County of El Paso Purchasing Department
800 E. Overland Room 300
El Paso, Texas 79901
(915) 546-2048 / Fax: (915) 546-8180

ADDENDUM 1

To: **All Interested Bidders**

From: **Lucy Balderama, Inventory Bid Technician**

Date: **July 3, 2012**

Subject: **BID # 12-046, Construction for the Tornillo Guadalupe International Bridge Toll Plaza**

The bid opening has been rescheduled to July 17, 2012 at 2:00 P.M.

The following addendum items have been issued to notify vendors of the questions submitted and responses to submitted questions.

Item #1: Questions were received by El Paso County Purchasing Department prior to the Pre-Bid Meeting. The following is the responses to the questions:

Q1: Is there and engineer estimate for this project?
A1: Yes. The current engineer's estimate for this project is approximately $ 3.26 million.

Q2: If not, do you have an estimated value range or expect this project to be over $ 50,000?
A2: The project is estimated to be over $ 50,000.00, see question #1 above.

Q3: Is there an architect/engineer working on this project? If so, can you please provide me with the company name, phone number, location and a contact person?
A3: We do have an architect/engineer working on this project, however you may not have any communications, or contact with them or the department until this bid is awarded. All questions/clarifications will be direct through the Purchasing Department.

Q4: Can you please confirm bid date and time?
A1: The pre-bid is scheduled for Thursday, June 28. 2012.
The deadline for questions is July 2, 2012.
The bid opening is scheduled for Tuesday, July 10, 2012 at 2:00 P.M.

Item # 2: A pre-bid conference was held on Thursday June 28, 2012 at 2:00 P.M. in the Purchasing Conference Room located at 800 East Overland Room 300, El Paso, Texas 79901. The Purchasing Department received questions relating to the above referenced Bid at the pre-bid conference. The following is the responses to the questions:

Q1: Explain the Horned Toad Requirements?

A1: The Texas Horned Lizard was known to inhabit El Paso County within the region occupied by the project construction site. As a stipulation for receipt of environmental clearance for the International Bridge Project as a whole, all construction workers are required to receive instruction to facilitate identification of likely habitat, identification of Texas Horned Lizard Individuals and the Texas rules governing their relocation. El Paso County will provide an instructional video to the general contractor awarded the project. The general contractor will be required to show this video to each of his employees, all subcontractor employees and any others who will be working on the construction site. Each general contractor employee, subcontractor employee and others who do watch the video will be required to sign an attendance sheet to document their participation with the training. Copies of attendance sheets shall be provided to El Paso County and kept at the project site. The Texas Horned Lizard training can be conducted at a location of the general contractor's choice, but must be performed prior to initial construction, and must be repeated as new employees are assigned to the project site.

Subsequent to the initial training, should a Texas Horned Lizard be spotted on the project site, the general contractor and his subcontractors shall be responsible for protecting the individual and contacting the on-call biologist as identified within the contract document.

Q2: Is there water at the site?

A1: Yes, potable water is available immediately south of the Island Drain adjacent to the former FM 1109.

Q3: The Fire Alarm System specifications spell out three (3) vendors that are currently approved. Are there any other approved vendors for this system?

A3: There are no other vendors currently approved for this project. Substitutions for Fire Alarm Systems, may be considered when a product/vendor becomes unavailable through no fault of the Contractor.

A substitution for Fire Alarm Systems may be considered provided the Contractor submits a request including complete data substantiating compliance of the proposed substitution with the Contract Documents. A request constitutes a representation that the Proposer:

1. **Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product.**
2. **Will provide the same warranty for the Substitution as for the specified product.**

3. **Will coordinate installation and make changes to other Work which may be required for the Work to be complete with no additional cost to the Owner.**
4. **Waives all claims for additional costs or time extensions which may subsequently apparent .**
5. **Will reimburse the Owner and Architect for review or redesign services associated with the re-approval by authorities.**

Substitutions will not be considered when they are indicated or implied on shop drawings or product data submittals, without separate request, or when acceptance witll require revision to the Contract Documents.

