Leighton Consulting, Inc.
A LEIGHTON GROUP COMPANY

TRANSMITTAL

To: SB&O, Inc.
41689 Enterprise Circle North, Suite 126
Temecula, California 92590

Date: May 12, 2010

Project No: 602804-001

Attention: Daniel J. O'Rourke, P.E.

Transmitted:		*The Following:*		*For:*	
X	Mail/Overnight		Draft Report	X	Your Use
	Courier	X	Final Report		As Requested
	Pick Up		Extra Report		
			Proposal		
			Other		

Subject: Geotechnical Exploration, Date Street Improvements - CIP 8040, & Murrieta Hot Springs Road Widening - CIP 8079, Murrieta, California

LEIGHTON CONSULTING, INC.

By: Simon I. Saiid, GE

Copies to: (4) Addressee (plus CD)

GEOTECHNICAL EXPLORATION
DATE STREET IMPROVEMENTS - CIP 8040
& MURRIETA HOT SPRINGS ROAD WIDENING - CIP 8079
MURRIETA, CALIFORNIA

Prepared for

SB&O, INC.

41689 Enterprise Circle North, Suite 126
Temecula, California 92590

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Attention: Daniel J. O'Rourke, P.E.

Subject: Geotechnical Exploration, Date Street Improvements - CIP 8040, & Murrieta Hot Springs Road Widening - CIP 8079, Murrieta, California

In accordance with your authorization, we performed a geotechnical exploration for the subject project. This report presents our findings and provides geotechnical recommendations for the design and construction of the proposed improvements.

Based on the results of our geotechnical exploration, the proposed improvements appear feasible from a geotechnical viewpoint. The site materials generally consisted of dense silty to clayey sand and may be considered CalOSHA Type C soils. Based on our analyses, the proposed 2:1 slope for the extension of Date Street should be grossly stable under both static and dynamic conditions for the considered loads. Site soils are considered highly erosive and mitigation or erosion protection will be needed for the proposed major cut slopes.

The opportunity to be of service is sincerely appreciated. If you should have any questions, please do not hesitate to call our office.

Respectfully submitted,
LEIGHTON CONSULTING, INC.

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1.0 INTRODUCTION

1.1 Project and Site Description

The project site is located in the City of Murrieta, California, (see *Figure 1 – Site Location Map)*. The proposed Date Street Improvements (CIP 8040) generally consists of extending Date Street from Winchester Creek Avenue to Murrieta Hot Springs Road (MHSR). Approximately, the first 600 LF of this proposed extension has been previously improved and will only require minimal grading and pavement construction for the west bound lanes. The remaining portion of this extension will require major grading and deep excavations that will result in cut slopes up to approximately 60 feet in height in order to match existing grades at MHSR.

We also understand that the proposed improvements associated with MHSR (CIP 8079) include widening of MHSR from Via Princesa to Date Street. Retaining walls up to a maximum height of 15 feet are anticipated along both sides of MHSR approximately 800’ east and west of Calle Del Lago due to existing slopes and close proximity to private properties and existing improvements.

1.2 Purpose and Scope of Evaluation

As described in our proposal, the purpose and scope of our geotechnical evaluation included the following:

- ***Desktop Research:*** Review of existing geotechnical/geologic maps, reports or other related documents for the roadway alignment and widening areas.
- ***Pre-Field Preparation:*** Prior to scheduling fieldwork, Leighton Consulting, Inc. (Leighton) performed the following tasks:
  - Review available data and plans for proposed street improvements;
  - Obtained a “no fee” encroachment permit from the City of Murrieta.
  - Coordinated with Underground Surface Alert prior to field exploration.
- ***Field Exploration:*** Excavated, log and sample 9 exploratory test pits along the proposed road extension / widening and visual evaluation of existing pavement for MHSR.
- ***Laboratory Testing:*** Performed laboratory testing on representative onsite soil samples to determine maximum dry density, direct shear, grain size analysis and R-value.
- ***Geotechnical Report:*** Preparation of this geotechnical report which addresses the general geotechnical conditions of the site, and presents conclusions and recommendations with respect to the construction of the proposed street improvements.

1.3 Field Exploration

Our field exploration consisted of the excavation of 9 test pit excavations in accessible areas within the site. Prior to excavation, we located and marked test pit locations for coordination with Underground Service Alert (USA). Our field exploration was performed on April 20, 2010. Approximate locations of the test pits are shown on Figure 2.

The exploratory test pits for the extension of Date Street were excavated utilizing a rubber tired backhoe. The test pits were logged by a geologist from our firm. Logs of all test pits are included in Appendix A. During excavation, bulk and relatively undisturbed samples were obtained from the test pits for laboratory testing and evaluation. Our field evaluation for MHSR widening project (CIP 8079) included visual evaluation of existing pavement and a test pit excavation/hand auger along the existing slope north of the intersection of Calle Del Lago and MHSR.

1.4 Laboratory Testing

Laboratory tests were performed on representative samples to provide a basis for development of geotechnical design parameters. Selected samples were tested to determine the following parameters: insitu moisture and density, direct shear, maximum dry density and optimum moisture content, soluble sulfate content and expansion index. The results of our laboratory testing and summaries of the testing procedures are presented in Appendix B.

2.0 SUMMARY OF GEOTECHNICAL FINDINGS

A summary of our geotechnical/geologic findings from research of pertinent literature, site-specific field exploration, geotechnical laboratory testing and engineering analysis, is discussed in this section.

2.1 Geologic Settings

Murrieta is located within the Peninsular Ranges geomorphic province characterized by steep elongated ranges and valleys that trend northwesterly. More specifically, the subject site is located in the southwest portion of Perris Block and is located less approximately two miles east of a fault controlled, down dropped graben, known as the Elsinore Trough (Kennedy, 1977). The Elsinore Trough is bounded on the northeast by the Wildomar Fault and on the southwest by the Willard Fault. The Murrieta Hot Springs Fault, a roughly east-west-trending transverse splay of the Elsinore Fault Zone, is within approximately 1,000 feet north of the site. These faults are all part of the Elsinore Fault Zone, which extends from the San Gabriel River Valley southeasterly to south of the United States-Mexican border.

The Santa Ana Mountains lie along the western side of the Elsinore Fault Zone and the Perris Block is located along the eastern side of the fault zone. The Perris Block is underlain by pre-Cretaceous metasedimentary and metavolcanic rocks and Cretaceous plutonic rocks of the Southern California batholith. Tertiary sediments, volcanics and Quaternary sediments flank the mountain ranges. The Tertiary and Quaternary rocks are generally comprised of non-marine sediments consisting of sandstones, mudstones, conglomerates, and locally volcanic units. Alluviual deposits fill in the lower valley and drainage areas.

2.2 Site Geologic Units

Our field explorations, observations, and a review of the pertinent literature (References) indicate that earth materials within the site consist of several surficial units including fill soils, alluvium, and bedrock units locally known as Pauba formation and/or Wildomar Sandstone. The site specific geology is depicted on the Figure 3A (Date Street). Detailed descriptions of the earth materials encountered in each excavation are provided in Appendix B. A general description of each unit is provided below:

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- **Artificial Fill (not mapped): A**rtificial fill materials should be expected within the existing streets and generally consist of existing pavement and associated subgrade soils, retaining wall backfill and fill slopes, especially along portions of MHSR.
- **Alluvium (Qal):** Alluvial soils should be expected in localized areas along portions of MHSR where widening may require fill to meet design grades (~Sta. 62+00 to 66+00 - Southside). Also, as depicted on Figure 3A, localized alluvium ranging in depth up to 5.5 feet was encountered along the extension of Date Street (TP-5 & TP-6). Sampled alluvium from this area consisted generally of moist silty fine to coarse sand (SM) and expected to generally possess very low expansion (EI<21) due to its granular nature. Loose alluvium should generally be removed and recompacted prior to placing additional fills and/or structural improvements.
- **Pauba Formation (Qps):** Where encountered, the Pauba Formation generally consists of yellow- to red-brown, damp to moist, dense, silty sand (SM) with localized relatively clean (cohesionless) friable sand (SP) and clayey sand (SC). These materials are expected to possess low expanion potential and generally suitable for support of additional fills and/or structural improvements.
- **Sandstone and Conglomerate of Wildomar area (map symbol QTws)):** Although not encountered in our exploratory test pits, this formation consists primarily of friable, pale yellowish-green, medium grained, caliche-rich sandstone and located primarily along the alinemenet of MHSR based on published geologic maps and our in-house data.

2.3 Rippability / Excavation Characteristics

Where encountered, the onsite material (Pauba formation) was excavated without great difficulty utilizing a conventional rubber-tired backhoe. As such, rippability of the material is expected to be readily accomplished with standard heavy earthmoving equipment in good condition. Some localized cemented sandstone may be encountered, but should be limited in extent and generally rippable.

2.4 Surface and Groundwater

No surface water or groundwater was observed at the time of our field exploration. Groundwater seepage may be encountered locally or fluctuate seasonally within the proposed alignment, but is not anticipated to be a major constraint during construction of the proposed improvements. Perched water may develop in areas of soils with low permeabilities, possibly resulting in saturated fills or seepage from adjacent sites or slopes.

2.5 Faulting and Seismicity

The subject site, like the rest of Southern California, is located within a seismically active region as a result of being located near the active margin between the North American and Pacific tectonic plates. The principal source of seismic activity on this site is movement along the northwest-trending regional fault systems such as the San Andreas and San Jacinto. Based on our review of published geologic map (Hart, 1999, CGS, 1995), the subject site is not included within an Earthquake Fault Zone as created by the Alquist-Priolo Earthquake Fault Zoning Act.

The seismic coefficients based on the 2007 California Building Code (CBC) are calculated utilizing a software program, published by the United States Geological Survey (USGS), which follows the procedures, included in American Society of Civil Engineers (ASCE) Publication ASCE 7-05 and Chapter 16 of 2007 CBC.

Table 1. 2007 CBC Site-Specific Seismic Coefficients

CBC Categorization/Coefficient		Acceleration Value (g)
~Intersection of Date Street and Murrieta Hot Springs Road	Site Latitude (33.5540 N) Site Longitude (-117. 1460 W)	
Site Class Definition (Table 1613.5.2) – D		
Mapped Spectral Response Acceleration at 0.2s Period, S_s (Fig. 1613.5(3))		**1.6**
Mapped Spectral Response Acceleration at 1s Period, S_1 (Fig. 1613.5(4))		**0.6**
Short Period Site Coefficient at 0.2s Period, F_a (Table 1613.5.3(1))		1.0
Long Period Site Coefficient at 1s Period, F_v (Table 1613.5.3(2))		1.5
Adjusted Spectral Response Acceleration at 0.2s Period, S_{MS} (Eq. 16-37)		**1.6**
Adjusted Spectral Response Acceleration at 1s Period, S_{M1} (Eq. 16-38)		**0.9**
Design Spectral Response Acceleration at 0.2s Period, S_{DS} (Eq. 16-39)		**1.0**
Design Spectral Response Acceleration at 1s Period, S_{D1} (Eq. 16-40)		**0.6**

* g- Gravity acceleration

2.6 Secondary Seismic Hazards

Due to the nature of the site geologic conditions (dense Pauba), the potential for secondary seismic hazards that are generally associated with severe ground shaking during an earthquake such as surface ground rupture, liquefaction, lateral spreading, rock fall, and flooding are considered very low for this site.

2.7 Existing Pavement Surface Conditions

In general, the overall pavement surface along this portion of MHSR appears to be in a relatively poor to fair condition with a distinct change at approximately Station 77+00 to Winchester Road intersection. The existing asphalt concrete (AC) in this section (Sta. 77+00 to 99+00) is in a relatively good condition except for localized distressed areas within the eastbound right lane which appears to have been a most recent widening of the old MHSR. Our field observations of the pavement surface conditions from Winchester Road to Via Princessa are summarized below. Photos of the existing pavement at various locations are included in Appendix B.

MHSR (Sta. ~57+00 to 77+00):
The existing pavement surface along this section (Photos 1 through 5) is generally in a "poor to fair condition" and can be further characterized by the following:

- High-severity alligator cracking in localized areas (1/8" to 2" wide cracks).
- Small size potholes and loss of aggregates.
- Localized subgrade failure and patching.

MHSR (Sta. ~77+00 to 99+00):
The existing pavement surface (Photos 5 through 7) appears to be in a relatively "good condition" and can be further characterized by the following:

- Localized alligator cracking in eastbound right lane (1/8" to 1" wide cracks).
- Minor raveling and loss of aggregates (eastbound right lane).
- Low-severity thermal cracking

Based on the observed conditions, an AC overlay combined with minimal cold milling may be applied for the entire street section if required for structural adequacy. However, proper treatment of existing cracks and localized areas of removal and replacement may be necessary to retard reflective cracking and ensure adequate structural integrity. Methods of pavement rehabilitation for this street were beyond the scope of this study and would required additional field and laboratory testing.

3.0 CONCLUSIONS AND RECOMMENDATIONS

3.1 General

The proposed improvements appear feasible from a geotechnical viewpoint provided that the following recommendations are incorporated into the design and construction phases of development. The following geotechnical recommendations for design and construction are based on the limited subsurface soil conditions encountered during this evaluation. A review of the final grading and improvement plans should be made by Leighton before they are put out to bid or submitted for final approval.

3.2 Earthwork Considerations

Earthwork associated with the proposed improvements should be performed in accordance with applicable City Standards, “Standard Specifications for Public Works Construction” (Green Book, latest edition) and the recommendations included in the text of this report. The General Earthwork and Grading Specifications in Appendix D are general grading specifications provided for typical grading projects and some of the recommendations may not be strictly applicable to this project. In case of conflict, the specific recommendations contained in the text of this report supersede those included in Appendix D. Earthwork for the proposed improvements are generally associated with the extension of Date Street.

3.2.1 General: Excavation should be performed in accordance with the project plans, specifications, and all applicable OSHA requirements. The contractor should be responsible for providing the "competent person" required by OSHA standards. Contractors should be advised that sandy soils (such as onsite alluvium and Pauba) could make excavations particularly unsafe, even if all safety precautions are taken.

3.2.2 Pavement Subgrade / Date Street: The subgrade materials for the proposed extension of Date Street are expected to consist of dense formational materials (Pauba) at the proposed design grades. However, we recommend that after excavation, the upper 12 inches of subgrade be scarified, moisture conditioned, and compacted to at least 90 percent relative compaction (per ASTM 1557). Depending on actual field conditions encountered during construction, localized over-excavation may be necessary to remove unsuitable materials, especially at connection grades with MHSR.

3.2.3 MHSR Subgrade: The subgrade materials for proposed improvements along MHSR (i.e. sidewalks, medians, etc.) should require at least scarification and recompaction of the upper 12 inches and further evaluation of the geotechnical consultant during construction. Any widening areas in MHSR should require at least removal and recompaction of the upper 2 feet of existing soils or minimum of 2 feet below subgrade elevation in cut areas. Further field evaluation of the geotechnical consultant during construction should be implemented. The lateral extent of removal should be equivalent to that vertically removed.

3.2.4 Backfill: The onsite soils are generally suitable as backfill materials provided they are free of rocks over 3 inches in diameter and free of organic matter. Trench backfill should be compacted in uniform lifts by mechanical means to at least 90 percent relative compaction or as required per District standard specifications.

3.2.5 Shrinkage: Due to the proposed deep cuts for Date Streets, this project is expected to generate excess materials at the completion of grading. Based on the results of laboratory testing and our experience with similar materials, the following values are provided as guidelines:

- Topsoil, Alluvium/Colluvium: 10 to 15 percent shrinkage
- Undocumented-reusable Fill: 5 to 10 percent shrinkage
- Pauba Formation: 5 percent bulking to 5 percent shrinkage

3.3 Slope Stability

3.3.1 Analysis: Our review of the project plan indicates that cut slopes at inclinations of 2:1 (horizontal to vertical) or flatter with an approximate maximum height of 60 feet are proposed for Date Street. This slope was analyzed using a computer program called GSTABL7 with STEDwin, Version 2.0 (Gregory, 2004). The program uses the Modified Bishop and the Simplified Janbu method of slices for calculating the factor of safety against failure. Our cross-sectional model was generally analyzed based on circular type failure for the maximum anticipated height of 60 feet. The results of our analyses indicate that the proposed cut slope is considered grossly stable under both static and seismic loading. However, if surficial soils are allowed to become saturated without proper erosion control, surficial sloughing, erosion and instability should be expected. The strength parameters assumed in our analyses are based on our laboratory test results and our experience with similar units. The results of our analyses are included in Appendix C.

3.3.2 Slope Maintenance and Erosion Control: Since the onsite soils have a high susceptibility to erosion (Photo #9), vegetation selection and slope surface preparation are imperative to properly performing slopes. It is recommended that the exposed natural soils at cut slope face be at least be scarified in two directions and compacted to a minimum of 90 percent relative compaction. Immediately after, these slopes should be properly protected against erosion/drying by applying approved erosion control measures. Alternatively, replacement fill may be implemented by over-cutting into the slopes so that at least the outer 15 feet of cut slopes consist of compacted fill as depicted in Appendix D. Fill slopes are normally overbuilt and trimmed back to expose the properly compacted slope face or periodically back-rolled with increasing height of the fill slope with a weighted sheeps-foot compactor and track-walked with a tracked dozer or other equivalent proven methods. All graded slopes should then be landscaped with drought-tolerant, slope stabilizing vegetation as soon as possible to minimize the potential for erosion and slumping. Moisture in the slope face should be maintained relatively constant (i.e., prolonged drying and wetting of the slope faces should be avoided). Burrowing activity by rodents and other vermin should be controlled at all times. In addition, drainage should be directed away from the tops of slopes.

