Geotechnical Investigation

Revision 1

Landpro 8159-8162 Site
APN 0466-181-59, 60, 61 & 62
Helendale, CA

Prepared For:
Sunlight Partners
4215 East McDowell Rd. #212
Mesa, AZ. 85215
Attn: Jason Ellsworth

MEC No: 12.0010.0140
August 8, 2012

August 8, 2012

Sunlight Partners LLC
4215 East McDowell Rd. #212
Mesa, AZ. 85215
Attn: Jason Ellsworth

Re: Geotechnical Investigation
APN 0466-181-59, 60, 61 & 62
Helendale, CA

Mr. Ellsworth,

In accordance with your authorization, we have performed a preliminary soils investigation for the above-referenced project. The following report presents our findings based on the results of our field and laboratory investigation.

The investigation was planned and performed using the information provided by your firm in the development of this project. Our report includes recommendations for the development of this site, and presents an evaluation of existing conditions for the design of proposed foundations within this project site.

We anticipate the enclosed information to be highly useful during the design and construction phases of this project. If you have questions, please do not hesitate to contact our firm.

Sincerely,

Merrell Engineering Company, Inc.

Brad S. Merrell, PE, President
RCE 49423 Exp. 09/30/12

Ryan T. Heywood
Laboratory Manager

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Attachments

Introduction

Investigation

The purpose of this investigation was to explore and evaluate the subsurface soil conditions specifically for the proposed Photovoltaic Solar Farm, and to provide recommendations for site grading, design and construction of the proposed foundation(s) and site improvements.

We have performed a foundation investigation and comprised this report with our findings. This report represents the results of a subsurface geotechnical investigation at the site. The location of the proposed development is on the enclosed Site Vicinity Map (Attachment C2).

This report was written specifically for this project as described in this report. It is intended to be used by Sunlight Partners LLC and associated design professionals in the development of this project. Since this report is intended for use by the designer(s), it should be recognized that it is impossible to include all construction details at this phase in the project. Additional consultation may be prudent to interpret these findings for contractors, or possibly refine these recommendations based upon the final and actual conditions encountered during construction.

Scope of Services

Specifically, the scope of the investigation consisted of the following:

- Field investigation consisting of a total of ten exploratory borings. The exploratory borings extended to a maximum depth of thirty feet below the existing surface elevations.
- Laboratory Investigation consisting of Sieve Analysis, Compaction Characteristics (moisture density test), density testing of tube samples, Direct Shear, Consolidation, and pH, Resistivity, Sulfate, Chloride and Sulfide testing.
- Preparing this report, presenting our findings, conclusions and recommendations.

The scope of our investigation did **not** include the following:

- A detailed study of groundwater conditions
- The determination of dynamic soils properties.
- A detailed study of geological sand seismic hazards studies.

- Ground Motion Hazard Analysis
- The assessment of general site environmental conditions for the presence of contaminants in the soils and groundwater.
- Geological Hazards Study
- Empirical Prediction of Earthquake Induced Liquefaction Potential

Site Conditions

The approximate 80 acre site is located at the Southwest corner of Wild Road and Smithson Road in Helendale California. It is bound to the North by Wild Road, to the East by Smithson Road, to the South by Smithson Road, and to the West by similar developed land (see attached Vicinity Map C2 and Topographic Map C1). The topography for the site is relatively level. Free moisture was encountered during the exploratory boring operation at a depth of ten feet. According to information at http://wdr.water.usgs.gov/nwisgmap, adjacent wells indicate historical ground water levels no higher than 10'.

Proposed Development

The details provided to our office in regards to the proposed development are that Sunlight Partners LLC intends to construct a 7.5 MW Photovoltaic Solar Electric Generating Facility. The structural details for the proposed structures were not available at the time of this report. It should be noted that once the final details for the structure are available our office should be provided a set of plans for review and comments to develop additional recommendations if necessary.

It is believed that the grading operations for the site will consist of foundation excavating and compaction to create uniformly compacted and level foundations for the proposed structure. If grading limits/operations are in excess of those stated, our office should be notified to evaluate the conditions or to develop additional recommendations. Our office should be provided a copy of the approved grading plan for review and comments to develop additional recommendations if necessary.

Findings

Field Investigation

The exploratory borings were observed and documented by Ryan Heywood of Merrell Johnson Companies, and conducted by Jeff Calloway of 2R drilling with a CME-55 track drill rig equipped with 6” x 5’ hollow stem augers.

A continuous log of the subsurface conditions encountered within the exploratory excavations was recorded at the time of excavating operations and has been included as Attachment A2 within this report. Disturbed and relatively undisturbed soil samples of typical soil types were obtained and returned to the laboratory for testing and evaluation.

Laboratory Investigation

The laboratory test for the soil types encountered consisted of the following:

- B1 Laboratory Compaction Characteristics of Soil (Moisture Density Test)
- B2 Grain Size Analysis
- B3 pH, Resistivity, Sulfide, Chloride & Sulfate
- B4 Direct Shear
- B5 Consolidation

Subsurface Conditions

Data from our exploratory boring indicates that the soil profile at the site typically consists of what appears to be natural occurring alluvium and colluvial materials to the maximum depths explored in the boring, with the subsurface soils consisting of SW Well-graded sand with gravel, SM Silty sand, SM Silty sand with gravel and GW Well-graded gravel with having percent fines (passing the No. 200 sieve) of 1.9 to 16.4.

Free moisture was encountered in our field borings at an approximate depth of ten feet.

It should be noted that some caving of the borings occurred during removal of the augers, indicating potentially non-cohesive soils.

Site Class, Site Coefficient and Seismic Design Category

Based on the available information gathered for the proposed project, the soils underlying the site are classified as site class D according to the 2010 CBC. The Design Acceleration Parameters were determined according to chapter 11 of the ASCE 7-05 and are provided in the table below.

2010 California Building Code – Seismic Parameters

Mapped Spectral Acceleration Parameters	S_S = 1.223	and	S_1 = 0.483
Site Coefficients	F_a= 1.011	and	F_v = 1.517
Adjusted Maximum Considered Earthquake (MCE) Spectral Response Parameters	S_{MS} = 1.237	and	S_{M1} = 0.733
Design Spectral Acceleration Parameters	S_{DS} = 0.824	and	S_{D1} = 0.489

Conclusions and Recommendations

Conclusions

Based upon our field investigation and test data, combined with our engineering analysis, experience, and judgment, the on-site natural soils are considered to have good strength characteristics and low to moderate compressibility under relatively light to moderately heavy loads.

Existing upper soils overlying localized areas of the site are not considered suitable for the support of permanent foundations, floor slabs and pavements. These upper soils will not in their present condition, provide a uniform or adequate support for the proposed permanent structures. The underlying native underlying soils below these upper soils are generally in a dense state and are considered adequate for support. From a foundation standpoint, the underlying natural soils are generally considered competent bearing materials.

Based upon our field investigation and test data, combined with our engineering analysis, experience, and judgment, the on-site natural soils are considered to have good strength characteristics and low to moderate compressibility under relatively light to moderately heavy loads.

Based on the soil types encountered and the nature of the material as determined by the laboratory testing, the on-site soils are considered to have a (very low) potential for being

expansive. Further testing may be necessary during construction should other soil types be encountered. Adequate provisions in design and construction with the on-site soils should be considered to reduce their shrink-swell effects on foundations and floor slabs.

The generally medium dense to dense subsoils are such that the liquefaction potential at the site is considered to be moderate for ground motions resulting from the maximum credible earthquake that could conceivably occur and affect the site.

Assuming the above recommendation are followed and that the possibility of a ground water condition existing is unlikely, the dense to medium dense underlying subsoils are such that the liquefaction potential at the site is considered to be low to moderate for ground motions resulting from the maximum credible earthquake that could conceivably occur and affect the site. In the unlikely event of liquefaction at the site, it is expected to be localized and would have minor impact on the development, provided that the recommendations of this report are implemented.

It is our opinion that the proposed development is feasible, provided the recommendations in this report are implemented and special consideration/precautions are taken in design of the foundations and structures.

General Recommendations

Pre-Job Conference
Prior to the commencement of grading, a pre-job conference meeting should be held with representatives of this firm. The purpose of this meeting would be to clarify any questions related to the recommendations and specifications of this report.

General Grading Requirements

All grading operations must be observed and tested by our firm. Any imported fill material must be approved for use prior to importing. The governmental agencies having jurisdiction over the project must be notified prior to commencement of grading so that the necessary grading permits may be obtained and arrangements may be made for the required inspection(s).

Clearing & Grubbing

All debris, vegetation, irrigation lines and asphalt concrete pavement shall be removed prior to any grading work performed.

No debris or vegetation will be placed as site fill or grading operations. All deleterious materials (asphalt concrete, concrete, wood, trash, etc.) shall be disposed in accordance with the owner's instructions. Any roots shall be removed to a depth of five (5) feet below the pad elevation.

Scarification

All areas to receive fill and all areas of cut to support sub-grade soils shall be scarified to a depth of 12 inches. Scarified material shall be brought to within +/- 2 percent of optimum moisture content and compacted to the relative percent compaction per appendix E prior to the placement of fill (See Appendix E General Grading Specifications).

Compacted Fill Material

Fill material shall be from clean imported soils with rocks or other particles no larger than four inches in diameter. Our Engineer or representative should approve any import fill prior to placement. The on-site soils, less the oversized particles, debris or organic matter may be used in required fills.

Cobbles, rock and other particles larger than four inches in diameter should not be used in the fill.

Compacted Fill Placement

All fill placement and compaction shall be in accordance with the specification contained in this report, see Appendix E General Grading Specifications.

Settlement

Foundation size and depth, the foundation soils and the loads imposed can affect the estimated settlements, however for preliminary design purposes, the total settlement is estimated to be approximately ¾ inches for spread footings with a maximum column load of 60 kips and an allowable bearing capacity of 2,000 psf founded on compacted fill and prepared in accordance with the recommendations in this report

Column spacing, loads imposed, and foundation size and depth can all affect differential settlements. However, based on our investigation of the site, differential settlements are anticipated to be ½ inches in 40 feet or less. When detailed foundation load information is provided, comprehensive settlement analysis can be performed to evaluate total and differential

settlement.

Sub-Excavation

All area to support the development of this site that is susceptible to settlements (i.e. footings, slabs, lots, and site structure) shall be over-excavated to a depth of three feet. The above-mentioned re-compacted soil beneath the bottom of the proposed foundation shall extend horizontally five feet beyond the foundation of these structures. Boulders and cobble exceeding four inches encountered during sub-excavation and scarification operations should be removed and not used in fill.

The sub-excavation requirements must be followed in cut areas also if any portion of the foundation is founded in fill (see Attachment D-1, Transition Lot Detail).

Imported Soils

Imported soils required to complete the grading operations should consist of predominantly granular material with an expansion index less than 35 when tested in accordance with ASTM D-4829 and shall have a minimum R-Value of 60. All imported material shall be inspected and approved by our Engineer or representative prior to placement. Imported material utilized for trench backfill operations shall consist of granular material with a minimum sand equivalent of 35.

Foundation Design

If soils are prepared as recommended, a firm, dense soil should be established. The proposed structure may be supported on a foundation as designed and established by the structural engineer for this project. The minimum width and depth of the footings should be per the structural engineer's design and reviewed by our office. In no case shall they be less than 12 inches in width an 12 inches in depth.

Based on the provided design parameters (maximum axial load of 7,000 lbs, maximum ground moment of 20,000 ft-lbs, maximum ground lateral load of 3,000 lbs.), driven piles using wide flange beams (H piles) shall be a minimum of 12 feet deep.

Based on the provided design parameters (maximum axial load of 7,000 lbs, maximum ground moment of 60,000 ft-lbs, maximum ground lateral load of 6,000 lbs.) pier footings shall be a minimum of four feet in diameter and eight feet deep. Due to ground water levels, pier footings

may present obstacles driven piles do not, care should be taken that standing water not be in pier footings

For the minimum width and depth, footings may be designed for a maximum safe soil bearing pressure of 1000 pounds per square foot for dead plus live loads for a depth of one (1) foot below grade. This allowable bearing pressure may be increased by 250 pounds per square foot for each additional foot of depth to a maximum safe soil bearing pressure of 2000 pounds per square foot for dead plus live loads. The 1500 pounds per square foot is for a depth three (3) feet below grade. These bearing values may be increased by one-third for wind or seismic loading. The actual bearing value of the fill will depend on the material used and the compaction methods employed. The quoted bearing value should be applicable if the on-site or other acceptable materials are used and compacted as recommended. The bearing value of the fill should be confirmed upon completion of the grading operations.

Since the recommended bearing value is a net value, the weight of the concrete within the footings may be taken as equal to 50 pounds per cubic foot, and the weight of soil backfill may be neglected in determining the downward foundation loads for footing design.

Foundation concrete should be placed in compacted trenches with no caving of the sidewalls. The foundation excavation should be properly backfilled as recommended for site fill and tested for the percent of compaction. Concrete forms should not be placed until our office has inspected and conducted the field and laboratory testing required.

All footing excavations should be observed by personnel of our firm to verify satisfactory of supporting soils. Footings should be deepened if necessary to extend into satisfactory supporting soils.

Concrete foundations should be designed according to current local and state codes and constructed with a minimum 28-day compressive strength of 3000 psi and a water/cement ratio as dictated by the American Concrete Institutes Manuals of Concrete Practice. The foundation reinforcement shall be designed and calculated by the structural engineer in accordance with the reinforcement requirements per the Uniformed Building Code or per the California Building Code as indicated by the governing agency.

To reduce the potential of sulfate attack on concrete in contact with on-site native soils, a type II-V cement is recommended for use in concrete mix design.

Foundations should be designed with continuous reinforcing steel top and bottom. Reinforcing

steel should maintain minimum clearances specified by all applicable codes and job specifications.

Slabs on Grade

If the sub-grade is prepared as recommended as indicated within this report, building floor slabs can be supported on grade. To provide adequate support, concrete slabs on grade should bear on compacted soil. The final pad surface should be rolled to provide a smooth dense surface upon which to place the concrete. Therefore, we recommend that our field representative observe all grading operations and the condition of the final sub-grade soils immediately prior to slab-on grade construction and if necessary, perform further density and moisture content tests to determine the suitability of the final prepared sub-grade.

If the slab is to receive moisture sensitive coverings, it should be provided with a moisture vapor barrier. A low-slump concrete should be used to minimize possible curling of the slab. A 2-inch-thick layer of coarse sand can be placed over the vapor retarding membrane to reduce slab curling. If this sand bedding is used, care should be taken during the placement of the concrete to prevent displacement of the sand. The concrete slab should be allowed to cure properly before placing vinyl or other moisture-sensitive floor covering.

Concrete slabs on grade should be minimum thickness of four inches with a 28-day compressive strength of 2,500 psi and water/cement ratio as dictated by the American Concrete Institutes Manuals of Concrete Practice, a type II-V cement should be used. Slabs on grade shall have a minimum reinforcement per the American Concrete Institutes Manual of Concrete Practice and minimum code concrete to steel ratios for temperature and shrinkage requirements. *The slab on grade reinforcement should be tied into the foundation reinforcement.*

All concrete slabs should be designed to have concrete construction (i.e. jointing, etc.) in conformance with the American Concrete Institute Manual of Concrete Practice design and construction standards.

Slabs on grade should be designed with reinforcing steel in each direction. The structural designer of proposed development should allow for minimum or better ratios of temperature and shrinkage reinforcing steel. Slab on grade reinforcing steel should be doweled / tied into foundations and/or grade beams.

