APPENDIX GEOTECH

PRELIMINARY GEOTECHNICAL STUDY REPORT

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PRELIMINARY
GEOTECHNICAL STUDY REPORT

MAHA RESORT AT GUENOC VALLEY
22000 BUTTS CANYON ROAD
MIDDLETOWN, CALIFORNIA

Project Number:

7192.04.01.3

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INTRODUCTION

This report presents the results of our preliminary geotechnical study for the proposed Maha Resort at Guenoc Valley to be constructed at 22000 Butts Canyon Road in Middletown, California. The project includes dozens of parcels totaling approximately 16,000 acres. The terrain varies from relatively level valley floor areas to rolling hills and contains several lakes, established vineyards, and vast undeveloped areas. The site location is shown on Plate 1 in Appendix A.

We understand that the planned Maha Resort at Guenoc Valley will be an extensive, multi-phased resort including boutique hotels, residential communities, farmstead, golf course, equestrian facilities, and shops. As outlined in our proposal dated May 24, 2019, our preliminary study was broken into two phases. The purpose of Phase 1 was to evaluate the geologic hazards and pertinent geologic features and characteristics within certain proposed areas of development, and to comment on the geotechnical feasibility of the project. The purpose of Phase 2 was to refine the geologic hazards by collection of samples and testing for naturally-occurring asbestos (NOA) in areas that we identified as potentially containing serpentinite bedrock, landslide areas, and/or areas selected by the project team.

SCOPE

Our scope of work for Phase 1 was limited to a site reconnaissance, a review of selected published geologic data, aerial photographs and LiDAR, and preparation of this report. Our scope of work for Phase 2 included collection of samples and testing for NOA (see Appendix B). Based on the geologic literature review (References, see Appendix C), site reconnaissance, limited subsurface exploration and laboratory testing, we were to develop the following information:

1. A brief description of geologic, surface soil, and seepage/spring or other conditions observed during our reconnaissance;

2. Our opinion of potential cut and fill slope inclinations;

3. Distance to nearby active faults and a discussion of geologic hazards that may affect the proposed project;

4. Our opinions regarding the geotechnical feasibility of the project; and

5. Preliminary conclusions and recommendations concerning site-specific geotechnical services needed for actual development, design and construction of the project.

SERVICES PROVIDED

We reviewed aerial photographs of the site, 2-foot LiDAR contours of the entire property, and other select published geologic information pertinent to the site. A list of the geologic references reviewed is presented at the end of this report. On October 8, 9, 10, and November 12 and 20, 2018, our Engineering Geologist conducted a surficial reconnaissance of the property to observe exposed topographic features, surface soils, rock outcroppings and cut banks. We also excavated test pits on these days for the collection of preliminary geotechnical information and to assess the presence of NOA in areas mapped as serpentine-bearing. The test pit locations are shown on Plates 2 and 4A through 4E. Our Principal Engineering Geologist and Principal Geotechnical Engineer also performed a brief site reconnaissance of selected areas on October 8, 2018. Selected samples were laboratory tested to assess their pertinent engineering characteristics and potential presence and concentration of NOA. In addition to the test pits for our preliminary evaluation of the property, additional test pits were excavated for the Farmstead and access road geotechnical studies that were being performed concurrently. The logs for these test pits are included herein.

SITE CONDITIONS

General

Lake and Napa Counties are located within the California Coast Range geomorphic province. This province is a geologically complex and seismically active region characterized by sub-parallel northwest-trending faults, mountain ranges and valleys. The oldest bedrock units are the Jurassic-Cretaceous Franciscan Complex and Great Valley sequence sediments originally deposited in a marine environment. Subsequently, younger rocks such as the Tertiary-age Sonoma Volcanics group, the Plio-Pleistocene-age Clear Lake Volcanics and sedimentary rocks such as the Guinda, Domengine, Petaluma, Wilson Grove, Cache, Huichica and Glen Ellen formations were deposited throughout the province. Extensive folding and thrust faulting during late Cretaceous through early Tertiary geologic time created complex geologic conditions that underlie the highly varied topography of today. In valleys, the bedrock is covered by thick alluvial soils. The site is located in a northwest-trending, structurally-system of valleys and ridges in southeastern Lake county and northwestern Napa County.

Geology

Published geologic maps (Fox et al., 1973) indicate the property is underlain by igneous, sedimentary, and metamorphic bedrock formations ranging from Jurassic to Quaternary in age. The oldest bedrock formations mapped within the project area are the Jurassic Knoxville Formation, the Cretaceous-Jurassic Great Valley Sequence and Franciscan Assemblage. The Knoxville Formation is comprised mainly of massive clayey siltstone with minor sedimentary serpentine, and is mapped primarily within the valley walls of Bucksnort Creek, and in an isolated area south of Butts Canyon Road. The Great Valley Sequence units shown to be present in the project area include mudstone, siltstone, and sandstone. The mapped Franciscan Assemblage outcrops include metagraywacke, metagreenstone, and metachert, with discrete masses of serpentinite and silica-carbonate rocks strewn throughout the property. One of the predominant rock types present is the Tertiary Clear Lake volcanics olivine basalt. This resistant unit caps the many resistant knobs and ridges throughout the property such as Snell Peak, Goat Hill, Jim Davis Peak, and similar topographic high points. It also blankets a vast, northwest -trending swath north of Upper Bohn Lake and extending to the edge of Bucksnort Creeks valley. It is usually underlain by small bodies of Franciscan silica-carbonates and large masses of Franciscan serpentinite, the other dominant rock type according to the geologic maps. The Tertiary-aged Sonoma Volcanics occurs south of Butts Canyon Road at higher elevations. The valley floors throughout the project area, such as Bohn Valley and the low areas directly south of McCreary Lake, are blanketed by Quaternary alluvium, the youngest unit consisting of unconsolidated gravel, sand, silt, and clay.

Landslides

Published landslide maps (Dwyer, 1976) indicate many isolated areas of large-scale slope instability at the site. Presented on Plate 3 is our interpretation of the locations presented on Dwyer's map. Dwyer's "definite" and "probable" landslides primarily occur within areas mapped by Fox et al. (1973) as Franciscan Assemblage including metagraywacke, metagreenstone, metachert, and bodies of serpentine. We outlined these, as well as other areas with suspicious topographic features we observed using LiDAR, on the LiDAR overlay in Google Earth. Our engineering geologists then excavated test pits in several of the areas where planned roads crossed the mapped landslide areas and other suspicious areas based on our LiDAR review. In some cases, the rubbly surface outcrops and "float" (boulders carried downslope by gravity) prevented excavator access to these areas, such as on the northeastern flank of Goat Mountain. Based on our surface and subsurface observations we revised the landslide mapping. Where these physical areas were observed and revised by RGH, the landslide boundaries are considered approximate. We have not undertaken detailed studies of the individual landslide areas. The scope of this phase of investigation was to confirm or refute the presence of actual landslide debris in certain mapped and conspicuous locations that could directly affect road construction at the site. The revised features are presented on Plates 4A through 4E.

A summary of the subsurface soil, rock, and groundwater conditions found within landslide test pits LSTP-1 through LSTP-25 is presented in the table below. In some cases, our subsurface observations indicate that no landslide was present. Where we interpret the deposits as landslide-derived, our opinion as to the type of landslide, degree of certainty, thickness of deposits, and state of landslide activity is indicated with a 4-digit number in the right-hand column of the table. A key to the numerical landslide identification and nomenclature is given on Plate 5. The soil is described in accordance with the Unified Soil Classification System, outlined on Plate 6. Bedrock is described in accordance with Engineering Geology Rock Terms, shown on Plate 7.

Test Pit #	Depth (ft.)	Description	Landslide Type
LSTP-1	0.0-1.0	DARK BROWN SANDY CLAY WITH GRAVEL (CH) soft, moist (surface soil)	
	1.0-4.75	GRAY GREEN MOTTLED CLAY WITH SAND (CH) soft to medium stiff, moist (Qls)	Possible Landslide

		- possible slide plane -	3312
	4.75-6.5	DARK GRAY GREENSTONE very closely spaced fractures, firm, weak, moderately weathered Seepage at 6 feet	
LSTP-2	0.0-1.25	BROWN SANDY CLAY (CH) soft to medium stiff, moist (surface soil)	No Landslide
	1.25-5.0	DARK GRAY GREENSTONE closely spaced fractures, firm to moderately hard, weak to moderately strong, slightly weathered	
LSTP-3	0.0-1.5	RED-BROWN CLAY WITH SAND (CH) hard, dry to moist, weak and porous to 6 inches, with gravel and cobbles up to 6 inches in diameter, vertical pressure facets (VPF) Qls	
	1.5-3.5	RED-BROWN BRECCIA closely spaced fractures, moderately hard, moderately strong, highly weathered, subangular, poorly sorted clasts from coarse sand to small cobbles, volcanic and ultramafic (healed landslide/Qls)	3323
	3.0-3.5 (locally)	OLIVE GREEN SANDY CLAY (CH) very hard, dry, with gravel Practical refusal at 3½ feet	
LSTP-4	0.0-2.5	RED BROWN SANDY CLAY (CL) very stiff to hard, dry, weak and porous to 6 inches, gravel to 2 inches in diameter, somewhat porous (colluvium)	
	2.5-3.5	RED-BROWN CLAY WITH SAND AND GRAVEL (CH) hard, moist, increased gravels and cobbles, angular, poorly sorted (colluvium)	3323
	3.5-10.0	DARK RED-BROWN BRECCIA no visible fractures, firm, weak, highly weathered, poorly sorted angular to subrounded polished clasts (healed landslide/Qls)	
LSTP-5	0.0-2.0	BROWN TO DARK BROWN CLAY WITH SAND (CL-CH) medium stiff, dry to moist, with coarse sand to gravel, weak and porous to 6 inches, roots to 2 feet (Qls)	
	2.0-5.0	DARK BROWN CLAY WITH SAND AND GRAVEL (CH) hard to very hard, moist, with VPF and shearing from creep, angular gravels to 2 inches in diameter (Qls)	3323
	5.0-9.0	DARK BROWN SANDY CLAY TO CLAYEY SAND (CH) hard/dense, moist, poorly sorted, clay less fat than B unit, coarse sand and small gravels, larger cobbles to 6 inches in diameter starting at 8 feet (Qls)	

	9.0-9.5	GRAY ANDESITE closely spaced fractures, very hard, very strong, slightly weathered, soil infilling Refusal in boulders at 9½ feet	3323
LSTP-6	0.0-2.0 2.0-4.5 4.5-7.0	BROWN TO DARK BROWN SANDY CLAY WITH GRAVEL AND COBBLES (CH) soft, dry, weak and porous to 1 foot; hard, moist 1 to 2½, cobbles and clasts to 8 inches in diameter (Qls) RED -BROWN BRECCIA no visible fractures, firm, weak, highly weathered, clasts poorly sorted, angular, coarse sand to cobbles 6 inches in diameter (well-indurated/healed Qls) RED-BROWN SERPENTINIZED GREENSTONE closely spaced fractures, firm, weak, completely to highly weathered	3213
LSTP-7	0.0-0.5 0.5-4.0 4.0-5.0	LIGHT OLIVE-BROWN CLAY (CH) medium stiff, dry, with desiccation cracks, weak and porous DARK OLIVE GRAY SILTSTONE/SHALE closely laminated, extremely closely spaced fractures, moderately hard to hard, weak, moderately weathered to brown, dips into hillside; completely weathered to soil-like from ½ to 1 foot DARK GRAY SANDSTONE massive to thickly bedded, moderately spaced fractures, hard to very hard, strong, slightly weathered, very fine grained	No Landslide
LSTP-8	0.0-0.5 0.5-2.0 2.0-2.5 2.5-5.0	LIGHT OLIVE-BROWN CLAY (CH) medium stiff, dry, with desiccation cracks, weak and porous RED-BROWN CLAY WITH GRAVEL AND COBBLES (CH) very stiff to hard, moist, angular cobbles to 6 inches in diameter, some roots (Qc/residual soil) DARK GRAY CLAY WITH SAND (CH) very stiff, dry to moist, with shale inclusions (Qls) DARK OLIVE GRAY SILTSTONE/SHALE closely laminated, extremely closely spaced fractures, moderately hard to hard, weak, moderately weathered to brown, sheared	Outside of Landslide 3322
LSTP-9	0.0-1.0 1.0-2.0	LIGHT OLIVE-BROWN CLAY (CH) medium stiff, dry, with desiccation cracks, weak and porous, with angular gravels and cobbles, roots DARK GRAY SHALE crushed, sheared, firm, plastic, completely weathered to soil (residual/colluvium/Qc)	Outside of Landslide 3221

