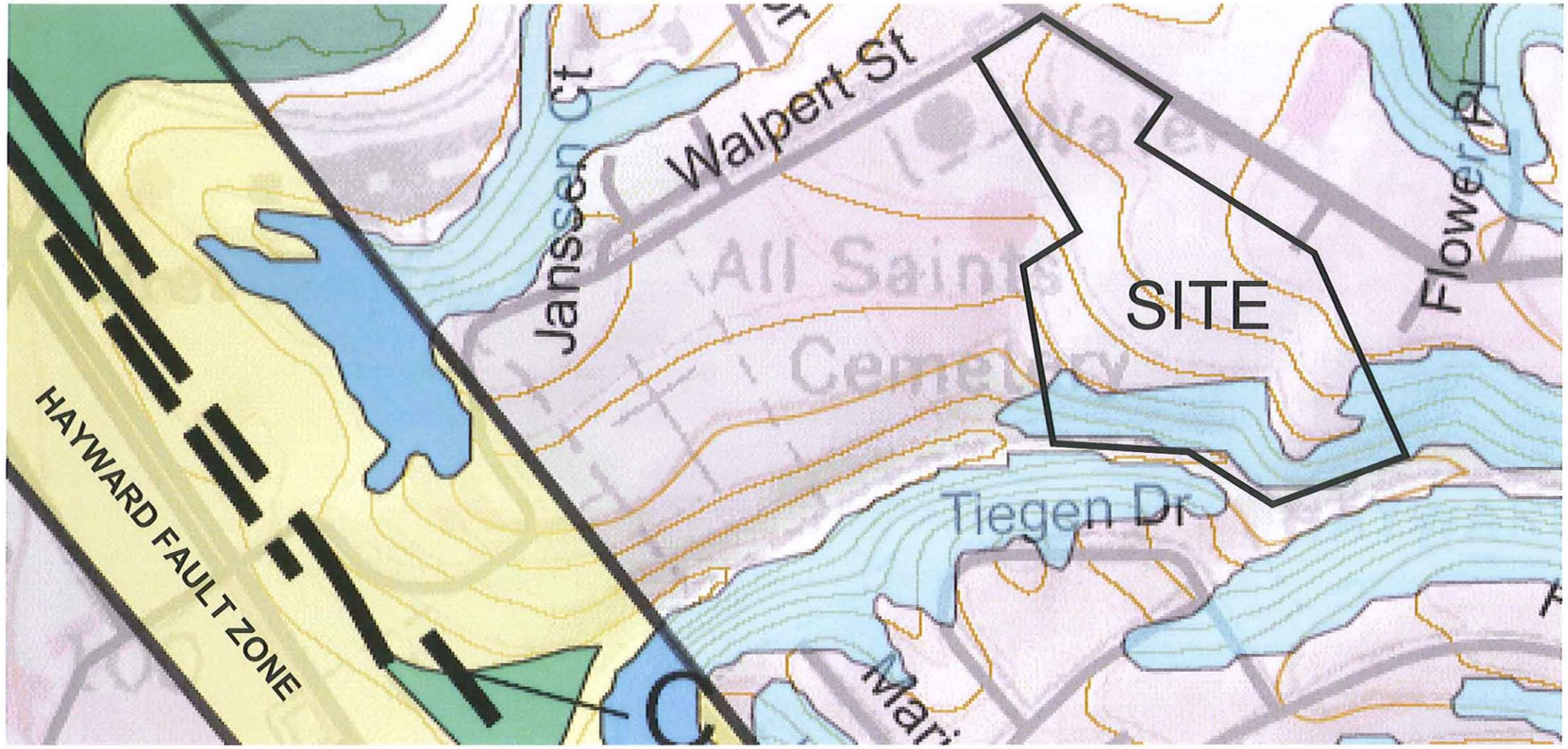
NOTES	DATE JUNE 2014	PRA Group CONSULTING ENGINEERS	
SOURCE:	JOB NO. G319-01		
DIBBLEE (1980)	DWG NO. G31901FIG 6	DIBBLEE GEOLOGY MAP	FIGURE NO.
	DRAWN IDA	SE OF WALPERT STREET AND 2ND STREET HAYWARD, CALIFORNIA	6
	CHK'D DJR		
	APP'D DJR	CLIENT AMG & ASSOCIATES, LLC	REV. NO.



KEY

- Qu – Undivided Quaternary deposits
- **Qoa – Older alluvial deposits**
- **Jgb – Gabbro and diabase**
- JKk – Knoxville Formation

NOTES SOURCE: GRAYMER, JONES AND BRABB (1995)	DATE JUNE 2014 JOB NO. G319-01 DWG NO. G31901FIG7 DRAWN IDA CHK'D DJR APP'D DJR	**PRA Group** CONSULTING ENGINEERS **GEOLOGY OF HAYWARD FAULT ZONE** SE OF WALPERT STREET AND 2ND STREET HAYWARD, CALIFORNIA CLIENT AMG & ASSOCIATES, LLC	FIGURE NO. 7 REV. NO.



Earthquake Fault Zones
Zones are areas delineated as straight-line segments that connect encircled turning points encompassing active faults that constitute a potential hazard to structures from surface faulting or fault creep such that avoidance as defined in Public Resources Code Section 2621.5(a) would be required.

Earthquake-Induced Landslides
Areas where previous occurrence of landslide movement, or local topographic, geological, geotechnical and subsurface water conditions indicate a potential for permanent ground displacements such that mitigation as defined in Public Resources Code Section 2693(c) would be required.

