Geotechnical Investigation Report
Oakville to Oak Knoll (OVOK) Reach
Napa River Restoration
Napa County, California

SUBMITTED TO:

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September 26, 2013

FINAL DRAFT

A3GEO

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RE: Geotechnical Investigation Report – Final Draft
Napa River Restoration Project
Oakville to Oak Knoll (OVOK) Reach
Napa County, California

Dear Mr. Blomberg,

This report presents the results of our geotechnical investigation for the Napa River Restoration Project, Oakville to Oak Knoll (OVOK) reach. Following the text of this report are a list of references, illustrative Plates, technical Figures, and Appendices. A3GEO's services in this phase were authorized under ESA PWA's Agreement for Subconsultant Services dated October 30, 2012, which references our October 2, 2012 proposal. Additional services were subsequently authorized per our December 10, 2012 scope and fee estimate.

1.00 INTRODUCTION

1.01 Project Description

The project includes floodplain restoration, active channel widening, managed bank retreat and related modifications along one or both sides of the Napa River and some of its subparallel tributary channels between Oakville Road (upstream) and Oak Knoll Avenue (downstream). Currently, there are 28 restoration areas (Sites) within the OVOK reach. The sites are numbered sequentially starting with Site 1 near the downstream end. As shown on the Vicinity Maps on Plates 1 and 2, the OVOK reach is segmented into two non-contiguous phases:

> ***Phase 1 Project Reach*** – extends from Oakville Road south to near the town of Yountville (Plate 1) and includes 18 Sites: Sites 14 through 23; 26A through 26E; and 27 through 29 (Figure1, Phase 1 – Overview).
>
> ***Phase 2 Project Reach*** – extends from near the town of Yountville south to Oak Knoll Road (Plate 2) and includes 10 Sites: Sites 1 through 3; 5; 7 through 10; 12 and 13 (Figure 2, Phase 2 – Overview).

Design-level documents are currently being prepared for selected sites within Phase 1 Project Reach Sites, only. A special design consideration for the OVOK reach is a hardpan deposit (previously mislabeled by others as Huichica clay) present locally within portions of the river channel. This deposit forms bold outcrops, is highly resistant to erosion, and is typically un-vegetated where currently exposed in the river channel. We understand that planning-level concepts include minimizing/mitigating exposures of this resistant material within the modified channel and floodplains.

1.02 Purpose and Scope of Services

The primary purpose the geotechnical and geologic services outlined in this report was to provide the geotechnical data, evaluations, conclusions and recommendations needed for the: 1) design and construction of the Sites in the Phase 1 Project Reach for which design-level documents are currently being prepared; and 2) planning of future restoration activities for Sites in the Phase 2 Project Reach.

As outlined in our October 2 proposal and December 10, 2012 scope and fee estimate, the scope of our investigation consisted of:

- Reviewing available geotechnical, geologic and seismic information;
- Observing and documenting geotechnical/geologic conditions;
- Conducting detailed geologic mapping of hardpan deposits;
- Drilling geotechnical borings and installing standpipe piezometers;
- Performing geotechnical laboratory tests;
- Identifying hardpan deposits in borings and subsurface samples;
- Preparing geologic cross sections;
- Evaluating liquefaction potential and other seismic effects;
- Developing conclusions and recommendations pertaining to the geotechnical aspects of the project; and
- Preparing this geotechnical investigation report.

Since there are no structures planned, California Building Code seismic design criteria are not needed for the restoration design. Also, the scope of our services did *not* include an environmental assessment or investigation for the presence of hazardous, toxic, or corrosive materials on, below, or around the planned restoration sites.

1.03 Identification/Characterization of Hardpan Deposits - Overview

Based on our research, analyses, geologic mapping and subsurface exploration, we interpret the hardpan deposits identified in surface exposures in and along the Napa River (and in our recent boreholes) within the OVOK reach as old alluvial fan deposits of Late Pleistocene age (greater than about 30,000 years old). Old alluvial fan deposits have been reported along the south reaches of the Napa River, north of the City of Napa, and both north and south of Oak Knoll Road (Kunkel and Upson, 1960). The noted exposures of old alluvial fan deposits by Kunkel and Upson correspond to the area of Site 1 (Phase 2) of our study area (cover photo). Generally, these deposits are described by Kunkel and Upson as poorly to moderately cemented clay, silt, and sand with varying amounts of gravel and some reworked tuff. During the early planning phases of this project, these old alluvial fan (i.e., hardpan) deposits were misinterpreted by some as belonging to the Huichica Formation, presumably due to their erosional resistant nature and similar lithologic characteristics. More detailed information pertaining to the identification and characterization of these hardpan deposits is presented in Section 4.01 of this report.

According to published literature, rocks assigned to the Huichica Formation have been identified in isolated surface exposures in the hills above Napa and Sonoma Valleys, in more extensive areas in the hills north of the tidal marshlands of San Pablo Bay and beneath Napa and Sonoma Valleys in water well borings drilled in the 1940s and 1950s. The Huichica Formation, identified in old water wells, rests directly on bedrock (Sonoma Volcanics) in the Napa Valley and may be as much as 900 feet thick (Kunkel and Upson, 1960). Generally, the Huichica Formation consists of clay, silt, sand, gravel and reworked tuff. These lithologies are similar to those described for the old alluvial fan (hardpan) deposits; however, some beds of the Huichica Formation observed in outcrops are strongly deformed and rest unconformably on tilted bedrock. This is not the situation for the old alluvial fan (hardpan) deposits. The age of the Huichica is interpreted as Early Pleistocene to Pliocene in age (between about 5.5 and 0.8 million years before present [Ma]) whereas the hardpan deposits are interpreted as Late Pleistocene in age (greater than about 30,000 years old). Clahan and others (2004) note that a tuff interbed within the Huichica has been dated using Potassium-Argon methods to be about 4 Ma.

A recent geologic map published by the California Geological Survey (Clahan and others, 2004) maps the closest surface exposures of the Huichica Formation in the hills northeast of the City of Napa, approximately 1.3 miles southeast of the southernmost point of the project site. No Huichica deposits have been mapped in or along the Napa River in any of the published geologic maps reviewed (Bezone and others, 2005; Clahan and others, 2004; Clahan and others, 2005; Ellen and Wentworth, 1995; Fox, 1983; Fox and others, 1973; Graymer and others, 2007; Wagner and Gutierrez, 2010; and Weaver, 1949).

1.04 Report Organization

The remainder of this report is organized as follows:

Section 2.00 describes our methods of investigation;
Section 3.00 describes the site geologic and seismic setting based on a review of pre-existing information;
Section 4.00 characterizes the site conditions based on new and existing data;
Section 5.00 presents our geotechnical evaluations and conclusions for the Phase 1 Project Reach;
Section 6.00 presents our recommendations for the project; and
Section 7.00 outlines the limitations of our study.

Following the illustrative plates and figures are five appendices:

Appendix A presents logs of borings from this investigation and previous investigations;
Appendix B presents laboratory test data;
Appendix C presents slope stability results;
Appendix D presents liquefaction analyses results; and
Appendix E presents site-specific evaluations and recommendations.

2.00 METHODS OF INVESTIGATION

2.01 Review of Existing Information

A variety of published sources were reviewed to evaluate geotechnical data relevant to the subject site. These sources included geotechnical and geologic literature, reports, and maps published by various public agencies including, but not limited to, topographic, geologic, flooding, liquefaction, and fault zone maps published by the U.S. Geological Survey (USGS), the California Geological Survey (CGS) (formerly the California Division of Mines and Geology) (CDMG), and Napa County. Information obtained from our review of published information is discussed in Section 3.00, Geologic and Seismic Setting. A list of the references used in our investigation is presented at the end of this report.

2.02 Geologic Mapping of Hardpan Deposits

Mr. Patrick Drumm, CEG of A3GEO, performed a detailed geologic reconnaissance of the river channel during which he identified and mapped exposures of the hardpan or old alluvial fan deposits, where observed in the river bed and/or banks. Mr. Drumm's mapping was performed on LiDAR-based topographic survey drawings provided by ESA PWA using project survey stakes in the field as locational references. The results of our geologic mapping of hardpan deposits are discussed and presented in Section 4.01.2, Geologic Mapping of Hardpan Surface Exposures.

2.03 Geotechnical Site Reconnaissance Visits

Ms. Dona Mann, GE, of A3GEO visited the site on multiple occasions between October 2012 and May 2013 to: 1) observe geotechnical and geologic features of general interest; 2) coordinate our onsite investigative activities; and 3) identify surface exposures of hardpan deposits. Observations made during our geotechnical site reconnaissance visits are discussed in Section 4.02, Phase 1 Project Reach Site Conditions.

2.04 Subsurface Explorations

Our subsurface exploration program was performed between November 6, 2012 and January 23, 2013, to investigate and sample the subsurface materials. We drilled and logged a total of 46 borings (two of which were converted into standpipe piezometers) at the approximate locations shown on the Site Plans, Figures 5 through 9 (Phase 1) and Figures 13 through 21 (Phase 2). The borings extended to depths that varied between 10.0 and 29.5 feet below the ground surface. Most borings were drilled along the existing

riverbanks and generally extended to the approximate thalweg elevation of the adjacent channel. The exceptions were the relatively shallow borings (10.0 to 11.5 feet deep) which were drilled on Site 18 to evaluate the conditions for a proposed berm.

North Star Drilling, Inc. of Escalon, California drilled the borings using a truck-mounted drill rig equipped with 4.5-inch solid stem flight augers. Mr. Patrick Drumm, CEG, of A3GEO logged the borings, directed the drilling, and obtained samples at frequent intervals. Soil samples were obtained using a 2-inch outside diameter (O.D.) Standard Penetration Test (SPT) sampler without liners and a 3-inch O.D. California Modified sampler with liners. The samplers were driven with a rope-and-cathead-activated 140-pound hammer falling 30 inches. The hammer blows required to drive the sampler the final 12 inches of each 18-inch drive are presented on the boring logs. Sampler blow counts presented on the logs are adjusted N-values. Blow counts have been adjusted for sampler type only. Following the field operations, the borings were immediately grouted, except where piezometers were installed.

During drilling, Mr. Drumm visually/manually classified the soil in general accordance with ASTM D2488 classifications which are based on the Unified Soil Classification System (USCS). Field classifications were subsequently checked and revised, where appropriate, based on laboratory test data. The logs of the borings are attached in Appendix A preceded by a Key to Exploratory Boring Logs that describes the USCS and the symbols used on the logs.

Please note that the attached boring logs and related information depict subsurface conditions only at the approximate locations shown on the Site Plans on the particular date designated on the boring logs. The attached boring logs represent our interpretation of the subsurface materials at the boring locations at the time of drilling and the passage of time may result in changes in the subsurface conditions. Groundwater elevation may be higher or lower than observed during drilling due to multiple factors, including seasonal rainfall. The boring locations indicated on the attached figures were determined by measuring from existing surveyor stakes located at 500-foot stations along the riverbank and should be considered approximate. A summary of our findings from our subsurface exploration can be found in Section 4.02, Phase 1 Project Reach Site Conditions.

2.05 Laboratory Testing

Our geotechnical laboratory testing program was directed toward a quantitative and qualitative evaluation of the physical properties of the soils that underlie the site. The following geotechnical laboratory tests were performed:

- Water content per ASTM Test Designation D-2216;
- Dry density per ASTM Test Designation D-2937;
- Atterberg Limits per ASTM Test Designation D-4318;
- Percent minus #200 sieve per ASTM Test Designation D-1140;
- Grain size distribution per ASTM Test Designation D-422; and
- Slaking.

Although beyond the scope of our investigation, we also performed thin-section analyses using a petrographic microscope for selected samples of hardpan deposits in order to evaluate the mineralogy of the soil matrix and individual grains. Hardpan deposit samples were selected for thin-section analyses because field identification during the geologic mapping phase of the project suggested volcanic ash deposits were present where none had been previously mapped or because of geotechnical laboratory test results (i.e., slake testing).

The results of the laboratory tests are summarized in Appendix B and are also presented on the boring logs at the corresponding sample depths. The laboratory test data sheets are included in Appendix B.

3.00 GEOLOGIC AND SEISMIC SETTING

3.01 Regional Faults and Seismicity

The Napa River and Napa Valley are within the San Francisco Bay portion of the Coast Ranges Geomorphic Province of California, a region characterized by northwest-trending mountain ranges and intervening valleys. In the context of global plate tectonics, the Coast Ranges are located near the boundary between two crustal plates, the North American Plate and the Pacific Plate. The characteristic topography of the region formed through a complex series of processes that have included deposition, accretion, faulting, folding, uplift, volcanism and changes in sea level.

Locally, the relative motion of the Pacific and North American crustal plates is presently accommodated by a series of seismically active northwest-trending faults that occur over a deformation zone of more than 50 miles. Faults that are defined as seismically "active" exhibit one or more of the following: (1) evidence of Holocene-age (within about the past 11,000 years) displacement, (2) measurable aseismic fault creep, (3) close proximity to linear concentrations or trends of earthquake epicenters, and (4) prominent tectonic-related aseismic geomorphology. By comparison potentially active faults are defined as those that are not known to be active, but exhibit evidence of Quaternary-age displacement (within about the past 2 million years).

The closest major active faults to the site include the Green Valley fault located approximately 6 miles to the southeast and the Rogers Creek fault zone located approximately 16 miles to the southwest (Jennings and Bryant, 2010). There is a small portion of the West Napa fault zoned as active which is located approximately 4 miles to the south (near the Napa Airport). Other major faults in the region include the Soda Creek fault (approximately 3 miles east), the Maacama fault (approximately 25 miles northwest), the Hunting Creek fault (approximately 27 miles northeast), and the San Andreas fault (approximately 35 miles west) (Jennings and Bryant, 2010). The site is not within an Alquist-Priolo Earthquake Fault Zone as designated by the State of California for active faults and no active faults have been mapped in the direct vicinity of the project site (Bryant, 1982; Hart and Bryant, 1997; and Wesling and Hanson, 2008).

The geologic maps presented on Plates 5 and 6 and Figures 3 and 4 show surface traces of various, mostly north or northwest-trending faults, none of which are zoned as Holocene-active. Note that other faults may exist below the valley floor that are not mapped because their presence is obscured by alluvium.

Since 1836, six earthquakes of magnitude 6.5 or greater have occurred in the Bay Area (Bakun, 1999). The largest earthquake that has occurred within the region during historic time is the 1906 San Francisco Earthquake. Recent estimates of the moment magnitude (M_W) of this event are 7.7 and 7.9. During the 1906 San Francisco Earthquake, the San Andreas fault ruptured over a length of almost 300 miles from near Shelter Cove in the north to near San Juan Bautista in the south. Active faults that are closer to the site (e.g. the Green Valley and Rogers Creek faults) have not produced a major earthquake in historic time (i.e. since before 1776).

Studies by the USGS's Working Group on California Earthquake Probabilities have estimated a 63 percent probability of at least one magnitude 6.7 or greater earthquake occurring in the San Francisco Bay Region before the year 2037 (WGCEP, 2008). This seismicity estimate is dominated by the Rogers Creek-Hayward (southeast continuation) and San Andreas fault systems, for which the probabilities of a magnitude 6.7 or greater earthquake during this time period are estimated to be 31 and 21 percent, respectively. The corresponding probability estimate for the Green Valley-Concord (southeast continuation) fault system is 3 percent.

3.02 Regional Geology

The west side of the Napa Valley is generally composed of Jurassic-Cretaceous Franciscan Complex rocks and the east side of the valley is generally composed of Cretaceous Great Valley rocks, both considered "basement" rock complexes, that commonly occur elsewhere in the San Francisco Bay Area

(Ellen and Wentworth, 1995; Graymer and others, 2007; Wagner and Bortugno, 1982; and Wagner and Gutierrez, 2010); The Great Valley and the Franciscan Complex are of Mesozoic age (225 to 65 million years old). The Mesozoic basement rocks are locally overlain by or juxtaposed with a diverse sequence of Cenozoic Era (younger than 65 million years) sedimentary and volcanic rocks, which include the Sonoma Volcanics. Since their deposition, the Mesozoic and Cenozoic rocks have been extensively deformed by repeated episodes of folding and faulting. The Bay Area experienced several episodes of uplift, faulting and volcanism during late Tertiary Period (about 25 - 2 Ma) that produced the region's characteristic northwest-trending mountain ranges and valleys. Incremental movements along active strike-slip faults have produced large-scale lateral displacements of land masses throughout the region. At times, some structural basins that now drain to the Pacific Ocean were closed thereby accelerating the rate at which sediment was deposited within them.

Worldwide climate fluctuations during the Pleistocene (about 1.8 million to 11 thousand years ago) resulted in several distinct glacial periods. A lowering of sea level accompanied each glacial advance as water became stored in vast continental ice sheets and alpine glaciers. Melting of the continental glaciers during warm intervals caused corresponding rises in sea level. High sea levels favored rapid and widespread deposition in the bay and surrounding floodplains. Low sea levels during glacial advances steepened the gradients of streams and rivers draining to the sea thereby encouraging erosional channel downcutting. The most recent glacial interval ended about 15,000 years ago. Evidence suggests that during the maximum extent of this latest glaciation, sea level was 300 to 400 feet below its present elevation and streams draining the Great Valley flowed to the Pacific Ocean more than 30 miles west of the Golden Gate (Helley and Lajoie, 1979).

Near the beginning of the Holocene age (about 11 thousand years ago) the rising sea re-entered the Golden Gate, and sediments accumulated rapidly beneath the rising San Francisco Bay and on the surrounding floodplains. The Holocene-age surface deposits are generally less consolidated and weaker than the adjacent/deeper Pleistocene-age soils that predate the last sea level rise.

3.03 Local Geology

3.03.1 Topography and Geomorphology

The Vicinity Maps presented on Plates 1 and 2 utilize California Geological Survey 7.5-minute topographic maps (Rutherford, Yountville and Napa Quadrangles) as a base. Aerial images of the site vicinity are presented on Plate 3; the oblique imagery presented on the lower half of Plate 3 includes vertical exaggeration.

The portion of the Napa Valley containing the OVOK Reach is approximately 3 miles wide and is bordered on the east and west by north-northwesterly-trending mountain ranges that rise abruptly one to two thousand feet above the valley floor. The valley floor is locally punctuated by isolated bedrock hills, the largest of which rise about 400 feet above the valley floor. Within the OVOK Reach, the Napa River flows along the base of hills at two principal locations north and east of Yountville (Plates 1 and 2). At the northern (upstream) end of OVOK reach, the elevation of the valley floor adjacent to the river channel is about 130 feet above mean sea level (AMSL). At the southern (downstream) end of OVOK Reach, the elevation of the valley floor is about 55 feet AMSL.

Within the OVOK Reach, the Napa River flows within locally incised and eroded channels that are up to 25 feet deep. Within Phase 1, the Napa River flows within a single channel in part due to the localized constraints imposed by the hills to the north and east of Yountville. Downstream of the hills (within Phase 2), the river splits into two channels for a horizontal straight-line distance of about 4,600 feet before recombining into a single channel. Near the southern end of Phase 2, the natural floodplain was once dissected by an array of creeks/drainages entering the Napa River from the north and west; many of these former channels have been filled in as part of vineyard development.

3.03.2 Bedrock Geology

The Napa Valley is a relatively narrow elongate alluvial-filled trough flanked by bedrock mountains with isolated bedrock hills locally punctuating the valley floor. Various researchers have prepared maps of this general area depicting surficial geologic units as well as bedrock structure. The CGS maps of local geology presented on Plates 5 and 6 provide information on the geologic context of the site relative to the Napa Valley. Enlarged versions of these maps presented on Figures 3 and 4 include overlays showing the approximate locations of planned restoration areas (Sites). Bedrock was not encountered in any of our exploratory borings nor was bedrock observed along any of the reaches of Napa River involved in the proposed restoration sites.

Mesozoic (Jurassic to Cretaceous age) sedimentary rocks assigned to the Great Valley Sequence (map symbol KJgv) and the Franciscan Complex (map symbol KJfs) underlie much of the mountain range to the west of the OVOK Reach. Franciscan Complex rocks are also mapped locally along the eastern side of the valley within the bedrock hills east of Yountville. Miocene-age rocks of the Stags Leap stock (map symbol Tgisl) are mapped on the northeast side of the Napa River adjacent to the hills east of Yountville. Younger Miocene to Pliocene age volcanic rocks exist locally within the valley, along the western valley margin and throughout much of the mountain range to the east of the OVOK Reach. The diverse sequence of volcanic rocks shown comprises subunits within the Tertiary age Sonoma Volcanics (map symbol prefix Tsv). The bedrock units/subunits mapped closest to the Napa River are described on the CGS maps as follows (from oldest to youngest):

> ***Map symbol Tgisl - Stags Leap stock (Figure 4) -*** *Coarse to fine-grained granitic intrusive with abundant quartz veining and hydrothermal alteration.*
> ***Map symbol Tsvabsl (Figures 3 and 4) -*** *Andesite flow breccia of Stags Leap*
>
> ***Map symbol Tsvr (Figure 3) –*** *Undifferentiated rhyolite lava flows, and flow breccias. Light grey to dark grey*
>
> ***Map symbol Tsvdg - Dacite of Mt. George (Figures 3 and 4) -*** *Flows, domes and shallow intrusions of gray to tan porphyritic dacite. The dacite is typically strongly flow banded. The upper surfaces of flows and the margins of domes and intrusions are commonly perlitic. The base of the flows is a black porphyritic pitchstone and pitchstone breccia. K-Ar ages for the dacite on the Mt. George quadrangle are 4.3±0.2 and 3.73±1.23 Ma (Mankinen, 1972; Fox and others, 1985).*

3.03.3 Old Alluvium

The thickness of alluvial deposits in the vicinity of the OVOK Reach is likely highly variable and has not been clearly defined in the literature. Within the Napa Valley, it is thought that alluvium may be 1,000 or more feet thick in isolated areas affected by possible buried faults (Luhdorff & Scalmanini, 2012; and Weaver, 1949). However, the alluvium generally thins near the sides of the valley and close to the isolated hills where bedrock is shallower. The deepest alluvium in the valley is several millions of years old.

Pleistocene-age deposits described on the CGS maps presented on Plates 5 and 6 and Figures 3 and 4 are as follows:

> ***Map Symbol Qoa -*** *Alluvial deposits, undivided (early to late Pleistocene) - Alluvial fan, stream terrace, basin, and channel deposits. Topography is gently rolling with little or no original alluvial surfaces preserved; moderately to deeply dissected.*

Kunkel and Upson (1960) describe Older Alluvium as “composed of lenticular deposits of unconsolidated and poorly sorted clay, silt, sand and gravel. Where the alluvium is exposed, claypan or hardpan soil characteristically has developed on the surface. The beds are undeformed.” As previously mentioned, Kunkel and Upson (1960) go on to note locations where Older Alluvium is exposed along the Napa River, which include “north of Oak Knoll Avenue a sequence of alternating beds of yellow silt, sand and gravel is exposed” (this location corresponds to Site 1, Phase 2, see cover photo) and “about a half mile north of

Oak Knoll Avenue, the Napa River has exposed yellow hard clay or silt." As shown on Figure 4, Pleistocene-age alluvium (map symbol Qoa) is mapped (at the ground surface) by the CGS near the base of the hills east of Sites 1 through 3.

The hardpan deposits identified within the project sites are similar to the descriptions quoted above. We have interpreted these hardpan sediments as Late Pleistocene alluvial fan deposits (i.e., Old Alluvium).

3.03.4 Younger Alluvium

East of Sites 14 through 17, the CGS maps Quaternary age (Pleistocene and Holocene) alluvial fan deposits described as follows:

> ***Map Symbol Qf -*** *Alluvial fan deposits (latest Pleistocene <~30,000 years to Holocene) - Sand, gravel, silt and clay mapped on gently sloping, fan-shaped, relatively undissected alluvial surfaces.*

Other alluvial deposits mapped by the CGS in the vicinity of OVOK reach are interpreted as Holocene age (< 11,000 years old). These deposits include:

> ***Map Symbol Qha -*** *Alluvium, undivided (Holocene) - Alluvium deposited on fans, terraces, or in basins; composed of sand, gravel, silt, and clay that are poorly sorted.*
>
> ***Map Symbol Qhf -*** *Alluvial fan deposits (Holocene) - Alluvial fan sediment deposited by streams emanating from mountain drainages onto alluvial valleys; composed of moderately to poorly sorted sand, gravel, silt and clay.*

The younger alluvial deposits (Pleistocene and Holocene age) consisting of fan deposits described above and shown on the published geologic maps for the project site (Figures 3 and 4) are present along the Napa River. These younger deposits are statigraphically above and in many locations, directly cap the Late Pleistocene alluvial fan deposits identified and geologically mapped by us along the proposed river restoration sites for the Napa River.

3.03.5 Youngest Alluvium

Within OVOK reach, the alluvial deposits mapped within and proximate to the river channel are mapped by the CGS as less than 1,000 years old. Note that geologic maps of this scale and purpose: 1) show geologic units interpreted to be present at or near the ground surface; and 2) are not mapped at the level of detail that would be needed to discriminate different geologic units that may be visible in river banks or other localized exposures. Within the OVOK Reach, most of the near-surface soils blanketing the valley floor outside of the river channels are mapped on Figures 3 and 4 as:

> ***Map symbol Qhty - Stream Terrace Deposits (latest Holocene < 1,000 years)***
> *Stream terraces deposited as point bar and overbank deposits; composed of moderately sorted clayey sand and sandy clay with gravel.*

Near the northern end of the project (northeast of Sites 27 and 28) the surficial valley floor deposits are mapped as:

> ***Map symbol Qhay - Alluvial deposits (latest Holocene <1,000 years) -*** Fluvial sediment deposited on the modern flood plains.

Near the far southern end of the project (southwest of Site 1), surficial valley floor deposits are mapped as:

> ***Map Symbol Qhfy – Alluvial fan deposits (Latest Holocene)***
> *Alluvial fan sediments deposited by streams emanating from Dry Creek drainage, composed of moderately to poorly sorted and bedded sand, gravel, silt, and clay.*

Within the channel itself, the river bottom deposits are generally mapped as:

> ***Map Symbol Qhc Modern stream channel deposits (Holocene <150 years)***
> *Deposits in active, natural stream channels; consists of loose alluvial sand, gravel and silt.*

The youngest alluvial deposits (<1,000 years old) consisting of stream terrace, fluvial, and fan deposits described above and shown on the published geologic maps for the project site (Figures 3 and 4) are present along the Napa River. These youngest deposits are statigraphically, above and in many locations, directly cap the Late Pleistocene alluvial fan deposits identified and geologically mapped by us along the proposed stream restoration sites for the Napa River.

3.04 Napa County Hazard Mapping

The Safety Element of the 2009 Napa County General Plan identifies safety hazards within the county including areas that may be prone to earthquake faulting, liquefaction susceptibility, flooding and dam inundation. As shown on Plates 7 through 9, the plan maps the project site within: 1) a very high liquefaction susceptibility zone, 2) the 100-year flood zone, and 3) several Dam Inundation areas.

4.00 SITE CONDITIONS

4.01 Hardpan Deposits

4.01.1 Overview

The hardpan deposits which form bold outcrops along some of the reaches of the Napa River were identified as generally fine to medium-grained, fluvial deposits. These deposits, where geologically mapped along the river channel, generally consist of weakly consolidated, slightly weathered materials including clays, silts and fine to medium-grained sands with varying amounts of reworked tuff. It is important to note that the predominantly fine to medium-grained deposits exist adjacent to and within predominantly coarser-grained, interbedded and lenticular, sands and gravels of the same formation. ***The predominantly coarse-grained deposits appear to be less resistant to erosion, are generally not exposed on the terrace surfaces of the bold outcrops as frequently as the finer-grained materials, and for geotechnical purposes, have not been included in our identification of hardpan deposits.*** Overall, these hardpan deposits and associated interbedded gravel layers have been interpreted as a complex sequence of Late Pleistocene alluvial fan deposits that have not been previously mapped along the project site of the Napa River.

Because many of the exposed hardpan deposits exhibit a slight inclination or dip (ranging from 3 to 18 degrees with most dips less than 10 degrees) to the northwest, west, southwest, and southeast, they presumably formed from erosion of the nearby bedrock hills along the east side of Napa Valley. The upper portions of some of these bold outcrops observed along the river bank exhibited basal scour contacts with truncated beds and lenticular-bedding, suggestive of reworking of the older alluvial fan deposits by younger fluvial processes (for example in Site 29, Phase 1). Some of the more extensive exposures of hardpan deposits in the channel were separated by a much thinner paleosol indicating a substantial pause in deposition (for example in Site 1, Phase 2). A single isolated deposit of volcanic ash was identified in Site 29 near the top of the bank. Other hardpan deposits contained significant tuffaceous materials, indicating reworking from a volcanic source area. The identification of volcanic tuff materials within the hardpan deposits was only realized by thin-sectioning selected samples and analyzing the sections with a petrographic microscope.

The hardpan deposits within the OVOK Reach exist as lenses, interbeds, and layers and *not* as a widespread tabular deposit of uniform thickness. The slight inclination/dip of bedding indicates that the deposits have not experienced the same degree of tectonic uplift or tilting reported in the literature for the Huichica Formation or the underlying Sonoma Volcanics (Knudsen and Upson 1960). The spatial distribution of the hardpan deposits identified in the field and in borings appears consistent with alluvial fan development processes, which involves the more or less random deposition of layers/lenses of well-sorted soils transported by streams from adjacent upland areas. ***An important aspect of this finding is that the areal extent, thickness and physical characteristics of these hardpan deposits of potential concern are likely to vary considerably and somewhat unpredictably throughout much of the OVOK Reach.***

4.01.2 Geologic Mapping of Hardpan Surface Exposures

In this study, our Certified Engineering Geologist (CEG) mapped the locations of the hardpan deposits, where exposed in the river bed and banks. Within Phase 1, our objective was to geologically map exposures within designated restoration areas (Sites) for design purposes. Therefore, lithologic characteristics and variation were noted, stratigraphic context of fine and coarse layers were determined, and bedding inclination, if present, was collected from outcrops. In Phase 1, field mapping was performed from within the river channel and attempts were made to correlate exposures to nearby borehole data. Within Phase 2, exposures along the river channel and banks were mapped at a level of detail considered appropriate for planning efforts. Areas where slope instability and possible landslide deposits exist were also highlighted along the Phase 2 reaches of the project site.

Detailed maps of the visibly exposed hardpan deposits are presented on the Site Plans, Figures 5 through 9 (Phase 1) and Figures 13 through 21 (Phase 2). Because these deposits are distributed as

layers/lenses interbedded within other old alluvial deposits and are *not* the upper surface of a deposit of great thickness, inferences pertaining to the presence or absence of hardpan deposits at locations other than those shown may be problematic.

4.01.3 Geotechnical Characterization

A portion of our geotechnical laboratory testing program was directed at characterizing the hardpan deposits exposed within the OVOK reach of the river. The laboratory tests performed for this purpose included determinations of soil plasticity (Atterberg Limits), grain size (particle size distribution) and slaking potential (reaction to submergence in water).

Laboratory tests and visual characterization were performed on bulk samples that we collected from the hardpan deposits exposed within the river channel at six different restoration sites within the OVOK reach. A summary of the laboratory tests performed on the bulk samples from the river is included in the table below:

Laboratory Test Results of Hardpan Deposits Collected from River Channel (Bulk Samples)

OVOK REACH					Particle Size Distribution (% by Weight)								Slake Test
					Gravel	Sands				Fines			
Source / Boring ID	Sample ID or Depth	USCS	PI	LL	Total	Total Sands	Coarse	Medium	Fine	Total Fines	Silt	Clay	Stability Class
Site 29 River Channel	Bulk 29-1	SC	14	33	9	46	15	16	15	45	18	27	6
Site 22 River Channel	Bulk 22-1	SC	12	34	1	61	2	11	48	38	30	8	3
Site 19 River Channel	Bulk 19-1	SC	21	42	2	67	2	22	43	31	23	8	3
Site 18 River Channel	Bulk 18-1	CL	17	33	4	46	7	22	17	50	19	31	2
Site 17 River Channel	Bulk 17-1	SC	10	32	4	61	10	19	32	35	18	17	6
Site 1 River Channel	Bulk 1-2	CL	25	47	0	14	0	4	10	86	40	46	4

In general, the hardpan deposits that we tested shared the following geotechnical characteristics:

- Exhibited a mottled appearance usually with yellowish brown to olive brown colors,
- Often contained iron and/or manganese oxide staining,
- Classified as either a lean clay (CL) or clayey sand (SC) based on the Unified Soil Classification System (USCS),
- Contained little to no gravel,
- Contained little to no coarse-grained sand, and
- Contained low to moderately plastic fines (e.g., LL≤47; 14≤PI≤25).

4.01.4 Identification of Hardpan Deposits in Boreholes

We utilized the laboratory test results obtained from the bulk samples of the hardpan exposures in the river, in combination with our visual observations and geologic mapping, as a guideline to attempt to identify the hardpan deposits in the boreholes. This proved to be difficult for a variety of reasons, but primarily, because: 1) it is not possible to visually identify the age and/or accurately evaluate the grain size percentages of a soil, 2) it is difficult to use 2.5-inch diameter, 12 to 18-inch long samples collected every 5 vertical feet to interpret complex geology, and 3) the samples collected from the borings drilled on the banks did not always match the geotechnical properties of the adjacent hardpan exposures in the channel (e.g., color, density, moisture, plasticity and slaking).

It is important to note that a significant amount of interpretation was involved when trying to identify hardpan deposits from the boring samples. In general, we included soil from the borings as a hardpan deposit if it met all of the following criteria:

- Appeared to be Late Pleistocene in age (i.e., appeared more consolidated),
- Consisted of predominantly fine to medium-grained soils (i.e., clay, silt, and/or fine to medium-grained sand),
- Appeared lighter in color and was occasionally mottled (e.g., generally not dark gray or dark brown)
- Contained little to no gravel,
- Contained little coarse-grained sand, and
- Contained some cohesion (plasticity).

In our identification of hardpan deposits within the borings, it is important to note that we have included soils classified as fat clay (CH), although, none of the bulk river samples were found to be "fat" (i.e., LL≥50). One of the bulk river samples (Bulk 1-2 from Site 1) contained a LL of 47. The fat clay samples tested within the borings were found to be just barely "fat" with liquid limits (LL) of 50 and 51; therefore, it was difficult to exclude these soils from the hardpan grouping.

A summary of the laboratory tests performed on hardpan samples from the borings is included in the table below:

Laboratory Test Results of Hardpan Samples from Borings

OVOK REACH								Particle Size Distribution (% by Weight)								Slake Test
								Gravel	Sands				Fines			
Source / Boring ID	Sample ID or Depth	USCS	Adjusted Blow Count	PI	LL	Moisture Content (%)	Dry Density (pcf)	Total	Total Sands	Coarse	Medium	Fine	Total Fines	Silt	Clay	Stability Class
B-17-4	11 ft	CH	39	29	50	20	101	1	8	7	1	0	91	39	52	--
B-17-4	15.5-16	SC	28	12	35	23	100	5	67	7	32	28	28	14	14	2
B-17-5	10.5 ft	SC	32/6"	24	42	15	109	8	52	10	17	25	40	12	28	--
B-17-6	21 ft	CL	32/6"	18	45	29	94	0	17	1	5	11	83	48	35	3+
B-17-7	22 ft	CL	30	22	45	31	91	1	26	3	10	13	73	33	40	3+
B-18-1	21 ft	CH	40	26	51	28	95	0	7	0	2	5	93	43	50	3
B-22-1	21 ft	CH	11	27	51	39	83	0	3	0	1	2	97	82	15	3+
B-26A-1	15.5 ft	CL	5	14	33	29	91	0	44	0	1	43	56	41	15	6
B-29-1	25 ft	SC	32/5"	11	33	18	108	3	61	12	26	23	36	15	21	2

4.02 Phase 1 Project Reach Site Conditions

4.02.1 General

Within the northern reaches of Phase 1, the Napa River generally flows from northwest to southeast within a single main channel that passes near the base of bedrock hills north of Yountville. Small tributary creeks enter the Napa River from the west near Sites 27/29 and 26C. After passing the bedrock hills, the Napa River turns easterly before meeting Conn Creek, which joins the Napa River from the north. Between Sites 22 and 15 (approximately), the Napa River and Conn Creek flow within two roughly parallel and interconnected channels. In general, the river channels, banks, and the islands between them are covered with trees and other types of riparian vegetation, whereas valley floor areas outside of the river channels are mostly vineyards.

Topographic conditions within and adjacent to the river are illustrated by the LiDAR-based topographic contours shown on the detailed maps presented on Figures 5 through 9. Brief descriptions of surface and subsurface conditions at Phase 1 Sites follow. The sites are discussed in an upstream to downstream direction (i.e., Site 28 to Site 14). ***In all cases, left and right banks of the river are from the perspective of facing upstream.*** The approximate locations of our borings are shown on the Site Plans, Figures 5 through 9; logs of the borings are presented in Appendix A.

Extensive hardpan deposits were geologically mapped along the channel and river banks at Sites 22 and 29, and isolated hardpan deposits were observed along the channel at Sites 14, 15, 16, 17, 18 and 19. No obvious hardpan deposits were observed in surface exposures in Sites 26 (all), 27 and 28.

4.02.2 Site 28

Site 28 (Figure 5) is located on the right bank of the Napa River between Station 424+00 and 420+00 at a transition from a broader floodplain to a narrower channel. The channel is about 115 feet wide at its top at Station 420+48.5 (the downstream end of the site); the banks on both sides are terraced. The channel bottom (thalweg) is about 23 feet below the elevation of the adjacent vineyard properties. The channel is characterized by abundant gravel bars separating relatively shallow pools.

At Site 28, we drilled one boring (Boring B-28-1) along the vineyard road near Station 420+00 above the right bank of the channel. In general, Boring B-28-1 encountered medium dense sand with varying amounts of silt and clay which extended to the bottom of the boring at 21.5 feet. Groundwater was measured at a depth of approximately 19.4 feet in B-28-1 at the end of drilling.

No obvious hardpan deposits were exposed in the river channel at the time of mapping and no hardpan deposits were identified in our boring at Site 28.

4.02.3 Sites 27 and 29

Sites 27 and 29 (Figure 5) are located across the river from each other between Station 400+00 and 410+00. Site 27 is on the right interior bank of an outside meander bend, and Site 29 is on the left bank of the inside meander bend. The Napa River is joined by a small tributary at the upstream end of Site 29. The main channel is approximately 140 feet wide at its top at Station 404+43.1 (about the center of the site). The left bank is relatively steep with a slope inclination of about 1:1 (horizontal to vertical) near the top and becoming near vertical near the channel; the right bank is wider and terraced with a maximum inclination of about 3:1. The thalweg is about 25 feet below the elevation of the adjacent vineyard properties. A deep pool (greater than 6 feet) exists along the outside meander bend of Site 29 at Station 405+00 where the base of the stream bank is the steepest.

At Site 27, we drilled one boring (B-27-1) along the vineyard road near Station 405+00. Boring B-27-1 encountered 9 feet of firm, lean clay over 11 feet of medium dense sands and gravels over dense to very dense gravels which extended to the bottom of the boring at 26.5 feet. Groundwater was measured at a depth of about 17 feet at the end of drilling.

At Site 29, we drilled three borings (B-29-1, B-29-2 and B-29-3) along the vineyard road near Stations 407+00, 405+00 and 402+00, respectively. In general, the borings at Site 29 encountered medium dense to very dense sands and gravels, with varying amounts of silt and clay, which extended to the bottom of the borings (25.5 to 26.0 feet). Groundwater was measured at a depth of 23.5 feet in B-29-2 at the end of drilling; groundwater was not encountered in B-29-2 and B-29-3 during drilling.

Figure 5 shows locations of the hardpan deposits mapped within the vicinity of the sites which were exposed within the small tributary near the upstream portion of Site 29 and along most of the Site 29 river bank. A layered sequence of silty fine sand and gravel layers characterize the outside meander bend of the river. An isolated volcanic ash outcrop is part of the sequence of deposits near Station 405+00 where it forms a prominent near vertical slope that extends below the waterline. Figure 10 shows a geologic cross section through Sites 27 and 29 (at Station 404+43.1) identifying the interpreted hardpan deposits and channel geometry. Hardpan deposits were encountered in B-29-1 and B-29-2, but were not encountered in B-27-1 and B-29-3. A summary of the hardpan deposits encountered in each boring is summarized in the table below (BOH = Bottom of Hole):

	Site 27	Site 29		
Depth	B-27-1	B-29-1	B-29-2	B-29-3
0				
1				
2				
3				
4				
5				
6		CL		
7		CL		
8		CL	SC	
9		SM	SC	
10		SM	SC	
11		SM	CH	
12		SM	CH	
13		SM	CH	
14		SM	CH	
15		SM	CH	
16			ML	
17				
18				
19				
20				
21				
22				
23				
24		SC		
25		SC		
26		BOH	BOH	BOH
27	BOH at 26.4'	at 26'	at 25.9'	at 25.5'

SC Hardpan Deposit, Soil Classification Identified

CL: Lean Clay; CH: Fat Clay; ML: Silt; SM: Silty Sand; SC: Clayey Sand

4.02.4 Sites 26A through 26E

Within Sites 26A through 26E, our scope of work only included Sites 26A, 26B and 26C (Figure 6) which are located on the right bank of the Napa River between Station 390+00 and 357+00. Site 26A is at the upstream end, and Site 26C is at the downstream end. The Napa River is joined by a small tributary at the upstream end of Site 26C. The main channel is approximately 140 feet wide at its top at Station 385+00 (Site 26A), 140 feet at Station 370+00 (Site 26B) and 115 feet at Station 360+00 (Site 26C). The banks along Site 26A-C vary, but in some cases are steeper than 1:1 (horizontal to vertical). The thalweg is about 25 feet below the elevation of the adjacent vineyard properties.

At Sites 26A, 26B and 26C, we drilled one boring at each site along the vineyard road near Stations 385+00, 370+00 and 360+00, respectively. In general, the borings at Site 26 encountered loose to medium dense sands and gravels, with varying amounts of silt, which extended to the bottom of the borings (21.5 to 26.5 feet). Some layers of firm clay were encountered at Site 26A. Groundwater was measured at a depth of 18 feet in B-26A-1, 20.4 feet in B-26B-1 and 21.7 feet in B-26C-1 at the end of drilling.

No obvious hardpan deposits were mapped along the channel within the vicinity of the sites; however, hardpan deposits were encountered in Boring B-26A-1 between 13 feet and the bottom of the boring at 27 feet. A summary of the hardpan deposits encountered in each boring is summarized in the table below (BOH = Bottom of Hole):

	Site 26		
Depth	B-26A-1	B-26B-1	B-26C-1
0			
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13	CL		
14	CL		
15	CL		
16	CL		
17	CL		
18	CL		
19	CL		
20	SM		
21	SM		
22	CH	BOH	
23	CH	at 21.5'	
24	CH		
25	CH		
26	CH		
27	BOH at 26.5'		BOH at 26.5'

CL Hardpan Deposit, Soil Classification Identified

CL: Lean Clay; CH: Fat Clay; ML: Silt; SM: Silty Sand; SC: Clayey Sand

4.02.5 Site 22

Site 22 (Figure 7) is located at the Yountville Preserve along the left bank of the Napa River between Station 284+00 and 271+00. The downstream end of the site borders Yountville Cross Road. Near the center of Site 22 (at about Station 277+50), the Napa River is joined by Conn Creek which enters from the right (facing upstream). Between the two channels is a slightly elevated island covered with thick brush and trees. The channel is about 170 feet wide at its top at Station 275+00. The left bank is topped by an artificial berm about 4 feet high. Slope inclinations are on the order of 2.5:1 (horizontal to vertical) at Station 275+00. The river bank becomes near vertical upstream where large overhanging trees have protected the softer sediments below. The channel can be characterized as being broad and relatively shallow upstream of Conn Creek and becoming confined, narrow and relatively deep (greater than 5 feet) downstream of Conn Creek. The thalweg is about 18 feet below the elevation of the adjacent Preserve.

We drilled four borings at Site 22 (B-22-1 through B-22-4). Two borings (B-22-3 and B-22-4) were drilled at the base of the berm, and two borings (B-22-1 and B-22-2) were drilled on the opposite side of the site. In general, the borings encountered layered deposits of medium dense to dense sands and gravels with varying amounts of silt and clay and stiff, lean to fat clays which extended to the bottom of the borings (between 16.5 and 21.5 feet). Groundwater was encountered in Borings B-22-1 and B-22-2 at depths of 20.1 feet and 13.0 feet, respectively. Groundwater was not observed in Borings B-22-3 and B-22-4.

Hardpan deposits were encountered in all four borings at Site 22. Figure 7 shows locations of extensive hardpan deposits forming a broad terrace mapped within the vicinity of the site. The top of the hardpan deposits coincides with the approximate low water level of the channel. Figure 11 shows a geologic cross section through Site 22 and the river channel (at about Station 277+50). The cross section identifies the interpreted hardpan deposits and channel geometry. A summary of the hardpan deposits encountered in each boring is summarized in the table below (BOH = Bottom of Hole):

	Site 22			
Depth	B-22-1	B-22-2	B-22-3	B-22-4
0				
1				
2	CH	CL		
3	CH	CL		
4	CH	CL		
5	CH	CL		
6	SC	CL	CL	CL
7	SC	CL	CL	CL
8	SC	CL		CL
9	SC	CL		CL
10	SC			
11	SC			
12	SC			
13	SC	CL	CH	
14	SC	CL	CH	
15		CL	CH	
16		CL	CH	
17		CL	BOH	BOH
18		CL	at 16.5'	at 16.5'
19				
20	CH			
21	CH			
22	BOH at 21.5'	BOH at 21.5'		

CL Hardpan Deposit, Soil Classification Identified

CL: Lean Clay; CH: Fat Clay; ML: Silt; SM: Silty Sand; SC: Clayey Sand

4.02.6 Site 19

Site 19 (Figure 8) is located upstream of Site 22 on the right bank of Conn Creek, a sub-parallel tributary to the east of the Napa River, in the California Department of Fish & Wildlife Napa River Ecological Reserve. Site 19 is undeveloped and is generally covered with tall grasses, thick bushes and few trees. No topographic surveying was conducted at Site 19; therefore there is no stationing along this stretch of Conn Creek. The site is along a broad outside meander bend of the creek. The channel bottom was relatively dry at the time of our investigation with a few isolated pools of water. The thalweg ranges from 19 to 15 feet below the adjacent floodplain and the banks are generally 1:1 (horizontal to vertical).

We drilled two borings at Site 19 (B-19-1 and B-19-2). Both borings were drilled about 200 feet away from Conn Creek and were converted into standpipe piezometers. In general, the borings at Site 19 encountered medium dense to very dense sands and gravels with varying amounts of silt and clay which extended to the bottom of the borings (between 17.8 and 18.0 feet). Groundwater was not encountered in either boring during drilling. To our knowledge, groundwater measurements have not been made in the piezometers since installation.

Hardpan deposits were encountered in both borings at Site 19. Figure 8 shows locations of the hardpan deposits mapped within the vicinity of the site and can be correlated to the hardpan deposits identified in the borings. The hardpan deposits exposed in the channel appear to be partially covered by a relatively thin veneer of recent loose gravel and cobbles and may be more expansive than shown on our maps. A summary of the hardpan deposits encountered in each boring is summarized in the table below (BOH = Bottom of Hole):

	Site 19	
Depth	B-19-1	B-19-2
0		
1		
2		
3		
4		
5		
6		
7		
8		
9		
10	CL	
11	SC	
12		SM
13		SM
14		SM
15		SM
16	SC	SM
17	SC	SM
18	BOH at 18'	BOH at 17.8'

CL Hardpan Deposit, Soil Classification Identified

CL: Lean Clay; CH: Fat Clay; ML: Silt; SM: Silty Sand; SC: Clayey Sand

4.02.7 Sites 14, 15, 16, 17 and 18

Sites 14 through 18 (Figure 9) are located immediately south of Yountville Cross Road between Stations 270+00 and 239+00. Along these contiguous sites, the main channel of the Napa River is relatively narrow and incised with steep banks and deep water pools (greater than 5 feet). Site 18 is located along the left bank of the Napa River with steep slopes, near vertical in areas. There is an existing rip-rap berm at the top of the bank which runs along the entire length of Site 18. Sites 14 through 17 are located across the river along the right bank (east side). There is a secondary channel which runs along the back (northeast) side of Site 17 and meanders across Site 17 to join the main channel at Station 255+00.

As shown on Figure 9, a total of 17 borings were drilled at Sites 14 through 18. We drilled eight borings at Site 18 (B-18-1 through B-18-8); four at the base of the existing berm and three approximately 75 feet back (west) from the existing berm in an area where a new berm is planned. Seven borings were drilled at Site 17 (B-17-1 through B-17-7), three borings along the right bank of the main channel and three along the secondary channel to the northeast of the main channel. Two borings were drilled at Site 14 (B-14-1 and B-14-2) at the base of the detention pond side slopes.

In general, the borings at Sites 14, 17 and 18 encountered layered deposits of medium dense to very dense sands and gravels with varying amounts of silt and clay and stiff to hard, lean to fat clays which extended to the bottoms of the borings (between 10.0 and 26.5 feet). Groundwater was observed in some of the borings at Site 17 between 16.2 and 26.0 feet below the ground surface. Groundwater was observed in some of the borings at Site 18 between 17.1 and 19.2 feet below the ground surface. Groundwater was observed in Boring B-14-2 at depth of 2 feet below the ground surface and was not observed in Boring B-14-1. The elevated groundwater level in Boring B-14-2 was likely related to the adjacent detention pond that is topographically higher than the boring location.

Hardpan deposits were encountered in all of the borings at Sites 14, 17 and 18 except for B-18-4, B-18-5 and B-18-6. Figure 9 shows locations of the hardpan deposits mapped within the vicinity of the sites. Generally, exposures of the hardpan deposits along the main channel were few and scattered. No hardpan deposits were observed along the secondary channel to the northeast of the main channel except where it flows into the main channel near Station 255+00. Figure 12 shows a geologic cross section through Sites 17 and 18 at Station 259+97.0. The cross section identifies the interpreted hardpan deposits and channel geometry.

A summary of the hardpan deposits encountered in each boring is summarized in the table below (BOH = Bottom of Hole):

	Site 18								Site 17							Site 14	
Depth	B-18-1	B-18-2	B-18-3	B-18-4	B-18-5	B-18-6	B-18-7	B-18-8	B-17-1	B-17-2	B-17-3	B-17-4	B-17-5	B-17-6	B-17-7	B-14-1	B-14-2
0																	
1																	
2							CL										
3							CL										
4							CL			SC							
5		CL					CL			SC							
6		CL					CL	ML		SC		CL					CL
7		CL					CL	ML		SC		CL					CL
8		CL					CL	ML	CL	SC		CL					CL
9		CL					CL	ML	CL	SC		CL					SC
10						BOH at 10'		ML	CL	SC		CL	SC				SC
11								ML	CL	SC		CH	SC				SC
12					BOH at 11.5'		BOH at 11.5'	BOH at 11.5'	CL	SC		CH	SC				SC
13									CL	SC		CH	SC				ML
14	CL								CL			SC				CL	ML
15	CL											SC				CL	ML
16	CH															CL	ML
17	CH								BOH at 16.5'							BOH at 16.5'	BOH at 16.5'
18	CH														CL		
19	CH											SM			CL		
20	CH											SM			CL		
21	CH											SM		CL	CL		
22	CH													CL	CL		
23	CH	CL	SM								CL		CL	CL	CL		
24	CH	CL	SM								CL	CH	CL	CL	CL		
25	CH	CL	SM								CL	CH	CL	CL	CL		
26	CH	CL	SM							BOH at 26'	CL	CH	CL	CL	CL		
	BOH at 26.5'	BOH at 26.5'	BOH at 26.5'	BOH at 26.5'							BOH at 26.5'	BOH at 26.5'	BOH at 26.5'	BOH at 26.5'	BOH at 26.5'		

CL Hardpan Deposit, Soil Classification Identified

CL: Lean Clay; CH: Fat Clay; ML: Silt; SM: Silty Sand; SC: Clayey Sand

4.03 Phase 2 Project Reach Site Conditions

Geologic mapping was only performed at selected sites due to the budgeted time allowance. The following sites were mapped: Sites 13, 9, 8, 3, 2 and 1 (Figures 13 through 21). Extensive hardpan deposits were mapped along the channel and river banks at Sites 13, 9, 8, 3, 2 and 1.

We drilled 15 borings on the Phase 2 Sites. The approximate locations of our borings are shown on the Phase 2 Overview Map, Figure 2; logs of the borings are presented in Appendix A. A summary of the borings (depths and hardpan deposits encountered) is included in the table below (BOH = Bottom of Hole):

	Site 13	Site 10	Site 9		Site 8				Site 7	Site 5	Site 3	Site 2	Site 1		
Depth	B-13-1	B-10-1	B-9-1	B-9-2	B-8-1	B-8-2	B-8-3	B-8-4	B-7-1	B-5-1	B-3-1	B-2-1	B-1-1	B-1-2	B-1-3
0									CL						
1									CL						
2									CL						
3									CL						
4									CL						
5									CL					CL	
6									CL					CL	
7									CL			SC		CL	
8				CL		CL	CL		CL			SC		CL	CL
9				CL		CL	CL		CL			SC	CL	CL	CL
10	CL	CL	CL	CL	CL	CL	CL	CL	CL			SC	CL	CL	CL
11	CL	CL	CL	CL	CL	CL	CL	CL	CL			SC	CL	SC	CL
12	CL	CL	CL	CL	CL	CL	CL	CL	CL			SC	CL	SC	CL
13	CL	CL	CL	CL	CL	CL	CL	CL	CL			SC	CL	SC	CL
14	CL	CL	CL	CL		SC	CL		CL	SC		CL	CL	CL	CL
15		CL	CL	SC		SC	CL			SC		CL	CL	CL	CL
16		CL	CL	SC		SC	CL			SC		CL	CL	CL	CL
17		CL	CL	SC		SC	BOH	BOH		BOH		CL	CL	CL	CL
18		CL	CL	SC	CL	SC	at 16.5'	at 16.5'		at 16.5'			CL	CL	
19		CL	CL	SC	CL	CL							CL	CL	
20		CL	CH	SC	CL	CL			SC				CL	CL	
21		CL	SC	SC	CL	CL			SC				CL	CL	
22		CL	SC	BOH	CL	CL						BOH	BOH	BOH	BOH
23		CL	SC	at 21.5'	CL	CL						at 21.5'	at 21.5'	at 21.5'	at 21.5'
24		CL	CH			CL									
25			CH			CL									
26			CH			CL									
27	BOH	BOH	CH		BOH	CL			BOH		BOH				
28	at 26.5'	at 26.5'			at 26.5'	CL			at 26.5'		at 26.5'				
29						CL									
30						BOH									
			BOH			at 29.5'									
			at 29.5'												

SC Hardpan Deposit, Soil Classification Identified

CL: Lean Clay; CH: Fat Clay; ML: Silt; SM: Silty Sand; SC: Clayey Sand

Groundwater was encountered in all but four borings during drilling between depths of 11.3 and 21.0 feet below the ground surface.

4.04 Groundwater

At the time of drilling, we measured groundwater levels in the borings (where encountered); these groundwater depth measurements are shown on the boring logs, cross sections (Figures 10 through 12) and is discussed in the sections above. Measurements made in borings that were backfilled with grout shortly after drilling may not be representative of equilibrium groundwater conditions. Groundwater was not noted to be observed in multiple borings, but this does not guarantee that there is no presence

groundwater at this location at the time. If the soils at depth are fine grained and not enough time was allowed to bring the groundwater to its equilibrium levels, then the elevation of measured groundwater will be noted as lower than what the true condition is.

5.00 EVALUATIONS AND CONCLUSIONS – PHASE 1 PROJECT REACH

5.01 General

We understand that it is an objective of the project to restore the creek channel to a more natural condition. In general, our investigation did not encounter conditions that would preclude accomplishing this basic objective. The fine- and coarse-grained soils encountered in the borings are typically capable of standing at the proposed cut slope inclination of 3:1 (horizontal to vertical) under normal conditions. Site specific evaluations and recommendations for planned cut slopes steeper than 3:1 are addressed in Appendix E, Site Specific Evaluations and Recommendations. Cut slopes should be planted or otherwise protected to resist erosion. More aggressive erosion control measures are warranted in coarse-grained soils and fine-grained soils of low plasticity due to erodability concerns.

As with most river channels, it is possible that slope failures could occur at some locations due to flood conditions. However, we anticipate that such static (i.e. non-earthquake) failures would typically be localized and limited in both depth and lateral extent. Broader and more extensive slope failures could occur due to earthquake-induced soil liquefaction in locations where continuous layers of liquefiable soils are saturated (i.e. below groundwater) at the time that a large earthquake occurs. However, soil liquefaction and related hazards, such as lateral spreading, would also be present if the river were entirely in a natural condition. In that the work required to mitigate liquefaction and related effects could be extensive and costly, it appears appropriate to exclude liquefaction mitigation from the scope of the planned river restoration project.

5.02 Hardpan Deposits

The hardpan deposits identified within the channel and encountered in our borings do not appear to adversely affect the geotechnical aspects of the project (e.g., grading, slope stability, berm configuration, etc.). We anticipate that these deposits can be excavated with conventional earth-moving equipment such as dozers, backhoes, and excavators. Note, however, that mitigation measures such as soil amendments and preparation related to revegetation and establishment of terrestrial habitats not included in our scope of work and would be provided by others, if necessary.

5.03 Slope Stability

We analyzed the static stability of proposed cut slopes using conventional slope stability analysis software (SLIDE, version 6.0 by Rocscience, Inc.); key inputs to the program include soil shear strength, soil unit weight and groundwater surface. Simplified analytical cross sections were developed to model planned 3:1 soil slopes using average strength parameters. The geotechnical input parameters we used for each soil layer are summarized on the result printouts included in Appendix C.

For each Site, we analyzed slope stability for two different water levels and two different slope inclinations. For the “low” groundwater case, we modeled a uniform (horizontal) water surface within the channel and slope coincident with the base of the slope. For the “high” groundwater case, we modeled a uniform (horizontal) water surface within the channel and slope coincident with the elevation at a depth of 5 feet below the top of slope. Both 2:1 and 3:1 (horizontal to vertical) slopes were analyzed.

For each analysis case, we calculated the slope’s minimum static factor of safety (FS) against sliding. The FS is commonly defined as the sum of the forces resisting movement divided by the sum of the forces driving movement. A slope with a FS greater than unity (1.0) is theoretically stable. The results of our analyses are presented in Appendix C and summarized in the table on the following page.

Static Slope Stability Analysis Results
FS = Factor of Safety (Minimum)

Site #	Idealized Soil Profile	Slope Inclination (Horizontal to Vertical)	GW Level	Minimum FS
Sites: 29, 28, 27, 26B, 22, 19	Medium Dense Sand/Gravel	2:1	High	1.613
			Low	1.368
	Medium Dense Sand/Gravel	3:1	High	1.952
		3:1	Low	1.916
Sites: 26C, 26A	Loose Sand/Gravel	2:1	High	1.313
		2:1	Low	1.151
	Loose Sand/Gravel	3:1	High	1.661
		3:1	Low	1.612
Site 18	0 to 5': Loose Sand 5' to 10': Stiff to Very Stiff Clay 10' to 15': Dense Gravel 15' to 20': Loose Sand	2:1	High	1.236
		2:1	Low	1.198
		3:1	High	1.703
		3:1	Low	1.694
Site 17	0 to 6': Medium Dense Sand 6' to 14': Very Stiff Clay >14': Dense Gravel	2:1	High	1.298
		2:1	Low	1.271
		3:1	High	1.803
		3:1	Low	1.781

The results of our slope stability analyses generally show the proposed cut slopes to be stable under static (i.e. non-earthquake) conditions for both 2:1 and 3:1 slope inclinations. The FS against sliding for 2:1 slopes often fall below 1.5; therefore, we are recommending using a maximum slope inclination of 3:1 for the design of the project.