3.4 Utility Trench

Utility trenches should be backfilled with compacted fill in accordance with Sections 306-1.2 and 306-1.3 of the *Standard Specifications for Public Works Construction*, ("Greenbook"), 2009 Edition. Fill material above the pipe zone should be placed in lifts not exceeding 8 inches in uncompacted thickness and should be compacted to at least 90 percent relative compaction (ASTM D 1557) by mechanical means only. Site soils may generally be suitable as trench backfill provided these soils are screened of rocks over 1½ inches in diameter and organic matter. If imported sand is used as backfill, the upper 3 feet in building and pavement areas should be compacted to 95 percent. The upper 6 inches of backfill in all pavement areas should be compacted to at least 95 percent relative compaction.

Where granular backfill is used in utility trenches adjacent moisture sensitive subgrades and foundation soils, we recommend that a cut-off "plug" of impermeable material be placed in these trenches at the perimeter of buildings, and at pavement edges adjacent to irrigated landscaped areas. A "plug" can consist of a 5-foot long section of clayey soils with more than 35-percent passing the No. 200 sieve, or a Controlled Low Strength Material (CLSM) consisting of one sack of Portland-cement plus one sack of bentonite per cubic-yard of sand. CLSM should generally conform to Section 201-6 of the *Standard Specifications for Public Works Construction*, ("Greenbook"), 2009 Edition. This is intended to reduce the likelihood of water permeating trenches from landscaped areas, then seeping along permeable trench backfill into the building and pavement subgrades, resulting in wetting of moisture sensitive subgrade earth materials under buildings and pavements.

Excavation of utility trenches should be performed in accordance with the project plans, specifications and the *California Construction Safety Orders* (2009 Edition or more current). The contractor should be responsible for providing a "competent person" as defined in Article 6 of the *California Construction Safety Orders*. Contractors should be advised that sandy soils (such as fills generated from the onsite alluvium) could make excavations particularly unsafe if all safety precautions are not properly implemented. In addition, excavations at or near the toe of slopes and/or parallel to slopes may be highly unstable due to the increased driving force and load on the trench wall. Spoil piles from the excavation(s) and construction equipment should be kept away from the sides of the trenches. Leighton does not consult in the area of safety engineering.

3.5 Bearing Capacity and Passive Resistance

A net allowable bearing capacity of 2,500 psf, or a modulus of subgrade reaction of 150 pci may be used for design of retaining wall footings or any appurtenant structures founded into compacted fill or dense Pauba. A minimum base width of 18 inches for continuous footings and a minimum bearing area of 3 square feet (1.75 ft by 1.75 ft) for pad foundations should be used. Additionally, an increase of one-third may be applied when considering short-term live loads (e.g. seismic and wind). An net allowable passive pressure based on an equivalent fluid pressure of 250 pounds-per-cubic-foot (pcf), not to exceed 2,500 pounds per square foot (psf) can be used. A coefficient of friction between soil and concrete of 0.35 may be used with dead load forces. When combining passive pressure and frictional resistance, the total pressure should be reduced by fifty percent. Alternatively, either the base or passive resistance should be used in the design. Based on known conditions, total settlement is expected to be less than ½ inch with ¼ inch differential settlement across a lateral distance of 30 feet.

3.6 Asphalt Paving

Pavement construction associated with the proposed street improvements should conform to latest version of *Caltrans Standard Specifications* or the *Standard Specifications for Public Works Construction* (Green Book), and applicable City Standards. Our laboratory test results on representative samples of the onsite soils materials indicate R-values ranging from 26 to 49 for the anticipated pavement subgrade (see Appendix B).

Based on the design procedures outlined in the current Caltrans Highway Design Manual, and a conservative R-value of 26, the recommended flexible pavement sections are provided in Table 2 below for assumed Traffic Indices (TIs) ranging from 7.5 to 9.0.

Table 2. Preliminary Pavement Sections

Traffic Index	Asphalt Concrete (AC) Thickness (in)	Class 2 Aggregate Base (AB) Thickness (in)
7.5 to 8.0	5.0	11.5
8.5 to 9.0	5.0	14.5

Representative samples of the actual subgrade materials for R-value testing during subgrade preparation or prior to pavement construction should be performed and appropriate Traffic Index (TI) data should be selected or verified by the project civil engineer or traffic engineering consultant prior to finalizing the pavement section design. Based on our field exploration, the existing pavement for a portion of Date Street consists of 5 to 6 inches of AC over approximately 6 to 7 inches of AB.

Prior to placing aggregate base or asphalt, the subgrade soils should be evaluated and approved by the geotechnical consultant. The Aggregate Base (AB) and at least the upper 8 inches of subgrade in pavement areas should be compacted to a minimum of 95 percent relative compaction.

3.7 Soil Sulfate Evaluation

Table below summarizes current standards for concrete exposed to sulfate-containing solutions.

Table 3. Sulfate Concentration and Sulfate Exposure

Sulfate In Water (parts-per-million)	Water-Soluble Sulfate (SO_4) in soil (percentage by weight)	Sulfate Exposure
0-150	0.00 - 0.10	Negligible
150-1,500	0.10 - 0.20	Moderate (Seawater)
1,500-10,000	0.20 - 2.00	Severe
>10,000	Over 2.00	Very Severe

The results indicate that the water soluble sulfate is less than 0.2 percent by weight, which is considered moderate as per Table above.

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3.8 Retaining Walls

As indicated in Section 1.1, retaining walls up to a maximum height of 15 feet are anticipated along both sides of MHSR for any proposed future widening. Retaining walls backfilled with low-expansive soils (EI<51) should be designed using the following equivalent fluid pressures:

Table 4. Retaining Wall Design Earth Pressures (Static, Drained)

Loading Conditions	Equivalent Fluid Density (pcf)	
	Level Backfill	2:1 Backfill
Active	35	50
At-Rest	50	85
Passive*	300	150 (2:1, sloping down)

* This assumes level condition in front of the wall will remain for the duration of the project, not to exceed 3,500 psf at depth. If sloping down (2:1) grades exist in front of walls, then they should be designed using passive values reduced to ½ of level backfill passive resistance values.

Retaining wall earth pressures are a function of the amount of wall yielding horizontally under load. If the wall can yield enough to mobilize full shear strength of backfill soils, then the wall can be designed for "active" pressure. If the wall cannot yield under the applied load, the shear strength of the soil cannot be mobilized and the earth pressure will be higher. Such walls should be designed for "at rest" conditions. If a structure moves toward the soils, the resulting resistance developed by the soil is the "passive" resistance.

Total depth of retained earth for design of cantilever walls should be measured as the vertical distance below the ground surface measured at the wall face for stem design, or measured at the heel of the footing for overturning and sliding calculations. Should a sloping backfill other than a 2:1 (horizontal:vertical) be constructed above the wall (or a backfill is loaded by an adjacent surcharge load), the equivalent fluid weight values provided above should be re-evaluated on an individual case basis by us. Non-standard wall designs should also be reviewed by us prior to construction to check that the proper soil parameters have been incorporated into the wall design.

For retaining walls less-than (<) 12 feet in height, incremental seismic loads need not be considered per the 2007 CBC. However, for wall more than 12 feet in height, an incremental seismic load should be used for design. Utilizing the Mononobe-Okabe method of analysis and incorporating an estimated PGA of 0.4g based on Sds/2.5 (2007 CBC), the seismic resultant of lateral pressure for a wall with level backfill should be $14H^2$ lbs, where H is the retained height in feet. These equivalent fluid pressures (triangular pressure distribution) should be applied as inverted triangles with the maximum lateral earth pressure at the top and zero pressure at the bottom. Therefore, the resultant of this pressure, as force per horizontal-foot of wall, may be assumed to be acting at 2/3 the wall height measured up from the bottom of the wall. These pressures are in addition to the static earth pressure presented above. Higher magnitude of the seismic resultant/lateral earth pressures should be incorporated if sloped backfill is constructed.

The subgrade materials for the proposed retaining walls should consist of compacted fill or dense formational materials. In cut areas (>2feet), we recommend at the least the upper 8 inches of subgrade be scarified and compacted to at least 90 percent relative compaction (per ASTM 1557). In fill areas (or cut < 2feet), we recommend at the least the 2 feet of subgrade be removed and compacted to at least 90 percent relative compaction. Depending on actual field conditions encountered during construction, localized over-excavation may be necessary to remove unsuitable materials, especially for retaining walls greater than 10 feet in height.

All retaining walls should be provided with appropriate drainage. The outlet pipe should be sloped to drain to a suitable outlet. Typical wall drainage design is illustrated in Appendix D, *Retaining Wall Backfill and Subdrain Detail*. Wall backfill should be low expansive soils (EI ≤ 51) compacted by mechanical methods to a minimum of 90 percent relative compaction (ASTM D 1557). Clayey/expansive site soils should not be used as wall backfill. Walls should not be backfilled until wall concrete attains the 28-day compressive strength and/or as determined by the Structural Engineer that the wall is structurally capable of supporting backfill. Lightweight compaction equipment should be used, unless other wise approved by the Structural Engineer.

3.9 Additional Geotechnical Services

This report was based in part on data obtained from a limited number of observations, site visits, soil excavations, samples and tests. Such information is, by necessity, incomplete. The nature of many roadway alignments is such that differing soil or geologic conditions can be present within relatively small distances between test pits and under varying climatic conditions. Changes in subsurface conditions can and do occur over time. Therefore, our findings, conclusions and recommendations presented in this report are only valid if Leighton has the opportunity to observe subsurface conditions during construction, to confirm that our preliminary data are representative for the alignment. Geotechnical observation and testing should be provided by Leighton during grading construction and when any unusual conditions are encountered.

REFERENCES

American Society of Civil Engineers, ASCE, 2005, Minimum Design Loads for Buildings and Other Structures, ASCE Standard 7-05, Includes Supplement No. 1 and Errata.

Blake, T. F., 2000a, EQFAULT, Version 3.00a, A Computer Program, for the Deterministic Prediction of Peak Horizontal Acceleration from Digitized California Faults, with 2003 updated fault model database.

California Geologic Survey (CGS), 2003a, Preliminary Geologic Map of the Murrieta 7.5' Quadrangle, Riverside County, Michael P. Kennedy and Douglas M. Morton, Open File Report of 03-189.

California Geologic Survey (CGS), 2003b, The Revised 2002 California Probabilistic Seismic Hazard Maps, June 2003, by Tianquing Cao, William A. Bryant, Badie Rowshandel, David Branum and Christopher J. Wills.

California Geologic Survey, (CGS), 2006, Geologic Map of the San Bernardino and Santa Ana 30' X 60' Quadrangle, Southern California, Version 1.0, Compiled by Douglas M. Morton and Fred K. Miller, Open File Report 06-1217.

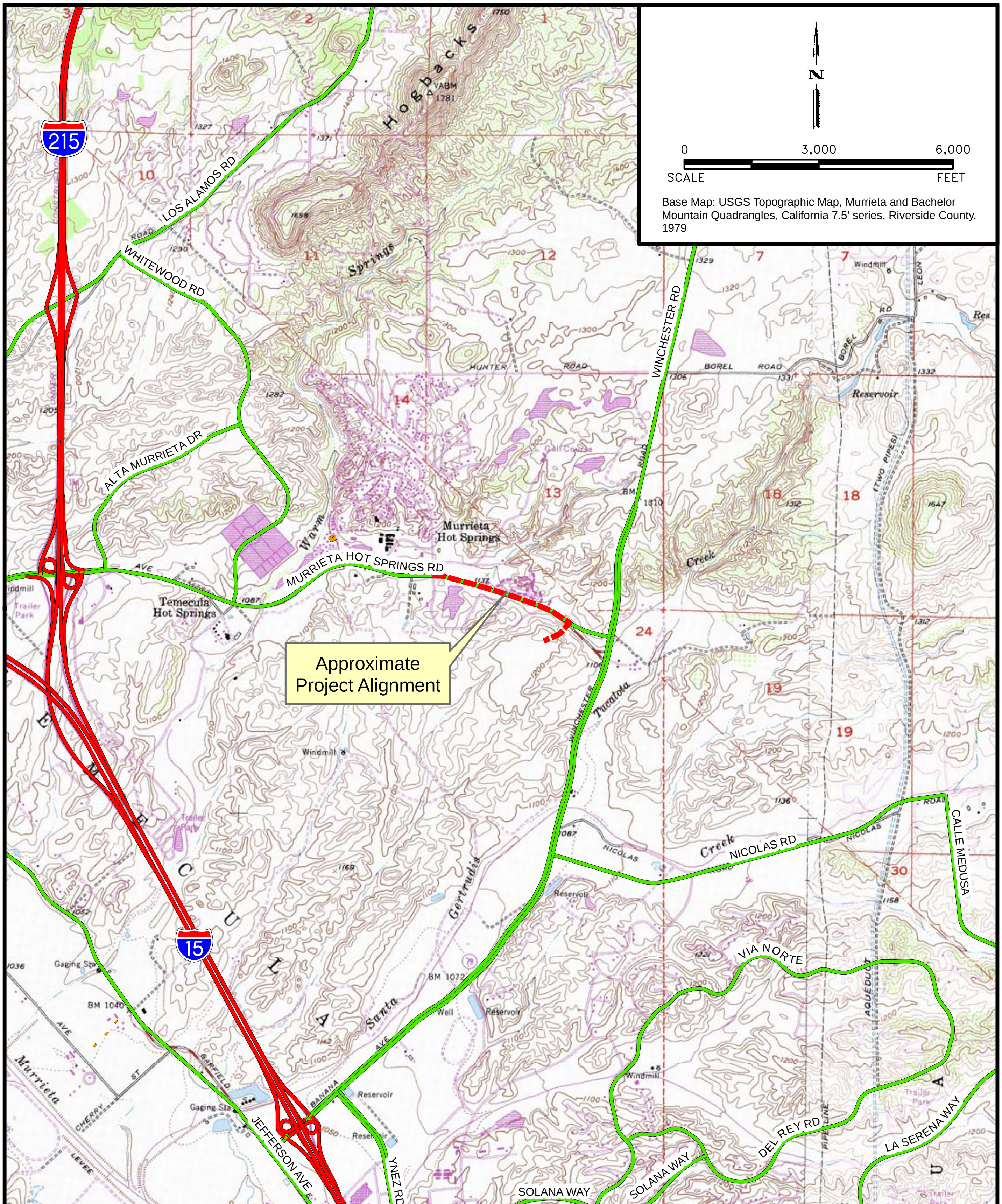
California Geologic Survey, (CGS), 2007b, Seismic Hazard Zone Report for the Murrieta 7.5-Minute Quadrangle, Seismic Hazard Zone Report 115.

Hart, E.W., Bryant, W. A., 1999, Fault-Rupture Hazard Zones in California, Alquist-Priolo Earthquake Fault Zoning with Index to Earthquake Zones Maps: Department of Conservation, Division of Mines and Geology, Special Publication 42. Revised 1997, Supplements 1 and 2 added 1999.

Leighton and Associates, Inc., 1997, Supplemental Geotechnical Evaluation for 32-acre Site, Portion of Warm Springs Development, Southeast of Margarita Road and Murrieta Hot Springs Road, Riverside County, California, PN 870125-003, December 3.

Leighton and Associates, Inc., 2000, Supplemental Geotechnical Evaluation, 12.25-acre Site, Amended TTM 29144, Portion of Warm Springs Development, Riverside County, California, Project No. 6870125-01, dated March 16.

Martin, G. R., and Lew, M., ed., 1999, "Recommended Procedures for Implementation of DMG Special Publication 117, Guidelines for Analyzing and Mitigating Liquefaction Hazards in California," Southern California Earthquake Center, dated March.