NOTES

SOURCE: CALIFORNIA GEOLOGICAL SURVEY (2012)

DATE	JUNE 2014
JOB NO.	G319-01
DWG NO.	G31901FIG8
DRAWN	IDA
CHK'D	DJR
APP'D	DJR

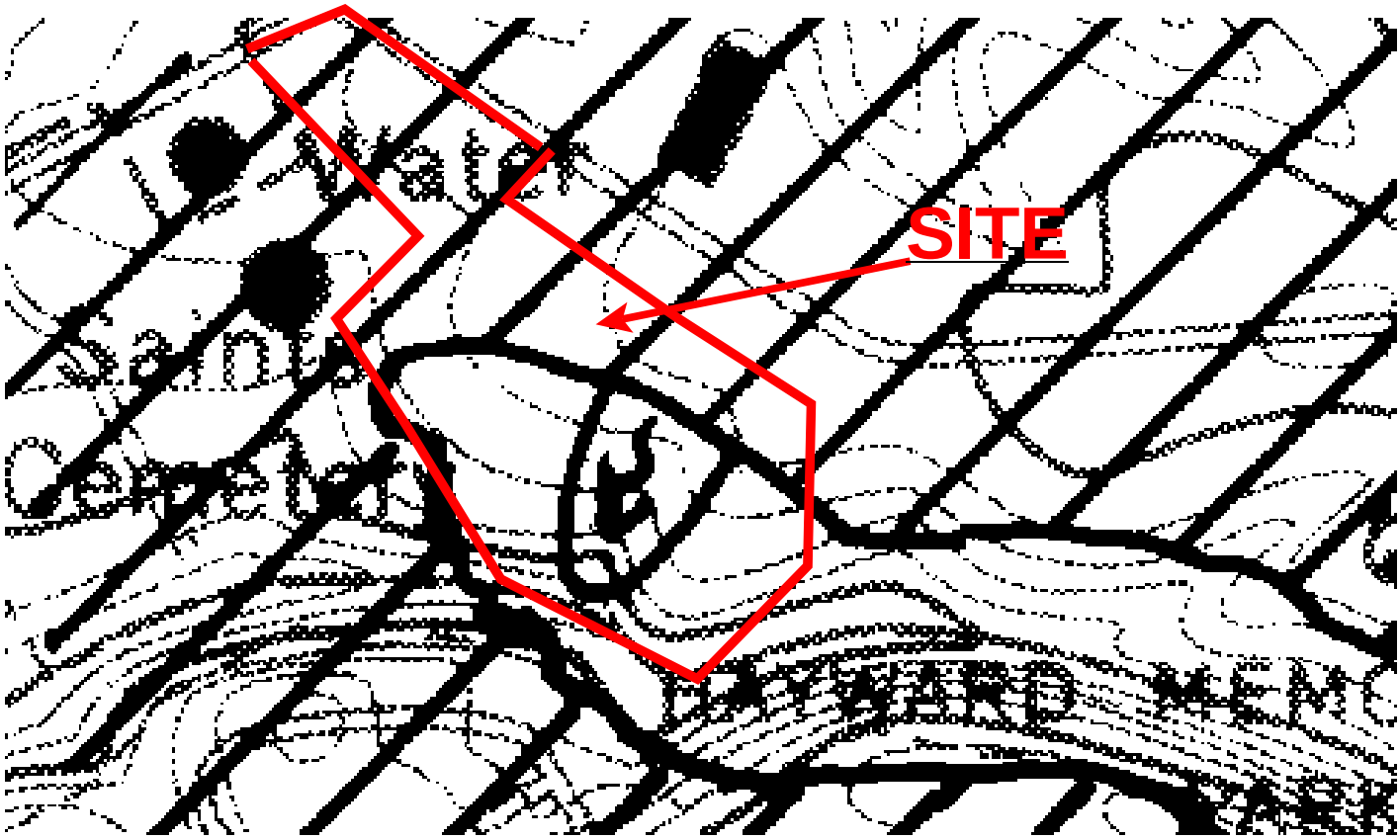
PRA Group
CONSULTING ENGINEERS

EARTHQUAKE ZONES OF REQUIRED INVESTIGATION
SE OF WALNUT STREET AND 2ND STREET
HAYWARD, CALIFORNIA

CLIENT AMG & ASSOCIATES

FIGURE NO.
8

REV. NO.



KEY

EARTHFLOW. Relatively shallow deposit of soil or other colluvial material that has oozed downslope, commonly at a rate too slow to observe except over long duration. Source area shown by hachures where mapped. Area immediately upslope of failure typically unravels due to successive small slumps that occur in the oversteepened banks left by movement of the main body away from the source area. Wiggle arrow shows general direction of movement.

UNMAPPED AREA. Area not mapped because of significant modification by grading and/or development or mining activity.

NOTES

SOURCE:

MAJMUNDAR (1996)

DATE	JUNE 2014
JOB NO.	G319-01
DWG NO.	G31901FIG8A
DRAWN	IDA
CHK'D	DJR
APP'D	DJR

PRA Group
CONSULTING ENGINEERS

AREA LANDSLIDE MAP
SE OF WALPERT STREET AND 2ND STREET
HAYWARD, CALIFORNIA

FIGURE NO. 8A

CLIENT AMG & ASSOCIATES, LLC

REV. NO.

EXPLORATORY TEST PIT LOG

CLIENT: AMG & ASSOCIATES PROJECT NO.: G319-01	LOGGED BY: MS	DATE EXCAVATED: 5-28-14	PAGE 1 OF 1
BACKHOE: EXCAVATOR: AZIMUTH: N60°W		PIT ELEV.: E.G. PIT WIDTH/LENGTH:	TEST PIT NO. **TP-1**

FIELD				DESCRIPTION			LABORATORY					
DEPTH (FT.)	SAMPLE	SAMPLE NO.	BLOWS / FT.	MATERIAL DESCRIPTION AND REMARKS	CONSISTENCY	USCS LETTER SYMBOL	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	pH @ °C	PLASTICITY INDEX (%)	POCKET PENETROMETER (TSF)	SULFATES (mg/Kg)
1		T1-1		CLAYEY SILT, with some sand, reddish brown, dry, stiff; with interbeds of SILTY CLAY, yellow brown, dry, stiff	Stiff	MH CH	100.0	18.4			4.5+	
2												
3				CLAYEY SILT, with some sand light brown, dry, stiff, intermixed with hard clasts of diabase		SM-SC						
4												
5												
6				SAND-SILT, yellow brown, moist, very stiff	Very Stiff	SM-SC						
7												
8	TD			FREE GROUNDWATER NOT ENCOUNTERED TO MAXIMUM DEPTH OF EXCAVATION AT 7.5 FEET. TEST PIT BACKFILLED AND COMPACTED TO LESS THAN 90% RELATIVE COMPACTION. ALL SAMPLES RECOVERED USING A PORTABLE 2.5 INCH O.D. MOD. CAL. SAMPLER.								
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PRA Group
CONSULTING ENGINEERS