Lateral Loading

Resistance to lateral loads will be provided by passive earth pressure and base friction. For footings bearing against approved native fill, the passive earth pressure may be developed at a rate of 350 pounds per square foot of depth. A safe assumption for basal friction would be 0.35 of the actual dead load. Base friction and passive earth pressure may be combined without reduction. Active earth pressure for retaining structures (retaining walls 8 feet in height) should be designed with an equivalent fluid pressure of 45 pounds per square foot of height, plus any additional building or equipment surcharges.

Drainage

It is important that all water be kept a minimum of 10 feet from structures and slabs. No ponding adjacent to buildings/structures is allowed. All surfaces shall have a positive two percent minimum slope away from structures.

Retaining walls should be designed to resist hydrostatic pressures or be provided with a drainpipe, weep holes and/or the necessary drainage capabilities for the wall.

If a basement or subterranean structure is constructed a subsurface drainage system is recommended to be designed and constructed.

Footing and Utility Excavations

Footing and utility excavations for this project may require sloping sidewalls or shoring. All excavations shall be done in accordance with the California Administrative code, Title 8, Industrial Relations, Chapter 4, Division of Industrial Safety, Subchapter 4, Construction Safety Orders, Article 6. Temporary excavations shall have sloping sidewalls no steeper than 1(H): 1(V).

Footings shall be over-excavated in accordance with the requirements/recommendations of this report.

Excavation Procedures

Temporary excavations in site soils should be shored or sloped in accordance with Cal OSHA requirements. Presented herein are guidelines for temporary slope construction and recommendations for shoring in granular soils, (Type C Soils), which were the predominant soils

encountered in our borings. In addition, alternate guidelines are provided for temporary slope construction in clayey soils, (Type B Soils) which were encountered in some borings and may be encountered in the areas of planned excavations.

Temporary Slopes

Temporary excavations in site granular soils (Type C Soils) should be sloped no steeper than 1.5 horizontal to 1 vertical for excavations up to 20 feet in depth. Compound excavations with vertical sides in lower portions should be properly shielded to a minimum height of 18 inches above the top of the vertical side, with the upper portion having a maximum allowable slope of 1.5 horizontal to 1 vertical.

Temporary excavations in site clayey soils (Type B Soils) should be sloped no steeper than 1 horizontal to 1 vertical for trenches up to 20 feet in depth. Benched excavations 20 feet in depth or less in site clayey soils should be sloped no steeper than 1 horizontal to 1 vertical, with a maximum bench height of 4 feet. Compound excavations with vertical sides in the lower portions should be properly shielded to a minimum height of 18 inches above the top of the vertical side, with upper portion having a maximum allowable slope of 1 horizontal to 1 vertical.

A Registered Professional Engineer should design slopes or benching for excavations greater than 20 feet in depth.

Should running sand conditions be experienced during excavations operations, flattening of cut slopes faces, or other special procedures, may be required to achieve stable, temporary slopes.

During construction, the soil conditions should be regularly evaluated to verify that conditions are as anticipated. The contractor should be responsible for providing the “competent person” required by OSHA standards to evaluate the soil conditions. Close coordination between the competent person and the soils engineer should be maintained to facilitate construction while providing safe excavations.

Shoring

Temporary shoring will be required for those excavations where temporary slope cuts as specified above are not feasible. Internally braced shoring may be utilized for excavations, ***however, it is anticipated that difficulties will be experienced during shoring installation due to the presence of dry loose soils in some areas***. It is recommended that temporary braced shoring retaining site sandy/gravelly soils be designed considering a uniform lateral

earth pressure distribution for the full height of the shoring, with a maximum pressure equal to 22H in pounds per square foot, where H is the height of shoring in feet.

The recommended soil pressure will apply to level soil conditions behind braced shoring. Where a combination of slope embankment and braced shoring is used, the soil pressure will be greater and must be evaluated for actual conditions.

In addition to the above recommended lateral earth pressures, a minimum uniform lateral pressure of 125 pounds per square foot should be incorporated in the design of the upper ten feet of shoring when normal traffic is permitted within ten feet of the shoring. The design of temporary shoring should also include the surcharge loading effects of delivery and construction equipment adjacent to the shoring, as appropriate.

Limitations and Additional Services

Limitations

The recommendations given in this report are based on results of field and laboratory investigations, combined with interpolation of subsurface conditions between exploration locations for only this project. The nature and extent of variations between the explorations may not become evident until construction. If variations are exposed during construction, this office should be notified so the variations can be reviewed and the recommendations of this report modified or verified in writing.

If changes in the nature, design or action of the structure are planned, the recommendations contained in this report shall not be considered valid unless the changes are reviewed and the recommendations of this report modified or verified in writing.

This report has been prepared only to aid in the evaluation of this site and to provide geotechnical recommendations for the design of this project. *Any person using this report for bidding or construction purposes should be aware of the limitations of this report as mentioned above and should conduct an independent investigation as he deems necessary to satisfy themselves as to the surface and subsurface conditions to be encountered, and the procedures to be used in the performance of work on this project.*

Our professional services have been performed using the degree of care and skill ordinarily exercised, under similar circumstances, by reputable engineering consultants practicing in this or similar localities. No other warranty, expressed or implied, is made as to the professional

advice included in this report. This report has not been prepared for use by other parties, and may not contain sufficient information for purposes of other parties or other uses.

This report is issued with the understanding that the owner has the responsibility to bring the information and recommendations contained herein to the attention of the designers and builders of this project. The owner also has the responsibility to verify that the contractors/builders follow such recommendations. It is understood that the owner is responsible for submittal of the report to the appropriate governing agencies.

This report is based on the assumption that adequate client consultation, construction monitoring, and testing will be performed during the final design and construction to be incompliant with the recommendations of this report.

Additional Testing

Maintaining Merrell Engineering Company, Inc. as the soils engineering consultant from beginning to end of the project will provide continuity of services. **The engineering firm providing testing and observations shall assume the responsibility of Soils Engineer of Record.**

Construction monitoring and testing would be additional services provided by this firm. The costs of these services are not included in our present professional service agreement or part of our current scope of work. It is recommended that this firm be contacted to perform additional earthwork and materials observation and testing during the following phases of the project:

- Foundation / Footing Excavation & Utility Trench Backfill
- Over-excavation and re-compaction per this report
- Retaining Wall Construction and/or Backfill
- Sub-grade Preparation in New Pavement Areas
- Unusual Conditions Encountered
- Materials Testing and Special Inspections

Closure

We appreciate the opportunity to be of service. Should you have any questions or need further assistance, please do not hesitate to contact our office.

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Merrell Johnson COMPANIES

ATTACHMENT A

EXPLORATORY LOGS

Major Divisions			Letter	Typical Descriptions
Coarse Grained Soils (More Than 50% Of Material Is Larger Than No. 200 Sieve Size)	**Gravel And Gravelly Soils** (More Than 50% Retained On No. 4)	**Clean Gravels** (Little Or No Fines)	**GW**	Well-Graded Gravels, Gravel-Sand Mixtures Little Or No Fines
			GP	Poorly-Graded Gravels, Gravel-Sand Mixtures Little Or No Fines
		Gravels w/ Fines (Appreciable Amount)	**GM**	Silty Gravels, Gravel-Sand-Silt Mixtures
			GC	Clayey Gravels, Gravel-Sand-Clay Mixtures
	Sand And Sandy Soils (More Than 50% Passing No. 4)	**Clean Sand** (Little Or No Fines)	**SW**	Well-Graded Sands, Gravelly Sands, Little Or No Fines
			SP	Poorly-Graded Sands, Gravelly Sands Little Or No Fines
		Sands w/ Fines (Appreciable Amount)	**SM**	Silty-Sands, Sand-Silt Mixtures
			SC	Clayey Sands, Sand-Clay Mixtures
Fine Grained Soils (More Than 50% Of Material Is Smaller Than No. 200 Sieve Size)	**Silts and Clays** (Liquid Limit Less Than 50)		**ML**	Inorganic Silts And Very Fine Sands, Rock Flour, Silty Or Clayey Fine Sands Or Clayey Silts
			CL	Inorganic Clays Of Low To Medium Plasticity Gravelly Clays, Sandy Clays, Silty Clays
			OL	Organic Silts And Organic Silty Clays Of Low Placticity
	Silts and Clays (Liquid Limit Greater Than 50)		**MH**	Inorganic Silts, Micaceous Or Diatomaceous Fine Sand Or Silty Soils
			CH	Inorganic Clays Of High Plasticity, Fat Clays
			OH	Organic Clays Of Medium To High Plasticity, Organic Silts
Highly Organic Soils			**PT**	Peat, Humus, Swamp Soils With High Organic Contents

Relationship of SPT to Relative Denisty of Sand

Description	*SPT N Blows/ft.*	*Relative Density %*
Very Loose	4	0-15
Loose	4-10	15-35
Medium Dense	10-30	35-65
Dense	30-50	65-85
Very Dense	50	85-100

Unified Soil Classification System

Boulders		>300mm	>11.8in
Cobbles		75-300mm	2.9-11.8in
Gravel	*Coarse*	75-19mm	2.9-.75in
	Fine	19-4.8mm	.75-.19in
Sand	*Coarse*	4.8-2.0mm	.19-.08in
	Medium	2.0-.43mm	.08-.02in
	Fine	.43-.08mm	.02-.003in
Fines	*Silts*	<.08mm	<.003in
	Clays	<.08mm	<.003in

Relative Proportions of Sand and Gravel

Descriptive Terms	*Percent of Dry Weight*
Trace	**<15**
With	**15-29**
Modifier	**>30**

Relative Proportions of Fines

Descriptive Terms	*Percent of Dry Weight*
Trace	**>5**
With	**5-12**
Modifier	**>12**

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SOIL CLASSIFICATION CHART

Unified Soil Classification System

Project:	Landpro 8159-8162 Site	**Project No:**	12.0010.0140
Client:	Sunlight Partners LLC	**Sample ID:**	NA
		Attachment:	A1
		Sheet:	1 of 1

Depth (ft.)	SPT (/ft).	Sample Type	WC (%)	In-Place Density	Lab Tests	USCS Group	Material Description	Remarks / Observations
0		Bulk				SM	Silty sand	Easy Drilling
1								
2								
3								Difficulty Drilling
4								
5	6	SPT				SW	Well graded sand with gravel	Very Difficult drilling
6	22							
7	27	Tube						Auger Refusal at 7'
8								Rock Bit required
9								Medium difficulty drilling
10	11	SPT				GW	Well-graded gravel with sand	Ground water encounterd at +/- 10'
11	50x3							
12		TUBE	7.45	141.0 pcf				
13								Some collapsing occurred
14								upon removal of augers
15	19	SPT				SW	Well graded sand with gravel	
16	31							
17	23							
18								Medium difficulty drilling
19								
20	24	SPT				SM	Silty sand with gravel	
21	35							
22	42							
23								
24								Medium difficulty drilling
25	25	SPT				SM	Silty sand with gravel	
26	50x6							
27								
28								
29								
30	10	SPT				SM	Silty sand with gravel	Boring Terminated at 30'
31	42							
32	31							
33								
34								

Conducted By:	Ryan Heywood	**Equipment Operator:**	Jeff Calloway
Exploration Type:	Boring	**Dimmensions:**	30' x 8"
Equipment Type:	CME 55 Limited Access Drill Rig	**Drive Weight / Type:**	140 lbs
Boring Orientation:	Vertical	**Drill Rod; Type / Dim.:**	Hollow Stem Auger / 5' X 8"
Advance Method:	None	**Sampler Insertion:**	Driven
Field Tests Conducted:	SPT	**Sample Preservation:**	D4220
Shoring Type Used:	NA	**Backfilled / Date:**	1/18/2011
Weather Conditions:	None to note	**Groundwater Level:**	Not Encountered
Start / End Date:	01/18/12 / 01/18/11	**Start / End Time:**	7:00 / 8:30

Merrell Johnson COMPANIES

EXPLORATORY LOG

ASTM D 5434, D 1452, D 1586, D 1587, D2488 (USCS), D3550

Project:	Landpro 8159-8162 Site	**Project No:**	12.0010.0140
Client:	Sunlight Partners LLC	**Location No.:**	B1
Location:	See Attachment C4	**Attachment:**	A2
Surface Elev:	Approximately 2,407'	**Sheet:**	1 of 10

Depth (ft.)	SPT (/ft).	Sample Type	WC (%)	In-Place Density	Lab Tests	USCS Group	Material Description	Remarks / Observations
0		Bulk				SM	Silty sand	Easy Drilling with rock bit
1								
2								
3								
4								
5	11	SPT	20.3		SA	SW	Well graded sand with gravel	1.9% fines
6	18							
7	23							Medium difficulty drilling
8								
9								Ground water encounterd at +/- 10'
10	23	SPT	10.9		SA	SW	Well graded sand with gravel	4.5% fines
11	13							
12	12							
13								Some collapsing occurred
14								upon removal of augers
15	12	SPT			SA	SW	Well graded sand with gravel	
16	13							
17	21							
18								Medium difficulty drilling
19								
20	6	SPT	12.9			SM	Silty sand with gravel	16.4% fines
21	29							
22	19							
23								
24								
25	19	SPT				SM	Silty sand with gravel	Boring Terminated at 25'
26	29							
27	26							
28								
29								
30								
31								
32								
33								
34								

Conducted By:	Ryan Heywood	**Equipment Operator:**	Jeff Calloway
Exploration Type:	Boring	**Dimmensions:**	25' x 8"
Equipment Type:	CME 55 Limited Access Drill Rig	**Drive Weight / Type:**	140 lbs
Boring Orientation:	Vertical	**Drill Rod; Type / Dim.:**	Hollow Stem Auger / 5' X 8"
Advance Method:	None	**Sampler Insertion:**	Driven
Field Tests Conducted:	SPT	**Sample Preservation:**	D4220
Shoring Type Used:	NA	**Backfilled / Date:**	1/18/2011
Weather Conditions:	None to note	**Groundwater Level:**	Not Encountered
Start / End Date:	01/18/12 / 01/18/11	**Start / End Time:**	8:30 / 9:15

Merrell Johnson COMPANIES

EXPLORATORY LOG

ASTM D 5434, D 1452, D 1586, D 1587, D2488 (USCS), D3550

Project:	Landpro 8159-8162 Site	**Project No:**	12.0010.0140
Client:	Sunlight Partners LLC	**Location No.:**	B2
Location:	See Attachment C4	**Attachment:**	A2
Surface Elev:	Approximately 2,407'	**Sheet:**	2 of 10

Depth (ft.)	SPT (/ft).	Sample Type	WC (%)	In-Place Density	Lab Tests	USCS Group	Material Description	Remarks / Observations
0		Bulk				SM	Silty sand	Easy Drilling with rock bit
1								
2								
3								Traces of clay
4								
5	5	SPT				SW	Well graded sand with gravel	Medium difficulty drilling
6	4							
7	4	Tube	16.58	120.6 pcf				
8								
9								
10	10	SPT				SW	Well graded sand with gravel	Ground water encounterd at +/- 10'
11	14							
12	10							
13								Some collapsing occurred
14								upon removal of augers
15	14	SPT				SW	Well graded sand with gravel	
16	14							
17	23							
18								Medium difficulty drilling
19								
20	20	SPT				SM	Silty sand with gravel	Traces of clay
21	50x6							
22								
23								
24								
25	35	SPT				SM	Silty sand with gravel	Boring Terminated at 25'
26	35							
27	50x4							
28								
29								
30								
31								
32								
33								
34								

