GEOLOGIC HAZARD REPORT

HOWELL MOUNTAIN CEMETERY
1225 HOWELL MOUNTAIN ROAD
ANGWIN, CALIFORNIA

Project Number:

7775.01.01.2

Prepared For:
Wildlands
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TABLE OF CONTENTS

INTRODUCTION

This report presents the results of our geologic hazard study for the proposed driveway and welcome center for the Howell Mountain Cemetery to be constructed at 1225 Howell Mountain Road in Angwin, California. The site location is shown on Plate 1.

We understand it is planned to construct a new driveway and welcome center in the south-central portion of the project site. The purpose of our study as outlined in our proposal dated October 5, 2023, was to evaluate the geologic hazards within the property and comment on the geotechnical feasibility of the project in accordance with Napa County Code, section 15.08.050.

SCOPE

Our scope of work was limited to a brief site reconnaissance, a review of selected published geologic data and LIDAR imagery pertinent to the site, and preparation of this report. Site-specific subsurface exploration was not requested, authorized, or performed for this phase of our services.

SERVICES PROVIDED

We reviewed LIDAR imagery of the site and 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 11, 2023, our Certified Engineering Geologist conducted a surficial reconnaissance of the property to observe exposed topographic features, surface soils, rock outcroppings and cut banks. A topographic map of the property showing the location/alignment of proposed improvements is presented on Plate 2.

Based on the geologic literature review and site reconnaissance, we were to develop the following information:

1. A brief description of surface soil, geologic exposures and spring or seepage conditions observed during our reconnaissance
2. A discussion of geologic hazards that may affect the proposed project
3. Our opinions regarding the feasibility of the project
4. Preliminary conclusions and recommendations concerning:
    a. Primary geotechnical engineering concerns and possible mitigating measures, as applicable
    b. Suitable foundation systems for the structures and retaining walls
    c. Stability and feasibility of stable building envelopes and access routes
    d. Preliminary recommendations for drainage systems and other requirements for soil stability
    e. Supplemental geotechnical engineering services including recommendations for site-specific subsurface exploration

SITE CONDITIONS

General

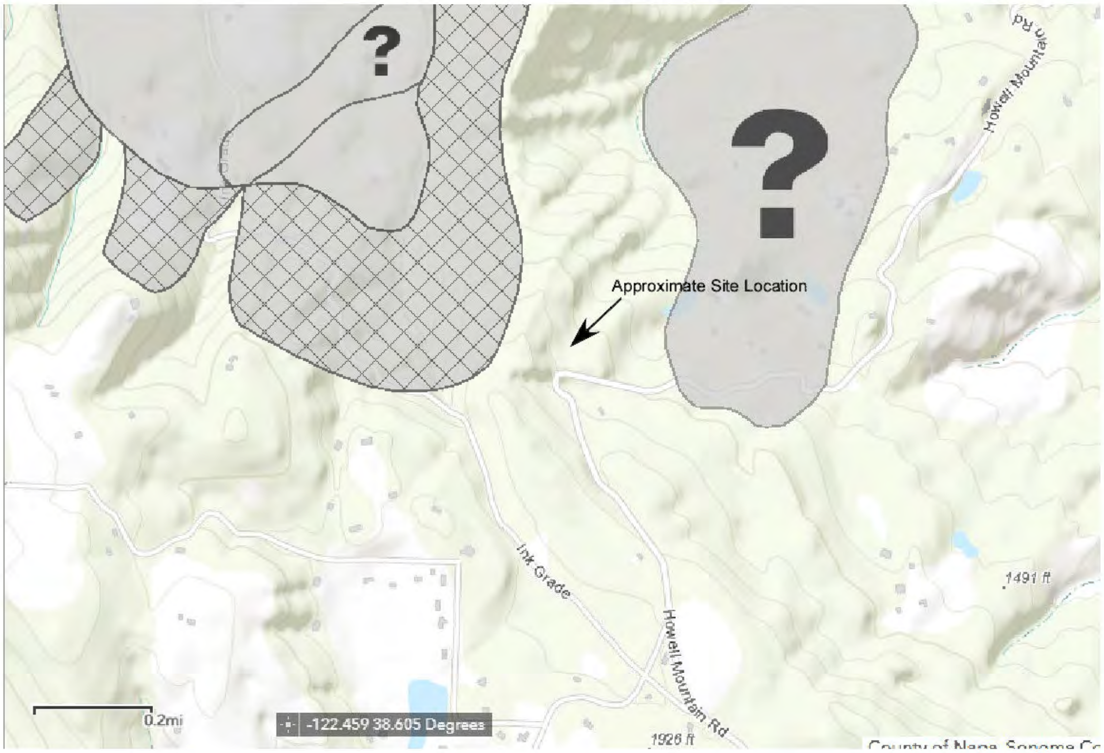
Napa County is located within the California Coast Range geomorphic province. This province is a geologically complex and seismically active region characterized by sub-parallel northwest-trending faults, mountain ranges and valleys. The oldest bedrock units are the Jurassic-Cretaceous Franciscan Complex 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 along a western facing slope above Pope Valley.