Substitution Submittal Procedure:

1. **Submit four copies of the request for Substitution for consideration. Limit each request to one proposed Substitution.**
2. **Such requests shall include the name of the material or equipment for which it is to be substituted and a complete description of the proposed substitution including drawings, performance and test data, and other information necessary for evaluation.**
3. **An item by item (line by line) comparison of each item listed in the specifications shall be compiled and submitted comparing specified material/project with the proposed substitution.**
4. **A statement setting forth changes in other material, equipment, or other portions of the Work including changes in the work of other contracts that incorporation of the proposed substitution would require shall be included.**
5. **Submit shop drawings, product data, and certified test results attesting to the proposed product equivalence.**
6. **The Engineer/Architect will notify Contractor, in writing, of decision to accept or reject request.**

Q4: Toll booth E-drawings indicate treadle and loops as part of the booth package. Is this correct?

A4: Reference is made to plan sheet E-502, specifically the section of notes entitled "TOLL BOOTH DETAIL GENERAL NOTES". Item C. is revised to read as follows:

C. The actual toll collection equipment and instrumentation will be provided by a toll collection system vendor, under separate contract with El Paso County. The equipment provided under separate contract, but shown on this plan sheet, includes the canopy traffic light, antenna, tire detector, treadle, AVI Reader, and fare display. The booth itself along with all connections, conduit, conductors, and coordination to support the booth and infrastructure shown on this sheet are to be included and installed as a part of this project.

Q5: A soils report is referenced within the contract documents. Will it be issued for review by the bidders?

A5: Yes, the soils report is being issued as an attachment to this addendum.

Q6: Two types of concrete are referenced. The specs indicate 4000 psi. Plan sheet C-402 references paving to be 3000 psi. What strength of concrete is required?
A6: Specification section 03300 requires that product data and a mixture design be submitted for each mixture utilized on the project. Specified concrete strength shall be as indicated on the plan sheets. Plan sheet C-402 includes concrete strength requirements for civil concrete, which is 3000 psi. Plan sheet S-001 includes concrete strength requirements for structural slab, foundation and other structural concrete, which is 4000 psi.

Q7: Can recycled concrete be used in lieu of flexible base material?
A7: No.

Q8: Confirm who will be providing the conduit for all special systems, such as fire alarm, data, IT, telephone etc?
A8: All conduits, whether they be buried, embedded in pavement, embedded in concrete foundations, in attic space, etc. are to be furnished and installed as a part of this project and in accordance with the plans in specifications. This is true for all types of systems, including but not limited to the electrical, communication, fire alarm, IT, toll collection, future microwave tower, and future toll collection booth systems.

Item #3: The soils and geotechnical report for this project , prepared by CQC Geotechnical Engineering, dated August 12, 2011 is hereby attached and made a part of the official bid documents for this project.

NOTE: BIDDERS ARE REQUIRED TO INDICATE THEIR ACKNOWLEDGEMENT OF THIS ADDENDUM IN THE APPROPRIATE LOCATION ON THE BID PROPOSAL FORM.

END OF ADDENDUM NO. 1

BID # 12-046 TORNILLO-GUADALUPE INTERNATIONAL BRIDGE TOLL PLAZA
ATTACHMENT TO ADDENDUM NO. 1

GENERAL SOILS INVESTIGATION REPORT

For

PROPOSED TOLL PLAZA FOR TORNILLO/GUADALUPE NEW INTERNATIONAL BRIDGE MAJOR ARTERIAL ROADWAY NORTH OF THE PROPOSED NEW PORT OF ENTRY TORNILLO, EL PASO COUNTY, TEXAS

Prepared For

EL PASO COUNTY ROAD AND BRIDGE DEPARTMENT
800 E. OVERLAND, SUITE 407
EL PASO, TEXAS, 79901

Prepared By

construction quality control
testing and engineering

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PROJECT NO. AGCQC11-034 / ATCQC11-021

construction quality control
testing and engineering

Construction Materials Testing
Geotechnical Engineering
Environmental Site Assessments
Forensic Analysis / Testing

September 27, 2011

El Paso County Road and Bridge Department
800 E. Overland, Suite 407
El Paso, Texas 79901

Attn.: Mr. Ernesto Carrizal III, P.E.
Public Works Director

Re: General Soils Investigation Report
Proposed Toll Plaza for Tornillo/Guadalupe
New International Bridge Major Arterial Roadway
North of the Proposed New Port of Entry
Tornillo, El Paso County, Texas
CQC Project No. AGCQC11-034 / ATCQC11-021-01

Dear Mr. Carrizal:

In accordance with our agreement and scope of services under proposal PTCQC11-014, dated March 29, 2011, CQC Testing and Engineering LLC is pleased to provide El Paso County Road and Bridge Department (Client) with this general soils investigation report for the above referenced project. This report presents the results of our general widely spaced exploration soil boring, field and laboratory soil classification test results, general foundation system and pavement section design recommendations for this project. Please note that a preliminary report was provided to our Client on August 12, 2011.