5.04 Seismic Hazard Potential

The subject site is located in the highly seismic San Francisco Bay Region, and it is certain that the completed project will be subjected to strong earthquake groundshaking at some point in the future. The site is not near a CGS-defined Alquist-Priolo Earthquake Fault Zone; consequently, the potential for surface fault rupture at the site is very low to negligible. The OVOK Reach of the Napa River features a creek channel incised into natural Late Pleistocene-age alluvium that can generally be characterized as variable. Strong earthquake groundshaking has the potential to cause localized failures within the creek banks through mechanisms involving liquefaction, lateral spreading, and/or landsliding. Potential hazards associated with these particular mechanisms are evaluated in the sections that follow.

5.05 Earthquake-Induced Soil Liquefaction

Liquefaction is a phenomenon whereby certain types of soils below groundwater lose strength in response to earthquake shaking. The soils considered most susceptible to liquefaction include loose, coarse-grained materials (i.e., sands and gravels); liquefaction susceptibility in these coarse-grained materials is most commonly correlated to “corrected” Standard Penetration Test (SPT) blow counts.

We evaluated liquefaction susceptibility and potential using the data from the site borings. In general, all of the loose to medium dense coarse-grained soils we encountered are considered susceptible to liquefaction *if they are below the groundwater table during a strong earthquake.* All of the clayey soils

encountered in the borings are sufficiently stiff to very stiff and/or plastic to exhibit earthquake-induced softening or liquefaction-type behavior.

Where soils susceptible to liquefaction are present, additional steps are needed to evaluate whether the ground shaking that occurs at the site during a large earthquake will initiate (trigger) liquefaction. We evaluated liquefaction triggering using the methodology outlined in Youd and Idriss, 2001. This method involves assessing the seismic demand on a soil layer, expressed in terms of the cyclic stress ratio (CSR), and comparing this value to the capacity of the soil to resist liquefaction, expressed in terms of the cyclic resistance ratio (CRR). The factor of safety (FS) against liquefaction is determined by dividing the CRR by the CSR. Soils having a FS less than or equal to 1.0 are considered liquefiable.

Levels of ground shaking used in our analyses were based on an earthquake moment magnitude (M_W) of 7.0 with a peak ground acceleration (PGA) of 0.42g. This PGA value was selected to be consistent with the probabilistically derived values (corresponding to a 10 percent chance of exceedence in 50 years level of hazard) obtained from the CGS Probabilistic Seismic Hazards Mapping Ground Motion Page (http://redirect.conservation.ca.gov/cgs/rghm/pshamap/pshamap.asp). An assumed design groundwater depth of 8 feet below the ground surface was used in our analyses.

The soil layers found to have a FS against liquefaction of less than or equal to one are summarized in the following table (BOH signifies “Bottom of Hole”):

Potentially Liquefiable Soil Layers

Boring ID	Depth of Liquefiable Layer (feet below ground surface)	Elevation of Liquefiable layer (feet, AMSL)	USCS Soil Classification
B-17-1	15.0 - BOH @16.5	73.0 - 71.5	SC
B-17-2	20.5 - 25.0	75.5 - 71.0	SM
B-17-5	16.5 - 23.5	77.5 - 70.5	SM/GC
B-17-7	12.0 - 18.0	82.0 - 76.0	SM
B-18-2	15.0 - 20.0	78.0 - 73.0	SC
B-18-3	11.5 - 20.0 23.5 - BOH@26.5	81.5 - 73.0 69.5 - 66.5	GC/SM SM
B-18-4	18.0 - 23.0 23.0 - BOH@26.5	75.0 - 70.0 70.0 - 66.5	SM GP
B-18-8	8.0 - BOH@11.5	83.0 - 79.5	ML
B-19-2	8.0 - 10.0	92.0 - 90.0	SC
B-22-4	9.5 - 13.0 13.0 - BOH@16.5	83.5 - 80.0 80.0 - 76.5	GC SC
B-26A-1	8.0 - 13.0 20.0 - 21.3	110.0 - 105.0 98.0 - 96.8	SM SM
B-26B-1	8.0 - 20.8 20.8 - BOH@21.5	106.0 - 93.3 93.3 - 92.5	SP/SM GP
B-26C-1	14.0 - 19.0 19.0 - 24.0 24.0 - BOH@26.5	100.0 - 95.0 95.0 - 90.0 90.0 - 87.5	SW SP GP
B-27-1	9.0 - 13.0 13.0 - 20.0	115.0 - 111.0 111.0 - 104.0	SM GW
B-28-1	8.0 - 15.0 15.0 - 20.0 20.0 - BOH@21.5	117.0 - 110.0 110.0 - 105.0 105.0 - 103.5	SW-SM SP-SC SP

The results of our liquefaction analyses are also included in Appendix D.

5.06 Lateral Spreading

Lateral spreading is a phenomenon where non-liquefied soil can move laterally on a weakened liquefied layer. Lateral spreading generally requires that liquefaction occur over a significant area, and that the non-liquefied soil above it be adjacent to a “free face” towards which movement can occur.

Sites 17, 18, 19, 22, 26A-C, 27 and 28 encountered medium dense sands and gravels that are potentially liquefiable, when submerged. If these materials are part of a continuous layer that daylights at the river bank and the layer liquefies, then there is a potential for the material above the liquefied layer to spread laterally. Unfortunately, we do not have enough information/data to confirm if this is the case.

The principal effects of lateral spreading could include cracking and slumping of creek banks that extend onto adjacent vineyard properties. Natural pre-existing hazards such as liquefaction and lateral spreading will not be mitigated as a part of the river restoration project. Individual landowners could elect to mitigate liquefaction and lateral spreading on their own if they consider these types of potential seismic hazards to be unacceptable.

5.07 Seismic Slope Stability

The results of our slope stability analyses (Section 5.03) produced minimum static factors of safety of 2.1 and 2.2 for the fine-grained soil case and it was noted that actual factors of safety for plausible landslide failure surfaces would necessarily be higher. Where soils having the potential for seismic strength loss are absent, these calculated factors of safety are considered sufficiently high to produce adequate seismic slope performance. This condition is interpreted to exist where fine-grained soils dominate and potentially liquefiable soils are not interpreted to be present (approximately Reach 9, Stations 11+00 to 27+00; and Reach 7, Stations 80+00 to 86+00). Where potentially liquefiable soils *are* present, seismic slope performance will be controlled by the liquefaction and lateral spreading mechanisms previously discussed.

5.08 Cut Slopes

In our slope stability analysis (Section 5.03; Appendix C), we calculated factors of safety against landsliding of 1.5 or greater for 3:1 slopes with non-earthquake conditions. These values indicates that the planned 3:1 slopes should generally be stable, statically (a factor of safety less than 1 would correspond to a slope that is not stable). This conclusion is generally valid under idealized conditions, but it should be anticipated that soil conditions along actual excavation cuts will vary and that severe or extreme flooding conditions may occur post-construction. These types of conditions, neither of which can explicitly be modeled, have the potential to produce slope instabilities requiring maintenance and/or repair.

In general, flatter cut slopes will be more stable and may be easier to vegetate and maintain. However, the planned cut slopes are considered acceptable provided that the designer and owner recognize and accept that shallow slope failures may occasionally occur and that periodic inspections, maintenance and repair of 3:1 cut slopes may be necessary.

5.09 Construction Considerations

We anticipate soil materials at the site can be excavated with conventional earth-moving equipment such as dozers, backhoes, and excavators; however, it is possible that rubble or buried obstructions could be encountered. All excavations deeper than 4 feet that will be entered by workers should be shored or sloped for safety in accordance with the California Occupational Safety and Health Administration (Cal-OSHA) standards. In general, the stability of site shoring and all temporary construction slopes as well as the protection of nearby site improvements during construction are responsibilities of the contractor.

It is possible that some site excavations could extend below groundwater, particularly if the work is performed during or shortly after the winter rainy season. Seepage zones or locally perched groundwater conditions could also be encountered. The control of groundwater during construction is the responsibility

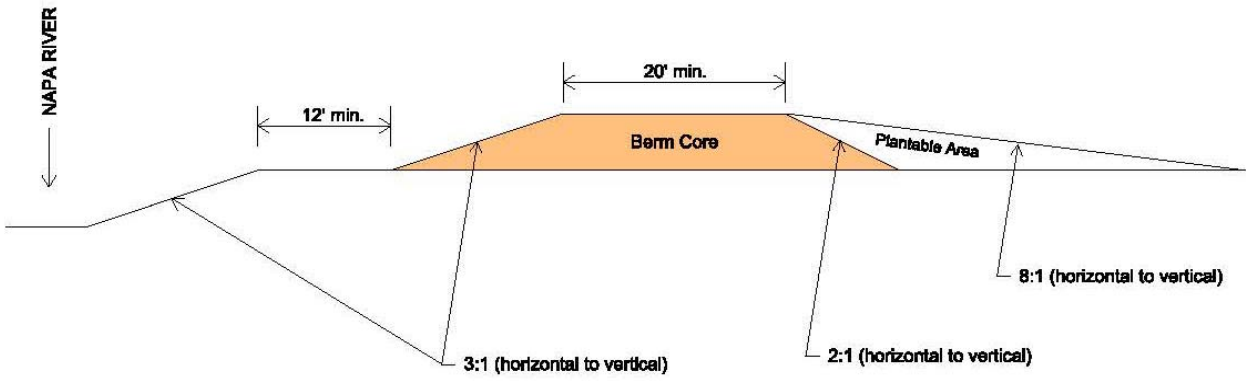
of the contractor. Possible groundwater control methods include pumping from sumps at low points within excavations, horizontal drains and dewatering wells. The design, permitting, installation, monitoring, and abandonment of site dewatering and discharge systems are the contractor's responsibility. These responsibilities also include any special regulatory or health and safety requirements that may be associated with the disposal and/or discharge of construction water.

Although it is possible for construction to proceed during or immediately following the wet winter months, a number of geotechnical problems may occur which may increase costs and cause project delays. The water content of onsite soils may increase during the winter and rise significantly above optimum moisture content for compaction of subgrade or backfill materials. If this occurs, the contractor may be unable to achieve the specified levels of compaction. Dewatering requirements will potentially increase due to rainfall, surface runoff, seepage and rises in groundwater level. The stability of temporary slopes will decrease, potentially increasing the lateral extent of excavation required. If excavation trenches are open during winter rains, caving of the trench walls may occur. In general, we note that it has also been our experience that increased clean-up costs may be incurred, and greater safety hazards may exist, if the work proceeds during the wet winter months.

6.00 RECOMMENDATIONS

6.01 Berm Configuration

As shown in the detail below, new berms should include a core with a minimum crest width of 20 feet, a river-side slope inclination of 3:1 (horizontal to vertical) or flatter, and a land-side slope inclination of 2:1 or flatter. The land-side slope should have a plantable shoulder inclined at 8:1 or flatter. The toe of the new berm should be set back at least 12 feet from the adjacent river-side cut slope. Fill for the berm should conform to the requirements specified in Section 6.03, Earthwork.



6.02 Site Preparation

Prior to the start of work, the contractor should locate and mark all active subsurface utilities in the general vicinity of the site. The contractor should protect all utilities that are to remain in and surrounding the site (including existing piezometers) during onsite excavation and construction activities. Existing piezometers to be demolished or abandoned will need to done in a manner consistent with local regulations.

The site should then be cleared and grubbed of surface and subsurface deleterious matter including vegetation, aggregate road-base material, and abandoned utilities. These materials should be removed from the site or stockpiled for reuse if approved by the owner in consultation with our firm. Depressions resulting from the removal of underground obstructions (including tree stumps and root balls) that extend below the proposed finished grades should be cleared and the depressions backfilled with suitable material compacted to the requirements given in Section 6.03, Earthwork.

Special attention should be given to site preparation in areas where new berms are planned. Within berm areas, A3GEO should observe exposed conditions after vegetation and organic-laden soils are removed but prior to any fill placement to: 1) verify the adequacy of stripping; 2) check that suitable soils are exposed. Soils that are loose, weak, highly permeable or otherwise unsuitable should be overexcavated under A3GEO's direct observation and replaced with engineered material appropriate for berm construction.

6.03 Earthwork

6.03.1 Fill Materials

All proposed fill materials should be approved by A3GEO prior to use. The materials cleared or excavated from the site may be suitable for re-use as fill, from a geotechnical standpoint, if they meet or can be processed (i.e., by crushing and/or blending) to meet the requirements presented in this section. Material that cannot be mixed or processed to meet specification requirements should be disposed of offsite or stockpiled for other uses at the discretion of the owner. If the re-use of aggregate base or gravel is to be considered, it must first be approved by the owner in consultation with our firm.

General Fill – On-site native soil can be used as General Fill, provided it conforms to the requirements presented below:

- Has an organic content of less than 3 percent by volume,
- Does not contain rocks or lumps larger than 4 inches in greatest dimension, and
- Has no more than 15 percent of material larger than 2.5 inches.

General Fill can be used as engineered fill/backfill except where Berm Core Fill is required.

Berm Core Fill – In addition to the requirements for General Fill, Berm Core Fill should classify as Clay based on USCS criteria, have a Plasticity Index between 12 and 35 *and* have a Liquid Limit no greater than 55. If sands are mixed with clay to create Berm Core Fill, such mixtures should be blended and thoroughly mixed in a borrow area and be evaluated and approved by A3GEO prior to its importation to the site. Blending in a fill area is not acceptable.

Offsite fill material (if used) should comply with the requirements appropriate its intended use and be evaluated and approved by A3GEO prior to its importation to the site.

6.03.2 Subgrade Preparation

Subgrade surfaces in areas to receive fill should be firm, unyielding, and compacted to the requirements for engineered fill (refer to Section 6.03.3 below). Soft, yielding or otherwise unsuitable subgrade soils should be overexcavated to expose firm non-yielding materials and replaced with appropriately engineered fill. Additional requirements for the preparation of areas to receive fill are presented Section 6.02, Site Preparation.

Immediately prior to fill placement, exposed subgrade soils should be scarified to a depth of 6 inches or the full depth of any existing shrinkage cracks. The scarified subgrade soils should then be moisture conditioned to slightly above optimum water content and compacted to at least 90 percent relative compaction based on the ASTM D-1557 test method (latest version). A3GEO should observe and test, as appropriate, during subgrade preparation to check that surfaces to receive fill are properly prepared and verify that specified compaction and moisture conditioning requirements are achieved.

6.03.3 Engineered Fill Placement

All fill should be spread in lifts not exceeding 8 inches in uncompacted thickness on surfaces that are approximately level, moisture conditioned, as appropriate, and compacted by mechanical means to the required levels of compaction). It is possible that fill and/or subgrade soils may be excessively wet or dry depending on the moisture content at the time of construction. If the fill soils are too wet, they may be dried by aeration or by mixing with drier materials. If the fill soils are too dry, water will need to be added. Required levels of compaction should be as follows (all per ASTM D-1557, latest version):

Berm Core – at least 90 percent relative compaction
Plantable Shoulder – at least 85 percent relative compaction
Roadway Aggregate Base and/or Gravel – at least 95 percent relative compaction
Other Fill Areas – at least 90 percent relative compaction

A3GEO should observe and test, as appropriate, during fill placement to verify that specified compaction and moisture conditioning requirements are achieved

The following additional requirements apply specifically to berm core construction. Berm Core Fill should be moisture conditioned to about 2 or 3 percent over optimum, as determined by ASTM D-1557 (latest version). Materials comprising the berm core should be approximately uniform and the placement adjacent dissimilar materials should be avoided. The berm core should be compacted in a systematic manner using a sheepsfoot kneading compactor or equivalent equipment. Material that fails the moisture or compaction criteria should be loosened by ripping or scarifying, moisture conditioned, and then recompacted.

6.04 Surface Drainage

Positive surface drainage should be provided to direct surface water away from slopes. Ponding or collection of surface water should be avoided in any areas adjacent to slopes. The river side of the berm should be designed to sheet flow to and beyond the berm toe. The crest of the berm should either be crowned to split the sheet flow runoff to both sides of the berm or the crown should be graded for sheet flow toward the vineyards. Grading plans should account for the swale that will be formed at the toe of the vineyard side of the slope and grade it to drain.

6.05 Maintenance

Annual inspection and maintenance should be performed late summer to early fall. The berm should be mowed prior to inspection to facilitate observation and repair. Trees or shrubs should not be allowed to grow on the berm and shrubs and saplings should be removed from the crest and river-side slope of the berm. Rodent activity should be monitored and population control initiated where rodent infestation is observed. Berm damage from tree or shrub removal, erosion, scour, rodent activity, etc. should be repaired to maintain the integrity of the berm.

6.06 Future Geotechnical Services

We recommend our firm be provided the opportunity for a general review of the geotechnical aspects of the final plans and specifications for this project in order verify that our geotechnical recommendations were properly interpreted and implemented. If our firm is not accorded the privilege of making the recommended review, we can assume no responsibility for misinterpretation of our recommendations.

The analyses and recommendations submitted in this report are based in part upon the data obtained from the soil borings. The nature and extent of variations across the site may not become evident until construction. If variations then become apparent, it will be necessary to re-examine the recommendations of this report.

A3GEO should review all submittals from the contractors that are geotechnical in nature, before geotechnical materials are delivered or equipment is mobilized to the site.

We recommend our firm be retained to provide geotechnical engineering services during the construction of the proposed project. This is to observe compliance with the design concepts, specifications, and recommendations and to allow design changes in the event that subsurface conditions differ from those anticipated prior to the start of construction. During construction, A3GEO should observe the following:

- Soil conditions exposed by site excavations,
- Subgrade preparation, and
- Fill placement and compaction.

7.00 LIMITATIONS

This report has been prepared for the exclusive use of you and your consultants in accordance with generally accepted geotechnical engineering practices for specific application to the construction of the proposed Napa River OVOK Reach Restoration Project in Napa County, California. No other warranty, either expressed or implied, is made. In the event the nature, design, or location of the improvements differs significantly from what has been noted above, the conclusions and recommendations contained in this report should not be considered valid unless the changes are reviewed and the conclusions of this report are modified or verified in writing.

The findings of this report are valid as of the present date. However, the passing of time will likely change the conditions of the existing property due to natural processes or the works of man. In addition, due to legislation or the broadening of knowledge, changes in applicable or appropriate standards may occur. Accordingly, the findings of this report may be invalidated, wholly or partly, by changes beyond our control. Therefore, this report should not be relied upon after three years without being reviewed by this office.

If you have any questions concerning this report, please call us.

Very truly yours,

Dona K. Mann, G.E.
Principal Engineer
(415) 425-0247

Patrick Drumm, C.E.G.
Project Geologist

Copies: Addressee (1 via email)

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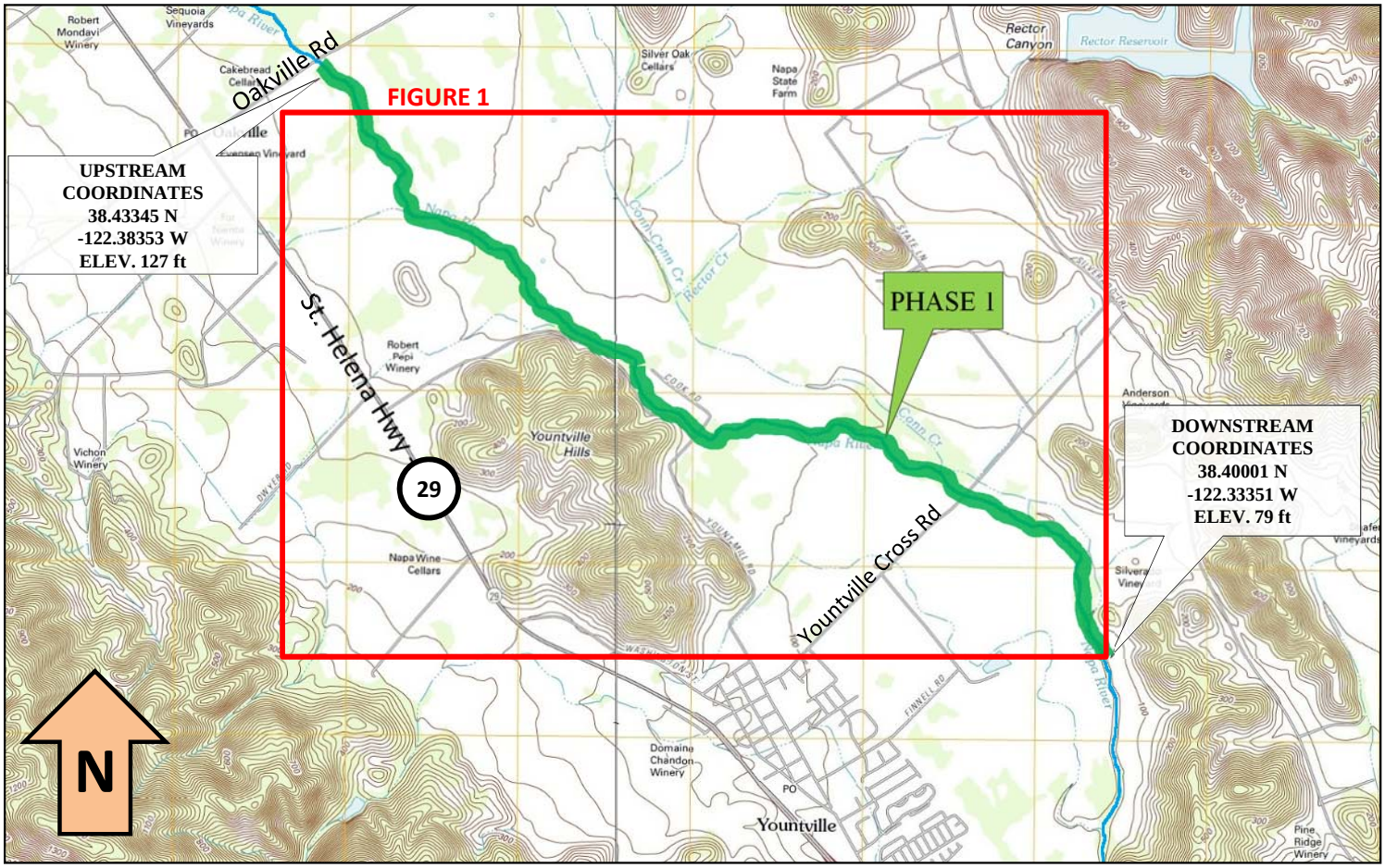
PLATES

Source: USGS topographic map 2012, Rutherford and Yountville Quadrangles, California, 7.5 Series



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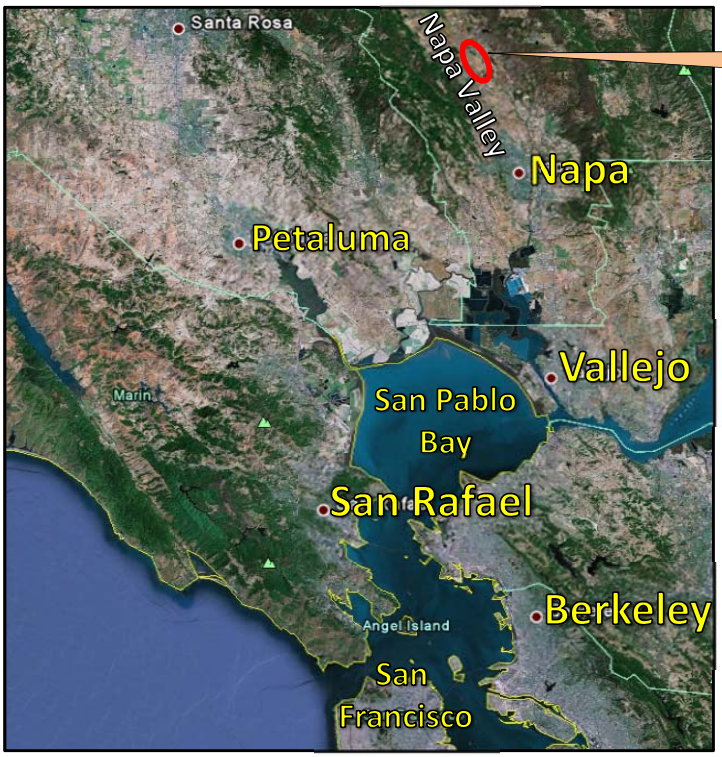
Approximate scale



SITE LOCATION

EXPLANATION

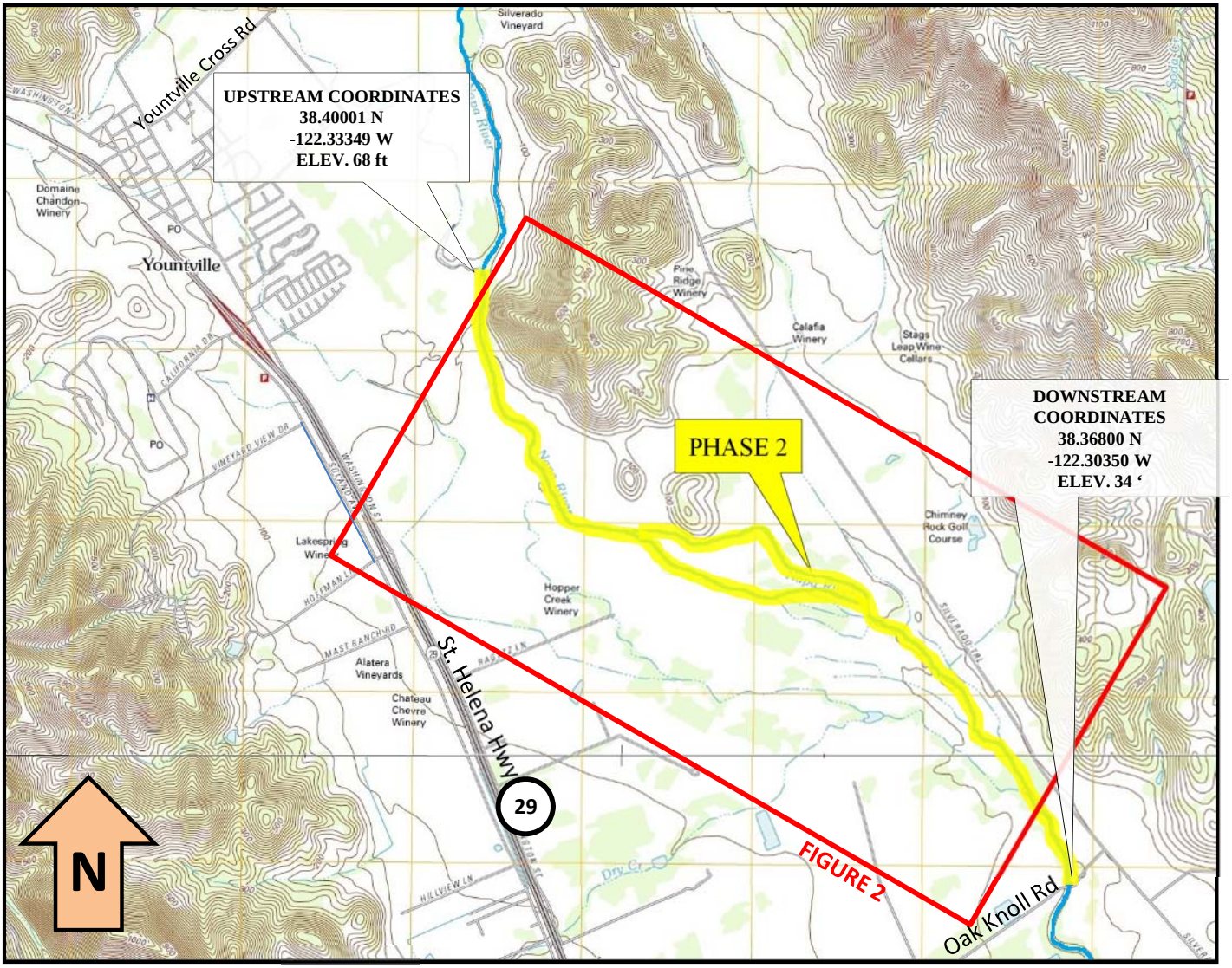
Napa River Channel

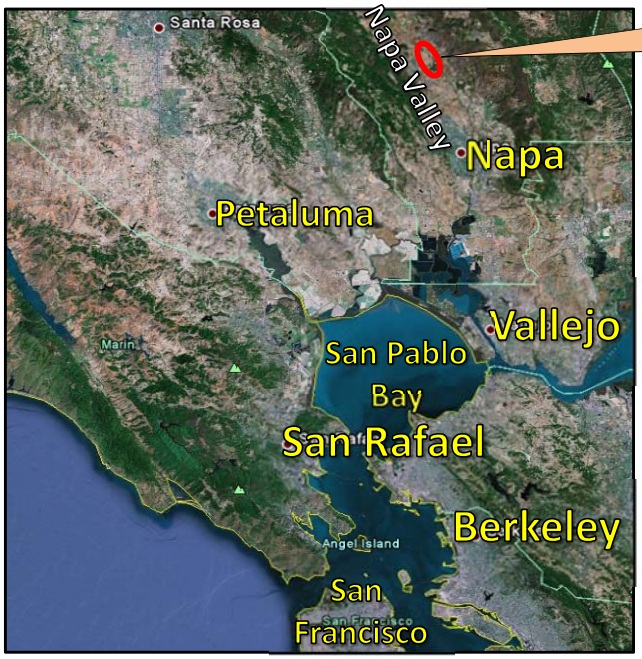
Approximate Phase 1 Project Reach

NAPA RIVER RESTORATION
OVOK REACH

Plate 1
Vicinity Map Phase 1

Source: USGS topographic map 2012, Yountville and Napa Quadrangles, California, 7.5 Series





SITE LOCATION

0 0.5 1 miles
Approximate scale

EXPLANATION

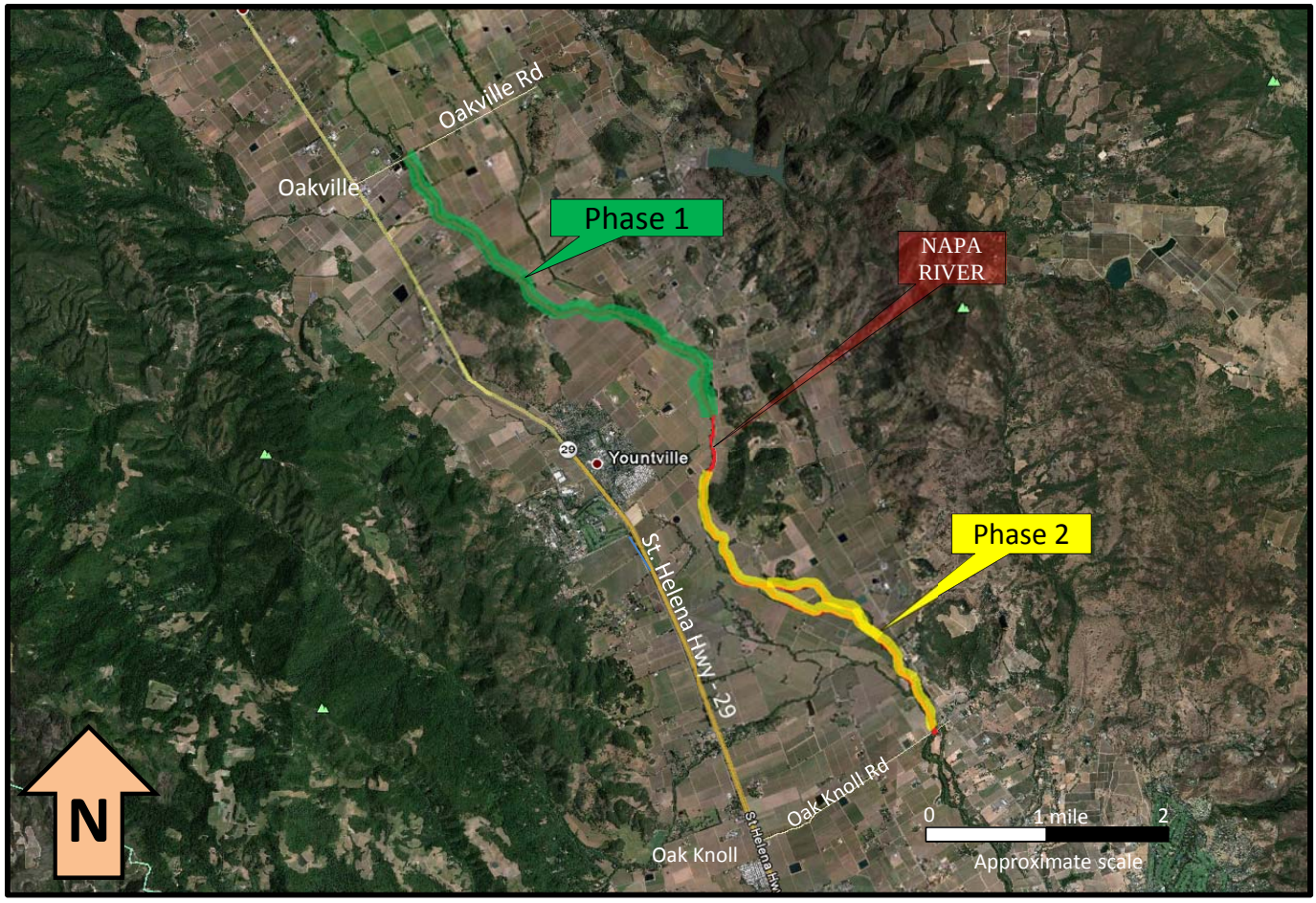
Napa River Channel

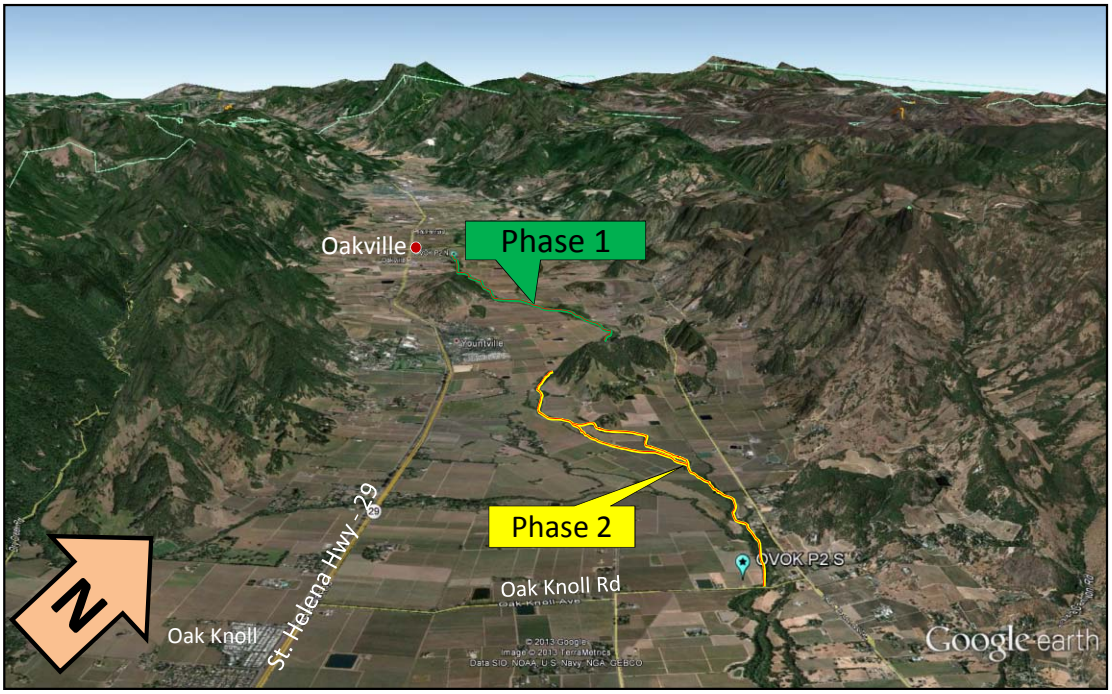
Approximate Phase 2 Project Reach

NAPA RIVER RESTORATION
OVOK REACH

Plate 2
Vicinity Map Phase 2

SOURCE: Google Earth, Imagery date: 05/06/2012





NOT TO SCALE

EXPLANATION

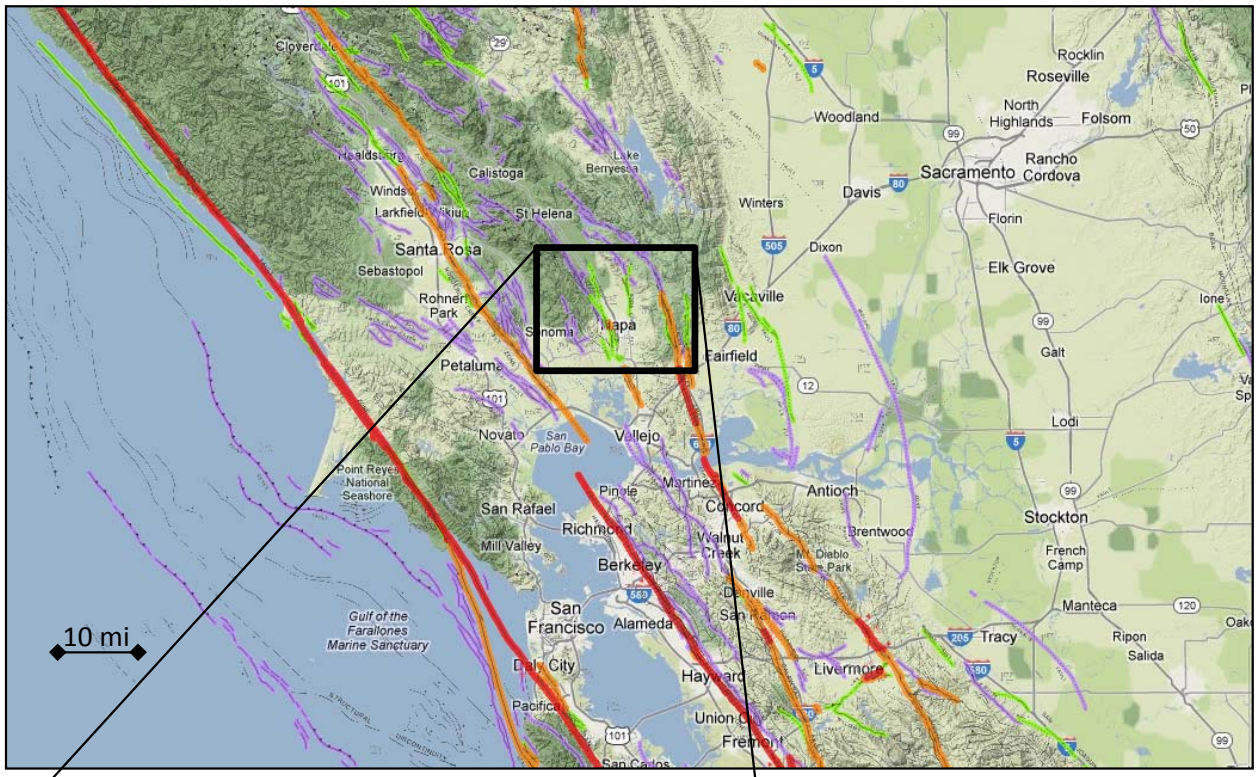
Napa River Channel

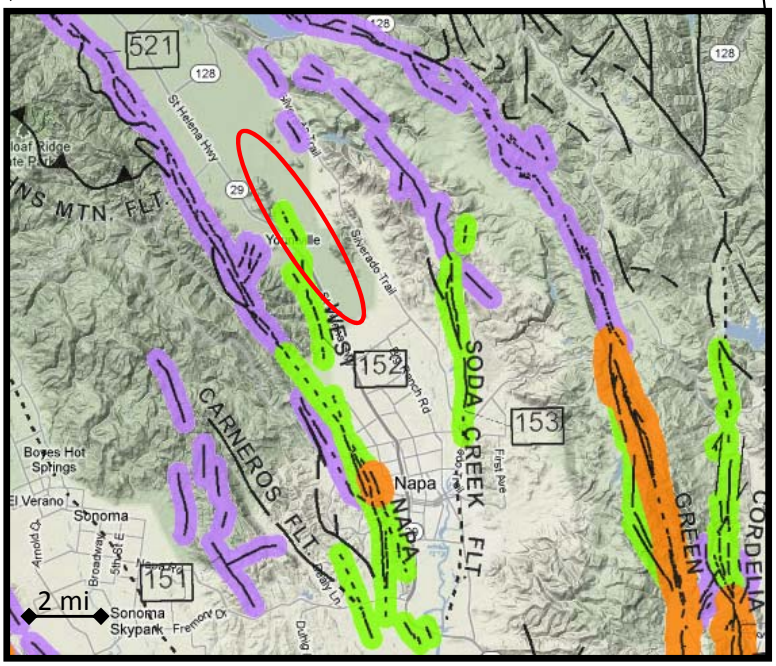
Approximate Phase 1 Project Reach

Approximate Phase 2 Project Reach

NAPA RIVER RESTORATION
OVOK REACH

Plate 3
Site Aerial Photograph





EXPLANATION

FAULT CLASSIFICATION COLOR CODE
(Indicating Recency of Movement)

Fault along which historic (last 200 years) displacement has occurred.

Holocene fault displacement (during past 11,700 years) without historic record.

Late Quaternary fault displacement (during past 700,000 years).

Quaternary fault (age undifferentiated).

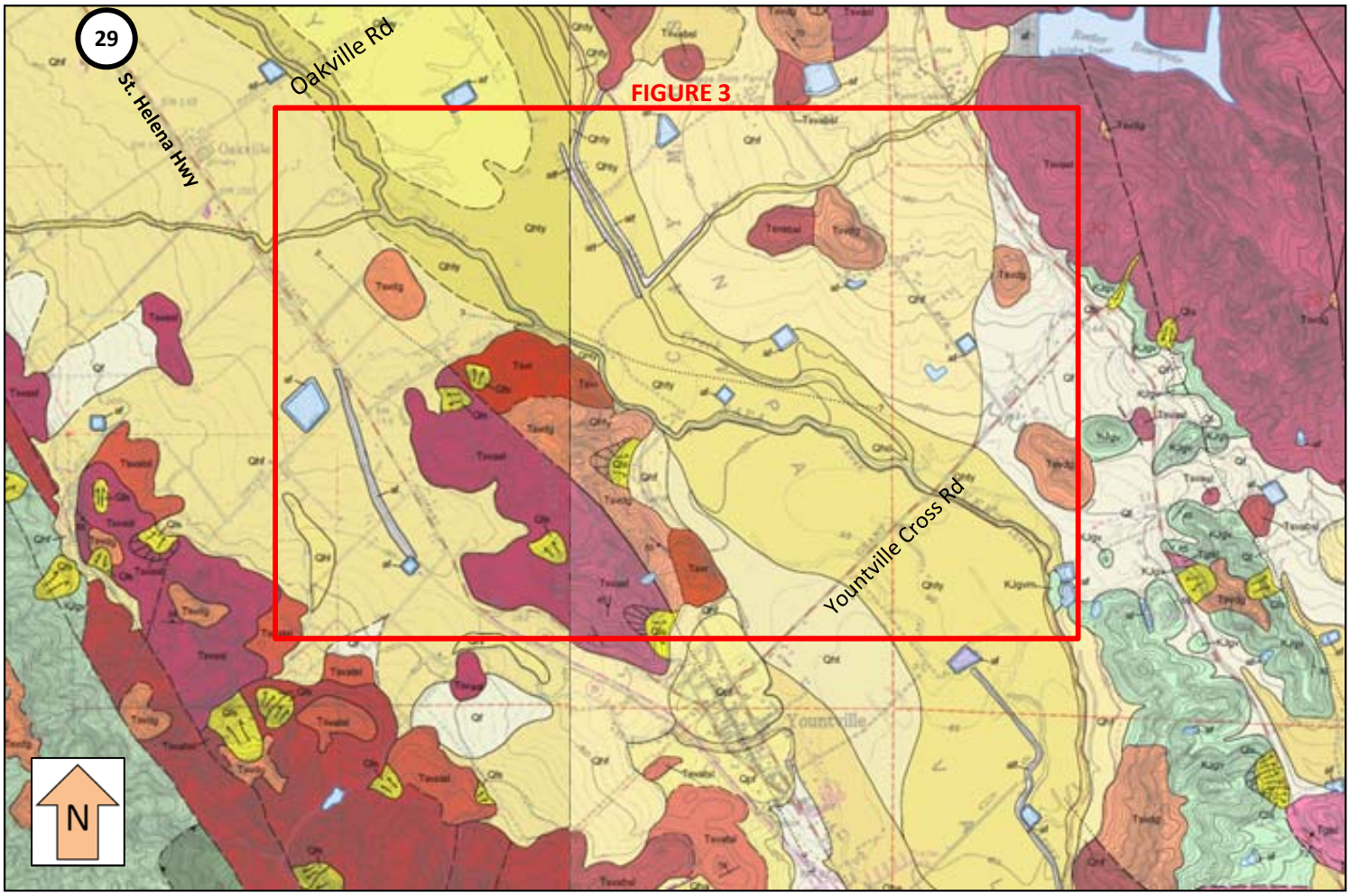
Approximate Project Reach

SOURCE:
http://www.quake.ca.gov/gmaps/FAM/faultactivitymap.html
(Jennings & Bryant,2010)

NAPA RIVER RESTORATION
OVOK REACH

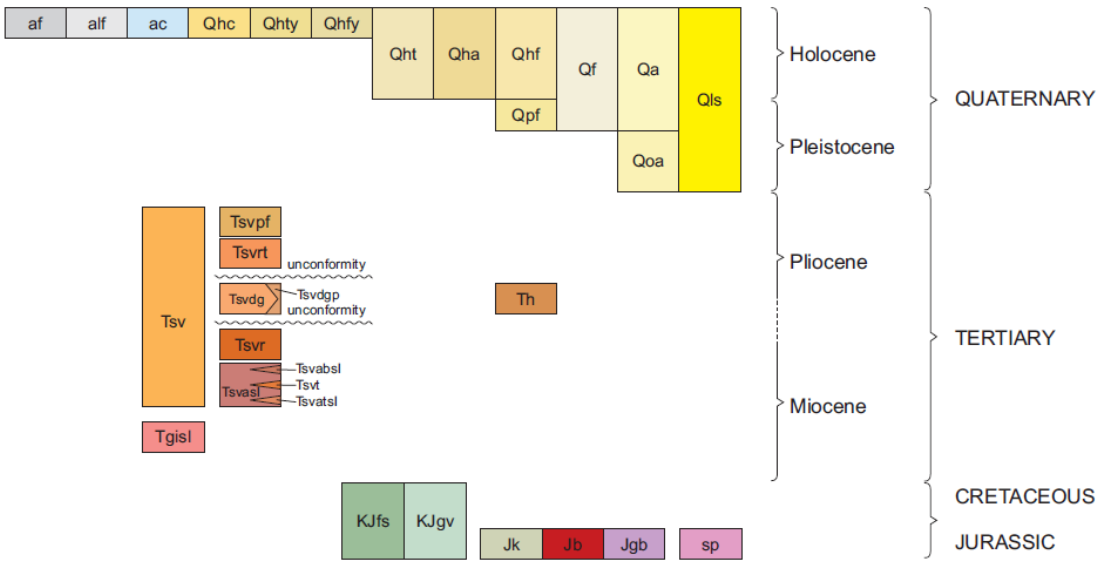
Plate 4
CGS Fault Activity Map

SOURCE: Clahan and others, 2005 (Rutherford 7.5’ Quadrangle); Bezore and others, 2005 (Yountville 7.5’ Quadrangle)



See report text for geologic unit names and descriptions

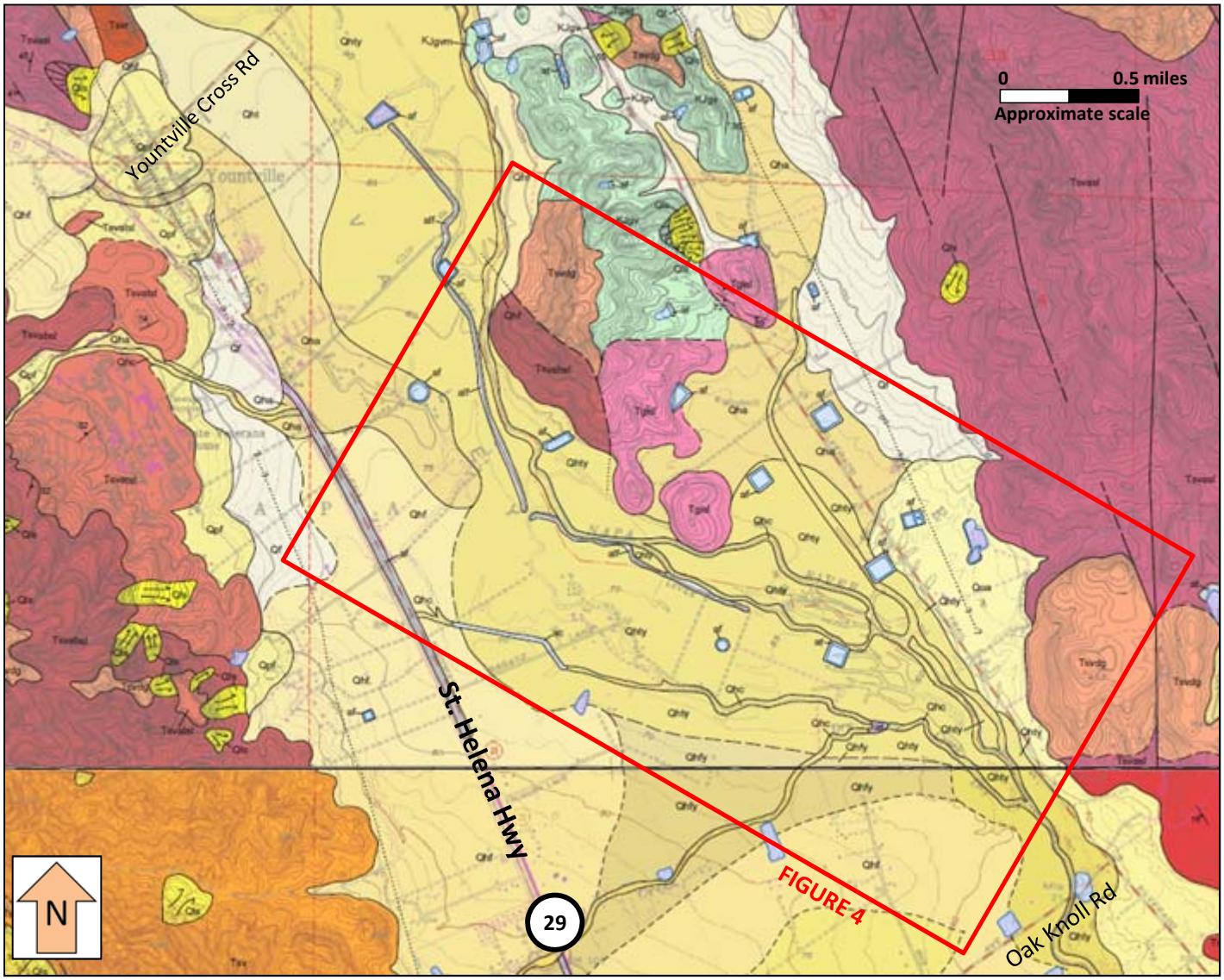
Unit Correlation



NAPA RIVER RESTORATION
OVOK REACH

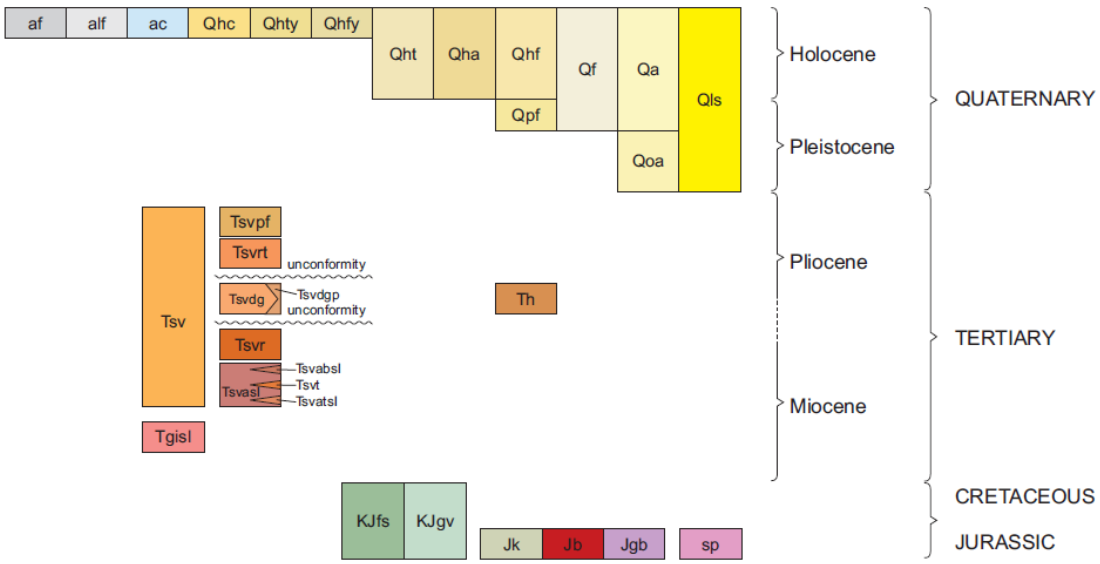
Plate 5
CGS Geologic Map 2005

SOURCE: Bezore and others, 2005 (Yountville 7.5’ Quadrangle); Clahan and others, 2004 (Napa 7.5’ Quadrangle)



See report text for geologic unit names and descriptions

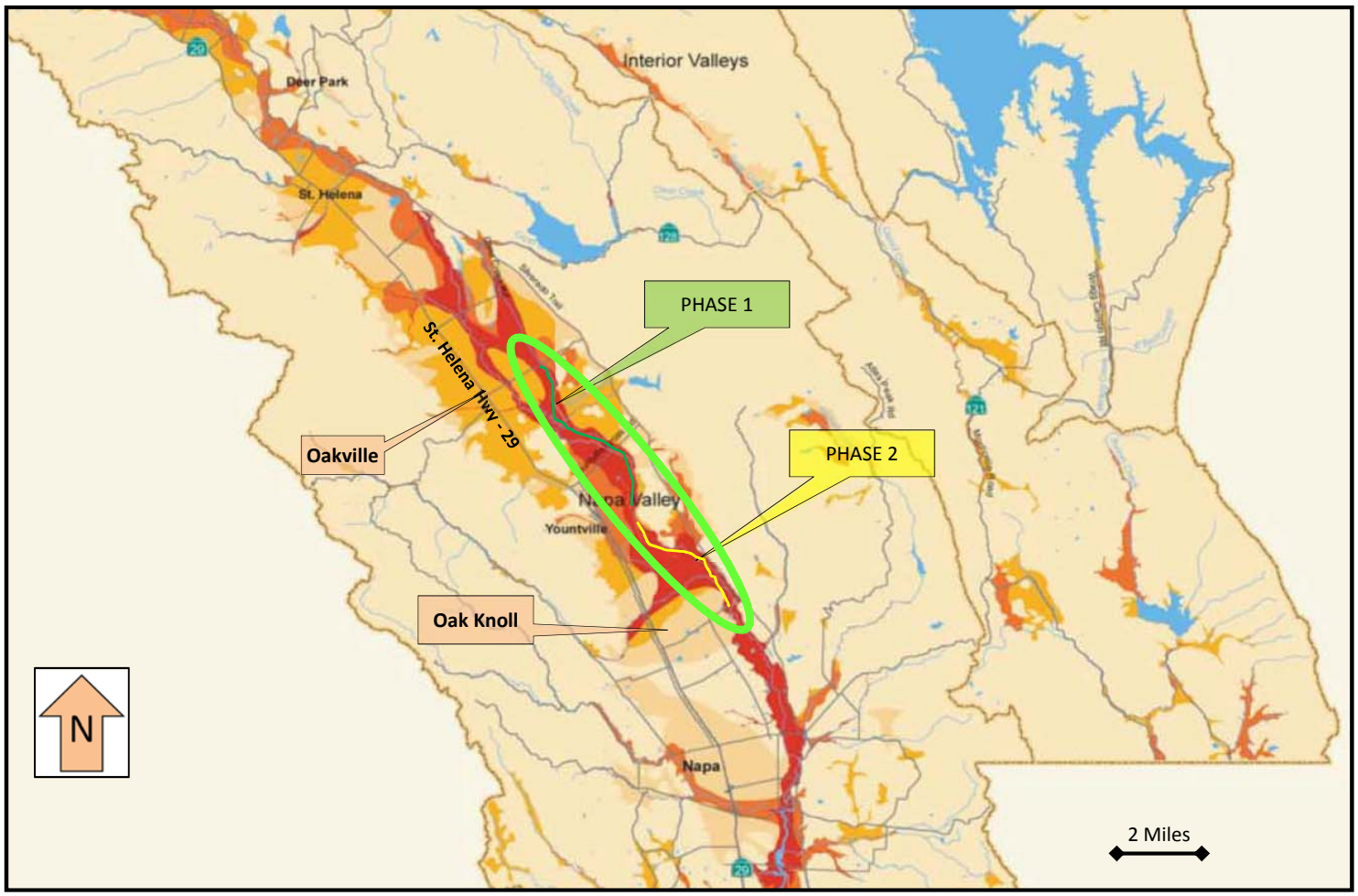
Unit Correlation



NAPA RIVER RESTORATION
OVOK REACH

Plate 6
CGS Geologic Map 2005

SOURCE: California Geological Survey; Napa County; ESRI – Safety Hazard Napa County General Plan - 2009



LEGEND

Liquefaction Susceptibility
- Very Low
- Low
- Moderate
- High
- Very High
- Water
- Evaluation Areas
- Lakes
- Streams
- Major Roads