Conducted By:	Ryan Heywood	**Equipment Operator:**	Jeff Calloway
Exploration Type:	Boring	**Dimmensions:**	25' x 8"
Equipment Type:	CME 55 Limited Access Drill Rig	**Drive Weight / Type:**	140 lbs
Boring Orientation:	Vertical	**Drill Rod; Type / Dim.:**	Hollow Stem Auger / 5' X 8"
Advance Method:	None	**Sampler Insertion:**	Driven
Field Tests Conducted:	SPT	**Sample Preservation:**	D4220
Shoring Type Used:	NA	**Backfilled / Date:**	1/18/2011
Weather Conditions:	None to note	**Groundwater Level:**	Not Encountered
Start / End Date:	01/18/12 / 01/18/11	**Start / End Time:**	9:15 / 10:00

Merrell Johnson COMPANIES

EXPLORATORY LOG

ASTM D 5434, D 1452, D 1586, D 1587, D2488 (USCS), D3550

Project:	Landpro 8159-8162 Site	**Project No:**	12.0010.0140
Client:	Sunlight Partners LLC	**Location No.:**	B3
Location:	See Attachment C4	**Attachment:**	A2
Surface Elev:	Approximately 2,407'	**Sheet:**	3 of 10

Depth (ft.)	SPT (/ft).	Sample Type	WC (%)	In-Place Density	Lab Tests	USCS Group	Material Description	Remarks / Observations
0		Bulk				SM	Silty sand	Easy Drilling with rock bit
1								
2								
3								
4								
5	9					SW	Well graded sand with gravel	Medium difficulty drilling
6	11							
7	11							
8								
9								
10	12					SW	Well graded sand with gravel	
11	25							
12	20							
13								Ground water encounterd at +/- 13'
14								
15	16					SW	Well graded sand with gravel	Some collapsing occurred
16	29							upon removal of augers
17	50x3							
18								Medium difficulty drilling
19								
20	26					SM	Silty sand with gravel	Traces of clay
21	50x5							
22								
23								
24								
25	15					SM	Silty sand with gravel	Boring Terminated at 25'
26	31							
27	50							
28								
29								
30	15					SM	Silty sand with gravel	Boring Terminated at 30'
31	37							
32	42							
33								
34								

Conducted By:	Ryan Heywood	**Equipment Operator:**	Jeff Calloway
Exploration Type:	Boring	**Dimmensions:**	30' x 8"
Equipment Type:	CME 55 Limited Access Drill Rig	**Drive Weight / Type:**	140 lbs
Boring Orientation:	Vertical	**Drill Rod; Type / Dim.:**	Hollow Stem Auger / 5' X 8"
Advance Method:	None	**Sampler Insertion:**	Driven
Field Tests Conducted:	SPT	**Sample Preservation:**	D4220
Shoring Type Used:	NA	**Backfilled / Date:**	1/18/2011
Weather Conditions:	None to note	**Groundwater Level:**	Not Encountered
Start / End Date:	01/18/12 / 01/18/11	**Start / End Time:**	10:00 / 11:00

Merrell Johnson COMPANIES

EXPLORATORY LOG

ASTM D 5434, D 1452, D 1586, D 1587, D2488 (USCS), D3550

Project:	Landpro 8159-8162 Site	**Project No:**	12.0010.0140
Client:	Sunlight Partners LLC	**Location No.:**	B4
Location:	See Attachment C4	**Attachment:**	A2
Surface Elev:	Approximately 2,407'	**Sheet:**	4 of 10

Depth (ft.)	SPT (/ft).	Sample Type	WC (%)	In-Place Density	Lab Tests	USCS Group	Material Description	Remarks / Observations
0		Bulk				SM	Silty sand	Easy Drilling with rock bit
1								
2								
3								
4								
5	3					SW	Well graded sand with gravel	Medium difficulty drilling
6	4							
7	6							Some collapsing occurred
8								upon removal of augers
9								
10	5					SW	Well graded sand with gravel	
11	8							
12	9							Ground water encounterd at +/- 12'
13								
14								
15	5					SW	Well graded sand with gravel	Boring Terminated at 15'
16	50x3							
17								
18								
19								
20								
21								
22								
23								
24								
25								
26								
27								
28								
29								
30								
31								
32								
33								
34								

Conducted By:	Ryan Heywood	**Equipment Operator:**	Jeff Calloway
Exploration Type:	Boring	**Dimmensions:**	15' x 8"
Equipment Type:	CME 55 Limited Access Drill Rig	**Drive Weight / Type:**	140 lbs
Boring Orientation:	Vertical	**Drill Rod; Type / Dim.:**	Hollow Stem Auger / 5' X 8"
Advance Method:	None	**Sampler Insertion:**	Driven
Field Tests Conducted:	SPT	**Sample Preservation:**	D4220
Shoring Type Used:	NA	**Backfilled / Date:**	1/18/2011
Weather Conditions:	None to note	**Groundwater Level:**	Not Encountered
Start / End Date:	01/18/12 / 01/18/11	**Start / End Time:**	11:00 / 11:30

Merrell Johnson COMPANIES

EXPLORATORY LOG

ASTM D 5434, D 1452, D 1586, D 1587, D2488 (USCS), D3550

Project:	Landpro 8159-8162 Site	**Project No:**	12.0010.0140
Client:	Sunlight Partners LLC	**Location No.:**	B5
Location:	See Attachment C4	**Attachment:**	A2
Surface Elev:	Approximately 2,407'	**Sheet:**	5 of 10

Depth (ft.)	SPT (/ft).	Sample Type	WC (%)	In-Place Density	Lab Tests	USCS Group	Material Description	Remarks / Observations
0						SM	Silty sand	Easy Drilling with rock bit
1								
2								Traces of clay
3								
4								
5	12					SW	Well graded sand with gravel	Medium difficulty drilling
6	18							
7	18							Some collapsing occurred
8								upon removal of augers
9								
10	26					SW	Well graded sand with gravel	
11	21							
12	21							
13								Ground water encounterd at +/- 13'
14								
15	12	SPT				SW	Well graded sand with gravel	Boring Terminated at 15'
16	30							
17	40							
18								
19								
20								
21								
22								
23								
24								
25								
26								
27								
28								
29								
30								
31								
32								
33								
34								

Conducted By:	Ryan Heywood	**Equipment Operator:**	Jeff Calloway
Exploration Type:	Boring	**Dimmensions:**	15' x 8"
Equipment Type:	CME 55 Limited Access Drill Rig	**Drive Weight / Type:**	140 lbs
Boring Orientation:	Vertical	**Drill Rod; Type / Dim.:**	Hollow Stem Auger / 5' X 8"
Advance Method:	None	**Sampler Insertion:**	Driven
Field Tests Conducted:	SPT	**Sample Preservation:**	D4220
Shoring Type Used:	NA	**Backfilled / Date:**	1/18/2011
Weather Conditions:	None to note	**Groundwater Level:**	Not Encountered
Start / End Date:	01/18/12 / 01/18/11	**Start / End Time:**	11:30 / 12:00

Merrell Johnson COMPANIES

EXPLORATORY LOG

ASTM D 5434, D 1452, D 1586, D 1587, D2488 (USCS), D3550

Project:	Landpro 8159-8162 Site	**Project No:**	12.0010.0140
Client:	Sunlight Partners LLC	**Location No.:**	B6
Location:	See Attachment C4	**Attachment:**	A2
Surface Elev:	Approximately 2,407'	**Sheet:**	6 of 10

Depth (ft.)	SPT (/ft).	Sample Type	WC (%)	In-Place Density	Lab Tests	USCS Group	Material Description	Remarks / Observations
0						SM	Silty sand	Easy Drilling with rock bit
1								
2								Traces of clay
3								
4								
5	5					SW	Well graded sand with gravel	Medium difficulty drilling
6	5							
7	6	Tube						Some collapsing occurred
8								upon removal of augers
9								
10	6					GW	Well graded sand with gravel	
11	11							Ground water encounterd at +/- 11'
12	14							
13								
14								
15	4					SW	Well graded sand with gravel	Boring Terminated at 15'
16	7							
17	14							
18								
19								
20								
21								
22								
23								
24								
25								
26								
27								
28								
29								
30								
31								
32								
33								
34								

Conducted By:	Ryan Heywood	**Equipment Operator:**	Jeff Calloway
Exploration Type:	Boring	**Dimmensions:**	15' x 8"
Equipment Type:	CME 55 Limited Access Drill Rig	**Drive Weight / Type:**	140 lbs
Boring Orientation:	Vertical	**Drill Rod; Type / Dim.:**	Hollow Stem Auger / 5' X 8"
Advance Method:	None	**Sampler Insertion:**	Driven
Field Tests Conducted:	SPT	**Sample Preservation:**	D4220
Shoring Type Used:	NA	**Backfilled / Date:**	1/18/2011
Weather Conditions:	None to note	**Groundwater Level:**	Not Encountered
Start / End Date:	01/18/12 / 01/18/11	**Start / End Time:**	12:00 / 12:30

Merrell Johnson COMPANIES

EXPLORATORY LOG

ASTM D 5434, D 1452, D 1586, D 1587, D2488 (USCS), D3550

Project:	Landpro 8159-8162 Site	**Project No:**	12.0010.0140
Client:	Sunlight Partners LLC	**Location No.:**	B7
Location:	See Attachment C4	**Attachment:**	A2
Surface Elev:	Approximately 2,407'	**Sheet:**	7 of 10

Depth (ft.)	SPT (/ft).	Sample Type	WC (%)	In-Place Density	Lab Tests	USCS Group	Material Description	Remarks / Observations
0						SM	Silty sand	Easy Drilling with rock bit
1								
2								Traces of clay
3								
4								
5	10					SW	Well graded sand with gravel	Medium difficulty drilling
6	25							
7	50x5							Some collapsing occurred
8								upon removal of augers
9								
10	23					GW	Well graded sand with gravel	Ground water encounterd at +/- 10'
11	20							
12	17							
13								
14								
15	12					SW	Well graded sand with gravel	Boring Terminated at 15'
16	24							
17	21							
18								
19								
20								
21								
22								
23								
24								
25								
26								
27								
28								
29								
30								
31								
32								
33								
34								

Conducted By:	Ryan Heywood	**Equipment Operator:**	Jeff Calloway
Exploration Type:	Boring	**Dimmensions:**	15' x 8"
Equipment Type:	CME 55 Limited Access Drill Rig	**Drive Weight / Type:**	140 lbs
Boring Orientation:	Vertical	**Drill Rod; Type / Dim.:**	Hollow Stem Auger / 5' X 8"
Advance Method:	None	**Sampler Insertion:**	Driven
Field Tests Conducted:	SPT	**Sample Preservation:**	D4220
Shoring Type Used:	NA	**Backfilled / Date:**	1/18/2011
Weather Conditions:	None to note	**Groundwater Level:**	Not Encountered
Start / End Date:	01/18/12 / 01/18/11	**Start / End Time:**	12:30 / 13:00

Merrell Johnson COMPANIES

EXPLORATORY LOG

ASTM D 5434, D 1452, D 1586, D 1587, D2488 (USCS), D3550

Project:	Landpro 8159-8162 Site	**Project No:**	12.0010.0140
Client:	Sunlight Partners LLC	**Location No.:**	B8
Location:	See Attachment C4	**Attachment:**	A2
Surface Elev:	Approximately 2,407'	**Sheet:**	8 of 10

Depth (ft.)	SPT (/ft).	Sample Type	WC (%)	In-Place Density	Lab Tests	USCS Group	Material Description	Remarks / Observations
0						SM	Silty sand	Easy Drilling with rock bit
1								
2								
3								
4								
5	7					SW	Well graded sand with gravel	Medium difficulty drilling
6	6							
7	9							Some collapsing occurred
8								upon removal of augers
9								
10	6					SW	Well graded sand with gravel	
11	9							
12	19							
13								
14								Muddy, nut no free moisture
15	5					SW	Well graded sand with gravel	Boring Terminated at 15'
16	11							
17	30							
18								
19								
20								
21								
22								
23								
24								
25								
26								
27								
28								
29								
30								
31								
32								
33								
34								

Conducted By:	Ryan Heywood	**Equipment Operator:**	Jeff Calloway
Exploration Type:	Boring	**Dimmensions:**	15' x 8"
Equipment Type:	CME 55 Limited Access Drill Rig	**Drive Weight / Type:**	140 lbs
Boring Orientation:	Vertical	**Drill Rod; Type / Dim.:**	Hollow Stem Auger / 5' X 8"
Advance Method:	None	**Sampler Insertion:**	Driven
Field Tests Conducted:	SPT	**Sample Preservation:**	D4220
Shoring Type Used:	NA	**Backfilled / Date:**	1/18/2011
Weather Conditions:	None to note	**Groundwater Level:**	Not Encountered
Start / End Date:	01/18/12 / 01/18/11	**Start / End Time:**	13:00 / 13:30

Merrell Johnson COMPANIES

EXPLORATORY LOG

ASTM D 5434, D 1452, D 1586, D 1587, D2488 (USCS), D3550

Project:	Landpro 8159-8162 Site	**Project No:**	12.0010.0140
Client:	Sunlight Partners LLC	**Location No.:**	B9
Location:	See Attachment C4	**Attachment:**	A2
Surface Elev:	Approximately 2,407'	**Sheet:**	9 of 10

Depth (ft.)	SPT (/ft).	Sample Type	WC (%)	In-Place Density	Lab Tests	USCS Group	Material Description	Remarks / Observations
0						SM	Silty sand	Easy Drilling with rock bit
1								
2								
3								
4								
5	6					SW	Well graded sand with gravel	Medium difficulty drilling
6	6							
7	8							Some collapsing occurred
8								upon removal of augers
9								
10	7					SW	Well graded sand with gravel	
11	7							Ground water at +/- 11'
12	13							
13								
14								
15	4					SW	Well graded sand with gravel	Boring Terminated at 15'
16	9							
17	18							
18								
19								
20								
21								
22								
23								
24								
25								
26								
27								
28								
29								
30								
31								
32								
33								
34								

Conducted By:	Ryan Heywood	**Equipment Operator:**	Jeff Calloway
Exploration Type:	Boring	**Dimmensions:**	15' x 8"
Equipment Type:	CME 55 Limited Access Drill Rig	**Drive Weight / Type:**	140 lbs
Boring Orientation:	Vertical	**Drill Rod; Type / Dim.:**	Hollow Stem Auger / 5' X 8"
Advance Method:	None	**Sampler Insertion:**	Driven
Field Tests Conducted:	SPT	**Sample Preservation:**	D4220
Shoring Type Used:	NA	**Backfilled / Date:**	1/18/2011
Weather Conditions:	None to note	**Groundwater Level:**	Not Encountered
Start / End Date:	01/18/12 / 01/18/11	**Start / End Time:**	13:30 / 14:00

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EXPLORATORY LOG

ASTM D 5434, D 1452, D 1586, D 1587, D2488 (USCS), D3550

Project:	Landpro 8159-8162 Site	**Project No:**	12.0010.0140
Client:	Sunlight Partners LLC	**Location No.:**	B10
Location:	See Attachment C4	**Attachment:**	A2
Surface Elev:	Approximately 2,407'	**Sheet:**	10 of 10

