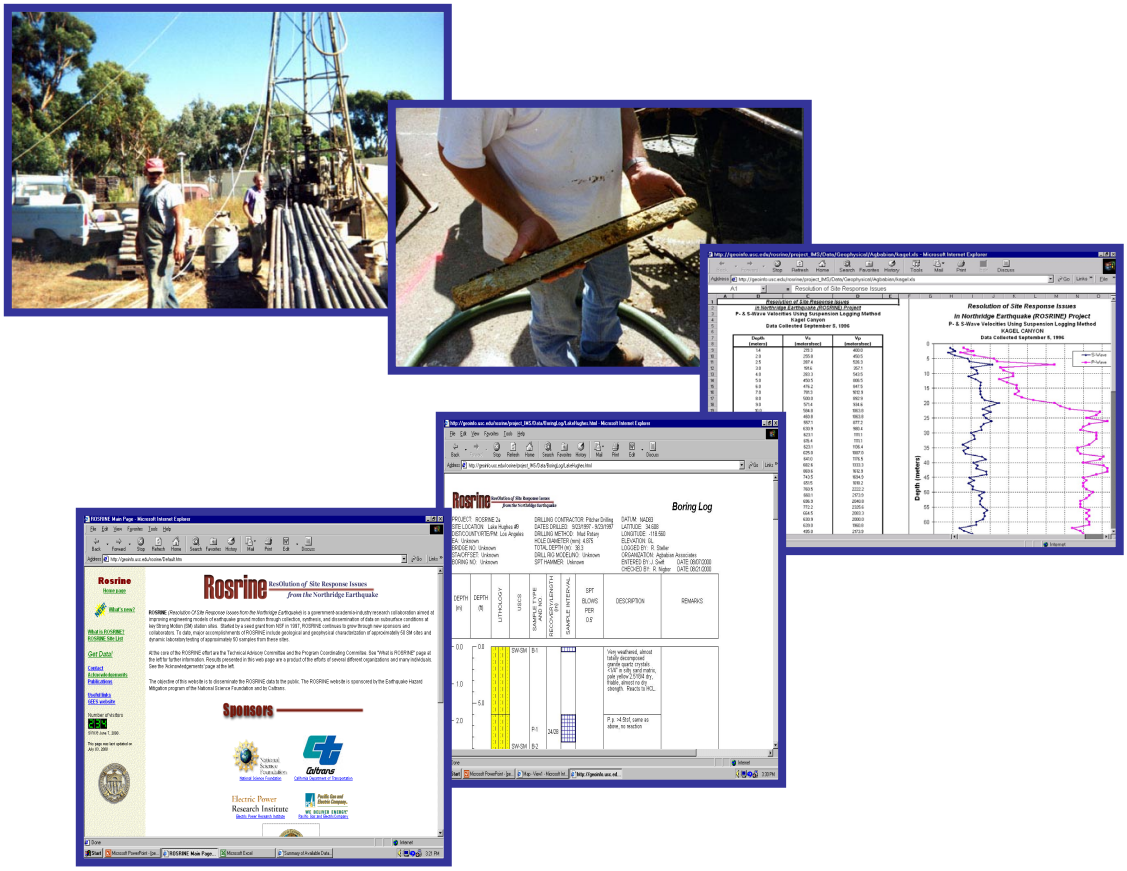
Resolution of Site Response Issues in the Northridge Earthquake (ROSRINE)

DATA COLLECTION, PROCESSING AND DISSEMINATION FROM PHASE 5b FIELD AND LABORATORY INVESTIGATIONS



Rosrine ResOlution of Site Response Issues from the Northridge Earthquake

26 November, 2001

ROSRINE PHASE REPORT

Resolution of Site Response Issues in the Northridge Earthquake (ROSRINE)

DATA COLLECTION, PROCESSING AND DISSEMINATION FROM PHASE 5b FIELD AND LABORATORY INVESTIGATIONS

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For further information about the ROSRINE (*Resolution of Site Response Issues in the Northridge Earthquake*) Project, this publication, or to order additional copies, please see the ROSRINE website at http://geoinfo.usc.edu/rosrine/, or contact:

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- United States Geological Survey (USGS)

Executive Summary

ROSRINE (*Resolution of Site Response Issues in the Northridge Earthquake*) is an on-going collaborative research project aimed at improving engineering models for estimation of earthquake ground motions. The ROSRINE project is a government-academia-industry research collaboration focused on improving engineering models of earthquake ground motion through collection, synthesis, and dissemination of data on subsurface conditions at key Strong Ground Motion (SM) station sites. The central component of this project is the collection, curation, and dissemination of high quality subsurface data obtained primarily from instrument sites that recorded strong shaking during the 1994 Northridge earthquake. More recently, regions other than that affected by the Northridge Earthquake are being studied as well.

ROSRINE provides high quality raw and processed data in a timely manner for use by the academic and engineering community as well as the sponsors. A website, http://geoinfo.usc.edu/rosrine, has been designed to efficiently organize ROSRINE data digitally and to and disseminate it the public. Geotechnical data is organized into a Relational Database Management System (RDBMS) integrated with a Geographic Information System (GIS) and an Internet Map Server (IMS). The RDBMS allows the definition of data structures and guidelines for data entry, and efficient organization and release of digital data, technical drawings, and photographs through GIS and IMS technologies. A combination of Microsoft Access, custom Active Server Scripts (ASP), ESRI's ArcView, ArcView IMS, Avenue and Dynamic Hypertext Markup Language (DHTML) custom programming process the end user queries. Thus the website is geared toward providing a direct link from the original project data to the public.

The results of field investigations and lab tests of ROSRINE Phase 5b are provided in this report. This phase was funded through the PEER Lifelines Program. Data were obtained from a total of nine SM sites in California:

Site ID	Location	Site Code	Borehole Latitude	Borehole Longitude	SMA Station
1	Bell-LA Bulk Mail	LBM	33.996	-118.162	USGS 5129
2	Yermo	YRM	34.904	-116.823	CDMG 22074
3	Joshua Tree	JTR	34.130	-116.314	CDMG 22170
4	Halls Valley	HVL	37.338	-121.714	CDMG 36227
5	Gilroy 3	GR3	36.987	-121.538	CDMG 24605
6	Superstition Mountain Top	SMT	32.955	-115.825	USGS 286
7	Parachute Test Site Control Bldg. 5000	PTS	32.930	-115.700	USGS 5051
8	IBM Almaden (Santa Teresa Hills)	IBM	37.206	-121.824	CDMG 57382
9	Pier F Long Beach (USGS)	PRF	33.746	-118.215	USGS new

This report summarizes the efforts in this Phase 5b of ROSRINE and presents the data obtained from the nine SM sites.

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Section 1

1.1 Introduction

Resolution of Site Response Issues from the Northridge Earthquake (ROSRINE) is a government-academia-industry research collaboration aimed at improving engineering models of earthquake ground motion through collection, synthesis, and dissemination of data on subsurface conditions at key Strong Motion (SM) station sites (ROSRINE, 2000). Started by a seed grant from NSF in 1996, ROSRINE continues to grow through new sponsors and collaborators. Since 1996, more than 50 strong-motion recording sites have been characterized. V_{30} results show that many sites previously have been misclassified, and therefore that site-specific investigations are important.

ROSRINE Phase 5b has been funded by the Pacific Earthquake Engineering Research Center (PEER) within its Lifelines Program, and by Caltrans' Program of Earthquake Applied Research for Lifelines (PEARL). Geologists, geotechnical engineers and geophysicists from public and private organizations have extensively investigated nine sites. The ROSRINE 5b field investigations at the selected SM sites included:

- Collection of information from previous site investigations
- Obtaining permissions and permits
- Drilling to 100m (soil sites) or 30m (rock sites)
- Lithology logging during drilling
- Collection of SPT samples for index property testing
- Collection of high-quality samples (Pitcher or Shelby tube) for dynamic laboratory testing
- Measurement of P- and S-wave velocity profiles

Dynamic soil testing will be performed at the University of Texas, Austin and at the University of Southern California on high-quality samples collected from ROSRINE boreholes in the near future. Certified commercial laboratories conducted simple index property testing on soil samples. The geographic locations of the sites are shown in Figures 1 and 2 and listed in Table 1, which provides information on the associated strong motion stations (SMA).

The results of the field investigations and lab test data completed to date are provided in Appendices A through J of this report. Appendix A contains the ROSRINE lithology key, and Appendices B through J contain the following types of information for each site: a geologic log, P- and S- wave velocity data and plots, the results of index property tests, site field photos, and lastly a site location map.

The data dissemination efforts by the ROSRINE project team are described in detail in the ROSRINE Phase 1, 2 & 4 Report (Nigbor and Swift, 2001). All data provided in this report (Appendices B - J) are digitally disseminated to the public through the project's web site http://geoinfo.usc.edu/rosrine.

Figure 1: Regional map of ROSRINE 5b site investigations. Shaded relief basemap by Sterner, 1995.

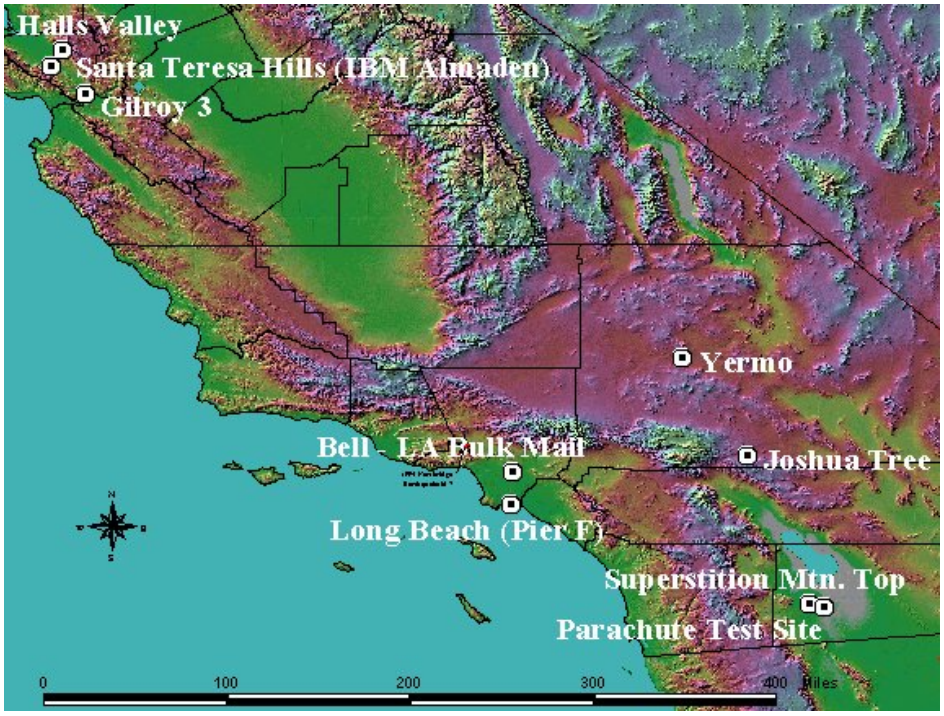


Figure 2: Regional map showing local transportation network near sites.

Table 1: ROSRINE 5b site locations and nearby SMA's.

Site ID	Location	Site Code	Borehole Latitude	Borehole Longitude	SMA Station
1	Bell-LA Bulk Mail	LBM	33.996	-118.162	USGS 5129
2	Yermo	YRM	34.904	-116.823	CDMG 22074
3	Joshua Tree	JTR	34.13	-116.314	CDMG 22170
4	Halls Valley	HVL	37.338	-121.714	CDMG 36227
5	Gilroy 3	GR3	36.987	-121.538	CDMG 24605
6	Superstition Mountain Top	SMT	32.955	-115.825	USGS 286
7	Parachute Test Site Control Bldg. 5000	PTS	32.93	-115.70	USGS 5051
8	IBM Almaden (Santa Teresa Hills)	IBM	37.206	-121.824	CDMG 57382
9	Pier F Long Beach (USGS)	PRF	33.746	-118.215	USGS new

Section 2

2.1 Geologic Setting

The ROSRINE Phase 5b investigation locations lie within California (see Figure 1). The geological settings of the nine sites are varied, from granitic rock to deep alluvium. A brief summary of the regional geologic setting including references to more detailed studies is provided in the ROSRINE Phase 1, 2 & 4 Report (Nigbor and Swift, 2001).

2.2 Site Selection

A total of nine sites in southern California were targeted by ROSRINE Phase 5b (Table 2). These ROSRINE sites were selected either at or near strong ground instrument sites that recorded strong shaking during the 1994 Northridge earthquake (Gibbs et al., 1999) and/or other strong earthquakes. Selection was done by the ROSRINE Technical Advisory Committee, based upon an assessment of information needs and site access/availability.

Two of the nine, the Parachute Test Site and Long Beach Pier F, were collaborative efforts between ROSRINE and the USGS. At Pier F the USGS collected Shelby tube samples at depths requested by ROSRINE, and ROSRINE performed geophysical tests.

Table 2: Phase 5b site investigation collaborations.

Site ID	Location	Site Selection: ROSRINE-
1	Bell-LA Bulk Mail	Targeted
2	Yermo	Targeted
3	Joshua Tree	Targeted
4	Halls Valley	Targeted
5	Gilroy 3	Targeted
6	Superstition Mountain Top	Targeted
7	Parachute Test Site Control Bldg. 5000	USGS Collaborative
8	IBM Almaden (Santa Teresa Hills)	Targeted
9	Pier F Long Beach (USGS)	USGS Collaborative

Section 3

3.1 Data Collection

During ROSRINE Phase 5b, as boreholes were drilled lithologic logs were compiled and soil samples were collected by an experienced geologist. After drilling was completed, geophysical logging was performed as appropriate. Typical field data includes geologic and geophysical logs to depths of 100 meters or more. The field and lab procedures and data collected are briefly discussed in this section.

At investigation sites, combinations of the following types of data have been produce:

- Geologic data - Boring logs
- Geophysical data - P&S wave velocity; and caliper, spontaneous potential, resistivity and resistance logging
- Lab test data from soil samples- Index properties
- Field photos
- Site plans

Dynamic soil test data will be added to the ROSRINE database and appended to this report as soon as the tests are completed, and the results are transferred to the ROSRINE project staff.

3.2 Geologic Data

ROSRINE targeted borings (except SSM) were drilled by a commercial drilling company using the mud rotary wash method at each site. All of the sites were drilled by Pitcher Drilling of San Jose, California, using a Failing F-10 drilling rig. Typically a tricone drill bit and three-meter lengths of drill rod were used to advance the boring. Bentonite drilling mud was pumped into the drill-hole to lubricate the drill bit and to bring soil cuttings to the surface. Detailed information on the rotary wash drilling procedure is contained in the ROSRINE Field Procedures Manual (ROSRINE FPM, Swift et al., 2001b).

The only exception was Superstition Mountain, where the air rotary method was used.

All drilling and grouting operations were supervised by an experienced California CRG field geologist. Upon completion of the geophysical logging, the borings were grouted and abandoned. Displaced drilling mud was placed into a containment bin along with any soil cuttings for disposal off-site. The site was then restored to its original state.

As the boring was progressed at each ROSRINE site, lithology and drilling information were recorded on detailed boring logs in conformance with the ROSRINE FPM and the Unified Soil Classification System (USCS) (see Caltrans, 1996). Physical properties recorded in the soil descriptions include color, depth, texture, lithology, estimated geologic age, and correlation with

other mapped geologic units. Information on soil sampling during drilling (section 3.4) was also recorded on the boring logs and in the field geologist's field notes.

At the USGS collaborative site Pier F in Long Beach, a generalized log of earth materials underlying the drill sites was prepared from three sources: detailed logs compiled in the USGS mobile filed lab during the drilling, "undisturbed" samples, and a geophysical log. A detailed lithologic description of the USGS drill sites will be provided at a later date for addition to the ROSRINE database and website. At the USGS Parachute test site in Imperial Valley, the USGS boring log drilled in 1981 is given in Appendix H (Porcella, 1984). The log accompanying P & S wave velocity data are provided on the RSORINE website as an Adobe Acrobat file (*.ppf).

The ROSRINE and USGS boring logs for phase 5b boreholes are provided in Appendices B - J.

3.3 Geophysical Data

3.3.1 P-S Wave Velocity Logging

Suspension P-S velocity logging conducted as part of ROSRINE Phases 5b was performed by GEOVision Geophysical Services. All borehole velocity measurements were conducted in accordance with the *Procedure for OYO P-S Suspension Velocity Logging Method* contained in the ROSRINE FPM. The OYO Model 170 Suspension Logging Recorder and Suspension Logging Probe were used to obtain in-situ horizontal P- and S_H-wave velocity measurements at 0.5 m intervals. The acquired data were analyzed and a profile of velocity versus depth was produced for both P- and S_H-waves The ROSRINE sites where P-S suspension logging was performed are given in Table 3.

Table 3: ROSRINE 5b sites where geophysical logging was performed in boreholes.

Site ID	Location	Type of Geophysical Logging
1	Bell-LA Bulk Mail	Suspension P&S Wave Velocity
2	Yermo	Suspension P&S Wave Velocity
3	Joshua Tree	Suspension P&S Wave Velocity
4	Gilroy 3	Suspension P&S Wave Velocity
5	Superstition Mountain Top	Suspension P&S Wave Velocity
6	Parachute Test Site Control Bldg. 5000	Downhole P&S Wave Velocity
7	IBM Almaden (Santa Teresa Hills)	Suspension P&S Wave Velocity
8	Pier F Long Beach (USGS)	Suspension P&S Wave Velocity

3.3.2 V_{30} Calculations

Site categories determined by calculating V_{30} through summation of the interval travel times per the NEHRP procedure (FEMA, 1997) are provided in Table 4. ROSRINE provides an example of the level of investigations required to achieve accurate site soil classifications.

Table 4: V_{30} calculated by summing interval travel times per the NEHRP procedure.

ROSRINE Site	V30, m/s	V30, ft/sec	NEHRP Category (Field Measurements)
Bell-LA Bulk Mail	298	977	D
Yermo	352	1155	D
Joshua Tree	343	1125	D
Halls Valley	-	-	-
Gilroy 3	278	912	D
Superstition Mountain Top	358	1174	D
Parachute Test Site Control Bldg. 5000	351	1151	D
IBM Almaden (Santa Teresa Hills)	648	2126	C
Pier F Long Beach (USGS)	150	492	E

3.4 Samples and Lab Data

3.4.1 Soil Sampling

As the boring was progressed at each ROSRINE site, the soil cuttings were sampled at approximately 1.5-meter intervals for lithologic interpretation. The cuttings were collected in a sieve in the stream of drilling mud brought to the surface. Typically, once a 1.5-meter section was progressed, a "grab" sample of the soil cutting was transferred from the sieve into a plastic bag and sealed. The samples were used for soil documentation in general conformance with the USCS.

Where possible, Standard Penetration Test (SPT) split spoon samples were collected to a depth of approximately 100', and disturbed samples were collected in plastic bags or 6" brass tubes. The SPT sampler was used to obtain blow counts directly (GRL, 1999). The blow counts were recoded by the field geologist on the boring logs and in the field notes as drilling progressed.

Undisturbed soil samples for laboratory analysis were collected at regular intervals using the pitcher-tube sample method (ROSRINE FPM). When a significant variation in the soil type was indicated by a grab sample or drill rate, a pitcher-tube sample was collected. The drilling rod and bit were removed from the hole and a pitcher-tube sampling barrel was used to cut an undisturbed sample at the bottom of the hole for approximately 1 meter. The sample barrel was then brought to the surface where the sample tube was removed from the barrel. The sample was measured for percent recovery and soil type, sealed with wax, and capped. The plastic caps were sealed with electric tape. The samples were labeled, stored upright, and then hand-delivered to the laboratory for testing.

Detailed information on these sampling procedures is contained in the ROSRINE FPM.

3.4.2 Laboratory Testing

Index property tests were conducted on grab and SPT samples by the commercial laboratory Teratest Labs, Inc. (Teratest, 2001). Index testing including standard USC soil classification, grain size distribution, Atterburg limits, density and moisture content were done on selected samples collected at the sites as shown in Table 7.

Teratest Inc., performed a total of 97 lab tests. The tests were performed in accordance with American Society for Testing Materials (ASTM) standards ASTM D2216 for Water (Moisture) Content of Soil and Rock, ASTM D2937 for Dry Density, ASTM D4318 for Atterburg Limits, ASTM D422 Particle Size Distribution, and D2487 for Soil Classification. A total of 24 Atterburg liquid limit tests, 24 grain size analysis tests, and 24 soil classification tests were conducted. Moisture content tests were performed on a total of 17 samples, and dry density tests were conducted on 8 samples. The test results were conducted on disturbed and undisturbed samples, and were used to determine the classification symbols of the soils tested.

Table 5: ROSRINE sites where laboratory samples were collected and tested, to date.

Site ID	Location	Lab Tests Conducted on Borehole Samples
1	Bell-LA Bulk Mail	Index Properties (Teratest)
2	Yermo	Index Properties (Teratest)
3	Joshua Tree	Index Properties (Teratest)
4	Halls Valley	Index Properties (Teratest)
5	Gilroy 3	Index Properties (Teratest)
6	Superstition Mountain Top	Index Properties (Teratest)
8	IBM Almaden (Santa Teresa Hills)	Index Properties (Teratest)

Dynamic lab tests will be conducted at University of Texas at Austin and UCLA, on pitcher samples collected from boreholes. Monotonic and cyclic laboratory tests will be performed on well preserved soil specimens. The cyclic testing component combines experiments at the two different university laboratories, each having responsibility to conduct different types of cyclic tests. Resonant column and torsional shear tests will be performed on specimens at UTA.

The tabulated lab test results for each ROSRINE site are provided in this report in Appendices B - J.

3.5 Field Photos

Photographs were taken at each ROSRINE site to record information about the location and borehole, and examples of logging and sampling results. In particular photos were taken of any unusual geology observed during sampling. Photos were taken with either a 35 mm or digital camera. Photos taken with 35 mm film were later scanned. The digital files were documented and linked with captions and other information in the ROSRINE database, discussed in detail in Section 4. Representative photos from the sites listed in Table 8 are provided in Appendices B though I.

Table 6: Examples of photos taken at these ROSRINE 5b sites (Appendices B – I).

Site ID	Location of Field Photos
64	Bell-LA Bulk Mail
65	Yermo
66	Joshua Tree
67	Halls Valley
68	Gilroy 3
69	Superstition Mountain Top
70	Parachute Test Site Control Bldg. 5000
71	IBM Almaden (Santa Teresa Hills)

3.6 Quality Assurance / Quality Control

Investigations are carried out under ROSRINE procedures and within a formal Quality Assurance environment to insure reliable data. The ROSRINE FPM contains the field procedures that are followed for drilling, sampling, borehole logging and geophysical logging.

Section 4

4.1 Data Processing and Dissemination

An integrated system based on Relational Database Management System (RDBMS), Geographic Information System (GIS) and Internet Map Server (IMS) was recently developed at USC by J. Swift, J.-P. Bardet and R. Nigbor to disseminate the geotechnical data of ROSRINE over the Internet (Swift et al., 2001a). In the framework of this particular large-scale collaborative research project in geotechnical earthquake engineering and engineering seismology, RDBMS, GIS and IMS technologies were combined to efficiently collect, organize and disseminate an increasing amount of information, including soil boreholes, shear wave velocity profiles, technical drawings, photographs, and basic information on associated strong motion stations (http://geoinfo.usc.edu/rosrine/). The integration of RDBMS, GIS and IMS allows users to query spatially geotechnical, geophysical and laboratory data and web operators to maintain data more efficiently. In 2001 this technology was improved to include a combination of Microsoft Access, custom Active Server Pages (ASP), ESRI's ArcView, ArcView IMS, Avenue and Dynamic Hypertext Markup Language (DHTML) custom programming to process the end user queries with increased efficiency. This system is described in detail in the ROSRINE Phases 1, 2 & 4 Report (Nigbor and Swift, 2001).

In July 2001 the ROSRINE website was significantly upgraded with the following features, shown in Figure 3:

- The interactive GIS-based map server queries data geographically through the "Get Data! Interactive Map" to the left. This map of ROSRINE sites in California is powered by ESRI software, and the program was updated to query the ROSRINE database directly using custom Active Server Pages (ASP's)
- A New "SEARCH ENGINE - Query the ROSRINE Database" was made available; this query is also ASP-driven, allowing the user greater query power and direct access to the database and data, without the GIS map interface
- The "ROSRINE Site List" was also updated through an ASP, providing a complete list of sites organized according to collaborative efforts; his link also allows direct access to the ROSRINE database and data without the GIS map interface.
- A New "Mailing List" feature is available; the ROSRINE Mailings will include information on Website data updates and current ROSRINE activities only.

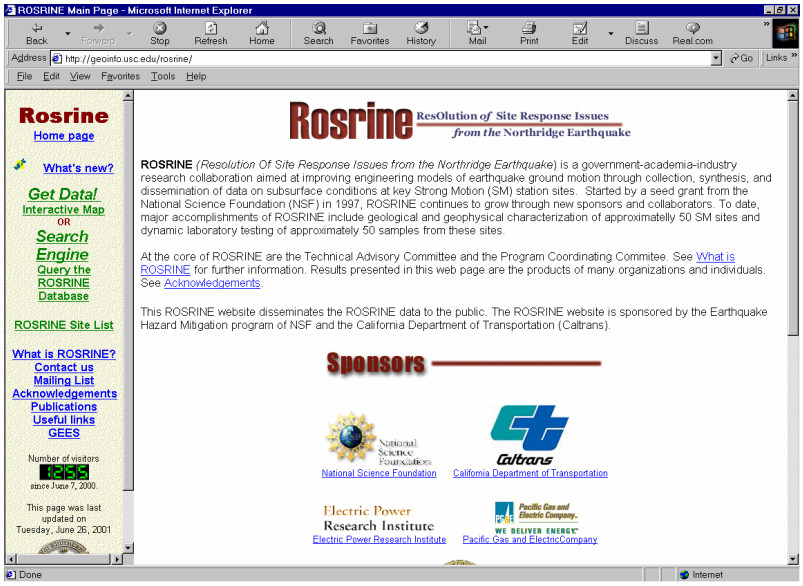


Figure 3: New features on the ROSRINE website, http://geoinfo.usc.edu/rosrine.

Besides new data and the programming improvements, additional information on the ROSRINE website include the following:

- The ROSRINE Lithology Key has been expanded
- Information on which company or organization performed a given site investigation
- Site Plans have been added for the ROSRINE Phase 5b sites, provided dynamically along with the other data whenever a site is queried, either through the GIS map or via the search engine
- Scanned images of boring logs (with P & S wave plots) have been added from the USGS OFR 00-470 (Gibbs et al, 2000), for the following sites (USGS Site Codes):
    - Brentwood VA Hospital (BVA)
    - ETEC (RD7)
    - LADWP Receiving Station East (RSE)
    - Sylmar Converter East (ESC1)
    - Sylmar Converter East #2 (ESC2)
    - Wadsworth VA North (WVAN)
    - Wadsworth VA South (WVAS)

Section 5

5.1 Progress of Current ROSRINE Phase

In addition to the dynamic laboratory testing yet to be completed, in a related PEER Lifelines effort a team from the University of Texas, Austin led by Prof. Ken Stokoe will be measuring V_S profiles using surface wave (SASW) methods at approximately 15 strong motion sites in Southern California. In addition, further dynamic soil testing will be done later this year under separate PEER Lifelines funding (Project 2B01/02).

The work sited above will be done later this year. Following QA/QC of the data, the results will be added to the ROSRINE website.

5.2 Future Work

Many analytical studies of site response have used and are using ROSRINE data. In order to preserve this information resource for the future, the community (through a COSMOS working group) is looking at development of unified geotechnical data storage and dissemination for ROSRINE and other similar projects. In a PEER-sponsored workshop held October 4 & 5, 2001, there was a successful attempt to resolve issues and move forward with implementation. The results and recommendations coming out of the workshop will be available on the COSMOS website by the end of November 2001 (COSMOS, 2001).

A new ROSRINE Phase 6 project for characterization of more sites and collaboration with the USGS deep borehole project is currently being organized.

References

Caltrans, "Soil and Rock Logging Classification Manual (Field Guide)", Sate of California Department of Transportation Engineering Service Center, Office of Structural Foundations, August, 1996, 31 p.

CDMG, "Preliminary Working Digital Maps of Portions of Los Angeles, Orange, and Ventura Counties, California, Compiled for Seismic Hazard Zoning", 1:24,000, Seismic Hazard Mapping Program Staff, California Department of Conservation, Division of Mines and Geology (DMG), Sacramento, CA, 1999.

COSMOS, The Consortium of Organizations for Strong Motion Observation Systems, http://www.cosmos-eq.org/default.html [2001].

FEMA, "NEHRP Recommended Provisions for Seismic Regulations for New Buildings and Other Structures", Federal Emergency Management Agency, FEMA 302, February 1997.

GeoVision, "Health and Safety Plan for Geotechnical Investigation and Engineering Services Associated with the ROSRINE 5B Seismic Investigation IBM Almaden Facility", prepared for IBM Almaden Research Facility, San Jose, CA, by Geovision Geophysical Services, Corona, CA, August 20, 2001, 47 p.

Gibbs, J.F., Tinsley, J., Boore, D.M., and Joyner, W.B., "Seismic velocities and geological conditions at twelve sites subjected to strong ground motion in the 1994 Northridge, California Earthquake: A Revision of OFR 96-740", USGS OFR 99-446, 1999, 142 p.

Gibbs, J.F., Tinsley, J.C., Boore, D.M., and Joyner, W.B., "Borehole velocity measurments and geological conditions at thirteen sites in the Los Angeles, California Region", USGS Open-File Report 00-470, 2000, 118 p.

GRL, Goble Rausche Likins and Associates, Inc., "Research report on Pitcher Drilling's 140 lb hammer used by Pitcher Drilling throughout the ROSRINE project", [Online]. Available: http://geoinfo.usc.edu/rosrine/: Get Data!, ROSRINE FAQ #10, July 1999, 34 p.

Nigbor, R.L., and Swift, J. N., "Resolution of Site Response Issues in the Northridge Earthquake (ROSRINE), Data Collection, Processing And Dissemination From Phases 1, 2 & 4 Field And Laboratory Investigations", USC Report CE472**,** 15 June 2001, 250 p.

Porcella, R.L., "Geotechnical Investigations at Strong Motion Instrument Stations in Imperial Valley", USGS Open-File Report 84-562, August 1984.

ROSRINE, ROSRINE Resolution of Site Response Issues from the Northridge Earthquake [Online]. Available: http://geoinfo.usc.edu/rosrine/, August, 2000.

Sterner, R., Color Landform Atlas of the United States [Online]. Available: http://fermi.jhuapl.edu/states/**,** John Hopkins University Applied Physics Laboratory, 1995.

Swift, J., Nigbor, R.L., Bardet, J.-P., and Hu, J., "An Integrated RDBMS-GIS-IMS System For Dissemination Of Information In Geotechnical Earthquake Engineering", submitted to Computers & Geosciences, June, 2001a.

Swift, J. N., Nigbor, R. L., and Diehl, J., "ROSRINE: Resolution of Site Response Issues from the Northridge Earthquake, Field Procedures Manual," USC Report CE471, 15 June 2001b, 76 p.

Teratest, Inc., Teratest Reports, Laboratory test results, ROSRINE B5 Project – USC, for GeoVision, Project No.: 1284, Lab Project No.: 015041: L.A. Bulk Mail, May 7; Joshua Tree Fire Station, May 9; Yermo Fire Station, May 10; Halls Valley B-2, June 21; Superstition Mountain S-8 B #1, June 28; Gilroy #3, June27; and IBM Almaden Research Facility, October 2, 2001.

Appendix A: ROSRINE Lithology Key

Appendix B: Detailed Results for Bell - LA Bulk Mail Site

Appendix C: Detailed Results for Yermo Site

Appendix D: Detailed Results for Joshua Tree Site

Appendix E: Detailed Results for Halls Valley Site

Appendix F: Detailed Results for Gilroy #3 Site

Appendix G: Detailed Results for Superstition Mountain Top Site

Appendix H: Detailed Results for Parachute Test Site

Appendix I: Detailed Results for IBM Almaden (Santa Teresa Hills) Site

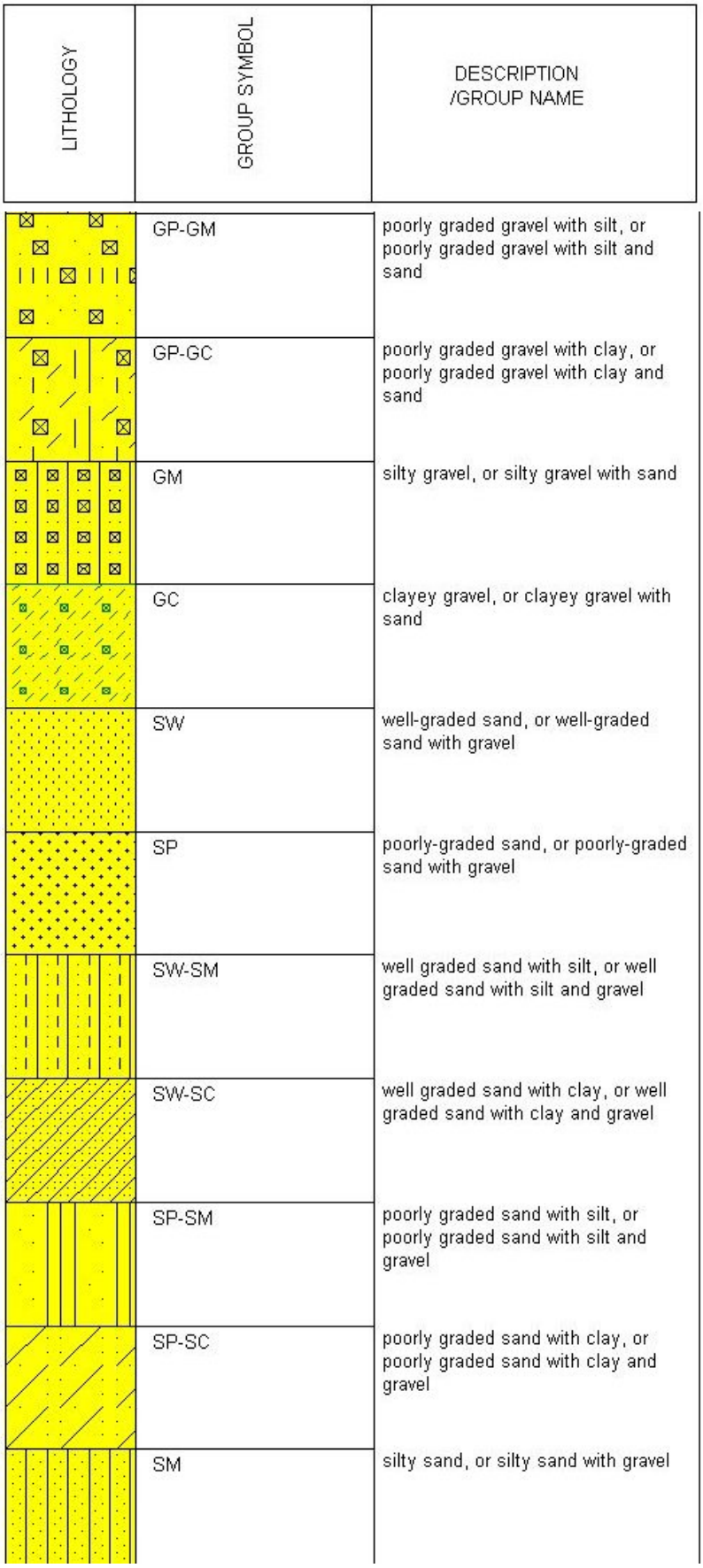
Appendix J: Detailed Results for Pier F Long Beach Site

Appendix A: Lithology Key

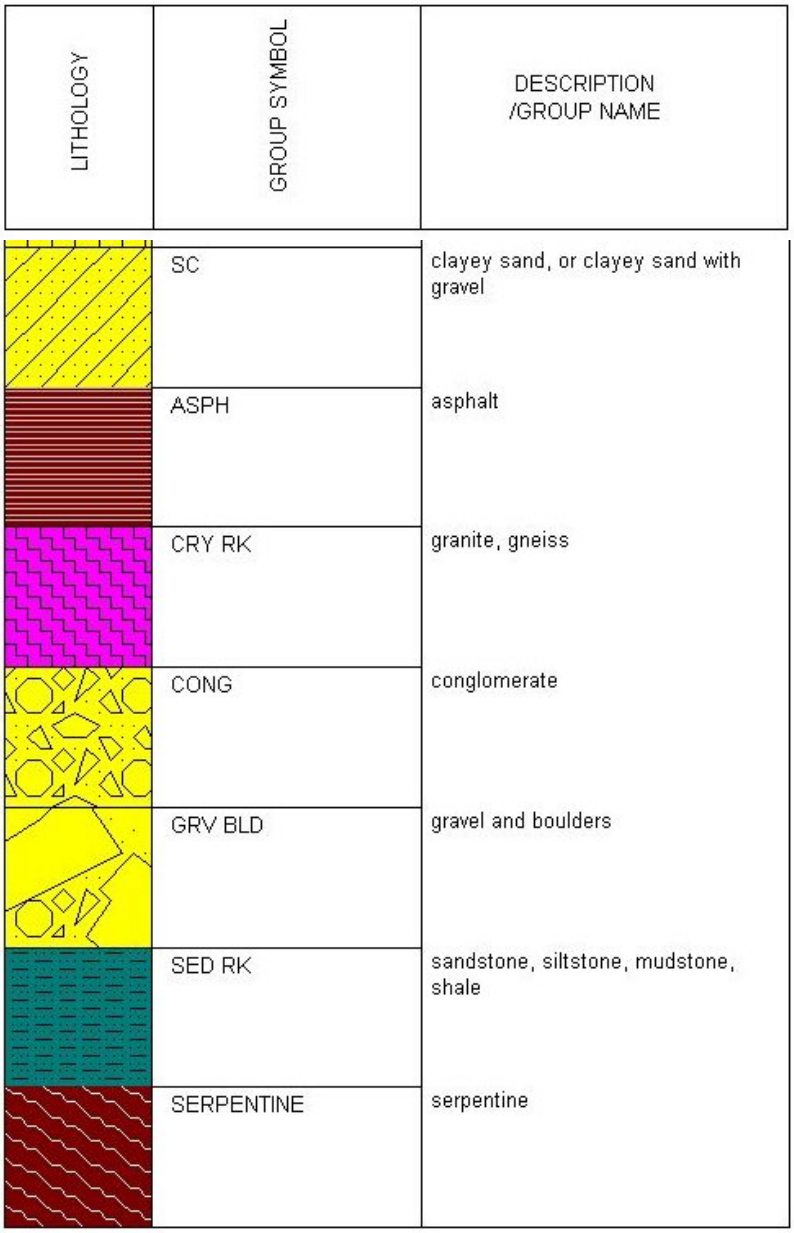
Rosrine ResOlution of Site Response Issues from the Northridge Earthquake

