

August 14, 2017

TO: Daniel J. Lafferty  
Watershed Management Division

Attention Giles Coon

FROM: Greg Kelley *Greg Kelley*  
Geotechnical and Materials Engineering Division

**GEOTECHNICAL INVESTIGATION  
GATES CANYON PARK  
REGIONAL LOW IMPACT DEVELOPMENT  
PROJECT NO. F21816I02**

In accordance with your request, we performed a geotechnical investigation for the subject project. Our findings and recommendations are included in the attached report.

If you have any questions regarding this matter, please contact Yonah Halpern or Karin Burger at Extension 4925. To provide feedback on our services, please access <http://dpw.lacounty.gov/go/gmedsurvey> to complete a Customer Service Survey.

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*Log* Attach.

# GEOTECHNICAL INVESTIGATION

## GATES CANYON PARK REGIONAL LOW IMPACT DEVELOPMENT UNINCORPORATED CALABASAS

Prepared for

County of Los Angeles  
Department of Public Works  
Watershed Management Division

Prepared by

County of Los Angeles  
Department of Public Works  
Geotechnical and Materials Engineering Division  
Soils and Geology Investigation Units

August 14, 2017



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## INTRODUCTION

In response to a verbal request from Watershed Management Division (WMD) on March 10, 2016, Geotechnical and Materials Engineering Division (GMED) performed a geotechnical investigation for the proposed Gates Canyon Park Regional Low Impact Development (LID) project. The project proposes to divert stormwater from existing storm drains into infiltration basins, drywells, and other devices for regional stormwater infiltration. The project is located in the unincorporated area of Calabasas at Gates Canyon Park, shown on the Site Location Map (Figure 1). Our scope of work included desktop research, subsurface exploration including percolation testing, engineering analyses, and preparation of this report. Geotechnical findings and recommendations are presented herein.

## PROJECT BACKGROUND

The project proposes to capture a design volume of approximately 3.1 acre-feet (1,010,139 gallons) of stormwater for the design event. It is our understanding that stormwater would be diverted from existing storm drains along Thousand Oaks Boulevard, pre-treated and temporarily stored in cisterns below the park, and then pumped up to a series of dry wells and infiltrated into bedrock. Potential dry well locations were selected for subsurface exploration and evaluation of infiltration potential based on feasibility of construction along with consideration for not disturbing existing park facilities or oak trees. These locations included the ascending slope to the west of the parking lot (Area A), and the ascending slope northwest of the tennis courts and north of the basketball court (Area B), refer to Figure 2. Percolation testing within the developed park was not performed because it is generally underlain by deep engineered fill up to 80 feet thick. The open grassy field location was evaluated to determine if construction of a cistern was feasible in that location and if incidental infiltration was acceptable.

## SITE LOCATION

Topographic relief across the park ranges from elevation 1,010 feet above mean sea level (msl) at the top of the west ascending slope to elevation 915 feet above msl in the parking lot adjacent to the toe of slope, with a maximum slope gradient of approximately 5:1 (horizontal:vertical). Prior to development, natural drainage throughout the subdivision consisted of a dendritic pattern across the structural trends of the underlying bedrock. Rainfall would sheet flow from the steeper hill slopes and channel flow to collect in the valley areas where it would flow to Las Virgenes Creek.



## SITE HISTORY

Grading for Gates Canyon Park was performed in the late 1980's during the development of residential Tract 39509 under the geotechnical direction of Staal, Gardner, & Dunne, Inc., Consulting Engineers and Geologists. The park site is located on Lot 386 of the tract. Based on our review of the final as-graded geotechnical map for the tract, grading at the park location included canyon cleanouts, landslide removals, canyon subdrain installations, and fill placement. It appears that up to 80 feet of engineered fill was placed at the park site and adjacent to Thousand Oaks Boulevard to achieve finished grade. Fill materials generally consisted of sandy clays and were compacted to at least 90 percent relative compaction and documented in interim construction reports. The aforementioned as-built geotechnical map and corresponding geologic cross-sections from Tract 39509 are included in Appendix A.

Note that sandy clay engineered fill materials compacted to 90 percent relative compaction are typically not suitable for stormwater infiltration. Based on conversations with WMD, City of Calabasas maintenance personnel have complained that water ponds in the park during and after rain events. This ponding suggests that the fill at the park is consistent with low-infiltration materials such as sandy clay.

## SUBSURFACE INVESTIGATION

To evaluate the site and determine subsurface conditions, nine exploratory borings were drilled and eight percolation tests were conducted on June 8 through 15, 2016, under the supervision of GMED personnel. Borings were drilled by Roy Brothers Drilling, Inc. using a LoDrill attachment to a track mounted Caterpillar Excavator. Borings were mostly drilled using a 24-inch diameter flight auger, although the bucket auger was required to penetrate intermittent hard layers. Borings were drilled to a maximum depth of 80 feet below grade.

Direct observation of the bedrock was performed through downhole logging by the project geologist in Borings B-1 through B-4, B-6, and B-8. The approximate boring locations are shown on Figure 2 and the Log of Borings are provided in Appendix B.

Eight of the borings were used to conduct percolation testing per the Department of Public Health guide to Onsite Wastewater Treatment Systems (OWTS) for Seepage Pit Dispersal Systems. The test procedure was adapted slightly for the purposes of evaluating stormwater infiltration.



## GEOLOGIC SETTING

### Regional Geology

The region is underlain by unnamed Miocene shale and sandstone overlying Modelo Formation (Dibblee, 1992). The unnamed units are characterized by fine grained sandstone, claystone, siltstone, and diatomaceous shale, which is divided into four dominant units. The Modelo Formation is characterized by relatively thick sequences of shale, siltstone, and sandstone and is divided into three dominant units. The bedrock is folded into a series of northwest-southeast trending anticlines and synclines.

### Local Geology

The study location is underlain by bedrock that is characterized by interbedded claystone and siltstone that is moderately bedded and crumbly where weathered. The shale is overlain by colluvium. The distribution of geologic materials is shown on the geologic map and cross-section (Figure 3) and described in detail below. The Log of Borings contain detailed descriptions of subsurface findings and are included in Appendix B.

### *Artificial Fill (af)*

Artificial fill was placed during construction of Thousand Oaks Boulevard and Gates Canyon Park. The materials are a mixture of clayey silt to silty clay with sporadic gravels and small boulders. The materials are dark brown to dark gray and were found to be in a dense to very dense condition and ranged from moist to wet.

### *Colluvium (Qc)*

Colluvium consists of angular rock fragments within a dark brown silty clay to sandy clay matrix. The rock fragments consist of light brown to tan, blocky and highly weathered shale fragments ranging from 2- to 4-inches in diameter. Colluvial thickness ranged from just a few feet thick up to 23 feet where encountered. The colluvial matrix is dark brown to brown-black and ranged from dry to moist.

### *Shale (Tush)*

Shale ranges from thinly to poorly bedded and consisted of interbedded claystone and siltstone of varying hardness. Siliceous layers, gypsum veins, and altered ash layers were encountered and ranged in thickness from ¼ inch up to 1½ inches thick and often defined bedding. Manganese mottling and rusty oxidation staining and mottling was



observed on bedding planes and fracture surfaces. The shale was found to be in a moist condition and wet or saturated where seepage was encountered.

## HYDROGEOLOGY

### Regional Hydrogeology

The site is located within an area characterized by bedrock ridges and intervening valleys. Based on the California Geologic Survey, Seismic Hazard Zone Report (06) for the Calabasas 7.5-Minute Quadrangle, the historical high groundwater levels are at 20 feet below ground surface and confined to the Las Virgenes Canyon. Groundwater is localized to alluvial deposits found in the valleys, which is directly controlled by regional rainfall. Perched water may be encountered at varying depths depending on local bedrock conditions.

### Local Hydrogeology

Subsurface water was encountered as weeping or seepage in Borings B-1 through B-3, B-5, and B-7 at the time of exploration. Table 1 is a summary of the subsurface water that was observed in the borings, including depth to water below existing ground surface and the corresponding date of observation. Where encountered, weeping or seepage was confined to perched zones or fracture zones. Standing water was observed in Boring B-1; however, the bore was allowed to accumulate water overnight. Encountered conditions are described in detail in the Log of Borings included in Appendix B.

**Table 1: Subsurface Water Observations**

Boring Number	Depth to Weeping and Seepage (feet)	Date of Observation	Depth to Standing Water (feet)	Date of Observation
B-1	61	5/23/16	77	5/24/16
B-2	40.5	5/24/16	Not Encountered	Not Observed
B-3	35	5/24/16	Not Encountered	Not Observed
B-4	Not Encountered	5/26/16	Not Encountered	Not Observed
B-5	57	5/25/16	Not Encountered	Not Observed
B-6	Not Encountered	5/26/16	Not Encountered	Not Observed
B-7	25; 57	5/25/16	Not Encountered	Not Observed
B-8	Not Encountered	5/26/16	Not Encountered	Not Observed
B-9	Not Encountered	5/26/16	Not Encountered	Not Observed





## ENVIRONMENTAL CONSIDERATIONS

Prior to the development of Tract 39509, the project site and vicinity consisted of a remote and undeveloped natural area. Per the guidelines contained the Corrective Action Plan (2013) pertaining to the need for a Preliminary Environmental Site Screening (PESS), GMED waived the need to prepare a PESS because based on a natural and undeveloped site history, contamination is not anticipated.

## LABORATORY TESTING

Bulk and relatively undisturbed samples were collected from the borings to determine soil properties and confirm classifications made in the field. GMED's Materials Laboratory at the Alcazar Yard performed the testing. A summary of the test results is provided in Appendix C.

## SLOPE STABILITY

Slope stability analyses were performed based on Geologic Cross-Section A-A' (Figure 3) provided in Appendix D. Shear strength parameters used in the analyses were selected based on an evaluation of the previous geotechnical test results and data from consultant reports for Tract 39509 (Staal, Gardner, and Dunne, Inc., 1987) compared to the results of site specific shear testing on samples collected from the borings during this exploration. A summary of shear strength parameters used in the analyses is presented in Table 2 below.

**Table 2: Shear Strength Parameters**

Material	Unit Weight (pcf)	Friction Angle (phi)	Cohesion (psf)
Engineered Fill (af)	120	26	500
Colluvium (Qc)	120	12	310
Shale Bedrock (Tush) along bedding 12°-22°	120	22	150
Shale Bedrock (Tush) across bedding	120	30	300

Analyses were performed with the program Slope/W 2012 Version, using Spencer's method of analysis. The analyses were performed to evaluate the current condition of the slope, under static and seismic conditions, for both translational and circular failures. The seismic analyses used a coefficient of 0.15 for the horizontal inertial force ( $K_h$ ) and ultimate shear values instead of peak for additional conservatism.



In order to evaluate the impact of stormwater infiltration, the slope was also evaluated for the proposed condition after dry wells have been constructed. The proposed condition was modeled using a piezometric surface to mimic the anticipated movement of water. It was assumed that stormwater will not infiltrate through the layer of colluvium above bedrock where the recommended capping depth is or penetrate very significantly into clayey engineered fill at the toe of the slope.

All the conditions analyzed have factors of safety greater than the County's requirements of 1.5 for static conditions and 1.1 for seismic conditions. A summary of the results is presented in Table 3 below. A complete copy of the results is included in Appendix D.

**Table 3: Slope Stability Results**

Section A-A' Analyzed	Factor of Safety (current)	Factor of Safety (proposed)
Translational Static	2.22	1.87
Translational Seismic	1.37	1.16
Circular Static	1.76	1.75
Circular Seismic	1.30	1.28

## FINDINGS

### Subsurface Conditions

- Shale bedrock encountered in Borings B-1 through B-8 was generally found to be moderately bedded with randomly oriented fractures that were commonly infilled.
- Shale bedrock suitable for infiltration was encountered in Borings B-1 through B-3, shown as Area A on Figure 2. The distribution of geologic materials is shown on the geologic map and illustrated on Geologic Cross Section A-A' (Figure 3).
- Bedrock encountered in Borings B-4 through B-8, shown as Area B on Figure 2, was found to be disturbed and weak with heavy seepage encountered in Borings B-5 and B-7. Based on the bedrock conditions, the potential for water mounding, daylighting, and/or instability of the ascending slopes would preclude Area B from consideration to infiltrate stormwater.
- Results of percolation testing indicate the bedrock in Area A has a range of infiltration rates greater than 0.3 inches per hour, as required by the NPDES permit. The data has been reduced and correction factors applied to generate the



design infiltration rate presented in the recommendations below. The Percolation Test Calculation Sheets are included in Appendix E.

- An additional boring, Boring B-9, was drilled in the open grassy field to confirm subsurface information from the existing tract file regarding infeasibility of fill to infiltrate stormwater and evaluate the potential for incidental infiltration. Subsurface materials encountered in Boring B-9 consisted predominantly of stiff to very stiff sandy clay and may be classified as Hydrologic Soil Group (HSG) C. Water movement through HSG C is considered to be impeded.

### Groundwater

- Perched groundwater was encountered during exploration as weeping or seepage in Borings B-1, B-2, B-3, B-5, and B-7 at approximate depths of 77, 40.5, 35, 57, and 25 and 57 feet, respectively (refer to Table 1). Although groundwater was encountered, it is not part of a regional groundwater table or aquifer and its occurrence may vary locally in response to rainfall and irrigation of the adjoining neighborhood to the west.
- Based on review of the California Geological Survey Seismic Hazard Zone Report (06) for the Calabasas 7.5-Minute Quadrangle, the historical high groundwater level for the subject site is undetermined.

## **CONCLUSIONS**

Based on the above findings, the proposed project is feasible for Area A from a geotechnical perspective if the recommendations provided below are followed. The infiltration rate for Area A is greater than the required 0.3 inches per hour, and although weeping and seepage occurred in some of the boreholes, a regional groundwater table or aquifer was not encountered to the maximum exploration depth of 80 feet. Area B is not considered suitable for infiltration.



## RECOMMENDATIONS

### Design Infiltration Rate

- Proposed dry wells may be designed using an infiltration rate of 1.4 inches per hour (20.9 gallons per square foot per day). This rate includes a total correction factor of 8 determined from the GS 200.1 Guidelines for Geotechnical Reporting for Low Impact Development.
- The recommended correction factors are presented in Table 4 below with additional notes regarding the reduction of correction factors for use in the design and construction phases of the project.

**Table 4: Reduction Factors**

Reduction Factors Applied to Measured Infiltration Rates	
Test method ( $CF_t$ )	2
Site variability ( $CF_v$ )	2
Siltation and maintenance ( $CF_s$ )	2
Total Reduction Factor ( $CF_t \times CF_v \times CF_s$ )	8

#### Reduction Factor Notes:

- The reduction factor for siltation and maintenance may be reduced to 1 if the civil designer provides adequate pretreatment such that only clean water with no turbidity is infiltrated into the dry wells.
- The reduction factor for site variability may be reduced to 1 if the verification testing recommended in the Construction Considerations section below is followed.

### Allowable Zone of Infiltration

- The capping depth (top of well) for the proposed dry wells should be whichever of the following produces the greatest depth: at least 15 feet below grade, or at least 3 feet below the contact between colluvium and bedrock as shown on Geologic Cross Section A-A'.
- The recommended height of dry wells is 25 feet, starting below the capping depth extending to approximately 40 feet below grade. Results of the percolation testing indicate the zone of infiltration is limited to the upper bedrock materials. Deeper zones increase in density and decrease in fractures that facilitate infiltration.



- A minimum separation of 10 feet is required between the bottom of proposed dry wells and the seasonal high groundwater elevation. Since a true groundwater table was not encountered to the maximum exploration depth of 80 feet, dry wells will comply with this requirement if the recommended zone of infiltration above is followed.

### Dry Well Design

- A minimum dry well spacing of five diameters (center to center) is recommended. The anticipated zone of influence of dry wells for this project is particularly difficult to estimate due to the randomly distributed orientation of fractures in the bedrock. This spacing should be increased to the maximum possible extent within the project limits and constraints to optimize performance of the dry wells.
- A setback of two dry well diameters is recommended from the toe of slope, where the daylight contact is made between artificial fill and bedrock, to the outer diameter of adjacent dry wells.
- In order to improve performance of the proposed dry wells, it would be beneficial to consider the hydraulics of the proposed network such that adjacent dry wells are not filled at the same time in smaller storm events. It is preferred that the dry wells be filled in an alternating "every-other" pattern, if possible.

### Storage Cistern Design

- Incidental stormwater infiltration for the proposed storage cistern in the park area is acceptable from a geotechnical perspective and not likely to trigger any geotechnical hazards. The infiltration rate in clayey engineered fill, up to 80 feet thick in some areas below the park, will be extremely low and capture volume should be considered marginal.
- Additional geotechnical parameters for design of the proposed storage cistern can be provided as the project plans, including dimensions and footprint of the proposed cistern, are developed.

### Diversion Pipe Bedding and Backfill

- Excavated on-site material is not suitable for use as bedding subject to the requirements of Standards Specifications for Public Works Construction (SSPWC) Section 217-1.



- Excavated on-site material is suitable for use as trench backfill in areas where no load will be placed above the trenches, subject to the requirements of SSPWC Section 217-2.
- In areas where trench backfill will be subjected to loading, imported backfill should be used in accordance with the requirements of SSPWC Section 217-3.
- All backfill must be compacted to a minimum relative compaction of 90 percent of the maximum dry density and tested using ASTM D1557.

### Temporary Excavations

- Dry well excavations will likely require surface casing to 15 feet, or to bedrock, to protect workers from caving of loose colluvium soils during construction.
- The soils encountered in borings B-2, B-3, and B-4 can be classified as Type C, and the soils encountered in Boring B-9 may be classified as Type B as defined in the California Code of Regulation Title 8, Division 1, Chapter 4, Subchapter 4, Article 6, Appendix A.
- Excavations greater than 5 feet in depth should either be shored or sloped back at a gradient per Cal/OSHA requirements, excluding the dry well excavations.
- The Amendments to Specifications to be included in the Special Provisions will be provided under separate cover as the project specifications are prepared.

### General

- Per the Environmental Protection Agency Underground Injection Control (UIC), proposed dry wells may be classified as Class V wells subject to UIC requirements that include submitting inventory information.
- It is our understanding that additional ancillary structures including a storage cistern, pump station and diversion pipes may be required for this project. A supplementary geotechnical investigation can be performed to provide design parameters for these facilities as the project plans are developed.
- The Log of Borings provided in Appendix B and the boring locations shown on the boring location map should be included in the project plans.



- Preliminary plans and final design plans and specifications should be submitted to GMED for review, comment, and approval to ensure the recommendations have been properly incorporated into the plans.

### **CONSTRUCTION CONSIDERATIONS**

- The recommended reduction factor for site variability and corresponding design infiltration rate may be reduced to 1 during construction based on in situ as-built verification testing. Percolation tests can be performed in dry wells once they have been installed and the number of wells may be adjusted based on measured infiltration rates. A quality control program should be outlined in the project bid documents and developed with GMED input during the plan and specification review process.
- The capping depths of dry wells (top of well) should be verified by a registered professional geologist during construction. Inspection should be performed to verify the capping depth is at least 3 feet below colluvium to ensure recommendations and slope stability analyses presented herein remain valid. Please contact us at least 2 weeks prior to construction.
- GMED should be notified immediately to verify any change of conditions observed during construction operations.

### **LIMITATIONS**

This report has been prepared for the exclusive use of Public Works for the specific site discussed herein and should not be considered transferable to other sites or projects. In the event that any modification of the design, configuration, or use of the site is planned, the conclusions and recommendations contained in this report are no longer valid. This study was conducted according to generally accepted geotechnical practice for projects of this magnitude.


Our findings, conclusions, and recommendations are based on our field and laboratory results and our interpretation of the data. The attached boring logs contain observations and interpretations that are valid only for the specific date and location of the borings. Subsurface conditions may vary between boring locations and time. Hence, our conclusions and recommendations are professional opinions and are not meant to be a control of nature. No warranty is herein expressed or implied.

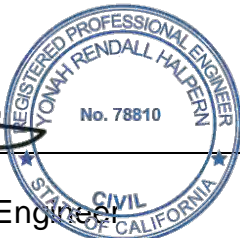
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If you have any questions regarding this report, please contact Yonah Halpern or Karin Burger of the Geotechnical and Materials Engineering Division at Extension 4925.


Prepared by:

  
Yonah Halpern  
Associate Civil Engineer



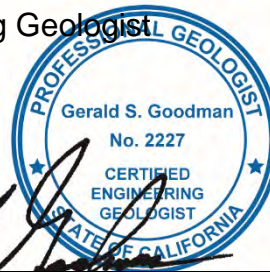
  
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Engineering Geologist



  
William Man  
Civil Engineer



  
Gerald Goodman  
Engineering Geologist II





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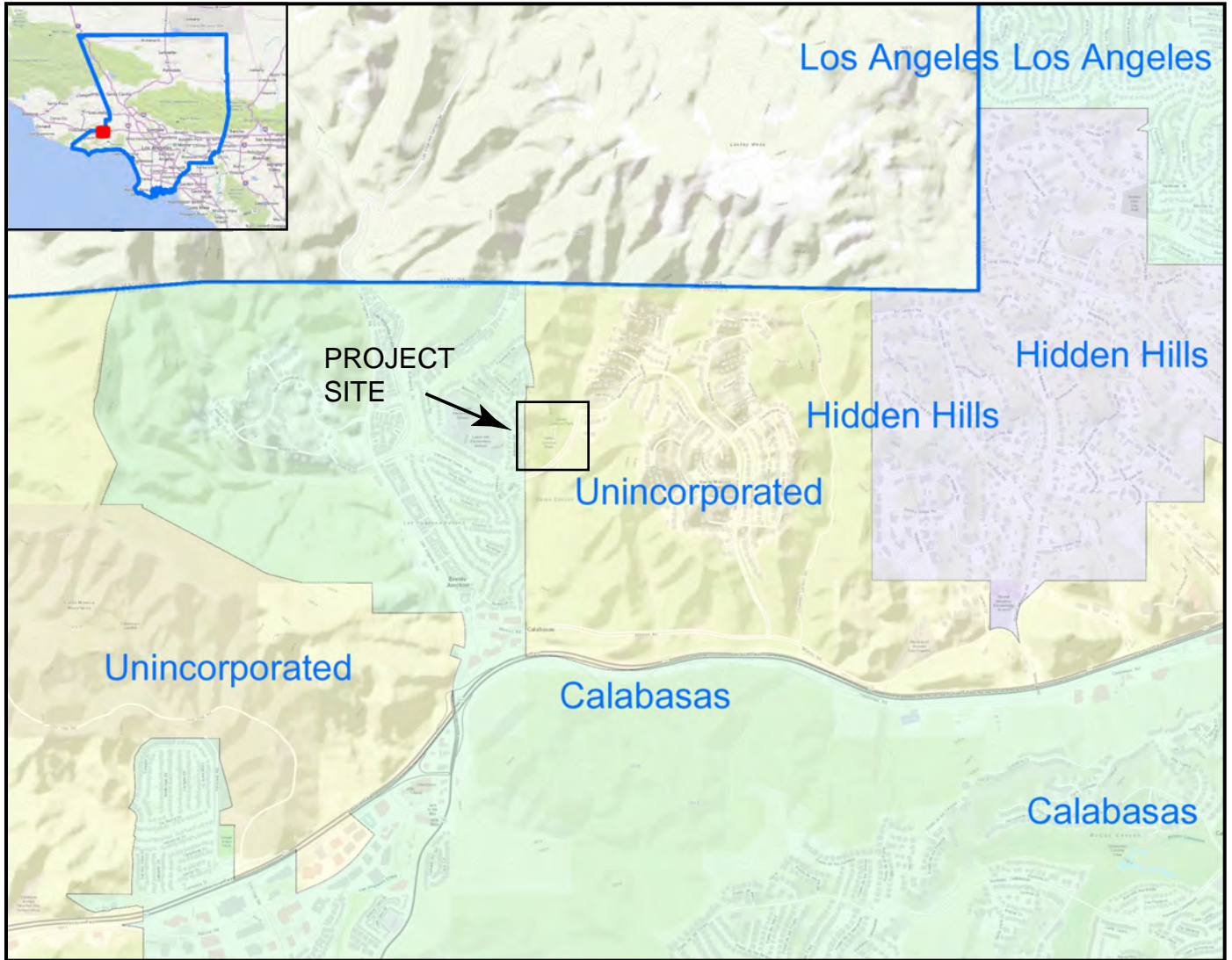
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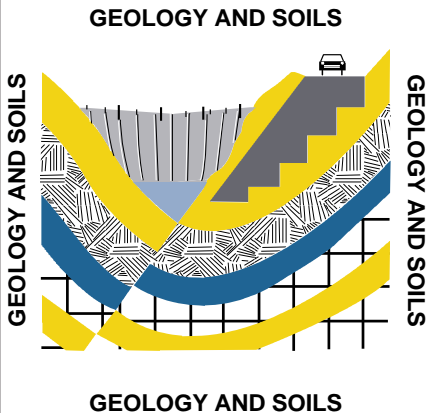


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LOS ANGELES COUNTY DEPARTMENT OF PUBLIC WORKS  
 GEOTECHNICAL AND MATERIALS ENGINEERING DIVISION

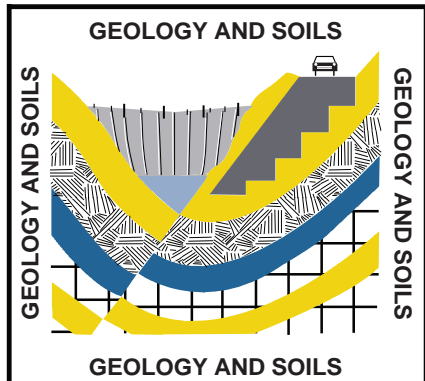
SITE LOCATION MAP  
 GATES CANYON PARK INFILTRATION STUDY  
 UNINCORPORATED CALABASAS AREA