Date Street Improvement
Murrieta, California

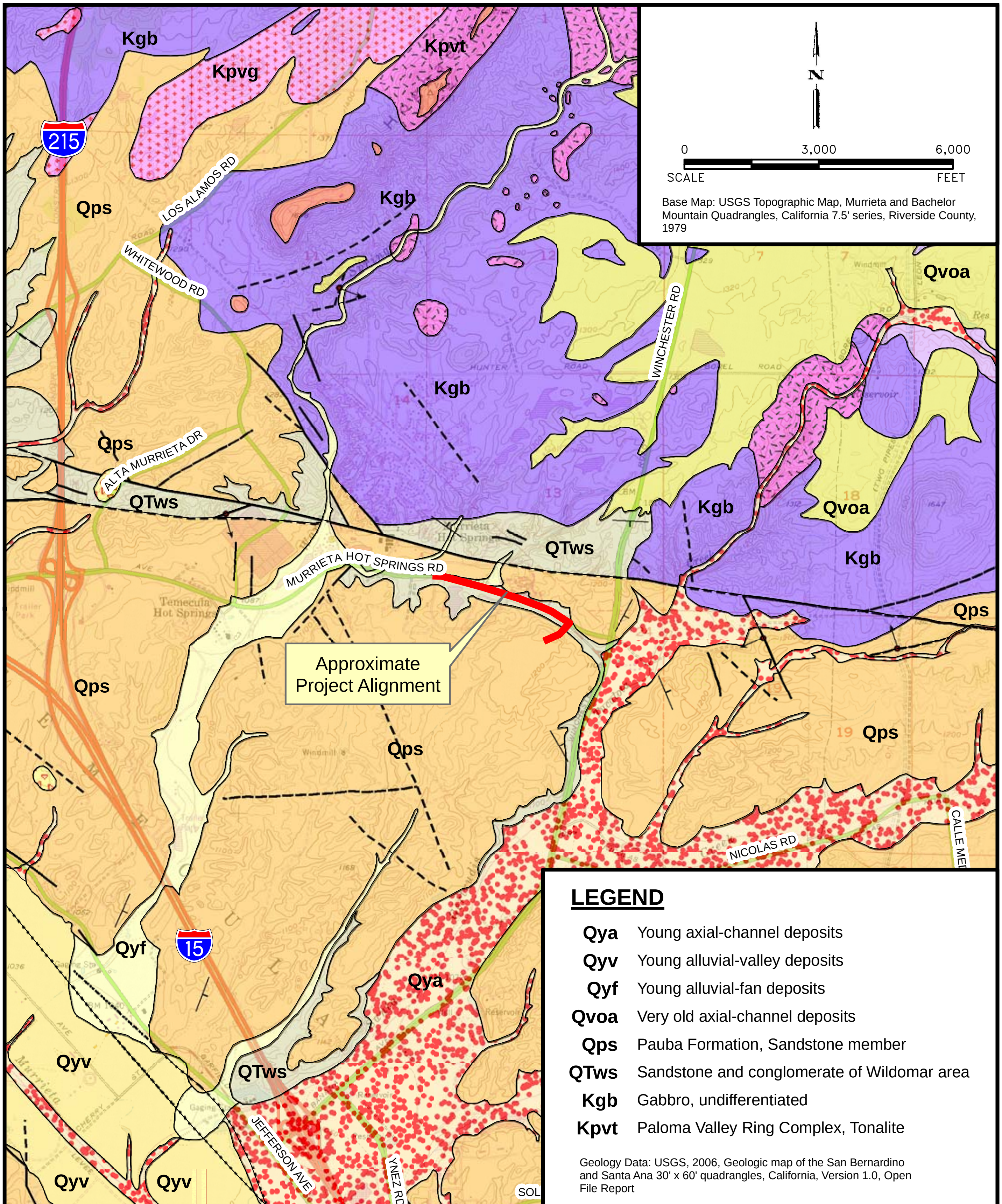
SITE LOCATION MAP

Project No.
602804-001

Date
May 2010

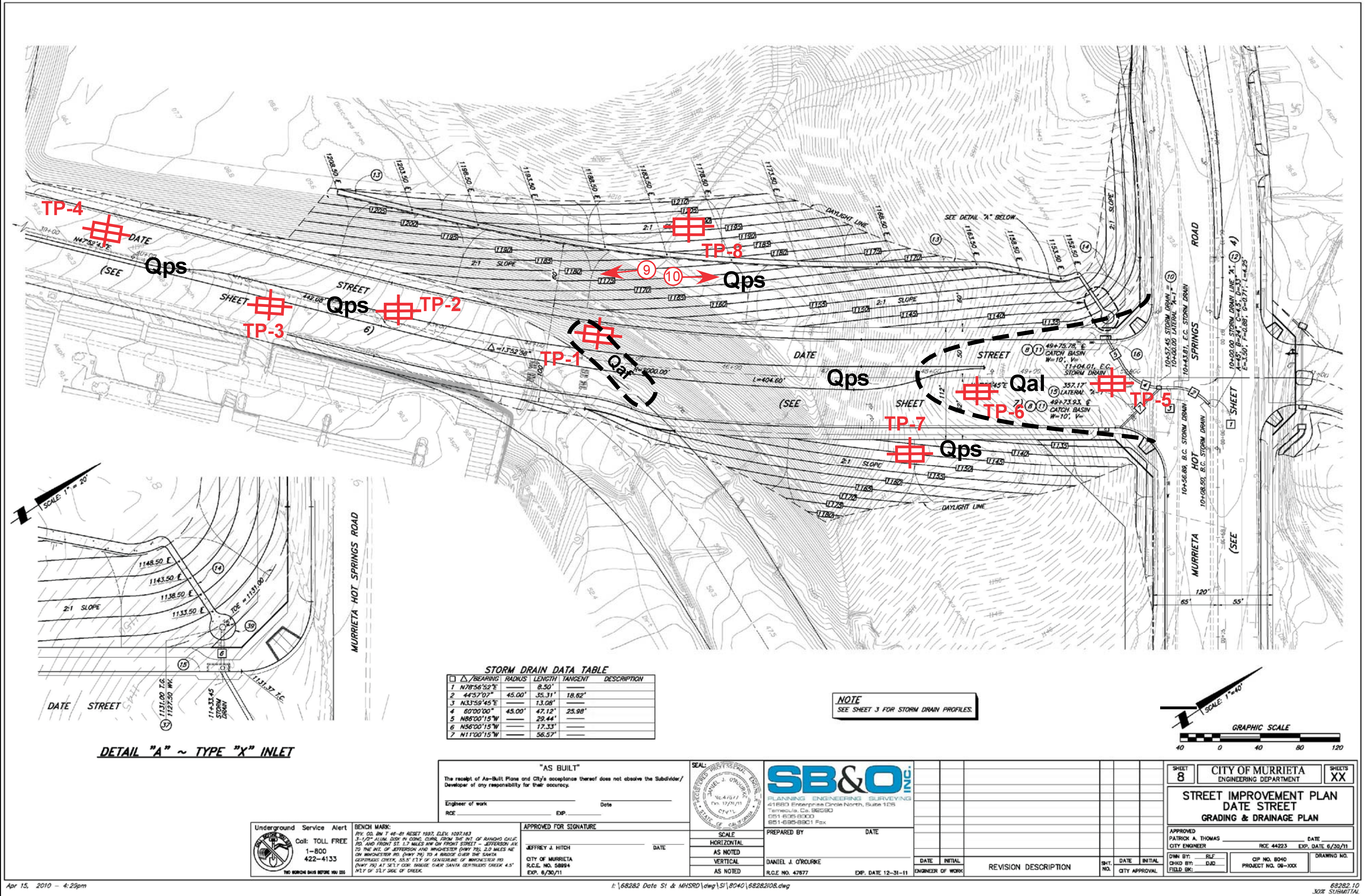
Figure 1

\\geomatics\data2\Drafting\602804\001\GIS\of_2010-04-28\Figure1-SiteLocationMap.mxd



Date Street Improvement **Murrieta, California**	**REGIONAL GEOLOGY MAP**	Project No. **602804-001** Date **May 2010** Figure 2

\\geomatics\data2\Drafting\602804\001\GIS\of_2010-04-28\Figure2-GeologyMap.mxd



STORM DRAIN DATA TABLE

□	Δ/BEARING	RADIUS	LENGTH	TANGENT	DESCRIPTION
1	N78°56'52"E	——	8.50'	——	
2	44°57'07"	45.00'	35.31'	18.62'	
3	N33°59'45"E	——	13.08'	——	
4	60°00'00"	45.00'	47.12'	25.98'	
5	N86°00'15"W	——	29.44'	——	
6	N56°00'15"W	——	17.33'	——	
7	N11°00'15"W	——	56.57'	——	

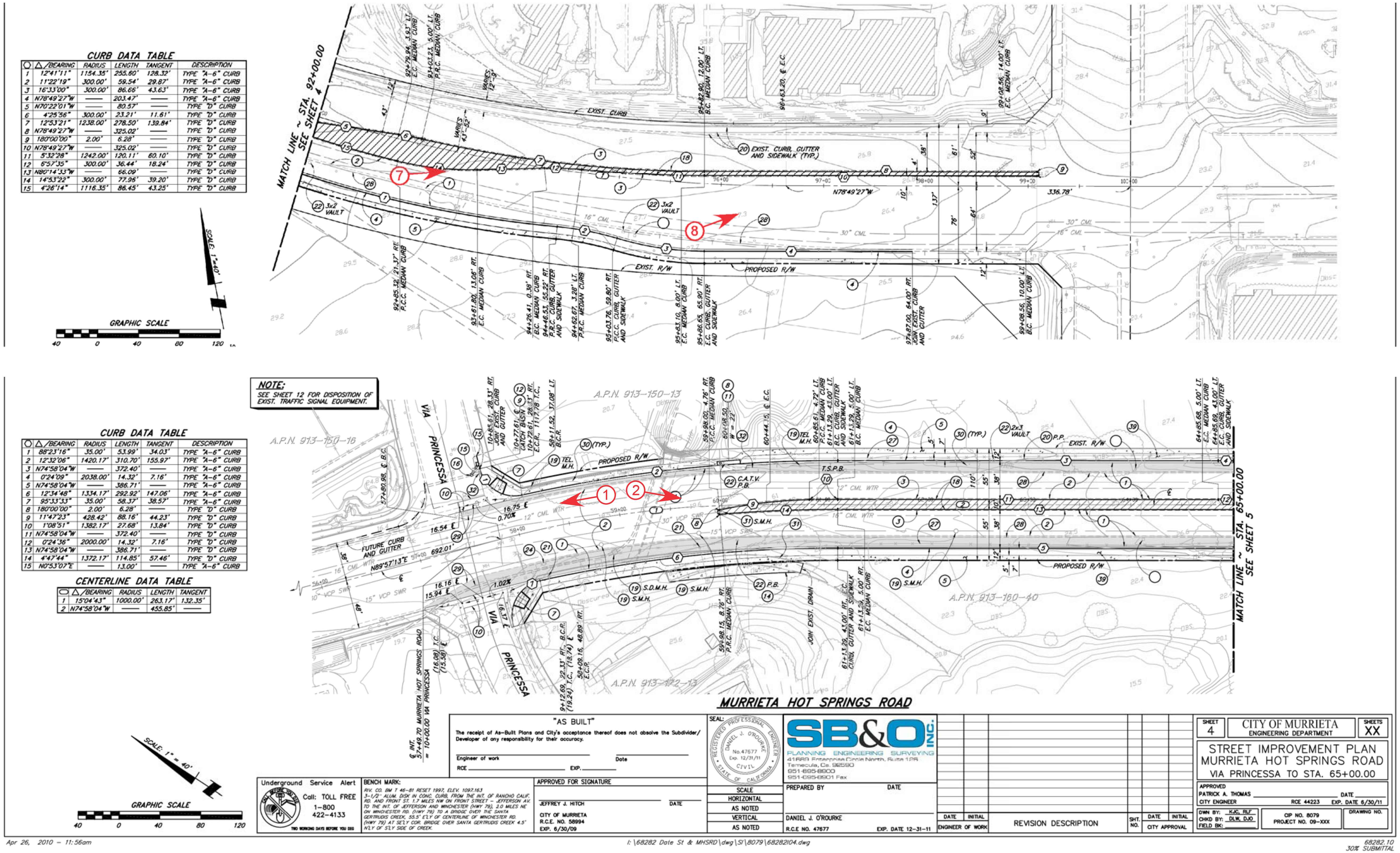
LEGEND:

- TP-8 Geotechnical Test Pit
- Qaf Artificial Fill
- Qal Quaternary Alluvium
- Qps Pauba Formation Sandstone
- - - - Geologic Contact
- (10) Photo Location and Direction

All Locations are Approximate

Project: 602804-001	Eng/Geol: SIS/LAB	**Test Pit Location Plan** Date Street Improvement Murrieta, California	FIGURE 3A
Scale: 1" = 100'	Date: 05/10		Leighton

Drafted by: BSS | Checked by: SIS | Base Map: SB&^O, Inc., Date St &^ MHSRD, Project No. 09-XXX, April 15, 2010, Sheet 8



LEGEND:

⑧ → **Photo Location and Direction**

All Locations are Approximate

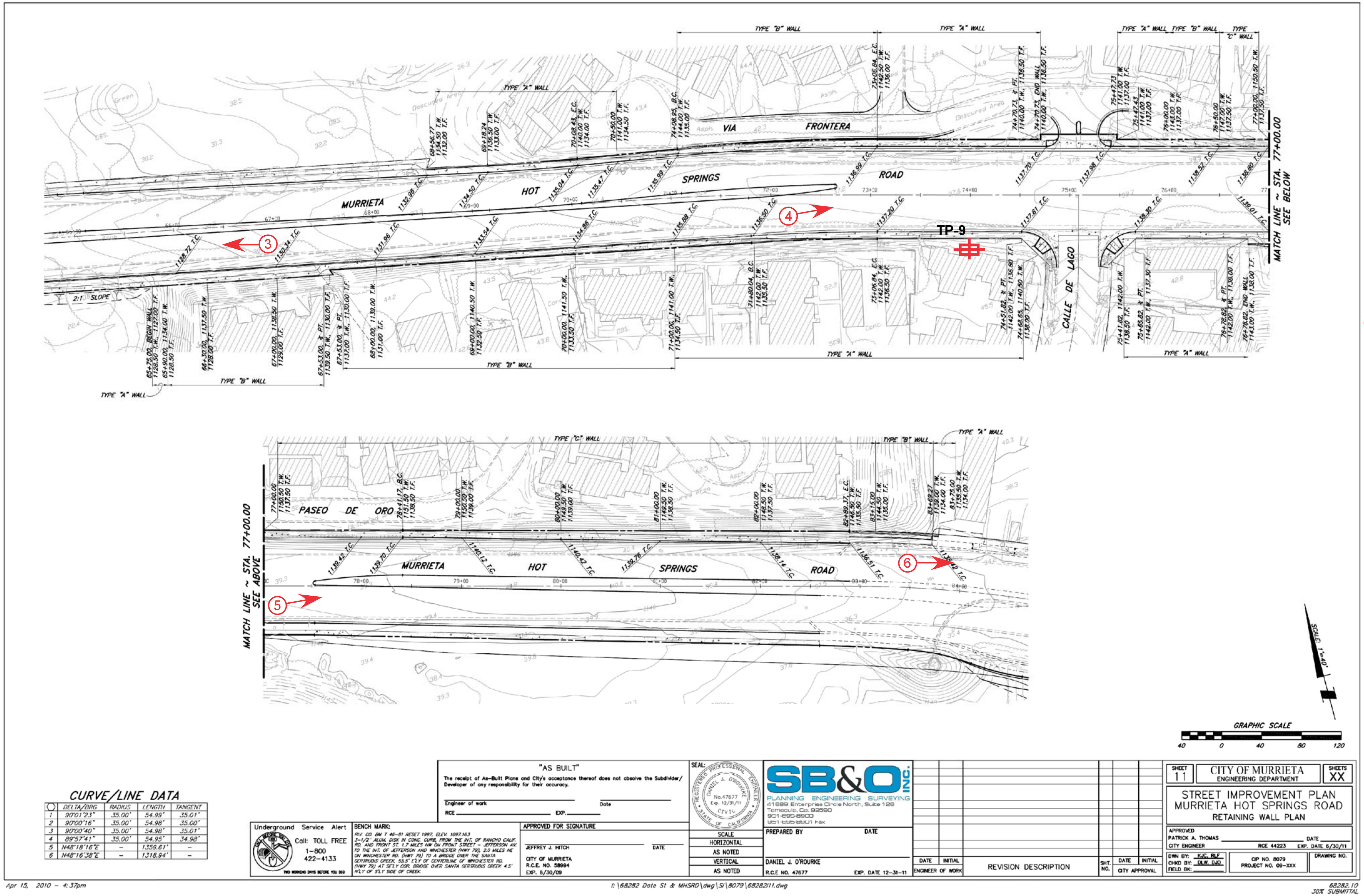
Project: 602804-001	Eng/Geol: SIS/LAB
Scale: 1" = 100'	Date: 05/10

Drafted by: BSS | Checked by: SIS | Base Map: SB&^O, Inc., Date St &^ MHSRD, Project No. 09-XXX, April 15, 2010, Sheet 8

Test Pit Location Plan
Date Street Improvement
Murrieta, California

FIGURE 3B

Leighton



LEGEND:

TP-9 Geotechnical Test Pit

6 Photo Location and Direction

All Locations are Approximate

Project: 602804-001	Eng/Geol: SIS/LAB
Scale: 1" = 100'	Date: 05/10

Drafted by: BSS | Checked by: SIS | Base Map: SB&^O, Inc., Date St &^ MHSRD, Project No. 09-XXX, April 15, 2010, Sheet 8

Test Pit Location Plan
Date Street Improvement
Murrieta, California

FIGURE 3C

Leighton

APPENDIX A

Field Exploration and Photos

GEOTECHNICAL TEST PIT LOG TP-1

Project No.	602804001	**Date Excavated**	4-20-10
Project	Date Street Extension	**Logged By**	LAB
Equipment Comp.	Cut-N-Core	**Bucket Size**	24-inch
Excavation Method	Backhoe	**Ground Elevation**	1165-1170'
Location	See Figure 2	**Sampled By**	LAB

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION *This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.*	Type of Tests
	0							PAUBA FORMATION (Qps).	
				B1			SM	SILTY SANDSTONE, light yellow brown, dense to medium dense, moist, predominantly fine to medium with abundant silt and trace coarse sand.	MD, SA
				R1	106.0	7			DS
							SP	SAND, very light yellow brown, very dense to hard, dry to slightly moist, coarse sand with trace silt, very friable.	
	5							Dense, moist.	
								Total Depth 4' 9", No Groundwater Encountered, Backfilled. Horizontal contacts slightly gradational.	
	10								
	15								
	20								
	25								
	30								

SAMPLE TYPES:
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:
- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

GEOTECHNICAL TEST PIT LOG TP-2

Project No.	602804001	**Date Excavated**	4-20-10
Project	Date Street Extension	**Logged By**	LAB
Equipment Comp.	Cut-N-Core	**Bucket Size**	24-inch
Excavation Method	Backhoe	**Ground Elevation**	1176'
Location	See Figure 2	**Sampled By**	LAB

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
	0						SP	PAUBA FORMATION (Qps). SANDSTONE, light yellow brown, dense, moist, coarse sand, moderately friable, some roots.	
1175				B1			SC/SM	Yellow brown, dense, moist, medium to coarse sand with silt and clay - blocky.	RV
								Total Depth 3', No Groundwater Encountered, Backfilled.	
								Generally horizontal contact - not sharp, slight gradational.	
	5								
1170									
	10								
1165									
	15								
1160									
	20								
1155									
	25								
1150									
	30								

This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.

SAMPLE TYPES:
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:
- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

*** This log is a part of a report by Leighton and should not be used as a stand-alone document. ***

GEOTECHNICAL TEST PIT LOG TP-3

Project No.	602804001	**Date Excavated**	4-20-10
Project	Date Street Extension	**Logged By**	LAB
Equipment Comp.	Cut-N-Core	**Bucket Size**	24-inch
Excavation Method	Backhoe	**Ground Elevation**	1183'
Location	See Figure 2	**Sampled By**	LAB

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
	0							6" AC over.	
								6" Base.	
				B1			SM	PAUBA FORMATION (Qps). SANDSTONE, red brown, medium dense, moist, fine to coarse sand with abundant silt and trace clay, slightly blocky.	
1180									
								Total Depth 2' 4", No Groundwater Encountered, Backfilled.	
	5								
1175									
	10								
1170									
	15								
1165									
	20								
1160									
	25								
1155									
	30								

This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.