Boring Log Lithology Key

LITHOLOGY	GROUP SYMBOL	DESCRIPTION /GROUP NAME
	CH	fat clay, fat clay with sand, fat clay with gravel, sandy fat clay, sandy fat clay with gravel, gravelly fat clay, or gravelly fat clay with sand
	CL	lean clay, lean clay with sand, lean clay with gravel, sandy lean clay, sandy lean clay with gravel, gravelly lean clay, or gravelly lean clay with sand
	MH	elastic silt, elastic silt with sand, elastic silt with gravel, sandy elastic silt, sandy elastic silt with gravel, gravelly elastic silt, or gravelly elastic silt with sand
	ML	silt, silt with sand, silt with gravel, sandy silt, sandy silt with gravel, gravelly silt, or gravelly silt with sand
	OL/OH	organic soil, organic soil with sand, organic soil with gravel, sandy organic soil, sandy organic soil with gravel, gravelly organic soil, or gravelly organic soil with sand
	GW	well graded gravel, or well graded gravel with sand
	GP	poorly graded gravel, or poorly graded gravel with sand
	GW-GM	well graded gravel with silt, or well graded gravel with silt and sand
	GW-GC	well graded gravel with clay, or well graded gravel with clay and sand



LITHOLOGY	GROUP SYMBOL	DESCRIPTION /GROUP NAME
	GP-GM	poorly graded gravel with silt, or poorly graded gravel with silt and sand
	GP-GC	poorly graded gravel with clay, or poorly graded gravel with clay and sand
	GM	silty gravel, or silty gravel with sand
	GC	clayey gravel, or clayey gravel with sand
	SW	well-graded sand, or well-graded sand with gravel
	SP	poorly-graded sand, or poorly-graded sand with gravel
	SW-SM	well graded sand with silt, or well graded sand with silt and gravel
	SW-SC	well graded sand with clay, or well graded sand with clay and gravel
	SP-SM	poorly graded sand with silt, or poorly graded sand with silt and gravel
	SP-SC	poorly graded sand with clay, or poorly graded sand with clay and gravel
	SM	silty sand, or silty sand with gravel



B = Bag
SH = Shelby Tube
SOT = Split Spoon
T = Wireline Tube
P = Pitcher Tube
USCS: caps = Lab Results, lower case = Field Interpretation

Appendix B: Detailed Results for Bell - LA Bulk Mail Site

ROSRINE 5b - Bell-LA Bulk Mail

Rosrine ResOlution of Site Response Issues from the Northridge Earthquake

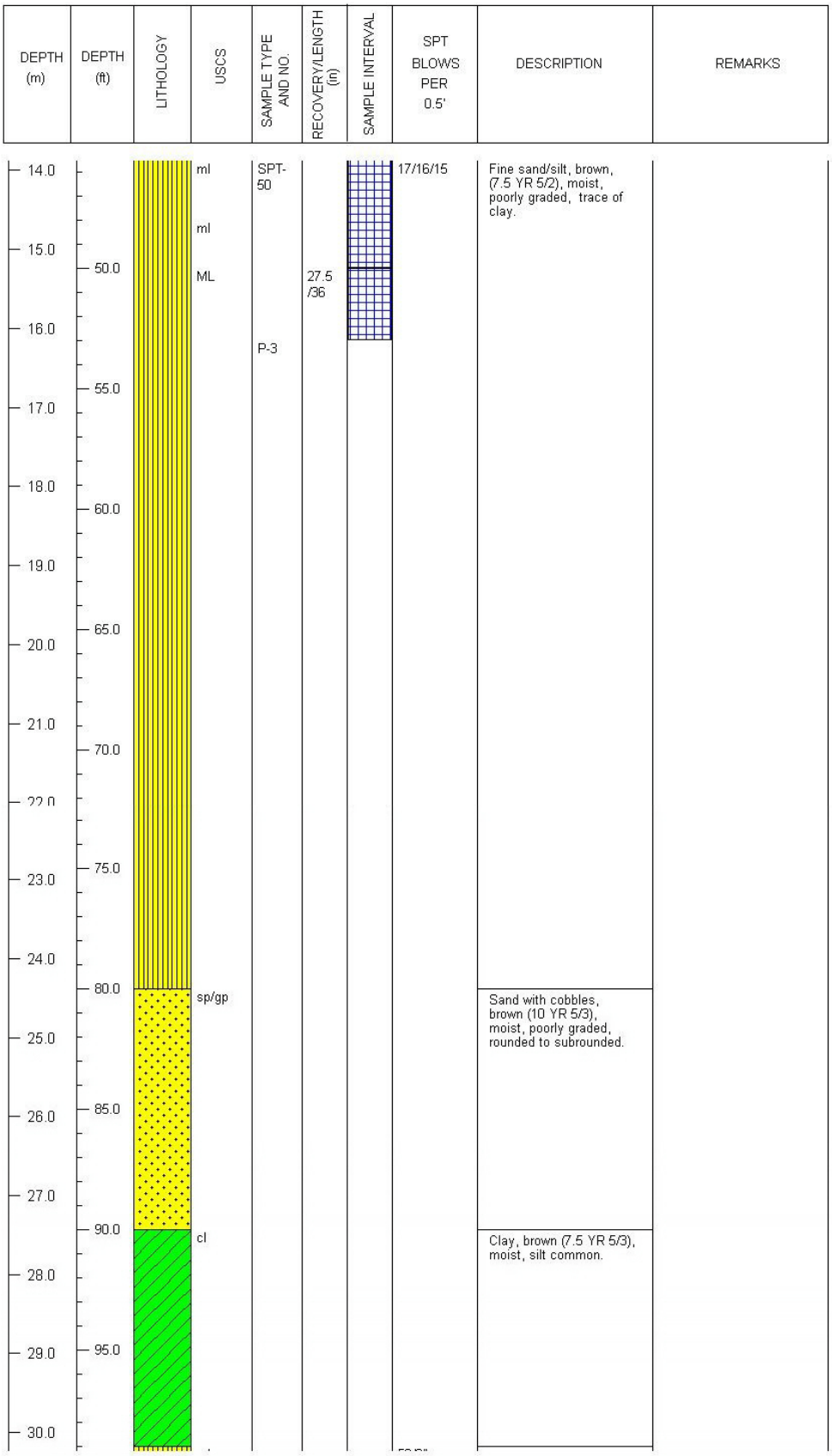
Boring Log

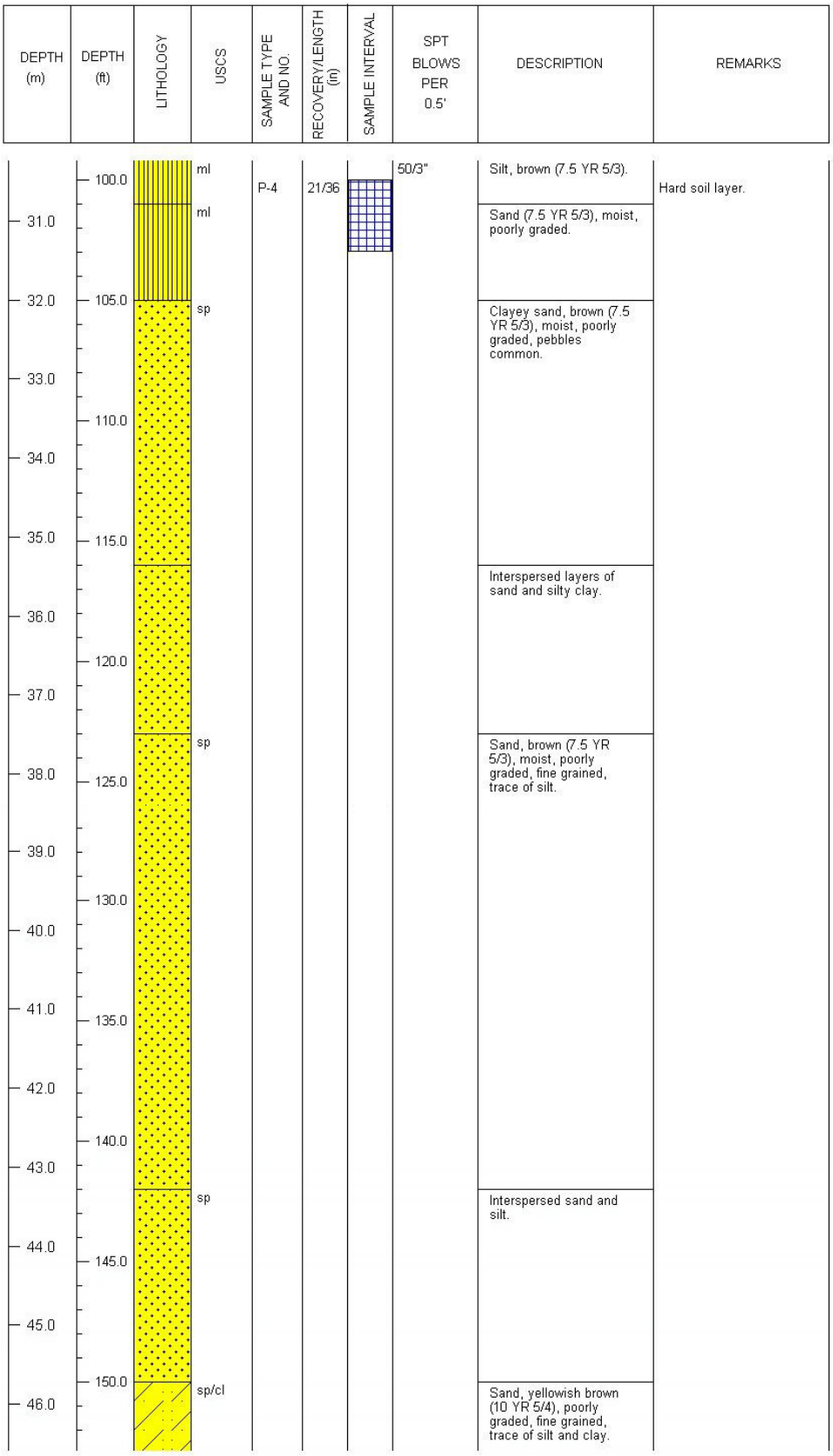
PROJECT: ROSRINE 5b
SITE LOCATION: Bell - L.A. Bulk Mail
DIST/COUNTY/RTE/PM: Los Angeles
EA: n/a
BRIDGE NO: n/a
STA/OFFSET: n/a
BORING NO: B-1

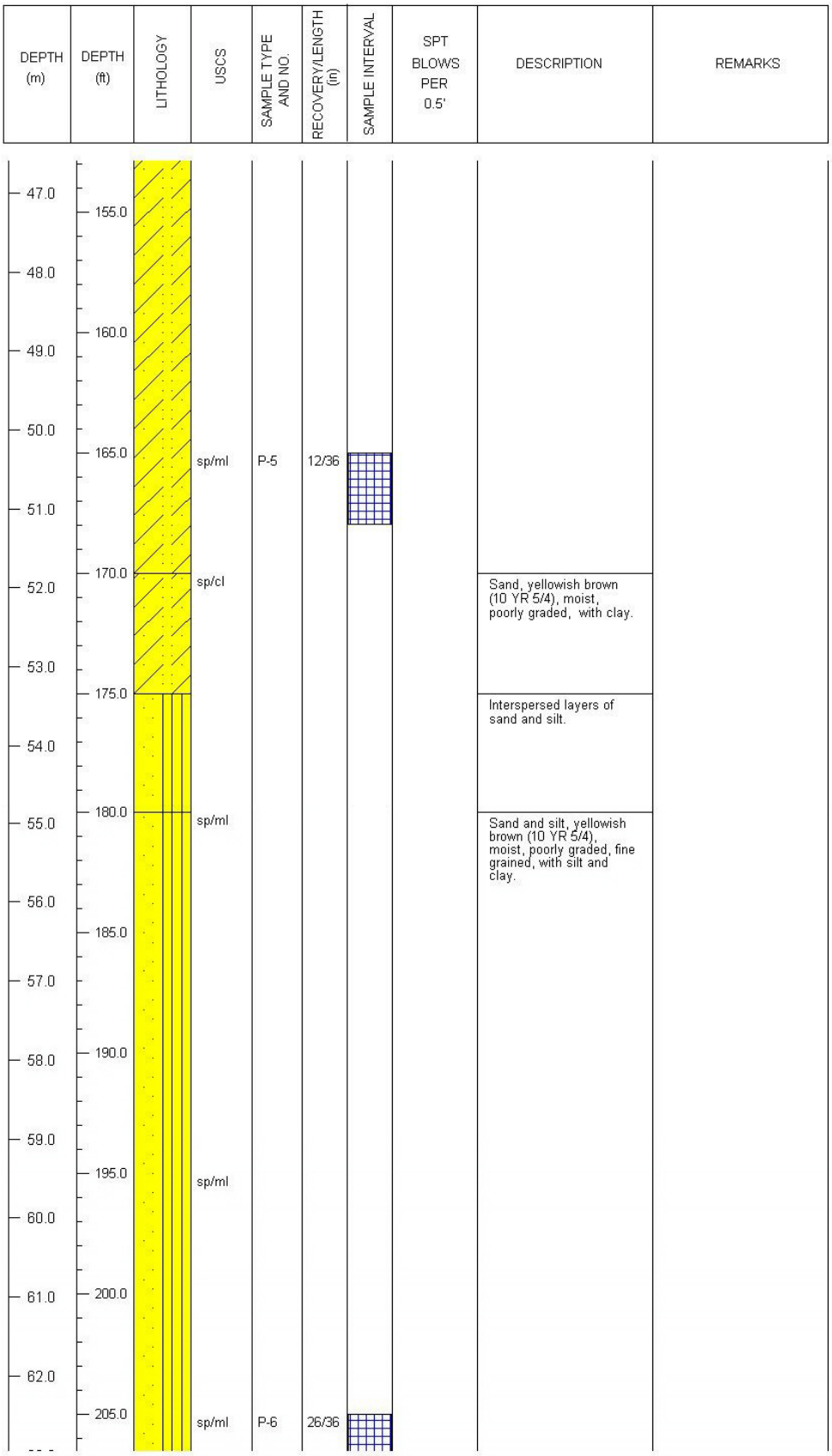
DRILLING CONTRACTOR: Pitcher Drilling
DATES DRILLED: 04/16/2001 - 04/19/2001
DRILLING METHOD: Mud Rotary
HOLE DIAMETER (mm): 168.28
TOTAL DEPTH (m): 106.83
DRILL RIG MODEL/NO: Failig F-10
SPT HAMMER: Acker 140 lb

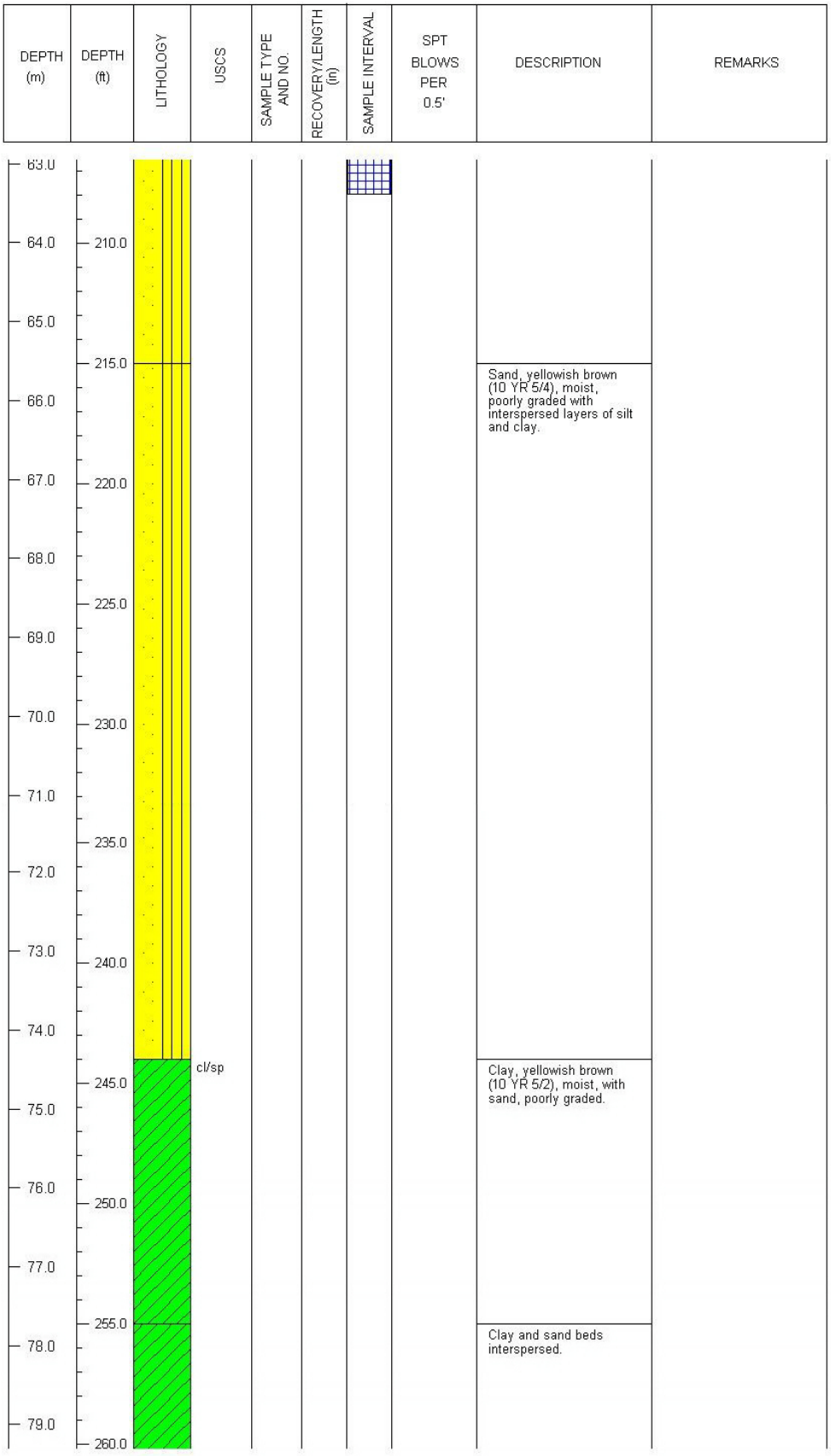
DATUM: NAD27
LATITUDE: 33.996
LONGITUDE: -118.162
ELEVATION: 140 ft.
LOGGED BY: A. Jack
ORGANIZATION: GeoVision
ENTERED BY: J. Swift DATE: 06/27/2001
CHECKED BY: R. Nigbor DATE: 06/29/2001

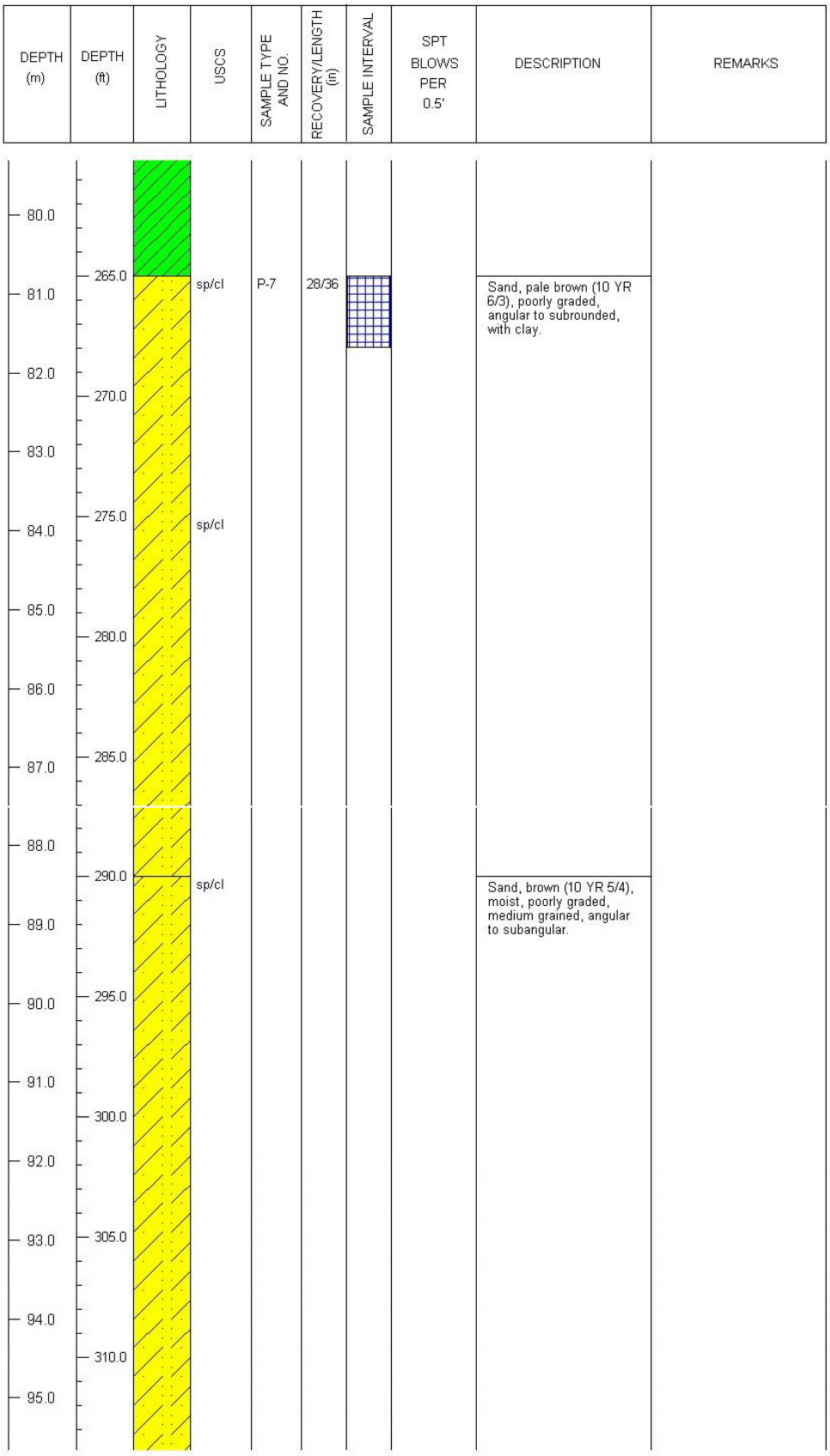
DEPTH (m)	DEPTH (ft)	LITHOLOGY	USCS	SAMPLE TYPE AND NO.	RECOVERY/LENGTH (in)	SAMPLE INTERVAL	SPT BLOWS PER 0.5'	DESCRIPTION	REMARKS
0.0	0.0							Fill.	
1.0									
	5.0		ml					Silt, brown, (10 YR 5/2), moist, fine grained with trace of clay.	
2.0									
3.0	10.0		(ML)s	SPT-10			10/15/18		
4.0									
	15.0		ml	P-1	25/36				
5.0									
6.0	20.0		s(CL)	SPT-20	27.5/36		12/18/24		
7.0			ml	P-2					
	25.0								
8.0									
9.0	30.0								
10.0									
	35.0		s(ML)	SPT-35			15/17/18		
11.0			ml						
12.0	40.0		CL	SPT-40					
13.0									
	45.0		ml	SPT-			17/16/15	Fine sand/silt, brown	

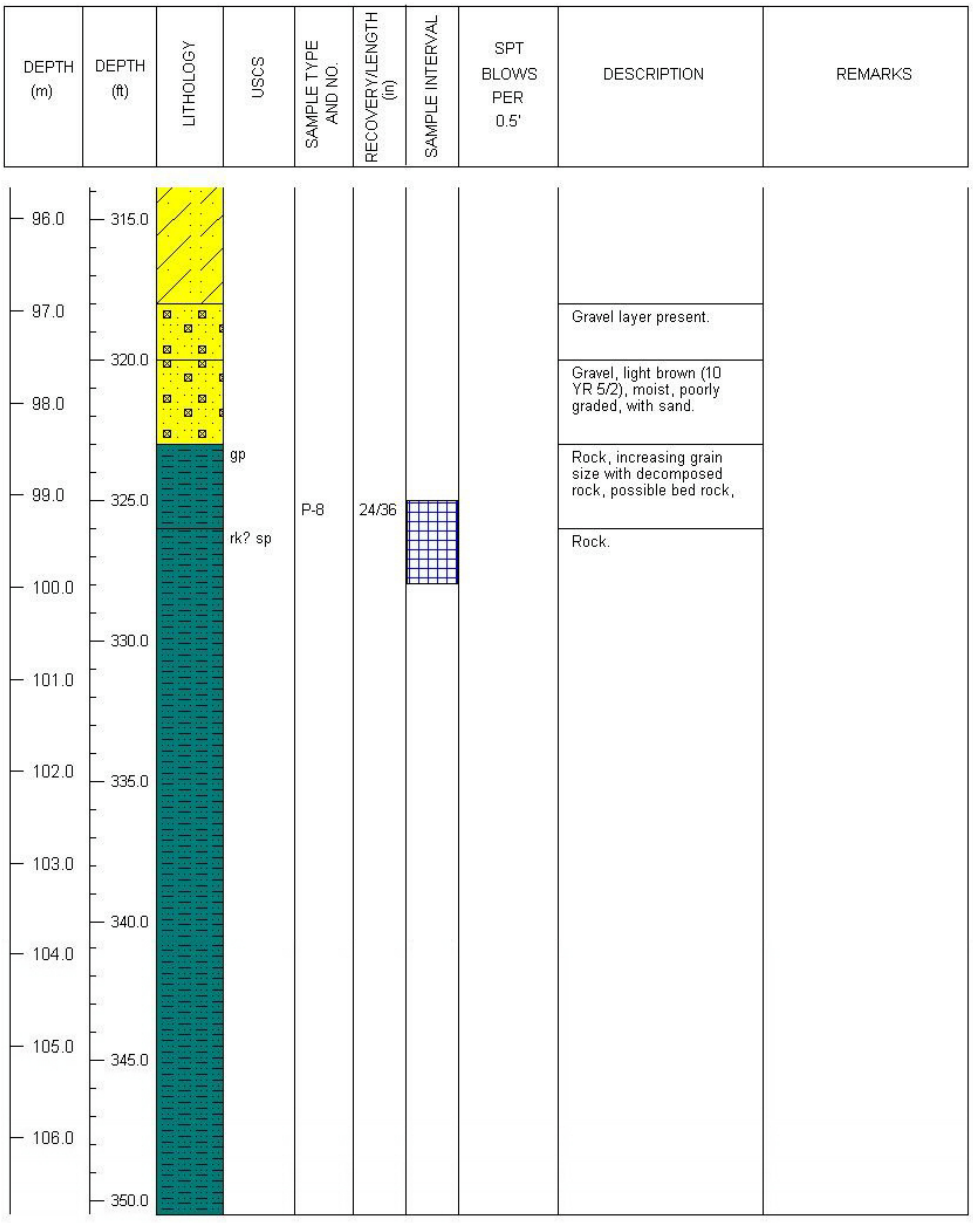

DEPTH (m)
DEPTH (ft)
LITHOLOGY
USCS
SAMPLE TYPE AND NO.
RECOVERY/LENGTH (in)
SAMPLE INTERVAL
SPT BLOWS PER 0.5'
DESCRIPTION
REMARKS
14.0
15.0
16.0
17.0
18.0
19.0
20.0
21.0
22.0
23.0
24.0
25.0
26.0
27.0
28.0
29.0
30.0
50.0
55.0
60.0
65.0
70.0
75.0
80.0
85.0
90.0
95.0
ml
ml
ML
sp/gp
cl
SPT-50
P-3
27.5 /36
17/16/15
Fine sand/silt, brown, (7.5 YR 5/2), moist, poorly graded, trace of clay.
Sand with cobbles, brown (10 YR 5/3), moist, poorly graded, rounded to subrounded.
Clay, brown (7.5 YR 5/3), moist, silt common.

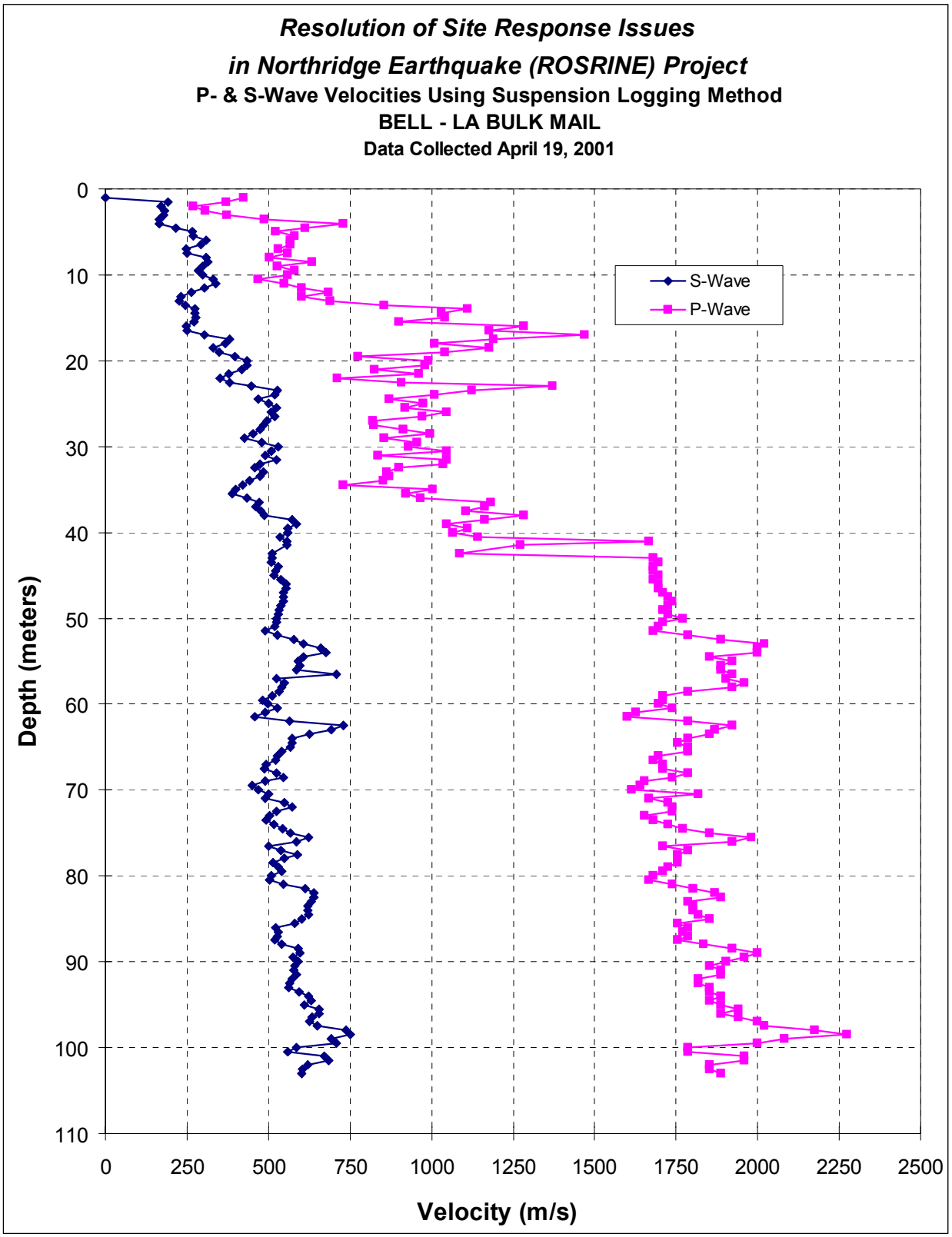

DEPTH (m)
DEPTH (ft)
LITHOLOGY
USCS
SAMPLE TYPE AND NO.
RECOVERY/LENGTH (in)
SAMPLE INTERVAL
SPT BLOWS PER 0.5'
DESCRIPTION
REMARKS
31.0
32.0
33.0
34.0
35.0
36.0
37.0
38.0
39.0
40.0
41.0
42.0
43.0
44.0
45.0
46.0
100.0
105.0
110.0
115.0
120.0
125.0
130.0
135.0
140.0
145.0
150.0
ml
ml
sp
sp
sp
sp/cl
P-4
21/36
50/3"
Silt, brown (7.5 YR 5/3).
Hard soil layer.
Sand (7.5 YR 5/3), moist, poorly graded.
Clayey sand, brown (7.5 YR 5/3), moist, poorly graded, pebbles common.
Interspersed layers of sand and silty clay.
Sand, brown (7.5 YR 5/3), moist, poorly graded, fine grained, trace of silt.
Interspersed sand and silt.
Sand, yellowish brown (10 YR 5/4), poorly graded, fine grained, trace of silt and clay.


DEPTH (m)
DEPTH (ft)
LITHOLOGY
USCS
SAMPLE TYPE AND NO.
RECOVERY/LENGTH (in)
SAMPLE INTERVAL
SPT BLOWS PER 0.5'
DESCRIPTION
REMARKS
47.0
48.0
49.0
50.0
51.0
52.0
53.0
54.0
55.0
56.0
57.0
58.0
59.0
60.0
61.0
62.0
155.0
160.0
165.0
170.0
175.0
180.0
185.0
190.0
195.0
200.0
205.0
sp/ml
sp/cl
sp/ml
sp/ml
sp/ml
P-5
P-6
12/36
26/36
Sand, yellowish brown (10 YR 5/4), moist, poorly graded, with clay.
Interspersed layers of sand and silt.
Sand and silt, yellowish brown (10 YR 5/4), moist, poorly graded, fine grained, with silt and clay.


DEPTH (m)
DEPTH (ft)
LITHOLOGY
USCS
SAMPLE TYPE AND NO.
RECOVERY/LENGTH (in)
SAMPLE INTERVAL
SPT BLOWS PER 0.5'
DESCRIPTION
REMARKS
63.0
64.0
65.0
66.0
67.0
68.0
69.0
70.0
71.0
72.0
73.0
74.0
75.0
76.0
77.0
78.0
79.0
210.0
215.0
220.0
225.0
230.0
235.0
240.0
245.0
250.0
255.0
260.0
cl/sp
Sand, yellowish brown (10 YR 5/4), moist, poorly graded with interspersed layers of silt and clay.
Clay, yellowish brown (10 YR 5/2), moist, with sand, poorly graded.
Clay and sand beds interspersed.


DEPTH (m)
DEPTH (ft)
LITHOLOGY
USCS
SAMPLE TYPE AND NO.
RECOVERY/LENGTH (in)
SAMPLE INTERVAL
SPT BLOWS PER 0.5'
DESCRIPTION
REMARKS
80.0
81.0
82.0
83.0
84.0
85.0
86.0
87.0
88.0
89.0
90.0
91.0
92.0
93.0
94.0
95.0
265.0
270.0
275.0
280.0
285.0
290.0
295.0
300.0
305.0
310.0
sp/cl
sp/cl
sp/cl
P-7
28/36
Sand, pale brown (10 YR 6/3), poorly graded, angular to subrounded, with clay.
Sand, brown (10 YR 5/4), moist, poorly graded, medium grained, angular to subangular.


DEPTH (m)
DEPTH (ft)
LITHOLOGY
USCS
SAMPLE TYPE AND NO.
RECOVERY/LENGTH (in)
SAMPLE INTERVAL
SPT BLOWS PER 0.5'
DESCRIPTION
REMARKS
96.0
97.0
98.0
99.0
100.0
101.0
102.0
103.0
104.0
105.0
106.0
315.0
320.0
325.0
330.0
335.0
340.0
345.0
350.0
gp
rk? sp
P-8
24/36
Gravel layer present.
Gravel, light brown (10 YR 5/2), moist, poorly graded, with sand.
Rock, increasing grain size with decomposed rock, possible bed rock,
Rock.