Date: April 2017 | Drafted by: KLB | Scale: As Shown | FIGURE 1





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GEOTECHNICAL AND MATERIALS ENGINEERING DIVISION

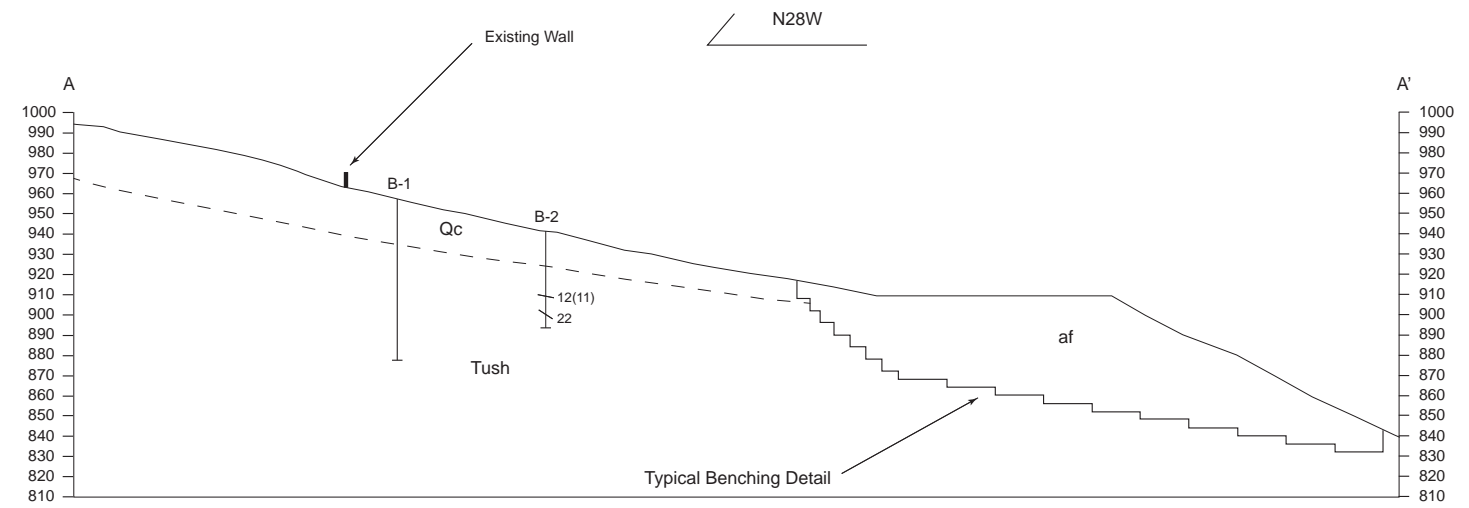
**BORING LOCATION MAP**  
 with REDUCED INFILTRATION RATES  
**GATES CANYON PARK INFILTRATION STUDY**  
 UNINCORPORATED CALABASAS AREA

Date: August 2016

Drafted by: KP

Scale: as shown

FIGURE 2



**EXPLANATION**

- af artificial fill (Tract 39509)
- Qc Quaternary Colluvium
- Tush Tertiary Undifferentiated Shale
- B-3 Boring Location (2016)
- 12 Bedding Attitude
- 20 Joint/Fracture Attitude
- - - Contact (approximated)

	LOS ANGELES COUNTY DEPARTMENT OF PUBLIC WORKS		
	GEOTECHNICAL AND MATERIALS ENGINEERING DIVISION		
<b>GEOLOGIC MAP &amp; CROSS-SECTION GATES CANYON PARK INFILTRATION STUDY UNINCORPORATED CALABASAS AREA</b>			
Date: Jan 2017	Drafted by: KLB	Scale: As Shown	FIGURE 3

# **Appendix A**

As-Built Geotechnical Map and  
Cross-Sections (TR 39509)



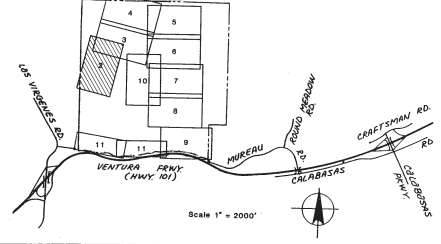
REVISIONS	BY

OWNER - SUBDIVIDER  
 MORRISON ENTITY  
 29022 LARO DRIVE  
 AGOURA HILLS, CA 91301  
 (818) 991-4610  
 ATTN: MICHAEL J. GREYNALD

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 SAN GABRIEL, CA 91776  
 (818) 266-6127  
 (213) 283-1515

DATE	SCALE	DRAWN	JOB	SHEET	OF 12 SHEETS
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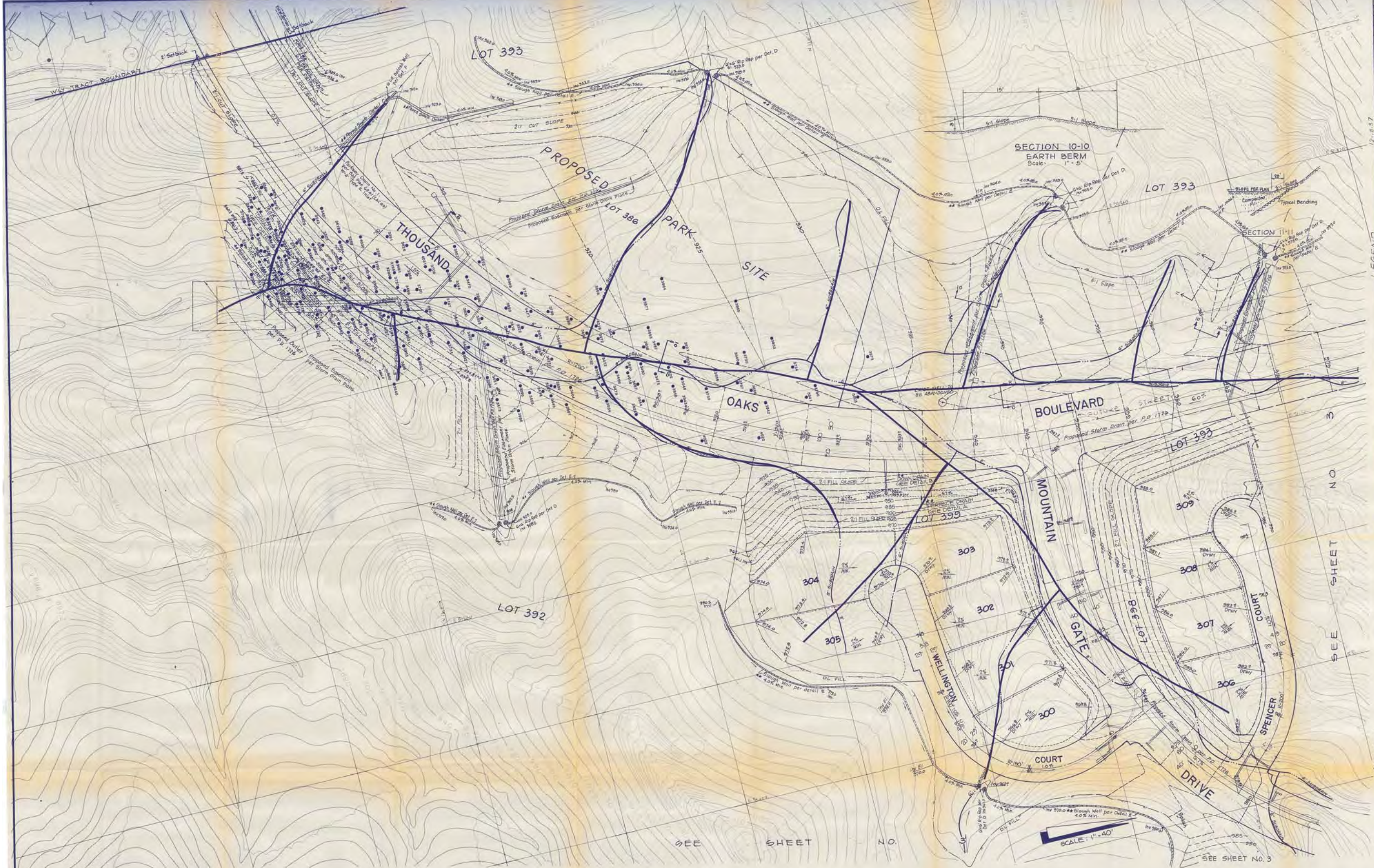


LEGEND

[af]	ARTIFICIAL FILL	[U]	APPROXIMATE LOCATION OF FAULT OR SHEAR, DASHED WHERE APPROXIMATELY LOCATED, DOTTED WHERE CONCEALED OR INFERRED, ARROW INDICATES DIRECTION AND AMOUNT OF DIP, LETTERS INDICATE RELATIVE OFFSET	[CH-3]	APPROXIMATE LOCATION OF CORE HOLE
[Qc]	COLLUVIUM	[25]	STRIKE AND DIP OF BEDDING (* DENOTES BEDDING ATTITUDE MEASURED FROM SUBSURFACE EXCAVATION)	[DH-3]	APPROXIMATE LOCATION OF DRILL HOLE
[Qal]	ALLUVIUM	[-----]	MAPPABLE BED	[TP-3]	APPROXIMATE LOCATION OF TEST PIT
[Qls]	LANDSLIDE DEPOSITS	[H]	HORIZONTAL BEDDING	[A]	SURFACE SAMPLES
[Tto]	TOWNSLEY FORMATION	[+ - -]	ANTICLINE, DASHED WHERE APPROXIMATELY LOCATED	[S-L]	APPROXIMATE LOCATION OF SEISMIC LINE FOR RIPABILITY INVESTIGATION
[Tmsh]	MODELO FORMATION, UPPER SHALE MEMBER	[+ - -]	SYNCLINE, DASHED WHERE APPROXIMATELY LOCATED	[A']	APPROXIMATE LOCATION OF GEOLOGIC SECTION
[Tmms]	MODELO FORMATION, MIDDLE SANDSTONE MEMBER	[Q]	WATER WELL	[S]	SLOPE NUMBER
[Tmlsh]	MODELO FORMATION, LOWER SHALE MEMBER	[---]	CONTACT, DASHED WHERE APPROXIMATELY LOCATED, DOTTED WHERE CONCEALED OR INFERRED	[B]	APPROXIMATE LOCATION OF BUTTRESS/STABILITY FILL KEY



GEOTECHNICAL MAP  
 For: MORRISON ENTITY  
 CB6077 July 1980 Plate 1.1  
 Staal, Gardner, & Dunne, Inc.  
 Consulting Engineers and Geologists



REVISIONS	BY

OWNER - SUBDIVIDER  
**MORRISON ENTITY**  
 26002 LAGO DRIVE  
 28008A HILLS, CA 91301  
 (818) 991-4810  
 ATTN: MICHAEL J. GREYNALD

GEOTECHNICAL CONSULTANTS  
**STAAL, GARDNER & DUNNE, INC.**  
 191 N. FIR ST. SUITE F  
 VENTURA, CA 93001  
 (805) 653-5556

CIVIL ENGINEER  
**ROBERT K. KAMEOKA**  
 5011 ACACIA ST. - 91776  
 (818) 286-5127  
 (213) 283-1515

Date: 7-12-87  
 Scale: 1" = 40'  
 Drawn: C.F.  
 Job: [blank]  
 Sheet: 2  
 Of 12 Sheets

LEGEND

--- Existing contour

SEE SHEET NO. 3

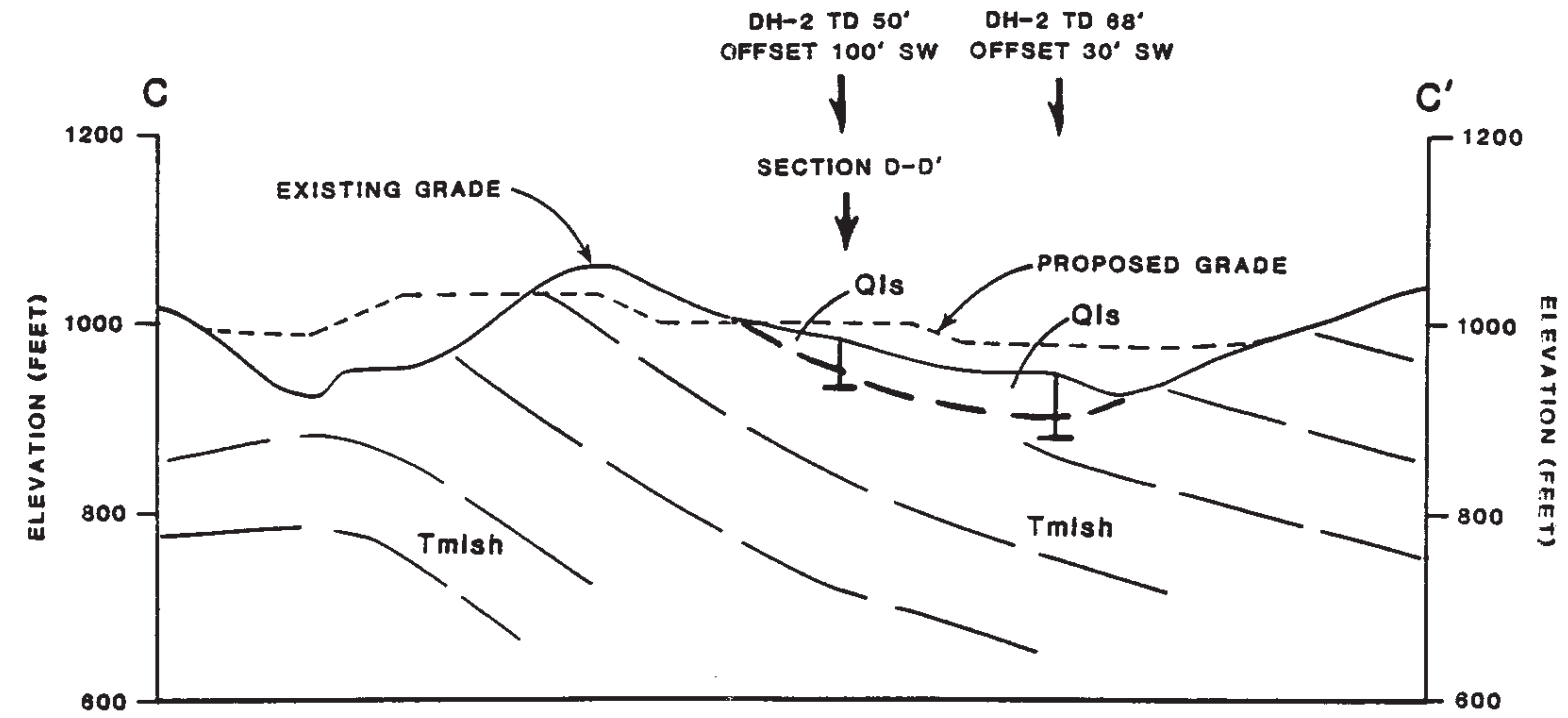
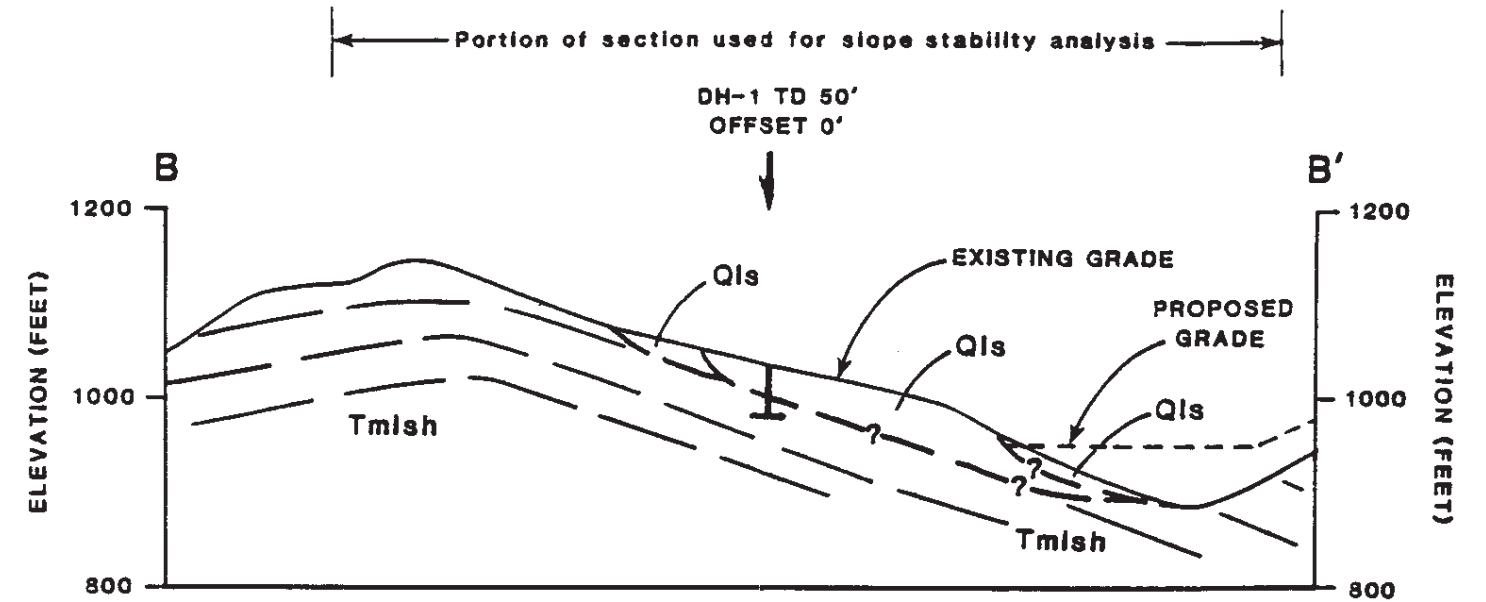
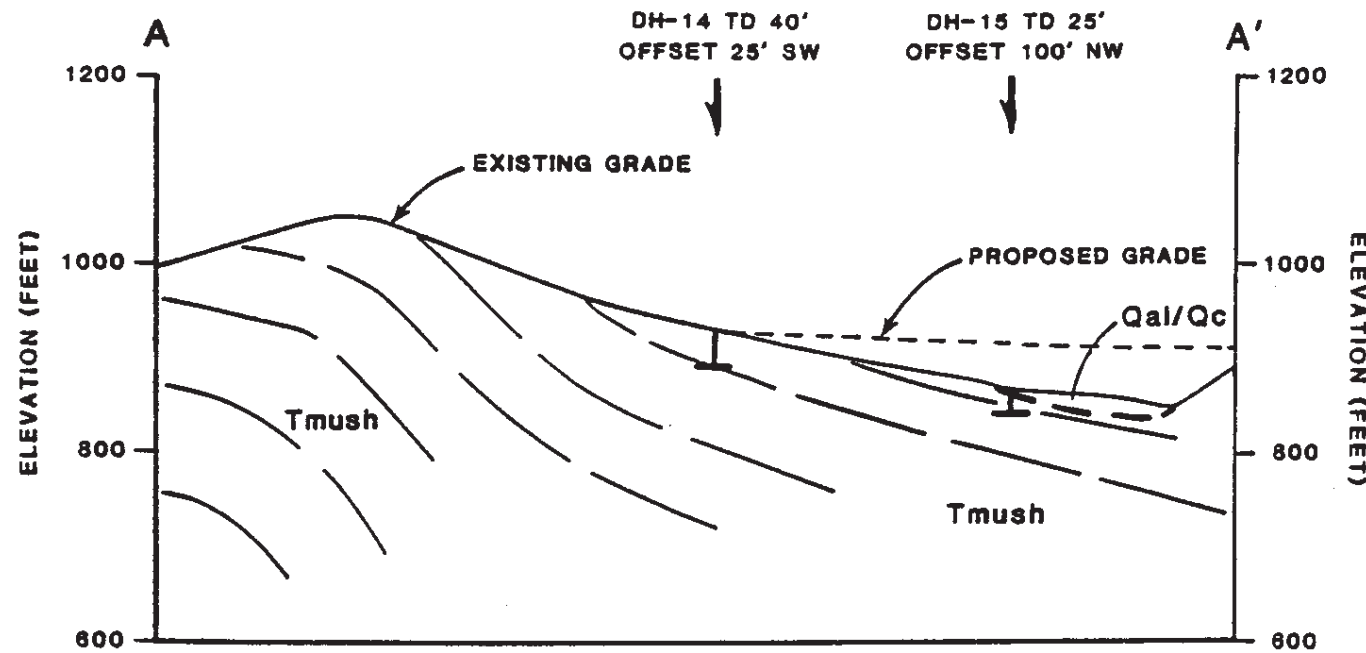
**DENSITY TESTS LOCATION MAP**

For: MORRISON ENTITY  
 C88077 July 1988 Plate 1.1

Staal, Gardner, & Dunne, Inc.  
 Consulting Engineers and Geologists







LEGEND

af	ARTIFICIAL FILL	Tto	TOPANGA FORMATION		GEOLOGIC CONTACT, DASHED WHERE APPROXIMATELY LOCATED
Qc	COLLUVIUM	Tmush	MODELO FORMATION, UPPER SHALE MEMBER		ESTIMATED BEDDING PLANE IN LINE OF SECTION
Qal	ALLUVIUM	Tmms	MODELO FORMATION, MIDDLE SANDSTONE MEMBER		
Qls	LANDSLIDE DEPOSITS	Tmlsh	MODELO FORMATION, LOWER SHALE MEMBER		



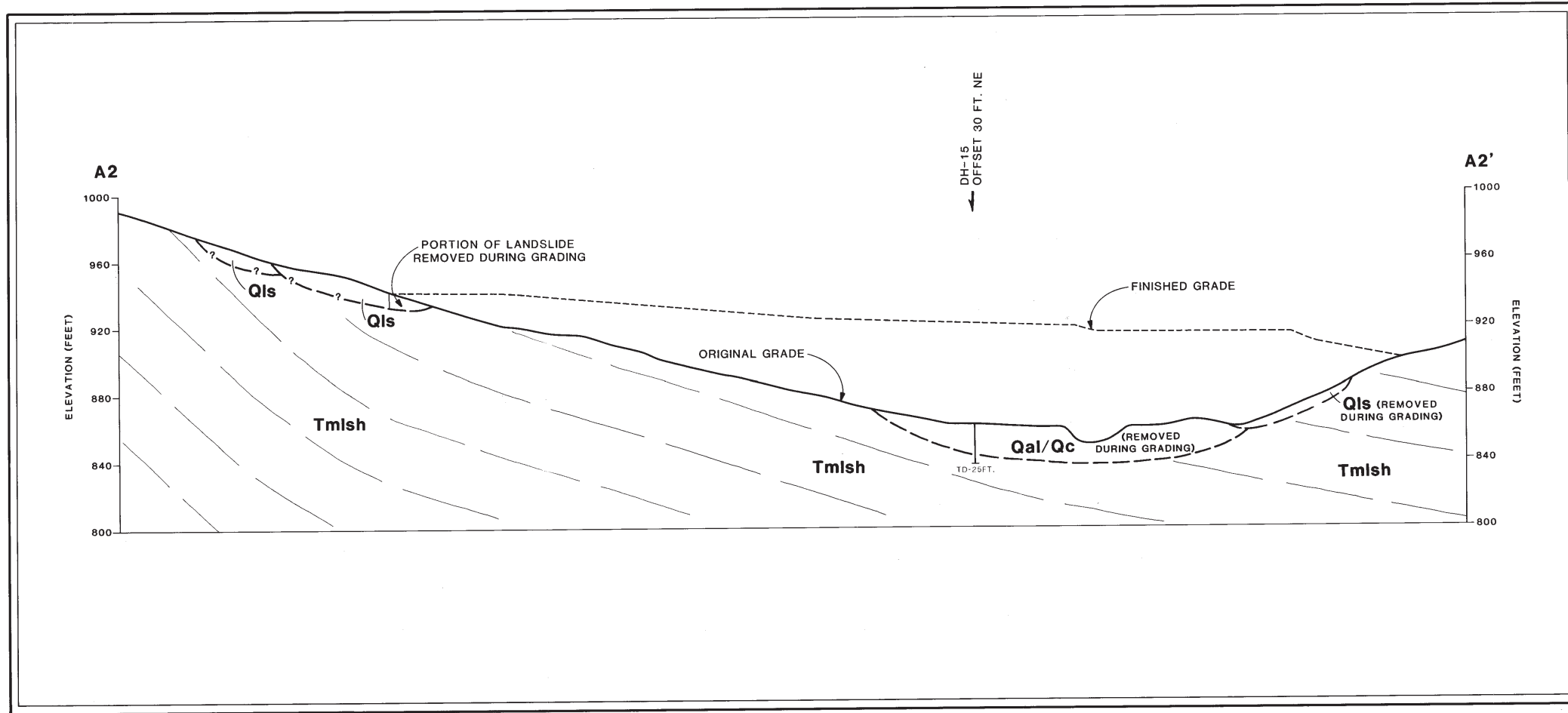
**GEOTECHNICAL SECTIONS**

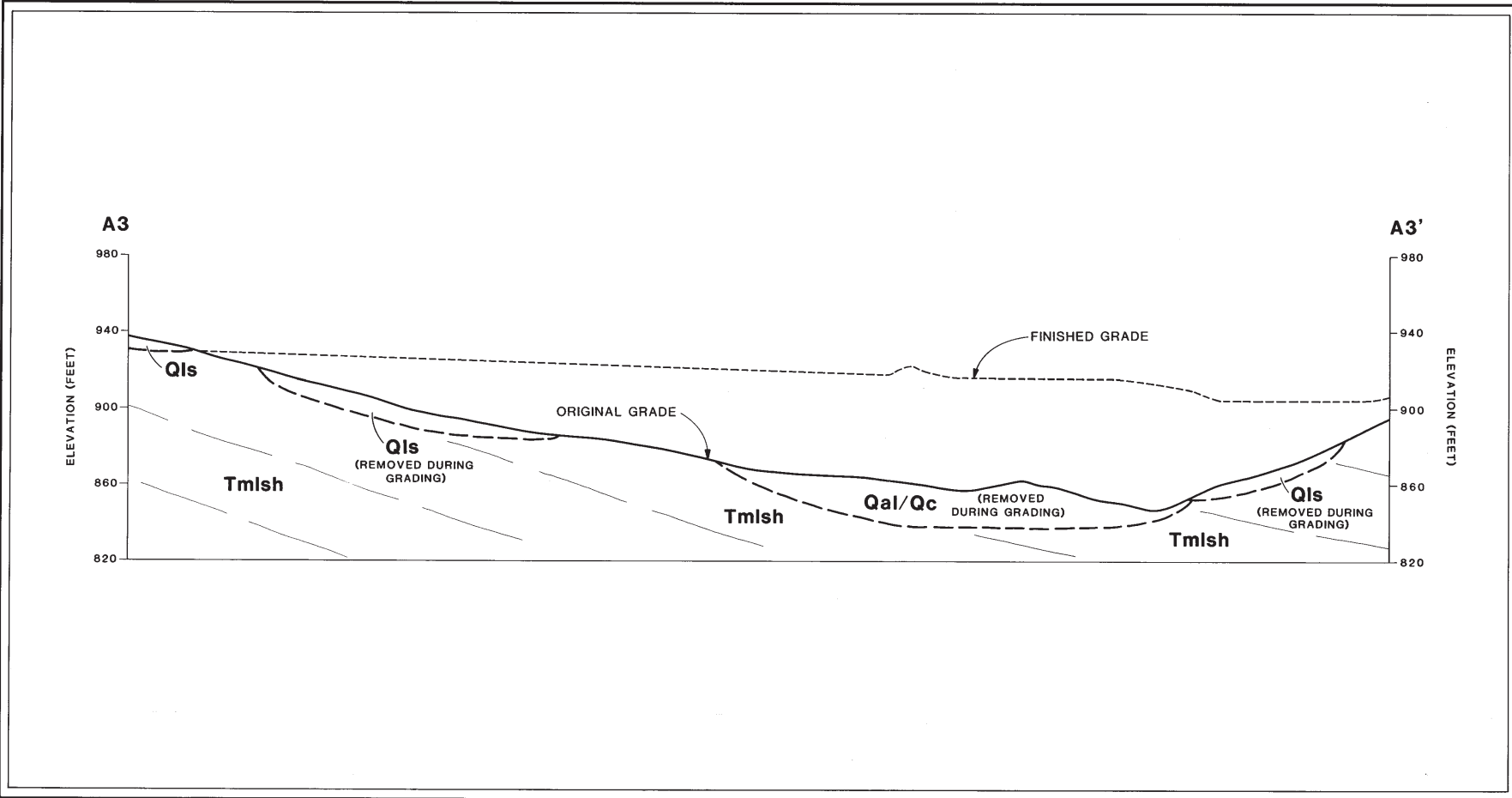
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For: MORRISON ENTITY

86077      January 1987      Plate 2.1

*S G D*  
**Staal, Gardner, & Dunne, Inc.**  
Consulting Engineers and Geologists





- LEGEND**
- Qc COLLUVIUM
  - Qal ALLUVIUM
  - Qls LANDSLIDE DEPOSITS
  - Tmlsh MODELO FORMATION, LOWER SHALE MEMBER
  - GEOLOGIC CONTACT, DASHED WHERE APPROXIMATELY LOCATED
  - - - ESTIMATED BEDDING PLANE IN LINE OF SECTION
- SEE PLATE 1.1 FOR SECTION LOCATION



**GEO TECHNICAL SECTION  
A3-A3'**

For: MORRISON ENTITY  
C88077 July 1990 Plate 2.2

**Staal, Gardner & Dunne, Inc.**  
Consulting Engineers and Geologists

# **Appendix B**

Log of Borings

LOS ANGELES COUNTY DEPARTMENT OF PUBLIC WORKS  
 GEOTECHNICAL AND MATERIALS ENGINEERING DIVISION

**SUMMARY LOG OF BORING B-1**

PROJECT Gates Canyon Park PROJECT ID GME000279 PAGE 1 OF 4  
 CLIENT Watershed Management Division ELEVATION ~955' LOGGED BY K. Burger/Y. Halpern  
 TYPE/DIAMETER OF BORING 24" diameter/Lo-Drill DRILLER Roy Bros TOTAL DEPTH 80'  
 DATE(S) 5/23/2016 LOCATION See Boring Location Map

Note: This log contains observations and interpretations that are valid only for the specific date and location of the boring. Subsurface conditions vary between borings and with time. Lithologic descriptions are derived using visual classification methods and may vary from descriptions/classifications based on laboratory testing.