SAMPLE TYPES:
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:
- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

* * * This log is a part of a report by Leighton and should not be used as a stand-alone document. * * *

GEOTECHNICAL TEST PIT LOG TP-4

Project No.	602804001	**Date Excavated**	4-20-10
Project	Date Street Extension	**Logged By**	LAB
Equipment Comp.	Cut-N-Core	**Bucket Size**	24-inch
Excavation Method	Backhoe	**Ground Elevation**	1192'
Location	See Figure 2	**Sampled By**	LAB

SOIL DESCRIPTION

This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.

Elevation Feet	Depth Feet	Graphic Log (N – S)	Attitudes	Sample No.	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	Soil Description	Type of Tests
	0							5" AC over.	
								7" base.	
1190				B1			SM	PAUBA FORMATION (Qps). SILTY SAND, red brown, dense, moist, fine to coarse sand with abundant silt, trace clay, blocky.	
								Total Depth 2' 8", No Groundwater Encountered, Backfilled.	
	5								
1185									
	10								
1180									
	15								
1175									
	20								
1170									
	25								
1165									
	30								

SAMPLE TYPES:
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:

-200	% FINES PASSING	DS	DIRECT SHEAR	SA	SIEVE ANALYSIS
AL	ATTERBERG LIMITS	EI	EXPANSION INDEX	SE	SAND EQUIVALENT
CN	CONSOLIDATION	H	HYDROMETER	SG	SPECIFIC GRAVITY
CO	COLLAPSE	MD	MAXIMUM DENSITY	UC	UNCONFINED COMPRESSIVE STRENGTH
CR	CORROSION	PP	POCKET PENETROMETER		
CU	UNDRAINED TRIAXIAL	RV	R VALUE		

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GEOTECHNICAL TEST PIT LOG TP-5

Project No.	602804001	**Date Excavated**	4-20-10
Project	Date Street Extension	**Logged By**	LAB
Equipment Comp.	Cut-N-Core	**Bucket Size**	24-inch
Excavation Method	Backhoe	**Ground Elevation**	1140'
Location	See Figure 2	**Sampled By**	LAB

SOIL DESCRIPTION

This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	Soil Description	Type of Tests
1140	0							QUATERNARY ALLUVIUM (Qal). SILTY SAND, dark brown, medium dense, moist, slightly porous, dry in the upper 1'.	
				B1			SM		CR, RV
							SM	PAUBA FORMATION (Qps). SILTY SAND, red brown, dense, moist, coarse sand.	
1135	5								
								Total Depth 5', No Groundwater Encountered, Backfilled.	
1130	10								
1125	15								
1120	20								
1115	25								
1110	30								

SAMPLE TYPES:
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:
- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

*** This log is a part of a report by Leighton and should not be used as a stand-alone document. ***

GEOTECHNICAL TEST PIT LOG TP-6

Project No.	602804001	**Date Excavated**	4-20-10
Project	Date Street Extension	**Logged By**	LAB
Equipment Comp.	Cut-N-Core	**Bucket Size**	24-inch
Excavation Method	Backhoe	**Ground Elevation**	1162'
Location	See Figure 2	**Sampled By**	LAB

SOIL DESCRIPTION

This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.

Graphic Log: N — S

Elevation Feet	Depth Feet	Attitudes	Sample No.	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	Soil Description	Type of Tests
	0						QUATERNARY ALLUVIUM (Qal).	
						SM	SILTY SAND, dark brown, loose to medium dense, moist, dry in upper 1'.	
1160								
							Coarse sand increases.	
	5					SM	PAUBA FORMATION (Qps). SILTY SAND, yellow brown, dense to medium dense, damp to moist, coarse, trace clay, trace carbonate, blocky, weathered in upper 1'. @ 7': dense.	
1155								
	10							
1150							@11': SILTY SAND, light yellow brown, dense, damp, becomes less cemented to more coarse, slightly friable.	
	15					SP/SM	SAND with some silt, very light yellow gray, dense, damp, coarse, friable.	
1145							Total Depth 16', No Groundwater Encountered, Backfilled.	
	20							
1140								
	25							
1135								
	30							

SAMPLE TYPES:
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:

-200	% FINES PASSING	DS	DIRECT SHEAR	SA	SIEVE ANALYSIS
AL	ATTERBERG LIMITS	EI	EXPANSION INDEX	SE	SAND EQUIVALENT
CN	CONSOLIDATION	H	HYDROMETER	SG	SPECIFIC GRAVITY
CO	COLLAPSE	MD	MAXIMUM DENSITY	UC	UNCONFINED COMPRESSIVE STRENGTH
CR	CORROSION	PP	POCKET PENETROMETER		
CU	UNDRAINED TRIAXIAL	RV	R VALUE		

*** This log is a part of a report by Leighton and should not be used as a stand-alone document. ***

GEOTECHNICAL TEST PIT LOG TP-7

Project No.	602804001	**Date Excavated**	4-20-10
Project	Date Street Extension	**Logged By**	LAB
Equipment Comp.	Cut-N-Core	**Bucket Size**	24-inch
Excavation Method	Backhoe	**Ground Elevation**	1178'
Location	See Figure 2	**Sampled By**	LAB

SOIL DESCRIPTION

This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
	0						SM	QUATERNARY COLLUVIUM (Qcol). SILTY SAND, dark brown, loose to medium dense, damp to moist.	
1175							SM	PAUBA FORMATION (Qps). SILTY SAND, light yellow brown, dense to medium dense, moist, coarse, trace roots. @3': SILTY SAND with clay, yellow brown, medium dense, moist, blocky, trace roots.	
	5							Total Depth 5', No Groundwater Encountered, Backfilled. Relatively horizontal, slightly gradational contact.	
1170									
	10								
1165									
	15								
1160									
	20								
1155									
	25								
1150									
	30								

SAMPLE TYPES:
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:
- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

***** This log is a part of a report by Leighton and should not be used as a stand-alone document. *****

GEOTECHNICAL TEST PIT LOG TP-8

Project No.	602804001	**Date Excavated**	4-20-10
Project	Date Street Extension	**Logged By**	LAB
Equipment Comp.	Cut-N-Core	**Bucket Size**	24-inch
Excavation Method	Backhoe	**Ground Elevation**	1214'
Location	See Figure 2	**Sampled By**	LAB

Elevation Feet	Depth Feet	Graphic Log (N / S)	Attitudes	Sample No.	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
								This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.	
	0						SM/SC	PAUBA FORMATION (Qps). SILTY SAND with clay, red brown, dense, damp, corse, blocky, fine roots to 2', tract roots below, becomes more coarse less silty.	
1210									
	5							Total Depth 5', No Groundwater Encountered, Backfilled.	
1205									
	10								
1200									
	15								
1195									
	20								
1190									
	25								
1185									
	30								

SAMPLE TYPES:
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:
- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

* * * This log is a part of a report by Leighton and should not be used as a stand-alone document. * * *

GEOTECHNICAL TEST PIT LOG TP-9

Project No.	602804001	**Date Excavated**	4-9-10
Project	Date Street Extension	**Logged By**	LRM
Equipment Comp.	N/A	**Bucket Size**	N/A
Excavation Method	Hand Auger	**Ground Elevation**	~1214'
Location	MHSR - Sta ~ 74+00 (south slope)	**Sampled By**	LAB

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
	0						SC	ARTIFICIAL FILL (Af). Clayey SAND, brown, loose, very moist, trace roots.	
	5							Total Depth 3.5', No Groundwater Encountered, Backfilled.	
	10								
	15								
	20								
	25								
	30								

This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.

SAMPLE TYPES:
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:
- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

PHOTO NO. 1:
MHSR / Sta. ~ 59+00 (northwest)

PHOTO NO. 2:
MHSR / Sta. ~ 59+00

PHOTO NO. 3:
MHSR / Sta. ~ 67+00 (west direction)

PHOTO NO. 4:
MHSR / Sta. ~ 72+00 (east direction)

PHOTO NO. 5:
MHSR / Sta. ~ 77+00 (east direction)

PHOTO NO. 6:
MHSR / Sta. ~ 83+50 (east)

PHOTO NO. 7:
MHSR / Sta. ~ 93+00 (east)

PHOTO NO. 8
MHSR / Sta. ~ 96+00 (east)

PHOTO NO. 9:
Date Street (west)

PHOTO NO. 10
Date Street (east)

APPENDIX B

Geotechnical Laboratory Testing Results

MODIFIED PROCTOR COMPACTION TEST

Leighton

ASTM D 1557

Project Name:	DATE ST. EXTENSION	Tested By :	JRH	Date:	4/23/10
Project No.:	602804-001	Input By :	JMB	Date:	4-26-10
Location:	**TP-1**	Depth (ft.)	1-3.0		
Sample No. :	**B-1**				
Soil Identification:	SILTY SAND (SM), fine to coarse grain, pale brown.				

Preparation Method: [X] Moist [ ] Dry [ ] Mechanical Ram [X] Manual Ram

Mold Volume (ft^3) 0.03328 *Ram Weight = 10 lb.; Drop = 18 in.*

TEST NO.	1	2	3	4	5	6
Moisture Added (ml)	0	50	100	150		
Wt. Compacted Soil + Mold (g)	6237	6366	6385	6322		
Weight of Mold (g)	4320	4320	4320	4320		
Net Weight of Soil (g)	1917	2046	2065	2002		
Wet Weight of Soil + Cont. (g)	413.0	612.4	551.7	490.1		
Dry Weight of Soil + Cont. (g)	399.3	580.0	516.2	453.3		
Weight of Container (g)	118.7	118.7	118.7	118.7		
Moisture Content (%)	4.9	7.0	8.9	11.0		
Wet Density (pcf)	127.0	135.6	136.8	132.6		
Dry Density (pcf)	121.1	126.7	125.6	119.5		

Maximum Dry Density (pcf) **127.0** **Optimum Moisture Content (%)** **7.5**

PROCEDURE USED

[X] **Procedure A**
Soil Passing No. 4 (4.75 mm) Sieve
Mold : 4 in. (101.6 mm) diameter
Layers : 5 (Five)
Blows per layer : 25 (twenty-five)
May be used if +#4 is 20% or less

[ ] **Procedure B**
Soil Passing 3/8 in. (9.5 mm) Sieve
Mold : 4 in. (101.6 mm) diameter
Layers : 5 (Five)
Blows per layer : 25 (twenty-five)
Use if +#4 is >20% and +3/8 in. is 20% or less

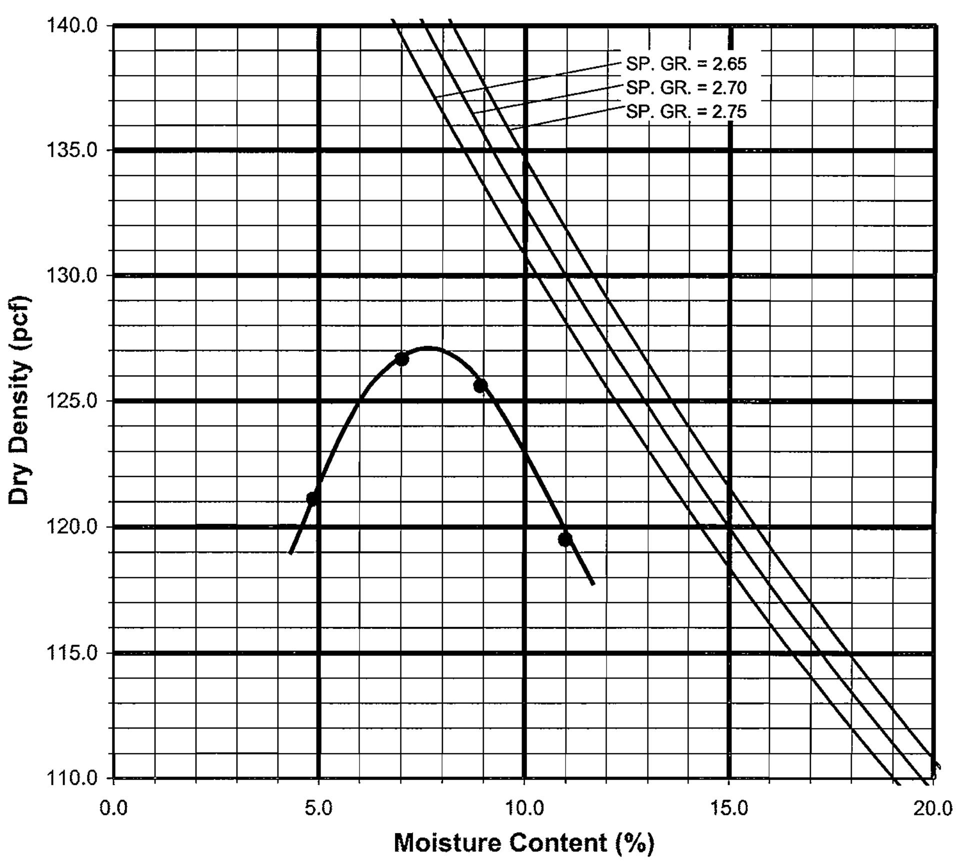
[ ] **Procedure C**
Soil Passing 3/4 in. (19.0 mm) Sieve
Mold : 6 in. (152.4 mm) diameter
Layers : 5 (Five)
Blows per layer : 56 (fifty-six)
Use if +3/8 in. is >20% and +¾ in. is <30%

Particle-Size Distribution:

GR:SA:FI

Atterberg Limits:

LL,PL,PI



Leighton

PARTICLE-SIZE ANALYSIS of SOILS
ASTM D 422

Project Name:	DATE ST. EXTENSION	Tested By:	JAP	Date:	04/23/10
Project No.:	602804-001	Checked By:	JMB	Date:	04/26/10
Boring No.:	**TP-1**	Depth (ft.):	1-3.0		
Sample No.:	**B-1**				

Visual Sample Description: SILTY SAND (SM), fine to coarse grain, pale brown.

		Moisture Content of Total Air - Dry Soil	
Container No.:	RBT	Wt. of Air-Dry Soil + Cont. (gm.)	1058.2
Wt. of Air Dry Soil+Cont.(gm.)	1058.2	Wt. of Dry Soil + Cont. (gm.)	1058.2
Wt. of Container (gm.)	578.9	Wt. of Container No. RBT (gm.)	578.9
Dry Wt. of Soil (gm.)	479.3	Moisture Content (%)	0.0

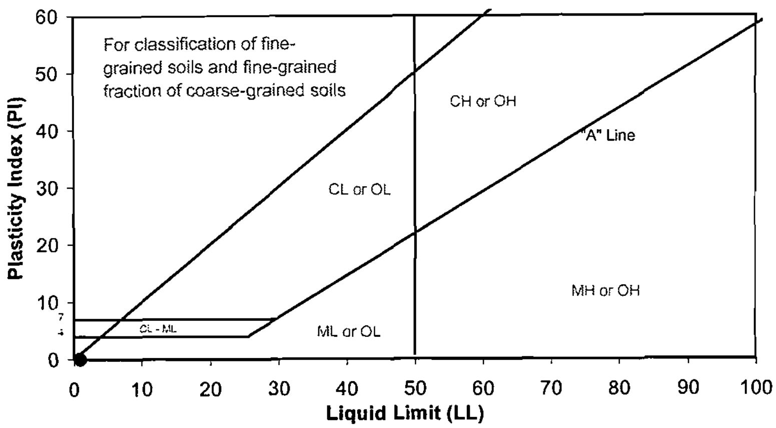
After Wet Sieve	Container No.	RBT
	Wt. of Dry Soil + Container (gm.)	880.2
	Wt. of Container (gm.)	578.9
	Dry Wt. of Soil Retained on # 200 Sieve (gm.)	301.3

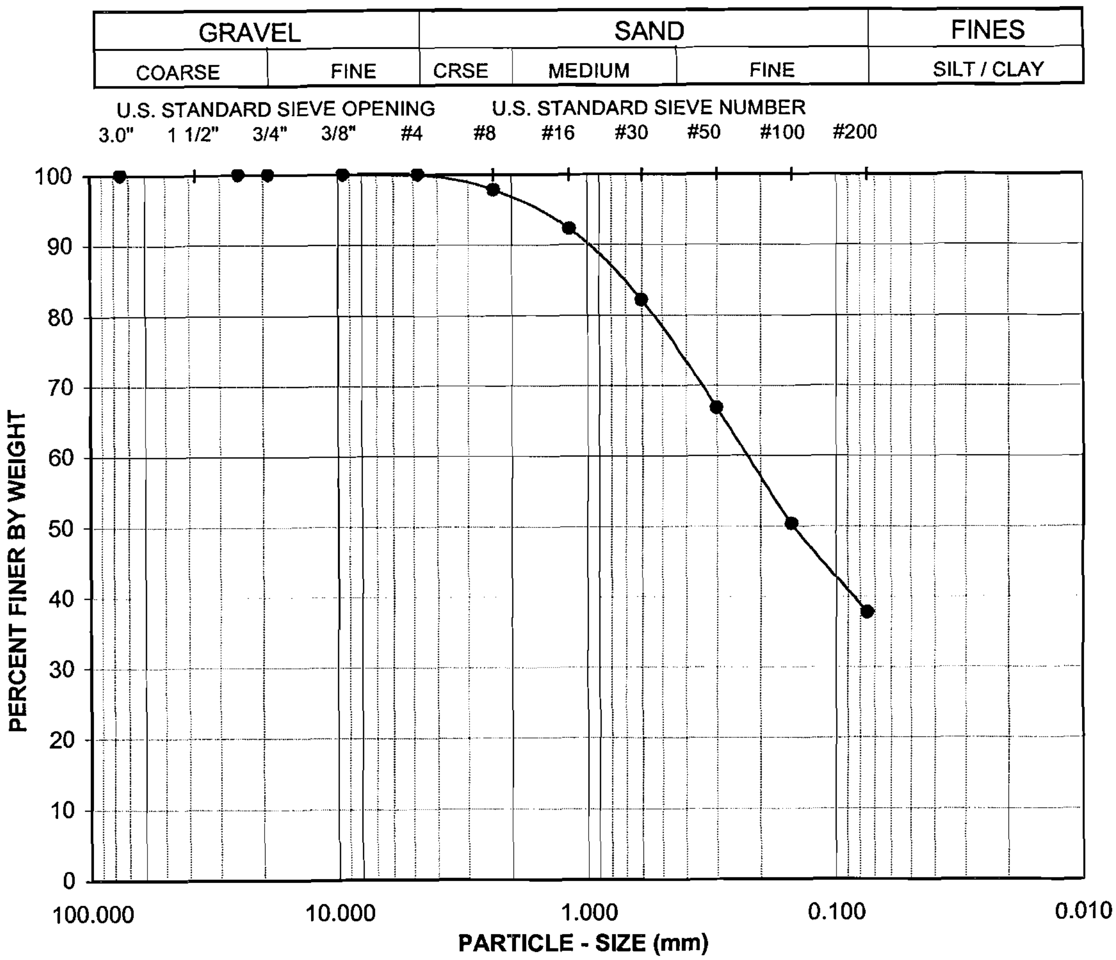
U. S. Sieve Size (in.)	U. S. Sieve Size (mm.)	Cumulative Weight Dry Soil Retained (gm.)	Percent Passing %	Spec.
6"	152.400		100.0	**
3"	75.000		100.0	**
1"	25.000		100.0	**
3/4"	19.000		100.0	**
3/8"	9.500		100.0	**
#4	4.750	0.0	100.0	**
#8	2.360	10.5	97.8	**
#16	1.180	37.1	92.3	**
#30	0.600	85.9	82.1	**
#50	0.300	158.9	66.8	**
#100	0.150	238.4	50.3	**
#200	0.075	298.5	37.7	**
PAN				