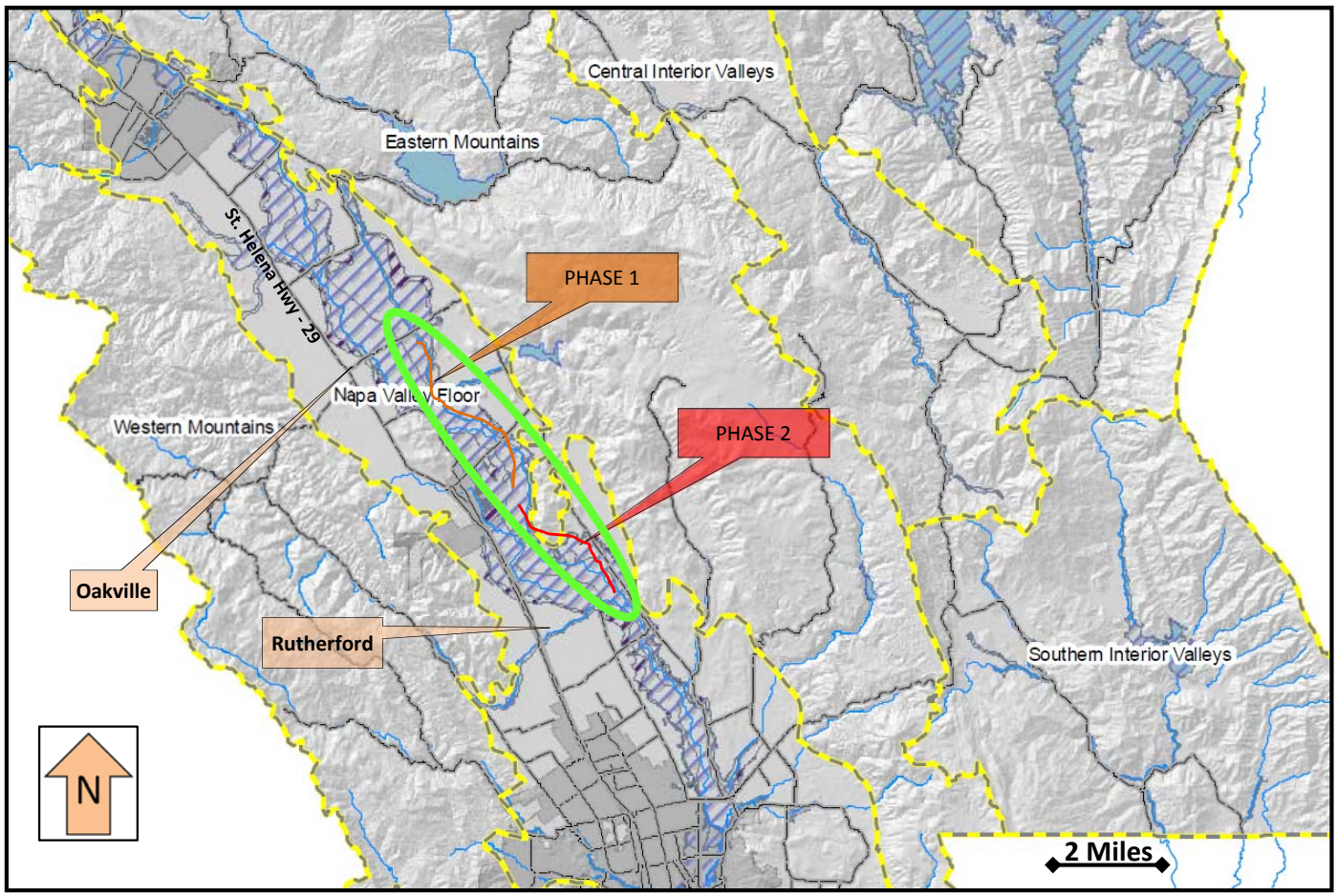
EXPLANATION

Approximate Project Reach

Plate 7
Napa County
Liquefaction Susceptibility Map

NAPA RIVER RESTORATION
OVOK REACH

SOURCE: California Geological Survey; Napa County; ESRI – Safety Hazard Napa County General Plan - 2009



Legend

- Evaluation Areas
- Major Roads
- **Flood Zones**
- Major Streams
- 100 year zone
- City Boundaries
- 500 year zone
- Major Water Bodies

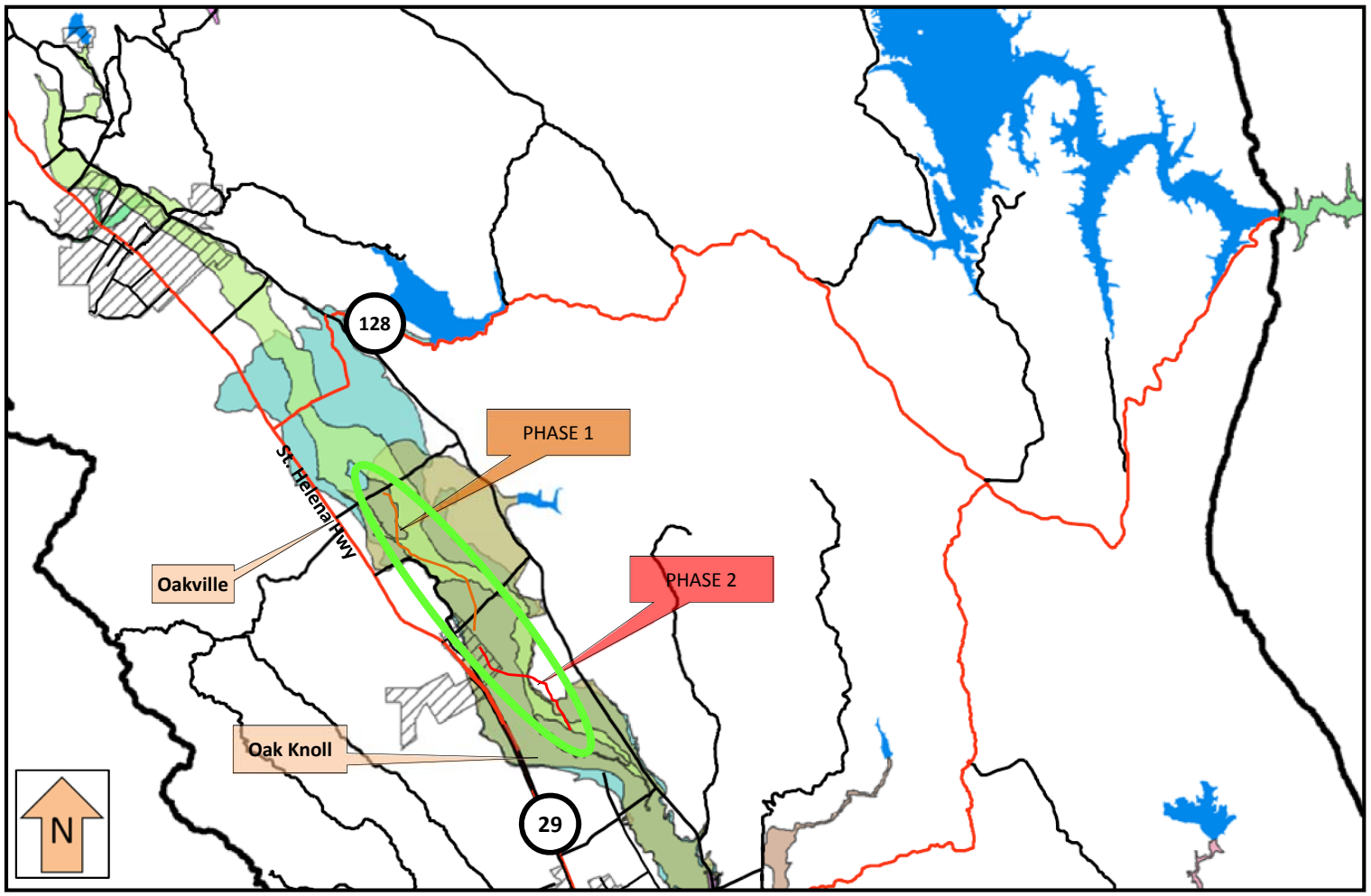
EXPLANATION

Approximate Project Reach

NAPA RIVER RESTORATION
OVOK REACH

Plate 8
Napa County Flood Zones Map

SOURCE: California Geological Survey; Napa County; ESRI – Safety Hazard Napa County General Plan - 2009



Dam / Levee Indundation Areas

- Milliken Dam
- Bell Canyon Dam
- Kimball Dam
- Kimball Dam Overflow Pond
- Lake Camille Dam
- Lake Curry Dam
- Lake Cynthia Dam
- Lake Marie Dam
- Monticello Dam
- Olson Dam
- Rector Creek Dam
- Silverado Lakes
- St Helena Lower Dam
- St Helena Upper Dam
- Summit Reservoir
- Conn Dam
- Water Bodies

City Boundaries

- City Boundaries

2 Miles

EXPLANATION

Approximate Project Reach

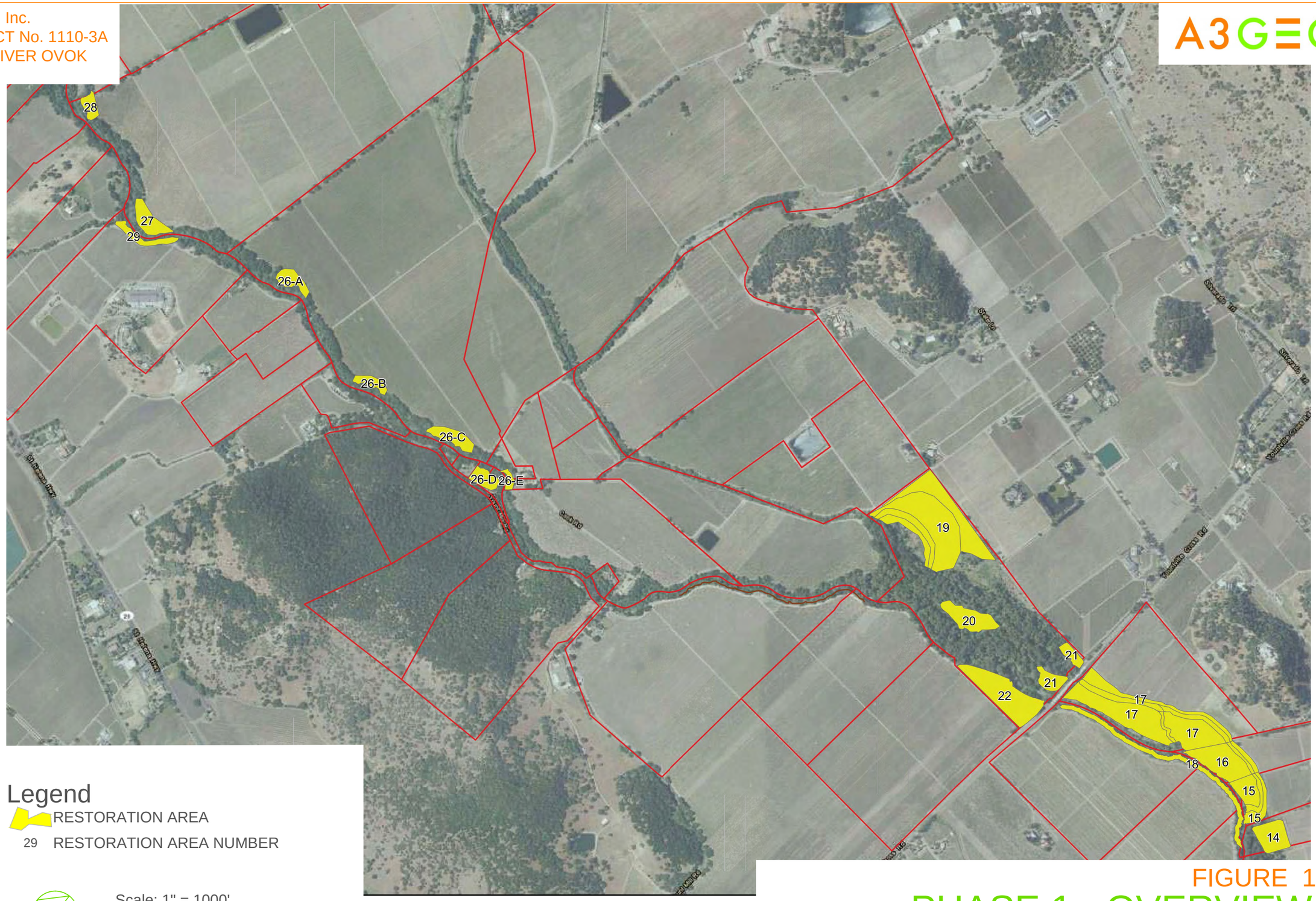
NAPA RIVER RESTORATION
OVOK REACH

Plate 9
Napa County Dam Inundation Map

FIGURES

A3GEO, Inc.
PROJECT No. 1110-3A
NAPA RIVER OVOK

A3GEO



Legend

RESTORATION AREA

29 RESTORATION AREA NUMBER

NORTH

Scale: 1" = 1000'

0' 500' 1000' 2000'

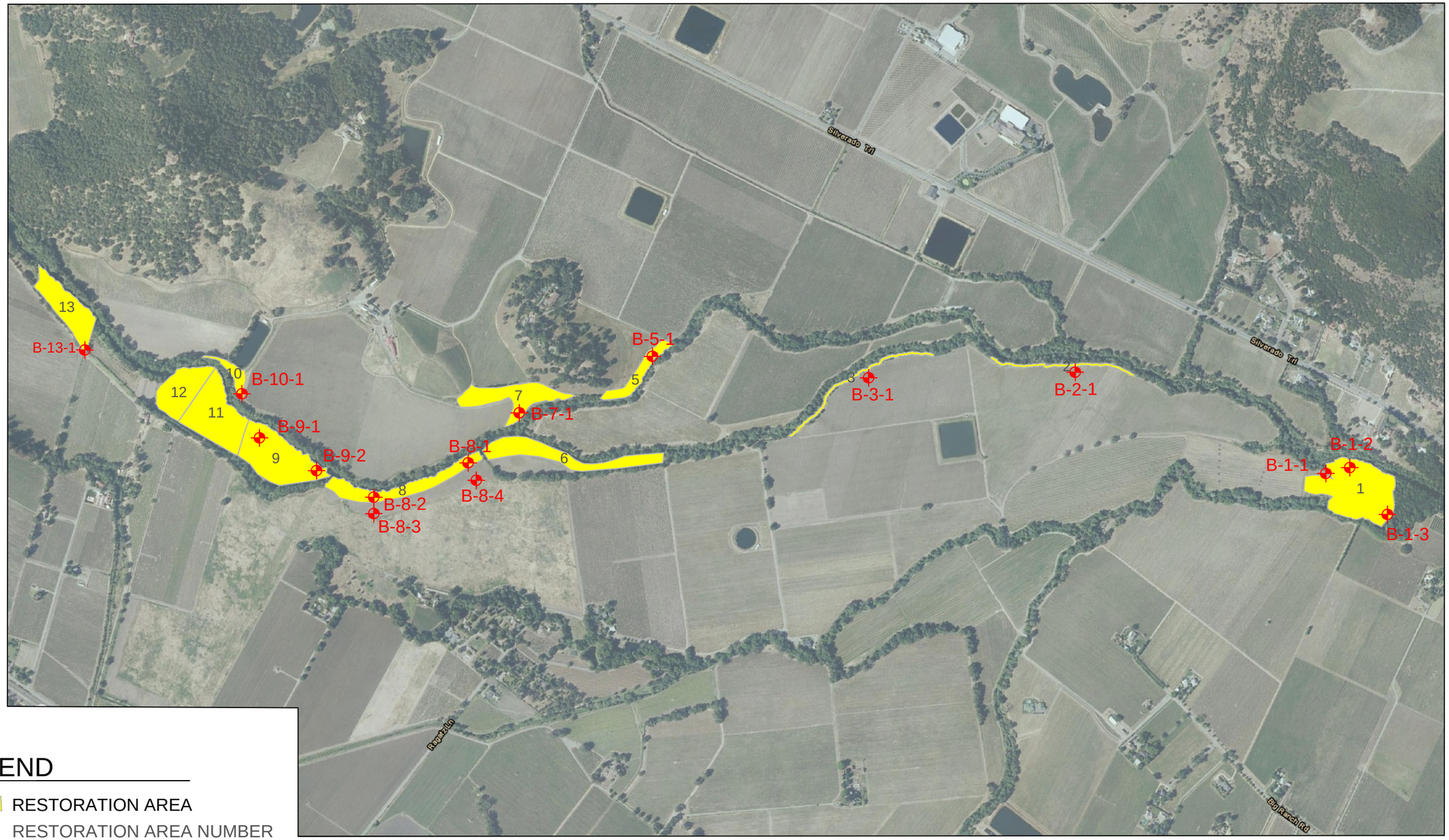
FIGURE 1

PHASE 1 - OVERVIEW

DRAFT

A3GEO, Inc.
PROJECT No.1110-3A
NAPA RIVER RESTORATION
OVOK REACH
NAPA, CALIFORNIA

A3GEO



LEGEND

- RESTORATION AREA
- 29 RESTORATION AREA NUMBER
- BORING LOCATIONS

SCALE
0 1000 2000
FEET

NORTH

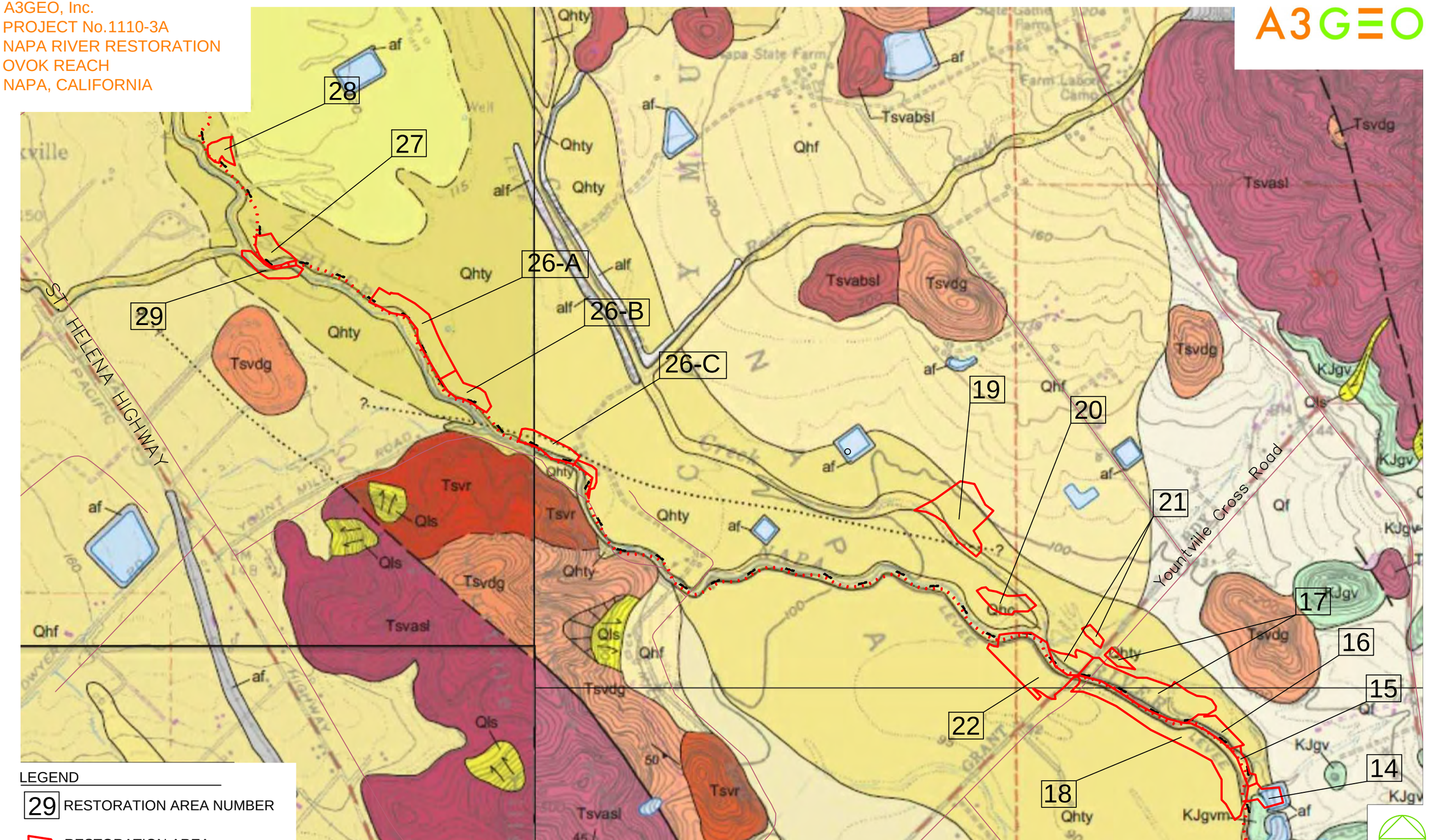
FIGURE 2

PHASE 2 - OVERVIEW

9/25/2013 12:58 PM A:\A3GEO Projects\1110 - ESA-PWA\1110-3A Napa River OVOK\A3GEO Figures\Figure 2 - Phase 2 - Overview.dwg

A3GEO, Inc.
PROJECT No.1110-3A
NAPA RIVER RESTORATION
OVOK REACH
NAPA, CALIFORNIA

A3GEO



LEGEND

29 RESTORATION AREA NUMBER

RESTORATION AREA

SCALE 0 1200 2400 FEET

FIGURE 3

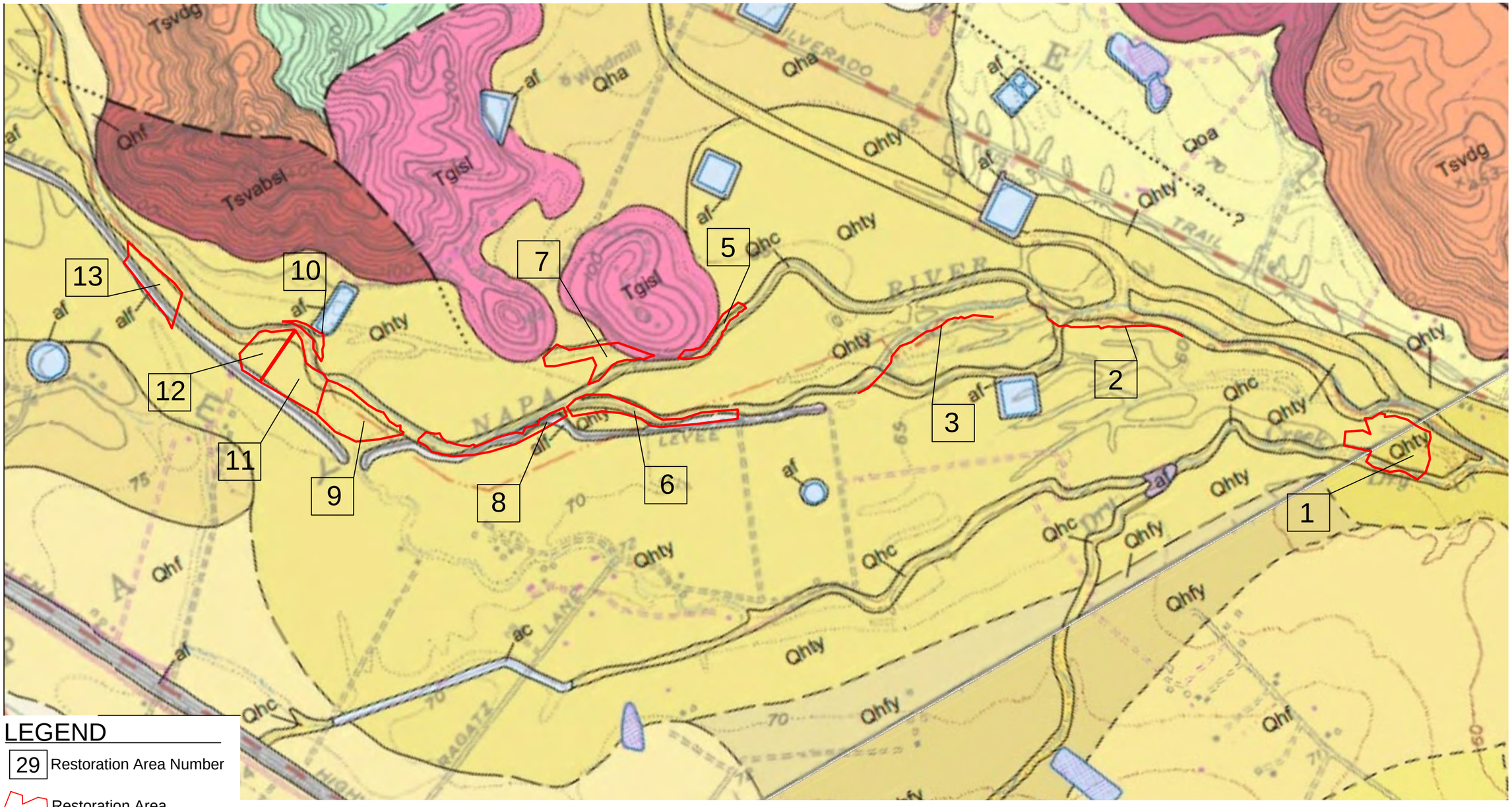
PHASE 1 - GEOLOGIC MAP

DRAFT

5/28/2013 1:20 PM A:\A3GEO Projects\1110 - ESA-PWA\1110-3A Napa River OVOK\A3GEO Figures\Figure 3 - Phase 1 - Geologic.dwg

A3GEO, Inc.
PROJECT No.1110-3A
NAPA RIVER RESTORATION
OVOK REACH
NAPA, CALIFORNIA

A3GEO



LEGEND

29 Restoration Area Number

Restoration Area

SCALE
0 1000 2000 FEET

NORTH

FIGURE 4
PHASE 2 - GEOLOGIC MAP
DRAFT

5/24/2013 11:37 AM A:\A3GEO Projects\1110 - ESA-PWA\1110-3A Napa River OVOK\A3GEO Figures\Figure 4 - Phase 2 - Geologic.dwg

A3GEO, Inc.
PROJECT No.1110-3A
NAPA RIVER RESTORATION
OVOK REACH
NAPA, CALIFORNIA

A3GEO

25+00
420+00
415+00
410+00
405+00
400+00
395+
28
27
29
B-28-1
B-27-1
B-29-1
B-29-2
B-29-3
BULK SAMPLE 29-2
BULK SAMPLE 29-2
N65W 10
N65W 10
A
A'
A
A'

LEGEND:
- BULK SAMPLE
- BORING LOCATION
- MAPPED AREA (HARDPAN DEPOSITS)
- 28 RESTORATION AREA NUMBER
- N65W 10 STRIKE & DIP OF DEPOSITS

SCALE
0 200 400
FEET

NORTH

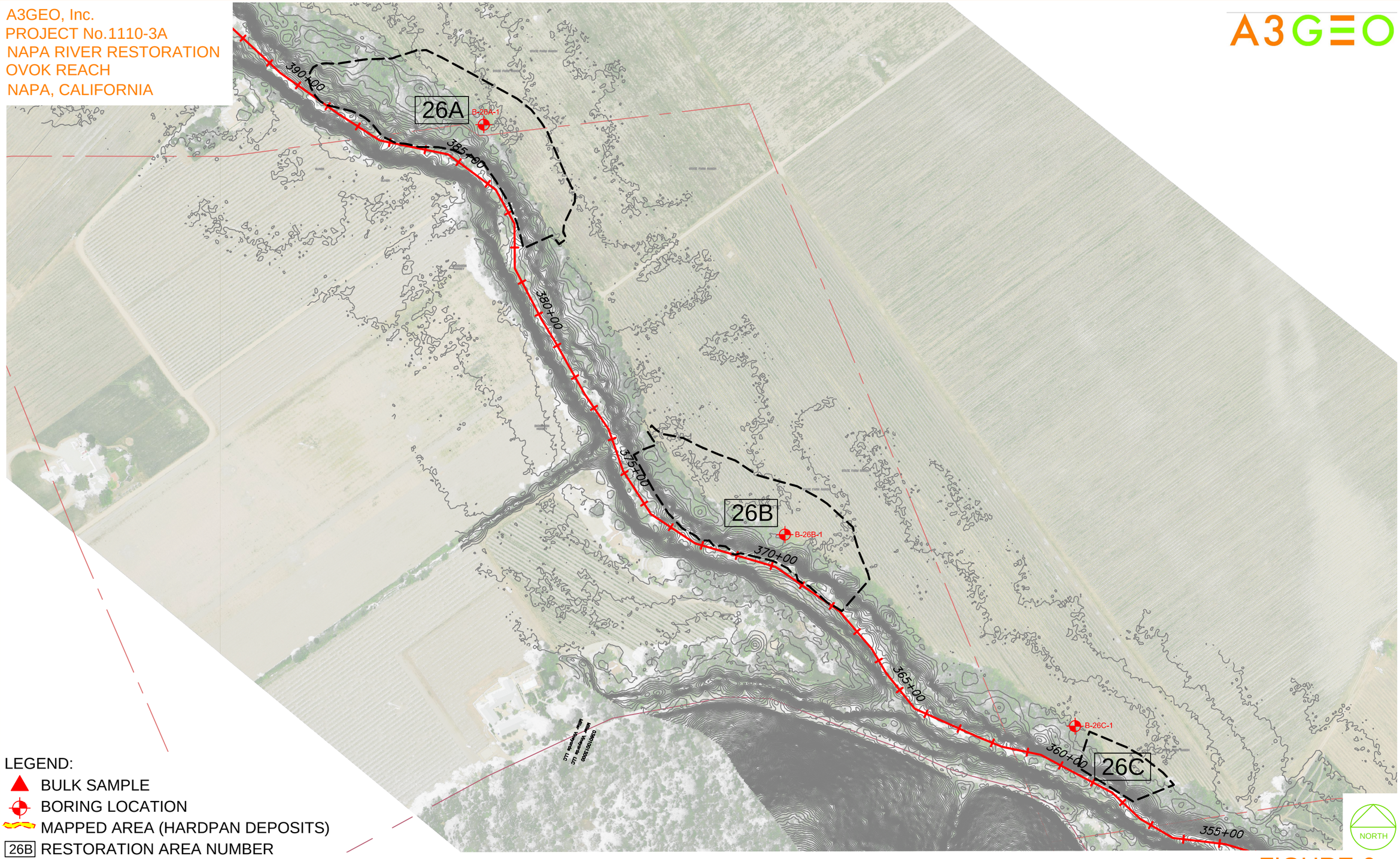
FIGURE 5
SITE PLAN - AREAS 27 - 29

DRAFT

5/30/2013 11:20 AM A:\A3GEO Projects\1110 - ESA-PWA\1110-3A Napa River OVOK\A3GEO Figures\Phase 1 - Site Plans_1110-3A Sites 14-22 26-29 final.dwg

A3GEO, Inc.
PROJECT No.1110-3A
NAPA RIVER RESTORATION
OVOK REACH
NAPA, CALIFORNIA

A3GEO



LEGEND:
- BULK SAMPLE
- BORING LOCATION
- MAPPED AREA (HARDPAN DEPOSITS)
- 26B RESTORATION AREA NUMBER

SCALE
0 250 500
FEET

FIGURE 6

SITE PLAN - AREAS 26A - 26C

9/25/2013 3:20 PM A:\A3GEO Projects\1110 - ESA-PWA\1110-3A Napa River OVOK\A3GEO Figures\Phase 1 - Site Plans_1110-3A Sites 14-22 26-29 final.dwg

A3GEO, Inc.
PROJECT No.1110-3A
NAPA RIVER RESTORATION
OVOK REACH
NAPA, CALIFORNIA

A3GEO

290+00
285+00
280+00
275+00
270+00
B
B'
BULK SAMPLE 22-2
BULK SAMPLE 22-3
BULK SAMPLE 22-4
N34W 25SW
N65W 10
B-22-2
B-22-3
B-22-4
B-22-1
22
YOUNTVILLE CROSSROAD
Treasury Wine Estates Americas Company
Treasury Wine Estates Americas Company
03601002600
NORTH

LEGEND:
- BULK SAMPLE
- BORING LOCATION
- MAPPED AREA (HARDPAN DEPOSITS)
- 28 RESTORATION AREA NUMBER
- N65W 10 STRIKE & DIP OF DEPOSITS

SCALE
0 100 200
FEET

FIGURE 7
SITE PLAN - AREA 22

DRAFT

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A3GEO, Inc.
PROJECT No. 1110-3A
NAPA RIVER RESTORATION
OVOK REACH
NAPA, CALIFORNIA

A3GEO

B-19-1

19

BULK SAMPLE 19-1

B-19-2

BULK SAMPLE 19-2

LEGEND:
- BULK SAMPLE
- BORING LOCATION
- MAPPED AREA (HARDPAN DEPOSITS)
- [28] RESTORATION AREA NUMBER
- N65W 10 STRIKE & DIP OF DEPOSITS

SCALE
0 100 200
FEET

NORTH

FIGURE 8
SITE PLAN - AREA 19

DRAFT

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A3GEO, Inc.
PROJECT No.1110-3A
NAPA RIVER RESTORATION
OVOK REACH
NAPA, CALIFORNIA

A3GEO

17
16
18
15
14

B-17-1
B-17-2
B-17-3
B-17-4
B-17-5
B-17-6
B-17-7
B-18-1
B-18-2
B-18-3
B-18-4
B-18-5
B-18-6
B-18-7
B-18-8
B-14-1
B-14-2

BULK SAMPLE 19-1
BULK SAMPLE 14-1

265+00
260+00
250+00
245+00
240+00

269+00
268+00
267+00
266+00

Miramar Family Limited Partnership
031220017000

LEGEND:
- BULK SAMPLE
- BORING LOCATION
- MAPPED AREA (HARDPAN DEPOSITS)
- 28 RESTORATION AREA NUMBER
- N65W 10 STRIKE & DIP OF DEPOSITS

SCALE
0 200 400
FEET

NORTH

FIGURE 9

SITE PLAN - AREAS 14 - 18

DRAFT

5/29/2013 12:58 PM A:\A3GEO Projects\1110 - ESA-PWA\1110-3A Napa River OVOK\A3GEO Figures\Phase 1 - Site Plans_1110-3A Sites 14-22 26-29 final.dwg

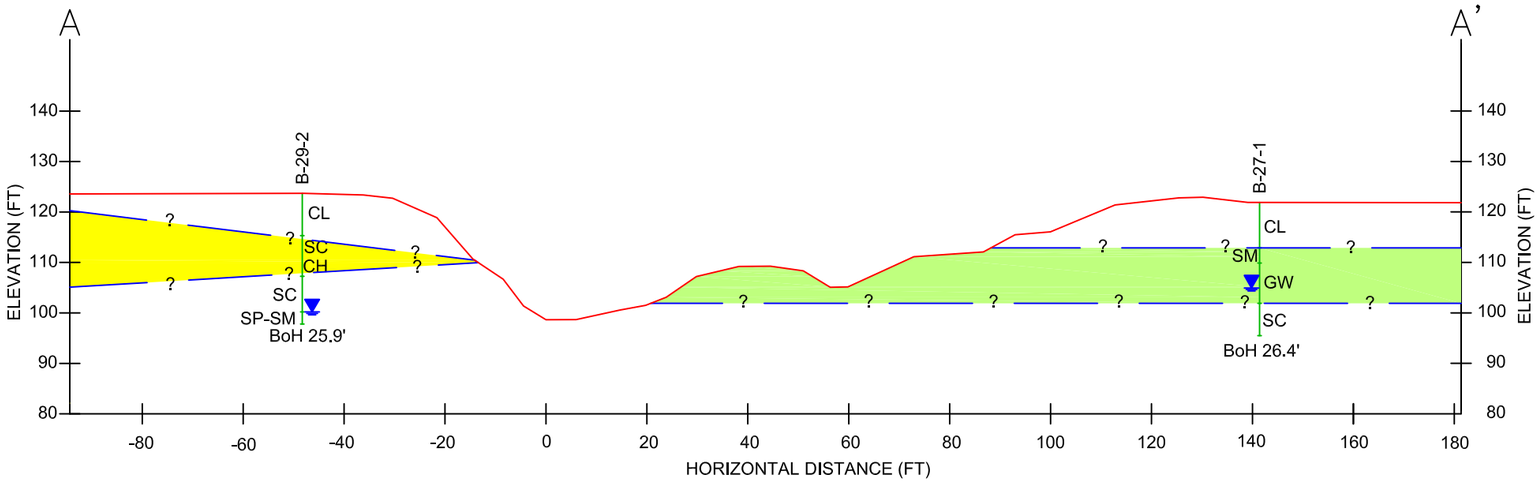
A3GEO, Inc.
PROJECT No. 1110-3A
NAPA RIVER RESTORATION
OVOK REACH
NAPA, CALIFORNIA

A3GEO

LEGEND

- Fine - Grained Pleistocene-Age Alluvial Deposits (Hardpan Deposits)
- Potentially Liquefiable Layer
- Depth of Measured Groundwater During Drilling

Station 404+43.1



Scale: 1" = 30'

0' 15' 30' 60'

FIGURE 10

SITE 27/29 - CROSS SECTION A-A'

A3GEO, Inc.
PROJECT No. 1110-3A
NAPA RIVER RESTORATION
OVOK REACH - NAPA, CALIFORNIA

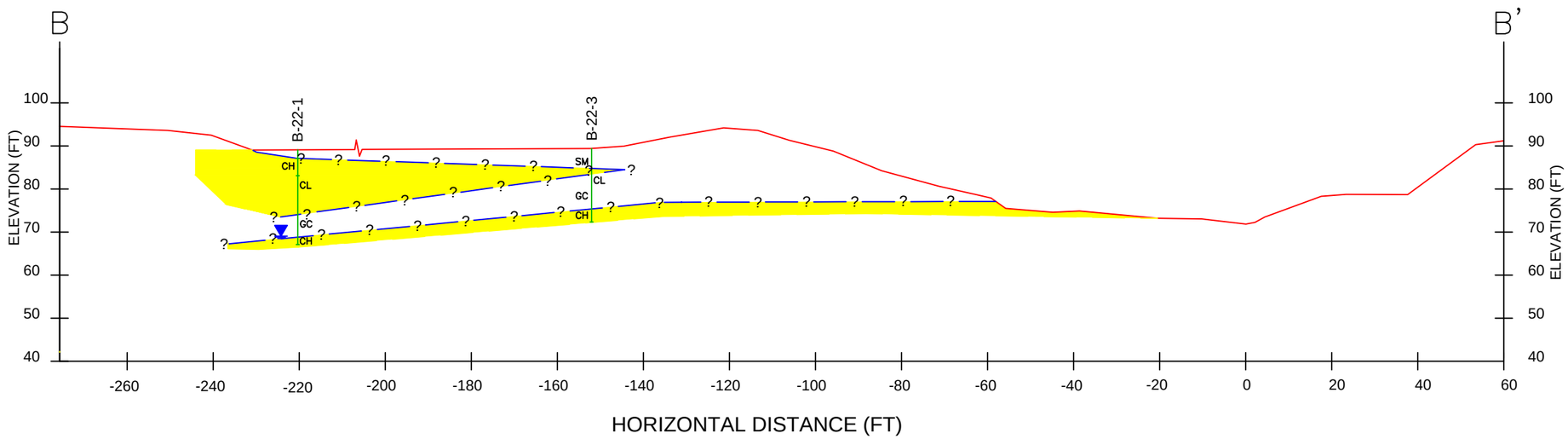
A3GEO

LEGEND

Fine - Grained Pleistocene-Age Alluvial Deposits (Hardpan Deposits)

Depth of Measured Groundwater During Drilling

Station 277+50



Scale: 1" = 30'

0' 30' 60'

FIGURE 11
SITE 22 - CROSS SECTION B-B'

DRAFT

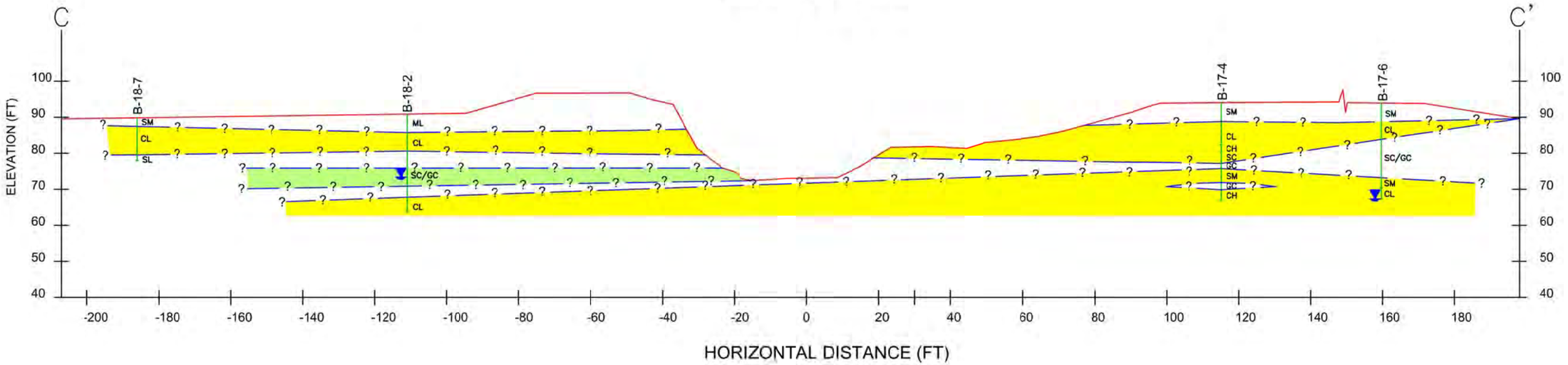
A3GEO, Inc.
PROJECT No. 1110-3A
NAPA RIVER RESTORATION
OVOK REACH - NAPA, CALIFORNIA

A3GEO

LEGEND

- Fine - Grained Pleistocene-Age Alluvial Deposits (Hardpan Deposits)
- Potentially Liquefiable Layer
- Depth of Measured Groundwater During Drilling

Station 259+97.0



Scale: 1" = 30'

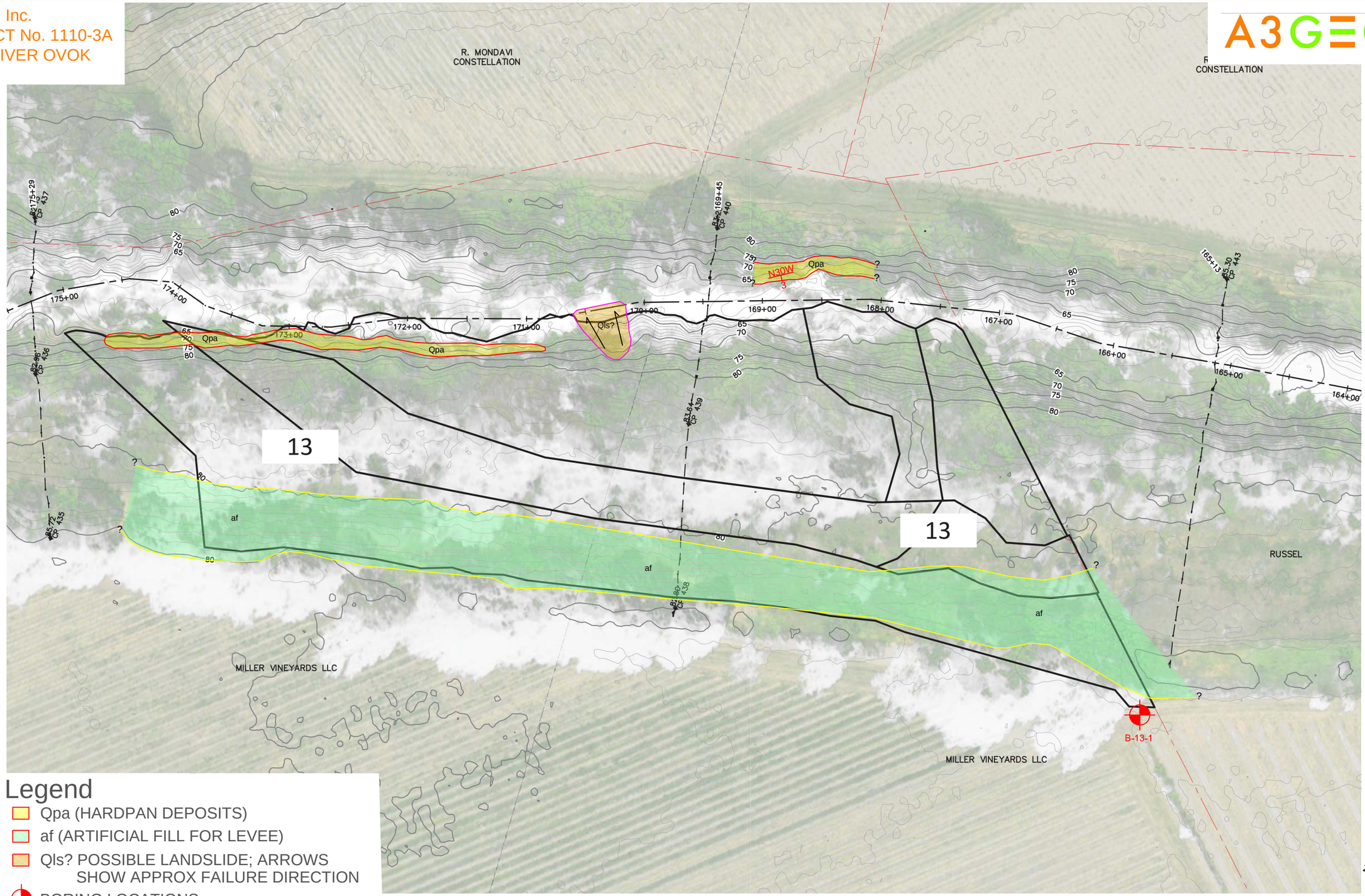
0' 30' 60'

FIGURE 12
SITE 17/18 - CROSS SECTION C-C'

DRAFT

A3GEO, Inc.
PROJECT No. 1110-3A
NAPA RIVER OVOK

A3GEO



Legend

- Qpa (HARDPAN DEPOSITS)
- af (ARTIFICIAL FILL FOR LEVEE)
- Qls? POSSIBLE LANDSLIDE; ARROWS SHOW APPROX FAILURE DIRECTION
- BORING LOCATIONS
- N30W / 3 — APPROX STRIKE & DIP OF DEPOSITS

NORTH

Scale: 1" = 80'

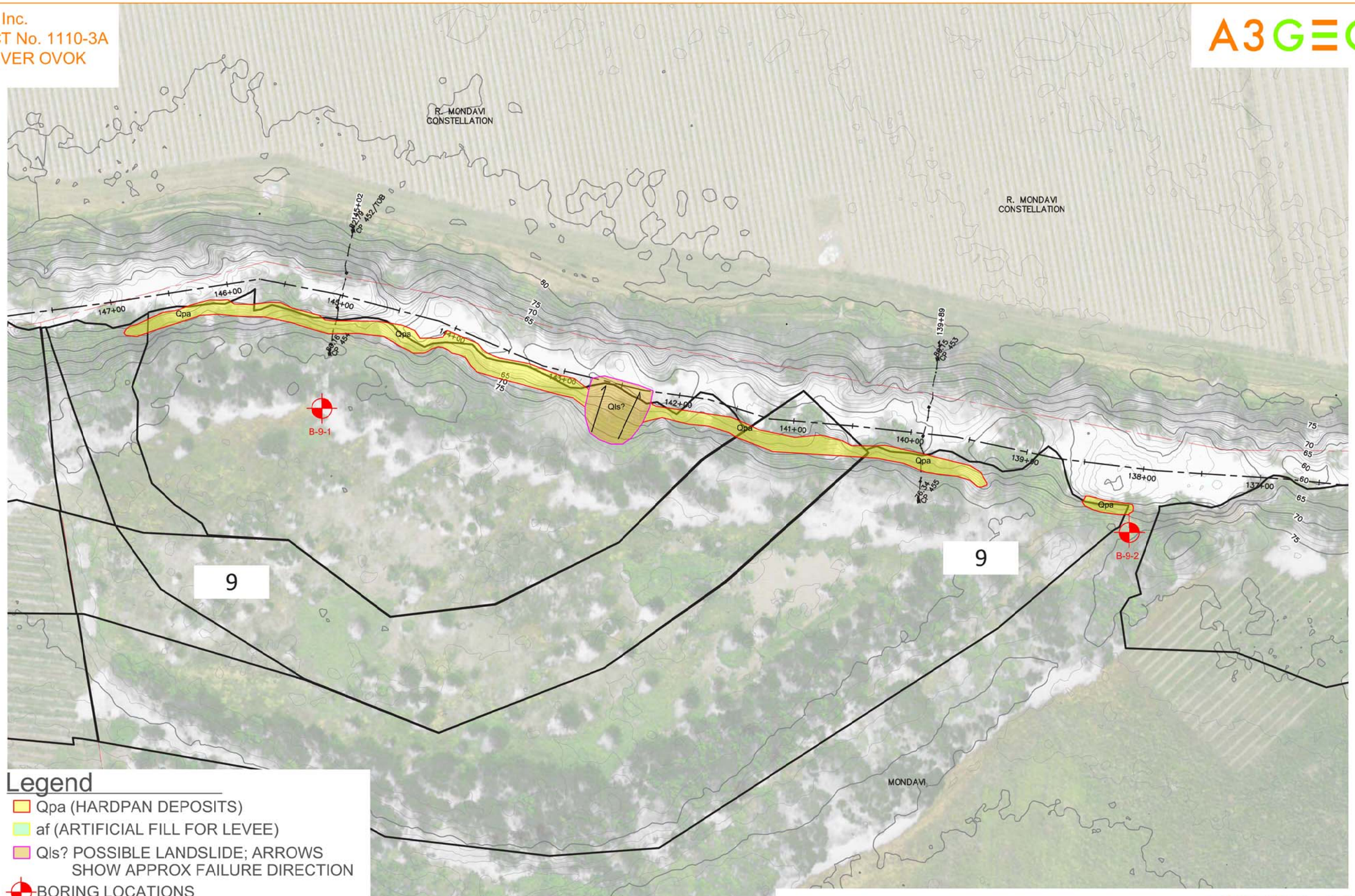
0' 40' 80' 160'

FIGURE 13

SITE MAP - AREA 13

A3GEO, Inc.
PROJECT No. 1110-3A
NAPA RIVER OVOK

A3GEO



Legend

- Qpa (HARDPAN DEPOSITS)
- af (ARTIFICIAL FILL FOR LEVEE)
- Qls? POSSIBLE LANDSLIDE; ARROWS SHOW APPROX FAILURE DIRECTION
- BORING LOCATIONS

NORTH

Scale: 1" = 80'

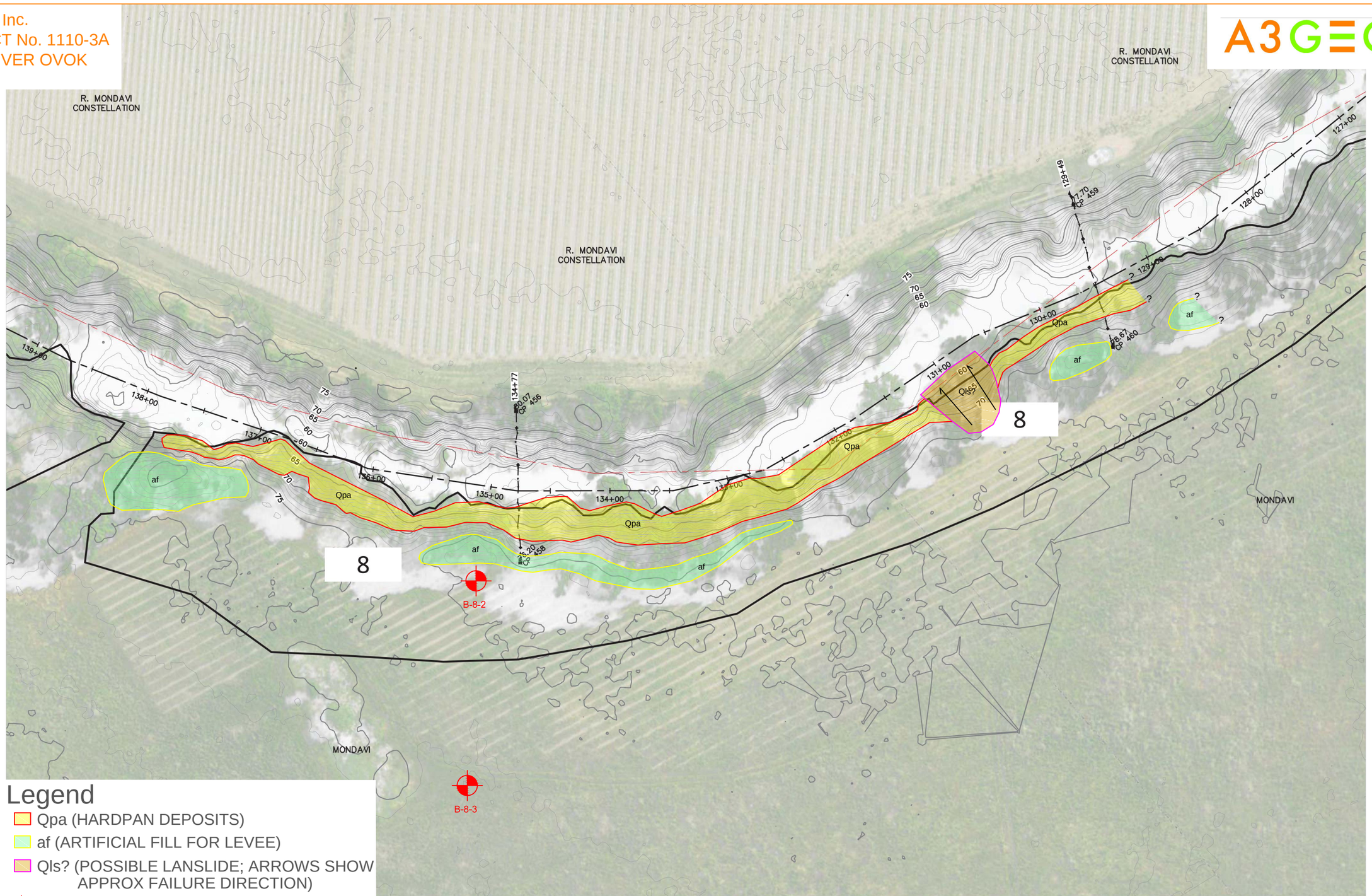
0' 40' 80' 160'

FIGURE 14

SITE MAP - AREA 9

A3GEO, Inc.
PROJECT No. 1110-3A
NAPA RIVER OVOK

A3GEO



Legend

- Qpa (HARDPAN DEPOSITS)
- af (ARTIFICIAL FILL FOR LEVEE)
- Qls? (POSSIBLE LANSLIDE; ARROWS SHOW APPROX FAILURE DIRECTION)
- BORING LOCATIONS

NORTH

Scale: 1" = 80'

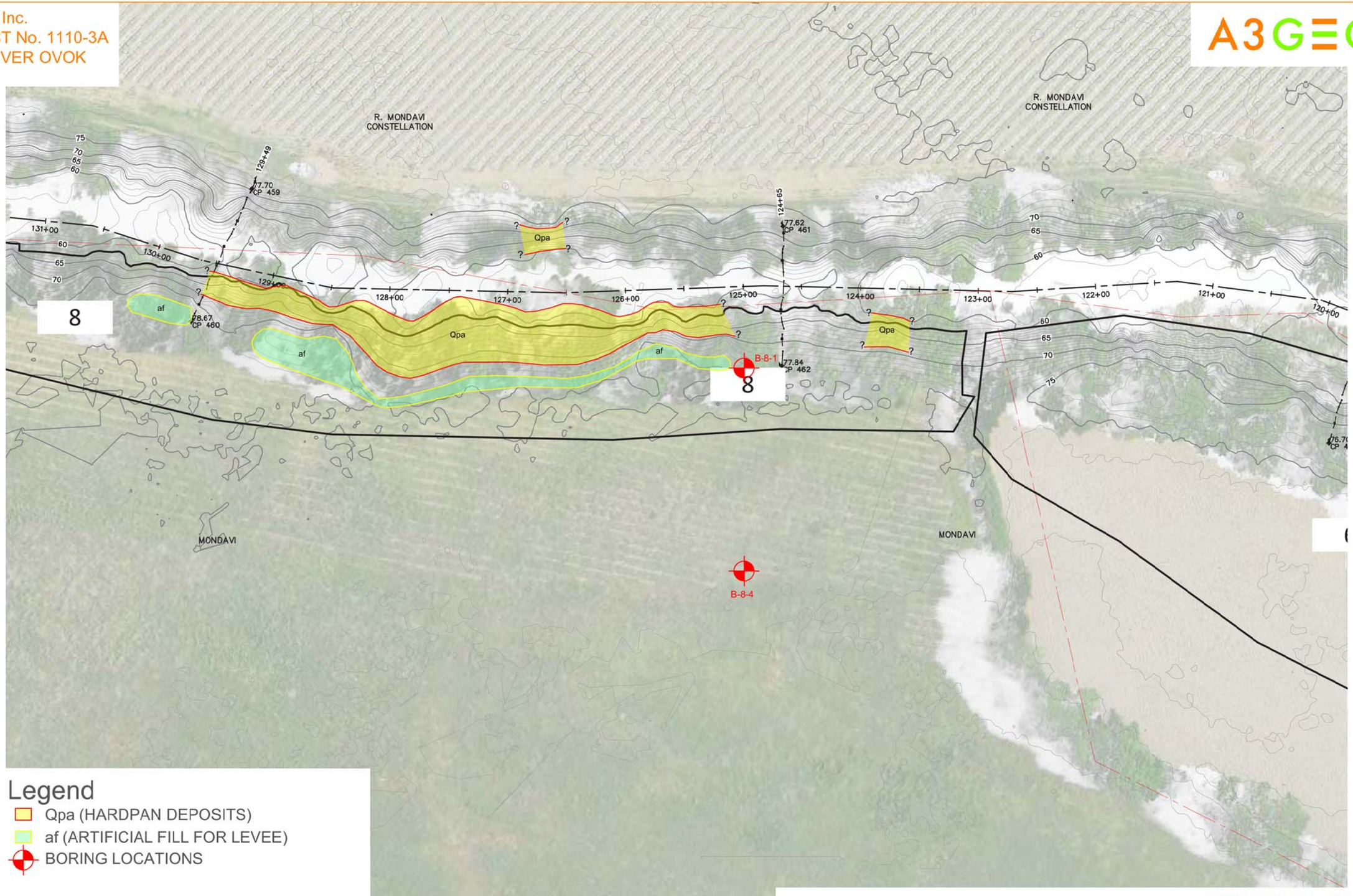
0' 40' 80' 160'

FIGURE 15

SITE PLAN - AREA 8.1

A3GEO, Inc.
PROJECT No. 1110-3A
NAPA RIVER OVOK

A3GEO



Legend

- Qpa (HARDPAN DEPOSITS)
- af (ARTIFICIAL FILL FOR LEVEE)
- BORING LOCATIONS

NORTH

Scale: 1" = 80'

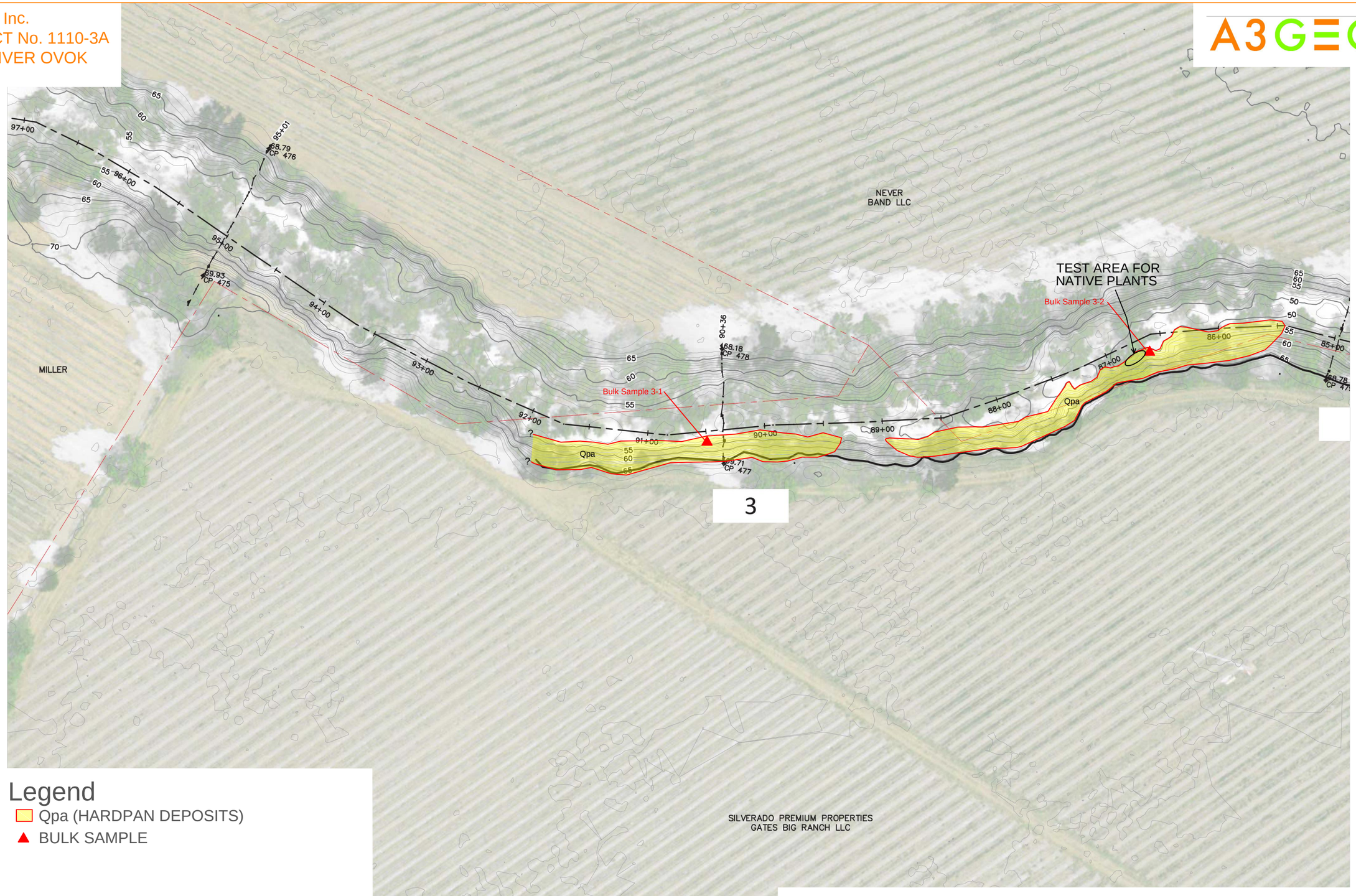
0' 40' 80' 160'

FIGURE 16

SITE PLAN - AREA 8.2

A3GEO, Inc.
PROJECT No. 1110-3A
NAPA RIVER OVOK

A3GEO



Legend

- Qpa (HARDPAN DEPOSITS)
- BULK SAMPLE

NORTH

Scale: 1" = 80'

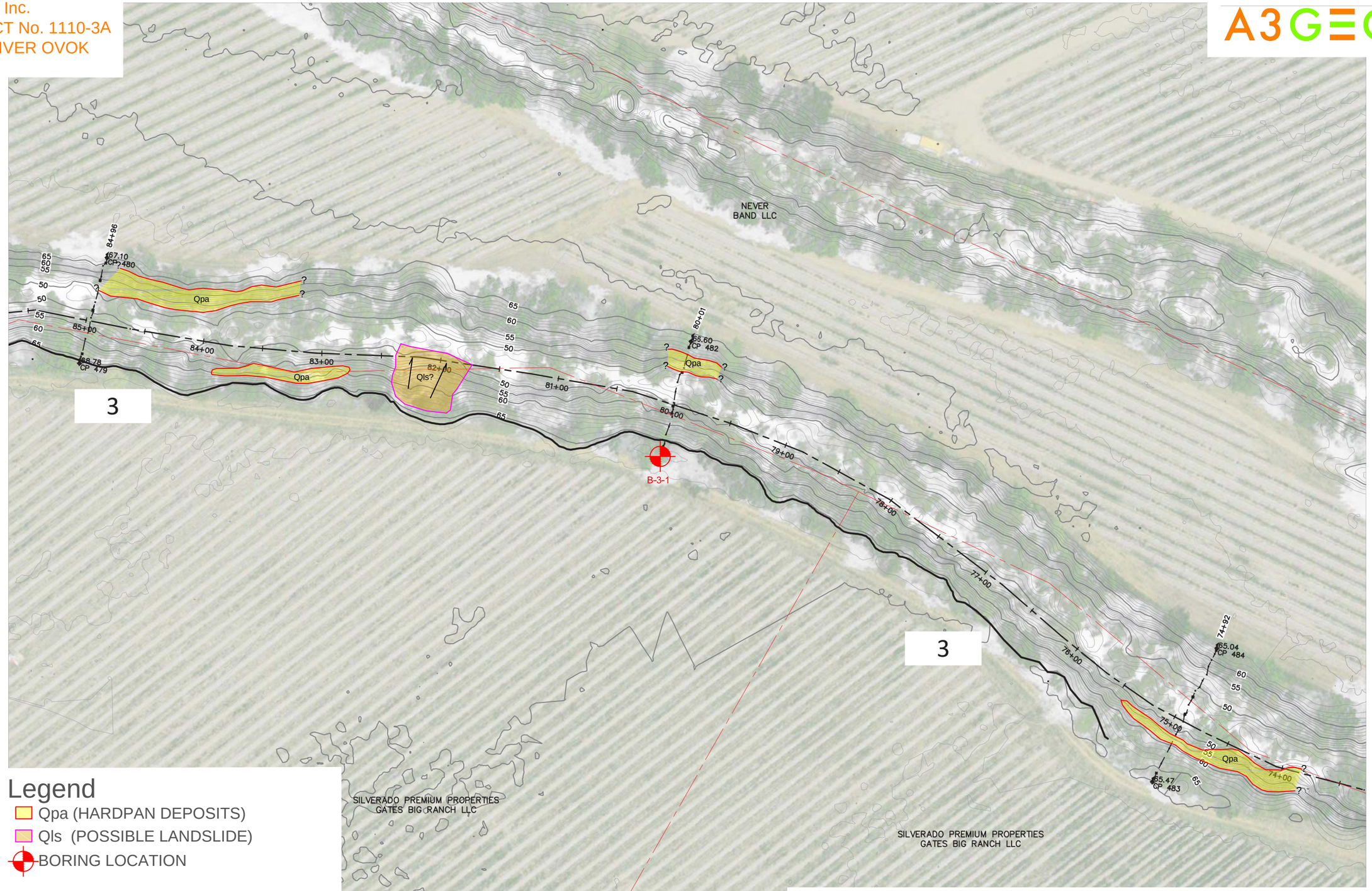
0' 40' 80' 160'

FIGURE 17

SITE MAP - AREA 3.1

A3GEO, Inc.
PROJECT No. 1110-3A
NAPA RIVER OVOK

A3GEO



Legend

- Qpa (HARDPAN DEPOSITS)
- Qls (POSSIBLE LANDSLIDE)
- BORING LOCATION

NORTH

Scale: 1" = 80'

0' 40' 80' 160'

FIGURE 18

SITE MAP - AREA 3.2

A3GEO, Inc.
PROJECT No. 1110-3A
NAPA RIVER OVOK

A3GEO

NEVER
BAND LLC

INTERBEDDED
GRAVELS

SILVERADO PREMIUM PROPERTIES
GATES BIG RANCH LLC

Qpa
Qls?
Bulk Sample 2-1
A135E
A120E
71+00
70+00
69+00
68+00
67+00
66+00
65+00
64+00
63+00
62+00
73+00
72+00

Legend

- Qpa (HARDPAN DEPOSITS)
- Qls (POSSIBLE LANDSLIDE)
- BULK SAMPLE
- APPROX STRIKE & DIP OF DEPOSITS

NORTH

Scale: 1" = 80'

0' 40' 80' 160'

FIGURE 19

SITE PLAN - AREA 2.1

A3GEO, Inc.
PROJECT No. 1110-3A
NAPA RIVER OVOK

A3GEO

NEVER
BAND LLC

INTERBEDDED WITH
TUFFACEOUS SANDS
WITH GRAVELS

Qpa

Qls?