	2.0-5.0	DARK OLIVE GRAY SILTSTONE/SHALE closely laminated, extremely closely spaced fractures, sheared, firm, friable, highly weathered to brown, with strong concretions	
LSTP-10	0-1.0 1.0-5.75 5.75-6.5 6.5-7.5	OLIVE BROWN SANDY CLAY (CH) hard, dry, with gravel, with roots (Qls) DARK OLIVE BROWN TO DARK OLIVE GREEN CLAY WITH GRAVEL AND COBBLES (CH) very hard, moist, very hard and very strong angular clasts of greenstone from 1 to 8 inches in diameter (Qls) OLIVE GREEN CLAY WITH SAND (CH) hard, moist, sheared, slicks, healed slide plane GREEN SERPENTINE MELANGE sheared, soft to firm, plastic to friable, highly weathered	3122
LSTP-11	0.0-2.5 2.5-3.0 3.0-5.0	RED CLAY WITH SAND (CH) (Qls) soft to hard, weak and porous to ½ foot, dry ½ to 2 feet then moist DARK OLIVE-GREEN CLAY (CH) hard, moist, sheared, with slicks, irregular edges, locally pinched out (healed side plane) (Qls) OLIVE GREEN WITH RED WEATHERING SERPENTINTE MELANGE firm, friable, highly weathered, with hard, strong, greenstone inclusions	3312
LSTP-12	0.0-1.0 1.0-3.5 3.5-5.0 5.0-7.0	BROWN CLAY (CH) stiff, dry to moist, with angular volcanic cobbles to 6 inches in diameter, weak and porous, with roots (Qc) (Qls) RED BROWN CLAY (CH) hard, moist, with coarse sand and volcanic cobbles approximately 6 inches in diameter from 2½ to 3½ feet, with roots at base of layer (Qls) RED-BROWN SANDY CLAY (CL-CH) very hard, dry to moist, with sand to small cobbles and volcanic gravels (completely weathered lithic tuff) YELLOW-GREEN LITHIC TUFF closely to very closely spaced fractures, firm, friable, highly weathered	Question-able 3312
LSTP-13	0.0-3.0 3.0-4.0 4.0-5.5	GRAY BROWN SANDY CLAY WITH GRAVEL AND COBBLES (CH) stiff to very stiff, dry to moist, shrinkage crack ½ inch wide and 12 inches deep RED BROWN SANDY CLAY WITH COBBLES (CH) very stiff, moist, with volcanic and greenstone cobbles GRAY GREEN SERPENTINITE	3312

		Closely to very closely spaced fractures, firm, weak to friable, moderately weathered	
LSTP-14	0.0-1.5 1.5-2.5 2.5-5.0	RED-BROWN CLAY WITH SAND AND GRAVEL (CL) soft to medium stiff, dry to moist, weak and porous, with angular volcanic cobbles to 1½ feet (Qc) RED-BROWN CLAY (CH) hard, moist (residual soil) SERPENTINIZED GREENSTONE extremely closely spaced fractures, moderately hard, weak, highly weathered	No Landslide
LSTP-15	0.0-4.0 4.0-7.0	RED BROWN SANDY CLAY WITH COBBLES AND BOULDERS (CH) very stiff, moist, porous in upper 1 foot GREEN SERPENTINITE closely spaced fractures, firm, weak, moderately weathered	3212
LSTP-16	0.0-1.0 1.0-3.5 3.5-4.5	BROWN CLAY WITH SAND (CH) soft to medium stiff, dry, with cobbles and small boulders, with boulder float at surface (Qc/Qls) BROWN CLAY WITH SAND AND GRAVEL (CH) hard, moist, with prominent VPF, angular volcanic cobbles (Qls) BROWN CONGLOMERATE no visible fractures, moderately hard, moderately strong, moderately to highly weathered, serpentinite clasts (KJF)	3212
LSTP-17	0.0-1.5 1.5-3.0 3.0-5.0	BROWN SANDY CLAY (CH) soft to medium stiff, dry to moist, with desiccation cracks, with roots, weak and porous to ½ foot, with boulder float at surface (residual soil) GREEN SERPENTINIZED GREENSTONE closely spaced fractures, firm, weak to moderately strong, highly weathered GREEN SERPENTINIZED GREENSTONE closely spaced fractures, moderately hard, weak to moderately strong, moderately weathered	Outside of Landslide
LSTP-18	0.0-1.0 1.0-4.0	BLUE GREEN CLAYEY SAND (SC) medium dense, dry (residual soil) BLUE GREEN SERPENTINITE sheared, very closely spaced fractures, firm to moderately hard, weak, highly to moderately weathered, highly sheared and weathered from 1 to 2 feet	Above Landslide Head Scarp (Outside of Landslide)
LSTP-19	0.0-2.5 2.5-3.0	LIGHT GRAY-BROWN CLAY (CL-CH) hard, dry, weak and porous to 3 feet (Qc) GRAY SILTSTONE	

		extremely closely spaced fractures, moderately hard, weak, highly weathered to brown	No Landslide
	3.0-5.0	GRAY SILTSTONE very closely to closely spaced fractures, moderately hard, moderately strong, moderately weathered	
LSTP-20	0.0-1.5	LIGHT GRAY-BROWN SANDY CLAY (CH) hard, dry, grades to completely weathered siltstone from 1 to 1½ feet, volcanic rubbly float at surface	No Landslide
	1.5-5.0	GRAY-BROWN SHALE closely to very closely spaced fractures, moderately hard, moderately strong, moderately weathered	
LSTP-21	0.0-1.0	VERY LIGHT BROWN SANDY CLAY WITH GRAVEL (CL) medium stiff, dry, with volcanic cobbles and rubbly surface float (Qc)	No Landslide
	1.0-7.0	GRAY SILTSTONE/SHALE extremely closely spaced fractures, moderately hard, moderately strong, moderately weathered	
LSTP-22	0.0-2.0	VERY DARK GRAY BROWN CLAY (CH) hard, dry, with volcanic cobbles and rubbly surface float (Qls)	3313
	2.0-3.0	VERY DARK GRAY BROWN CLAY WITH COBBLE (CH) medium stiff, dry to moist, with angular gravel and cobbles to 8 inches in diameter, clast-supported (old Qls)	
	3.0-4.5	OLIVE BROWN SHALE extremely closely spaced fractures, firm, weak, highly weathered	
LSTP-23	0.0-3.5	LIGHT RED-BROWN SANDY CLAY (CL) medium stiff, dry, with cobbles and boulders, angular gravel, very clayey from 3 to 3½ feet (Qls)	5322
	3.5-4.5	BROWN SANDY CLAYSTONE WITH BOULDERS closely spaced fractures, firm, plastic to friable, highly weathered, with pressure facets	
LSTP-24	0.0-5.0	GRAY BROWN TO DARK GRAY BROWN SANDY CLAY (CH) very stiff to hard, dry to moist, weak and porous to 1½ feet, sparse volcanic gravels (alluvium)	No Landslide
	5.0-6.0	VOLCANIC BOULDERS rubbly flow deposit (Qob – Clearlake Volcanics)	
LSTP-25	0.0-1.0	BROWN SANDY CLAY (CH) medium stiff, dry, with desiccation cracks	No Landslide
	1.0-7.0	DARK GRAY SILTSTONE closely to very closely spaced fractures, firm to moderately hard, weak to moderately strong, moderately weathered	

Faulting

The site is not within a current Alquist-Priolo Earthquake Fault Zone for active faults as defined by California geological Survey (CGS). CGS defines active faults as those exhibiting evidence of surface displacement during Holocene time (last 11,000 years). However, the site is within an area affected by strong seismic activity. Several northwest-trending Earthquake Fault Zones exist in close proximity to, and within several miles of, the site (Bortugno, 1982). The shortest distances from the site to the mapped surface expression of these faults are presented in the table below.

ACTIVE FAULT PROXIMITY		
Fault	**Direction**	**Distance-Miles**
San Andreas	SW	41
Healdsburg-Rodgers Creek	SW	20
Concord-Green Valley	SE	30
Cordelia	SE	30
West Napa	SE	21½
Maacama	SW	16
Konocti	NW	14
Hunting Creek	NE	5¾

Surface

The property extends primarily over relatively level valley floor areas as well as rugged, moderately to steeply sloping terrain. Volcanic-capped peaks are characteristically conical in shape. The vegetation consists of seasonal grasses, chaparral, oak, and other common shrubs of the region. Many acres have been planted in wine grapes.

We understand that several archaeological/cultural historic sites are present on the property. We observed one spring on the southwestern shore of Upper Bohn Lake that reportedly flows all year long (Randy Sternberg, personal communication, 2018).

In general, the ground surface includes both soft, spongy areas, and relatively hard, dry areas. Either condition can generally be associated with weak, porous surface soils. Along existing roads and around existing building areas, some fill soils are present. Undocumented or heterogeneous fill soils, as well as weak, porous surface soils, often have unknown bearing capacity and unpredictable settlement under new loads.

Natural drainage consists of overland flow over the ground surface that concentrates on a natural drainage element such as swales and ravines. Because of the large size of the property, there are several micro-water sheds that trend toward local low areas, such as Bohn Valley, Bucksnort Creek valley, and the Upper Bohn Lake area.

Subsurface

Our observations of the subsurface materials generally agreed with the published geologic maps with respect to mapped geologic units and bedrock types. The bedrock characteristics vary with the rock type. A summary of the subsurface conditions as observed within our test pits is presented below. Our laboratory testing indicates that two of the five samples of serpentine bedrock tested contained detectable levels of naturally-occurring asbestos mineral fibers (1.58 percent and 2.17 percent; see below and Appendix B for full report).

A composite sample of the near-surface soils from test pits TP-1 through TP-6 exhibits medium plasticity (LL = 48.1; PI = 18.7), very low expansion potential (EI = 8), and moderate to high R-Value (R-Value = 50). A composite sample of the near-surface soils from test pits TP-7 through TP-12 exhibits medium plasticity (LL = 55.8; PI = 28.0), medium expansion potential (EI = 81), and low R-Value (R-Value = 7).

ORIGINAL ENTRY ROAD - TEST PITS TP-1 THROUGH TP-12

Test Pit #	Depth (ft.)	Description	NOA tested/detected
TP-1	0-4	RED-BROWN GRAVEL WITH SILT AND SAND (GP-GM), Loose to medium dense, dry, with roots and rootlets throughout, angular coarse gravel to cobbles (colluvium - Qc)	
	4-5	GREEN SERPENTINITE, crushed, sheared, moderately hard, weak to moderately strong, highly weathered, with hard boulders. No Groundwater encountered	2.17% Chrysotile
TP-2	0-0.5	RED-BROWN CLAYEY SAND (SC), loose, dry, weak and porous, abundant rootlets (surface soil)	
	0.5-1.5	RED-BROWN CLAYEY SAND (SC), with gravel, medium dense, dry to moist, weak and porous, with roots	
	1.5-3	RED-BROWN SILTY GRAVEL WITH SAND (SM), medium dense, moist (Qc)	
	3-4	GRAY SERPENTINIZED GREENSTONE, closely spaced fractures, hard, strong, highly weathered. No Groundwater encountered	
TP-3	0-0.5	RED-BROWN CLAYEY SAND (SC), loose, dry, weak and porous, with gravel, abundant rootlets (Surface soil)	
	0.5-3	GREEN SERPENTINITE, closely to very closely spaced fractures, hard, strong, moderately weathered. No Groundwater encountered	
TP-4	0-0.5	BROWN CLAYEY SAND WITH GRAVEL (SC), loose, moist, weak and porous, with abundant rootlets and organics (surface soil)	

	0.5-2	BLUE-GRAY GREENSTONE, closely spaced fractures, hard, strong, moderately weathered, with serpentinized areas. Very hard digging. No Groundwater encountered	
TP-5	0-0.5 0.5-1.5	RED-BROWN CLAYEY SAND (SC), loose, dry to moist, weak and porous, with abundant rootlets and organics (surface soil) GREEN SERPENTINITE, closely spaced fractures, sheared, moderately hard, weak, highly weathered. No Groundwater encountered	
TP-6	0-2	BROWN CLAYEY SAND WITH GRAVEL (SC), medium dense, dry to moist, with cobbles and boulders, rip rap (fill) Digging refusal in boulders. No Groundwater encountered	
TP-7	0-1.5 1.5-4	RED-BROWN CLAYEY SAND WITH GRAVEL (SC), loose, dry, weak and porous (Qc) ORANGE-BROWN MELANGE, sheared, firm, friable, completely/highly weathered, with hard cobbles of greenstone No Groundwater encountered	ND (non-detect, <0.08%)
TP-8	0-1 1-2 2-6	RED-BROWN CLAYEY SAND (SC), loose to medium dense, dry, with gravel and cobbles (Qc) RED CLAY (CH), hard, dry (residual soil) RED BASALT, closely spaced fractures, firm, weak, highly weathered. No Groundwater encountered	
TP-9	0-0.5 0.5-1 1-2.5	RED CLAY WITH SAND (CL), soft, moist, weak and porous, with abundant rootlets RED CLAY WITH SAND (CL), hard, dry, with gravel (residual soil) RED-BROWN PEBBLY COARSE SANDSTONE, firm, weak, highly weathered No Groundwater encountered	
TP-10	0-2 2-3 3-5	LIGHT BROWN SILTY-CLAYEY SAND (SC), medium dense, dry to moist, weak and porous LIGHT BROWN CLAYEY SAND (SC), medium dense to dense, dry to moist, with gravel (residual soil) ORANGE BROWN GREENSTONE, very to extremely closely spaced fractures, firm, weak, highly weathered No Groundwater encountered	
TP-11	0-1.5 1.5-3	RED-BROWN CLAY WITH SAND (CL), soft to medium stiff, moist, weak and porous, with roots to 2’ RED-BROWN SANDY CLAY (CH), hard, dry	

	3-4 4-5	GREEN TO RED-BROWN MELANGE, sheared, firm, weak, highly weathered, with resistant greenstone fragments. DARK GRAY-GREEN GREENSTONE, sheared, moderately hard, moderately strong, moderately weathered to red in color. No Groundwater encountered	
TP-12	0-2 2-5 5-5.5	DARK BROWN SANDY CLAY (CH), hard, dry, weak and porous to 0.5', with roots, GREEN TO BROWN MELANGE, sheared, firm, weak, highly weathered GRAYWACKE SANDSTONE, closely spaced fractures, hard, moderately strong to strong, moderately weathered. No Groundwater encountered	

Our laboratory tests indicate that throughout the Farmstead area, most of the near-surface soils exhibit high plasticity (LL from 60.3 to 91.6; PI from 39.5 to 63.1), and medium to high expansion potential (EI from 88 to 123).