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ATTACHMENT B

LABORATORY TESTING

Laboratory Compaction Characteristics

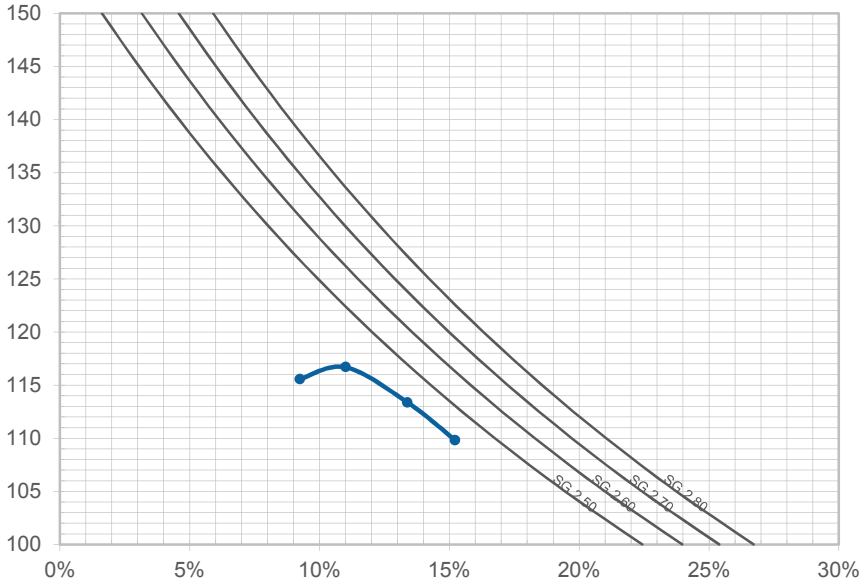
ASTM D1557, D2488

Report Date:	01/27/12
Sheet:	1 *of* 1
Attachment:	
Permit No.:	
Client Project No.:	
Other:	
DSA File No.:	
DSA Application No.:	
DSA LEA No.:	

Project Number:	12.0010.0140
Project Title:	Landpro 8159-8162 Site, APN 0466-181-59, 60, 61 & 62
Project Location:	Helendale, CA
Client:	Sunlight Partners

Sample ID: RTH01181215 **Maximum Dry Unit Weight** (lbf/ft^3): 116.7 **Optimum Moisture Content** (%): 11.0

Classification, ASTM D2488: SM Silty sand with clay
Sample Origin: B3 @0-3
Laboratory Remarks:



Tested By:	JSB
Received Moisture:	3.3%
Preparation:	Moist
Specific Gravity:	
SG Method:	
Start Weight (lb):	
Retained on 3/4" (lb):	
Retained on 3/8" (lb):	
Retained on No. 4 (lb):	
Retained on 3/4" (%):	
Retained on 3/8" (%):	
Retained on No. 4 (%):	
Oversize Correction:	
Volume of Mold:	30.00
Tare Weight:	5.29
Rammer Used:	Manual

Method Used: ☑ A ☐ B ☐ C

Weight of Soil and Tare (lb):	9.50	9.61	9.58	9.51
Wet Weight (g):	308.1	305.4	302.2	310.4
Dry Weight (g):	282.0	275.1	266.5	269.4
Moisture Content (%):	9.3%	11.0%	13.4%	15.2%
Dry Unit Weight (lb/ft^3):	115.5	116.7	113.4	109.8

The Material ☐ Was ☐ Was Not Sampled & tested in accordance with the reqs. of the DSA approved documents.
The Material Tested ☐ Met ☐ Did Not Meet The requirements of the DSA approved documents.

cc: Project Architect, Structural Engineer, Project Inspector, DSA Regional Office, School District

Reviewed By (Signature)

Jeff Burns / Division Manager
Name / Title

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concept to completion
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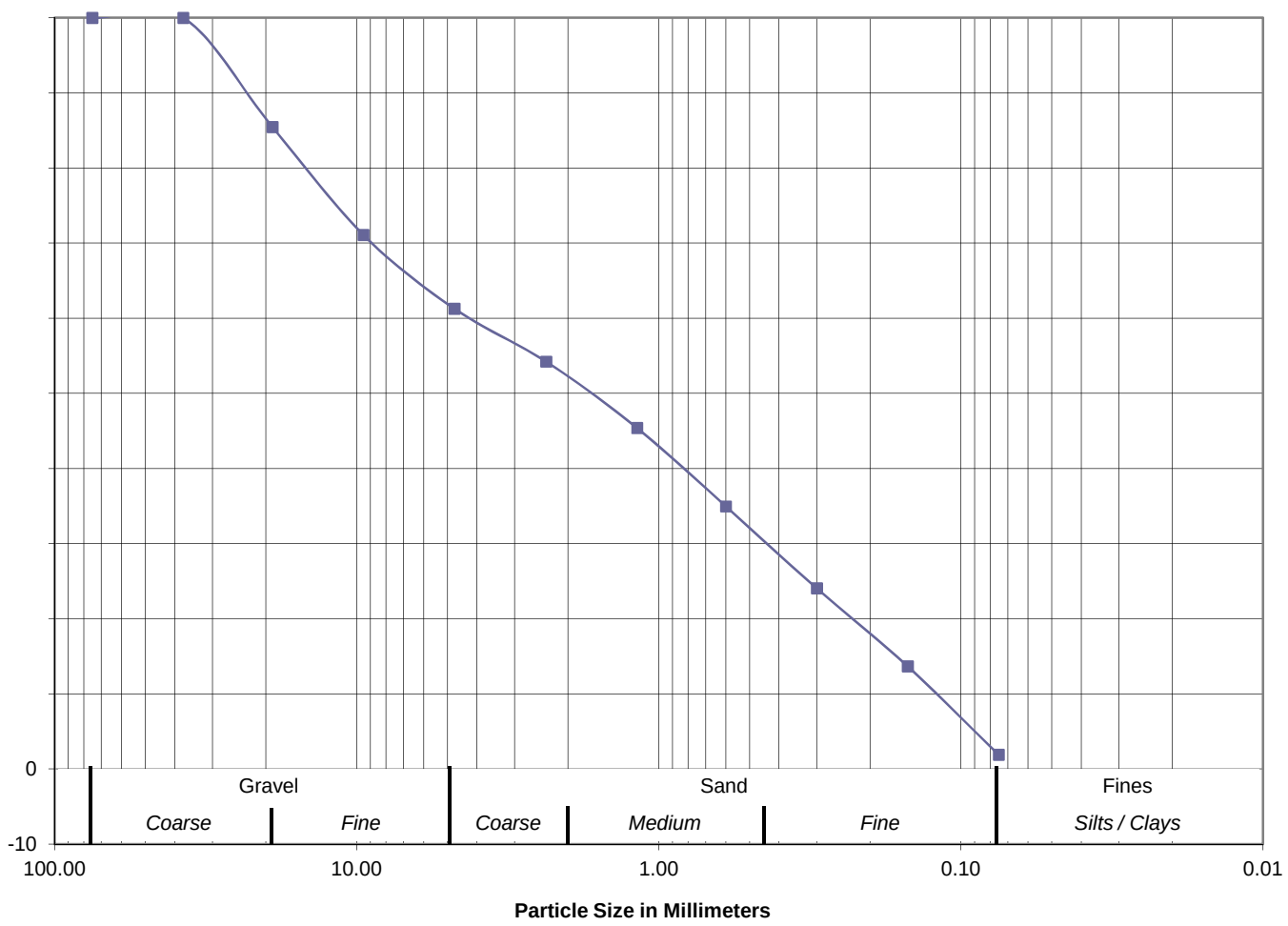
t)760.256.2068 f)760.256.0418 w)www.merrelljohnson.com



Gravel	Sand	Fines	C_u	C_c	MC	D_{100}	D_{60}	D_{30}	D_{10}	LL	PL	PI	SG	FM
38.7%	59.4%	1.9%	40	0	20.3%	38.000	4.010	0.401	0.101	ND	ND	ND	ND	ND

Classification / Description (D 2487): SW Well-graded sand with gravel
Color (Moist, Munsell): Not Determined
Sample Origin: Boring two at an approximate depth of five feet

Method/Procedure Used (C 117, D 1140): Procedure A
Size of Initial Dry Mass (g): 786.2
Determination of Dry Mass (D 1140): Not Applicable
Particles; Shape & Hardness (D 422):: Not Applicable
Dispersion Device/Period (D 422): Not Applicable
Difficulty, Type & Amount of Agent (D 422): Not Applicable
Laboratory Comments: -

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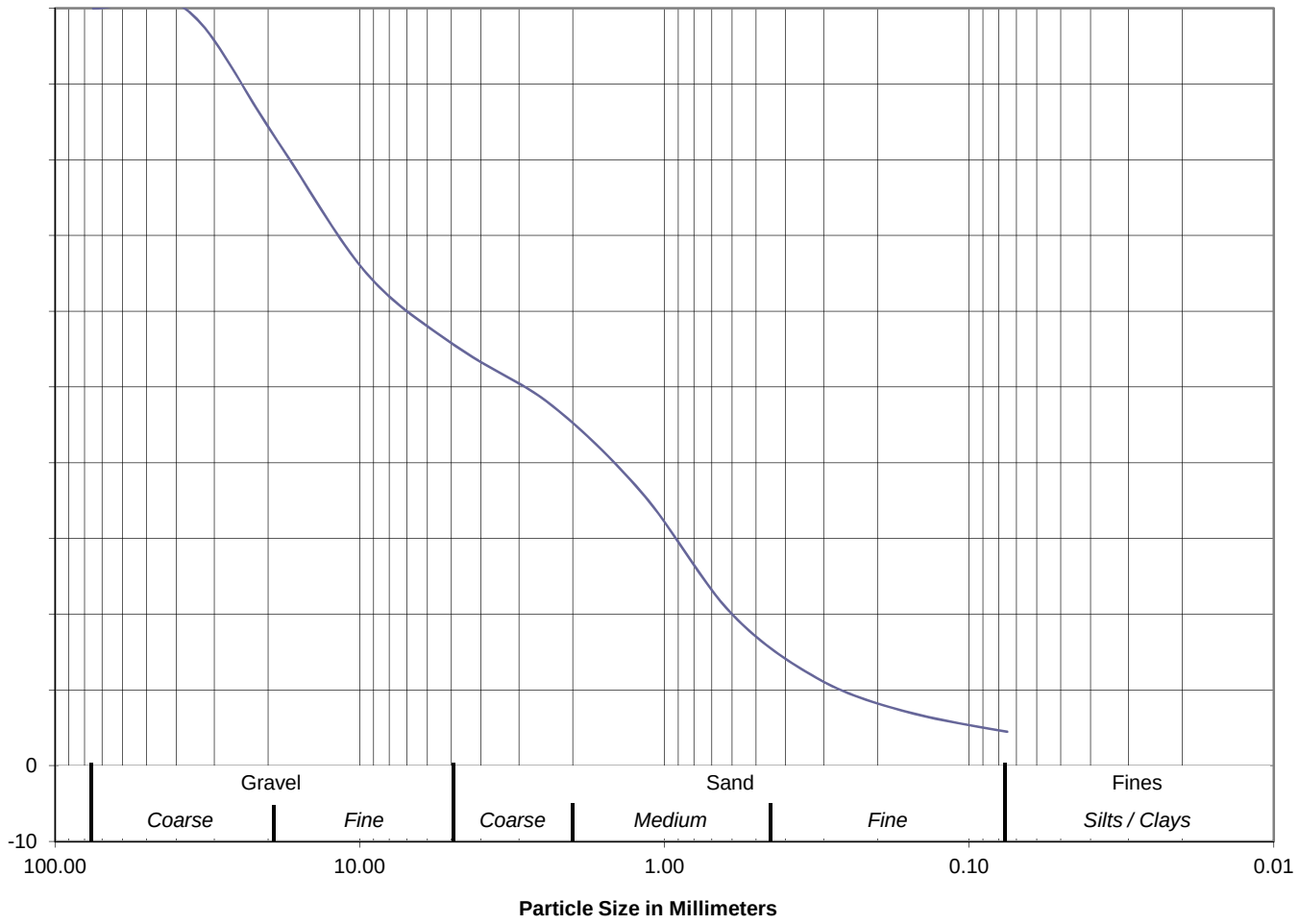
GRAIN SIZE ANALYSIS

ASTM C 136, C 117, D 422, D 1140, D2487

Project: Landpro 8159-8162 Site
Client: Sunlight Partners LLC
Project No: 12.0010.0140
Sample ID: RTH01181210
Attachment: B2
Sheet: 1 of 3

U.S. Sieve Opening In Inches	U.S. Standard Sieve Number	Hydrometer



Gravel	Sand	Fines	C_u	C_c	MC	D_{100}	D_{60}	D_{30}	D_{10}	LL	PL	PI	SG	FM
44.8%	50.7%	4.5%	27	0	10.9%	38.000	7.000	0.900	0.260	ND	ND	ND	ND	ND

Classification / Description (D 2487):	SW Well-graded sand with gravel
Color (Moist, Munsell):	Not Determined
Sample Origin:	Boring two at an approximate depth of ten feet
Method/Procedure Used (C 117, D 1140):	Procedure A
Size of Initial Dry Mass (g):	593.4
Determination of Dry Mass (D 1140):	Not Applicable
Particles; Shape & Hardness (D 422)::	Not Applicable
Dispersion Device/Period (D 422):	Not Applicable
Difficulty, Type & Amount of Agent (D 422):	Not Applicable
Laboratory Comments:	-

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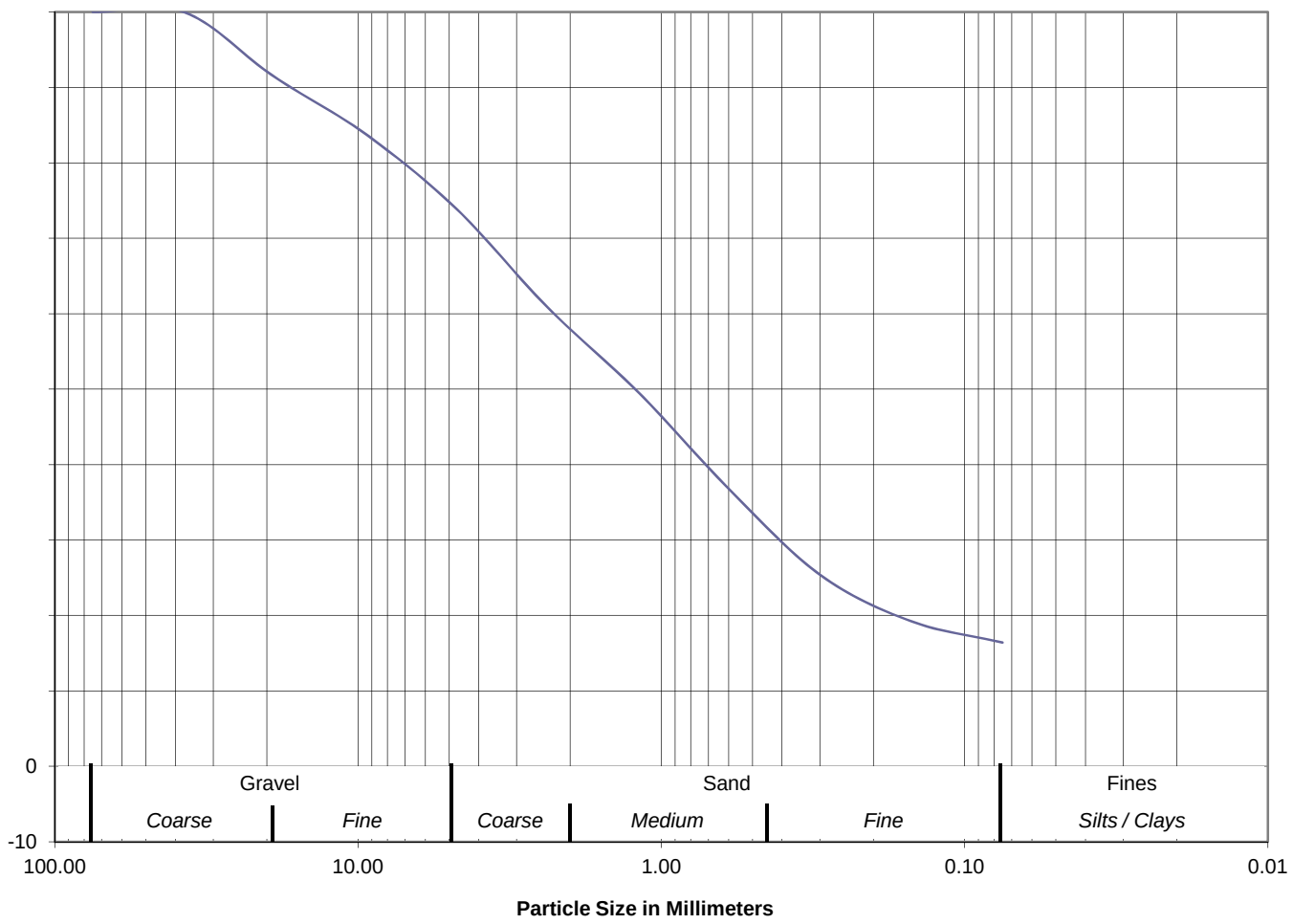
GRAIN SIZE ANALYSIS