Geology

Published geologic maps (Fox et al., 1973) indicate the property is underlain by pumicious ash-flow tuff of the Tertiary age Sonoma Volcanics. This unit is described as locally welded or partly welded with intercalated bedded agglomeratic tuff, andesitic or basaltic lava flows, tuff breccia, bedded tuff and pumicitic tuff.

Landslides

The California Landslide Inventory (CGS, 2023) does not indicate large-scale slope instability at the portion of the site to be developed. However, large-scale landslides are mapped downslope of the project site and on the opposite side of the ridge to the northwest of the development area (see below). Although not shown on the CGS map, the scarp of the landslide downslope of the project site extends upwards toward the project site. The scarp of this large-scale feature exposes undisturbed lithic tuff bedrock. The observed landslide scarp is mapped on Plate 2.



Faulting

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 (Bryant and Hart, 2007). Therefore, we believe the risk of fault rupture at the site is low. However, the site is within an area affected by strong seismic activity and future seismic shaking should be anticipated at the site. It will be necessary to design and construct the proposed improvements in strict adherence with current standards for earthquake-resistant construction.

Surface

The property extends primarily over gently sloping to steeply sloping terrain. The vegetation consists of mature stands of fir and oak. The proposed building site is located in the southern central portion of the property and extends to the northwest off Howell Mountain Road.

In general, the ground surface is soft and spongy. This is a condition generally associated with weak, porous surface souls. Natural drainage consists of overland flow over the ground surface that concentrates on a natural drainage element such as swales and ravines. The drainage trends toward Pope Valley.

DISCUSSION AND CONCLUSIONS

Geologic Hazards

Landslides

As discussed previously, the scarp of a large scale landslide feature was mapped and observed at the project site. The observed landslide features are mapped on Plate 2. We understand that the planned development will not encroach into the landslide features, but the welcome center will be constructed adjacent to the scarp of a large landslide feature. We did observe undisturbed bedrock outcrops exposed in the scarp feature. The welcome center planned adjacent to the scarp feature should gain support in undisturbed bedrock and should have adequate lateral confinement based on the slope geometry and bedrock joint and/or bedding orientations should be considered in the foundation construction. The final geotechnical study should address these issues in detail.

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 improvements 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 is not located within an area delineated by the California Geological Survey as being susceptible to liquefaction (Knudsen, et al, 2000). Therefore, we judge that there is a low potential for liquefaction at the site.

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. Provided foundations are installed as discussed herein, we judge the potential for densification to impact structures at the site is low.

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 improvements 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.

Geotechnical Issues

Based upon the results of our geologic data review and reconnaissance, we judge that it is geotechnically feasible to construct the planned driveway and welcome center. The primary geotechnical considerations and potential mitigating measures 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.

Welcome Center Location

The proposed building envelope for the welcome center must be located outside unstable areas and steep slopes in order to reduce the risks associated with slope instability. The location of the building envelop in relation to such areas is shown on Plate 2. A site-specific study should finalize recommended structural set back and foundation design for the welcome center.