N25E
18

B-2-1

INTERBEDDED
CEMENTED GRAVELS

TEST AREA FOR
NATIVE PLANTS

Bulk Sample 2-2

61+00
62+00
63+00
60+00
59+00
58+00
57+00
56+00
55+00
54+00
53+00
52+00

2

2

SILVERADO PREMIUM PROPERTIES
GATES BIG RANCH LLC

Legend

- Qpa (HARDPAN DEPOSITS)
- Qls (POSSIBLE LANDSLIDE)
- BULK SAMPLE
- APPROX STRIKE& DIP OF DEPOSITS
- BORING LOCATION

Scale: 1" = 80'

0' 40' 80' 160'

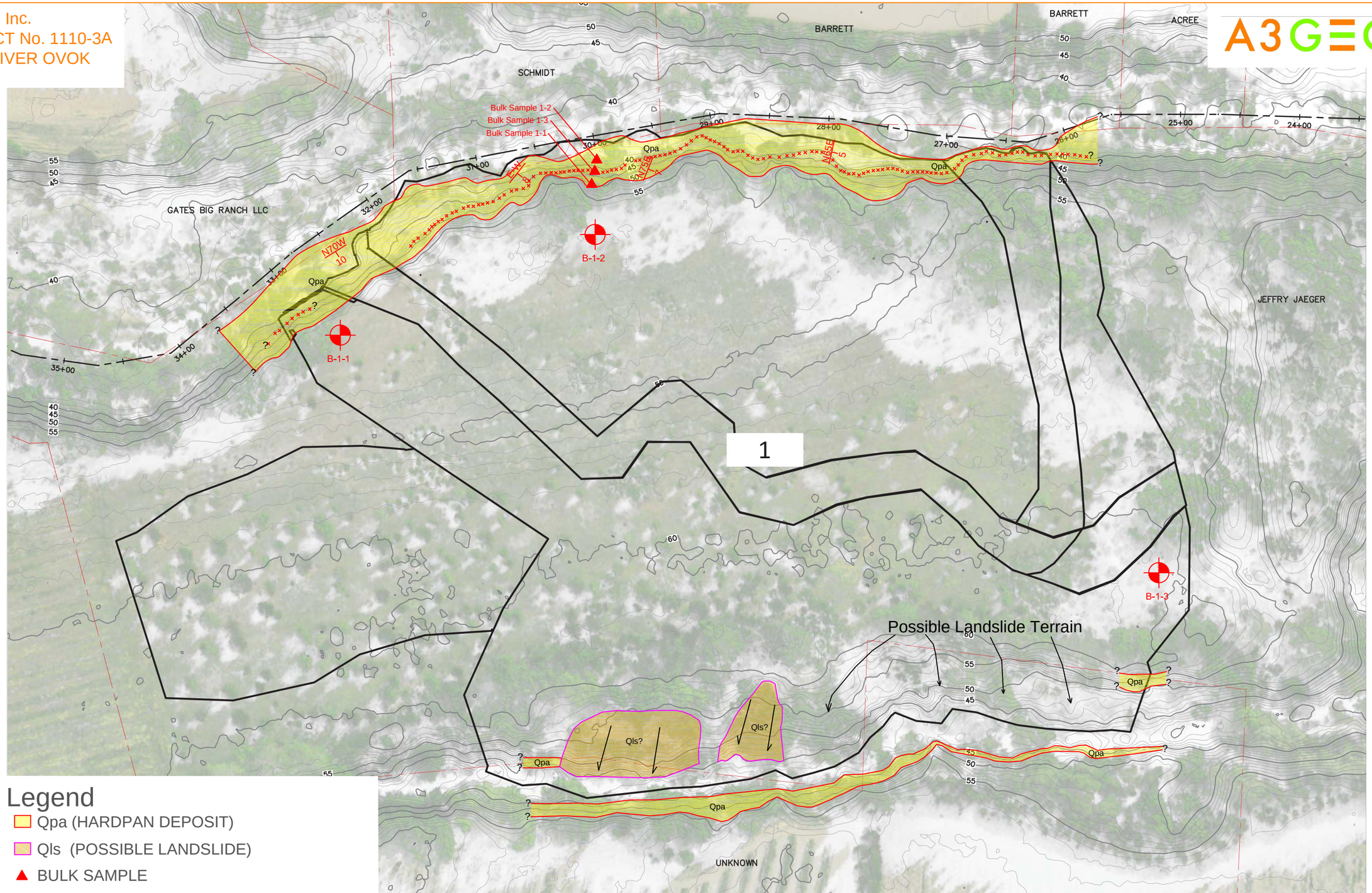
NORTH

FIGURE 20

SITE PLAN - AREA 2.2

A3GEO, Inc.
PROJECT No. 1110-3A
NAPA RIVER OVOK

A3GEO



Legend

- Qpa (HARDPAN DEPOSIT)
- Qls (POSSIBLE LANDSLIDE)
- BULK SAMPLE
- PALEOSOL OUTCROP
- APPROXIMATE STRIKE & DIP OF DEPOSITS
- BORING LOCATION

Scale: 1" = 80'

0' 40' 80' 160'

NORTH

FIGURE 21

SITE PLAN - AREA 1

Appendix A

Boring Logs

A3GEO

UNIFIED SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYM	TYPICAL NAMES
COARSE GRAINED SOILS: more than 50% retained on No. 200 sieve	**GRAVELS:** 50% or more of coarse fraction retained on No. 4 sieve	CLEAN GRAVELS	GW	Well graded gravels and gravel-sand mixtures, little or no fines
			GP	Poorly graded gravels and gravel-sand mixtures, little or no fines
		GRAVELS WITH FINES	GM	Silty gravels and gravel-sand-silt mixtures
			GC	Clayey gravels and gravel-sand-clay mixtures
	SANDS: more than 50% of coarse fraction passes through No. 4 sieve	CLEAN SANDS	SW	Well graded sands and gravelly sand, little or no fines
			SP	Poorly graded sands and gravelly sand, little or no fines
		SANDS WITH FINES	SM	Silty sands, sand-silt mixtures
			SC	Clayey sands, sand-silt mixtures
FINE-GRAINED SOILS: 50% or more passes No. 200 sieve	**SILTS AND CLAYS:** Liquid Limit 50% or less		ML	Inorganic silts, very fine sands, rock flour, silty or clayey fine sands
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
			OL	Organic silts and organic silty clays of low plasticity
	SILTS AND CLAYS: Liquid Limit greater than 50%		MH	Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic clays
			CH	Inorganic clays of high plasticity, fat clays
			OH	Organic clays of medium to high plasticity
HIGHLY ORGANIC SOILS			PT	Peat, muck and other highly organic soils

BOUNDARY CLASSIFICATION AND GRAIN SIZES

SILT OR CLAY	SAND			GRAVEL		COBBLES	BOULDERS
	FINE	MEDIUM	COARSE	FINE	COARSE		
U.S. STANDARD SIEVE SIZES	No. 200	No. 40	No. 10	No. 4	3/4"	3"	12"

KEY TO LOGS

SAMPLE TYPE	DESCRIPTION
	**Modified California Sampler** (3" O.D.): blowcount is equivalent SPT N value (converted by multiplying field blowcounts by 0.63)
	**Standard Penetration Test** (2" O.D.)
	**Thin-walled tube using Pitcher Barrel**
	**Shelby Tube**, pushed or used Osterberg Sampler
	**Disturbed Sample**

*NOTE: RECORDED BLOW COUNTS HAVE NOT BEEN ADJUSTED FOR HAMMER ENERGY

KEY TO EXPLORATORY BORING LOGS

A3GEO, Inc.
1331 Seventh St., Unit E
Berkeley, CA 94710

BORING NUMBER B-1-1

CLIENT ESA-PWA
PROJECT NAME Napa River Restoration - OVOK Reach
PROJECT NUMBER 1110-3A
PROJECT LOCATION Napa, California
DATE STARTED 1/14/13 **COMPLETED** 1/14/13
GROUND ELEVATION 56 ft **HOLE SIZE** 4.5 in
DRILLING CONTRACTOR Northstar Drilling, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Solid Stem Auger
AT TIME OF DRILLING ---
LOGGED BY Patrick Drumm **CHECKED BY** KMA
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	ADJUSTED BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ROCK RECOVERY % (RQD)	OTHER LAB TESTS / NOTES
0		SANDY CLAY WITH GRAVEL (CL) - Dark brown, soft to firm, moist.							
5		SANDY LEAN CLAY WITH GRAVEL (CL) - Mottled olive brown and dark brown, stiff, fine grained sand, medium plasticity fines, slightly moist.	MC	10	1.0 > 4.5				
10		SANDY CLAY (CL) - Yellowish brown, hard, moist. (HARDPAN DEPOSIT)							
		LEAN CLAY (CL) - Mottled yellowish brown and light brown, dense, slightly moist. (HARDPAN DEPOSIT)	MC	35	> 4.5				
15		- at 16.0': Few fine sand.	MC	32	4.5				
20		LEAN CLAY WITH SAND (CL) - Mottled brown and dark brown, hard, stratified silt and silty fine sand layers. (HARDPAN DEPOSIT)	MC	32	> 4.5				

Bottom of borehole at 21.5 feet.
Notes:
1. Stratification lines represent the approximate boundaries between material types and the transitions may be gradual.
2. Modified California (MC) blowcounts were adjusted by multiplying field blowcounts by a factor 0.63.
3. Ground elevation should be considered approximate. Elevations from Doble Thomas 2011 survey data.
4. Backfilled with cement grout immediately upon completion of drilling.
5. Sampler driving method - rope and cathead.
6. Groundwater not encountered.

A3GEO, Inc
1331 Seventh Street, Unit E
Berkeley, CA 94710

BORING NUMBER B-1-2

CLIENT ESA-PWA
PROJECT NAME Napa River Restoration - OVOK Reach
PROJECT NUMBER 1110-3A
PROJECT LOCATION Napa, California
DATE STARTED 1/14/13 **COMPLETED** 1/14/13
GROUND ELEVATION 57 ft **HOLE SIZE** 4.5 in
DRILLING CONTRACTOR Northstar Drilling, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Solid Stem Auger
AT TIME OF DRILLING ---
LOGGED BY Patrick Drumm **CHECKED BY** KMA
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	ADJUSTED BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ROCK RECOVERY % (RQD)	OTHER LAB TESTS / NOTES
0		SANDY CLAY (CL) - Dark brown, firm, slightly moist to moist; possibly Holocene age.							
5		LEAN CLAY WITH SAND (CL) - Mottled gray and brown, hard, fine grained sand, slightly moist.	MC	38	> 4.5				
		- at 6.0': (HARDPAN DEPOSIT)							
10		- at 9.0': Dark brown.							
		CLAYEY SAND (SC) - Light grayish brown, very dense, fine grained sand, slightly moist. (HARDPAN DEPOSIT)	MC	32/5.0"	> 4.5				
15		SANDY LEAN CLAY (CL) - Mottled olive brown with red, white, and yellowish brown, very dense, medium to coarse grained sand, moist. (HARDPAN DEPOSIT)	MC	32/2.5"	> 4.5				
		LEAN CLAY WITH SAND (CL) - Olive gray, very stiff, fine grained sand, moist. (HARDPAN DEPOSIT)							
20			SPT	27					

Bottom of borehole at 21.5 feet.
Notes:
1. Stratification lines represent the approximate boundaries between material types and the transitions may be gradual.
2. Modified California (MC) blowcounts were adjusted by multiplying field blowcounts by a factor 0.63.
3. Ground elevation should be considered approximate. Elevations from Doble Thomas 2011 survey data.
4. Backfilled with cement grout immediately upon completion of drilling.
5. Sampler driving method - rope and cathead.
6. Groundwater not encountered.

A3GEO, Inc.
1331 Seventh St., Unit E
Berkeley, CA 94710

BORING NUMBER B-1-3

CLIENT ESA-PWA
PROJECT NAME Napa River Restoration - OVOK Reach
PROJECT NUMBER 1110-3A
PROJECT LOCATION Napa, California
DATE STARTED 1/14/13 **COMPLETED** 1/14/13
GROUND ELEVATION 56 ft **HOLE SIZE** 4.5 in
DRILLING CONTRACTOR Northstar Drilling, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Solid Stem Auger
AT TIME OF DRILLING ---
LOGGED BY Patrick Drumm **CHECKED BY** KMA
AT END OF DRILLING 21.00 ft / Elev 35.00 ft
NOTES
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	ADJUSTED BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ROCK RECOVERY % (RQD)	OTHER LAB TESTS / NOTES
0		SANDY CLAY (CL) - Dark brown, soft to firm, moist.							
5		SILTY SAND (SM) - Dark brown, medium dense, fine to medium grained sand, non-plastic fines, slightly moist to moist.	MC	10					
		- at 6.5': Wet.							
10		LEAN CLAY (CL) - Yellowish brown, very stiff, slightly moist. (HARDPAN DEPOSIT)	MC	29	> 4.5				
		- at 11.0': Light yellowish brown, more silty, less plastic.							
15		- at 14.0': Dark gray, trace fine grained sand, moist.	MC	20	> 4.5				
		- at 15.0': Brown.							
20		SILTY SAND (SM) - Yellowish brown, loose, fine to medium grained sand, fines have no plasticity, some laminated light yellowish brown lenses, wet.	MC	11					

Bottom of borehole at 21.5 feet.
Notes:
1. Stratification lines represent the approximate boundaries between material types and the transitions may be gradual.
2. Modified California (MC) blowcounts were adjusted by multiplying field blowcounts by a factor 0.63.
3. Ground elevation should be considered approximate. Elevations from Doble Thomas 2011 survey data.
4. Backfilled with cement grout 10 min. after completion of drilling.
5. Sampler driving method - rope and cathead.

A3GEO, Inc
1331 Seventh Street, Unit E
Berkeley, CA 94710

BORING NUMBER B-2-1

CLIENT ESA-PWA
PROJECT NAME Napa River Restoration - OVOK Reach
PROJECT NUMBER 1110-3A
PROJECT LOCATION Napa, California
DATE STARTED 1/14/13 **COMPLETED** 1/14/13
GROUND ELEVATION 63 ft **HOLE SIZE** 4.5 in
DRILLING CONTRACTOR Northstar Drilling, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Solid Stem Auger
AT TIME OF DRILLING ---
LOGGED BY Patrick Drumm **CHECKED BY** KMA
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	ADJUSTED BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ROCK RECOVERY % (RQD)	OTHER LAB TESTS / NOTES
0		SANDY CLAY (CL) - Dark brown, soft, moist.							
		LEAN CLAY WITH SAND (CL) - Very dark grayish brown, stiff, fine grained sand, slightly moist.							
5		- at 6.0': 0.1" diameter rootlet in sample.	MC	9	1.75				
		CLAYEY SAND (SC) - Reddish brown, dense to very dense, fine to medium grained sand, slightly moist. (HARDPAN DEPOSIT)							
10		- at 11.0': Brown.	MC	32/4"					
15		LEAN CLAY (CL) - Yellow, stiff, moist. (HARDPAN DEPOSIT)	MC	13	> 4.5				
		LEAN CLAY WITH SAND (CL) - Yellowish brown, stiff, fine to medium grained sand, moist. (HARDPAN DEPOSIT)							
20		SILTY SAND (SM) - Yellowish brown, loose, fine to medium grained sand, fines have no plasticity, wet.	MC	5					

Bottom of borehole at 21.5 feet.
Notes:
1. Stratification lines represent the approximate boundaries between material types and the transitions may be gradual.
2. Modified California (MC) blowcounts were adjusted by multiplying field blowcounts by a factor 0.63.
3. Ground elevation should be considered approximate. Elevations from Doble Thomas 2011 survey data.
4. Backfilled with cement grout 15 min. after completion.
5. Sampler driving method - rope and cathead.
6. Groundwater measured 13 min. after completion at drilling.

A3GEO, Inc.
1331 Seventh St., Unit E
Berkeley, CA 94710

BORING NUMBER B-3-1

CLIENT ESA-PWA
PROJECT NAME Napa River Restoration - OVOK Reach
PROJECT NUMBER 1110-3A
PROJECT LOCATION Napa, California
DATE STARTED 1/15/13 **COMPLETED** 1/15/13
GROUND ELEVATION 68 ft **HOLE SIZE** 4.5 in
DRILLING CONTRACTOR Northstar Drilling, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Solid Stem Auger
AT TIME OF DRILLING ---
LOGGED BY Patrick Drumm **CHECKED BY** KMA
AT END OF DRILLING ---
NOTES
AFTER DRILLING 13.30 ft / Elev 54.70 ft

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	ADJUSTED BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ROCK RECOVERY % (RQD)	OTHER LAB TESTS / NOTES
0		CLAYEY SAND (SC) - Dark brown, medium dense, moist.							
5		SANDY CLAY (CL) - Very dark grayish brown, very stiff, slightly moist to moist.	MC	19	3.75				
10		- at 6.5': Trace fine rootlets.							
		CLAYEY SAND WITH GRAVEL (SC) - Mottled reddish brown and brown, medium dense, medium to coarse grained sand, angular fine gravel, slightly moist.	MC	10					
15		CLAYEY GRAVEL WITH SAND (GC) - Mottled brown, medium dense, subrounded gravel, wet.	SPT	32					
20		- at 20.0': Very dense.	MC	54					
25		GRAVEL WITH SAND AND CLAY (GP-GC) - Olive gray, medium dense, fine uniformly graded (0.2" diameter) gravel, some coarse sand, wet.	SPT	17					

Bottom of borehole at 26.5 feet.

Notes:
1. Stratification lines represent the approximate boundaries between material types and the transitions may be gradual.
2. Modified California (MC) blowcounts were adjusted by multiplying field blowcounts by a factor 0.63.
3. Ground elevation should be considered approximate. Elevations from Doble Thomas 2011 survey data.
4. Backfilled with cement grout 15 min. after completion.
5. Sampler diving method - rope and cathead.
6. Groundwater measured 10 min. after completion at drilling.

A3GEO, Inc
1331 Seventh Street, Unit E
Berkeley, CA 94710

BORING NUMBER B-5-1

CLIENT ESA-PWA
PROJECT NAME Napa River Restoration - OVOK Reach
PROJECT NUMBER 1110-3A
PROJECT LOCATION Napa, California
DATE STARTED 1/15/13 **COMPLETED** 1/15/13
GROUND ELEVATION 72 ft **HOLE SIZE** 4.5 in
DRILLING CONTRACTOR Northstar Drilling, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Solid Stem Auger
AT TIME OF DRILLING ---
LOGGED BY Patrick Drumm **CHECKED BY** KMA
AT END OF DRILLING ---
NOTES
AFTER DRILLING 13.40 ft / Elev 58.60 ft

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	ADJUSTED BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ROCK RECOVERY % (RQD)	OTHER LAB TESTS / NOTES
0		SANDY CLAY (CL) - Dark brown, soft, moist; possibly Holocene age.							
5		SANDY LEAN CLAY (CL) - Very dark grayish brown, stiff, fine grained sand, dark orange seams pervasive (possible Iron-oxide staining), moist; possibly Holocene age.	MC	11	2.5				
10		- at 10.0': Brown, trace fine roots.	SPT	11					
15		CLAYEY SAND (SC) - Light yellowish brown, dense, fine to coarse grained sand, low plasticity fines, some 1/2-inch thick fine subrounded gravel layers, slightly moist. (HARDPAN DEPOSIT)	SPT	31					

Bottom of borehole at 16.5 feet.
Notes:
1. Stratification lines represent the approximate boundaries between material types and the transitions may be gradual.
2. Modified California (MC) blowcounts were adjusted by multiplying field blowcounts by a factor 0.63.
3. Ground elevation should be considered approximate. Elevations from Google Earth and Doble Thomas 2011 survey data.
4. Backfilled with cement grout 15 min. after completion of boring.
5. Sampler driving method - rope and cathead.
6. Groundwater measured 9 min. after drilling of boring.

A3GEO, Inc.
1331 Seventh St., Unit E
Berkeley, CA 94710

BORING NUMBER B-7-1

CLIENT ESA-PWA
PROJECT NAME Napa River Restoration - OVOK Reach
PROJECT NUMBER 1110-3A
PROJECT LOCATION Napa, California
DATE STARTED 12/3/12 **COMPLETED** 12/3/12
GROUND ELEVATION 80 ft **HOLE SIZE** 4.5 in
DRILLING CONTRACTOR Northstar Drilling, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Solid Stem Auger
AT TIME OF DRILLING ---
LOGGED BY Patrick Drumm **CHECKED BY** KMA
AT END OF DRILLING 11.30 ft / Elev 68.70 ft
NOTES
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	ADJUSTED BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ROCK RECOVERY % (RQD)	OTHER LAB TESTS / NOTES
0		LEAN CLAY WITH SAND (CL) - Dark gray and dark yellowish brown, very stiff, slightly moist.							
5			MC	19	> 4.5	111	16		LL: 41 PI: 22 Gravel: 0% Sand: 29% Silt: 26% Clay: 45%
10		SANDY LEAN CLAY (CL) - Dark grayish brown, stiff, fine grained sand, slightly moist.	MC	11	2.25	100	22		LL: 34 PI: 17 Gravel: 0% Sand: 40% Silt: 27% Clay: 33%
15		SILTY CLAY WITH SAND (CL-ML) - Olive brown, firm, fine grained sand, low plasticity fines, wet.	SPT	5					
20		- at 19.5' : Mottled light brown and reddish brown, very stiff. CLAYEY SAND (SC) - Mottled light brown, medium dense, fine to coarse grained sand, trace fine gravel, moist.	SPT	18					
25		POORLY GRADED GRAVEL WITH CLAY (GP-GC) - Dark brown, loose, medium to coarse grained sand, subangular firm to coarse gravel, wet.	SPT	8					

Bottom of borehole at 26.5 feet.

Notes:
1. Stratification lines represent the approximate boundaries between material types and the transitions may be gradual.
2. Modified California (MC) blowcounts were adjusted by multiplying field blowcounts by a factor 0.63.
3. Ground elevation should be considered approximate. Elevations from Google Earth and Doble Thomas 2011 survey data.
4. Backfilled with cement grout immediately after completion.
5. Sampler driving method - rope and cathead.

A3GEO, Inc.
1331 Seventh St., Unit E
Berkeley, CA 94710

BORING NUMBER B-8-1

CLIENT ESA-PWA
PROJECT NAME Napa River Restoration - OVOK Reach
PROJECT NUMBER 1110-3A
PROJECT LOCATION Napa, California
DATE STARTED 1/22/13 **COMPLETED** 1/22/13
GROUND ELEVATION 75 ft **HOLE SIZE** 4.5 in
DRILLING CONTRACTOR Northstar Drilling, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Solid Stem Auger
AT TIME OF DRILLING ---
LOGGED BY Patrick Drumm **CHECKED BY** KMA
AT END OF DRILLING ---
NOTES
AFTER DRILLING 17.00 ft / Elev 58.00 ft

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	ADJUSTED BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ROCK RECOVERY % (RQD)	OTHER LAB TESTS / NOTES
0		SANDY CLAY (CL) - Very dark grayish brown, stiff, fine to coarse grained sand, moist.							
5			MC	12	3.75				
10		- at 10.0': Olive brown, fine grained sand, medium plasticity. (HARDPAN DEPOSIT)	MC	8	1.5				
15		SILTY SAND (SM) - Dark grayish brown, loose, fine grained sand, micaceous, low plasticity fines, moist.	MC	6					
20		SANDY CLAY (CL) - Mottled brown and dark brown, very stiff, fine grained sand, moist. (HARDPAN DEPOSIT)	MC	22	4				
25		SANDY LEAN CLAY WITH GRAVEL (CL) - Mottled dark brown with red and yellow, stiff, fine to coarse grained sand, fine gravel, moist.	SPT	8					

Bottom of borehole at 26.5 feet.
Notes:
1. Stratification lines represent the approximate boundaries between material types and the transitions may be gradual.
2. Modified California (MC) blowcounts were adjusted by multiplying field blowcounts by a factor 0.63.
3. Ground elevation should be considered approximate. Elevations from Doble Thomas 2011 survey data.
4. Backfilled with cement grout 15 min. after completion.
5. Sampler driving method - rope and cathead.
6. Groundwater observed 10 min. after drilling of boring.

BORING NUMBER B-8-2

A3GEO, Inc
1331 Seventh Street, Unit E
Berkeley, CA 94710

CLIENT ESA-PWA
PROJECT NAME Napa River Restoration - OVOK Reach
PROJECT NUMBER 1110-3A
PROJECT LOCATION Napa, California
DATE STARTED 1/23/13 **COMPLETED** 1/23/13
GROUND ELEVATION 76 ft **HOLE SIZE** 4.5 in
DRILLING CONTRACTOR Northstar Drilling, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Solid Stem Auger
AT TIME OF DRILLING ---
LOGGED BY Patrick Drumm **CHECKED BY** KMA
AT END OF DRILLING 16.50 ft / Elev 59.50 ft
NOTES
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	ADJUSTED BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ROCK RECOVERY % (RQD)	OTHER LAB TESTS / NOTES
0		SANDY CLAY (CL) - Very dark grayish brown, soft, moist; Possibly Holocene age.							
5		SILTY SAND WITH CLAY (SM) - Dark grayish brown, loose, fine grained sand, moist; Possibly Holocene age.	MC	8					
10		SANDY CLAY (CL) - Mottled grayish brown and dark brown, stiff, fine grained sand iron-oxide staining, moist. (HARDPAN DEPOSIT)	MC	14	2.25				
		- at 11.0': 2-inch long rootlet.							
15		CLAYEY SAND (SC) - Mottled dark brown, loose, fine grained sand, low plasticity fines, iron-oxide staining, moist. (HARDPAN DEPOSIT)	MC	6					
20		SANDY CLAY (CL) - Mottled dark brown and reddish brown, very stiff, fine to medium grained sand, moist. (HARDPAN DEPOSIT)	MC	16	3.25				
25		- at 23.5': Mottled yellowish brown, firm, low plasticity, wet.	MC	5	1.0				
		- at 28.0': Olive brown, soft.	MC	4	0.5				

Bottom of borehole at 29.5 feet.

Notes:
1. Stratification lines represent the approximate boundaries between material types and the transitions may be gradual.
2. Modified California (MC) blowcounts were adjusted by multiplying field blowcounts by a factor 0.63.
3. Ground elevation should be considered approximate. Elevations from Doble Thomas 2011 survey data.
4. Backfilled with cement grout 10 min. after completion.
5. Sampler driving method - rope and cathead.

A3GEO, Inc.
1331 Seventh St., Unit E
Berkeley, CA 94710

BORING NUMBER B-8-3

CLIENT ESA-PWA
PROJECT NAME Napa River Restoration - OVOK Reach
PROJECT NUMBER 1110-3A
PROJECT LOCATION Napa, California
DATE STARTED 1/23/13 **COMPLETED** 1/23/13
GROUND ELEVATION 76 ft **HOLE SIZE** 4.5 in
DRILLING CONTRACTOR Northstar Drilling, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Solid Stem Auger
AT TIME OF DRILLING ---
LOGGED BY Patrick Drumm **CHECKED BY** KMA
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	ADJUSTED BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ROCK RECOVERY % (RQD)	OTHER LAB TESTS / NOTES
0		SANDY LEAN CLAY (CL) - Very dark grayish brown, soft, moist.							
5		LEAN CLAY (CL) - Dark grayish brown, very stiff, trace fine sand, moist.	MC	17	3.75				
10		CLAY WITH SAND (CL) - Mottled grayish brown, stiff, fine grained sand, moist. (HARDPAN DEPOSIT)	MC	11	3.25				
15		- at 13.5': Yellowish brown, firm, iron-oxide staining.	MC	6	0.75				

Bottom of borehole at 16.5 feet.
Notes:
1. Stratification lines represent the approximate boundaries between material types and the transitions may be gradual.
2. Modified California (MC) blowcounts were adjusted by multiplying field blowcounts by a factor 0.63.
3. Ground elevation should be considered approximate. Elevations from Doble Thomas 2011 survey data.
4. Backfilled with cement grout 15 min. after completion.
5. Sampler driving method - rope and cathead.
6. Groundwater not observed.

A3GEO, Inc.
1331 Seventh St., Unit E
Berkeley, CA 94710

BORING NUMBER B-8-4

CLIENT ESA-PWA
PROJECT NAME Napa River Restoration - OVOK Reach
PROJECT NUMBER 1110-3A
PROJECT LOCATION Napa, California
DATE STARTED 1/23/13 **COMPLETED** 1/23/13
GROUND ELEVATION 75 ft **HOLE SIZE** 4.5 in
DRILLING CONTRACTOR Northstar Drilling, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Solid Stem Auger
AT TIME OF DRILLING ---
LOGGED BY Patrick Drumm **CHECKED BY** KMA
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	ADJUSTED BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ROCK RECOVERY % (RQD)	OTHER LAB TESTS / NOTES
0		SANDY CLAY (CL) - Very dark grayish brown, stiff, moist.							
5									
10		- at 10.0': Mottled brown. (HARDPAN DEPOSIT)	MC	9	2.25				
15		SILTY SAND (SM) - Grayish brown, loose, fine grained sand, moist to wet.	SPT	6					No sample recovered

Bottom of borehole at 16.5 feet.
Notes:
1. Stratification lines represent the approximate boundaries between material types and the transitions may be gradual.
2. Modified California (MC) blowcounts were adjusted by multiplying field blowcounts by a factor 0.63.
3. Ground elevation should be considered approximate. Elevations from Doble Thomas 2011 survey data.
4. Backfilled with cement grout 15 min. after completion.
5. Sampler driving method - rope and cathead.
6. Groundwater not observed.

A3GEO, Inc.
1331 Seventh St., Unit E
Berkeley, CA 94710

BORING NUMBER B-9-1

CLIENT ESA-PWA
PROJECT NAME Napa River Restoration - OVOK Reach
PROJECT NUMBER 1110-3A
PROJECT LOCATION Napa, California
DATE STARTED 1/23/13 **COMPLETED** 1/23/13
GROUND ELEVATION 80 ft **HOLE SIZE** 4.5 in
DRILLING CONTRACTOR Northstar Drilling, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Solid Stem Auger
AT TIME OF DRILLING ---
LOGGED BY Patrick Drumm **CHECKED BY** KMA
AT END OF DRILLING ---
NOTES
AFTER DRILLING 20.00 ft / Elev 60.00 ft

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	ADJUSTED BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ROCK RECOVERY % (RQD)	OTHER LAB TESTS / NOTES
0		LEAN CLAY WITH SAND (CL) - Dark grayish brown, stiff, few fine gravel, moist.							
5			MC	11	3.25				
10		SANDY LEAN CLAY (CL) -Mottled dark gray and yellowish brown, stiff, fine grained sand, low plasticity, moist. (HARDPAN DEPOSIT)	MC	9	1.5				
15		LEAN CLAY WITH SAND (CL) - Mottled dark gray and yellowish brown, stiff, fine grained sand, moist. (HARDPAN DEPOSIT) - at 15.5': Thin rootlets in sample.	MC	10	1.75				
20		FAT CLAY (CH) - Brown, firm, trace fine sand, moist. (HARDPAN DEPOSIT)	MC	5	1.25				
		CLAYEY SAND (SC) - Brown, loose, fine to medium grained sand, wet. (HARDPAN DEPOSIT)							
25		FAT CLAY (CH) - Dark olive brown, soft, wet. (HARDPAN DEPOSIT)	MC	4	.5				
		CLAYEY GRAVEL WITH SAND (GC) - Mottled dark olive brown, very stiff, rounded fine gravel, medium to coarse grained sand, wet.	MC	24					

Bottom of borehole at 29.5 feet.

Notes:
1. Stratification lines represent the approximate boundaries between material types and the transitions may be gradual.
2. Modified California (MC) blowcounts were adjusted by multiplying field blowcounts by a factor 0.63.
3. Ground elevation should be considered approximate. Elevations from Doble Thomas 2011 survey data.
4. Backfilled with cement grout 20 min. after completion of drilling.
5. Sampler driving method - rope and cathead.
6. Groundwater measure 13 min. after drilling.

A3GEO, Inc
1331 Seventh Street, Unit E
Berkeley, CA 94710

BORING NUMBER B-9-2

CLIENT ESA-PWA
PROJECT NAME Napa River Restoration - OVOK Reach
PROJECT NUMBER 1110-3A
PROJECT LOCATION Napa, California
DATE STARTED 1/23/13 **COMPLETED** 1/23/13
GROUND ELEVATION 76 ft **HOLE SIZE** 4.5 in
DRILLING CONTRACTOR Northstar Drilling, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Solid Stem Auger
AT TIME OF DRILLING ---
LOGGED BY Patrick Drumm **CHECKED BY** KMA
AT END OF DRILLING 19.30 ft / Elev 56.70 ft
NOTES
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	ADJUSTED BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ROCK RECOVERY % (RQD)	OTHER LAB TESTS / NOTES
0		SANDY CLAY (CL) - Dark grayish brown, stiff, fine grained sand, moist; possibly Holocene age.							
5		- at 5.5': Trace fine rootlets.	MC	15	3.00				
		SANDY CLAY (CL) - Grayish brown stiff, fine grained sand, iron-oxide staining, moist. (HARDPAN DEPOSIT)							
10		- at 10.5': Iron-oxide stained streaks.	MC	13	2.5				
15		CLAYEY SAND (SC) - Grayish brown, loose, fine grained sand, little to no plasticity, iron-oxide staining, moist. (HARDPAN DEPOSIT)	MC	6					
20			MC	11					

Bottom of borehole at 21.5 feet.
Notes:
1. Stratification lines represent the approximate boundaries between material types and the transitions may be gradual.
2. Modified California (MC) blowcounts were adjusted by multiplying field blowcounts by a factor 0.63.
3. Ground elevation should be considered approximate. Elevations from Doble Thomas 2011 survey data.
4. Backfilled with cement grout 20 min. after completion of drilling.
5. Sampler driving method - rope and cathead.

A3GEO, Inc.
1331 Seventh St., Unit E
Berkeley, CA 94710

BORING NUMBER B-10-1

CLIENT ESA-PWA
PROJECT NAME Napa River Restoration - OVOK Reach
PROJECT NUMBER 1110-3A
PROJECT LOCATION Napa, California
DATE STARTED 12/3/12 **COMPLETED** 12/3/12
GROUND ELEVATION 82 ft **HOLE SIZE** 4.5 in
DRILLING CONTRACTOR Northstar Drilling, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Solid Stem Auger
AT TIME OF DRILLING ---
LOGGED BY Patrick Drumm **CHECKED BY** KMA
AT END OF DRILLING 11.60 ft / Elev 70.40 ft
NOTES
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	ADJUSTED BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ROCK RECOVERY % (RQD)	OTHER LAB TESTS / NOTES
0		CLAYEY SAND (SC) - Dark brown, stiff, fine to medium grained sand, low plasticity, moist; Possible Holocene age.							
5		- at 5.5': Thin green rootlet in sample.	MC	9	2.5				
		SILTY SAND (SM) - Mottled dark grayish brown and dark yellowish brown, loose, moist.							
10		SILTY CLAY WITH SAND (CL-ML) - Olive brown, stiff, fine grained sand, low plasticity fines, moist. (HARDPAN DEPOSIT)	MC	8	1.25				
15		LEAN CLAY WITH SAND (CL) - Olive brown, stiff, fine grained sand, wet. (HARDPAN DEPOSIT)	SPT	10					
20		- at 20.0': Firm.	SPT	6					
25		LEAN CLAY WITH SAND AND GRAVEL (CL) - Olive brown, stiff, fine grained sand, angular to subrounded fine gravel, wet.	SPT	9					

Bottom of borehole at 26.5 feet.

Notes:
1. Stratification lines represent the approximate boundaries between material types and the transitions may be gradual.
2. Modified California (MC) blowcounts were adjusted by multiplying field blowcounts by a factor 0.63.
3. Ground elevation should be considered approximate. Elevations from Google Earth and Doble Thomas 2011 survey data.
4. Backfilled with cement grout upon completion of drilling.
5. Sampler driving method - rope and cathead.

A3GEO, Inc.
1331 Seventh St., Unit E
Berkeley, CA 94710

BORING NUMBER B-13-1

CLIENT ESA-PWA
PROJECT NAME Napa River Restoration - OVOK Reach
PROJECT NUMBER 1110-3A
PROJECT LOCATION Napa, California
DATE STARTED 1/22/13 **COMPLETED** 1/22/13
GROUND ELEVATION 81 ft **HOLE SIZE** 4.5 in
DRILLING CONTRACTOR Northstar Drilling, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Solid Stem Auger
AT TIME OF DRILLING ---
LOGGED BY Patrick Drumm **CHECKED BY** KMA
AT END OF DRILLING ---
NOTES
AFTER DRILLING 12.20 ft / Elev 68.80 ft

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	ADJUSTED BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ROCK RECOVERY % (RQD)	OTHER LAB TESTS / NOTES
0		CLAYEY SAND (SC) - Very dark grayish brown, medium dense, moist.							
		FAT CLAY WITH SAND (CH) - Dark brown, soft, fine grained sand, moist.							
5		- at 5.75': Grayish brown and dark yellowish brown, stiff.	MC	9	2.25				
10		LEAN CLAY WITH SAND (CL) - Mottled dark brown and brown, firm, fine grained sand, iron-oxide staining, moist. (HARDPAN DEPOSIT)	MC	7	2.5				
15		FAT CLAY WITH SAND (CH) - Mottled dark brown, stiff, wet.	MC	8	1.75				
20		- at 21.0': Grayish brown with dark yellowish brown mottling.	MC	8	1.25				
25		- at 25.0': Firm.	MC	5	1.50				

Bottom of borehole at 26.5 feet.

Notes:
1. Stratification lines represent the approximate boundaries between material types and the transitions may be gradual.
2. Modified California (MC) blowcounts were adjusted by multiplying field blowcounts by a factor 0.63.
3. Ground elevation should be considered approximate. Elevations from Doble Thomas 2011 survey data.
4. Backfilled with cement grout 15 min. after completion of drilling.
5. Sampler driving method - rope and cathead.
6. Groundwater observation 10 min. after completion of drilling.

A3GEO, Inc
1331 Seventh Street, Unit E
Berkeley, CA 94710

BORING NUMBER B-14-1

CLIENT ESA-PWA
PROJECT NAME Napa River Restoration - OVOK Reach
PROJECT NUMBER 1110-3A
PROJECT LOCATION Napa, California
DATE STARTED 1/15/13 **COMPLETED** 1/15/13
GROUND ELEVATION 99 ft **HOLE SIZE** 4.5 in
DRILLING CONTRACTOR Northstar Drilling, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Solid Stem Auger
AT TIME OF DRILLING ---
LOGGED BY Patrick Drumm **CHECKED BY** KMA
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	ADJUSTED BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ROCK RECOVERY % (RQD)	OTHER LAB TESTS / NOTES
0		SANDY CLAY (CL) - Mottled very dark grayish brown with red and yellow, soft, fine to coarse grained sand, moist.							
		- at 3.0': hard, slightly moist.							
5			MC	31	>4.50				
		CLAYEY SAND WITH GRAVEL (SC) - Gray, dense, fine gravel, slightly moist.							
		- at 8.5': Mottled brown, red brown and yellowish brown, medium dense.							
10			SPT	26					
15		SANDY CLAY (CL) - Yellowish brown and reddish brown, hard, fine to coarse grained sand, slightly moist. (HARDPAN DEPOSIT)	MC	39	3.50				

Bottom of borehole at 16.5 feet.
Notes:
1. Stratification lines represent the approximate boundaries between material types and the transitions may be gradual.
2. Modified California (MC) blowcounts were adjusted by multiplying field blowcounts by a factor 0.63.
3. Ground elevation should be considered approximate. Elevations from Google Earth and Doble Thomas 2011 survey data.
4. Boring backfilled with cement grout immediately upon completion.
5. Sample driving method - rope and cathead.
6. Groundwater was not encountered.

BORING NUMBER B-14-2

A3GEO, Inc.
1331 Seventh St., Unit E
Berkeley, CA 94710

CLIENT ESA-PWA
PROJECT NAME Napa River Restoration - OVOK Reach
PROJECT NUMBER 1110-3A
PROJECT LOCATION Napa, California
DATE STARTED 1/15/13 **COMPLETED** 1/15/13
GROUND ELEVATION 114 ft **HOLE SIZE** 4.5 in
DRILLING CONTRACTOR Northstar Drilling, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Solid Stem Auger
AT TIME OF DRILLING ---
LOGGED BY Patrick Drumm **CHECKED BY** KMA
AT END OF DRILLING ---
NOTES
AFTER DRILLING 2.00 ft / Elev 112.00 ft

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	ADJUSTED BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ROCK RECOVERY % (RQD)	OTHER LAB TESTS / NOTES
0		SANDY CLAY (CL) - Very dark grayish brown with red and yellow, soft, moist.							
5		SANDY CLAY WITH GRAVEL (CL) - Mottled very dark grayish brown with red, stiff, fine gravel, fine to coarse grained sand, slightly moist.	MC	9	2.75				
		SANDY CLAY (CL) - Brown, stiff, fine grained sand, low plasticity fines, moist. (HARDPAN DEPOSIT)							
10		CLAYEY SAND (SC) - Brown, dense to very dense, fine to medium grained sand, few fine gravel, slightly moist. (HARDPAN DEPOSIT)	MC	41					
15		SANDY SILT (ML) - Yellowish brown, very stiff, fine grained sand, little clay, moist. (HARDPAN DEPOSIT)	MC	20	3.75				

Bottom of borehole at 16.5 feet.

Notes:
1. Stratification lines represent the approximate boundaries between material types and the transitions may be gradual.
2. Modified California (MC) blowcounts were adjusted by multiplying field blowcounts by a factor 0.63.
3. Ground elevation should be considered approximate. Elevations from Google Earth and Doble Thomas 2011 survey data.
4. Boring backfilled with cement grout 15 minutes after competion.
5. Sample driving method - rope and cathead.
6. Groundwater elevation was observed 10 minutes after completion of hole.

A3GEO, Inc.
1331 Seventh St., Unit E
Berkeley, CA 94710

BORING NUMBER B-17-1

CLIENT ESA-PWA
PROJECT NAME Napa River Restoration - OVOK Reach
PROJECT NUMBER 1110-3A
PROJECT LOCATION Napa, California
DATE STARTED 11/7/12 **COMPLETED** 11/7/12
GROUND ELEVATION 88 ft **HOLE SIZE** 4.5 in
DRILLING CONTRACTOR Northstar Drilling, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Solid Stem Auger
▽ **AT TIME OF DRILLING** 16.20 ft / Elev 71.80 ft
LOGGED BY Pat Drumm **CHECKED BY** KMA
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	ADJUSTED BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ROCK RECOVERY % (RQD)	OTHER LAB TESTS / NOTES
0		WELL-GRADED GRAVEL (GW) - Mottled gray, medium dense to dense, includes cobbles from vineyard road, slightly moist.							
5		CLAYEY SAND (SC) - Yellowish brown, medium dense, fine grained sand, slightly moist; iron-oxide staining. (HARDPAN DEPOSIT)	MC	33					
10		LEAN CLAY (CL) - Yellowish brown, stiff, slightly silty and sandy, slightly moist to moist. (HARDPAN DEPOSIT)	MC	13	> 4.5				
15		▽ CLAYEY SAND (SC) - Gray, medium dense, medium to coarse grained sand, trace fines, and trace fine gravel, wet.	MC	21					

Bottom of borehole at 16.5 feet.
Notes:
1. Stratification lines represent the approximate boundaries between material types and the transitions may be gradual.
2. Modified California (MC) blowcounts were adjusted by multiplying field blowcounts by a factor 0.63.
3. Ground elevation should be considered approximate. Elevations from Doble Thomas 2011 survey data.
4. Backfilled with cement grout immediately upon completion.
5. Sample driving method - rope and cathead.

BORING NUMBER B-17-2

A3GEO, Inc.
1331 Seventh St., Unit E
Berkeley, CA 94710

CLIENT ESA-PWA
PROJECT NAME Napa River Restoration - OVOK Reach
PROJECT NUMBER 1110-3A
PROJECT LOCATION Napa, California
DATE STARTED 11/7/12 **COMPLETED** 11/7/12
GROUND ELEVATION 96 ft **HOLE SIZE** 4.5 in
DRILLING CONTRACTOR Northstar Drilling, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Solid Stem Auger
AT TIME OF DRILLING 22.50 ft / Elev 73.50 ft
LOGGED BY Pat Drumm **CHECKED BY** KMA
AT END OF DRILLING 23.20 ft / Elev 72.80 ft
NOTES
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	ADJUSTED BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ROCK RECOVERY % (RQD)	OTHER LAB TESTS / NOTES
0		SILTY SAND (SM) - Dark brown, medium dense, fine grained sand, slightly moist.							
5			MC	17					
10		CLAYEY SAND (SC) - Dark brown with some orange and black mottling, medium dense, fine grained sand, slightly moist; fines consist of high plasticity sandy clay and low plasticity silty sand. (HARDPAN DEPOSIT)	MC	23					
15		WELL-GRADED GRAVEL (GW) - Light brownish gray, very dense, subrounded up to 2.0", slightly moist.	MC	32/2"					
20			SPT	8					
25		SILTY SAND (SM) - Dark brown, loose, fine grained sand, some fine gravel, fines have no pasticity, moist.							
		WELL GRADED GRAVEL (GW) - Mottled Brown, very dense, subrounded upto 2.0", wet.	MC	32/6"					

Bottom of borehole at 26.0 feet.

Notes:
1. Stratification lines represent the approximate boundaries between material types and the transitions may be gradual.
2. Modified California (MC) blowcounts were adjusted by multiplying field blowcounts by a factor 0.63.
3. Ground elevation should be considered approximate. Elevations from Doble Thomas 2011 survey data.
4. Backfilled with cement grout immediately upon completion.
5. Sample driving method - rope and cathead.

A3GEO, Inc.
1331 Seventh St., Unit E
Berkeley, CA 94710

BORING NUMBER B-17-3

CLIENT ESA-PWA
PROJECT NAME Napa River Restoration - OVOK Reach
PROJECT NUMBER 1110-3A
PROJECT LOCATION Napa, California
DATE STARTED 11/7/12 **COMPLETED** 11/7/12
GROUND ELEVATION 94 ft **HOLE SIZE** 4.5 in
DRILLING CONTRACTOR Northstar Drilling, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Solid Stem Auger
AT TIME OF DRILLING ---
LOGGED BY Pat Drumm **CHECKED BY** KMA
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	ADJUSTED BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ROCK RECOVERY % (RQD)	OTHER LAB TESTS / NOTES
0		SILTY SAND (SM) - Dark brown, dense, fine grained sand, slightly moist; possibly Holocene age.							
5		SANDY SILT (ML) - Dark brown with black and orange mottling, stiff, slightly moist; possibly Holocene age. - at 5.5': Many thin roots	MC	13					
10		SANDY LEAN CLAY (CL) - Dark brown to gray, very stiff, slightly moist; possibly Holocene age. - at 11.0': Many hair-like fibers	MC	20					
15		CLAYEY GRAVEL WITH SAND (GC) - Mottled gray and brown, medium dense, coarse subrounded gravel, slightly moist.	MC	33					
20		SANDY LEAN CLAY (CL) - Dark brown, hard, coarse grained sand, few fine gravel, moist.	MC	32/5"					
		CLAYEY GRAVEL WITH SAND (GC) - Mottled gray and brown, very dense, moist.							
25		LEAN CLAY WITH SAND (CL) - Greenish brown, hard, some fine gravel, moist. (HARDPAN DEPOSIT)	MC	42					

Bottom of borehole at 26.5 feet.
Notes:
1. Stratification lines represent the approximate boundaries between material types and the transitions may be gradual.
2. Modified California (MC) blowcounts were adjusted by multiplying field blowcounts by a factor 0.63.
3. Ground elevation should be considered approximate. Elevations from Doble Thomas 2011 survey data.
4. Backfilled with cement grout immediately upon completion.
5. Sample driving method - rope and cathead.
6. Groundwater was not encountered.

A3GEO, Inc.
1331 Seventh St., Unit E
Berkeley, CA 94710

BORING NUMBER B-17-4

CLIENT ESA-PWA
PROJECT NAME Napa River Restoration - OVOK Reach
PROJECT NUMBER 1110-3A
PROJECT LOCATION Napa, California
DATE STARTED 11/7/12 **COMPLETED** 11/7/12
GROUND ELEVATION 94 ft **HOLE SIZE** 4.5 in
DRILLING CONTRACTOR Northstar Drilling, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Solid Stem Auger
AT TIME OF DRILLING ---
LOGGED BY Pat Drumm **CHECKED BY** KMA
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	ADJUSTED BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ROCK RECOVERY % (RQD)	OTHER LAB TESTS / NOTES
0		SILTY SAND (SM) - Dark brown, medium dense, fine grained sand, slightly moist; possibly Holocene age.							
5			MC	15	> 4.5				
		SANDY CLAY (CL) - Brown with some mottled orange and black, very stiff, fine grained sand, slightly moist. (HARDPAN DEPOSIT)							
10			MC	39	> 4.5	101	20		
		FAT CLAY (CH) - Dark brown, hard, few fine grained sand, slightly moist. (HARDPAN DEPOSIT)							LL: 50 PI: 29 Gravel: 1% Sand: 8% Silt: 39% Clay: 52%
15		CLAYEY SAND (SC) - Olive brown, medium dense, few gravels, little silt, fine to medium grained sand, slightly moist. (HARDPAN DEPOSIT)	MC	28		100	23		LL: 35 PI: 12 Gravel: 5% Sand: 67% Silt: 14% Clay: 14%
		CLAYEY GRAVEL WITH SAND (GC) - Gray and brown, medium dense, moist.							
20		SILTY SAND (SM) - Mottled dark yellowish brown, very dense, fine grained sand, slightly moist. (HARDPAN DEPOSIT)	MC	56/11"					
		CLAYEY GRAVEL WITH SAND (GC) - Mottled gray and brown, dense to very dense, moist.							
25		FAT CLAY WITH SAND (CH) - Brown, hard, fine grained sand, slightly moist. (HARDPAN DEPOSIT)	MC	32					

Bottom of borehole at 26.5 feet.

Notes:
1. Stratification lines represent the approximate boundaries between material types and the transitions may be gradual.
2. Modified California (MC) blowcounts were adjusted by multiplying field blowcounts by a factor 0.63.
3. Ground elevation should be considered approximate. Elevations from Doble Thomas 2011 survey data.
4. Backfilled with cement grout immediately upon completion.
5. Sample driving method - rope and cathead.
6. Groundwater was not encountered.

