Western Laboratories
Geotechnical Engineering

GEOTECHNICAL ENGINEERING REPORT

PROPOSED SINGLE FAMILY RESIDENCE
1514 SILVER STREET
HERMOSA BEACH, CALIFORNIA

AUGUST 17, 2015

WORK ORDER 15-4561

PREPARED FOR:

MR. LARRY MATHEWSON
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MR. LARRY MATHEWSON
1514 Silver Street
Hermosa Beach, California 90254

Subject: Geotechnical Exploration
Proposed Single Family Residence
1514 Silver Street
Hermosa Beach, California

Dear Sir:

Pursuant to your authorization to provide geotechnical engineering consulting services for the above referenced project, the accompanying Geotechnical Engineering Report has been prepared.

Based upon the subsurface conditions that were encountered during our exploration, it is our conclusion that the proposed single family residence is feasible from a geotechnical engineering standpoint, provided the recommendations contained herein are incorporated into project planning, design, and construction.

The contents in this report should be reviewed in detail and be made a portion of the project design package. Please contact this office if any questions arise regarding the contents of this report.

Respectfully submitted,

WESTERN LABORATORIES

Edward Castellanos
GE 191

REGISTERED PROFESSIONAL ENGINEER
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GEOTECHNICAL
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Introduction

This report presents the results of our geotechnical exploration performed for a proposed single family residence to be constructed at 1514 Silver Street, in the City of Hermosa Beach, California. Our exploration was limited due to the presence of existing site improvements.

It is proposed to demolish the existing residence and associated improvements and construct a two-story split-level single family residence with a tuck-under garage on the subject property. It is anticipated that masonry block or poured in-place concrete will be used in construction of the semi-subterranean walls of the proposed garage, and that timber and stucco will be used for the exterior walls to be constructed above grade of the proposed residence.

Purpose and Scope of Work

The purpose of our exploration was to evaluate the subsurface soil conditions at the site to provide geotechnical engineering recommendations for design and construction of the proposed single family residence. Our work was conducted in accordance with generally accepted geotechnical engineering principles and practices at this time and location. The scope of our services included: a review of selected geologic maps of the area, a field examination of the site, subsurface exploration by two hand auger borings, soil classification, laboratory testing on selected samples encountered, and analyzing the results of the field and laboratory work to provide the geotechnical design information contained herein.

Site Description

The subject site is a rectangular shaped parcel, approximately 3000 square feet in size and is improved with a one story single family residence with a detached garage at the rear of the site. In addition to the subject residence, the property is improved with a driveway located adjacent to the north property line, flatwork areas, block walls, wood fencing and associated lawn and landscape areas. The property is bordered on the west by Silver Street, on the east by Harper Avenue, and on the north and south sides by existing residential developments. Site topography is comprised of a relatively level pad area off of Silver Street on the west side and then gradually slopes down to Harper Avenue on the east side with a difference in elevation of approximately 12 feet. Surface drainage appears to be accommodated by sheet flow.

Field Exploration

The subsurface conditions were explored by drilling two (2), 4" diameter exploratory borings using hand-auger sampling techniques at the locations depicted on the attached Plot Plan. The borings were logged by our field representative and disturbed and relatively undisturbed samples were obtained for laboratory testing and analysis.

Descriptions of the materials encountered in our borings are presented on the logs in Appendix A. The logs depict subsurface conditions on the dates shown on the logs at the approximate locations shown on the Plot Plan. Subsurface conditions may differ across the site from the conditions encountered in our borings.

Penetration Tests were performed in the field by driving a 2-inch outside diameter, 1⅜-inch constant inside diameter split-barrel sampler into in-situ soil to obtain a measure of the resistance of the soil to the penetration of the sampler using a 32-lb. hand-raised slide hammer with a 30-inch drop. The sampler was driven to 18". The reported data on the boring logs are the approximate number of blows (correlated "N" value per the Foundation Engineering Handbook) equivalent from driving the sampler 1.0 foot from a 140-pound hammer with a 30-inch drop.

Bulk and relatively undisturbed soil samples were obtained at depths appropriate to the exploration. Relatively undisturbed ring samples were obtained from the borings using a soil sampler. The California Drive sampler utilized in our exploration consisted of a 3-inch outside diameter drive barrel lined with 1-inch brass rings with an inside diameter of approximately 2.4 inches. The bottom portion of the ring samples were retained for testing. All samples were carefully sealed in moisture-resistant containers, labeled, logged and transported to our laboratory. Penetration samples and relatively undisturbed ring samples served as the basis for the laboratory testing and engineering conclusions contained in this report.

A brief description of the laboratory tests performed along with the test results are included in Appendix B, or shown on the logs.

Subsurface Conditions

Disturbed top soils were encountered in both of our borings to approximately 2.0 feet below ground surface (bgs). These soils are comprised of loose, moist, silty sands with rootlets.

The native soils encountered beneath the upper low density soils are comprised of medium dense, moist, silty sands, underlain by layers of medium dense, moist, clayey and poorly graded sands.

Groundwater

Groundwater seepage was not encountered in our field exploration work to the maximum depths explored of approximately 13.5 feet. The historically highest groundwater depth recorded within the vicinity of the site is estimated to be approximately ten (10) feet below ground surface.

The above estimate was derived in part by using, Plate 1.2 of the "Seismic Hazard Zone Report (031) For The Redondo Beach 7.5-Minute Quadrangle, Los Angeles County, California," 1998, with updates through 01/17/2006, from the California Geologic Survey's (CGS) website.

Fluctuation of the groundwater level at the site could occur due to variations in precipitation patterns, runoff, irrigation, basin management and other numerous factors.

Faulting and Seismicity

The subject site is located in an area of high regional seismicity and is likely to be subjected to strong ground shaking during the life of the project from nearby and distant faults, which is characteristic of all Southern California. There are no known active or potentially active faults shown on reviewed published maps as crossing, or projected to the property. No Earthquake Fault Zones have been identified at the site. Therefore, the potential for surface rupture on the subject site is considered to be low. However, it should be recognized that recent earthquakes have resulted in surface rupture where no faults had been previously mapped.

Liquefaction Potential and Earthquake-Induced Landslides

This office has reviewed the Seismic Hazard Zones Official Map of the Redondo Beach Quadrangle prepared by the State of California, Department of Conservation, Division of Mines and Geology (CDMG) Released: 03/25/1999.

The purpose of this map is to delineate areas that may be subject to liquefaction and/or landsliding during a strong seismic event. Based on this map, the property is <u>not</u> located within an area of study for liquefaction potential <u>or</u> earthquake-induced landsliding.

