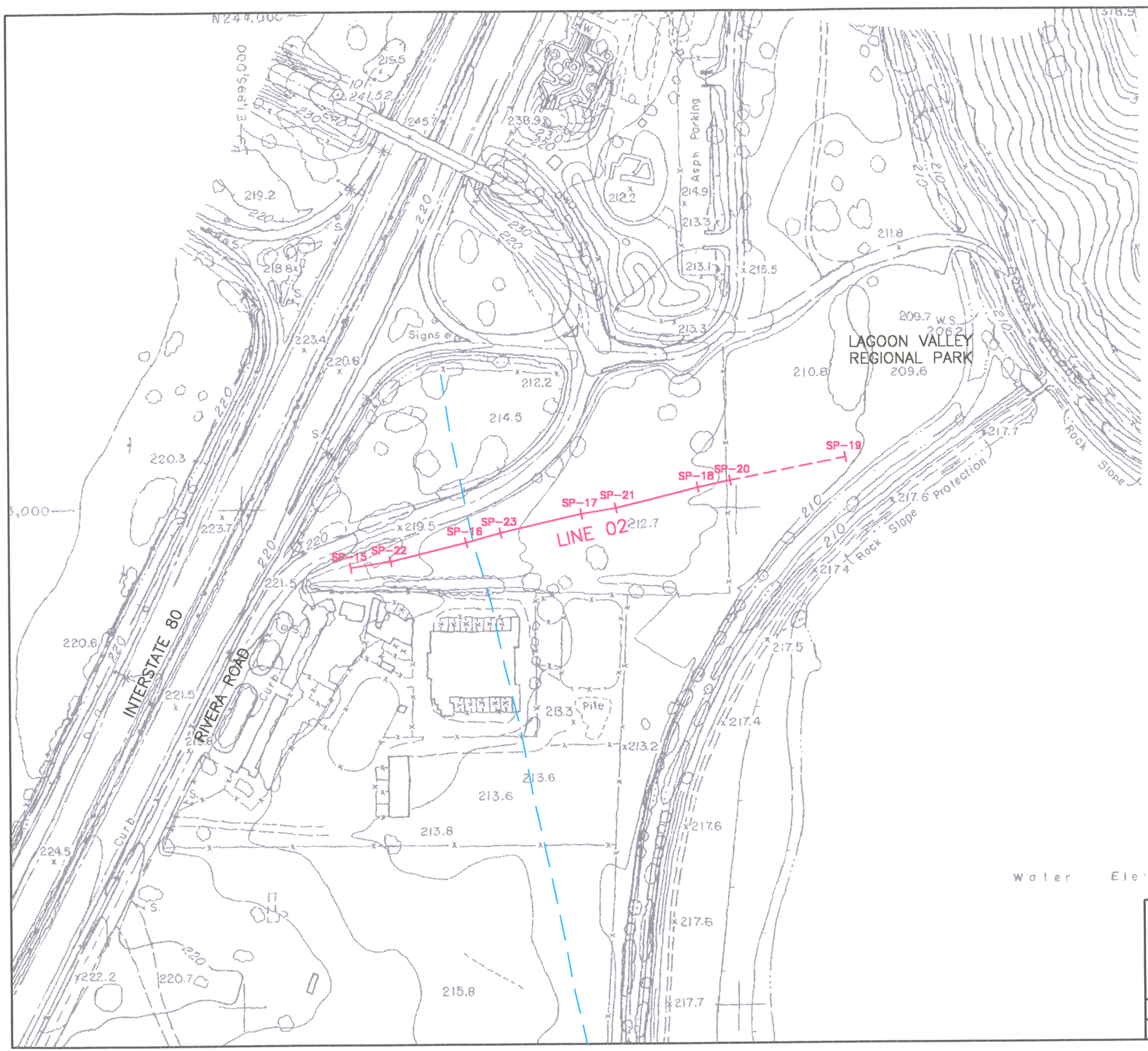


SCALE

0 100 200 400

(1 inch = 200 feet)

LEGEND

	SEISMIC REFRACTION PROFILE
SP-15	SHOT POINT LOCATION
	SUSPECTED FAULT TRACE

NORCAL

LOCATION MAP
SEISMIC REFRACTION SURVEY
LAGOON VALLEY

LOCATION: VACAVILLE, CALIFORNIA

CLIENT: ENGEO

NORCAL GEOPHYSICAL CONSULTANTS INC.