A3GEO, Inc.
1331 Seventh St., Unit E
Berkeley, CA 94710

BORING NUMBER B-17-5

CLIENT ESA-PWA
PROJECT NAME Napa River Restoration - OVOK Reach
PROJECT NUMBER 1110-3A
PROJECT LOCATION Napa, California
DATE STARTED 11/12/12 **COMPLETED** 11/12/12
GROUND ELEVATION 94 ft **HOLE SIZE** 4.5 in
DRILLING CONTRACTOR Northstar Drilling, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Solid Stem Auger
AT TIME OF DRILLING 23.10 ft / Elev 70.90 ft
LOGGED BY Pat Drumm **CHECKED BY** KMA
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	ADJUSTED BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ROCK RECOVERY % (RQD)	OTHER LAB TESTS / NOTES
0		SANDY SILT (ML) - Dark yellowish brown, hard, fine grained sand, slightly moist.							
5		CLAYEY SAND WITH GRAVEL (SC) - Very dark grayish brown, dense, fine grained sand, little gravel and silt, slightly moist.	MC	38		114	11		LL: 41 PI:22 Gravel: 15% Sand: 39% Silt: 17% Clay: 29%
10		CLAYEY SAND (SC) - Grayish brown, very dense, fine grained sand, few gravel and silt, slightly moist.	MC	32/6"		109	15		LL: 42 PI:24 Gravel: 8% Sand: 52% Silt: 12% Clay: 28%
15		CLAYEY GRAVEL (GC) - Mottled yellow brown and gray, very dense, coarsed grained gravel, slightly moist.	SPT	53					
20		SILTY SAND (SM) - Dark brown, medium dense, fine to coarse grained sand, trace fine gravel, moist.	MC	19					
		CLAYEY GRAVEL (GC) - Mottled yellow-brown, medium dense, fine grained subrounded gravel up to 1" diameter, slightly moist.							
		SILTY SAND (SM) - Dark grayish brown, medium dense, medium to coarse sand, wet.							
		CLAYEY GRAVEL (GC) - Mottled, dense, moist.							
25		LEAN CLAY (CL) - Mottled grayish brown and dark yellowish brown, hard, slightly moist.	MC	32	> 4.5				

Bottom of borehole at 26.5 feet.

Notes:
1. Stratification lines represent the approximate boundaries between material types and the transitions may be gradual.
2. Modified California (MC) blowcounts were adjusted by multiplying field blowcounts by a factor 0.63.
3. Ground elevation should be considered approximate. Elevations from Doble Thomas 2011 survey data.
4. Backfilled with cement grout immediately upon completion.
5. Sample driving method - rope and cathead.

A3GEO, Inc.
1331 Seventh St., Unit E
Berkeley, CA 94710

BORING NUMBER B-17-6

CLIENT ESA-PWA
PROJECT NAME Napa River Restoration - OVOK Reach
PROJECT NUMBER 1110-3A
PROJECT LOCATION Napa, California
DATE STARTED 11/12/12 **COMPLETED** 11/12/12
GROUND ELEVATION 94 ft **HOLE SIZE** 4.5 in
DRILLING CONTRACTOR Northstar Drilling, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Solid Stem Auger
AT TIME OF DRILLING ---
LOGGED BY Pat Drumm **CHECKED BY** KMA
AT END OF DRILLING 26.40 ft / Elev 67.60 ft
NOTES
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	ADJUSTED BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ROCK RECOVERY % (RQD)	OTHER LAB TESTS / NOTES
0		SILTY SAND (SM) - Dark yellowish brown, medium dense, fine grained sand, slightly moist.							
5		POORLY GRADED SAND WITH CLAY (SP) - Dark grayish brown, medium dense, fine to medium grained sand, some fine gravel, slightly moist.	MC	28	> 4.5				
10		CLAYEY GRAVEL (GC) - Mottled yellowish brown, gray and red, very dense, fine subrounded gravel up to 1"- diameter, some sand, slightly moist.	MC	32/5"					
15		CLAYEY SAND (SC) - Mottled dark yellowish brown with red and yellow, very dense, little gravel, fine to coarse grained sand, slightly moist to moist.	MC	32/5"					
20		LEAN CLAY WITH SAND (CL) - Brown, hard, fine grained sand, slightly moist. (HARDPAN DEPOSIT)	MC	55	2.25	94	29		LL: 45 PI:18 Gravel: 0% Sand: 17% Silt: 48% Clay: 35%
25		SANDY LEAN CLAY (CL) - Mottled grayish brown and dark yellowish brown, very stiff, moist. (HARDPAN DEPOSIT)	MC	25	> 4.5				

Bottom of borehole at 26.5 feet.

Notes:
1. Stratification lines represent the approximate boundaries between material types and the transitions may be gradual.
2. Modified California (MC) blowcounts were adjusted by multiplying field blowcounts by a factor 0.63.
3. Ground elevation should be considered approximate. Elevations from Doble Thomas 2011 survey data.
4. Backfilled with cement grout immediately upon completion.
5. Sample driving method - rope and cathead.

A3GEO, Inc.
1331 Seventh St., Unit E
Berkeley, CA 94710

BORING NUMBER B-17-7

CLIENT ESA-PWA
PROJECT NAME Napa River Restoration - OVOK Reach
PROJECT NUMBER 1110-3A
PROJECT LOCATION Napa, California
DATE STARTED 11/12/12 **COMPLETED** 11/12/12
GROUND ELEVATION 94 ft **HOLE SIZE** 4.5 in
DRILLING CONTRACTOR Northstar Drilling, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Solid Stem Auger
AT TIME OF DRILLING ---
LOGGED BY Pat Drumm **CHECKED BY** KMA
AT END OF DRILLING 25.50 ft / Elev 68.50 ft
NOTES
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	ADJUSTED BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ROCK RECOVERY % (RQD)	OTHER LAB TESTS / NOTES
0		SILTY SAND (SM) - Dark yellowish brown, dense, fine grained sand, slightly moist; possibly Holocene age.							
5		CLAYEY SAND (SC) - Mottled red, yellow and white, very dense, fine to medium grained sand, slightly moist.	MC	32/6"					
10		CLAYEY GRAVEL WITH SAND (GC) - Mottled dark brown, dense, coarse grained subrounded gravel up to 2" diameter, some sand, slightly moist.	MC	43					
15		SILTY SAND (SM) - Brown, dense, some fine gravel, wet. - at 15.0': no recovery in sampler	MC	17					
20		LEAN CLAY WITH SAND (CL) - Mottled grayish brown, hard, some fine grained sand and some silt, trace gravel, slightly moist. (HARDPAN DEPOSIT)	MC	30	> 4.5	91	31		LL: 45 PI:22 Gravel: 1% Sand: 26% Silt: 33% Clay: 40%
25		▼ - at 25.0': increase in medium to coarse grained sand, wet, grades to loose density.	MC	10					

Bottom of borehole at 26.5 feet.

Notes:
1. Stratification lines represent the approximate boundaries between material types and the transitions may be gradual.
2. Modified California (MC) blowcounts were adjusted by multiplying field blowcounts by a factor 0.63.
3. Ground elevation should be considered approximate. Elevations from Doble Thomas 2011 survey data.
4. Backfilled with cement grout immediately upon completion.
5. Sample driving method - rope and cathead.
6. Sample at 15.0' had no recovery.

A3GEO, Inc.
1331 Seventh St., Unit E
Berkeley, CA 94710

BORING NUMBER B-18-1

CLIENT ESA-PWA
PROJECT NAME Napa River Restoration - OVOK Reach
PROJECT NUMBER 1110-3A
PROJECT LOCATION Napa, California
DATE STARTED 11/13/12 **COMPLETED** 11/13/12
GROUND ELEVATION 95 ft **HOLE SIZE** 4.5 in
DRILLING CONTRACTOR Northstar Drilling, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Solid Stem Auger
AT TIME OF DRILLING ---
LOGGED BY Patrick Drumm **CHECKED BY** KMA
AT END OF DRILLING 18.80 ft / Elev 76.20 ft
NOTES
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	ADJUSTED BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ROCK RECOVERY % (RQD)	OTHER LAB TESTS / NOTES
0		SANDY SILT WITH GRAVEL (ML) - Dark brown, stiff, slightly moist.							
5			MC	14					
		LEAN CLAY WITH SAND (CL) - Very dark brown, stiff, fine grained sand, moist.							
10			MC	16	4.0				
		FAT CLAY (CH) - Brown, very stiff, some silt, slightly moist.							
15		LEAN CLAY WITH SAND (CL) - Mottled yellowish brown, very stiff, some coarse gravel, slightly moist. (HARDPAN DEPOSIT)	SPT	26					
		FAT CLAY WITH SAND (CH) - Brown, very stiff, fine grained sand, slightly moist. (HARDPAN DEPOSIT)							
20		▼ - at 18.5': Brown, hard	MC	40	> 4.5	95	28		LL: 51 PI: 26 Gravel: 0% Sand: 7% Silt: 43% Clay: 50%
25			MC	18	4.0				

Bottom of borehole at 26.5 feet.

Notes:
1. Stratification lines represent the approximate boundaries between material types and the transitions may be gradual.
2. Modified California (MC) blowcounts were adjusted by multiplying field blowcounts by a factor 0.63.
3. Ground elevation should be considered approximate. Elevations from Doble Thomas 2011 survey data.
4. Backfilled with cement grout immediately upon completion.
5. Sampler driven by rope and cathead method.

BORING NUMBER B-18-2

A3GEO, Inc.
1331 Seventh St., Unit E
Berkeley, CA 94710

CLIENT ESA-PWA
PROJECT NAME Napa River Restoration - OVOK Reach
PROJECT NUMBER 1110-3A
PROJECT LOCATION Napa, California
DATE STARTED 11/13/12 **COMPLETED** 11/13/12
GROUND ELEVATION 93 ft **HOLE SIZE** 4.5 in
DRILLING CONTRACTOR Northstar Drilling, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Solid Stem Auger
AT TIME OF DRILLING ---
LOGGED BY Patrick Drumm **CHECKED BY** KMA
AT END OF DRILLING 17.10 ft / Elev 75.90 ft
NOTES
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	ADJUSTED BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ROCK RECOVERY % (RQD)	OTHER LAB TESTS / NOTES
0		SILT WITH SAND (ML) - Dark brown, firm, fine grained sand some gravel, slightly moist.							
5		LEAN CLAY WITH SAND (CL) - Dark brown and reddish brown, stiff, some silt, low plasticity, some mottling, slightly moist. (HARDPAN DEPOSIT)	MC	14	4.25				
10		CLAYEY GRAVEL WITH SAND (GC) - Mottled dark reddish brown, dense, coarse subrounded gravel up to 2 inches in diameter, moist.	MC	49					
15		CLAYEY SAND WITH GRAVEL (SC) - Mottled reddish brown, medium dense, fine to coarse grained sand, fine to medium gravel, moist.	SPT	15					
20		- at 20.0': Wet, gravel up to 1 inch diameter	SPT	29					
25		LEAN CLAY WITH SAND (CL) - Dark yellowish brown, hard, fine grained sand, sand lenses, moist. (HARDPAN DEPOSIT)							
		- at 25.0': No recovery	MC	53					

Bottom of borehole at 26.5 feet.

Notes:
1. Stratification lines represent the approximate boundaries between material types and the transitions may be gradual.
2. Modified California (MC) blowcounts were adjusted by multiplying field blowcounts by a factor 0.63.
3. Ground elevation should be considered approximate. Elevations from Doble Thomas 2011 survey data.
4. Backfilled with cement grout immediately upon completion.
5. Sampler driven by rope and cathead method.

A3GEO, Inc.
1331 Seventh St., Unit E
Berkeley, CA 94710

BORING NUMBER B-18-3

CLIENT ESA-PWA
PROJECT NAME Napa River Restoration - OVOK Reach
PROJECT NUMBER 1110-3A
PROJECT LOCATION Napa, California
DATE STARTED 11/13/12 **COMPLETED** 11/13/12
GROUND ELEVATION 93 ft **HOLE SIZE** 4.5 in
DRILLING CONTRACTOR Northstar Drilling, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Solid Stem Auger
AT TIME OF DRILLING ---
LOGGED BY Patrick Drumm **CHECKED BY** KMA
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	ADJUSTED BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ROCK RECOVERY % (RQD)	OTHER LAB TESTS / NOTES
0		SILTY SAND (SM) - Dark brown, medium dense, fine grained sand, slightly moist; possibly Holocene age.							
5			MC	17	> 4.5				
		FAT CLAY (CH) - Brown, very stiff, little fine grained sand, slightly moist.							
10			MC	19	4.5				
		CLAYEY GRAVEL (GC) - Mottled brown, dense, slightly moist.							
15		SAND WITH SILT (SP) - Mottled dark brown, medium dense, trace clay, fine to medium grained sand, low plasticity fines, slightly moist. - at 16.0': Iron-oxide staining	MC	11					
20		WELL GRADED GRAVEL (GW) - Mottled dark brown, dense, some medium to coarse grained sand, wet.	MC	50					
25		SILTY SAND (SM) - Pale brown with yellowish brown mottling, medium dense, fine grained sand, moist. (HARDPAN DEPOSIT)	MC	15					

Bottom of borehole at 26.5 feet.
Notes:
1. Stratification lines represent the approximate boundaries between material types and the transitions may be gradual.
2. Modified California (MC) blowcounts were adjusted by multiplying field blowcounts by a factor 0.63.
3. Ground elevation should be considered approximate. Elevations from Doble Thomas 2011 survey data.
4. Backfilled with cement grout immediately upon completion.
5. Sampler driven by rope and cathead method.
6. Groundwater was not encountered.

A3GEO, Inc.
1331 Seventh St., Unit E
Berkeley, CA 94710

BORING NUMBER B-18-4

CLIENT ESA-PWA
PROJECT NAME Napa River Restoration - OVOK Reach
PROJECT NUMBER 1110-3A
PROJECT LOCATION Napa, California
DATE STARTED 11/13/12 **COMPLETED** 11/13/12
GROUND ELEVATION 93 ft **HOLE SIZE** 4.5 in
DRILLING CONTRACTOR Northstar Drilling, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Solid Stem Auger
AT TIME OF DRILLING ---
LOGGED BY Patrick Drumm **CHECKED BY** KMA
AT END OF DRILLING 19.20 ft / Elev 73.80 ft
NOTES
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	ADJUSTED BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ROCK RECOVERY % (RQD)	OTHER LAB TESTS / NOTES
0		SILTY SAND (SM) - Dark brown, medium dense, fine grained sand, low plasticity fines, slightly moist.							
5		- at 6.0': Dark grayish brown, fine to medium grained sand, little fine gravel, no plasticity.	MC	15					
10		CLAYEY GRAVEL (GC) - Mottled dark brown and dark reddish brown, medium dense, few fine sand, iron oxide staining, slightly moist.	MC	26					
15		- at 15.0': wet, fine to coarse gravel. - at 16.5': rounded 2 inch diameter clast.	MC	37					
20		SILTY SAND (SM) - Dark brown, loose, wet.	MC	7					Sample at 20.0 ft had no recovery.
25		POORLY GRADED GRAVEL WITH SAND (GP) - Brown, medium dense, little silt, wet.	SPT	18					

Bottom of borehole at 26.5 feet.

Notes:
1. Stratification lines represent the approximate boundaries between material types and the transitions may be gradual.
2. Modified California (MC) blowcounts were adjusted by multiplying field blowcounts by a factor 0.63.
3. Ground elevation should be considered approximate. Elevations from Doble Thomas 2011 survey data.
4. Backfilled with cement grout immediately upon completion.
5. Sampler driven by rope and cathead method.

A3GEO, Inc.
1331 Seventh St., Unit E
Berkeley, CA 94710

BORING NUMBER B-18-5

CLIENT ESA-PWA
PROJECT NAME Napa River Restoration - OVOK Reach
PROJECT NUMBER 1110-3A
PROJECT LOCATION Napa, California
DATE STARTED 11/14/12 **COMPLETED** 11/14/12
GROUND ELEVATION 95 ft **HOLE SIZE** 4.5 in
DRILLING CONTRACTOR Northstar Drilling, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Solid Stem Auger
AT TIME OF DRILLING ---
LOGGED BY Patrick Drumm **CHECKED BY** KMA
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	ADJUSTED BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ROCK RECOVERY % (RQD)	OTHER LAB TESTS / NOTES
0		SILTY SAND (SM) - Dark brown to light brown, medium dense, trace gravel, fine grained sand, slightly moist; possibly Holocene age.	MC	18					
		- At 2.5': Loose, few gravel.	SPT	10					
5		SILT WITH SAND (ML) - Dark yellowish brown, very stiff, moderate cementation, fine grained sand, trace fine roots, slightly moist; possibly Holocene age.	MC	21	> 4.5				
		- At 6.5': Stiff.	SPT	15					
10		CLAYEY SAND (SC) - Mottled orange and brown, medium dense, fine to coarse grained sand, few gravels, slightly moist.	MC	43					

Bottom of borehole at 11.5 feet.
Notes:
1. Stratification lines represent the approximate boundaries between material types and the transitions may be gradual.
2. Modified California (MC) blowcounts were adjusted by multiplying field blowcounts by a factor 0.63.
3. Ground elevation should be considered approximate. Elevations from Doble Thomas 2011 survey data.
4. Backfilled with cement grout immediately upon completion.
5. Sampler driven by rope and cathead method.
6. Groundwater was not encountered.

A3GEO, Inc.
1331 Seventh St., Unit E
Berkeley, CA 94710

BORING NUMBER B-18-6

CLIENT ESA-PWA
PROJECT NAME Napa River Restoration - OVOK Reach
PROJECT NUMBER 1110-3A
PROJECT LOCATION Napa, California
DATE STARTED 11/14/12 **COMPLETED** 11/14/12
GROUND ELEVATION 94 ft **HOLE SIZE** 4.5 in
DRILLING CONTRACTOR Northstar Drilling, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Solid Stem Auger
AT TIME OF DRILLING ---
LOGGED BY Patrick Drumm **CHECKED BY** KMA
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	ADJUSTED BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ROCK RECOVERY % (RQD)	OTHER LAB TESTS / NOTES
0		LEAN CLAY (CL) - Yellowish brown, stiff, few fine sand, slightly moist; possibly top soil.							
		SILTY SAND (SM) - Brown, medium dense, fine grained sand, slightly moist; possibly Holocene age.	MC	16					
		SILT WITH SAND (ML) - Dark yellowish brown, stiff, fine grained sand, fines have no plasticity, moderately cemented, trace fine roots, slightly moist; possibly Holocene age.	SPT	14					
5		- At 5.0': Very stiff.	MC	21	> 4.5				
		- At 6.5': Stiff.	SPT	14					
10		CLAYEY GRAVEL (GC) - Brown, dense, subangular coarse grained gravel up to 1-1/2 inch diameter, slightly moist.							

Bottom of borehole at 10.0 feet.
Notes:
1. Stratification lines represent the approximate boundaries between material types and the transitions may be gradual.
2. Modified California (MC) blowcounts were adjusted by multiplying field blowcounts by a factor 0.63.
3. Ground elevation should be considered approximate. Elevations from Doble Thomas 2011 survey data.
4. Backfilled with cement grout immediately upon completion.
5. Sampler driven by rope and cathead method.
6. Groundwater was not encountered.

A3GEO, Inc.
1331 Seventh St., Unit E
Berkeley, CA 94710

BORING NUMBER B-18-7

CLIENT ESA-PWA
PROJECT NAME Napa River Restoration - OVOK Reach
PROJECT NUMBER 1110-3A
PROJECT LOCATION Napa, California
DATE STARTED 11/14/12 **COMPLETED** 11/14/12
GROUND ELEVATION 93 ft **HOLE SIZE** 4.5 in
DRILLING CONTRACTOR Northstar Drilling, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Solid Stem Auger
AT TIME OF DRILLING ---
LOGGED BY Patrick Drumm **CHECKED BY** KMA
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	ADJUSTED BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ROCK RECOVERY % (RQD)	OTHER LAB TESTS / NOTES
0		SILTY SAND (SM) - Brown, medium dense, fine grained sand, slightly moist; possibly Holocene age.	MC	16	> 4.5				
		- at 2.0': Few hair like fibers.	SPT	13					
		SANDY LEAN CLAY (CL) - Dark yellowish brown, stiff, fine grained sand, slightly moist. (HARDPAN DEPOSIT)							
5			MC	20	> 4.5				
		- at 6.0': Medium plasticity, very stiff.	SPT	9					
		- at 6.5': Some reddish brown mottling, stiff.							
10									
		CLAYEY SAND WITH GRAVEL (SC) - Brown, medium dense, fine to medium grained sand, few rounded coarse gravel up to 1-1/2 inch diameter, slightly moist.	MC	28					

Bottom of borehole at 11.5 feet.
Notes:
1. Stratification lines represent the approximate boundaries between material types and the transitions may be gradual.
2. Modified California (MC) blowcounts were adjusted by multiplying field blowcounts by a factor 0.63.
3. Ground elevation should be considered approximate. Elevations from Doble Thomas 2011 survey data.
4. Backfilled with cement grout immediately upon completion.
5. Sampler driven by rope and cathead method.
6. Groundwater was not encountered.

A3GEO, Inc.
1331 Seventh St., Unit E
Berkeley, CA 94710

BORING NUMBER B-18-8

CLIENT ESA-PWA
PROJECT NAME Napa River Restoration - OVOK Reach
PROJECT NUMBER 1110-3A
PROJECT LOCATION Napa, California
DATE STARTED 11/14/12 **COMPLETED** 11/14/12
GROUND ELEVATION 91 ft **HOLE SIZE** 4.5 in
DRILLING CONTRACTOR Northstar Drilling, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Solid Stem Auger
AT TIME OF DRILLING ---
LOGGED BY Patrick Drumm **CHECKED BY** KMA
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	ADJUSTED BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ROCK RECOVERY % (RQD)	OTHER LAB TESTS / NOTES
0		SILTY SAND (SM) - Brown, loose to medium dense, fine grained sand, slightly moist; possibly Holocene age.	MC	13	> 4.5				
		SANDY SILT (ML) - Dark yellowish brown, stiff, fine grained sand, slightly moist.	SPT	9					
5		- at 5.0': Some reddish brown mottling, single 3-inch long root.	MC	13	> 4.5				
		- at 6.5': Firm, some reddish brown mottling. (HARDPAN DEPOSIT)	SPT	6					
10		- at 10.0': Stiff, low to medium plasticity. - at 11.5': Fine gravel.	MC	12	3.75				

Bottom of borehole at 11.5 feet.
Notes:
1. Stratification lines represent the approximate boundaries between material types and the transitions may be gradual.
2. Modified California (MC) blowcounts were adjusted by multiplying field blowcounts by a factor 0.63.
3. Ground elevation should be considered approximate. Elevations from Doble Thomas 2011 survey data.
4. Backfilled with cement grout immediately upon completion.
5. Sampler driven by rope and cathead method.
6. Groundwater was not encountered.

A3GEO, Inc.
1331 Seventh St., Unit E
Berkeley, CA 94710

BORING NUMBER B-19-1

CLIENT ESA-PWA
PROJECT NAME Napa River Restoration - OVOK Reach
PROJECT NUMBER 1110-3A
PROJECT LOCATION Napa, California
DATE STARTED 11/19/12 **COMPLETED** 11/19/12
GROUND ELEVATION 100 ft **HOLE SIZE** 4.5 in
DRILLING CONTRACTOR Northstar Drilling, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Solid Stem Auger
AT TIME OF DRILLING ---
LOGGED BY Pat Drumm **CHECKED BY** KMA
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	ADJUSTED BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ROCK RECOVERY % (RQD)	OTHER LAB TESTS / NOTES
0		SANDY SILT WITH GRAVEL (ML) - Mottled dark brown, firm to stiff, slightly moist.							
5		SILTY SAND WITH GRAVEL (SM) - Mottled dark yellowish brown with red and yellow, dense, fine to coarse grained sand, fine to coarse gravel, slightly moist.	SPT	31					
10		SANDY CLAY (CL) - Olive brown, very stiff, fine to coase grained sand, trace fine gravel, low plasticity fines, moist. (HARDPAN DEPOSIT)	MC	21					
		CLAYEY SAND (SC) - Mottled olive gray with red and yellow, medium dense, fine to coarse sand, few fine gravel, wet. (HARDPAN DEPOSIT)							
15		CLAYEY GRAVEL WITH SAND (GC) - Mottled brown, medium dense, subrounded 2-1/2 in diameter coarse gravel in shoe, moist.							
		CLAYEY SAND (SC) - Dark yellowish brown, medium dense, fine to medium grained sand, moist to wet. (HARDPAN DEPOSIT)	SPT	18					

Bottom of borehole at 18.0 feet.
Notes:
1. Stratification lines represent the approximate boundaries between material types and the transitions may be gradual.
2. Modified California (MC) blowcounts were adjusted by multiplying field blowcounts by a factor 0.63.
3. Ground elevation should be considered approximate. Elevations from Lidar topographic map.
4. Caving observed in bottom 1 foot of hole.
5. Sampler driven by rope - cathead method.
6. Groundwater not encountered.
7. Piezometer installed in excavated boring. See Report for additional information.

A3GEO, Inc.
1331 Seventh St., Unit E
Berkeley, CA 94710

BORING NUMBER B-19-2

CLIENT ESA-PWA
PROJECT NAME Napa River Restoration - OVOK Reach
PROJECT NUMBER 1110-3A
PROJECT LOCATION Napa, California
DATE STARTED 11/19/12 **COMPLETED** 11/19/12
GROUND ELEVATION 100 ft **HOLE SIZE** 4.5 in
DRILLING CONTRACTOR Northstar Drilling, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Solid Stem Auger
AT TIME OF DRILLING ---
LOGGED BY Pat Drumm **CHECKED BY** KMA
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	ADJUSTED BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ROCK RECOVERY % (RQD)	OTHER LAB TESTS / NOTES
0		SILTY SAND WITH GRAVEL (SM) - Dark brown, very stiff, fine to coarse grained sand, fine to coarse gravel, slightly moist; possibly Holocene age.							
5			MC	17	4.5				
		CLAYEY SAND WITH GRAVEL (SC) - Brown, medium dense, fine to coarse grained sand, fine gravel, moist to wet.							
10		POORLY GRADED SAND WITH CLAY AND GRAVEL (SP-SC) - Mottled dark brown with red and yellow, dense, medium to coarse grained sand, fine to coarse gravel, medium plasticity fines, wet.	MC	37					
		SILTY SAND (SM) - Pale brown, very dense, fine grained sand, few fine gravel, slightly moist. (HARDPAN DEPOSIT)							
15			MC	32/4"					

Bottom of borehole at 17.8 feet.
Notes:
1. Stratification lines represent the approximate boundaries between material types and the transitions may be gradual.
2. Modified California (MC) blowcounts were adjusted by multiplying field blowcounts by a factor 0.63.
3. Ground elevation should be considered approximate. Elevations from Lidar topographic map.
4. Caving observed in bottom 1 foot of hole.
5. Sampler driven by rope - cathead method.
6. Groundwater not encountered.
7. Piezometer installed in excavated boring. See Report for additional information.

A3GEO, Inc.
1331 Seventh St., Unit E
Berkeley, CA 94710

BORING NUMBER B-22-1

CLIENT ESA-PWA
PROJECT NAME Napa River Restoration - OVOK Reach
PROJECT NUMBER 1110-3A
PROJECT LOCATION Napa, California
DATE STARTED 11/6/12 **COMPLETED** 11/6/12
GROUND ELEVATION 92 ft **HOLE SIZE** 4.5 in
DRILLING CONTRACTOR Northstar Drilling, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Solid Stem Auger
AT TIME OF DRILLING ---
LOGGED BY Patrick Drumm **CHECKED BY** KMA
AT END OF DRILLING 20.10 ft / Elev 71.90 ft
NOTES
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	ADJUSTED BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ROCK RECOVERY % (RQD)	OTHER LAB TESTS / NOTES
0		FAT CLAY WITH SAND (CH) - Yellowish brown with some orange mottling, stiff, slightly moist. (HARDPAN DEPOSIT)	MC	13	> 4.5				
		- at 3.0': Very stiff.	MC	25	> 4.5				
5			MC	23					
		CLAYEY SAND (SC) - Mottled dark brown and dark yellowish brown, medium dense, fine grained sand, moist. (HARDPAN DEPOSIT)							
10		- at 10.0': Dense.	MC	32					
15		CLAYEY GRAVEL WITH SAND (GC) - Mottled brown and gray, dense, subgrounded coarse gravel, wet.	MC	43					
20		FAT CLAY (CH) - Light yellowish brown, stiff, low plasticity fines, trace fine grained sand, moist. (HARDPAN DEPOSIT)	MC	11	3.25 2.0	83	39		LL: 51 PI: 27 Gravel: 0% Sand: 3% Silt: 82% Clay: 15%

Bottom of borehole at 21.5 feet.

Notes:
1. Stratification lines represent the approximate boundaries between material types and the transitions may be gradual.
2. Modified California (MC) blowcounts were adjusted by multiplying field blowcounts by a factor 0.63.
3. Ground elevation should be considered approximate. Elevations from Doble Thomas 2011 survey data.
4. Backfilled with cement grout immediately upon completion.
5. Sampler driving method - rope and cathead.

A3GEO, Inc.
1331 Seventh St., Unit E
Berkeley, CA 94710

BORING NUMBER B-22-2

CLIENT ESA-PWA
PROJECT NAME Napa River Restoration - OVOK Reach
PROJECT NUMBER 1110-3A
PROJECT LOCATION Napa, California
DATE STARTED 11/6/12 **COMPLETED** 11/6/12
GROUND ELEVATION 98 ft **HOLE SIZE** 4.5 in
DRILLING CONTRACTOR Northstar Drilling, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Solid Stem Auger
AT TIME OF DRILLING ---
LOGGED BY Patrick Drumm **CHECKED BY** KMA
AT END OF DRILLING 13.30 ft / Elev 84.70 ft
NOTES
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	ADJUSTED BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ROCK RECOVERY % (RQD)	OTHER LAB TESTS / NOTES
0		SILTY SAND (SM) - Dark yellowish brown, fine grained sand, medium dense, slightly moist; possibly Holocene age.	MC	10					
		POORLY GRADED SAND (SP) - Mottled gray and brown, medium dense, slightly moist.							
		SANDY LEAN CLAY (CL) - Mottled yellowish brown with orange, stiff, fine grained sand, moderate plasticity, slightly moist. (HARDPAN DEPOSIT)	MC	14	4.5				
5		- at 5.0': Mottled dark grayish brown and orange.	MC	15	4.5				
10		- at 10.0': Fine grained gravel.	MC	38					
		CLAYEY GRAVEL WITH SAND (GC) - Mottled brown and gray, dense, slightly moist.							
		SANDY LEAN CLAY (CL) - Yellowish brown, stiff, fine grained sand, plastic fines, wet. (HARDPAN DEPOSIT)							
15			MC	15	> 4.5				
20		CLAYEY GRAVEL WITH SAND (GC) - Mottled reddish brown, olive brown, and gray, dense, subrounded fine gravel, coarse grained sand, moist.	MC	44					

Bottom of borehole at 21.5 feet.

Notes:
1. Stratification lines represent the approximate boundaries between material types and the transitions may be gradual.
2. Modified California (MC) blowcounts were adjusted by multiplying field blowcounts by a factor 0.63.
3. Ground elevation should be considered approximate. Elevations from Doble Thomas 2011 survey data.
4. Backfilled with cement grout immediately upon completion.
5. Sampler driving method - rope and cathead.

A3GEO, Inc.
1331 Seventh St., Unit E
Berkeley, CA 94710

BORING NUMBER B-22-3

CLIENT ESA-PWA
PROJECT NAME Napa River Restoration - OVOK Reach
PROJECT NUMBER 1110-3A
PROJECT LOCATION Napa, California
DATE STARTED 11/6/12 **COMPLETED** 11/6/12
GROUND ELEVATION 95 ft **HOLE SIZE** 4.5 in
DRILLING CONTRACTOR Northstar Drilling, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Solid Stem Auger
AT TIME OF DRILLING ---
LOGGED BY Patrick Drumm **CHECKED BY** KMA
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	ADJUSTED BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ROCK RECOVERY % (RQD)	OTHER LAB TESTS / NOTES
0		SILTY SAND (SM) - Dark brown, medium dense, fine grained sand, slightly moist; Possible Holocene age.							
5		SANDY CLAY (CL) - Mottled grayish brown and orange, stiff, fine grained sand, slightly moist. (HARDPAN DEPOSIT)	MC	14	> 4.5				
		CLAYEY GRAVEL (GC) - Mottled brown and gray, dense, subrounded gravel, slightly moist.							
10			MC	35					
		SANDY FAT CLAY (CH) - Mottled dark yellowish brown and reddish brown, stiff, fine grained sand, wet. (HARDPAN DEPOSIT)							
15			MC	11	4.5				

Bottom of borehole at 16.5 feet.

Notes:
1. Stratification lines represent the approximate boundaries between material types and the transitions may be gradual.
2. Modified California (MC) blowcounts were adjusted by multiplying field blowcounts by a factor 0.63.
3. Ground elevation should be considered approximate. Elevations from Doble Thomas 2011 survey data.
4. Backfilled with cement grout immediately upon completion.
5. Sampler driving method - rope and cathead.
6. Groundwater was not encountered.

A3GEO, Inc.
1331 Seventh St., Unit E
Berkeley, CA 94710

BORING NUMBER B-22-4

CLIENT ESA-PWA
PROJECT NAME Napa River Restoration - OVOK Reach
PROJECT NUMBER 1110-3A
PROJECT LOCATION Napa, California
DATE STARTED 11/6/12 **COMPLETED** 11/6/12
GROUND ELEVATION 93 ft **HOLE SIZE** 4.5 in
DRILLING CONTRACTOR Northstar Drilling, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Solid Stem Auger
AT TIME OF DRILLING ---
LOGGED BY Patrick Drumm **CHECKED BY** KMA
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	ADJUSTED BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ROCK RECOVERY % (RQD)	OTHER LAB TESTS / NOTES
0		SILTY SAND (SM) - Dark brown, medium dense, fine grained sand, slightly moist; Possible Holocene age.							
5		SANDY LEAN CLAY (CL) - Mottled gray and dark yellowish brown, fine grained sand, stiff, slightly moist. (HARDPAN DEPOSIT)	MC	15	> 4.5				
10		CLAYEY GRAVEL WITH SAND (GC) - Mottled gray and brown, medium dense, coarse grained sand, slightly moist; granular material consist of andesite and riolite volcanics.	SPT	14					
15		CLAYEY SAND (SC) - Mottled gray and brown, medium dense, coarse grained sand and fine gravel, moist.	MC	17					

Bottom of borehole at 16.5 feet.
Notes:
1. Stratification lines represent the approximate boundaries between material types and the transitions may be gradual.
2. Modified California (MC) blowcounts were adjusted by multiplying field blowcounts by a factor 0.63.
3. Ground elevation should be considered approximate. Elevations from Doble Thomas 2011 survey data.
4. Backfilled with cement grout immediately upon completion.
5. Sampler driving method - rope and cathead.
6. Groundwater was not encountered.

BORING NUMBER B-26A-1

A3GEO, Inc.
1331 Seventh St., Unit E
Berkeley, CA 94710

CLIENT ESA-PWA
PROJECT NAME Napa River Restoration - OVOK Reach
PROJECT NUMBER 1110-3A
PROJECT LOCATION Napa, California
DATE STARTED 11/26/12 **COMPLETED** 11/26/12
GROUND ELEVATION 118 ft **HOLE SIZE** 4.5 in
DRILLING CONTRACTOR Northstar Drilling, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Solid Stem Auger
AT TIME OF DRILLING ---
LOGGED BY Patrick Drumm **CHECKED BY** KMA
AT END OF DRILLING 18.10 ft / Elev 99.90 ft
NOTES
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	ADJUSTED BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ROCK RECOVERY % (RQD)	OTHER LAB TESTS / NOTES
0		SILTY SAND (SM) - Dark yellowish brown, medium dense, fine grained sand, fines have low plasticity, slightly moist.							
5			MC	25					
10		- at 11.0': Golden yellow brown, trace micaceous fines.	MC	18					
15		SANDY LEAN CLAY (CL) - Brown, firm, fine grained sand, trace micaceous fines, moist. (HARDPAN DEPOSIT)	MC	5	1.5	91	29		LL: 33 PI: 14 Gravel: 0% Sand: 44% Silt: 41% Clay: 15%
20		SILTY SAND (SM) - Olive brown, loose, fine to medium sand, fines have no plasticity, wet. (HARDPAN DEPOSIT)	MC	8	0.05				
		FAT CLAY WITH SAND (CH) - Dark olive brown, firm, medium to coarse grained sand, wet. (HARDPAN DEPOSIT)							
25		- at 25' : Olive gray and greenish gray, stiff, fine grained sand	MC	9	1.75				

Bottom of borehole at 26.5 feet.
Notes:
1. Stratification lines represent the approximate boundaries between material types and the transitions may be gradual.
2. Modified California (MC) blowcounts were adjusted by multiplying field blowcounts by a factor 0.63.
3. Ground elevation should be considered approximate. Elevations from Doble Thomas 2011 survey data.
4. Backfilled with cement grout immediately upon completion.
5. Sampler driving method - rope and cathead.

BORING NUMBER B-26B-1

A3GEO, Inc.
1331 Seventh St., Unit E
Berkeley, CA 94710

CLIENT ESA-PWA
PROJECT NAME Napa River Restoration - OVOK Reach
PROJECT NUMBER 1110-3A
PROJECT LOCATION Napa, California
DATE STARTED 11/26/12 **COMPLETED** 11/26/12
GROUND ELEVATION 114 ft **HOLE SIZE** 4.5 in
DRILLING CONTRACTOR Northstar Drilling, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Solid Stem Auger
AT TIME OF DRILLING ---
LOGGED BY Patrick Drumm **CHECKED BY** KMA
AT END OF DRILLING 20.40 ft / Elev 93.60 ft
NOTES
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	ADJUSTED BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ROCK RECOVERY % (RQD)	OTHER LAB TESTS / NOTES
0		SILTY SAND (SM) - Dark yellowish brown, medium dense, fine grained sand, slightly moist; possibly Holocene age.							
5		- at 5.5': Fine to medium grained sand, thin 1-1/2 inch long root.	MC	16					
10		SAND WITH SILT (SP-SM) - Yellowish brown, medium dense, fine to medium grained sand, no plasticity, trace micaceous fines, moist; possibly Holocene age. - at 10.5' to 16.0': 0.1-inch diameter root found through samples.	MC	20					
15			MC	18					
20		SAND (SP) - Yellow and reddish brown, medium dense, fine to medium grained sand, moist to wet.							
		POORLY GRADED GRAVEL WITH SAND (GP) - Dark gray, medium dense, medium to coarse grained sand, fine grained gravel, subangular to subrounded gravel, wet.	MC	15					

Bottom of borehole at 21.5 feet.

Notes:
1. Stratification lines represent the approximate boundaries between material types and the transitions may be gradual.
2. Modified California (MC) blowcounts were adjusted by multiplying field blowcounts by a factor 0.63.
3. Ground elevation should be considered approximate. Elevations from Doble Thomas 2011 survey data.
4. Backfilled with cement grout immediately upon completion.
5. Sampler driving method - rope and cathead.

BORING NUMBER B-26C-1

A3GEO, Inc.
1331 Seventh St., Unit E
Berkeley, CA 94710

CLIENT ESA-PWA
PROJECT NAME Napa River Restoration - OVOK Reach
PROJECT NUMBER 1110-3A
PROJECT LOCATION Napa, California
DATE STARTED 11/26/12 **COMPLETED** 11/26/12
GROUND ELEVATION 114 ft **HOLE SIZE** 4.5 in
DRILLING CONTRACTOR Northstar Drilling, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Solid Stem Auger
AT TIME OF DRILLING ---
LOGGED BY Patrick Drumm **CHECKED BY** KMA
AT END OF DRILLING 21.70 ft / Elev 92.30 ft
NOTES
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	ADJUSTED BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ROCK RECOVERY % (RQD)	OTHER LAB TESTS / NOTES
0		SILTY SAND (SM) - Yellowish brown, fine grained sand, medium dense, fines have no plasticity, slightly moist.							
5			MC	18					
10		- at 10.5': Lightly cemented.	MC	21					
15		WELL GRADED SAND (SW) - Yellowish brown and black, loose, fine to coarse sand, trace fine gravel, slightly moist.	MC	9					
20		POORLY GRADED SAND WITH GRAVEL (SP) - Dark gray, loose, medium to coarse grained sand, fine gravel, slightly moist. ▼	MC	4					
25		POORLY GRADED GRAVEL WITH SAND (GP) - Olive to dark brown, medium dense, medium to coarse grained sand, fine gravel, few silt, wet.	MC	16					

Bottom of borehole at 26.5 feet.
Notes:
1. Stratification lines represent the approximate boundaries between material types and the transitions may be gradual.
2. Modified California (MC) blowcounts were adjusted by multiplying field blowcounts by a factor 0.63.
3. Ground elevation should be considered approximate. Elevations from Doble Thomas 2011 survey data.
4. Backfilled with cement grout immediately upon completion.
5. Sampler driving method - rope and cathead.

BORING NUMBER B-27-1

A3GEO, Inc.
1331 Seventh St., Unit E
Berkeley, CA 94710

CLIENT ESA-PWA
PROJECT NAME Napa River Restoration - OVOK Reach
PROJECT NUMBER 1110-3A
PROJECT LOCATION Napa, California
DATE STARTED 1/22/13 **COMPLETED** 1/22/13
GROUND ELEVATION 124 ft **HOLE SIZE** 4.5 in
DRILLING CONTRACTOR Northstar Drilling, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Solid Stem Auger
AT TIME OF DRILLING ---
LOGGED BY Patrick Drumm **CHECKED BY** KMA
AT END OF DRILLING ---
NOTES
AFTER DRILLING 17.00 ft / Elev 107.00 ft

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	ADJUSTED BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ROCK RECOVERY % (RQD)	OTHER LAB TESTS / NOTES
0		LEAN CLAY (CL) - Dark brown, firm, little fine sand, moist; possibly Holocene age.							
5			MC	8					
10		SILTY SAND (SM) - Dark brown, medium dense, fine grained sand, moist; poorly consolidated. - At 11.5': Encountered small gravel and charcoal fragments during drilling.	MC	13					
15		WELL GRADED GRAVEL WITH SAND (GW) - Mottled gray and brown, medium dense, trace clay, moist.	MC	12					
20		CLAYEY SAND WITH GRAVEL (SC) - Mottled gray and brown, dense to very dense, medium to coarse grained sand, moist.							- At 20': Excessive caving caused use of bentonite to seal area in order to continue drilling and sampling.
25			SPT	52/11"					

Bottom of borehole at 26.4 feet.
Notes:
1. Stratification lines represent approximate boundaries betweeen material types and transitions may be gradual.
2. Modified California (MC) blowcounts were adjusted by multiplying field blowcounts by a factor of 0.63
3. Ground elevation should be considered approximate. Elevations from Doble Thomas 2011 survey data.
4. Caving observed below a depth of 20 feet.
5. SPT Sample attempted at 20' - 21.5' but excessive carving caused inaccurate blow count readings.
6. Backfilled with cement grout 15 minutes after completion.
7. Groundwater reading taken 10 minutes after completion of boring.

A3GEO, Inc.
1331 Seventh St., Unit E
Berkeley, CA 94710

BORING NUMBER B-28-1

CLIENT ESA-PWA
PROJECT NAME Napa River Restoration - OVOK Reach
PROJECT NUMBER 1110-3A
PROJECT LOCATION Napa, California
DATE STARTED 11/26/12 **COMPLETED** 11/26/12
GROUND ELEVATION 125 ft **HOLE SIZE** 4.5 in
DRILLING CONTRACTOR Northstar Drilling, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Solid Stem Auger
AT TIME OF DRILLING ---
LOGGED BY Patrick Drumm **CHECKED BY** KMA
AT END OF DRILLING 19.40 ft / Elev 105.60 ft
NOTES
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	ADJUSTED BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ROCK RECOVERY % (RQD)	OTHER LAB TESTS / NOTES
0		SILTY SAND (SM) - Dark yellowish brown, fine to medium grained sand, medium dense, slightly moist.							
5		- At 5.5': 0.3 inch diameter root found in sampler.	MC	19					
		WELL GRADED SAND WITH SILT AND GRAVEL (SW-SM) - Dark gray, medium dense, fine to coarse grained sand, fine gravel, fines have no plasticity, slightly moist.							
10			MC	14					
15		POORLY GRADED SAND WITH CLAY AND GRAVEL (SP-SC) - Olive brown, medium dense, fine to coarse grained sand, fine gravel, low plasticity fines, moist.	MC	11					
20		POORLY GRADED SAND WITH GRAVEL (SP) - Dark gray, medium dense, fine to coarse grained sand, fine to coarse gravel (rounded to subrounded), trace silt, moist.	MC	20					

Bottom of borehole at 21.5 feet.

Notes:
1. Stratification lines represent the approximate boundaries between material types and the transitions may be gradual.
2. Modified California (MC) blowcounts were adjusted by multiplying field blowcounts by a factor 0.63.
3. Ground elevation should be considered approximate. Elevations from Doble Thomas 2011 survey data.
4. Backfilled with cement grout upon completion of drilling.

A3GEO, Inc.
1331 Seventh St., Unit E
Berkeley, CA 94710

BORING NUMBER B-29-1

CLIENT ESA-PWA
PROJECT NAME Napa River Restoration - OVOK Reach
PROJECT NUMBER 1110-3A
PROJECT LOCATION Napa, California
DATE STARTED 11/27/12 **COMPLETED** 11/27/12
GROUND ELEVATION 124 ft **HOLE SIZE** 4.5 in
DRILLING CONTRACTOR Northstar Drilling, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Solid Stem Auger
AT TIME OF DRILLING ---
LOGGED BY Patrick Drumm **CHECKED BY** KMA
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	ADJUSTED BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ROCK RECOVERY % (RQD)	OTHER LAB TESTS / NOTES
0		SILTY SAND (SM) - Yellowish brown, fine grained sand, medium dense, fines have no plasticity, slightly moist; possibly Holocene age.							
5		SANDY LEAN CLAY (CL) - Very dark gray, very stiff to hard, fine grained sand, slightly moist. (HARDPAN DEPOSIT)	MC	19	> 4.5				
10		SILTY SAND (SM) - Light yellowish brown, little fine grained gravel, very dense, slightly moist. (HARDPAN DEPOSIT)	MC	32/4"					
15		- At 14' : Mottled light brownish gray and brown, lightly cemented.	MC	32/3"		100	23		LL: 28 PI: 0 Gravel: 22% Sand: 64% Silt: 7% Clay: 7%
20		SILTY SAND WITH GRAVEL (SM) - Yellowish brown, fine to coarse grained sand, little gravel, very dense, slightly moist to moist.							
		SANDY GRAVEL WITH CLAY (GP) - Mottled yellowish brown and dark brown, medium to coarse grained sand, fine gravel, dense, wet. - At 21': Some maroon-red colored gravel.	MC	37					
25		CLAYEY SAND (SC) - Grayish brown, very dense, fine to coarse grained sand, trace fine gravel, slightly moist. (HARDPAN DEPOSIT)	MC SPT	32/5" 50/5"		108	18		LL: 33 PI: 11 Gravel: 3% Sand: 61% Silt: 15% Clay: 21%

Bottom of borehole at 26.0 feet.

Notes:
1. Stratification lines represent the approximate boundaries between material types and the transitions may be gradual.
2. Modified California (MC) blowcounts were adjusted by multiplying field blowcounts by a factor 0.63.
3. Ground elevation should be considered approximate. Elevations from Doble Thomas 2011 survey data.
4. Ground water not encountered.
5. Backfilled with cement grout immediately upon completion.
6. Sample driving method - rope and cathead.

BORING NUMBER B-29-2

A3GEO, Inc.
1331 Seventh St., Unit E
Berkeley, CA 94710

CLIENT ESA-PWA
PROJECT NAME Napa River Restoration - OVOK Reach
PROJECT NUMBER 1110-3A
PROJECT LOCATION Napa, California
DATE STARTED 11/27/12 **COMPLETED** 11/27/12
GROUND ELEVATION 123 ft **HOLE SIZE** 4.5 in
DRILLING CONTRACTOR Northstar Drilling, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Solid Stem Auger
AT TIME OF DRILLING ---
LOGGED BY Patrick Drumm **CHECKED BY** KMA
AT END OF DRILLING 23.50 ft / Elev 99.50 ft
NOTES
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	ADJUSTED BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ROCK RECOVERY % (RQD)	OTHER LAB TESTS / NOTES
0		SANDY LEAN CLAY (CL) - Brown, very stiff, fine grained sand, medium plasticity fines, lightly cemented, slightly moist.							
5			MC	25					
10		CLAYEY SAND (SC) - Mottled light brown and dark brown, very stiff to hard, fine to coarse grained sand, high plasticity fines, slightly moist; possibly paleosol.	MC	32/5"	> 4.5				
		- At 11' : less clay more gravel. FAT CLAY WITH SAND (CH) - Light grayish brown, hard, fine to coarse grained sand, few fine grained gravel, slightly moist; possibly volcanic tuff.							
15		SILT WITH SAND (ML) - Mottled bluish gray and rusty red, very dense fine grained sand, slightly moist.	MC	44	> 4.5				
20		CLAYEY SAND WITH GRAVEL (SC) - Mottled gray and yellowish brown, medium dense, coarse grained sand, fine to coarse gravel, moist to wet.	MC	24					
		- At 21.5' : Coarse subrounded gravel up to 1.5 inches in diameter.							
25		POORLY GRADED SAND WITH GRAVEL (SP-SM) - Dark gray, very dense, medium to coarse grained sand, fine subrounded gravel, little non-plastic silt, moist.	MC	32/5"					

Bottom of borehole at 25.9 feet.

Notes:
1. Stratification lines represent the approximate boundaries between material types and the transitions may be gradual.
2. Modified California (MC) blowcounts were adjusted by multiplying field blowcounts by a factor 0.63.
3. Ground elevation should be considered approximate. Elevations from Google Earth and Doble Thomas 2011 survey data.
4. Backfilled with cement grout immediately upon completion.
5. Sample driving method - rope and cathead.

A3GEO, Inc.
1331 Seventh St., Unit E
Berkeley, CA 94710

BORING NUMBER B-29-3

CLIENT ESA-PWA
PROJECT NAME Napa River Restoration - OVOK Reach
PROJECT NUMBER 1110-3A
PROJECT LOCATION Napa, California
DATE STARTED 11/27/12 **COMPLETED** 11/27/12
GROUND ELEVATION 121 ft **HOLE SIZE** 4.5 in
DRILLING CONTRACTOR Northstar Drilling, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Solid Stem Auger
AT TIME OF DRILLING ---
LOGGED BY Patrick Drumm **CHECKED BY** KMA
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	ADJUSTED BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ROCK RECOVERY % (RQD)	OTHER LAB TESTS / NOTES
0		SILTY SAND (SM) - Dark reddish brown, medium dense, fine grained sand, slightly moist.							
5		- At 6' : Trace fine subrounded coarse gravels.	MC	16	> 4.5				
		CLAYEY SAND (SC) - Dark brown, medium dense, fine to medium grained sand, trace fine gravel, low plasticity fines, slightly moist.							
10			MC	21					
		CLAYEY SAND WITH GRAVEL (SC) - Dark brown, medium dense, fine to coarse grained sand, fine gravel, slightly moist.							
15			MC	28					
		WELL GRADED SAND WITH SILTY CLAY (SW-SC) - Yellowish brown, few fine angular to subrounded gravel, fine to coarse gravel sand, slightly moist.							
20		POORY GRADED GRAVEL WITH CLAY (GP) - Yellowish brown and grayish brown, dense, fine to coarse grained sand, fine gravel, moist to wet.	MC	40					
		- At 21.0' to 21.5' : No fine to medium grained sand.							
25		POORLY GRADED SAND WITH GRAVEL AND SILT (SP-SM) - Yellowish brown, very dense, fine to coarse grained sand, fine gravel, moist to wet.	MC	32/6"					

Bottom of borehole at 25.5 feet.

Notes:
1. Stratification lines represent the approximate boundaries between material types and the transitions may be gradual.
2. Modified California (MC) blowcounts were adjusted by multiplying field blowcounts by a factor 0.63.
3. Ground elevation should be considered approximate. Elevations from Doble Thomas 2011 survey data.
4. Ground water not encountered.
5. Backfilled with cement grout immediately upon completion.
6. Sample driving method - rope and cathead.