FARMSTEAD/MAHA Farm- TEST PITS TP-13 THROUGH TP-30

Test Pit #	Depth (ft.)	Description	NOA tested/detected
TP-13	0-0.5 0.5-3	BROWN CLAYEY SAND (SC), loose, moist, weak and porous, with gravel and cobbles, with abundant roots, organics YELLOW TO OLIVE GREEN TUFF, firm to moderately hard, weak, highly weathered, hydrothermally altered. No Groundwater encountered	
TP-14	0-1 1-1.5 1.5-2	RED-BROWN CLAY WITH SAND (CL), soft, moist, weak and porous, with gravel, with roots (surface soil) RED-BROWN CLAY WITH SAND (CH), hard, moist, with cobbles, vertical pressure facets RED-BROWN SILTY GRAVEL WITH SAND (SM), medium dense, moist (Qc) GREEN SERPENTINITE, sheared, moderately hard, moderately strong, highly weathered. No Groundwater encountered	1.58 % Chrysotile
TP-15	0-2 2-2.5 2.5-6	RED-BROWN CLAY WITH SAND AND GRAVEL (CL), medium stiff, dry, with rootlets to 0.5, weak and porous to 1' (surface soil) RED-BROWN CLAYEY GRAVEL (GC), dense, dry to moist, angular volcanic gravels (Qt) RED-BROWN CLAY WITH SAND (CH), hard, dry to moist, vertical pressure facets	

	6-7	RED-ORANGE CLAY WITH SAND (CL), hard, dry, with basalt gravel and cobbles, becomes indurated (MUDSTONE) at 7'. No Groundwater encountered	
TP-16	0-0.75 0.75-2	BROWN SANDY CLAY (CH), medium stiff to very stiff, moist, weak and porous to 0.5', with roots throughout BROWN, GREEN, ORANGE SERPENTINITE, extremely closely spaced fractures, moderately hard, strong, highly weathered; hard digging No Groundwater encountered	 ND (<0.08%)
TP-17	0-2 2-2.5 2.5-5 5-5.5	RED-BROWN CLAY WITH SAND AND GRAVEL (CL), medium stiff, dry, with rootlets to 0.5', weak and porous to 1' (Surface soil) RED-BROWN CLAYEY GRAVEL (GC), dense, dry to moist, angular volcanic gravels (terrace deposits - Qt) RED-BROWN CLAY WITH SAND (CH), hard, dry to moist, vertical pressure facets, with sand, with serpentinite and obsidian gravels (Qt and residual soil) GREEN AND BLACK SERPENTINITE, sheared, firm, weak, highly weathered No Groundwater encountered	 ND (<0.08%)
TP-18	0-1.5 1.5-3 3-4	LIGHT BROWN CLAYEY SAND (SC), medium dense, dry to moist, weak and porous throughout, with gravel, with large roots to 3', increased gravels at base of layer RED TO OLIVE BROWN CLAY (CH), hard to very hard, moist, vertical pressure facets LIGHT BROWN SANDSTONE, closely to very closely spaced fractures, moderately hard, weak to moderately strong, moderately to highly weathered. No Groundwater encountered	
TP-19	0-1.5 1.5-3.5 3.5-5.5	RED-BROWN CLAY WITH SAND (CH), medium stiff, dry to moist, weak and porous, with abundant roots, with volcanic gravels RED-BROWN CLAY (CH), hard to very hard, moist, with some gravels VOLCANIC BRECCIA, closely spaced fractures, firm, friable, highly weathered No Groundwater encountered	
TP-20	0-2 2-4	RED-BROWN CLAY WITH SAND (CL), medium stiff to very stiff, moist, weak and porous, abundant roots and rootlets RED-BROWN CLAY (CH), hard to very hard, moist, with large gravels/small cobbles of basalt-andesite	

	4-4.5	ORANGE-BROWN SANDY VOLCANIC AGGLOMERATE, closely spaced fractures, firm, weak, highly weathered. No Groundwater encountered	
TP-21	0-1.5 1.5-3	RED-BROWN CLAY WITH SAND (CL), soft to medium stiff, dry, weak and porous, with abundant roots, with weathered silicic gravels LIGHT YELLOW TO RED VOLCANIC AGGLOMERATE, closely spaced fractures, firm to moderately hard, weak, highly weathered, with spheroidally weathered dacite cobbles in a red clay matrix. No Groundwater encountered	
TP-22	0-1.5 1.5-2 2-3 3-3.5	RED-BROWN SANDY CLAY WITH GRAVEL (CL), medium stiff, dry, weak and porous RED-BROWN CLAY WITH SAND (CH), hard, dry, with light gray silicic volcanic gravels RED-BROWN CLAY (CH), hard to very hard, moist ORANGE SANDY LITHIC TUFF, partly welded, closely spaced fractures, firm to moderately hard, weak, highly weathered No Groundwater encountered	
TP-23	0-2 2-5.5	RED CLAYEY SAND (SC), dense, moist, weak and porous to 1', with roots to 2', with abundant small gravels (residual soil) RED AGGLOMERATE, firm, weak, highly weathered No Groundwater encountered	
TP-24	0-2 2-3 3-4	RED-BROWN SANDY CLAY (CL), medium stiff, moist, with abundant volcanic gravel, with abundant roots to 2.5', weak and porous to 0.5' MOTTLED RED-BROWN AND GRAY CLAY (CH), hard to very hard, moist, vertical pressure facets (residual soil) RED TO LIGHT GRAY TUFF AND TUFF AGGLOMERATE, closely spaced fractures, firm, weak, highly weathered No Groundwater encountered	
TP-25	0-2.5 2.5-3 3-3.5	BROWN SANDY CLAY (CL), soft to medium stiff, moist, weak and porous, with abundant roots and volcanic cobbles. GRAY-OLIVE BROWN CLAY WITH SAND (CH), hard, moist RED WELDED TUFF, closely spaced fractures, moderately hard, moderately strong, highly weathered. No Groundwater encountered	
TP-26	0-2 2-3.5	RED-BROWN SANDY CLAY (CL), soft to medium stiff, moist, with abundant dacite cobbles and boulders GRAY AND RED DACITE AGGLOMERATE, spheroidally weathered clasts in a weathered RED CLAY (CH) matrix, clasts are very hard, very strong; clast-supported	

		No Groundwater encountered	
TP-27	0-0.5 0.5-2	RED-BROWN SANDY CLAY (CL), soft, moist, weak and porous, with abundant rootlets and volcanic cobbles DARK GRAY BASALT AGGLOMERATE, moderately to widely spaced fractures, very hard, very strong, moderately weathered to red on fracture surfaces, clast-supported, boulders in a soft, dry clay matrix, very hard digging No Groundwater encountered	
TP-28	0-0.5 0.5-2	RED-BROWN SANDY CLAY (CL), soft, moist, weak and porous, with abundant rootlets and volcanic cobbles DARK GRAY BASALT AGGLOMERATE, moderately to widely spaced fractures, very hard, very strong, moderately weathered to red on fracture surfaces, clast-supported, boulders in a soft, dry clay matrix, very hard digging No Groundwater encountered	
TP-29	0-1 1-1.5 1.5-2.5 2.5-3	RED SANDY CLAY (CL), soft to medium stiff, dry to moist, with gravel RED SILTY GRAVEL (GM), dense, moist, with sand, spheroidally weathered dacite cobbles in a soil matrix RED-BROWN CLAY (CH), hard, moist, with gravel, vertical pressure facets ORANGE-BROWN VOLCANIC AGGLOMERATE, very hard, moderately strong, moderately weathered. No Groundwater encountered	
TP-30	0-3	RED-BROWN SANDY CLAY (CL), soft, weak and porous to 2’, hard, clast-supported 2’ to 3’, dry to moist, with cobbles and boulders of very hard, very strong basalt; digging refusal in boulders at 3’ No Groundwater encountered	

OTHER AREAS - TEST PITS TP-31 THROUGH TP-45

Test Pit #	Depth (ft.)	Description	NOA tested/detected
TP-31	0 – 3 3 - 5	BROWN SILTY SAND (SM), loose to medium dense, dry to moist, with cobbles to boulders of serpentinized greenstone, weak & porous to 1.5’, roots to 3’ Green serpentinite, extremely closely spaced fractures, moderately hard, moderately strong to strong, moderately to highly weathered. No Groundwater encountered	
TP-32	0 - 1	REDDISH BROWN SANDY CLAY (CL), soft to medium stiff, dry, with cobbles. – Hang-dug pit, no excavator access. Float on surface of gray basalt, closely spaced fractures, hard to very hard, very strong, highly to moderately weathered.	

		No Groundwater encountered	
TP-33	0 – 2	LIGHT BROWN CLAY (CL), soft to medium stiff, dry, with cobbles of very light gray dacite; weak and porous to 1’	
	2 – 3.5	LIGHT GRAY & RED AGGLOMERATE. Light gray DACITE cobbles in a very stiff to hard, red CLAY (CH) matrix. Matrix-supported and highly weathered 1 to 2’; clast-supported below 2’; closely spaced fractures. No Groundwater encountered	
TP-34	0 – 1	BROWN SANDY CLAY (CH), very stiff to hard, dry, with gravel (volcanic, angular clasts); weak and porous; desiccation cracks at surface extend 1.5’ below surface.	
	1 – 3	BLACK CLAY (CH), hard, dry to moist, with black and green greenstone fragments; with vertical pressure facets	
	3 – 5.5	BLACK TO GREEN SERPENTINITE & SERPENTINIZED GREENSTONE, extremely closely spaced fracatures, hard to very hard, strong to very strong, moderate weathering. No Groundwater encountered	
TP-35	0 – 5.5	RED-BROWN SANDY CLAY (CL-CH), stiff, dry, weak to 1’, somewhat porous to 2’, roots to 3’, with coarse sand and gravel. Becomes, hard, less porous at 2’, with increased dacite gravel and cobbles.	
	5.5 - 7	LIGHT GRAY & RED AGGLOMERATE. Light gray DACITE cobbles in a very stiff to hard, red CLAY (CH) matrix. Clast-supported; closely spaced fractures. No Groundwater encountered	
TP-36	0 – 1	BROWN CLAY (CH), very stiff, dry, with sand and gravel, weak and porous to 0.5’, sparse roots	
	1 - 5	BLACK AND GREEN SERPENTINIZED GREENSTONE, extremely closely spaced fractures, sheared texture, friable to moderately hard, moderately strong, highly weathered; completely weathered with soil matrix from 1 to 1.5’. No Groundwater encountered	
TP-37	0 – 1.5	BROWN CLAY (CL), very stiff, dry, weak to 0.5’	
	1.5 – 4.5	VERY DARK BROWN SANDY CLAY (CH), hard, moist, with red volcanic cobbles, with serpentinite gravels, some roots to 3.5’.	
	4.5 – 7	RED-BROWN SANDY CLAY (CH), hard, dry to moist, with serpentinite gravels	
	7	RED-BROWN GREENSTONE/BASALT, closely spaced fractures, hard, moderately strong, highly weathered. No Groundwater encountered	ND (< 0.08%)
TP-38	0 – 1	LIGHT BROWN CLAY (CL), medium stiff, dry, with cobbles, weak and porous, with roots	