EXPLORATORY TEST PIT LOG TP-1
SE OF WALPERT AND 2ND STREETS
HAYWARD, CALIFORNIA

Client: AMG&ASSOCIATES

FIGURE NO.
9

EXPLORATORY TEST PIT LOG

CLIENT: AMG & ASSOCIATES PROJECT NO.: G319-01	LOGGED BY: MS	DATE EXCAVATED: 5-28-14	PAGE 1 OF 1
BACKHOE: EXCAVATOR: AZIMUTH: N50°W		PIT ELEV.: E.G. PIT WIDTH/LENGTH:	TEST PIT NO. **TP-2**

FIELD				DESCRIPTION			LABORATORY					
DEPTH (FT.)	SAMPLE	SAMPLE NO.	BLOWS / FT.	MATERIAL DESCRIPTION AND REMARKS	CONSISTENCY	USCS LETTER SYMBOL	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	pH @ °C	PLASTICITY INDEX (%)	POCKET PENETROMETER (TSF)	SULFATES (mg/Kg)
1				CLAYEY SILT, with some sand, yellow brown, dry, stiff; with interbeds of SILTY CLAY, yellow brown, dry, stiff		MH CH						
2												
3		T2-1		CLAYEY SILT, with some sand yellow brown, dry, very stiff,	Very Stiff	MH	93.7	10.0			4.5+	
4												
5												
6				SAND-SILT, yellow brown, moist, very stiff	Very Stiff	SM-SC						
7												
8	TD			FREE GROUNDWATER NOT ENCOUNTERED TO MAXIMUM DEPTH OF EXCAVATION AT 8 FEET. TEST PIT BACKFILLED AND COMPACTED TO LESS THAN 90% RELATIVE COMPACTION ALL SAMPLES RECOVERED USING A PORTABLE 2.5 INCH O.D. MOD. CAL. SAMPLER.								
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PRA Group
CONSULTING ENGINEERS

EXPLORATORY TEST PIT LOG TP-2
SE OF WALPERT AND 2ND STREETS
HAYWARD, CALIFORNIA

Client: AMG&ASSOCIATES

FIGURE NO.
10

EXPLORATORY TEST PIT LOG

CLIENT: AMG & ASSOCIATES PROJECT NO.: G319-01	LOGGED BY: MS	DATE EXCAVATED: 5-28-14	PAGE 1 OF 1
BACKHOE: EXCAVATOR: AZIMUTH: N60°W		PIT ELEV.: E.G. PIT WIDTH/LENGTH:	TEST PIT NO. **TP-3**

FIELD				DESCRIPTION			LABORATORY					
DEPTH (FT.)	SAMPLE	SAMPLE NO.	BLOWS / FT.	MATERIAL DESCRIPTION AND REMARKS	CONSISTENCY	USCS LETTER SYMBOL	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	pH @ °C	PLASTICITY INDEX (%)	POCKET PENETROMETER (TSF)	SULFATES (mg/Kg)
1				FILL- CLAYEY SILT, with some sand, yellow brown, dry, medum stiff; with interbeds of SILTY CLAY, yellow brown, dry, stiff		MH CH						
2												
3		T3-1										
4				CLAYEY SILT, with some sand yellow brown, dry, stiff, intermixied with clasts of diabase	Very Stiff	MH	97.0	20.1			2.75	
5												
6				BEDROCK - WEATHERED DIABASE, fractured, highly weathered, brown with white streaks, dense	Dense	Rx						
7	TD			FREE GROUNDWATER NOT ENCOUNTERED TO MAXIMUM DEPTH OF EXCAVATION AT 6 FEET. TEST PIT BACKFILLED AND COMPACTED TO LESS THAN 90% RELATIVE COMPACTION ALL SAMPLES RECOVERED USING A PORTABLE 2.5 INCH O.D. MOD. CAL. SAMPLER.								
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PRA Group
CONSULTING ENGINEERS

EXPLORATORY TEST PIT LOG TP- 3
SE OF WALPERT AND 2ND STREETS
HAYWARD, CALIFORNIA

Client: AMG&ASSOCIATES

FIGURE NO.
11

EXPLORATORY TEST PIT LOG

CLIENT: AMG & ASSOCIATES PROJECT NO.: G319-01	LOGGED BY: MS	DATE EXCAVATED: 5-28-14	PAGE 1 OF 1
BACKHOE: EXCAVATOR: AZIMUTH: N30°E		PIT ELEV.: E.G. PIT WIDTH/LENGTH:	TEST PIT NO. **TP-4**

FIELD				DESCRIPTION			LABORATORY					
DEPTH (FT.)	SAMPLE	SAMPLE NO.	BLOWS / FT.	MATERIAL DESCRIPTION AND REMARKS	CONSISTENCY	USCS LETTER SYMBOL	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	pH @ °C	PLASTICITY INDEX (%)	POCKET PENETROMETER (TSF)	SULFATES (mg/Kg)
1				CLAYEY SILT, with some sand, yellow brown, dry, medum stiff; with interbeds of SILTY CLAY, yellow brown, dry, stiff								
2	■	T4-1			Medium Stiff	MH CH	90.2	14.2			4.5+	
3												
4				SAND-SILT, with some clay yellow brown, dry, stiff,	Stiff	SM						
5												
6												
7	TD			FREE GROUNDWATER NOT ENCOUNTERED TO MAXIMUM DEPTH OF EXCAVATION AT 7 FEET. TEST PIT BACKFILLED AND COMPACTED TO LESS THAN 90% RELATIVE COMPACTION ALL SAMPLES RECOVERED USING A PORTABLE 2.5 INCH O.D. MOD. CAL. SAMPLER.								
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PRA Group
CONSULTING ENGINEERS