GRAVEL:	**0 %**	Liquid Limit:	**
SAND:	**62 %**	Plastic Limit	**
FINES:	**38 %**	Plasticity Index:	**
GRP. SYMBOL:	**SM**	Cu = D60/D10 =	N/A
		Cc = (D30)²/(D60*D10) =	N/A

Remarks: **

Rev. 08-04





Boring No.:	Sample No.:	Depth (ft.):	Soil Type	GR:SA:FI	LL,PL,PI
TP-1	**B-1**	1-3.0	SM	0 : 62 : 38	** : ** : ** :

Project No.: 602804-001

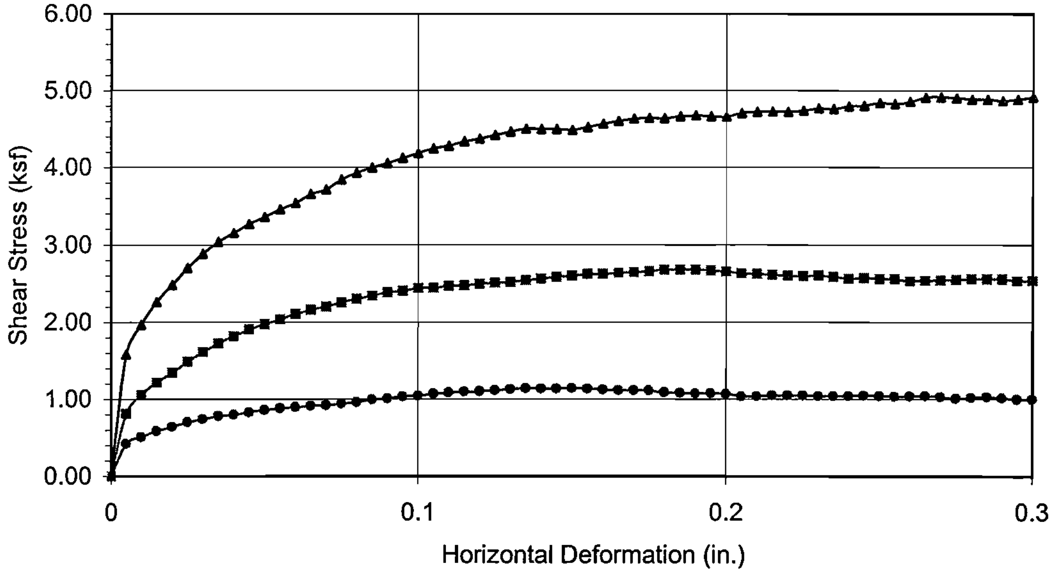
DATE ST. EXTENSION

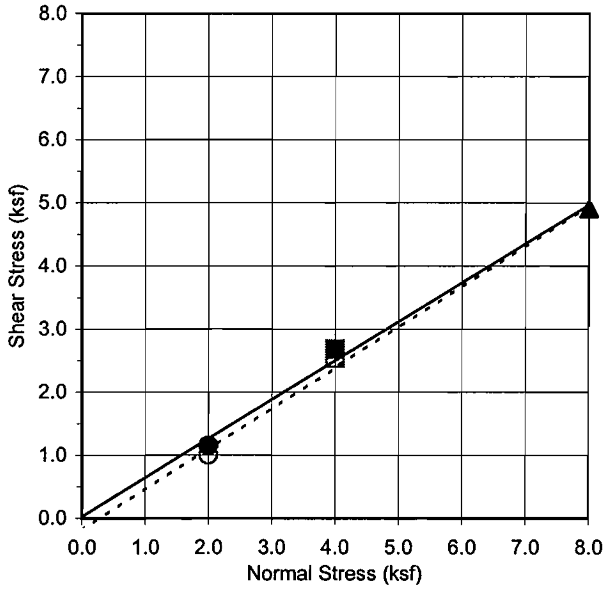
Visual Sample Description:
SILTY SAND (SM), fine to coarse grain, pale brown.

PARTICLE - SIZE CURVE
ASTM D 422

Leighton

Sieve; TP-1, B-1 Rev. 08-04





Boring No.	**TP-1**
Sample No.	**R-1**
Depth (ft)	**2.5**
Sample Type:	Drive
Soil Identification: Light olive brown sandy lean clay s(CL)	

Strength Parameters

	C (psf)	ϕ (°)
Peak	26.0	31.7
Ultimate	-191.5	32.8

Normal Stress (kip/ft²)	2.000	4.000	8.000
Peak Shear Stress (kip/ft²)	● 1.144	■ 2.678	▲ 4.914
Shear Stress @ End of Test (ksf)	○ 0.997	□ 2.537	△ 4.914
Deformation Rate (in./min.)	0.0500	0.0500	0.0500
Initial Sample Height (in.)	1.000	1.000	1.000
Diameter (in.)	2.415	2.415	2.415
Initial Moisture Content (%)	6.96	6.96	6.96
Dry Density (pcf)	100.0	106.1	106.4
Saturation (%)	27.4	31.9	32.2
Soil Height Before Shearing (in.)	0.9511	0.9509	0.9245
Final Moisture Content (%)	21.3	19.5	17.2

Leighton

DIRECT SHEAR TEST RESULTS
Consolidated Undrained

Project No.: 602804-001

Date Street Extension

04-10

Direct Shear TP-1, R-1 @ 2.5

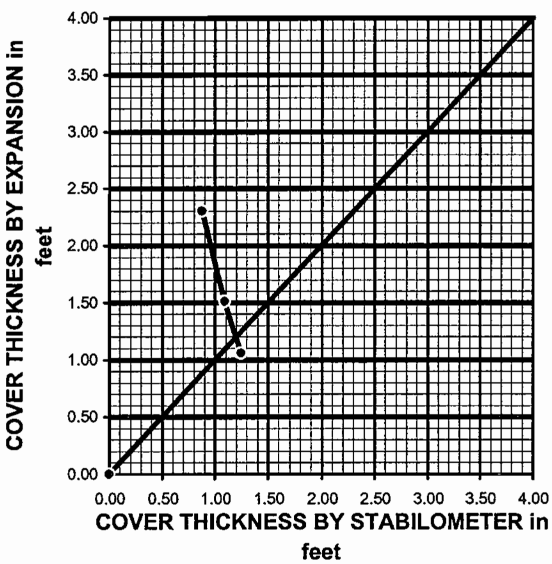
Leighton

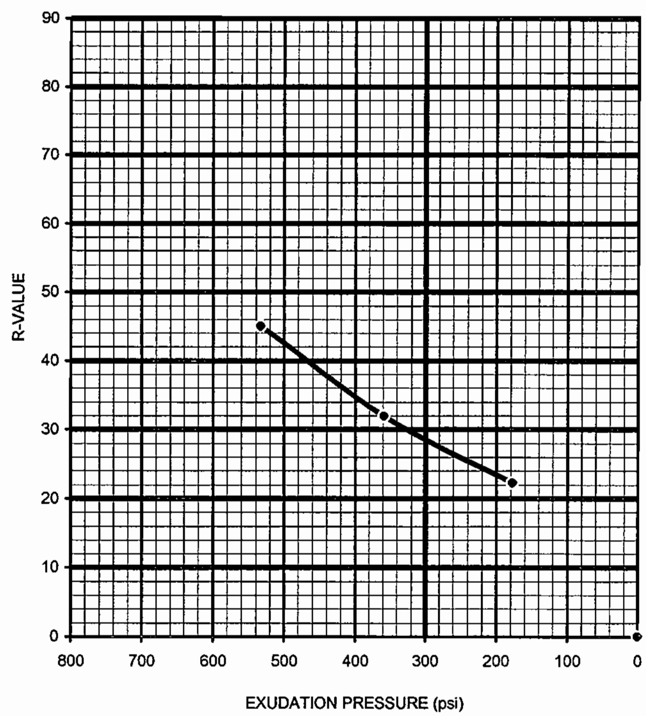
R-VALUE TEST RESULTS

Project Name:	DATE ST. EXTENSION	Date:	4/22/10
Project Number:	602804-001	Technician:	JRH
Boring Number:	TP-2	Depth (ft.):	1-3.0
Sample Number:	B-1	Sample Location:	**
Sample Description:	CLAYEY SAND (SC), fine to coarse grain, pale brown.		

TEST SPECIMEN	A	B	C
MOISTURE AT COMPACTION %	12.0	13.2	14.3
HEIGHT OF SAMPLE, Inches	2.41	2.50	2.55
DRY DENSITY, pcf	118.7	123.8	119.6
COMPACTOR AIR PRESSURE, psi	150	100	50
EXUDATION PRESSURE, psi	533	358	177
EXPANSION, Inches x 10exp-4	61	40	28
STABILITY Ph 2,000 lbs (160 psi)	70	92	108
TURNS DISPLACEMENT	3.56	3.95	4.22
R-VALUE UNCORRECTED	47	32	22
R-VALUE CORRECTED	45	32	22

DESIGN CALCULATION DATA	a	b	c
GRAVEL EQUIVALENT FACTOR	1.0	1.0	1.0
TRAFFIC INDEX	5.0	5.0	5.0
STABILOMETER THICKNESS, ft.	0.88	1.09	1.24
EXPANSION PRESSURE THICKNESS, ft.	2.30	1.51	1.06





R-VALUE BY EXPANSION:	26
R-VALUE BY EXUDATION:	29
EQUILIBRIUM R-VALUE:	26

Rev. 08-04

Leighton

Soluble Sulfates
(Hach Sulfate Test Kit)

Project Name: DATE ST. EXTENSION
Project Number: 602804-001
Date: 4/23/10
Technician: JRH

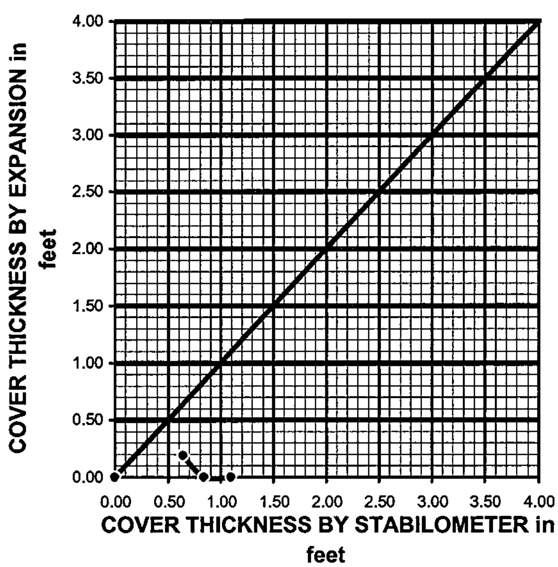
Sample Identification		Dilution	Reading (PPM) Water Fraction	Tube Reading	% Sulfates
Boring No.:	**TP-5**	3 :1	3	65	**0.0195**
Sample No:	**B-1**		=	195	
Depth (ft.):	2-4.0				

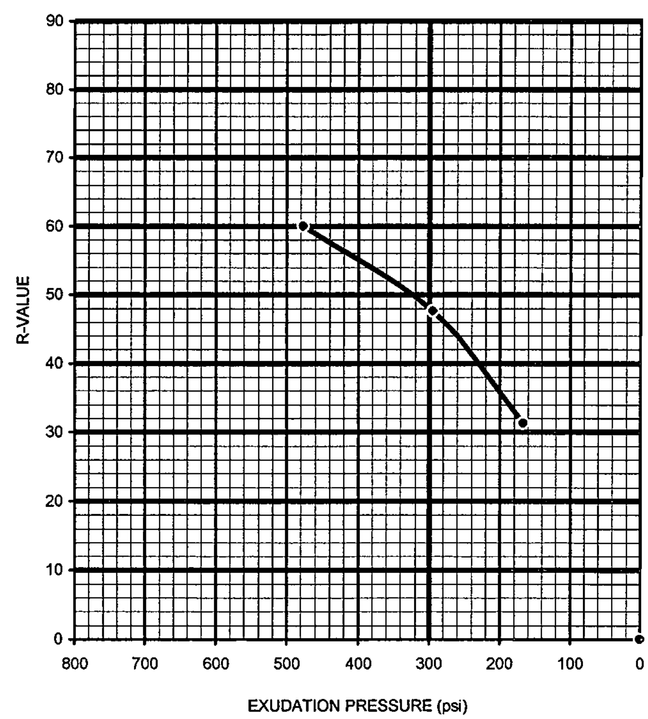
Leighton	R-VALUE TEST RESULTS

Project Name:	DATE ST. EXTENSION	Date:	4/22/10
Project Number:	602804-001	Technician:	JRH
Boring Number:	TP-5	Depth (ft.):	2-4.0
Sample Number:	B-1	Sample Location:	**
Sample Description:	SILTY SAND (SM), fine to coarse grain, pale brown.		

TEST SPECIMEN	A	B	C
MOISTURE AT COMPACTION %	9.4	10.5	11.6
HEIGHT OF SAMPLE, Inches	2.40	2.54	2.54
DRY DENSITY, pcf	127.1	125.8	124.0
COMPACTOR AIR PRESSURE, psi	125	100	50
EXUDATION PRESSURE, psi	477	294	167
EXPANSION, Inches x 10exp-4	5	0	0
STABILITY Ph 2,000 lbs (160 psi)	44	63	84
TURNS DISPLACEMENT	4.02	4.23	4.96
R-VALUE UNCORRECTED	62	48	31
R-VALUE CORRECTED	60	48	31

DESIGN CALCULATION DATA	a	b	c
GRAVEL EQUIVALENT FACTOR	1.0	1.0	1.0
TRAFFIC INDEX	5.0	5.0	5.0
STABILOMETER THICKNESS, ft.	0.64	0.84	1.10
EXPANSION PRESSURE THICKNESS, ft.	0.19	0.00	0.00





R-VALUE BY EXPANSION:	N/A
R-VALUE BY EXUDATION:	49
EQUILIBRIUM R-VALUE:	49

Rev. 08-04

APPENDIX C

Slope Stability Analysis

Date Street Extension - Murrieta Slope Stability - Seismic

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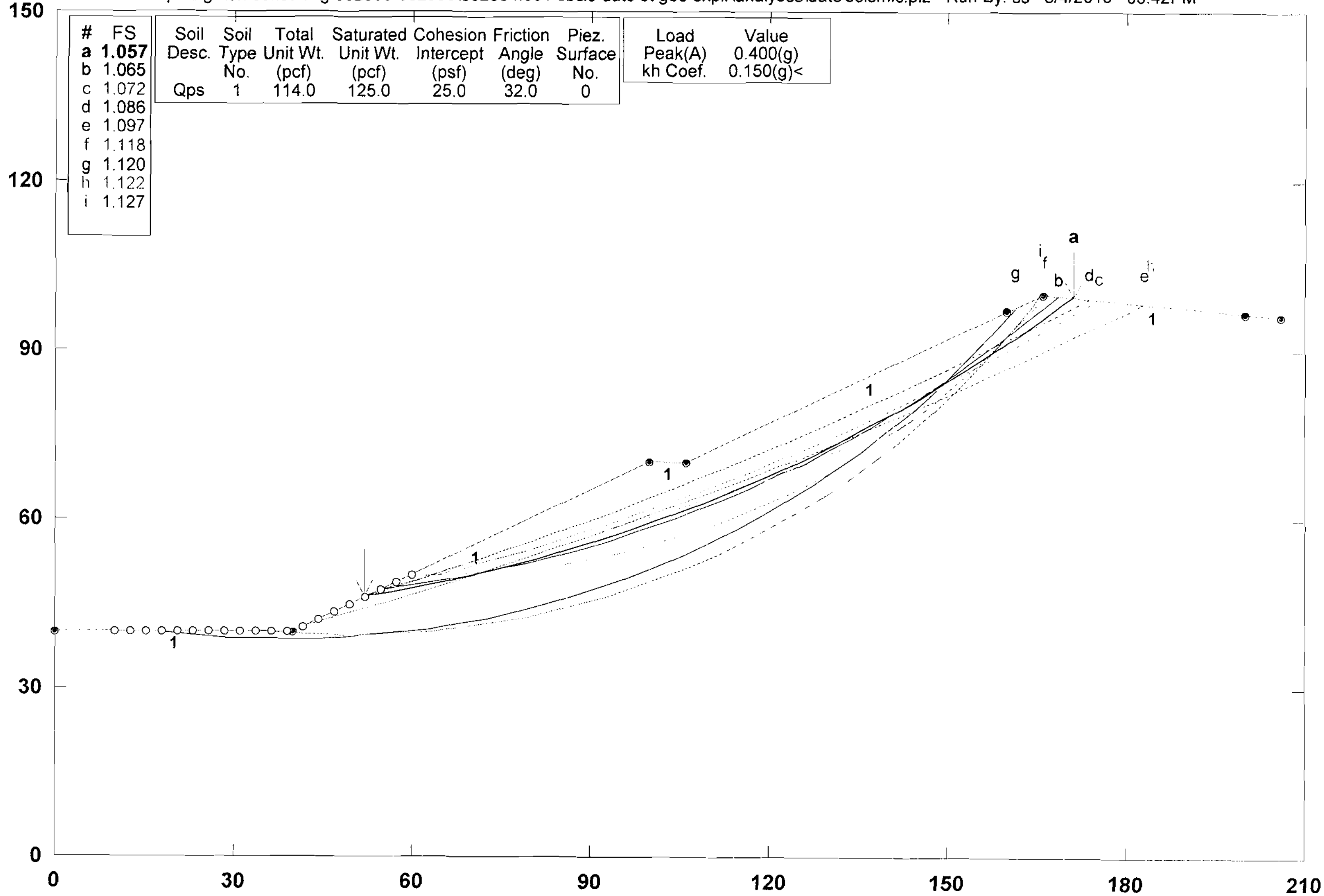