Downslope Creep

Weak, creep-prone surface soils, such as those found at the site, tend to naturally consolidate and settle on sloping terrain that is 5:1 (horizontal to vertical) or steeper. Fills and foundations deriving support from these materials will be susceptible and contribute to the downslope creep and settlement unless properly embedded in bedrock or buttressed (keyed, benched, drained and compacted), respectively. The settlement causes cracks in the slabs and structural distress in the form of cracked plaster, and sticky doors and windows. Therefore, it will be necessary to obtain fill and/or foundation support below the creeping soils and design the foundations to resist stresses imposed by the creeping soils.

Fill Support

Hillside fills need to be constructed on level keyways and benches excavated entirely on rock. However, regardless of the care used during grading, buttressed fills of uneven thickness such as those typically built on hillsides, will settle differentially. Satisfactory performance of structural elements constructed on hillside fills, such as houses, pools, pool decks, garage slabs and driveways, will require the use of specialized grading techniques discussed in the following sections of this report. These include excavating all creeping soils, and replacing said materials as a buttressed fill of even thickness or constructing said improvements entirely on cut.

Foundation Support

Satisfactory foundation support on sloping terrain can be obtained from spread footings that bottom at minimum depth on firm bedrock exposed by planned excavations, or in bedrock reached by footings excavated through the creeping soils, or from spread footings supported on buttressed fills of equal thickness. Where the creeping soils are not buttressed or removed by grading the residential footings must be designed to resist creep forces.

As an alternative, drilled piers gaining support in bedrock and designed to resist creeping forces, as needed, can be used for foundation support either under all parts of the structure or within areas of deep soils or buttressed fill of even thickness. Criteria for the design of such systems should be developed by a site-specific geotechnical study as recommended in the supplemental services section of this report.

Access Driveway

The proposed roadway alignment does not traverse across mapped or observed unstable areas. Therefore, we judge its geotechnically feasible to construct the driveway as shown. Final roadway design should include a site-specific study of the alignment, particularly areas of inherent weakness such as steep slopes, swales and ravines. In general, new driveways should be aligned to avoid steep slopes and areas of potential instability in order to reduce construction costs and future maintenance. Since slopes from the existing road to the proposed building site are level to moderate, we anticipate driveway grading to be geotechnically feasible.

Erosion and Site Drainage

The long-term satisfactory performance of roadways and structural development constructed on hillsides results primarily from strict control of surface runoff and subsurface seepage. The site's surface soils have a moderate erosion potential depending on slope inclination. Uncontrolled erosion could induce sloughing or landsliding. Downspouts from the future structure should discharge into closed glued pipes that empty away from unstable areas and into nearby roadway or natural drainages. Discharge for roadway culverts and ditches need to be protected against erosion and sloughing by energy dissipators such as rip-rap and gabions, or equivalent protective and energy dissipation measures, as appropriate.

Groundwater

Free groundwater seeps or springs were not observed during our reconnaissance. On hillsides, rainwater typically percolates through the porous topsoil and migrates downslope in the form of seepage at the interface of the topsoil and bedrock, and through cracks in the bedrock. Fluctuations in the seepage rates typically occur due to variations in rainfall and other factors such as periodic irrigation.

Supplemental Services

We should perform a detailed geotechnical study prior to the construction of the improvements and roadway. The study 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 residential 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 the property owner and their consultants to evaluate the geotechnical feasibility of residential development within the proposed subdivision.

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 proposed parcel split: 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. A 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.