EXPLORATORY TEST PIT LOG TP- 4
SE OF WALPERT AND 2ND STREETS
HAYWARD, CALIFORNIA

Client: AMG&ASSOCIATES

FIGURE NO.
12

EXPLORATORY TEST PIT LOG

CLIENT: AMG & ASSOCIATES PROJECT NO.: G319-01	LOGGED BY: MS	DATE EXCAVATED: 5-28-14	PAGE 1 OF 1
BACKHOE: EXCAVATOR: AZIMUTH: N53°E		PIT ELEV.: E.G. PIT WIDTH/LENGTH:	TEST PIT NO. **TP-5**

FIELD				DESCRIPTION			LABORATORY					
DEPTH (FT.)	SAMPLE	SAMPLE NO.	BLOWS / FT.	MATERIAL DESCRIPTION AND REMARKS	CONSISTENCY	USCS LETTER SYMBOL	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	pH @ °C	PLASTICITY INDEX (%)	POCKET PENETROMETER (TSF)	SULFATES (mg/Kg)
1–2				CLAYEY SILT, with some sand, yellow brown, dry, medum stiff; with interbeds of SILTY CLAY, yellow brown, dry, stiff	Medium Stiff	MH CH						
3–6				SAND-SILT, with some clasts of diabase dry, stiff,	Stiff	SM						
7	TD			FREE GROUNDWATER NOT ENCOUNTERED TO MAXIMUM DEPTH OF EXCAVATION AT 7 FEET. TEST PIT BACKFILLED AND COMPACTED TO LESS THAN 90% RELATIVE COMPACTION ALL SAMPLES RECOVERED USING A PORTABLE 2.5 INCH O.D. MOD. CAL. SAMPLER.								
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PRA Group
CONSULTING ENGINEERS

EXPLORATORY TEST PIT LOG TP- 5
SE OF WALPERT AND 2ND STREETS
HAYWARD, CALIFORNIA

Client: AMG&ASSOCIATES

FIGURE NO.
13

EXPLORATORY TEST PIT LOG

CLIENT: AMG & ASSOCIATES PROJECT NO.: G319-01	LOGGED BY: MS	DATE EXCAVATED: 5-28-14	PAGE 1 OF 1
BACKHOE: EXCAVATOR:		PIT ELEV.: E.G.	TEST PIT NO.
AZIMUTH: N30°E		PIT WIDTH/LENGTH:	**TP-6**

FIELD				DESCRIPTION			LABORATORY					
DEPTH (FT.)	SAMPLE	SAMPLE NO.	BLOWS / FT.	MATERIAL DESCRIPTION AND REMARKS	CONSISTENCY	USCS LETTER SYMBOL	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	pH @ °C	PLASTICITY INDEX (%)	POCKET PENETROMETER (TSF)	SULFATES (mg/Kg)
1				CLAYEY SILT, black, dry, stiff;	Stiff	MH						
2												
3				SAND - SILT, dry yellow brown, dry, stiff,	Stiff	SM						
4												
5												
6	■	T6-1		WEATHERED BEDROCK - mix of reddish brown and white, fractured, highly weathered diabase, dry, dense	Dense	Rx	78.0	13.9			4.5+	
7												
8	TD			FREE GROUNDWATER NOT ENCOUNTERED TO MAXIMUM DEPTH OF EXCAVATION AT 8 FEET. TEST PIT BACKFILLED AND COMPACTED TO LESS THAN 90% RELATIVE COMPACTION. ALL SAMPLES RECOVERED USING A PORTABLE 2.5 INCH O.D. MOD. CAL. SAMPLER.								
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PRA Group
CONSULTING ENGINEERS

EXPLORATORY TEST PIT LOG TP- 6
SE OF WALPERT AND 2ND STREETS
HAYWARD, CALIFORNIA

Client: AMG&ASSOCIATES

FIGURE NO.
14

EXPLORATORY TEST PIT LOG

CLIENT: AMG & ASSOCIATES PROJECT NO.: G319-01	LOGGED BY: MS	DATE EXCAVATED: 5-28-14	PAGE 1 OF 1
BACKHOE: EXCAVATOR:		PIT ELEV.: E.G.	TEST PIT NO.
AZIMUTH: N30°E		PIT WIDTH/LENGTH:	**TP-7**

FIELD				DESCRIPTION			LABORATORY					
DEPTH (FT.)	SAMPLE	SAMPLE NO.	BLOWS / FT.	MATERIAL DESCRIPTION AND REMARKS	CONSISTENCY	USCS LETTER SYMBOL	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	pH @ °C	PLASTICITY INDEX (%)	POCKET PENETROMETER (TSF)	SULFATES (mg/Kg)
1				SAND SILT, brown, dry, stiff, with large cobbles	Stiff	SM						
2												
3												
4												
5												
6					Very Stiff	SM						
7												
8	TD			FREE GROUNDWATER NOT ENCOUNTERED TO MAXIMUM DEPTH OF EXCAVATION AT 7 FEET. TEST PIT BACKFILLED AND COMPACTED TO LESS THAN 90% RELATIVE COMPACTION. ALL SAMPLES RECOVERED USING A PORTABLE 2.5 INCH O.D. MOD. CAL. SAMPLER.								
9												
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PRA Group
CONSULTING ENGINEERS

EXPLORATORY TEST PIT LOG TP- 7
SE OF WALPERT AND 2ND STREETS
HAYWARD, CALIFORNIA

Client: AMG&ASSOCIATES

FIGURE NO.
15

EXPLORATORY TEST PIT LOG

CLIENT: AMG & ASSOCIATES PROJECT NO.: G319-01	LOGGED BY: MS	DATE EXCAVATED: 5-28-14	PAGE 1 OF 1
BACKHOE: EXCAVATOR: AZIMUTH: N30°E		PIT ELEV.: E.G. PIT WIDTH/LENGTH:	TEST PIT NO. **TP-8**