	1 – 1.5 1.5 - 4	RED CLAY (CH), hard, moist, with sand and gravel RED VOLCANIC AGGLOMERATE – subangular gravel- to cobble-sized andesite-dacite clasts in a hard, red SANDY CLAY (CH) matrix, matrix-supported; massive, no visible fracturing, moderately hard, moderately strong, moderate weathering, hard digging. No Groundwater encountered	 ND (< 0.08%)
TP-39	0 – 1.5 1.5 - 4	DARK BROWN SANDY CLAY (CH), medium stiff to hard, dry to moist, weak and porous to 0.5’, with abundant roots throughout, with serpentinite clasts/weathered bedrock surface 1-1.5’. DARK GRAY GREEN SERPENTINIZED GREENSTONE & SERPENTININTE, sheared, closely to extremely closely spaced fractures, moderately hard, weak to moderately strong, highly weathered. No Groundwater encountered	 Chrysotile (< 0.08%)
TP-40	0 – 1.5 1.5 - 3	RED-BROWN CLAY (CH), medium stiff to very stiff, moist, with gravels and cobbles of serpentinite GREEN SERPENTINITE, sheared, extremely closely spaced fractures, moderately hard, weak to moderately strong, highly weathered from 1.5’ to 2.5’, moderately weathered 2.5’ to 3’, hard digging. No Groundwater encountered	 3.92% Chrysotile
TP-41	0 – 1 (locally) 0 – 1.5	RED-BROWN SANDY CLAY (CL), soft, dry, weak and porous, with roots GREEN SERPENTINITE, sheared, closely-spaced fractures, moderately hard, moderately strong, highly weathered 0 to 1’, moderately to slightly weathered 1 to 1.5;, digging refusal at 1.5’.	 1% Chrysotile
TP-42	0 – 2 2 – 3.5	LIGHT REDDISH-BROWN CLAY WITH SAND (CL), medium stiff, dry, with roots, weak and porous; increased large gravels and small cobbles 1’ to 2’. VOLCANIC AGGLOMERATE, closely to very closely spaced fractures, hard to very hard, strong to very strong, large cobble-sized clasts of subangular, spheroidally-weathered basalt; clast-supported. Digging refusal at 3’. No Groundwater encountered	
TP-43	0 – 1.5 1.5 - 2	RED-BROWN SILT (ML), medium stiff, dry, weak and porous throughout GRAY TO PINK TUFF AGGLOMERATE, closely spaced fractures, hard, strong, moderate weathering. No Groundwater encountered	ND (< 0.08%)
TP-44	0 – 1 (locally) 0 – 1.5	LIGHT RED-BROWN SILT (ML), medium stiff, dry, weak and porous GRAY ANDESITE, closely spaced fractures, hard, strong, slightly to	ND (< 0.08%)

		moderately weathered to red-brown on fractures. Digging refusal at 1.5'. No Groundwater encountered	
TP-45	0 – 1 1 - 2	LIGHT RED-BROWN SILT (ML), medium stiff, dry, weak and porous GRAY ANDESITE, closely spaced fractures, hard, strong, highly weathered from 1 to 1.5', slightly to moderately weathered to red-brown on fractures below 1.5'. Digging refusal at 2'. No Groundwater encountered	ND (< 0.08%)

DISCUSSION AND CONCLUSIONS

Geologic Hazards

Serpentinite Bedrock and NOA

The site has areas mapped as having ultramafic bedrock units. Some ultramafic bedrock types contain naturally occurring asbestos. Test pits TP-1, -2, -3, -4, -5, -14, -16, -17, -31, -34, -36, -40, and -41 encountered serpentinite and/or serpentinized greenstone bedrock at depths of 0 to 5 feet. This bedrock could be exposed during grading and can contain naturally occurring asbestos fibers. There are State enforced regulations giving specific measures that must be used during grading to mitigate hazards associated with airborne asbestos particles. If these materials are exposed during grading, we will notify the client and the general contractor of the potential hazard. We recommend you retain certified asbestos personnel to develop a work plan to address airborne asbestos during grading.

Landslides

As discussed previously, landslide/debris/earth flow features have been mapped by others (Dwyer, 1976) at the project site and primarily occur with Franciscan Complex bedrock. Development including roadway and utilities should avoid these areas unless remedial work is performed to stabilize the slopes. Remedial work could include removing the landslide debris and constructing a buttress. In addition, debris/earth flow features can have adverse impact on improvements constructed downslope if the feature were to reactivate. The design level geotechnical studies at each structure location should address these issues in detail.

In general, most of the deposits we interpret to have been emplaced through landslide processes are less than 5 feet thick and consist of angular cobbles within a sandy clay matrix. Often, an old clay slide plane and/or layer of larger cobbles or boulders was observed along the base of the deposit. All of the landslides we observed in test pits are at least dormant, with some being ancient and well-indurated or "healed". The oldest of the landslides exhibits a high degree of cementation and induration, being described as hardpan soil or breccia. In test pits LSTP-3 and LSTP-4, we encountered digging refusal within the well-indurated, ancient landslide deposits. In some areas, the material described as landslide debris may be more colluvial in nature (colluvium is unconsolidated soil and rock material that moves downslope primarily due to gravity rather than saturation, material characteristics, or inherent planes of weakness). However, due to the unconsolidated and geologically young nature of these deposits, loose colluvium may pose similar risks to construction as landslide debris, when disturbed.

The most notable areas in which we anticipate the presence of landslide deposits will be a prominent geotechnical consideration during construction are the landslides mapped at LSTP-15 and -16, -11, -13, -6, and along the main entry road. Separate reports addressing the main entry road, other roads, and the Polo Lodge, respectively, will address these landslides on a case by case basis.

Fault Rupture

We did not observe landforms within the area that would indicate the presence of active faults and the site is not within a current Alquist-Priolo Earthquake Fault Zone. Therefore, we believe the risk of fault rupture at the site is low.

Strong Ground Shaking

Data presented by the Working Group on California Earthquake Probabilities (2002) estimates the chance of one or more large earthquakes (Magnitude 6.7 or greater) in the San Francisco Bay region within the next 30 years to be approximately 62 percent. Therefore, future seismic shaking should be anticipated at the site. It will be necessary to design and construct the proposed structures in strict adherence with current standards for earthquake-resistant construction.

Liquefaction

Liquefaction is a rapid loss of shear strength experienced in saturated, predominantly granular soils below the groundwater level during strong earthquake ground shaking due to an increase in pore water pressure. The occurrence of this phenomenon is dependent on many complex factors including the intensity and duration of ground shaking, particle size distribution and density of the soil. The site contains several isolated areas delineated by Slosson and Associates (1976) as liquefaction study zones, including Bohn Valley, the flat, low-lying area south of McCreary Lake, the small basin surrounding Wildcat Lake, and the low-lying areas surrounding Ink Ranch in the far northeastern corner of the property. Therefore, we judge that there is a moderate potential for liquefaction at the site within these areas. The final geotechnical study should address liquefaction in detail, especially if development is planned in these areas.

Densification

Densification is the settlement of loose, granular soils above the groundwater level due to earthquake shaking. Densification typically occurs in old fills and in soils that if saturated would be susceptible to liquefaction. The final geotechnical study should address densification in detail, especially in areas of planned development.

Lurching

Seismic slope failure or lurching is a phenomenon that occurs during earthquakes when slopes or man-made embankments yield and displace in the unsupported direction. Provided the improvements are located outside areas of identified slope instability and the foundations are installed as recommended herein, and the proposed fills are adequately keyed into underlying bedrock material, as subsequently discussed, we judge the potential for impact to the proposed fills from the occurrence of these phenomena at the site is low. However, some of these secondary earthquake effects are unpredictable as to location and extent, as evidenced by the 1989 Loma Prieta Earthquake.

Volcanism

The Clear Lake volcanic field has experienced a complex and cyclic eruptive history. The youngest eruptive sequence is dated at 10,000 years old (Miller, 1989; Sims and Rymer, 1975), and fumaroles (gas vents) are active throughout the Clear Lake Basin. These conditions suggest that the Clear Lake Volcanic System is not extinct and future eruptions could occur. Volcanic hazards that may be pertinent to the site area include phreatic and tephra eruptions and surges (Miller, 1989). Volcanic impact could range from inundation by several inches of ash to major ash flow eruptions. Due to the complex nature of the past episodic volcanic activity, no prediction regarding the extent or time of future volcanic activity is available. The risk of impact from volcanism at the site can be further influenced by wind and other climatologic conditions, is consistent with that of other properties in the Clear Lake area, and is not considered to be sufficiently defined to preclude site development.

Flooding and Seiche

Our review of the Federal Emergency Management Agency (FEMA) Flood Zone Maps for Lake County, California, Unincorporated Areas (No. 06033C1000D dated September 26, 2008 and 06033C0900D dated September 30, 2005), indicate that the entire property lies within Zone D, defined as an area of undetermined flood hazards. Evaluation of flooding potential is typically the responsibility of the project civil engineer.

The site includes several lakes ranging greatly in size, and as previously discussed, is susceptible to impact from seismic shaking. Strong, sudden earthquake waves can produce surges in bodies of water (seiches) that can cause damage and flooding similar to the effect of tsunami along the coastline. Site-specific evaluation of seiche impact to the project is beyond the scope of this study.

Expansive Soil

We encountered expansive soils in some of our test pits. Expansive soil is considered a geologic hazard because of the costly damage it causes to structures when its effects are not considered during construction. Expansive surface soils shrink and swell as they lose and gain moisture throughout the yearly weather cycle. Near the surface, the resulting movements can heave and crack lightly loaded shallow foundations, slabs and pavements. The zone of significant moisture variation (active layer) is dependent on the expansion potential of the soil and the extent of the dry season. In the Lake and Napa County area, the active layer is generally considered to range in thickness from about 2 to 3 feet. The detrimental effects of the above-described movements can be reduced by treating or capping the expansive soils during grading, and/or by utilizing foundation systems that either gain support below the active layer, or are designed to move with the soils and bridge the heave effects.

Conclusions and Recommendations

Based upon the results of our geologic data review and reconnaissance, we judge that it is geotechnically feasible to construct the resort. The primary geotechnical considerations and potential mitigating measures recommended for parcel creation, building site development and roadway construction are discussed in the following sections of the report. These conclusions are preliminary and will need to be verified or modified during final design following detailed site-specific subsurface exploration, laboratory testing and geotechnical engineering evaluations, as recommended herein.

Permanent Cut and Fill Slopes

In general, cut and fill slopes should be designed and constructed at slope gradients of 2:1 (horizontal to vertical) or flatter, unless otherwise approved by the geotechnical engineer in specified areas. In expansive soil areas and serpentinite or highly weathered mélange bedrock, cut and fill slopes should be no steeper than 3:1. Where steeper slopes are required, retaining walls should be used. Fill slopes steeper than 2:1 will require the use of geogrid to increase stability.

If the owner is willing to accept on-going maintenance, steeper slopes may be constructed within roadway cutslopes on a case-by-case basis. Cutslopes up to 1:1 may be allowable in certain areas with certain remedial measures.

In general, slopes within serpentinite-derived soils and Franciscan mélange or serpentinite bedrock are highly weathered and are less stable than slopes on younger and/or harder bedrock types. In addition, some of the younger volcanic bedrock formations are rubbly to agglomeritic in nature and may be prone to rockfalls or debris flows as the clayey matrix becomes saturated on steep slopes. The geotechnical engineer should review preliminary site-specific grading plans and profiles for potential slope stability concerns.

Landslide Areas

In general, weak landslide/colluvium deposits on the order of 5 to 10 feet thick can be removed during grading and replaced as drained, buttressed fills. Support for new fills or retaining walls can be found below relatively shallow unconsolidated deposits. Cuts within surficial landslide deposits or loose colluvium can be retained, laid back, and/or the unconsolidated deposits removed on slopes steeper than about 5:1, to prevent reactivation of movement. Denuded slopes should be planted with fast-growing plants to stabilize the bare soils. In the ancient landslide explored with test pits LSTP-3, -4, and -5, the landslide debris is so ancient and consolidated that it constitutes supporting material. In this area, and on stable slopes in general, the younger, weak surface soil and colluvium will still need to be reworked if it is to be used for support.

Residence Locations

The proposed building envelopes must be located outside unstable areas and steep slopes in order to reduce the risks associated with slope instability. Initially, a structural setback of approximately 50-feet from unstable areas and breaks in slope of 2:1 or steeper should be established. A site-specific study should finalize recommended structural setbacks.