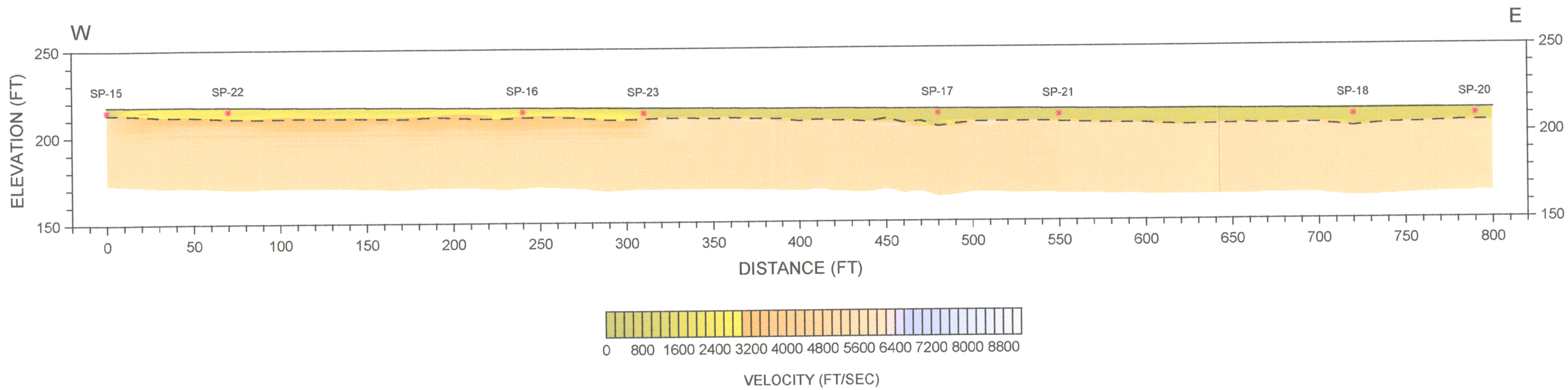
JOB #: 03-241.10

DATE: AUG 2003

DRAWN BY: G.RANDALL

APPROVED BY: WEB

PLATE 4



LEGEND

———	GROUND SURFACE
— — — -	SEISMIC VELOCITY INTERFACE
SP-15 *	SHOT POINT

NORCAL

LINE 02
SEISMIC REFRACTION SURVEY
LAGOON VALLEY

LOCATION: VACAVILLE, CALIFORNIA

CLIENT: ENGEO

NORCAL GEOPHYSICAL CONSULTANTS INC.

JOB #: 03-241.10

DATE: AUG 2003

DRAWN BY: WEB

APPROVED BY: WEB

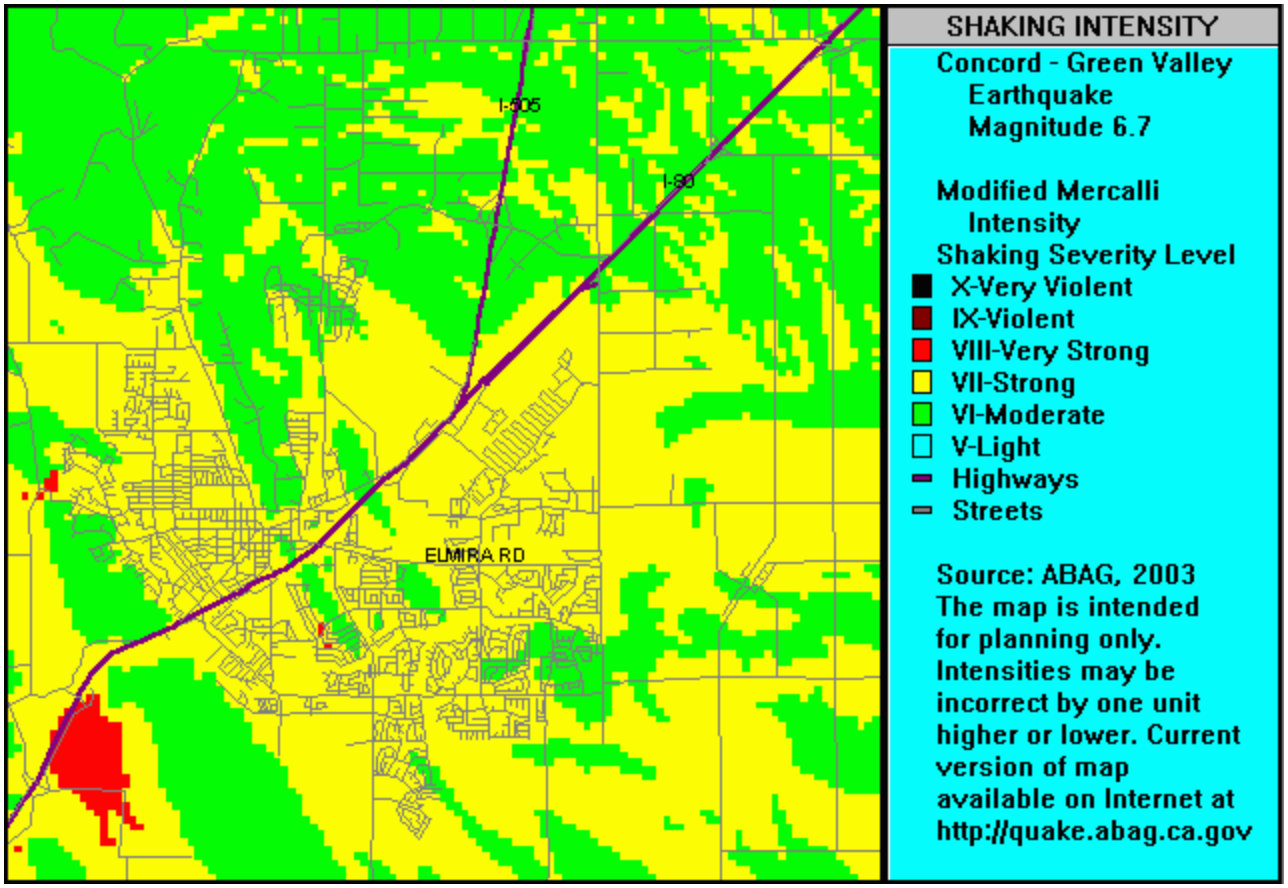
PLATE 5

Earthquake Hazard Map for Vacaville
Scenario: Concord-Green Valley Fault

These intensity maps are not intended to be site-specific. Rather, they depict the general risk within neighborhoods and the relative risk from community to community.