COMMENTS INTERPRETATIONS ATTITUDES	GRAPHIC	DEPTH (FT.)	DESCRIPTION
<p>@ 10' easy drilling</p> <p>@ 15' harder drilling</p> <p>@ 16.5' - 18' ring sample (1R)</p> <p>Caved zone - belled to 1 ft beyond bore diameter. Unsafe to downhole log below 19'</p>		0	Surface is soil with dried grass
		1	0' - 23' Colluvium, small angular rock fragments in sandy silt, medium dense, dark brown.
		2	
		3	
		4	
		5	@ 5' randomly oriented rock debris, highly weathered shale fragments
		6	
		7	
		8	
		9	
		10	
		11	
		12	
		13	@ 13' very to extremely loose rocks, randomly oriented rock fragments in a loose sandy clay matrix.
		14	
		15	
		16	
		17	
		18	
		19	@ 19' highly weathered rock, bedding is discontinuous, rocks are randomly oriented.
		20	
		21	
		22	
23	23' - TD Bedrock, shale (Tush), weathered, bedding not well defined, mottled gray-brown with orange mottling.		
24			
25			

LOS ANGELES COUNTY DEPARTMENT OF PUBLIC WORKS  
 GEOTECHNICAL AND MATERIALS ENGINEERING DIVISION

**SUMMARY LOG OF BORING B-1**

PROJECT Gates Canyon Park PROJECT ID GME000279 PAGE 2 OF 4  
 CLIENT Watershed Management Division ELEVATION ~955' LOGGED BY K. Burger/Y. Halpern  
 TYPE/DIAMETER OF BORING 24" diameter/Lo-Drill DRILLER Roy Bros TOTAL DEPTH 80'  
 DATE(S) 5/23/2016 LOCATION See Boring Location Map

Note: This log contains observations and interpretations that are valid only for the specific date and location of the boring. Subsurface conditions vary between borings and with time. Lithologic descriptions are derived using visual classification methods and may vary from descriptions/classifications based on laboratory testing.

COMMENTS INTERPRETATIONS ATTITUDES	GRAPHIC	DEPTH (F.T.)	DESCRIPTION
<p>@ 26' harder drilling</p> <p>@ 30' - 31.5' ring sample (2R)</p> <p>@ 32' easier drilling</p>		<p>25</p> <p>26</p> <p>27</p> <p>28</p> <p>29</p> <p>30</p> <p>31</p> <p>32</p> <p>33</p> <p>34</p> <p>35</p> <p>36</p> <p>37</p> <p>38</p> <p>39</p> <p>40</p> <p>41</p> <p>42</p> <p>43</p> <p>44</p> <p>45</p> <p>46</p> <p>47</p> <p>48</p> <p>49</p> <p>50</p>	<p>@ 30' silicious zone, hard.</p>

LOS ANGELES COUNTY DEPARTMENT OF PUBLIC WORKS  
 GEOTECHNICAL AND MATERIALS ENGINEERING DIVISION

**SUMMARY LOG OF BORING B-1**

PROJECT Gates Canyon Park PROJECT ID GME000279 PAGE 3 OF 4  
 CLIENT Watershed Management Division ELEVATION ~955' LOGGED BY K. Burger/Y. Halpern  
 TYPE/DIAMETER OF BORING 24" diameter/Lo-Drill DRILLER Roy Bros TOTAL DEPTH       
 DATE(S) 5/23/2016 LOCATION See Boring Location Map

Note: This log contains observations and interpretations that are valid only for the specific date and location of the boring. Subsurface conditions vary between borings and with time. Lithologic descriptions are derived using visual classification methods and may vary from descriptions/classifications based on laboratory testing.


COMMENTS INTERPRETATIONS ATTITUDES	GRAPHIC	DEPTH (F.T.)	DESCRIPTION
		50	
		51	
		52	
		53	
		54	
		55	
		56	
		57	
		58	
		59	
		60	
@ 60' - 61.5' ring sample (3R)	▽	61	@ 61' seepage
@ 61' tip of auger is wet		62	
		63	
		64	
		65	
		66	
		67	@ 67' hard zone, slight odor
		68	
		69	
		70	
		71	
		72	
		73	
		74	
		75	

LOS ANGELES COUNTY DEPARTMENT OF PUBLIC WORKS  
 GEOTECHNICAL AND MATERIALS ENGINEERING DIVISION

**SUMMARY LOG OF BORING B-1**

PROJECT Gates Canyon Park PROJECT ID GME000279 PAGE 4 OF 4  
 CLIENT Watershed Management Division ELEVATION ~955' LOGGED BY K. Burger/Y. Halpern  
 TYPE/DIAMETER OF BORING 24" diameter/Lo-Drill DRILLER Roy Bros TOTAL DEPTH 80'  
 DATE(S) 5/23/2016 LOCATION See Boring Location Map

Note: This log contains observations and interpretations that are valid only for the specific date and location of the boring. Subsurface conditions vary between borings and with time. Lithologic descriptions are derived using visual classification methods and may vary from descriptions/classifications based on laboratory testing.

COMMENTS INTERPRETATIONS ATTITUDES	GRAPHIC	DEPTH (F.T.)	DESCRIPTION
		75 76 77 78 79 80	
		81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100	TD = 80' Seepage @ 61' on 5/23/16 Water up to 77' on 5/24/16 Surface logging by Y. Halpern Downhole logging by K. Burger Downhole logged to 19' due to hazardous caving below 19'





LOS ANGELES COUNTY DEPARTMENT OF PUBLIC WORKS  
 GEOTECHNICAL AND MATERIALS ENGINEERING DIVISION

**SUMMARY LOG OF BORING B-2**

PROJECT Gates Canyon Park PROJECT ID GME000279 PAGE 1 OF 3  
 CLIENT WMD ELEVATION ~945' LOGGED BY K. Burger / Y. Halpern  
 TYPE/DIAMETER OF BORING 24" diameter/Lo-Drill DRILLER Roy Bros TOTAL DEPTH 60'  
 DATE(S) 5/24/2016 LOCATION See Boring Location Map

Note: This log contains observations and interpretations that are valid only for the specific date and location of the boring. Subsurface conditions vary between borings and with time. Lithologic descriptions are derived using visual classification methods and may vary from descriptions/classifications based on laboratory testing.

COMMENTS INTERPRETATIONS ATTITUDES	GRAPHIC	DEPTH (FT.)	DESCRIPTION
		0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16	Surface is soil with dried grass. 0' - 16' 8" Colluvium, highly weathered, rock fragments, blocky, jumbled, loose, soft clayey matrix.
@ 17' harder zone		17 18 19 20 21 22 23 24 25	@ 16' 8" - TD Bedrock, shale (Tush), clayey, weathered, bedding not well defined, mottled gray-brown with orange-brown.

LOS ANGELES COUNTY DEPARTMENT OF PUBLIC WORKS  
 GEOTECHNICAL AND MATERIALS ENGINEERING DIVISION

**SUMMARY LOG OF BORING B-2**

PROJECT Gates Canyon Park PROJECT ID GME000279 PAGE 2 OF 3  
 CLIENT WMD ELEVATION ~945' LOGGED BY K. Burger / Y. Halpern  
 TYPE/DIAMETER OF BORING 24" diameter/Lo-Drill DRILLER Roy Bros TOTAL DEPTH 60'  
 DATE(S) 5/24/2016 LOCATION See Boring Location Map

Note: This log contains observations and interpretations that are valid only for the specific date and location of the boring. Subsurface conditions vary between borings and with time. Lithologic descriptions are derived using visual classification methods and may vary from descriptions/classifications based on laboratory testing.


COMMENTS INTERPRETATIONS ATTITUDES	GRAPHIC	DEPTH (FT.)	DESCRIPTION
		25	
		26	@ 26' very hard, silicious layer, whitish with some oxidation staining along bedding.
		27	@ 27' clayey, orangish-tan and manganese oxide with oxidation along fractures and bedding, bedding not well defined, oxidation with gypsum veining, normal to bedding.
		28	
		29	@ 27'11" contact marked by color change, becomes gray, mottled brown and gray, bedding not well defined.
		30	
@ 31' b-N26E, 12N (approximate)		31	@ 31' yellowish layer, continuous around hole, ~1/8" thick, undulatory.
		32	
		33	
		34	
		35	@ 34' 5" well bedded material, alternates between orange-brown and gypsum veins parallel to bedding, roughly dipping NE.
		36	@ 35' 6" gypsum veins defining bedding planes, becomes gray below 35' 6", clayey, hard, less clay where oxidized.
		37	
		38	
		39	
		40	@ 40' 6" minor weeping, continuous around hole on top of ash bed.
@ 41' 11" b-N39E, 22S base of ash bed		41	@ 40' 11" altered ash bed, white with some yellow mottling, continuous with gypsum layer at base of ash bed, 1 1/4 - 1 1/2" thick.
		42	
		43	@ 41' 5" ash bed is soft, whitish gray, moist, yellowish mottling due to oxidation from above.
		44	@ 42' clayey, bedding not well defined, hard, gray.
		45	
		46	
		47	
		48	
		49	
		50	

LOS ANGELES COUNTY DEPARTMENT OF PUBLIC WORKS  
 GEOTECHNICAL AND MATERIALS ENGINEERING DIVISION

**SUMMARY LOG OF BORING** B-2

PROJECT Gates Canyon Park PROJECT ID GME000279 PAGE 3 OF 3  
 CLIENT WMD ELEVATION ~945' LOGGED BY K. Burger / Y. Halpern  
 TYPE/DIAMETER OF BORING 24" diameter/Lo-Drill DRILLER Roy Bros TOTAL DEPTH 60'  
 DATE(S) 5/24/2016 LOCATION See Boring Location Map

Note: This log contains observations and interpretations that are valid only for the specific date and location of the boring. Subsurface conditions vary between borings and with time. Lithologic descriptions are derived using visual classification methods and may vary from descriptions/classifications based on laboratory testing.

COMMENTS INTERPRETATIONS ATTITUDES	GRAPHIC	DEPTH (F.T.)	DESCRIPTION
		50	
		51	@ 51' dark gray-brown, very hard, bedding distinguished by varying hardness.
		52	
		53	@ 53' fine sandy layer, tight, hard, 4" thick gypsum bed, clayey shale below.
		54	
		55	
		56	
		57	
		58	@ 58' fine root hairs scattered around hole.
		59	
		60	TD = 60'
		61	Weeping @ 40' 6"
		62	Surface logging by Y. Halpern 5/24/16
		63	Downhole logging by K. Burger 5/24/16
		64	Downhole logged to 58'
		65	
		66	
		67	
		68	
		69	
		70	
		71	
		72	
		73	
		74	
		75	

LOS ANGELES COUNTY DEPARTMENT OF PUBLIC WORKS  
 GEOTECHNICAL AND MATERIALS ENGINEERING DIVISION

**SUMMARY LOG OF BORING B-3**

PROJECT Gates Canyon Park PROJECT ID GME000279 PAGE 1 OF 2  
 CLIENT WMD ELEVATION ~935' LOGGED BY K. Burger / Y. Halpern  
 TYPE/DIAMETER OF BORING 24" diameter/Lo-Drill DRILLER Roy Bros TOTAL DEPTH 40'  
 DATE(S) 5/24/2016 LOCATION See Boring Location Map

Note: This log contains observations and interpretations that are valid only for the specific date and location of the boring. Subsurface conditions vary between borings and with time. Lithologic descriptions are derived using visual classification methods and may vary from descriptions/classifications based on laboratory testing.


COMMENTS INTERPRETATIONS ATTITUDES	GRAPHIC	DEPTH (FT.)	DESCRIPTION
		0	Surface is soil with dried grass
		1	0' - 6' 3" Colluvium, angular rock fragments 2-3" diameter, light brown to tan, dry to moist.
		2	
		3	
		4	
		5	
		6	
		7	6' 3" - TD Bedrock, shale (Tush) thinly bedded shale, well bedded, blocky, fine grained, well cemented.
		8	
		9	
		10	@ 10' 6" blocky, hard, fractured, less clayey, oxidation on fracture surfaces, orange staining on fractures.
@ 10' - 11.5' ring sample (1R)		11	
@ 10' 6" b - N44W, 20N f - E-W, 77S		12	
		13	
		14	@ 14' 9" manganese oxidation on fracture surfaces, dark gray.
		15	
		16	
@ 17' 6" j - N19W, 88W j - N88W, 85S		17	@ 17' 6" intersecting joint set, oxidized, yellow-orange staining on all surfaces.
		18	
		19	
@ 20' - 21.5' ring sample (2R)		20	@ 20 - 21' gypsum visible on fracture surface (micro-crystalline)
		21	
		22	@ 22 - 35' formation becomes tight, hard, oxidized layers interbedded with gypsum, becomes dark brown to gray with oxidation, bedding accentuated by variations in color, minor fracturing.
		23	
		24	
		25	

LOS ANGELES COUNTY DEPARTMENT OF PUBLIC WORKS  
 GEOTECHNICAL AND MATERIALS ENGINEERING DIVISION

**SUMMARY LOG OF BORING B-3**

PROJECT Gates Canyon Park PROJECT ID GME000279 PAGE 2 OF 2  
 CLIENT WMD ELEVATION ~935' LOGGED BY K. Burger / Y. Halpern  
 TYPE/DIAMETER OF BORING 24" diameter/Lo-Drill DRILLER Roy Bros TOTAL DEPTH 40'  
 DATE(S) 5/24/2016 LOCATION See Boring Location Map

Note: This log contains observations and interpretations that are valid only for the specific date and location of the boring. Subsurface conditions vary between borings and with time. Lithologic descriptions are derived using visual classification methods and may vary from descriptions/classifications based on laboratory testing.

COMMENTS INTERPRETATIONS ATTITUDES	GRAPHIC	DEPTH (FT.)	DESCRIPTION
<p>@ 30' - 31.5' ring sample (3R)                      @ 31' drilling becomes slightly harder</p>		<p>25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40</p>	<p>@ 35' blocky, loose, manganese oxide on fracture surfaces, moist, yellow, orange clay below blocky material, 1/4" thick, may be weathered ash bed, seepage when wall of boring is scraped.</p>
<p>@ 37' meter alarm - indicated oxygen at 19.5% - allowed time for condition to clear                      @ 40' - 41.5' ring sample (4R)</p>			<p>TD = 40'                      Seepage @ 35'                      Surface logging by Y. Halpern 5/24/16                      Downhole logging by K. Burger 5/24/16                      Downhole logged to 37'</p>

LOS ANGELES COUNTY DEPARTMENT OF PUBLIC WORKS  
 GEOTECHNICAL AND MATERIALS ENGINEERING DIVISION

**SUMMARY LOG OF BORING B-4**

PROJECT Gates Canyon Park PROJECT ID GME000279 PAGE 1 OF 3  
 CLIENT WMD ELEVATION ~938' LOGGED BY K. Burger / Y. Halpern  
 TYPE/DIAMETER OF BORING 24" diameter/Lo-Drill DRILLER Roy Bros TOTAL DEPTH 50.5'  
 DATE(S) 5/26/2016 LOCATION See Boring Location Map

Note: This log contains observations and interpretations that are valid only for the specific date and location of the boring. Subsurface conditions vary between borings and with time. Lithologic descriptions are derived using visual classification methods and may vary from descriptions/classifications based on laboratory testing.

COMMENTS INTERPRETATIONS ATTITUDES	GRAPHIC	DEPTH (FT.)	DESCRIPTION
		0	Surface is soil with dried grass
		1	0' - TD Bedrock, shale (Tush), weathered suggestion of bedding from different coloration of layers, relatively intact.
		2	
		3	
		4	@ 4' 6" rodent burrow (krotovina).
		5	@ 5' weathered rock, tight.
		6	
		7	
		8	
		9	
		10	
		11	
		12	
		13	
		14	
		15	
		16	
		17	
		18	
		19	
		20	
		21	
		22	@ 22' suggestion of bedding, orange oxidation bedded material has variable hardnesses.
		23	
		24	
		25	

LOS ANGELES COUNTY DEPARTMENT OF PUBLIC WORKS  
 GEOTECHNICAL AND MATERIALS ENGINEERING DIVISION

**SUMMARY LOG OF BORING** B-4

PROJECT Gates Canyon Park PROJECT ID GME000279 PAGE 2 OF 3  
 CLIENT WMD ELEVATION ~938' LOGGED BY K. Burger / Y. Halpern  
 TYPE/DIAMETER OF BORING 24" diameter/Lo-Drill DRILLER Roy Bros TOTAL DEPTH 50.5'  
 DATE(S) 5/26/2016 LOCATION See Boring Location Map

Note: This log contains observations and interpretations that are valid only for the specific date and location of the boring. Subsurface conditions vary between borings and with time. Lithologic descriptions are derived using visual classification methods and may vary from descriptions/classifications based on laboratory testing.

COMMENTS INTERPRETATIONS ATTITUDES	GRAPHIC	DEPTH (FT.)	DESCRIPTION
		25	
		26	
		27	
		28	
		29	@ 28' 6" internal shearing visible, 4 - 6" thick, internally sheared along bed, increased moisture, undulatory around hole, discontinuous, more prevalent on uphill side of hole (NW), thinner on downslope side.
		30	
		31	@ 31' variable hardness, suggestion of bedding.
		32	
		33	
		34	
		35	@ 35' 6" internal shearing in slightly harder layer, moisture on surfaces, irregular oxidation.
		36	@ 36' highly oxidized.
		37	
		38	
		39	
		40	@ 40' gray mottling, poorly bedded.
@ 40' - 41.5' ring sample (1R)		41	@ 41' hard white layer, 1/16" thick, silty clay layers below, tan, 1/8-1/16" thick, light tan interlayered with gray siltstone beds.
@ 41' b-N24E, 22S		42	
@ 41' harder drilling		43	
		44	
		45	
@ 46' b-N85E, 28N (approximate)		46	@ 46' distinct bedding plane.
		47	@ 46' 6" ash bed, 1/4" thick, tan gray, within hard gray siltstone, undulatory.
		48	@ 47' rock becomes more indurated.
		49	
		50	

LOS ANGELES COUNTY DEPARTMENT OF PUBLIC WORKS  
 GEOTECHNICAL AND MATERIALS ENGINEERING DIVISION

**SUMMARY LOG OF BORING B-4**

PROJECT Gates Canyon Park PROJECT ID GME000279 PAGE 3 OF 3  
 CLIENT WMD ELEVATION ~938' LOGGED BY K. Burger / Y. Halpern  
 TYPE/DIAMETER OF BORING 24" diameter/Lo-Drill DRILLER Roy Bros TOTAL DEPTH 50.5'  
 DATE(S) 5/26/2016 LOCATION See Boring Location Map

Note: This log contains observations and interpretations that are valid only for the specific date and location of the boring. Subsurface conditions vary between borings and with time. Lithologic descriptions are derived using visual classification methods and may vary from descriptions/classifications based on laboratory testing.

COMMENTS INTERPRETATIONS ATTITUDES	GRAPHIC	DEPTH (F.T.)	DESCRIPTION
		50	
		51	TD = 50.5'
		52	Ground water or seepage not encountered
		53	Surface logging by Y. Halpern 5/26/16
		54	Downhole logging by K. Burger 5/26/16
		55	Downhole logged to 47'
		56	
		57	
		58	
		59	
		60	
		61	
		62	
		63	
		64	
		65	
		66	
		67	
		68	
		69	
		70	
		71	
		72	
		73	
		74	
		75	







LOS ANGELES COUNTY DEPARTMENT OF PUBLIC WORKS  
 GEOTECHNICAL AND MATERIALS ENGINEERING DIVISION

**SUMMARY LOG OF BORING** B-5

PROJECT Gates Canyon Park PROJECT ID GME000279 PAGE 3 OF 3  
 CLIENT WMD ELEVATION ~950' LOGGED BY Y. Halpern  
 TYPE/DIAMETER OF BORING 24" diameter/ Flight auger with Lo-Drill DRILLER Roy Bros TOTAL DEPTH 60.5'  
 DATE(S) 5/25/2016 LOCATION Behind tennis court #2

Note: This log contains observations and interpretations that are valid only for the specific date and location of the boring. Subsurface conditions vary between borings and with time. Lithologic descriptions are derived using visual classification methods and may vary from descriptions/classifications based on laboratory testing.

COMMENTS INTERPRETATIONS ATTITUDES	GRAPHIC	DEPTH (F.T.)	DESCRIPTION
		50	
		51	
		52	
		53	
		54	
		55	
		56	
		57	@ 57' seepage, clayey piece at tip
		58	
		59	
		60	Ground water encountered at 60'
		61	TD = 60.5'
		62	Not downhole logged
		63	Surface logging by Y. Halpern 5/25/16
		64	Seepage at 57'
		65	Standing water at 60'
		66	
		67	
		68	
		69	
		70	
		71	
		72	
		73	
		74	
		75	

LOS ANGELES COUNTY DEPARTMENT OF PUBLIC WORKS  
 GEOTECHNICAL AND MATERIALS ENGINEERING DIVISION

**SUMMARY LOG OF BORING B-6**

PROJECT Gates Canyon Park PROJECT ID GME000279 PAGE 1 OF 2  
 CLIENT WMD ELEVATION ~955' LOGGED BY K. Burger / Y. Halpern  
 TYPE/DIAMETER OF BORING 24" diameter DRILLER Roy Bros TOTAL DEPTH 60'  
 DATE(S) 5/26/2016 LOCATION See Boring Location Map

Note: This log contains observations and interpretations that are valid only for the specific date and location of the boring. Subsurface conditions vary between borings and with time. Lithologic descriptions are derived using visual classification methods and may vary from descriptions/classifications based on laboratory testing.

COMMENTS INTERPRETATIONS ATTITUDES	GRAPHIC	DEPTH (FT.)	DESCRIPTION
		0	0-6.5' Colluvium - Soil
		1	brown/ black, clayey with shale rock fragments, mostly matrix
		2	
		3	
		4	
		5	
		6	6.5' to TD - graded contact
		7	Shale, white, suggestion of bedding, but no continuous layers
		8	
		9	
		10	
		11	
		12	@ 12' jumbled rock, loose fragments, variable hardness, no bedding, tight material, clayey
		13	
		14	
		15	
		16	
		17	
@ 18' 4" b- N78W, 30E		18	@18.5' suggestion of bedding, not sure if continuous around hole @19' 3"
@ 20'- 21.5' ring sample (1R)		19	rock is slightly dilated below, somewhat coherent, whitish tan, clayey
		20	(minor fracturing, light oxidation on fractures @ 24')
		21	@19.5' bedded towards into slope, dipping to NW, light tan, oxidation,
		22	layer continuous, hard, well bedded
		23	
		24	
		25	

LOS ANGELES COUNTY DEPARTMENT OF PUBLIC WORKS  
 GEOTECHNICAL AND MATERIALS ENGINEERING DIVISION

**SUMMARY LOG OF BORING** B-6

PROJECT Gates Canyon Park PROJECT ID GME000279 PAGE 2 OF 2  
 CLIENT WMD ELEVATION ~955' LOGGED BY K. Burger / Y. Halpern  
 TYPE/DIAMETER OF BORING 24" diameter DRILLER Roy Bros TOTAL DEPTH 60'  
 DATE(S) 5/26/2016 LOCATION See Boring Location Map

Note: This log contains observations and interpretations that are valid only for the specific date and location of the boring. Subsurface conditions vary between borings and with time. Lithologic descriptions are derived using visual classification methods and may vary from descriptions/classifications based on laboratory testing.