Thank you for selecting our firm for geotechnical consulting services and we look forward to working with the design team on the construction phase of this project. Please feel free to contact us if you have any questions regarding the contents of this report, or if we may assist you with other services.

Respectfully Submitted,
CQC Testing and Engineering LLC

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Copies: 1.) Above Addressee – 4 Original Report Copies by hand delivery /1 Copy by e-mail / carrizal@epcounty.com) / (jibarra@epcounty.com)
2.) SEA, Inc. – 1 Copy via Overnight Delivery / 1 Copy via e-mail / (smielke@seatx.com) / (aromero@seatx.com)
3.) File

X:\CQC Files\CQC Files\CQC Working Files\GEO\Reports\2011\11-034-21 - Proposed Toll Plaza for TG International Bridge

Report Table of Contents

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Section 1.0 – General Project Site Information

The subject project consists of the design and construction of a toll plaza facility which will include the design and construction of a concrete masonry unit (CMU) building facility, a metal canopy structure and a septic system. The planned project site is located within a former agricultural farming field north of the planned new port of entry in Tornillo, El Paso County, Texas. We anticipate that the new structure shall create relatively light to moderate loads to be supported by the planned foundation system. It is our understanding that for a shallow conventional spread and continuous footing foundation system shall be preferred by our client for the toll plaza building and drilled straight shaft concrete pier foundations for the canopy structure.

As requested, the soil related information presented in this report is based on the data obtained from a total of three (3) soil exploration borings; two (2) borings were drilled within the building footprint area to a maximum depth of 25 feet and a single soil boring was drilled within the proposed septic system area as shown in the attached "General Boring/Percolation Test Location Plan" in Appendix A, Sheet A1. In addition, a single percolation test was performed within the proposed septic system area.

Our objective and scope of services for this project consisted of generally evaluating the subsurface soil conditions within the project area by conducting soil exploration borings, collecting soil samples and performing laboratory soil classification tests to provide general guidelines with respect to potential foundation systems that may be specified for the planned new building. The following sections of this report present our field investigation methods, site soil-related considerations, site preparation guidelines, and foundation system and pavements section recommendations. The entire report should be read for a thorough understanding of our evaluation, findings and guideline recommendations.

1.1 - Foundation Design Loads and Pavement Vehicle Loadings

Based on information provided by our Client's project structural engineer, it is our understanding that the new building structure shall create maximum column loads of up to 50 kips and wall loads of up to 2.0 kips/foot. It is also our understanding that the proposed new canopy structure shall contain vertical downward and uplift reactions at the base of the columns in the order of 40 to 50 kips and 5 to 10 kips, respectively. The horizontal shear reactions shall be in the order of 5 kips. In the event that these loads vary significantly from the final design loads, CQC Testing and Engineering LLC (CQC) should be contacted to reevaluate our foundation recommendations with respect to foundation types, allowable soil bearing capacity values, and soil improvement below foundation systems and sitework structures.

Parking and access driveway areas associated with this project will be subjected to varying vehicle loads throughout its service lifetime. To perform a detailed pavement design analysis it is required to know the types of

vehicles (passenger cars, light-duty trucks, heavy-duty trucks), number of vehicles, daily volume or total volume projected by the owner for the service life of the facility. A traffic study or traffic counts from a similar facility may be used for estimating purposes. The only information available for our review was a chapter from a traffic forecast study prepared for the Tornillo-Guadalupe New International Bridge Traffic. The traffic study indicates that depending on multiple scenarios prepared southbound traffic is anticipated to range from 4,027 to 8,601 vehicles per day in the year 2025. The percent of commercial traffic was projected to range from 3.3 to 7.8 percent trucks. Annual traffic volumes are anticipated to increase at a rate of 2.2 to 3% annually. Based on the information reviewed above, 18-kip Equivalent Single Axle Load (ESAL) values were estimated to range from 2,086,000 to 4,980,000 ESAL's over a period of 20 years for the toll facility main driveway lanes. The parking lot area was assumed to be subject to primarily standard vehicle traffic with a minimum ESAL value of 80,000 and maximum value of 630,00 ESAL's.