ASTM C 136, C 117, D 422, D 1140, D2487

Project:	Landpro 8159-8162 Site	**Project No:**	12.0010.0140
Client:	Sunlight Partners LLC	**Sample ID:**	RTH01181211
		Attachment:	B2
		Sheet:	2 of 3



Gravel	Sand	Fines	C_u	C_c	MC	D_{100}	D_{60}	D_{30}	D_{10}	LL	PL	PI	SG	FM
26.1%	57.5%	16.4%	NA	NA	12.9%	30.700	2.100	0.400	NA	ND	ND	ND	ND	ND

Classification / Description (D 2487): SM Silty sand with gravel
Color (Moist, Munsell): Not Determined
Sample Origin: Boring two at an approximate depth of twenty feet

Method/Procedure Used (C 117, D 1140): Procedure A
Size of Initial Dry Mass (g): 950.1
Determination of Dry Mass (D 1140): Not Applicable
Particles; Shape & Hardness (D 422):: Not Applicable
Dispersion Device/Period (D 422): Not Applicable
Difficulty, Type & Amount of Agent (D 422): Not Applicable
Laboratory Comments: -

Merrell Johnson COMPANIES

GRAIN SIZE ANALYSIS

ASTM C 136, C 117, D 422, D 1140, D2487

Project: Landpro 8159-8162 Site
Client: Sunlight Partners LLC
Project No: 12.0010.0140
Sample ID: RTH01181213
Attachment: B2
Sheet: 3 of 3

Analysis	Results	Units
Saturated Resistivity	600	ohm-cm
Chloride	150	ppm
Sulfate	350	ppm
PH	7.5	pH units
Redox Potential	140	mV
Sulfide	Negative	NA

Merrell Johnson COMPANIES

CORROSION POTENTIAL TEST RESULTS

Project:	Landpro 8159-8162 Site	**Project No:**	12.0010.0140
Client:	Sunlight Partners LLC	**Sample ID:**	RTH01181215
Tested By:	John R. Byerly	**Attachment:**	B3
		Sheet:	1 of 1

Angle of Internal Friction (°)	Cohesion (PSF)
30.0	25

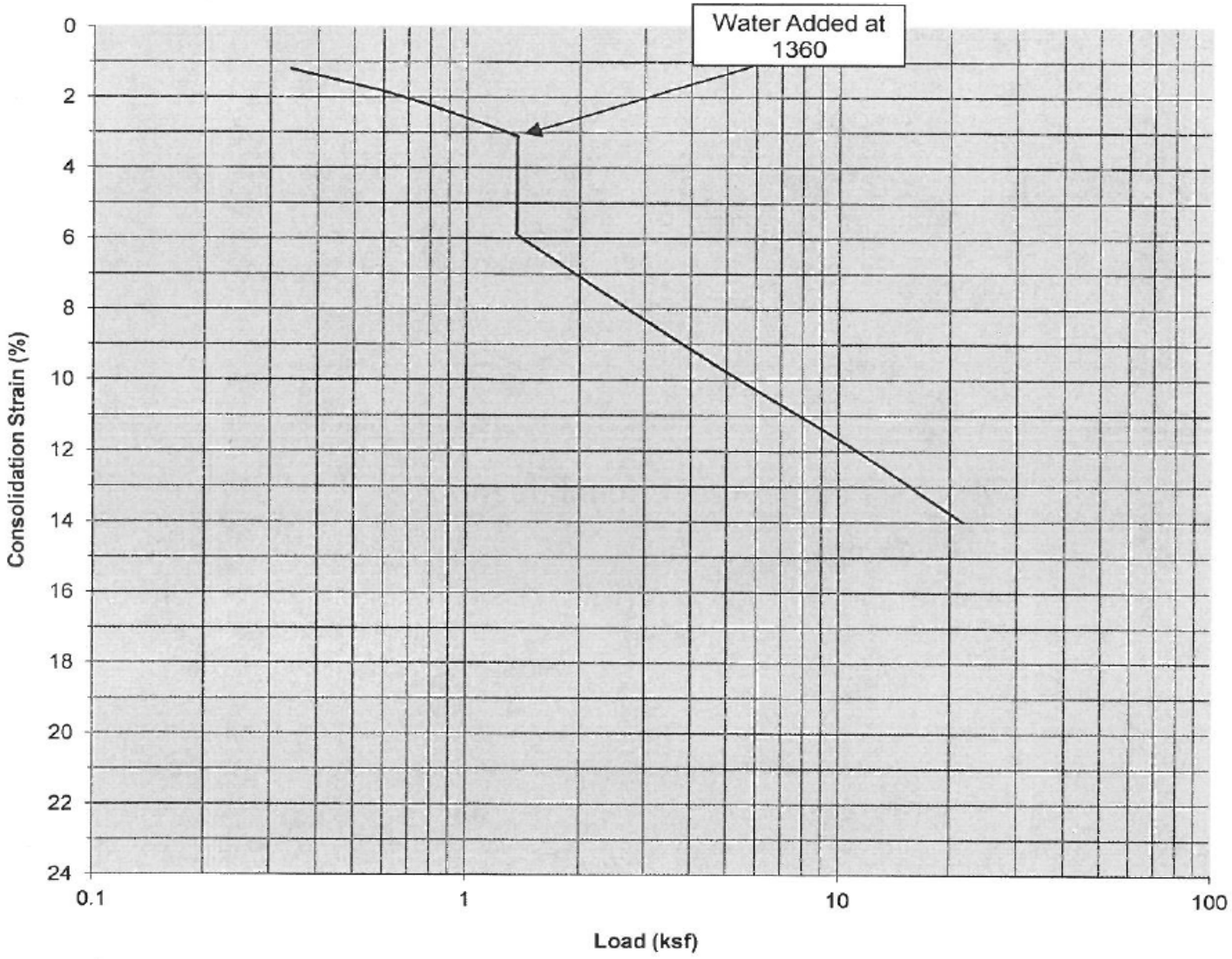
Sample Origin: **Boring seven at an approximate depth of seven feet**

Merrell Johnson COMPANIES

DIRECT SHEAR

Project:	Landpro 8159-8162 Site	**Project No:**	12.0010.0140
Client:	Sunlight Partners LLC	**Sample ID:**	RTH01181225
Tested By:	John R. Byerly	**Attachment:**	B4
		Sheet:	1 of 1

Consolidation Test Results



Classification

Boring Number:	7	Initial Moisture Content (%)	
Depth (ft):	7	Final Moisture Content (%)	22.2
Specimen Diameter (in)	2.46	Initial Dry Density (pcf)	
Specimen Thickness (in)	1.0		

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CONSOLIDATION

Project:	Landpro 8159-8162 Site	**Project No:**	12.0010.0140
Client:	Sunlight Partners LLC	**Sample ID:**	RTH01181225
Tested By:	John R. Byerly	**Attachment:**	B5
		Sheet:	1 of 1

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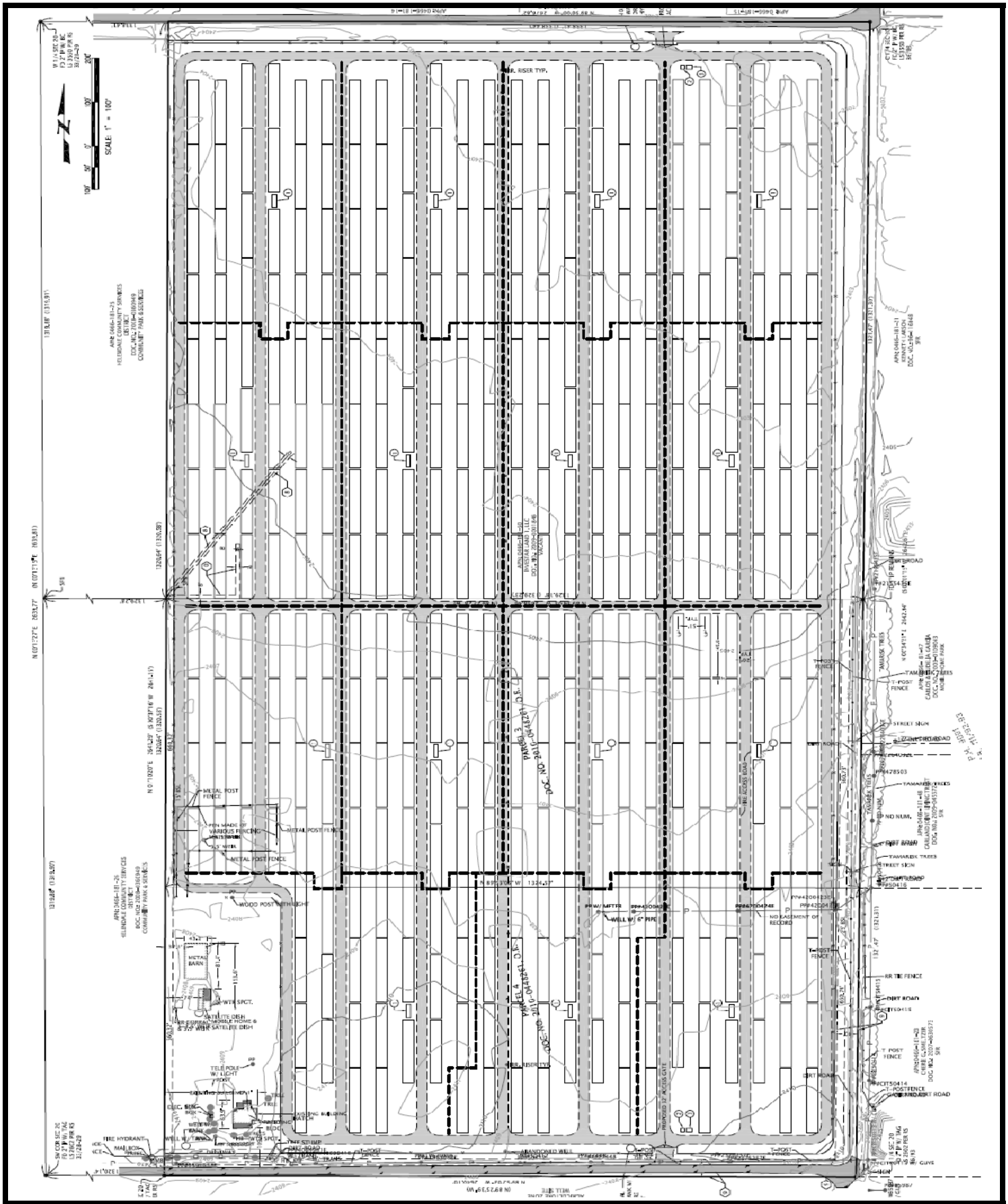
ATTACHMENT C

