GEOTECHNICAL ENGINEERING INVESTIGATION REPORT
TURLOCK WWTP LAYDOWN AREA
901 SOUTH WALNUT ROAD
TURLOCK, CALIFORNIA 95380

BSK PROJECT G18-113-11F

PREPARED FOR:

AECOM
1360 E. SPRUCE AVENUE, SUITE 101
FRESNO, CALIFORNIA 93720

AUGUST 6, 2018

GEOTECHNICAL ENGINEERING INVESTIGATION REPORT
TURLOCK WWTP LAYDOWN AREA
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TURLOCK, CALIFORNIA 95380

Prepared for:

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BSK Project: G18-113-11F

August 6, 2018

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1. INTRODUCTION

This report presents the results of a Geotechnical Engineering Investigation conducted by BSK Associates (BSK), for the Turlock WWTP Laydown Area (Site). The site is located at 901 S. Walnut Road in Turlock, as shown on the Site Vicinity Map, Figure 1. The geotechnical engineering investigation was conducted in accordance with the scope of work as outlined in the subcontract agreement, dated April 18, 2017.

This report provides a description of the geotechnical conditions at the Site and provides specific recommendations for site preparation with respect to the planned improvement. In the event that changes occur in the design of the project, this report's conclusions and recommendations will not be considered valid unless the changes are reviewed with BSK and the conclusions and recommendations are modified or verified in writing. Examples of such changes would include location, size of projects, etc.

1.1. Planned Construction

BSK understands that the proposed project will consist of the construction of an approximately 110,000 square foot sludge drying bed at the WWTP in Turlock, California. The drying beds are planned to be asphalt concrete paved. Full depth reclamation with cement is proposed as an option for subgrade improvement. It is understood 6 to 7 trucks will drive on the beds per day. The axle loads on trucks are unknown at this time, but anticipated to be less than 32-kip/axles. Push walls are planned on the north and south edge of the proposed drying beds. Walls are planned to be CMU up to 6 feet in height and founded on shallow footings. Wall loads are unknown at this time but anticipated to be less than 2 ksf.

1.2. Purpose and Scope of Services

The objective of this geotechnical investigation was to characterize the subsurface conditions in the areas of the proposed construction, and provide geotechnical engineering recommendations for the preparation of plans and specifications. The scope of the investigation included a field exploration, laboratory testing, engineering analyses, and preparation of this report.

2. FIELD INVESTIGATION AND LABORATORY TESTING

2.1. Field Exploration

The field exploration for this investigation was conducted under the oversight of a BSK engineer. Five (5) borings were drilled at the Site on April 23, 2018 using a manually operated hand auger equipment. The borings were drilled to a maximum depth of between 2 and 10 feet below the existing ground surface. In addition bulk samples of the on-site stockpile were taken at various locations and composited.

The soil materials encountered in the borings were visually classified in the field, and the logs were recorded during the drilling and sampling operations. Visual classifications of the materials encountered in the borings were made in general accordance with the Unified Soil Classification System (ASTM D 2488). A soil classification chart is presented in Appendix A.

Boring logs are presented in Appendix A and should be consulted for more details concerning subsurface conditions. Stratification lines were approximated by the field staff based on observations made at the time of drilling, while the actual boundaries between soil types may be gradual and soil conditions may vary at other locations.

2.2. Laboratory Testing

Laboratory tests were performed on selected soil samples to evaluate dry density/moisture content, maximum density optimum moisture relationship (compaction), sieve corrosion characteristics (pH, Soluble Sulfates, compressive minimum resistivity, and Soluble Chlorides), resistance-value (R-value), direct shear and cement treated strength. A description of the laboratory test methods and results are presented in Appendix B.

3. SITE CONDITIONS

The following sections address the site descriptions and surface conditions, subsurface conditions, and groundwater conditions at the site. This information is based on BSK's field exploration and published maps and reports.

3.1. Site Description and Surface/Subsurface Conditions

At the time of the field investigation the project site was undeveloped. WGS84 GPS coordinates for the center of the site are 37.482242 degrees North latitude and 120.872221 degrees West longitude. The sludge drying bed project site is within the Turlock WWTP which was bounded to the north by a concrete pad with walls, to the south by an open field, to the west by a stockpile, and to the east by basins.

The subsurface soils encountered at the site consisted primarily of undocumented fine to medium grained silty sand to the maximum depth of exploration (10 feet bgs). The boring logs in Appendix A provide a more detailed description of the materials encountered, including the applicable Unified Soil Classification System symbols.

3.2. Groundwater Conditions

Groundwater was not encountered within borings during the site visit on April 23, 2018. The California Department of Water Resources indicates the depth to groundwater at the project site is between 20 and 30 feet bgs. However, fluctuations in the groundwater level or the presence of perched groundwater may

occur due to variations in rainfall, infiltration at basins, irrigation, seasonal factors, pumping from wells and other factors that were not evident at the time of our investigation.

4. CONCLUSIONS AND RECOMMENDATIONS

Based upon the data collected during this investigation, and from a geotechnical engineering standpoint, it is our opinion that the soil conditions would not preclude the construction of the proposed improvements, provided the recommendations in Section 4.2 are followed.

The presence of undocumented fill to various depths may be problematic to proposed improvements. See section 4.2 for further discussion.

4.1. Soil Reactivity with Cement

A surface soil sample obtained from the Site was tested to provide a preliminary screening of the potential for concrete deterioration or steel corrosion due to attack by soil-borne soluble salts. The test results are presented in Appendix B. Based on the laboratory testing results, the on-site soils are considered to have a low to moderate corrosion potential with respect to buried concrete, and highly corrosive to unprotected metal.

BSK recommends that a Type II cement be used in the formulation of concrete, but suggest a reduced water content ratio and that buried reinforcing steel protection be provided with a minimum concrete cover required by the American Concrete Institute (ACI) Building Code for Structural Concrete, ACI 318, Chapter 7.7. Buried metal conduits must have protective coatings in accordance with the manufacturer's specifications. If detailed recommendations for corrosion protection are desired, a corrosion specialist should be consulted.

4.2. Site Preparation and Earthwork Construction

The following procedures must be implemented during site preparation for the proposed site. It should be noted that references to maximum dry density, optimum moisture content, and relative compaction are based on ASTM: D1557 (latest test revision) laboratory test procedures.

1. Prior to any site grading, all miscellaneous surface obstructions must be removed from the improvement area. Near surface soils containing vegetation, roots, organics, or other objectionable material must be stripped to a depth of at least 8-inches to expose a clean soil surface. Surface strippings must not be incorporated into engineered fill unless the organic content is less than 3 percent by weight (ASTM: D2974).
2. Existing utilities or irrigation pipes, if any, must be removed to a point at least 5-feet horizontally outside the proposed improvement area. Resultant cavities must be backfilled with engineered fill. Abandoned pipelines to remain that are less than 2 inches in diameter should be capped at the

cutoff point, while pipelines greater than 2 inches in diameter must be filled with a 1-sack sand-cement slurry.