COMMENTS INTERPRETATIONS ATTITUDES	GRAPHIC	DEPTH (FT.)	DESCRIPTION
@ 27' b - N69E, 25S		25	@ 25' strong oxidation, soft material, no obvious bedding,
		26	hard rock pieces of more jumbled, varied rock fragments, oxidation
		27	@ 27' clayey zone 6-8" thick, very soft continuous around hole,
		28	shearing along bedding planes, polished surface below soft clay
		29	
		30	@ 29' oxidized claystone, orange, oxidation, suggestion of bedding,
		31	interlayered tan with orange oxidation clayey, stiff
		32	
		33	
		34	
		35	@ 35' gray-brown, hint of bedding, hard material
		36	
		37	
		38	
		39	
		40	
		41	
		42	
		43	
		44	@ 43' 8" ash bed 1" thick, continuous around hole
		45	(high pt)
46	@ 44' 9" hard material below ash bed, gray		
47	(low pt)		
48			
49	@ 50' 6" bottom of tape		
50	Total Depth 60'		
	Downhole logged by K. Burger to 50' 6"		
	Groundwater or seepage not encountered		

LOS ANGELES COUNTY DEPARTMENT OF PUBLIC WORKS  
 GEOTECHNICAL AND MATERIALS ENGINEERING DIVISION

**SUMMARY LOG OF BORING B-7**

PROJECT Gates Canyon Park PROJECT ID GME000279 PAGE 1 OF 3  
 CLIENT WMD ELEVATION ~960' LOGGED BY Y. Halpern  
 TYPE/DIAMETER OF BORING 24" diameter/Lo-Drill DRILLER Roy Bros TOTAL DEPTH 61'  
 DATE(S) 5/25/2016 LOCATION Behind Basketball Court

Note: This log contains observations and interpretations that are valid only for the specific date and location of the boring. Subsurface conditions vary between borings and with time. Lithologic descriptions are derived using visual classification methods and may vary from descriptions/classifications based on laboratory testing.


COMMENTS INTERPRETATIONS ATTITUDES	GRAPHIC	DEPTH (FT.)	DESCRIPTION
		0	Dark angular pieces at surface to 2' - depth
		1	
		2	
		3	
		4	@ ~4' tan-brown, sandy cuttings
		5	
		6	
		7	
		8	
		9	
		10	
		11	
		12	
		13	
		14	
		15	
		16	
		17	
		18	@ 18' reddish brown cuttings, oxidized, with 6-8" angular gravel pieces
		19	
		20	
		21	
		22	
		23	
		24	
		25	@ 25' seepage, red clayey material in tip

LOS ANGELES COUNTY DEPARTMENT OF PUBLIC WORKS  
 GEOTECHNICAL AND MATERIALS ENGINEERING DIVISION

**SUMMARY LOG OF BORING** B-7

PROJECT Gates Canyon Park PROJECT ID GME000279 PAGE 2 OF 3  
 CLIENT WMD ELEVATION ~960' LOGGED BY Y. Halpern  
 TYPE/DIAMETER OF BORING 24" diameter/Lo-Drill DRILLER Roy Bros TOTAL DEPTH 61'  
 DATE(S) 5/25/2016 LOCATION Behind Basketball Court

Note: This log contains observations and interpretations that are valid only for the specific date and location of the boring. Subsurface conditions vary between borings and with time. Lithologic descriptions are derived using visual classification methods and may vary from descriptions/classifications based on laboratory testing.


COMMENTS INTERPRETATIONS ATTITUDES	GRAPHIC	DEPTH (F.T.)	DESCRIPTION
		25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50	
			@ 36' black/ dark gray cuttings

LOS ANGELES COUNTY DEPARTMENT OF PUBLIC WORKS  
 GEOTECHNICAL AND MATERIALS ENGINEERING DIVISION

**SUMMARY LOG OF BORING B-7**

PROJECT Gates Canyon Park PROJECT ID GME000279 PAGE 3 OF 3  
 CLIENT WMD ELEVATION ~960' LOGGED BY Y. Halpern  
 TYPE/DIAMETER OF BORING 24" diameter/Lo-Drill DRILLER Roy Bros TOTAL DEPTH 61'  
 DATE(S) 5/25/2016 LOCATION Behind Basketball Court

Note: This log contains observations and interpretations that are valid only for the specific date and location of the boring. Subsurface conditions vary between borings and with time. Lithologic descriptions are derived using visual classification methods and may vary from descriptions/classifications based on laboratory testing.

COMMENTS INTERPRETATIONS ATTITUDES	GRAPHIC	DEPTH (F.T.)	DESCRIPTION
		50	
		51	
		52	
		53	
		54	
		55	
		56	
		57	H2O / Seepage encountered at 57' 5/26/16
		58	
		59	
		60	
		61	TD = 61'
		62	Not Downhole logged
		63	Surface logging by Y. Halpern 5/25/16
		64	Seepage at 25, 57'
		65	
		66	
		67	
		68	
		69	
		70	
		71	
		72	
		73	
		74	
		75	



LOS ANGELES COUNTY DEPARTMENT OF PUBLIC WORKS  
 GEOTECHNICAL AND MATERIALS ENGINEERING DIVISION

**SUMMARY LOG OF BORING B-8**

PROJECT Gates Canyon Park PROJECT ID GME000279 PAGE 1 OF 3  
 CLIENT WMD ELEVATION ~965' LOGGED BY K. Burger / Y. Halpern  
 TYPE/DIAMETER OF BORING 24" diameter DRILLER Roy Bros TOTAL DEPTH 60'  
 DATE(S) 5/26/2016 LOCATION See Boring Location Map

Note: This log contains observations and interpretations that are valid only for the specific date and location of the boring. Subsurface conditions vary between borings and with time. Lithologic descriptions are derived using visual classification methods and may vary from descriptions/classifications based on laboratory testing.


COMMENTS INTERPRETATIONS ATTITUDES	GRAPHIC	DEPTH (FT.)	DESCRIPTION
		0	@ 0' TD Bedrock (Tush)
		1	
		2	
		3	
@ 4' b - N76W, 34S		4	@ 4' well bedded, light tan shade with orange brown oxidation on surfaces, blocky
		5	
		6	
		7	
		8	
		9	
		10	@ 10' not blocky, hard, white, some caving down to 12', "fairly coherent"
		11	
		12	clayey below 10.5'
		13	orange brown mottled with tan, rocky
@ 14' 11" b - N7W, 57S		14	@ 14' 11" 1/2" thick orange, mottled with whitish yellow, dry, clayey layer
		15	(high pt.)
		16	@ 16' 5" 12" continuous around hole
		17	(low pt.)
		18	@ 17' 8" cave zone - "blocky"
		19	to 20' 6" approximately 1' wide, abundant oxidation, yellow: orange
		20	
		21	
		22	@ 22' 10" Right of tape, cave zone, "blocky", approximately 12" wide
		23	
		24	@ 24' 6" fracture ~ 3" wide - entire arm to elbow into side wall
		25	to 24' 8" at base of cave zone, white patch at 25' 7 1/2"

LOS ANGELES COUNTY DEPARTMENT OF PUBLIC WORKS  
 GEOTECHNICAL AND MATERIALS ENGINEERING DIVISION

**SUMMARY LOG OF BORING B-8**

PROJECT Gates Canyon Park PROJECT ID GME000279 PAGE 2 OF 3  
 CLIENT WMD ELEVATION ~965' LOGGED BY K. Burger / Y. Halpern  
 TYPE/DIAMETER OF BORING 24" diameter DRILLER Roy Bros TOTAL DEPTH 60'  
 DATE(S) 5/26/2016 LOCATION See Boring Location Map

Note: This log contains observations and interpretations that are valid only for the specific date and location of the boring. Subsurface conditions vary between borings and with time. Lithologic descriptions are derived using visual classification methods and may vary from descriptions/classifications based on laboratory testing.


COMMENTS INTERPRETATIONS ATTITUDES	GRAPHIC	DEPTH (FT.)	DESCRIPTION
@ 27' 9 3/4" N10W, 35 S		25	
		26	
		27	@ 26' 5" white ash bed continuous around hole 1 1/2" thick, poorly defined
		28	
		29	@ 29' 4 1/2" weakly developed, brown dark/grey brown and orangish tan
		30	
		31	@ 30' 7" blocky zone to 41' - (fault) ~ 1' wide
		32	
		33	
		34	
		35	
		36	
		37	
		38	
		39	
		40	
		41	@ 41' 9" darker grey-brown, faint bedding, less oxidation, clayey
		42	
		43	
		44	
		45	
		46	
		47	
		48	
		49	
50			

LOS ANGELES COUNTY DEPARTMENT OF PUBLIC WORKS  
 GEOTECHNICAL AND MATERIALS ENGINEERING DIVISION

**SUMMARY LOG OF BORING B-8**

PROJECT Gates Canyon Park PROJECT ID GME000279 PAGE 3 OF 3  
 CLIENT WMD ELEVATION ~965' LOGGED BY K. Burger / Y. Halpern  
 TYPE/DIAMETER OF BORING 24" diameter DRILLER Roy Bros TOTAL DEPTH 60'  
 DATE(S) 5/26/2016 LOCATION See Boring Location Map

Note: This log contains observations and interpretations that are valid only for the specific date and location of the boring. Subsurface conditions vary between borings and with time. Lithologic descriptions are derived using visual classification methods and may vary from descriptions/classifications based on laboratory testing.

COMMENTS INTERPRETATIONS ATTITUDES	GRAPHIC	DEPTH (F.T.)	DESCRIPTION
		50	
		51	
		52	
		53	
		54	@ 54' 8" contact with hard material below, sandier, harder, less clayey
		55	@ 55' 10" hard layer ends
		56	
		57	
		58	
		59	
		60	
		61	TD = 60'
		62	Ground water or seepage not encountered
		63	Surface logging by Y. Halpern 5/26/16
		64	Downhole logging by K. Burger 5/26/16
		65	Downhole logged to 60'
		66	
		67	
		68	
		69	
		70	
		71	
		72	
		73	
		74	
		75	

LOS ANGELES COUNTY DEPARTMENT OF PUBLIC WORKS  
 GEOTECHNICAL AND MATERIALS ENGINEERING DIVISION

**SUMMARY LOG OF BORING** B-9

PROJECT Gates Canyon Park PROJECT ID \_\_\_\_\_ PAGE 1 OF 1  
 CLIENT WMD ELEVATION \_\_\_\_\_ LOGGED BY Y. Halpern  
 TYPE/DIAMETER OF BORING 18" diameter DRILLER Roy Bros TOTAL DEPTH 21'  
 DATE(S) 5/26/2016 LOCATION Field

Note: This log contains observations and interpretations that are valid only for the specific date and location of the boring. Subsurface conditions vary between borings and with time. Lithologic descriptions are derived using visual classification methods and may vary from descriptions/classifications based on laboratory testing.

COMMENTS INTERPRETATIONS ATTITUDES	GRAPHIC	DEPTH (FT.)	DESCRIPTION
		0	CL Lean Clay, (fill)
		1	med - moist to wet, trace sand, with angular gravels, dense, up to 4" diameter
		2	@ 1' large ~ 12-14" angular boulder visible in sidewall bedrock
		3	
		4	
		5	@ 5' dark/ black clay with angular gravel, small boulder `8" diameter
		6	
		7	
		8	@ 8' grey silt, ML, with some fine sand
		9	
		10	@ 10' silty clay, dark grey
		11	@ 11' back to clay, lean clay, dark brown/ black silt/ clay mix with some
		12	with some oxidation small pebbles and gravels, fine sand
		13	
		14	
		15	@ 15' dense fill, with silt and clay ~ 6" angular bedrock in cuttings
		16	small cobbles and pebbles in fill, slight oxidation patches, dense fill
		17	
		18	@ 18' hard rock at tip ~ 12" - thick
		19	
		20	@ 20' fill matrix, pebbles and gravels, trace oxidation pieces of shale
		21	very dense
		22	End of Boring @ 21'
		23	
		24	
		25	

# **Appendix C**

Summary of Laboratory Results



# LOS ANGELES COUNTY DEPARTMENT OF PUBLIC WORKS

Material Engineering Division  
Geotechnical Laboratory

## *Chemical / Resistivity Report*

PROJECT NAME: Gates Canyon Park  
PCA: F21816i02  
ENGINEER: Y. Halpern

BORING-SAMPLE:	B3-1R			
DEPTH:	10-11'			
MINIMUM RESISTIVITY (K ohms-cm):	n/a			
PH :	6.8			
CHLORIDE CONTENT (ppm):	4			
SO4 (ppm):	24			

Remarks:

**LOS ANGELES COUNTY DEPARTMENT OF PUBLIC WORKS  
GEOTECHNICAL AND MATERIALS ENGINEERING DIVISION**

Field Moisture and Density Data Sheet / ASTM D2216 & CTM 226

PROJECT NAME: Gate Canyon Park  
 PCA: GF21816i02  
 PROJECT ENGINEER: Y. Halpern

DATE TESTED: 10/6/2016  
 TECHNICIAN: CL  
 CHECKED BY: EH

	1	2	3	4	5	6	7	8
<b>BORING NO./SAMPLE NO.</b>	<b>B1-1R</b>	<b>B4-1R</b>	<b>B5-1R</b>	<b>B6-1R</b>				
LABORATORY NO.	n/a	n/a	n/a	n/a				
DEPTH (ft.)	16.5-17.5	40-41	30-31	20-21				
FIELD CLASSIFICATION	Colluvium	Mudstone	Mudstone	Hard BR				
SAMPLE SIZE (in.)	2.375	2.375	2.375	2.375				
NO. OF RINGS SAMPLED	4	6	6	4				
NO. OF RINGS TESTED	3	4	5	4				
VOLUME OF SOIL TESTED (ft <sup>3</sup> )	0.00769	0.01025	0.01282	0.01025				
TARE + WET SOIL (lbs.)	1.20	1.66	2.05	1.50				
TARE (lbs.)	0.45	0.60	0.75	0.60				
WET SOIL (lbs.)	0.75	1.06	1.30	0.90				
WEIGHT OF #4 ROCK (lbs.)	0.19	0.00	0.00	0.00				
WEIGHT OF 3/4 ROCK (lbs.)	0.00	0.00	0.00	0.00				
WET FINES	0.56	1.06	1.30	0.90				
WET WEIGHT (gms.)FOR MOIST. CONTENT	51.3	108.5	146.9	107.3				
DRY WEIGHT FOR MOISTURE CONTENT (GMS)	41.3	82.9	109.2	84.4				
MOISTURE CONTENT OF FINES (%)	24.2	30.9	34.5	27.1				
DRY FINES	0.45	0.81	0.97	0.71				
TOTAL DRY SOIL (lbs.)	0.64	0.81	0.97	0.71				
TOTAL WATER (lbs.)	0.11	0.25	0.33	0.19				
<b>COMPOSITE MOISTURE (%)</b>	<b>17.0</b>	<b>30.9</b>	<b>34.5</b>	<b>27.1</b>				
% OF #4 ROCK	29.6	0.0	0.0	0.0				
% OF 3/4 ROCK	0.0	0.0	0.0	0.0				
<b>COMPOSITE DRY DENSITY (pcf)</b>	<b>83.3</b>	<b>79.0</b>	<b>75.4</b>	<b>69.0</b>				
Void Ratio:	0.98	1.09	1.19	1.40				
Degree of Saturation (%):	45.85	74.81	76.65	51.52				



# LOS ANGELES COUNTY DEPARTMENT OF PUBLIC WORKS

## Geotechnical and Materials Engineering Division

Geotechnical Laboratory - ASTM D2487, D6913, C117, C136

### SIEVE ANALYSIS WORKSHEET

PROJECT NAME: Gates Canyon Park  
 LAB. ID: n/a  
 CLASSIFICATION: **SM**  
 TESTED BY: CL  
 CHECKED BY: EH

PCA: F21816i02  
 BORING / SAMPLE: B1-1R  
 DEPTH (FT): 16.5-17.5  
 DATE TESTED: 10/6/16  
 DATE CHECKED: 10/17/16  
 % ret. #4 / % ret. #200 : **40.5**  
If % Accum. Ret. #4 / % Accum. Ret. #200 < 50%, then Sand  
 If % Passing #200 < 50%, SILT, SAND or DUAL

#### COARSE (Plus no. 4)

ASTM SIEVE NUMBER	SIZE (mm)	RETAINED (lb)	% OF TOTAL OVEN DRY RETAINED	ACCUM. % RETAINED	ACCUM. % PASSING	
					ACTUAL	SPEC. REQ.
6"	152.4					
3"	76.2					
1 1/2"	38.1					
1"	25.4					
3/4"	19.1				100.0	
3/8"	9.52	0.06	9.4	9.4	90.6	
No. 4	4.76	0.13	20.3	29.7	70.3	
PAN	0	0.56				
<b>MOISTURE CONTENT OF FINES</b>						
<b>TOTAL FRACTIONS</b>		0.75			Wet WGT. (gm)	51.30
<b>OVEN-DRY FINES</b>		0.45			Dry WGT. (gm)	41.30
<b>* TOTAL OVEN-DRY</b>		0.641			MOISTURE (%)	24.21

\* Cobbles not included in total oven-dry weight.

<b>MOISTURE CONTENT OF COURSE</b>	
Wet WGT. (gm)	0.19
Dry WGT. (gm)	0.18
MOISTURE (%)	0.06

#### FINES (Minus no. 4)

<b>WET WEIGHT OF FINES USED FOR WASHING (gms)</b>	51.30
<b>CALCULATED OVEN-DRY WEIGHT (gms)</b>	41.30
<b>WT. OF TOTAL SAMPLE REPRESENTED BY FINES, OVEN-DRY (gms):</b>	58.71

ASTM SIEVE NUMBER	SIZE (mm)	RETAINED (gms)	% OF TOTAL OVEN DRY RETAINED	ACCUM. % RETAINED	ACCUM. % PASSING	
					ACTUAL	SPEC. REQ.
8	2.38					
16	1.19					
30	0.59					
50	0.297					
100	0.149					
200	0.074			73.2	26.8	
PAN	0					
<b>TOTAL FRACTIONS</b>		0.00	0.0			
<b>TOTAL DRY WEIGHT AFTER WET SEIVING</b>		25.58	43.6			
<b>SIEVE LOSS-GAIN</b>		25.58				

<b>Atterberg Test</b>	
Liquid Limit	56
Plastic Limit	36
Plastic Index	20

SOIL DESCRIP. / REMARKS: semi plastic

**LOS ANGELES COUNTY DEPARTMENT OF PUBLIC WORKS**  
**GEOTECHNICAL & MATERIALS ENGINEERING DIVISION / Geotechnical Laboratory**  
**LIQUID LIMIT AND PLASTICITY INDEX TESTS**  
 ASTM D4318 / CTM 204

**PROJECT NAME:** Gates Canyon Park  
**LABORATORY ID:** n/a  
**TESTED BY:** CL  
**CHECKED BY:** EH  
**CLASSIFICATION:**

**PCA:** F21816i02  
**BOR./SAMP.:** B1-1R  
**DATE TESTED:** 10/6/2016  
**DATE CHECKED:** 10/17/2016  
**- #(200):** 26.8

**LIQUID LIMIT**

Container Number	G19
Number of Blows (N)	24
Wet Sample + Tare (gms.)	15.9530
Dry Sample + Tare (gms.)	15.7580
Wt. of Water (gms.)	0.1950
Wt. of Tare (gms.)	15.4100
Wt. of Dry Soil (gms.)	0.3480
Moisture Content (% $W_n$ )	56.0

**Liquid Limit** **56**  $LL = (W_n)(N/25)^{0.121}$

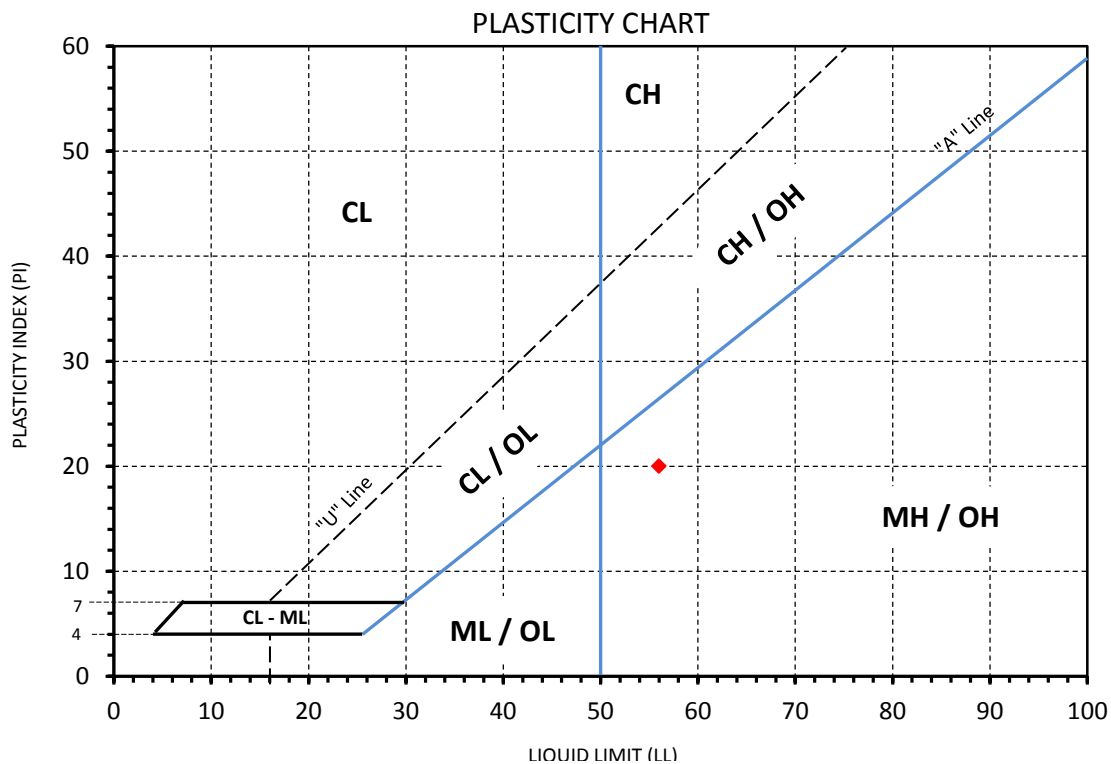
**PLASTICITY INDEX**

(LL-PL) = **20**

**PLASTIC LIMIT**

No. of Samples Tested	3		
Run Number	1	2	3
Container Number	G0	G14	G24
Wet Sample + Tare (gms.)	7.2780	7.6970	6.8150
Dry Sample + Tare (gms.)	6.8152	7.1910	6.4981
Wt. of Water (gms.)	0.4628	0.5060	0.3169
Wt. of Tare (gms.)	5.5800	5.7840	5.5970
Wt. of Dry Soil (gms.)	1.2352	1.4070	0.9011
Moisture Content (%)	37.5	36.0	35.2

**Plastic Limit (Avg. Value)** **36**





**DEPARTMENT OF PUBLIC WORKS, LOS ANGELES  
GEOTECHNICAL & MATERIALS ENGINEERING**

DIRECT SHEAR ASTM D3080

**Project:** Gates Canyon Park

**PCA:** F21816i02

**USC:** n/a

**% (-200):** n/a

**Boring/Sample:** B1-2R

**LL:** n/a

**PI:** n/a

**Depth (ft):** 30

**% ret. 3/4":** 0.0

**% ret. #4:** 0.0

**Sample Condition:** soft

**Composite Dry Density (pcf):** 83.5

**Field Class.:** n/a

**Composite Moisture (%):** 24.4

**Number of Rings:** 6

**Initial (Field) Void Ratio:** 0.98

**App. Soaking Time:** 15 hrs.

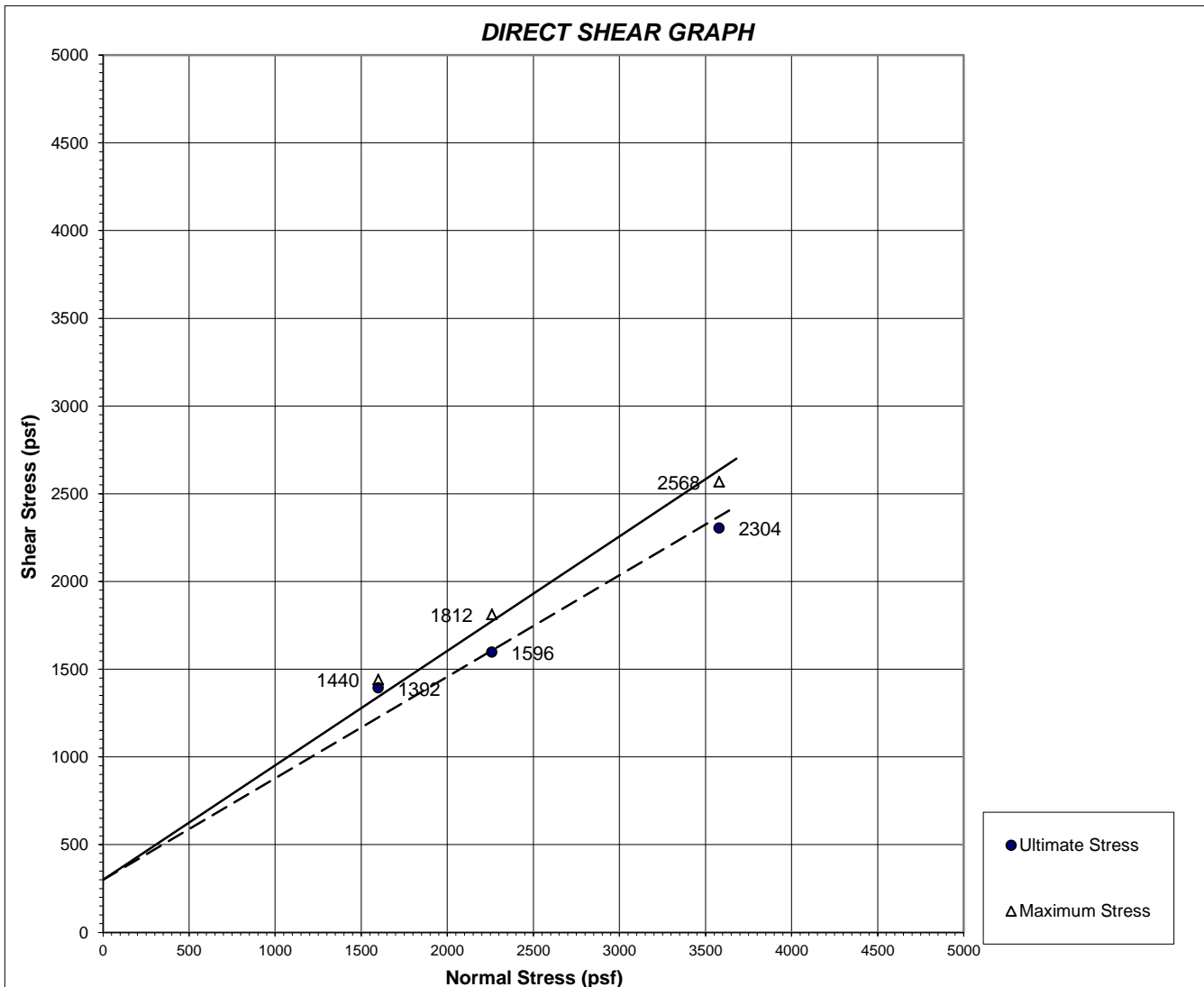
**Initial (Field) Saturation (%):** 66.1