Supplemental Services

We should perform detailed, site-specific geotechnical studies prior to the construction of the different phases of the resort, including access roads, the farmstead, hotels, spa, equestrian center, shops, residences, and other planned features. The studies should include test borings or backhoe pits, laboratory testing and engineering analyses. The geotechnical study should address specific design and locating aspects of each planned structure location and the access road, and the data generated should be incorporated into project plans. The plans should then be reviewed by the geotechnical engineer and /or engineering geologist prior to receiving bids for planned work.

LIMITATIONS

This report has been prepared by RGH for the exclusive use of Lotusland Investment Holdings, Inc. and their consultants to evaluate the geotechnical feasibility of the proposed resort.

Our services consist of professional opinions and conclusions developed in accordance with generally accepted geotechnical engineering principles and practices. We provide no warranty, either expressed or implied. Our conclusions and recommendations are based on the information provided to us regarding the project, the results of our field reconnaissance, data review, and professional judgment. As such, our conclusions and recommendations should be considered preliminary and for feasibility and planning purposes only. Additional subsurface study, such as recommended herein, may reveal conditions different from those inferred by surface observation and data review only. Such subsurface study may warrant a revision to our preliminary conclusions.

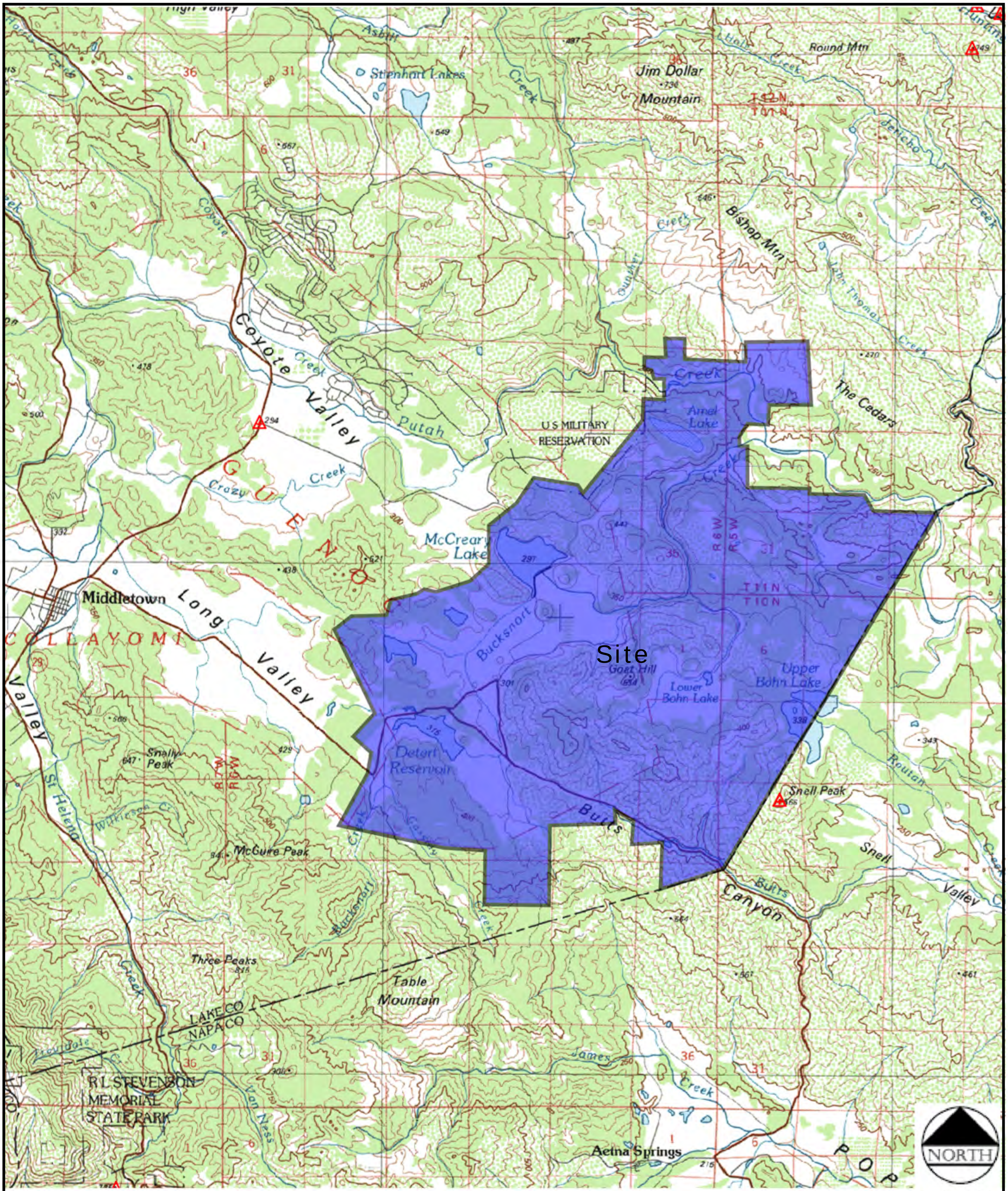
Site conditions and cultural features described in the text of this report are those existing at the time of our field exploration in 2018 and 2019, and may not necessarily be the same or comparable at other times.

It should be understood that slope failures including landslides, debris flows and erosion are on-going natural processes which gradually wear away the landscape. Residual soils and weathered bedrock can be susceptible to downslope movement, even on apparently stable sites. Such inherent hillside and slope risks are generally more prevalent during periods of intense and prolonged rainfall, which occasionally occur in northern California and/or during earthquakes. Therefore, it must be accepted that occasional slope failure and erosion and deposition of the residual soils and weathered bedrock materials are irreducible risks and hazards of building upon or near the base of any hillside or steep slope throughout northern California. By accepting this report, the client and other recipients acknowledge their understanding and acceptance of these risks and hazards.

Except for the testing for the presence of NOA as discussed herein, the scope of our services did not include an environmental assessment or a study of the presence (or absence) of hazardous, toxic or corrosive materials in the soil, surface water, groundwater or air on, below, or around this site, nor did it include an evaluation or study for the presence (or absence) of wetlands.

APPENDIX A – PLATES

LIST OF PLATES

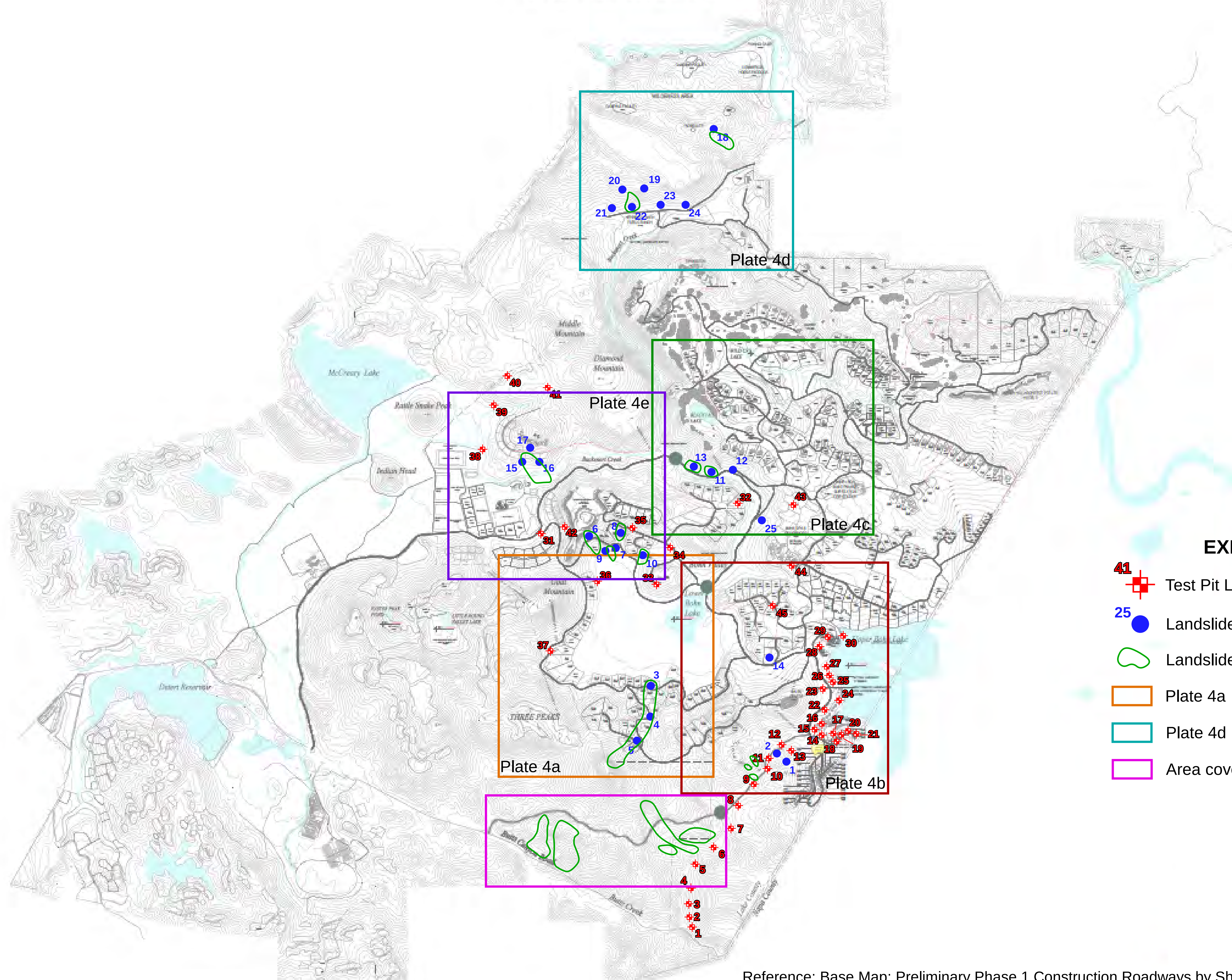


Reference: Maptech Topoquad

Scale: 1:100,000

RGH CONSULTANTS	**SITE LOCATION MAP** MAHA Resort at Guenoc Valley 22000 Butts Canyon Road Middletown, California	PLATE 1
Job No: 7192.04.01.3 Date: DEC 2019		

OVERALL SITE MAP

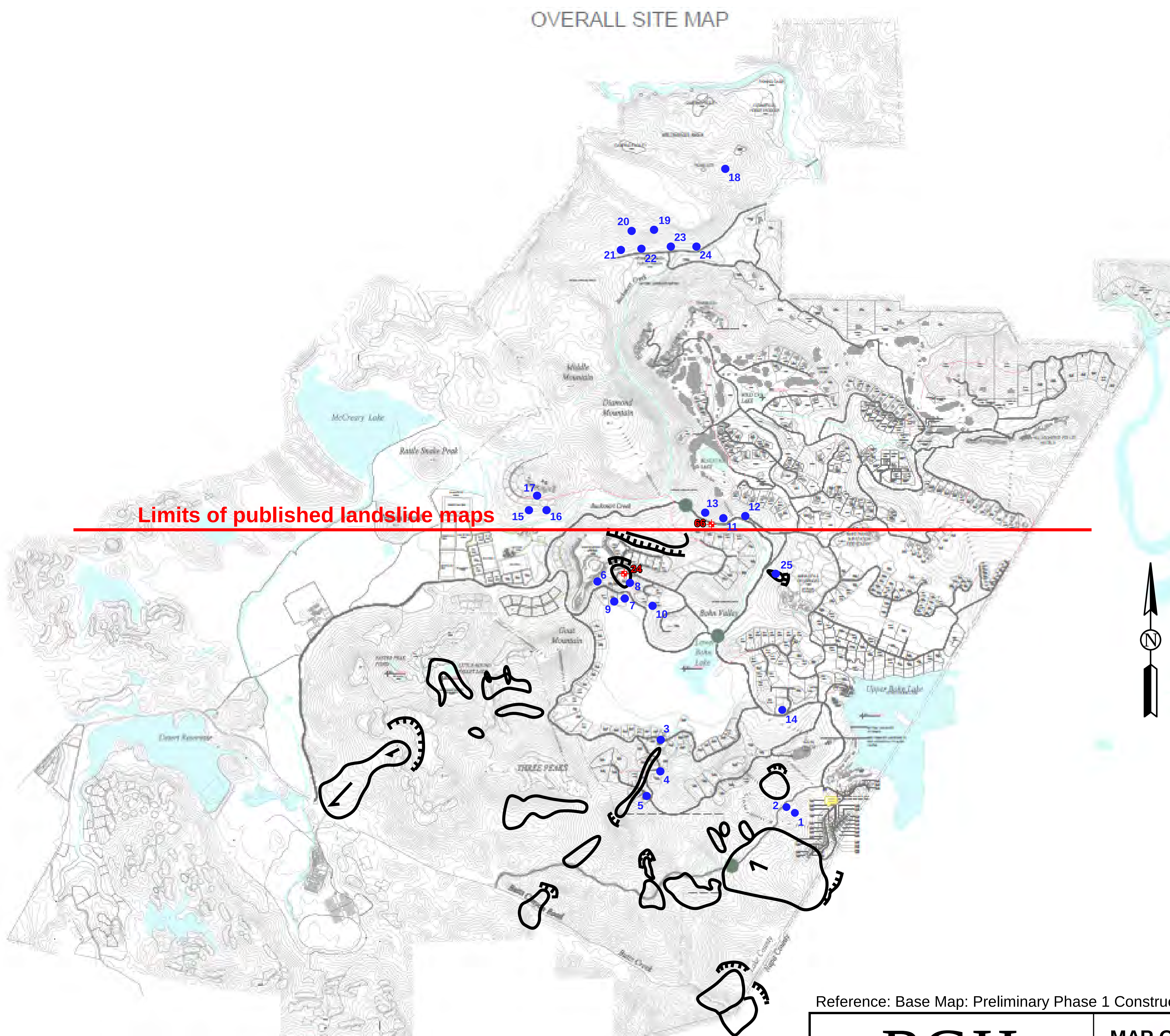


EXPLANATION

- 41 Test Pit Location and Number
- 25 Landslide Test Pit Location and Number (LSTP)
- Landslide observed/mapped by RGH
- Plate 4a
- Plate 4b
- Plate 4c
- Plate 4d
- Plate 4e
- Area covered in detail in Main Entry Road Report