The design and construction of the proposed residence in conformance with current building codes and engineering practices for earthquake design is expected to provide mitigation of liquefaction potential hazards that can occur in Southern California.

Lateral Spreading

Lateral spreading is generally caused by liquefaction of soils along continuous planes or layers at depth within gentle slopes. As liquefaction is considered unlikely to occur, we judge that there is little risk of lateral spreading caused by an earthquake.

Seismic Information

The following table summarizes site-specific design criteria obtained from the 2013 California Building Code (CBC) and the American Society of Civil Engineers (ASCE) 7-10. The data was calculated using the U.S. Seismic Design Maps web application provided by the United States Geologic Survey (USGS) and site coordinates: latitude 33.8671° and longitude -118.3878°.

Parameter		Design Value
Site Class		D
0.2-second Period Mapped Spectral Acceleration	S_s	1.62g
1-second Period Mapped Spectral Acceleration	S_1	0.61g
Short-Period Site Coefficient	F_A	1.0
Long-Period Site Coefficient	F_V	1.5
0.2-second Period, Maximum Considered Earthquake Spectral Response Acceleration	S_{MS}	1.62g
1-second Period, Maximum Considered Earthquake Spectral Response Acceleration	S_{M1}	0.92g
0.2-second Period, Design Earthquake Spectral Response Acceleration	S_{DS}	1.08g
1-second Period, Design Earthquake Spectral Response Acceleration	S_{D1}	0.613g

The seismic design category for the site was determined to be D.

It should be noted that conformance with the criteria listed above for structural seismic design does not constitute any kind of warranty or assurance that significant structural damage or permanent ground displacement will not occur if a maximum level seismic event occurs. The primary goal of seismic design is to protect life and limb, and catastrophic failure, and not to avoid all damage, since such design may be economically prohibitive.

Any proposed retaining wall supporting more than six (6) feet of backfill height should comply with Section 1803.5.12 of the 2013 CBC. Calculations for the seismic component for the design of the retaining wall as set forth by the City of Los Angeles "Seismic Lateral Earth Pressures on Basement and Retaining Walls" dated 07/16/2014, which states: "For the PGA corresponding to one-half of two-thirds of the PGA_M, dynamic seismic lateral earth pressures on retaining walls shall be determined." A minimum safety factor of 1.0 is required. The calculation is presented below:

PGA_M = 1 x 0.622 = 0.622g from:
[http://earthquake.usgs.gov/designmaps/us/application.php]
(using the aforementioned site coordinates and Site Class D)

$_\Delta$Kae =2/6 x PGA_M = 0.622/3 = 0.207.
Therefore, $\mathbf{EFP_{seis}}$ = 0.207 x 111* = **23** pounds per cubic foot (pcf)
*(from our direct shear test DS-1 contained in Appendix B)

Therefore, for retaining walls supporting more than six (6) feet of backfill height, we recommend using EFP_{seis} of 23pcf for the seismic component of the retaining wall. An inverted triangular distribution should be used to apply this pressure.

Hydrocollapse Potential

The addition of water to the loaded consolidation test sample resulted in less than one percent soil collapse. Based upon this result, we judge that the potential for hydroconsolidation adversely affecting the proposed residence is low.

Conclusions and Recommendations

The proposed single family residence is considered to be feasible from a geotechnical engineering standpoint, subject to the conclusions and recommendations that follow.

Detailed recommendations to be utilized in the design and construction of the proposed residence are presented in the following sections of this report.

The recommendations provided in this report are based upon observations made in the field, the results of laboratory tests on samples of the materials encountered during the subsurface exploration, our engineering analyses, and the past experience of this office.

Notification of Governing Authorities

Site grading and construction should be performed in accordance with the City of Hermosa Beach Building Division and the rules and regulations of those governmental agencies having jurisdiction over the subject construction. Permits should be obtained, and inspections made by the proper authorities as required.

Prior to initiating grading operations, a meeting should be conducted at the site with the owner's representative, the grading contractor, the grading inspector or building official, and a representative of this company. The grading contractor is responsible to notify the required governmental agencies and the geotechnical engineer prior to initiating grading operations, and any time grading is resumed after an interruption.

Temporary Excavations

Any unsurcharged temporary excavation without shoring may be cut at a maximum slope of 1.25h:1v (horizontal to vertical) to a maximum height of 8.0 feet. A visual inspection should be performed during the excavation by a representative of this firm. If any signs of sloughing or lateral movement are observed, immediate measures for support should be implemented by the contractor. Temporary construction cut slopes are suitable for a short time duration, possibly only a few days for the soils encountered at the site. The slopes should be kept moist but not saturated.

No excavation shall be made that would remove lateral support of any off-site improvements. All excavations should conform to Cal-OSHA Standards. The contractor is solely responsible for site safety.

Shoring of vertical excavation walls should be provided where temporary slopes aren't feasible.

Shoring

Shoring is anticipated along portions of the north and south property lines in the vicinity of the proposed garage. The shoring system used should be designed by a registered civil engineer who is thoroughly familiar with design of shoring systems and their performance in the field. The design should accommodate support of adjacent soils, any off-site improvements, and safeguarding personnel.

Temporary shoring design may utilize an active earth pressure of 25 pcf without any surcharge due to equipment or structures.

Site Demolition

Demolition operations should include the removal of all of the buildings and structural features such as footings and slabs, along with abandoned utility lines and flatwork.

Site Plan Review & Discussion

Proposed foundations and slabs-on-grade should not transition from a condition where they are underlain by native soils to one where they are underlain by compacted/engineered fill soils (cut/fill transition).

Based on our review of a Site Plan, it appears that a cut will be made into the slope off of Harper Avenue for the proposed semi-subterranean garage. It is anticipated that the foundations for the proposed garage retaining walls will be founded into competent native soils. Therefore, it is recommended that all of the remaining foundations for the proposed residence should also be founded their recommended design depth into competent native soils.

Areas to receive concrete slabs-on-grade, should be graded in accordance with the recommendations contained under the following heading.

Site Grading and Compaction

Prior to commencing grading operations, all demolition debris including abandoned utility lines should be removed from the site. Any remaining vegetation and soils containing organic matter within the proposed grading area should be stripped and also removed from the site.

A diligent search for abandoned septic tanks, cesspools or underground lines should be performed during the grading operation.

The disturbed top soils encountered during our exploration are not suitable in their present condition for structural or slab support. This also includes soils disturbed during demolition and removal of old foundations and utility lines. These soils should be excavated to medium dense native soils throughout the building pad, extending a minimum horizontal distance of two (2) feet beyond the exterior building lines of the proposed structure.