3. Soil disturbed as a result of demolition, undocumented shallow fill (as deep as 10 feet bgs), debris, abandoned underground structures must be excavated to expose undisturbed native soil. Within the proposed wall areas, the site should be over-excavated down to native materials, or at least 12 inches below the bottom of footing, whichever is deeper. Over-excavation should extend laterally five feet beyond the edge of foundations. Yielding areas should be observed by the geotechnical consultant and removed and recompacted if necessary. In the proposed lay-down area, over-excavation could be reduced to 2 feet provided the edges of the lay-down area are over-excavated to native soil in an effort to mitigate the risk of lateral water migration.

4. Over-excavated materials, with less than 3 percent organics content and deleterious substances, may be used engineered fills, provided they meet the requirements for Import Fill below. Engineered fill derived from soils should not have any particles greater than 3 inches, at least 80 percent passing the #4 Sieve, and from 15 to 40 percent passing the #200 Sieve.

5. All engineered fill should be placed in uniform layers not exceeding 8 inches in loose thickness, moisture conditioned to within 2 percent of optimum moisture content, and compacted to at least 95 percent. Where fill is placed on natural slopes that are steeper than 3H:1V, horizontal benches at least 4 feet wide should be cut into the face of natural slopes prior to placing the fill.

6. Import fill materials must be free from organic matter or deleterious substances. The project specifications must require the contractor to contact BSK to review the proposed import fill materials for conformance with these recommendations at least one week prior to importing to the site, whether from on-site or off-site borrow areas. Imported fill soils must be non-hazardous and derived from a single, consistent soil type source conforming to the following criteria:

Plasticity Index:	less than 12
Expansion Index:	less than 20
Maximum Particle Size:	3-inches
Percent Passing #4 Sieve:	65 - 100
Percent Passing #200 Sieve:	20 - 50
Organic Content:	Less than 3 percent
Corrosion Potential:	Soluble Sulfates less than 1,500 ppm
	Soluble Chlorides less than 300 ppm
	Minimum Resistivity greater than 5,000 ohm-cm

Earthwork operations should be scheduled as to avoid working during periods of inclement weather. Should these operations be performed during or shortly following periods of inclement weather, unstable soil conditions may result in the soils exhibiting a “pumping” condition. This condition is caused by excess moisture, in combination with compaction, resulting in saturation and zero air voids in the soils. If this condition occurs, the adverse soils will need to be over-excavated to the depth at which stable soils are encountered and replaced with suitable soils compacted as engineered fill. Alternatively, the Contractor

may proceed with grading operations after utilizing an alternative method of soil stabilization, which should be subject to review and approval by BSK prior to implementation.

4.3. Conventional Pavement Section Recommendations

BSK calculated the conventional pavement section thicknesses using a design subgrade R-Value of 50 and Traffic Indexes of 5 through 7. Options include with or without aggregate base (AB). BSK has presented a summary of its pavement section thickness recommendations in Table 2, *Conventional Pavement Section Recommendations.*

TABLE 1
Conventional Pavement Section Recommendations
(R-Value = 50, 25-yr design life)

Traffic Index	Conventional Section	
	HMA (inches)	AB (inches)
5.0	2.5	4
	5.0	-
5.5	3.0	4
	5.5	-
6.0	3.5	4
	6.5	-
6.5	3.5	4.5
	6.5	-
7.0	4.0	4
	7.0	-

Notes:
HMA: Hot Mix Asphalt
AB: Caltrans Class 2 Aggregate Base (Minimum R-Value = 78)

Hot mix asphalt, Class 2 aggregate base should conform to and be placed in accordance with the latest revision of Caltrans Standard Specifications. It is recommended soil subgrade be scarified to a depth of 8 inches, moisture conditioned and compacted to at least 95% maximum density, based on ASTM D1557 prior to placing new aggregate base section.

4.4. Soil-Cement Treated Subgrade – Pavement Section Recommendations

Based on laboratory testing, 6% cement additive would result in cement treated subgrade strengths of 250 psi. Results of the preliminary mix design are provided in Appendix B. BSK recommends using soil-cement with a cement content of 6%. BSK calculated the pavement section thicknesses using a compressive strength of 250 psi, a design subgrade R-Value of 50 and Traffic Indexes of 5 through 7. BSK has presented a summary of its pavement section thickness recommendations in Table 3, *Soil Cement Pavement Section Recommendations.*

TABLE 2
Soil Cement Subgrade - Pavement Section Recommendations
(Cement Content = 6%, Unconfined Compressive Strength = 250 psi, R-Value = 50, 25-yr design life)

Traffic Index	Soil-Cement Section	
	HMA (inches)	Soil-Cement Thickness (inches)
5.0	2.5	12
5.5	3.0	12
6.0	3.5	12
6.5	3.5	12
7.0	4.0	12

Notes:
HMA: Hot Mix Asphalt
Soil-Cement Treat Subgrade with 6% cement to a depth of 12 inches.

We recommend that prior to soil cement treatment. BSK recommends after initial site grading, uniformly mix remaining material with 6% cement, moisture condition to 4% above optimum moisture content, and compact it to 95% relative compaction by ASTM D1557. Specifications can be provided for use in construction, if desired.

Hot mix asphalt should conform to and be placed in accordance with the latest revision of Caltrans Standard Specifications.

If unstable soil conditions occur during construction, BSK recommends replacing unstable material with a minimum of two feet of Class II aggregate base or 18 inches of soil cement. The aggregate base should be compacted to 95% relative compaction, and soil cement should follow recommendations above.

4.4.1 Construction Considerations

The Contractor must develop their own mix design to be approved by the design team and Owner.

Cement must be Type II or Type V portland cement specified in ASTM C 150/150M. Cement should be added to the laydown area after pulverizing and shaping. It is recommended mixing equipment overlap passes at least 12 inches to confirm even spreading and mixing. Mixing must occur within 30 minutes of spreading and all grading and compaction must be completed within 2 hours. At least 2 hours of curing time without equipment or traffic loading should be provided, but can be waived if too limiting to traffic.

The minimum depth of cement treat is 12 inches, but is suggested the section extend to the depth operating equipment can achieve compaction, typically 18 inches. The soil-cement material shall be uniformly mixed at least twice to the specified treatment depth. The mixed material shall have a uniform color reaction with sprayed phenolphthalein pH indicator solution for the full specified treatment depth.

Immediately after compaction, apply water and roll with pneumatic-tired rollers or steel drum roller with no vibration. The finished surface must be free of ruts, bumps, indentations, segregation, raveling, and any loose material. Localized areas of unsuitable material should be removed, disposed and replaced with soil-cement material or new Class 2 AB. As with all in-place recycling operations, control over material uniformity is largely dependent on site conditions. Field adjustments to parameters such as production and application rates will be necessary during construction as indicated by changes to in-situ conditions or QC/QA test results. Large clumps of material greater than 3 inches in diameter are detrimental to soil-cement material and should be removed prior to final grading and compaction.

Keep the compacted surface damp by lightly watering until asphaltic emulsion is applied.