1.2 - Site Geologic Considerations

The Geologic Atlas of Texas (Van Horn-El Paso Sheet, Revised 1983) published by the Bureau of Economic Geology at the University of Texas at Austin indicates that the project site is located in an area of Young Quartenary Deposits (Qair) from the Holocene period. These deposits typically consist of alluvium along the Rio Grande and are usually variable over relatively short distances. In addition, the project site is located southwest of an upward/downward fault according to the geologic map.

1.3 - Existing Topographic Conditions

Based on our review of preliminary topographic information provided by our client, the existing elevations at the project location indicate that the elevations range from 3590 to 3592 msl or applicable county datum elevation. The grading and drainage plan indicates that the planned finished floor of the new building shall be 3594.80.

1.4 – Seismic Considerations

Based on our review of the current International Building Code and Site Classification for Seismic Design Definitions in conjunction with our review of the geologic conditions in the area, it is our professional opinion that a Site Class D may be used for this site. Please note that a geologic atlas of the area was used to supplement our analysis since our boring was performed to maximum depths of 25 feet below the existing ground surface elevation and the building code considers the average soil properties in the top 100 feet of the subject site. In the event that the owner and/or design representative is interested in determining the building code Site Class with a higher degree of accuracy, additional tests beyond our original requested scope of work shall be required.

Based on a Soil Site Class D, seismic ground motion values for the site latitude coordinate of 31.438722º and longitude coordinate of -106.1396527º are defined in the table below. The seismic coefficients were generated through the USGS Seismic Hazard Curves & Uniform Hazard Response Spectra website. The values should be verified by the project structural engineer prior to use in structural analysis. CQC should be informed if the reported values vary significantly.

Period (Seconds)	Spectral Accelerations (g)	Site Coefficient F_a	Site Coefficient F_v
0.2 (S_s)	0.359	1.513	-
1.0 (S_1)	0.111	-	2.356

Section 2.0 – General Subsurface Soil Exploration Methods and Testing

As requested by our Client, the subsurface soils within the project site were evaluated by completing a total of three (3) widely spaced exploration soil borings; two (2) soil borings (were drilled to the maximum depth of 25 feet and one (1) soil boring was drilled to the maximum depth of 10 feet, each below the existing ground surface elevation at the time of our drilling activities. The approximate locations are shown in the General Soil Boring and Percolation Test Location Plan in Appendix A, Sheet A1. The borings were drilled with a CME-55 rotary drilling rig, hollow stem auger drilling techniques and were logged during our drilling operations by a certified and/or trained member of our staff. Our boring logs are presented in Appendix A, Sheets A2 through A4. In general, soil Borings B-1 and B-2 were completed within the general footprint area of the proposed new building facility and soil Boring P-1 was completed within the proposed septic system area. The soil borings were located at the site by our Client.

During our drilling operations Standard Penetration Tests (SPT) were performed in general conformance with ASTM D 1586. Soil samples were collected within the split-spoon sampler at discrete depth intervals and were containerized and transported to our laboratory for further physical and classification testing. Our soil classification tests (i.e., moisture contents, sieve analysis, and Atterberg Limit Tests) were performed in accordance with accepted ASTM test procedures D-2216, D-1140, D-2217, D-6913, and D-4318, respectively. The results of our tests and estimated "N-Values" are presented in our boring logs and Summary of Field and Laboratory Test Results in Appendix A, Sheet A9. At the completion of our drilling activities, the borings were backfilled with auger cuttings and firmly compacted at the ground surface.

The following table summarizes the completion depths of our borings, type and number of collected samples, and ground water depth recorded at the time of our drilling operations.

Summary of Field Investigation				
Borehole No.	**Termination Depth (ft.)**	**No. Split-Spoon Samples**	**No. Auger Samples**	**Observed Groundwater Depth (ft.)**
B-1	25	8	-	9
B-2	25	8	-	9
P-1	10	4	-	NE

NE- Not encountered at the time of our drilling activities.

Please note that the collected soil samples from our general soils investigation shall be stored for a period of up to 60 days after the submittal of this report. If a longer period of storage is required by our client, CQC should be informed in writing.