The grading operation will be limited by the north and south property lines. Grading operations to be performed adjacent to these property lines having off-site improvements should be done with caution and may require the installation of temporary or permanent shoring, or by performing grading operations by slot cutting in alternate (8-ft. wide maximum) A-B-C sections.

The native soils exposed within the excavation bottoms should be observed and approved by a representative of WL. The exposed subgrade should be scarified to a minimum depth of six (6) inches, be moisture-conditioned as necessary (approximately 1% to 3%, as directed in the field) above optimum moisture content of the tested material, and be compacted to at least 90% of the corresponding laboratory maximum density test (ASTM D1557, latest version).

The excavated soils may be used for engineered fill provided they are free of deleterious debris such as wood and root structures, are moisture-conditioned as necessary (approximately 1% to 3%, as directed in the field) above optimum moisture of the tested material, are spread in 6 to 8 inch thick loose lifts, and are compacted to a minimum of 90% of the corresponding laboratory maximum density test (ASTM D1557, latest version), in accordance with the "General Specifications for Compacted Fill Soils."

Unstable subsurface conditions are sometimes encountered when grading operations are conducted when the ground is wet. If areas of unstable subgrade are encountered during grading operations, stabilization will be required prior to placement of fill soils, construction of slabs or foundations. Stabilization may entail adequately reducing the moisture of the exposed soils and placement of a stabilization layer that may be comprised of compacted base or crushed angular rock, geotextile fabrics or geogrid, etc. Unit prices should be obtained from the contractor in advance for this work.

The Geotechnical Engineer or his or her representative may require that additional shallow excavations be made periodically in the exposed bottom to determine whether sufficient removal has been made prior to replacement and compaction of fill material.

If import fill is required during the grading operation, the fill should be approved by the Geotechnical Engineer prior to transporting it to the site. Representative samples of soils planned to be imported to the site should be provided to the Geotechnical Engineer at least 48 hours before importing begins in order that they may be examined and evaluated as to their potential impact on project design and construction.

Utility Trenches

Backfill of utilities within right-of-ways should be placed in strict conformance with the requirements of the governing agencies.

Following placement of utility lines within private property, the space under and around the line (bedding and shading zone) should be backfilled with carefully compacted clean sand or approved granular soil, having a minimum Sand Equivalent value of 30, to approximately one (1) foot over the pipe. The bedding and shading may be uniformly jetted into place before the remainder of the backfill is placed. The jetting nozzle should not be withdrawn from one location until the water shows at the surface.

Backfill over the bedding and shading material should be mechanically compacted to at least 90% of the maximum density obtainable by the latest version of ASTM D1557 method. Jetting or flooding of the backfill should not be permitted.

Utility trench backfills should be observed and tested during backfill operations as the work progresses. If testing of a backfill is performed after completion, without observing the backfill operations, then only the test results at the test locations can be given, and no guarantee of the condition of the remaining backfill can be provided.

Spread Footing Foundations

Following completion of the grading operation and field density testing, the proposed split-level residence with a tuck-under garage should be supported on conventional continuous and isolated foundations excavated to minimum widths of 15 and 24 inches, respectively. Retaining wall foundations for the garage level should be founded a minimum of 12 inches into competent native soils. The widths of retaining wall foundations should be determined by the project Design Engineer.

As previously stated, all of the remaining foundations for the proposed residence should be founded their recommended design depth (18 inches) into medium dense native soils, so that all of the foundations for the entire structure are founded in the same like material (i.e. medium dense native soils), or approximately 3.5 feet bgs. This is based on the upper two (2) feet of disturbed top soils being removed and compacted for slab support during the aforementioned site grading. Continuous and isolated foundations having the preceding minimum dimensions should be designed utilizing allowable bearing pressures of 2000 pounds per square foot (psf) and 2500 psf, respectively. These bearing pressures reflect a reasonable reduction in order to limit potential static settlements to tolerable values.

The proposed structure should be designed to accommodate total foundation settlement due to structural loadings on the order of approximately 1 inch, and differential settlements of approximately 0.5 inch along a 30-ft. span of continuous footings. These estimates are based upon the foundations being designed and constructed in accordance with the recommendations contained in this report. Most of the total settlement is expected to occur upon load application.

Resistance to lateral loadings may be provided by a combination of passive pressure on the footing walls and friction acting on the base of the footings that are in contact with medium dense native soils. Passive earth pressure should be computed as an equivalent fluid unit weight of 290 pounds per cubic foot (pcf), to a maximum value of 3000 psf. A coefficient of friction of 0.4 may be applied to dead load forces for the sliding resistance calculation.

The allowable soil pressures may be increased one-third for combinations of vertical and horizontal wind or seismic forces where permitted by the latest edition of the CBC.

Excavations for proposed foundations should be stepped as necessary to produce level bottoms. Foundations should be deepened to provide a minimum of H/3 feet of horizontal confinement between the bottom outside edge of the foundation and the face of the nearest slope, where H equals the overall height of the slope. The foundation setback should be a minimum of eight (8) feet.

All foundations within the influence zone of underground lines or associated backfills, shall be deepened below a 1h:1v plane projected from the invert of the underground line or the native soil/backfill contact to ground surface. Also, for adjacent footings constructed at different levels, the bottom of the deeper footing should be below a 1h:1v line drawn down from the bottom of the shallower footing.

Foundations perpendicular to the rear garage retaining wall should be stepped down through the backfill soils into competent native soils as they approach the retaining wall. Alternatively, foundations perpendicular to the rear garage retaining wall may be designed as a grade beam and be structurally connected to the wall, as long as the retaining wall is designed for the additional loads.

The soils encountered in our exploratory borings are considered to be non-expansive. Therefore, no special recommendations relative to expansive soils are presented regarding footing reinforcement. Structural requirements will include reinforcement.

Foundation excavations should be observed by a representative of this company prior to the placement of reinforcing steel to verify uniform soil conditions and conformance with the recommendations in this report.

Slabs-on-Grade

The upper on-site soils are considered to be non-expansive. Therefore, no special recommendations relative to expansive soils are presented regarding reinforcement of slabs. Structural requirements will include reinforcement and should govern the design. However, it is recommended that the minimum slab thickness be 4 inches.

Slabs should be underlain with a capillary moisture break consisting of a minimum of 4 inches of clean sand and an impermeable membrane moisture vapor barrier (10 mil polyethylene or equivalent). The membrane should be encased within the sand layer to protect it during construction.