For information on how these maps were made, click here.
To see the full description of the modified Mercalli intensity scale, click here.
Are you in a hazard zone? For help with retrofitting, go to our HOME QUAKE SAFETY TOOLKIT.

Did you get to this page from a QUIZ? If so, close this window to return to the QUIZ.



PRELIMINARY GEOTECHNICAL EXPLORATION

LAGOON VALLEY

VACAVILLE, CALIFORNIA

SUBMITTED

TO

TRIAD GROUP

VALLEJO, CALIFORNIA

PREPARED

BY

ENGEO INCORPORATED

PROJECT NO. 5489.2.002.01

JULY 25, 2003

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ENGEO INCORPORATED

GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS
MATERIALS TESTING

Project No.
5489.2.002.01

July 25, 2003

Mr. Tom Egidio
Triad Development
1095 Hiddenbrooke Parkway
Vallejo, CA 94591

Subject: Residential/Recreational Development
Lagoon Valley
Vacaville, California

PRELIMINARY GEOTECHNICAL EXPLORATION

Dear Mr. Egidio:

With your authorization, ENGEO Incorporated has conducted a preliminary geotechnical exploration as part of the Environmental Impact Report (EIR) for the Lagoon Valley project in Vacaville, California. The accompanying report presents the results of our site exploration and planning-level conclusions and recommendations appropriate for preparation of preliminary development plans. Based on our study, it is our opinion that the currently proposed development is feasible from a geotechnical standpoint provided the recommendations included in this report are followed.

We are pleased to provide our services to you on this project and look forward to consulting further with you and your design team.

Very truly yours,

ENGEO INCORPORATED

Stefanos A. Papadopulos
Staff Engineer

Robert Boeche
Project Geologist
sp/tb/cc:pregex

Reviewed by:

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INTRODUCTION

Purpose and Scope

The purpose of this geotechnical report is to characterize geologic conditions at the site and develop planning-level conclusions and recommendations appropriate for preparation of preliminary development plans for the project.

The scope of our exploration included the following:

- Review of pertinent geologic maps and literature.
- Examination of stereographic aerial photographs covering the site.
- Geologic reconnaissance of the site.
- Seismic Refraction Survey consisting of two lines across the Lagoon Valley.
- Drilling and logging of 6 exploratory borings.
- Laboratory testing of soil and bedrock materials including moisture content, dry density, Atterberg limits, fines content, and unconfined compressive strength.
- Analysis of the geological and geotechnical data.
- Preparation of this report summarizing our findings and conclusions.

This report was prepared for the exclusive use of Triad Development and its design team consultants. In the event that any changes are made in the character, design, or layout of the development, the conclusions and recommendations contained in this report should be reviewed by ENGEO Incorporated to determine whether modifications to the report are necessary. This document may not be reproduced in whole or in part by any means whatsoever, nor may it be quoted or excerpted without the express written consent of ENGEO Incorporated.

Site Location and Description

The project site is located in Vacaville, California. The 730-acre site is generally bounded to the north by Lagoon Lake, south and east by rolling hills and to the west by Interstate 80, as shown on Figure 1. The planned development area currently consists of existing residential development, open land, and agricultural land including the large Hines Horticulture facility.

Proposed Development

The development is in the planning stage at the current time. Based on the request for proposal (RFP) that you faxed us on March 25, 2002, the proposed project would consist of a 729-acre residential/recreational community with approximately 1300 homes, a championship style golf course, neighborhood and commercial uses as well as open space. According to preliminary cut/fill grading plans prepared by BKF on March 12, 2003, grading is expected to involve cuts up to 6 feet deep and fills up to about 16 feet above existing ground (Figure 2).

GEOLOGY AND SEISMICITY

Geologic Setting

As mapped by Graymer (2002) on the Regional Geologic Map, Figure 3, the bedrock near the site consists of Cretaceous-age Guinda Formation (Kg). The bedrock characteristically consists of calcareous sandstone with interbedded siltstone. The geologic structure at the site is the result of past tectonic uplift and faulting, followed by deposition of alluvium. The majority of this uplift and tilting is thought to have occurred during Pleistocene time, beginning around 2 million years ago. Deposition of alluvium along the central portion of the site covered the bedrock with many feet of unconsolidated sand, silt, clay and gravel (Qpf).

Faulting and Seismicity

The site is not located within a State of California Earthquake Fault Zone. No active faults are mapped on the property. The nearest active fault is the Great Valley fault, located about 5 miles east of the site. Although the Great Valley fault is close to the site, the activity status of the active Concord-Green Valley fault, located 9.8 miles west, suggests that it presents a greater seismic risk to the site (Figure 4).