2.1 - Soil Classification Laboratory Testing

In the laboratory, selected soil samples were evaluated and visually classified by our geotechnical engineering staff in general accordance with the Unified Soil Classification System (USCS). The geotechnical engineering properties of selected samples were evaluated by the following tests:

Type of Test	Total Number Conducted
Natural Moisture Content Tests	11
Atterberg Limits Tests	6
Particle Size Analysis	11

Sieve analysis test curves are reported in Appendix A, Sheet A5 through A8. A summary of our field and laboratory soil classification test results is reported in Appendix A, Sheet A9 for ease of reference in this report. In addition to our field activities, a single soil percolation test was performed near soil boring P-1. In general, the soil percolation test (PT-1) was performed at an approximately 8 to 12 inches below the existing ground surface elevation. The result of our soil percolation test is presented in Appendix A, Sheet A12.

At the time of our drilling activities, a bulk subgrade soil sample was obtained from Soil Boring B-2 for laboratory moisture density-relationship and California Bearing Ratio (CBR) testing. The sample was collected from a depth of about 0.5 to 3 feet below the existing ground surface elevation. The results of a single moisture density relationship test (i.e., proctor) conducted on the collected sample is presented in Appendix A, Sheet A10. The proctor was prepared in accordance with compaction test procedure ASTM D 698, Method "A". The measured optimum dry density and moisture content values are presented in the table below.

The collected bulk subgrade sample was also subjected to CBR testing and the results are presented in Appendix A, Sheet A11. Our test was performed in general accordance with ASTM standard test method D 1883.

The results of our tests are tabulated below for ease of reference.

		M-D Information		CBR Information				
Sample Location	**Soil Classification**	**Dry Density (pcf)**	**Moisture %**	**Dry Density prior to Soaking (pcf)**	**Dry Density after Soaking (pcf)**	**Swell %**	**CBR at 0.1" Pen.**	**CBR at 0.2" Pen.**
B-2	CL	108.3	12.4	104.4	95.4	0.280	3	3

Based on our CBR test results, the subgrade soils may provide a relatively low level of support for the new pavement structure. The pavement recommendations in Section 6.0 of this report should be considered by the owner and design representatives to mitigate potential poor pavement performance and rutting of the pavement if not properly placed, compacted, and tested.

Section 3.0 – Subsurface Soil Conditions, Classification and Strength Considerations

As requested, the subsurface soil conditions were generally evaluated based on our observations and field tests conducted on soil samples collected from three (3) widely spaced soil exploration borings drilled within the proposed project site. In general, the subsurface soils encountered at the site may be described by two (2) major soil stratums. The logged depth of the reported soil stratums is approximately delineated in our soil boring logs. Due to the geologic location of the site, it is possible for variations in the types and depths of the soil formations to occur over relatively short distances.

Stratum I consists of fine grained, light brown silty sands with traces of clay and/or multicolored, poorly graded sands. The encountered depths of these soils are described in our soil boring logs. In general, these soils were encountered at approximately 2 feet and extending to 5 feet within Boring B-1. In Borings B-1 and B-2 these soils were encountered again at 10 feet and extending to at least 25 feet. In Boring P-1, these soils were encountered at approximately 2½ to 3 feet below the ground surface. This stratum was encountered at a loose to medium dense relative density with SPT N-values ranging from 6 to 22 blows per foot of penetration. Measured moisture contents ranged from 8 to 27 percent. Our sieve analysis tests indicated that these soils contained fines (i.e., percent particles passing a sieve with 0.074 mm square openings) ranging from 4 to 30 percent. In general, these soils may be classified as SM, SP and SP-SM in general accordance with the USCS. These sandy soils shall be susceptible to erosion and sloughing during construction. Soils classified as SP are not recommended to be utilized as Select Fill below foundation elements. However, these soils may be blended with suitable on-site silty sands or Select Fill clayey soils to meet the requirements of Section 8.1 of this report.