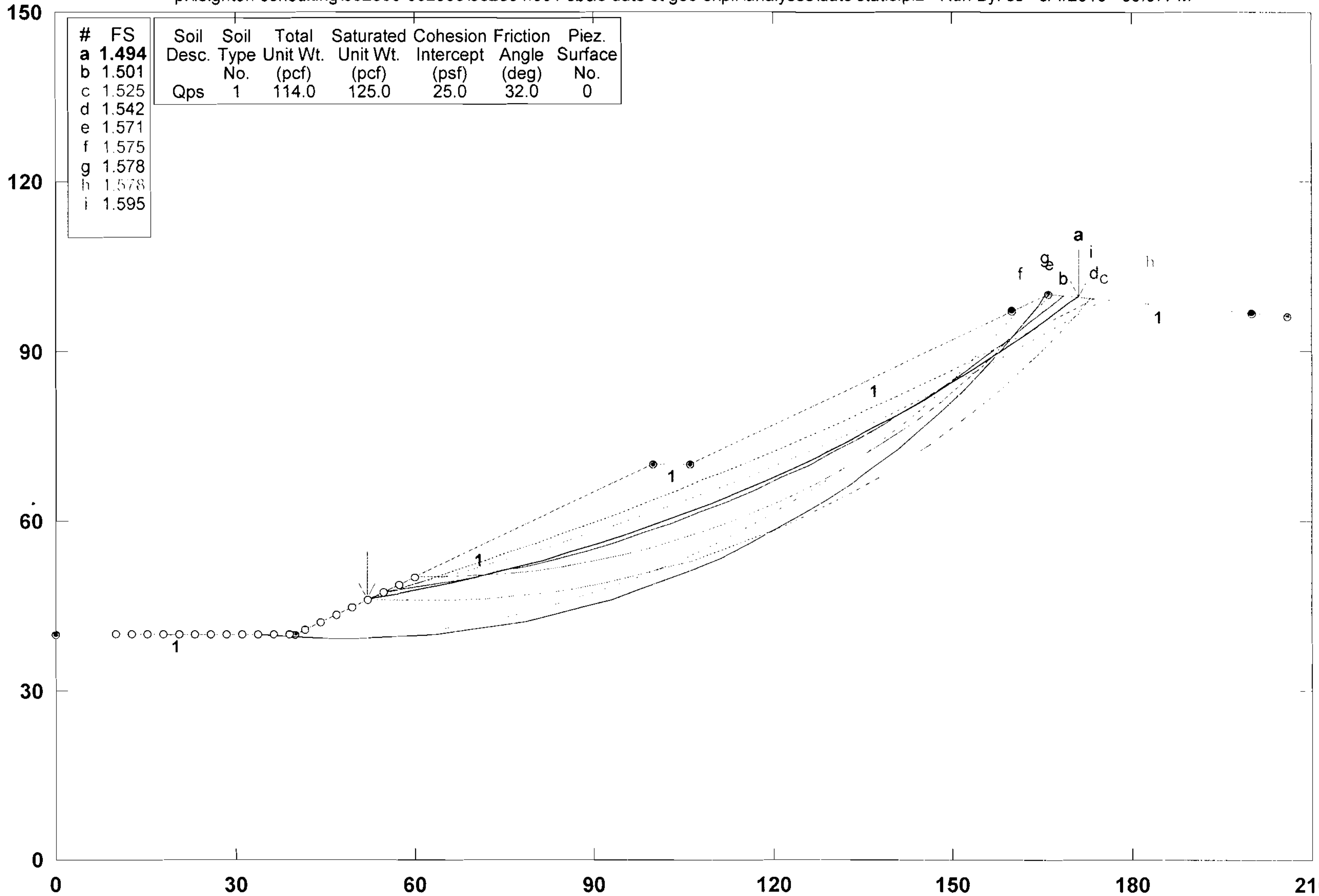
GSTABL7 v.2 FSmin=1.057

Safety Factors Are Calculated By The Modified Bishop Method

GSTABL7

Date Street Extension - Murrieta Slope Stability - Static

p:\leighton consulting\602500-602999\602804.001 sb&o date st geo explr\analyses\date'static.pl2 Run By: ss 5/4/2010 03:37PM



GSTABL7 v.2 FSmin=1.494

Safety Factors Are Calculated By The Modified Bishop Method

GSTABL7

```
                         ***  GSTABL7  ***
                ** GSTABL7 by Garry H. Gregory, P.E. **
   ** Original Version 1.0, January 1996; Current Version 2.004, June 2003 **
            (All Rights Reserved-Unauthorized Use Prohibited)
 *********************************************************************************
                     SLOPE STABILITY ANALYSIS SYSTEM
       Modified Bishop, Simplified Janbu, or GLE Method of Slices.
       (Includes Spencer & Morgenstern-Price Type Analysis)
       Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
       Nonlinear Undrained Shear Strength, Curved Phi Envelope,
       Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
       Surfaces, Pseudo-Static & Newmark Earthquake, and Applied Forces.
 *********************************************************************************
   Analysis Run Date:        5/4/2010
   Time of Run:              03:37PM
   Run By:                   ss
   Input Data Filename:      P:\Leighton Consulting\602500-602999\602804.001 SB&O DATE ST
GEO EXPLR\Analyses\date'static.in
   Output Filename:          P:\Leighton Consulting\602500-602999\602804.001 SB&O DATE ST
GEO EXPLR\Analyses\date'static.OUT
   Unit System:              English
   Plotted Output Filename:  P:\Leighton Consulting\602500-602999\602804.001 SB&O DATE ST
GEO EXPLR\Analyses\date'static.PLT
   PROBLEM DESCRIPTION:  Date Street Extension - Murrieta
                         Slope Stability - Static
   BOUNDARY COORDINATES
```

5 Top Boundaries
5 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	40.00	40.00	40.00	1
2	40.00	40.00	100.00	70.00	1
3	100.00	70.00	106.00	70.00	1
4	106.00	70.00	166.00	100.00	1
5	166.00	100.00	206.00	96.00	1

Default Y-Origin = 0.00(ft)
Default X-Plus Value = 0.00(ft)
Default Y-Plus Value = 0.00(ft)
ISOTROPIC SOIL PARAMETERS
1 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	114.0	125.0	25.0	32.0	0.00	0.0	0

A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
400 Trial Surfaces Have Been Generated.
20 Surface(s) Initiate(s) From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 10.00(ft)
and X = 60.00(ft)
Each Surface Terminates Between X = 160.00(ft)
and X = 200.00(ft)
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 10.00(ft)
5.00(ft) Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Evaluated. They Are
Ordered - Most Critical First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Total Number of Trial Surfaces Attempted = 400
Number of Trial Surfaces With Valid FS = 400
Statistical Data On All Valid FS Values:
FS Max = 3.109 FS Min = 1.494 FS Ave = 2.287
Standard Deviation = 0.442 Coefficient of Variation = 19.32 %
Failure Surface Specified By 28 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	52.105	46.053
2	57.023	46.955
3	61.923	47.951
4	66.803	49.039
5	71.662	50.219
6	76.498	51.490
7	81.308	52.853
8	86.092	54.306
9	90.848	55.850
10	95.574	57.483
11	100.268	59.205
12	104.929	61.016
13	109.554	62.914
14	114.143	64.899
15	118.694	66.971
16	123.204	69.129
17	127.673	71.371
18	132.099	73.698
19	136.480	76.107
20	140.815	78.599
21	145.102	81.173
22	149.339	83.827
23	153.526	86.560
24	157.660	89.373
25	161.740	92.263
26	165.765	95.229

27	169.733	98.271
28	171.244	99.476

Circle Center At X = 6.863 ; Y = 306.504 ; and Radius = 264.351

Factor of Safety

*** 1.494 ***

Individual data on the 30 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	4.9	436.3	0.0	0.0	0.	0.	0.0	0.0	0.0
2	4.9	1275.6	0.0	0.0	0.	0.	0.0	0.0	0.0
3	4.9	2051.2	0.0	0.0	0.	0.	0.0	0.0	0.0
4	4.9	2762.7	0.0	0.0	0.	0.	0.0	0.0	0.0
5	4.8	3409.9	0.0	0.0	0.	0.	0.0	0.0	0.0
6	4.8	3992.6	0.0	0.0	0.	0.	0.0	0.0	0.0
7	4.8	4510.8	0.0	0.0	0.	0.	0.0	0.0	0.0
8	4.8	4964.7	0.0	0.0	0.	0.	0.0	0.0	0.0
9	4.7	5354.7	0.0	0.0	0.	0.	0.0	0.0	0.0
10	4.4	5347.7	0.0	0.0	0.	0.	0.0	0.0	0.0
11	0.3	331.4	0.0	0.0	0.	0.	0.0	0.0	0.0
12	4.7	5254.5	0.0	0.0	0.	0.	0.0	0.0	0.0
13	1.1	1070.4	0.0	0.0	0.	0.	0.0	0.0	0.0
14	3.6	3526.8	0.0	0.0	0.	0.	0.0	0.0	0.0
15	4.6	4717.4	0.0	0.0	0.	0.	0.0	0.0	0.0
16	4.6	4810.9	0.0	0.0	0.	0.	0.0	0.0	0.0
17	4.5	4846.1	0.0	0.0	0.	0.	0.0	0.0	0.0
18	4.5	4824.3	0.0	0.0	0.	0.	0.0	0.0	0.0
19	4.4	4747.1	0.0	0.0	0.	0.	0.0	0.0	0.0
20	4.4	4616.1	0.0	0.0	0.	0.	0.0	0.0	0.0
21	4.3	4432.9	0.0	0.0	0.	0.	0.0	0.0	0.0
22	4.3	4199.5	0.0	0.0	0.	0.	0.0	0.0	0.0
23	4.2	3917.9	0.0	0.0	0.	0.	0.0	0.0	0.0
24	4.2	3590.3	0.0	0.0	0.	0.	0.0	0.0	0.0
25	4.1	3218.8	0.0	0.0	0.	0.	0.0	0.0	0.0
26	4.1	2805.8	0.0	0.0	0.	0.	0.0	0.0	0.0
27	4.0	2353.9	0.0	0.0	0.	0.	0.0	0.0	0.0
28	0.2	123.9	0.0	0.0	0.	0.	0.0	0.0	0.0
29	3.7	1265.1	0.0	0.0	0.	0.	0.0	0.0	0.0
30	1.5	116.7	0.0	0.0	0.	0.	0.0	0.0	0.0

Failure Surface Specified By 27 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	54.737	47.368
2	59.688	48.066
3	64.621	48.882
4	69.533	49.815
5	74.422	50.864
6	79.284	52.030
7	84.117	53.311
8	88.918	54.706
9	93.685	56.216
10	98.415	57.838
11	103.104	59.572
12	107.751	61.418
13	112.353	63.374
14	116.907	65.438
15	121.410	67.611
16	125.860	69.890
17	130.255	72.274
18	134.592	74.762
19	138.869	77.353
20	143.082	80.045
21	147.231	82.836
22	151.312	85.725
23	155.322	88.710
24	159.261	91.790

25	163.125	94.963
26	166.913	98.227
27	168.588	99.741

Circle Center At X = 27.886 ; Y = 255.732 ; and Radius = 210.086

Factor of Safety

*** 1.501 ***

Failure Surface Specified By 28 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	54.737	47.368
2	59.578	48.618
3	64.404	49.926
4	69.214	51.292
5	74.007	52.715
6	78.783	54.195
7	83.541	55.732
8	88.280	57.327
9	92.999	58.978
10	97.699	60.685
11	102.377	62.449
12	107.035	64.269
13	111.670	66.144
14	116.282	68.074
15	120.871	70.060
16	125.435	72.101
17	129.975	74.196
18	134.489	76.345
19	138.978	78.549
20	143.439	80.806
21	147.874	83.116
22	152.280	85.479
23	156.658	87.895
24	161.006	90.363
25	165.325	92.883
26	169.613	95.454
27	173.869	98.077
28	175.420	99.058

Circle Center At X = -47.069 ; Y = 451.788 ; and Radius = 417.037

Factor of Safety

*** 1.525 ***

Failure Surface Specified By 28 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	52.105	46.053
2	56.852	47.624
3	61.587	49.229
4	66.311	50.868
5	71.023	52.541
6	75.723	54.248
7	80.410	55.988
8	85.085	57.761
9	89.747	59.569
10	94.396	61.409
11	99.031	63.283
12	103.653	65.190
13	108.262	67.130
14	112.856	69.103
15	117.436	71.109
16	122.001	73.148
17	126.552	75.219
18	131.088	77.323
19	135.608	79.460
20	140.114	81.628
21	144.603	83.829
22	149.077	86.062
23	153.534	88.327
24	157.976	90.624

25	162.400	92.953
26	166.808	95.313
27	171.199	97.705
28	173.912	99.209

Circle Center At X = -164.618 ; Y = 708.811 ; and Radius = 697.293

Factor of Safety

*** 1.542 ***

Failure Surface Specified By 26 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	60.000	50.000
2	65.000	49.974
3	69.997	50.138
4	74.985	50.492
5	79.955	51.035
6	84.901	51.766
7	89.816	52.684
8	94.693	53.788
9	99.524	55.076
10	104.303	56.547
11	109.023	58.198
12	113.676	60.027
13	118.257	62.031
14	122.758	64.207
15	127.174	66.553
16	131.497	69.065
17	135.722	71.739
18	139.842	74.571
19	143.852	77.558
20	147.746	80.695
21	151.518	83.977
22	155.162	87.400
23	158.674	90.959
24	162.048	94.649
25	165.280	98.464
26	166.449	99.955

Circle Center At X = 63.198 ; Y = 181.579 ; and Radius = 131.618

Factor of Safety

*** 1.571 ***

Failure Surface Specified By 34 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	17.895	40.000
2	22.861	39.421
3	27.843	39.000
4	32.837	38.738
5	37.835	38.635
6	42.835	38.691
7	47.831	38.905
8	52.817	39.278
9	57.788	39.809
10	62.741	40.499
11	67.668	41.345
12	72.567	42.347
13	77.431	43.504
14	82.256	44.816
15	87.037	46.280
16	91.769	47.895
17	96.447	49.660
18	101.067	51.573
19	105.623	53.632
20	110.112	55.834
21	114.529	58.178
22	118.869	60.661
23	123.127	63.280
24	127.301	66.034
25	131.384	68.919

26	135.374	71.932
27	139.267	75.071
28	143.057	78.332
29	146.742	81.711
30	150.318	85.206
31	153.781	88.813
32	157.127	92.528
33	160.354	96.347
34	161.442	97.721

Circle Center At X = 38.595 ; Y = 195.874 ; and Radius = 157.242

Factor of Safety

*** 1.575 ***

Failure Surface Specified By 32 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	33.684	40.000
2	38.665	39.557
3	43.657	39.288
4	48.656	39.195
5	53.656	39.276
6	58.649	39.532
7	63.631	39.962
8	68.594	40.567
9	73.533	41.344
10	78.442	42.294
11	83.315	43.415
12	88.145	44.706
13	92.928	46.164
14	97.656	47.790
15	102.325	49.579
16	106.928	51.531
17	111.461	53.642
18	115.916	55.911
19	120.290	58.334
20	124.576	60.909
21	128.770	63.632
22	132.865	66.500
23	136.858	69.510
24	140.743	72.657
25	144.516	75.938
26	148.172	79.349
27	151.706	82.886
28	155.114	86.545
29	158.392	90.320
30	161.537	94.208
31	164.543	98.203
32	165.691	99.846

Circle Center At X = 48.849 ; Y = 182.062 ; and Radius = 142.869

Factor of Safety

*** 1.578 ***

Failure Surface Specified By 32 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	41.579	40.789
2	46.373	42.211
3	51.157	43.665
4	55.931	45.150
5	60.695	46.666
6	65.450	48.215
7	70.194	49.794
8	74.927	51.405
9	79.650	53.047
10	84.362	54.720
11	89.062	56.424
12	93.751	58.160
13	98.429	59.926
14	103.095	61.723

15	107.749	63.551
16	112.390	65.410
17	117.020	67.299
18	121.636	69.219
19	126.240	71.170
20	130.831	73.150
21	135.409	75.161
22	139.973	77.203
23	144.524	79.274
24	149.061	81.376
25	153.584	83.507
26	158.093	85.668
27	162.587	87.859
28	167.067	90.080
29	171.532	92.330
30	175.982	94.610
31	180.417	96.919
32	183.023	98.298