During the period from 48 to 72 hours after compaction, microcrack the surface by applying 3 single passes with a 12-ton vibratory steel drum roller at maximum amplitude travelling from 2 to 3 mph, regardless of whether asphaltic emulsion has been applied. Shrinkage cracking can develop in soil-cement and ultimately reflect into the HMA layer, opening the pavement to water infiltration and increasing the likelihood of accelerated pavement distress. Microcracking can reduce shrinkage cracking. Microcracking is the application of several vibratory roller passes typically 48 to 72 days after finish grading, to create a network of cracks. The goal of microcracking is to prevent severe, wide cracks from forming the thus reduce the potential for reflective cracking through the HMA layer. Microcracking can be performed before or after the application of asphaltic emulsion.

If asphaltic emulsion is to be used, apply a coat of diluted asphaltic emulsion to the finished surface when it is damp but free of standing water. The application rate of asphaltic emulsion must be from 0.13 to 0.25 gal/sq yd. Do not water after applying asphaltic emulsion. Do not open to traffic without authorization.

Conflicting utilities, including valves and access points, must be referenced and lowered at least 6 inches below the soil-cement depth or worked around. If utility depths have not been confirmed by field inspection, potholing, or GPR, the design soil-cement depth should be at least 12 inches above the approximate utility depth.

4.5 Shallow Foundations

The proposed retaining wall may be supported on reinforced concrete continuous footings bearing on engineered fill or firm undisturbed native soil. The allowable bearing pressure applies to the dead load plus live load (DL + LL). The foundation must be designed with reinforcing steel as recommended by the project Structural Engineer. The allowable bearing capacity presented below considers a safety factor of 3. Footing design must follow the criteria listed below:

Footing Embedment[2] (inches)	Minimum Footing Width (inches)	Allowable Bearing Capacity((psf)
12	24	2,500

The total settlement of a 2-foot wide retaining wall footing will be approximately 0.10 inch per 1,000 psf of long-term loading in engineered fill or native material. Due to the nature of the foundation soils, a significant fraction of the settlement is expected to occur following the end of construction as the design building loads area applied.

4.6 Lateral Earth pressure and Frictional Resistance

Lateral loads applied against foundations may be resisted by a combination of passive resistance against the vertical faces of the foundations and friction between the foundation bottom and the supporting subgrade. The parameters shown in the table below are for drained conditions of select engineered fill or undisturbed native soil.

Recommended Lateral Earth Pressures	
Lateral Pressure Condition	Equivalent Fluid Density (psf/ft)
Active Pressure	30
At-Rest Pressure	45
Passive Pressure	370

An unfactored coefficient of friction of 0.67 may be used between soil subgrade and the foundation bottom. The coefficient of friction and passive earth pressure values given above represent ultimate soil strength values. BSK recommends that a safety factor consistent with the design conditions be included in their usage. For resistance against lateral sliding that is countered solely by the passive earth pressure against footings or friction along the bottom of footings, a minimum safety factor of 1.5 is recommended. For stability against lateral sliding that is resisted by combined passive pressure and frictional resistance, a minimum safety factor of 2.0 is recommended. For lateral resistance against seismic loading conditions, a minimum safety factor of 1.2 is recommended. We based these lateral resistance values on the assumption that the concrete for the foundations is either placed directly against undisturbed soils or that the voids created from the use of forms are backfilled with engineered fill or other approved materials, such as lean concrete. Passive resistance in the upper foot of soil cover below finished grades should be neglected unless the ground surface is confined by concrete slabs, pavements, or other such positive protection.

5. PLANS AND SPECIFICATIONS REVIEW

BSK recommends that it be retained to review the draft plans and specifications for the project, with regard to earthwork, prior to their being finalized and issued for construction bidding.

6. CONSTRUCTION TESTING AND OBSERVATIONS

Geotechnical testing and observation during construction is a vital extension of this geotechnical investigation. BSK recommends that it be retained for those services. Field review during Site preparation and grading allows for evaluation of the exposed soil conditions and confirmation or revision of the assumptions and extrapolations made in formulating the design parameters and recommendations. BSK's observations must be supplemented with periodic compaction tests to establish substantial conformance with these recommendations. BSK must also be called to the Site to observe site preparation and soil cement preparation.

If a firm other than BSK is retained for these services during construction, then that firm must notify the owner, project designers, governmental building officials, and BSK that the firm has assumed the responsibility for all phases (i.e., both design and construction) of the project within the purview of the geotechnical engineer. Notification must indicate that the firm has reviewed this report and any subsequent addenda, and that it either agrees with BSK's conclusions and recommendations, or that it will provide independent recommendations.

7. LIMITATIONS

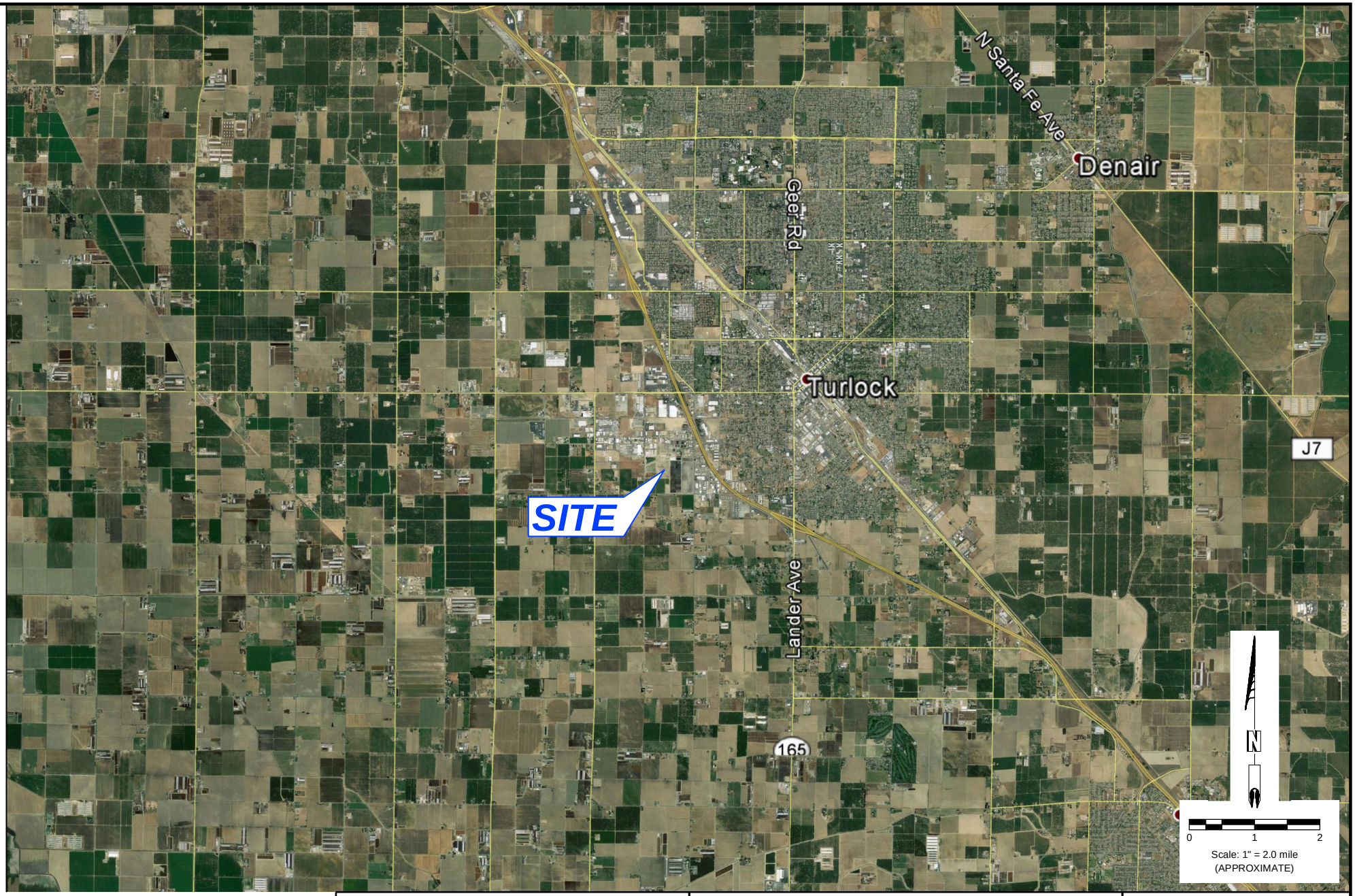
The analyses and recommendations submitted in this report are based upon the data obtained from the Borings performed at the locations shown on the Boring Location Map, Figure 2. The report does not reflect variations which may occur between or beyond the Borings. The nature and extent of such variations may not become evident until construction is initiated. If variations then appear, a re-evaluation of the recommendations of this report will be necessary after performing on-Site observations during the excavation period and noting the characteristics of the variations.