Reference: Base Map: Preliminary Phase 1 Construction Roadways by Sherwood Design Engineers Not To Scale

RGH CONSULTANTS Job No: 7192.04.01.3 Date: DEC 2019	**EXPLORATION PLAN WITH LANDSLIDE MAPPING** MAHA Resort at Guenoc Valley 22000 Butts Canyon Road Middletown, California	PLATE **2**



EXPLANATION

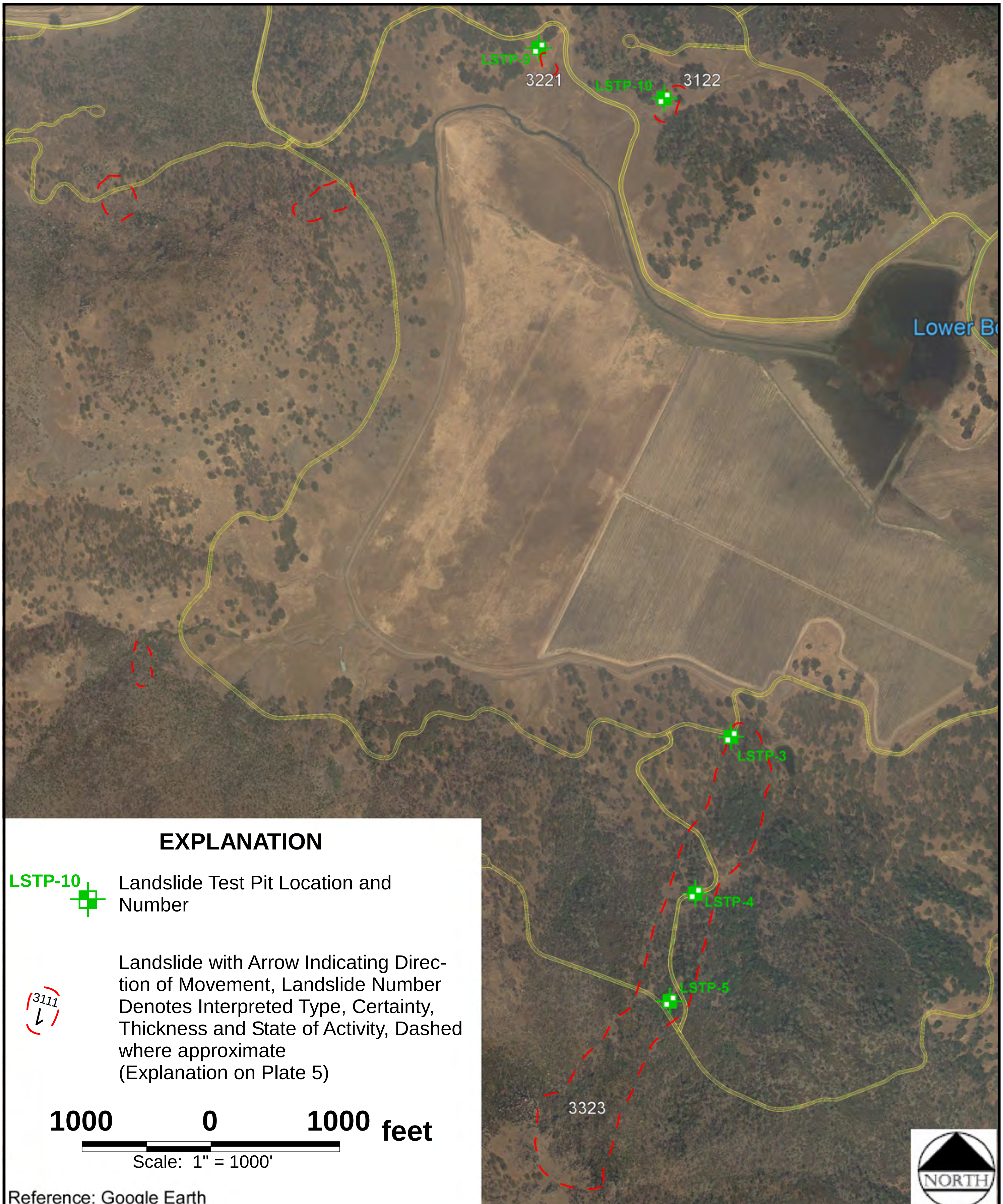
Approximate location of published landslide and direction of movement (Dwyer, 1976)

66 Road Test Pit Location and Number (TPR)

25 Landslide Test Pit Location and Number (LSTP)

Reference: Base Map: Preliminary Phase 1 Construction Roadways by Sherwood Design Engineers   Not To Scale

RGH CONSULTANTS	**MAP OF PUBLISHED LANDSLIDES** MAHA Resort at Guenoc Valley 22000 Butts Canyon Road Middletown, California	PLATE 3
Job No: 7192.04.01.3 Date: DEC 2019		



EXPLANATION

LSTP-10 — Landslide Test Pit Location and Number

3111 — Landslide with Arrow Indicating Direction of Movement, Landslide Number Denotes Interpreted Type, Certainty, Thickness and State of Activity, Dashed where approximate (Explanation on Plate 5)

1000 0 1000 feet

Scale: 1" = 1000'

Reference: Google Earth

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Job No: 7192.04.01.3 | Date: DEC 2019

AERIEAL IMAGES OF LANDSLIDE AREAS
MAHA Resort at Guenoc Valley
2200 Butts Canyon Road
Middletown, California

PLATE
4a

EXPLANATION

LSTP-14 Landslide Test Pit Location and Number

3111 Landslide with Arrow Indicating Direction of Movement, Landslide Number Denotes Interpreted Type, Certainty, Thickness and State of Activity, Dashed where approximate (Explanation on Plate 5)

1000 0 1000 feet

Scale: 1" = 1000'

NORTH

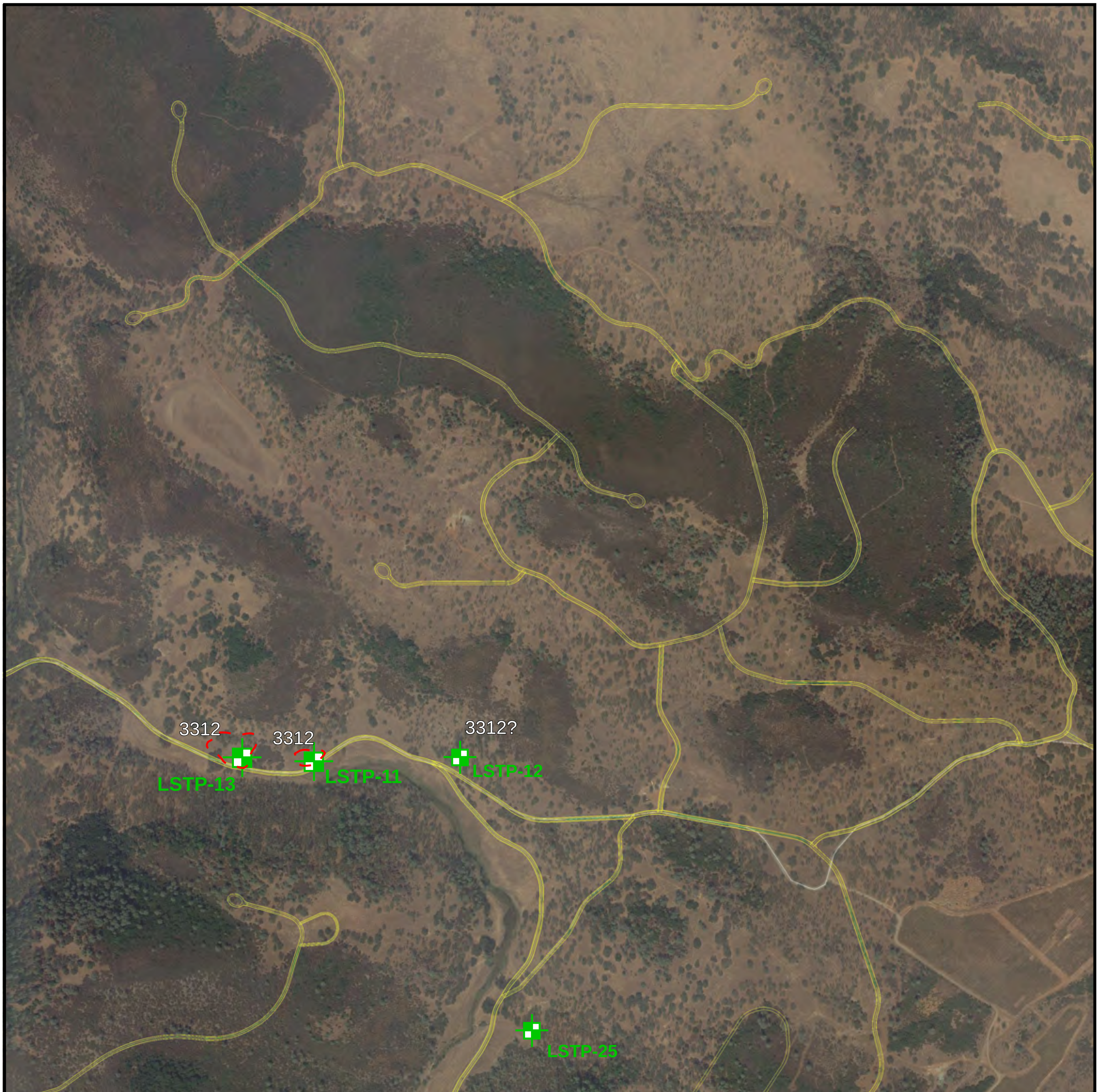
Reference: Google Earth

RGH CONSULTANTS

Job No: 7192.04.01.03 | Date: DEC 2019

AERIAL IMAGES OF LANDSLIDE AREAS
MAHA Resort at Guenoc Valley
22000 Butts Canyon Road
Middletown, California

PLATE **4b**



EXPLANATION

LSTP-25 Landslide Test Pit Location and Number

3111 Landslide with Arrow Indicating Direction of Movement, Landslide Number Denotes Interpreted Type, Certainty, Thickness and State of Activity, Dashed where approximate (Explanation on Plate 5)

1000 0 1000 feet

Scale: 1" = 1000'