Stratum II consists of brown to dark brown, moderately plastic to plastic, clays with variable amounts of sand. In soil Boring B-1, these clays were encountered from the ground surface and extending to approximately 2 feet. These clays were encountered again below the Stratum I soils at approximately 5 feet and extending to an approximate depth 9 feet. In Borings B-2 and P-1 the clays were encountered from the ground surface and extending to depths ranging from 7 to 10 feet. This stratum was encountered at a soft to stiff consistency with SPT N-values ranging from 3 to 9 blows per foot of penetration. Measured moisture contents ranged from 5 to 29 percent. Our sieve analysis tests indicated that these soils contained fines (i.e., percent particles passing a sieve with 0.074 mm square openings) ranging from 56 to 88 percent. Atterberg limit tests indicate that these soils contain liquid limits ranging from 32 to 59 and plasticity indices ranging from 16 to 40. These soils may be classified as CL and CH in general accordance with the USCS. These soils are not suitable for use as Select Fill soils. Based on the measured moisture content of these clays, these soils below an approximate depth of 7½ shall be susceptible to consolidation settlement. The clay soils from the ground surface to an approximate depth of 7½ feet shall be susceptible to shrinkage and swelling movements.

3.1 - Groundwater Depth Considerations

At the time of our drilling operations, groundwater was encountered at an approximate depth of 9 feet below the existing ground surface elevation in our soil borings. However, the soils at an approximate depth 6 feet and extending to the reported ground water elevation appeared to be at a very moist to wet condition. This may be associated with the capillary rise of moisture through the soils above the groundwater depth. It is highly recommended that the contractor verify the groundwater depth prior to performing excavations at this site deeper than 5 feet from the existing ground surface elevation. If shallow groundwater is encountered, CQC should be contacted immediately to perform site observations of the noted conditions to develop additional recommendations, if necessary.

3.2 - Soil Related Movements

The results of our observations and soil classification tests were used to evaluate the Potential Vertical Rise (PVR) of the subsurface soils in accordance with a published empirical method. This method is used to estimate the potential vertical movements (i.e., shrinkage and swelling) of the cohesive soils based on the plasticity indices (PI) of the soil. Based on the encountered soil moisture conditions, a surcharge pressure of at least 1 psi and an active soil zone of 9 feet, a maximum PVR value of up to 1-3/4 inches was estimated for these soil strata.

The table below indicates the potential reductions in PVR with additional Select Fill surcharge above the

existing grade and overexcavation and Select Fill replacement below the floor slab system. The table below presents a maximum surcharge of 4 feet, which is based on our understanding that the design finished floor elevation shall be approximately 4 feet above the existing grade elevations. As a result of the estimated PVR value, it is highly recommended that the recommended minimum amounts of Select Fill below the floor slab and surcharge addition be considered in the design of the floor slab to mitigate soil related vertical movements.

Fill Placed Above Existing Ground Surface (ft)	**PVR (in.)**
0	1-3/4
1	1.44
2	1-1/4
3	1.11
4	1.00
Overexcavation and Select Fill Replacement of Existing Subgrade Soils (ft)	**PVR (in.)**
1	0.89
2	0.81
2.5	¾

In moisture sensitive areas and areas where the floor will be covered with moisture sensitive materials (such as tile or carpet), we recommend placing a plastic vapor barrier above 4 inches of moist clean sand over Select Fill material or as required by the Architect's specified flooring products. The vapor barrier shall mitigate the movement flooring products which are sensitive to moisture penetration through the slab. This is highly recommended for this site.

Site work grading should be designed in a manner that will provide positive surface drainage and prevent water from ponding adjacent to flat work and building foundations. Drainage flumes and areas where storm water will naturally be allowed to "sheet flow" should be appropriately sealed and protected to prevent erosion of the supporting soils.

The estimated PVR movements should be considered in the design of flat site work (i.e., sidewalks, ramps, etc., and floor slabs), which shall be primarily influenced by the estimated potential vertical movement. The dead weight and live loads imposed on load bearing foundation elements may be greater than the potential uplift swelling pressure of the clay formation. This may be further evaluated through additional soil swell tests if authorized by our Client.

3.3- Subsurface Soil Considerations and Preparation

The following section presents specific conditions that we have observed during our evaluation that should be considered by our Client and design team with respect to earthwork estimates and operations.

Special Considerations

- Site work should be performed in accordance with the Site Preparation section of this report or as required by the project plans and specifications, whichever is more stringent.