Resolution of Site Response Issues
in Northridge Earthquake (ROSRINE) Project
P- & S-Wave Velocities Using Suspension Logging Method
BELL - LA BULK MAIL
Data Collected April 19, 2001
S-Wave
P-Wave
Depth (meters)
0
10
20
30
40
50
60
70
80
90
100
110
0
250
500
750
1000
1250
1500
1750
2000
2250
2500
Velocity (m/s)

Bell – LA Bulk Mail

Depth (meters)	Vs (meters/sec)	Vp (meters/sec)
1	0	423.729
1.5	190.476	370.37
2	170.94	268.817
2.5	181.818	304.878
3	177.305	371.747
3.5	163.934	487.805
4	163.934	729.927
4.5	216.45	613.497
5	267.38	520.833
5.5	268.097	581.395
6	307.692	568.182
6.5	294.118	568.182
7	248.139	529.101
7.5	249.377	558.659
8	309.598	502.513
8.5	313.48	632.911
9	297.619	526.316
9.5	284.9	581.395
10	298.507	558.659
10.5	330.033	469.484
11	338.983	549.451
11.5	303.951	602.41
12	263.852	684.932
12.5	232.558	602.41
13	226.757	689.655
13.5	245.7	854.701
14	273.224	1111.111
14.5	273.973	1030.927
15	276.243	1041.667
15.5	270.27	900.901
16	248.756	1282.052
16.5	250	1176.471
17	303.951	1470.589
17.5	381.679	1190.476
18	367.647	1010.101
18.5	331.126	1176.47
19	348.432	1041.667
19.5	396.825	775.194
20	434.783	990.099
20.5	432.9	980.392
21	419.287	826.446
21.5	377.359	961.539
22	350.263	711.744
22.5	379.507	909.091
23	446.429	1369.863
23.5	526.316	1123.596
24	519.481	1010.101
24.5	467.29	869.565
25	501.253	975.61

Depth (meters)	Vs (meters/sec)	Vp (meters/sec)
25.5	524.934	917.431
26	507.614	1047.12
26.5	519.48	970.874
27	495.049	819.672
27.5	485.437	823.045
28	472.813	913.242
28.5	453.515	995.025
29	425.532	854.701
29.5	478.469	956.938
30	529.1	930.233
30.5	508.906	1047.12
31	490.196	836.82
31.5	524.934	1047.12
32	473.934	1036.269
32.5	457.666	900.901
33	485.437	862.069
33.5	472.813	869.565
34	441.501	851.064
34.5	421.941	729.927
35	400	1005.025
35.5	389.864	921.659
36	432.9	966.184
36.5	471.698	1183.432
37	459.77	1162.791
37.5	476.19	1104.973
38	486.618	1282.051
38.5	571.429	1162.791
39	586.51	1047.12
39.5	560.224	1111.111
40	560.224	1063.83
40.5	536.193	1142.857
41	557.103	1666.667
41.5	557.103	1273.886
42.5	510.204	1086.956
43	510.204	1680.673
43.5	507.614	1694.915
44	530.504	1680.673
44.5	522.193	1680.673
45	515.464	1694.915
45.5	537.635	1680.673
46	552.486	1694.916
46.5	552.486	1694.915
47	546.448	1709.402
47.5	544.959	1724.138
48	544.959	1739.131
48.5	537.634	1724.138
49	533.333	1709.402
49.5	529.101	1724.137
50	523.56	1769.911
50.5	524.934	1709.402
51	518.135	1694.916
51.5	490.196	1680.673

Depth (meters)	Vs (meters/sec)	Vp (meters/sec)
52	527.704	1785.714
52.5	578.035	1886.792
53	607.903	2020.203
53.5	660.066	2000
54	675.676	2000
54.5	607.903	1851.852
55	591.716	1923.077
55.5	595.238	1886.793
56	584.795	1886.792
56.5	709.22	1923.077
57	523.56	1904.762
57.5	547.945	1960.783
58	540.541	1923.077
58.5	531.915	1785.714
59	510.204	1709.402
59.5	481.928	1709.402
60	498.753	1694.915
60.5	526.316	1739.131
61	488.998	1626.016
61.5	458.716	1600
62	564.972	1785.714
62.5	729.927	1923.077
63	692.041	1869.158
63.5	625	1851.85
64	571.429	1785.714
64.5	571.429	1754.385
65	566.572	1785.713
65.5	540.541	1785.714
66	526.316	1694.915
66.5	520.833	1680.673
67	492.611	1709.402
67.5	487.805	1709.402
68	523.56	1785.714
68.5	544.959	1739.131
69	490.196	1652.892
69.5	450.451	1639.344
70	469.484	1612.904
70.5	501.253	1818.183
71	490.196	1666.667
71.5	547.945	1724.138
72	573.066	1739.13
72.5	523.56	1739.13
73	502.513	1652.892
73.5	492.611	1680.673
74	516.796	1724.138
74.5	543.478	1769.911
75	568.182	1851.852
75.5	623.053	1980.199
76	586.51	1923.077
76.5	500	1709.402
77	537.634	1785.714
77.5	588.235	1754.385

Depth (meters)	Vs (meters/sec)	Vp (meters/sec)
78	549.451	1754.385
78.5	514.139	1754.387
79	530.504	1724.137
79.5	540.541	1709.402
80	508.906	1680.673
80.5	502.513	1666.666
81	546.448	1739.131
81.5	613.497	1801.802
82	638.978	1869.159
82.5	638.978	1886.792
83	630.915	1785.714
83.5	619.195	1801.802
84	621.118	1801.802
84.5	623.053	1818.183
85	600.601	1851.852
85.5	579.71	1754.385
86	522.193	1785.714
86.5	530.504	1769.913
87	527.705	1785.714
87.5	518.135	1754.387
88	540.541	1834.862
88.5	589.971	1923.077
89	595.238	2000
89.5	576.369	1960.783
90	591.716	1904.763
90.5	581.395	1851.852
91	578.035	1886.792
91.5	584.795	1886.792
92	571.428	1818.183
92.5	564.972	1818.183
93	561.798	1851.852
93.5	593.472	1851.852
94	623.053	1886.792
94.5	630.915	1851.852
95	609.756	1886.792
95.5	655.738	1941.748
96	655.738	1886.792
96.5	632.911	1941.746
97	626.959	2000
97.5	649.351	2020.203
98	738.008	2173.913
98.5	751.88	2272.727
99	692.042	2083.333
99.5	709.22	2000
100	584.795	1785.714
100.5	560.224	1785.714
101	671.141	1960.785
101.5	684.932	1960.785
102	619.195	1851.852
102.5	604.23	1851.852
103	602.41	1886.793

ROSRINE 5b

Index Property Testing of Soil Samples

From Teratest Labs' Report, May 7, 2001

J. Swift, 6/20/2001

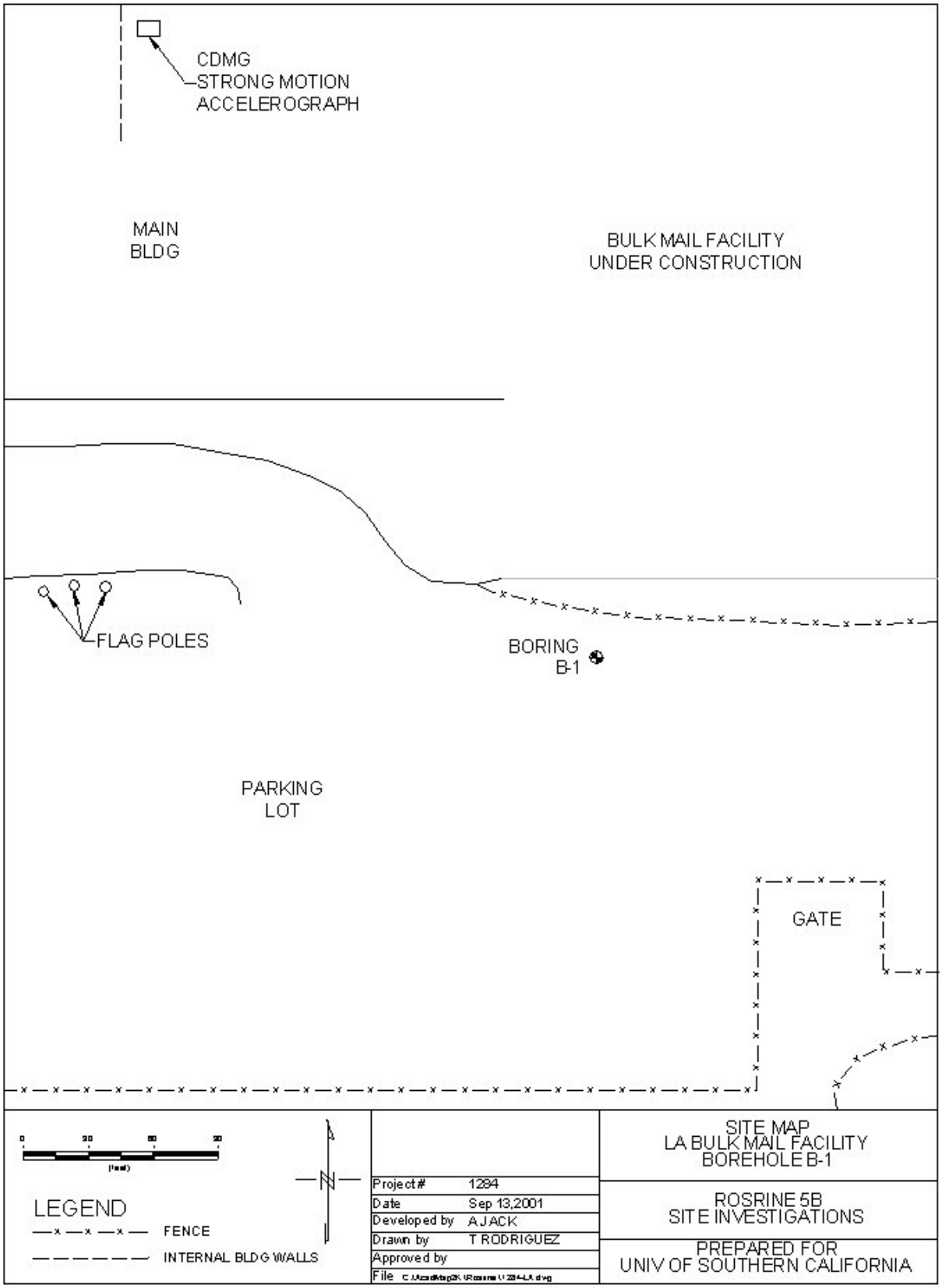
Bell - LA Bulk Mail

Sample	Depth, ft (range: # to #)		Depth, m (range: # to #)		Visual Classification	Soil Class	D50 (mm)	Moisture Content (%)	LL	PL	PI
SPT 10	10	12	3.0	3.7	n/a	(ML)s	n/a	29.7	n/a	n/a	n/a
SPT 20	20	22	6.1	6.7	n/a	s(CL)	n/a	18.9	30	18	12
SPT 35	35.0	37.0	10.7	11.3	n/a	s(ML)	n/a	25.1	n/a	n/a	n/a
SPT 40	40.0	42.0	12.2	12.8	n/a	CL	n/a	32.2	39	25	14
SPT 50	45.0	50.0	13.7	15.2	n/a	ML	n/a	47.0	44	28	16

Drill site next to Bell Postal Facility.

Drilling activities.

PS logging activities.


CDMG
STRONG MOTION
ACCELEROGRAPH
MAIN
BLDG
BULK MAIL FACILITY
UNDER CONSTRUCTION
FLAG POLES
BORING
B-1
PARKING
LOT
GATE
LEGEND
FENCE
INTERNAL BLDG WALLS
Project # 1284
Date Sep 13,2001
Developed by A JACK
Drawn by T RODRIGUEZ
Approved by
File
SITE MAP
LA BULK MAIL FACILITY
BOREHOLE B-1
ROSRINE 5B
SITE INVESTIGATIONS
PREPARED FOR
UNIV OF SOUTHERN CALIFORNIA

Appendix C: Detailed Results for Yermo Site

ROSRINE 5b – Yermo

Rosrine ResOlution of Site Response Issues from the Northridge Earthquake

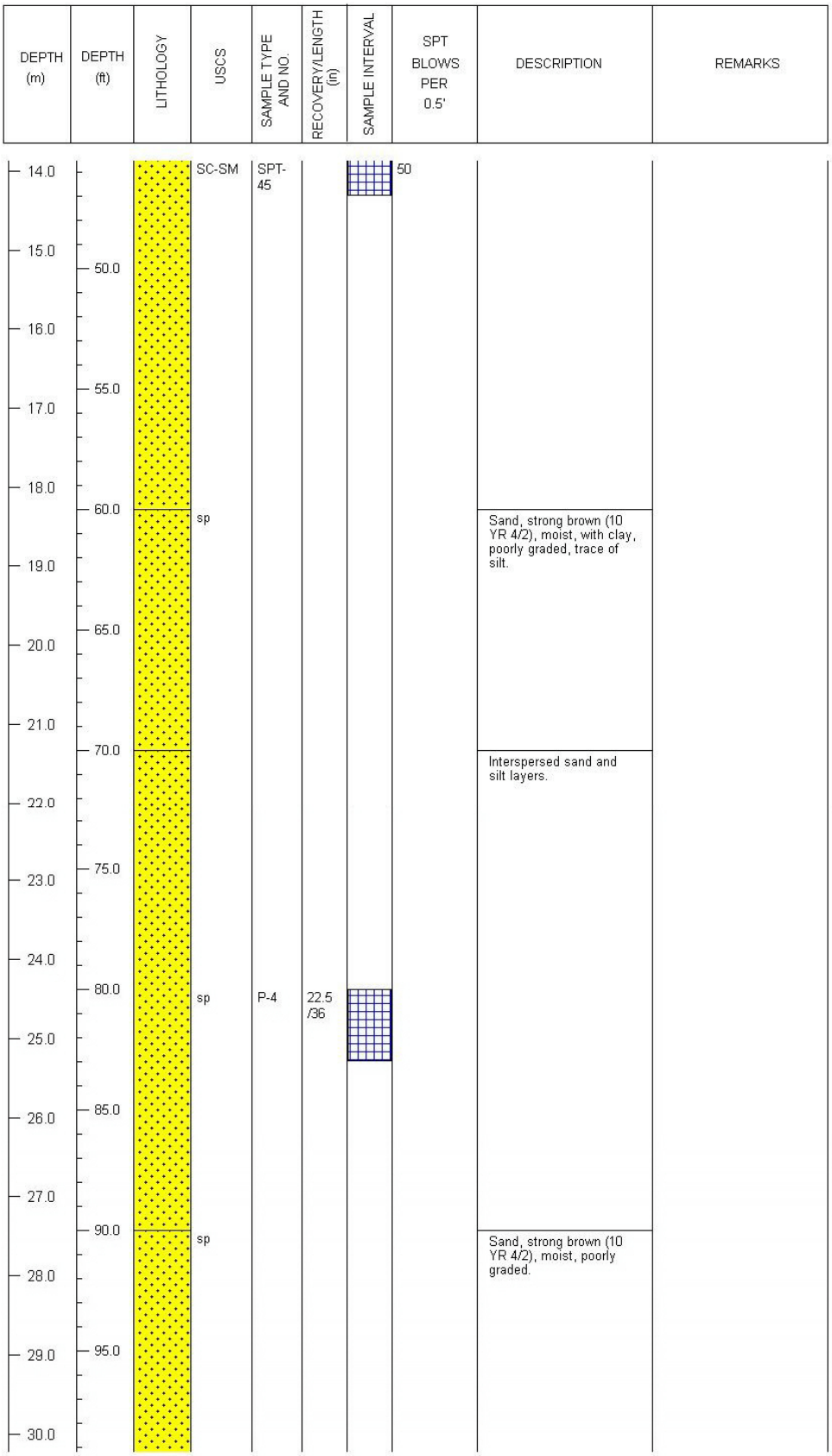
Boring Log

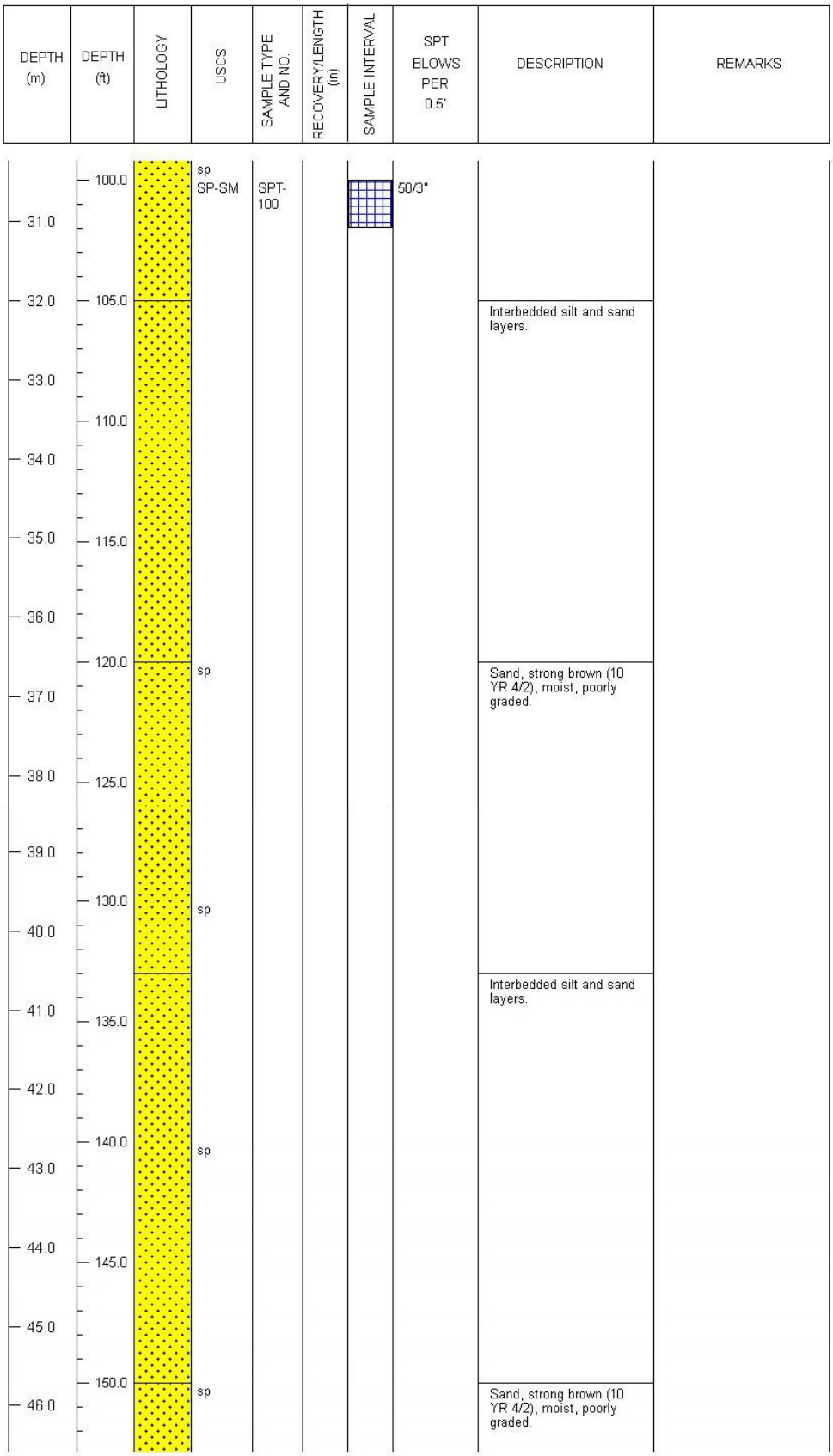
PROJECT: ROSRINE 5b
SITE LOCATION: Yermo Fire Station
DIST/COUNTY/RTE/PM: San Bernadino
EA: n/a
BRIDGE NO: n/a
STA/OFFSET: n/a
BORING NO: B-1

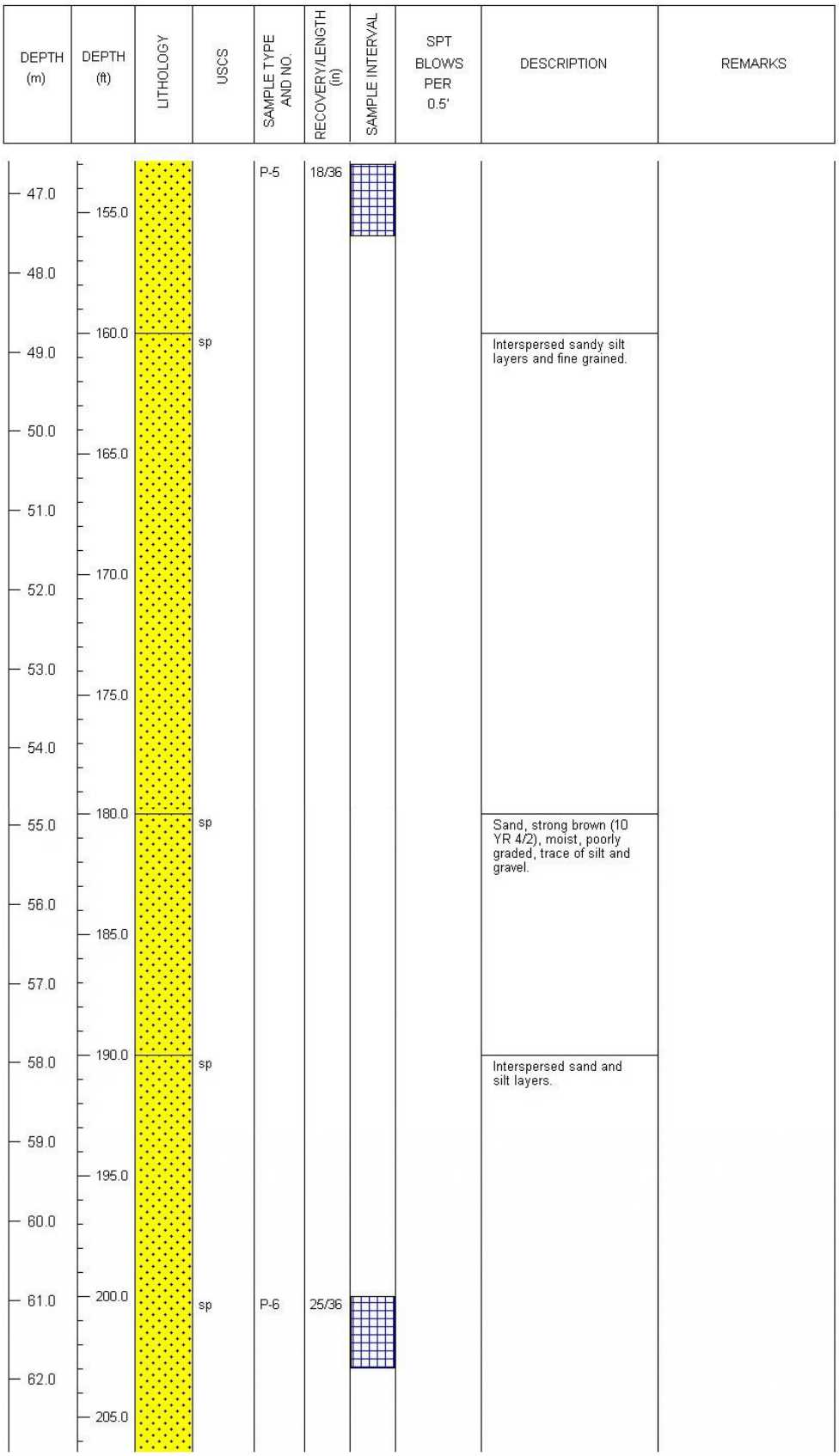
DRILLING CONTRACTOR: Pitcher Drilling
DATES DRILLED: 04/23/2001 - 04/24/2001
DRILLING METHOD: Mud Rotary
HOLE DIAMETER (mm): 168.28
TOTAL DEPTH (m): 106.80
DRILL RIG MODEL/NO: Failig F-10
SPT HAMMER: Acker 140 lb

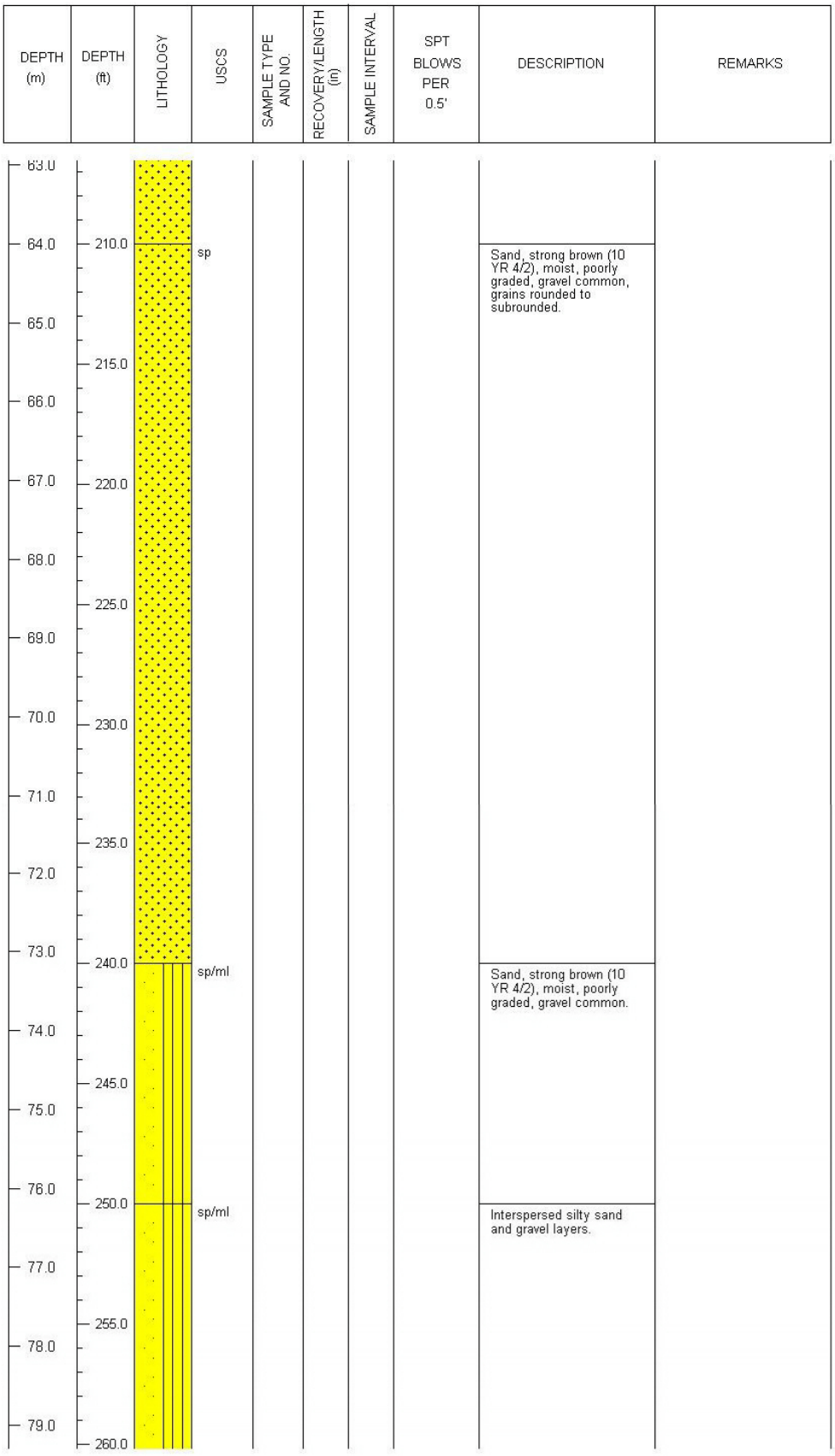
DATUM: NAD27
LATITUDE: 34.904
LONGITUDE: -116.823
ELEVATION: 1930 ft.
LOGGED BY: A. Jack
ORGANIZATION: GeoVision
ENTERED BY: J. Swift DATE: 06/28/2001
CHECKED BY: R. Nigbor DATE: 06/29/2001

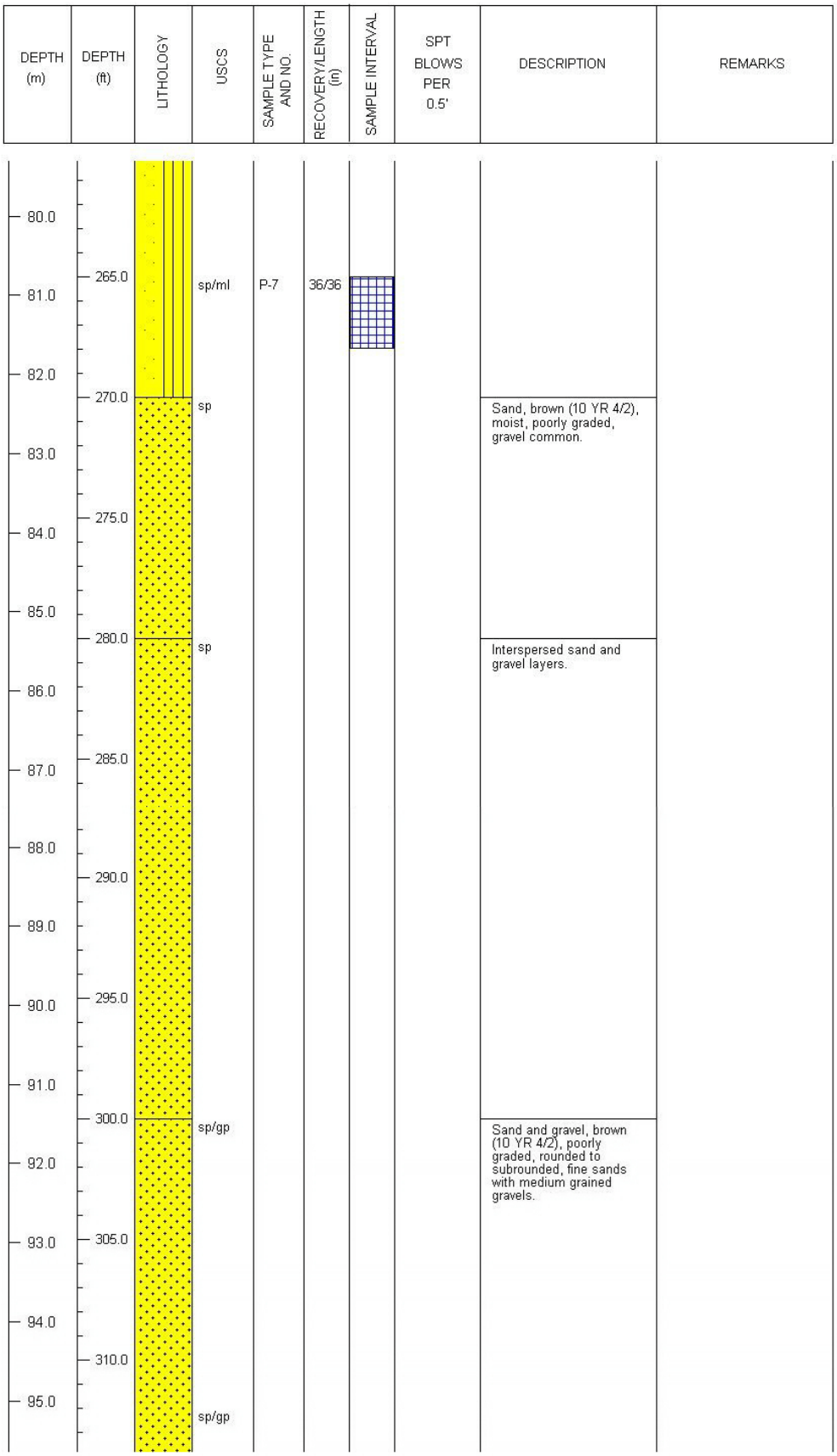
DEPTH (m)	DEPTH (ft)	USCS	SAMPLE TYPE AND NO.	RECOVERY/LENGTH (in)	SPT BLOWS PER 0.5'	DESCRIPTION	REMARKS
0.0	0.0	sp				Sand, strong brown (7.5 YR 5/6), dry, poorly graded, silt, pebbles common.	
1.0							
	5.0	ml SC-SM	SPT-5		4/5/7	Silt, brown, (10 YR 4/2), moist.	
2.0							
3.0	10.0	sp SW-SM	SPT-10	18.5 /36	4/6/7		
4.0		sp	P-1			Clay, strong brown, (7.5 YR 5/6), with silt, pebbles common.	
	15.0	SM	SPT-15		6/8/10		
5.0						Sand, strong brown (7.5 YR 5/6), moist, with clay, poorly graded, pebbles common.	
6.0	20.0	sp	P-2	0/36			
7.0							
	25.0						
8.0							
9.0		sp					
	30.0	s(CL)	SPT-30		21/25/39		
10.0							
	35.0						
11.0							
12.0	40.0	sp	P-3	30/36			
13.0							
	45.0	sp SC-SM	SPT-		50		

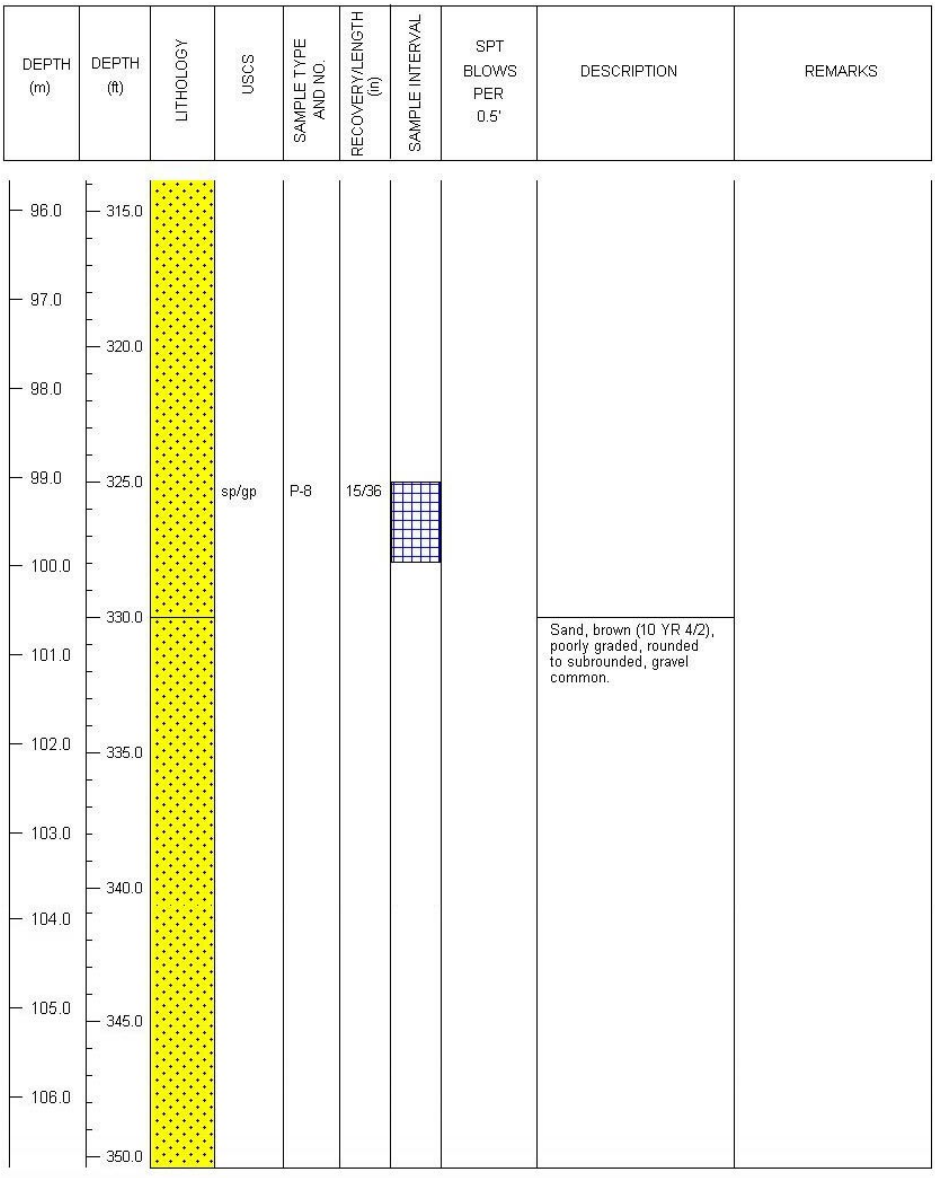

DEPTH (m)
DEPTH (ft)
LITHOLOGY
USCS
SAMPLE TYPE AND NO.
RECOVERY/LENGTH (in)
SAMPLE INTERVAL
SPT BLOWS PER 0.5'
DESCRIPTION
REMARKS
14.0
15.0
16.0
17.0
18.0
19.0
20.0
21.0
22.0
23.0
24.0
25.0
26.0
27.0
28.0
29.0
30.0
50.0
55.0
60.0
65.0
70.0
75.0
80.0
85.0
90.0
95.0
SC-SM
sp
sp
sp
SPT-45
P-4
50
22.5 /36
Sand, strong brown (10 YR 4/2), moist, with clay, poorly graded, trace of silt.
Interspersed sand and silt layers.
Sand, strong brown (10 YR 4/2), moist, poorly graded.

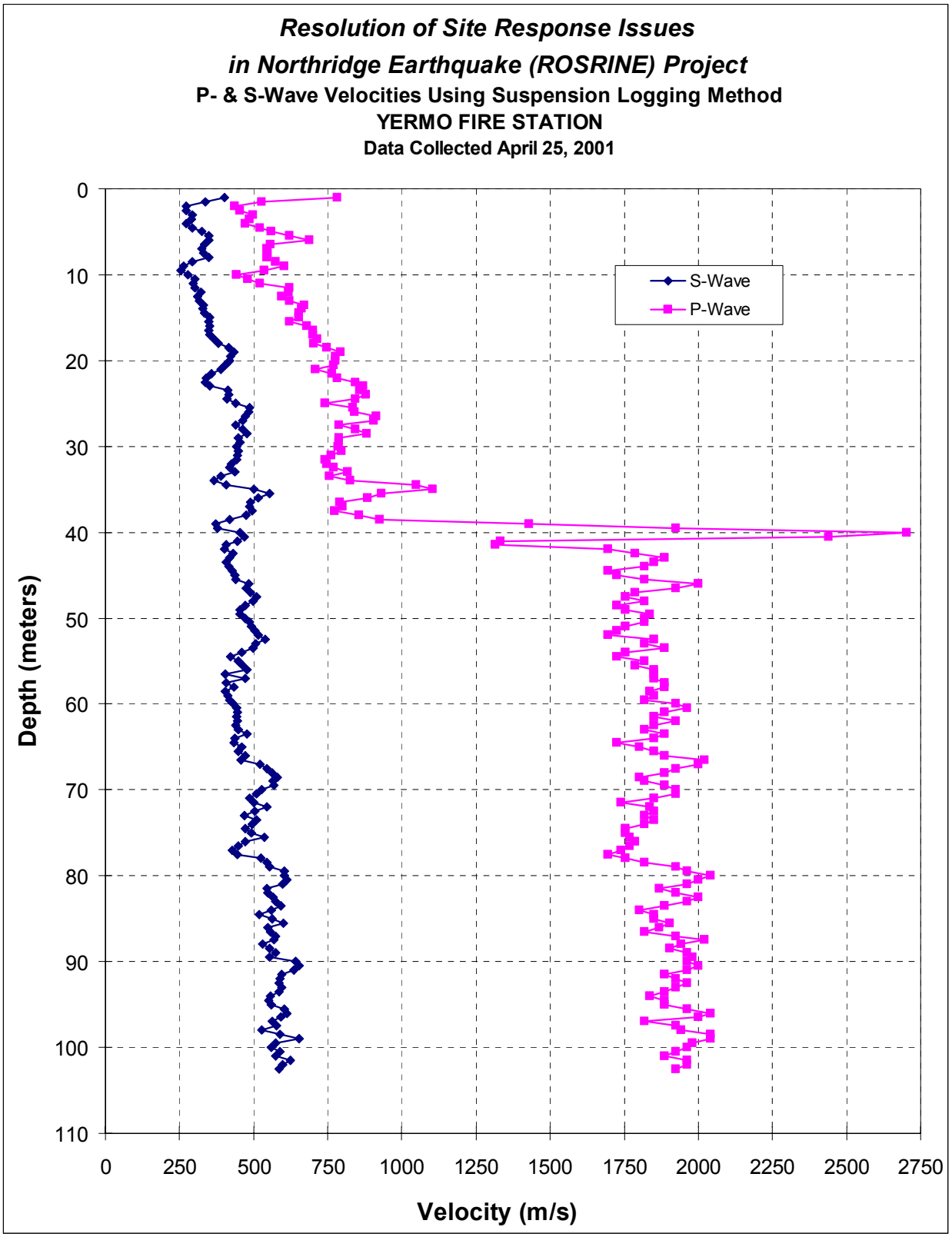

DEPTH (m)
DEPTH (ft)
LITHOLOGY
USCS
SAMPLE TYPE AND NO.
RECOVERY/LENGTH (in)
SAMPLE INTERVAL
SPT BLOWS PER 0.5'
DESCRIPTION
REMARKS
31.0
32.0
33.0
34.0
35.0
36.0
37.0
38.0
39.0
40.0
41.0
42.0
43.0
44.0
45.0
46.0
100.0
105.0
110.0
115.0
120.0
125.0
130.0
135.0
140.0
145.0
150.0
sp
SP-SM
sp
sp
sp
sp
SPT-100
50/3"
Interbedded silt and sand layers.
Sand, strong brown (10 YR 4/2), moist, poorly graded.
Interbedded silt and sand layers.
Sand, strong brown (10 YR 4/2), moist, poorly graded.