**Notes:** Dark Brown, Silt w/ trace of clay, plastic, moist.

Ring Dia.:	2.375		
Normal Stress	Ultimate Stress	Maximum Stress	RATE
(psf)	(psf)	(psf)	IN./MIN
	----	----	----
			0.005
1600	1392	1440	
2260	1596	1812	
3580	2304	2568	

$\phi$ Max	33
$\phi$ Ult	30
$C_{max}$	300
$C_{ult}$	300

Max (-tan)	0.6522
Ult (-tan)	0.5785



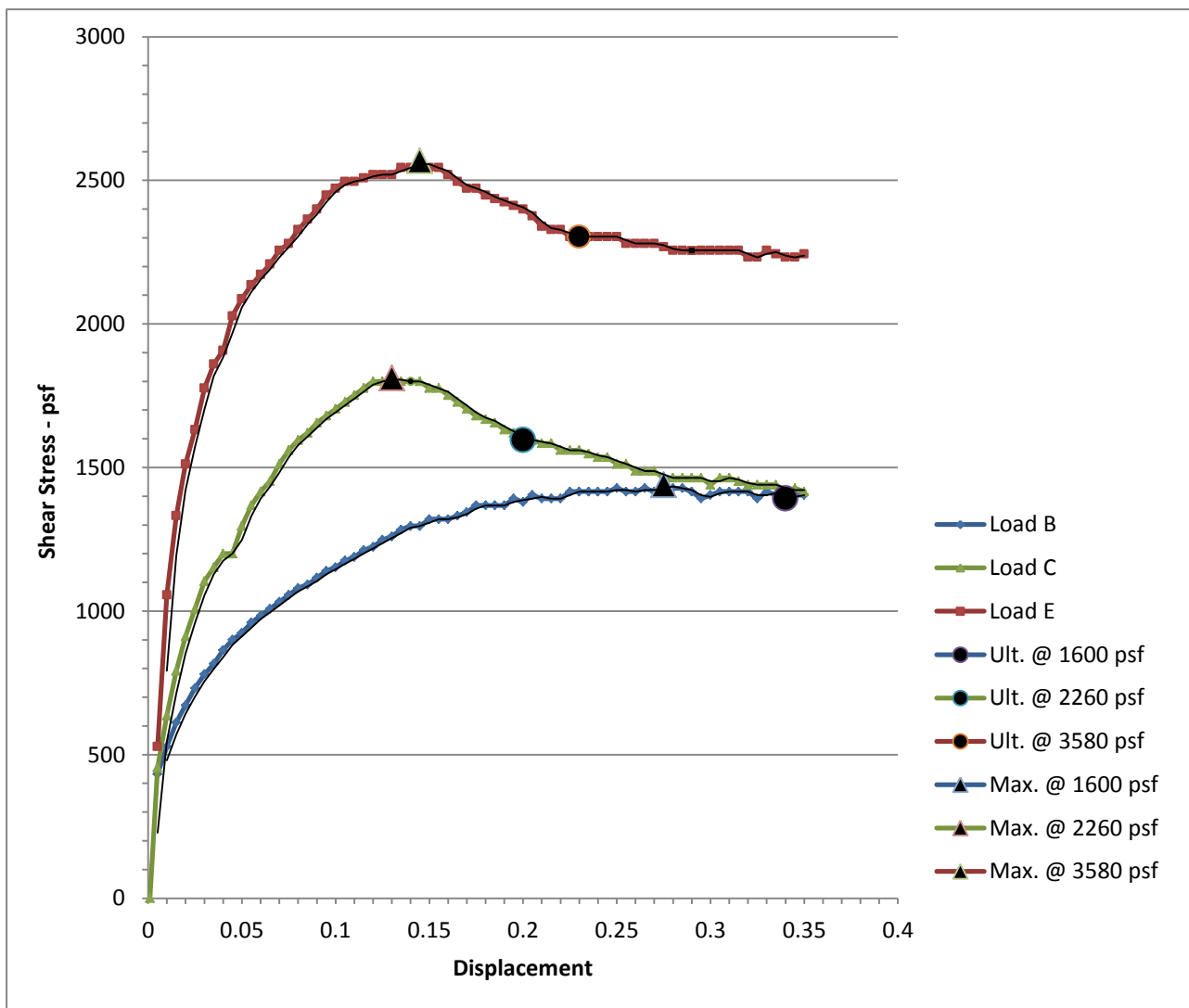
**DEPARTMENT OF PUBLIC WORKS, LOS ANGELES  
GEOTECHNICAL & MATERIALS ENGINEERING**

DIRECT SHEAR ASTM D3080

**Multi Graph**

Project Name: **Gates Canyon Park**  
 PCA: F21816i02  
 Boring/Sample: **B1-2R**

	Normal Stress psf	Ult. Stress psf	Dist. inch	Max. Stress psf	Dist. inch	Ring WGT + Wet Soil lb.	Approx. Field Density psf
Load B	1600	1392	0.34	1440	0.275	0.4111	81.8
Load C	2260	1596	0.2	1812	0.13	0.4201	84.7
Load E	3580	2304	0.23	2568	0.145	0.4295	87.6



**DEPARTMENT OF PUBLIC WORKS, LOS ANGELES  
GEOTECHNICAL & MATERIALS ENGINEERING**

DIRECT SHEAR ASTM D3080

**Project:** Gates Canyon Park

**PCA:** F21816i02

**USC:** n/a

**% (-200):** n/a

**Boring/Sample:** B1-3R

**LL:** n/a

**PI:** n/a

**Depth (ft):** 60

**% ret. 3/4":** 0.0

**% ret. #4:** 0.0

**Sample Condition:** soft

**Composite Dry Density (pcf):** 84.2

**Field Class.:** n/a

**Composite Moisture (%):** 21.9

**Number of Rings:** 6

**Initial (Field) Void Ratio:** 0.96

**App. Soaking Time:** 24 hrs

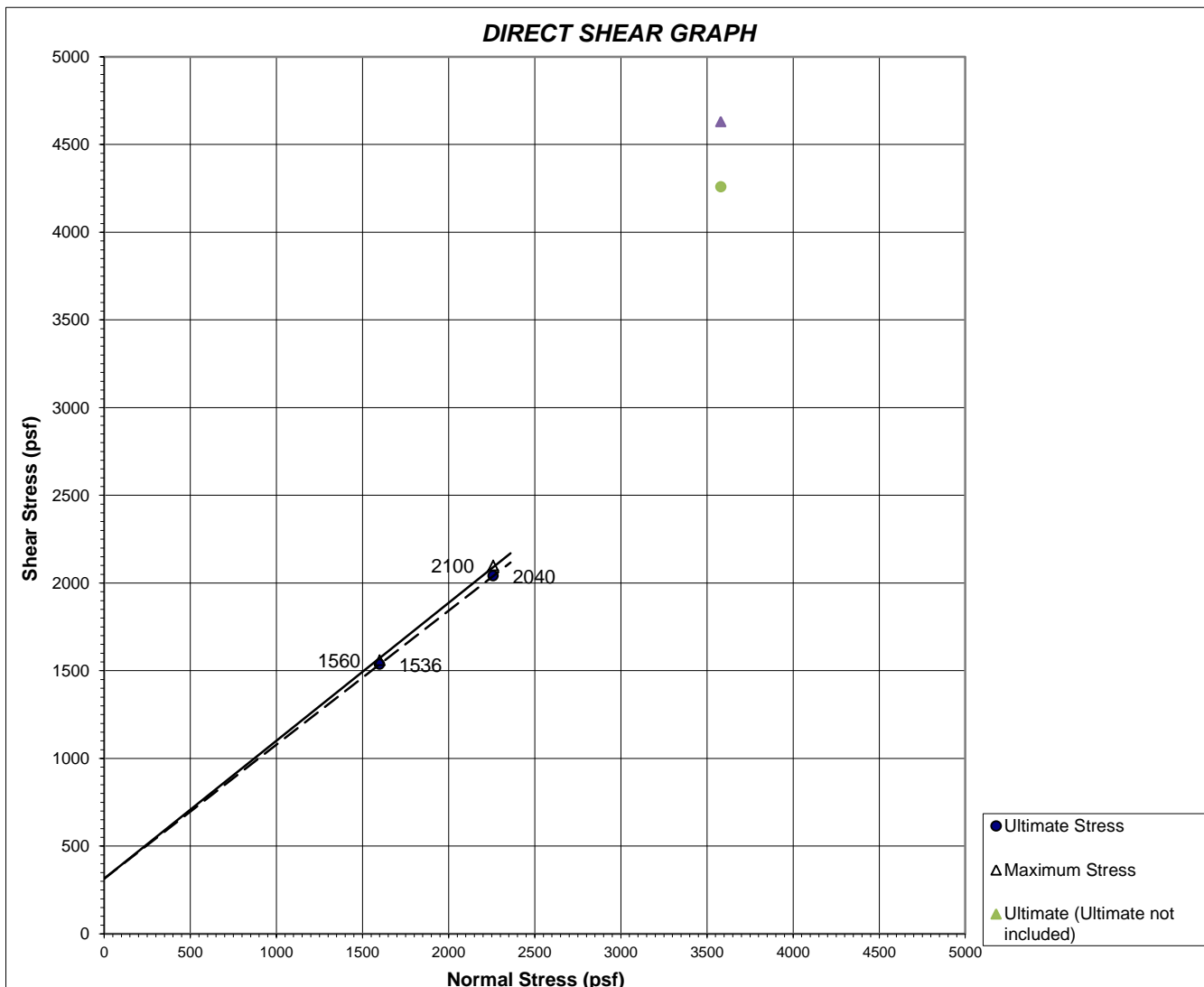
**Initial (Field) Saturation (%):** 60.3

**Notes:** Dense, Dark brown, silt with trace of clay, plastic, clay stones present from weak to moderate strength

Ring Dia.:	2.375		
Normal Stress	Ultimate Stress	Maximum Stress	RATE
(psf)	(psf)	(psf)	IN./MIN
	----	----	----
			0.008
1600	1536	1560	
2260	2040	2100	
3580	4259	4631	

$\phi$ Max	38
$\phi$ Ult	37
$C_{max}$	314
$C_{ult}$	314

Max (-tan)	0.7863
Ult (-tan)	0.7636



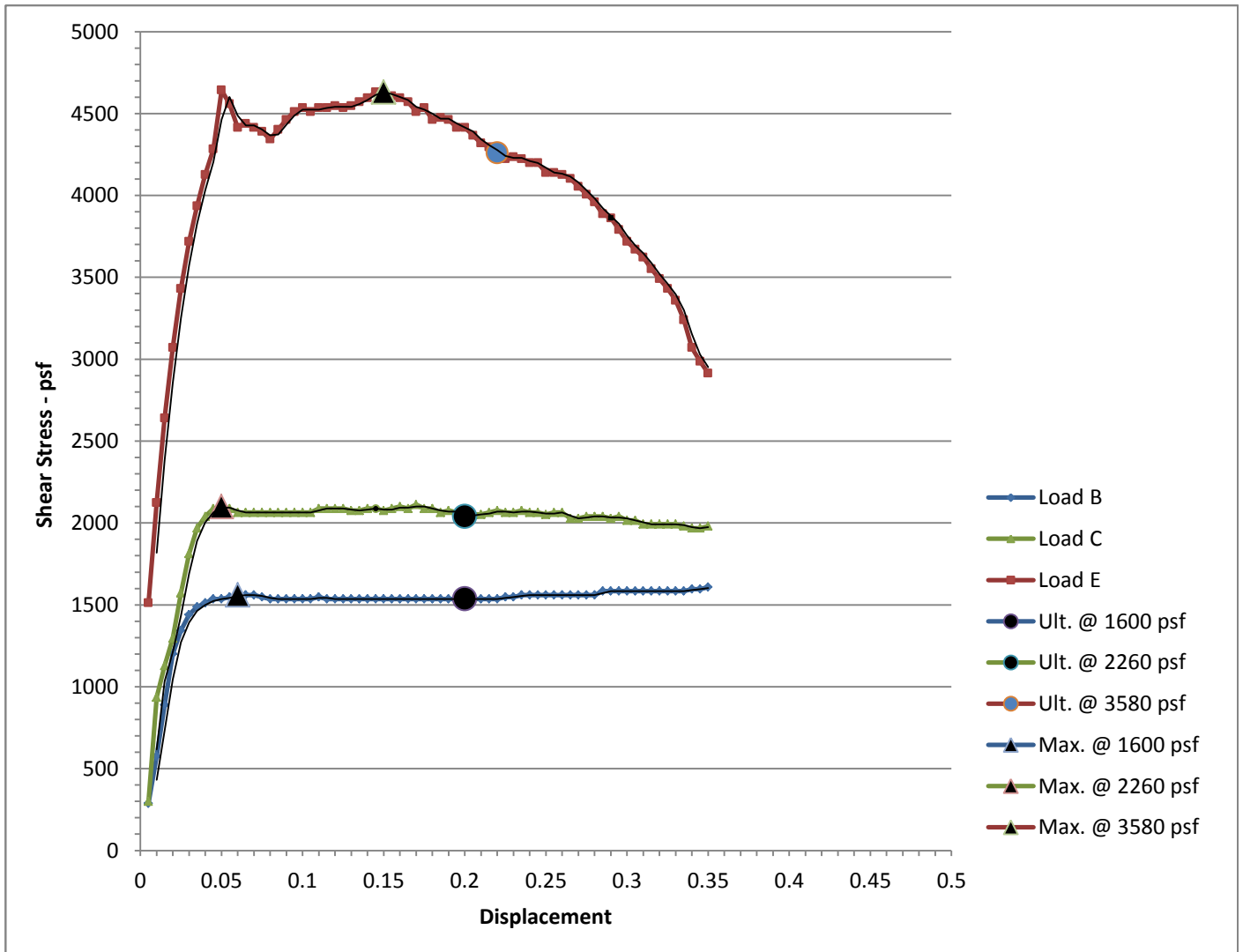
**DEPARTMENT OF PUBLIC WORKS, LOS ANGELES**  
**GEOTECHNICAL & MATERIALS ENGINEERING**  
 DIRECT SHEAR ASTM D3080

Multi Graph

Project Name: **Gates Canyon Park**  
 PCA: F21816i02  
 Boring/Sample: **B1-3R**

	Normal Stress psf	Ult. Stress psf	Dist. inch	Max. Stress psf	Dist. inch
Load B	1600	1536	0.2	1560	0.06
Load C	2260	2040	0.2	2100	0.05
Load E	3580	4259	0.22	4631	0.15

Ring WGT + Wet Soil lb.	Approx. Field Density psf
0.4090	82.8
0.4190	86.0
0.4290	89.2



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DIRECT SHEAR ASTM D3080

**Project:** Gates Canyon Park

**PCA:** F21816i02

**USC:** n/a

**% (-200):** n/a

**Boring/Sample:** B3-2R

**LL:** n/a

**PI:** n/a

**Depth (ft):** 30

**% ret. 3/4":** 0.0

**% ret. #4:** 0.0

**Sample Condition:** soft

**Composite Dry Density (pcf):** 80.5

**Field Class.:** n/a

**Composite Moisture (%):** 25.6

**Number of Rings:** 6

**Initial (Field) Void Ratio:** 1.05

**App. Soaking Time:** 24 hrs

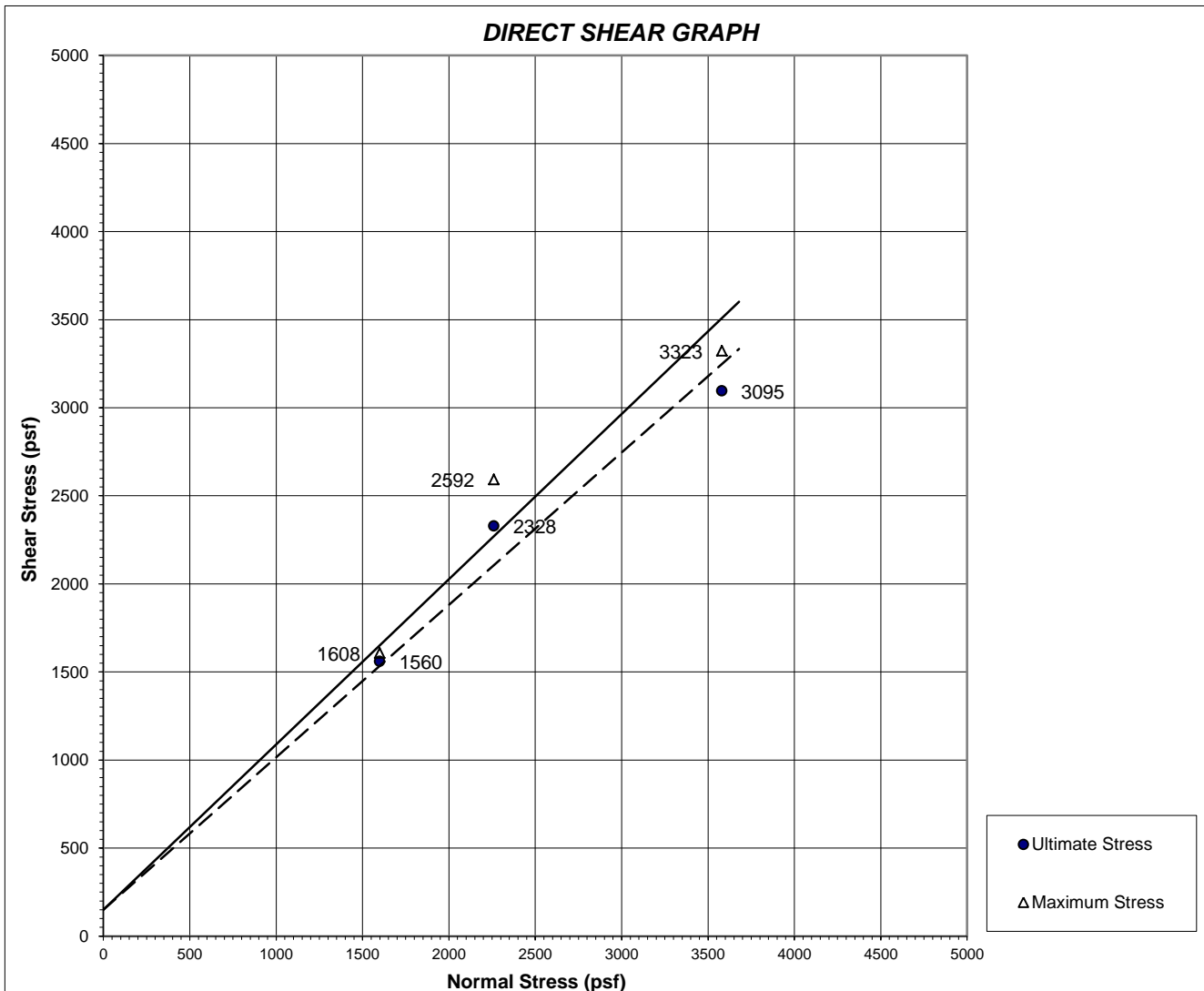
**Initial (Field) Saturation (%):** 64.3

**Notes:** Silt Stone, dry, brown, sedimentation, pocket of clay stone present.

Ring Dia.:	2.375		
Normal Stress	Ultimate Stress	Maximum Stress	RATE
(psf)	(psf)	(psf)	IN./MIN
	----	----	----
			0.015
1600	1560	1608	
2260	2328	2592	
3580	3095	3323	

$\phi$ Max	43
$\phi$ Ult	41
$C_{max}$	150
$C_{ult}$	150

Max (-tan)	0.9379
Ult (-tan)	0.8651





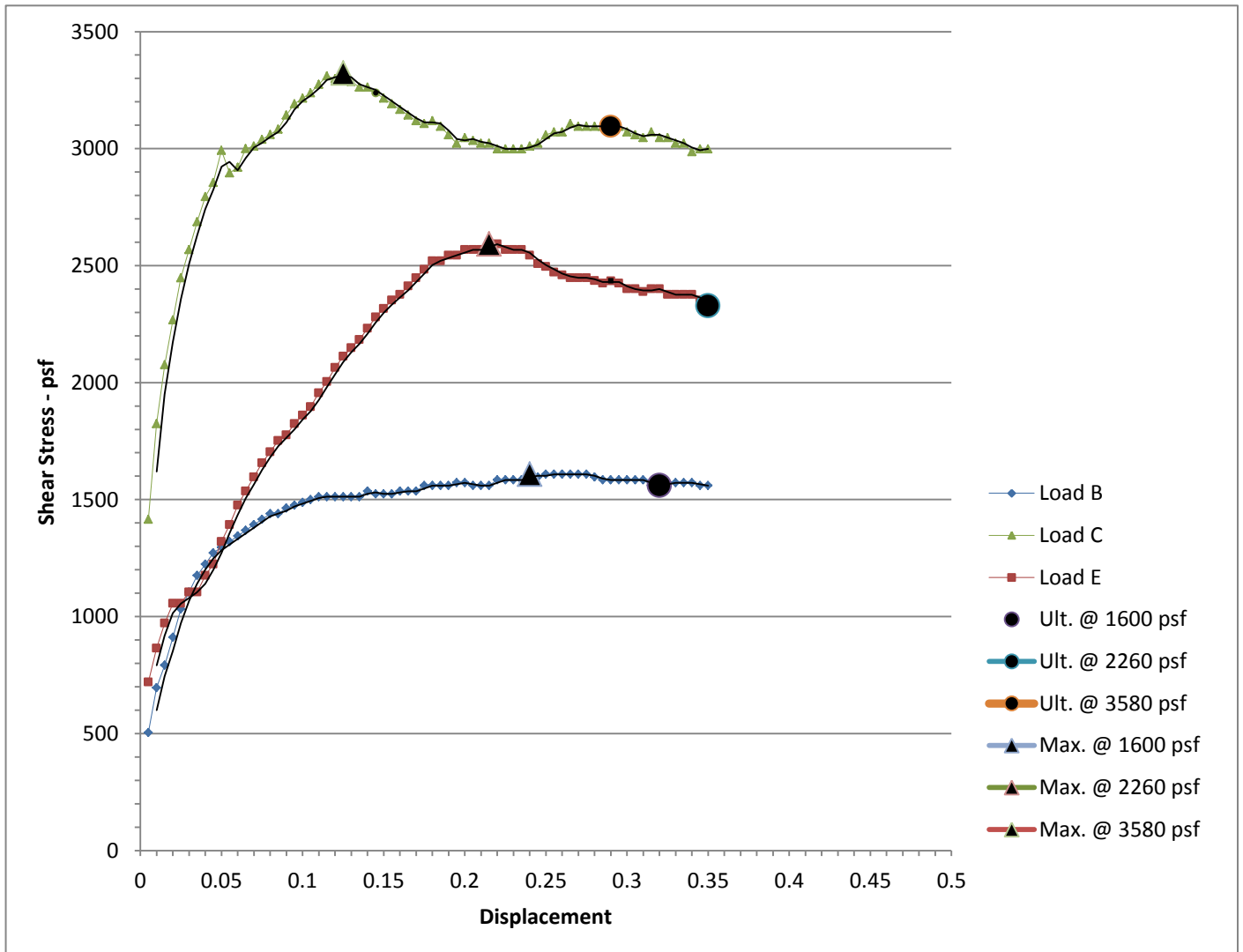
**DEPARTMENT OF PUBLIC WORKS, LOS ANGELES**  
**GEOTECHNICAL & MATERIALS ENGINEERING**  
 DIRECT SHEAR ASTM D3080

Multi Graph

Project Name: **Gates Canyon Park**  
 PCA: F21816i02  
 Boring/Sample: **B3-2R**

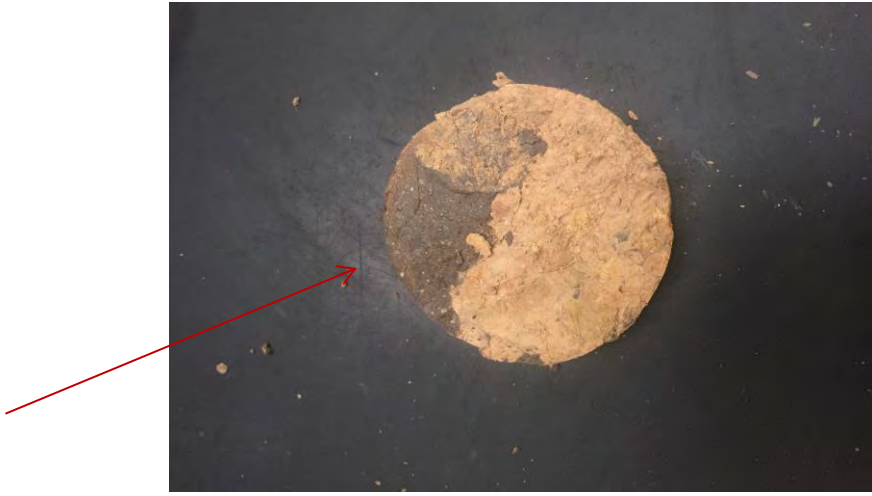
	Normal Stress psf	Ult. Stress psf	Dist. inch	Max. Stress psf	Dist. inch
Load B	1600	1560	0.32	1608	0.24
Load C	2260	2328	0.35	2592	0.215
Load E	3580	3095	0.29	3323	0.125

Ring WGT + Wet Soil lb.	Approx. Field Density psf
0.3985	77.2
0.4014	78.1
0.4151	82.4