- The project Contractor shall be responsible for conducting their own tests to verify the actual depths of the soil types within the project limits to perform earthwork. The owner shall not incur additional costs for variations in the soil formations within the project limits and/or additional excavation requirements by the contractor. The boring logs in this report are intended for engineering design purposes and not for the contractor's evaluation use and/or interpretation for earthwork estimates.

- Based on our SPT data, the near subsurface soils encountered in our soil borings are considered to be at a relatively loose to medium dense relative density and/or soft to medium stiff consistency. Soils in a loose and/or soft condition may be susceptible to elastic and/or consolidation settlements when exposed to the proposed new structure loads and variable moisture infiltration. As a result, the owner and design team should consider the recommendations below and in Section 4.0 to mitigate potential soil settlements.

- The encountered soils are susceptible to environmental erosion, as a result plumbing installations below the floor slab should be inspected and pressure tested to ensure that water leaks are controlled to mitigate potential foundation soil support erosion and the creation of a "water saturated zone" over time. Poor soil support may result in settlement and distress cracks in the structural elements over time.

- Based on our experience with similar soils in the area, the contractor should consider that it is possible for sloughing (i.e., erosion) of the granular sandy soils to occur during excavations for this project. Sloughing of granular soils may hinder the installation of form work and cause excavations to be wider than expected. Proper moisture conditioning and compaction of these soils may mitigate potential soil sloughing.

- Based on our soil boring logs and soil classification tests, the soils encountered at this site should be considered Type "C" for Stratum I soils and Type "B" for Stratum II soils under current Occupational Safety and Health Administration (OSHA) regulations (Standard – 29 CFR-Part 1926.650, Subpart P- Excavations) pertaining to excavations. In excavations penetrating these soils, the non-permanent sloping and benching schemes specified for Type "B" and "C" soils under the OSHA regulations require that the excavation sidewalls be sloped no steeper than 1:1 for Type "B" soils and 1½:1 for Type "C" soils. Trenches or excavations 5 feet and deeper shall require the development of a trench safety plan to protect employees and the general public. Please note that it is the contractor's responsibility to assign a "competent" person to perform daily inspections and required documentation in accordance with OSHA regulations. In addition, OSHA limits excavations to 20 feet when excavations utilize soil benching and sloping methods and braced/shored trench box (i.e., rated) shielded systems designed by a licensed professional engineer. Trench excavations utilizing sheet piling systems or un-braced temporary shielded systems per OSHA regulations shall be designed by a licensed professional engineer for any excavation depth in consideration to protect the health and safety of all workers and the public.

- When utility lines are installed at this site, the utility contractor should adequately overexcavate the soils in the utility line trench area and backfill with properly compacted in-situ or Select Fill soils to mitigate

potential settlements caused by uncontrolled backfill during construction. In-situ and/or select fill soils should be placed in loose lifts not to exceed 8 inches in thickness to the finished subgrade elevation or in accordance with the project plans and specifications, whichever is more stringent and compacted to at least 95 percent of the maximum dry density as determined by ASTM D 1557. Prior to placing the select fill soils, the existing native soils at the bottom of the trench should be scarified and recompacted to a minimum 90-95 percent of the maximum dry density as determined by ASTM D 698 or 1557 and/or as required by the pipe manufacturer or design engineer.

Site Preparation and Foundation/Floor Slab Support

- Existing soils that will support compacted Select Fill, shallow foundation elements, floor slabs, and pavement structures should be cleared of all vegetation, organic matter, topsoil, construction debris, and/or any foreign matter. The cleared subgrade soils with a PI less than 18 should be scarified to a minimum depth of 8 inches and recompacted to 95 percent of ASTM D 1557 at ±3 percent of optimum moisture content. Cohesive subgrade soils or clays (i.e., soils with a PI greater than 18) should be compacted to at least 90 percent of maximum dry density per ASTM D-1557 with a water content within 0 to +3 percentage points of optimum. Weak or compressible soil zones identified during earthwork operations should be removed and replaced with properly compacted Select Fill to a minimum depth of 8 inches or as required to appropriately bridge over these soils, whichever is deeper. Proofrolling operations should be observed by a member of CQC to document subgrade preparation.
- We recommend that shallow foundations and floor slabs be supported by the minimum amounts of prepared and compacted suitable existing soils or Select Fill as recommended in Section 4.0 of this report. The recommended amounts of Select Fill below foundation elements should extend at least 18-inches beyond the edges of the footings and 5 feet beyond floor slabs, where applicable.
- In areas where Select Fill will be required to raise the existing grades to the finished grade elevations, the Select Fill should be placed in loose lifts not exceeding 8 inches in thickness and compacted to at least 95 percent of maximum dry density as determined by the ASTM D 1557. The moisture content of the fill should be maintained within a range of ±3 percent of the optimum moisture content until permanently covered. The fill should be appropriately tested at standard frequencies or as required by the project specifications and plans, whichever is more stringent.