The Working Group on California Earthquake Probabilities (WGEP, 1999) evaluated the 30-year probability of a M6.7 or greater earthquake occurring on the known active fault systems in the Bay Area, including the nearby Concord-Green Valley fault. The WGEP calculated an overall probability of 70 percent for the Bay Area as a whole. The Concord-Green Valley fault is assigned a 30-year probability of 6 percent.

The Lagoon Valley fault is mapped by Sims (1973) and Graymer (2002) traversing the center portion of the site. The fault is mapped as two subparallel traces to the south of the site. The

western most trace is concealed by the alluvium as it traverses the site. The eastern trace is mapped as dying out as it enters the site.

PREVIOUS STUDIES

The site was previously studied by Anderson Geotechnical Consultants (Anderson) in 1990 and 1991. The previous Anderson work included a fault study, landslide study and a geotechnical exploration. Geologic mapping, drilling of borings, excavation of trenches, and limited laboratory testing were performed for these studies. The locations of Anderson's exploration points and trenches are shown on Figure 5, the test borings and trench logs are included in Appendix A, and the laboratory test results are included in Appendix B.

Darwin Myers Associates prepared a Seismicity and Geology study, May 2, 2003. The study was included in the Environmental Impact Report of the Lagoon Valley Annexation, provided an overview of the existing geologic and seismic information and maps.

GEOTECHNICAL EXPLORATION

The field exploration for this study was conducted on May 28 and May 29, 2003, and consisted of drilling 6 exploratory borings, ranging from 26.5 to 41.5 feet deep. The approximate boring locations are shown on Figure 3. These areas of subsurface exploration were located by pacing from existing features, and the elevations were estimated from the plans provided at the time of our study.

The borings were drilled using a truck-mounted drill rig equipped with 6-inch-diameter hollow-stem augers. An ENGEO Geologist logged the boreholes in the field and collected soil samples using a 1-1/2-inch O.D, Standard Penetration Test (SPT) sampler or a 3-inch O.D California-type split-spoon sampler fitted with 6-inch-long brass liners. The 3-inch-diameter split-spoon sampler was advanced by a 140-pound cat-head hammer with a 30-inch drop. The penetration of the sampler into the native materials is field recorded as the number of blows needed to drive the sampler 18 inches in 6-inch increments. Results on the boring logs are recorded as the number of blows required for the last one foot of penetration. No correction factors have been applied to field blow counts presented on the borelogs.

The field logs were used to develop the report borelogs (Appendix A). The logs depict subsurface conditions within the borings for the date of drilling; however, subsurface conditions may vary with time. The boreholes were backfilled to the ground surface with site soil on the day of the field exploration.

Laboratory Testing

Following drilling, we re-examined the samples in our laboratory to confirm field classifications. Representative samples recovered from our borings were tested for the following physical characteristics:

Characteristic	Test Method	Location of Results Within this Report
Natural Unit Weight	ASTM D-2216	Appendix A
Natural Moisture Content	ASTM D-2216	Appendix A
Gradation (% Fines)	ASTM D-422-63	Appendix B
Atterberg Limits	ASTM D-4318	Appendix B
Unconfined Compression	ASTM D-2166	Appendix B

Geologic Units

Existing Uncontrolled Fill. Small deposits of undocumented fill occur on the site associated with existing roads and stock ponds. These fills can be expected to consist of compressible mixtures of soil and rock fragments.

Alluvium. The majority of the flat lying portion of the site consists as alluvium, as shown on Figure 3. The alluvial deposits can be expected to consist of inter-layered silty clay, silts, clayey sand and clayey gravel, with minor lenses of sand.

Residual Soil and Colluvium. The site bedrock is typically mantled with a minimum of four feet of residual soil formed from weathering and decomposition of the underlying bedrock. On the site, the weathering of the bedrock typically produces a fine-grained soil containing expansive clays. Downslope movement and deposition of residual soil by such processes as slopewash, sloughing/shallow sliding and creep has formed deposits of clay soil identified as colluvium on Figure 3. Based on our experience in the area, deposits of colluvium (typically thicker than 5 feet) likely occur in most swales and ravines and at the bases on many slopes on the property. The colluvium typically consists of expansive silty clay with rock fragments. However, the composition of the colluvium typically varies with the composition of the underlying bedrock.

For preliminary planning purposes, the colluvial soils should be considered potentially unstable, since such deposits often contain shear planes, even when there is no visible evidence of recent slope movement.

Landslides. Landslides are a significant geotechnical consideration for the proposed development of the site. Landslide deposits identified during this and previous studies were mapped using stereo-paired aerial photographs and field checked during site reconnaissance and field explorations. Known and suspected landslides are shown on Figure 3. The landslides identified on Figure 3 can be mitigated through commonly used corrective grading procedures. Typical corrective grading measures can include removing landslide debris and replacing it with engineered fill, construction of engineered shear keys, providing toe buttresses debris catchments, and providing setback areas between landslides and proposed development. Landslide mitigation measures should be implemented where landslides could affect improvements. The specific location, extent and depth of the required landslide mitigation will be presented on the final grading plans. The following is a description of the types of landslides identified at the Lagoon Valley Property.