Shrinkage cracks in floor slabs during curing are very common and are independent of the underlying soil characteristics. As concrete loses moisture, it shrinks in dimension. The occurrence of shrinkage cracks can be reduced and/or controlled by limiting the slump of the concrete, properly placing and curing concrete in accordance with the American Concrete Institute (ACI) recommended practices, and by placing crack control joints spaced at a maximum distance of 12.0 feet in each direction. The control joints should be cut to a depth equivalent to ¼ of the thickness of the slab. Reinforcement is intended to reduce, not stop cracking, and its proper positioning within the concrete section is critical to the overall performance of the slab.

Retaining Structures

Cantilever retaining structures constructed at the site should be designed to resist active lateral earth pressures. Unrestrained retaining structures should be designed to resist pressures calculated using Equivalent-Fluid unit weights presented in the table below.

Surface Slope of Retained Material (Horizontal to Vertical)	Equivalent-Fluid Unit Weight (Lbs./Cu.Ft.)
Level	36
2 to 1	48

Seismic design of walls supporting more than six (6) feet in backfill height should be based on an (EFP_{seis}) of 23 pcf, as previously mentioned under the "Seismic Information" heading of this report.

Retaining walls that are restrained from horizontal movement should be designed using an equivalent fluid pressure of 54 pcf.

Retaining structures should also be designed to accommodate any surcharge load that may be imposed by construction equipment, stockpiled materials, parked or traveling vehicles, existing or proposed structures on adjacent properties, etc.

Retaining walls should be supported on a continuous foundation system designed in conformance with the recommendations presented in the preceding portions of this report.

Retaining walls should be waterproofed in areas where moisture migration through the wall is undesirable. An extensive, multi-layered type waterproofing system is recommended to minimize the potential for moisture vapor and/or seepage through these walls.

Retaining walls should be backdrained to collect accumulated moisture and prevent hydrostatic pressures from accumulating. One of the three options presented below should be used for design. Options 1 and 2 present backdrainage alternatives. Option 3 assumes that design will incorporate hydrostatic pressures.

For retaining walls less than three (3) feet in height, no significant hydrostatic pressure increments are anticipated, therefore, the backdrainage can be omitted.

Option 1:

A perforated 4-inch diameter Schedule 40, PVC pipe or equivalent, should be placed at the base of the proposed backfill to collect any accumulated moisture. The drain pipe should be encased in a minimum of one cubic foot of clean, free-draining crushed rock or gravel, per lineal foot of pipe. The perforations should be pointing down and out to the side. The crushed rock should be encapsulated in a geofabric (e.g. Mirafi 140NL or equivalent). The geofabric should be laid down prior to the placement of the drain pipe and crushed rock and should run the entire length of the proposed backfill. The width of the geofabric should be of such size, so that when complete, it encapsulates the crushed rock and drain pipe in the form of a burrito. The pipe should be sloped to drain to appropriate receptacles by gravity and daylights to the atmosphere.

The remainder of the backfill should be comprised of compacted clean sand, having a minimum width of 1.0 foot on top of the geofabric, extending vertically to within two feet of proposed final grade. The remaining two feet of the backfill should be comprised of fill material commensurate with the on-site soils compacted in accordance with the recommendations contained below.

Soils to be placed as retaining wall backfill shall be free of deleterious debris such as wood and root structures, be moisture-conditioned as necessary (approximately 1% to 3%, as directed in the field) above optimum moisture of the tested material, are spread in 6 to 8 inch thick loose lifts, and are mechanically compacted to a minimum of 90% of the corresponding laboratory maximum density test (ASTM D1557, latest version). Field density tests should be performed by a representative of this company and should be performed at vertical intervals not to exceed two (2) feet. Care should be taken during the backfilling operation so as not to damage the backdrainage system or the wall. If import soils are required during the backfilling operation, the fill should be approved by the Geotechnical Engineer prior to transporting it to the site. Representative samples of soils planned to be imported to the site should be provided to the Geotechnical Engineer at least 48 hours prior to importing.

Heavy construction equipment should be maintained a distance of at least 3 feet away from these walls during the backfilling operation. Hand-operated compaction equipment should be used to compact the backfill soils within a 3-ft. wide zone adjacent to these walls.

Proper compaction of the backfill will be necessary to reduce settlement of the backfill, which may lead to some distress of the overlying features. Some settlement of the backfill should be anticipated, and any utilities supported therein, or hardscape which spans across the backfill should be designed to accept some minor differential settlement. The backfill should be capped by concrete flatwork on the north and south sides of the garage to prevent surface water infiltration.

Option 2:

The retaining wall backdrainage system may consist of a geocomposite (e.g. Greenstreak or Miradrain) placed against the wall which allows accumulated moisture to flow to an encased 4-inch diameter perforated drain pipe placed at the base of the backfill. The drain pipe should be sloped to drain to appropriate receptacles by gravity. Native soils may be then be placed as compacted/engineered fill behind the wall in accordance with the recommendations contained under Option 1 above. Care should be taken during the backfilling operation so as not to damage the backdrainage system or the wall.

All drainage from the drain pipes should be transferred to an approved drainage area via non-erosive devices.

Option 3:

If a daylight point for the subdrain does not exist, or if the owner chooses not to place the subdrain pipe behind the walls, undrained conditions will apply and an equivalent fluid pressure of 78 pcf should be used for design to account for hydrostatic pressures on cantilever walls. For restrained walls, this value should be 86 pcf. Native soils may then be placed as compacted/engineered fill behind the walls in accordance with the recommendations contained under Option 1 above. Care should be taken during the backfilling operation so as not to damage the wall.

Retaining walls should be backfilled prior to building on, as the walls will yield slightly during the backfilling operation.

To prevent the build up of lateral soil pressures in excess of the recommended design pressures, overloading the walls should be avoided. This can be accomplished by placement of the backfill above a 45 degree plane, projected upward from the base of the wall, in lifts not exceeding eight (8) inches in loose depth, and mechanically compacting it with hand-operated equipment.

Chemical Tests

It is recommended that chemical tests be performed on the soils that will be in contact with the proposed improvements to aid in the evaluation of soil corrosion potential and the attack on concrete by sulfates and soil corrosivity effects to metals. The tests should be performed when the recommended grading operation nears completion for the building pad and prior to foundation construction. In this way the material to be tested and the results obtained, will be based upon the as-graded soil conditions. Pending the results of the tests, Type V cement should be specified for concrete that will be in contact with the earth.

If any proposed subsurface utilities have metallic elements associated with them, it is recommended that the services of a qualified corrosion specialist be contracted by the owner of the property to evaluate soil corrosion potential at the site. No corrosion protection measures are required for buried utility lines comprised of vitrified clay, PVC, or other flexible plastic piping.