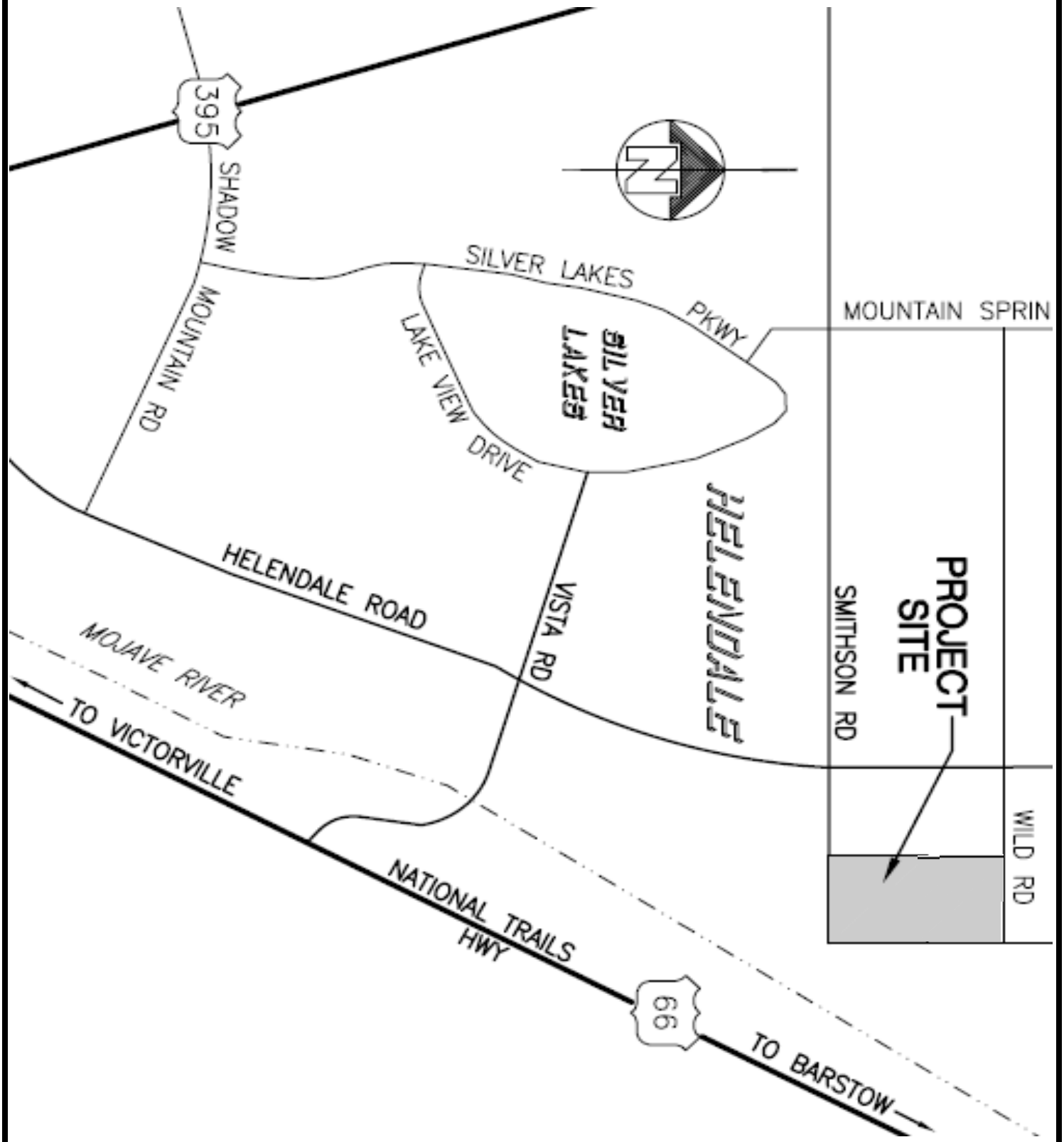
SITE REFERENCE



TOPOGRAPHIC PLOT

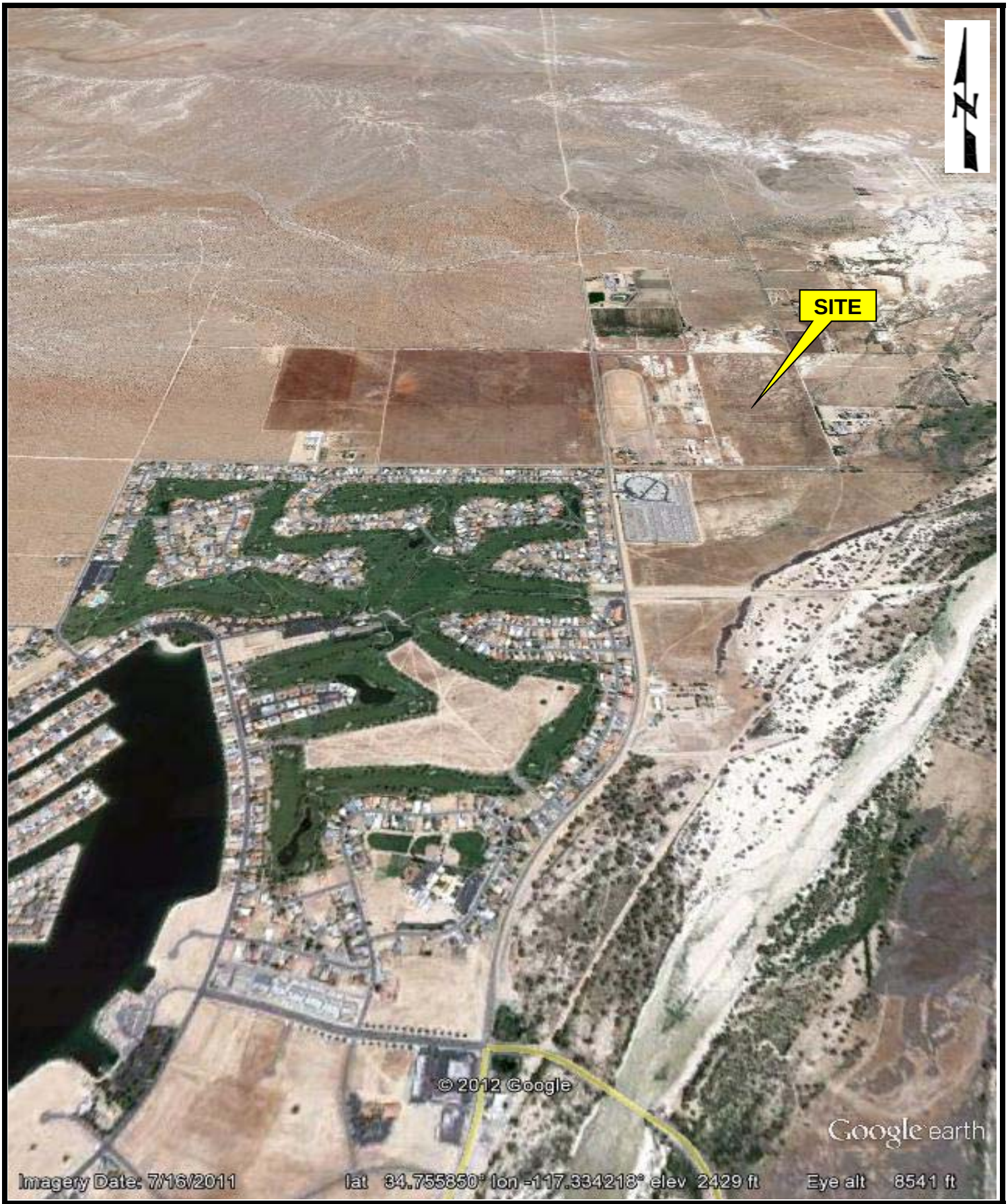
Site Plan Excerpt

Project:	Landpro 8159-8162 Site	**Project No:**	12.0010.0140
Client:	Sunlight Partners LLC	**Sample ID:**	NA
		Attachment:	C1
		Sheet:	1 of 1



SITE VICINITY MAP

Project:	Landpro 8159-8162 Site	**Project No:**	12.0010.0140
Client:	Sunlight Partners LLC	**Sample ID:**	NA
		Attachment:	C2
		Sheet:	1 of 1



AERIAL VIEW

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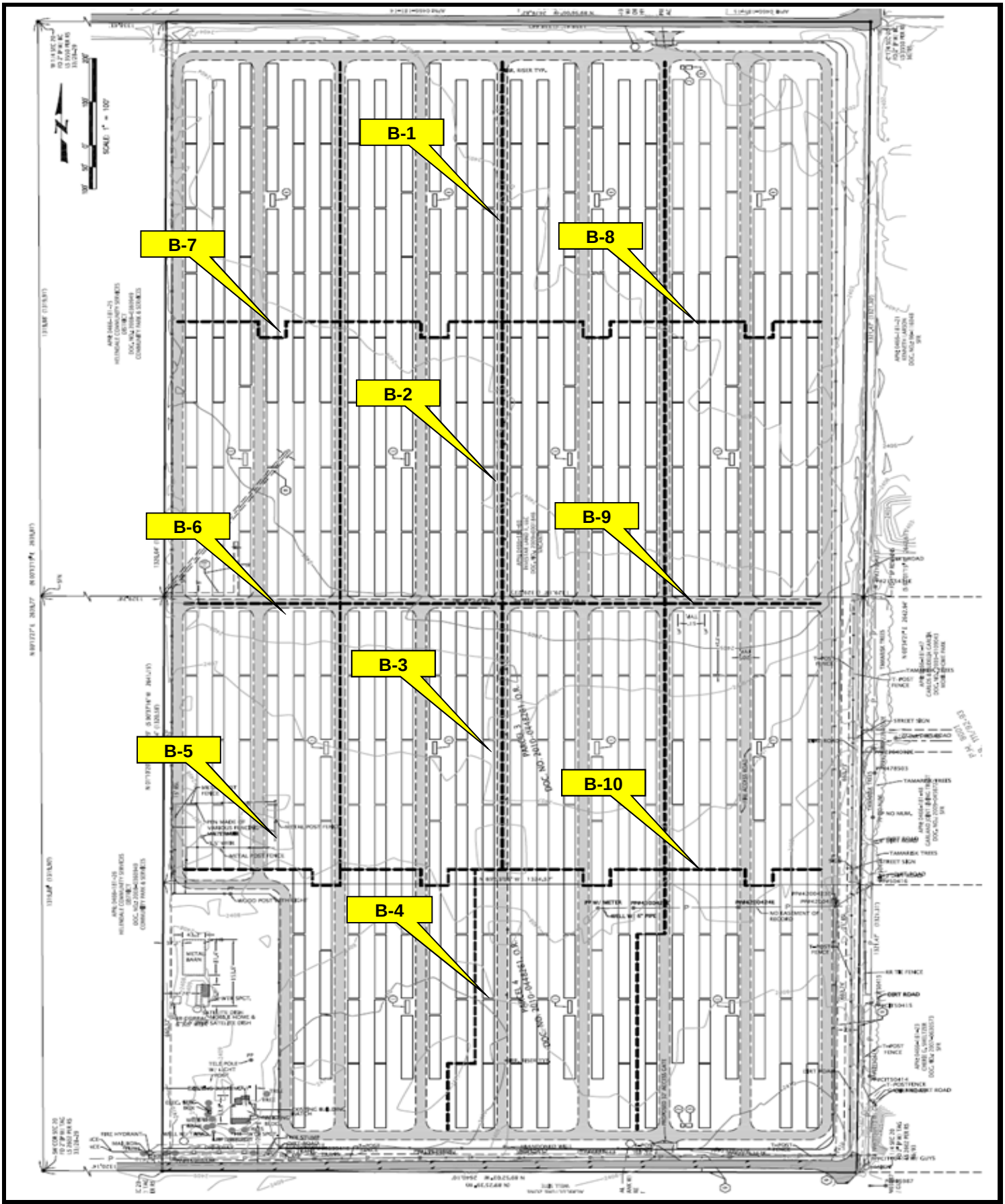
Project:	Landpro 8159-8162 Site	**Project No:**	12.0010.0140
Client:	Sunlight Partners LLC	**Sample ID:**	NA
		Attachment:	C3
		Sheet:	1 of 1



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APPROXIMATE EXCAVATIONS LOCATIONS PLOT

Site Plan Excerpt

Project:	Landpro 8159-8162 Site	**Project No:**	12.0010.0140
Client:	Sunlight Partners LLC	**Sample ID:**	NA
		Attachment:	C4
		Sheet:	1 of 1

ON SITE PHOTOGRAPHS

Project:	Landpro 8159-8162 Site	**Project No:**	12.0010.0140
Client:	Sunlight Partners LLC	**Sample ID:**	NA
		Attachment:	C5
		Sheet:	1 of 5

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ON SITE PHOTOGRAPHS

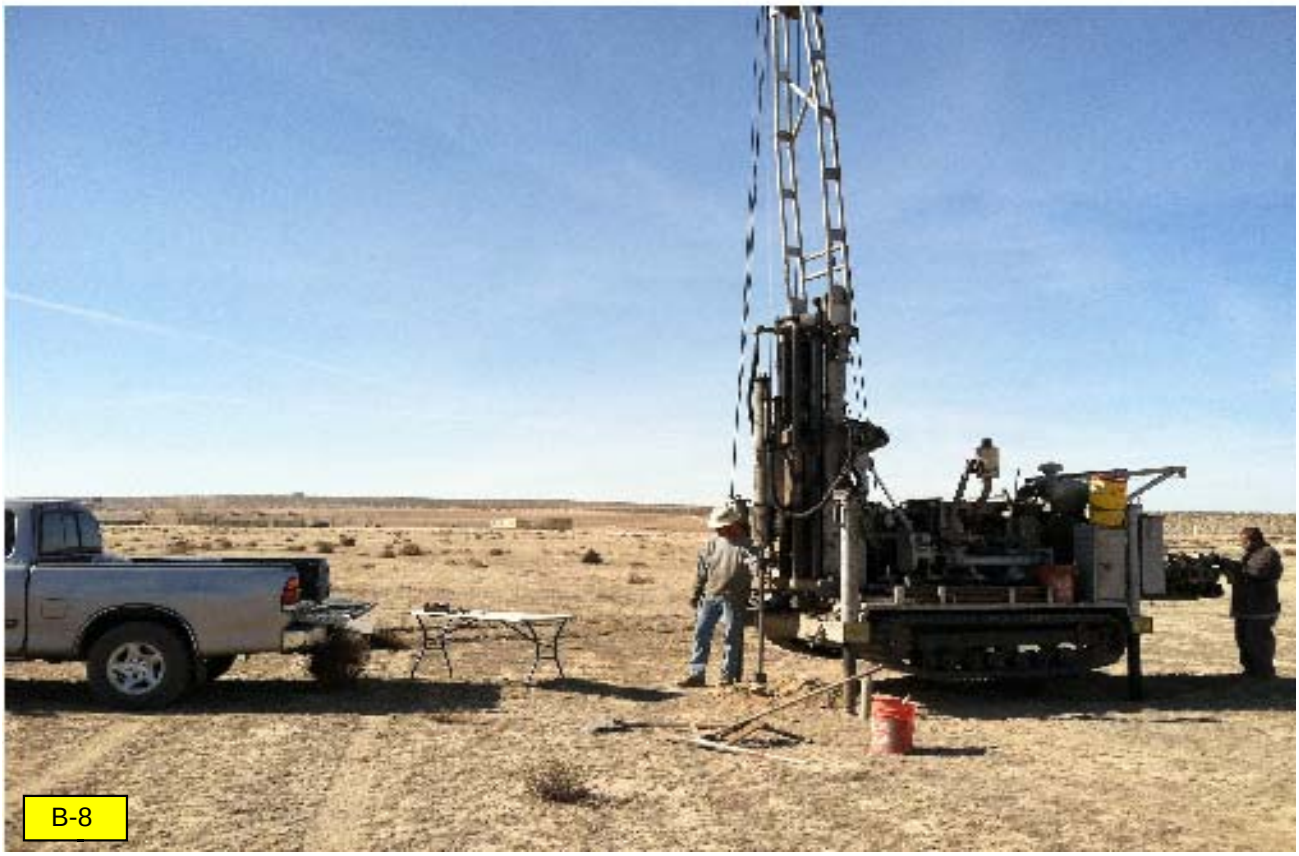
Project:	Landpro 8159-8162 Site	**Project No:**	12.0010.0140
Client:	Sunlight Partners LLC	**Sample ID:**	NA
		Attachment:	C5
		Sheet:	2 of 5

Merrell Johnson COMPANIES

ON SITE PHOTOGRAPHS

Project:	Landpro 8159-8162 Site	**Project No:**	12.0010.0140
Client:	Sunlight Partners LLC	**Sample ID:**	NA
		Attachment:	C5
		Sheet:	3 of 5

Merrell Johnson COMPANIES



ON SITE PHOTOGRAPHS

Project:	Landpro 8159-8162 Site	**Project No:**	12.0010.0140
Client:	Sunlight Partners LLC	**Sample ID:**	NA
		Attachment:	C5
		Sheet:	4 of 5

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ON SITE PHOTOGRAPHS

Project:	Landpro 8159-8162 Site	**Project No:**	12.0010.0140
Client:	Sunlight Partners LLC	**Sample ID:**	NA
		Attachment:	C5
		Sheet:	5 of 5