FIELD				DESCRIPTION			LABORATORY					
DEPTH (FT.)	SAMPLE	SAMPLE NO.	BLOWS / FT.	MATERIAL DESCRIPTION AND REMARKS	CONSISTENCY	USCS LETTER SYMBOL	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	pH @ °C	PLASTICITY INDEX (%)	POCKET PENETROMETER (TSF)	SULFATES (mg/Kg)
1				CLAYEY SILT, black, dry, medum stiff	Medium Stiff	CH						
2												
3				SAND-SILT, reddish brown, with hard clasts of weathered diabase								
4	■	T8-1			Stiff	SM		11.7			4.5+	
5												
6	TD			FREE GROUNDWATER NOT ENCOUNTERED TO MAXIMUM DEPTH OF EXCAVATION AT 5 FEET. TEST PIT BACKFILLED AND COMPACTED TO LESS THAN 90% RELATIVE COMPACTION ALL SAMPLES RECOVERED USING A PORTABLE 2.5 INCH O.D. MOD. CAL. SAMPLER.								
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PRA Group
CONSULTING ENGINEERS

EXPLORATORY TEST PIT LOG TP- 8
SE OF WALPERT AND 2ND STREETS
HAYWARD, CALIFORNIA

Client: AMG&ASSOCIATES

FIGURE NO.
16

EXPLORATORY TEST PIT LOG

CLIENT: AMG & ASSOCIATES PROJECT NO.: G319-01	LOGGED BY: MS	DATE EXCAVATED: 5-28-14	PAGE 1 OF 1
BACKHOE: EXCAVATOR: AZIMUTH: N30°E		PIT ELEV.: E.G. PIT WIDTH/LENGTH:	TEST PIT NO. **TP- 9**

FIELD				DESCRIPTION			LABORATORY					
DEPTH (FT.)	SAMPLE	SAMPLE NO.	BLOWS / FT.	MATERIAL DESCRIPTION AND REMARKS	CONSISTENCY	USCS LETTER SYMBOL	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	pH @ °C	PLASTICITY INDEX (%)	POCKET PENETROMETER (TSF)	SULFATES (mg/Kg)
1												
2				SAND-SILT, yellow brown, dry with intermixed clasts of weathered diabase	Medium Stiff	SM						
3												
4					Stiff							
5												
6												
7					Very Stiff							
8												
9	TD			FREE GROUNDWATER NOT ENCOUNTERED TO MAXIMUM DEPTH OF EXCAVATION AT 8 FEET. TEST PIT BACKFILLED AND COMPACTED TO LESS THAN 90% RELATIVE ALL SAMPLES RECOVERED USING A PORTABLE 2.5 INCH O.D. MOD. CAL. SAMPLER.								
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32												

PRA Group
CONSULTING ENGINEERS

EXPLORATORY TEST PIT LOG TP- 9
SE OF WALPERT AND 2ND STREETS
HAYWARD, CALIFORNIA

Client: AMG&ASSOCIATES

FIGURE NO.
17

EXPLORATORY TEST PIT LOG

CLIENT: AMG & ASSOCIATES PROJECT NO.: G319-01	LOGGED BY: MS	DATE EXCAVATED: 5-28-14	PAGE 1 OF 1
BACKHOE: EXCAVATOR: AZIMUTH: N30°E		PIT ELEV.: E.G. PIT WIDTH/LENGTH:	TEST PIT NO. **TP-10**

FIELD				DESCRIPTION			LABORATORY					
DEPTH (FT.)	SAMPLE	SAMPLE NO.	BLOWS / FT.	MATERIAL DESCRIPTION AND REMARKS	CONSISTENCY	USCS LETTER SYMBOL	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	pH @ °C	PLASTICITY INDEX (%)	POCKET PENETROMETER (TSF)	SULFATES (mg/Kg)
1–2	■	T10-1		SAND SILT, yellow brown, dry, medium stiff	Medum Stiff	SM	84.6	14.4			4.5+	
3–4				SAND - SILT, dry, reddish brown, medium stiff with hard clasts of weathered diabase	Medium Stiff	SM						
5–6												
7					Stiff	SM						
8	TD			FREE GROUNDWATER NOT ENCOUNTERED TO MAXIMUM DEPTH OF EXCAVATION AT 8 FEET. TEST PIT BACKFILLED AND COMPACTED TO LESS THAN 90% RELATIVE COMPACTION. ALL SAMPLES RECOVERED USING A PORTABLE 2.5 INCH O.D. MOD. CAL. SAMPLER.								
9–32												

PRA Group
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EXPLORATORY TEST PIT LOG TP- 10
SE OF WALPERT AND 2ND STREETS
HAYWARD, CALIFORNIA

Client: AMG&ASSOCIATES

FIGURE NO.
18

EXPLORATORY TEST PIT LOG

CLIENT: AMG & ASSOCIATES PROJECT NO.: G319-01	LOGGED BY: MS	DATE EXCAVATED: 5-28-14	PAGE 1 OF 1
BACKHOE: EXCAVATOR:		PIT ELEV.: E.G.	TEST PIT NO.
AZIMUTH: N30°E		PIT WIDTH/LENGTH:	**TP-11**