Site Surface Drainage

Control of site surface drainage of irrigation and stormwater is critical for the long-term performance of the proposed residential development. All site drainage should be collected and controlled in non-erosive drainage devices. Positive site drainage should be provided away from building foundations and flatwork in accordance with Section 1804.3 of the 2013 CBC.

Roofs should be provided with gutters, and the downspouts should be connected to appropriate receptacles. Drainage should not be allowed to pond anywhere on the site.

Planters near building foundations should be sealed to prevent moisture intrusion into soils providing foundation or slab support. Trees and large shrubbery should not be planted near the residences where roots could grow under its foundations and flatwork areas.

Closure

This report is prepared for the specific use of Mr. Larry Mathewson, for the proposed project described herein. Findings in this report are valid as of this date; however, changes in conditions of a property can occur due to the passage of time, whether they are due to natural processes or works of man, on this or adjacent properties. In addition, changes in applicable or appropriate standards occur whether they result from legislation or broadening of knowledge. Accordingly, findings of this report may be invalidated wholly or partially by changes outside our control. Therefore, this report is subject to review after a period of one year.

Our services consist of professional opinions and conclusions developed by a consulting California Registered Geotechnical Engineer. The warranty made by the consultant in connection with the services performed for this project is that such services are performed with the care and skill ordinarily exercised by members of the same profession practicing under similar conditions at the same time and in the same or a similar locality. No other guarantee or warranty, either expressed or implied, is made or attempted by rendition of consulting services or by furnishing written reports of the findings.

The information and recommendations contained in this report are based upon the assumption that the soil conditions do not deviate from those disclosed in our two (2) exploratory borings. If any variations or undesirable conditions are encountered during the grading operation or construction, or if the proposed development will differ from that planned at the present time, WL should be notified so that supplemental recommendations can be provided, if warranted.

This report is issued with the understanding that it is the responsibility of the owner or of his or her representative, to ensure that the information and recommendations contained herein are called to the attention of the Architect and Engineers for the project and incorporated into the plans and that the necessary steps are taken to see that the Contractors and Subcontractors carry out such recommendations during construction.

This report is subject to review by the controlling authorities for the project.

Our scope of work did not include evaluation of potential hazardous material contamination of soil or groundwater.

Supplemental Services

During the grading operation and construction, we should observe the conditions encountered in excavations and, if warranted, modify our recommendations.

We should observe excavations for proposed foundations prior to placement of forms or reinforcement. Our services during foundation construction are limited to observation of soil conditions and depth of the excavations.

Our services do not include observation or approval of steel, concrete, or asphalt; nor do they include establishing or verifying construction lines and grades. These services should be performed by the appropriate licensed parties.

Our supplemental services are performed on an as-requested basis, and WL cannot accept responsibility for items that we are not notified to observe or test. These supplemental services are in addition to this geotechnical engineering report, and will be billed for on a time and materials basis in accordance with our Professional Fee Schedule and our General and Commercial Terms & Conditions.

Maintenance

Periodic land maintenance will be required. Surface and subsurface drainage facilities must be checked frequently to assure that they are clean and working properly. Any damage to the drainage facilities must be repaired immediately.

Selected References

- American Society for Testing and Materials (ASTM) Volumes 04.08(I) & 4.09(II), Soil and Rock, 03/2015;
- ASCE/SEI 7-10, Minimum Design Loads for Buildings and Other Structures, 06/2013;
- Bowles, J.E., Foundation Analysis and Design, 4th Edition, McGraw Hill, 1988;
- California Building Standards Commission, 2013, California Building Code (CBC) California Code of Regulations Title 24, Part 2, Volume 2 of 2, effective date 01/2014;
- CDMG Fault-Rupture Hazard Zones in California, Alquist-Priolo Earthquake Fault Zoning Act with Index to Earthquake Fault Zone Maps, Special Publication 42, Revised 1997, Supplements 1 and 2 added in 1999, Supplement 3 added in 2003;
- CGS, Seismic Hazard Zones Map, Redondo Beach Quadrangle, Official Map dated 03/25/1999;
- CGS, Seismic Hazard Zone Report (031) for the Redondo Beach 7.5-Minute Quadrangle, Los Angeles County, California, 1998, with revisions through 01/17/2006;
- Dibblee, Jr., T.W., Geologic Map of the Palos Verdes Peninsula, 1999;
- USGS, Earthquake Hazards Program, Seismic Design Maps, http://earthquake.usgs.gov/designmaps/us/application.php;
- USGS, Map Showing Late Quaternary Faults of the Los Angeles Region, 1989;
- WL unpublished in-house data.

General Specifications for Compacted Fill Soils

Preparation

The existing disturbed top soils should be removed under the observation of a representative of WL to expose subgrade competent to support the engineered fill. After the foundation for the engineered fill has been exposed, it shall be scarified until it is uniform and free from large clods, be moisture-conditioned where necessary and compacted, as specified in the body of this report, in accordance with the latest version of ASTM D1557. The recommendations below expand but do not supersede different recommendations provided in the main text of this report.

Materials

On-site soils may be used for the engineered fill, or imported fill materials shall consist of materials approved by the Geotechnical Engineer, and may be obtained from the excavation of banks, borrow pits or any other approved source. The materials used should be free of organic matter and other deleterious substances and should not contain rocks or lumps greater than six (6) inches in maximum dimension.

Placing, Spreading and Compacting Fill Materials

A. The selected fill material should be placed in layers that when compacted shall not exceed six (6) inches in thickness. Each layer should be spread evenly and thoroughly mixed during the spreading to attain uniformity of material and moisture of each layer.

B. Where the moisture content of the fill material is below the limits specified by the Geotechnical Engineer, water should be added until the moisture content is satisfactory to attain thorough bonding and compaction.

C. Where the moisture content of the fill material is above satisfactory limits, the fill materials should be aerated, blended or dried until the moisture content is satisfactory.

D. After each layer has been placed, mixed and evenly spread, it should be compacted as specified in the body of this report. Compaction equipment should be selected by the contractor and be of such design that they will be able to compact the fill to the specified density.

Compaction should be accomplished while the moisture content of the fill material is within the compactable range. Compaction of each layer should be accomplished by rolling the entire area with sufficient trips to attain the desired density. The final surface of areas to receive slabs-on-grade should be rolled to a dense, smooth, unyielding surface.

E. Field density tests should be performed by a representative of this company. Density tests should be performed at vertical intervals not to exceed two feet. When these readings indicate the density of any layer of fill is below the required density, the fill should be reworked until the required density has been obtained.

Observation

A representative of WL should observe all filling and compacting operations to verify that the fill is consistent and in compliance with the recommendations.