DEPTH (m)
DEPTH (ft)
LITHOLOGY
USCS
SAMPLE TYPE AND NO.
RECOVERY/LENGTH (in)
SAMPLE INTERVAL
SPT BLOWS PER 0.5'
DESCRIPTION
REMARKS
47.0
48.0
49.0
50.0
51.0
52.0
53.0
54.0
55.0
56.0
57.0
58.0
59.0
60.0
61.0
62.0
155.0
160.0
165.0
170.0
175.0
180.0
185.0
190.0
195.0
200.0
205.0
sp
sp
sp
sp
P-5
P-6
18/36
25/36
Interspersed sandy silt layers and fine grained.
Sand, strong brown (10 YR 4/2), moist, poorly graded, trace of silt and gravel.
Interspersed sand and silt layers.


DEPTH (m)
DEPTH (ft)
LITHOLOGY
USCS
SAMPLE TYPE AND NO.
RECOVERY/LENGTH (in)
SAMPLE INTERVAL
SPT BLOWS PER 0.5'
DESCRIPTION
REMARKS
63.0
64.0
65.0
66.0
67.0
68.0
69.0
70.0
71.0
72.0
73.0
74.0
75.0
76.0
77.0
78.0
79.0
210.0
215.0
220.0
225.0
230.0
235.0
240.0
245.0
250.0
255.0
260.0
sp
sp/ml
sp/ml
Sand, strong brown (10 YR 4/2), moist, poorly graded, gravel common, grains rounded to subrounded.
Sand, strong brown (10 YR 4/2), moist, poorly graded, gravel common.
Interspersed silty sand and gravel layers.


DEPTH (m)
DEPTH (ft)
LITHOLOGY
USCS
SAMPLE TYPE AND NO.
RECOVERY/LENGTH (in)
SAMPLE INTERVAL
SPT BLOWS PER 0.5'
DESCRIPTION
REMARKS
80.0
81.0
82.0
83.0
84.0
85.0
86.0
87.0
88.0
89.0
90.0
91.0
92.0
93.0
94.0
95.0
265.0
270.0
275.0
280.0
285.0
290.0
295.0
300.0
305.0
310.0
sp/ml
sp
sp
sp/gp
sp/gp
P-7
36/36
Sand, brown (10 YR 4/2), moist, poorly graded, gravel common.
Interspersed sand and gravel layers.
Sand and gravel, brown (10 YR 4/2), poorly graded, rounded to subrounded, fine sands with medium grained gravels.


DEPTH (m)
DEPTH (ft)
LITHOLOGY
USCS
SAMPLE TYPE AND NO.
RECOVERY/LENGTH (in)
SAMPLE INTERVAL
SPT BLOWS PER 0.5'
DESCRIPTION
REMARKS
96.0
97.0
98.0
99.0
100.0
101.0
102.0
103.0
104.0
105.0
106.0
315.0
320.0
325.0
330.0
335.0
340.0
345.0
350.0
sp/gp
P-8
15/36
Sand, brown (10 YR 4/2), poorly graded, rounded to subrounded, gravel common.


Resolution of Site Response Issues
in Northridge Earthquake (ROSRINE) Project
P- & S-Wave Velocities Using Suspension Logging Method
YERMO FIRE STATION
Data Collected April 25, 2001
S-Wave
P-Wave
Depth (meters)
0
10
20
30
40
50
60
70
80
90
100
110
0
250
500
750
1000
1250
1500
1750
2000
2250
2500
2750
Velocity (m/s)

Yermo

Depth (meters)	Vs (meters/sec)	Vp (meters/sec)
1	402	781
1.5	338	526
2	272	437
2.5	273	452
3	294	498
3.5	289	485
4	272	472
4.5	294	521
5	325	559
5.5	348	621
6	347	690
6.5	333	556
7	326	543
7.5	330	546
8	347	543
8.5	292	575
9	264	602
9.5	256	535
10	277	442
10.5	301	481
11	296	521
11.5	301	621
12	323	617
12.5	311	595
13	315	621
13.5	330	671
14	328	662
14.5	333	654
15	351	654
15.5	350	621
16	352	680
16.5	350	699
17	352	699
17.5	365	714
18	382	704
18.5	415	746
19	433	794
19.5	422	775
20	420	775
20.5	405	769
21	391	709
21.5	358	763
22	339	781
22.5	337	844
23	352	870
23.5	413	858
24	415	877
24.5	411	844
25	441	741

Depth (meters)	Vs (meters/sec)	Vp (meters/sec)
25.5	487	833
26	482	840
26.5	473	913
27	464	905
27.5	439	787
28	462	844
28.5	476	881
29	449	787
29.5	452	787
30	443	784
30.5	448	797
31	446	760
31.5	442	741
32	424	746
32.5	418	769
33	438	816
33.5	389	755
34	367	826
34.5	407	1047
35	500	1105
35.5	552	930
36	517	885
36.5	488	791
37	485	800
37.5	495	772
38	475	855
38.5	418	926
39	372	1429
39.5	377	1923
40	454	2703
40.5	468	2439
41	444	1333
41.5	408	1316
42	402	1695
42.5	429	1786
43	420	1887
43.5	406	1852
44	416	1818
44.5	427	1695
45	436	1724
45.5	440	1818
46	482	2000
46.5	475	1923
47	489	1786
47.5	510	1754
48	498	1818
48.5	473	1724
49	452	1754
49.5	454	1835
50	473	1818
50.5	487	1818
51	493	1754

Depth (meters)	Vs (meters/sec)	Vp (meters/sec)
51.5	505	1724
52	514	1695
52.5	539	1852
53	508	1818
53.5	498	1887
54	459	1754
54.5	422	1724
55	447	1818
55.5	463	1786
56	476	1852
56.5	405	1852
57	472	1852
57.5	408	1887
58	435	1887
58.5	405	1835
59	412	1852
59.5	419	1818
60	430	1923
60.5	442	1961
61	445	1887
61.5	442	1852
62	444	1923
62.5	441	1852
63	449	1818
63.5	478	1887
64	438	1852
64.5	435	1724
65	459	1802
65.5	447	1852
66	472	1887
66.5	456	2020
67	522	2000
67.5	543	1923
68	562	1887
68.5	580	1802
69	565	1818
69.5	568	1887
70	526	1923
70.5	510	1923
71	485	1852
71.5	501	1739
72	543	1835
72.5	505	1852
73	467	1818
73.5	509	1852
74	494	1818
74.5	473	1754
75	493	1754
75.5	536	1770
76	473	1786
76.5	447	1770
77	428	1739

Depth (meters)	Vs (meters/sec)	Vp (meters/sec)
77.5	444	1695
78	524	1754
78.5	543	1818
79	554	1923
79.5	604	1961
80	602	2041
80.5	613	2000
81	599	1961
81.5	545	1869
82	546	1923
82.5	565	2000
83	573	1961
83.5	592	1887
84	560	1802
84.5	518	1852
85	562	1852
85.5	601	1905
86	546	1869
86.5	557	1818
87	573	1923
87.5	568	2020
88	529	1942
88.5	552	1905
89	573	1961
89.5	554	1980
90	641	1961
90.5	654	2000
91	637	1961
91.5	595	1887
92	588	1923
92.5	587	1961
93	595	1923
93.5	587	1887
94	556	1835
94.5	549	1887
95	559	1887
95.5	604	1961
96	612	2041
96.5	592	2000
97	562	1818
97.5	578	1923
98	526	1942
98.5	590	2041
99	654	2041
99.5	575	1980
100	560	1961
100.5	588	1923
101	573	1887
101.5	623	1961
102	597	1961
102.5	585	1923

ROSRINE 5b

Index Property Testing of Soil Samples

From Teratest Labs' Report, May 10, 2001

J. Swift, 6/20/2001

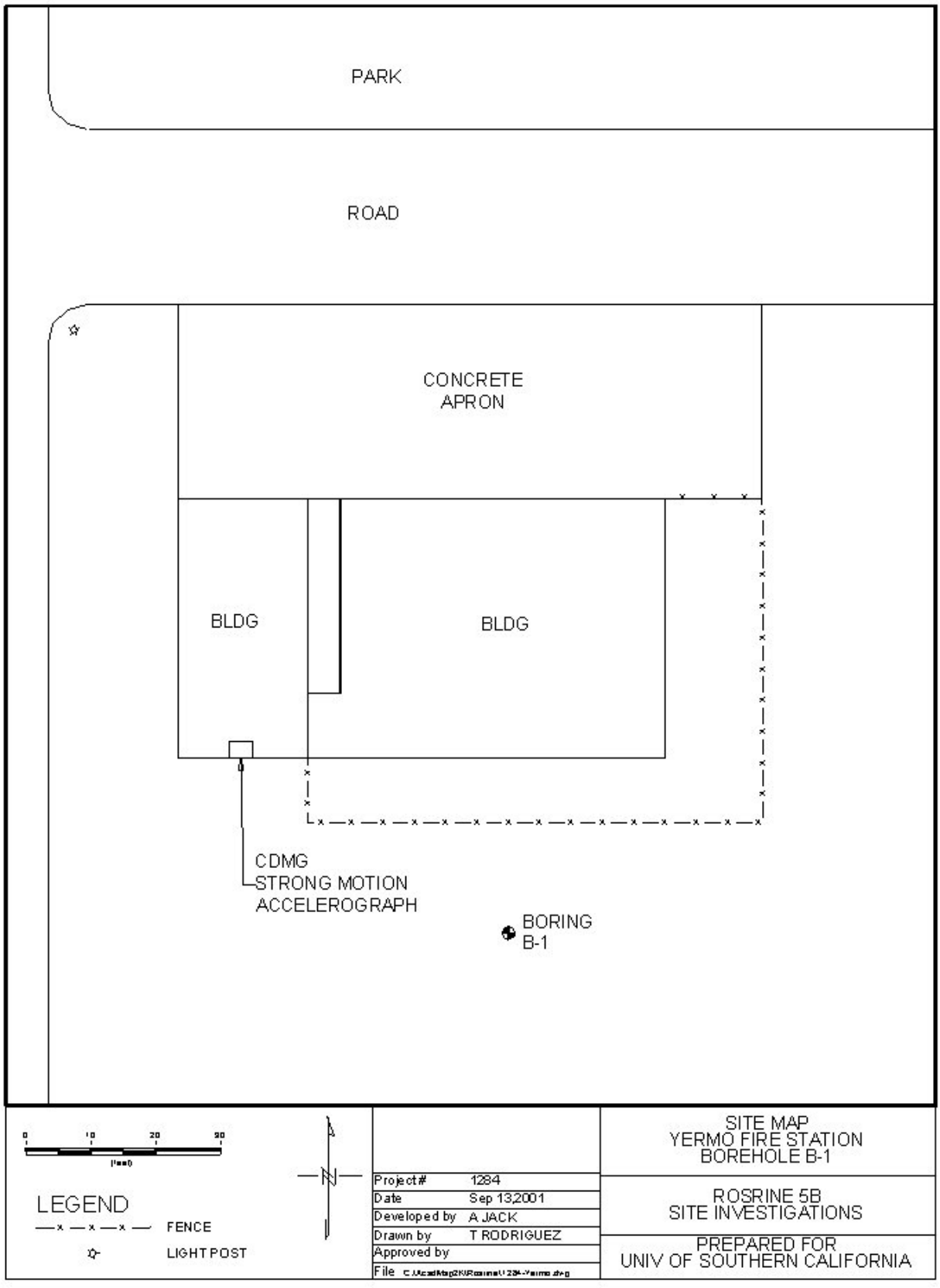
Yermo

Sample	Depth, ft (range: # to #)		Depth, m (range: # to #)		Visual Classification	Soil Class	D50 (mm)	Moisture Content (%)	LL	PL	PI
SPT 5	5	7	1.5	2.1	n/a	SC-SM	0.18	13.5	25	19	6
SPT 10	10	12	3.0	3.7	n/a	SW-SM	0.9	14	n/a	n/a	n/a
SPT 15	15.0	17.0	4.6	5.2	n/a	SM	0.5	12.1	n/a	n/a	n/a
SPT 30	30.0	32.0	9.1	9.8	n/a	s(CL)	n/a	19.9	30	23	7
SPT 45	45.0	47.0	13.7	14.3	n/a	SC-SM	0.09	15.4	24	20	4
SPT 100	100.0	102.0	30.5	31.1	n/a	SP-SM	0.55	17.1	n/a	n/a	n/a

Drill site near Yermo Fire Station.

Drilling activities.

PS Logging activities.


PARK
ROAD
CONCRETE
APRON
BLDG
BLDG
CDMG
STRONG MOTION
ACCELEROGRAPH
BORING
B-1
0
10
20
30
(Feet)
LEGEND
FENCE
LIGHT POST
Project# 1284
Date Sep 13,2001
Developed by A JACK
Drawn by T RODRIGUEZ
Approved by
File
SITE MAP
YERMO FIRE STATION
BOREHOLE B-1
ROSRINE 5B
SITE INVESTIGATIONS
PREPARED FOR
UNIV OF SOUTHERN CALIFORNIA

Appendix D: Detailed Results for Joshua Tree Mail Site

ROSRINE 5b – Joshua Tree

Rosrine ResOlution of Site Response Issues from the Northridge Earthquake

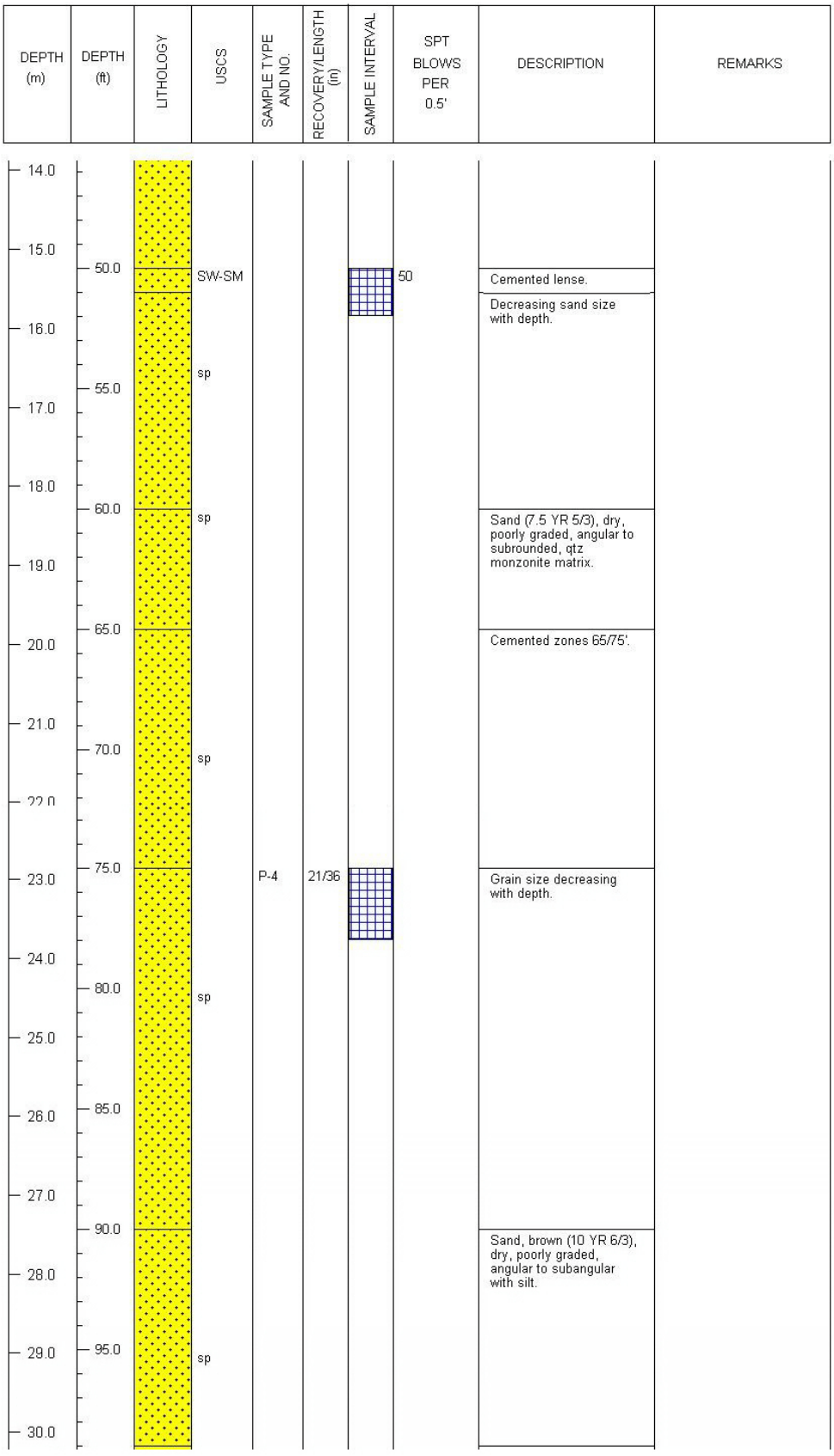
Boring Log

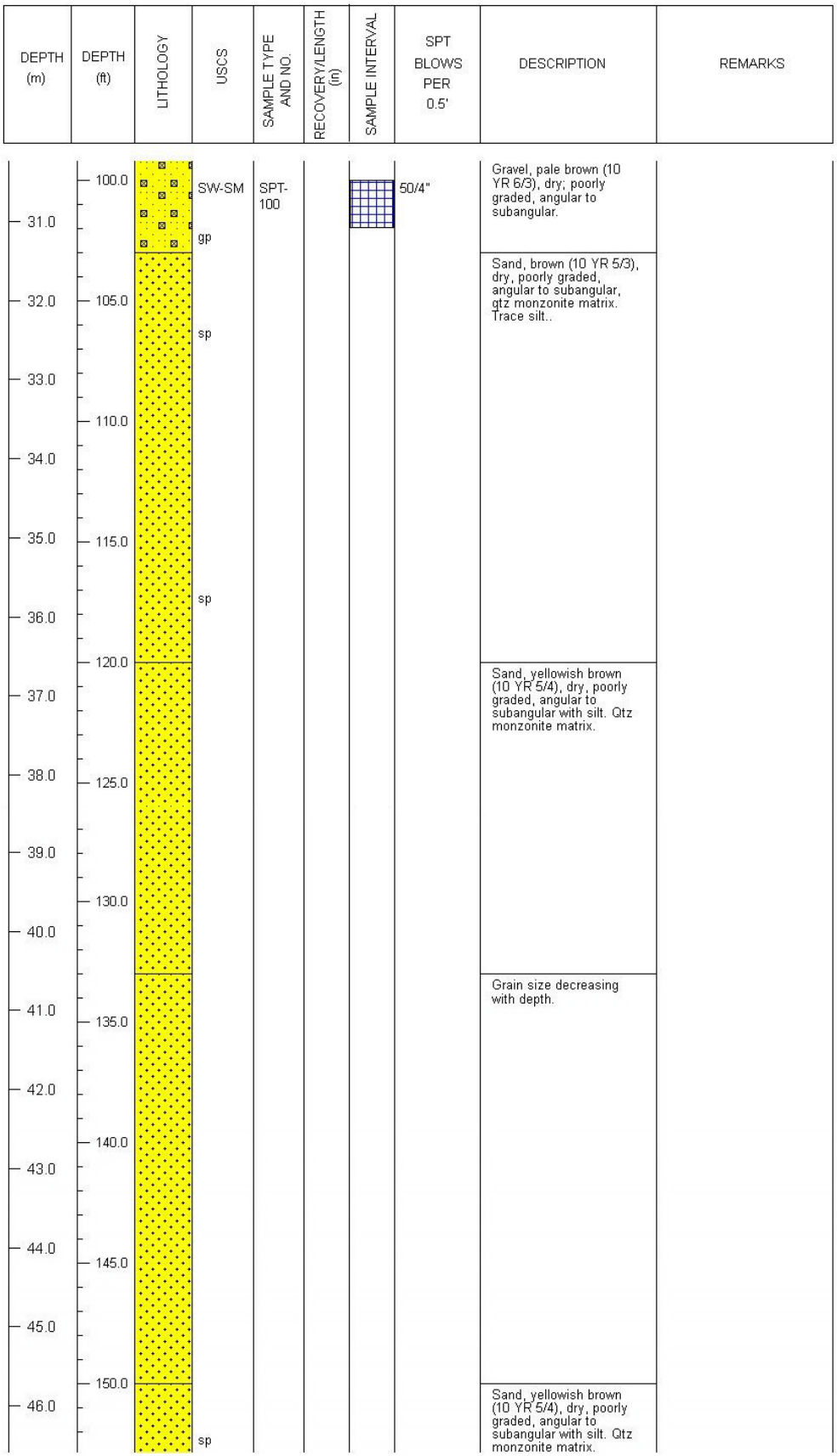
PROJECT: ROSRINE 5b
SITE LOCATION: Joshua Tree Fire Station
DIST/COUNTY/RTE/PM: San Bernadino
EA: n/a
BRIDGE NO: n/a
STA/OFFSET: n/a
BORING NO: B-1

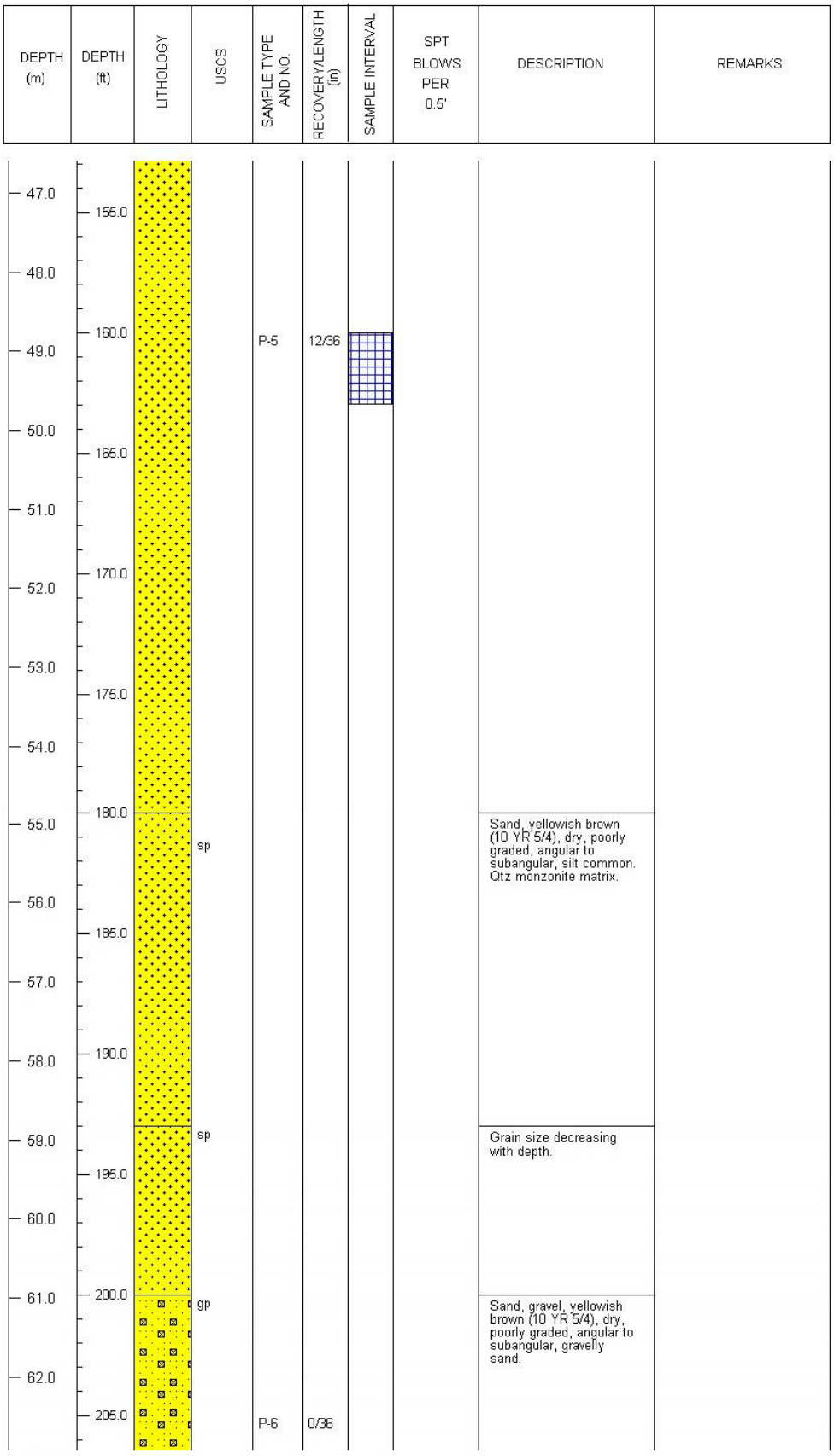
DRILLING CONTRACTOR: Pitcher Drilling
DATES DRILLED: 04/30/2001 - 05/01/2001
DRILLING METHOD: Mud Rotary
HOLE DIAMETER (mm): 168.28
TOTAL DEPTH (m): 106.68
DRILL RIG MODEL/NO: Failig F-10
SPT HAMMER: Acker 140 lb

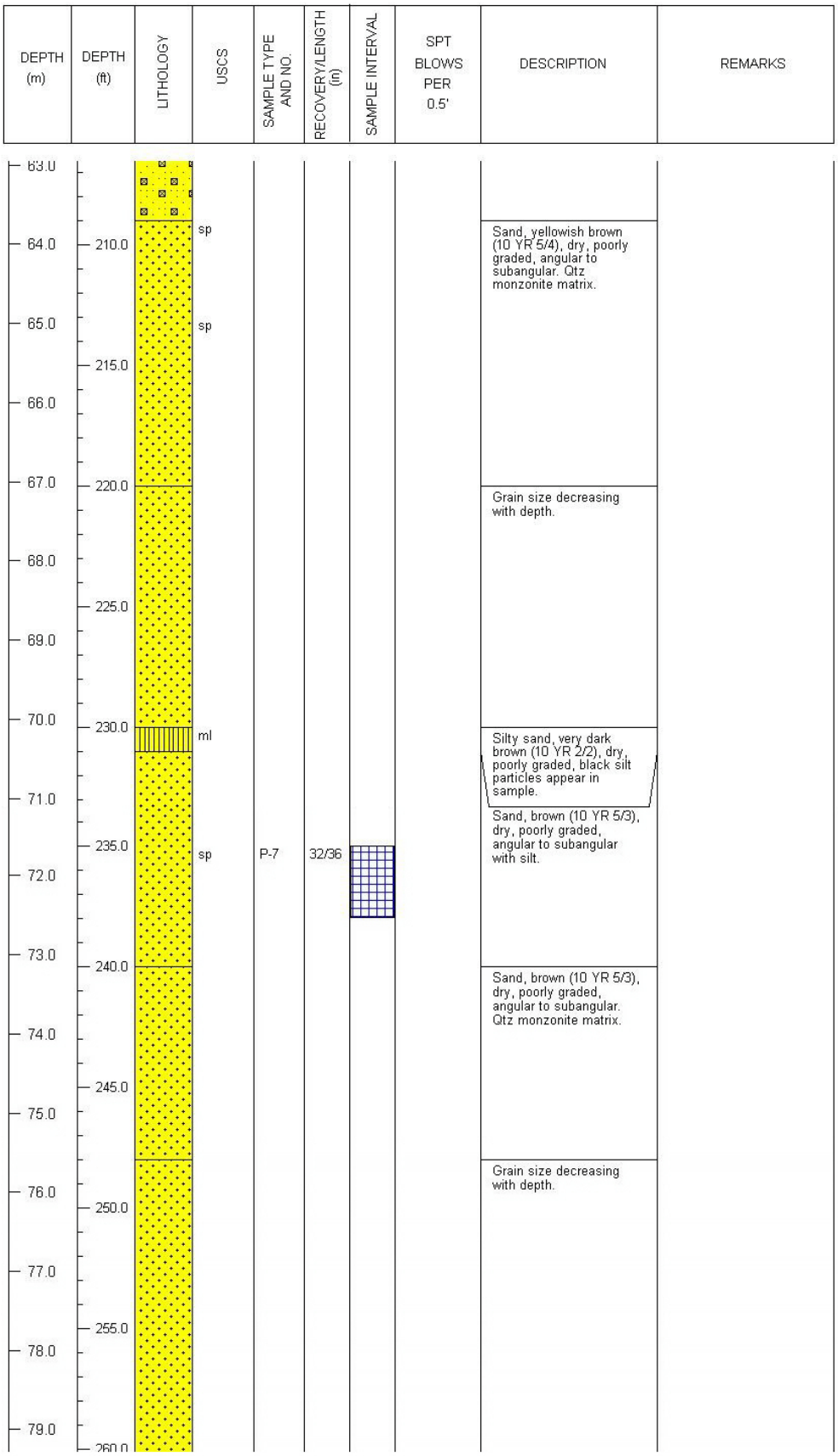
DATUM: NAD27
LATITUDE: 34.131
LONGITUDE: -116.314
ELEVATION: 2775 ft.
LOGGED BY: A. Jack
ORGANIZATION: GeoVision
ENTERED BY: J. Swift DATE: 06/10/2001
CHECKED BY: R. Nigbor DATE: 06/29/2001

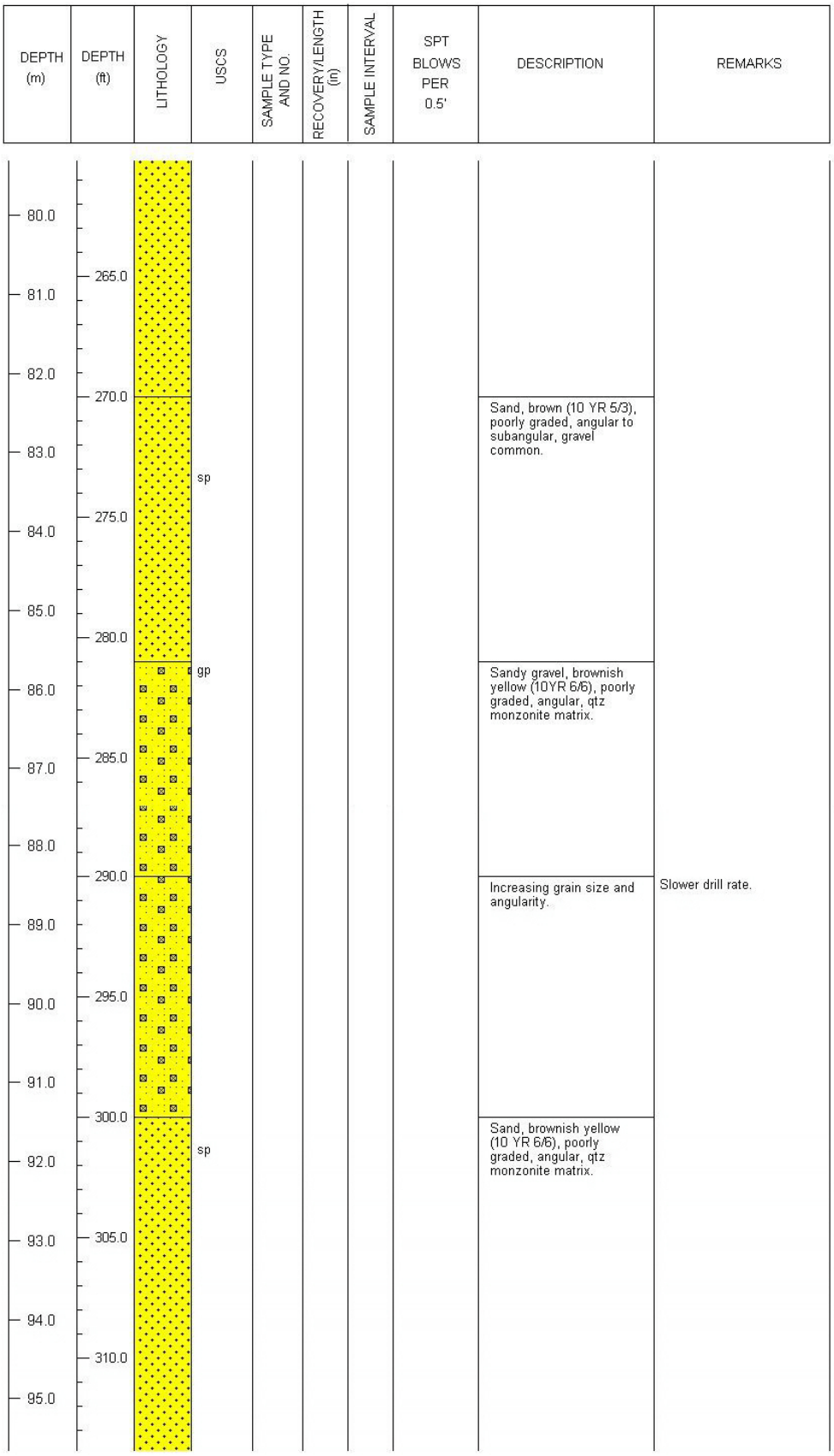
DEPTH (m)	DEPTH (ft)	LITHOLOGY	USCS	SAMPLE TYPE AND NO.	RECOVERY/LENGTH (in)	SAMPLE INTERVAL	SPT BLOWS PER 0.5'	DESCRIPTION	REMARKS
0.0	0.0							Sand, brown (7.5 YR 4/9), dry, poorly graded, qtz monzonite matrix. Increase in grain size with depth.	
1.0			sp						
	5.0		SW-SM	SPT-5			9/15/19		
2.0									
3.0	10.0			P-1	0/36			Sand, brown (10 YR 5/2), dry, poorly graded, angular to subrounded gravel common.	
			sp						
4.0			(SW-SM)g	SPT-12			10/13/29		
	15.0								
5.0									
6.0	20.0			P-2	20.5/36			Interbedded fine sands, coarse sands and gravel.	
			sp						
7.0			SW-SM	SPT-23			10/17/20		
	25.0								
8.0									
9.0	30.0		SW-SM	SPT-30			13/50	Sand, brown (7.5 YR 5/3), dry, poorly graded, angular to subangular.	
			sp						
10.0									
	35.0								
11.0									
12.0	40.0		sp	P-3	36/36				
13.0			SM	SPT-50			31/36/41		
	45.0								

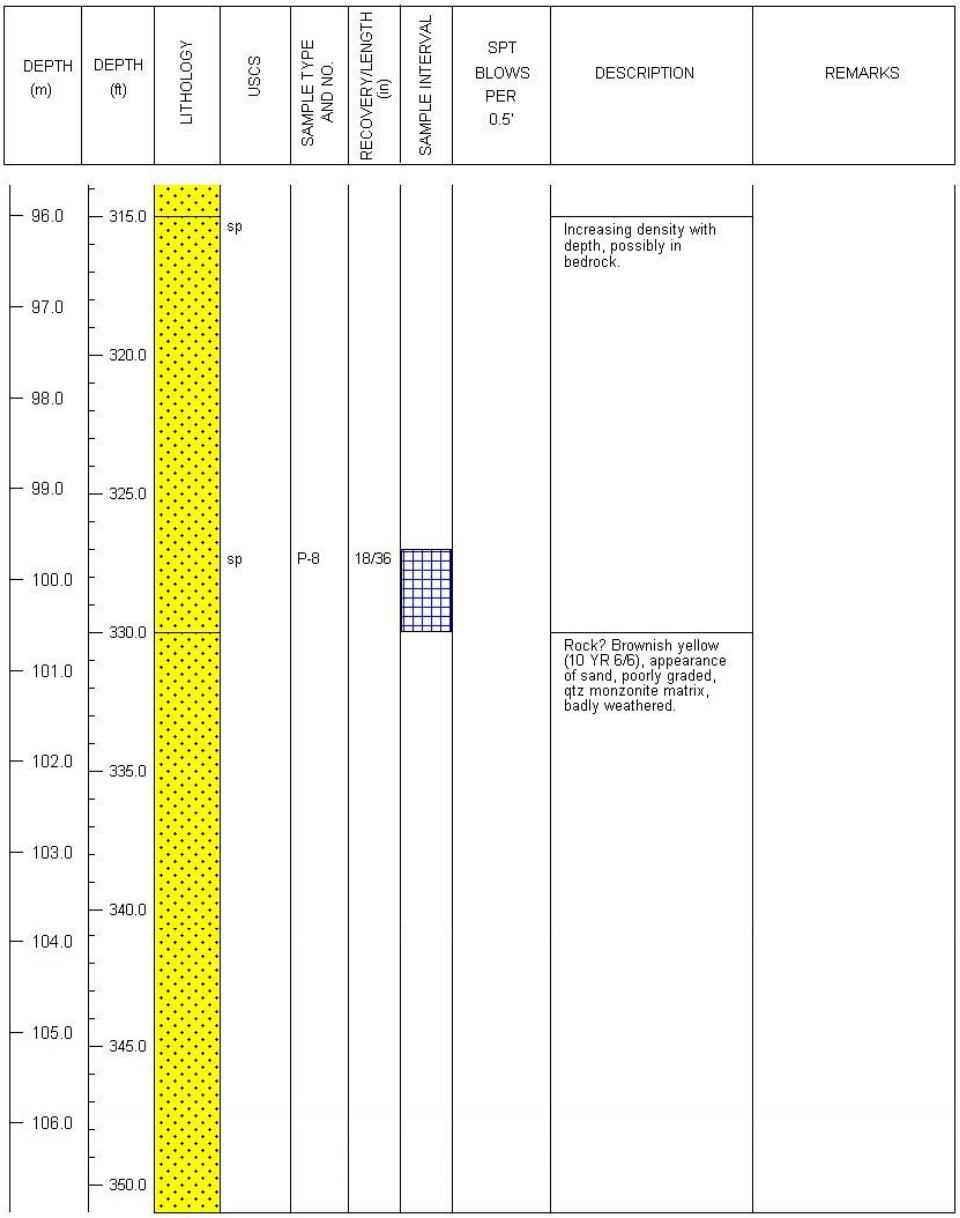

DEPTH (m)
DEPTH (ft)
LITHOLOGY
USCS
SAMPLE TYPE AND NO.
RECOVERY/LENGTH (in)
SAMPLE INTERVAL
SPT BLOWS PER 0.5'
DESCRIPTION
REMARKS
14.0
15.0
16.0
17.0
18.0
19.0
20.0
21.0
22.0
23.0
24.0
25.0
26.0
27.0
28.0
29.0
30.0
50.0
55.0
60.0
65.0
70.0
75.0
80.0
85.0
90.0
95.0
SW-SM
sp
sp
sp
P-4
21/36
sp
50
Cemented lense.
Decreasing sand size with depth.
Sand (7.5 YR 5/3), dry, poorly graded, angular to subrounded, qtz monzonite matrix.
Cemented zones 65/75'.
Grain size decreasing with depth.
Sand, brown (10 YR 6/3), dry, poorly graded, angular to subangular with silt.