FIELD				DESCRIPTION			LABORATORY					
DEPTH (FT.)	SAMPLE	SAMPLE NO.	BLOWS / FT.	MATERIAL DESCRIPTION AND REMARKS	CONSISTENCY	USCS LETTER SYMBOL	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	pH @ °C	PLASTICITY INDEX (%)	POCKET PENETROMETER (TSF)	SULFATES (mg/Kg)
1				SAND SILT, yellow brown, dry, medium stiff	Medum Stiff	SM						
2												
3				WEATHERED BEDROCK - reddish brown with white streaks, highly weathered diabase, dense	Dense	Rx						
4												
5												
6												
7	TD			FREE GROUNDWATER NOT ENCOUNTERED TO MAXIMUM DEPTH OF EXCAVATION AT 6 FEET. TEST PIT BACKFILLED AND COMPACTED TO LESS THAN 90% RELATIVE COMPACTION. ALL SAMPLES RECOVERED USING A PORTABLE 2.5 INCH O.D. MOD. CAL. SAMPLER.								
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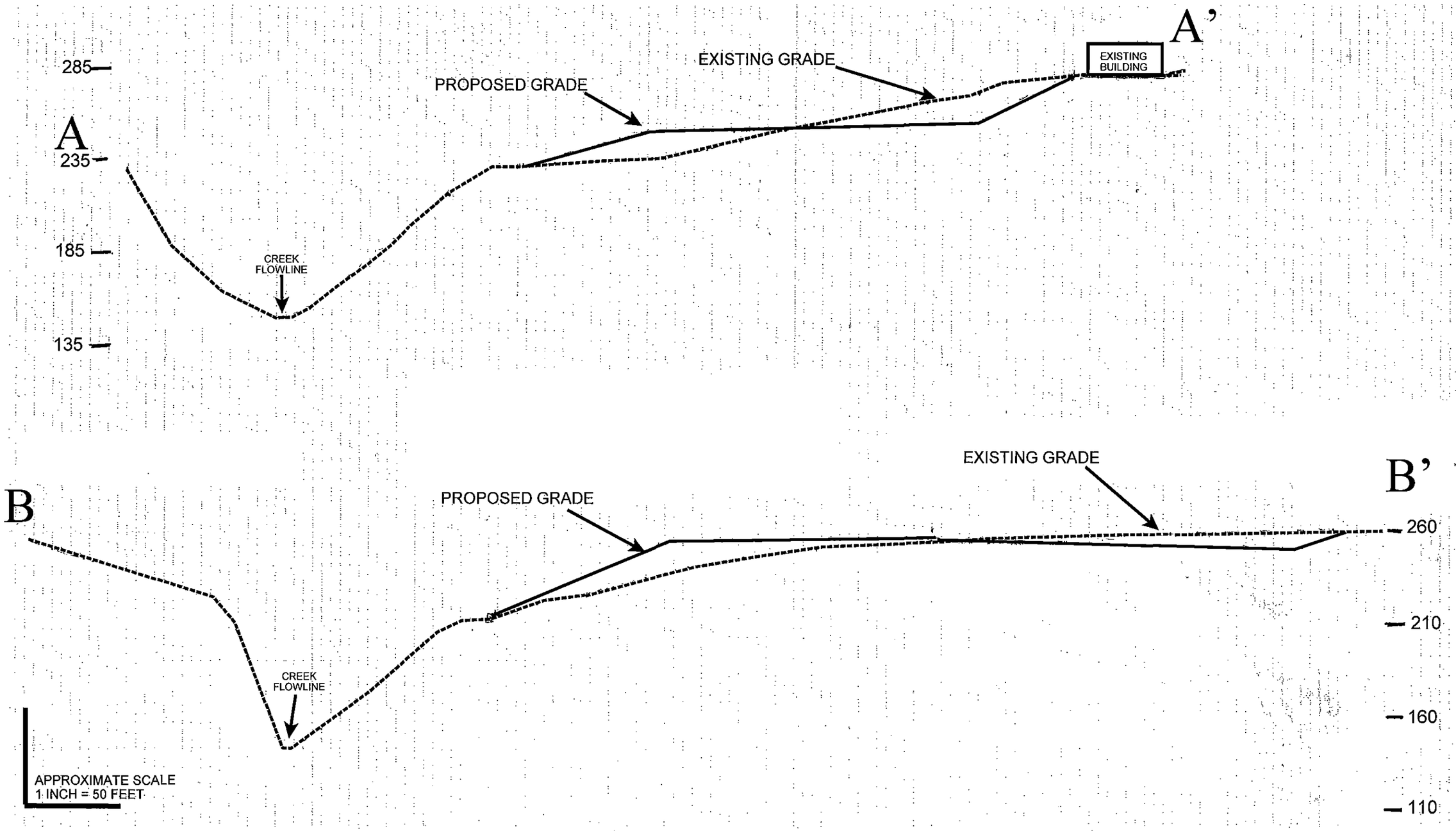
PRA Group
CONSULTING ENGINEERS

EXPLORATORY TEST PIT LOG TP- 11
SE OF WALPERT AND 2ND STREETS
HAYWARD, CALIFORNIA

Client: AMG&ASSOCIATES

FIGURE NO.
19



NOTES

SEE FIGURE 3 FOR LOCATION OF CROSS SECTIONS

DATE	JUNE 2014
JOB NO.	G319-01
DWG NO.	G31901FIG 20
DRAWN	IDA
CHK'D	DJR
APP'D	DJR

PRA Group
CONSULTING ENGINEERS

TOPOGRAPHIC CROSS SECTIONS
SE OF WALNUT STREET AND 2ND STREET
HAYWARD, CALIFORNIA

CLIENT AMG & ASSOCIATES

FIGURE NO.
20

REV. NO.

APPENDIX A

CERCO ANALYTICAL CORROSION REPORT

California State Certified Laboratory No. 2153

CERCO analytical
1100 Willow Pass Court, Suite A
Concord, CA 94520-1006
925 462 2771 Fax. 925 462 2775
www.cercoanalytical.com

17 June, 2014

Job No.1406091
Cust. No.11002

Mr. Joe Ambrosino
Purcell, Rhoades & Associates
1041 Hook Avenue
Pleasant Hill, CA 94523

Subject: Project No.: G319-01
Project Name: Hayward Condo, 2nd Street
Corrosivity Analysis – ASTM Test Methods

Dear Mr. Ambrosino:

Pursuant to your request, CERCO Analytical has analyzed the soil sample submitted on June 11, 2014. Based on the analytical results, this brief corrosivity evaluation is enclosed for your consideration.

Based upon the resistivity measurement, this sample is classified as "moderately corrosive". All buried iron, steel, cast iron, ductile iron, galvanized steel and dielectric coated steel or iron should be properly protected against corrosion depending upon the critical nature of the structure. All buried metallic pressure piping such as ductile iron firewater pipelines should be protected against corrosion.

The chloride ion concentration reflects none detected with a detection limit of 15 mg/kg.

The sulfate ion concentration reflects none detected with a detection limit of 15 mg/kg.

The pH of the soil is 7.65, which does not present corrosion problems for buried iron, steel, mortar-coated steel and reinforced concrete structures.