NORTH

Reference: Google Earth

RGH CONSULTANTS

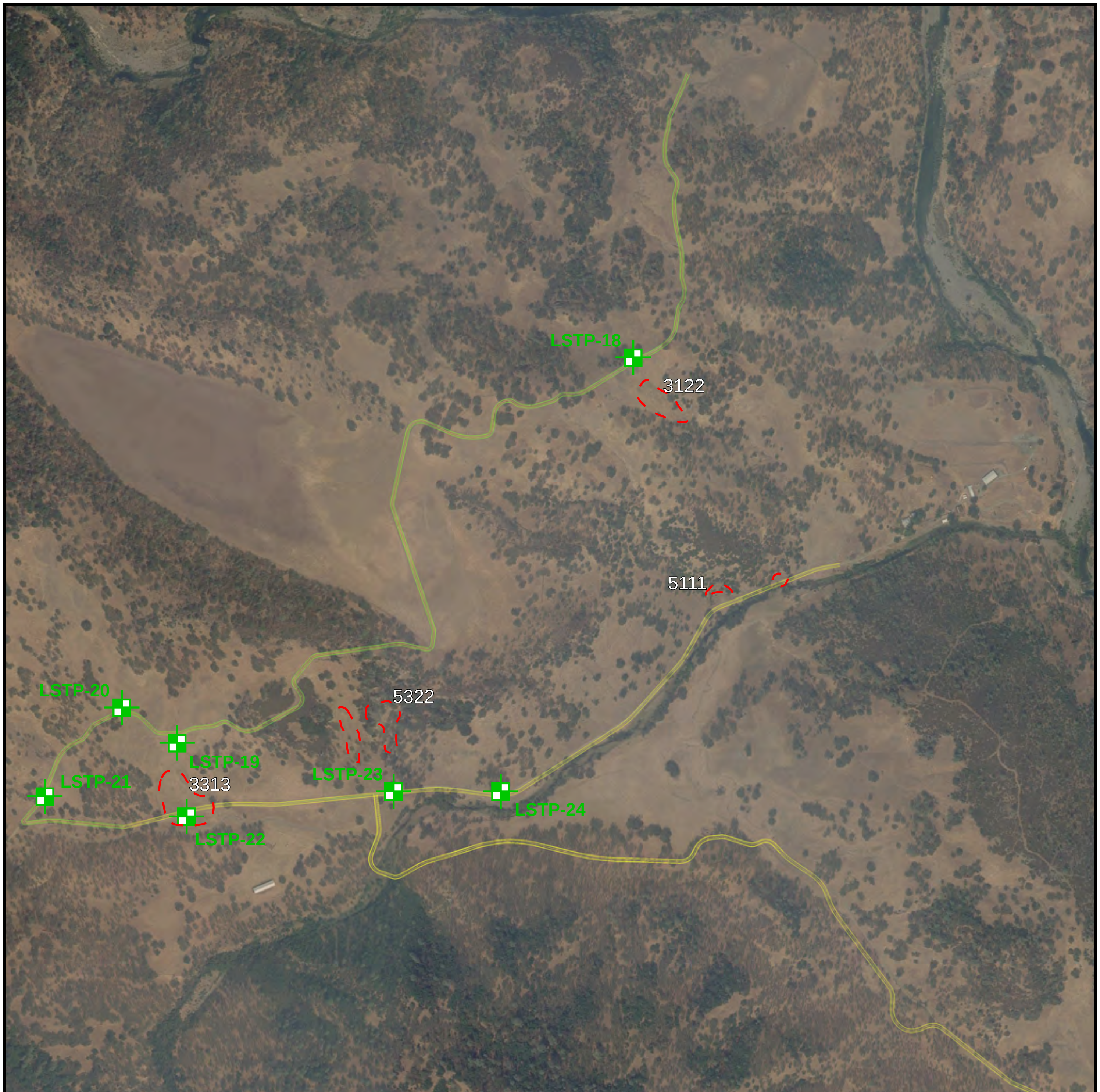
Job No: 7192.04.01.03 | Date: DEC 2019

AERIAL IMAGES OF LANDSLIDE AREAS

MAHA Resort at Guenoc Valley
22000 Butts Canyon Road
Middletown, California

PLATE

4c



EXPLANATION

LSTP-24 Landslide Test Pit Location and Number

3111 Landslide with Arrow Indicating Direction of Movement, Landslide Number Denotes Interpreted Type, Certainty, Thickness and State of Activity, Dashed where approximate (Explanation on Plate 5)

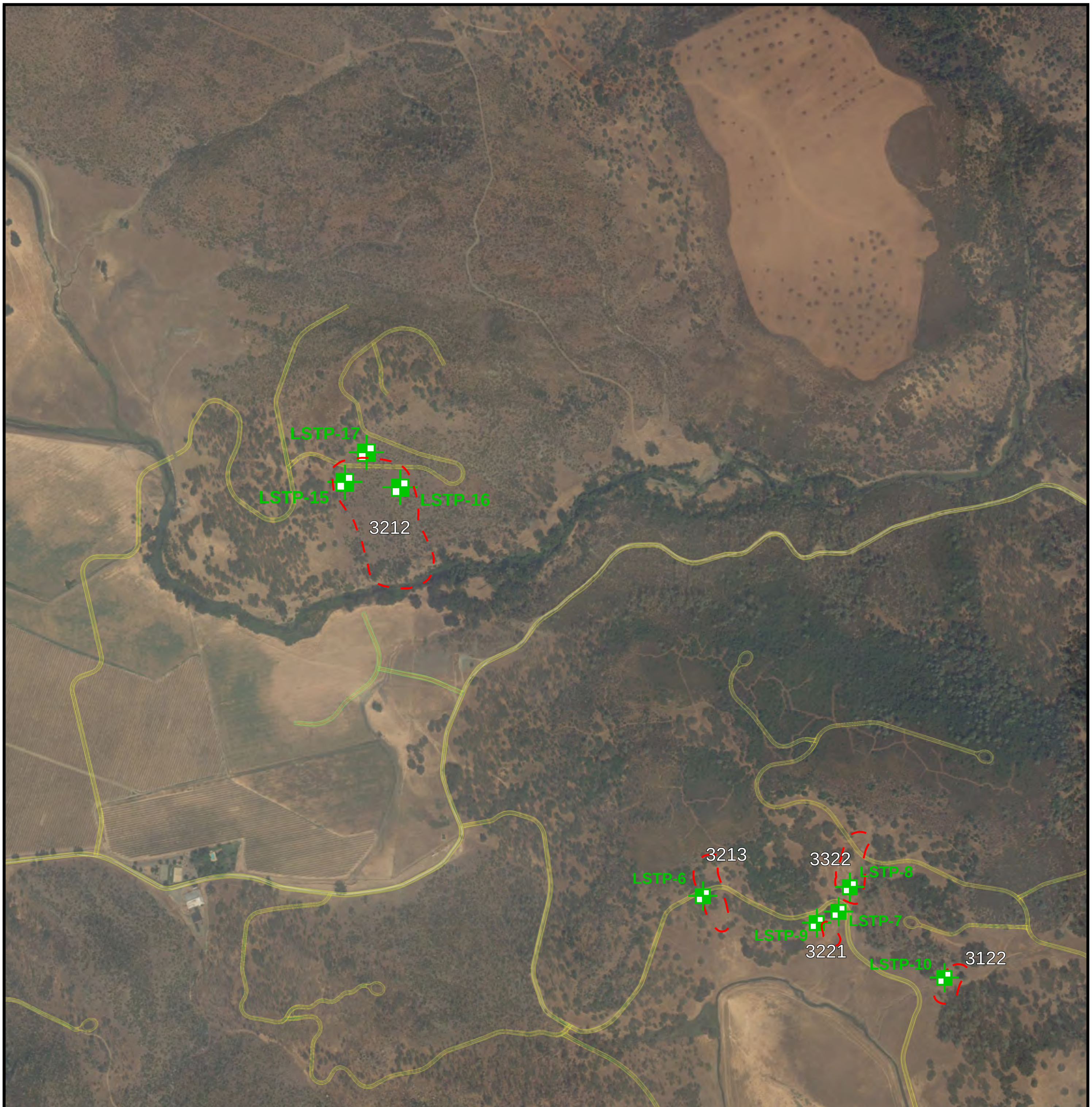
1000 0 1000 feet

Scale: 1" = 1000'

NORTH

Reference: Google Earth

RGH CONSULTANTS	**AERIAL IMAGES OF LANDSLIDE AREAS** MAHA Resort at Guenoc Valley 22000 Butts Canyon Road Middletown, California	PLATE **4d**
Job No: 7192.04.01.03 Date: DEC 2019		



EXPLANATION

LSTP-17 — Landslide Test Pit Location and Number

3111 — Landslide with Arrow Indicating Direction of Movement, Landslide Number Denotes Interpreted Type, Certainty, Thickness and State of Activity, Dashed where approximate (Explanation on Plate 5)

1000 0 1000 feet

Scale: 1" = 1000'

Reference: Google Earth

NORTH

RGH CONSULTANTS	**AERIAL IMAGES OF LANDSLIDE AREAS** MAHA Resort at Guenoc Valley 22000 Butts Canyon Road Middletown, California	PLATE **4e**
Job No: 7192.04.01.3 · Date: DEC 2019		

Landslide Identification Nomenclature *

Type of Landslide Movement

1	Rotational (Earth Slump)	Movement due to forces that cause a turning moment about a point above the center of gravity of the unit.
2	Translational	Movement predominantly along more or less planar or gently undulatory surfaces.
3	Debris Flow	Rapid movement (50 to 80 kph) within displaced mass such that the form taken by moving material or the apparent distribution of velocities and displacements resemble those of viscous fluids.
4	Earth Flow	Downslope viscous flow of fine grained materials that have been saturated and moves under the pull of gravity. Typically slow moving (a few meters per day or less).
5	Debris Slide	Unconsolidated rock and soil moved downslope along a relatively shallow failure plane
6	Rock Fall	Fragments of rock detached by toppling or falling that falls along a vertical or sub-vertical cliff.
C	Many landslides consist of one or more type of movement. The listed type of movement is modified with a "C" to indicate a Complex of landslides.	

Certainty of Landslide Identification

1	Definite
2	Probable
3	Questionable

Estimated Thickness of Landslide Deposits

1	Less than 5 feet
2	5 to 20 feet
3	20 to 50 feet
4	Greater than 50 feet

State of Landslide Activity

1	Recently Active	Currently moving or estimated movement within recent years.
2	Dormant	Marginally stable with mature and subdued expression of the landslide. Mostly re-vegetated.
3	Ancient	Most landslide features are eroded. Heavily vegetated.

* The landslide identification mapping is designed for planning purposes only and should not be used in lieu of a detailed site specific investigation. Our mapping should be considered preliminary and for feasibility and planning purposes only. A subsurface study may reveal conditions different from those inferred by surface observations and data review only. Such subsurface study may warrant a revision to our preliminary mapping.

UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			SYMBOLS GRAPH	SYMBOLS LETTER	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	**GRAVEL AND GRAVELLY SOILS** MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	**CLEAN GRAVEL** (LITTLE OR FINES)		**GW**	WELL-GRADED GRAVEL, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
				GP	POORLY-GRADED GRAVEL, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
		GRAVEL WITH FINES (OVER 12% OF FINES)		**GM**	WELL-GRADED GRAVEL, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
				GC	CLAYEY GRAVEL, POORLY GRADED GRAVEL-SAND-CLAY MIXTURES
	SAND AND SANDY SOILS MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	**CLEAN SANDS** (LITTLE OR NO FINES)		**SW**	WELL-GRADED SAND, GRAVELLY SAND, LITTLE OR NO FINES
				SP	POORLY-GRADED SAND, GRAVELLY SAND, LITTLE OR NO FINES
		SANDS WITH FINES (OVER 12% OF FINES)		**SM**	SILTY SANDS, POORLY GRADED SAND-SILT MIXTURES
				SC	CLAYEY SANDS, POORLY GRADED SAND-CLAY MIXTURES
FINE GRAINED SOILS MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	**SILTS AND CLAYS** LIQUID LIMIT LESS THAN 50			**ML**	INORGANICS SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS, OR CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC CLAYS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS LIQUID LIMIT GREATER THAN 50			**MH**	ORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDY OR SILTY SOILS, ELASTIC SILTS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS				**PT**	PEAT, HUMUS, SWAMP SOILS AND OTHER SOILS WITH HIGH ORGANIC-CONTENTS

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

KEY TO TEST DATA

Consol - Consolidation
Gs - Specific Gravity
SA - Sieve Analysis
■ - "Undisturbed" Sample
☒ - Bulk or Disturbed Sample
◪ - Standard Penetration Test
⧄ - Sample Attempt With No Recovery
▯ - Sample Recovered But Not Retained

	Shear Strength, psf	Confining Pressure, psf	
Tx	320	(2600)	- Unconsolidated Undrained Traixial
TxCU	320	(2600)	- Consolidated Undrained Triaxial
DS	2750	(2600)	- Consolidated Drained Direct Shear
UC	2000		- Unconfined Compression
FVS	470		- Field Vane Shear
LVS	700		- Laboratory Vane Shear
SS			- Shrink Swell
EXP			- Expansion
P			- Permeability

Note: All strength tests on 2.8-in. or 2.4-in. diameter sample, unless otherwise indicated.