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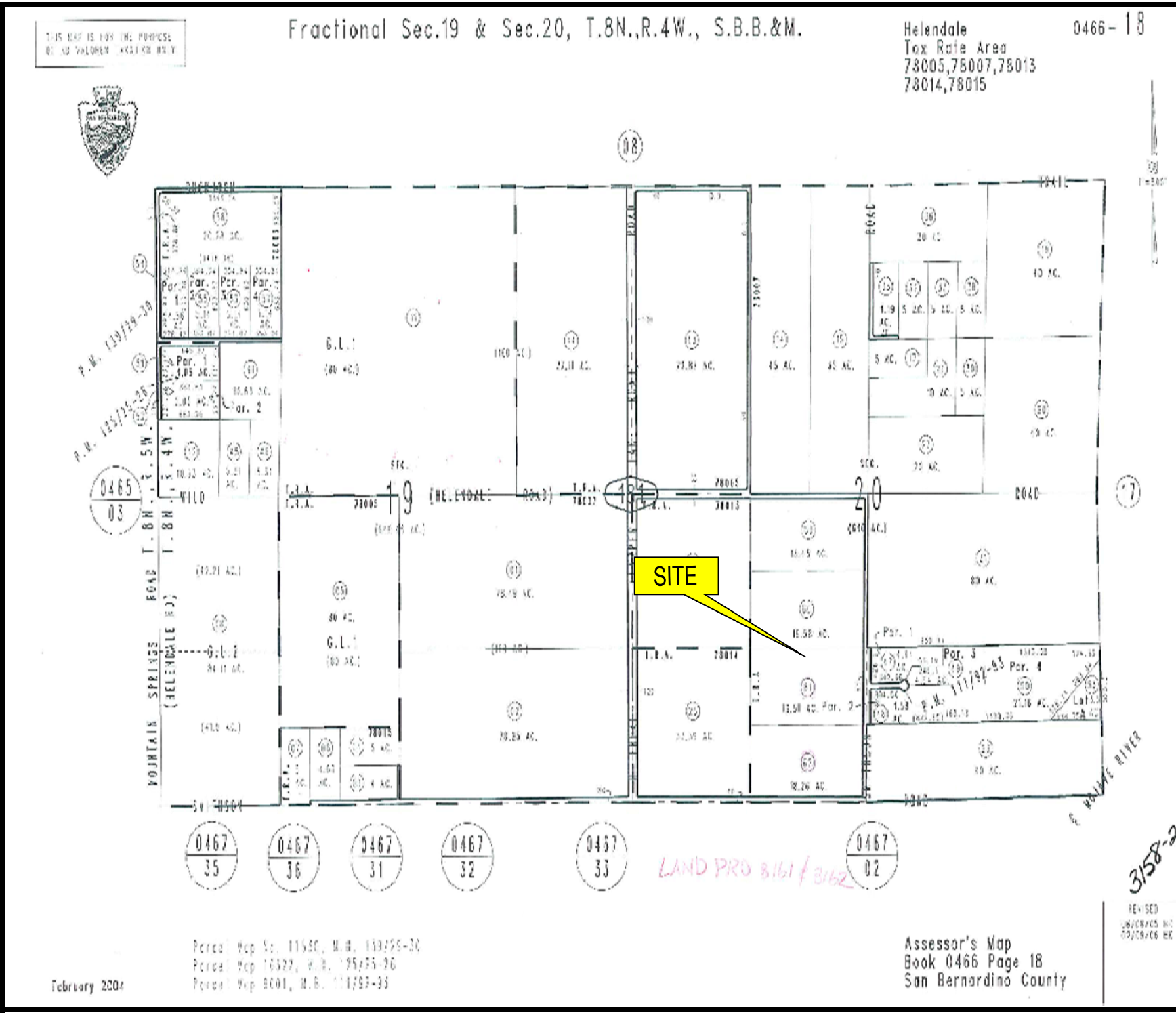
ASSESSOR'S PARCEL MAP

Project:	Landpro 8159-8162 Site
Client:	Sunlight Partners LLC
Project No:	12.0010.0140
Sample ID:	NA
Attachment:	C6
Sheet:	1 of 1



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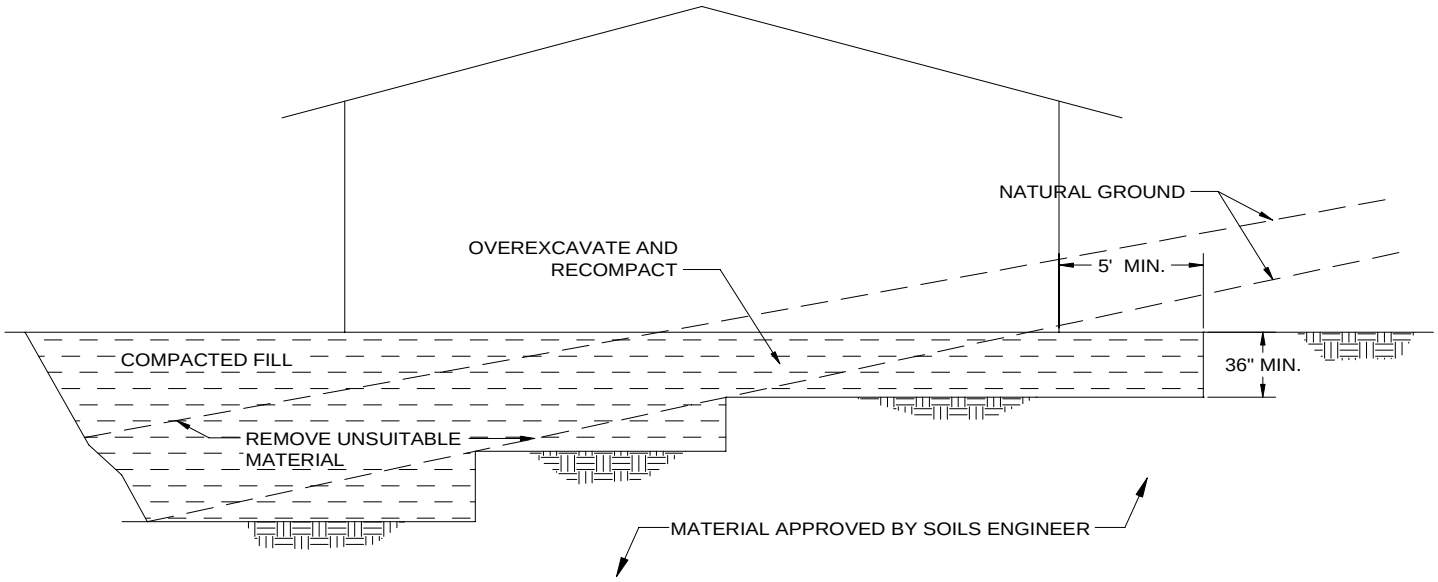
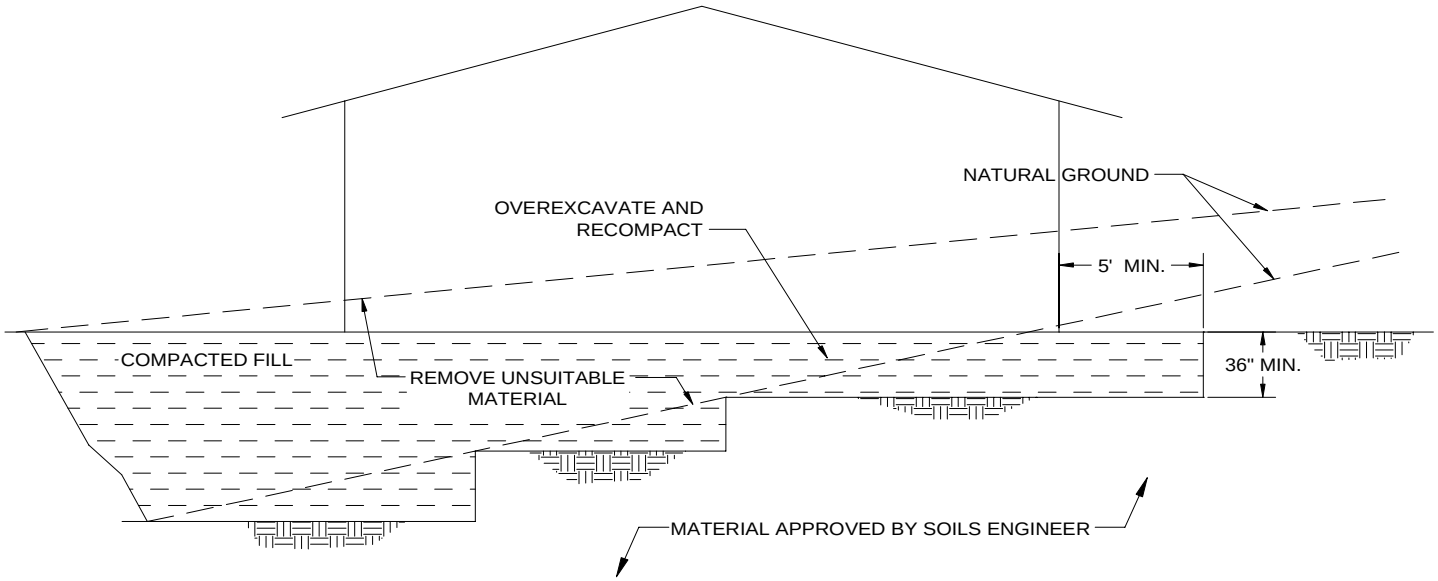
ATTACHMENT D

DETAIL ILLUSTRATIONS



CUT-FILL LOT



CUT LOT

NOTE:

DEEPER OVEREXCAVATION AND RECOMPACTION SHALL BE PERFORMED IF DETERMINED NECESARY BY SOILS ENGINEER.

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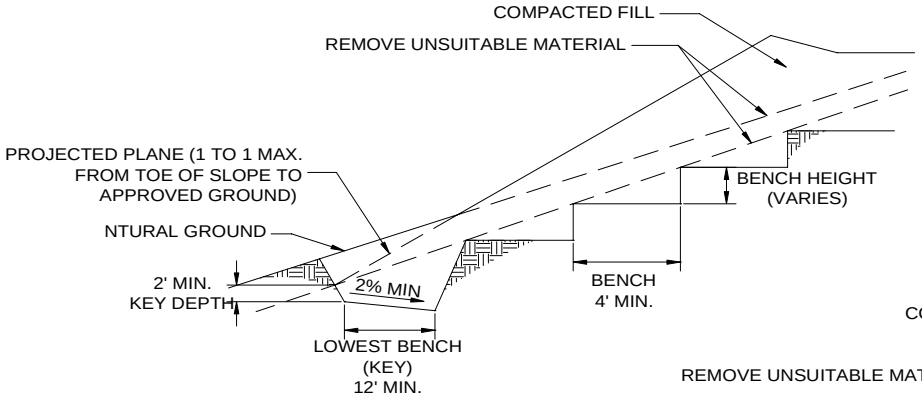
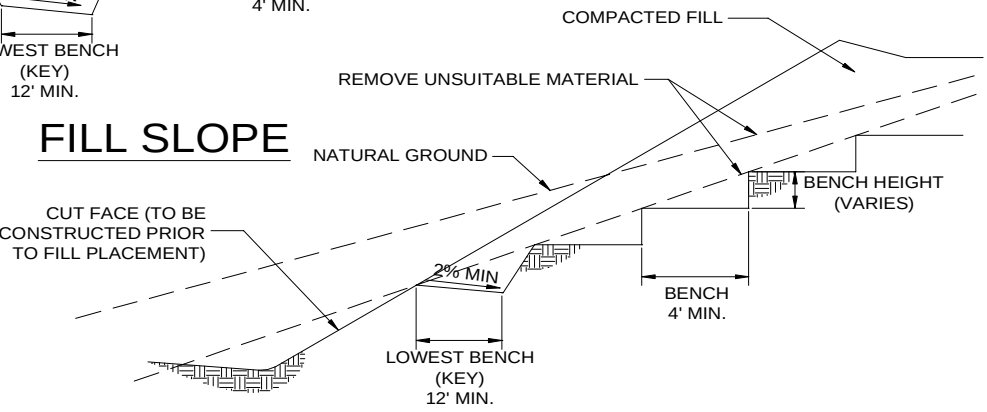
TRANSITION LOT DETAIL

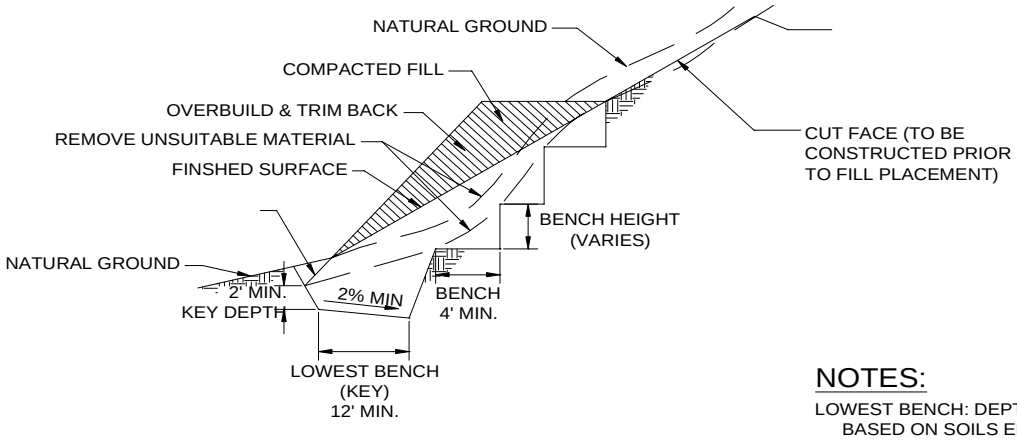
Project:	Landpro 8159-8162 Site	**Project No:**	12.0010.0140
Client:	Sunlight Partners LLC	**Sample ID:**	NA
		Attachment:	D1
		Sheet:	1 of 1



FILL SLOPE



FILL-OVER-CUT SLOPE



CUT-OVER-FILL SLOPE

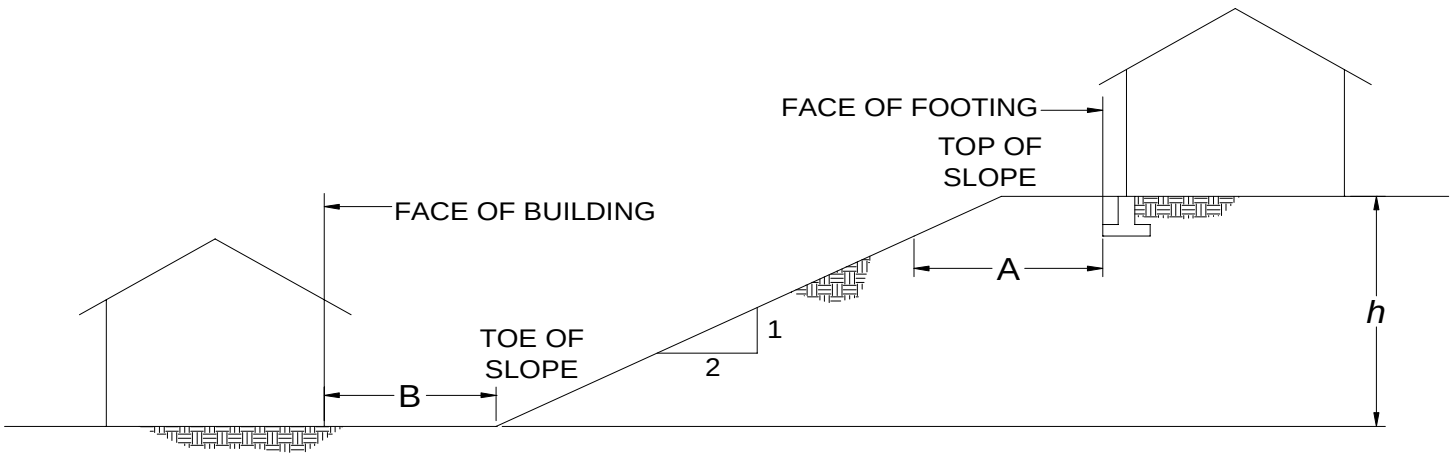
NOTES:

LOWEST BENCH: DEPTH AND WIDTH SUBJECT TO FIELD CHANGE BASED ON SOILS ENGINEER'S INSEPCTION.

SUBDRAINAGE: BACK DRAINS MAY BE REQUIRED AT THE DISCRETION OF THE SOILS ENGINEER.