Appendix B

Laboratory Test Data

B. HILLEBRANDT SOILS TESTING, INC.

29 Sugarloaf Terrace, Alamo, CA 94507 - Tel: (510) 409-2916 - Fax: (925) 891-9267 - Email: soiltesting@aol.com

LAB RESULTS SUMMARY FORM

Project Number: 1110-3A **Project Name:** Napa River OVOK **Results Due By:**
Requested By: DM **Request Date:** 12/7/12 **Throw Samples Out On:**

					Atterberg			-200			Compaction				
Boring #	Sample Depth (feet)	Dry Density (pcf)	Moisture Content (%)	Unconfined Compressive (ksf)	Liquid Limit	Plastic Limit	Plasicity Index	Passing #4 Sieve (%)	Passing #40 sieve (%)	Passing #200 sieve (%)	Maximum Dry Density (pcf)	Optimum Moisture (%)	Pocket Penetrometer (tsf)	Torvane (tsf)	Remarks
B7-1	6.0 - 6.5	111	16		41	19	22	100	98	71					
B7-1	10.5 - 11.0	100	22		34	17	17	100	99	60					
B18-1	21.0 - 21.5	95	28		51	25	26	100	98	93					
B22-1	21.0 - 21.5	83	39		51	24	27	100	100	97					
B26-A-1	15.5 - 16.0	91	29		33	19	14	100	99	56					
Bulk river site 17			18		32	22	10	96	67	35					

B. HILLEBRANDT SOILS TESTING, INC.

29 Sugarloaf Terrace, Alamo, CA 94507 - Tel: (510) 409-2916 - Fax: (925) 891-9267 - Email: soiltesting@aol.com

MOISTURE CONTENT/DRY DENSITY

Job #: 1110-3A
Job Name: Napa River OVOK
Date: 12/7/12
Tested by: Brad Hillebrandt

Additional Tests:	PI, FS, Hyd	PI, FS, Hyd	PI, FS, Hyd	PI, FS, Hyd	PI, FS, Hyd	
Boring #:	B7-1	B7-1	B18-1	B-22-1	B26-A-1	
Depth (feet):	6.0 - 6.5	10.5 - 11.0	21.0 - 21.5	21.0 - 21.5	15.5 - 16.0	
Sample Description:	Brown lean CLAY with sand	Brown sandy lean CLAY	Brown fat CLAY	Olive brown fat CLAY	Grayish brown sandy lean CLAY	
Can #:	352	351	310	354	309	
Wet Sample + can	406.5	428.4	393.7	388.3	384.4	
Dry Sample + can	354.9	356.8	315.9	289.5	307.6	
Weight can	33.8	33.8	37.9	33.8	37.7	
Weight water	51.6	71.6	77.8	98.8	76.8	
Weight Dry Sample	321.1	323	278	255.7	269.9	
WATER CONTENT (%)	**16.1%**	**22.2%**	**28.0%**	**38.6%**	**28.5%**	
Weight Sample + Liner	1105	1118	1071	990	1001	
Weight Liner	258	254	250	258	268	
Sample Length (Lo)	5.425	5.85	5.625	5.3	5.2	
Multiplication Factor	1.21	1.21	1.21	1.21	1.21	
DRY DENSITY (pcf)	**111.4**	**100.2**	**94.5**	**82.5**	**90.9**	

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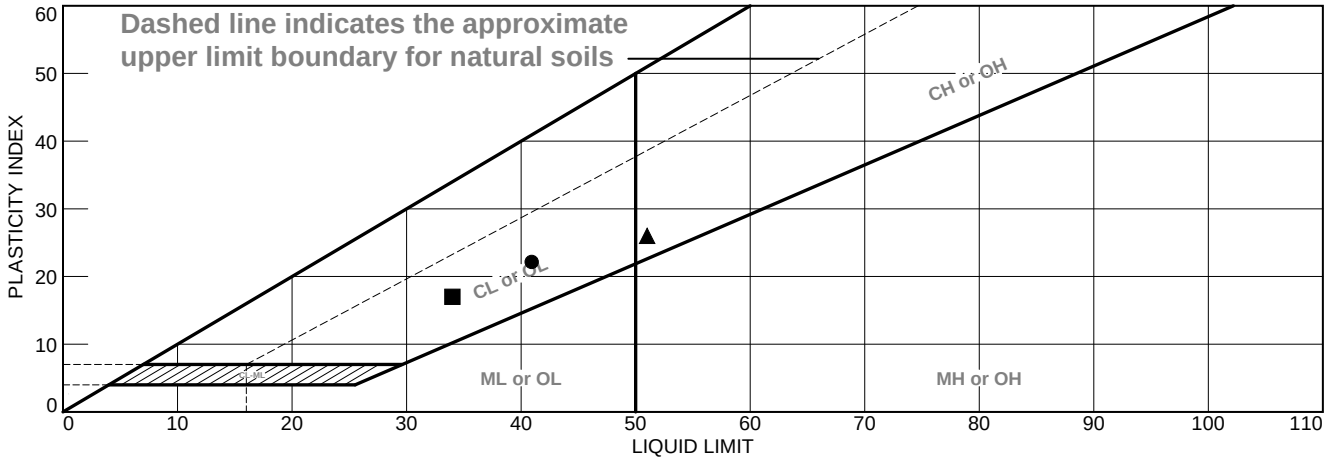
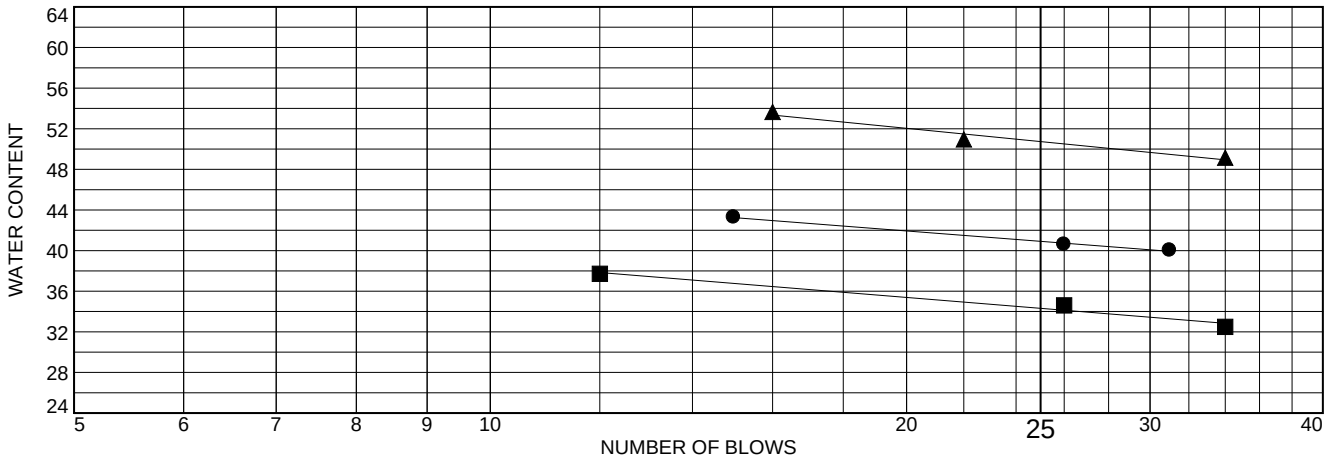
MOISTURE CONTENT WORKSHEET

Job #: 1110-3A
Job Name: Napa River OVOK
Date: 12/7/12
Tested by: B. Hillebrandt

Additional Tests:	PI, FS, Hyd								
Boring #:	Bulk Site 17								
Depth (feet):									
Sample Description:	Brown clayey SAND								
Can #:	330								
Wet Sample + can	259.4								
Dry Sample + can	226.1								
Weight can	38.4								
Weight water	33.3								
Weight Dry Sample	187.7								
WATER CONTENT (%)	**17.7%**								

LIQUID AND PLASTIC LIMITS TEST REPORT





	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Brown lean CLAY with sand	41	19	22	97.9	70.6	CL
■	Brown sandy lean CLAY	34	17	17	98.5	59.6	CL
▲	Brown fat CLAY	51	25	26	97.9	93.3	CH

Project No. 1110-3A **Client:** A3Geo

Project: Napa River OVOK

Remarks:

●**Source of Sample:** B7-1 **Depth:** 6.0 - 6.5'

■**Source of Sample:** B7-1 **Depth:** 10.5 - 11.0'

▲**Source of Sample:** B18-1 **Depth:** 21.0 - 21.5'

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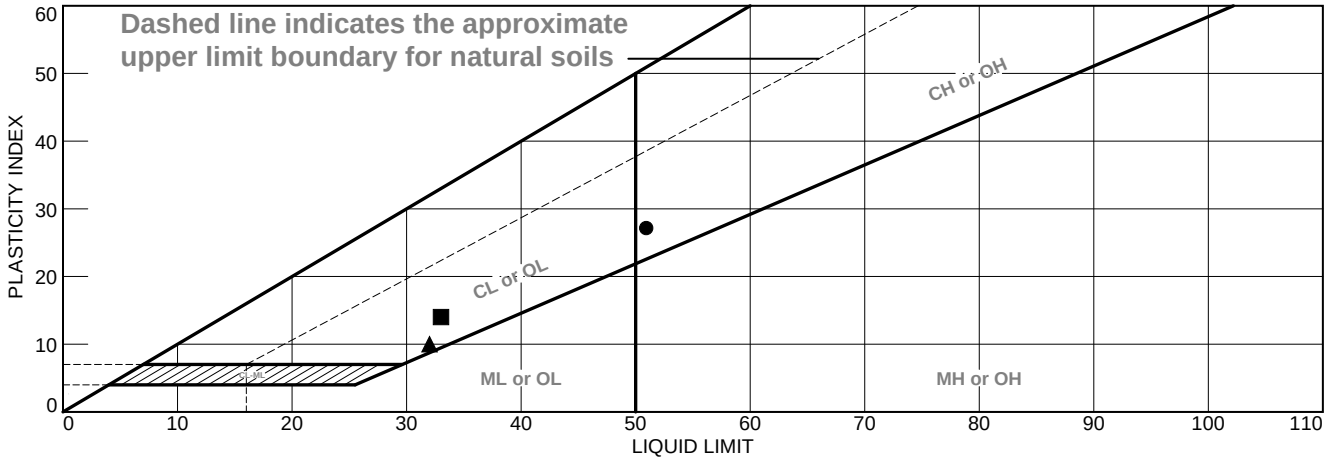
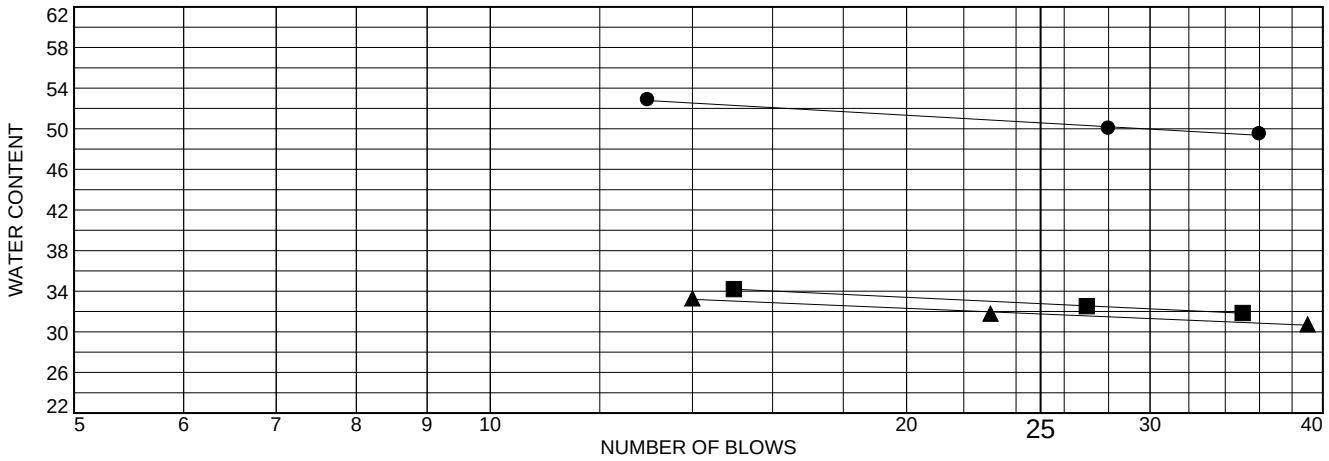
Figure

Tested By: BH

LIQUID AND PLASTIC LIMITS TEST REPORT





	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Olive brown fat CLAY	51	24	27	99.6	97.3	CH
■	Grayish brown sandy lean CLAY	33	19	14	99.1	55.8	CL
▲	Brown clayey SAND	32	22	10	66.8	34.7	SC

Project No. 1110-3A **Client:** A3Geo

Project: Napa River OVOK

●**Source of Sample:** B22-1 **Depth:** 21.0 - 21.5'

■**Source of Sample:** B26-A-1 **Depth:** 15.5 - 16.0'

▲**Source of Sample:** Bulk Sample from River - Site 17 **Sample Number:** 1

Remarks:

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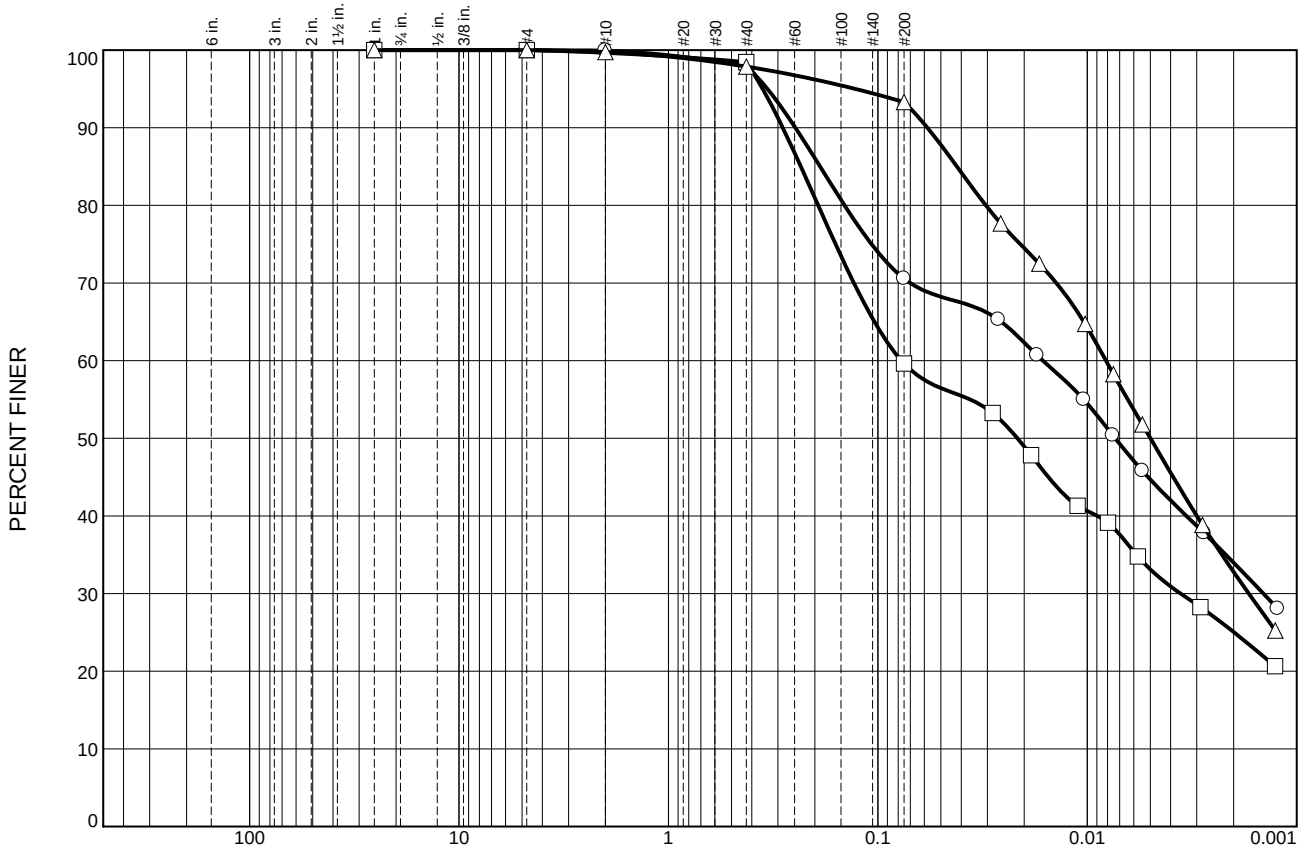
Figure

Tested By: BH

Particle Size Distribution Report



	% +3"	% Gravel	% Sand	% Silt	% Clay
○	0.0	0.0	29.4	25.9	44.7
□	0.0	0.0	40.4	26.5	33.1
△	0.0	0.0	6.7	43.3	50.0

SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH (ft.)	Material Description	USCS
○	B7-1		6.0 - 6.5'	Brown lean CLAY with sand	CL
□	B7-1		10.5 - 11.0'	Brown sandy lean CLAY	CL
△	B18-1		21.0 - 21.5'	Brown fat CLAY	CH

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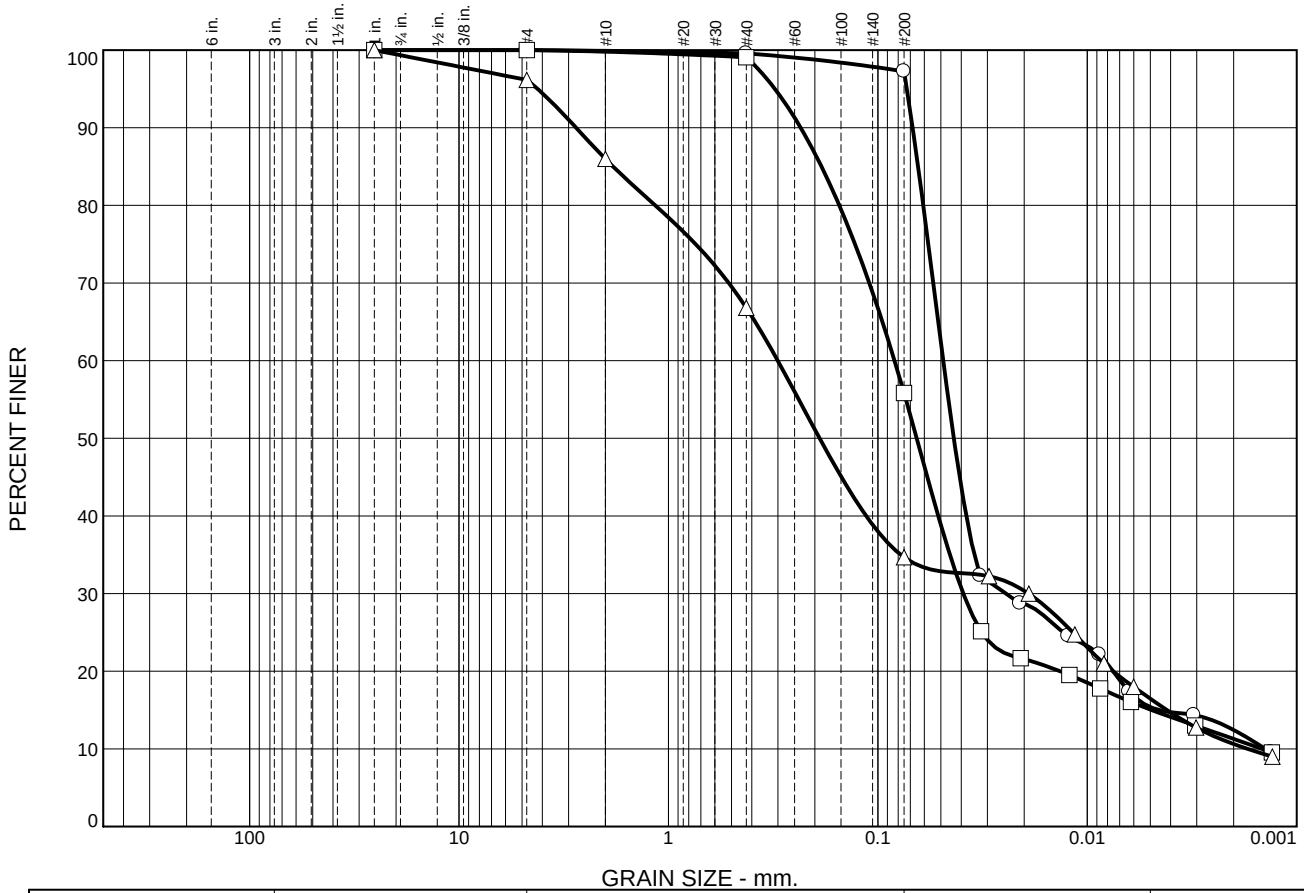
Client: A3Geo
Project: Napa River OVOK
Project No.: 1110-3A **Figure**

Tested By: BH

Particle Size Distribution Report



	% +3"	% Gravel	% Sand	% Silt	% Clay
○	0.0	0.0	2.7	81.9	15.4
□	0.0	0.0	44.2	40.7	15.1
△	0.0	3.8	61.5	18.2	16.5

SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH (ft.)	Material Description	USCS
○	B22-1		21.0 - 21.5'	Olive brown fat CLAY	CH
□	B26-A-1		15.5 - 16.0'	Grayish brown sandy lean CLAY	CL
△	Bulk Sample	1		Brown clayey SAND	SC
	from River -				
	Site 17				

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Client: A3Geo
Project: Napa River OVOK
Project No.: 1110-3A **Figure**

Tested By: BH

GRAIN SIZE DISTRIBUTION TEST DATA

12/10/2012

Client: A3Geo
Project: Napa River OVOK
Project Number: 1110-3A
Location: B7-1
Depth: 6.0 - 6.5'
Material Description: Brown lean CLAY with sand
USCS: CL
Tested by: BH

Sieve Test Data

Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
354.90	33.80	1"	0.00	0.00	100.0
		#4	31.00	31.00	100.0
		#10	31.20	31.00	99.9
		#40	37.50	31.00	97.9
		#200	118.80	31.00	70.6

Hydrometer Test Data

Hydrometer test uses material passing #10
Percent passing #10 based upon complete sample = 99.9
Weight of hydrometer sample =69.29
Table of composite correction values:

Temp., deg. C:	20.1	21.2	19.3	21.7	18.6
Comp. corr.:	-3.0	-3.0	-4.0	-3.0	-4.0

Meniscus correction only = 0.5
Specific gravity of solids = 2.7
Hydrometer type = 151H
Hydrometer effective depth equation: L = 16.294964 **-** 0.2645 **x Rm**

Elapsed Time (min.)	Temp. (deg. C.)	Actual Reading	Corrected Reading	K	Rm	Eff. Depth	Diameter (mm.)	Percent Finer
2.00	20.1	1.0315	1.0285	0.0134	32.0	7.8	0.0266	65.3
5.00	20.1	1.0295	1.0265	0.0134	30.0	8.4	0.0174	60.7
15.00	20.3	1.0270	1.0240	0.0134	27.5	9.0	0.0104	55.0
30.00	20.3	1.0250	1.0220	0.0134	25.5	9.6	0.0076	50.4
60.00	20.8	1.0230	1.0200	0.0133	23.5	10.1	0.0055	45.8
250.00	21.5	1.0195	1.0165	0.0132	20.0	11.0	0.0028	37.8
1440.00	19.5	1.0160	1.0123	0.0135	16.5	11.9	0.0012	28.1

Fractional Components

Cobbles	Gravel	Sand	Silt	Clay
0.0	0.0	29.4	25.9	44.7

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
			0.0014	0.0074	0.0163	0.1442	0.1888	0.2476	0.3367

Fineness Modulus
0.28

GRAIN SIZE DISTRIBUTION TEST DATA

12/10/2012

Client: A3Geo
Project: Napa River OVOK
Project Number: 1110-3A
Location: B7-1
Depth: 10.5 - 11.0'
Material Description: Brown sandy lean CLAY
USCS: CL
Tested by: BH

Sieve Test Data

Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
356.80	33.80	1"	0.00	0.00	100.0
		#4	31.00	31.00	100.0
		#40	36.00	31.00	98.5
		#200	156.40	31.00	59.6

Hydrometer Test Data

Hydrometer test uses material passing #10
Percent passing #10 based upon complete sample = 100.0
Weight of hydrometer sample =73.06
Table of composite correction values:

Temp., deg. C:	20.1	21.2	19.3	21.7	18.6
Comp. corr.:	-3.0	-3.0	-4.0	-3.0	-4.0

Meniscus correction only = 0.5
Specific gravity of solids = 2.7
Hydrometer type = 151H
Hydrometer effective depth equation: L = 16.294964 **-** 0.2645 **x Rm**

Elapsed Time (min.)	Temp. (deg. C.)	Actual Reading	Corrected Reading	K	Rm	Eff. Depth	Diameter (mm.)	Percent Finer
2.00	20.1	1.0275	1.0245	0.0134	28.0	8.9	0.0283	53.3
5.00	20.1	1.0250	1.0220	0.0134	25.5	9.6	0.0186	47.8
15.00	20.3	1.0220	1.0190	0.0134	22.5	10.3	0.0111	41.3
30.00	20.3	1.0210	1.0180	0.0134	21.5	10.6	0.0080	39.1
60.00	20.8	1.0190	1.0160	0.0133	19.5	11.1	0.0057	34.8
250.00	21.5	1.0160	1.0130	0.0132	16.5	11.9	0.0029	28.3
1440.00	19.5	1.0132	1.0095	0.0135	13.8	12.7	0.0013	20.7

Fractional Components

Cobbles	Gravel	Sand	Silt	Clay
0.0	0.0	40.4	26.5	33.1

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
			0.0036	0.0216	0.0772	0.1927	0.2333	0.2846	0.3548

Fineness Modulus
0.37

GRAIN SIZE DISTRIBUTION TEST DATA

12/10/2012

Client: A3Geo
Project: Napa River OVOK
Project Number: 1110-3A
Location: B18-1
Depth: 21.0 - 21.5'
Material Description: Brown fat CLAY
USCS: CH
Tested by: BH

Sieve Test Data

Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
315.90	37.90	1"	31.00	31.00	100.0
		#4	31.00	31.00	100.0
		#10	31.70	31.00	99.7
		#40	36.20	31.00	97.9
		#200	43.70	31.00	93.3

Hydrometer Test Data

Hydrometer test uses material passing #10
Percent passing #10 based upon complete sample = 99.7
Weight of hydrometer sample =61.19
Table of composite correction values:

Temp., deg. C:	20.1	21.2	19.3	21.7	18.6
Comp. corr.:	-3.0	-3.0	-4.0	-3.0	-4.0

Meniscus correction only = 0.5
Specific gravity of solids = 2.7
Hydrometer type = 151H
Hydrometer effective depth equation: L = 16.294964 **-** 0.2645 **x Rm**

Elapsed Time (min.)	Temp. (deg. C.)	Actual Reading	Corrected Reading	K	Rm	Eff. Depth	Diameter (mm.)	Percent Finer
2.00	20.1	1.0330	1.0300	0.0134	33.5	7.4	0.0259	77.7
5.00	20.1	1.0310	1.0280	0.0134	31.5	8.0	0.0169	72.5
15.00	20.3	1.0280	1.0250	0.0134	28.5	8.8	0.0102	64.7
30.00	20.3	1.0255	1.0225	0.0134	26.0	9.4	0.0075	58.3
60.00	20.8	1.0230	1.0200	0.0133	23.5	10.1	0.0055	51.8
250.00	21.5	1.0180	1.0150	0.0132	18.5	11.4	0.0028	38.8
1440.00	19.5	1.0135	1.0097	0.0135	14.0	12.6	0.0013	25.2

Fractional Components

Cobbles	Gravel	Sand	Silt	Clay
0.0	0.0	6.7	43.3	50.0

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
			0.0017	0.0050	0.0081	0.0305	0.0419	0.0580	0.1282

Fineness Modulus
0.10

GRAIN SIZE DISTRIBUTION TEST DATA

12/10/2012

Client: A3Geo
Project: Napa River OVOK
Project Number: 1110-3A
Location: B22-1
Depth: 21.0 - 21.5'
Material Description: Olive brown fat CLAY
USCS: CH
Tested by: BH

Sieve Test Data

Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
289.50	33.80	1"	0.00	0.00	100.0
		#4	31.00	31.00	100.0
		#40	32.10	31.00	99.6
		#200	36.90	31.00	97.3

Hydrometer Test Data

Hydrometer test uses material passing #10
Percent passing #10 based upon complete sample = 100.0
Weight of hydrometer sample =66.32
Table of composite correction values:

Temp., deg. C:	20.1	21.2	19.3	21.7	18.6
Comp. corr.:	-3.0	-3.0	-4.0	-3.0	-4.0

Meniscus correction only = 0.5
Specific gravity of solids = 2.7
Hydrometer type = 151H
Hydrometer effective depth equation: L = 16.294964 **-** 0.2645 **x Rm**

Elapsed Time (min.)	Temp. (deg. C.)	Actual Reading	Corrected Reading	K	Rm	Eff. Depth	Diameter (mm.)	Percent Finer
2.00	20.3	1.0165	1.0135	0.0134	17.0	11.8	0.0325	32.3
5.00	20.3	1.0150	1.0120	0.0134	15.5	12.2	0.0209	28.7
15.00	20.3	1.0132	1.0103	0.0134	13.8	12.7	0.0123	24.5
30.00	20.5	1.0123	1.0092	0.0134	12.8	12.9	0.0088	22.2
60.00	20.7	1.0103	1.0072	0.0133	10.8	13.5	0.0063	17.4
250.00	21.5	1.0090	1.0060	0.0132	9.5	13.8	0.0031	14.4
1440.00	20.5	1.0070	1.0040	0.0134	7.5	14.3	0.0013	9.6

Fractional Components

Cobbles	Gravel	Sand	Silt	Clay
0.0	0.0	2.7	81.9	15.4

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
0.0014	0.0045	0.0075	0.0245	0.0434	0.0487	0.0607	0.0642	0.0682	0.0727

Fineness Modulus	C_u	C_c
0.03	34.58	8.71

GRAIN SIZE DISTRIBUTION TEST DATA

12/10/2012

Client: A3Geo
Project: Napa River OVOK
Project Number: 1110-3A
Location: B26-A-1
Depth: 15.5 - 16.0'
Material Description: Grayish brown sandy lean CLAY
USCS: CL
Tested by: BH

Sieve Test Data

Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
307.60	37.70	1"	0.00	0.00	100.0
		#4	31.00	31.00	100.0
		#40	33.50	31.00	99.1
		#200	147.70	31.00	55.8

Hydrometer Test Data

Hydrometer test uses material passing #10
Percent passing #10 based upon complete sample = 100.0
Weight of hydrometer sample =91.56
Table of composite correction values:

Temp., deg. C:	20.1	21.2	19.3	21.7	18.6
Comp. corr.:	-3.0	-3.0	-4.0	-3.0	-4.0

Meniscus correction only = 0.5
Specific gravity of solids = 2.7
Hydrometer type = 151H
Hydrometer effective depth equation: L = 16.294964 **-** 0.2645 **x Rm**

Elapsed Time (min.)	Temp. (deg. C.)	Actual Reading	Corrected Reading	K	Rm	Eff. Depth	Diameter (mm.)	Percent Finer
2.00	20.3	1.0175	1.0145	0.0134	18.0	11.5	0.0322	25.2
5.00	20.3	1.0155	1.0125	0.0134	16.0	12.1	0.0208	21.7
15.00	20.3	1.0143	1.0112	0.0134	14.8	12.4	0.0122	19.5
30.00	20.5	1.0132	1.0103	0.0134	13.8	12.7	0.0087	17.8
60.00	20.7	1.0123	1.0092	0.0133	12.8	12.9	0.0062	16.0
250.00	21.5	1.0105	1.0075	0.0132	11.0	13.4	0.0031	13.0
1440.00	20.5	1.0085	1.0055	0.0134	9.0	13.9	0.0013	9.5

Fractional Components

Cobbles	Gravel	Sand	Silt	Clay
0.0	0.0	44.2	40.7	15.1

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
0.0015	0.0049	0.0135	0.0391	0.0653	0.0833	0.1528	0.1859	0.2336	0.3102

Fineness Modulus	C_u	C_c
0.27	56.74	12.51

GRAIN SIZE DISTRIBUTION TEST DATA

12/10/2012

Client: A3Geo
Project: Napa River OVOK
Project Number: 1110-3A
Location: Bulk Sample from River - Site 17
Sample Number: 1
Material Description: Brown clayey SAND
USCS: SC
Tested by: BH

Sieve Test Data

Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
226.10	38.40	1"	0.00	0.00	100.0
		#4	38.20	31.00	96.2
		#10	50.10	31.00	86.0
		#40	67.00	31.00	66.8
		#200	91.30	31.00	34.7

Hydrometer Test Data

Hydrometer test uses material passing #10
Percent passing #10 based upon complete sample = 86.0
Weight of hydrometer sample =91.08
Table of composite correction values:

Temp., deg. C:	20.1	21.2	19.3	21.7	18.6
Comp. corr.:	-3.0	-3.0	-4.0	-3.0	-4.0

Meniscus correction only = 0.5
Specific gravity of solids = 2.7
Hydrometer type = 151H
Hydrometer effective depth equation: L = 16.294964 **-** 0.2645 **x Rm**

Elapsed Time (min.)	Temp. (deg. C.)	Actual Reading	Corrected Reading	K	Rm	Eff. Depth	Diameter (mm.)	Percent Finer
2.00	20.3	1.0245	1.0215	0.0134	25.0	9.7	0.0295	32.2
5.00	20.3	1.0230	1.0200	0.0134	23.5	10.1	0.0190	30.0
15.00	20.3	1.0195	1.0165	0.0134	20.0	11.0	0.0115	24.7
30.00	20.5	1.0170	1.0140	0.0134	17.5	11.7	0.0083	21.0
60.00	20.7	1.0150	1.0120	0.0133	15.5	12.2	0.0060	18.0
250.00	21.5	1.0115	1.0085	0.0132	12.0	13.1	0.0030	12.7
1440.00	20.5	1.0090	1.0060	0.0134	9.5	13.8	0.0013	9.0

Fractional Components

Cobbles	Gravel	Sand	Silt	Clay
0.0	3.8	61.5	18.2	16.5

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
0.0017	0.0042	0.0075	0.0190	0.1898	0.3007	1.1564	1.8373	2.7615	4.2158

Fineness Modulus	C_u	C_c
1.61	175.47	0.70

B. HILLEBRANDT SOILS TESTING, INC.

29 Sugarloaf Terrace, Alamo, CA 94507 - Tel: (510) 409-2916 - Fax: (925) 891-9267 - Email: soiltesting@aol.com

LAB RESULTS SUMMARY FORM

Project Number: 1110-3A **Project Name:** Napa River Restoration - OVOK #2 **Results Due By:**
Requested By: DM **Request Date:** 12/15/12 **Throw Samples Out On:**

					Atterberg			-200			Compaction				
Boring #	Sample Depth (feet)	Dry Density (pcf)	Moisture Content (%)	Unconfined Compressive (ksf)	Liquid Limit	Plastic Limit	Plasicity Index	Passing #4 Sieve (%)	Passing #40 sieve (%)	Passing #200 sieve (%)	Maximum Dry Density (pcf)	Optimum Moisture (%)	Pocket Penetrometer (tsf)	Torvane (tsf)	Remarks
B-17-4	11.0 - 11.5	101	20		50	21	29	100	98	91					
B-17-4	15.5 - 16.0	100	23		35	23	12	95	56	28					
B-17-5	6.0 - 6.5	114	11		41	19	22	85	66	46					
B-17-5	10.5 - 11.0	109	15		42	18	24	92	65	40					
B-17-6	21.0 - 21.5	94	29		45	27	18	100	94	83					
B-17-7	21.0 - 21.5	91	31		45	23	22	99	87	73					
B-29-1	15.5 - 16.0	100	23		28	30	NP	78	38	14					
B-29-1	25.0 - 25.4	108	18		33	22	11	96	58	36					

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MOISTURE CONTENT/DRY DENSITY

Job #: 1110-3A
Job Name: Napa River Restoration - OVOK #2
Date: 12/15/12
Tested by: Brad Hillebrandt

Additional Tests:	PI, -200, Hyd.	PI, -200, Hyd.	PI, -200, Hyd.	PI, -200, Hyd.	PI, -200, Hyd.	PI, -200, Hyd.
Boring #:	B-17-4	B-17-4	B-17-5	B-17-5	B-17-6	B-17-7
Depth (feet):	11.0 - 11.5	15.5 - 16.0	6.0 - 6.5	10.5 - 11.0	21.0 - 21.5	21.0 - 21.5
Sample Description:	Brown fat CLAY	Olive brown clayey SAND	Brown clayey SAND with gravel	Grayish brown clayey SAND	Brown lean CLAY with sand	Brownish gray lean CLAY with sand
Can #:	368	365	B-14	B-20	364	361
Wet Sample + can	316.0	412.9	737.7	774.7	320.5	323.1
Dry Sample + can	269.7	341.7	686.8	710.3	256.8	254.3
Weight can	35.7	34.2	230.2	271.4	34.0	33.6
Weight water	46.3	71.2	50.9	64.4	63.7	68.8
Weight Dry Sample	234	307.5	456.6	438.9	222.8	220.7
WATER CONTENT (%)	**19.8%**	**23.2%**	**11.1%**	**14.7%**	**28.6%**	**31.2%**
Weight Sample + Liner	1074	1094	1170	1135	1082	1114
Weight Liner	248	258	253	262	254	253
Sample Length (Lo)	5.675	5.65	6.0	5.8	5.7	6.0
Multiplication Factor	1.21	1.21	1.21	1.21	1.21	1.21
DRY DENSITY (pcf)	**100.7**	**99.5**	**113.9**	**108.7**	**93.6**	**90.6**

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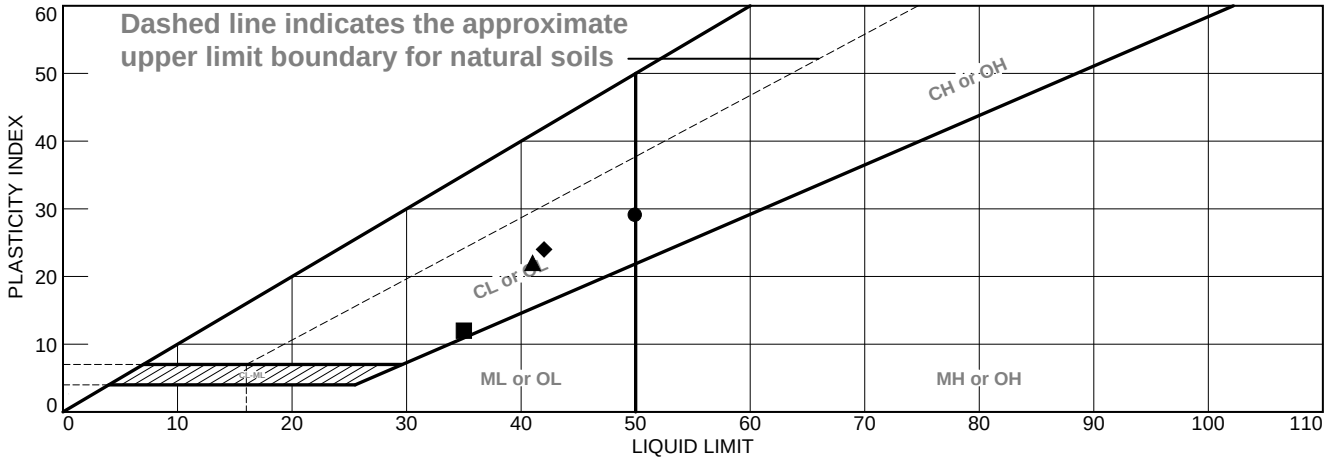
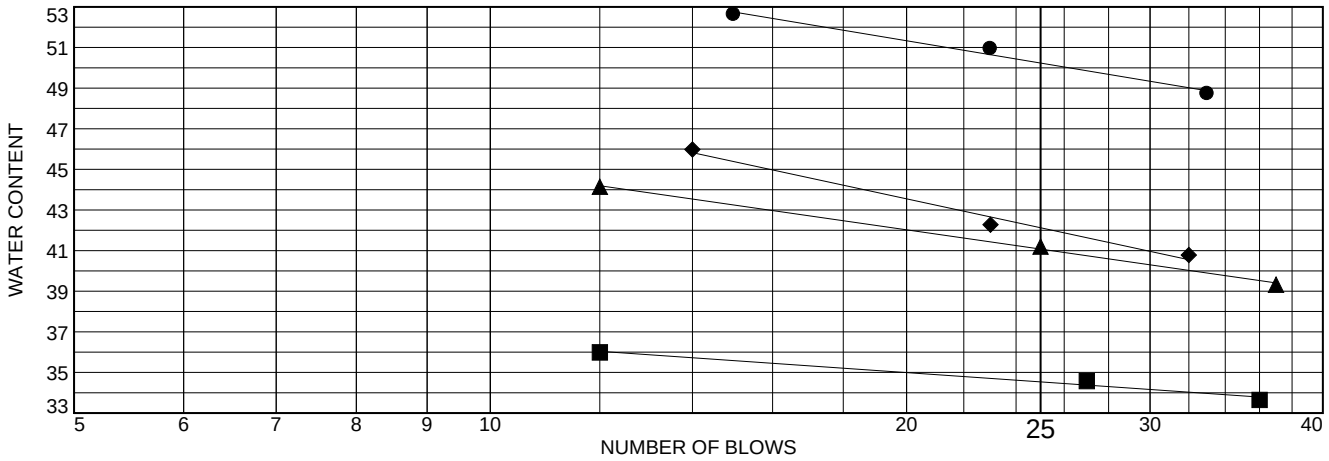
MOISTURE CONTENT/DRY DENSITY

Job #: 1110-3A
Job Name: Napa River Restoration - OVOK #2
Date: 12/15/12
Tested by: Brad Hillebrandt

Additional Tests:	PI, -200, Hyd.	PI, -200, Hyd.				
Boring #:	B-29-1	B-29-1				
Depth (feet):	15.5 - 16.0	25.0 - 25.4				
Sample Description:	Olive gray silty SAND with gravel	Olive brown to olive gray clayey SAND				
Can #:	362	367				
Wet Sample + can	385.2	390.7				
Dry Sample + can	319.4	336.9				
Weight can	34.0	33.9				
Weight water	65.8	53.8				
Weight Dry Sample	285.4	303				
WATER CONTENT (%)	**23.1%**	**17.8%**				
Weight Sample + Liner	1028	1144				
Weight Liner	259	254				
Sample Length (Lo)	5.2	5.8				
Multiplication Factor	1.21	1.21				
DRY DENSITY (pcf)	**99.6**	**108.0**				

LIQUID AND PLASTIC LIMITS TEST REPORT





	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Brown fat CLAY	50	21	29	97.9	91.0	CH
■	Olive brown clayey SAND	35	23	12	56.1	27.7	SC
▲	Brown clayey SAND with gravel	41	19	22	66.2	46.1	SC
◆	Grayish brown clayey SAND	42	18	24	64.5	39.8	SC

Project No. **Client:**

Project:

●**Source of Sample:** B-17-4 **Depth:** 11.0 - 11.5'
■**Source of Sample:** B-17-4 **Depth:** 15.5 - 16.0'
▲**Source of Sample:** B-17-5 **Depth:** 6.0 - 6.5'
◆**Source of Sample:** B-17-5 **Depth:** 10.5 - 11.0'

Remarks:

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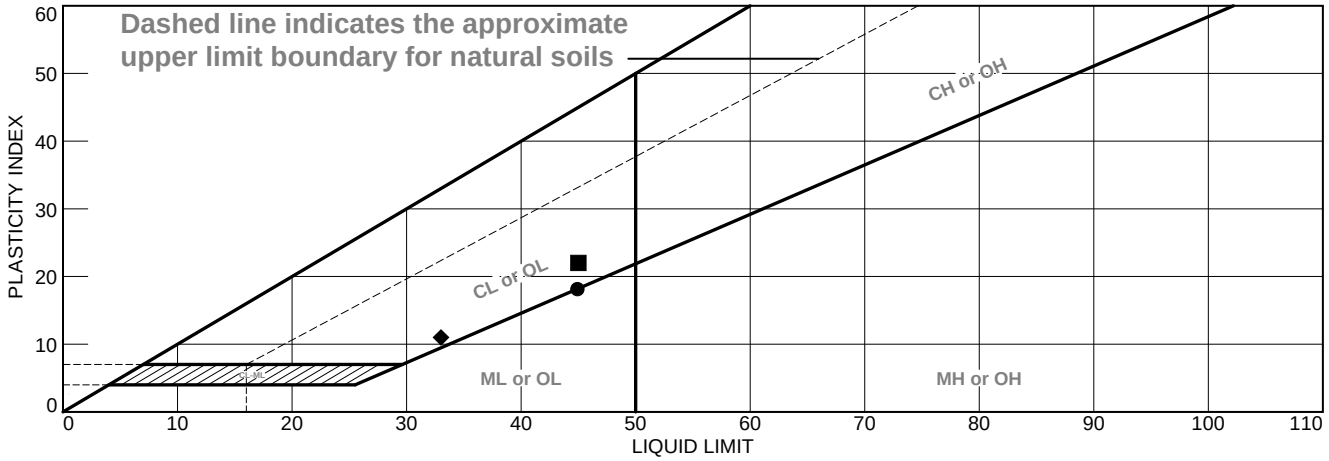
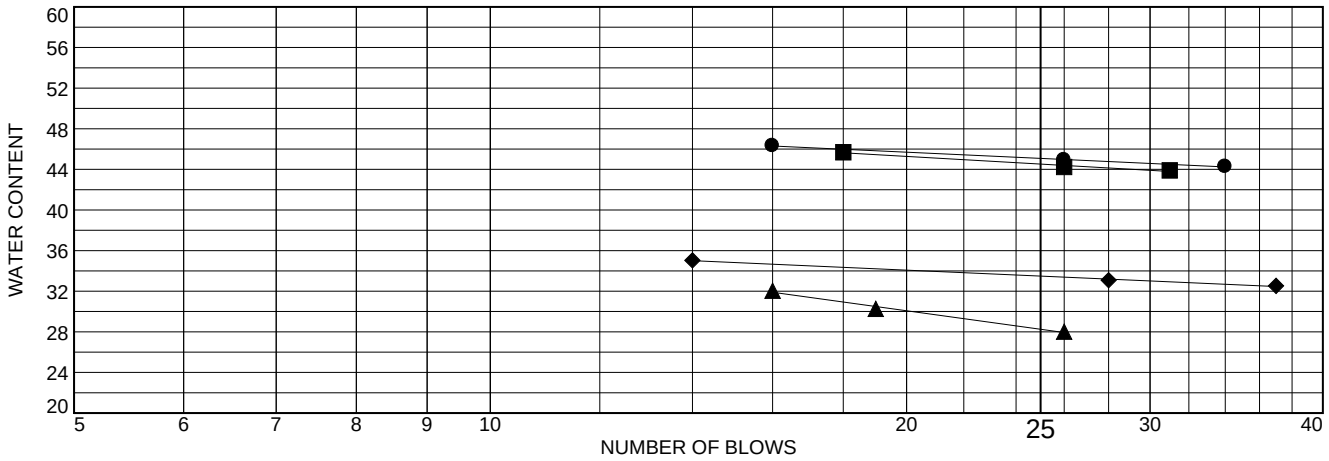
Figure

Tested By: BH

LIQUID AND PLASTIC LIMITS TEST REPORT





	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Brown lean CLAY with sand	45	27	18	93.6	83.0	CL
■	Brownish gray lean CLAY with sand	45	23	22	86.5	72.5	CL
▲	Olive gray silty SAND with gravel	28	30	NP	38.0	14.4	SM
◆	Olive brown to olive gray clayey SAND	33	22	11	58.2	35.7	SC

Project No. **Client:**

Project:

●**Source of Sample:** B-17-6 **Depth:** 21.0 - 21.5'
■**Source of Sample:** B-17-7 **Depth:** 21.0 - 21.5'
▲**Source of Sample:** B-29-1 **Depth:** 15.5 - 16.0'
◆**Source of Sample:** B-29-1 **Depth:** 25.0 - 25.4.

Remarks:

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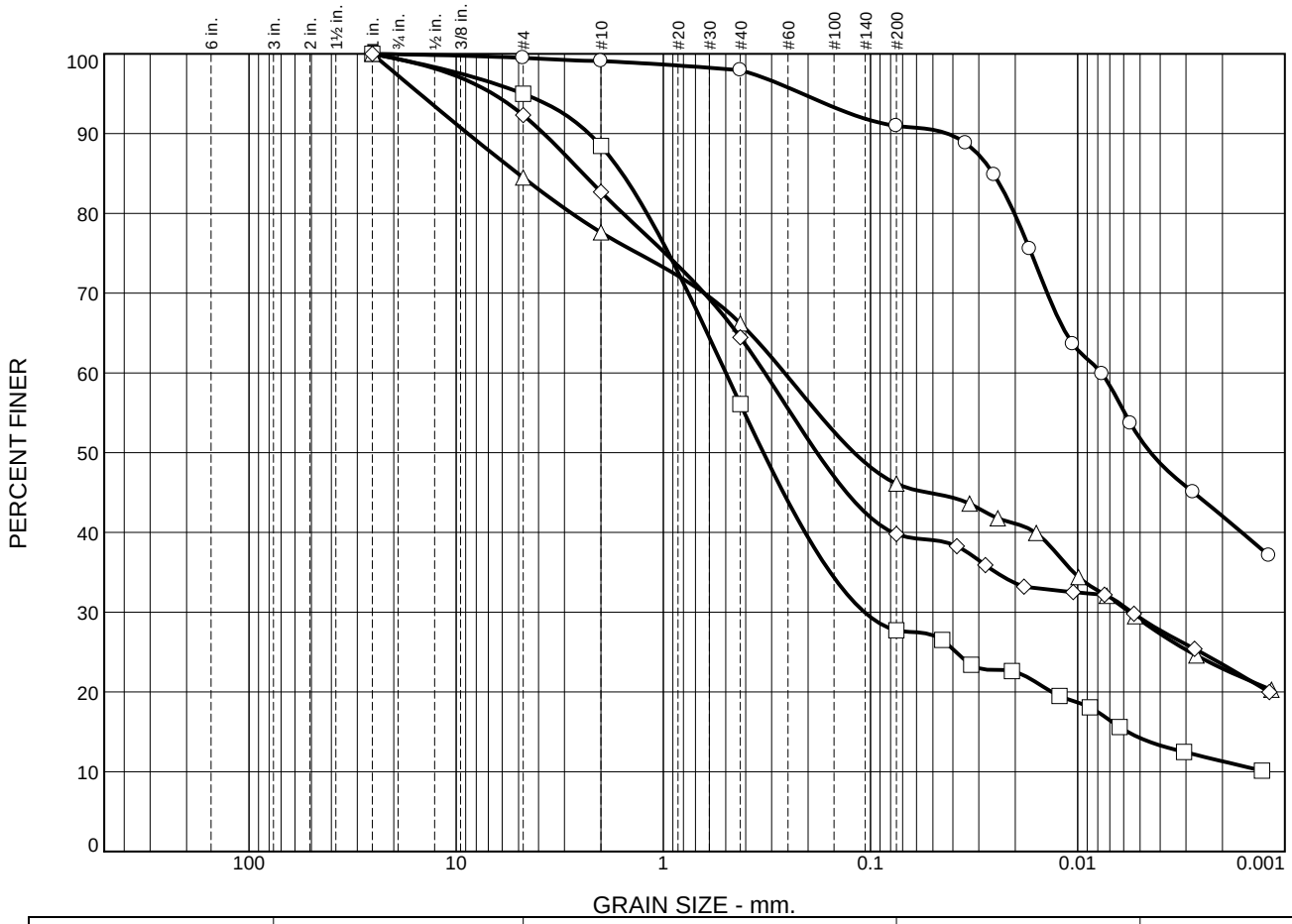
Figure

Tested By: BH

Particle Size Distribution Report



	% +3"	% Gravel	% Sand	% Silt	% Clay
○	0.0	0.5	8.5	39.2	51.8
□	0.0	5.0	67.3	13.5	14.2
△	0.0	15.5	38.4	17.1	29.0
◇	0.0	7.7	52.5	10.5	29.3

SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH (ft.)	Material Description	USCS
○	B-17-4		11.0 - 11.5'	Brown fat CLAY	CH
□	B-17-4		15.5 - 16.0'	Olive brown clayey SAND	SC
△	B-17-5		6.0 - 6.5'	Brown clayey SAND with gravel	SC
◇	B-17-5		10.5 - 11.0'	Grayish brown clayey SAND	SC

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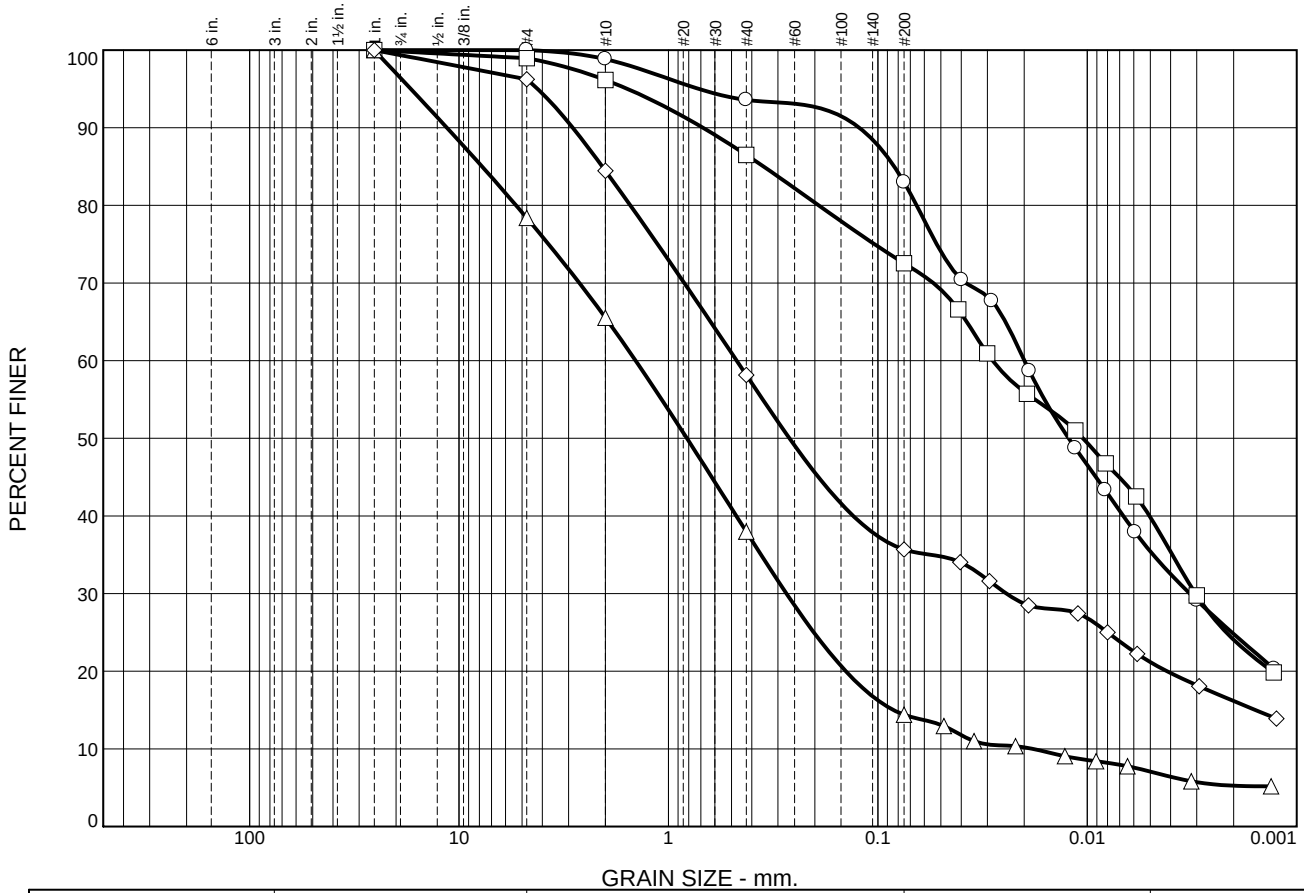
Client:
Project:

Project No.: **Figure**

Particle Size Distribution Report



	% +3"	% Gravel	% Sand	% Silt	% Clay
○	0.0	0.0	17.0	47.6	35.4
□	0.0	1.0	26.5	32.7	39.8
△	0.0	21.6	64.0	7.3	7.1
◇	0.0	3.8	60.5	14.5	21.2

SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH (ft.)	Material Description	USCS
○	B-17-6		21.0 - 21.5'	Brown lean CLAY with sand	CL
□	B-17-7		21.0 - 21.5'	Brownish gray lean CLAY with sand	CL
△	B-29-1		15.5 - 16.0'	Olive gray silty SAND with gravel	SM
◇	B-29-1		25.0 - 25.4.	Olive brown to olive gray clayey SAND	SC

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Client:
Project:
Project No.: **Figure**

Tested By: BH

GRAIN SIZE DISTRIBUTION TEST DATA

12/19/2012

Location: B-17-4
Depth: 11.0 - 11.5'
Material Description: Brown fat CLAY
USCS: CH

Sieve Test Data

Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
269.70	35.70	1"	0.00	0.00	100.0
		#4	32.20	31.00	99.5
		#10	31.90	31.00	99.1
		#40	33.70	31.00	97.9
		#200	47.33	31.00	91.0

Hydrometer Test Data

Hydrometer test uses material passing #4
Percent passing #4 based upon complete sample = 99.5
Weight of hydrometer sample =59.61
Table of composite correction values:

Temp., deg. C:	18.2	18.4	19.0	20.8	22.0
Comp. corr.:	-3.5	-3.5	-3.0	-3.0	-2.0

Meniscus correction only = 0.5
Specific gravity of solids = 2.70
Hydrometer type = 151H
Hydrometer effective depth equation: L = 16.294964 **-** 0.2645 **x Rm**

Elapsed Time (min.)	Temp. (deg. C.)	Actual Reading	Corrected Reading	K	Rm	Eff. Depth	Diameter (mm.)	Percent Finer
1.00	18.2	1.0370	1.0335	0.0138	37.5	6.4	0.0347	88.8
2.00	18.2	1.0355	1.0320	0.0138	36.0	6.8	0.0253	84.8
5.00	18.2	1.0320	1.0285	0.0138	32.5	7.7	0.0171	75.5
15.00	18.4	1.0275	1.0240	0.0137	28.0	8.9	0.0106	63.6
30.00	18.5	1.0260	1.0226	0.0137	26.5	9.3	0.0076	59.9
60.00	19.0	1.0232	1.0203	0.0136	23.8	10.0	0.0056	53.7
250.00	20.8	1.0200	1.0170	0.0133	20.5	10.9	0.0028	45.1
1440.00	22.0	1.0160	1.0140	0.0131	16.5	11.9	0.0012	37.1

Fractional Components

Cobbles	Gravel	Sand	Silt	Clay
0.0	0.5	8.5	39.2	51.8

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
				0.0044	0.0077	0.0202	0.0256	0.0425	0.2131

Fineness Modulus
0.15

B. Hillebrandt Soils Testing, Inc.

GRAIN SIZE DISTRIBUTION TEST DATA

12/19/2012

Location: B-17-4
Depth: 15.5 - 16.0'
Material Description: Olive brown clayey SAND
USCS: SC

Sieve Test Data

Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
341.70	34.20	1"	0.00	0.00	100.0
		#4	46.40	31.00	95.0
		#10	51.10	31.00	88.5
		#40	130.50	31.00	56.1
		#200	118.20	31.00	27.7

Hydrometer Test Data

Hydrometer test uses material passing #10
Percent passing #10 based upon complete sample = 88.5
Weight of hydrometer sample =90.04
Table of composite correction values:

Temp., deg. C:	18.2	18.4	19.0	20.8	22.0
Comp. corr.:	-3.5	-3.5	-3.0	-3.0	-2.0

Meniscus correction only = 0.5
Specific gravity of solids = 2.7
Hydrometer type = 151H
Hydrometer effective depth equation: L = 16.294964 **-** 0.2645 **x Rm**

Elapsed Time (min.)	Temp. (deg. C.)	Actual Reading	Corrected Reading	K	Rm	Eff. Depth	Diameter (mm.)	Percent Finer
1.00	18.2	1.0205	1.0170	0.0138	21.0	10.7	0.0451	26.5
2.00	18.2	1.0185	1.0150	0.0138	19.0	11.3	0.0326	23.4
5.00	18.2	1.0180	1.0145	0.0138	18.5	11.4	0.0208	22.6
15.00	18.4	1.0160	1.0125	0.0137	16.5	11.9	0.0122	19.5
30.00	18.5	1.0150	1.0116	0.0137	15.5	12.2	0.0087	18.1
60.00	19.0	1.0130	1.0100	0.0136	13.5	12.7	0.0063	15.6
250.00	20.8	1.0110	1.0080	0.0133	11.5	13.3	0.0031	12.5
1440.00	22.0	1.0085	1.0065	0.0131	9.0	13.9	0.0013	10.1

Fractional Components

Cobbles	Gravel	Sand	Silt	Clay
0.0	5.0	67.3	13.5	14.2

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
	0.0057	0.0133	0.1068	0.3287	0.4992	1.1992	1.5794	2.2821	4.7588

Fineness Modulus
1.91

B. Hillebrandt Soils Testing, Inc.

GRAIN SIZE DISTRIBUTION TEST DATA

12/19/2012

Location: B-17-5
Depth: 6.0 - 6.5'
Material Description: Brown clayey SAND with gravel
USCS: SC

Sieve Test Data

Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
686.80	230.20	1"	0.00	0.00	100.0
		#4	101.80	31.00	84.5
		#10	62.40	31.00	77.6
		#40	83.10	31.00	66.2
		#200	122.70	31.00	46.1

Hydrometer Test Data

Hydrometer test uses material passing #10
Percent passing #10 based upon complete sample = 77.6
Weight of hydrometer sample =100.34
Table of composite correction values:

Temp., deg. C:	18.2	18.4	19.0	20.8	22.0
Comp. corr.:	-3.5	-3.5	-3.0	-3.0	-2.0

Meniscus correction only = 0.5
Specific gravity of solids = 2.7
Hydrometer type = 151H
Hydrometer effective depth equation: L = 16.294964 **-** 0.2645 **x Rm**

Elapsed Time (min.)	Temp. (deg. C.)	Actual Reading	Corrected Reading	K	Rm	Eff. Depth	Diameter (mm.)	Percent Finer
1.00	18.2	1.0390	1.0355	0.0138	39.5	5.8	0.0333	43.6
2.00	18.2	1.0375	1.0340	0.0138	38.0	6.2	0.0243	41.8
5.00	18.2	1.0360	1.0325	0.0138	36.5	6.6	0.0158	39.9
15.00	18.4	1.0315	1.0280	0.0137	32.0	7.8	0.0099	34.4
30.00	18.5	1.0295	1.0261	0.0137	30.0	8.4	0.0072	32.0
60.00	19.0	1.0270	1.0240	0.0136	27.5	9.0	0.0053	29.5
250.00	20.8	1.0230	1.0200	0.0133	23.5	10.1	0.0027	24.6
1440.00	22.0	1.0185	1.0165	0.0131	19.0	11.3	0.0012	20.3

Fractional Components

Cobbles	Gravel	Sand	Silt	Clay
0.0	15.5	38.4	17.1	29.0

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
			0.0056	0.1199	0.2597	2.7670	5.0331	8.7754	14.9979

Fineness Modulus
1.90

GRAIN SIZE DISTRIBUTION TEST DATA

12/19/2012

Location: B-17-5
Depth: 10.5 - 11.0'
Material Description: Grayish brown clayey SAND
USCS: SC

Sieve Test Data

Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
710.30	271.40	1"	0.00	0.00	100.0
		#4	64.70	31.00	92.3
		#10	73.30	31.00	82.7
		#40	111.00	31.00	64.5
		#200	139.20	31.00	39.8

Hydrometer Test Data

Hydrometer test uses material passing #10
Percent passing #10 based upon complete sample = 82.7
Weight of hydrometer sample =96.91
Table of composite correction values:

Temp., deg. C:	18.2	18.4	19.0	20.8	22.0	21.3
Comp. corr.:	-3.5	-3.5	-3.0	-3.0	-2.0	-2.5

Meniscus correction only = 0.5
Specific gravity of solids = 2.7
Hydrometer type = 151H
Hydrometer effective depth equation: L = 16.294964 **-** 0.2645 **x Rm**

Elapsed Time (min.)	Temp. (deg. C.)	Actual Reading	Corrected Reading	K	Rm	Eff. Depth	Diameter (mm.)	Percent Finer
1.00	18.2	1.0317	1.0283	0.0138	32.3	7.8	0.0383	38.3
2.00	18.2	1.0300	1.0265	0.0138	30.5	8.2	0.0279	35.9
5.00	18.4	1.0280	1.0245	0.0137	28.5	8.8	0.0182	33.2
15.00	19.3	1.0270	1.0240	0.0136	27.5	9.0	0.0105	32.5
30.00	19.8	1.0268	1.0237	0.0135	27.3	9.1	0.0074	32.2
60.00	20.2	1.0250	1.0220	0.0134	25.5	9.6	0.0054	29.8
250.00	20.4	1.0217	1.0188	0.0134	22.3	10.4	0.0027	25.4
1440.00	21.3	1.0172	1.0148	0.0132	17.8	11.6	0.0012	20.0

Fractional Components

Cobbles	Gravel	Sand	Silt	Clay
0.0	7.7	52.5	10.5	29.3

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
		0.0012	0.0055	0.1813	0.3235	1.5664	2.4423	3.7730	6.6591

Fineness Modulus
1.75

GRAIN SIZE DISTRIBUTION TEST DATA

12/19/2012

Location: B-17-6
Depth: 21.0 - 21.5'
Material Description: Brown lean CLAY with sand
USCS: CL
Tested by: BH

Sieve Test Data

Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
256.80	34.00	1"	0.00	0.00	100.0
		#4	31.00	31.00	100.0
		#10	33.60	31.00	98.8
		#40	42.70	31.00	93.6
		#200	54.60	31.00	83.0

Hydrometer Test Data

Hydrometer test uses material passing #10
Percent passing #10 based upon complete sample = 98.8
Weight of hydrometer sample =57.96
Table of composite correction values:

Temp., deg. C:	18.2	18.4	19.0	20.8	22.0	21.3
Comp. corr.:	-3.5	-3.5	-3.0	-3.0	-2.0	-2.5

Meniscus correction only = 0.5
Specific gravity of solids = 2.7
Hydrometer type = 151H
Hydrometer effective depth equation: L = 16.294964 **-** 0.2645 **x Rm**