Circle Center At X = -170.994 ; Y = 766.319 ; and Radius = 756.030

Factor of Safety

*** 1.578 ***

Failure Surface Specified By 29 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	52.105	46.053
2	57.099	45.805
3	62.099	45.732
4	67.098	45.833
5	72.090	46.109
6	77.070	46.560
7	82.030	47.184
8	86.967	47.981
9	91.872	48.950
10	96.740	50.090
11	101.566	51.400
12	106.342	52.877
13	111.065	54.520
14	115.727	56.327
15	120.323	58.296
16	124.847	60.424
17	129.294	62.709
18	133.659	65.148
19	137.936	67.738
20	142.120	70.476
21	146.205	73.359
22	150.188	76.382
23	154.062	79.543
24	157.823	82.837
25	161.467	86.260
26	164.990	89.809
27	168.386	93.479
28	171.652	97.265
29	173.265	99.273

Circle Center At X = 61.692 ; Y = 188.811 ; and Radius = 143.080

Factor of Safety

*** 1.595 ***

Failure Surface Specified By 36 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	23.158	40.000
2	28.121	39.393
3	33.100	38.931
4	38.090	38.615
5	43.087	38.444
6	48.087	38.419
7	53.085	38.539
8	58.078	38.806

9	63.061	39.218
10	68.030	39.775
11	72.980	40.476
12	77.908	41.322
13	82.809	42.311
14	87.680	43.443
15	92.515	44.716
16	97.311	46.130
17	102.064	47.682
18	106.769	49.373
19	111.423	51.201
20	116.022	53.163
21	120.562	55.258
22	125.038	57.485
23	129.448	59.842
24	133.787	62.326
25	138.052	64.936
26	142.239	67.669
27	146.345	70.523
28	150.365	73.495
29	154.298	76.584
30	158.138	79.785
31	161.883	83.098
32	165.531	86.518
33	169.077	90.043
34	172.518	93.670
35	175.853	97.396
36	177.112	98.889

Circle Center At X = 46.456 ; Y = 209.780 ; and Radius = 171.371

Factor of Safety

*** 1.603 ***

**** END OF GSTABL7 OUTPUT ****

APPENDIX D

General Earthwork and Grading Specifications

APPENDIX D

EARTHWORK AND GRADING SPECIFICATIONS

TABLE OF CONTENTS

STANDARD DETAIL

D-1.0 GENERAL

D-1.1 Intent

These Earthwork and Grading Guide Specifications are for grading and earthwork shown on the current, approved grading plan(s) and/or indicated in the Leighton Consulting, Inc. geotechnical report(s). These Guide Specifications are a part of the recommendations contained in the geotechnical report(s). In case of conflict, the project-specific recommendations in the geotechnical report shall supersede these Guide Specifications. Leighton Consulting, Inc. shall provide geotechnical observation and testing during earthwork and grading. Based on these observations and tests, Leighton Consulting, Inc. may provide new or revised recommendations that could supersede these specifications or the recommendations in the geotechnical report(s).

D-1.2 Role of Leighton Consulting, Inc.

Prior to commencement of earthwork and grading, Leighton Consulting, Inc. shall meet with the earthwork contractor to review the earthwork contractor's work plan, to schedule sufficient personnel to perform the appropriate level of observation, mapping and compaction testing. During earthwork and grading, Leighton Consulting, Inc. shall observe, map, and document subsurface exposures to verify geotechnical design assumptions. If observed conditions are found to be significantly different than the interpreted assumptions during the design phase, Leighton Consulting, Inc. shall inform the owner, recommend appropriate changes in design to accommodate these observed conditions, and notify the review agency where required. Subsurface areas to be geotechnically observed, mapped, elevations recorded, and/or tested include (1) natural ground after clearing to receiving fill but before fill is placed, (2) bottoms of all "remedial removal" areas, (3) all key bottoms, and (4) benches made on sloping ground to receive fill.

Leighton Consulting, Inc. shall observe moisture-conditioning and processing of the subgrade and fill materials, and perform relative compaction testing of fill to determine the attained relative compaction. Leighton Consulting, Inc. shall provide *Daily Field Reports* to the owner and the Contractor on a routine and frequent basis.

D-1.3 The Earthwork Contractor

The earthwork contractor (Contractor) shall be qualified, experienced and knowledgeable in earthwork logistics, preparation and processing of ground to receive fill, moisture-conditioning and processing of fill, and compacting fill. The Contractor shall review and accept the plans, geotechnical report(s), and these Guide Specifications prior to commencement of grading. The Contractor shall be solely responsible for performing grading and backfilling in accordance with the current, approved plans and specifications.

The Contractor shall inform the owner and Leighton Consulting, Inc. of changes in work schedules at least one working day in advance of such changes so that appropriate observations and tests can be planned and accomplished. The Contractor shall not assume that Leighton Consulting, Inc. is aware of all grading operations.

The Contractor shall have the sole responsibility to provide adequate equipment and methods to accomplish earthwork and grading in accordance with the applicable grading codes and agency ordinances, these Guide Specifications, and recommendations in the approved geotechnical report(s) and grading plan(s). If, in the opinion of Leighton Consulting, Inc., unsatisfactory conditions, such as unsuitable soil, improper moisture condition, inadequate compaction, adverse weather, etc., are resulting in a quality of work less than required in these specifications, Leighton Consulting, Inc. shall reject the work and may recommend to the owner that earthwork and grading be stopped until unsatisfactory condition(s) are rectified.

D-2.0 PREPARATION OF AREAS TO BE FILLED

D-2.1 Clearing and Grubbing

Vegetation, such as brush, grass, roots and other deleterious material shall be sufficiently removed and properly disposed of in a method acceptable to the owner, governing agencies and Leighton Consulting, Inc.. Care should be taken not to encroach upon or otherwise damage native and/or historic trees designated by the Owner or appropriate agencies to remain. Pavements, flatwork or other construction should not extend under the "drip line" of designated trees to remain.

Leighton Consulting, Inc. shall evaluate the extent of these removals depending on specific site conditions. Earth fill material shall not contain more than 3 percent of organic materials (by dry weight: ASTM D 2974-00). Nesting of the organic materials shall not be allowed.

If potentially hazardous materials are encountered, the Contractor shall stop work in the affected area, and a hazardous material specialist shall be informed immediately for proper evaluation and handling of these materials prior to continuing to work in that area. As presently defined by the State of California, most refined petroleum products (gasoline, diesel fuel, motor oil, grease, coolant, etc.) have chemical constituents that are considered to be hazardous waste. As such, the indiscriminate dumping or spillage of these fluids onto the ground may constitute a misdemeanor, punishable by fines and/or imprisonment, and shall not be allowed.

D-2.2 Processing

Existing ground that has been declared satisfactory for support of fill, by Leighton Consulting, Inc., shall be scarified to a minimum depth of 6 inches (15 cm). Existing ground that is not satisfactory shall be overexcavated as specified in the following Section D-2.3. Scarification shall continue until soils are broken down and free of large clay lumps or clods and the working surface is reasonably uniform, flat, and free of uneven features that would inhibit uniform compaction.

D-2.3 Overexcavation

In addition to removals and overexcavations recommended in the approved geotechnical report(s) and the grading plan, soft, loose, dry, saturated, spongy, organic-rich, highly fractured or otherwise unsuitable ground shall be overexcavated to competent ground as evaluated by Leighton Consulting, Inc. during grading. All undocumented fill soils under proposed structure footprints should be excavated

D-2.4 Benching

Where fills are to be placed on ground with slopes steeper than 5:1 (horizontal to vertical units), (>20 percent grade) the ground shall be stepped or benched. The lowest bench or key shall be a minimum of 15 feet (4.5 m) wide and at least 2 feet (0.6 m) deep, into competent material as evaluated by Leighton Consulting, Inc.. Other benches shall be excavated a minimum height of 4 feet (1.2 m) into competent material or as otherwise recommended by Leighton Consulting, Inc.. Fill placed on ground sloping flatter than 5:1 (horizontal to vertical units), (<20 percent grade) shall also be benched or otherwise overexcavated to provide a flat subgrade for the fill.

D-2.5 Evaluation/Acceptance of Fill Areas

All areas to receive fill, including removal and processed areas, key bottoms, and benches, shall be observed, mapped, elevations recorded, and/or tested prior to being accepted by Leighton Consulting, Inc. as suitable to receive fill. The Contractor shall obtain a written acceptance (*Daily Field Report*) from Leighton Consulting, Inc. prior to fill placement. A licensed surveyor shall provide the survey control for determining elevations of processed areas, keys, and benches.

D-3.0 FILL MATERIAL

D-3.1 Fill Quality

Material to be used as fill shall be essentially free of organic matter and other deleterious substances evaluated and accepted by Leighton Consulting, Inc. prior to placement. Soils of poor quality, such as those with unacceptable gradation, high expansion potential, or low strength shall be placed in areas acceptable to Leighton Consulting, Inc. or mixed with other soils to achieve satisfactory fill material.

D-3.2 Oversize

Oversize material defined as rock, or other irreducible material with a maximum dimension greater than 6 inches (15 cm), shall not be buried or placed in fill unless location, materials and placement methods are specifically accepted by Leighton Consulting, Inc.. Placement operations shall be such that nesting of oversized material does not occur and such that oversize material is completely surrounded by compacted or densified fill. Oversize material shall not be placed within 10 feet (3 m) measured vertically from finish grade, or within 2 feet (0.61 m) of future utilities or underground construction.

D-3.3 Import

If importing of fill material is required for grading, proposed import material shall meet the requirements of Section D-3.1, and be free of hazardous materials ("contaminants") and rock larger than 3-inches (8 cm) in largest dimension. All import soils shall have an Expansion Index (EI) of 20 or less and a sulfate content no greater than (≤) 500 parts-per-million (ppm). A representative sample of a potential import source shall be given to Leighton Consulting, Inc. at least four full working days before importing begins, so that suitability of this import material can be determined and appropriate tests performed.

D-4.0 FILL PLACEMENT AND COMPACTION

D-4.1 Fill Layers

Approved fill material shall be placed in areas prepared to receive fill, as described in Section D-2.0, above, in near-horizontal layers not exceeding 8 inches (20 cm) in loose thickness. Leighton Consulting, Inc. may accept thicker layers if testing indicates the grading procedures can adequately compact the thicker layers, and only if the building officials with the appropriate jurisdiction approve. Each layer shall be spread evenly and mixed thoroughly to attain relative uniformity of material and moisture throughout.

D-4.2 Fill Moisture Conditioning

Fill soils shall be watered, dried back, blended, and/or mixed, as necessary to attain a relatively uniform moisture content at or slightly over optimum. Maximum density and optimum soil moisture content tests shall be performed in accordance with the American Society of Testing and Materials (ASTM) Test Method D 1557.

D-4.3 Compaction of Fill

After each layer has been moisture-conditioned, mixed, and evenly spread, it shall be uniformly compacted to not less than 90 percent of maximum dry density as determined by ASTM Test Method D 1557. For fills thicker than 15 feet (4.5 m), the portion of the fill deeper than 15 feet below proposed finish grade shall be compacted to 95 percent of the ASTM D 1557 laboratory maximum density. Compaction equipment shall be adequately sized and be either specifically designed for soil compaction or of proven reliability to efficiently achieve the specified level of compaction with uniformity.

D-4.4 Compaction of Fill Slopes

In addition to normal compaction procedures specified above, compaction of slopes shall be accomplished by backrolling of slopes with sheepsfoot rollers at increments of 3 to 4 feet (1 to 1.2 m) in fill elevation, or by other methods producing satisfactory results acceptable to Leighton Consulting, Inc.. Upon completion of grading, relative compaction of the fill, out to the slope face, shall be at least 90 percent of the ASTM D 1557 laboratory maximum density.

D-4.5 Compaction Testing

Field-tests for moisture content and relative compaction of the fill soils shall be performed by Leighton Consulting, Inc.. Location and frequency of tests shall be at our field representative(s) discretion based on field conditions encountered. Compaction test locations will not necessarily be selected on a random basis. Test locations shall be selected to verify adequacy of compaction levels in areas that are judged to be prone to inadequate compaction (such as close to slope faces and at the fill/bedrock benches).

D-4.6 Compaction Test Locations

Leighton Consulting, Inc. shall document the approximate elevation and horizontal coordinates of each density test location. The Contractor shall coordinate with the project surveyor to assure that sufficient grade stakes are established so that Leighton Consulting, Inc. can determine the test locations with sufficient accuracy. Adequate grade stakes shall be provided.

D-5.0 EXCAVATION

Excavations, as well as over-excavation for remedial purposes, shall be evaluated by Leighton Consulting, Inc. during grading. Remedial removal depths shown on geotechnical plans are estimates only. The actual extent of removal shall be determined by Leighton Consulting, Inc. based on the field evaluation of exposed conditions during grading. Where fill-over-cut slopes are to be graded, the cut portion of the slope shall be made, evaluated, and accepted by Leighton Consulting, Inc. prior to placement of materials for construction of the fill portion of the slope, unless otherwise recommended by Leighton Consulting, Inc..

D-6.0 TRENCH BACKFILLS

D-6.1 Safety

The Contractor shall follow all OSHA and Cal/OSHA requirements for safety of trench excavations. Work should be performed in accordance with Article 6 of the *California Construction Safety Orders*, 2003 Edition or more current.

D-6.2 Bedding and Backfill

All bedding and backfill of utility trenches shall be performed in accordance with the applicable provisions of Standard Specifications of Public Works Construction. Bedding material shall have a Sand Equivalent greater than 30 (SE>30). Bedding shall be placed to 1-foot (0.3 m) over the top of the conduit, and densified by jetting. Backfill shall be placed and densified to a minimum of 90 percent of relative compaction (ASTM D 1557) from 1 foot (0.3 m) above the top of the conduit to the surface. Jetting of the bedding around the conduits shall be observed by Leighton Consulting, Inc. and backfill above the pipe zone (bedding) shall be observed and tested by Leighton Consulting, Inc..

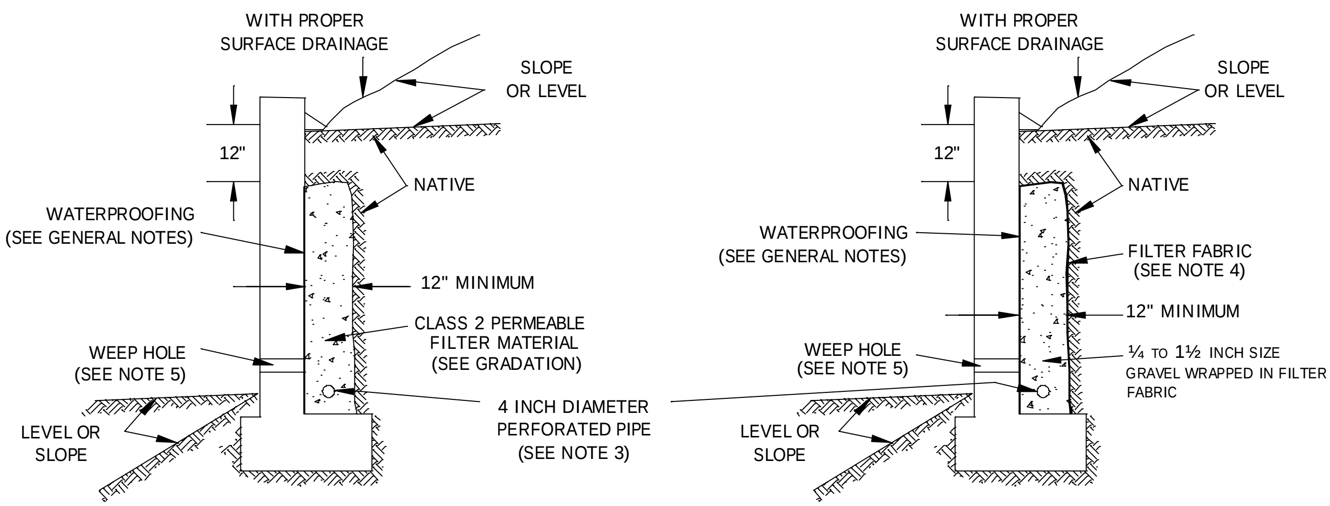
D-6.3 Lift Thickness

Lift thickness of trench backfill shall not exceed those allowed in the Standard Specifications of Public Works Construction unless the Contractor can demonstrate to Leighton Consulting, Inc. that the fill lift can be compacted to the minimum relative compaction by his alternative equipment and method, and only if the building officials with the appropriate jurisdiction approve.

SUBDRAIN OPTIONS AND BACKFILL WHEN NATIVE MATERIAL HAS EXPANSION INDEX OF ≤50

OPTION 1: PIPE SURROUNDED WITH CLASS 2 PERMEABLE MATERIAL

OPTION 2: GRAVEL WRAPPED IN FILTER FABRIC



Class 2 Filter Permeable Material Gradation
Per Caltrans Specifications

Sieve Size	Percent Passing
1"	100
3/4"	90-100
3/8"	40-100
No. 4	25-40
No. 8	18-33
No. 30	5-15
No. 50	0-7
No. 200	0-3

GENERAL NOTES:

* Waterproofing should be provided where moisture nuisance problem through the wall is undesirable.
* Water proofing of the walls is not under purview of the geotechnical engineer
* All drains should have a gradient of 1 percent minimum
* Outlet portion of the subdrain should have a 4-inch diameter solid pipe discharged into a suitable disposal area designed by the project engineer. The subdrain pipe should be accessible for maintenance (rodding)
* Other subdrain backfill options are subject to the review by the geotechnical engineer and modification of design parameters.