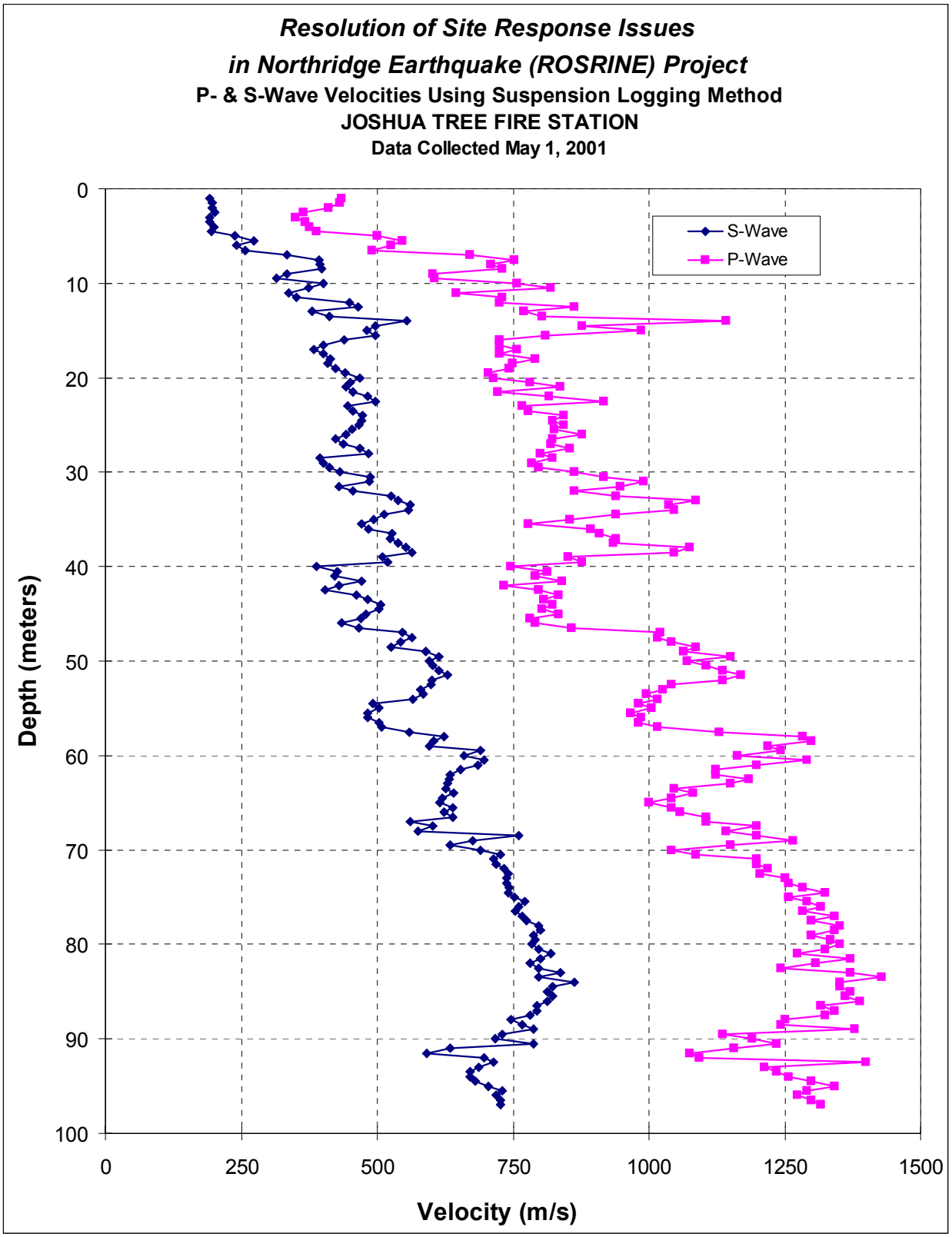

DEPTH (m)
DEPTH (ft)
LITHOLOGY
USCS
SAMPLE TYPE AND NO.
RECOVERY/LENGTH (in)
SAMPLE INTERVAL
SPT BLOWS PER 0.5'
DESCRIPTION
REMARKS
31.0
32.0
33.0
34.0
35.0
36.0
37.0
38.0
39.0
40.0
41.0
42.0
43.0
44.0
45.0
46.0
100.0
105.0
110.0
115.0
120.0
125.0
130.0
135.0
140.0
145.0
150.0
SW-SM
gp
sp
sp
sp
SPT-100
50/4"
Gravel, pale brown (10 YR 6/3), dry; poorly graded, angular to subangular.
Sand, brown (10 YR 5/3), dry, poorly graded, angular to subangular, qtz monzonite matrix. Trace silt..
Sand, yellowish brown (10 YR 5/4), dry, poorly graded, angular to subangular with silt. Qtz monzonite matrix.
Grain size decreasing with depth.
Sand, yellowish brown (10 YR 5/4), dry, poorly graded, angular to subangular with silt. Qtz monzonite matrix.


DEPTH (m)
DEPTH (ft)
LITHOLOGY
USCS
SAMPLE TYPE AND NO.
RECOVERY/LENGTH (in)
SAMPLE INTERVAL
SPT BLOWS PER 0.5'
DESCRIPTION
REMARKS
47.0
48.0
49.0
50.0
51.0
52.0
53.0
54.0
55.0
56.0
57.0
58.0
59.0
60.0
61.0
62.0
155.0
160.0
165.0
170.0
175.0
180.0
185.0
190.0
195.0
200.0
205.0
P-5
12/36
P-6
0/36
sp
sp
gp
Sand, yellowish brown (10 YR 5/4), dry, poorly graded, angular to subangular, silt common. Qtz monzonite matrix.
Grain size decreasing with depth.
Sand, gravel, yellowish brown (10 YR 5/4), dry, poorly graded, angular to subangular, gravelly sand.


DEPTH (m)
DEPTH (ft)
LITHOLOGY
USCS
SAMPLE TYPE AND NO.
RECOVERY/LENGTH (in)
SAMPLE INTERVAL
SPT BLOWS PER 0.5'
DESCRIPTION
REMARKS
63.0
64.0
65.0
66.0
67.0
68.0
69.0
70.0
71.0
72.0
73.0
74.0
75.0
76.0
77.0
78.0
79.0
210.0
215.0
220.0
225.0
230.0
235.0
240.0
245.0
250.0
255.0
260.0
sp
sp
ml
sp
P-7
32/36
Sand, yellowish brown (10 YR 5/4), dry, poorly graded, angular to subangular. Qtz monzonite matrix.
Grain size decreasing with depth.
Silty sand, very dark brown (10 YR 2/2), dry, poorly graded, black silt particles appear in sample.
Sand, brown (10 YR 5/3), dry, poorly graded, angular to subangular with silt.
Sand, brown (10 YR 5/3), dry, poorly graded, angular to subangular. Qtz monzonite matrix.
Grain size decreasing with depth.


DEPTH (m)
DEPTH (ft)
LITHOLOGY
USCS
SAMPLE TYPE AND NO.
RECOVERY/LENGTH (in)
SAMPLE INTERVAL
SPT BLOWS PER 0.5'
DESCRIPTION
REMARKS
80.0
81.0
82.0
83.0
84.0
85.0
86.0
87.0
88.0
89.0
90.0
91.0
92.0
93.0
94.0
95.0
265.0
270.0
275.0
280.0
285.0
290.0
295.0
300.0
305.0
310.0
sp
gp
sp
Sand, brown (10 YR 5/3), poorly graded, angular to subangular, gravel common.
Sandy gravel, brownish yellow (10YR 6/6), poorly graded, angular, qtz monzonite matrix.
Increasing grain size and angularity.
Slower drill rate.
Sand, brownish yellow (10 YR 6/6), poorly graded, angular, qtz monzonite matrix.


DEPTH (m)
DEPTH (ft)
LITHOLOGY
USCS
SAMPLE TYPE AND NO.
RECOVERY/LENGTH (in)
SAMPLE INTERVAL
SPT BLOWS PER 0.5'
DESCRIPTION
REMARKS
96.0
97.0
98.0
99.0
100.0
101.0
102.0
103.0
104.0
105.0
106.0
315.0
320.0
325.0
330.0
335.0
340.0
345.0
350.0
sp
sp
P-8
18/36
Increasing density with depth, possibly in bedrock.
Rock? Brownish yellow (10 YR 6/6), appearance of sand, poorly graded, qtz monzonite matrix, badly weathered.


Resolution of Site Response Issues
in Northridge Earthquake (ROSRINE) Project
P- & S-Wave Velocities Using Suspension Logging Method
JOSHUA TREE FIRE STATION
Data Collected May 1, 2001
S-Wave
P-Wave
Depth (meters)
0
10
20
30
40
50
60
70
80
90
100
0
250
500
750
1000
1250
1500
Velocity (m/s)

Joshua Tree

Depth (meters)	Vs (meters/sec)	Vp (meters/sec)
1.0	192	435
1.5	196	431
2.0	196	410
2.5	201	365
3.0	191	350
3.5	192	368
4.0	199	376
4.5	195	388
5.0	238	500
5.5	272	546
6.0	241	526
6.5	257	490
7.0	334	671
7.5	394	752
8.0	395	709
8.5	398	730
9.0	334	602
9.5	314	606
10.0	402	758
10.5	375	820
11.0	338	645
11.5	352	730
12.0	448	725
12.5	465	862
13.0	380	769
13.5	412	803
14.0	554	1143
14.5	496	877
15.0	481	985
15.5	498	810
16.0	440	725
16.5	401	725
17.0	383	758
17.5	402	725
18.0	413	791
18.5	408	749
19.0	423	743
19.5	442	704
20.0	467	714
20.5	450	781
21.0	442	837
21.5	455	722
22.0	482	816
22.5	496	917
23.0	446	766
23.5	456	778
24.0	473	844
24.5	472	823
25.0	466	844

Depth (meters)	Vs (meters/sec)	Vp (meters/sec)
25.5	454	826
26.0	442	877
26.5	423	823
27.0	438	820
27.5	468	855
28.0	484	800
28.5	395	823
29.0	401	784
29.5	412	797
30.0	431	862
30.5	487	917
31.0	485	990
31.5	429	948
32.0	456	862
32.5	525	939
33.0	539	1087
33.5	560	1036
34.0	557	1047
34.5	513	939
35.0	494	855
35.5	472	778
36.0	484	893
36.5	528	909
37.0	524	939
37.5	538	935
38.0	552	1075
38.5	563	1047
39.0	510	851
39.5	519	877
40.0	388	746
40.5	426	813
41.0	422	791
41.5	471	840
42.0	430	733
42.5	405	797
43.0	462	833
43.5	482	806
44.0	506	823
44.5	504	803
45.0	478	833
45.5	469	781
46.0	434	791
46.5	466	858
47.0	546	1020
47.5	563	1015
48.0	543	1042
48.5	525	1087
49.0	590	1064
49.5	613	1149
50.0	595	1070
50.5	602	1105
51.0	613	1136

Depth (meters)	Vs (meters/sec)	Vp (meters/sec)
51.5	629	1170
52.0	601	1136
52.5	599	1042
53.0	580	1026
53.5	585	995
54.0	565	1015
54.5	491	980
55.0	504	1005
55.5	483	966
56.0	482	985
56.5	504	980
57.0	508	1015
57.5	559	1130
58.0	623	1282
58.5	604	1299
59.0	595	1220
59.5	690	1242
60.0	660	1163
60.5	697	1290
61.0	685	1198
61.5	654	1124
62.0	635	1124
62.5	633	1183
63.0	629	1149
63.5	627	1047
64.0	641	1081
64.5	619	1042
65.0	615	1000
65.5	639	1042
66.0	623	1058
66.5	639	1105
67.0	560	1105
67.5	602	1198
68.0	575	1143
68.5	760	1198
69.0	676	1266
69.5	635	1149
70.0	690	1042
70.5	727	1087
71.0	714	1198
71.5	719	1198
72.0	733	1220
72.5	741	1205
73.0	738	1250
73.5	738	1258
74.0	743	1282
74.5	741	1325
75.0	752	1258
75.5	772	1290
76.0	760	1316
76.5	755	1282
77.0	766	1342

Depth (meters)	Vs (meters/sec)	Vp (meters/sec)
77.5	775	1299
78.0	797	1351
78.5	800	1342
79.0	787	1299
79.5	791	1333
80.0	784	1351
80.5	797	1325
81.0	820	1274
81.5	800	1370
82.0	781	1307
82.5	797	1242
83.0	837	1370
83.5	797	1429
84.0	862	1351
84.5	823	1351
85.0	813	1370
85.5	823	1361
86.0	813	1389
86.5	794	1316
87.0	794	1342
87.5	781	1325
88.0	746	1250
88.5	766	1242
89.0	787	1379
89.5	730	1136
90.0	717	1190
90.5	787	1235
91.0	635	1156
91.5	592	1075
92.0	697	1093
92.5	714	1399
93.0	687	1212
93.5	671	1235
94.0	671	1258
94.5	680	1299
95.0	704	1342
95.5	730	1290
96.0	719	1274
96.5	727	1299
97.0	727	1316

ROSRINE 5b

Index Property Testing of Soil Samples

From Teratest Labs' Report, May 9, 2001

J. Swift, 6/20/2001

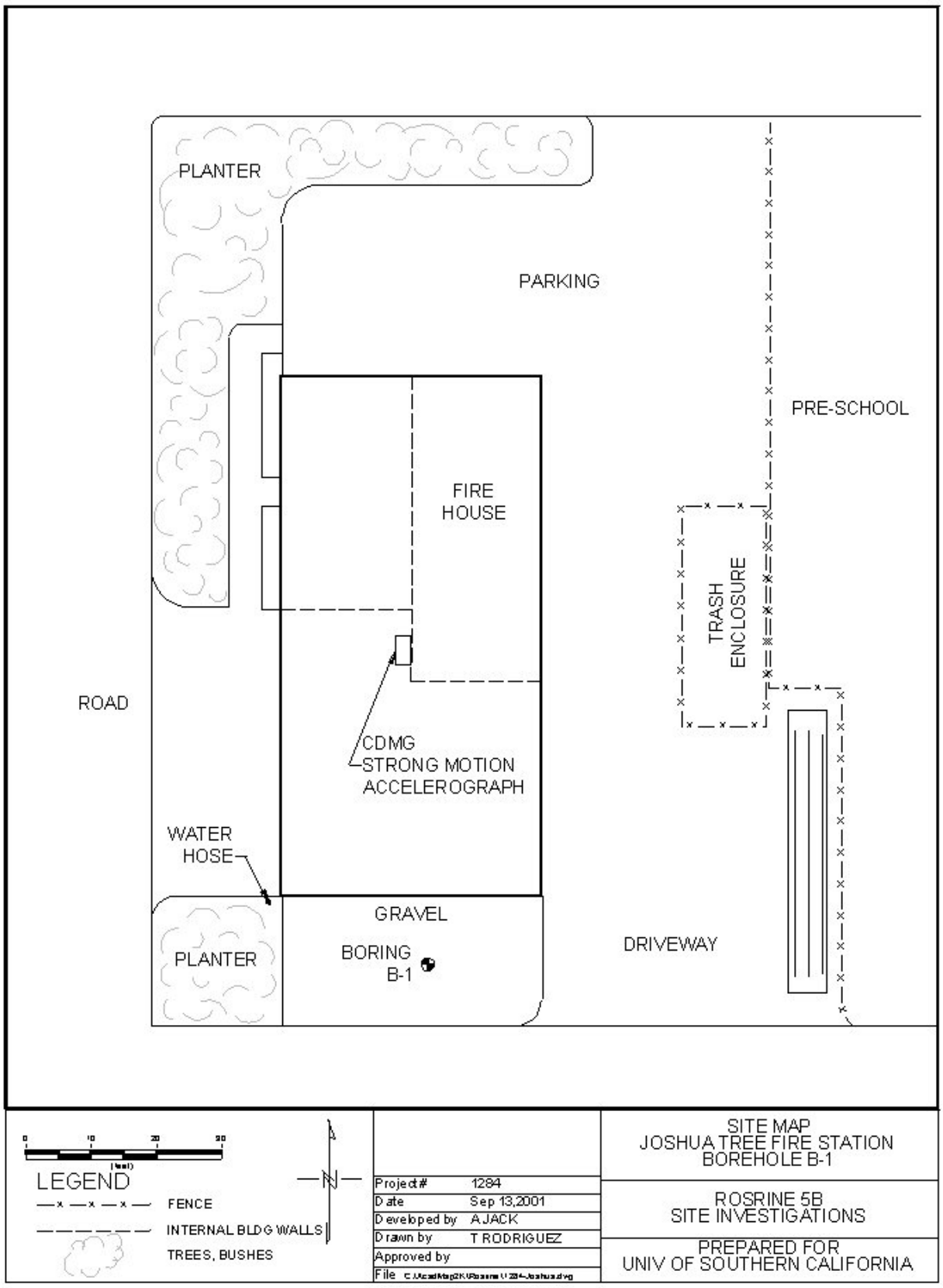
Joshua Tree

Sample	Depth, ft (range: # to #)		Depth, m (range: # to #)		Visual Classification	Soil Class	D50 (mm)	Moisture Content (%)	LL	PL	PI
SPT 5	5	7	1.5	2.1	n/a	SW-SM	0.7	9.6	n/a	n/a	n/a
SPT 12	12	14	3.7	4.3	n/a	(SW-SM)g	1.2	11.4	n/a	n/a	n/a
SPT 23	23.0	25.0	7.0	7.6	n/a	SW-SM	1.5	13.6	n/a	n/a	n/a
SPT 30	30.0	32.0	9.1	9.8	n/a	SW-SM	0.8	13.5	n/a	n/a	n/a
SPT 43	43.0	45.0	13.1	13.7	n/a	SM	0.45	14	n/a	n/a	n/a
SPT 50	50.0	52.0	15.2	15.9	n/a	SW-SM	0.65	13.9	n/a	n/a	n/a
SPT 100	100.0	102.0	30.5	31.1	n/a	SW-SM	0.65	17.3	n/a	n/a	n/a

Drill site next to Joshua Tree fire station.

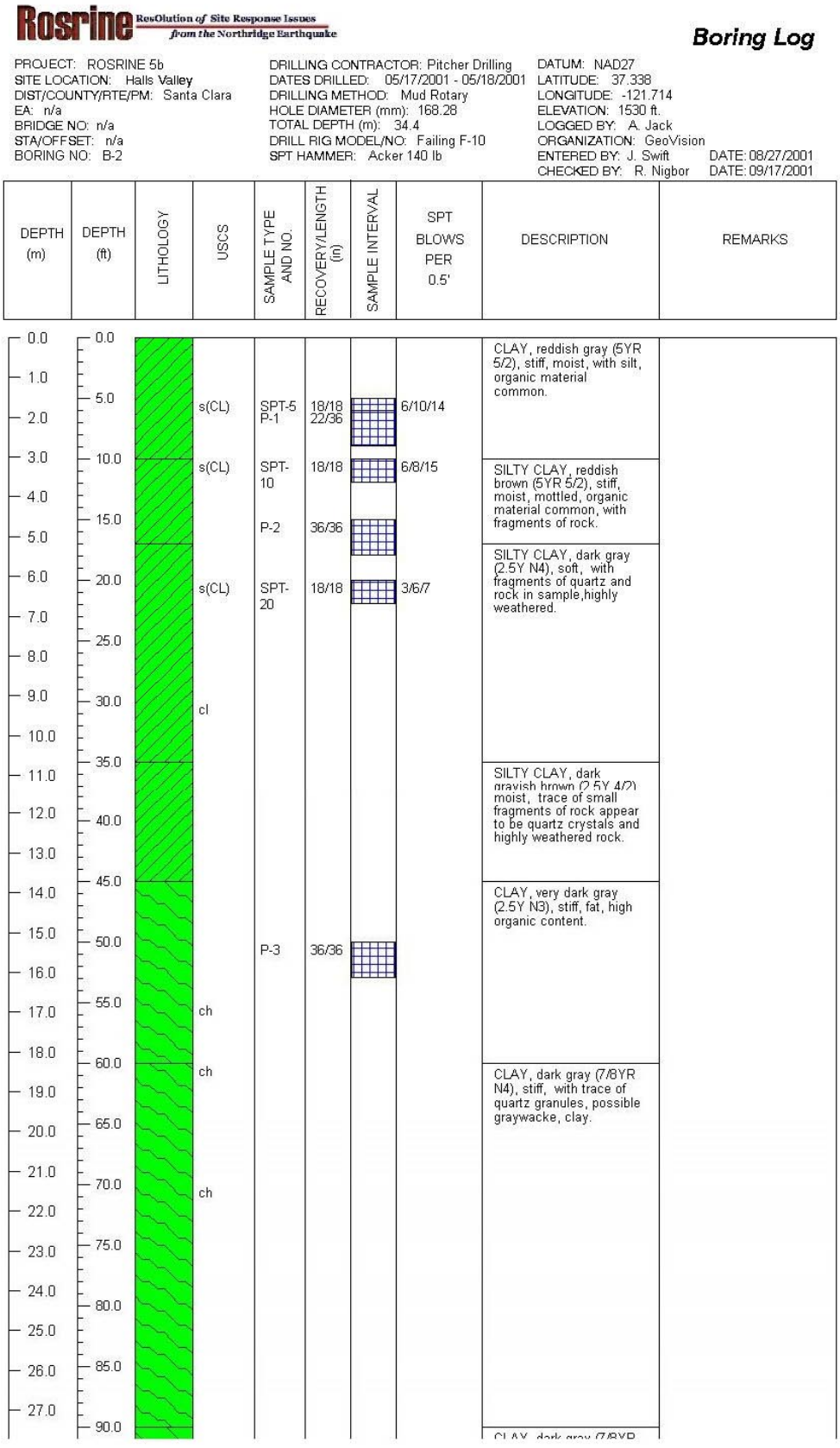
Drilling and sampling activities.

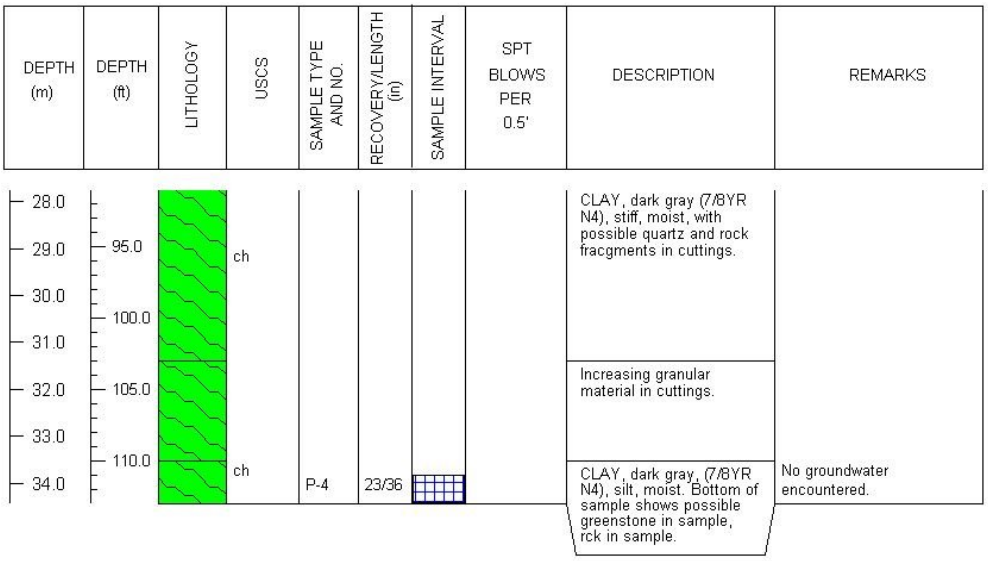
PS logging activities.


PLANTER
PARKING
PRE-SCHOOL
FIRE
HOUSE
TRASH
ENCLOSURE
ROAD
CDMG
STRONG MOTION
ACCELEROGRAPH
WATER
HOSE
GRAVEL
PLANTER
BORING
B-1
DRIVEWAY
LEGEND
FENCE
INTERNAL BLDG WALLS
TREES, BUSHES
N
Project# 1284
Date Sep 13,2001
Developed by AJACK
Drawn by T RODRIGUEZ
Approved by
File
SITE MAP
JOSHUA TREE FIRE STATION
BOREHOLE B-1
ROSRINE 5B
SITE INVESTIGATIONS
PREPARED FOR
UNIV OF SOUTHERN CALIFORNIA

Appendix E: Detailed Results for Halls Valley Site

ROSRINE 5b – Halls Valley




DEPTH (m)
DEPTH (ft)
LITHOLOGY
USCS
SAMPLE TYPE AND NO.
RECOVERY/LENGTH (in)
SAMPLE INTERVAL
SPT BLOWS PER 0.5'
DESCRIPTION
REMARKS
28.0
29.0
30.0
31.0
32.0
33.0
34.0
95.0
100.0
105.0
110.0
ch
ch
P-4
23/36
CLAY, dark gray (7/8YR N4), stiff, moist, with possible quartz and rock fracgments in cuttings.
Increasing granular material in cuttings.
CLAY, dark gray, (7/8YR N4), silt, moist. Bottom of sample shows possible greenstone in sample, rck in sample.
No groundwater encountered.

ROSRINE 5b

Index Property Testing of Soil Samples

From Teratest Labs' Report, June 27, 2001

J. Swift, 8/30/2001

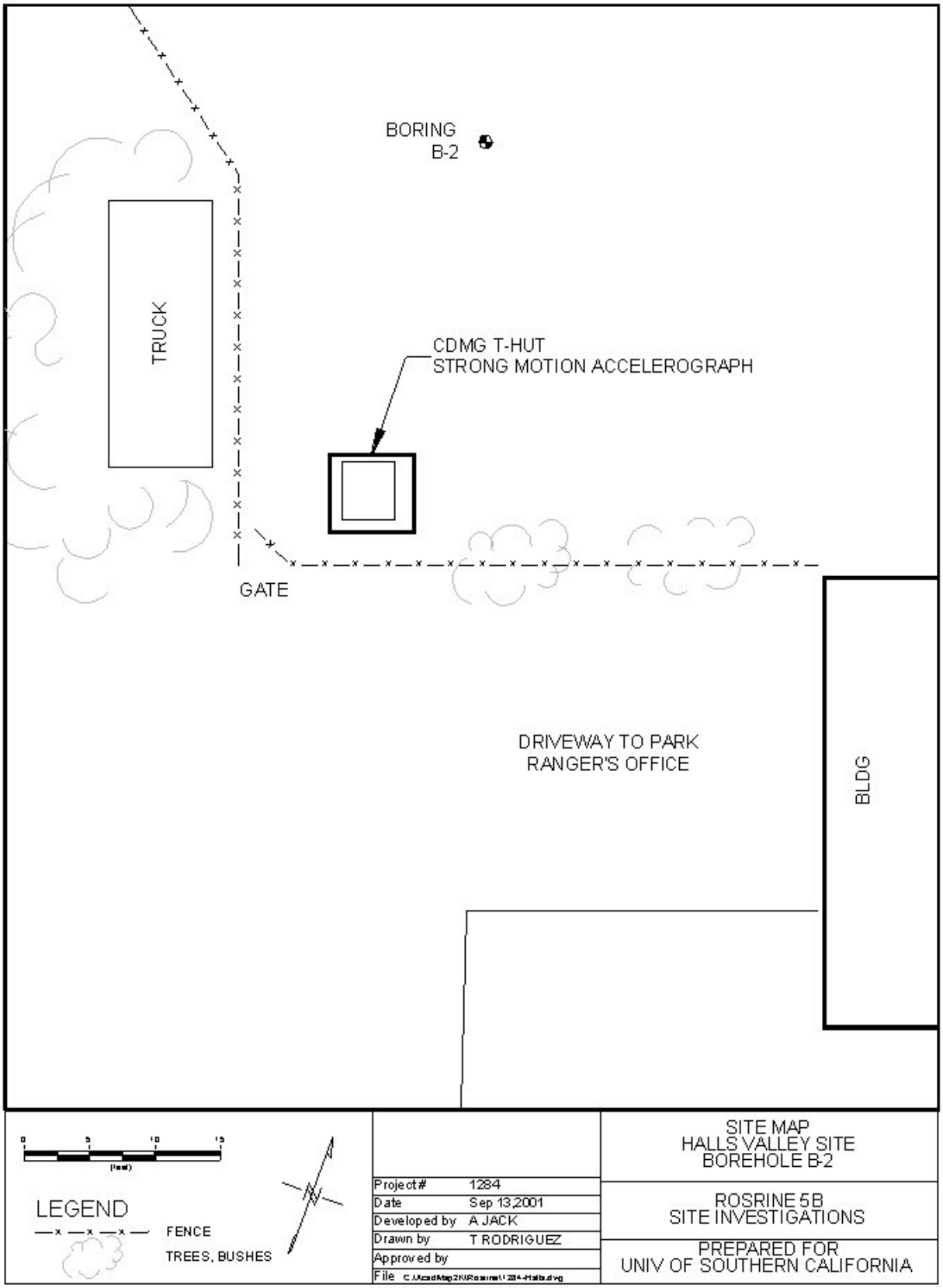
Halls Valley

Sample	Depth, ft (range: # to #)		Depth, m (range: # to #)		Visual Classification	Soil Class	D50 (mm)	Moisture Content (%)	LL	PL	PI
SPT 5	5	7	1.5	2.1	n/a	s(CL)	< .075	23	37	16	21
SPT 10	10	12	3.0	3.7	n/a	s(CL)	< .075	25.4	40	18	22
SPT 20	20.0	22.0	6.1	6.7	n/a	s(CL)	< .075	27.2	43	17	26

View North from Halls Valley Site.

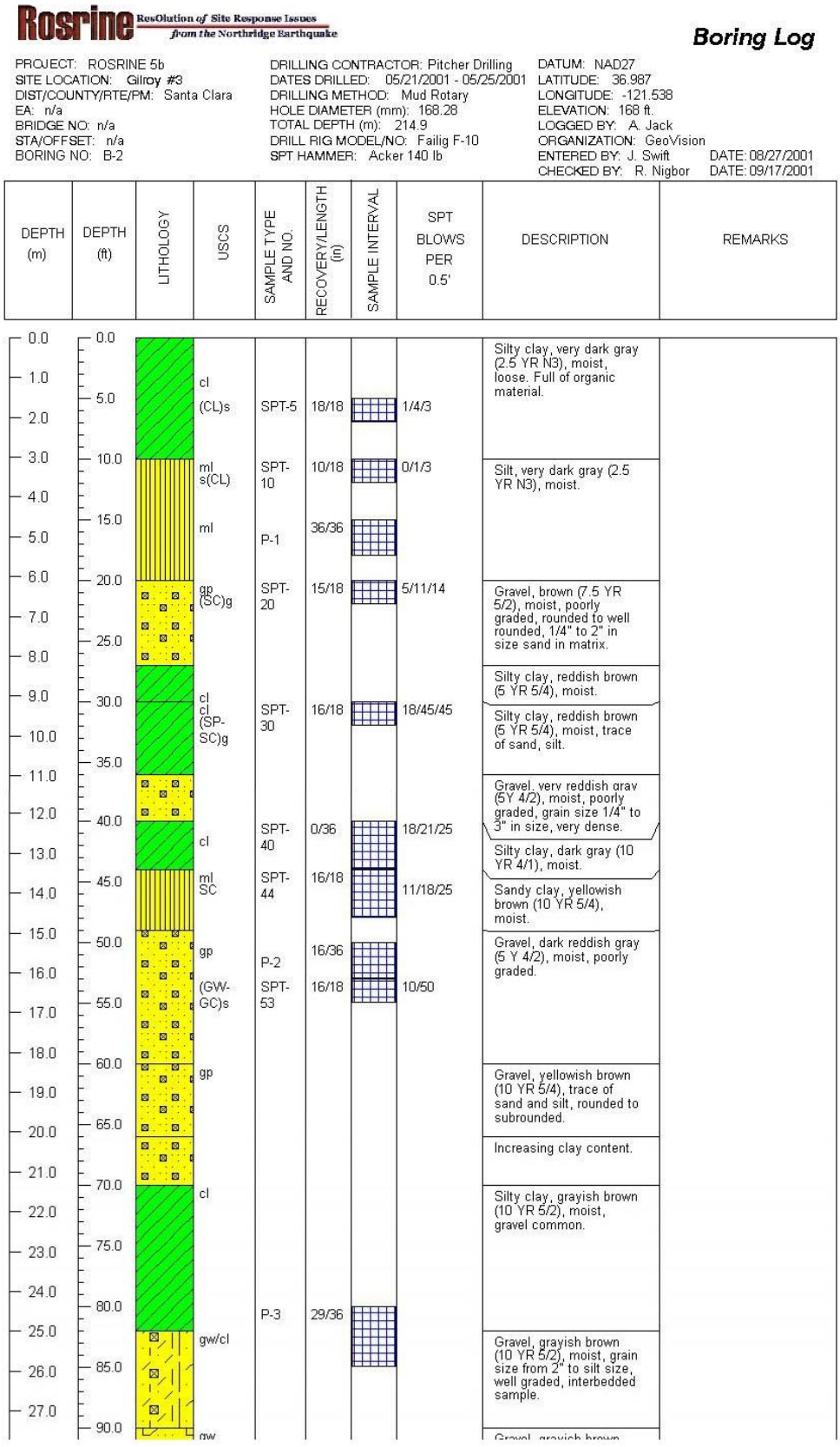
View West from site.

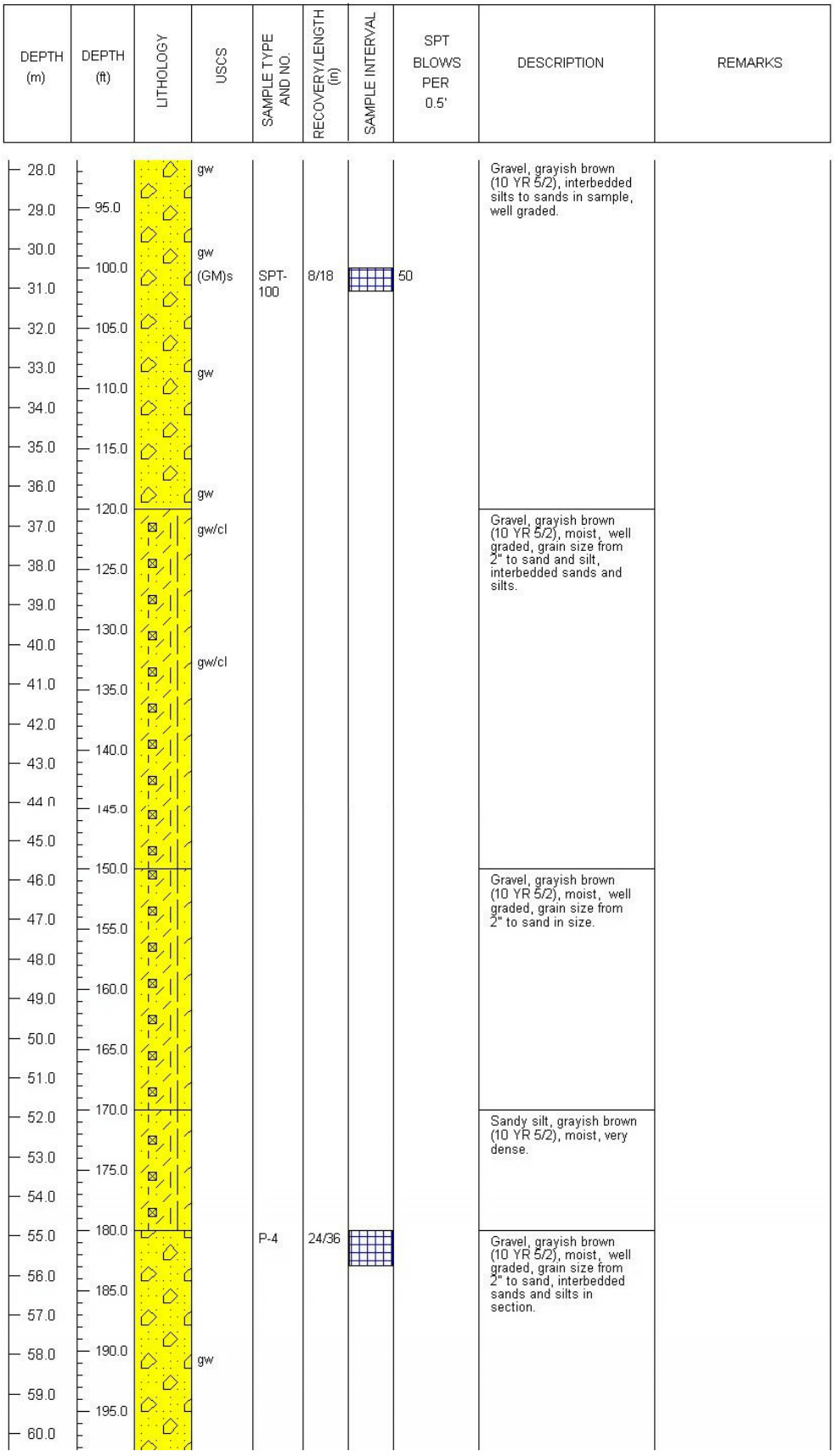
View South of seismograph.