Elapsed Time (min.)	Temp. (deg. C.)	Actual Reading	Corrected Reading	K	Rm	Eff. Depth	Diameter (mm.)	Percent Finer
1.00	18.2	1.0295	1.0260	0.0138	30.0	8.4	0.0398	70.4
2.00	18.2	1.0285	1.0250	0.0138	29.0	8.6	0.0286	67.7
5.00	18.6	1.0250	1.0217	0.0137	25.5	9.6	0.0189	58.7
15.00	19.3	1.0210	1.0180	0.0136	21.5	10.6	0.0114	48.7
30.00	19.8	1.0190	1.0160	0.0135	19.5	11.1	0.0082	43.3
60.00	20.2	1.0170	1.0140	0.0134	17.5	11.7	0.0059	37.9
250.00	20.4	1.0137	1.0108	0.0134	14.3	12.5	0.0030	29.1
1440.00	21.3	1.0100	1.0075	0.0132	10.5	13.5	0.0013	20.3

Fractional Components

Cobbles	Gravel	Sand	Silt	Clay
0.0	0.0	17.0	47.6	35.4

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
			0.0032	0.0123	0.0200	0.0653	0.0835	0.1226	0.7147

Fineness Modulus
0.25

GRAIN SIZE DISTRIBUTION TEST DATA

12/19/2012

Location: B-17-7
Depth: 21.0 - 21.5'
Material Description: Brownish gray lean CLAY with sand
USCS: CL
Tested by: BH

Sieve Test Data

Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
254.30	33.60	1"	0.00	0.00	100.0
		#4	33.30	31.00	99.0
		#10	37.20	31.00	96.1
		#40	52.30	31.00	86.5
		#200	61.80	31.00	72.5

Hydrometer Test Data

Hydrometer test uses material passing #10
Percent passing #10 based upon complete sample = 96.1
Weight of hydrometer sample =53.88
Table of composite correction values:

Temp., deg. C:	18.2	18.4	19.0	20.8	22.0	21.3
Comp. corr.:	-3.5	-3.5	-3.0	-3.0	-2.0	-2.5

Meniscus correction only = 0.5
Specific gravity of solids = 2.7
Hydrometer type = 151H
Hydrometer effective depth equation: L = 16.294964 **-** 0.2645 **x Rm**

Elapsed Time (min.)	Temp. (deg. C.)	Actual Reading	Corrected Reading	K	Rm	Eff. Depth	Diameter (mm.)	Percent Finer
1.00	18.2	1.0270	1.0235	0.0138	27.5	9.0	0.0413	66.6
2.00	18.2	1.0250	1.0215	0.0138	25.5	9.6	0.0300	60.9
5.00	18.6	1.0230	1.0197	0.0137	23.5	10.1	0.0194	55.7
15.00	19.3	1.0210	1.0180	0.0136	21.5	10.6	0.0114	51.0
30.00	19.8	1.0195	1.0165	0.0135	20.0	11.0	0.0082	46.8
60.00	20.2	1.0180	1.0150	0.0134	18.5	11.4	0.0058	42.5
250.00	20.4	1.0135	1.0105	0.0134	14.0	12.6	0.0030	29.8
1440.00	21.3	1.0095	1.0070	0.0132	10.0	13.6	0.0013	19.8

Fractional Components

Cobbles	Gravel	Sand	Silt	Clay
0.0	1.0	26.5	32.7	39.8

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
		0.0013	0.0030	0.0105	0.0283	0.1916	0.3515	0.6846	1.5695

Fineness Modulus
0.61

GRAIN SIZE DISTRIBUTION TEST DATA

12/19/2012

Location: B-29-1
Depth: 15.5 - 16.0'
Material Description: Olive gray silty SAND with gravel
USCS: SM
Tested by: BH

Sieve Test Data

Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
319.40	34.00	1"	0.00	0.00	100.0
		#4	92.70	31.00	78.4
		#10	67.70	31.00	65.5
		#40	109.60	31.00	38.0
		#200	98.30	31.00	14.4

Hydrometer Test Data

Hydrometer test uses material passing #10
Percent passing #10 based upon complete sample = 65.5
Weight of hydrometer sample =80.46
Table of composite correction values:

Temp., deg. C:	18.2	18.4	19.0	20.8	22.0	21.3
Comp. corr.:	-3.5	-3.5	-3.0	-3.0	-2.0	-2.5

Meniscus correction only = 0.5
Specific gravity of solids = 2.7
Hydrometer type = 151H
Hydrometer effective depth equation: L = 16.294964 **-** 0.2645 **x Rm**

Elapsed Time (min.)	Temp. (deg. C.)	Actual Reading	Corrected Reading	K	Rm	Eff. Depth	Diameter (mm.)	Percent Finer
1.00	19.3	1.0130	1.0100	0.0136	13.5	12.7	0.0484	12.9
2.00	19.3	1.0115	1.0085	0.0136	12.0	13.1	0.0347	11.0
5.00	19.5	1.0110	1.0080	0.0135	11.5	13.3	0.0220	10.3
15.00	19.8	1.0100	1.0070	0.0135	10.5	13.5	0.0128	9.1
30.00	19.9	1.0095	1.0065	0.0135	10.0	13.6	0.0091	8.4
60.00	20.2	1.0090	1.0060	0.0134	9.5	13.8	0.0064	7.8
250.00	20.4	1.0075	1.0045	0.0134	8.0	14.2	0.0032	5.8
1440.00	21.3	1.0065	1.0040	0.0132	7.0	14.4	0.0013	5.2

Fractional Components

Cobbles	Gravel	Sand	Silt	Clay
0.0	21.6	64.0	7.3	7.1

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
0.0182	0.0842	0.1423	0.2732	0.8163	1.4351	5.3427	7.7609	11.4264	16.9911

Fineness Modulus	C_u	C_c
3.16	78.84	2.86

GRAIN SIZE DISTRIBUTION TEST DATA

12/19/2012

Location: B-29-1
Depth: 25.0 - 25.4.
Material Description: Olive brown to olive gray clayey SAND
USCS: SC
Tested by: BH

Sieve Test Data

Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
336.90	33.90	1"	0.00	0.00	100.0
		#4	42.40	31.00	96.2
		#10	66.70	31.00	84.5
		#40	110.70	31.00	58.2
		#200	99.10	31.00	35.7

Hydrometer Test Data

Hydrometer test uses material passing #10
Percent passing #10 based upon complete sample = 84.5
Weight of hydrometer sample =96.54
Table of composite correction values:

Temp., deg. C:	18.2	18.4	19.0	20.8	22.0	21.3
Comp. corr.:	-3.5	-3.5	-3.0	-3.0	-2.0	-2.5

Meniscus correction only = 0.5
Specific gravity of solids = 2.7
Hydrometer type = 151H
Hydrometer effective depth equation: L = 16.294964 **-** 0.2645 **x Rm**

Elapsed Time (min.)	Temp. (deg. C.)	Actual Reading	Corrected Reading	K	Rm	Eff. Depth	Diameter (mm.)	Percent Finer
1.00	19.3	1.0275	1.0245	0.0136	28.0	8.9	0.0404	34.0
2.00	19.3	1.0257	1.0228	0.0136	26.3	9.4	0.0293	31.6
5.00	19.5	1.0235	1.0205	0.0135	24.0	9.9	0.0191	28.5
15.00	19.8	1.0228	1.0197	0.0135	23.3	10.1	0.0111	27.4
30.00	19.9	1.0210	1.0180	0.0135	21.5	10.6	0.0080	25.0
60.00	20.2	1.0190	1.0160	0.0134	19.5	11.1	0.0058	22.2
250.00	20.4	1.0160	1.0130	0.0134	16.5	11.9	0.0029	18.1
1440.00	21.3	1.0125	1.0100	0.0132	13.0	12.9	0.0012	13.9

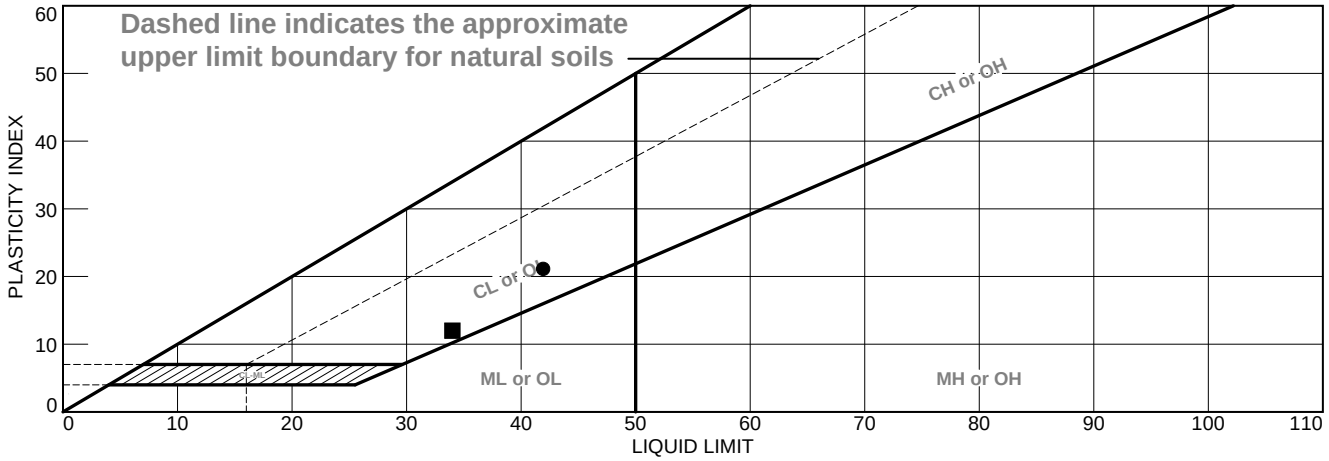
Fractional Components

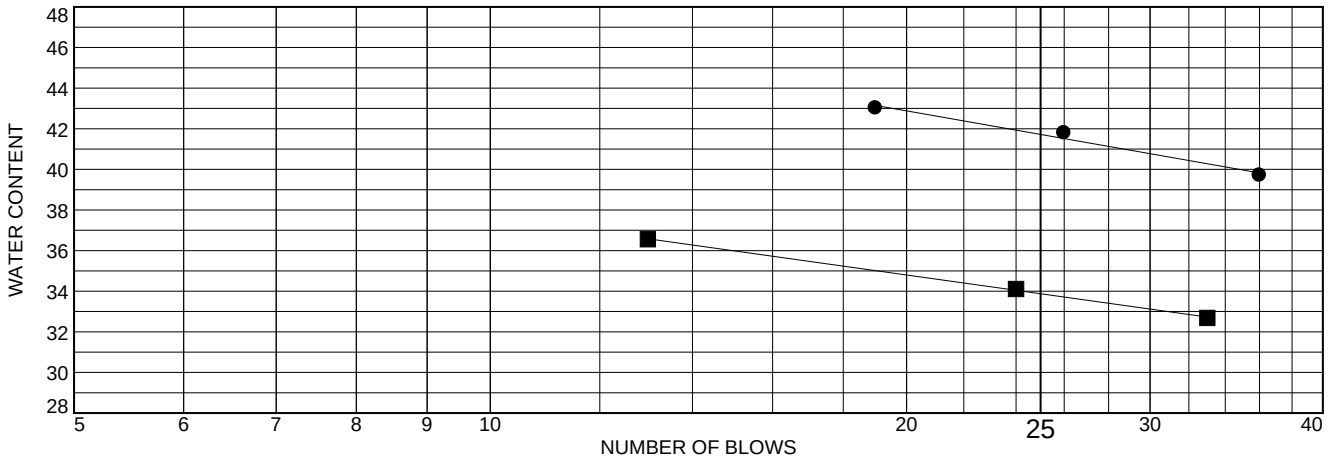
Cobbles	Gravel	Sand	Silt	Clay
0.0	3.8	60.5	14.5	21.2

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
	0.0016	0.0042	0.0243	0.2644	0.4724	1.5207	2.0693	2.8650	4.2138

Fineness Modulus
1.86

LIQUID AND PLASTIC LIMITS TEST REPORT





	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Dark yellowish brown clayey SAND	42	21	21	73.4	30.5	SC
■	Brown clayey SAND	34	22	12	86.6	38.1	SC

Project No. 1110-3A **Client:** A3Geo

Project: Napa River Restoration - OVOK

●**Source of Sample:** Site 19 River Channel **Sample Number:** Bulk 19-1

■**Source of Sample:** Site 22 River Channel **Sample Number:** Bulk 22-1

Remarks:

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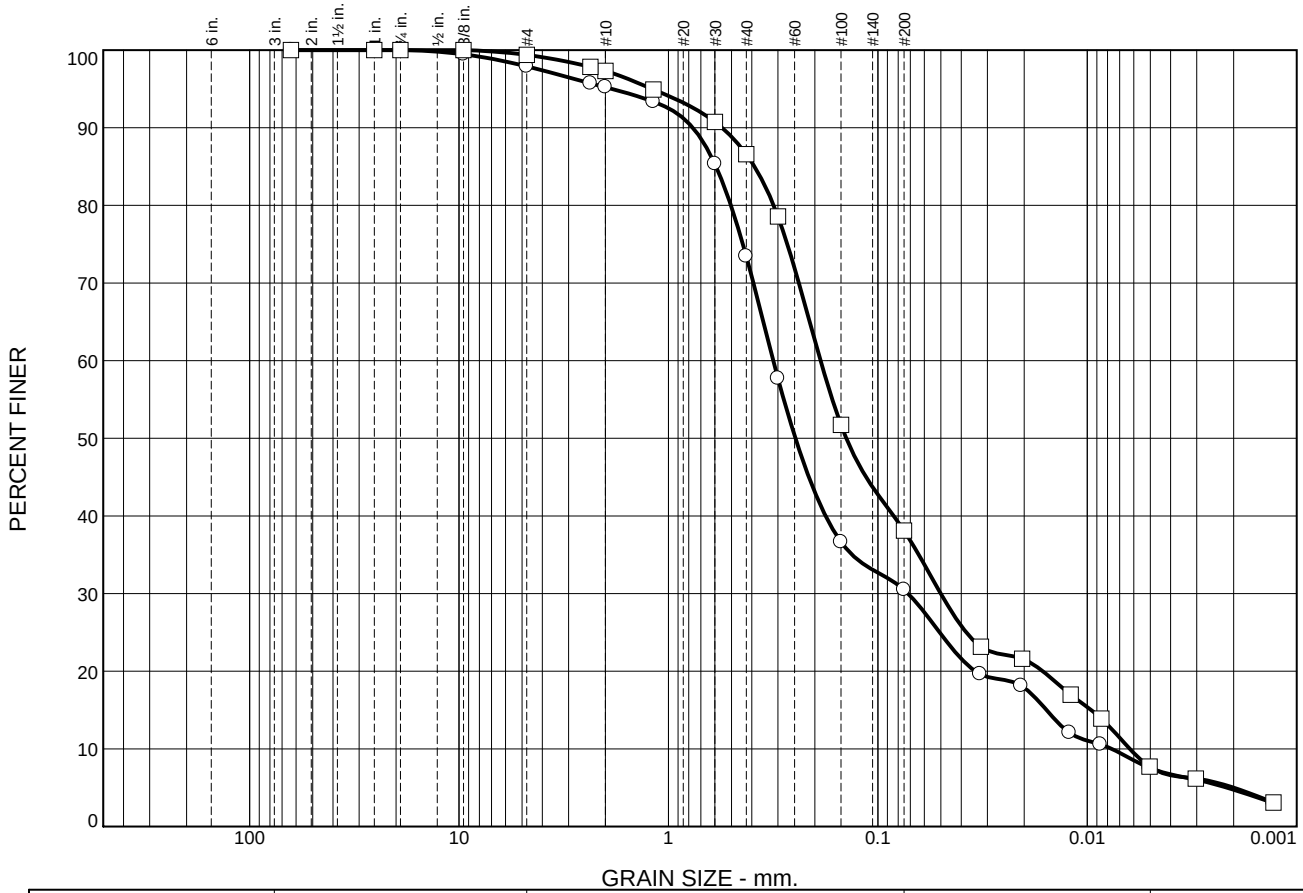
Figure

Tested By: BH

Particle Size Distribution Report



	% +3"	% Gravel	% Sand	% Silt	% Clay
○	0.0	2.1	67.4	23.0	7.5
□	0.0	0.6	61.3	30.4	7.7

SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH (ft.)	Material Description	USCS
○	Site 19 River	Bulk 19-1		Dark yellowish brown clayey SAND	SC
	Channel				
□	Site 22 River	Bulk 22-1		Brown clayey SAND	SC
	Channel				

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Client: A3Geo
Project: Napa River Restoration - OVOK
Project No.: 1110-3A **Figure**

Tested By: BH

GRAIN SIZE DISTRIBUTION TEST DATA

11/29/2012

Client: A3Geo
Project: Napa River Restoration - OVOK
Project Number: 1110-3A
Location: Site 19 River Channel
Sample Number: Bulk 19-1
Material Description: Dark yellowish brown clayey SAND
USCS: SC
Tested by: BH

Sieve Test Data

Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
808.50	274.50	2.5"	31.00	31.00	100.0
		1.0"	31.00	31.00	100.0
		.75"	31.00	31.00	100.0
		.375"	33.90	31.00	99.5
		#4	39.30	31.00	97.9
		#8	42.60	31.00	95.7
		#10	33.70	31.00	95.2
		#16	41.00	31.00	93.4
		#30	73.80	31.00	85.3
		#40	94.50	31.00	73.4
		#50	115.00	31.00	57.7
		#100	143.50	31.00	36.6
		#200	63.90	31.00	30.5

Hydrometer Test Data

Hydrometer test uses material passing #10
Percent passing #10 based upon complete sample = 95.2
Weight of hydrometer sample =50.04
Table of composite correction values:

Temp., deg. C:	26.0	26.2
Comp. corr.:	-5.0	-5.4

Meniscus correction only = 0.7
Specific gravity of solids = 2.7
Hydrometer type = 151H
Hydrometer effective depth equation: L = 16.294964 **-** 0.2645 **x Rm**

Elapsed Time (min.)	Temp. (deg. C.)	Actual Reading	Corrected Reading	K	Rm	Eff. Depth	Diameter (mm.)	Percent Finer
2.00	24.5	1.0115	1.0065	0.0127	12.2	13.1	0.0325	19.6
5.00	24.5	1.0110	1.0060	0.0127	11.7	13.2	0.0207	18.1
15.00	24.5	1.0090	1.0040	0.0127	9.7	13.7	0.0122	12.1
30.00	24.5	1.0085	1.0035	0.0127	9.2	13.9	0.0087	10.6
90.00	24.5	1.0075	1.0025	0.0127	8.2	14.1	0.0050	7.6
250.00	24.7	1.0070	1.0020	0.0127	7.7	14.3	0.0030	6.0
1440.00	23.7	1.0060	1.0010	0.0129	6.7	14.5	0.0013	3.0

Fractional Components

Cobbles	Gravel	Sand	Silt	Clay
0.0	2.1	67.4	23.0	7.5

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
0.0077	0.0157	0.0342	0.0718	0.2475	0.3159	0.5032	0.5922	0.7653	1.8600

Fineness Modulus	C_u	C_c
1.34	41.26	2.13

GRAIN SIZE DISTRIBUTION TEST DATA

11/29/2012

Client: A3Geo
Project: Napa River Restoration - OVOK
Project Number: 1110-3A
Location: Site 22 River Channel
Sample Number: Bulk 22-1
Material Description: Brown clayey SAND
USCS: SC
Tested by: BH

Sieve Test Data

Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
618.10	230.30	2.5"	31.00	31.00	100.0
		1.0"	31.00	31.00	100.0
		.75"	31.00	31.00	100.0
		.375"	31.00	31.00	100.0
		#4	33.40	31.00	99.4
		#8	37.00	31.00	97.8
		#10	33.00	31.00	97.3
		#16	40.30	31.00	94.9
		#30	47.20	31.00	90.7
		#40	47.10	31.00	86.6
		#50	62.10	31.00	78.6
		#100	135.10	31.00	51.7
		#200	83.80	31.00	38.1

Hydrometer Test Data

Hydrometer test uses material passing #10
Percent passing #10 based upon complete sample = 97.3
Weight of hydrometer sample =50.06
Table of composite correction values:

Temp., deg. C:	26.0	26.2
Comp. corr.:	-5.0	-5.4

Meniscus correction only = 0.7
Specific gravity of solids = 2.7
Hydrometer type = 151H
Hydrometer effective depth equation: L = 16.294964 **-** 0.2645 **x Rm**

Elapsed Time (min.)	Temp. (deg. C.)	Actual Reading	Corrected Reading	K	Rm	Eff. Depth	Diameter (mm.)	Percent Finer
2.00	24.5	1.0125	1.0075	0.0127	13.2	12.8	0.0322	23.2
5.00	24.5	1.0120	1.0070	0.0127	12.7	12.9	0.0205	21.6
15.00	24.5	1.0105	1.0055	0.0127	11.2	13.3	0.0120	17.0
30.00	24.5	1.0095	1.0045	0.0127	10.2	13.6	0.0086	13.9
90.00	24.5	1.0075	1.0025	0.0127	8.2	14.1	0.0050	7.7
250.00	24.7	1.0070	1.0020	0.0127	7.7	14.3	0.0030	6.2
1440.00	23.7	1.0060	1.0010	0.0129	6.7	14.5	0.0013	3.1

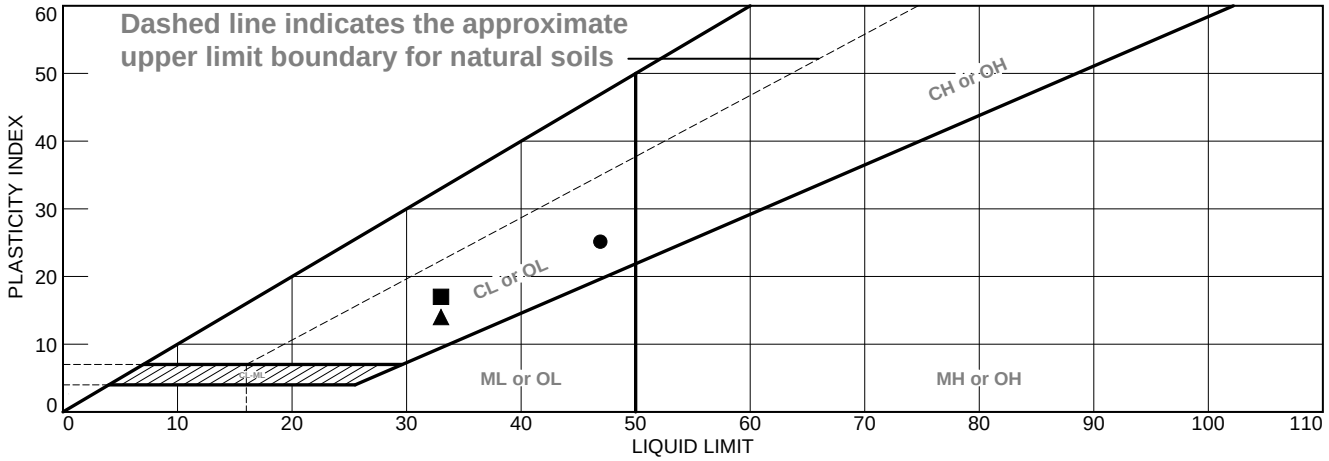
Fractional Components

Cobbles	Gravel	Sand	Silt	Clay
0.0	0.6	61.3	30.4	7.7

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
0.0063	0.0096	0.0163	0.0501	0.1415	0.1877	0.3144	0.3882	0.5547	1.1992

Fineness Modulus	C_u	C_c
0.87	29.96	2.13

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Brown lean CLAY. sample dropped off 5/10/13	47	22	25	97.6	86.3	CL
■	Olive brown sandy lean CLAY. Sample dropped off 5/10/13	33	16	17	66.9	50.5	CL
▲	Olive brown. Sample dropped off 5/10/13	33	19	14	59.9	45.4	SC

Project No. **Client:**

Project:

●**Source of Sample:** Site 1 Bulk 2
■**Source of Sample:** Bulk 18-1
▲**Source of Sample:** B-29-1

Remarks:

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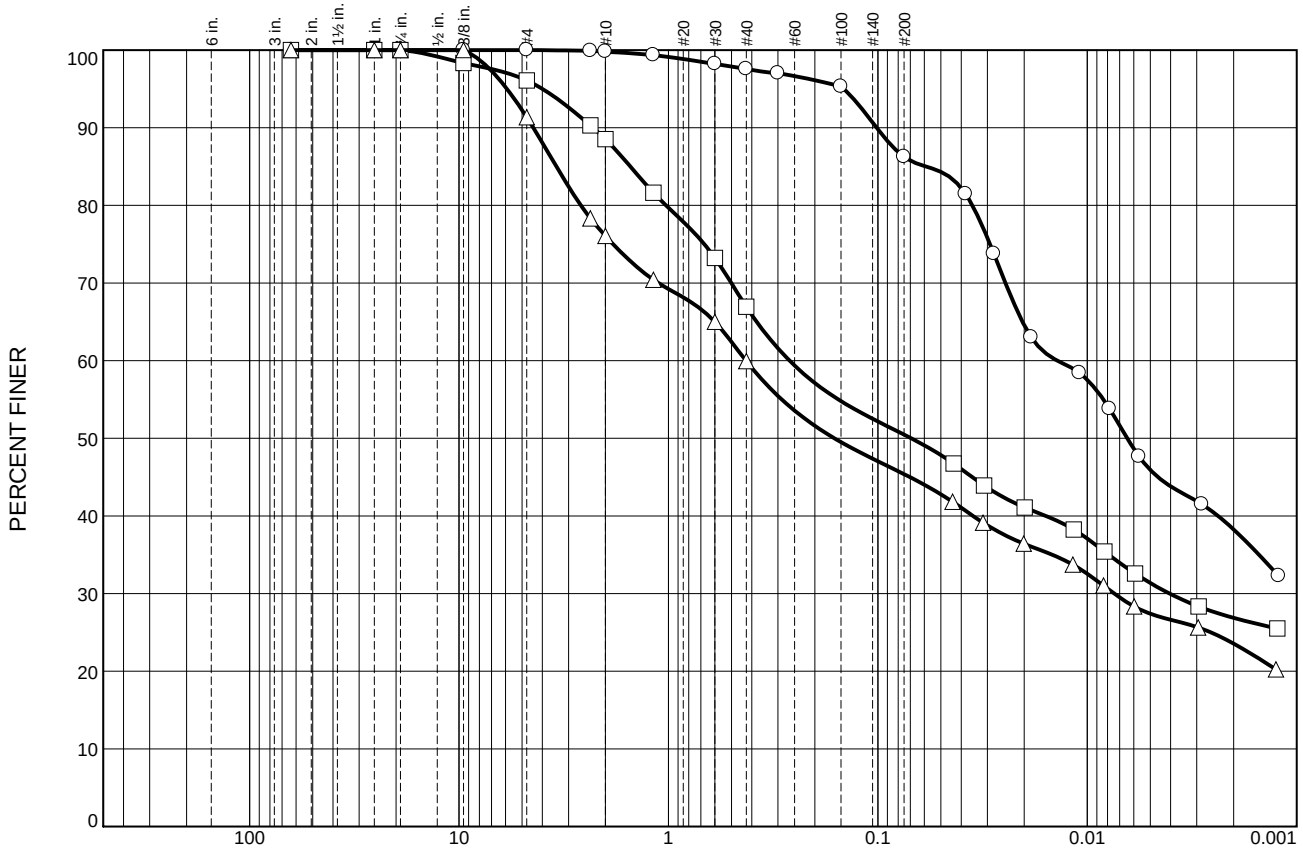
Figure

Tested By: BH

Particle Size Distribution Report



	% +3"	% Gravel	% Sand	% Silt	% Clay
○	0.0	0.0	13.7	40.4	45.9
□	0.0	3.9	45.6	19.1	31.4
△	0.0	8.7	45.9	18.0	27.4

SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH (ft.)	Material Description	USCS
○	Site 1 Bulk 2			Brown lean CLAY. sample dropped off 5/10/13	CL
□	Bulk 18-1			Olive brown sandy lean CLAY. Sample dropped off 5/10/13	CL
△	B-29-1			Olive brown. Sample dropped off 5/10/13	SC

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Client:
Project:
Project No.: **Figure**

Tested By: BH

GRAIN SIZE DISTRIBUTION TEST DATA

5/13/2013

Location: B-29-1
Material Description: Olive brown. Sample dropped off 5/10/13
USCS: SC
Tested by: BH

Sieve Test Data

Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
586.30	280.00	2.5"	0.00	0.00	100.0
		1.0"	0.00	0.00	100.0
		.75"	0.00	0.00	100.0
		.375"	0.00	0.00	100.0
		#4	57.50	31.00	91.3
		#8	70.90	31.00	78.3
		#10	37.90	31.00	76.1
		#16	48.30	31.00	70.4
		#30	47.60	31.00	65.0
		#40	46.50	31.00	59.9

Hydrometer Test Data

Hydrometer test uses material passing #4
Percent passing #4 based upon complete sample = 91.3
Weight of hydrometer sample =53.76
Table of composite correction values:

Temp., deg. C:	23.5	23.6	23.7	23.8	24.2
Comp. corr.:	-1.5	-1.5	-1.5	-1.5	-1.0

Meniscus correction only = 0.5
Specific gravity of solids = 2.7
Hydrometer type = 151H
Hydrometer effective depth equation: L = 16.294964 **-** 0.2645 **x Rm**

Elapsed Time (min.)	Temp. (deg. C.)	Actual Reading	Corrected Reading	K	Rm	Eff. Depth	Diameter (mm.)	Percent Finer
1.00	23.5	1.0170	1.0155	0.0129	17.5	11.7	0.0440	41.8
2.00	23.5	1.0160	1.0145	0.0129	16.5	11.9	0.0315	39.1
5.00	23.5	1.0150	1.0135	0.0129	15.5	12.2	0.0201	36.4
15.00	23.6	1.0140	1.0125	0.0129	14.5	12.5	0.0117	33.7
30.00	23.7	1.0130	1.0115	0.0129	13.5	12.7	0.0084	31.0
60.00	23.8	1.0120	1.0105	0.0128	12.5	13.0	0.0060	28.3
250.00	23.8	1.0110	1.0095	0.0128	11.5	13.3	0.0030	25.6
1440.00	24.2	1.0085	1.0075	0.0128	9.0	13.9	0.0013	20.2

Hydrometer Test Data (continued)

Elapsed Time (min.)	Temp. (deg. C.)	Actual Reading	Corrected Reading	K	Rm	Eff. Depth	Diameter (mm.)	Percent Finer

Fractional Components

Cobbles	Gravel	Sand	Silt	Clay
0.0	8.7	45.9	18.0	27.4

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
			0.0074	0.1612	0.4267	2.6207	3.4270	4.4197	5.9016

Fineness Modulus
1.90

GRAIN SIZE DISTRIBUTION TEST DATA

5/13/2013

Location: Bulk 18-1
Material Description: Olive brown sandy lean CLAY. Sample dropped off 5/10/13
USCS: CL
Tested by: BH

Sieve Test Data

Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
579.10	272.00	2.5"	0.00	0.00	100.0
		1.0"	0.00	0.00	100.0
		.75"	0.00	0.00	100.0
		.375"	36.10	31.00	98.3
		#4	37.90	31.00	96.1
		#8	48.80	31.00	90.3
		#10	36.40	31.00	88.5
		#16	52.20	31.00	81.6
		#30	56.80	31.00	73.2
		#40	50.30	31.00	66.9

Hydrometer Test Data

Hydrometer test uses material passing #4
Percent passing #4 based upon complete sample = 96.1
Weight of hydrometer sample =53.86
Table of composite correction values:

Temp., deg. C:	23.5	23.6	23.7	23.8	24.2
Comp. corr.:	-1.5	-1.5	-1.5	-1.5	-1.0

Meniscus correction only = 0.5
Specific gravity of solids = 2.7
Hydrometer type = 151H
Hydrometer effective depth equation: L = 16.294964 **-** 0.2645 **x Rm**

Elapsed Time (min.)	Temp. (deg. C.)	Actual Reading	Corrected Reading	K	Rm	Eff. Depth	Diameter (mm.)	Percent Finer
1.00	23.5	1.0180	1.0165	0.0129	18.5	11.4	0.0435	46.8
2.00	23.5	1.0170	1.0155	0.0129	17.5	11.7	0.0311	43.9
5.00	23.5	1.0160	1.0145	0.0129	16.5	11.9	0.0199	41.1
15.00	23.6	1.0150	1.0135	0.0129	15.5	12.2	0.0116	38.3
30.00	23.7	1.0140	1.0125	0.0129	14.5	12.5	0.0083	35.4
60.00	23.8	1.0130	1.0115	0.0128	13.5	12.7	0.0059	32.6
250.00	23.8	1.0115	1.0100	0.0128	12.0	13.1	0.0029	28.3
1440.00	24.2	1.0100	1.0090	0.0128	10.5	13.5	0.0012	25.5

Fractional Components

Cobbles	Gravel	Sand	Silt	Clay
0.0	3.9	45.6	19.1	31.4

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
			0.0040	0.0693	0.2639	1.0266	1.5202	2.2920	3.9976

Fineness Modulus
1.44

GRAIN SIZE DISTRIBUTION TEST DATA

5/13/2013

Location: B-29-1
Material Description: Olive brown. Sample dropped off 5/10/13
USCS: SC
Tested by: BH

Sieve Test Data

Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer
586.30	280.00	2.5"	0.00	0.00	100.0
		1.0"	0.00	0.00	100.0
		.75"	0.00	0.00	100.0
		.375"	0.00	0.00	100.0
		#4	57.50	31.00	91.3
		#8	70.90	31.00	78.3
		#10	37.90	31.00	76.1
		#16	48.30	31.00	70.4
		#30	47.60	31.00	65.0
		#40	46.50	31.00	59.9

Hydrometer Test Data

Hydrometer test uses material passing #4
Percent passing #4 based upon complete sample = 91.3
Weight of hydrometer sample =53.76
Table of composite correction values:

Temp., deg. C:	23.5	23.6	23.7	23.8	24.2
Comp. corr.:	-1.5	-1.5	-1.5	-1.5	-1.0

Meniscus correction only = 0.5
Specific gravity of solids = 2.7
Hydrometer type = 151H
Hydrometer effective depth equation: L = 16.294964 **-** 0.2645 **x Rm**

Elapsed Time (min.)	Temp. (deg. C.)	Actual Reading	Corrected Reading	K	Rm	Eff. Depth	Diameter (mm.)	Percent Finer
1.00	23.5	1.0170	1.0155	0.0129	17.5	11.7	0.0440	41.8
2.00	23.5	1.0160	1.0145	0.0129	16.5	11.9	0.0315	39.1
5.00	23.5	1.0150	1.0135	0.0129	15.5	12.2	0.0201	36.4
15.00	23.6	1.0140	1.0125	0.0129	14.5	12.5	0.0117	33.7
30.00	23.7	1.0130	1.0115	0.0129	13.5	12.7	0.0084	31.0
60.00	23.8	1.0120	1.0105	0.0128	12.5	13.0	0.0060	28.3
250.00	23.8	1.0110	1.0095	0.0128	11.5	13.3	0.0030	25.6
1440.00	24.2	1.0085	1.0075	0.0128	9.0	13.9	0.0013	20.2

Hydrometer Test Data (continued)

Elapsed Time (min.)	Temp. (deg. C.)	Actual Reading	Corrected Reading	K	Rm	Eff. Depth	Diameter (mm.)	Percent Finer

Fractional Components

Cobbles	Gravel	Sand	Silt	Clay
0.0	8.7	45.9	18.0	27.4

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
			0.0074	0.1612	0.4267	2.6207	3.4270	4.4197	5.9016

Fineness Modulus
1.90

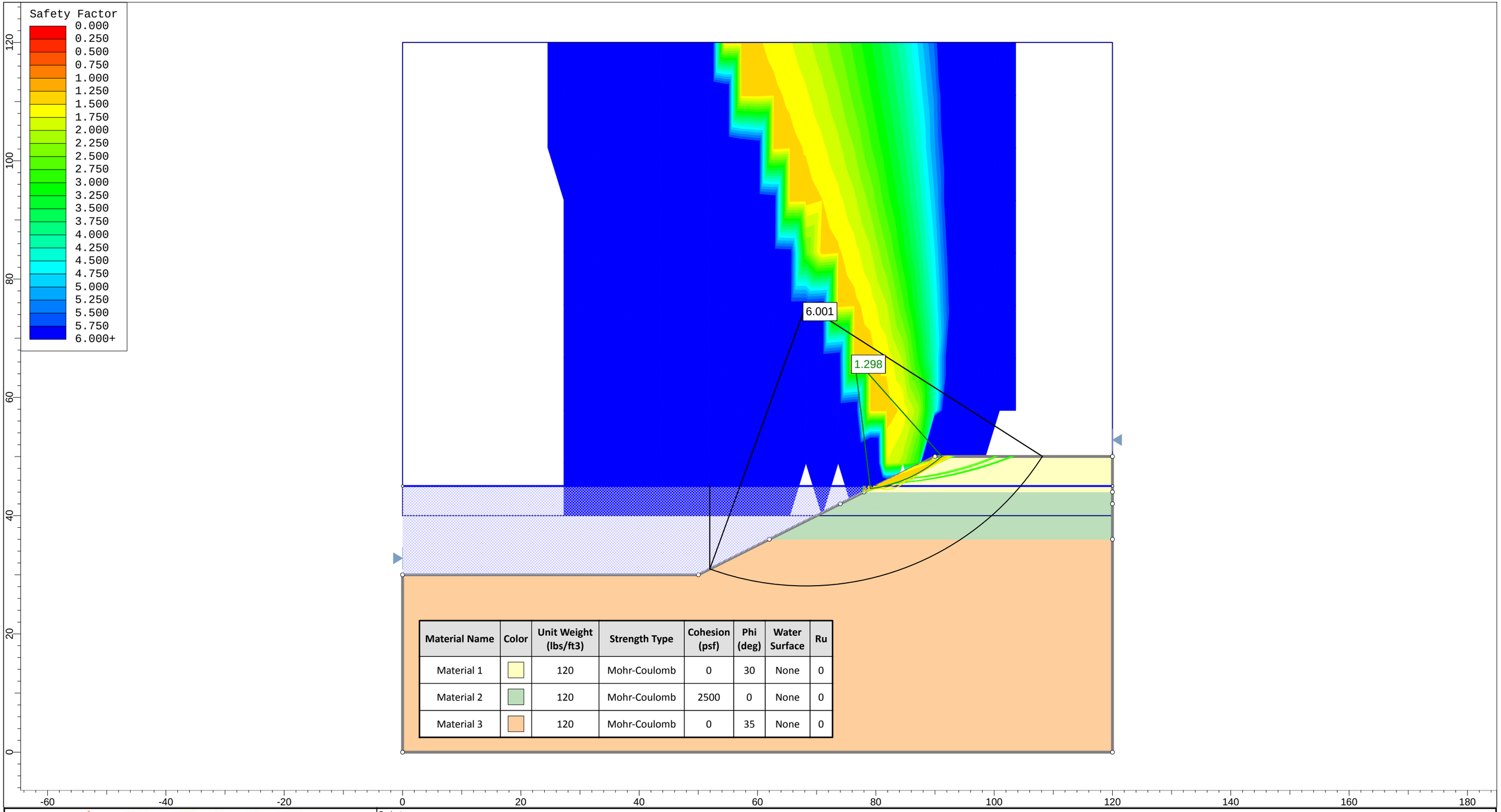
Slake Test Results
Napa River - OVOK Reach
A3GEO Project #1110-3A

Time	5 sec.	30 sec.	5 min.	30 min.	1 hr	6hr	12 hrs	Stability Class	Notes
	Structural Integrity Notes								
Sample ID									
Bulk 1-2 - River Channel (moist)	100	99	95	60	50			4	
Bulk 14-1 - River Channel (moist)	100	100	99.5	99.5	99.5	99.5	99.5	6	
Bulk 17-1 - River Channel	100	99	99	99	90	90	90	6	thin section analyzed
Bulk 18-1 - River Channel	70	10	0					2	
Bulk 19-2 - River Channel	95	90	10					3	
Bulk 22-2 - River Channel	95	90	10					3	
Bulk 22-2 - River Channel (moist)	99	99	99	99	99	99	99	6	
Bulk 29-1 - River Channel	100	100	100	100	100	100	100	6	nothing fell off
B-7-1 @15'	99	85	0					3	
B-17-4 @ 16-16.5'	90	80	0					2	
B-17-6 @ 21'	90	80	65	40				3+	
B-17-7 @ 22'	95	90	70	50				3+	
B-18-1 @ 15-16.5'	95	90	50	0				3	
B-18-1 @ 20.5 - 21'	90	80	50	0				3	
B-22-1 @ 21'	99	90	50	40				3+	
B-26A-1 @ 15.5'	99.5	99.5	99	99	95	90	80	6	
B-29-1 @ 15-15.5'	90	60	55	50				3	thin section analyzed
B-29-1 @ 25.5-26.0'	80	50						2	1/8" gravel remains

	Stability Class	Description
WORST	0	Soil too unstable to sample
	1	50% of structural integrity lost within **5 seconds** of insertion in water
	2	50% of structural integrity lost **5-30 seconds** after insertion
	3	50% of structural integrity lost within **30 sec. to 5 min.** after insertion
	4	50% of structural integrity remaining after **1 hour**
	5	50% of structural integrity remaining after **6 hours**
BEST	6	50% of structural integrity remaining after **12 hour**

Appendix C

Slope Stability Results

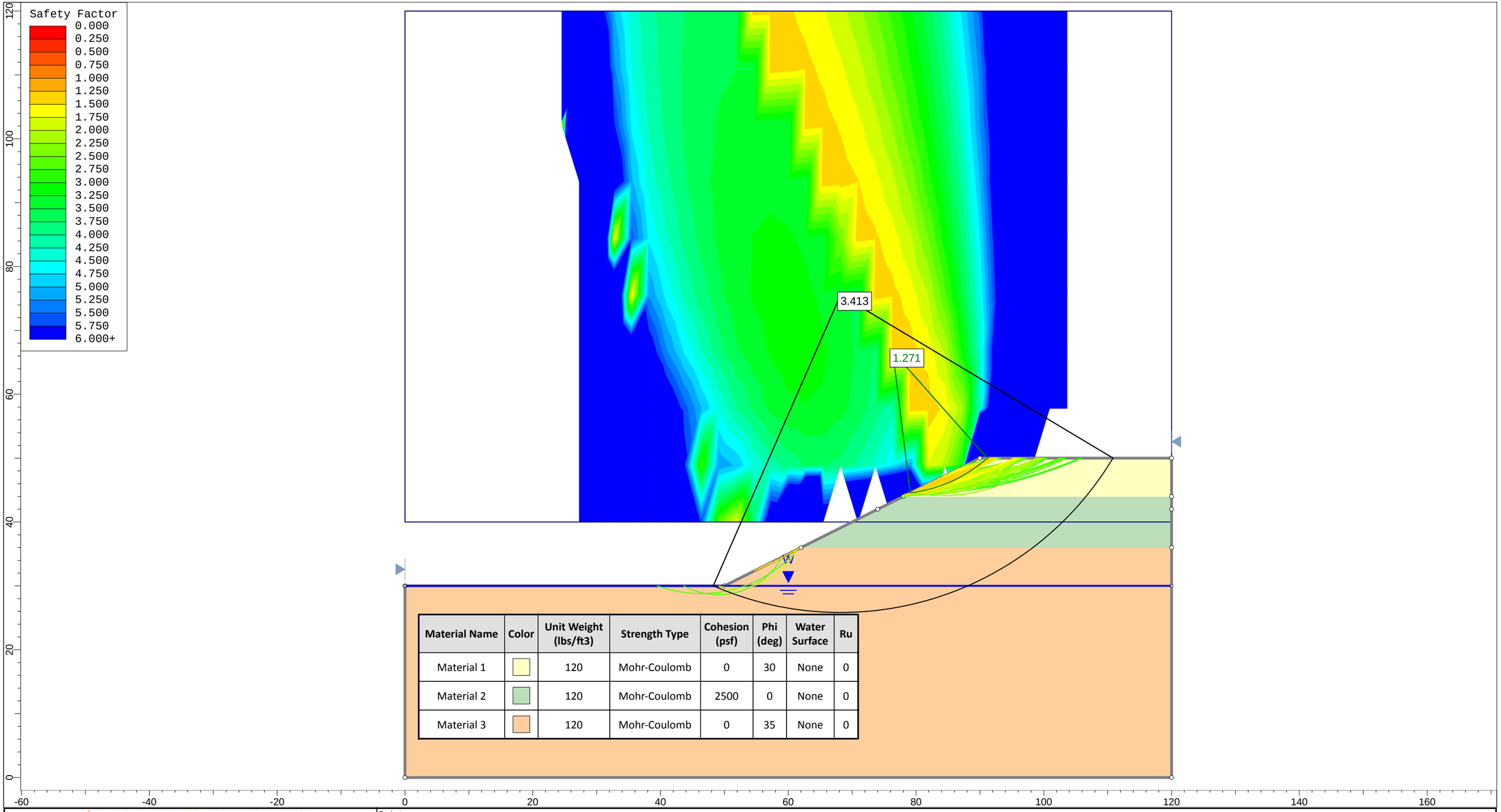


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru
Material 1		120	Mohr-Coulomb	0	30	None	0
Material 2		120	Mohr-Coulomb	2500	0	None	0
Material 3		120	Mohr-Coulomb	0	35	None	0

A3GEO GEOCONSULTANTS

SLIDEINTERPRET 6.022

Project	Napa River - Ovok Reach		
Analysis Description			
Drawn By		*Scale* 1:184	*Company*
Date	5/30/2013, 3:05:47 PM		*File Name* Site 17 - Slope 2-1 - High GW.slim

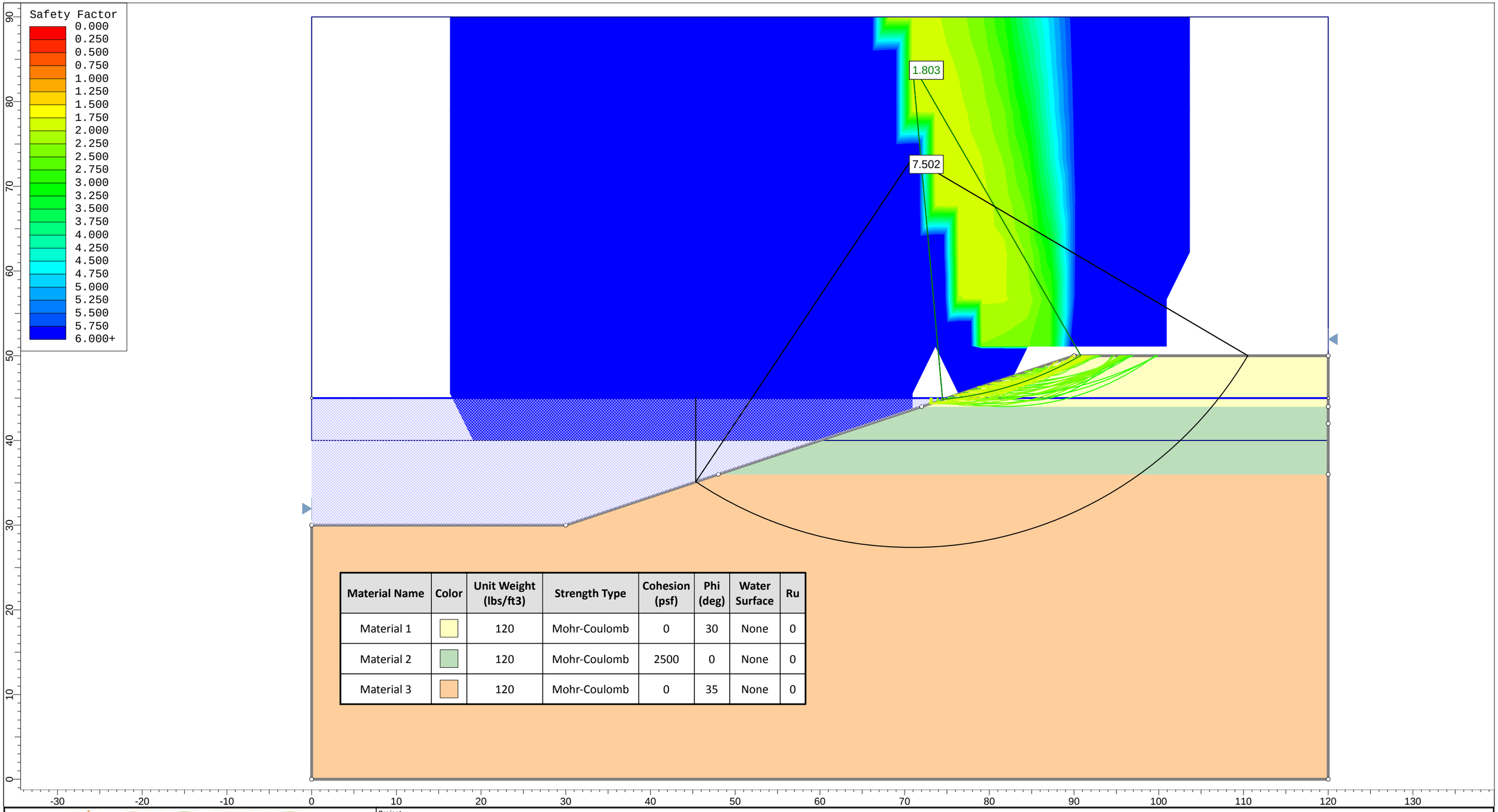


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru
Material 1		120	Mohr-Coulomb	0	30	None	0
Material 2		120	Mohr-Coulomb	2500	0	None	0
Material 3		120	Mohr-Coulomb	0	35	None	0

A3GEO GEOCONSULTANTS

SLIDEINTERPRET 6.022

Project	Napa River - Ovok Reach		
Analysis Description			
Drawn By		*Scale* 1:170	*Company*
Date	5/30/2013, 3:05:47 PM		*File Name* Site 17 - Slope 2-1 - Low GW.slim

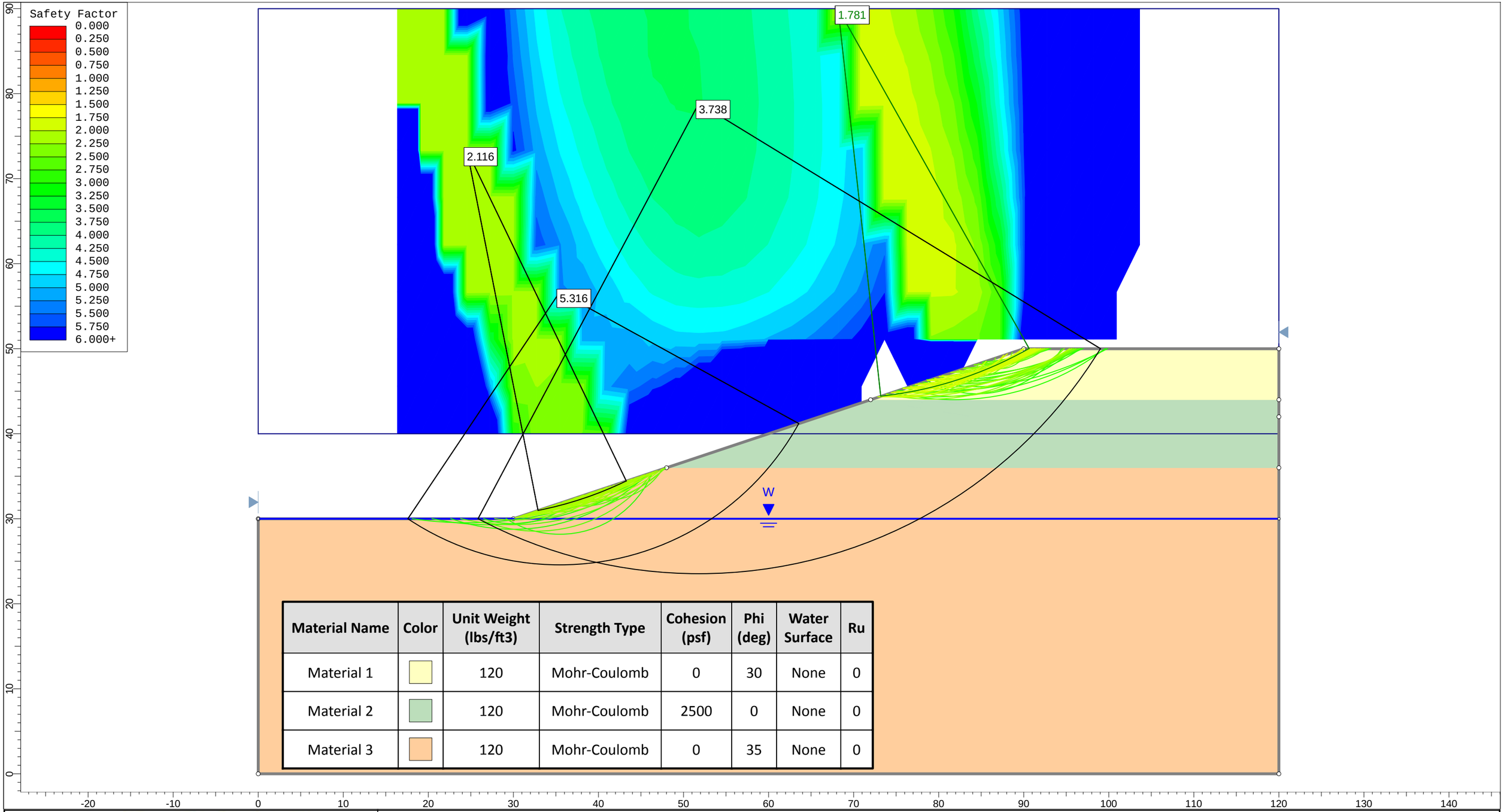


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru
Material 1		120	Mohr-Coulomb	0	30	None	0
Material 2		120	Mohr-Coulomb	2500	0	None	0
Material 3		120	Mohr-Coulomb	0	35	None	0

A3GEO GEOCONSULTANTS

SLIDEINTERPRET 6.022

Project	Napa River - Ovok Reach		
Analysis Description			
Drawn By		*Scale* 1:128	*Company*
Date	5/30/2013, 3:05:47 PM		*File Name* Site 17 - Slope 3-1 - High GW.slim

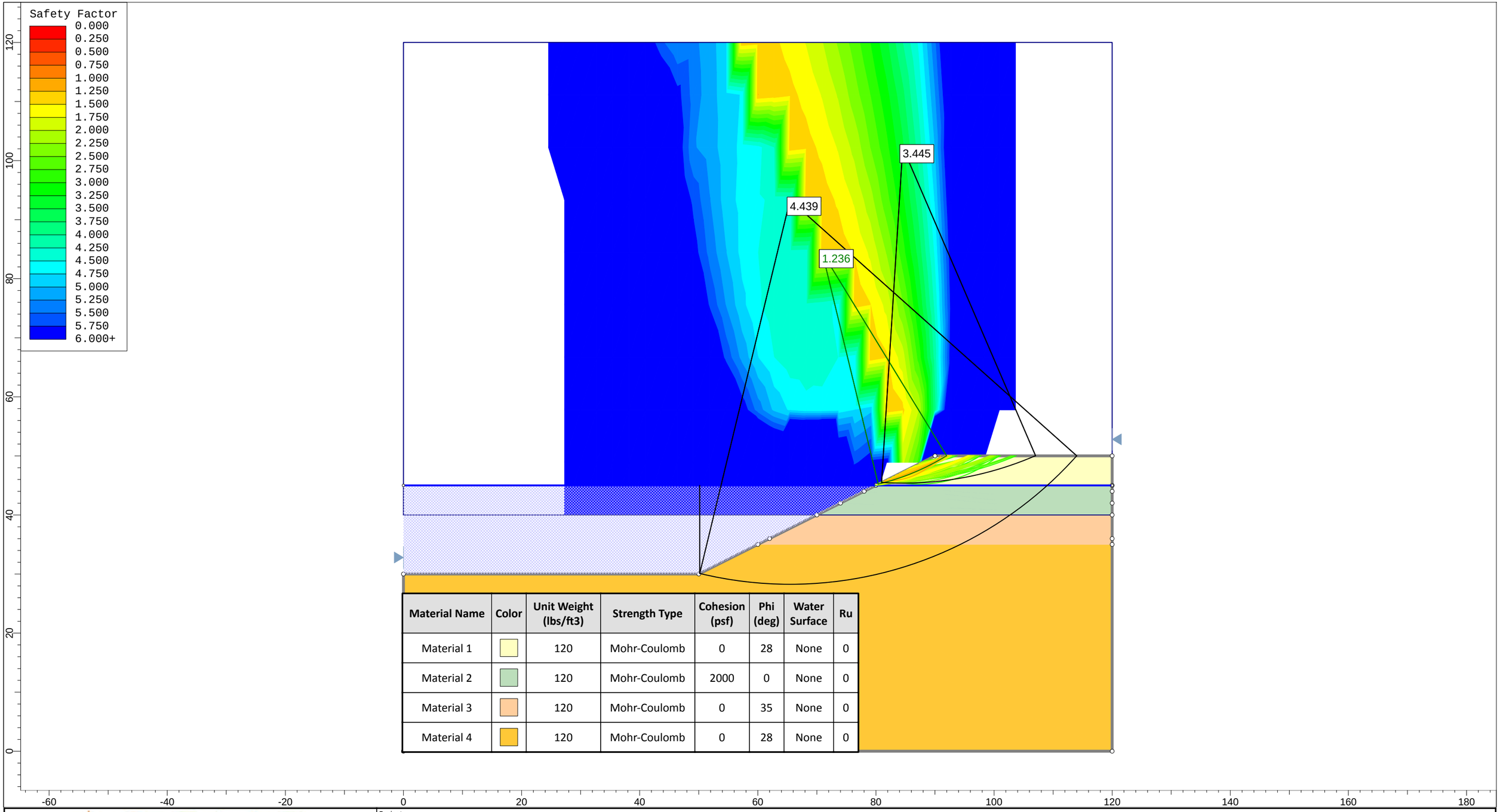


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru
Material 1		120	Mohr-Coulomb	0	30	None	0
Material 2		120	Mohr-Coulomb	2500	0	None	0
Material 3		120	Mohr-Coulomb	0	35	None	0

A3GEO GEOCONSULTANTS

SLIDEINTERPRET 6.022

Project	Napa River - Ovok Reach		
Analysis Description			
Drawn By		*Scale* 1:128	*Company*
Date	5/30/2013, 3:05:47 PM		*File Name* Site 17 - Slope 3-1 - Low GW.slim