The redox potential is 250-mV, which is indicative of potentially "slightly corrosive" soils resulting from anaerobic soil conditions.

This corrosivity evaluation is based on general corrosion engineering standards and is non-specific in nature. For specific long-term corrosion control design recommendations or consultation, please call *JDH Corrosion Consultants, Inc. at (925) 927-6630.*

We appreciate the opportunity of working with you on this project. If you have any questions, or if you require further information, please do not hesitate to contact us.

Very truly yours,
CERCO ANALYTICAL, INC.

J. Darby Howard, Jr., P.E.
President

JDH/jdl
Enclosure

California State Certified Laboratory No. 2153

CERCO analytical
1100 Willow Pass Court, Suite A
Concord, CA 94520-1006
925 462 2771 Fax. 925 462 2775
www.cercoanalytical.com

Client: Purcell, Rhoades & Associates
Client's Project No.: G319-01
Client's Project Name: Hayward Condo, 2nd Street
Date Sampled: 10-Jun-14
Date Received: 11-Jun-14
Matrix: Soil
Authorization: Signed Chain of Custody

Date of Report: 17-Jun-2014

Job/Sample No.	Sample I.D.	Redox (mV)	pH	Conductivity (umhos/cm)*	Resistivity (100% Saturation) (ohms-cm)	Sulfide (mg/kg)*	Chloride (mg/kg)*	Sulfate (mg/kg)*
1406091-001	TP-1	250	7.65	-	2,400	-	N.D.	N.D.

Method:	ASTM D1498	ASTM D4972	ASTM D1125M	ASTM G57	ASTM D4658M	ASTM D4327	ASTM D4327
Detection Limit:	-	-	10	-	50	15	15
	17-Jun-2014	17-Jun-2014	-	13-Jun-2014	-	16-Jun-2014	16-Jun-2014

Cheryl McMillen
Laboratory Director

* Results Reported on "As Received" Basis
N.D. - None Detected

Quality Control Summary - All laboratory quality control parameters were found to be within established limits

APPENDIX B

GENERAL GRADING SPECIFICATIONS

FOR

PROPOSED WALPERT STREET CONDOMINIUM PROJECT
SE OF WALPERT AND 2ND STREETS
HAYWARD, CALIFORNIA
FOR
AMG & ASSOCIATES, LLC

APPENDIX B

GENERAL GRADING SPECIFICATIONS

FOR

PROPOSED WALPERT STREET CONDOMINIUM PROJECT
SE OF WALPERT AND 2ND STREETS
HAYWARD, CALIFORNIA
FOR
AMG & ASSOCIATES, LLC

1. General

1.1 These General Grading Specifications (called "Specifications" here) provide general guidelines for soil engineering aspects of grading for the subject development. The Geotechnical Engineer from PRA GROUP (PRAG) should be consulted prior to any site work connected with grading. Please refer to the following report(s) for other grading recommendations supporting these Specifications.

1. PRAG, July 11, 2014, Geotechnical Study, Proposed Walpert Street Condominium Project, SE of Walpert and 2nd Streets, Hayward, California: Project No. GA-109/G319-01.

1.2 These Specifications include the following:

- clearing, stripping, grubbing, and preparing areas to be filled
- selecting materials for fill
- placing, spreading, and compacting fill
- completing subsidiary work necessary to conform to lines, grades, and slopes shown on accepted plans
- protecting the soil in slab and foundation areas from drying out between grading and construction

1.3 Tests and observations shall be made by a representative from PRAG during the grading so that we can confirm that grading was performed according to these Specifications. Such confirmation in a Final grading report is often required to obtain a building permit.

1.4 PRAG shall be notified at least two working days prior to placement of fill so arrangements

for testing and observation may be made.

1.5 Grading or placement of fill done without the presence of a representative of PRAG or without prior coordination between PRAG and the grading contractor shall be at the contractor's risk; PRAG will accept no responsibility for such work.

2. Testing

2.1 The American Society for Testing and Materials (ASTM) Test Procedure D 1557 shall be the standard test to define maximum densities for all compaction of fill. All densities shall be expressed as relative compaction in terms of the maximum dry density obtained in the laboratory by the foregoing standard procedure.

2.2 Field density tests shall be performed according to ASTM Test Procedures D 2922 and D 3017. The locations and number of field density tests shall be selected by the Geotechnical Engineer or the Engineer's Representative.

3. Clearing, Stripping, Grubbing, and Preparing of Areas to Be Filled

3.1 Trees, roots, vegetation, and organic surficial soil shall be removed from structural areas unless specified otherwise by PRAG. The depth of organic surficial soil to be removed will be recommended by the Geotechnical Engineer or the Engineer's Representative but, in general, will probably vary from about 2 to 4 inches.

3.2 Strippings are defined as surface vegetation and organic surficial soil. Strippings may not be used in fill unless specifically authorized and observed by the Geotechnical Engineer or the Engineer's Representative. Stripping may be stockpiled for landscaping use, with the approval of the landscape architect.

3.3 Soil deemed soft or unsuitable by the Geotechnical Engineer or the Engineer's Representative shall be removed. Loose fills and surface soil sloughs shall also be excavated.

3.4 Underground structures such as old foundations, abandoned pipelines, septic tanks, and leach fields shall be removed from the site.

3.5 The final stripping and excavation shall be approved by the Geotechnical Engineer or the Engineer's Representative before further grading is started.

3.6 The original ground on which the fill, foundation or slabs are to be placed shall be plowed or scarified at least 8 inches and until the surface is free from ruts, hummocks or uneven features which would tend to prevent compaction. The contractor shall observe the following guidelines:

- Where the slope ratio of the original ground is steeper than 5:1 (horizontal to vertical), the bank shall be stepped or benched.

- At the toe of the side slope fills, the base key shall be at least 20 feet in width, cut into firm, natural ground and sloped back into the hillside at a gradient of at least 2 percent.

- Subsequent keys or benches shall be 10 feet wide and placed no more than 4 feet in vertical height from the previous key or bench unless otherwise recommended by the Geotechnical Engineer or the Engineer's Representative.