Seasonal Limitations

No fill materials should be placed, spread or rolled during unfavorable weather conditions. When work is interrupted by heavy rains, fill operations should not be resumed until field tests performed by a representative of the Geotechnical Engineer indicate that the moisture content and density of the fill are as previously specified.

APPENDIX A
BORING LOGS

KEY TO EXPLORATORY LOGS

MAJOR DIVISIONS		USCS	DESCRIPTION	MAJOR DIVISIONS		USCS	DESCRIPTION
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	GW	Well-graded gravels or gravel-sand mixtures, little or no fines	FINE GRAINED SOILS	SILTS AND CLAYS LL <50	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands, or clayey silts with slight plasticity
		GP	Poorly-graded gravels or gravel-sand mixture. Little or no fines			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
		GM	Silty gravels, gravel-sand-silt mixtures			OL	Organic silts and organic silt-clays of low plasticity
		GC	Clayey gravels, gravel-sand-clay mixtures				
	SAND AND SANDY SOILS	SW	Well-graded sands or gravelly sand, little or no fines		SILTS AND CLAYS LL >50	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts
		SP	Poorly-graded sands or gravelly sands, little or no fines			CH	Fat clays, inorganic clays of high plasticity
		SM	Silty sands, poorly graded sand-silt mixtures			OH	Organic clays of medium to high plasticity
		SC	Clayey sand, poorly graded sand-clay mixtures	HIGHLY ORGANIC SOILS		PT	Peat and other highly organic soils

NOTES: (1) Dual USCS symbol, such as "SP-SM" or "SP-SC", denotes 5 to 12% of minor constituent (i.e. "M" for silt or "C" for clay), except "SC-SM" which denotes "silty, clayey sand".

(2) Dual symbols, such as "SM/ML" and "SC/CL", denote borderline coarse grained/fine-grained soils "silty sand-to-sandy silt" and "clayey sand-to-sandy clay", respectively.

RELATIVE DENSITY	SPT* (# blows/ft)	RELATIVE DENSITY(%)
Very loose	<4	0 – 15
Loose	5 – 10	15 – 35
Medium Dense	11 – 30	35 – 65
Dense	31 – 50	65 – 85
Very Dense	>51	85 – 100

CONSISTENCY	SPT* (# blows/ft)	UNCONFINED COMPRESSIVE STRENGTH (tsf)
Soft	0 – 4	0.25 – 0.5
Firm	5 – 8	0.5 – 1.0
Stiff	9 – 15	1.0 – 2.0
Very Stiff	16 – 30	2.0 – 4.0
Hard	>31	>4

* NUMBER OF BLOWS OF 140 POUND HAMMER FALLING 30 INCHES TO DRIVE THE SPT SAMPLER

<u>SAMPLE TYPE</u>:

CD = California Drive (or California Modified)(3 in. O.D./2.416 in. I.D.)
R = Relatively Undisturbed Ring Sample (3.25 in. O.D./2.42 in. I.D.)
SP = Standard Sampler for SPT Test (2 in. O.D./1-3/8 in. constant I.D.)*
SPT = Standard Penetration Test with SP Sampler (using Standard Hammer/Drop)**
**Where: Standard Hammer/Drop = 140lb/30"
WL = Western Laboratories Hammer/Drop (32lb/30")
B = Bulk Sample
NR = No Recovery

*References – Terzaghi & Peck (2nd edition), and "Influence of SPT Procedures in Soil Liquefaction Resistance Evaluation" by Seed, Tokimatsu, Harder & Chung (1985)

<u>LABORATORY TESTS</u>:

DS = Direct Shear
CN = Consolidation
EI = Expansion Index
AL = Atterberg Limits
MD = Maximum Density
RV = Resistance Value
COR = Corrosivity
SE = Sand Equivalent Value
UC = Unconfined Compression
HYD = Hydrometer Analysis
#200 = No. 200 Sieve Wash

BORING 1

Sheet 1 of 1

Work Order: 15-4561
Date Drilled:06-26-15

Client: MR. LARRY MATHEWSON
Project: *Proposed Single Family Residence*

Depth (ft)	Sample Type	Lab Tests	Blows/Foot*		DESCRIPTION 4" Diameter Hand Auger	Dry Unit Weight (pcf)	Moisture Content (%/Dry Wt.)	Notes
0				0.0-2.0	DISTURBED TOP SOIL-SILTY SAND (SM),			
	SP		7		loose, moist, dark brown, with rootlets		4.1	
				2.0-7.0	NATIVE SOIL			
	SP		15		SILTY SAND (SM), medium dense, moist,		4.8	
					dark brown			
5	CD	DS				106	6.2	
	CD	CN		7.0-10.0	CLAYEY SAND (SC), medium dense,	103	6.9	
					moist, brown			
10	CD			10.0-13.5	Poorly Graded SAND(SP), medium dense,	109	5.8	
					moist, tan			
	SP		19				5.3	
					Boring terminated and backfilled			
15					Groundwater not encountered			
20								
25								
30								
35								

* The blows noted are approximately equivalent SPT-N values already converted (per Foundation Engineering Handbook) from field blows from an SP Sampler using WL Hammer/Drop combination

BORING 2

Sheet 1 of 1

Work Order: 15-4561
Date Drilled:06-26-15

Client: MR. LARRY MATHEWSON
Project: *Proposed Single Family Residence*

Depth (ft)	Sample Type	Lab Tests	Blows/Foot*	DESCRIPTION 4" Diameter Hand Auger		Dry Unit Weight (pcf)	Moisture Content (%/Dry Wt.)	Notes
0				0.0-2.0	DISTURBED TOP SOIL-SILTY SAND (SM),			
	CD				loose, moist, dark brown, with rootlets	95	3.9	
				2.0-6.0	NATIVE SOIL			
	SP		17		SILTY SAND (SM), medium dense, moist,		5.3	
					dark brown			
5	SP		17				6.1	
				6.0-10.0	Poorly Graded SAND(SP), medium dense,			
	SP		21		moist, tan		7.1	
10	SP		24	10.0-12.0	CLAYEY SAND (SC), medium dense,		9.5	
					moist, brown			
	SP		27	12.0-13.5	Poorly Graded SAND(SP), medium dense,		5.4	
					moist, tan			
					Boring terminated and backfilled			
15					Groundwater not encountered			
20								
25								
30								
35								

* The blows noted are approximately equivalent SPT-N values already converted (per Foundation Engineering Handbook) from field blows from an SP Sampler using WL Hammer/Drop combination

APPENDIX B
LABORATORY TESTING

Laboratory Tests

In-situ Unit Weights:
The moisture content and dry unit weight of selected samples recovered from our exploratory borings was determined in general accordance with the latest version of ASTM D2216. The results are presented on the boring logs at the selected depths.