The validity of the recommendations contained in this report is also dependent upon an adequate testing and observation program during the construction phase. BSK assumes no responsibility for construction compliance with the design concepts or recommendations unless it has been retained to perform the testing and observation services during construction as described above.

The findings of this report are valid as of the present. However, changes in the conditions of the Site can occur with the passage of time, whether caused by natural processes or the work of man, on this property or adjacent property. In addition, changes in applicable or appropriate standards may occur, whether they result from legislation, governmental policy or the broadening of knowledge.

BSK has prepared this report for the exclusive use of the Client and members of the project design team. The report has been prepared in accordance with generally accepted geotechnical engineering practices which existed in Stanislaus County at the time the report was written. No other warranties either expressed or implied are made as to the professional advice provided under the terms of BSK's agreement with Client and included in this report.

FIGURES



SITE VICINITY MAP

FIGURE 1

Turlock WWTP Solids Laydown Area TO #
901 S. Walnut Road
Turlock, California 95380

BSK ASSOCIATES
550 West Locust Avenue
Fresno, California 93650
Tel. (559) 497-2880

JOB NO. G18-096-11F
DATE April 27, 2018
DR. BY JS
CH. BY NP
SCALE AS SHOWN
SHEET NO. 1
OF 1 SHEETS

REFERENCE IMAGE: Google Earth

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LEGEND:

B-5 APPROXIMATE BORING LOCATIONS

BSK ASSOCIATES
550 West Locust Avenue
Fresno, California 93650
Tel. (559) 497-2880

BORING LOCATION MAP

Turlock WWTP Solids Laydown Area TO #
901 S. Walnut Road
Turlock, California 95380

FIGURE 2

JOB NO. G18-113-11F
DATE April 27, 2018
DR. BY JS
CH. BY NP
SCALE AS SHOWN
SHEET NO. 1
OF 1 SHEETS

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APPENDIX A

FIELD EXPLORATION

APPENDIX A

FIELD EXPLORATION

The field exploration for this investigation was conducted under the oversight of a BSK staff member. Five (5) borings were drilled at the Site on April 23, 2018 using a manually operated hand auger equipment. The borings were drilled to a depth between 2 and 10 feet beneath the existing ground surface (bgs).

The soil materials encountered in the test borings were visually classified in the field, and the logs were recorded during the drilling and sampling operations. Visual classification of the materials encountered in the test borings was made in general accordance with the Unified Soil Classification System (ASTM D 2488). A soil classification chart is presented herein. Boring logs are presented herein and should be consulted for more details concerning subsurface conditions. Stratification lines were approximated by the field staff based on observations made at the time of drilling, while the actual boundaries between soil types may be gradual and soil conditions may vary at other locations.

At the completion of the field exploration, the test borings were backfilled with the excavated soil cuttings.

MAJOR DIVISIONS				TYPICAL NAMES
COARSE GRAINED SOILS More than Half > #200 sieve	GRAVELS MORE THAN HALF COARSE FRACTION IS LARGER THAN NO. 4 SIEVE	CLEAN GRAVELS WITH LITTLE OR NO FINES	GW	WELL GRADED GRAVELS, GRAVEL-SAND MIXTURES
			GP	POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES
		GRAVELS WITH OVER 15% FINES	GM	SILTY GRAVELS, POORLY GRADED GRAVEL-SAND-SILT MIXTURES
			GC	CLAYEY GRAVELS, POORLY GRADED GRAVEL-SAND-CLAY MIXTURES
	SANDS MORE THAN HALF COARSE FRACTION IS SMALLER THAN NO. 4 SIEVE	CLEAN SANDS WITH LITTLE OR NO FINES	SW	WELL GRADED SANDS, GRAVELLY SANDS
			SP	POORLY GRADED SANDS, GRAVELLY SANDS
		SANDS WITH OVER 15% FINES	SM	SILTY SANDS, POOORLY GRADED SAND-SILT MIXTURES
			SC	CLAYEY SANDS, POORLY GRADED SAND-CLAY MIXTURES
FINE GRAINED SOILS More than Half < #200 sieve	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 WITH SLIGHT PLASTICITY
			CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
			OL	ORGANIC CLAYS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACIOUS FINE SANDY OR SILTY SOILS, ELASTIC SILTS
			CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
			OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS			Pt	PEAT AND OTHER HIGHLY ORGANIC SOILS

■	Modified California	RV	R-Value
⧓	Standard Penetration Test (SPT)	SA	Sieve Analysis
☒	Split Spoon	SW	Swell Test
◪	Pushed Shelby Tube	TC	Cyclic Triaxial
	Auger Cuttings	TX	Unconsolidated Undrained Triaxial
	Grab Sample	TV	Torvane Shear
⧄	Sample Attempt with No Recovery	UC	Unconfined Compression
CA	Chemical Analysis	(1.2)	(Shear Strength, ksf)
CN	Consolidation	WA	Wash Analysis
CP	Compaction	(20)	(with % Passing No. 200 Sieve)
DS	Direct Shear	▽	Water Level at Time of Drilling
PM	Permeability	▼	Water Level after Drilling(with date measured)
PP	Pocket Penetrometer		