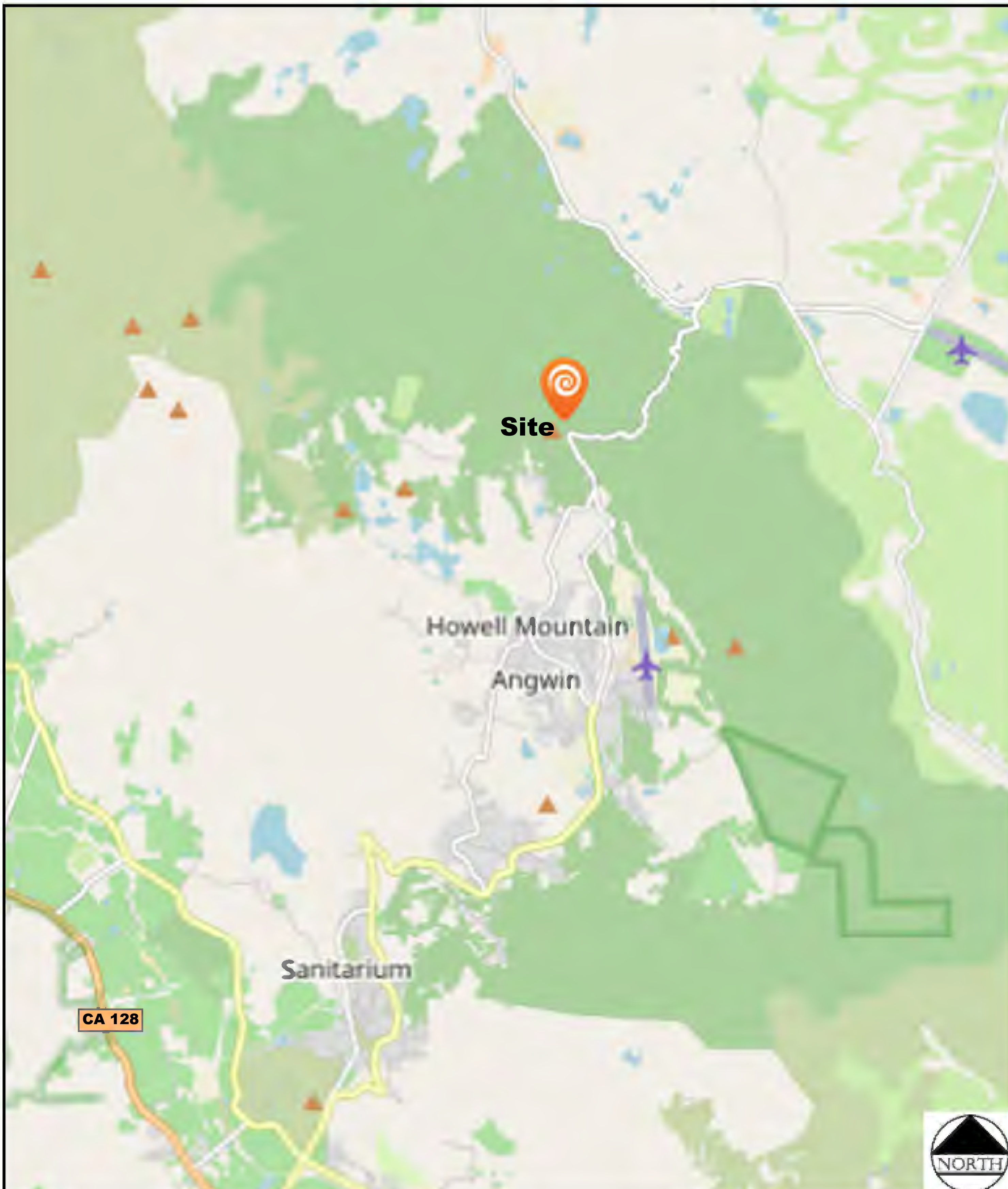
Site conditions and cultural features described in the text of this report are those existing at the time of our field exploration, and may not necessarily be the same or comparable at other times.

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.