Earthflows. Earthflows are a type of landslide that is characterized by mobilization as a viscous, slow-moving mass. Earthflows commonly move by a combination of semi-fluid flow and sliding along weak clay slip planes. They can occur by partial failure of colluvial soil masses or in association with rotational slumps or translation landslides (discussed below). Earthflows typically form when cohesive, clayey soils or weak bedrock become saturated during intense rains. Due to their high clay content, they tend to move relatively slowly, and movements usually persist for some time following peak rainfalls. Earthflows often accumulate as lobate masses of soil with complex internal shearing. Essentially all of the mapped landslides shown on Figure 3 can be categorized as earthflows.

Debris Flows. Debris flows are a type of landslide that can form during peak rainfall events when colluvium becomes saturated and fails, forming a fluid, mobile soil mass. Formation and mobilization of debris flows is generally considered most likely on slopes that are inclined at 2:1 (horizontal: vertical) or steeper. The mobility of debris flows and the potential distance that a flow can travel from the source area is related to the clay content of the colluvium at the source; flows generated from soils with high clay contents are typically less mobile than flows originating from relatively sandy soils. Another factor in debris-flow mobility is the steepness of the slope. As described above, it is our opinion that most of landslides at the site are earthflows. However, due to the sandy nature of the site bedrock, we would expect that debris flows could occur on steep slopes on the property, especially at the margins of existing landslides.

Bedrock Formation. Geologic mapping by Graymer (2002) shows Guinda Formation (Kg) on the west, south and east limits of the site. On the western side of the property the rock generally strikes to the north and dips to the east at 40 to 50 degrees. On the eastern side of the property the rock generally strikes to north and dips to the east at 35 to 40 degrees. On the southeastern side of the property the rock generally strikes to the north and dips to the west at 10 to 40 degrees.

In our field exploration, interbedded claystone and siltstone that is slightly weathered, closely fractured and weak was encountered in Boring B-4 at a depth of 23 feet. In Boring B-5 claystone moderately weathered, very closely fractured and weak was encountered at a depth of 40 feet. In a previous study conducted by Anderson Geotechnical Consultants, March 1990, siltstone was encountered in Borings 5 and 6 at a depth of 15 feet and 30 feet, respectively. The locations of the Anderson borings are shown on Figure 5 and the boring logs are included in Appendix A.

Groundwater

In Borings B-1, B-2, B-3, and B-6, groundwater was encountered at depths of about 16, 29½, 4, and 11 feet, respectively. In boring B-5, groundwater was encountered at 19 feet during drilling and it rose to 16 feet after drilling. Also in Borings 2 through 4 drilled by Anderson in 1990, the groundwater was first encountered at 5 to 13 feet but rose to within 3.5 to 4 feet of the surface in these borings after drilling ceased, meaning the water levels had not stabilized at the time the measurements were made. Groundwater conditions are expected to vary depending on factors such as weather conditions, time of year, and irrigation practices

Groundwater can be expected to impact the project in cut areas deeper than 5 feet and during excavation of utility trench excavations. Some dewatering of cut areas and/or utility trenches can be expected in the vicinity of Lagoon Valley Road.Cut areas or basement excavations with abundant seepage may require placement of subsurface drains to divert water around structural areas.

Fault Exploration

As noted above, the Lagoon Valley fault is mapped by Sims (1973) and Graymer (2002) traversing the center portion of the site. The fault is mapped as two subparallel traces to the south of the site. The western most trace is concealed by the alluvium as it traverses the site. The eastern trace is mapped as dying out as it enters the site. Previous exploration of the mapped fault was conducted by Anderson, to the north and south of the site. The exploration included four exploratory trenches at locations of the alleged fault traces. Minor offsets were observed in the trenches that did not extend into the overlying soils. Anderson concluded that no evidence of active regional faulting was encountered. To further explore the mapped trace of the Lagoon Valley fault within the site, we conducted a Seismic Refraction Survey.

Two seismic lines were used to obtain seismic refraction data. The seismic lines were positioned to slightly overlap each other along an approximate east-west alignment centered on the mapped trace of the Lagoon Valley Fault (Figure 3). The survey was performed by NORCAL Geophysical Consultants. NORCAL interpreted the seismic refraction data collected to be very uniform and not exhibiting travel time anomalies that are indicative of faulting. NORCAL's report is presented in Appendix C.

CONCLUSIONS

Based on the findings of our research and exploration, we conclude that the proposed development is suitable from geotechnical standpoint provided that appropriate design-level geotechnical studies are undertaken, as well as recommendations presented herein. The main geotechnical concerns for site development from a geotechnical perspective are slope stability, expansive soil and bedrock materials, and the swell/settlement potential of the proposed fills. These concerns and other geotechnical engineering issues such as potential seismic hazards and grading concepts are discussed in the subsequent sections of this report.

Slope Stability

The areas proposed for development are relatively flat-lying or gently sloping and are essentially stable in their undisturbed state. The hillslopes surrounding Lagoon Valley have unstable surface soils overlying claystone and siltstone bedrock. The shallow earthflows and debris flows which are common in the surrounded hillslopes could impact property developed close to the base of the slopes.

Where landslides could potentially impact the area of planned development, the hazard of landsliding can be mitigated by a combination of (1) complete removal of the slide debris; (2) reconstruction of the slide areas with drained, engineered fill; (3) buttressing the slide areas; or (4) designing the development and improvements in areas away from landslides.