SOIL CLASSIFICATION CHART AND LOG KEY

Figure A-1

BSK ASSOCIATES

BSK Associates
550 W Locust
93650
Telephone: 559-497-2880
Fax: 559-497-2886

Project: Turlock WWTP Solids Laydown Area TO # 1

Location: 901 S. Walnut Road Turlock, CA 95380

Project No.: G18-113-11F

Logged By: D. Messin

Checked By: N. Popenoe

Boring: **B-1**

Depth (Feet)	Samples	Bulk Samples	Penetration Blows / Foot	In-Situ Dry Density (pcf)	In-Situ Moisture Content (%)	% Passing No. 200 Sieve	Graphic Log	USCS	MATERIAL DESCRIPTION	REMARKS
1								SM	Fill: **Silty SAND** - brown, moist, fine to medium grained	Broken glass
2				100.1	7.5					
3									... decrease silt content	
4										
5									... reddish brown	
6				97.1	5.6					
7										
8				74.5	7.4					
9										
10									Boring terminated at approximately 10 feet bgs. No groundwater encountered. Boring backfilled with soil cuttings.	
11										
12										
13										
14										

Drilling Contractor: BSK Associates
Drilling Method: Hand Auger
Drilling Equipment:
Date Started: 4/23/18
Date Completed: 4/23/18

Surface Elevation:
Sample Method:
Groundwater Depth: Not Encountered
Completion Depth: 10 Feet
Borehole Diameter: 4"

* See key sheet for symbols and abbreviations used above.

GEO G18-113-11F.GPJ BSK.GDT 5/11/18

BSK Associates
550 W Locust
93650
Telephone: 559-497-2880
Fax: 559-497-2886

Project: Turlock WWTP Solids Laydown Area TO # 1

Location: 901 S. Walnut Road Turlock, CA 95380

Project No.: G18-113-11F

Logged By: D. Messin

Checked By: N. Popenoe

Boring: **B-2**

Depth (Feet)	Samples	Bulk Samples	Penetration Blows / Foot	In-Situ Dry Density (pcf)	In-Situ Moisture Content (%)	% Passing No. 200 Sieve	Graphic Log	USCS	MATERIAL DESCRIPTION	REMARKS
1				106.1	9.1			SM	Fill: **Silty SAND** - brown, moist, fine to medium grained	
2										
3									... dark brown	
4										
5									Boring terminated at approximately 5 feet bgs. No groundwater encountered. Boring backfilled with soil cuttings.	
6										
7										
8										
9										
10										
11										
12										
13										
14										

Drilling Contractor: BSK Associates
Drilling Method: Hand Auger
Drilling Equipment:
Date Started: 4/23/18
Date Completed: 4/23/18

Surface Elevation:
Sample Method:
Groundwater Depth: Not Encountered
Completion Depth: 5 Feet
Borehole Diameter: 4"

* See key sheet for symbols and abbreviations used above.

GEO G18-113-11F.GPJ BSK.GDT 5/11/18

BSK Associates
550 W Locust
93650
Telephone: 559-497-2880
Fax: 559-497-2886

Project: Turlock WWTP Solids Laydown Area TO # 1

Location: 901 S. Walnut Road Turlock, CA 95380

Project No.: G18-113-11F

Logged By: D. Messin

Checked By: N. Popenoe

Boring: **B-3**

Depth (Feet)	Samples	Bulk Samples	Penetration Blows / Foot	In-Situ Dry Density (pcf)	In-Situ Moisture Content (%)	% Passing No. 200 Sieve	Graphic Log	USCS	MATERIAL DESCRIPTION	REMARKS
1				102.8	7.4			SM	Fill: **Silty SAND** - brown, moist, fine to medium grained	Broken glass
2									Boring terminated at approximately 2 feet bgs. No groundwater encountered. Boring backfilled with soil cuttings.	
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										
13										
14										

Drilling Contractor: BSK Associates
Drilling Method: Hand Auger
Drilling Equipment:
Date Started: 4/23/18
Date Completed: 4/23/18

Surface Elevation:
Sample Method:
Groundwater Depth: Not Encountered
Completion Depth: 2 Feet
Borehole Diameter: 4"

* See key sheet for symbols and abbreviations used above.

GEO G18-113-11F.GPJ BSK.GDT 5/11/18

BSK Associates
550 W Locust
93650
Telephone: 559-497-2880
Fax: 559-497-2886

Project: Turlock WWTP Solids Laydown Area TO # 1

Location: 901 S. Walnut Road Turlock, CA 95380

Project No.: G18-113-11F

Logged By: D. Messin

Checked By: N. Popenoe

Boring: **B-4**

Depth (Feet)	Samples	Bulk Samples	Penetration Blows / Foot	In-Situ Dry Density (pcf)	In-Situ Moisture Content (%)	% Passing No. 200 Sieve	Graphic Log	USCS	MATERIAL DESCRIPTION	REMARKS
1								SM	Fill: **Silty SAND** - brown, moist, fine to medium grained	Broken glass
2				105.8	6.8					
3										
4									... reddish brown	
5				88.1	12.5					
6									... reddish brown	
7				101.3	10.0					Broken glass
8										
9										
10									Boring terminated at approximately 10 feet bgs. No groundwater encountered. Boring backfilled with soil cuttings.	
11										
12										
13										
14										

Drilling Contractor: BSK Associates
Drilling Method: Hand Auger
Drilling Equipment:
Date Started: 4/23/18
Date Completed: 4/23/18

Surface Elevation:
Sample Method:
Groundwater Depth: Not Encountered
Completion Depth: 10 Feet
Borehole Diameter: 4"

* See key sheet for symbols and abbreviations used above.

GEO G18-113-11F.GPJ BSK.GDT 5/11/18

BSK Associates
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Telephone: 559-497-2880
Fax: 559-497-2886

Project: Turlock WWTP Solids Laydown Area TO # 1

Location: 901 S. Walnut Road Turlock, CA 95380

Project No.: G18-113-11F

Logged By: D. Messin

Checked By: N. Popenoe

Boring: **B-5**

Depth (Feet)	Samples	Bulk Samples	Penetration Blows / Foot	In-Situ Dry Density (pcf)	In-Situ Moisture Content (%)	% Passing No. 200 Sieve	Graphic Log	USCS	MATERIAL DESCRIPTION	REMARKS
1								SM	Fill: **Silty SAND** - brown, moist, fine to medium grained	Broken glass
2				106.2	6.0					
3										
4				103.7	7.4					
5									Boring terminated at approximately 5 feet bgs. No groundwater encountered. Boring backfilled with soil cuttings.	
6										
7										
8										
9										
10										
11										
12										
13										
14										

Drilling Contractor: BSK Associates
Drilling Method: Hand Auger
Drilling Equipment:
Date Started: 4/23/18
Date Completed: 4/23/18

Surface Elevation:
Sample Method:
Groundwater Depth: Not Encountered
Completion Depth: 5 Feet
Borehole Diameter: 4"

* See key sheet for symbols and abbreviations used above.