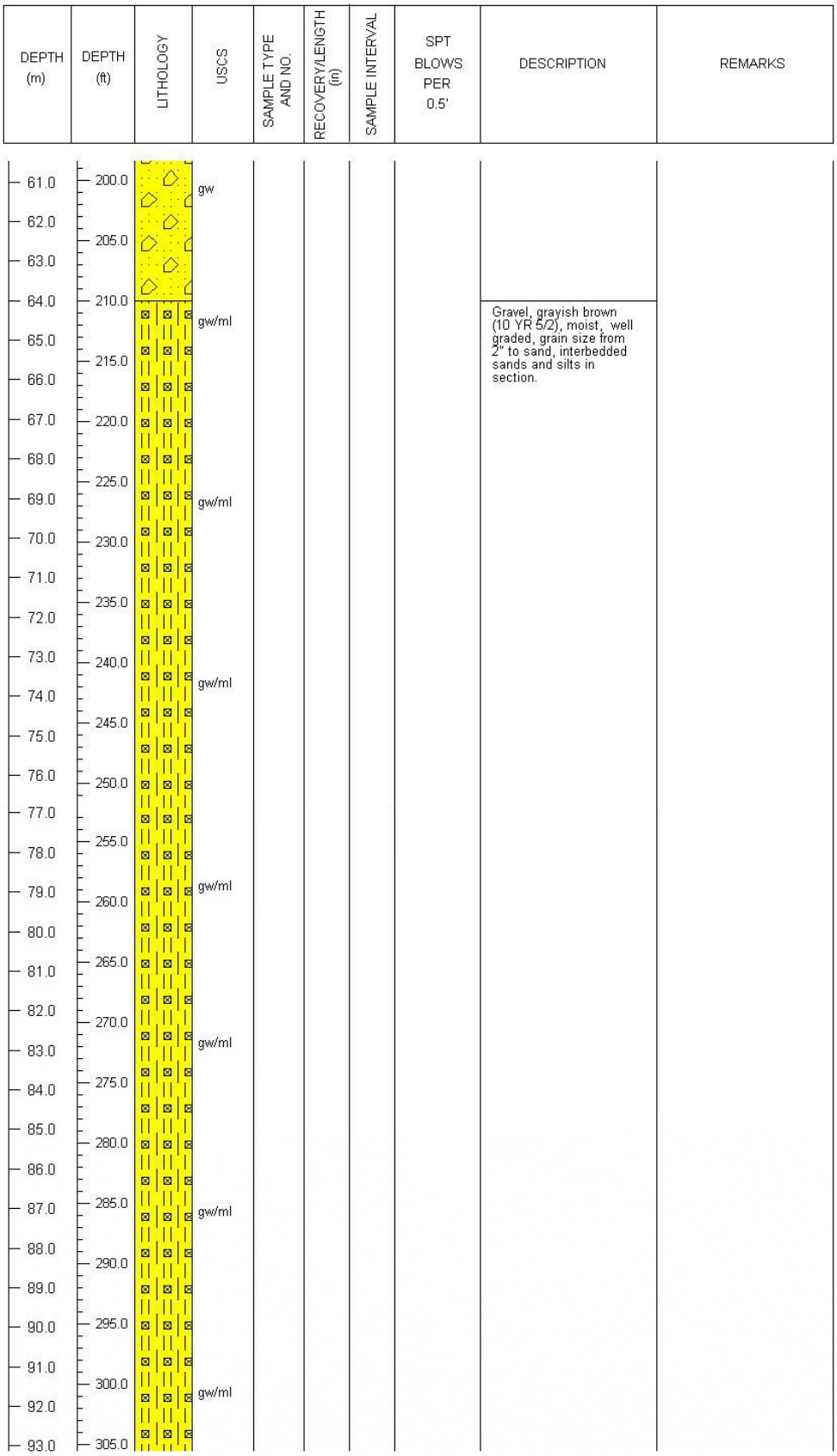

BORING
B-2
TRUCK
CDMG T-HUT
STRONG MOTION ACCELEROGRAPH
GATE
DRIVEWAY TO PARK
RANGER'S OFFICE
BLDG
0 5 10 15
(feet)
LEGEND
FENCE
TREES, BUSHES
Project# 1284
Date Sep 13,2001
Developed by A JACK
Drawn by T RODRIGUEZ
Approved by
File
SITE MAP
HALLS VALLEY SITE
BOREHOLE B-2
ROSRINE 5B
SITE INVESTIGATIONS
PREPARED FOR
UNIV OF SOUTHERN CALIFORNIA

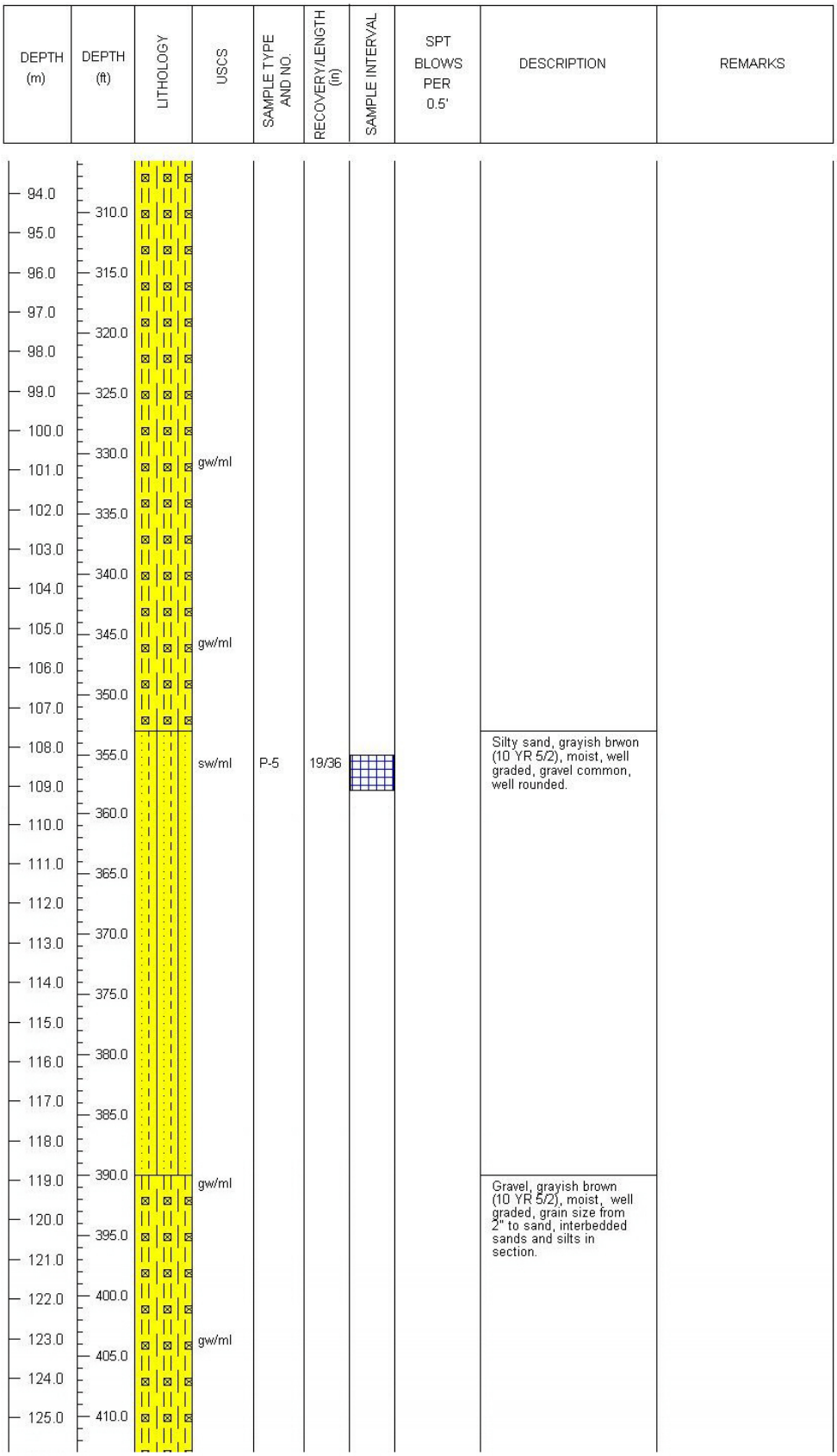
Appendix F: Detailed Results for Gilroy 3 Site

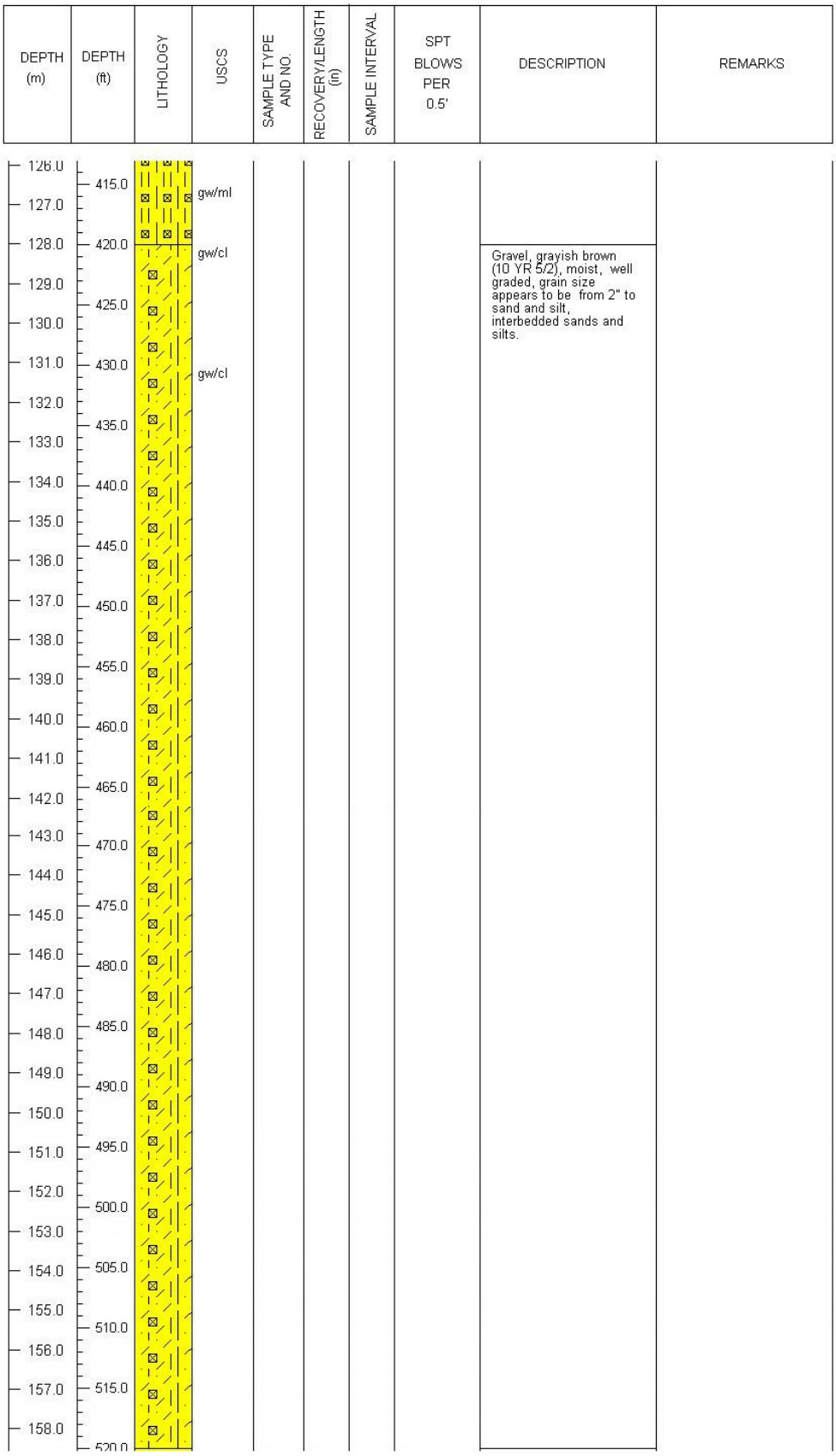
ROSRINE 5b – Gilroy 3

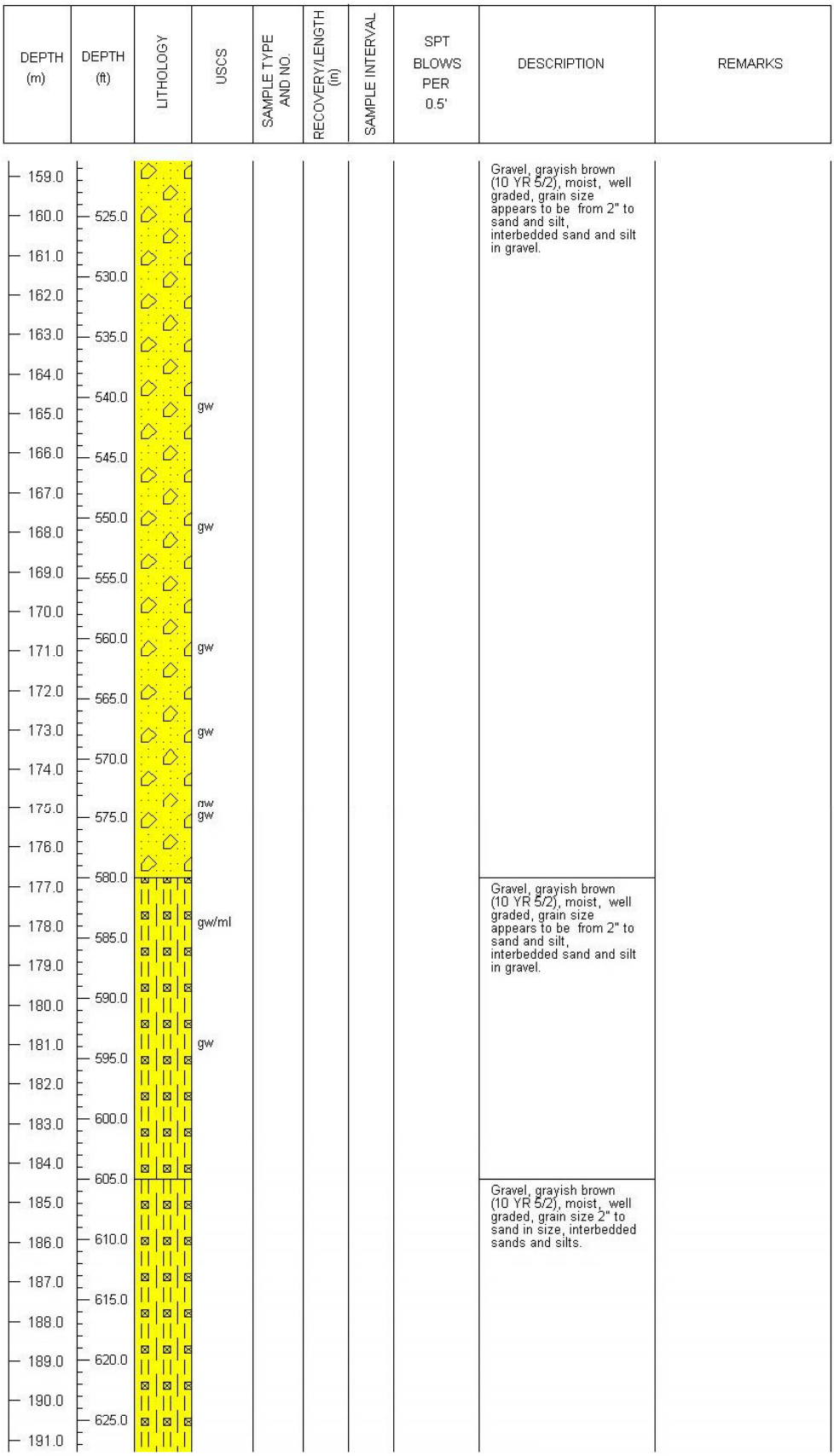


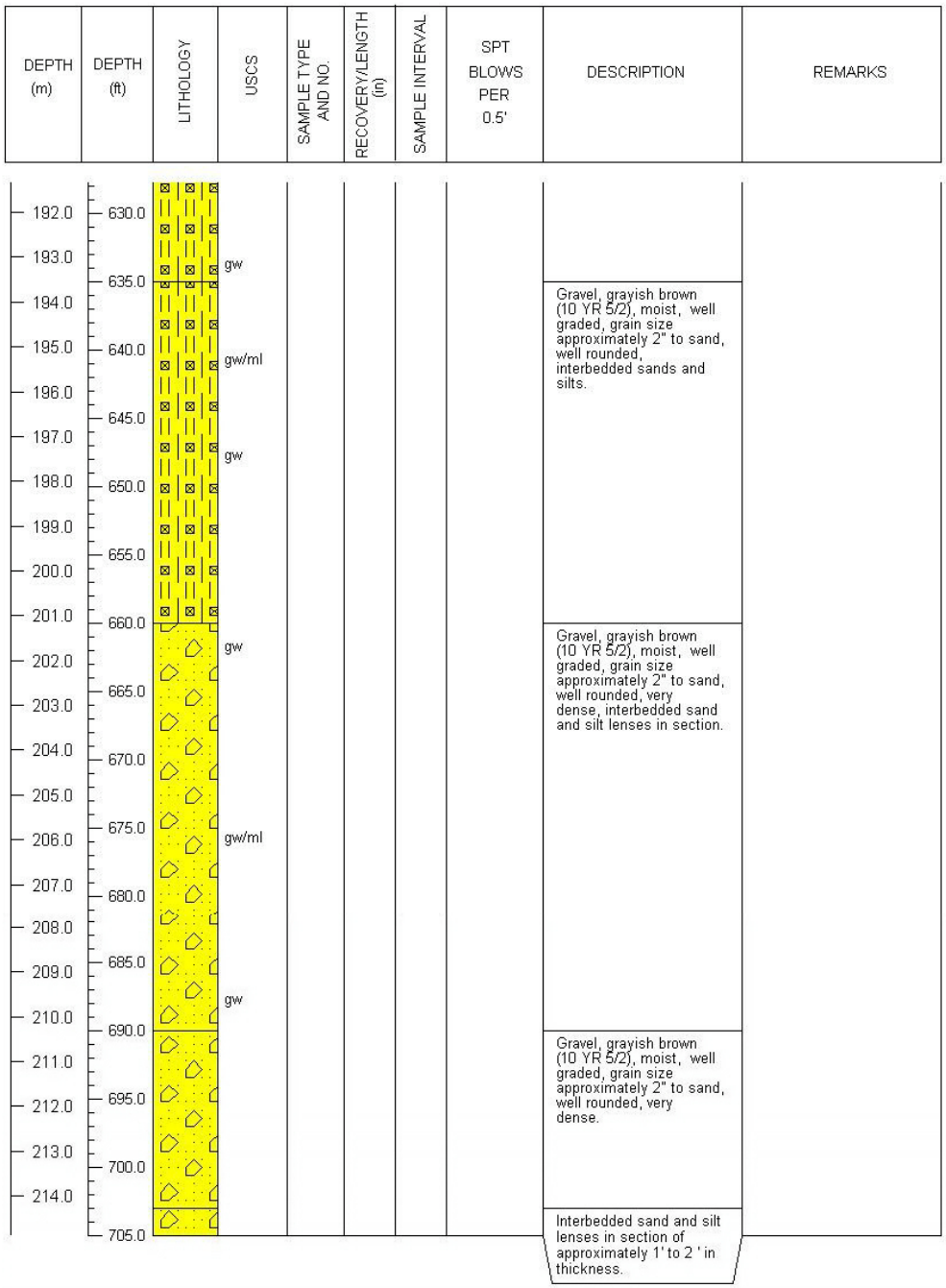

DEPTH (m)
DEPTH (ft)
LITHOLOGY
USCS
SAMPLE TYPE AND NO.
RECOVERY/LENGTH (in)
SAMPLE INTERVAL
SPT BLOWS PER 0.5'
DESCRIPTION
REMARKS
28.0
29.0
30.0
31.0
32.0
33.0
34.0
35.0
36.0
37.0
38.0
39.0
40.0
41.0
42.0
43.0
44.0
45.0
46.0
47.0
48.0
49.0
50.0
51.0
52.0
53.0
54.0
55.0
56.0
57.0
58.0
59.0
60.0
95.0
100.0
105.0
110.0
115.0
120.0
125.0
130.0
135.0
140.0
145.0
150.0
155.0
160.0
165.0
170.0
175.0
180.0
185.0
190.0
195.0
gw
gw
(GM)s
gw
gw
gw/cl
gw/cl
gw
SPT-100
8/18
50
P-4
24/36
Gravel, grayish brown (10 YR 5/2), interbedded silts to sands in sample, well graded.
Gravel, grayish brown (10 YR 5/2), moist, well graded, grain size from 2" to sand and silt, interbedded sands and silts.
Gravel, grayish brown (10 YR 5/2), moist, well graded, grain size from 2" to sand in size.
Sandy silt, grayish brown (10 YR 5/2), moist, very dense.
Gravel, grayish brown (10 YR 5/2), moist, well graded, grain size from 2" to sand, interbedded sands and silts in section.

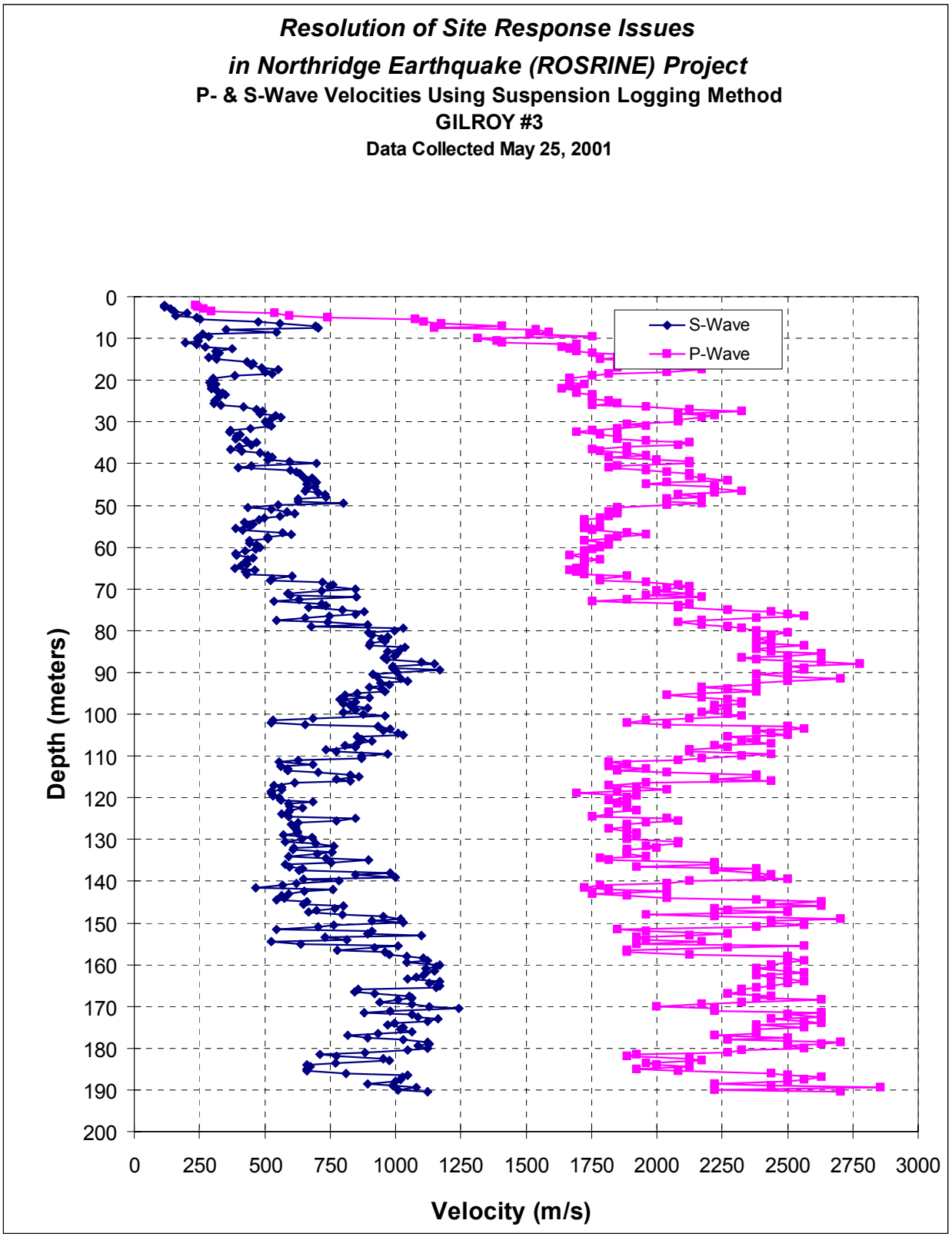

DEPTH (m)
DEPTH (ft)
LITHOLOGY
USCS
SAMPLE TYPE AND NO.
RECOVERY/LENGTH (in)
SAMPLE INTERVAL
SPT BLOWS PER 0.5'
DESCRIPTION
REMARKS
61.0
62.0
63.0
64.0
65.0
66.0
67.0
68.0
69.0
70.0
71.0
72.0
73.0
74.0
75.0
76.0
77.0
78.0
79.0
80.0
81.0
82.0
83.0
84.0
85.0
86.0
87.0
88.0
89.0
90.0
91.0
92.0
93.0
200.0
205.0
210.0
215.0
220.0
225.0
230.0
235.0
240.0
245.0
250.0
255.0
260.0
265.0
270.0
275.0
280.0
285.0
290.0
295.0
300.0
305.0
gw
gw/ml
gw/ml
gw/ml
gw/ml
gw/ml
gw/ml
Gravel, grayish brown (10 YR 5/2), moist, well graded, grain size from 2" to sand, interbedded sands and silts in section.


DEPTH (m)
DEPTH (ft)
LITHOLOGY
USCS
SAMPLE TYPE AND NO.
RECOVERY/LENGTH (in)
SAMPLE INTERVAL
SPT BLOWS PER 0.5'
DESCRIPTION
REMARKS
94.0
95.0
96.0
97.0
98.0
99.0
100.0
101.0
102.0
103.0
104.0
105.0
106.0
107.0
108.0
109.0
110.0
111.0
112.0
113.0
114.0
115.0
116.0
117.0
118.0
119.0
120.0
121.0
122.0
123.0
124.0
125.0
310.0
315.0
320.0
325.0
330.0
335.0
340.0
345.0
350.0
355.0
360.0
365.0
370.0
375.0
380.0
385.0
390.0
395.0
400.0
405.0
410.0
gw/ml
gw/ml
sw/ml
gw/ml
gw/ml
P-5
19/36
Silty sand, grayish brwon (10 YR 5/2), moist, well graded, gravel common, well rounded.
Gravel, grayish brown (10 YR 5/2), moist, well graded, grain size from 2" to sand, interbedded sands and silts in section.


DEPTH (m)
DEPTH (ft)
LITHOLOGY
USCS
SAMPLE TYPE AND NO.
RECOVERY/LENGTH (in)
SAMPLE INTERVAL
SPT BLOWS PER 0.5'
DESCRIPTION
REMARKS
126.0
127.0
128.0
129.0
130.0
131.0
132.0
133.0
134.0
135.0
136.0
137.0
138.0
139.0
140.0
141.0
142.0
143.0
144.0
145.0
146.0
147.0
148.0
149.0
150.0
151.0
152.0
153.0
154.0
155.0
156.0
157.0
158.0
415.0
420.0
425.0
430.0
435.0
440.0
445.0
450.0
455.0
460.0
465.0
470.0
475.0
480.0
485.0
490.0
495.0
500.0
505.0
510.0
515.0
520.0
gw/ml
gw/cl
gw/cl
Gravel, grayish brown (10 YR 5/2), moist, well graded, grain size appears to be from 2" to sand and silt, interbedded sands and silts.


DEPTH (m)
DEPTH (ft)
LITHOLOGY
USCS
SAMPLE TYPE AND NO.
RECOVERY/LENGTH (in)
SAMPLE INTERVAL
SPT BLOWS PER 0.5'
DESCRIPTION
REMARKS
159.0
160.0
161.0
162.0
163.0
164.0
165.0
166.0
167.0
168.0
169.0
170.0
171.0
172.0
173.0
174.0
175.0
176.0
177.0
178.0
179.0
180.0
181.0
182.0
183.0
184.0
185.0
186.0
187.0
188.0
189.0
190.0
191.0
525.0
530.0
535.0
540.0
545.0
550.0
555.0
560.0
565.0
570.0
575.0
580.0
585.0
590.0
595.0
600.0
605.0
610.0
615.0
620.0
625.0
gw
gw
gw
gw
gw
gw/ml
gw
Gravel, grayish brown (10 YR 5/2), moist, well graded, grain size appears to be from 2" to sand and silt, interbedded sand and silt in gravel.
Gravel, grayish brown (10 YR 5/2), moist, well graded, grain size appears to be from 2" to sand and silt, interbedded sand and silt in gravel.
Gravel, grayish brown (10 YR 5/2), moist, well graded, grain size 2" to sand in size, interbedded sands and silts.


DEPTH (m)
DEPTH (ft)
LITHOLOGY
USCS
SAMPLE TYPE AND NO.
RECOVERY/LENGTH (in)
SAMPLE INTERVAL
SPT BLOWS PER 0.5'
DESCRIPTION
REMARKS
192.0
193.0
194.0
195.0
196.0
197.0
198.0
199.0
200.0
201.0
202.0
203.0
204.0
205.0
206.0
207.0
208.0
209.0
210.0
211.0
212.0
213.0
214.0
630.0
635.0
640.0
645.0
650.0
655.0
660.0
665.0
670.0
675.0
680.0
685.0
690.0
695.0
700.0
705.0
gw
gw/ml
gw
gw
gw/ml
gw
Gravel, grayish brown (10 YR 5/2), moist, well graded, grain size approximately 2" to sand, well rounded, interbedded sands and silts.
Gravel, grayish brown (10 YR 5/2), moist, well graded, grain size approximately 2" to sand, well rounded, very dense, interbedded sand and silt lenses in section.
Gravel, grayish brown (10 YR 5/2), moist, well graded, grain size approximately 2" to sand, well rounded, very dense.
Interbedded sand and silt lenses in section of approximately 1' to 2 ' in thickness.


Resolution of Site Response Issues
in Northridge Earthquake (ROSRINE) Project
P- & S-Wave Velocities Using Suspension Logging Method
GILROY #3
Data Collected May 25, 2001
S-Wave
P-Wave
Depth (meters)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
190
200
0
250
500
750
1000
1250
1500
1750
2000
2250
2500
2750
3000
Velocity (m/s)

Gilroy #3

Depth (meters)	Vs (meters/sec)	Vp (meters/sec)
2.0	116	235
2.5	117	244
3.0	141	265
3.5	154	297
4.0	203	538
4.5	160	595
5.0	239	741
5.5	253	1075
6.0	474	1111
6.5	559	1176
7.0	694	1408
7.5	704	1149
8.0	351	1538
8.5	543	1587
9.0	261	1515
9.5	287	1754
10.0	243	1316
10.5	244	1389
11.0	195	1408
11.5	239	1695
12.0	271	1639
12.5	375	1667
13.0	313	1695
13.5	327	1754
14.0	315	1887
14.5	285	1852
15.0	315	1786
15.5	431	2000
16.0	457	1887
16.5	448	1852
17.0	488	1852
17.5	552	2174
18.0	500	2041
18.5	529	1818
19.0	385	1754
19.5	303	1667
20.0	305	1667
20.5	290	1667
21.0	313	1724
21.5	297	1667
22.0	296	1639
22.5	314	1695
23.0	338	1695
23.5	347	1754
24.0	325	1754
24.5	316	1754
25.0	308	1818
25.5	307	1852
26.0	331	1754
26.5	420	1961

Depth (meters)	Vs (meters/sec)	Vp (meters/sec)
27.0	469	2128
27.5	493	2326
28.0	483	2083
28.5	541	2222
29.0	562	2174
29.5	521	2083
30.0	503	2083
30.5	510	1887
31.0	526	1961
31.5	444	1852
32.0	368	1754
32.5	365	1695
33.0	405	1786
33.5	391	1852
34.0	388	1852
34.5	429	1961
35.0	469	2128
35.5	448	2083
36.0	402	1887
36.5	368	1754
37.0	413	1786
37.5	483	1887
38.0	510	1961
38.5	529	1818
39.0	513	2000
39.5	595	2128
40.0	699	2128
40.5	448	1852
41.0	398	1818
41.5	599	1961
42.0	621	2041
42.5	633	2128
43.0	645	2128
43.5	680	2174
44.0	662	2273
44.5	699	2041
45.0	662	1961
45.5	690	2222
46.0	662	2222
46.5	654	2326
47.0	704	2222
47.5	730	2083
48.0	735	2174
48.5	629	2041
49.0	629	2041
49.5	800	2174
50.0	552	2041
50.5	435	1852
51.0	524	1852
51.5	585	1818
52.0	613	1852
52.5	559	1818

Depth (meters)	Vs (meters/sec)	Vp (meters/sec)
53.0	498	1786
53.5	478	1724
54.0	422	1724
54.5	457	1724
55.0	441	1786
55.5	388	1724
56.0	415	1754
56.5	568	1887
57.0	602	1961
57.5	510	1852
58.0	510	1818
58.5	441	1724
59.0	441	1818
59.5	469	1818
60.0	481	1786
60.5	465	1754
61.0	424	1724
61.5	388	1724
62.0	391	1667
62.5	457	1724
63.0	437	1786
63.5	429	1724
64.0	433	1724
64.5	408	1724
65.0	385	1695
65.5	461	1667
66.0	424	1695
66.5	431	1724
67.0	604	1887
67.5	529	1786
68.0	521	1786
68.5	722	1961
69.0	760	2083
69.5	749	2128
70.0	847	2041
70.5	717	2000
71.0	588	2128
71.5	599	1961
72.0	851	2174
72.5	631	1887
73.0	536	1754
73.5	717	2128
74.0	735	2083
74.5	669	2083
75.0	797	2273
75.5	881	2439
76.0	847	2500
76.5	749	2564
77.0	654	2381
77.5	546	2174
78.0	741	2083
78.5	893	2174

Depth (meters)	Vs (meters/sec)	Vp (meters/sec)
79.0	678	2273
79.5	1031	2326
80.0	995	2381
80.5	897	2500
81.0	909	2439
81.5	971	2439
82.0	948	2381
82.5	962	2439
83.0	905	2381
83.5	901	2564
84.0	1036	2439
84.5	1020	2381
85.0	971	2439
85.5	1005	2632
86.0	995	2500
86.5	957	2326
87.0	966	2381
87.5	1099	2632
88.0	1149	2778
88.5	990	2500
89.0	990	2564
89.5	1170	2564
90.0	1005	2500
90.5	913	2381
91.1	930	2500
91.5	1020	2703
92.0	1047	2500
92.5	943	2381
93.0	976	2381
93.5	901	2174
94.0	948	2273
94.5	962	2381
95.0	855	2174
95.5	806	2041
96.0	901	2174
96.5	787	2273
97.0	847	2326
97.5	800	2326
98.0	826	2222
98.5	893	2273
99.0	847	2222
99.5	800	2174
100.0	877	2273
100.5	962	2326
101.0	685	2128
101.5	532	1961
102.0	526	1887
102.5	654	2041
103.0	935	2500
103.5	980	2564
104.0	952	2381
104.5	1010	2439

Depth (meters)	Vs (meters/sec)	Vp (meters/sec)
105.0	1031	2500
105.5	855	2273
106.0	870	2381
106.5	909	2326
107.0	855	2439
107.5	806	2222
108.0	847	2273
108.5	735	2128
109.0	775	2128
109.5	971	2439
110.0	870	2326
110.5	870	2174
111.0	629	2083
111.5	556	1818
112.0	685	1887
112.5	562	1818
113.0	588	1961
113.5	588	1852
114.0	704	2041
114.5	826	2381
115.0	862	2381
115.5	775	2222
116.0	826	2439
116.5	613	1961
117.0	535	1818
117.5	565	1923
118.0	565	2041
118.5	524	1852
119.0	526	1695
119.5	532	1923
120.0	556	1887
120.5	562	1818
121.0	685	1887
121.5	592	1852
122.0	595	1887
122.5	645	1887
123.0	595	1923
123.5	592	1818
124.0	565	1818
124.5	592	1754
125.0	847	2041
125.5	775	2083
126.0	629	1961
126.5	602	1887
127.0	617	1887
127.5	617	1818
128.0	625	1887
128.5	625	1923
129.0	571	1923
129.5	680	1887
130.0	641	1887
130.5	578	2083

Depth (meters)	Vs (meters/sec)	Vp (meters/sec)
131.0	694	2083
131.5	763	1961
132.0	612	2000
132.5	608	1887
133.0	758	1887
133.5	702	1887
134.0	592	1961
134.5	735	1786
135.0	897	1818
135.5	755	2222
136.0	578	2222
136.5	593	1923
137.0	645	2381
137.5	631	2222
138.0	980	2381
138.5	847	2439
139.0	1000	2381
139.5	647	2500
140.0	784	2128
140.5	621	2041
141.0	568	1786
141.5	466	1724
142.0	760	1818
142.5	651	2041
143.0	590	1754
143.5	563	1887
144.0	576	2041
144.5	546	2381
145.0	662	2632
145.5	649	2439
146.0	800	2632
146.5	766	2222
147.0	697	2273
147.5	667	2500
148.0	797	1961
148.5	952	2222
149.0	1020	2703
149.5	909	2439
150.0	1031	2439
150.5	763	2564
151.0	704	2381
151.5	543	1852
152.0	909	1961
152.5	893	2273
153.0	1099	2128
153.5	730	1923
154.0	813	1961
154.5	524	2174
155.0	637	1923
155.5	1010	2564
156.0	922	2273
156.5	778	1887