Gates Canyon Park - Ring Sample **B3-2R** Pictures

---



B2-3R Load E, Claystone pocket

**DEPARTMENT OF PUBLIC WORKS, LOS ANGELES  
GEOTECHNICAL & MATERIALS ENGINEERING**

DIRECT SHEAR ASTM D3080 / D2488

**Project:** Gates Canyon Park

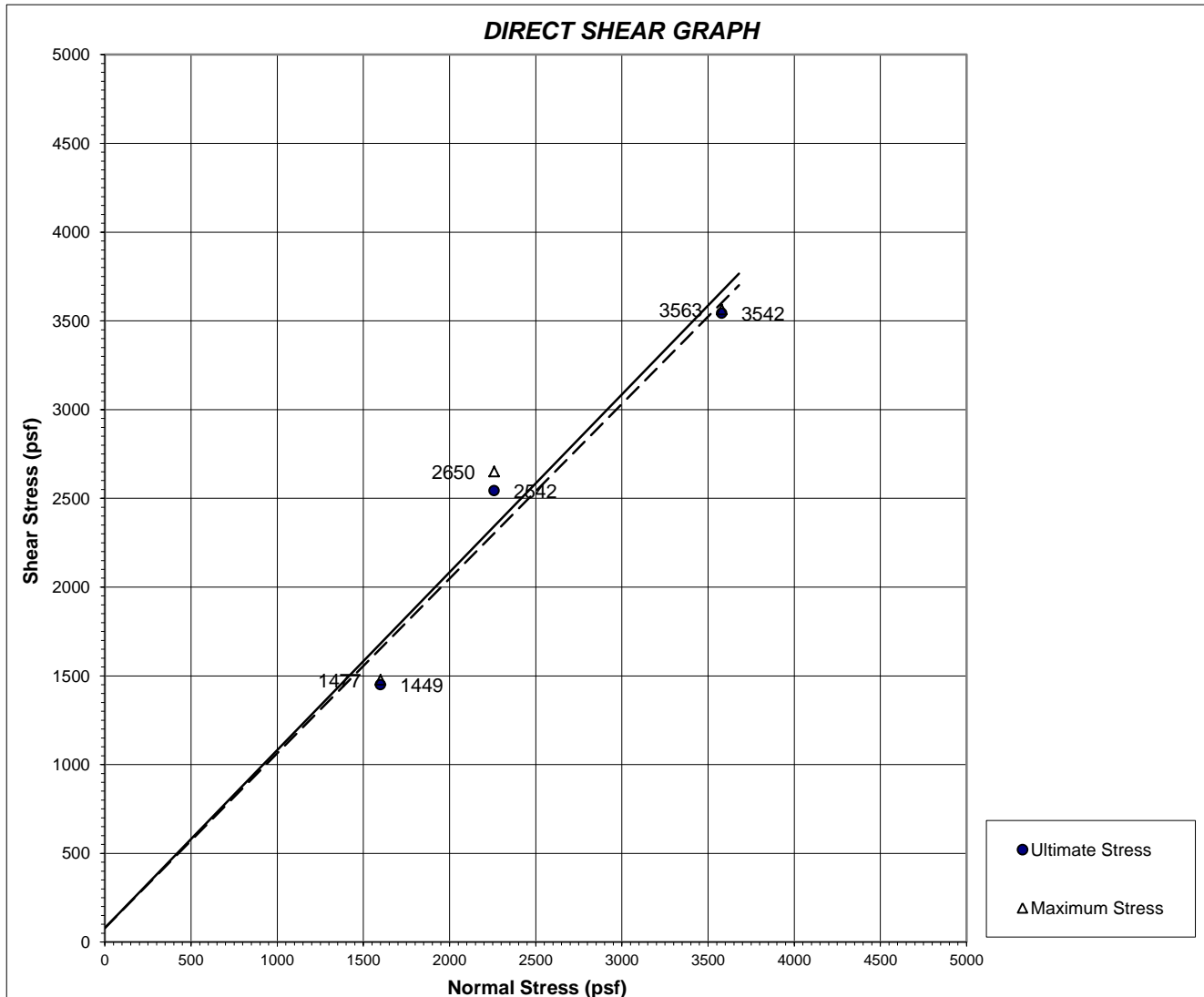
**PCA:** F21816i02      **USC:** n/a      **% (-200):** n/a  
**Boring/Sample:** B3-3R      **LL:** n/a      **PI:** n/a  
**Depth (ft):** 60      **% ret. 3/4":** 0.0      **% ret. #4:** 0.0  
**Sample Condition:** soft      **Composite Dry Density (pcf):** 75.6  
**Field Class.:** n/a      **Composite Moisture (%):** 24.3  
**Number of Rings:** 6      **Initial (Field) Void Ratio:** 1.19  
**App. Soaking Time:** 24 hrs      **Initial (Field) Saturation (%):** 54.2

**Notes:** Silt stone, light brown

Ring Dia.:	2.375		
<b>Normal Stress</b>	<b>Ultimate Stress</b>	<b>Maximum Stress</b>	<b>RATE</b>
(psf)	(psf)	(psf)	IN./MIN
	----	----	----
			0.015
1600	1449	1477	
2260	2542	2650	
3580	3542	3563	

$\phi$ Max	45
$\phi$ Ult	45
$C_{max}$	79
$C_{ult}$	79

Max (-tan)	1.0018
Ult (-tan)	0.9841



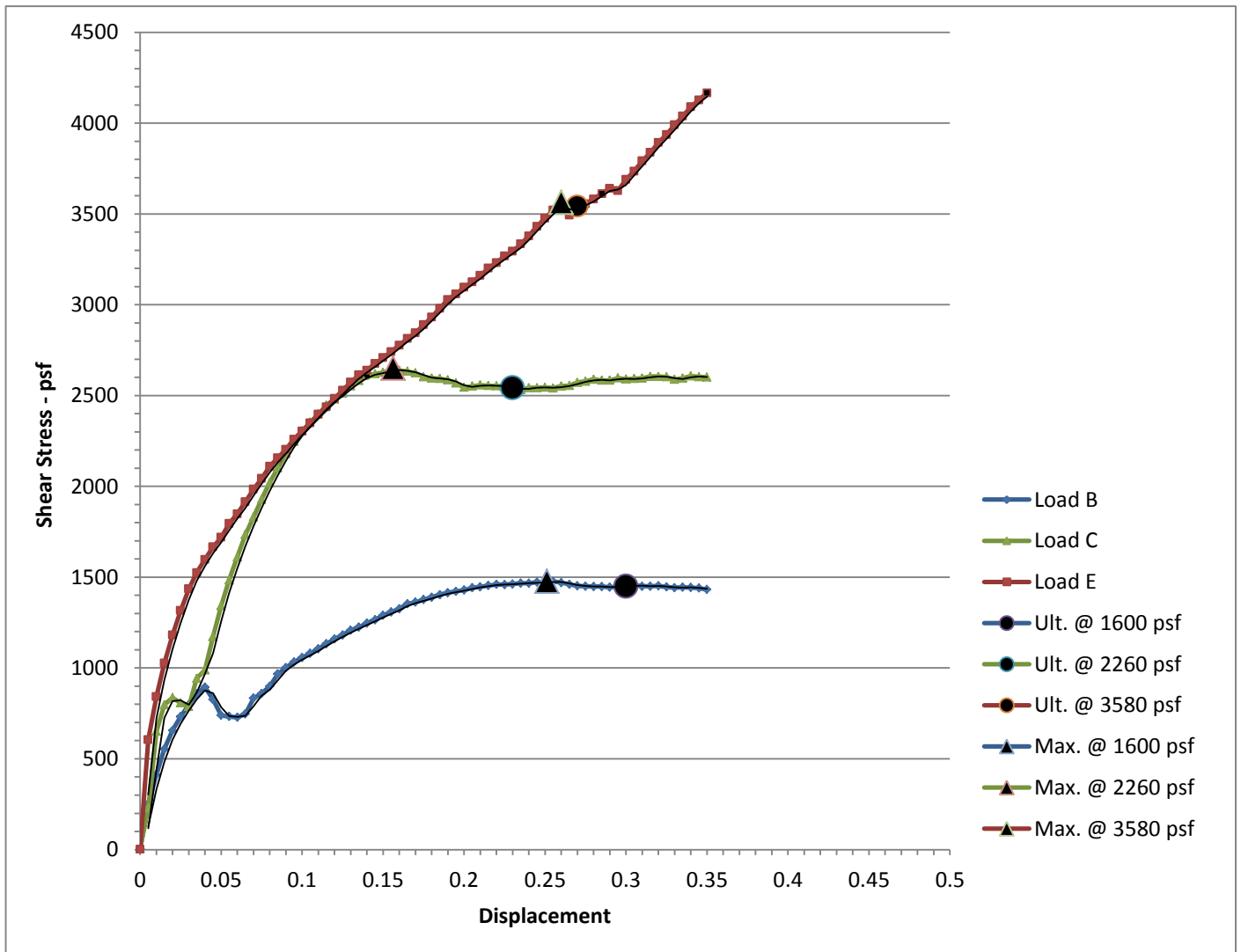
**DEPARTMENT OF PUBLIC WORKS, LOS ANGELES**  
**GEOTECHNICAL & MATERIALS ENGINEERING**  
 DIRECT SHEAR ASTM D3080

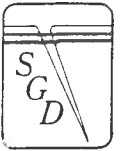
Multi Graph

Project Name: **Gates Canyon Park**  
 PCA: F21816i02  
 Boring/Sample: **B3-3R**

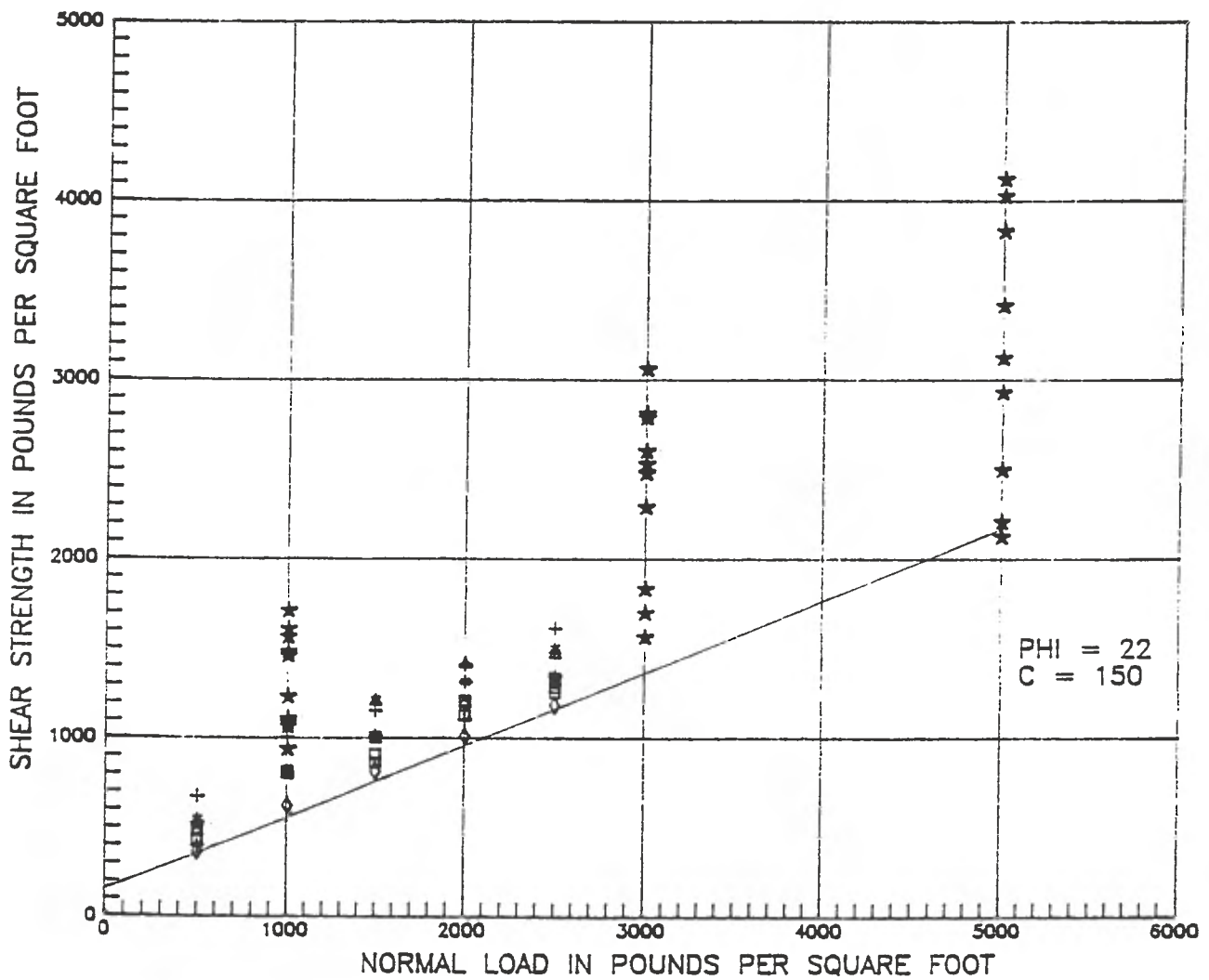
	Normal Stress psf	Ult. Stress psf	Dist. inch	Max. Stress psf	Dist. inch
Load B	1600	1449	0.3	1477	0.2512
Load C	2260	2542	0.23	2650	0.1562
Load E	3580	3542	0.27	3563	0.26

Ring WGT + Wet Soil lb.	Approx. Field Density psf
0.3845	73.6
0.3939	76.6
0.4100	81.6

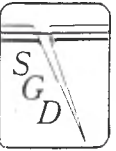




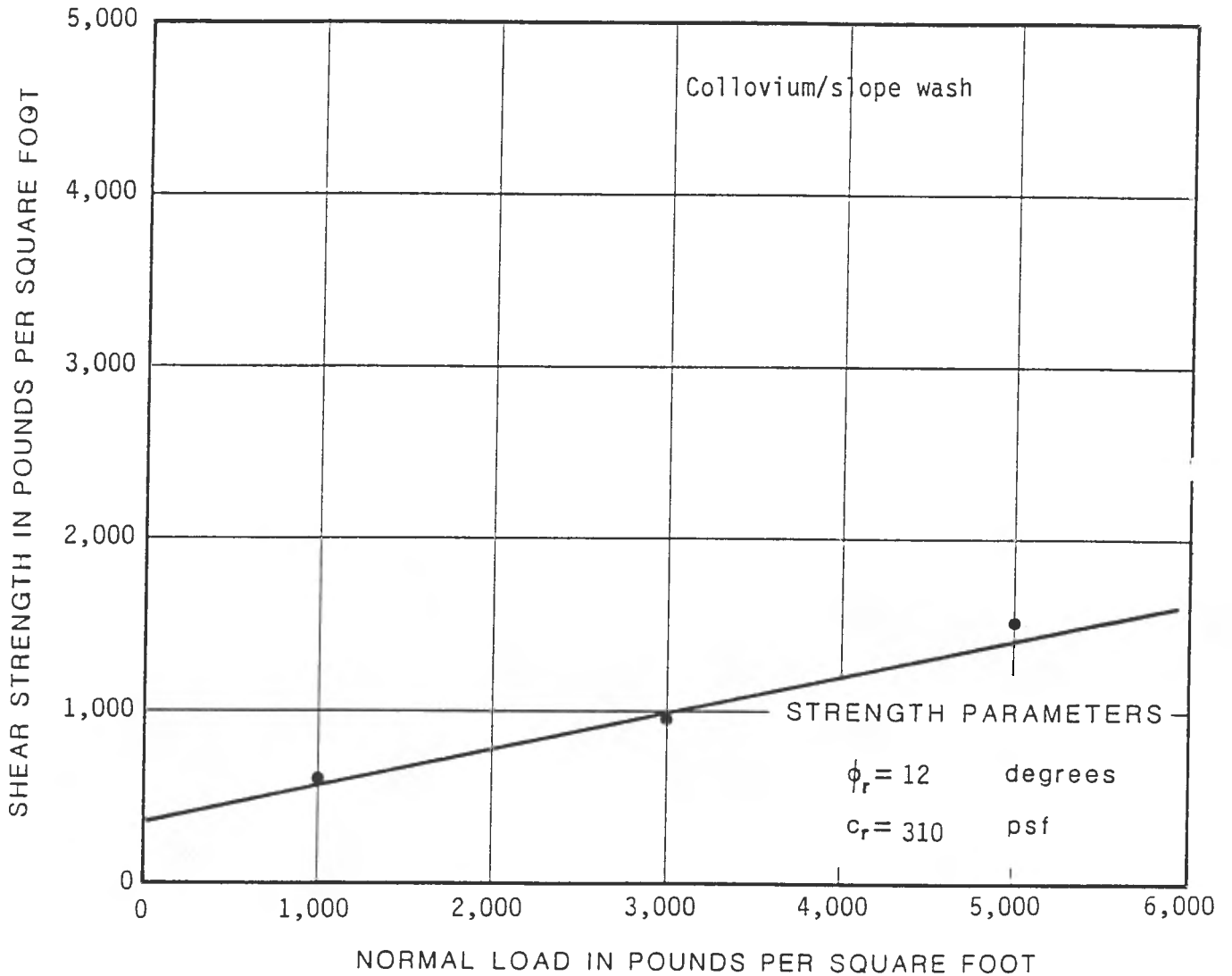
**FIGURE 3**  
**SHEAR STRENGTH ALONG BEDDING**  
 Modelo Mudstone, Claystone and Siltstone



Note: The '\*' indicates tests performed for this investigation while the other symbols indicate tests performed by Foundation Engineers, Inc. (1980)



## DIRECT SHEAR TEST DATA

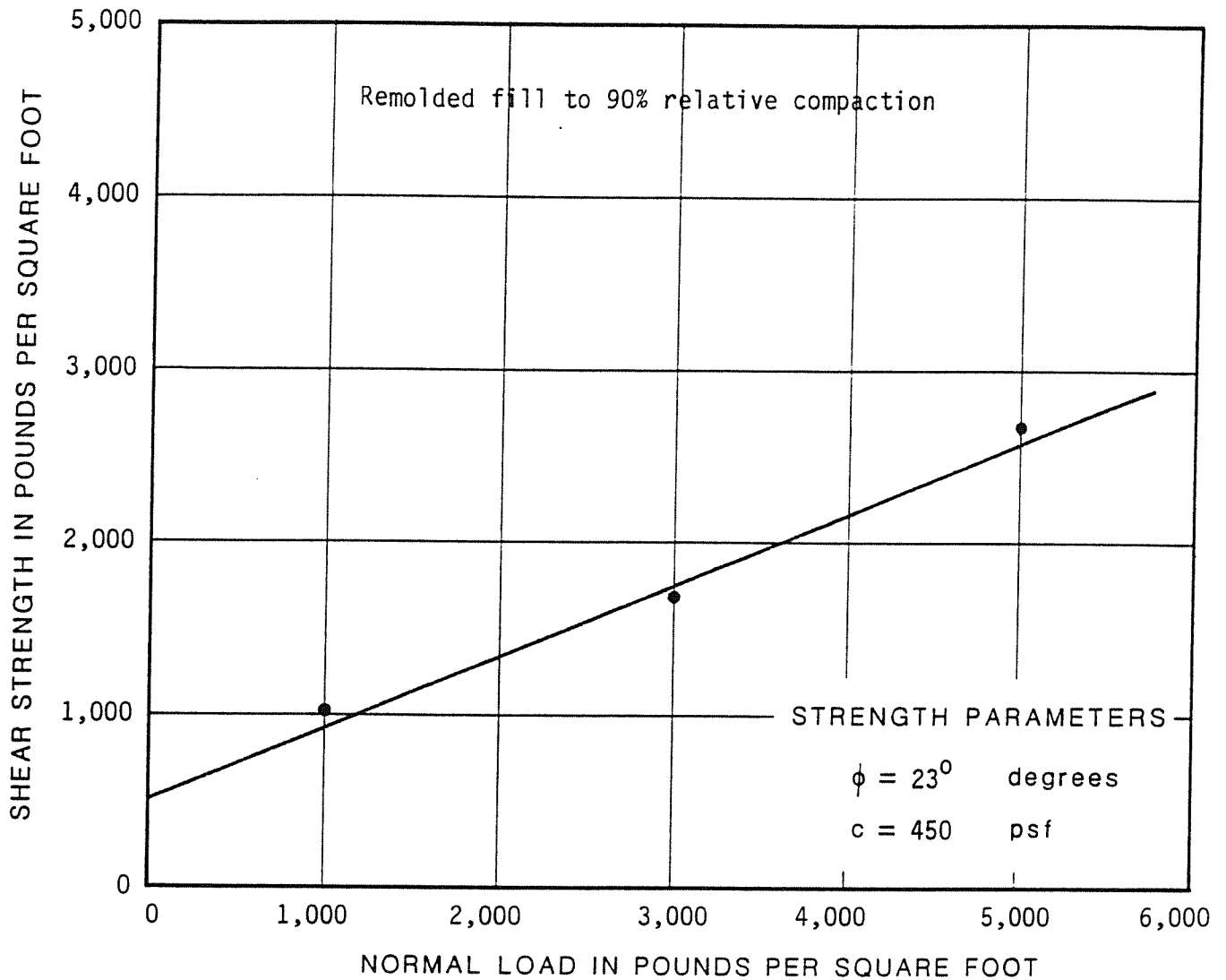


	SAMPLE 1	SAMPLE 2	SAMPLE 3
Location	Surface Grab.(a)		
Depth (ft.)	0		
Normal Load (psf)	1000	3000	5000
Dry Density (pcf)	89		
Moisture Content (%)	28		

Sample Type: Test performed on pre-cut shear plane.

Description: Firm, dark grey fat CLAY (CH)

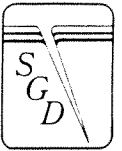
## DIRECT SHEAR TEST DATA



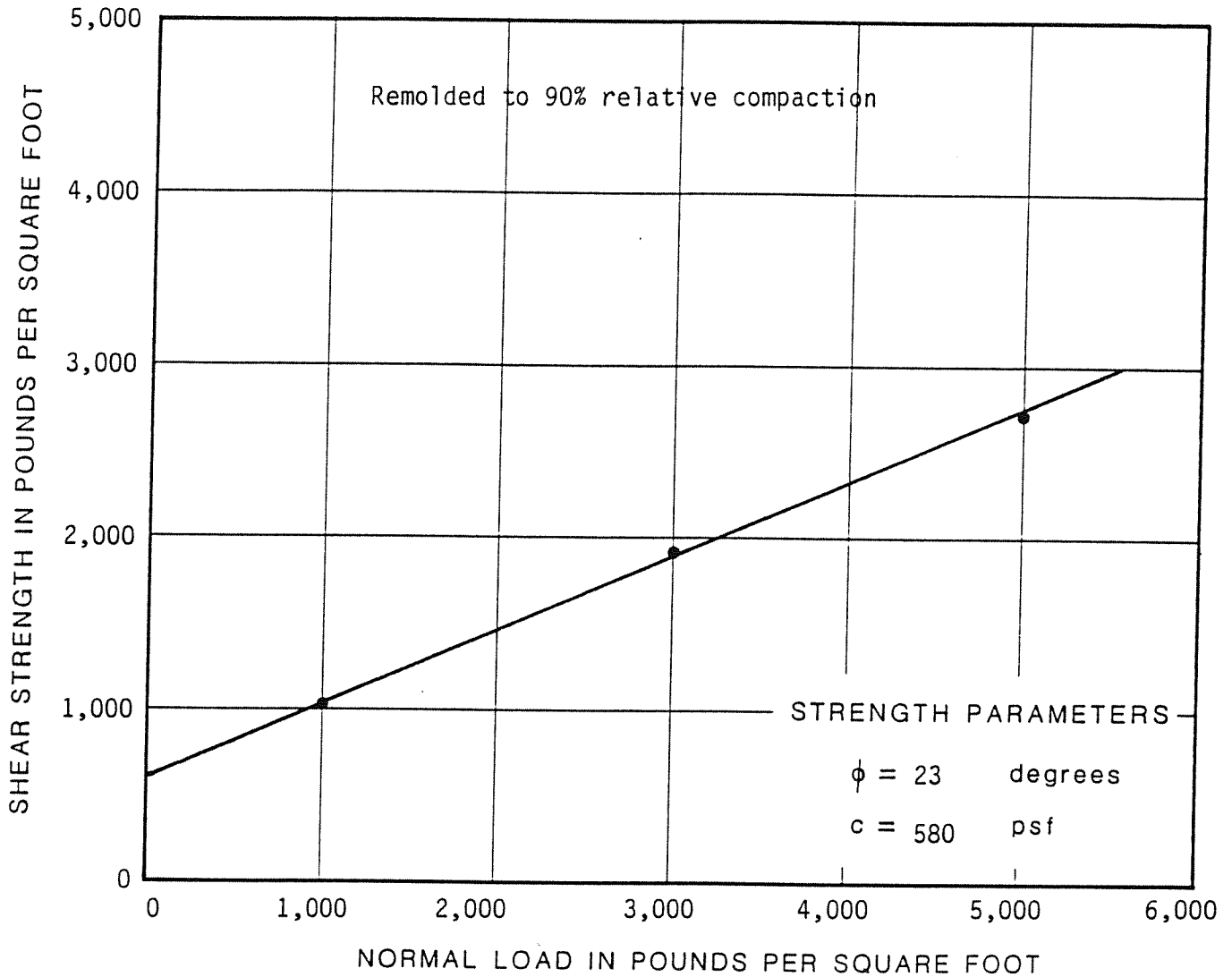
	SAMPLE 1	SAMPLE 2	SAMPLE 3
Location	9		
Depth (ft.)	28		
Normal Load (psf)	1000	3000	5000
Dry Density (pcf)	55	55	56
Moisture Content (%)	55	55	55

Sample Type: Remolded to 90% R.C.