GEO G18-113-11F.GPJ BSK.GDT 5/11/18

APPENDIX B

LABORATORY TESTING RESULTS

APPENDIX B
LABORATORY TESTING

Sieve Analysis Test

One (1) Sieve Analysis Test was performed on a selected soil sample in the area of planned construction. The test was performed in general accordance with Test Method ASTM: D422. The result of the test is presented on Figure B-1.

Maximum Dry Density and Optimum Moisture Content

Modified proctor test was performed to determine the maximum dry density and optimum moisture content of selected soil samples. The sample was compacted under a standardized compaction effort at varying moisture contents in general accordance with ASTM: D1557. The result is presented on Figure B-2.

Direct Shear Test

One (1) direct shear tests were performed on test specimens trimmed from selected soil samples. The three-point shear test was performed in general accordance with ASTM Test Method D3080, Direct Shear Test for Soil under Consolidated Drained Conditions. The test specimens, each 2.42 inches in diameter and 1 inch in height, were subjected to shear along a plane at mid-height after allowing for pore pressure dissipation. The results of this test are presented on Figure B-3.

R-Value Test

The Resistance-Value result of one (1) sample of the surficial soil was obtained in accordance with California Department of Transportation's Test Method CA 301. The result of the R-Value test is presented on Figure B-4.

Cement Treated Soil

A composite (B-1, B-2, B-3, B-4, and B-5) sample was mixed with various percentages of cement, compacted to 90 percent of maximum dry density, oven cured for 7 days, and unconfined compression tested in general accordance with Caltrans Test Method 373. The results are presented on Figure B-5.

Soil Corrosivity

One (1) Corrosivity Evaluations were performed on three bulk soil samples obtained at the time of drilling in the area of planned construction. The soil was evaluated for pH, minimum resistivity, sulfate ion concentration (CT 417), and chloride ion concentration (CT 422). The test results are presented in Table B-1.

Table B-1: Summary of Corrosion Test Results				
Sample Location	**pH**	**Sulfate, ppm**	**Chloride, ppm**	**Minimum Resistivity, ohm-cm**
B-1 @ 0-5 feet bgs	7.2	370	14	980

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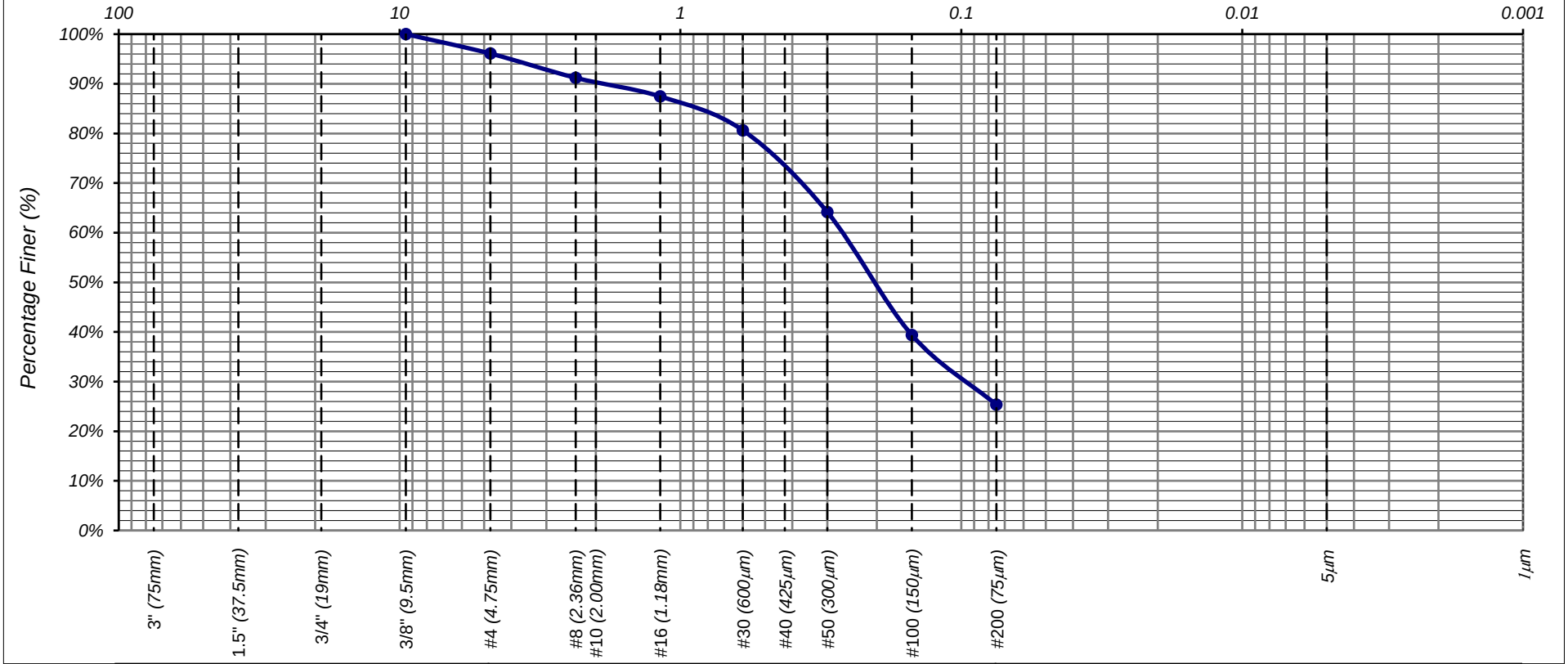
Gradation Analysis Report
ASTM D-422 / ASTM C-136

FIGURE B-1

Project Name:	**Turlock WWTP Solids Laydown Area**	**Project Number:**	G18-113-11F	**Report Date:**	5/4/2018
Sample Location:	B-1 @ 0-5'	**Sample Lab ID:**	F18-360	**Sample Date:**	4/23/2018
Sample Description:	Silty SAND (SM), brown, fine-coarse grained, moist			**Test Date:**	4/29/2018

Particle Size Distribution Diagram



Clear Square Openings (ASTM C-136)			US Standard Series (ASTM D-422)			Hydrometer Readings (ASTM D-422)
Cobble	Gravel		Sand			Silt (Non-Plastic) to Clay (Plastic)
	Coarse	Fine	Coarse	Medium	Fine	