Based on the preliminary development plans, conceptual remedial measures for landslides that could impact the proposed development area are summarized in the following table:

AREA DESIGNATION	TYPE OF FEATURE	CONCEPTUAL MITIGATION METHOD
1, 3, 2A, 2B	Coalescing landslide deposits	Construct shear keyway near toe of slide and buttress/catchment area for remaining upslope portion
2C, 3B, 3C, 3D, 13A	Debris flow	None – Outside property limits
2 4 through 9	Coalescing landslide deposits	None – Outside property limits
10 through 18	Coalescing landslide deposits	Construct shear keyway near toe of slide and buttress/catchment area for remaining upslope portion
12A	Possible deep seated	Construct shear keyway near toe of slide and buttress/catchment area for remaining upslope portion
19	Coalescing landslide deposits	Remove and replace
20 and 21	Coalescing landslide deposits	Construct shear keyway near toe of slide and buttress/catchment area for remaining upslope portion

Where remedial grading will involve buttressing portions of a slide mass that is to remain in-place, keyway excavation for the buttresses may need to take place in segments to reduce the potential for triggering movement of the upslope slide mass. Another remedial grading concern will be groundwater that will likely be encountered in deeper keyway excavations. Dewatering of deeper excavations should be anticipated during keyway excavation, particularly for keyways near the main valley floor.

Potential debris flow source areas are mapped on the site. Debris flow hazards in general are located primarily at the mouth of ravines and swales. Debris flow hazards can be mitigated by constructing containment areas or deflection berms to contain any debris that may effect the proposed development.

A design level geotechnical exploration of the site should be performed to further evaluate the potential landslide and debris flow hazards and provide recommendations for appropriate

mitigation measures for each landslide and debris flow source area that could impact the proposed development area.

Grading Concepts

As mentioned above, a geotechnical exploration of the site should be performed to further evaluate the geologic conditions described in this report; to characterize the engineering properties of soil and bedrock materials; and to address geotechnical engineering issues such as site preparation, grading, subdrains, keyways, foundations, etc. The recommendations presented herein are for planning purposes and will be refined as part of the geotechnical investigation.

Typical minimum keyway sizes and subdrains are shown on Figures 5 and 6.

In general, cut and fill slopes greater than 10 feet high should be no steeper than 3:1 (horizontal:vertical). Cut and fill slopes less than 10 feet high should be no steeper than 2:1. Depending on the findings of additional exploration and the availability of select fill material, higher fill slopes steeper than 3:1 may be feasible. It may also be feasible to construct fill slopes steeper than 3:1 using geogrid reinforcement.

A maintenance bench with a minimum of 20 to 30 feet in width should be provided at the toe of a major cut or fill slope. Typical debris bench construction details are shown on Figure 7. Access to these benches should be provided for maintenance purposes.

To reduce the magnitude of post-construction fill settlement, we anticipate recommendations for deeper fills will include higher compaction specifications in the deeper portions of fills and possibly selective grading methods. Moisture conditioning of clayey fill materials to above-optimum moisture content should also be anticipated. Detailed fill placement

recommendations will be provided based on laboratory testing and analysis performed in conjunction with a design-level geotechnical exploration for the project.

Excavation Characteristics

Based on our previous grading experience in the area and bedrock conditions exposed on the site, we anticipate that the bedrock materials should be rippable with conventional heavy grading equipment.

Expansive Soils

A significant geotechnical concern is the expansive nature of the native soil and bedrock, in the proposed development area. The clayey soil and claystone in this region have moderate to high plasticity and moderate to high expansion potentials with Plasticity Indices of 22 to 45. Expansive soils shrink and swell as a result of seasonal fluctuation in moisture content. This can cause heaving and cracking of slabs-on-grade, pavements and structures founded on shallow foundations. Building damage due to volume changes associated with expansive soils can be reduced through proper grading and foundation design.

Successful construction on expansive soils requires special attention during construction. It is imperative that exposed soils be kept moist by watering for several days before placement of concrete. It is extremely difficult to remoisturize clayey soils without excavation, moisture conditioning and recompaction. Mitigation measures should include the prevention of moisture variation.

Conceptual Foundation Design

The major considerations in foundation design for this project is the swell potential of some of the site's foundation soils. In order to reduce the effects of the potentially expansive soils, the foundations should be sufficiently stiff to move as rigid units with minimum differential movements.

Rigid structural mat systems such as post-tensioned foundations or structural mats are suitable to support anticipated residential structures for the planned development. Foundations may need to be stiffened to reduce differential movements from heaving to a value compatible with the type of structure that will be constructed. Design level studies and/or supplemental recommendations should be performed by the Geotechnical Engineer of Record to established foundation criteria.

Due to expansive site conditions foundation subgrades may require moisture conditioning and pre-saturation prior to foundation construction.

Secondary Slab-on-Grade Construction

Secondary slabs include exterior porch and patio slabs, walkways, driveways and steps. In order to allow slab movement to occur with minimal foundation distress, secondary slabs-on-grade should be constructed structurally independent of the foundation system. Differential movement between secondary slabs and foundation elements should be expected. An expansion joint material should be provided between architectural/structural elements constructed on adjacent secondary and foundation slabs to allow for each element to move independently and with minimal distress to the adjacent element. Where slab-on-grade construction is anticipated, care must be exercised in attaining a near-saturation condition of the subgrade soil before concrete placement.