Shear Strength:
A Direct Shear test was performed on a selected relatively undisturbed ring sample retrieved during our subsurface exploration. The test was performed in general accordance with the latest version of ASTM D3080. Three test specimens from the selected sample depth were placed in a ELE Soiltest D-500A Direct Shear Machine. A different normal load was applied vertically to each of the three specimens which were slowly inundated with distilled water and allowed to soak. The samples were then sheared in a horizontal direction at a constant strain rate (0.002 inch per minute) slow enough to allow for drainage. The results of this test are presented graphically on Figure DS-1 in this appendix.

Expansion:
The upper soils encountered during our subsurface exploration conducted at the site are considered to be non-expansive. Therefore, an Expansion Index test was not performed.

Consolidation:
A one-dimensional consolidation test was initiated on a specimen at in-situ moisture from the relatively undisturbed ring samples retrieved during our exploration. The test was performed in general accordance with the latest version of ASTM D2435. Successive load increments were applied to the top of the sample and progressive and final settlements under each increment were recorded to an accuracy of 0.0001 inch. The consolidometer, like the direct shear machine, is designed to receive the specimens in the field condition. Water was added after consolidation was achieved for the pressure as noted. Porous stones, placed at the top and bottom of the sample, permit the free flow of water into or from the sample during testing. The results of this test are presented graphically in this appendix.

Direct Shear Test Report

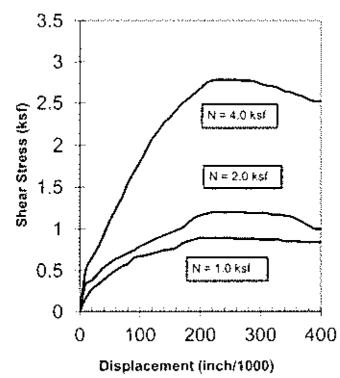
PROJECT: Mr. Larry Mathewson

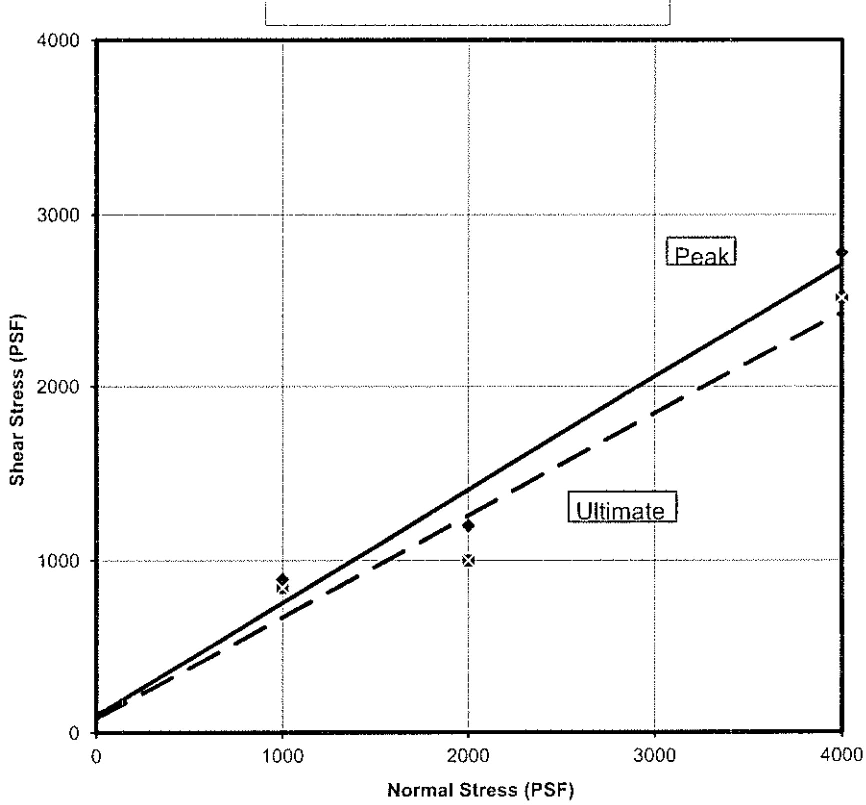
FIGURE NO.: DS-1
JOB No.: 15-4561
DATE: 07/23/15

Sample Identification	Sample Description	Sample Test State
B-1 @ 5'	Silty Sand	Saturated-Consolidated

Peak:	Phi (Degrees)	33.1	(Avg.Dry Dens. = 105.0 pcf)
	Cohesion (PSF)	100.0	(Avg.Moist. = 6.1 %)
Ultimate:	Phi (Degrees)	30.5	
	Cohesion (PSF)	80.0	