3.7 The native subgrade soil to receive fill shall be moisture-conditioned and compacted to the requirements specified in the referenced report and below for general fill placement:

Minimum relative compaction:	90	percent
Minimum moisture content:	3	percent over optimum
Special considerations:	85-90	percent compaction in designated expansive soil at 5 percent over optimum moisture condition.

4. Selecting Fill

4.1 The Geotechnical Engineer or the Engineer's Representative shall evaluate suitability of materials for compacted fills. The material shall be a soil or soil-rock mixture, free of organic matter or other deleterious substances. Within 3 feet of finished grade, the compacted fill shall contain no rocks or lumps over 6 inches in diameter and none that are more than 15 percent larger than 2-1/2 inches. Rocks greater than 6 inches in diameter shall be placed in deep fills as approved by the Geotechnical Engineer or the Engineer's Representative so that they are not nested and so compaction may be achieved around them.

4.2 If imported materials are needed, they must be approved by the Geotechnical Engineer or the Engineer's Representative prior to transporting the fill to the project. Unless otherwise exempted by the Geotechnical Engineer, they should meet the following requirements:

1. The plasticity index shall not exceed 15.
2. No rocks shall exceed 6 inches in diameter.

5. Placing, Spreading, and Compacting Fill

5.1 The fill shall be placed in uniform lifts of not more than 8 inches in uncompacted thickness. Each layer shall be spread evenly and shall be thoroughly blade mixed during spreading to

obtain uniformity of material. Before compaction begins, the fill shall be brought to a water content (as directed by the Geotechnical Engineer or the Engineer's Representative) that will permit proper compaction by either (1) aerating the material if it is too wet or (2) spraying the material with water if it is too dry.

5.2 After each layer has been placed, mixed, and spread evenly, it shall be compacted as specified on page 7 and 8 in the referenced report and below for general fill placement:

Minimum relative compaction:	90	percent
Minimum moisture content:	3	percent over optimum
See Section 3.7 for expansive soil criteria		

5.3 The contractor shall use appropriate equipment to compact the fill to the specified density. Compacting shall be performed while the fill is within the specified range of moisture content. Each layer shall be compacted over its entire area, and the compacting equipment shall make enough passes to achieve the required density.

5.4 Fill placed on slopes shall be compacted by means of suitable equipment. Benching of the slopes should be done in increments of 3 to 5 feet in height until the fill is brought to its specified height or as determined by the Geotechnical Engineer or the Engineer's Representative.

5.5 When sheepsfoot rollers are used for compaction, the density tests shall be taken in the compacted material below the surface disturbed by the roller. When these tests indicate that the density of any layer of fill, or portion thereof, is below the required density, it shall be reworked until the required compaction has been obtained.

5.6 Soil shall not be placed or compacted during periods of rain or on ground which is not drained of water. Soil which has been moistened by rain or other cause shall not be compacted until the moisture content is within the limits specified in the referenced report. Prior approval by the Geotechnical Engineer or the Engineer's Representative shall be obtained before continuing grading.

6. Backfilling Trenches

6.1 Geologic exploratory trenches (or other depressions), if any, within the proposed building or pavement areas, shall be re-excavated and backfilled to meet the requirements for compacted fill, as specified above.

6.2 The utility trenches extending under the perimeter foundation and concrete slabs-on-grade may require backfilling or plugging with impermeable soils at the building line with a 3-foot wide impermeable segment of compacted fill. Requirements will be specified during trench backfilling. Ponding or jetting of trench backfill is not recommended.

7. Removing Subsurface Pipes

7.1 The Geotechnical Engineer or Engineer's Representative shall designate the methods of removal of subsurface pipes. Depending upon depth and location, one of the following methods shall be specified:

- The pipe shall be removed, and the trench shall be filled and compacted according to applicable requirements for compacting native soil (Section 3) or fill (Section 5).
- The pipe shall be crushed in the trench, and the trench shall be filled and compacted according to applicable portions of Sections 3 and 5.
- The ends of the pipes shall be capped with concrete to prevent entrance of water. The length of the cap shall be at least 5 feet.

7.2 Any existing wells on the site shall be filled, buried and capped according to the requirements of the local regulatory agency. The final elevation of the top of the well casing shall be a minimum of 36 inches below any adjacent grade at the completion of grading or filling. Under no circumstances should structural foundations be placed over the capped wells.

8. Grading Slopes

8.1 Slopes shall be graded at gradients no steeper than 2:1 (horizontal to vertical) for fill and cut, except as noted in the referenced report.

8.2 After the slopes have been graded, they shall be track-rolled, and provisions shall be made for planting the slopes for erosion control. Drainage facilities shall be constructed to prevent water from flowing over slopes. No slope shall be left to stand through a winter season without erosion control.

9. Installing Subdrains

9.1 For subdrains, the contractor shall provide and install perforated pipe Standard Designation Ratio (SDR) 23.5 or equivalent approved by the Geotechnical Engineer or the Engineer's Representative and filter material for subdrains as shown on the plans or as directed by the PRAG. The following restrictions apply:

9.1.1 Clay drain tile, concrete drain tile and perforated clay pipe shall not be permitted. Use no wyes, tees, or other joints of these materials.

9.1.2 Porous concrete pipe, perforated asbestos-cement pipe, bituminous fiber or pipe of other materials shall be permitted only on written authorization of the Geotechnical Engineer.

9.1.3 The contractor shall use ½ by 3/4 inch drain rock wrapped within a filter fabric approved by our Geotechnical Engineer, unless otherwise permitted by written authorization from the Geotechnical Engineer.

9.1.4 Unless recommended otherwise by the Geotechnical Engineer or the Engineer's Representative, the contractor shall use pipes not less than 4 inches in diameter for lateral drains up to 50 feet in length. Use pipes of not less than 6 inches in diameter for lateral drains greater than 50 feet in length. Larger minimum pipe diameters may be specified by the Geotechnical Engineer or the Engineer's Representative during construction.

10. Unusual Conditions

10.1 If unusual conditions occur during grading, the Geotechnical Engineer shall be immediately notified for recommendations.