Secondary slabs-on-grade should be designed specifically for their intended use and loading requirements. Some of the site soils have a moderate expansion potential; therefore, cracking of the slabs should be expected. Frequent control joints should be provided during slab construction for control of cracking.

Steel should not be used to tie porch slabs, exterior patio slabs, driveways, walkways, or steps to adjacent foundations. Exterior slabs may be constructed with thickened edges extending at least 6 inches into compacted soil to minimize water infiltration, and they should slope away from the building to prevent water from flowing toward the house.

Secondary slabs-on-grade should have a minimum thickness of 4 inches and should be underlain by a 4-inch-thick layer of clean, crushed rock or gravel. As a minimum requirement, slabs-on-grade should be reinforced with No. 3 bars spaced 16 inches on center each way for control of cracking. The actual slab reinforcement should be designed by the Structural Engineer. In our experience, welded wire mesh may not be sufficient to control slab cracking.

Preliminary Pavement Design

The exploratory test borings exposed sandy and silty clays near the surface of the site. Based on the field exploration, we have assumed a Resistance Value (R-value) of 5 for the street subgrades in calculating pavement sections. The following preliminary pavement sections have been determined for a Traffic Index of 4.5, 5, 6, 7, 8 and the assumed R-value of 5 in accordance to methods contained in Topic 608 of Highway Design Manual by Caltrans.

Traffic Index	R-value	Asphaltic Concrete	AB Rock (R=78minimum)
4.5	5	2.5 inches	10 inches
5	5	3.0 inches	10 inches
6	5	3.5 inches	13 inches
7	5	4.0 inches	16 inches
8	5	5.0 inches	18 inches

Pavement materials and construction should conform to the specifications and requirements of the Standard Specifications by the Division of Highways, Department of Public Works, State of California, latest edition, City of Vacaville requirements.

Corrosion Potential

Alkali soils observed in the main valley suggest that some of the alluvial soils may have high corrosion potential. We recommend that the corrosion potential of the soils be evaluated in conjunction with future geotechnical exploration for the project.

Seismic Hazards

Potential seismic hazards resulting from a nearby moderate to major earthquake may include primary ground rupture, ground shaking, lurching, liquefaction, lateral spreading and earthquake induced landsliding. These potential hazards are discussed below. The proposed development is located immediately south of Lagoon Valley Lake; therefore, there are potential risks from seiches. Risks from tsunamis are considered low at the site

Ground Rupture. The site is not within a State of California Earthquake Fault Hazard Zone and no known seismogenic faults have been mapped on the site. As previously discussed, the Lagoon

Valley fault is not considered active or potentially active. Based on these findings, the potential for fault rupture at the site is considered low.

Ground Shaking. Ground shaking due to an earthquake can be expected at the site during the design life of the proposed project. The degree of the shaking is dependent upon the magnitude of the event and the distance to its epicenter. Generally, the closer to the epicenter, the larger the degree of shaking. The subsurface conditions beneath the site are also important in determining the ground-shaking risk. In general, bedrock formations are considerably less susceptible to the severity of ground shaking than are alluvial formations and man-made fill.

To mitigate ground-shaking effects, all structures should be designed using sound engineering judgment and the latest 1997 Uniform Building Code (UBC) requirements as a minimum. Based on the subsurface soil conditions encountered and the Concord-Green Valley fault seismic source, the site may be characterized for design based on Chapter 16 of the 1997 UBC using the following information:

Categorization/Coefficient	Design Value
Soil Profile Type (Table 16-J)	S_D
Seismic Zone (Figure 16A-2)	4
Seismic Zone Factor (Table 16-I)	0.4
Seismic Source Type (Table 16-U)	B
Near Source Factor N_a (Table 16-S)	1.0
Near Source Factor N_v (Table 16-T)	1.0
Seismic Coefficient C_a (Table 16-Q)	0.44 N_a
Seismic Coefficient C_v (Table 16-R)	0.64 N_v

Conformance to current building code recommendations does not constitute any kind of guarantee that significant structural damage will not occur in the event of a maximum-magnitude earthquake.

Liquefaction Potential. Soil liquefaction is a phenomenon under which saturated, cohesionless, loose soils experience a temporary loss of shear strength when subjected to the cyclic shear stresses caused by earthquake ground shaking. The soil materials encountered in the borings drilled within the site generally consist of stiff silty clay that are not susceptible to liquefaction. Additional exploration should be performed where improvements are planned in the main valley area to confirm that material susceptible to liquefaction is not present in these areas.

Lateral Spreading. Lateral spreading is a failure within weaker soil material which causes the soil mass to move towards a free face or down a gentle slope. Lateral spreading is often associated with underlying liquefiable soils. Surficial soils on slopes will be removed as a part of the recommended grading operations and liquefiable soils were not encountered; therefore, it is our opinion that lateral spreading is unlikely.

Seismically-Induced Landsliding. As with most of the surrounding hillside developments, landslides and slope stability are important issues for the project. Although seismically-induced landsliding can be a significant hazard, it can generally be mitigated through proper grading procedures. Mitigation measures for this project include removing landslide debris, replacing landslides with engineered fill, and providing toe buttresses, debris benches, and setback areas. The location, extent, and depth of the required landslide mitigation measures will be developed during design-level geotechnical studies for the project.