BENCHING DETAIL

Project:	Landpro 8159-8162 Site	**Project No:**	12.0010.0140
Client:	Sunlight Partners LLC	**Sample ID:**	NA
		Attachment:	D2
		Sheet:	1 of 1



TOP OF SLOPE

SLOPE HEIGHT (*h*) (feet)	SETBACK (A) (feet)
0 - 10'	5' MIN.
10' - 20'	*h*/2 MIN.
20'+	10'

TOE OF SLOPE

SLOPE HEIGHT (*h*) (feet)	SETBACK (B) (feet)
0 - 10'	5' MIN.
10' - 30'	*h*/2 MIN.
30'+	15'

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BUILDING SETBACK DETAIL

Project:	Landpro 8159-8162 Site	**Project No:**	12.0010.0140
Client:	Sunlight Partners LLC	**Sample ID:**	NA
		Attachment:	D3
		Sheet:	1 of 1

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ATTACHMENT E

GENERAL GRADING SPECIFICATIONS

GENERAL GRADING SPECIFICATIONS

Grading of the subject site should be performed in accordance with the provisions of the Uniform Building Code and/or applicable ordinances. The following is presented for your assistance in establishing proper grading criteria:

1. GENERAL INTENT

These specifications present the general procedure and requirements for grading and earthwork as shown on the approved grading plans, including preparation of areas to be filled, placement of fill, installation of sub-drains, and excavations. The recommendations contained in this geotechnical report are a part of the earthwork and grading specifications and shall supersede the provisions contained hereinafter in the case of conflict. Evaluations performed by the consultant during the course of grading may result in new recommendations, which could supersede these specifications, or the recommendations of this geotechnical report.

2. CONSTRUCTION INSPECTION

A representative of this firm should inspect all grading operations, including site clearing and stripping. The presence of our field representative will be for the purpose of providing observation and field testing, and will not include any supervising or directing of the actual work of the Contractor, his employees or agents. Neither the presence of our field representative nor the observations and testing by our firm shall excuse the Contractor in any way for defects discovered in this work. It is understood that our firm will not be responsible for job or site safety on this project, which will be the sole responsibility of the Contractor.

3. EARTHWORK OBSERVATION & TESTING

Prior to the commencement of grading, a representative of this firm or a qualified geotechnical consultant (soils engineer, engineering geologist, or their representatives) shall be employed for the purpose of observing earthwork procedures and testing the fills for conformance with recommendations of the geotechnical report and these specifications. It will be necessary that the consultant provide adequate testing and observation so that they may determine that the work was accomplished as specified. It shall be the responsibility of the contractor to assist the consultant and keep the consultant apprised of work schedules and changes so that the consultant may schedule personnel accordingly.

It shall be the sole responsibility of the contractor to provide adequate equipment and methods to accomplish the work in accordance with applicable grading codes and/or agency ordinances, these specifications and the approved grading plans. If, in the opinion of the consultant, unsatisfactory conditions, such as questionable soils, poor moisture condition, inadequate compaction, adverse weather, etc. are resulting in a quality of work less than required in these specifications, the consultant will be empowered to reject the work and recommend that construction be stopped until the conditions are rectified.

4. FILL PLACEMENT AND COMPACTION

4.1. Fill Lifts

Approved fill material shall be placed in areas prepared to receive fill in near-horizontal layers not exceeding eight (8) inches in compacted thickness. The consultant may approve thicker lifts if testing indicates the grading procedures are such that adequate compaction is being achieved with lifts of greater thickness. Each layer shall be spread evenly and shall be thoroughly mixed during spreading to attain uniformity of material and moisture in each layer.

Fill must be inorganic, granular sands or gravel, free from rocks, or lumps greater than six (6) inches in maximum dimension. Each fill lift should be brought to near optimum moisture content and compacted to at least 95 percent (ASTM D1557, D1556, D2922).

4.2. Fill Moisture

Fill layers at a moisture content no less or more than +/- 2 % of optimum shall be watered and mixed, and over saturated / wet fill layers shall be aerated by scarification or shall be blended with drier material to obtain a moisture content of +/- 2% of the optimum moisture. Moisture-conditioning and mixing of fill layers shall continue until the fill material is at uniform moisture content at or near optimum moisture but within +/- 2% of the optimum moisture.

4.3. Compaction of Fill

After each layer has been evenly spread, moisture conditioned, and mixed, it shall be uniformly compacted to not less than 95 percent of the maximum dry density (ASTM D1557). Compaction equipment shall be adequately sized and shall be either specifically designed for soil compaction or have proven reliability, to efficiently achieve the specified degree of compaction. In general, the compaction criteria specified below shall be followed unless otherwise noted.

• Footing Subgrade	95% or Greater at +/- 2% Optimum Moisture
• Concrete Slab Subgrade	95% or Greater at +/- 2% Optimum Moisture
• Aggregate Base for Paved Areas	95% or Greater at +/- 2% Optimum Moisture
• Upper 1' of Subgrade, Paved Areas	95% or Greater at +/- 2% Optimum Moisture
• Matt Foundation Subgrade	95% or Greater at +/- 2% Optimum Moisture
• Cross Gutter Subgrade	95% or Greater at +/- 2% Optimum Moisture
• Structural Fill	90% or Greater at +/- 2% Optimum Moisture
• Curb and Gutter Subgrade	90% or Greater at +/- 2% Optimum Moisture
• Sidewalk Subgrade	90% or Greater at +/- 2% Optimum Moisture
• Retaining Wall Backfill	90% or Greater at +/- 2% Optimum Moisture
• Trench Backfill	90% or Greater at +/- 2% Optimum Moisture

5. FILL SLOPES AND SLOPE CONSTRUCTION

Permanent cut or fill slopes should be constructed with no slopes steeper than 2 horizontal to 1 vertical.

Compacting of slopes shall be accomplished by one of the following procedures:

- By bankrolling of slopes with sheep foot roller at frequent increments of 1 to 2 feet in fill elevation gain, or by other methods producing satisfactory results.

- Fill slopes should be overfilled during construction and then cut back to expose fully compacted soil. The relative compaction of the slopes on to the slope face shall be at least 90 percent.

Where fills slopes are to be placed on existing slopes the ground should be benched. Any fills placed on slopes shall be benched and keyed per details of this report

If the fill is properly compacted, fill embankments may constructed at 2:1 (horizontal to vertical) of flatter. Fill slopes should be overfilled and trimmed back to the desired grade to provide a firm surface. All slopes should be provided with adequate drainage and should be planted immediately with erosion-resistant vegetation.

6. BENCHING

The existing surface shall be benched at least 12 feet wide at the lowest bench and shall be at least 2 feet deep into firm materials compacted to 90%. The lowest bench should be tilted in

the slope at a 2% slope into the embankment. Other benches should be excavated into firm material for a minimum width of 4 feet, and all benches should be approximately 2 feet in height. Deeper removal and re-compaction may be required.

The existing slopes shall be benched to key the fill material to the underlying ground. A minimum of 2 feet normal to the slope shall be removed and re-compacted, as the fill is brought up in layers, to ensure that the new work is constructed on a firm foundation fill. Benching may vary based on field conditions and will be verified/confirmed by our field representative.

In no case will horizontal benching be less than 4 feet and vertical lifts more than 2 feet.

7. COMPACTION TESTING

Field-tests to check the fill moisture and degree of compaction will be performed by the consultant. The location and frequency of tests shall be at the consultant's discretion. In general, the tests will be taken at an interval not exceeding two feet in vertical rise and/or 1,000 cubic yards of embankment. Compaction testing will be in performed in accordance with the American Society for Testing and Materials Standards (ASTM), test methods ASTM D1556 and/or D2922 or other applicable standards.

Maximum dry density tests used to determine the degree of compaction will be performed in accordance with the American Society for Testing and Materials Standards (ASTM), test method ASTM D1557.

8. EXCAVATION

Excavations and cut slopes will be examined during grading. If directed by the consultant, further excavation or over excavation and refilling of cut areas shall be performed, and/or remedial grading of cut slopes shall be performed. Where fill-over-cut slopes are to be graded, unless otherwise approved, the cut portion of the slope shall be made and approved by the consultant prior to placement of materials for construction of the fill portion of the slope.

9. TRENCH BACKFILL

Trench excavations for utility pipes shall be backfilled under engineering supervision. After the utility pipe has been laid, the space under and around the pipe shall be backfilled with clean

sand or approved granular soil to a depth of at least one foot over the top of the pipe. The sand backfill shall be uniformly jetted into place before the controlled backfill is placed over the sand.

The on-site materials, or other soils approved by the consultant, shall be watered and mixed as necessary prior to placement in lifts over the sand backfill.

The controlled backfill shall be compacted to at least 95 percent of the maximum laboratory density as determined by the ASTM compaction method described above.

Field density tests and inspection of the backfill procedures shall be made by the consultant during backfilling to see that proper moisture content and uniform compaction is being maintained. The contractor shall provide test holes and exploratory pits as required by the consultant to enable sampling and testing.

Merrell Johnson COMPANIES

ATTACHMENT F

IMPORTANT INFORMATION ABOUT YOUR GEOTECHNICAL ENGINEERING REPORT (ASFE PUBLICATION)

IMPORTANT INFORMATION
ABOUT YOUR
GEOTECHNICAL ENGINEERING REPORT

More construction problems are caused by site subsurface conditions than any other factor. As troublesome as subsurface problems can be, their frequency and extent have been lessened considerably in recent years, due in large measure to programs and publications of ASFE/ The Association of Engineering Firms Practicing in the Geosciences.

The following suggestions and observations are offered to help you reduce the geotechnical-related delays, cost-overruns and other costly headaches that can occur during a construction project.

A GEOTECHNICAL ENGINEERING REPORT IS BASED ON A UNIQUE SET OF PROJECT-SPECIFIC FACTORS

A geotechnical engineering report is based on a subsurface exploration plan designed to incorporate a unique set of project-specific factors. These typically include: the general nature of the structure involved, its size and configuration; the location of the structure on the site and its orientation; physical concomitants such as access roads, parking lots, and underground utilities, and the level of additional risk which the client assumed by virtue of limitations imposed upon the exploratory program. To help avoid costly problems, consult the geotechnical engineer to determine how any factors which change subsequent to the date of the report may affect its recommendations.

Unless your consulting geotechnical engineer indicates otherwise, *your geotechnical engineering report should not be used:*

- When the nature of the proposed structure is changed, for example, if an office building will be erected instead of a parking garage, or if a refrigerated warehouse will be built instead of an unrefrigerated one;
- when the size or configuration of the proposed structure is altered;
- when the location or orientation of the proposed structure is modified;
- when there is a change of ownership, or
- for application to an adjacent site.

Geotechnical engineers cannot accept responsibility for problems which may develop if they are not consulted after factors considered in their report's development have changed.

MOST GEOTECHNICAL "FINDINGS" ARE PROFESSIONAL ESTIMATES

Site exploration identifies actual subsurface conditions only at those points where samples are taken, when they are taken. Data derived through sampling and subsequent laboratory testing are extrapolated by geotechnical engineers who then render an opinion about overall subsurface conditions, their likely reaction to proposed construction activity, and appropriate foundation design. Even under optimal circumstances actual conditions may differ from those inferred to exist, because no geotechnical engineer, no matter how qualified, and no subsurface exploration program, no matter how comprehensive, can reveal what is hidden by earth, rock and time. The actual interface between materials may be far more gradual or abrupt than a report indicates. Actual conditions in areas not sampled may differ from predictions. *Nothing can be done to prevent the unanticipated, but steps can be taken to help minimize their impact.* For this reason, *most experienced owners retain their geotechnical consultants through the construction stage,* to identify variances, conduct additional tests which may be needed, and to recommend solutions to problems encountered on site.

SUBSURFACE CONDITIONS CAN CHANGE

Subsurface conditions may be modified by constantly-changing natural forces. Because a geotechnical engineering report is based on conditions which existed at the time of subsurface exploration, *construction decisions should not be based on a geotechnical engineering report whose adequacy may have been affected by time.* Speak with the geotechnical consultant to learn if additional tests are advisable before construction starts.

Construction operations at or adjacent to the site and natural events such as floods, earthquakes or groundwater fluctuations may also affect subsurface conditions and, thus, the continuing adequacy of a geotechnical report. The geotechnical engineer should be kept apprised of any such events, and should be consulted to determine if additional tests are necessary.

GEOTECHNICAL SERVICES ARE PERFORMED FOR SPECIFIC PURPOSES AND PERSONS

Geotechnical engineers' reports are prepared to meet the specific needs of specific individuals. A report prepared for a consulting civil engineer may not be adequate for a construction contractor, or even some other consulting civil engineer. Unless indicated otherwise, this report was prepared expressly for the client involved and expressly for purposes indicated by the client. Use by any other persons for any purpose, or by the client for a different purpose, may result in problems. *No individual other than the client should apply this report for its intended purpose without first conferring with the geotechnical engineer. No person should apply this report for any purpose other than that originally contemplated without first conferring with the geotechnical engineer.*

A GEOTECHNICAL ENGINEERING REPORT IS SUBJECT TO MISINTERPRETATION

Costly problems can occur when other design professionals develop their plans based on misinterpretations of a geotechnical engineering report. To help avoid these problems, the geotechnical engineer should be retained to work with other appropriate design professionals to explain relevant geotechnical findings and to review the adequacy of their plans and specifications relative to geotechnical issues.

BORING LOGS SHOULD NOT BE SEPARATED FROM THE ENGINEERING REPORT

Final boring logs are developed by geotechnical engineers based upon their interpretation of field logs (assembled by site personnel) and laboratory evaluation of field samples. Only final boring logs customarily are included in geotechnical engineering reports. *These logs should not under any circumstances be redrawn* for inclusion in architectural or other design drawings, because drafters may commit errors or omissions in the transfer process. Although photographic reproduction eliminates this problem, it does nothing to minimize the possibility of contractors misinterpreting the logs during bid preparation. When this occurs, delays, disputes and unanticipated costs are the all-too-frequent result.

To minimize the likelihood of boring log misinterpretation, *give contractors ready access to the complete geotechnical engineering report* prepared or authorized for their use. Those who do not provide such access may proceed under the *mistaken* impression that simply disclaiming responsibility for the accuracy of subsurface information always insulates them from attendant liability. Providing the best available information to contractors helps prevent costly construction problems and the adversarial attitudes which aggravate them to disproportionate scale.

READ RESPONSIBILITY CLAUSES CLOSELY

Because geotechnical engineering is based extensively on judgment and opinion, it is far less exact than other design disciplines. This situation has resulted in wholly unwarranted claims being lodged against geotechnical consultants. To help prevent this problem, geotechnical engineers have developed model clauses for use in written transmittals. These are *not* exculpatory clauses designed to foist geotechnical engineers' liabilities onto someone else. Rather, they are definitive clauses which identify where geotechnical engineers' responsibilities begin and end. Their use helps all parties involved recognize their individual responsibilities and take appropriate action. Some of these definitive clauses are likely to appear in your geotechnical engineering report, and you are encouraged to read them closely. Your geotechnical engineer will be pleased to give full and frank answers to your questions.

OTHER STEPS YOU CAN TAKE TO REDUCE RISK

Your consulting geotechnical engineer will be pleased to discuss other techniques which can be employed to mitigate risk. In addition, ASFE has developed a variety of materials which may be beneficial. Contact ASFE for a complimentary copy of its publications directory.

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8811 Colesville Road/Suite G106/Silver Spring, Maryland 20910/(301) 565-2733

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