Depth (meters)	Vs (meters/sec)	Vp (meters/sec)
157.0	962	1887
157.5	976	2128
158.0	1042	2500
158.5	1105	2500
159.0	1124	2564
159.5	1042	2500
160.0	1170	2439
160.5	1156	2439
161.0	1117	2381
161.5	1149	2500
162.0	1117	2564
162.5	1105	2381
163.0	1081	2439
163.5	1047	2500
164.0	1170	2564
164.5	1130	2500
165.0	1170	2439
165.5	1156	2381
166.0	858	2326
166.5	844	2326
167.0	922	2273
167.5	1053	2439
168.0	1064	2381
168.5	1010	2632
169.0	939	2326
169.5	1064	2174
170.0	1130	2000
170.5	1242	2222
171.0	980	2222
171.5	881	2632
172.0	1064	2500
172.5	1087	2632
173.0	1163	2439
173.5	1124	2564
174.0	995	2632
174.5	971	2381
175.0	1031	2564
175.5	1020	2381
176.0	1064	2381
176.5	935	2381
177.0	816	2222
177.5	893	2500
178.0	1031	2273
178.5	1124	2703
179.0	1130	2632
179.5	1087	2500
180.0	1124	2564
180.5	1047	2326
181.0	885	2273
181.5	712	1923
182.0	775	1887
182.5	952	2128

Depth (meters)	**Vs (meters/sec)**	**Vp (meters/sec)**
183.0	976	2174
183.5	769	1961
184.0	660	2000
184.5	676	2128
185.0	662	1923
185.5	662	2083
186.0	810	2439
186.5	1047	2500
187.0	1026	2632
187.5	1020	2564
188.0	1000	2500
188.5	893	2222
189.0	990	2439
189.5	1081	2857
190.0	1010	2222
190.5	1124	2703

ROSRINE 5b

Index Property Testing of Soil Samples

From Teratest Labs' Report, June 28, 2001

J Swift,8/30/2001

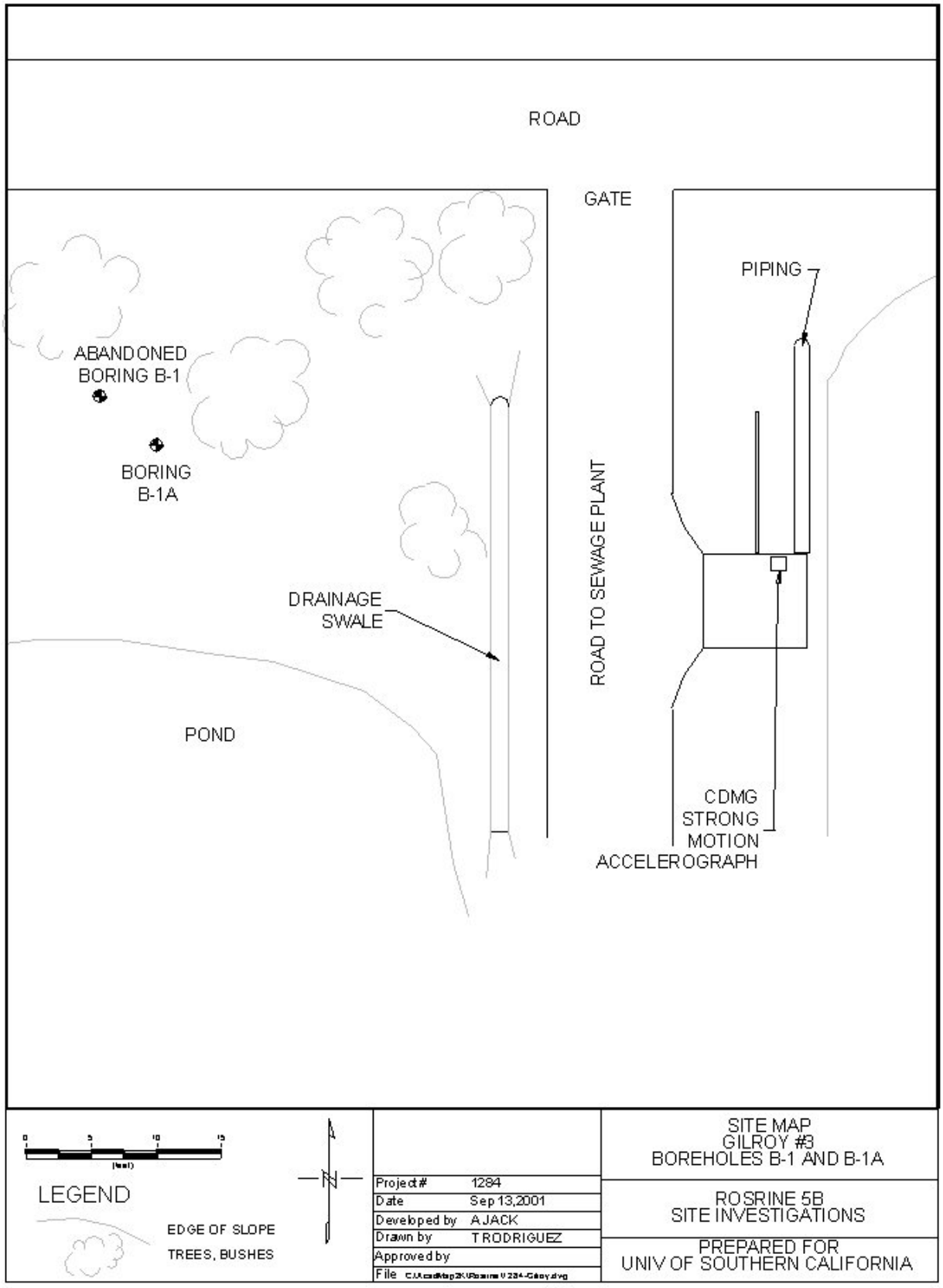
Gilroy #3

Sample	Depth, ft (range: # to #)		Depth, m (range: # to #)		Visual Classification	Soil Class	D50 (mm)	Wet Density (pcf)	Moisture Content (%)	Dry Density (pcf)	Void Ratio	Degree of Saturation	LL	PL	PI
SPT 5	5	7	1.5	2.1	n/a	(CL)s	na	107.4	35.9	79	1.133	85.7	44	25	19
SPT 10	10	12	3.0	3.7	n/a	s(CL)	na	122.6	26.5	96.9	0.739	96.9	31	19	12
SPT 20	20.0	22.0	6.1	6.7	n/a	(SC)g	0.3	131.4	15.9	113.4	0.486	88.1	27	16	11
SPT 30	30.0	32.0	9.1	9.8	n/a	(SP-SC)g	3.3	143.5	10.9	129.3	0.303	97.3	29	16	13
SPT 44	44.0	48.0	13.4	14.6	n/a	SC	0.1	127.2	20.7	105.3	0.600	93.3	26	18	8
SPT 53	53.0	55.0	16.2	16.8	n/a	(GW-GC)s	6.5	137.1	9.8	124.9	0.350	75.5	na	n/a	n/a
SPT 100	100.0	102.0	30.5	31.1	n/a	(GM)s	5.5	135.1	11.3	121.4	0.389	78.5	n/a	n/a	n/a

View of Gilroy drilling location.

View Southeast of drilling location.

View of seismograph building, looking south.


ROAD
GATE
PIPING
ABANDONED
BORING B-1
BORING
B-1A
DRAINAGE
SWALE
ROAD TO SEWAGE PLANT
POND
CDMG
STRONG
MOTION
ACCELEROGRAPH
LEGEND
EDGE OF SLOPE
TREES, BUSHES
Project# 1284
Date Sep 13,2001
Developed by AJACK
Drawn by TRODRIGUEZ
Approved by
File
SITE MAP
GILROY #3
BOREHOLES B-1 AND B-1A
ROSRINE 5B
SITE INVESTIGATIONS
PREPARED FOR
UNIV OF SOUTHERN CALIFORNIA

Appendix G: Detailed Results for Superstition Mountain Top Site

ROSRINE 5b – Superstition Mountain Top

Rosrine ResOlution of Site Response Issues from the Northridge Earthquake

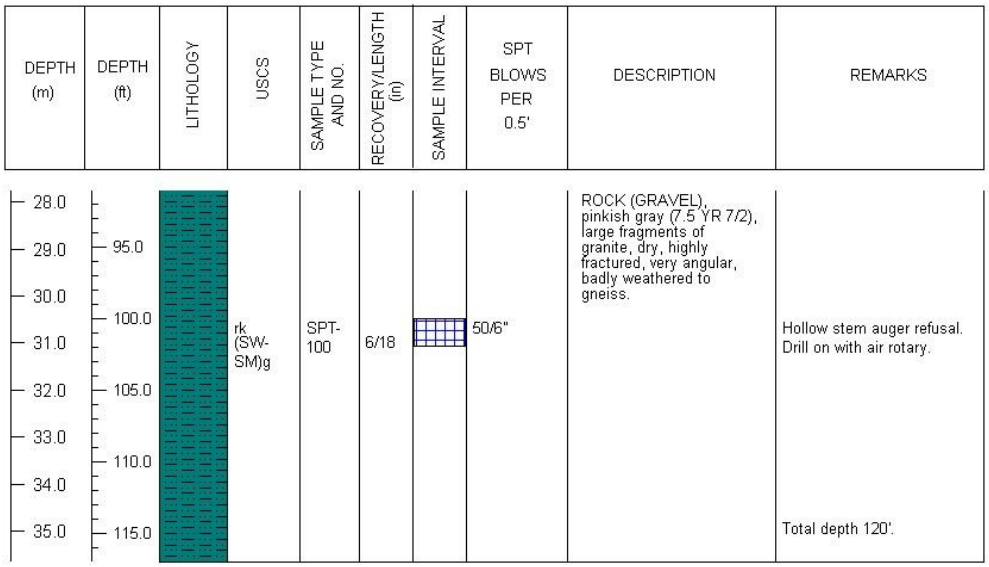
Boring Log

PROJECT: ROSRINE 5b
SITE LOCATION: Superstition Mountain
DIST/COUNTY/RTE/PM: Imperial
EA: n/a
BRIDGE NO: n/a
STA/OFFSET: n/a
BORING NO: B-1

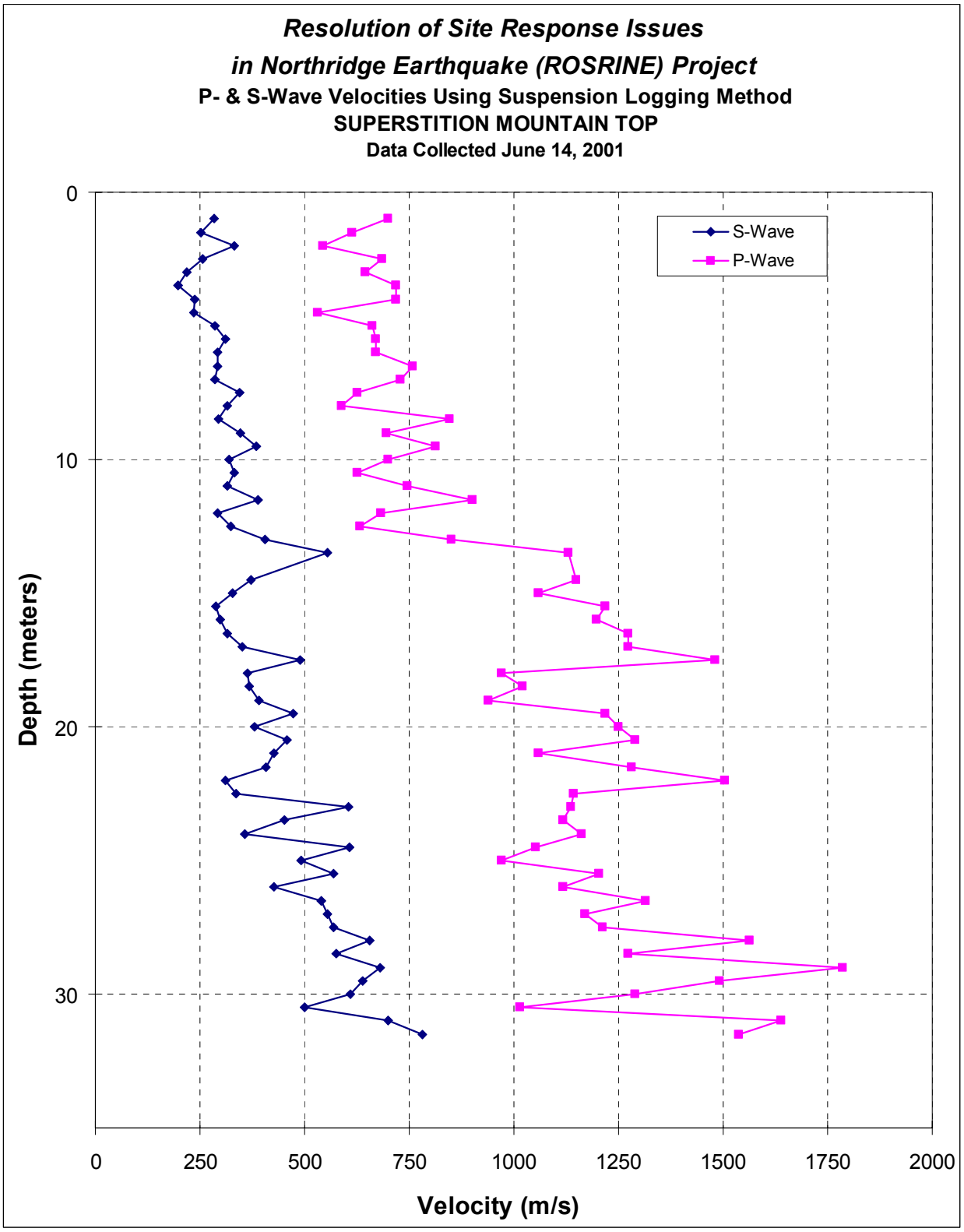
DRILLING CONTRACTOR: Cascade Drilling
DATES DRILLED: 06/06/2001 - 06/08/2001
DRILLING METHOD: Air Rotary
HOLE DIAMETER (mm): unknown
TOTAL DEPTH (m): 35.7
DRILL RIG MODEL/NO: unknown
SPT HAMMER: Acker 140 lb

DATUM: NAD27
LATITUDE: 32.955
LONGITUDE: -115.825
ELEVATION: 781 ft.
LOGGED BY: A. Jack
ORGANIZATION: GeoVision
ENTERED BY: J. Swift DATE: 09/30/2001
CHECKED BY: R. Nigbor DATE: 10/29/2001

DEPTH (m)	DEPTH (ft)	LITHOLOGY	USCS	SAMPLE TYPE AND NO.	RECOVERY/LENGTH (in)	SAMPLE INTERVAL	SPT BLOWS PER 0.5'	DESCRIPTION	REMARKS
0.0	0.0							ROCK (GRAVEL), pinkish gray (7.5 YR 7/2), large fragments of granite, dry, highly fractured, to gravel in form, very angular.	
1.0	5.0								
2.0									
3.0	10.0		rk SM	SPT-10	18/18		10/14/24		
4.0									
5.0	15.0		rk (SW-SM)g	SPT-15	16/18		13/36/50		
6.0	20.0		rk (SW-SM)g	SPT-20	16/18		13/30/28		
7.0									
8.0	25.0								
9.0	30.0								
10.0									
11.0	35.0		rk (SW-SM)g	SPT-35 30	12/18				
12.0	40.0		rk						
13.0									
14.0	45.0							ROCK (GRAVEL), pinkish gray (7.5 YR 7/2), large fragments, fractured, granite, dry, badly weathered to gneiss, consistency very angular.	
15.0									
16.0	50.0		(SM)g	SPT-50	10/18		33/50/6"		
17.0	55.0								
18.0									
19.0	60.0		rk					ROCK (GRAVEL), pinkish gray (7.5 YR 7/2), large fragments of granite, dry, highly fractured to gravel, very angular.	
20.0	65.0								
21.0									
22.0	70.0								
23.0	75.0		rk						
24.0									
25.0	80.0								
26.0	85.0							Increasing moisture content.	
27.0									
	90.0							ROCK (GRAVEL)	



DEPTH (m)	DEPTH (ft)	LITHOLOGY	USCS	SAMPLE TYPE AND NO.	RECOVERY/LENGTH (in)	SAMPLE INTERVAL	SPT BLOWS PER 0.5'	DESCRIPTION	REMARKS
28.0 29.0 30.0 31.0 32.0 33.0 34.0 35.0	95.0 100.0 105.0 110.0 115.0		rk (SW-SM)g	SPT-100	6/18		50/6"	ROCK (GRAVEL), pinkish gray (7.5 YR 7/2), large fragments of granite, dry, highly fractured, very angular, badly weathered to gneiss.	Hollow stem auger refusal. Drill on with air rotary. Total depth 120'.


Resolution of Site Response Issues
in Northridge Earthquake (ROSRINE) Project
P- & S-Wave Velocities Using Suspension Logging Method
SUPERSTITION MOUNTAIN TOP
Data Collected June 14, 2001
S-Wave
P-Wave
Depth (meters)
0
10
20
30
0
250
500
750
1000
1250
1500
1750
2000
Velocity (m/s)

Superstition Mountain Top

Depth (meters)	Vs (meters/sec)	Vp (meters/sec)
1.0	284	699
1.5	253	613
2.0	331	543
2.5	257	685
3.0	218	645
3.5	196	719
4.0	237	719
4.5	236	532
5.0	285	662
5.5	311	671
6.0	292	671
6.5	292	758
7.0	286	730
7.5	345	625
8.0	315	588
8.5	295	847
9.0	346	694
9.5	385	813
10.0	318	699
10.5	332	625
11.0	315	746
11.5	388	901
12.0	292	683
12.5	323	633
13.0	406	851
13.5	556	1130
14.5	372	1149
15.0	328	1058
15.5	288	1220
16.0	298	1198
16.5	314	1274
17.0	351	1274
17.5	490	1481
18.0	364	971
18.5	368	1020
19.0	391	939
19.5	472	1220
20.0	380	1250
20.5	459	1290
21.0	426	1058
21.5	408	1282
22.0	312	1504
22.5	336	1143
23.0	604	1136
23.5	451	1117
24.0	357	1163
24.5	608	1053
25.0	493	971
25.5	570	1205

Depth (meters)	**Vs (meters/sec)**	**Vp (meters/sec)**
26.0	426	1117
26.5	541	1316
27.0	554	1170
27.5	570	1212
28.0	656	1563
28.5	575	1274
29.0	680	1786
29.5	639	1493
30.0	610	1290
30.5	500	1015
31.0	699	1639
31.5	781	1538

ROSRINE 5b

Index Property Testing of Soil Samples

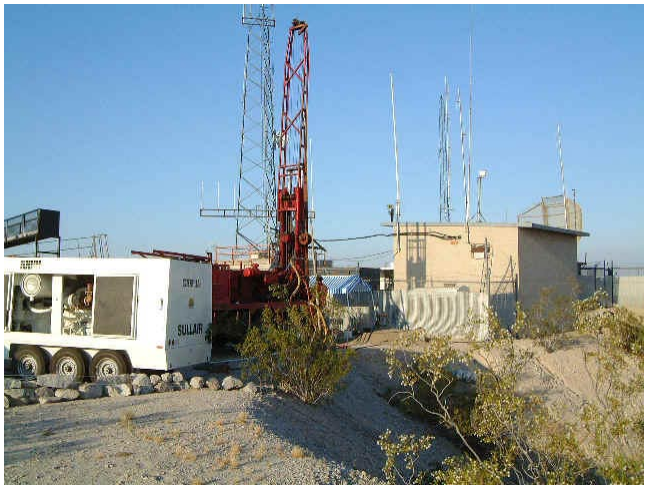
From Teratest Labs' Report, June 27, 2001

J. Swift, 8/30/2001

Superstition Mountain

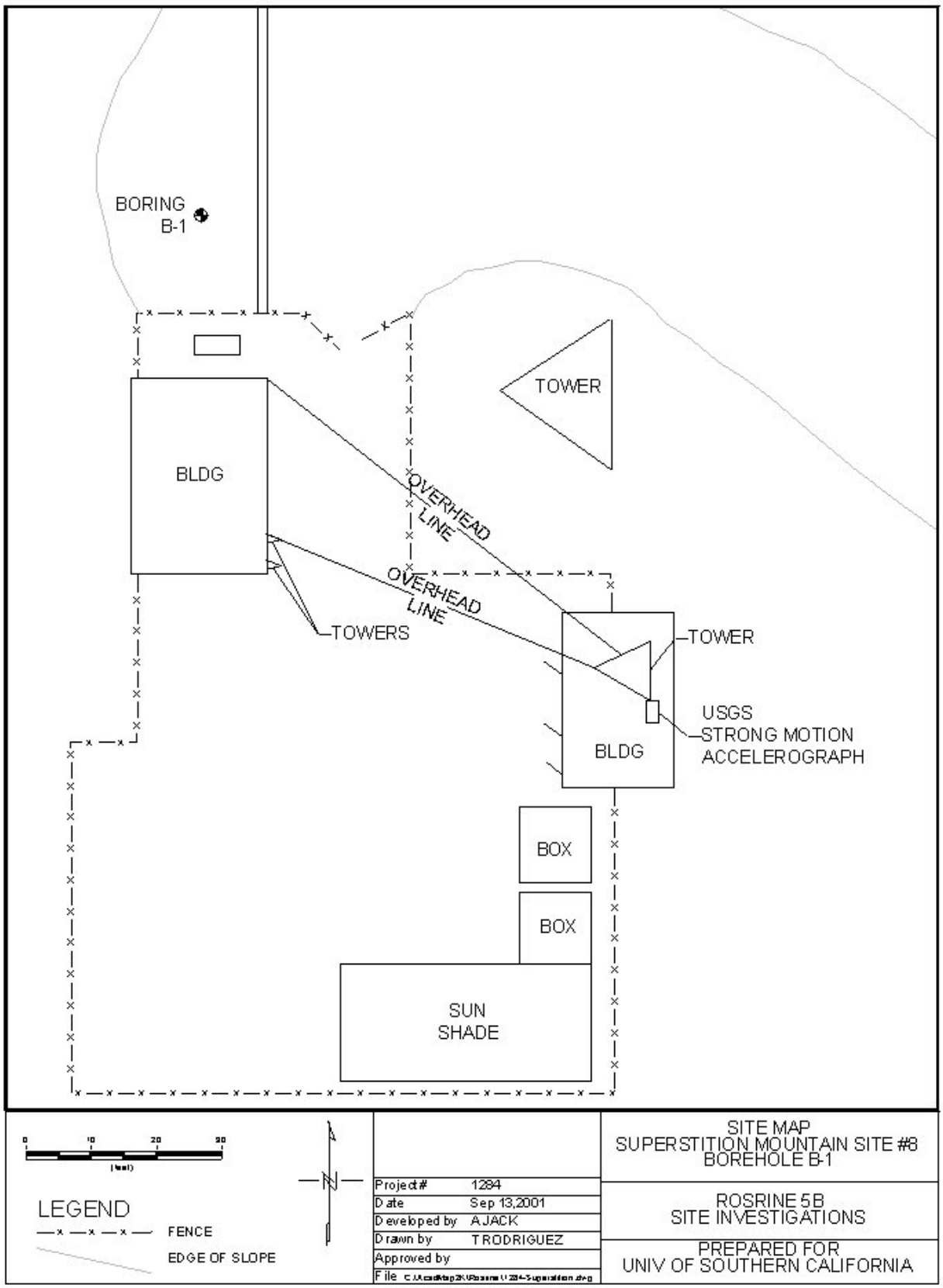
Sample	Depth, ft (range: # to #)		Depth, m (range: # to #)		Visual Classification	Soil Class	D50 (mm)	Moisture Content (%)	LL	PL	PI
SPT 10	10	12	3.0	3.7	Decomposed Rock	SM	0.5	0.6	na	na	na
SPT 15	15.0	17.0	4.6	5.2	Decomposed Rock	(SW-SM)g	2.2	0.4	na	na	na
SPT 20	20.0	22.0	6.1	6.7	Decomposed Rock	(SW-SM)g	3.0	0.4	na	na	na
SPT 30	35.0	37.0	10.7	11.3	Decomposed Rock	(SW-SM)g	2.5	0.3	na	na	na
SPT 50	50.0	52.0	15.2	15.9	Decomposed Rock	(SM)g	1.5	0.3	na	n/a	n/a
SPT 100	100.0	102.0	30.5	31.1	Decomposed Rock	(SW-SM)g	3.0	0.3	n/a	n/a	n/a

View of drill site from the road leading to the top of Superstition Mountain.



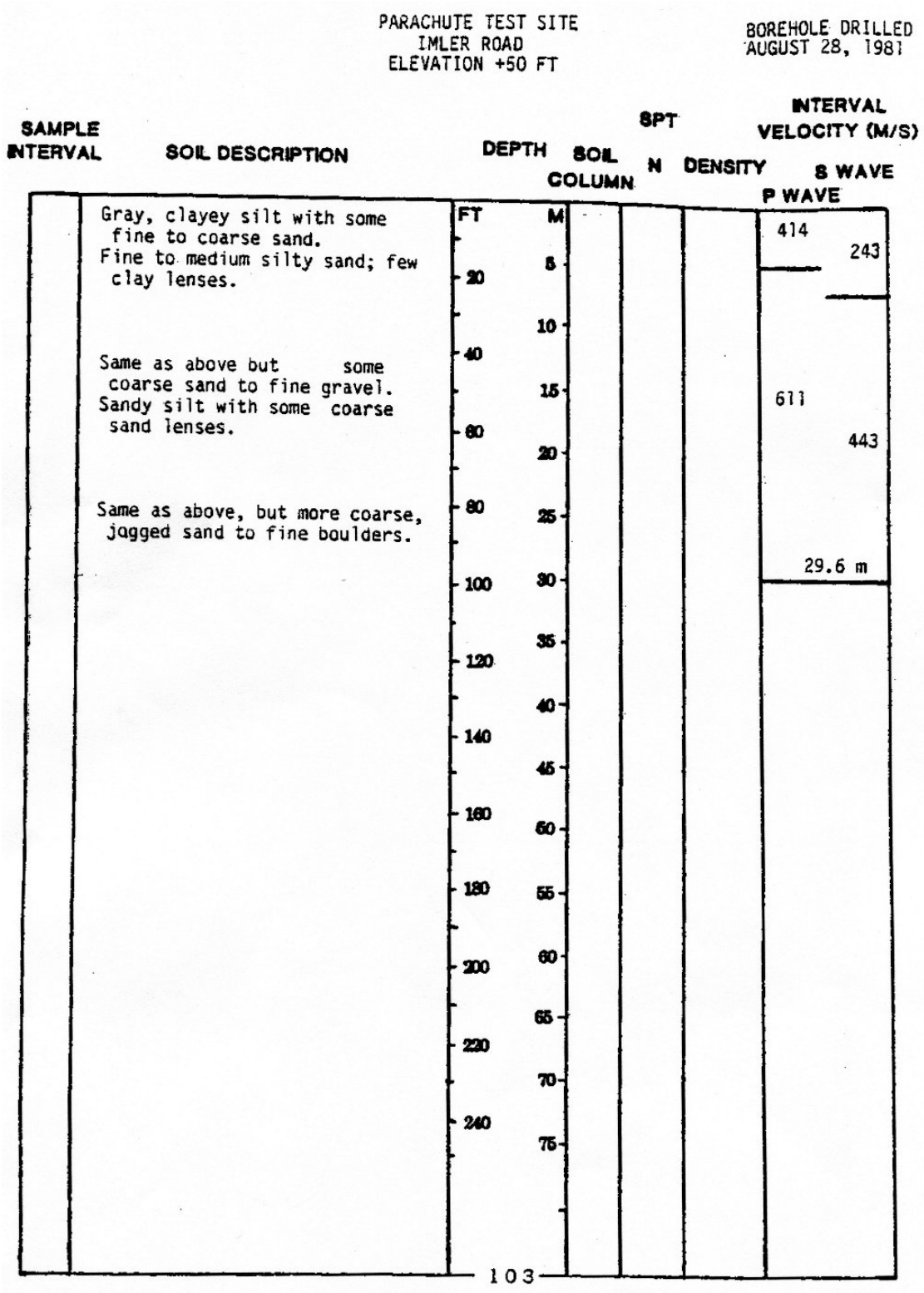
Drill site looking toward the radar station.

View of drill site (borehole) looking West.

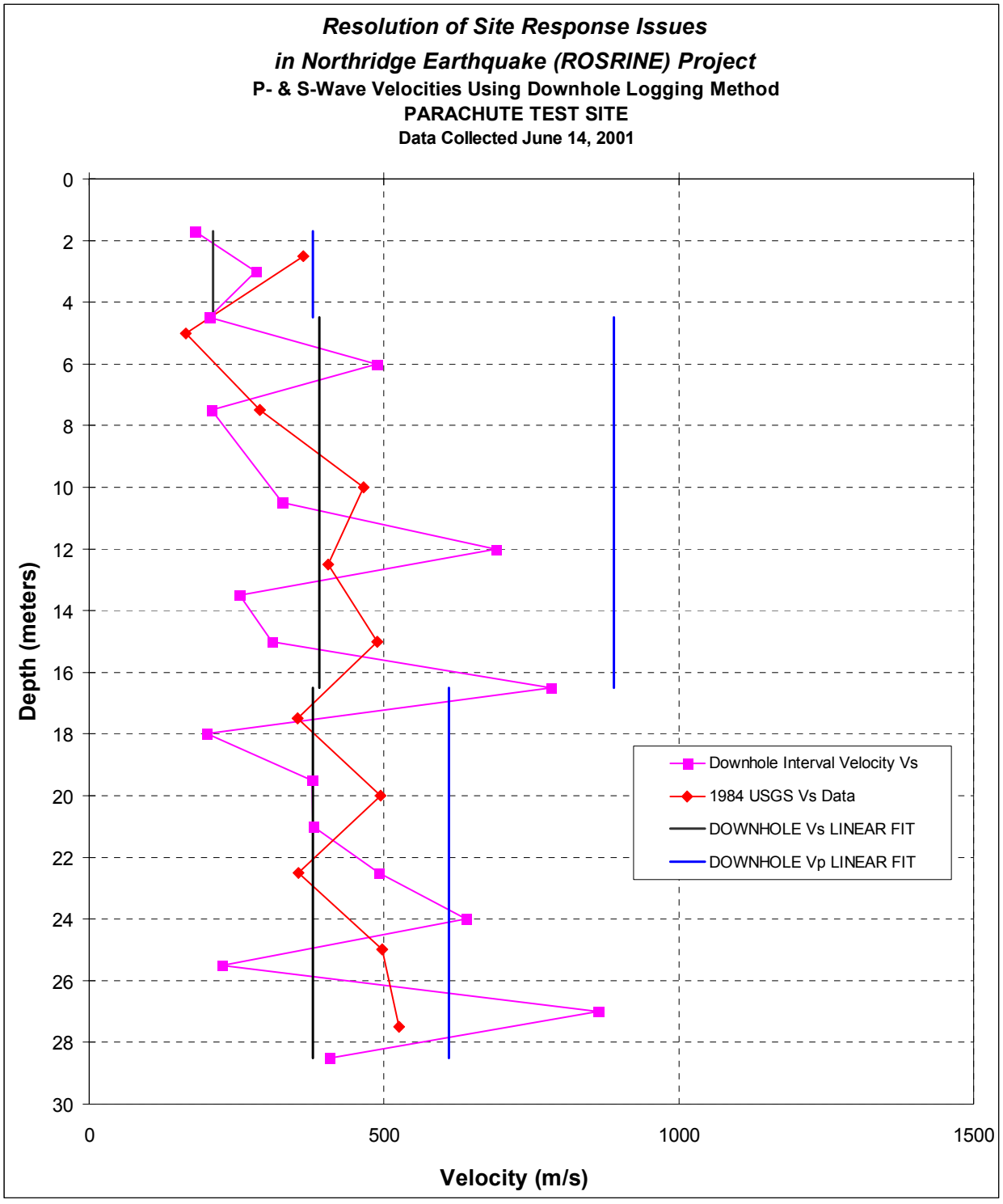

BORING
B-1
TOWER
BLDG
OVERHEAD
LINE
OVERHEAD
LINE
TOWERS
TOWER
USGS
STRONG MOTION
ACCELEROGRAPH
BLDG
BOX
BOX
SUN
SHADE
LEGEND
FENCE
EDGE OF SLOPE
Project# 1284
Date Sep 13,2001
Developed by AJACK
Drawn by TRODRIGUEZ
Approved by
File
SITE MAP
SUPERSTITION MOUNTAIN SITE #8
BOREHOLE B-1
ROSRINE 5B
SITE INVESTIGATIONS
PREPARED FOR
UNIV OF SOUTHERN CALIFORNIA

Appendix H: Detailed Results for Parachute Test Site

ROSRINE 5b – Parachute Test Site Control Bldg.



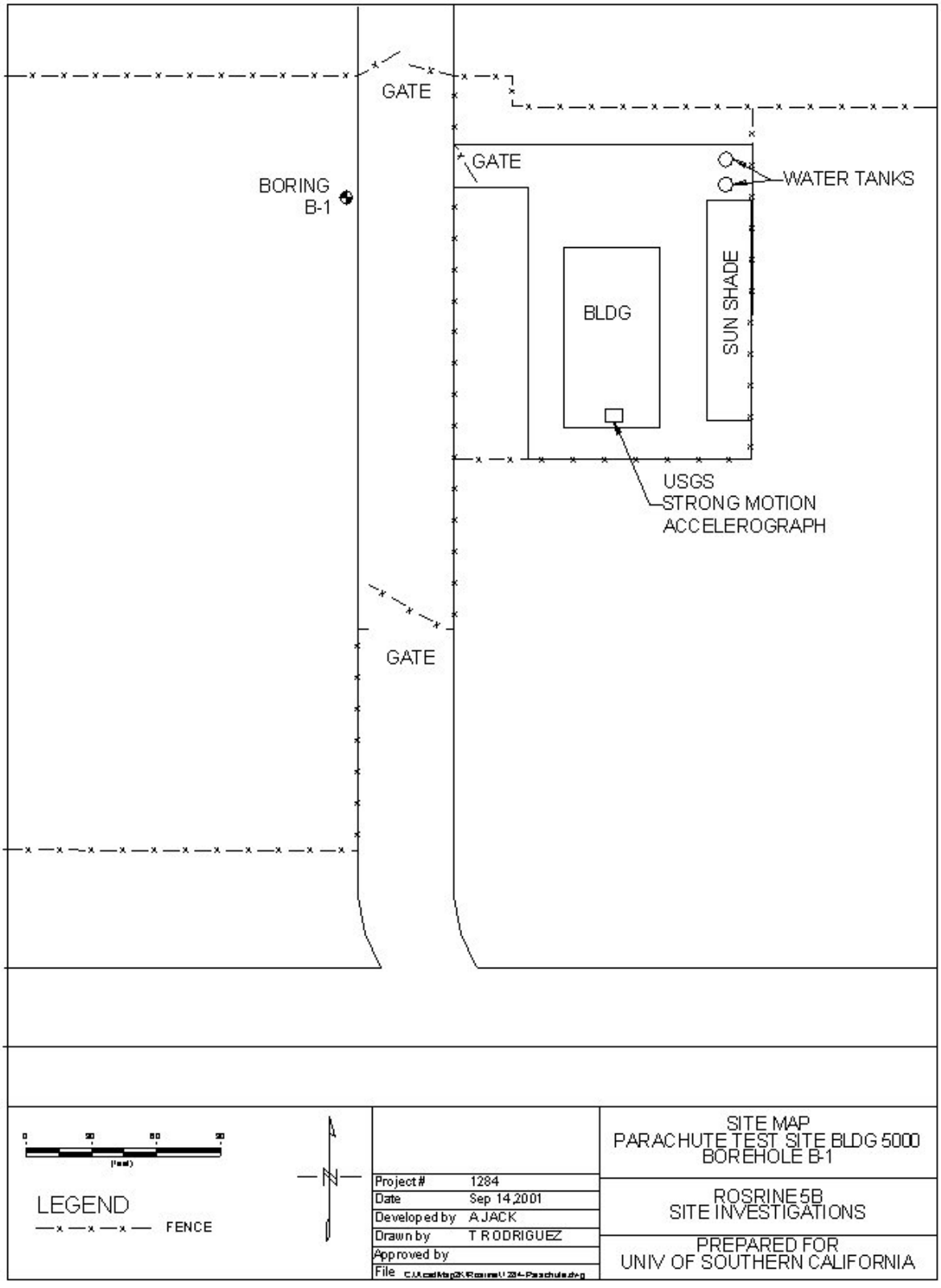
(Porcella, 1984)


Resolution of Site Response Issues
in Northridge Earthquake (ROSRINE) Project
P- & S-Wave Velocities Using Downhole Logging Method
PARACHUTE TEST SITE
Data Collected June 14, 2001
Depth (meters)
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
0
500
1000
1500
Velocity (m/s)
Downhole Interval Velocity Vs
1984 USGS Vs Data
DOWNHOLE Vs LINEAR FIT
DOWNHOLE Vp LINEAR FIT

Parachute Test Site
ROSRINE Downhole Measurements
GeoVision/Rob Steller, 6/14/01
Final QA by R. Nigbor, 11/20/01

INTERVAL VELOCITIES			LINEAR FIT RESULTS						Linear Fit Velocities				
Nominal Receiver Depth (m)	Interval Shear Velocity (m/sec)	Interval Compressional Velocity (m/sec)	Interval Shear Velocity (m/sec)	Interval Compressional Velocity (m/sec)	Interval Shear Velocity (m/sec)	Interval Compressional Velocity (m/sec)	Interval Shear Velocity (m/sec)	Interval Compressional Velocity (m/sec)	Depth Interval Start (m)	Depth Interval End (m)	Interval Shear Velocity (m/sec)	Interval Compressional Velocity (m/sec)	Interval Poissons Ratio
1.7	178	290	210	380					0	4.5	210	380	0.28
3.0	283	462	210	380					4.5	16.5	390	890	0.38
4.5	203	524	210	380	390	890			16.5	28.5	380	610	0.18
6.0	487	632			390	890							
7.5	207	876			390	890							
10.5	328	2183			390	890							
12.0	689	930			390	890							
13.5	255	1331			390	890							
15.0	310	787			390	890							
16.5	784	705			390	890	380	610					
18.0	199	599					380	610					
19.5	379	567					380	610					
21.0	380	640					380	610					
22.5	492	521					380	610					
24.0	639	465					380	610					
25.5	225	1254					380	610					
27.0	862	631					380	610					
28.5	408	659					380	610					

Exisitng USGS borehole location. SMA located in the building in the background.