Seiches. Lagoon Valley Lake is located immediately to the north of the proposed development and it provides a natural drainage basin for the entire site. Water elevation in the lake are shown to be at 211.5 feet above msl, dam crest elevation is at 217.6 feet, and preliminary grading plans of the site show elevations of 218 feet at the northern limits of the development. In March of 1986, the reservoir water level rose to within 1.5 feet of the dam crest. It is our opinion that there is a potential risks from seiches and further study needs to be done during the design level geotechnical

exploration.

LIMITATIONS AND UNIFORMITY OF CONDITIONS

This report is issued with the understanding that it is the responsibility of the owner to transmit the information and recommendations of this report to developers, contractors, buyers, architects, engineers, and designers for the project so that the necessary steps can be taken by the contractors and subcontractors to carry out such recommendations in the field. The conclusions and recommendations contained in this report are solely professional opinions.

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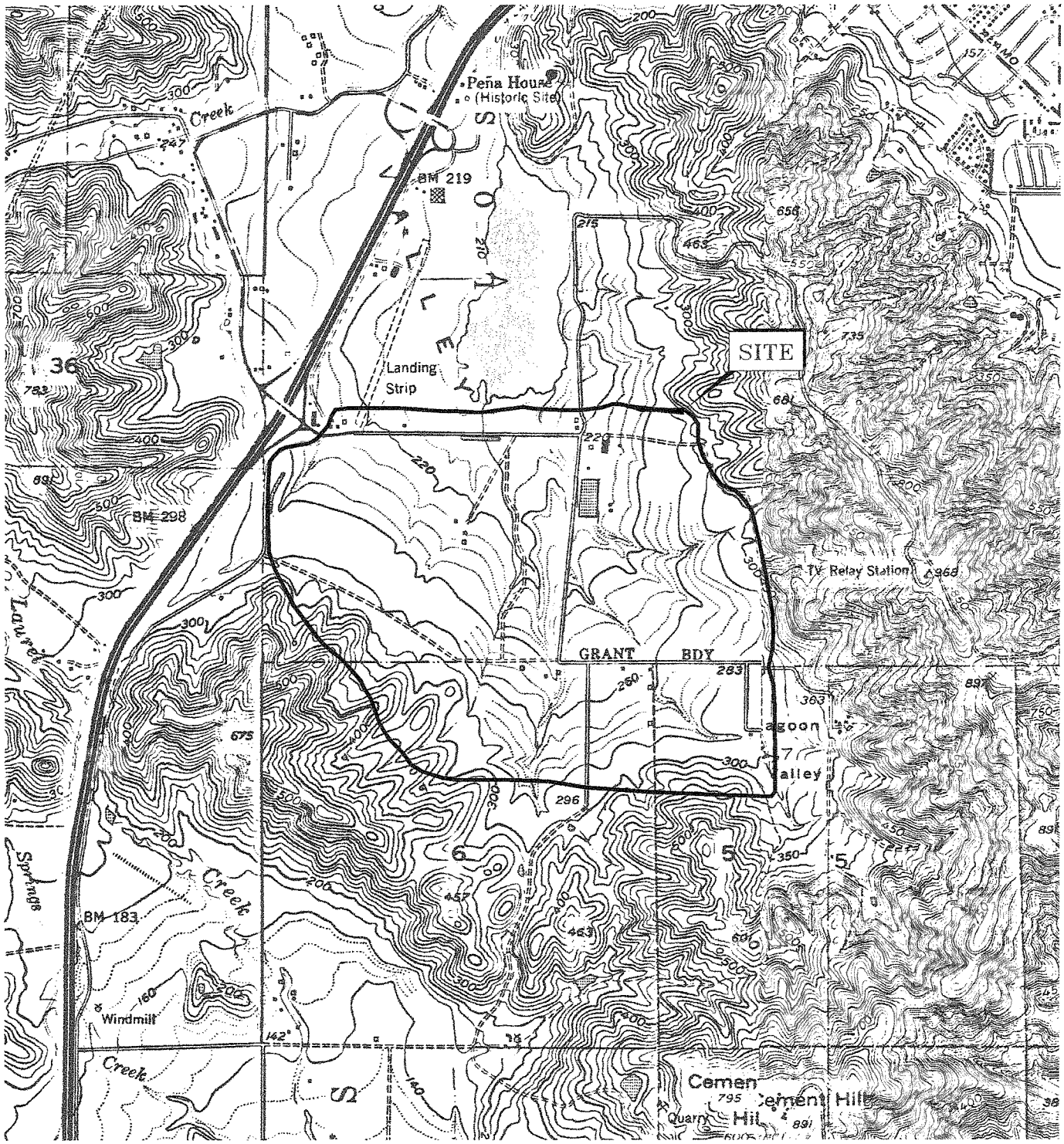

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BASE MAP SOURCE: U.S.G.S.

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VICINITY MAP

LAGOON VALLEY RESIDENTIAL/RECREATIONAL DEVELOPMENT

VACAVILLE, CALIFORNIA

PROJECT NO.: 5489.2.002.01	FIGURE NO. 1
DATE: JULY 2003	
DRAWN BY: SRP	CHECKED BY: TB

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