% Gravel = 4% **% Sand = 71%** **% Fines = 25%**

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Laboratory Compaction Curve

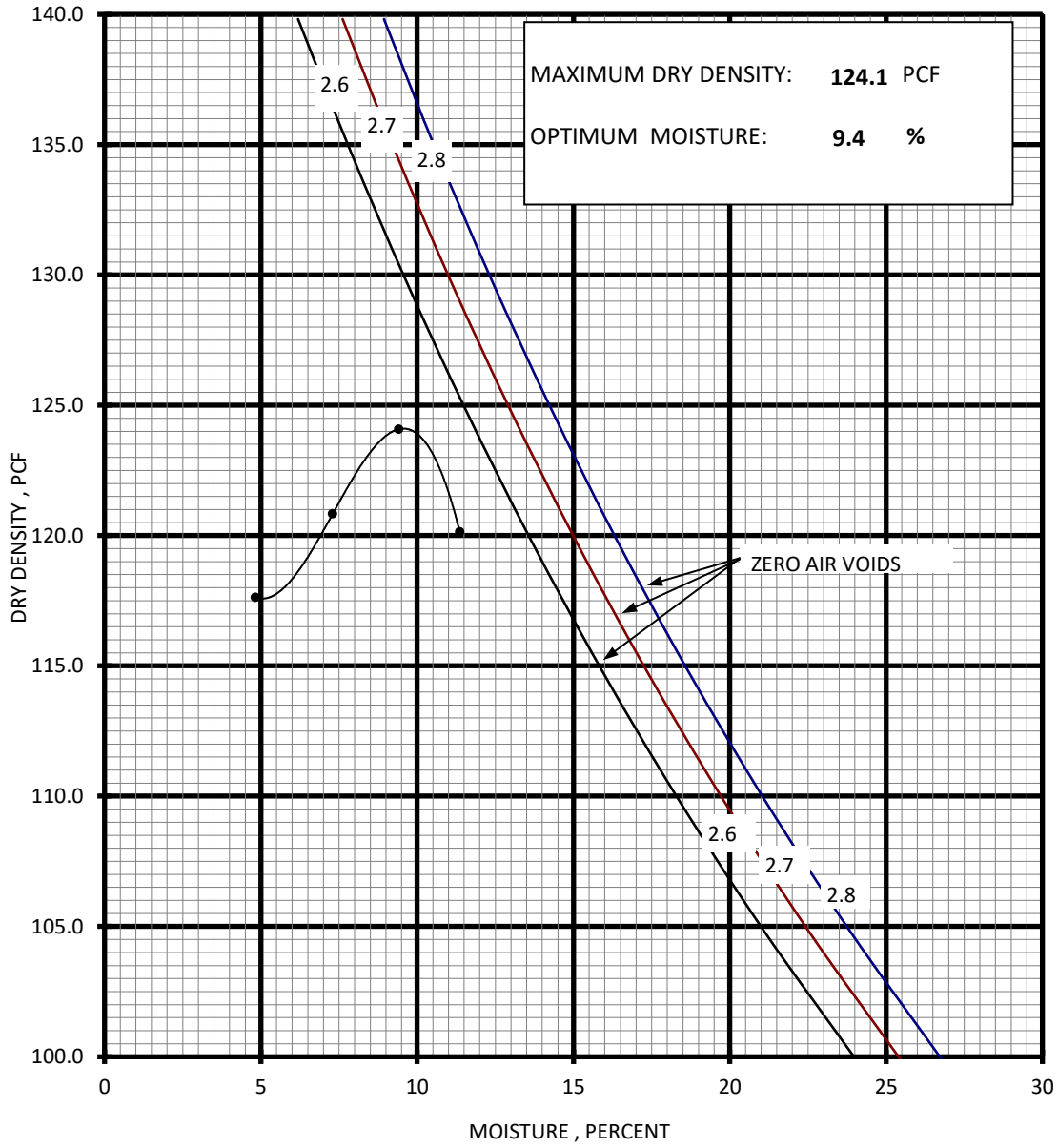
ASTM D-1557

Figure B-2

Project Name:	**Turlock WWTP Solids Laydown Area**			**Report Date:**	5/4/2018
Project Number:	G17-113-11F	**Sampled By:**	D.Messin	**Sample Date:**	4/23/2018
Lab Tracking ID:	F18-360	**Tested By:**	B.Mayl	**Test Date:**	4/24/2018
Sample Location:	B-1, B-2, B-3, B-4, and B-5 (composite)				
Sample Description:	Silty SAND (SM) - brown, moist, fine to medium grained				

PROCEDURE USED

Procedure A	x	**Procedure B**		**Procedure C**	



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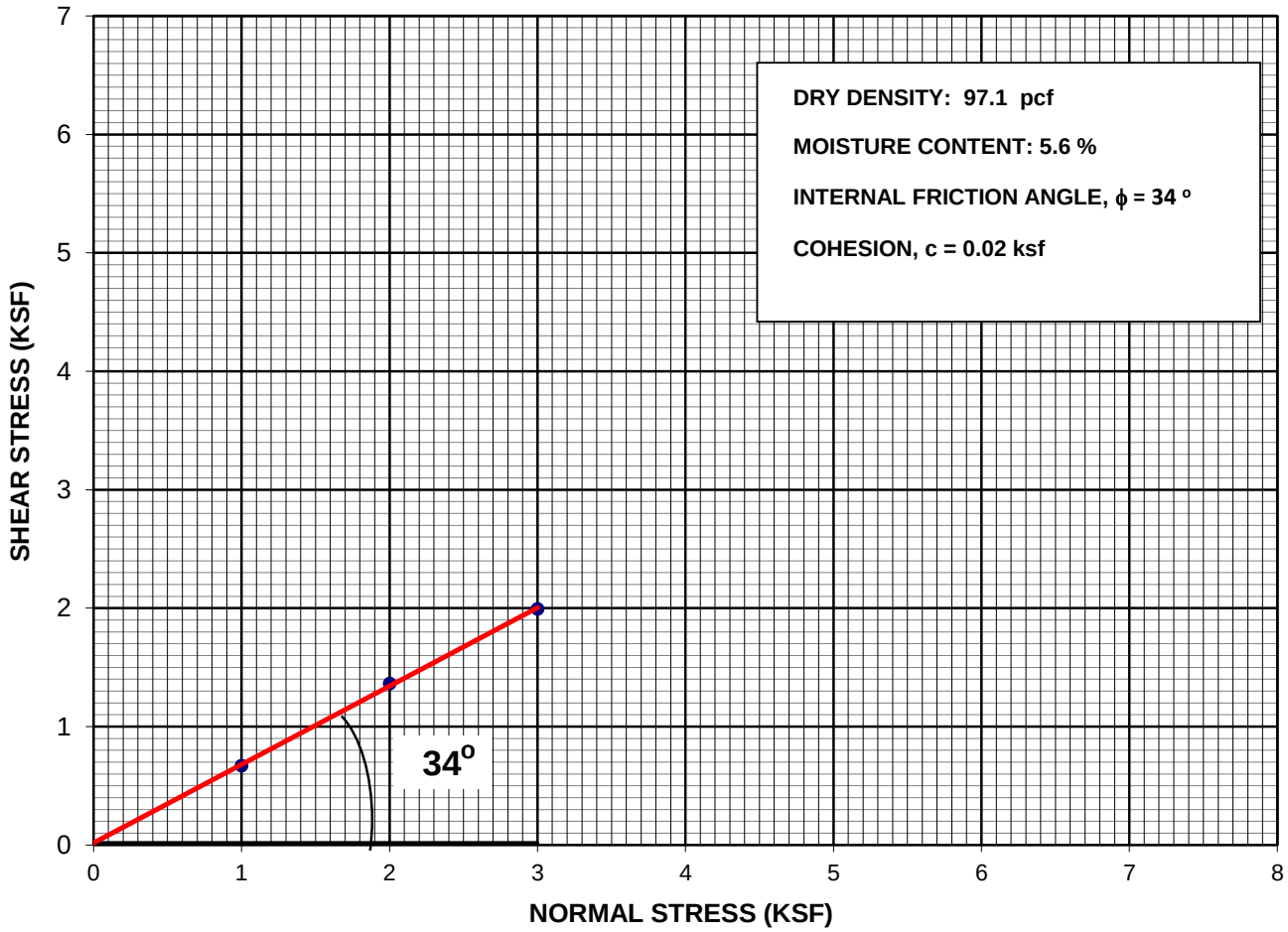
Direct Shear Test