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: Mapline

Scale: 1" = 1 Mile

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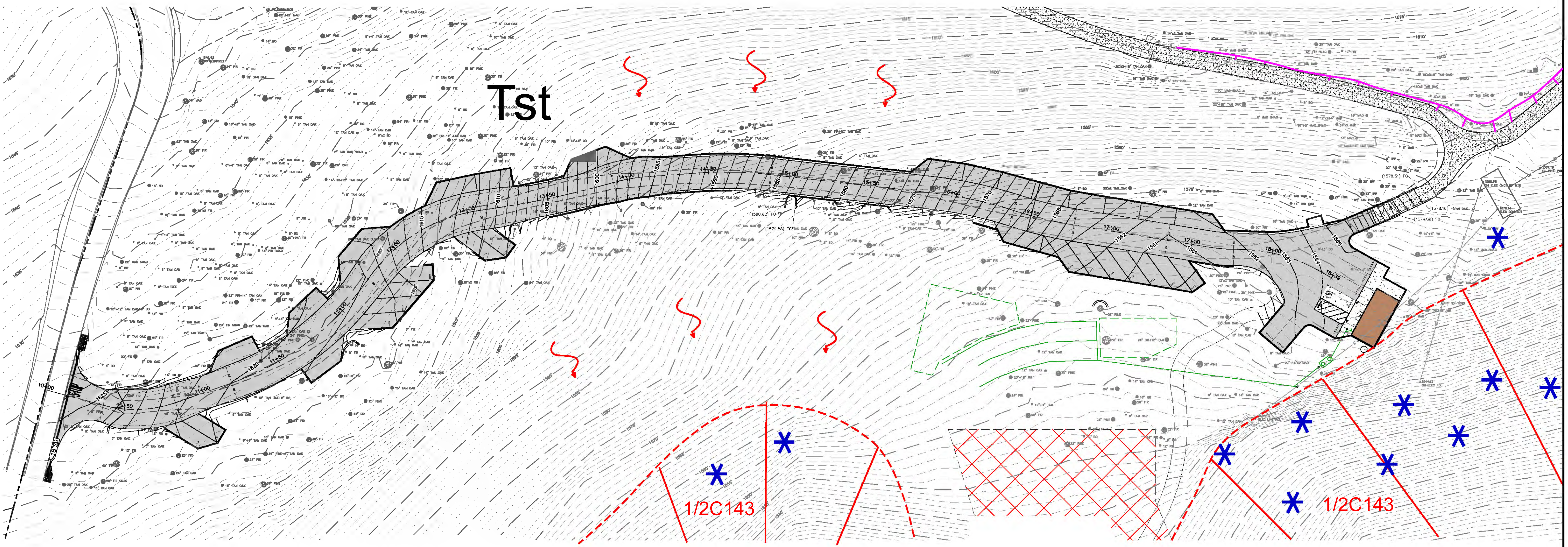
Job No: 7775.01.01.2 | Date: OCT 2023

SITE LOCATION MAP

Howell Mountain Cemetery
1225 Howell Mountain Road
Angwin, California

PLATE 1



EXPLANATION

Tst Sonoma Volcanics Ash-Flow Tuff

Bedrock Outcrop Area

Creeping Soil

Landslide, Dashed Where Approximate, Hatchures Indicate Scarp Area, Nomenclature Indicates Type, Certainty, Estimated Thickness and State of Activity, Described on Plate 3 (1/2C143)

Cutslope

N

60 0 60 feet

Scale: 1" = 60'

Reference: Preliminary Grading Plan, Howell Mountain Cemetery, TSD Engineering, Inc. September 29, 2023

RGH CONSULTANTS	SITE RECONNAISSANCE PLAN Howell Mountain Cemetery 1225 Howell Mountain Road Angwin, California	PLATE 2
Job No: 7775.01.01.2 Date: OCT 2023		

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.

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Job No: 7775.01.01.2 | Date: OCT 2023

LANDSLIDE IDENTIFICATION NOMENCLATURE
Howell Mountain Cemetery
1225 Howell Mountain Road
Angwin, California

PLATE
3

APPENDIX B - REFERENCES

Bryant, W.A., and Hart, E.W., Interim Revision 2007, Fault-Rupture Zones in California; California Geological Survey, Special Publication 42, p. 21 with Appendices A through F.

California Geological Survey, BETA Landslide Inventory and Deep-Seated Landslide Susceptibility Map, https://maps.conservation.ca.gov/cgs/lsi

Knudsen, K.L., Sowers, J.M., Witter, R.C., Wentworth, C.M., and Helley, E.J., 2000, Preliminary Maps of Quaternary Deposits and Liquefaction Susceptibility, Nine-County San Francisco Bay Region, California, U.S. Geological Survey, Open File Report 00-444.

NCALM, Open Topography, Napa Watershed, CA, 2003, https://portal.opentopography.org/lidarDataset?jobId=pc1695110545785

Fox, K.F., Jr., et al., 1973, Preliminary Geology Map of Eastern Sonoma County and Western Napa County, California: U.S. Geological Survey, Miscellaneous Field Studies Map MF-483, Basic Data Contribution 56, Scale 1:62,500.

APPENDIX C - DISTRIBUTION

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