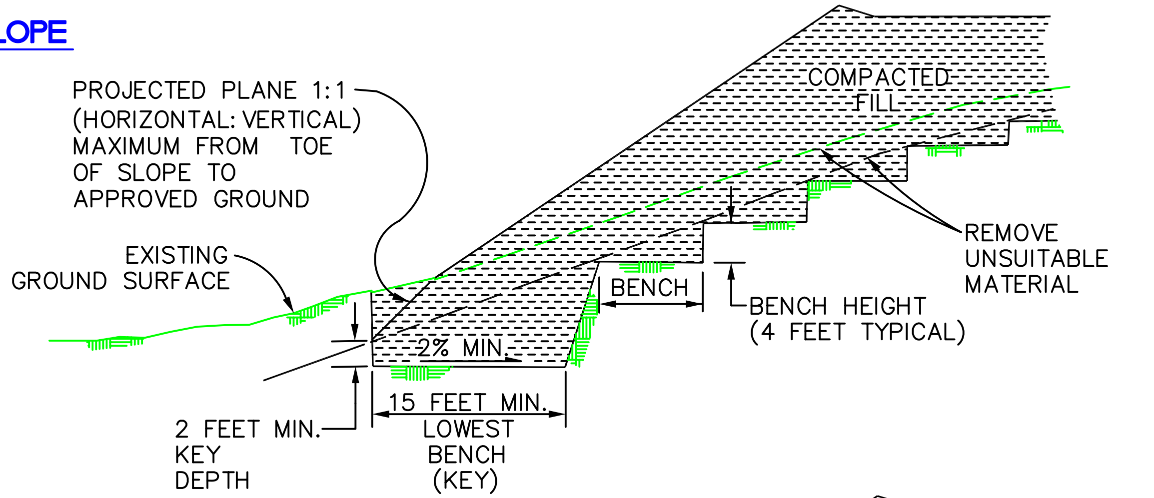
Notes:

1) Sand should have a sand equivalent of 30 or greater and may be densified by water jetting.
2) 1 Cu. ft. per ft. of 1/4- to 1 1/2-inch size gravel wrapped in filter fabric
3) Pipe type should be ASTM D1527 Acrylonitrile Butadiene Styrene (ABS) SDR35 or ASTM D1785 Polyvinyl Chloride plastic (PVC), Schedule 40, Armco A2000 PVC, or approved equivalent. Pipe should be installed with perforations down. Perforations should be 3/8 inch in diameter placed at the ends of a 120-degree arc in two rows at 3-inch on center (staggered)
4) Filter fabric should be Mirafi 140NC or approved equivalent.
5) Weephole should be 3-inch minimum diameter and provided at 10-foot maximum intervals. If exposure is permitted, weepholes should be located 12 inches above finished grade. If exposure is not permitted such as for a wall adjacent to a sidewalk/curb, a pipe under the sidewalk to be discharged through the curb face or equivalent should be provided. For a basement-type wall, a proper subdrain outlet system should be provided.
6) Retaining wall plans should be reviewed and approved by the geotechnical engineer.
7) Walls over six feet in height are subject to a special review by the geotechnical engineer and modifications to the above requirements.

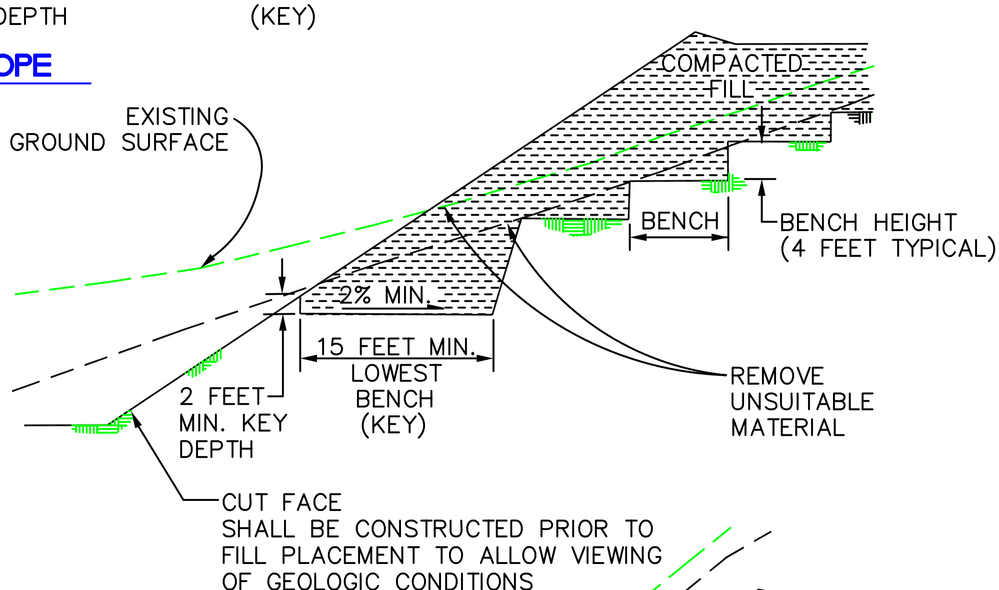
RETAINING WALL BACKFILL AND SUBDRAIN DETAIL FOR WALLS 6 FEET OR LESS IN HEIGHT

WHEN NATIVE MATERIAL HAS EXPANSION INDEX OF ≤50

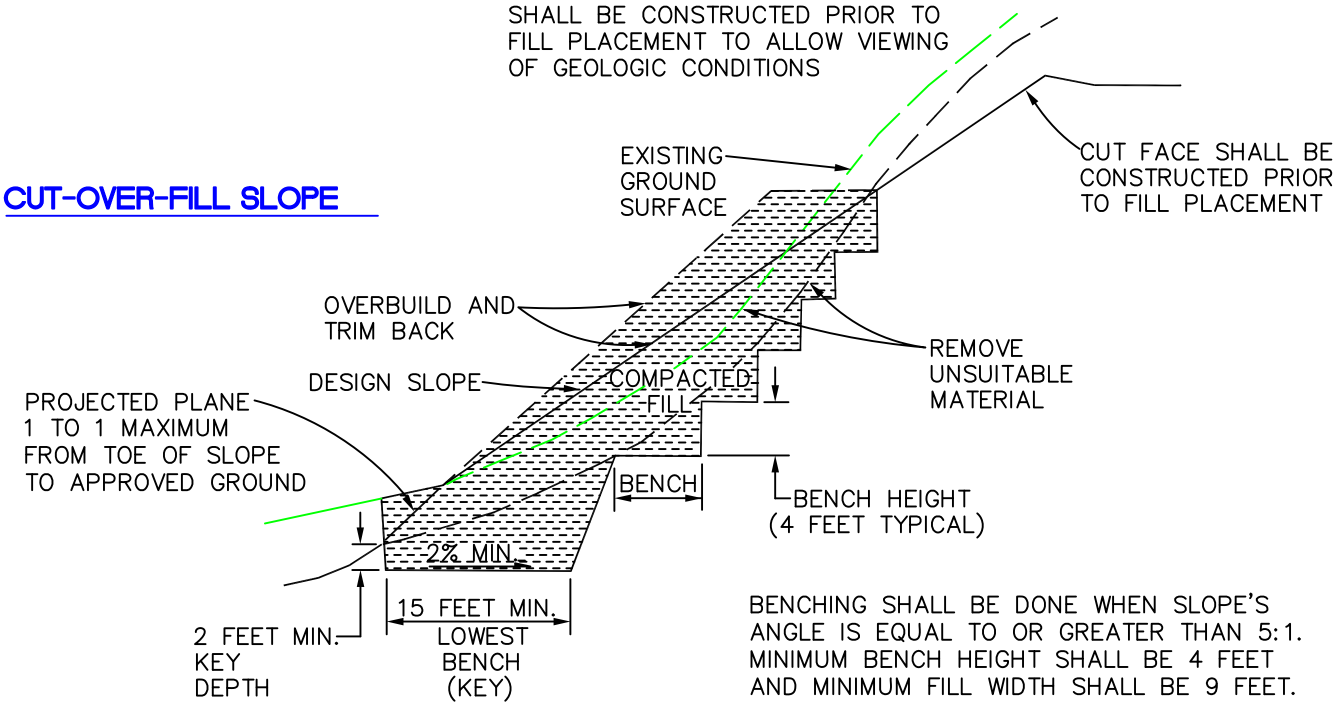
FILL SLOPE



FILL-OVER-CUT SLOPE

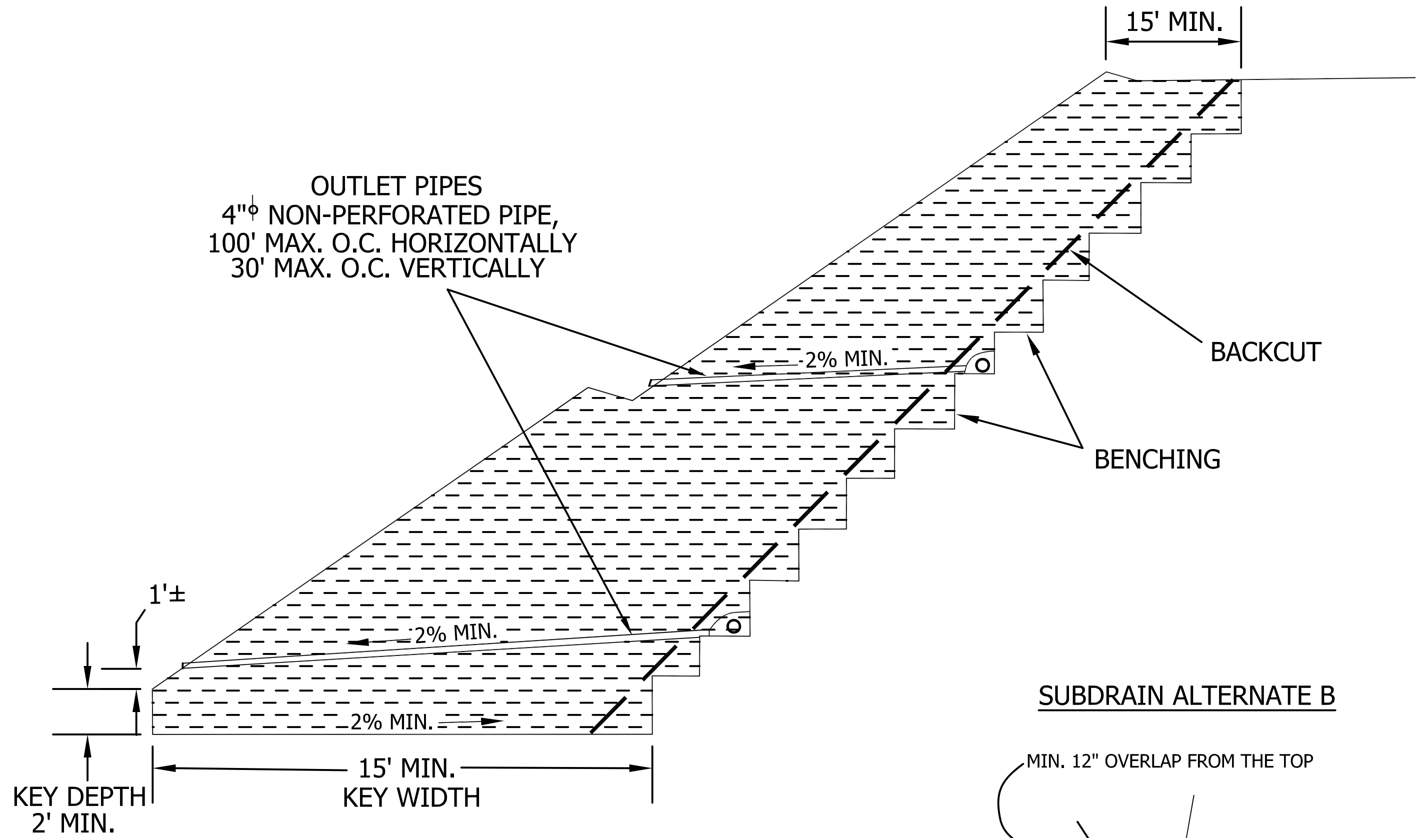


CUT-OVER-FILL SLOPE

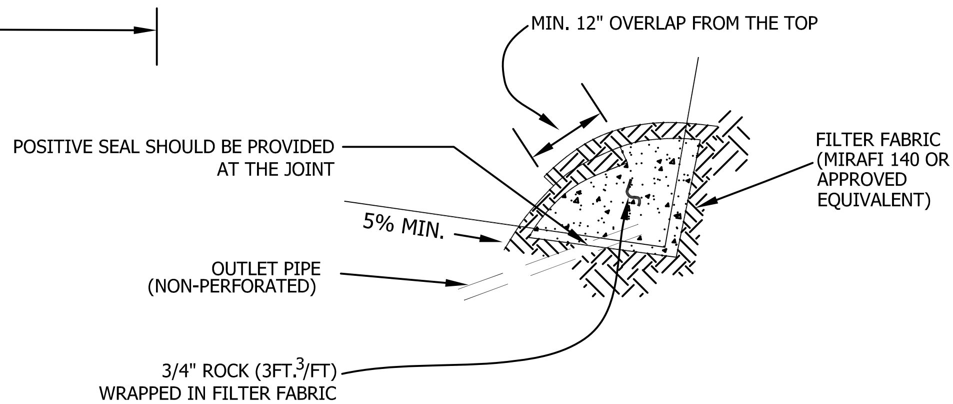


BENCHING SHALL BE DONE WHEN SLOPE'S ANGLE IS EQUAL TO OR GREATER THAN 5:1. MINIMUM BENCH HEIGHT SHALL BE 4 FEET AND MINIMUM FILL WIDTH SHALL BE 9 FEET.

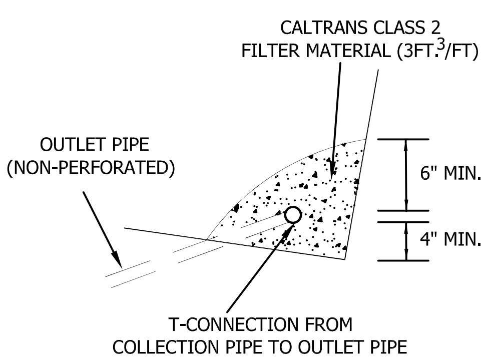
KEYING AND BENCHING	GENERAL EARTHWORK AND GRADING SPECIFICATIONS STANDARD DETAILS A	Leighton



SUBDRAIN ALTERNATE B



SUBDRAIN ALTERNATE A



- SUBDRAIN INSTALLATION - Subdrain collector pipe shall be installed with perforations down or, unless otherwise designated by the geotechnical consultant. Outlet pipes shall be non-perforated pipe. The subdrain pipe shall have at least 8 perforations uniformly spaced per foot. Perforation shall be 1/4" to 1/2" if drilled holes are used. All subdrain pipes shall have a gradient at least 2% towards the outlet.
- SUBDRAIN PIPE - Subdrain pipe shall be ASTM D2751, ASTM D1527 (Schedule 40) or SDR 23.5 ABS pipe or ASTM D3034 (Schedule 40) or SDR 23.5 PVC pipe.
- All outlet pipe shall be placed in a trench and, after fill is placed above it, rodded to verify integrity.

BUTTRESS OR REPLACEMENT FILL SUBDRAINS	GENERAL EARTHWORK AND GRADING SPECIFICATIONS STANDARD DETAILS D	Leighton

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APPENDIX E

ASFE Important Information About Your Geotechnical Report

Important Information About Your

Geotechnical Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

The following information is provided to help you manage your risks.

Geotechnical Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering study conducted for a civil engineer may not fulfill the needs of a construction contractor or even another civil engineer. Because each geotechnical engineering study is unique, each geotechnical engineering report is unique, prepared *solely* for the client. No one except you should rely on your geotechnical engineering report without first conferring with the geotechnical engineer who prepared it. *And no one — not even you* — should apply the report for any purpose or project except the one originally contemplated.

Read the Full Report

Serious problems have occurred because those relying on a geotechnical engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

A Geotechnical Engineering Report Is Based on A Unique Set of Project-Specific Factors

Geotechnical engineers consider a number of unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, do not rely on a geotechnical engineering report that was:

- not prepared for you,
- not prepared for your project,
- not prepared for the specific site explored, or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light industrial plant to a refrigerated warehouse,
- elevation, configuration, location, orientation, or weight of the proposed structure,
- composition of the design team, or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes—even minor ones—and request an assessment of their impact. *Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.*

Subsurface Conditions Can Change

A geotechnical engineering report is based on conditions that existed at the time the study was performed. *Do not rely on a geotechnical engineering report* whose adequacy may have been affected by: the passage of time; by man-made events, such as construction on or adjacent to the site; or by natural events, such as floods, earthquakes, or groundwater fluctuations. *Always* contact the geotechnical engineer before applying the report to determine if it is still reliable. A minor amount of additional testing or analysis could prevent major problems.

Most Geotechnical Findings Are Professional Opinions

Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ—sometimes significantly—from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risks associated with unanticipated conditions.

A Report's Recommendations Are *Not* Final

Do not overrely on the construction recommendations included in your report. *Those recommendations are not final,* because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations only by observing actual subsurface conditions revealed during construction. *The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's recommendations if that engineer does not perform construction observation.*

A Geotechnical Engineering Report Is Subject to Misinterpretation

Other design team members' misinterpretation of geotechnical engineering reports has resulted in costly problems. Lower that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Contractors can also misinterpret a geotechnical engineering report. Reduce that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing construction observation.

Do Not Redraw the Engineer's Logs

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

Give Contractors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make contractors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give contractors the complete geotechnical engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise contractors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure contractors have sufficient time* to perform additional study. Only then might you be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Read Responsibility Provisions Closely

Some clients, design professionals, and contractors do not recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled "limitations" many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The equipment, techniques, and personnel used to perform a *geoenvironmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical engineering report does not usually relate any geoenvironmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own geoenvironmental information, ask your geotechnical consultant for risk management guidance. *Do not rely on an environmental report prepared for someone else.*

Obtain Professional Assistance To Deal with Mold

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the *express purpose* of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, a number of mold prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical engineering study whose findings are conveyed in this report, the geotechnical engineer in charge of this project is not a mold prevention consultant; ***none of the services performed in connection with the geotechnical engineer's study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.***

Rely, on Your ASFE-Member Geotechncial Engineer for Additional Assistance

Membership in ASFE/The Best People on Earth exposes geotechnical engineers to a wide array of risk management techniques that can be of genuine benefit for everyone involved with a construction project. Confer with you ASFE-member geotechnical engineer for more information.

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