GATE
GATE
BORING
B-1
WATER TANKS
BLDG
SUN SHADE
USGS
STRONG MOTION
ACCELEROGRAPH
GATE
LEGEND
FENCE
Project # 1284
Date Sep 14,2001
Developed by A JACK
Drawn by T RODRIGUEZ
Approved by
File
SITE MAP
PARACHUTE TEST SITE BLDG 5000
BOREHOLE B-1
ROSRINE 5B
SITE INVESTIGATIONS
PREPARED FOR
UNIV OF SOUTHERN CALIFORNIA

Appendix I: Detailed Results for IMB Almaden (Santa Teresa Hills) Site

ROSRINE 5b –IBM Almaden (Santa Teresa Hills)

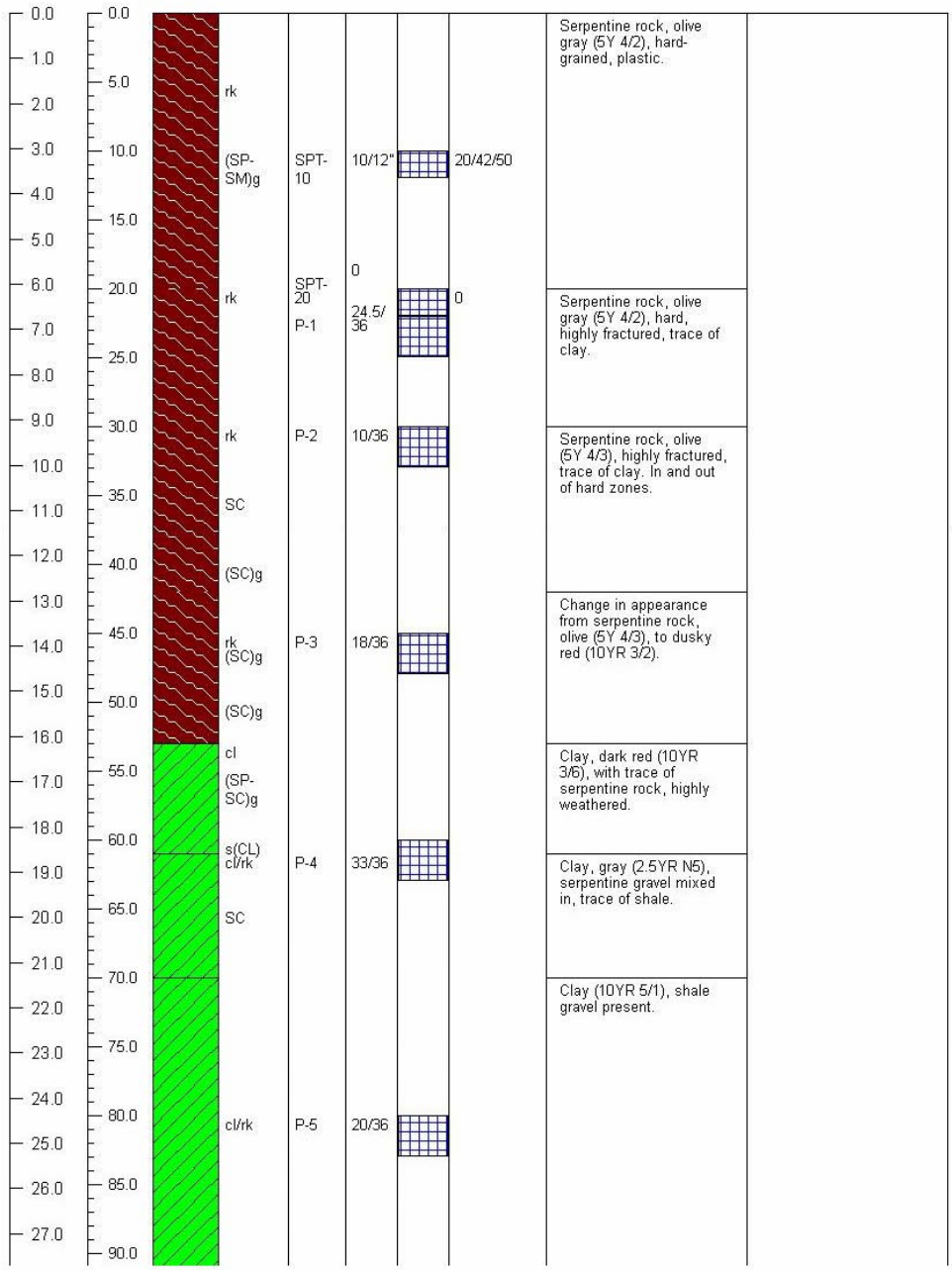
Rosrine ResOlution of Site Response Issues from the Northridge Earthquake

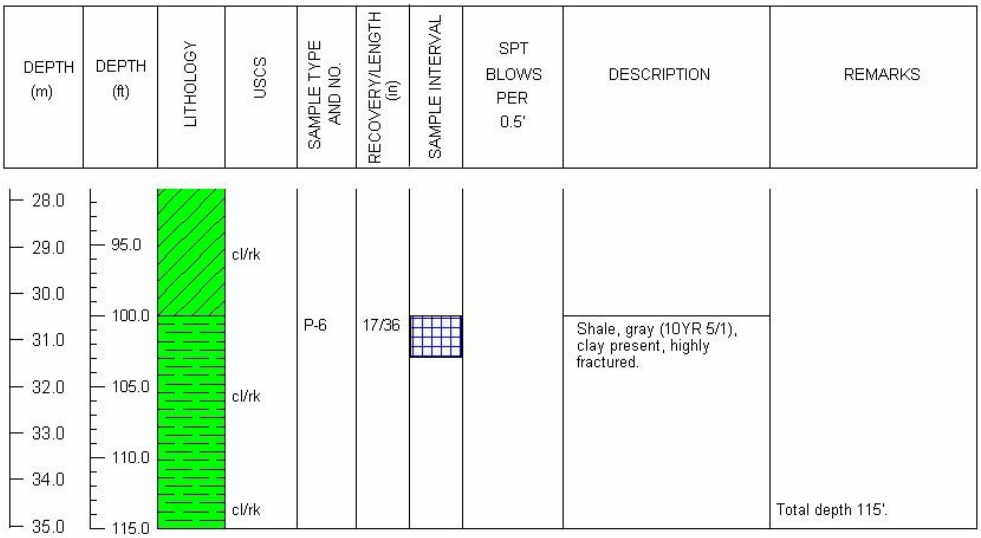
Boring Log

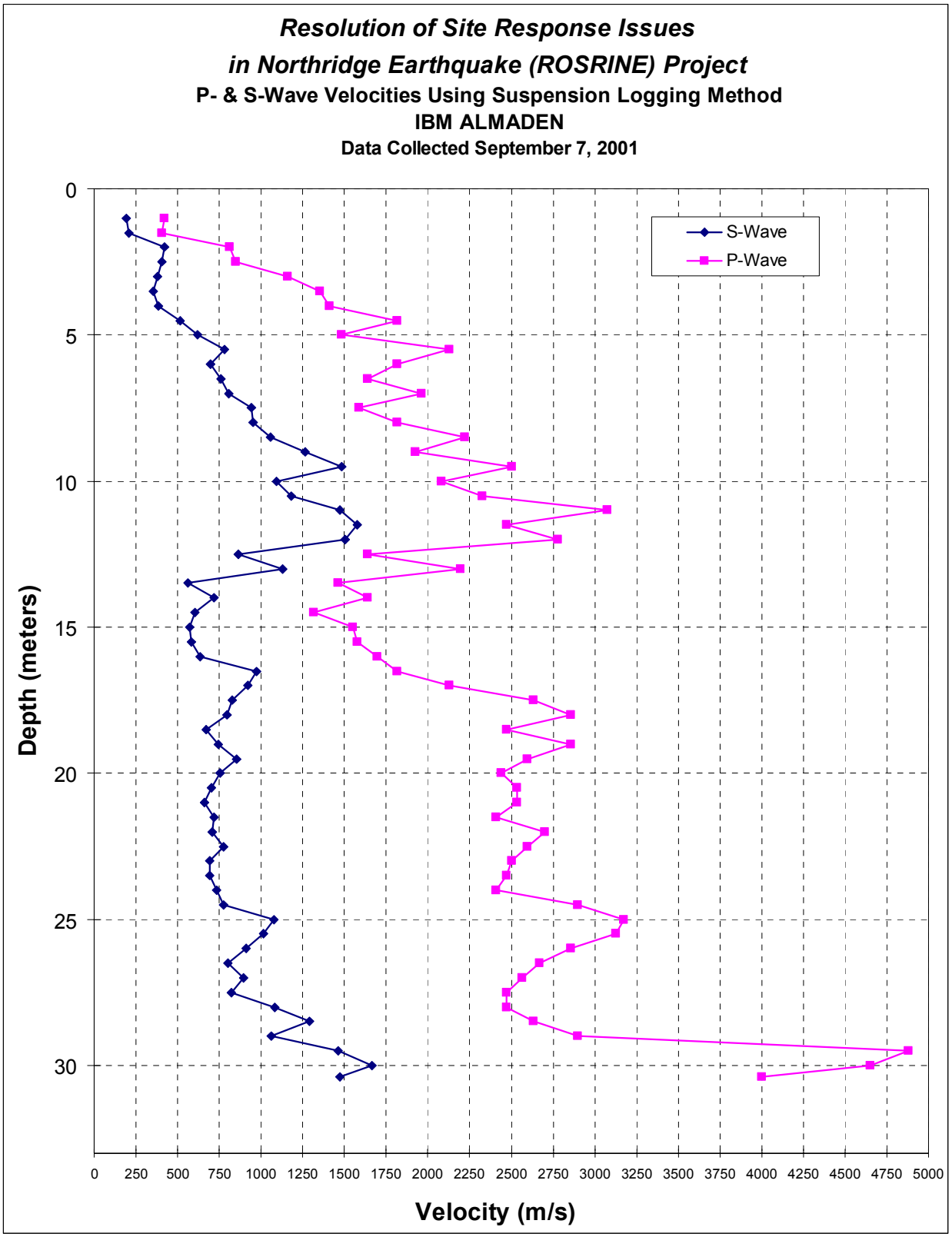
PROJECT: ROSRINE 5b
SITE LOCATION: IBM Almaden
DIST/COUNTY/RTE/PM: Santa Clara
EA: n/a
BRIDGE NO: n/a
STA/OFFSET: n/a
BORING NO: B-2

DRILLING CONTRACTOR: Pitcher Drilling
DATES DRILLED: 09/06/2001 - 09/07/2001
DRILLING METHOD: Mud Rotary
HOLE DIAMETER (mm): 149.22
TOTAL DEPTH (m): 34.8
DRILL RIG MODEL/NO: Failing F-10
SPT HAMMER: Acker 140 lb

DATUM: NAD27
LATITUDE: 37.206
LONGITUDE: -121.824
ELEVATION: 300 ft.
LOGGED BY: A. Jack
ORGANIZATION: GeoVision
ENTERED BY: J. Swift DATE: 09/12/2001
CHECKED BY: R. Nigbor DATE: 09/17/2001




DEPTH (m)
DEPTH (ft)
LITHOLOGY
USCS
SAMPLE TYPE AND NO.
RECOVERY/LENGTH (in)
SAMPLE INTERVAL
SPT BLOWS PER 0.5'
DESCRIPTION
REMARKS
28.0
29.0
30.0
31.0
32.0
33.0
34.0
35.0
95.0
100.0
105.0
110.0
115.0
cl/rk
cl/rk
cl/rk
P-6
17/36
Shale, gray (10YR 5/1), clay present, highly fractured.
Total depth 115'.


Resolution of Site Response Issues
in Northridge Earthquake (ROSRINE) Project
P- & S-Wave Velocities Using Suspension Logging Method
IBM ALMADEN
Data Collected September 7, 2001
S-Wave
P-Wave
Depth (meters)
0
5
10
15
20
25
30
0 250 500 750 1000 1250 1500 1750 2000 2250 2500 2750 3000 3250 3500 3750 4000 4250 4500 4750 5000
Velocity (m/s)

IBM Almaden

Depth (meters)	Vs (meters/sec)	Vp (meters/sec)
1.0	190	422
1.5	206	407
2.0	424	813
2.5	405	847
3.0	377	1163
3.5	353	1351
4.0	388	1408
4.5	515	1818
5.0	617	1481
5.5	778	2128
6.0	697	1818
6.5	758	1639
7.0	806	1961
7.5	943	1587
8.0	952	1818
8.5	1058	2222
9.0	1266	1923
9.5	1481	2500
10.0	1093	2083
10.5	1183	2326
11.0	1471	3077
11.5	1575	2469
12.0	1504	2778
12.5	862	1639
13.0	1130	2198
13.5	560	1460
14.0	719	1639
14.5	606	1316
15.0	570	1550
15.5	583	1575
16.0	637	1695
16.5	971	1818
17.0	922	2128
17.5	826	2632
18.0	794	2857
18.5	673	2469
19.0	746	2857
19.5	855	2597
20.0	755	2439
20.5	702	2532
21.0	660	2532
21.5	717	2410
22.0	709	2703
22.5	775	2597
23.0	692	2500
23.5	690	2469
24.0	735	2410
24.5	775	2899
25.0	1075	3175

Depth (meters)	**Vs (meters/sec)**	**Vp (meters/sec)**
25.5	1015	3125
26.0	909	2857
26.5	800	2667
27.0	897	2564
27.5	820	2469
28.0	1081	2469
28.5	1290	2632
29.0	1064	2899
29.5	1460	4878
30.0	1667	4651
30.4	1471	4000

ROSRINE 5b

Index Property Testing of Soil Samples

From Teratest Labs' Report, October 2, 2001

J. Swift, 10/20/2001

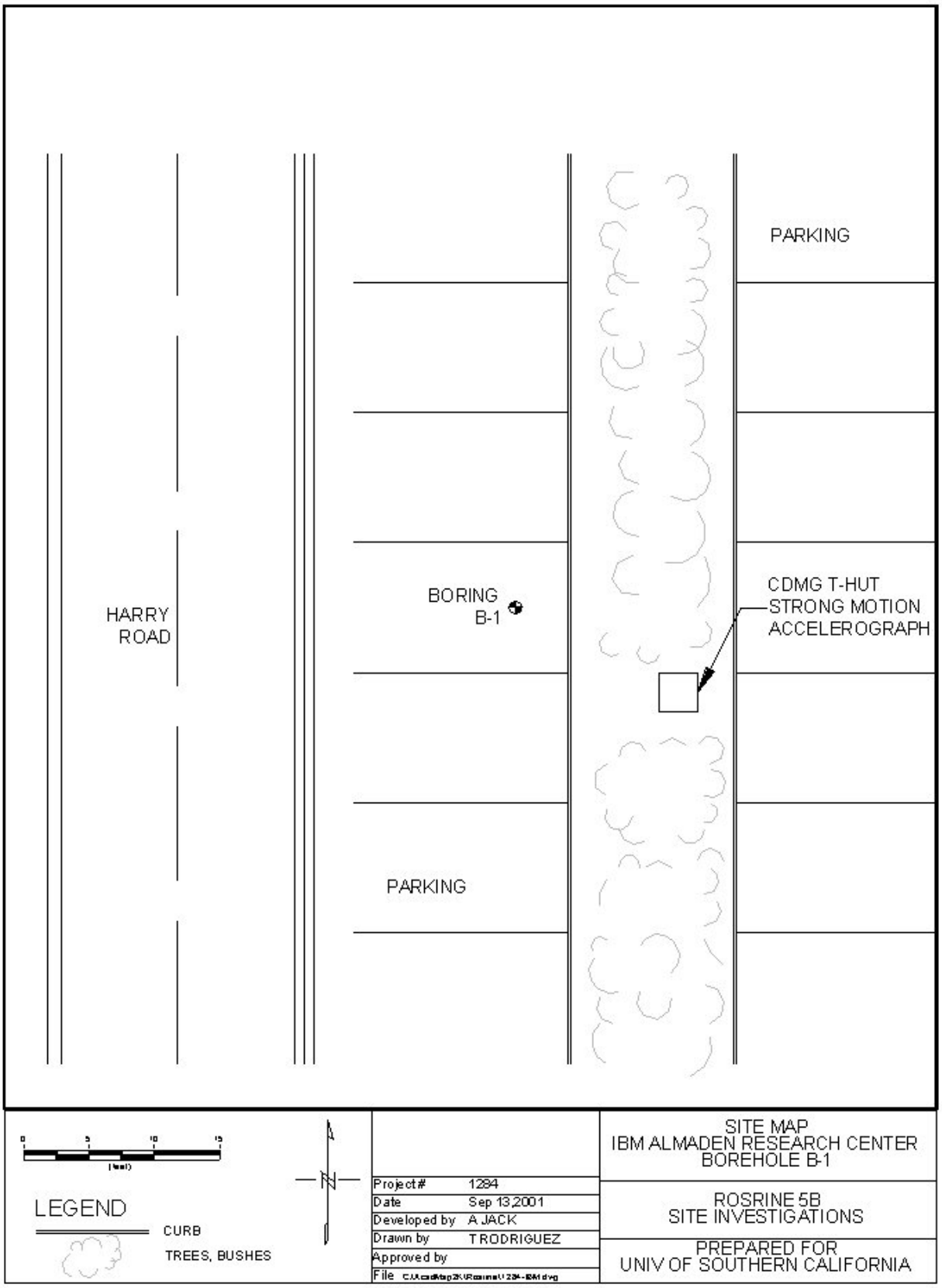
IBM Almaden

Sample	Depth, ft (range: # to #)		Depth, m (range: # to #)		Visual Classification	Soil Class	D50 (mm)	Dry Density (pcf)	Moisture Content (%)	LL	PL	PI
SPT 10	10	12	3.0	3.7	n/a	(SP-SM)g	1.7	101.7	22.7	n/a	n/a	n/a
Grab Sample 35	35	35	10.7	10.7	n/a	SC	1.0	n/a	n/a	24	16	8
Grab Sample 40	40	40	12.2	12.2	n/a	(SC)g	1.8	n/a	n/a	25	16	9
Grab Sample 45	45	45	13.7	13.7	n/a	(SC)g	1.5	n/a	n/a	31	20	11
Grab Sample 50	50	50	15.2	15.2	n/a	(SC)g	0.4	n/a	n/a	36	23	13
Grab Sample 55	55	55	16.8	16.8	n/a	(SP-SC)g	1.15	n/a	n/a	33	22	11
Grab Sample 60	60	60	18.3	18.3	n/a	s(CL)	n/a	n/a	n/a	45	18	27
Grab Sample 65	65	65	19.8	19.8	n/a	SC	1.0	n/a	n/a	41	17	24

Drill site of IBM Almaden site looking Northeast.

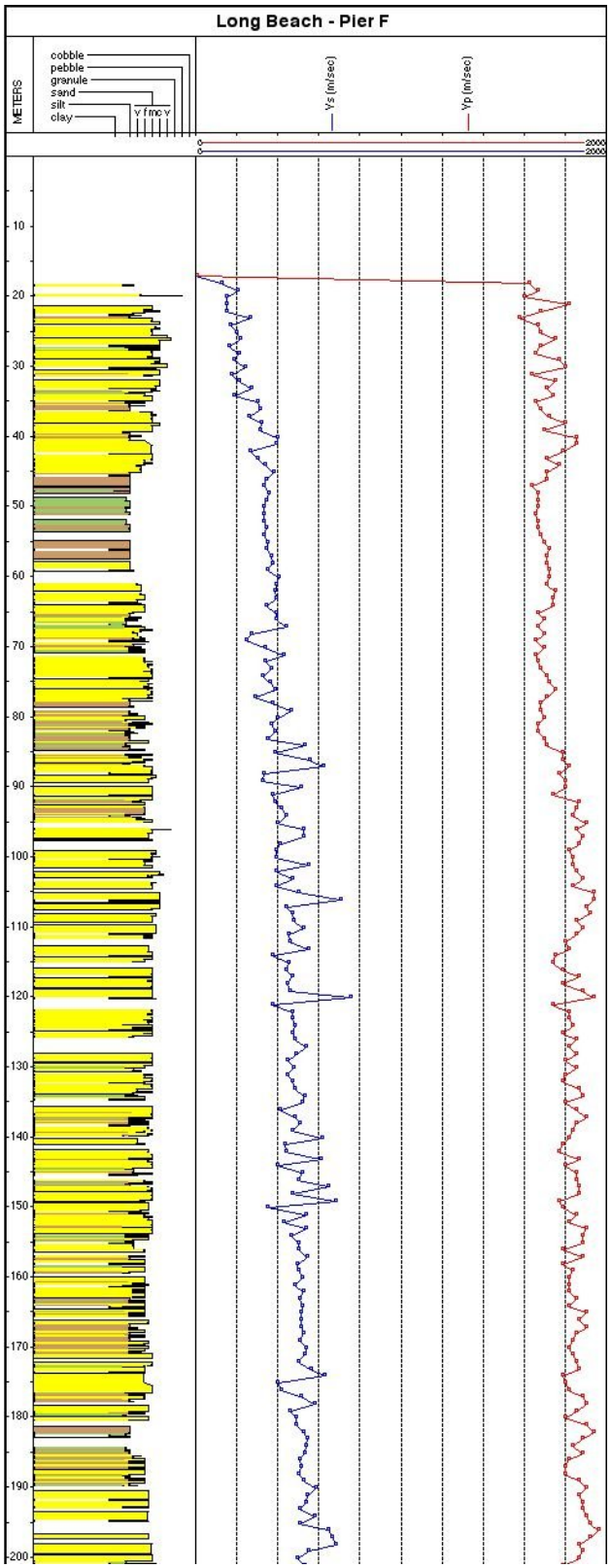
Drilling activities.

View of the drill site and T-Box containing seismograph.

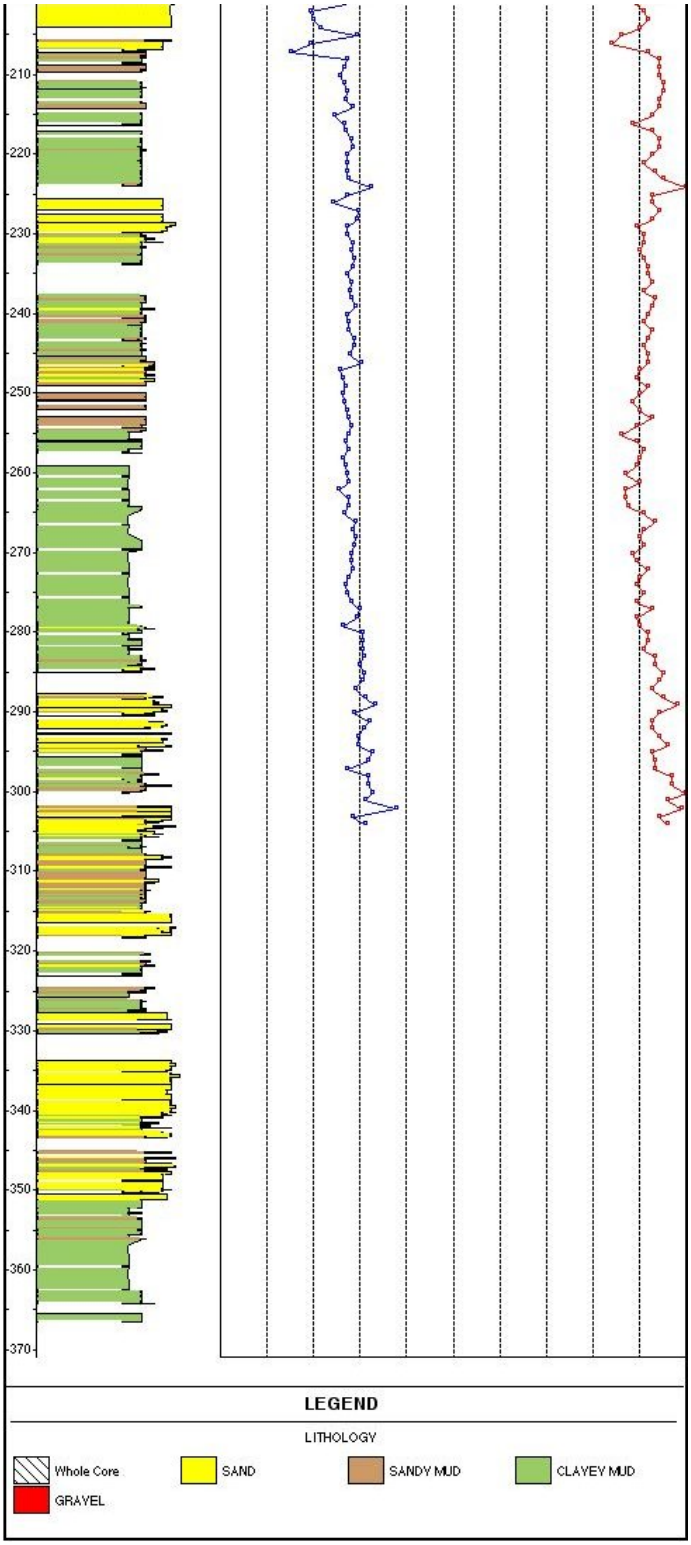

PARKING
HARRY
ROAD
BORING
B-1
CDMG T-HUT
STRONG MOTION
ACCELEROGRAPH
PARKING
LEGEND
CURB
TREES, BUSHES
Project# 1284
Date Sep 13,2001
Developed by A JACK
Drawn by TRODRIGUEZ
Approved by
File
SITE MAP
IBM ALMADEN RESEARCH CENTER
BOREHOLE B-1
ROSRINE 5B
SITE INVESTIGATIONS
PREPARED FOR
UNIV OF SOUTHERN CALIFORNIA

Appendix J: Detailed Results for Pier F Long Beach Site

ROSRINE 5b – Pier F Long Beach



(Preliminary Pier F Boring Log, by D. Ponti, USGS.
Finalized Log will be published in the near future in a USGS Open File Report)


210
220
230
240
250
260
270
280
290
300
310
320
330
340
350
360
370
LEGEND
LITHOLOGY
Whole Core
SAND
SANDY MUD
CLAYEY MUD
GRAVEL

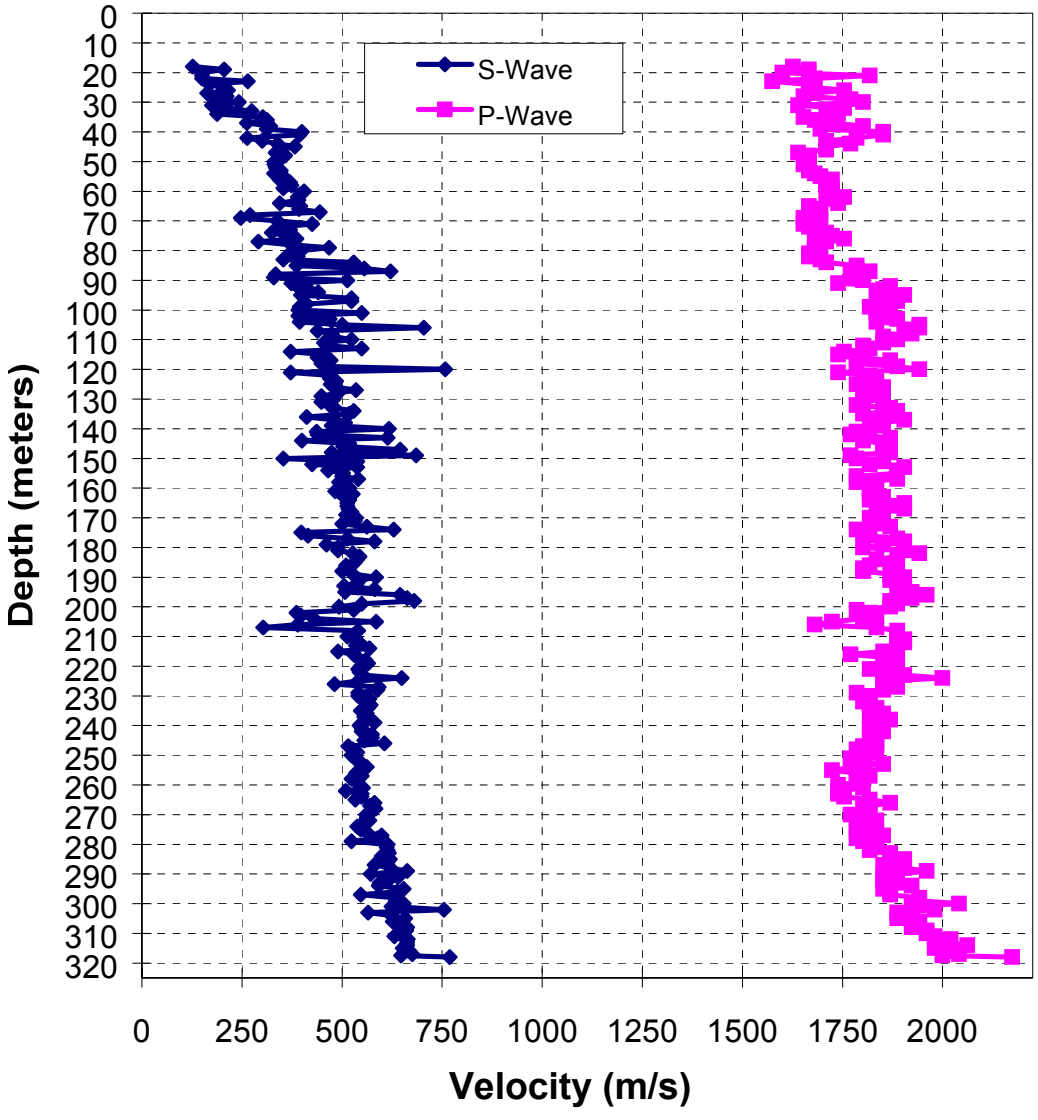
Resolution of Site Response Issues

in Northridge Earthquake (ROSRINE) Project

P- & S-Wave Velocities Using Suspension Logging Method

PIER F LONG BEACH

Data Collected October 4, 2001



Pier F Long Beach

Depth (meters)	Vs (meters/sec)	Vp (meters/sec)
18	127.389	1626.017
19	205.128	1666.667
20	149.813	1600
21	150.376	1818.181
22	150.376	1680.672
23	264.901	1574.803
24	168.776	1666.667
25	202.02	1680.673
26	215.054	1754.385
27	163.265	1680.672
28	211.64	1652.892
29	186.047	1769.911
30	242.424	1801.802
31	174.673	1639.344
32	212.766	1754.385
33	273.973	1709.402
34	187.793	1739.131
35	302.115	1652.892
36	312.5	1680.673
37	262.467	1724.137
38	320.513	1801.801
39	311.526	1694.915
40	400	1851.852
41	393.701	1851.852
42	263.158	1785.714
43	300.3	1709.402
44	338.983	1769.911
45	381.679	1709.402
46	343.643	1709.402
47	334.448	1639.344
48	358.423	1666.666
49	347.222	1666.666
50	331.126	1666.667
51	331.126	1652.892
52	334.448	1666.667
53	347.222	1666.667
54	330.033	1680.672
55	353.357	1694.916
56	343.643	1724.138
57	370.37	1709.402
58	373.134	1709.402
59	353.357	1724.138
60	404.858	1724.138
61	395.257	1709.402
62	389.105	1754.385
63	390.625	1739.13
64	344.828	1739.131
65	395.257	1666.667

Depth (meters)	Vs (meters/sec)	Vp (meters/sec)
66	392.157	1694.916
67	444.444	1666.667
68	270.27	1694.915
69	246.914	1652.892
70	337.838	1694.915
71	425.532	1652.892
72	341.297	1666.667
73	370.37	1680.673
74	324.675	1709.403
75	359.712	1724.138
76	386.1	1754.385
77	290.698	1709.402
78	373.134	1680.673
79	467.29	1680.672
80	398.406	1694.915
81	369.004	1666.667
82	389.105	1666.667
83	353.357	1694.915
84	529.101	1709.402
85	386.1	1785.714
86	555.556	1785.714
87	621.118	1818.181
88	334.448	1769.911
89	328.947	1801.801
90	512.821	1801.801
91	373.134	1739.13
92	387.597	1869.159
93	416.667	1851.852
94	440.529	1834.862
95	396.825	1904.762
96	523.56	1851.852
97	523.56	1886.793
98	411.523	1869.159
99	393.701	1818.181
100	390.625	1834.862
101	549.451	1834.864
102	390.625	1851.852
103	469.484	1886.792
104	393.701	1834.862
105	500	1941.748
106	704.225	1941.748
107	438.597	1904.763
108	473.934	1923.077
109	478.469	1851.852
110	523.56	1886.793
111	454.546	1851.852
112	460.829	1801.802
113	549.451	1818.181
114	371.747	1754.387

Depth (meters)	Vs (meters/sec)	Vp (meters/sec)
115	454.546	1739.13
116	438.597	1785.714
117	471.698	1869.158
118	448.43	1785.714
119	458.716	1886.793
120	757.576	1941.746
121	371.747	1739.131
122	469.484	1818.181
123	469.483	1818.183
124	485.437	1834.862
125	471.698	1785.713
126	485.437	1851.852
127	534.759	1818.181
128	490.196	1851.852
129	448.43	1801.802
130	478.469	1851.852
131	448.43	1801.802
132	469.484	1785.714
133	480.769	1869.159
134	529.1	1886.793
135	518.135	1801.802
136	411.523	1851.852
137	480.769	1904.762
138	507.614	1851.852
139	473.934	1834.862
140	617.284	1818.181
141	436.681	1785.714
142	438.597	1769.913
143	613.497	1869.159
144	400	1801.802
145	518.135	1851.852
146	502.513	1851.852
147	645.161	1869.159
148	473.934	1869.158
149	684.932	1769.911
150	353.357	1785.714
151	537.635	1851.852
152	425.532	1818.181
153	537.634	1904.763
154	465.116	1886.793
155	502.513	1886.792
156	500	1785.714
157	540.541	1886.793
158	492.611	1785.714
159	500	1834.864
160	518.135	1818.183
161	483.092	1818.181
162	526.316	1818.183
163	505.051	1851.852

Depth (meters)	Vs (meters/sec)	Vp (meters/sec)
164	518.135	1818.183
165	512.82	1904.763
166	512.821	1869.159
167	515.464	1904.762
168	523.56	1851.852
169	510.204	1834.862
170	534.759	1818.181
171	531.915	1834.862
172	500	1851.852
173	561.798	1869.158
174	628.931	1785.714
175	398.406	1801.801
176	414.938	1818.181
177	512.82	1886.793
178	581.395	1904.762
179	460.829	1851.852
180	490.196	1801.802
181	490.196	1904.762
182	526.316	1941.748
183	543.478	1886.793
184	537.634	1834.862
185	531.915	1886.793
186	510.204	1818.181
187	515.464	1801.802
188	500	1801.802
189	526.316	1869.159
190	584.795	1904.762
191	543.478	1869.159
192	537.635	1886.792
193	505.051	1886.792
194	581.395	1904.762
195	507.614	1923.077
196	645.161	1960.783
197	662.252	1923.077
198	680.272	1869.159
199	549.451	1886.793
200	492.611	1869.158
201	529.1	1785.714
202	386.1	1818.183
203	396.826	1834.862
204	429.185	1801.801
205	584.795	1724.138
206	389.105	1680.673
207	303.03	1834.862
208	540.54	1886.793
209	531.915	1886.793
210	512.82	1886.792
211	531.915	1904.762
212	543.478	1904.762

Depth (meters)	Vs (meters/sec)	Vp (meters/sec)
213	534.759	1886.793
214	568.182	1886.792
215	490.196	1851.852
216	529.101	1769.911
217	537.634	1851.85
218	558.659	1886.792
219	564.972	1886.792
220	546.448	1851.852
221	540.541	1818.181
222	543.478	1869.159
223	552.486	1904.762
224	649.351	2000.002
225	540.541	1851.852
226	480.769	1851.852
227	591.716	1886.793
228	588.235	1851.852
229	540.541	1785.714
230	540.54	1818.183
231	568.182	1818.181
232	558.659	1801.802
233	571.429	1818.183
234	564.972	1834.862
235	546.448	1834.862
236	561.798	1851.852
237	555.556	1818.181
238	561.798	1869.158
239	581.395	1851.852
240	543.478	1834.862
241	549.451	1818.183
242	549.451	1851.852
243	574.713	1834.862
244	574.713	1818.181
245	555.555	1834.862
246	606.06	1834.862
247	515.464	1801.802
248	526.316	1785.714
249	537.635	1834.864
250	523.56	1801.802
251	531.915	1769.911
252	543.478	1801.802
253	549.451	1851.852
254	561.798	1785.714
255	549.451	1724.138
256	534.76	1785.713
257	549.451	1818.183
258	523.56	1801.801
259	537.635	1785.713
260	543.478	1739.13
261	552.486	1801.802

Depth (meters)	Vs (meters/sec)	Vp (meters/sec)
262	508.906	1739.131
263	549.451	1739.131
264	547.945	1754.387
265	533.333	1818.181
266	581.395	1869.161
267	569.801	1818.183
268	583.09	1801.802
269	573.066	1818.181
270	560.224	1769.911
271	561.798	1785.714
272	568.182	1834.862
273	550.964	1801.802
274	537.634	1785.714
275	546.448	1818.181
276	561.798	1785.714
277	598.802	1851.852
278	588.235	1785.714
279	523.56	1801.801
280	613.497	1834.862
281	611.621	1834.862
282	613.497	1818.181
283	617.284	1869.158
284	598.802	1869.158
285	619.195	1904.762
286	613.497	1886.792
287	581.395	1851.852
288	621.118	1904.762
289	662.252	1960.783
290	571.429	1886.793
291	638.978	1851.852
292	617.284	1851.852
293	593.472	1886.792
294	591.716	1923.077
295	653.595	1851.852
296	636.943	1869.159
297	546.448	1869.159
298	634.921	1941.748
299	634.921	1941.748
300	653.594	2040.815
301	623.053	1923.077
302	754.717	1980.198
303	564.972	1886.793
304	623.053	1923.077
305	657.895	1886.792
306	626.959	1941.748
307	638.978	1941.746
308	662.252	1923.077
309	660.066	1960.785
310	643.087	1960.785

Depth (meters)	**Vs (meters/sec)**	**Vp (meters/sec)**
311	630.915	1980.198
312	664.452	2020.203
313	662.252	2000
314	662.252	2061.855
315	651.466	1980.199
316	668.896	2020.203
317	675.676	2040.815
317.5	647.249	2000
318	769.231	2173.913