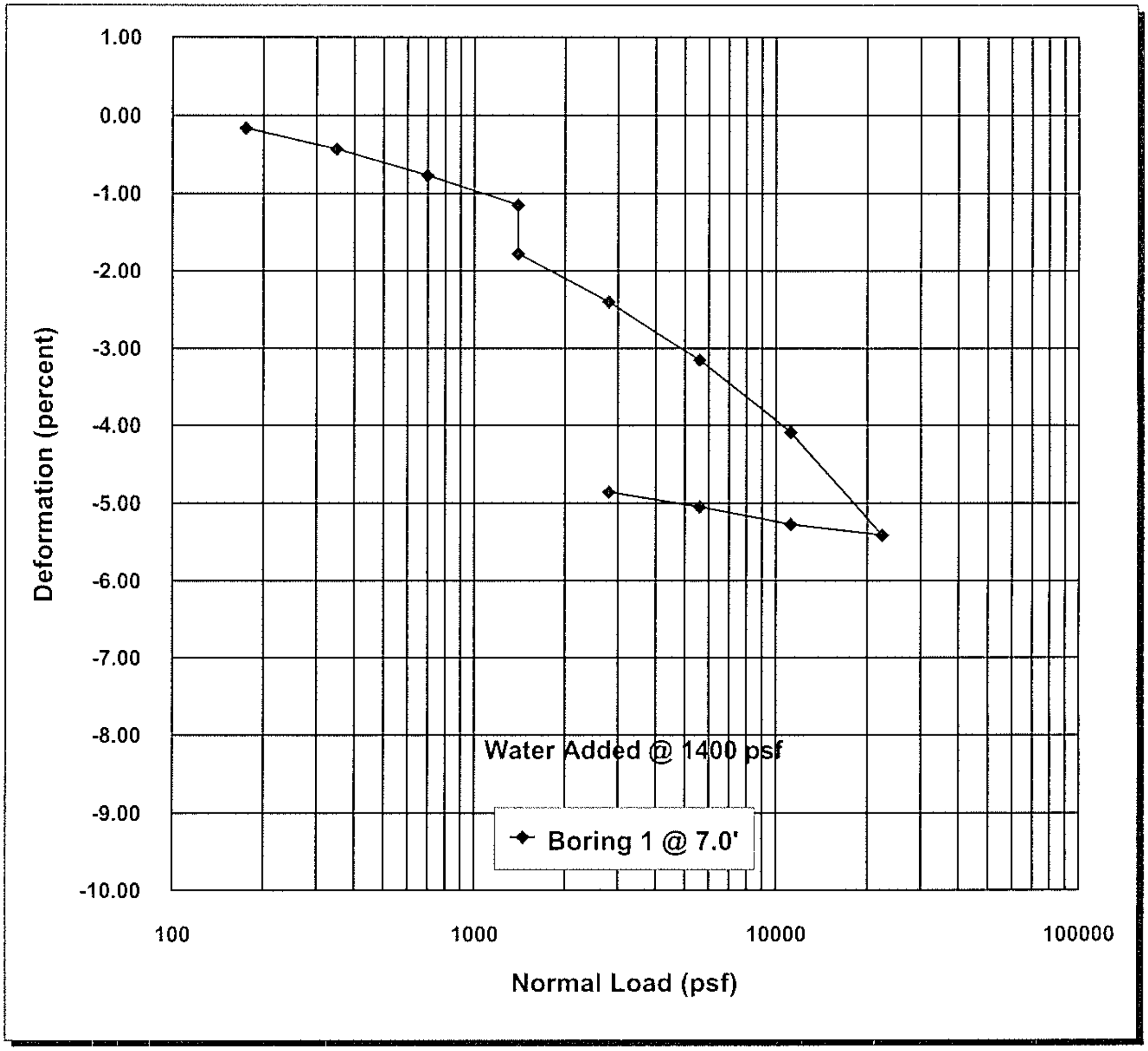
[X] Undisturbed
[ ] Remolded





Western Laboratories
Geotechnical Engineering

(ASTM D 2435)

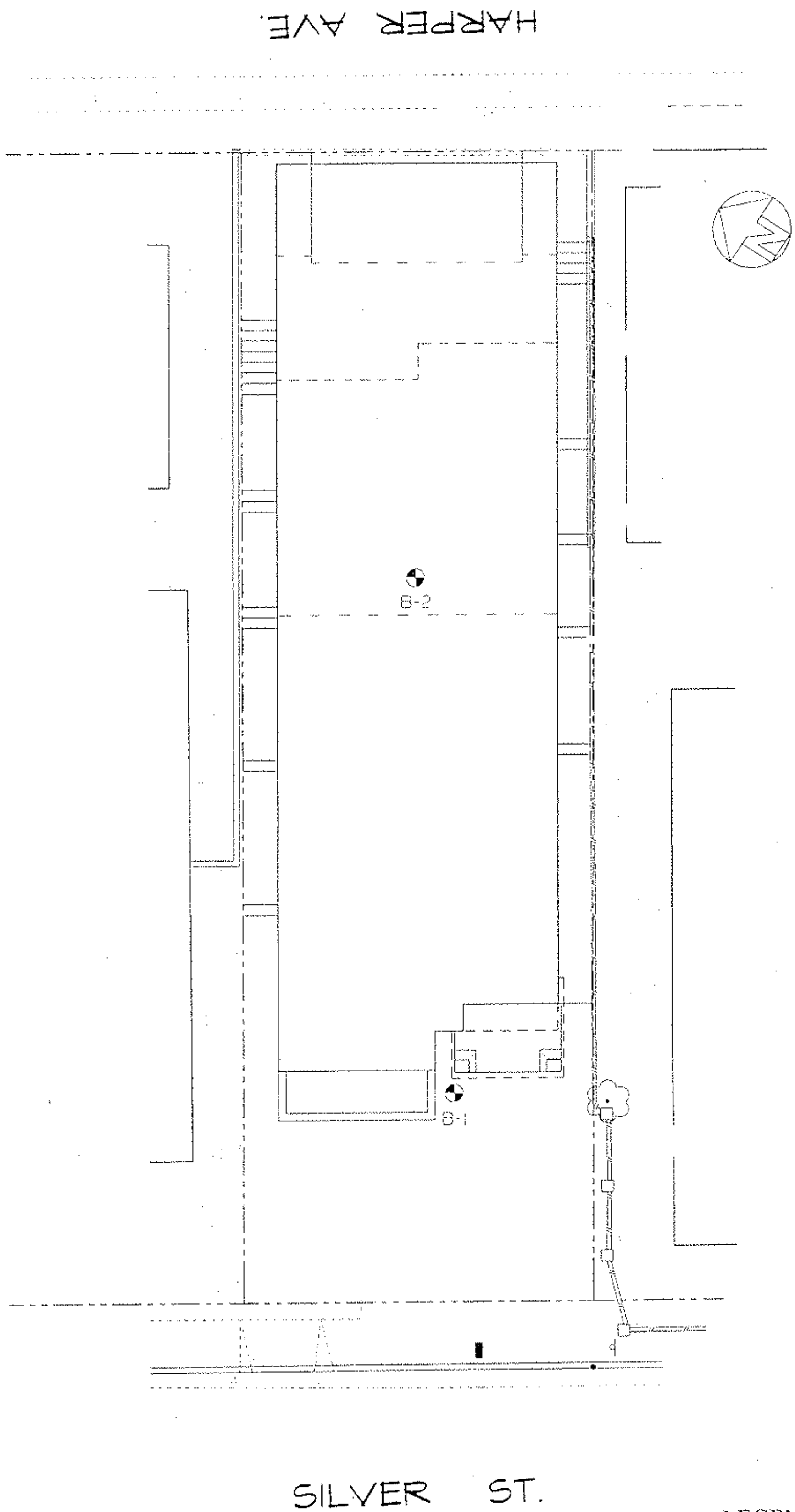


PROJECT: PROPOSED SINGLE FAMILY RESIDENCE	WORK ORDER 15-4561

CONSOLIDATION TEST

Western Laboratories

Geotechnical Engineering



LEGEND

⊕ = APPROXIMATE LOCATION OF EXPLORATORY BORING

PLOT PLAN			
SCALE:	N.T.S.		DRAWN BY
DATE:	08-17-15	MR. LARRY MATHEWSON	REVISED
1514 SILVER STREET HERMOSA BEACH, CALIFORNIA			
WESTERN LABORATORIES			DRAWING NUMBER 15-4561