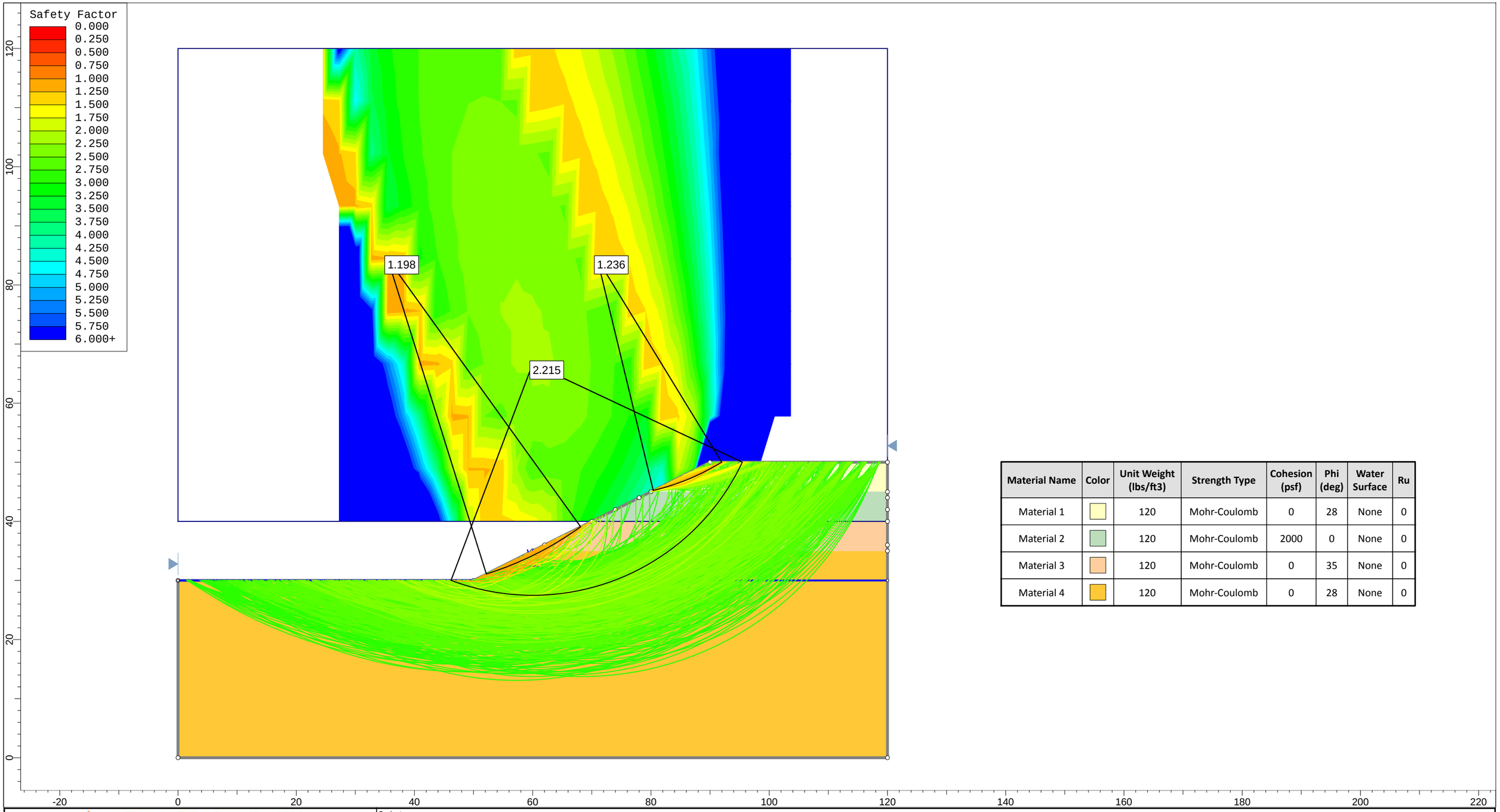


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru
Material 1		120	Mohr-Coulomb	0	28	None	0
Material 2		120	Mohr-Coulomb	2000	0	None	0
Material 3		120	Mohr-Coulomb	0	35	None	0
Material 4		120	Mohr-Coulomb	0	28	None	0

A3GEO GEOCONSULTANTS

SLIDEINTERPRET 6.022

Project	Napa River - Ovok Reach		
Analysis Description			
Drawn By		*Scale* 1:184	*Company*
Date	5/30/2013, 3:05:47 PM		*File Name* Site 18 - Slope 2-1 - High GW.slim

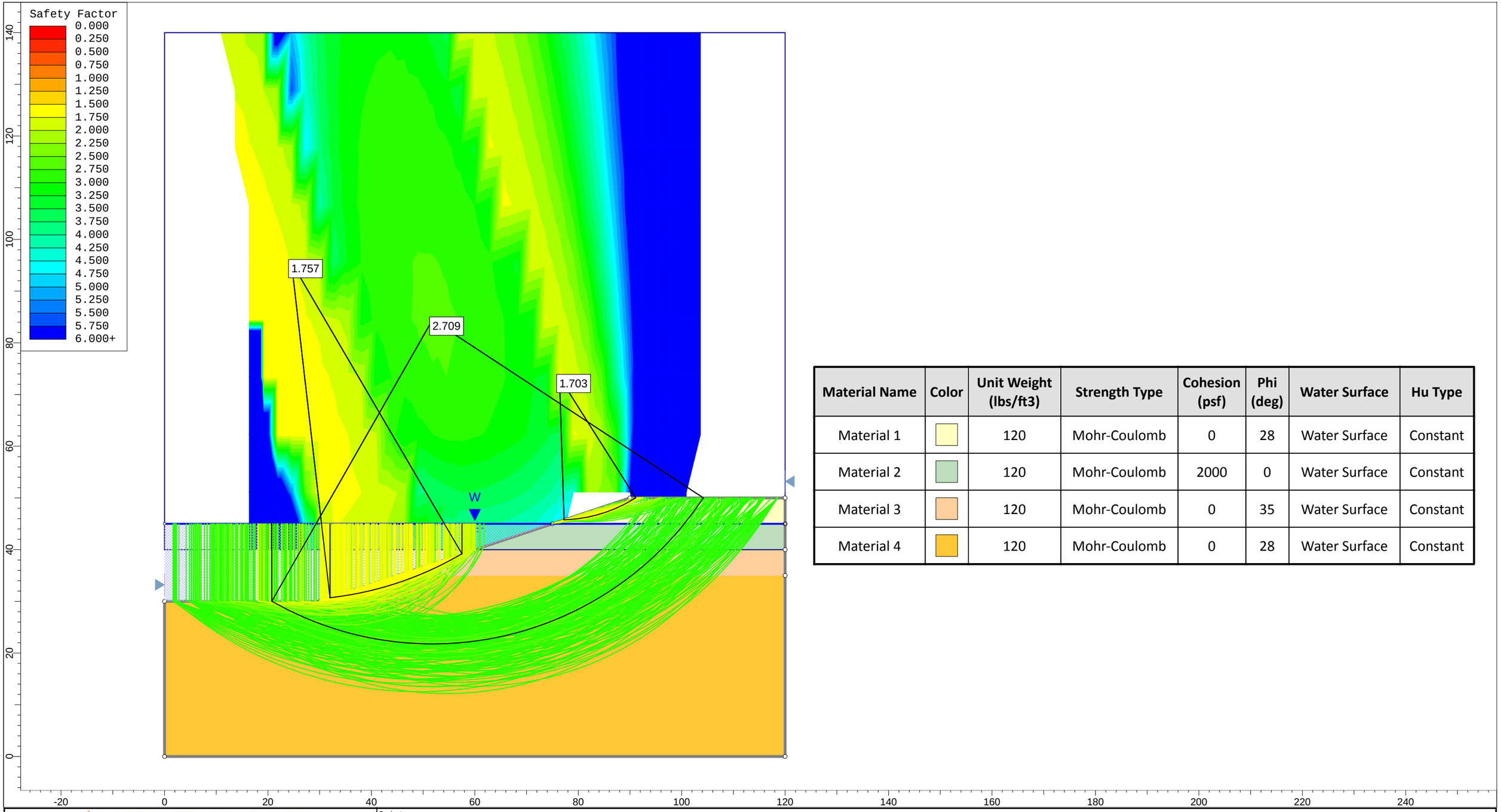


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru
Material 1		120	Mohr-Coulomb	0	28	None	0
Material 2		120	Mohr-Coulomb	2000	0	None	0
Material 3		120	Mohr-Coulomb	0	35	None	0
Material 4		120	Mohr-Coulomb	0	28	None	0

A3GEO GEOCONSULTANTS

SLIDEINTERPRET 6.022

Project	Napa River - Ovok Reach		
Analysis Description			
Drawn By		*Scale* 1:184	*Company*
Date	5/30/2013, 3:05:47 PM		*File Name* Site 18 - Slope 2-1 - Low GW.slim

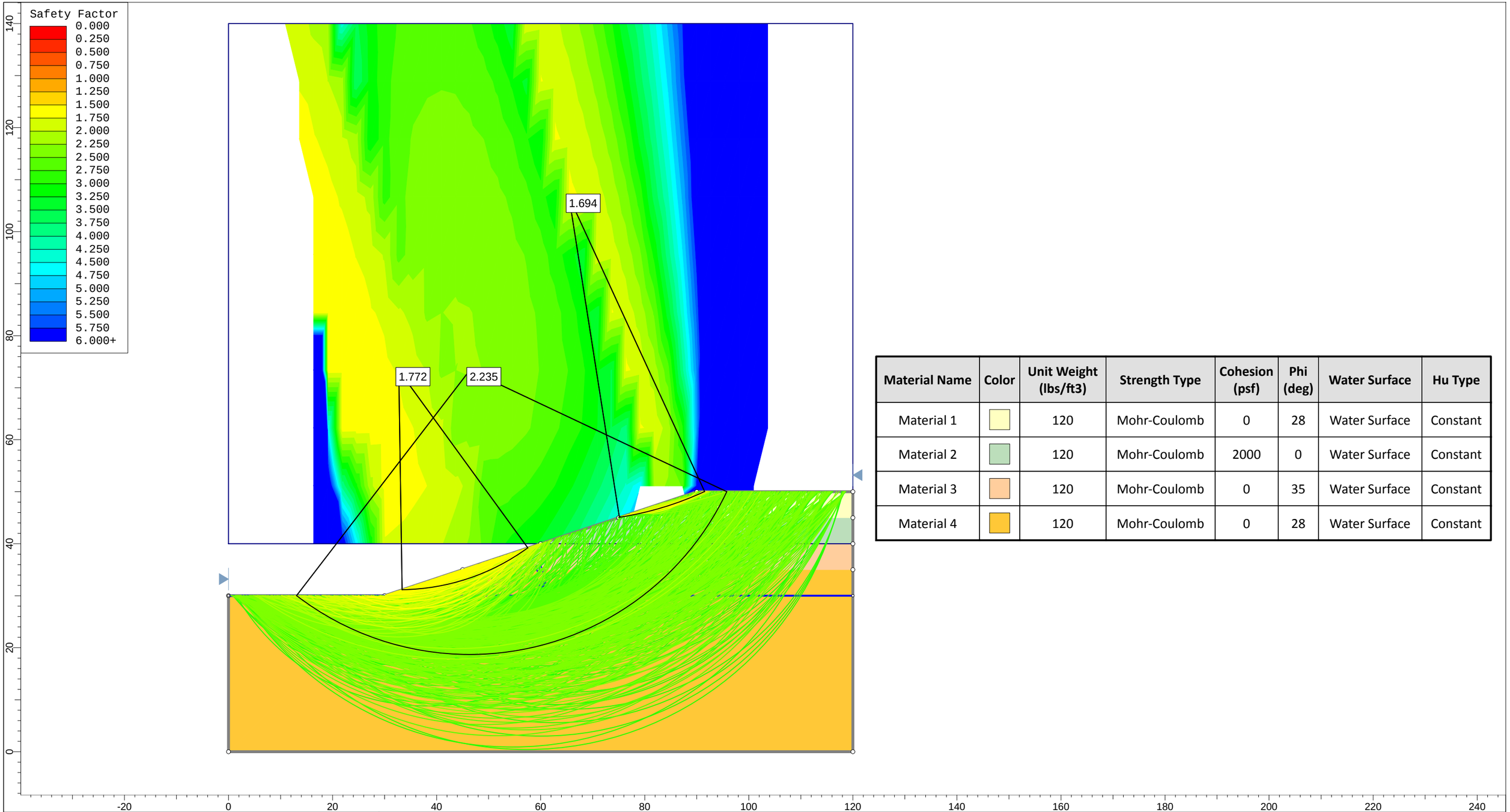


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Hu Type
Material 1		120	Mohr-Coulomb	0	28	Water Surface	Constant
Material 2		120	Mohr-Coulomb	2000	0	Water Surface	Constant
Material 3		120	Mohr-Coulomb	0	35	Water Surface	Constant
Material 4		120	Mohr-Coulomb	0	28	Water Surface	Constant

A3GEO GEOCONSULTANTS

SLIDEINTERPRET 6.022

Project	Napa River - Ovok Reach		
Analysis Description			
Drawn By		Scale 1:210	Company
Date	5/30/2013, 3:05:47 PM		File Name Site 18 - Slope 3-1 - High GW.slim

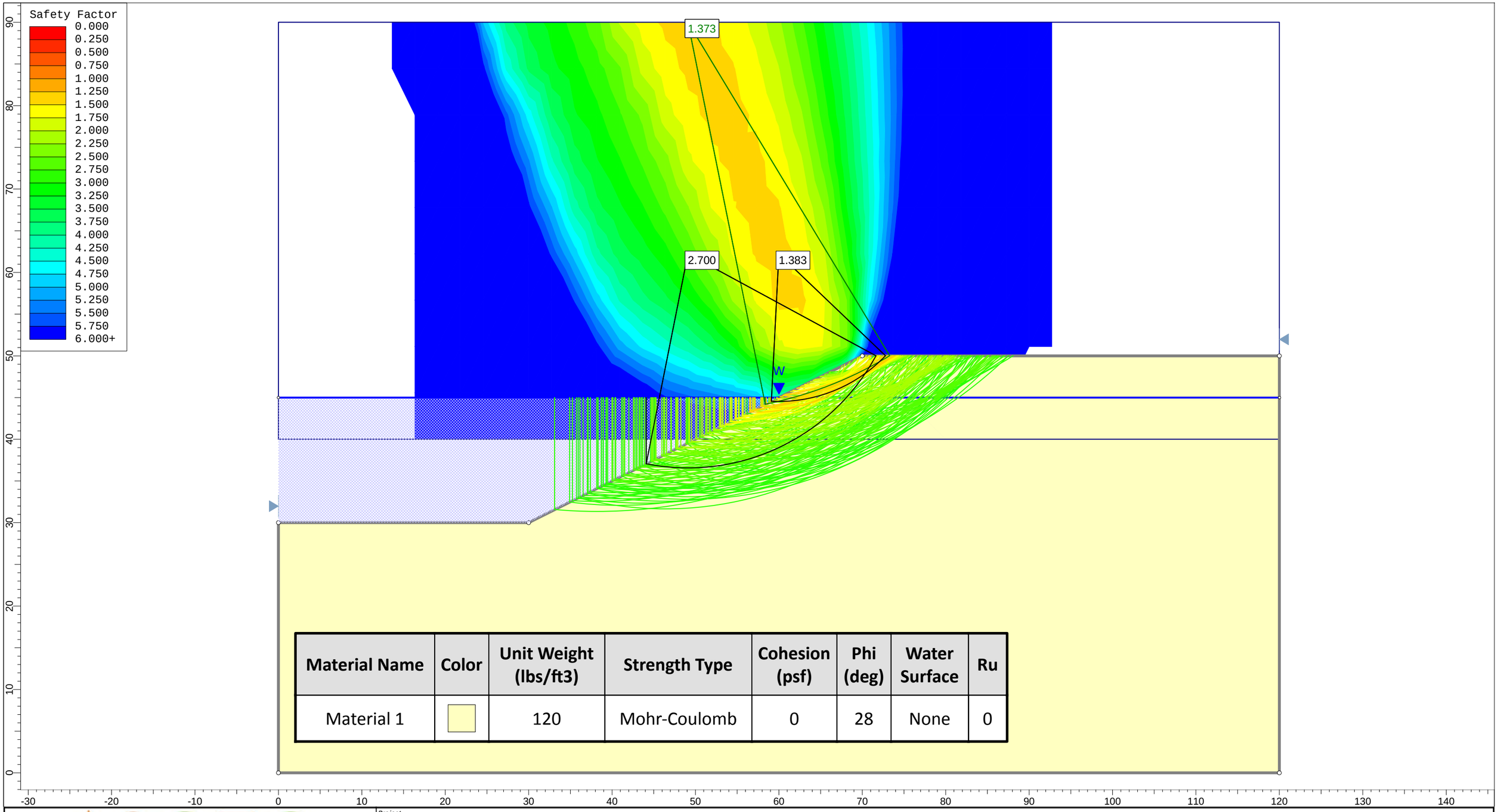


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Hu Type
Material 1		120	Mohr-Coulomb	0	28	Water Surface	Constant
Material 2		120	Mohr-Coulomb	2000	0	Water Surface	Constant
Material 3		120	Mohr-Coulomb	0	35	Water Surface	Constant
Material 4		120	Mohr-Coulomb	0	28	Water Surface	Constant

A3GEO GEOCONSULTANTS

SLIDEINTERPRET 6.022

Project	Napa River - Ovok Reach	
Analysis Description		
Drawn By	*Scale* 1:210	*Company*
Date 5/30/2013, 3:05:47 PM		*File Name* Site 18 - Slope 3-1 - Low GW.slim

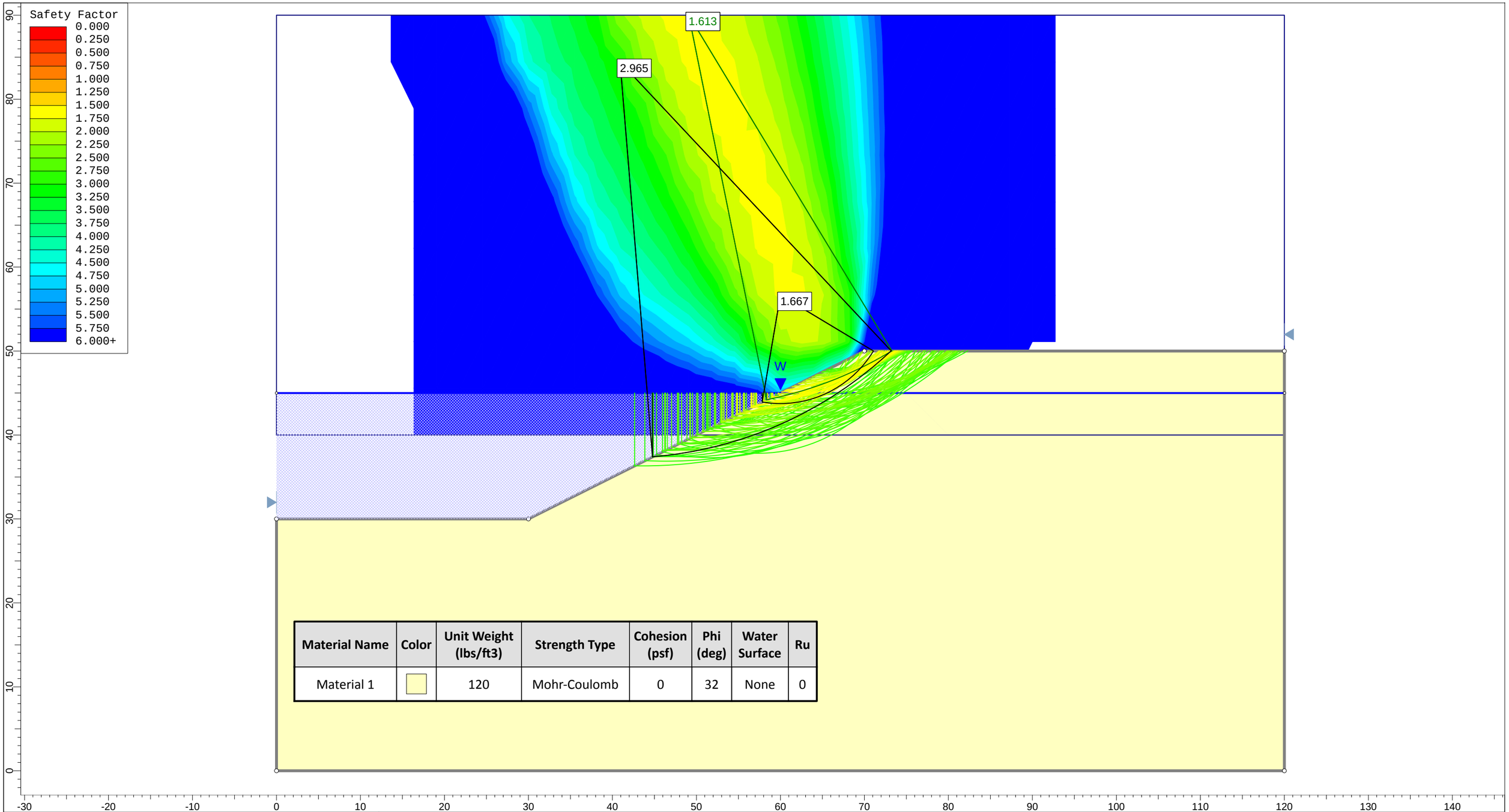


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru
Material 1		120	Mohr-Coulomb	0	28	None	0

A3GEO GEOCONSULTANTS

SLIDEINTERPRET 6.022

Project	Napa River - Ovok Reach		
Analysis Description			
Drawn By	*Scale* 1:130	*Company*	
Date	5/30/2013, 3:05:47 PM	*File Name*	Slope 2-1 - High GW - Phi 28.slim

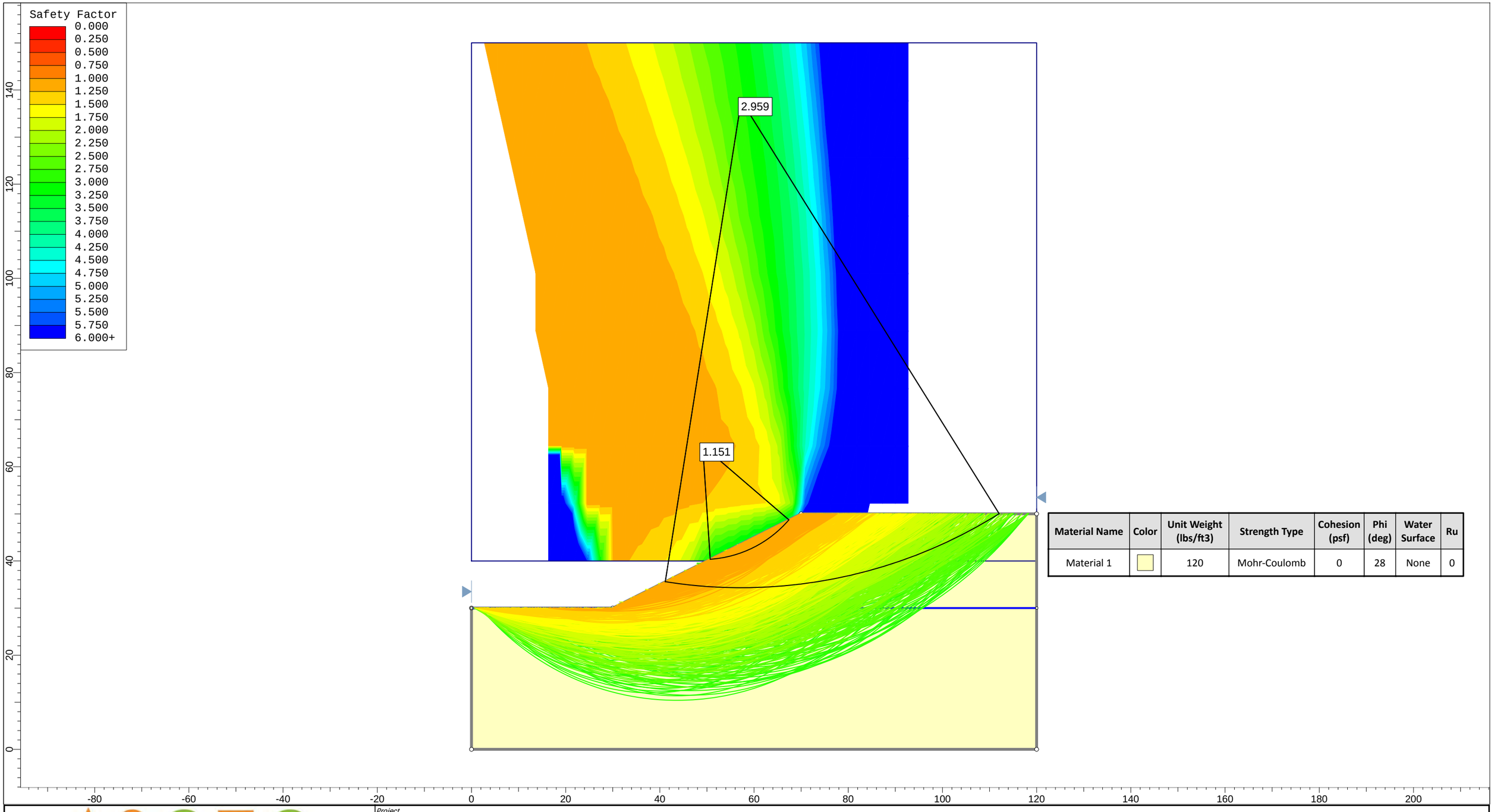


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru
Material 1		120	Mohr-Coulomb	0	32	None	0

A3GEO GEOCONSULTANTS

SLIDEINTERPRET 6.022

Project	Napa River - Ovok Reach	
Analysis Description		
Drawn By	*Scale* 1:130	*Company*
Date 5/30/2013, 3:05:47 PM		*File Name* Slope 2-1 - High GW - Phi 32.slim

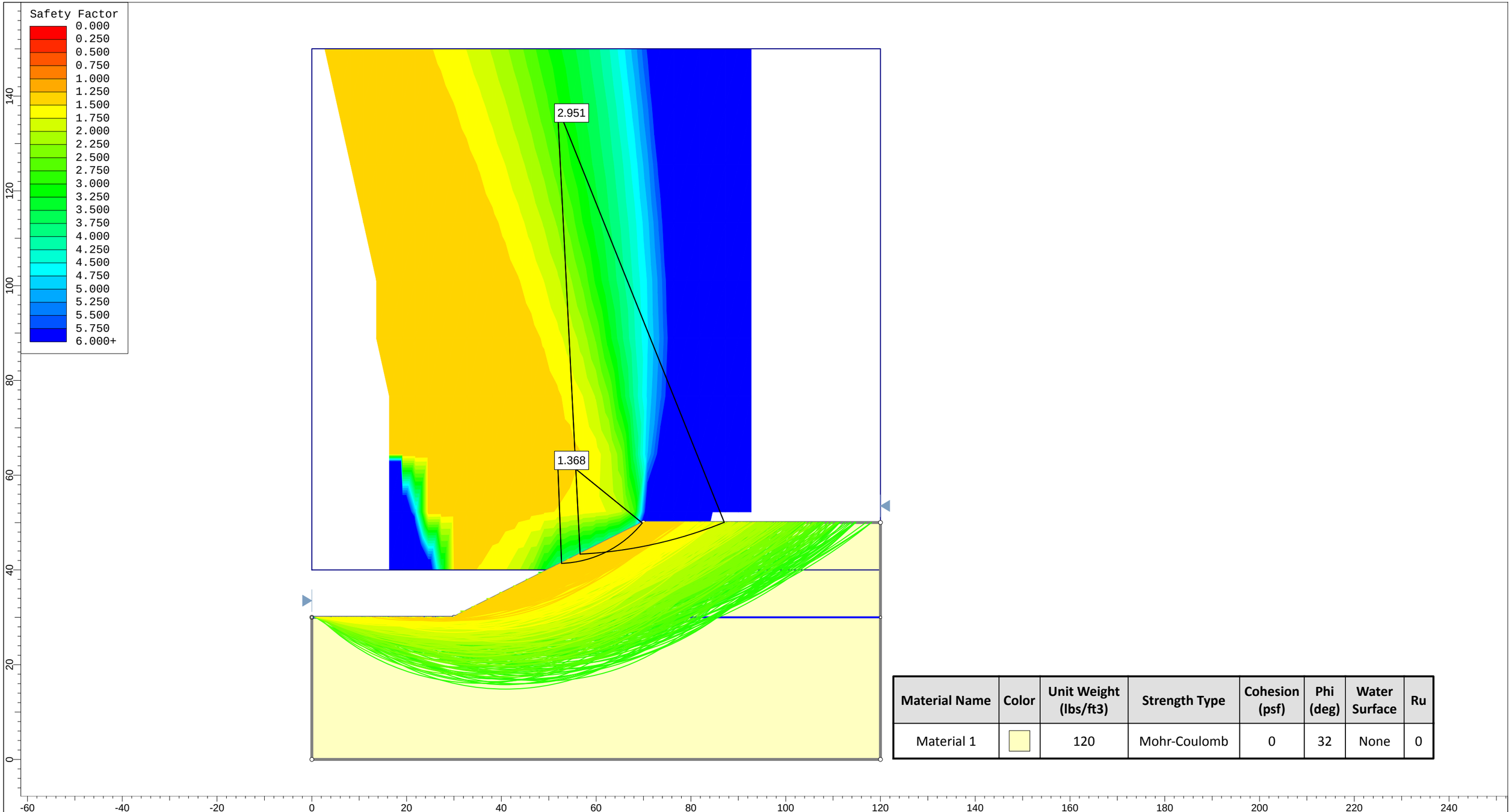


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru
Material 1		120	Mohr-Coulomb	0	28	None	0

A3GEO GEOCONSULTANTS

SLIDEINTERPRET 6.022

Project	Napa River - Ovok Reach		
Analysis Description			
Drawn By		*Scale* 1:230	*Company*
Date	5/30/2013, 3:05:47 PM		*File Name* Slope 2-1 - Low GW - Phi 28.slim

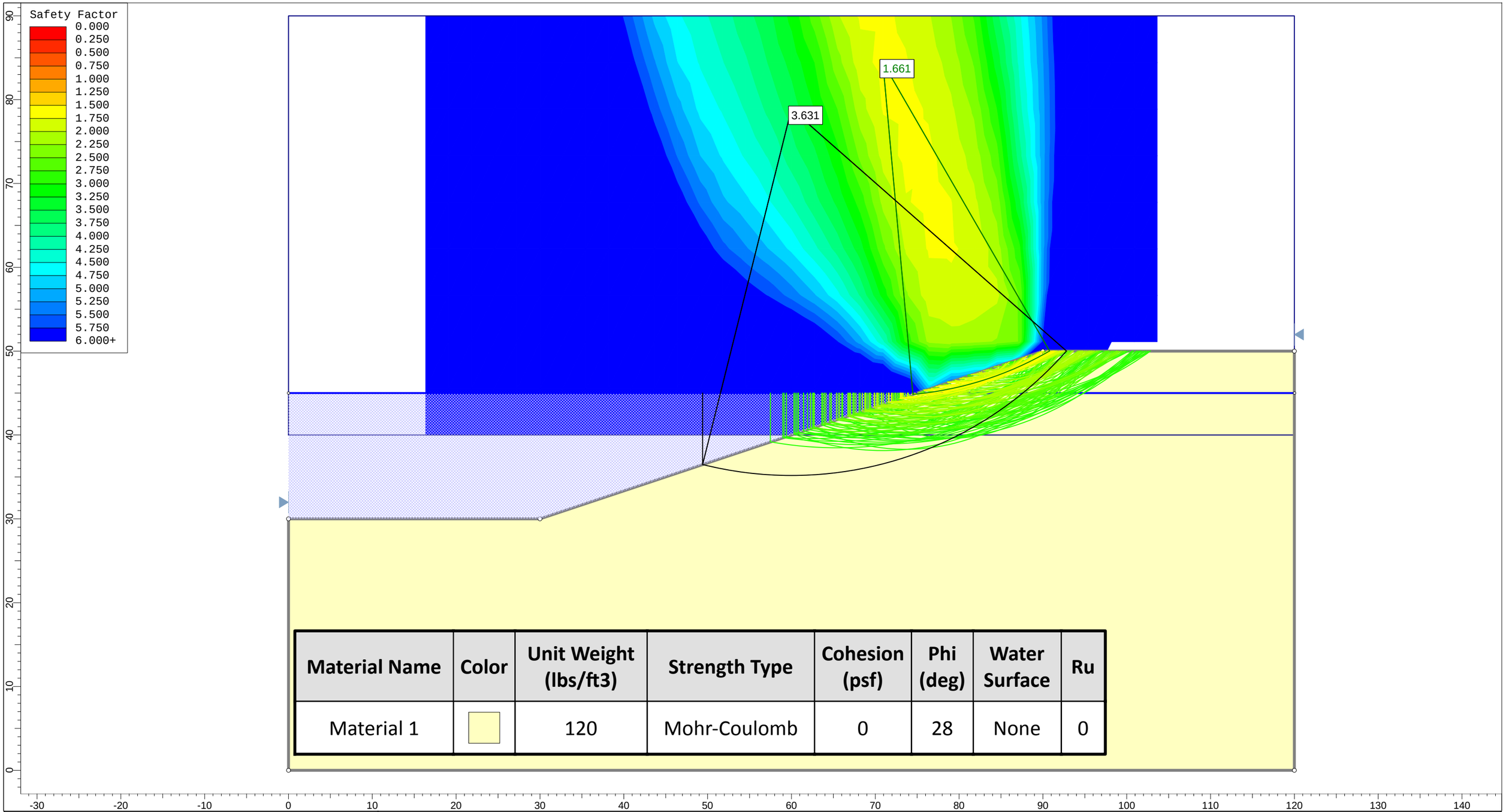


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru
Material 1		120	Mohr-Coulomb	0	32	None	0

A3GEO GEOCONSULTANTS

SLIDEINTERPRET 6.022

Project: Napa River - Ovok Reach		
Analysis Description:		
Drawn By:	Scale: 1:231	Company:
Date: 5/30/2013, 3:05:47 PM		File Name: Slope 2-1 - Low GW - Phi 32.slim

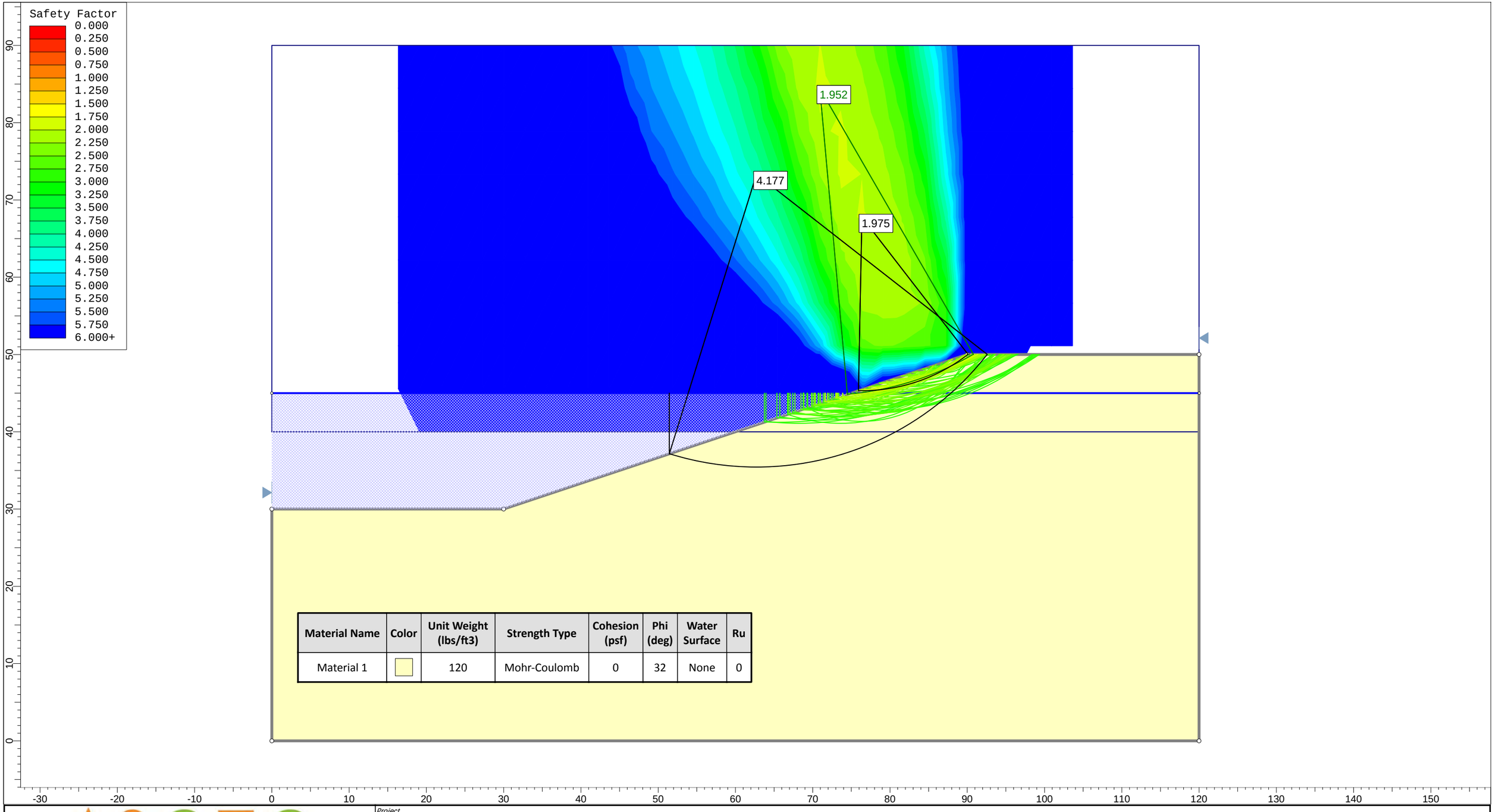


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru
Material 1		120	Mohr-Coulomb	0	28	None	0

A3GEO GEOCONSULTANTS

SLIDEINTERPRET 6.022

Project	Napa River - Ovok Reach		
Analysis Description			
Drawn By		Scale 1:130	Company
Date	5/30/2013, 3:05:47 PM		File Name Slope 3-1 - High GW - Phi 28.slim

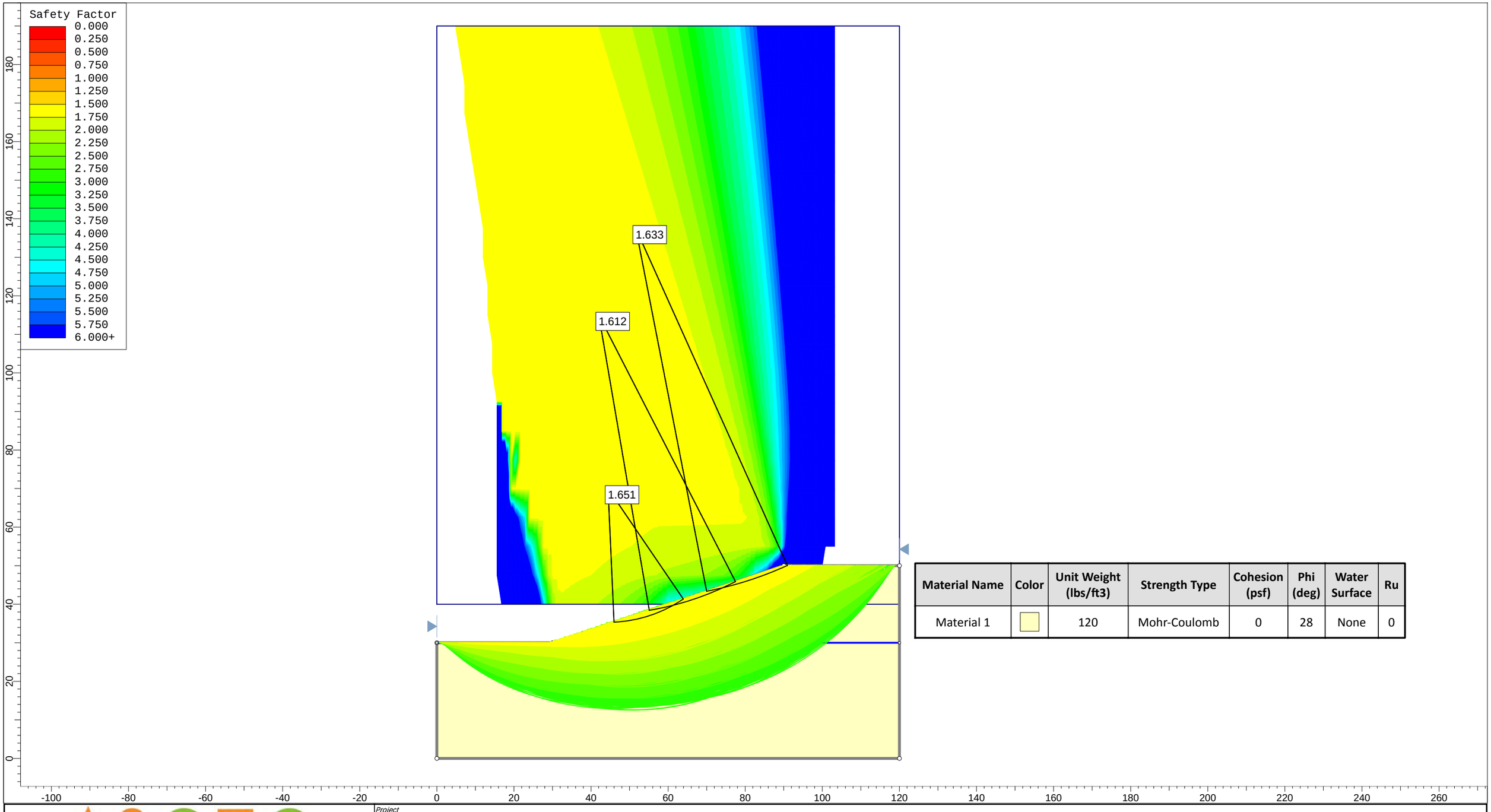


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru
Material 1		120	Mohr-Coulomb	0	32	None	0

A3GEO GEOCONSULTANTS

SLIDEINTERPRET 6.022

Project	Napa River - Ovok Reach		
Analysis Description			
Drawn By		Scale 1:140	Company
Date	5/30/2013, 3:05:47 PM		File Name Slope 3-1 - High GW - Phi 32.slim

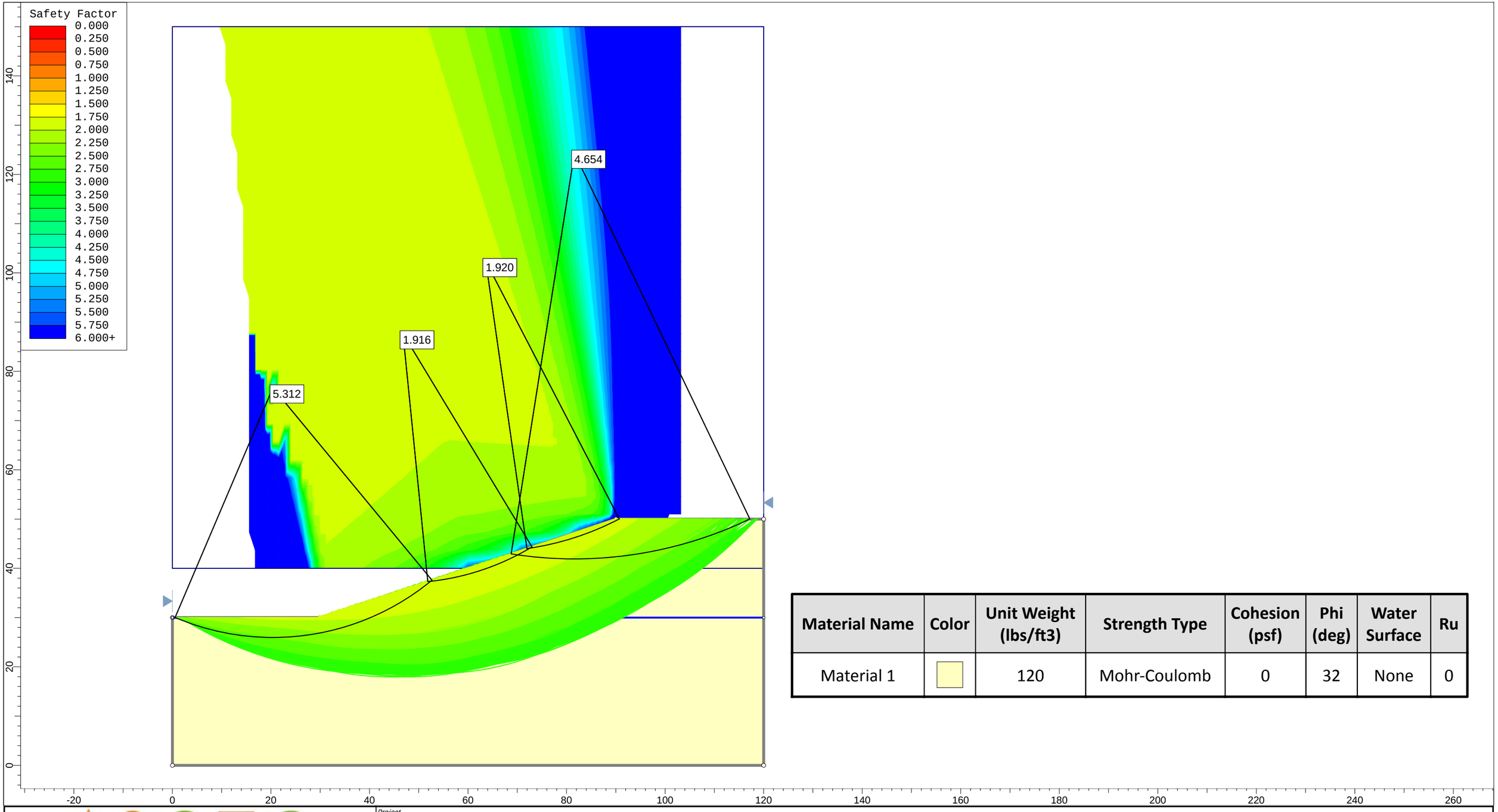


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru
Material 1		120	Mohr-Coulomb	0	28	None	0

A3GEO GEOCONSULTANTS

SLIDEINTERPRET 6.022

Project	Napa River - Ovok Reach		
Analysis Description			
Drawn By		*Scale* 1:280	*Company*
Date	5/30/2013, 3:05:47 PM		*File Name* Slope 3-1 - Low GW - Phi 28.slim



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru
Material 1		120	Mohr-Coulomb	0	32	None	0

A3GEO GEOCONSULTANTS

SLIDEINTERPRET 6.022

Project	Napa River - Ovok Reach		
Analysis Description			
Drawn By		Scale 1:220	Company
Date	5/30/2013, 3:05:47 PM		File Name Slope 3-1 - Low GW - Phi 32.slim

Appendix D

Liquefaction Analyses Results

TABLE 1 - LIQUEFACTION ANALYSIS

Napa River Restoration - OVOK Reach - Sites 14-29
A3GEO, Inc.
Project No. 1110-3A
5/30/2013
Columns highlighted in blue must be entered depending upon site specific conditions.

C_R = Correction Factor for Rod Length; 10-13' = 0.75; 13-20' = 0.85; 20-33' = 0.95; 33-99' = 1.0
C_S = Correction Factor for Sampling Method; SPT Sampler without liners = 1.2; Modified California Sampler = 0.63
C_B = Correction Factor for Borehole Diameter; For Hollow Stem, use ID.; 2.5-4.5" = 1.0; 5.9" = 1.05; 7.9" = 1.15
C_E - Correction Factor for Hammer Energy Ratio; Automatic Trip Hammer = 1.2, Rope and Cathead = 1.0
C_N - Correction Factor for Overburden Pressure

Design M_w = 7.0
water table = *8.0* ft below ground surface

			Youd, 2001																								Tokimatsu and Seed (1987)		
Boring	*Top of Layer (ft)*	*Bottom of Layer (ft)*	*Sample Depth (ft)*	*Unified Soil Class.*	*Layer Thickness*	*% Fines*	*N*	*C_R*	*C_S*	*C_B*	*C_E*	N_{60}	*γ_m*	σ_v	σ_v'	C_N	$N_{1,60}$	$N_{1,60cs}$			R_D	*a_{max}*	$(\tau_{max})_r$	$CSR_{,Mw}$	*MSF*	$CSR_{,M=7.5}$	$CRR_{,M=7.5}$	FS	Liq	$N_{1,60,cs}$	*ε (%)*	Settlement (in)
B-14-1	*8*	*14*	*11*	*SC*	*6*	*13*	*26*	*0.75*	*1.20*	*1.00*	*1.00*	23	*125*	1375	1188	1.33	31	--	34	--	0.98	*0.42*	564	0.309	*1.19*	0.259	--	--	no	34	-	-
B-14-2	*13*	*16.5*	*14.75*	*ML*	*3.5*	*60*	*20*	*0.85*	*1.00*	*1.00*	*1.00*	17	*125*	1844	1423	1.22	20	--	--	29	0.97	*0.42*	750	0.343	*1.19*	0.287	0.410	1.427	no	29	-	-
B-17-1	*15*	*16.5*	*15.75*	*SC*	*1.5*	*13*	*21*	*0.85*	*1.00*	*1.00*	*1.00*	18	*125*	1969	1485	1.19	21	--	24	--	0.97	*0.42*	800	0.350	*1.19*	0.293	0.268	0.912	yes	24	*1.2*	0.22
B-17-2	*8*	*14*	*11*	*SC*	*6*	*13*	*23*	*0.75*	*1.00*	*1.00*	*1.00*	17	*125*	1375	1188	1.33	23	--	26	--	0.98	*0.42*	564	0.309	*1.19*	0.259	0.307	1.187	no	26	-	-
B-17-2	*20.5*	*25*	*22.75*	*SM*	*4.5*	*13*	*8*	*0.95*	*1.20*	*1.00*	*1.00*	9	*125*	2844	1923	1.05	9	--	11	--	0.95	*0.42*	1134	0.383	*1.19*	0.321	0.124	0.386	yes	11	*2.5*	1.35
B-17-4	*13.5*	*18.5*	*16*	*SC/GC*	*5*	*28*	*28*	*0.85*	*1.00*	*1.00*	*1.00*	24	*125*	2000	1501	1.19	28	--	36	--	0.97	*0.42*	812	0.352	*1.19*	0.295	--	--	no	36	-	-
B-17-5	*16.5*	*23.5*	*20*	*SM/GC*	*7*	*13*	*19*	*0.95*	*1.00*	*1.00*	*1.00*	18	*125*	2500	1751	1.10	19	--	22	--	0.96	*0.42*	1005	0.373	*1.19*	0.313	0.236	0.756	yes	22	*1.4*	1.18
B-17-7	*12*	*18*	*15*	*SM*	*6*	*13*	*17*	*0.85*	*1.00*	*1.00*	*1.00*	14	*125*	1875	1438	1.21	17	--	20	--	0.97	*0.42*	763	0.345	*1.19*	0.289	0.209	0.725	yes	20	*1.5*	1.08
B-18-2	*15*	*20*	*17.5*	*SC*	*5*	*13*	*15*	*0.85*	*1.20*	*1.00*	*1.00*	15	*125*	2188	1595	1.15	17	--	20	--	0.96	*0.42*	885	0.361	*1.19*	0.302	0.209	0.693	yes	20	*1.5*	0.90
B-18-2	*20*	*23.5*	*21.75*	*SC*	*3.5*	*13*	*29*	*0.95*	*1.20*	*1.00*	*1.00*	33	*125*	2719	1861	1.07	35	--	38	--	0.95	*0.42*	1087	0.380	*1.19*	0.318	--	--	no	38	-	-
B-18-3	*11.5*	*20*	*15.75*	*GC/SM*	*8.5*	*13*	*11*	*0.85*	*1.00*	*1.00*	*1.00*	9	*125*	1969	1485	1.19	11	--	13	--	0.97	*0.42*	800	0.350	*1.19*	0.293	0.143	0.489	yes	13	*2.2*	2.24
B-18-3	*23.5*	*26.5*	*25*	*SM*	*3*	*13*	*15*	*0.95*	*1.00*	*1.00*	*1.00*	14	*125*	3125	2064	1.01	14	--	16	--	0.94	*0.42*	1236	0.389	*1.19*	0.326	0.174	0.535	yes	16	*1.9*	0.68
B-18-4	*18*	*23*	*20.5*	*SM*	*5*	*13*	*7*	*0.95*	*1.00*	*1.00*	*1.00*	7	*126*	2583	1803	1.08	7	--	9	--	0.96	*0.42*	1037	0.374	*1.19*	0.313	0.106	0.337	yes	9	*2.8*	1.68
B-18-4	*23*	*26.5*	*24.75*	*GP*	*3.5*	*4*	*18*	*0.95*	*1.20*	*1.00*	*1.00*	21	*125*	3094	2049	1.02	20	20	--	--	0.94	*0.42*	1225	0.389	*1.19*	0.326	0.215	0.661	yes	20	*1.5*	0.63
B-18-7	*10*	*11.5*	*10.75*	*SC*	*1.5*	*13*	*28*	*0.75*	*1.00*	*1.00*	*1.00*	21	*125*	1344	1172	1.34	28	--	31	--	0.98	*0.42*	552	0.306	*1.19*	0.256	--	--	no	31	-	-
B-18-8	*8*	*11.5*	*9.75*	*ML*	*3.5*	*60*	*12*	*0.75*	*1.00*	*1.00*	*1.00*	9	*125*	1219	1110	1.38	12	--	--	19	0.98	*0.42*	501	0.294	*1.19*	0.246	0.208	0.845	yes	19	*1.6*	0.67
B-19-1	*11*	*18*	*14.5*	*SC/GC*	*7*	*13*	*18*	*0.85*	*1.20*	*1.00*	*1.00*	18	*125*	1813	1407	1.23	22	--	25	--	0.97	*0.42*	738	0.341	*1.19*	0.286	0.286	1.001	no	25	-	-
B-19-2	*8*	*10*	*9*	*SC*	*2*	*13*	*17*	*0.75*	*1.00*	*1.00*	*1.00*	13	*125*	1125	1063	1.41	17	--	20	--	0.98	*0.42*	464	0.284	*1.19*	0.238	0.209	0.881	yes	20	*1.5*	0.36
B-22-4	*9.5*	*13*	*11.25*	*GC*	*3.5*	*13*	*14*	*0.75*	*1.20*	*1.00*	*1.00*	13	*125*	1406	1203	1.33	16	--	18	--	0.98	*0.42*	577	0.312	*1.19*	0.261	0.197	0.755	yes	18	*1.7*	0.71
B-22-4	*13*	*16.5*	*14.75*	*SC*	*3.5*	*13*	*17*	*0.85*	*1.00*	*1.00*	*1.00*	14	*125*	1844	1423	1.22	17	--	20	--	0.97	*0.42*	750	0.343	*1.19*	0.287	0.209	0.729	yes	20	*1.5*	0.63
B-26A-1	*8*	*13*	*10.5*	*SM*	*5*	*13*	*18*	*0.75*	*1.00*	*1.00*	*1.00*	14	*125*	1313	1157	1.35	18	--	21	--	0.98	*0.42*	539	0.303	*1.19*	0.254	0.222	0.875	yes	21	*1.4*	0.84
B-26A-1	*20*	*21.25*	*20.625*	*SM*	*1.25*	*13*	*8*	*0.95*	*1.00*	*1.00*	*1.00*	8	*125*	2578	1790	1.09	8	--	10	--	0.96	*0.42*	1034	0.376	*1.19*	0.315	0.115	0.364	yes	10	*2.6*	0.39
B-26B-1	*8*	*20.75*	*14.375*	*SP/SM*	*12.75*	*10*	*19*	*0.85*	*1.00*	*1.00*	*1.00*	16	*125*	1797	1399	1.23	19	--	20	--	0.97	*0.42*	732	0.340	*1.19*	0.285	0.219	0.768	yes	20	*1.5*	2.30
B-26B-1	*20.75*	*21.5*	*21.125*	*GP*	*0.75*	*4*	*15*	*0.95*	*1.00*	*1.00*	*1.00*	14	*125*	2641	1822	1.08	15	15	--	--	0.95	*0.42*	1058	0.377	*1.19*	0.316	0.160	0.506	yes	15	*2.0*	0.18
B-26C-1	*8*	*14*	*11*	*SM*	*6*	*13*	*21*	*0.75*	*1.00*	*1.00*	*1.00*	16	*125*	1375	1188	1.33	21	--	24	--	0.98	*0.42*	564	0.309	*1.19*	0.259	0.268	1.034	no	24	-	-
B-26C-1	*14*	*19*	*16.5*	*SW*	*5*	*4*	*9*	*0.85*	*1.00*	*1.00*	*1.00*	8	*125*	2063	1532	1.18	8	8	--	--	0.97	*0.42*	836	0.355	*1.19*	0.297	0.096	0.323	yes	8	*3.0*	1.80
B-26C-1	*19*	*24*	*21.5*	*SP*	*5*	*4*	*4*	*0.95*	*1.00*	*1.00*	*1.00*	4	*125*	2688	1845	1.07	4	4	--	--	0.95	*0.42*	1076	0.379	*1.19*	0.318	0.065	0.204	yes	4	*4.7*	2.82
B-26C-1	*24*	*26.5*	*25.25*	*GP*	*2.5*	*4*	*16*	*0.95*	*1.00*	*1.00*	*1.00*	15	*125*	3156	2080	1.01	15	15	--	--	0.94	*0.42*	1247	0.390	*1.19*	0.327	0.160	0.490	yes	15	*2.0*	0.60
B-27-1	*9*	*13*	*11*	*SM*	*4*	*13*	*13*	*0.75*	*1.00*	*1.00*	*1.00*	10	*125*	1375	1188	1.33	13	--	15	--	0.98	*0.42*	564	0.309	*1.19*	0.259	0.164	0.633	yes	15	*2.0*	0.96
B-27-1	*13*	*20*	*16.5*	*GW*	*7*	*4*	*12*	*0.85*	*1.00*	*1.00*	*1.00*	10	*125*	2063	1532	1.18	11	11	--	--	0.97	*0.42*	836	0.355	*1.19*	0.297	0.122	0.410	yes	11	*2.5*	2.10
B-28-1	*8*	*15*	*11.5*	*SW-SM*	*7*	*4*	*14*	*0.75*	*1.00*	*1.00*	*1.00*	11	*125*	1438	1219	1.32	13	13	--	--	0.98	*0.42*	589	0.314	*1.19*	0.263	0.141	0.534	yes	13	*2.2*	1.85
B-28-1	*15*	*20*	*17.5*	*SP-SC*	*5*	*10*	*11*	*0.85*	*1.00*	*1.00*	*1.00*	9	*125*	2188	1595	1.15	10	--	11	--	0.96	*0.42*	885	0.361	*1.19*	0.302	0.123	0.406	yes	11	*2.5*	1.50
B-28-1	*20*	*21.5*	*20.75*	*SP*	*1.5*	*4*	*20*	*0.95*	*1.00*	*1.00*	*1.00*	19	*125*	2594	1798	1.08	20	20	--	--	0.95	*0.42*	1040	0.376	*1.19*	0.315	0.215	0.683	yes	20	*1.5*	0.27
B-29-2	*16.5*	*25*	*20.75*	*SC*	*8.5*	*13*	*24*	*0.95*	*1.00*	*1.00*	*1.00*	23	*125*	2594	1798	1.08	24	--	27	--	0.95	*0.42*	1040	0.376	*1.19*	0.315	0.332	1.054	no	27	-	-
B-29-3	*8*	*11.5*	*9.75*	*SC*	*3.5*	*13*	*21*	*0.75*	*1.00*	*1.00*	*1.00*	16	*125*	1219	1110	1.38	21	--	24	--	0.98	*0.42*	501	0.294	*1.19*	0.246	0.268	1.087	no	24	-	-
B-29-3	*11.5*	*19*	*15.25*	*SC*	*7.5*	*13*	*28*	*0.85*	*1.00*	*1.00*	*1.00*	24	*125*	1906	1454	1.21	28	--	31	--	0.97	*0.42*	775	0.346	*1.19*	0.291	--	--	no	31	-	-

Appendix E

Site Specific Evaluations and Recommendations

If additional site-specific evaluations are required, supplemental recommendations will be incorporated in Appendix E.