RGH CONSULTANTS

Job No: 7192.04.01.3 | Date: DEC 2019

SOIL CLASSIFICATION AND KEY TO TEST DATA
MAHA Resort at Guenoc Valley
22000 Butts Canyon Road
Middletown, California

PLATE 6

LAYERING

MASSIVE	Greater than 6 feet
THICKLY BEDDED	2 to 6 feet
MEDIUM BEDDED	8 to 24 inches
THINLY BEDDED	2½ to 8 inches
VERY THINLY BEDDED	¾ to 2½ inches
CLOSELY LAMINATED	¼ to ¾ inches
VERY CLOSELY LAMINATED	Less than ¼ inch

JOINT, FRACTURE, OR SHEAR SPACING

VERY WIDELY SPACED	Greater than 6 feet
WIDELY SPACED	2 to 6 feet
MODERATELY SPACED	8 to 24 inches
CLOSELY SPACED	2½ to 8 inches
VERY CLOSELY SPACED	¾ to 2½ inches
EXTREMELY CLOSELY SPACED	Less than ¼ inch

HARDNESS

Soft - pliable; can be dug by hand
Firm - can be gouged deeply or carved with a pocket knife
Moderately Hard - can be readily scratched by a knife blade; scratch leaves heavy trace of dust and is readily visible after the powder has been blown away
Hard - can be scratched with difficulty; scratch produces little powder and is often faintly visible
Very Hard - cannot be scratched with pocket knife, leaves a metallic streak

STRENGTH

Plastic - capable of being molded by hand
Friable - crumbles by rubbing with fingers
Weak - an unfractured specimen of such material will crumble under light hammer blows
Moderately Strong - specimen will withstand a few heavy hammer blows before breaking
Strong - specimen will withstand a few heavy ringing hammer blows and usually yields large fragments
Very Strong - rock will resist heavy ringing hammer blows and will yield with difficulty only dust and small flying fragments

DEGREE OF WEATHERING

Highly Weathered - abundant fractures coated with oxides, carbonates, sulphates, mud, etc., thorough discoloration, rock disintegration, mineral decomposition
Moderately Weathered - some fracture coating, moderate or localized discoloration, little to no effect on cementation, slight mineral decomposition
Slightly Weathered - a few stained fractures, slight discoloration, little or no effect on cementation, no mineral composition
Fresh - unaffected by weathering agents; no appreciable change with depth

APPENDIX B - ASBESTOS REPORT

ASBESTOS TEM LABORATORIES, INC.

CARB Method 435
Polarized Light Microscopy
Analytical Report

Laboratory Job # 1392-00005

630 Bancroft Way
Berkeley, CA 94710
(510) 704-8930
FAX (510) 704-8429

ASBESTOS TEM LABORATORIES, INC

CA DPH ELAP
Lab No. 1866

NVLAP Lab Code: 101891-0
Berkeley, CA

Nov/13/2018

Travis Whitted
RGH Consultants
1305 North Dutton Avenue
Santa Rosa, CA 95401

RE: LABORATORY JOB #'s: 1392-00005
Polarized light microscopy analytical results for 5 bulk sample(s).
Job Site: 7192.04.01.3
Job No.: Maha Resort Middletown

Enclosed please find the bulk material analytical results for one or more samples submitted for asbestos analysis. The analyses were performed in accordance with a modified California Air Resources Board (ARB) Method 435 for the determination of asbestos in serpentine aggregate samples.

Prior to analysis, samples are logged-in and all data pertinent to the sample recorded. The samples are checked for damage or disruption of any chain-of-custody seals. A unique laboratory ID number is assigned to each sample. A hard copy log-in sheet containing all pertinent information concerning the sample is generated. This and all other relevant paper work are kept with the sample throughout the analytical procedures to assure proper analysis.

Sample preparation follows a standard CARB 435 prep method. The entire sample is dried at 135-150 C and then crushed to ~3/8" gravel size using a Bico Chipmunk crusher. The sample is then pulverized in a Bico Braun disc pulverizer calibrated to produce a nominal 200 mesh final product. Small aliquots are collected from throughout the pulverized material to create three separate microsope slide mounts containing the appropriate refractive index oil. The prepared slides are placed under a polarizing light microscope where standard mineralogical techniques are used to analyze the various materials present, including asbestos. If asbestos is identified and of less than 10% concentration by visual area estimate then an additional five sample mounts are prepared. Quantification of asbestos concentration is obtained using the modified CAL ARB Method 435 point count protocol. For samples observed to contain visible asbestos of less than 10% concentration, a point counting techinique was performed on multiple sample mounts for a total of 800 or 1200 particle points (a variation from the 400 points called for by the standard CARB 435 method) which is detailed on the test report. The data is then compiled into standard report format and subjected to a thorough quality assurance check before the information is released to the client.

While the CARB 435 method has much to commend it, there are a number of situations where it fails to provide sufficient accuracy to make a definitive determination of the presence/absence of asbestos and/or an accurate count of the asbestos concentration present in a given sample. These problems include, but are not limited to, 1) statistical uncertainty with samples containing <1% asbestos when too few particles are counted, 2) definitive identification and discrimination between various fibrous amphibole minerals such as tremolite/actnolite/ hornblende and the "Libby amphiboles" such as tremolite/winchite/richterite/arfvedsonite, and C) small asbestiform fibers which are near or below the resolution limit of the PLM microscope such as those found in various California coast range serpentine bodies. In these cases, further analysis by transmission electron microscopy (TEM) is recommended to obtain a more accurate result.

Sincerely Yours,

ASBESTOS TEM LABORATORIES, INC.

--- These results relate only to the samples tested and must not be reproduced, except in full, without the approval of the laboratory. ---

POLARIZED LIGHT MICROSCOPY
CARB 435 ANALYTICAL REPORT

Contact: Travis Whitted

Address: RGH Consultants
1305 North Dutton Avenue
Santa Rosa, CA

Samples Submittec 5

Samples Analyzed: 5

Job Site / No. Maha Resort Middletown 7192.04.01.3

Report No. 361417

Date Submitted: Nov-08-18

Date Reported: Nov-13-18

SAMPLE ID	POINTS COUNTED	ASBESTOS %	ASBESTOS TYPE	LOCATION / DESCRIPTION
TP-1-TP-6 Lab ID # 1392-00005-001	26 1200 - Total Points	2.17%	Chrysotile	Chrysotile and Antigorite fibers observed
TP-7-TP-12 Lab ID # 1392-00005-002	1200 - Total Points	<0.08%	None Detected	No Asbestos Detected
TP-14@15 Lab ID # 1392-00005-003	19 1200 - Total Points	1.58%	Chrysotile	Chrysotile and Antigorite fibers observed
TP-16@1'-2' Lab ID # 1392-00005-004	1200 - Total Points	<0.08%	None Detected	No Asbestos Detected
TP-17@5' Lab ID # 1392-00005-005	1200 - Total Points	<0.08%	None Detected	No Asbestos Detected
Lab ID #	- Total Points			
Lab ID #	- Total Points			
Lab ID #	- Total Points			
Lab ID #	- Total Points			
Lab ID #	- Total Points			

QC Reviewer R. Mc B[illegible] Analys Jo Ann H[illegible]

ASBESTOS TEM LABORATORIES, INC.

CARB Method 435
Polarized Light Microscopy
Analytical Report

Laboratory Job # 1392-00006

630 Bancroft Way
Berkeley, CA 94710
(510) 704-8930
FAX (510) 704-8429

ASBESTOS TEM LABORATORIES, INC

CA DPH ELAP
Lab No. 1866

NVLAP Lab Code: 101891-0
Berkeley, CA

Dec/07/2018

Travis Whitted
RGH Consultants
1305 North Dutton Avenue
Santa Rosa, CA 95401

RE: LABORATORY JOB #'s: 1392-00006
Polarized light microscopy analytical results for 9 bulk sample(s).
Job Site: 7192.04.01.3
Job No.: MAHA Resort Middletown

Enclosed please find the bulk material analytical results for one or more samples submitted for asbestos analysis. The analyses were performed in accordance with a modified California Air Resources Board (ARB) Method 435 for the determination of asbestos in serpentine aggregate samples.

Prior to analysis, samples are logged-in and all data pertinent to the sample recorded. The samples are checked for damage or disruption of any chain-of-custody seals. A unique laboratory ID number is assigned to each sample. A hard copy log-in sheet containing all pertinent information concerning the sample is generated. This and all other relevant paper work are kept with the sample throughout the analytical procedures to assure proper analysis.

Sample preparation follows a standard CARB 435 prep method. The entire sample is dried at 135-150 C and then crushed to ~3/8" gravel size using a Bico Chipmunk crusher. The sample is then pulverized in a Bico Braun disc pulverizer calibrated to produce a nominal 200 mesh final product. Small aliquots are collected from throughout the pulverized material to create three separate microsope slide mounts containing the appropriate refractive index oil. The prepared slides are placed under a polarizing light microscope where standard mineralogical techniques are used to analyze the various materials present, including asbestos. If asbestos is identified and of less than 10% concentration by visual area estimate then an additional five sample mounts are prepared. Quantification of asbestos concentration is obtained using the modified CAL ARB Method 435 point count protocol. For samples observed to contain visible asbestos of less than 10% concentration, a point counting techinique was performed on multiple sample mounts for a total of 800 or 1200 particle points (a variation from the 400 points called for by the standard CARB 435 method) which is detailed on the test report. The data is then compiled into standard report format and subjected to a thorough quality assurance check before the information is released to the client.

While the CARB 435 method has much to commend it, there are a number of situations where it fails to provide sufficient accuracy to make a definitive determination of the presence/absence of asbestos and/or an accurate count of the asbestos concentration present in a given sample. These problems include, but are not limited to, 1) statistical uncertainty with samples containing <1% asbestos when too few particles are counted, 2) definitive identification and discrimination between various fibrous amphibole minerals such as tremolite/actnolite/ hornblende and the "Libby amphiboles" such as tremolite/winchite/richterite/arfvedsonite, and C) small asbestiform fibers which are near or below the resolution limit of the PLM microscope such as those found in various California coast range serpentine bodies. In these cases, further analysis by transmission electron microscopy (TEM) is recommended to obtain a more accurate result.

Sincerely Yours,

ASBESTOS TEM LABORATORIES, INC.

--- These results relate only to the samples tested and must not be reproduced, except in full, without the approval of the laboratory. ---

POLARIZED LIGHT MICROSCOPY
CARB 435 ANALYTICAL REPORT

Contact: Travis Whitted	Samples Submittec 9	Report No. 361758
Address: RGH Consultants 1305 North Dutton Avenue Santa Rosa, CA	Samples Analyzed: 9	Date Submitted: Dec-03-18
	Job Site / No. MAHA Resort Middletown 7192.04.01.3	Date Reported: Dec-07-18

SAMPLE ID	POINTS COUNTED	ASBESTOS %	ASBESTOS TYPE	LOCATION / DESCRIPTION
TP-37@7' Lab ID # 1392-00006-001	1200 - Total Points	<0.08%	None Detected	No Asbestos Detected
TP-38@4' Lab ID # 1392-00006-002	1200 - Total Points	<0.08%	None Detected	No Asbestos Detected
TP-39@1S-4' Lab ID # 1392-00006-003	1200 - Total Points	<0.08%	Chrysotile	Trace Chrysotile fibers detected.
TP-40@1S-3' Lab ID # 1392-00006-004	47 1200 - Total Points	3.92%	Chrysotile	Chrysotile fibers detected.
TP-41@0-1S Lab ID # 1392-00006-005	12 1200 - Total Points	1 %	Chrysotile	Chrysotile fibers detected.
112018A@surface Lab ID # 1392-00006-006	1200 - Total Points	<0.08%	Chrysotile	Trace Chrysotile fibers detected.
TP-43@1S Lab ID # 1392-00006-007	1200 - Total Points	<0.08%	None Detected	No Asbestos Detected
TP-44@1' Lab ID # 1392-00006-008	1200 - Total Points	<0.08%	None Detected	No Asbestos Detected
TP-45@1'-2' Lab ID # 1392-00006-009	1200 - Total Points	<0.08%	None Detected	No Asbestos Detected
Lab ID #	- Total Points			

QC Reviewer ____________________ Analys ____________________

APPENDIX C - REFERENCES

Bortugno, E.J., 1982, Map Showing Recency of Faulting, Santa Rosa Quadrangle in Wagner and Bortugno, Geologic Map of the Santa Rosa Quadrangle: California Division of Mines and Geology, Regional Geologic Map Series, Map No. 2A, Santa Rosa Quadrangle, Scale 1:250,000.

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Dwyer, M.J., Noguchi, N., and O'Rourke, J., 1976, Reconnaissance Photo-Interpretation Map of Landslides in 24 Selected 7.5-Minute Quadrangles in Lake, Napa, Solano, and Sonoma Counties, California: U.S. Geological Survey OFR 76-74, 25 Plates, Scale 1:24,000.

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Miller, D.C., 1989, Potential Hazards from Future Volcanic Eruption in California, United States Geologic Survey Bulletin 1847, p. 17.

Slosson and Associates, 1976, Geologic and Seismic Technical Background Report for Seismic Safety Element and Geologic Hazards Portion of Safety Element, General Plan, Lake County, California.

U.S. Department of Housing and Urban Development, Federal Insurance Administration, 1980, Flood Insurance Rate Map, Sonoma County, California, Community Panel Number No. 06033C1000D dated September 26, 2008 and 06033C0900D dated September 30, 2005.

APPENDIX D - DISTRIBUTION

Kevin Case (0, e)
kc@mahaman.com

Kirsty Shelton (0, e)
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TAW:SCL:JJP:tw:nvd

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