Description: \_\_\_\_\_  
 \_\_\_\_\_



## DIRECT SHEAR TEST DATA



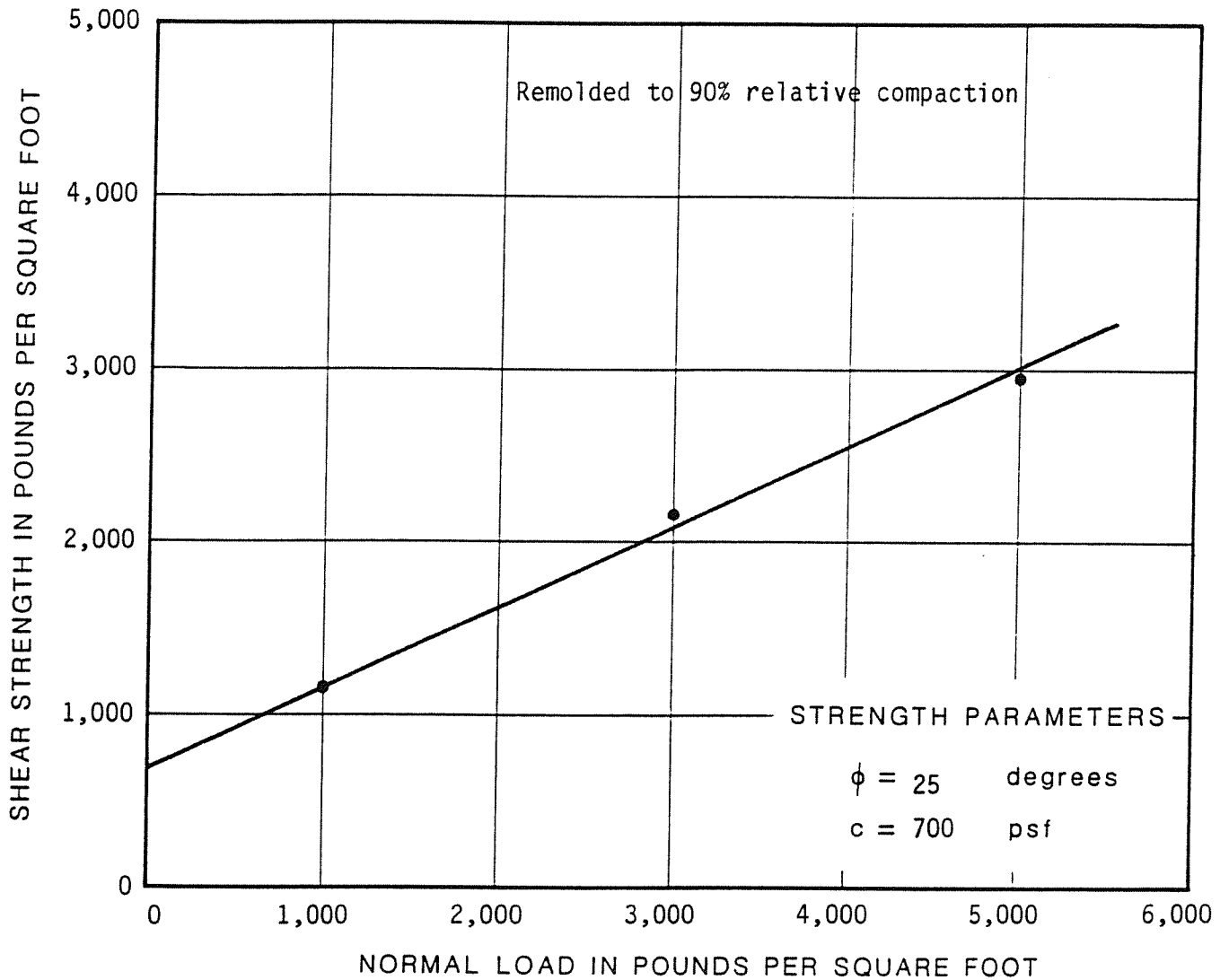
	SAMPLE 1	SAMPLE 2	SAMPLE 3
Location	DH - 10		
Depth (ft.)	7		
Normal Load (psf)	1000	3000	5000
Dry Density (pcf)	71	71	71
Moisture Content (%)	38	38	38

Sample Type: Remolded to 90% R.C.

Description: \_\_\_\_\_  
 \_\_\_\_\_



## DIRECT SHEAR TEST DATA



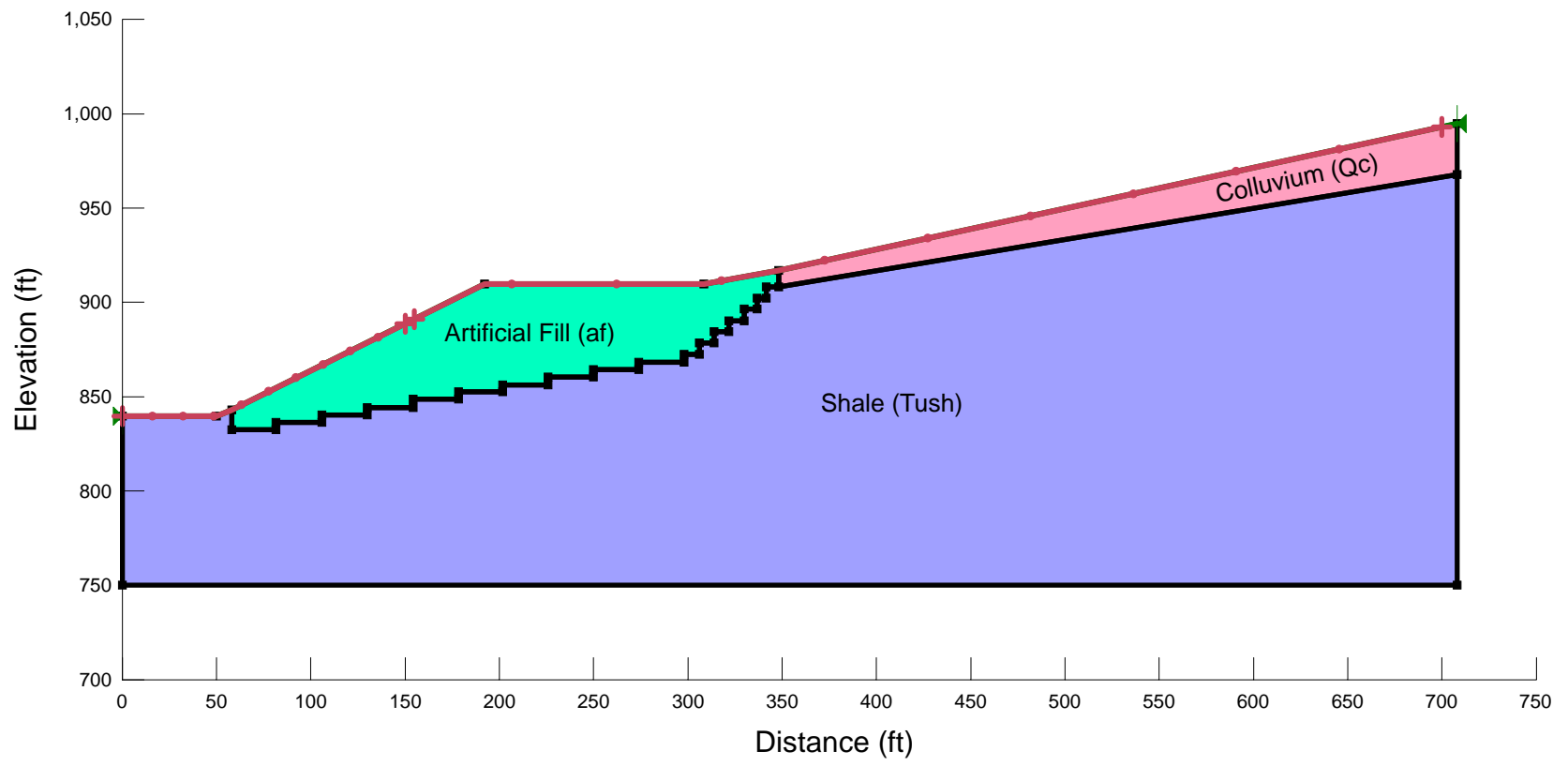
	SAMPLE 1	SAMPLE 2	SAMPLE 3
Location	DH - 12		
Depth (ft.)	3		
Normal Load (psf)	1000	3000	5000
Dry Density (pcf)	84	84	84
Moisture Content (%)	23	23	23

Sample Type: Remolded to 90% R.C.

Description: \_\_\_\_\_  
 \_\_\_\_\_

# **Appendix D**

Slope Stability Analyses



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Geotechnical and Materials Engineering Division

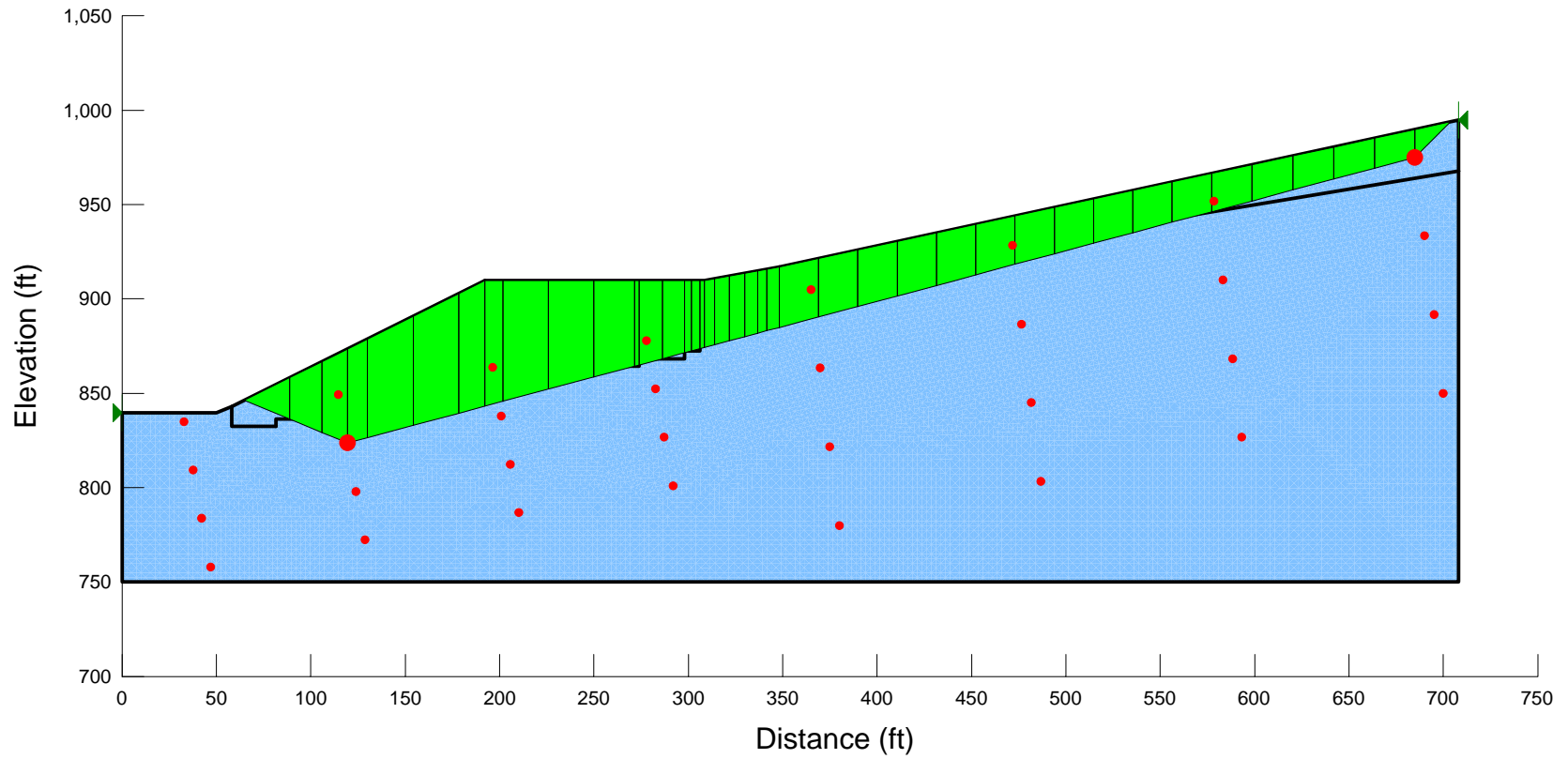
**Materials Cross-Section**

PREPARED BY:  
AKK & CMS

DATE:  
8/9/17

Figure D1

Factor of Safety: 2.218



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Geotechnical and Materials Engineering Division

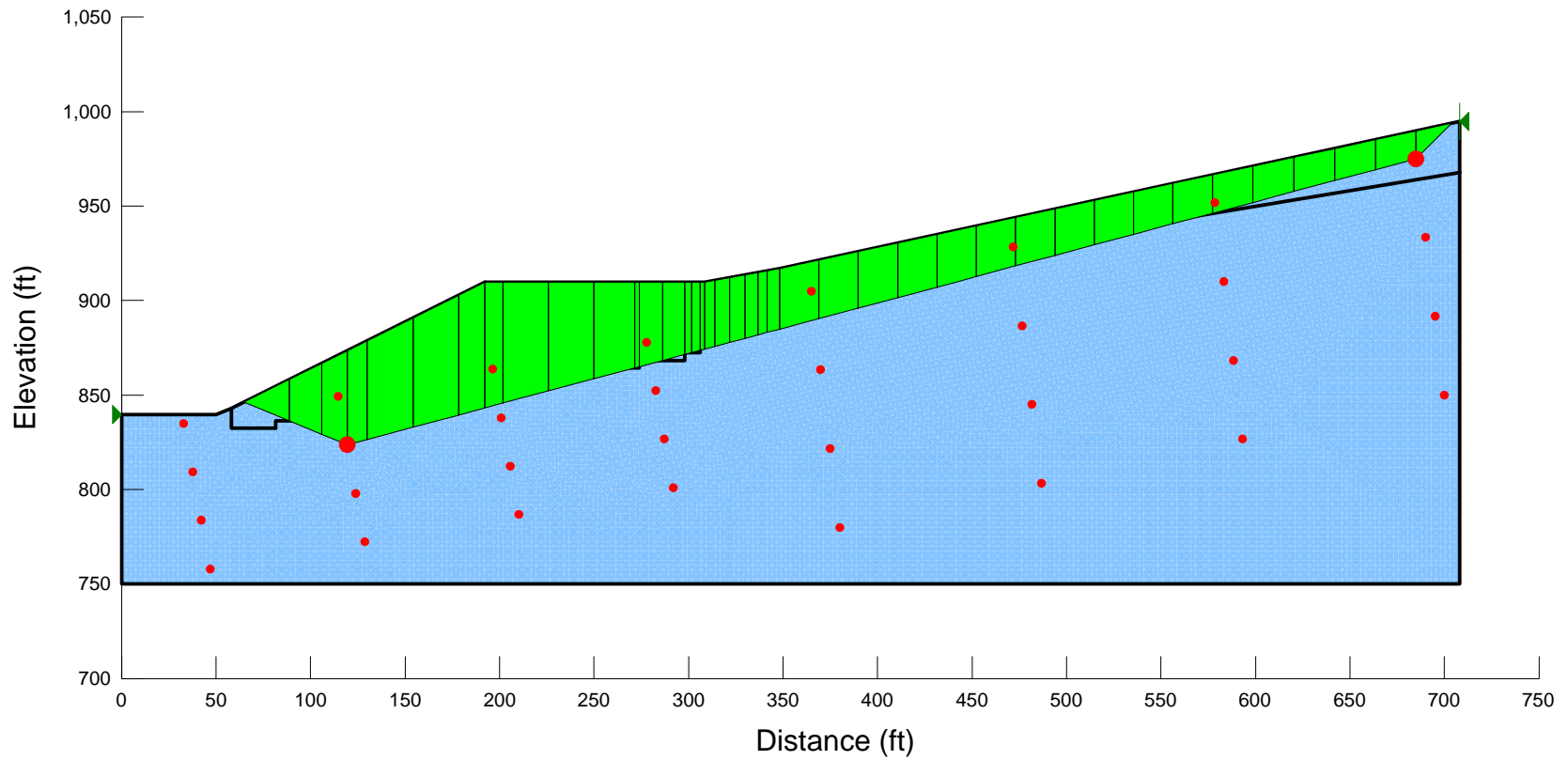
Existing Translational Static

PREPARED BY:  
AKK & CMS

DATE:  
8/9/17

Figure D2

Factor of Safety: 1.367



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Geotechnical and Materials Engineering Division

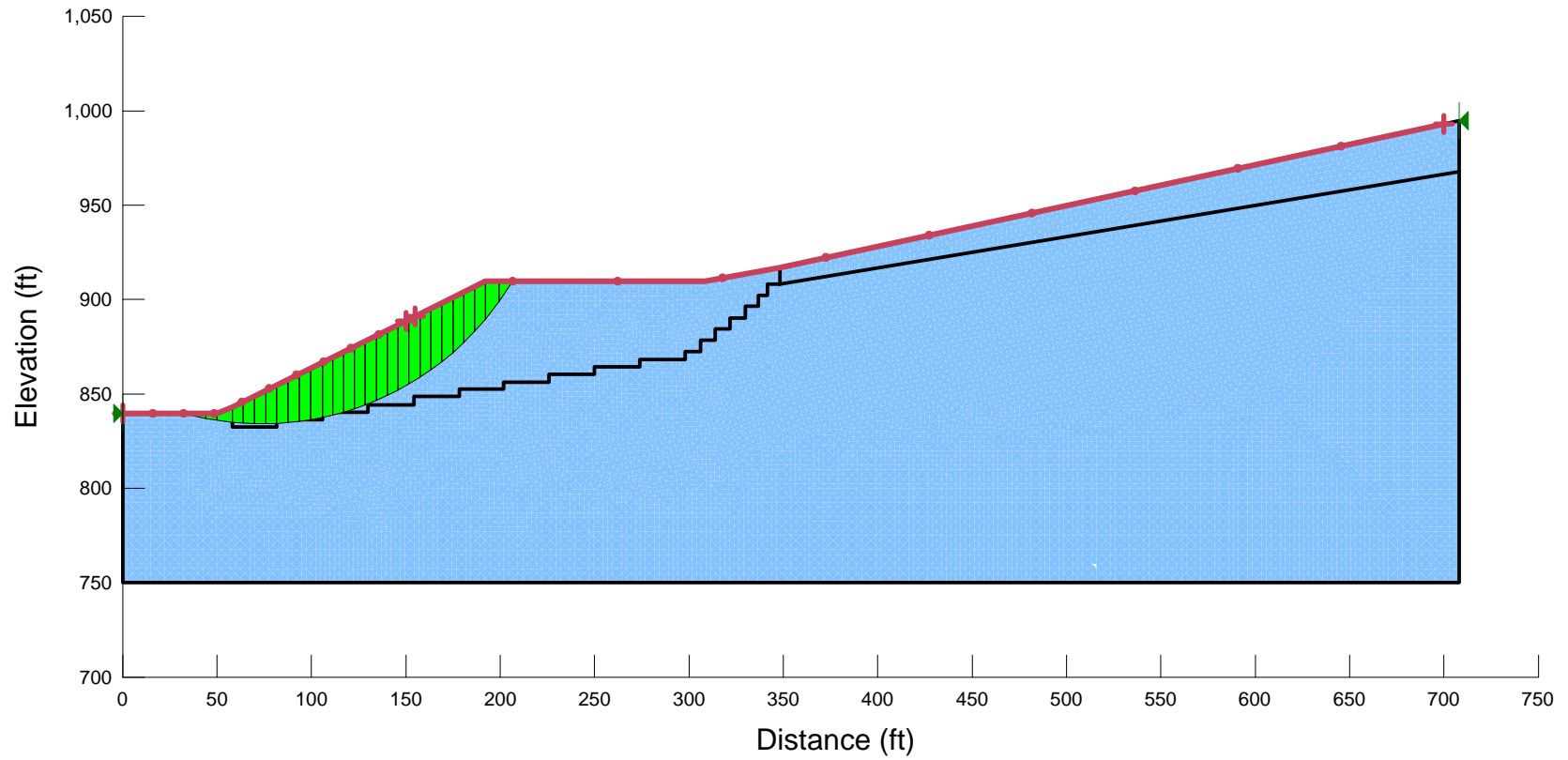
### Existing Translational Seismic

PREPARED BY:  
AKK & CMS

DATE:  
8/9/17

Figure D3

Factor of Safety: 1.762



COUNTY OF LOS ANGELES DEPARTMENT OF PUBLIC WORKS  
Geotechnical and Materials Engineering Division

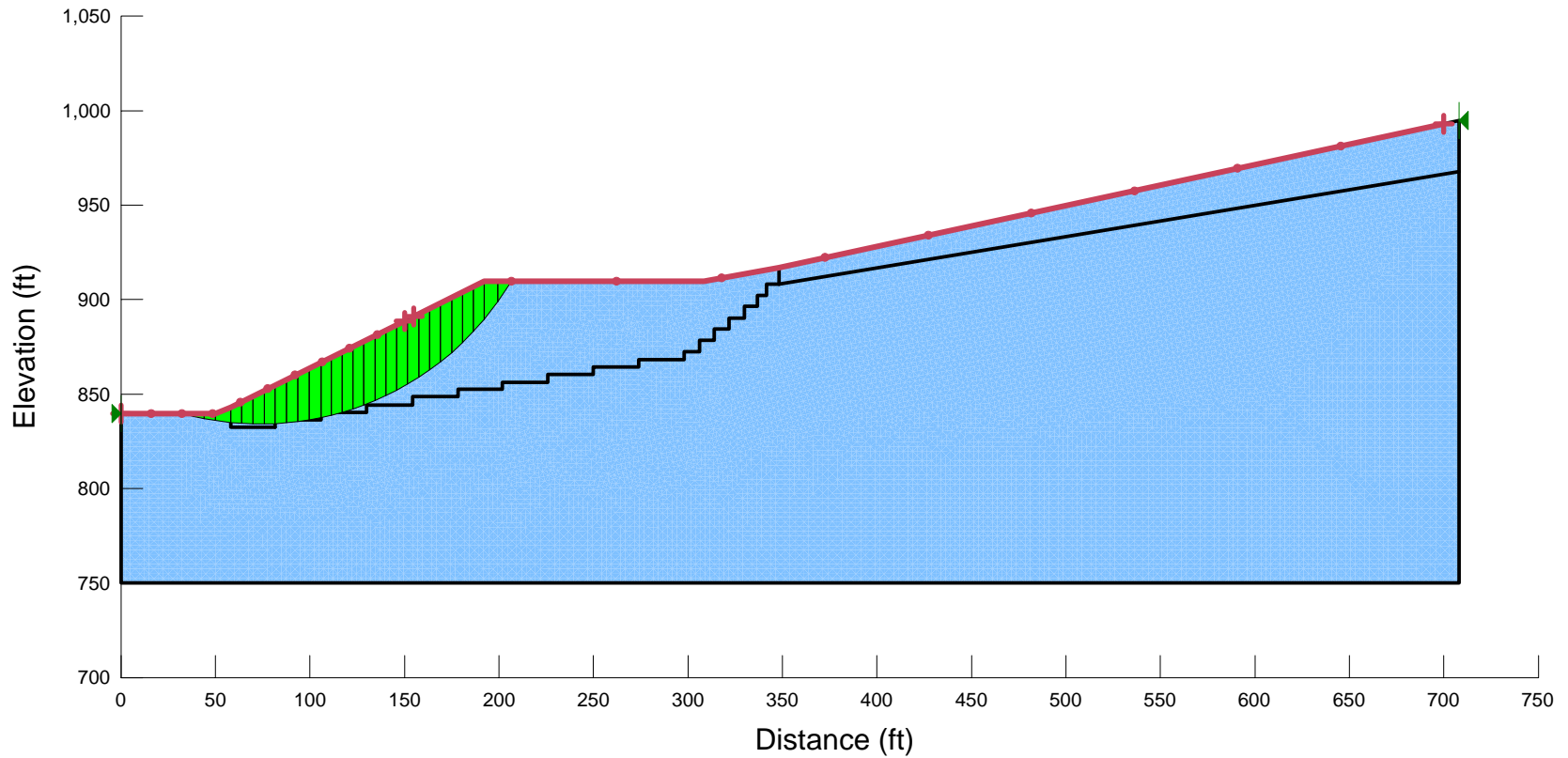
Existing Circular Static

PREPARED BY:  
AKK & CMS

DATE:  
8/9/17

Figure D4

Factor of Safety: 1.298



COUNTY OF LOS ANGELES DEPARTMENT OF PUBLIC WORKS  
Geotechnical and Materials Engineering Division

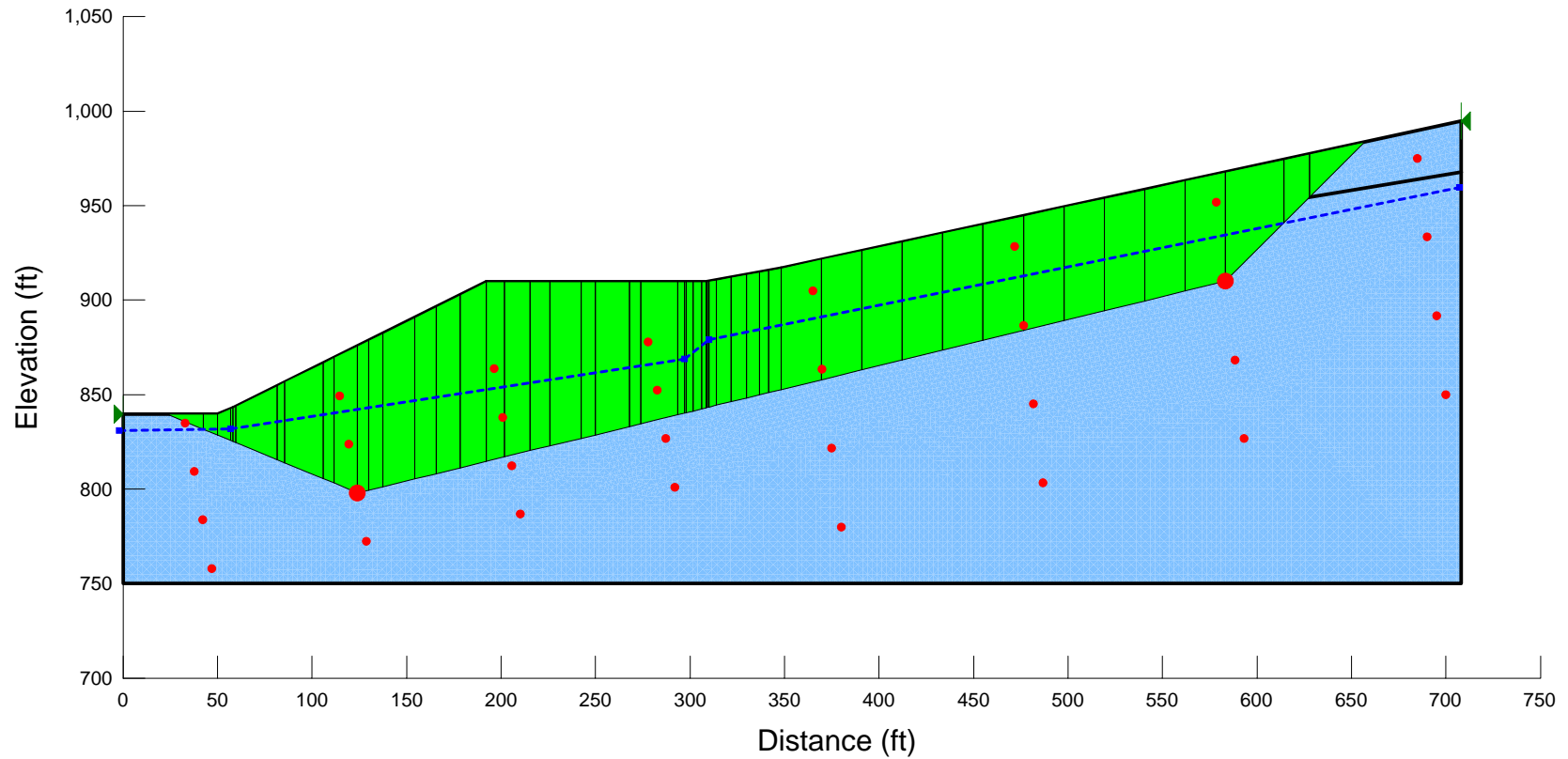
Existing Circular Seismic

PREPARED BY:  
AKK & CMS

DATE:  
8/9/17

Figure D5

Factor of Safety: 1.869



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**Proposed Translational Static**