ASTM D-3080

Figure B-3

Project Name:	**Turlock WWTP Solids Laydown Area**	**Sampled By:**	D.M.	**Sample Date:**	4/23/2018
		Tested By:	D.M.	**Test Date:**	5/3/2018
Project Number:	G18-113-11F	**Lab Tracking ID:**	F18-360	**Report Date:**	5/7/2018
Sample Location:	B-1 @ 5'	**Sample Description:**	Silty SAND (SM), reddish brown, moist, fine to medium grained		

SHEAR STRENGTH DIAGRAM



399 Lindbergh Ave
Livermore, CA 94551
Ph: (925) 315-3151
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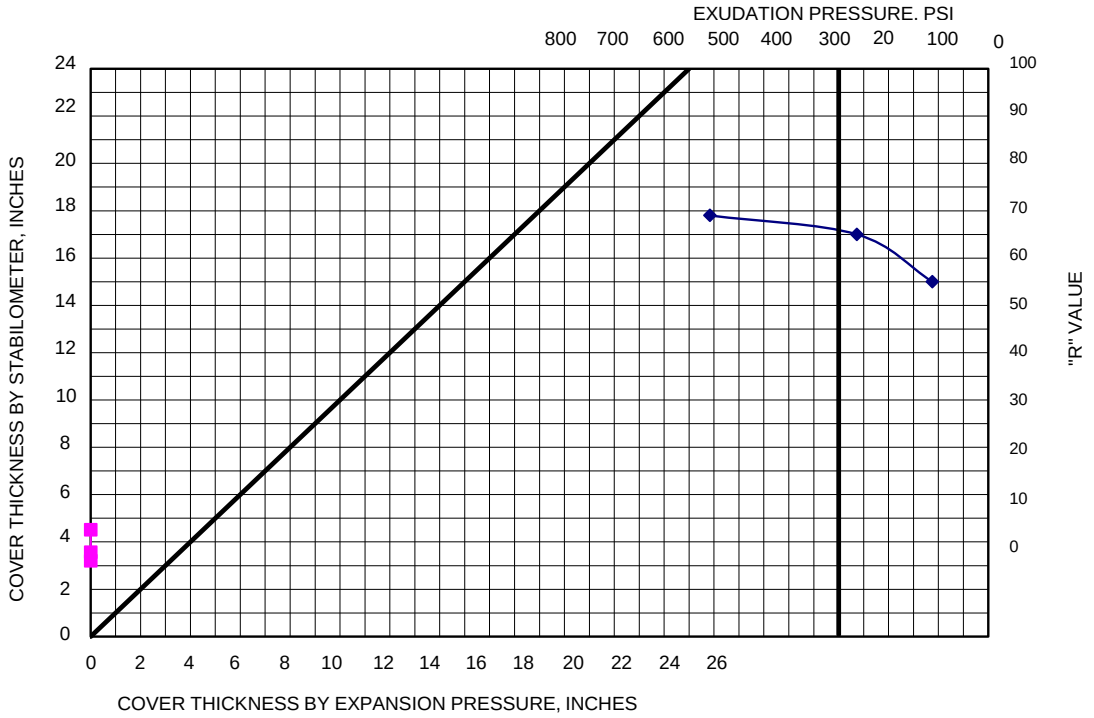
R-Value Test

Caltrans Test Method 301

Figure B-4

Project Name: Turlock Waste Water
Project Number: G18-113-11F
Sample Source:
Lab Tracking ID: L18-226
Sample Location: B3,B4,B5

Sample Date: 4/23/2018
Sample By: VR
Test Date: 4/25/2018
Report Date: 4/26/2018
Tested By: RC



Sample Description: Light brown silty sand

SPECIMEN	A	B	C
EXUDATION PRESSURE, LOAD (lb)	7013	3310	1410
EXUDATION PRESSURE, PSI	558	264	112
EXPANSION, * 0.0001 IN	0.0001	0.0002	0.0002
EXPANSION PRESSURE, PSF	0	0	0
STABILOMETER PH AT 2000 LBS	33	39	50
DISPLACEMENT	4.38	4.13	4.33
RESISTANCE VALUE "R"	69	65	56
"R" VALUE CORRECTED FOR HEIGHT	69	65	55
% MOISTURE AT TEST	10.7	11.4	12.4
DRY DENSITY AT TEST, PCF	120.1	118.4	118.0
"R" VALUE AT 300 PSI EXUDATION PRESSURE	**66**		
"R" VALUE BY EXPANSION PRESSURE TI = 4.0, GF=1.50	**N/A**		

Remark:

Reviewed By: JKA

550 W. Locust Avenue
Fresno, California 93650
Phone: 559-497-2868

Figure B-5

Contact: Stephen Spencer
Company: AECOM
Address:

BSK Project No.: G18-113-11F
Report Date: 05/25/2018
Specimen ID No.: F18-360

Subject: **Soil-Cement Compression Testing**
Project: Turlock WWTP Solids Laydown Area

Location of Work:
Sample Location: B-1, B-2, B-3, B-4, and B-5 (composite)
Date Sampled: 04/23/18
Date of Delivery: 04/23/18
# of Specimens: 6

Cement (%)	Date Tested	Age (days)	Compressive Strength (psi)	Max. Load, (lbs)	Tested By	Diameter or Dimension, (in)	Area in inches (squared)	Break Type
4	05/04/18	7	130	1,585	DM	4.00	12.57	
5	05/04/18	7	190	2,400	DM	4.00	12.57	
6	05/04/18	7	230	2,880	DM	4.00	12.57	
4	05/07/18	9	190	2,415	SJ	4.00	12.57	
5	05/07/18	9	250	3,190	SJ	4.00	12.57	
6	05/07/18	9	200	2,560	SJ	4.00	12.57	
4	05/25/18	28	250	3,095	SJ	4.00	12.57	
5	05/25/18	28	270	3,355	SJ	4.00	12.57	
6	05/25/18	28	280	3,545	SJ	4.00	12.57	

Time Sampled:	N/A
Cement Content:	See above

TYPE 1 = CONE
TYPE 2 = CONE/SPLIT
TYPE 3 = COLUMNAR
TYPE 4 = SHEAR
TYPE 5 = SIDE FRACTURES AT TOP OR BOTTOM
TYPE 6 = SIMILAR TO TYPE 5 BUT END OF CYLINDER IS POINTED

Soil-Cement specimens were tested in accordance with ASTM D-1633.
Samples remolded to 90% of ASTM D1557.