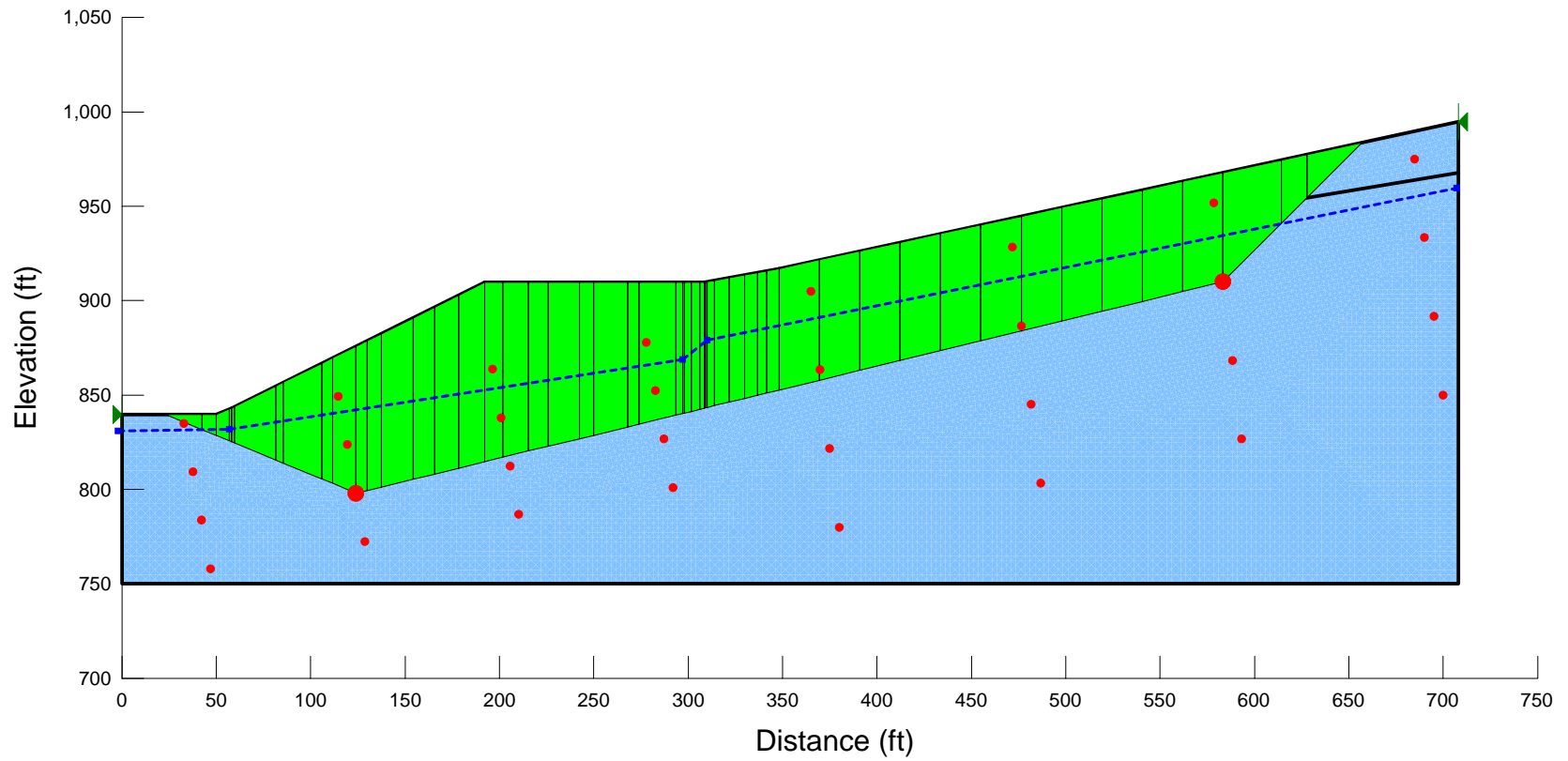
PREPARED BY:  
AKK & CMS

DATE:  
8/9/17

Figure D6



Factor of Safety: 1.164



COUNTY OF LOS ANGELES DEPARTMENT OF PUBLIC WORKS  
Geotechnical and Materials Engineering Division

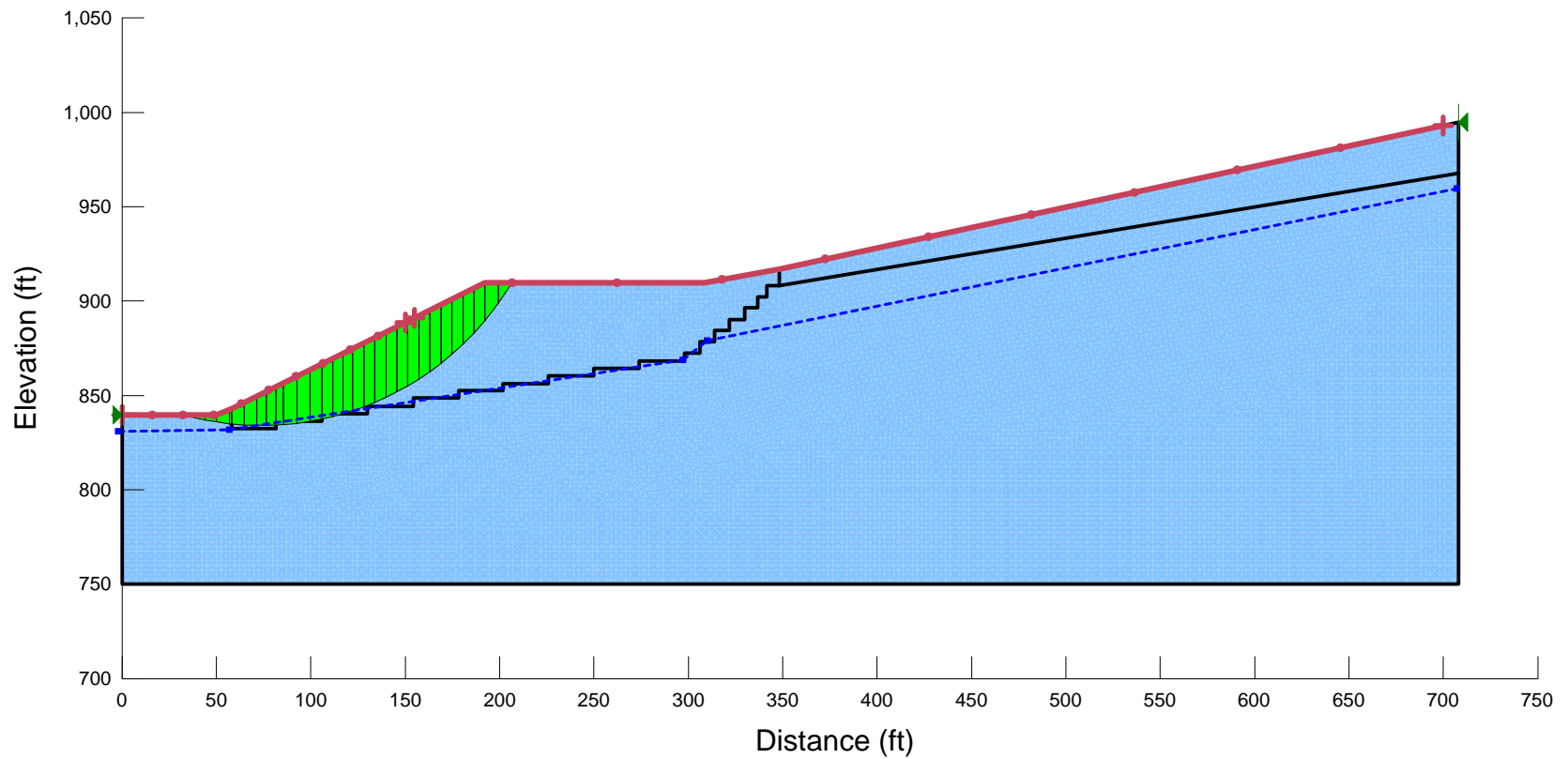
Proposed Translational Seismic

PREPARED BY:  
AKK & CMS

DATE:  
8/9/17

Figure D7

Factor of Safety: 1.748



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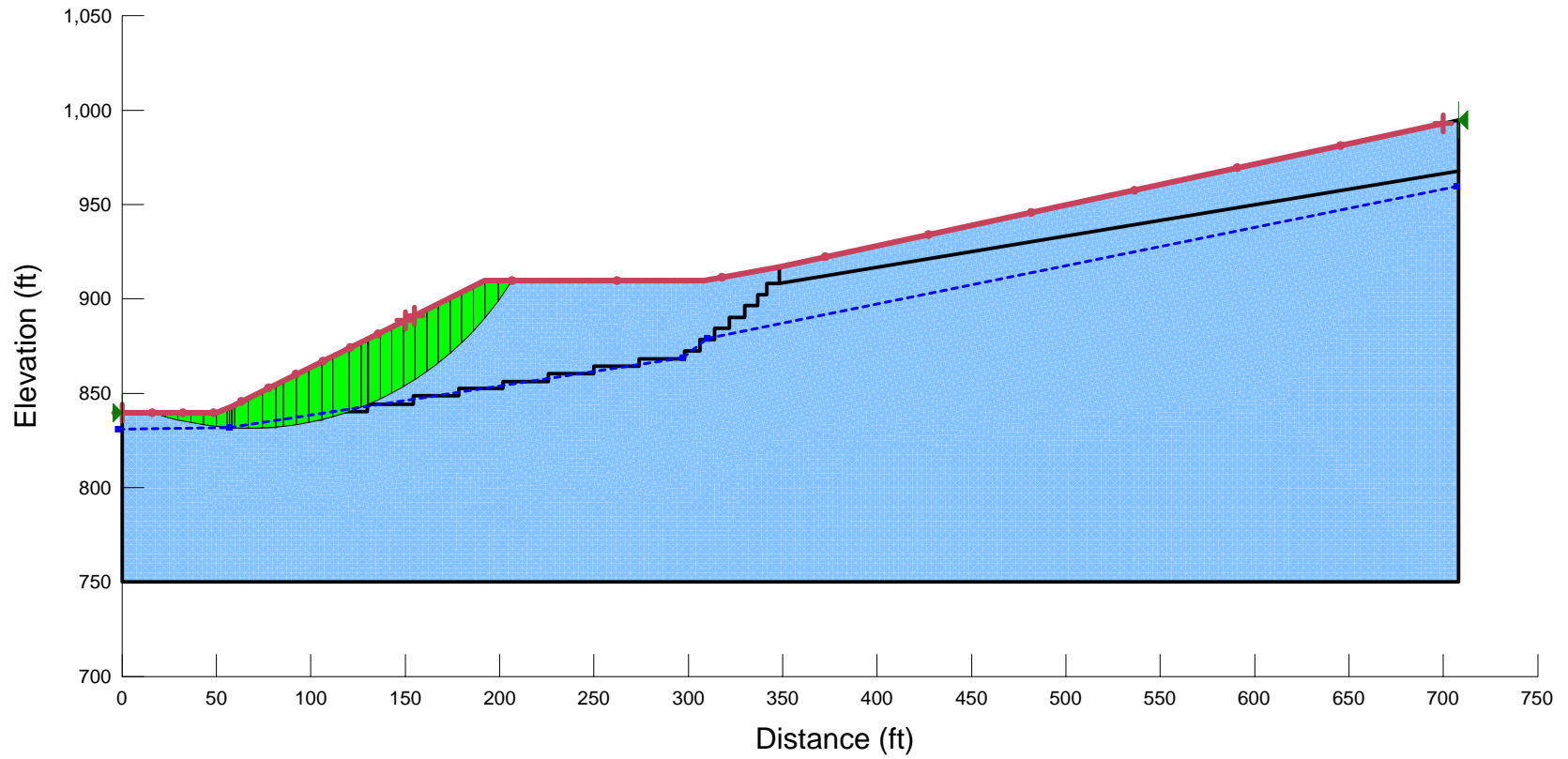
### Proposed Circular Static

PREPARED BY:  
AKK & CMS

DATE:  
8/9/17

Figure D8

Factor of Safety: 1.281



COUNTY OF LOS ANGELES DEPARTMENT OF PUBLIC WORKS  
Geotechnical and Materials Engineering Division

Proposed Circular Seismic

PREPARED BY:  
AKK & CMS

DATE:  
8/9/17

Figure D9

# **Appendix E**

Percolation Test Calculation Sheets

**PERCOLATION TEST DATA B-1**

Project	Gates Cyn Park	Job. No	F21816i02
Staff	Kevin Phan	Date	5/25/2016

Test Hole	B-1	Depth after Pre-Saturation	36.8 ft
Boring Diameter	2 ft	Effective Height	21.3 ft
Total Depth	80 ft	Effective Area	137.0 ft <sup>2</sup>
Capping Depth	15 ft	Total Time	0.4 days

Time (min)	Acc. Time (min)	Acc. Time (Hr)	Volume (Gallons)	Acc. Volume (Gallons)	Percolation Rate (in/hr)
69	69	1.15	495	495	5.04
66	135	2.25	594	1089	6.32
61	196	3.27	500	1589	5.76
54	250	4.17	448	2037	5.83
52	302	5.03	507	2544	6.85
62	364	6.07	500	3044	5.67
61	425	7.08	554	3598	6.38
96	521	8.68	752	4350	5.50
<b>Total</b>		<b>8.68</b>	<b>4350</b>		

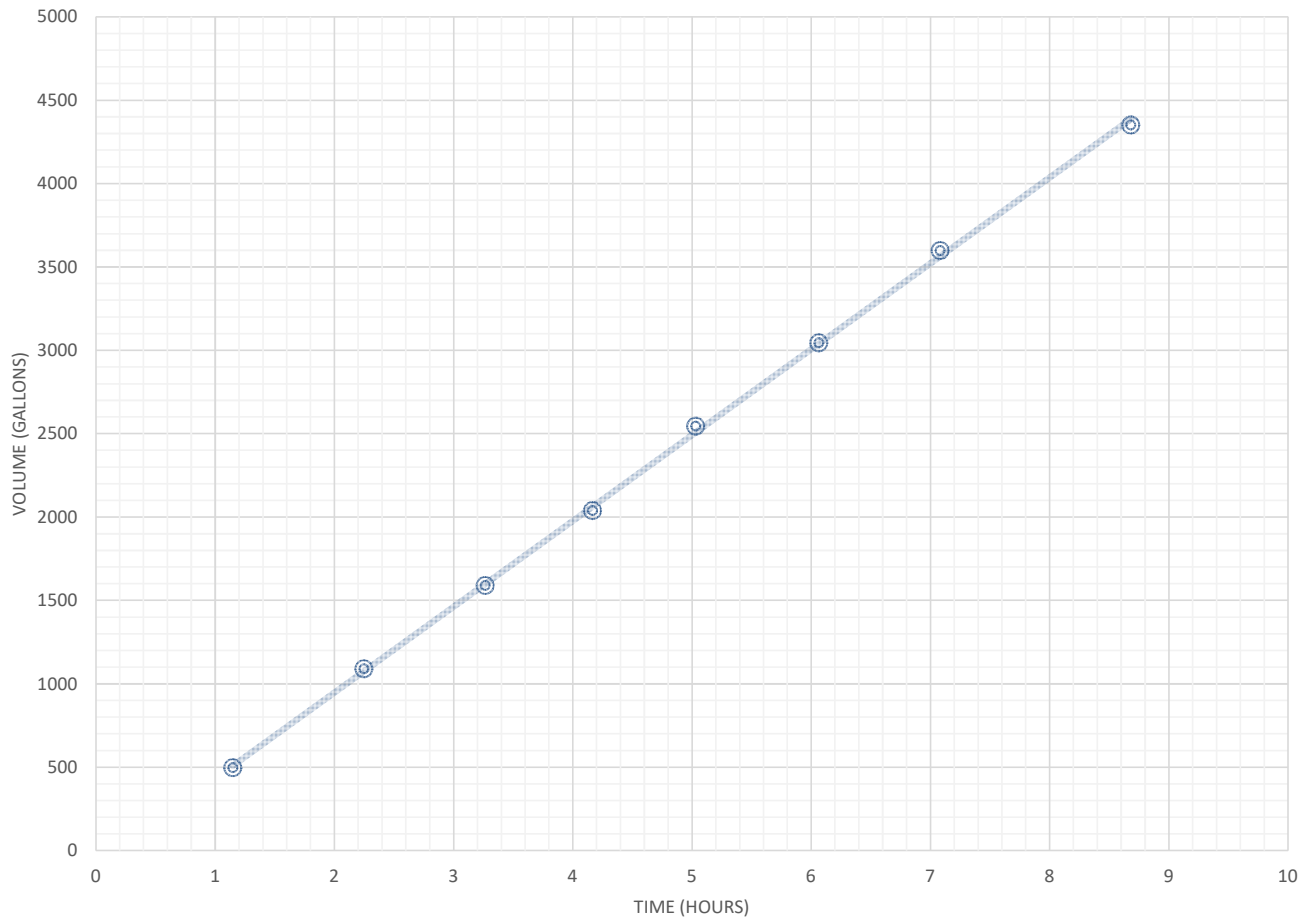
Acc. Perc Rate	<b>5.87</b>	<b>in/hr</b>
(from Totals)	<b>87.78</b>	<b>gal/ft<sup>2</sup>/day</b>

$$\text{Percolation Rate (in/hr)} = \text{Total Volume (Gallons)} \times \frac{1 \text{ (ft}^3\text{)}}{7.48052 \text{ (Gallons)}} \times \frac{1}{\text{Effective Area (ft}^2\text{)}} \times \frac{12 \text{ (in)}}{1 \text{ (ft)}} \times \frac{1}{\text{Total Time (hrs)}}$$

$$\text{Effective Area (ft}^2\text{)} = 2\pi rh + \pi r^2 ; \text{Where } r = \text{boring radius} = \frac{\text{Boring Diameter}}{2}, \text{ and } h = \text{Effective Height}$$

$$\text{Percolation Rate} \left( \frac{\text{Gallons}}{\text{ft}^2 \text{ day}} \right) = \frac{\text{Total Volume (Gallons)}}{\text{Effective Area (ft}^2\text{)} \times \text{Total Time (Days)}}$$

### B-1 Accumulated Volume vs Time



**PERCOLATION TEST DATA B-2**

Project	Gates Cyn Park	Job. No	F21816i02
Staff	Kevin Phan	Date	5/25/2016

Test Hole	B-2	Depth after Pre-Saturation	42.2 ft
Boring Diameter	2 ft	Effective Height	32.2 ft
Total Depth	60 ft	Effective Area	205.5 ft <sup>2</sup>
Capping Depth	10 ft	Total Time	0.4 days

Time (min)	Acc. Time (min)	Acc. Time (Hr)	Volume (Gallons)	Acc. Volume (Gallons)	Percolation Rate (in/hr)
71	71	1.18	351	351	2.32
62	133	2.22	298	649	2.25
61	194	3.23	298	947	2.29
53	247	4.12	275	1222	2.43
51	298	4.97	300	1522	2.76
63	361	6.02	305	1827	2.27
62	423	7.05	394	2221	2.98
85	508	8.47	396	2617	2.18
<b>Total:</b>		<b>8.47</b>	<b>2617</b>		

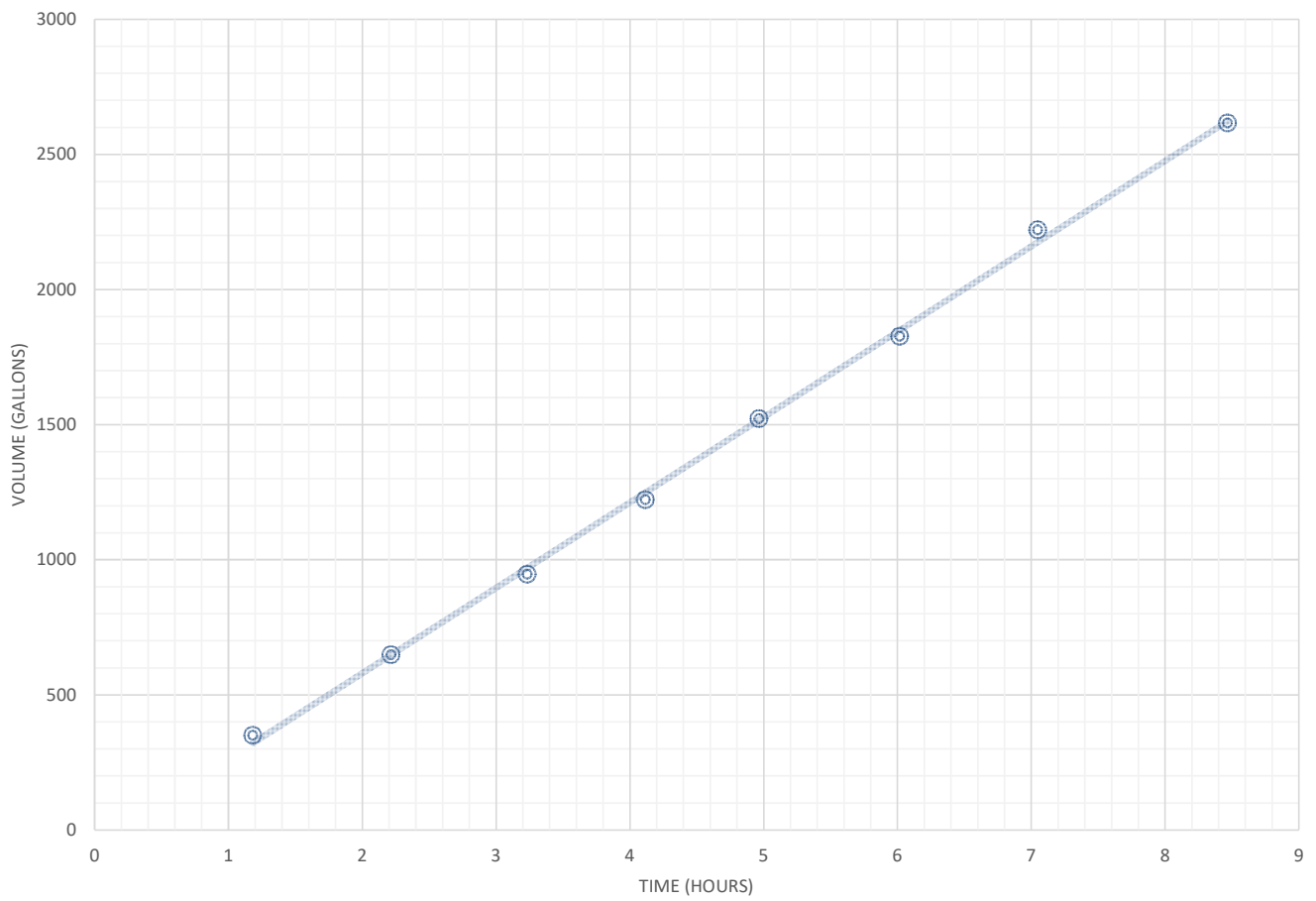
Acc. Perc Rate	<b>2.41</b>	<b>in/hr</b>
(from Totals)	<b>36.11</b>	<b>gal/ft<sup>2</sup>/day</b>

$$Percolation\ Rate\ (in/hr) = Total\ Volume\ (Gallons) \times \frac{1\ (ft^3)}{7.48052\ (Gallons)} \times \frac{1}{Effective\ Area\ (ft^2)} \times \frac{12\ (in)}{1\ (ft)} \times \frac{1}{Total\ Time\ (hrs)}$$

$$Effective\ Area\ (ft^2) = 2\pi rh + \pi r^2 ;\ Where\ r = boring\ radius = \frac{Boring\ Diameter}{2},\ and\ h = Effective\ Height$$

$$Percolation\ Rate\ \left( \frac{Gallons}{ft^2\ day} \right) = \frac{Total\ Volume\ (Gallons)}{Effective\ Area\ (ft^2) \times Total\ Time\ (Days)}$$

### B-2 Accumulated Volume vs Time





**PERCOLATION TEST DATA B-3**

Project	Gates Cyn Park	Job. No	F21816i02
Staff	Kevin Phan	Date	5/25/2016

Test Hole	B-3	Depth after Pre-Saturation	36.8 ft
Boring Diameter	2 ft	Effective Height	28 ft
Total Depth	40 ft	Effective Area	179.1 ft <sup>2</sup>
Capping Depth	12 ft	Total Time	0.3 days

Time (min)	Acc. Time (min)	Acc. Time (Hr)	Volume (Gallons)	Acc. Volume (Gallons)	Percolation Rate (in/hr)
67	67	1.12	2406	2406	19.30
63	130	2.17	3348	5754	28.57
58	188	3.13	3099	8853	28.72
51	239	3.98	2462	11315	25.95
61	300	5.00	2800	14115	24.67
61	361	6.02	2995	17110	26.39
60	421	7.02	2749	19859	24.63
68	489	8.15	3152	23011	24.92
<b>Total:</b>		<b>8.15</b>	<b>23011</b>		

Acc. Perc Rate	<b>25.29</b>	<b>in/hr</b>
(from Totals)	<b>378.41</b>	<b>gal/ft<sup>2</sup>/day</b>

$$Percolation\ Rate\ (in/hr) = Total\ Volume\ (Gallons) \times \frac{1\ (ft^3)}{7.48052\ (Gallons)} \times \frac{1}{Effective\ Area\ (ft^2)} \times \frac{12\ (in)}{1\ (ft)} \times \frac{1}{Total\ Time\ (hrs)}$$

$$Effective\ Area\ (ft^2) = 2\pi rh + \pi r^2 ;\ Where\ r = boring\ radius = \frac{Boring\ Diameter}{2},\ and\ h = Effective\ Height$$

$$Percolation\ Rate\ \left( \frac{Gallons}{ft^2\ day} \right) = \frac{Total\ Volume\ (Gallons)}{Effective\ Area\ (ft^2) \times Total\ Time\ (Days)}$$

### B-3 Accumulated Volume vs Time