Section 4.0 – Foundation and Floor Slab Design Recommendations

The following recommendations are based on the results of our field investigation and laboratory physical classification tests performed on selected sampled subsurface soil materials. The design team may utilize the following information to evaluate potential foundation types and proportion foundation structural elements as required for the project. Please contact CQC in the event that additional information is required and/or if the owner or design team is considering alternative foundation types. The foundation system recommendations presented in this report are based on the structural load information provided by our clients design representative. We highly recommend that CQC be contacted in the event that the final structure loads vary significantly than those indicated in this report.

4.1 – Foundations

- Building Foundation System

The proposed new building foundation system may consist of a structural grade beam and slab foundation system bearing on prepared and compacted Select Fill soils. The following allowable soil bearing capacities, minimum footing embedment depths and foundation widths are recommended for this site. Our engineering analysis below considered a factor of safety of at least 2 with respect to the soil bearing capacities presented below.

Net Allowable Soil Bearing Capacity: (Interior and Exterior Grade Beams and widened sections bearing on moisture conditioned and compacted Select Fill)	1,200 psf
Minimum Exterior Grade Beam and Widened Section Embedment Depths: (Below lowest adjacent finished grade)	24-inches
Minimum Interior Grade Beam Embedment Depth: (Below lowest adjacent finished grade)	22-inches
Minimum Grade Beam and Perimeter Beams Width:	16-inches
Minimum Column Widened Sections Widths:	24-inches

Based on our tests results, perimeter footings and interior grade beams should be supported by a minimum of 24 inches of Select Fill soils and widened beam sections should be supported by a minimum of 24 inches of Select Fill soils. The Select Fill should extend at least 24 inches beyond the edges of the footings. These soils should be moisture conditioned and compacted to a minimum of 95 percent of maximum dry density in accordance with ASTM D1557 and at ±3 percent of optimum moisture content until finally covered. The fill should be placed in loose lifts not to exceeding 6 inches and should be compacted with no vibratory impacts.

It is recommended that the space interval between grade beams should no more than 20 feet. Please note that the site may be raised to achieve the minimum recommended soil support below foundation footings.

Exposed subgrade soils that shall support compacted Select Fill, shallow foundation elements and floor slabs should be cleared of all vegetation, organic matter, topsoil, construction debris, and/or any foreign matter. The cleared subgrade soils with a PI less than 18 should be scarified to a minimum depth of 8 inches and recompacted to 95 percent of ASTM D 1557 at ±3 percent of optimum moisture content. Cohesive subgrade soils or clays (i.e., soils with a PI greater than 18) should be compacted to at least 90 percent of maximum dry density per ASTM D-1557 with water content within 0 to +3 percentage points of optimum. Weak or compressible soil zones identified during earthwork operations should be removed and replaced with properly compacted Select Fill to a minimum depth of 8 inches or as required to appropriately bridge over these soils, whichever is deeper.

Proofrolling operations should be observed by a member of CQC to document subgrade preparation.

Foundation steel reinforcement design should be determined by the project structural engineer. Reinforcing steel should be checked for size and placement prior to concrete placement. Placement of concrete should be accomplished as soon as possible after excavations to reduce changes in the moisture content or the state of stress of the foundation materials. No foundation element should be left open over 4 days without concreting and moisture content of the footing trenches should be maintained daily. The contractor should also follow the ACI recommended guidelines with respect to concrete placement temperatures during hot and cold weather conditions.

Foundation Settlements

Foundation systems designed in accordance with the recommendations given above will provide a factor of safety in excess of 2 with respect to the design soil shear strength, provided that the subgrade and fill soils are prepared in accordance with the recommendations provided in this report. Total settlements are anticipated to be less than 2 inches, provided that foundation widths are less than 8 feet in plan dimensions. Differential settlements typically are estimated to be about one-half the total estimated settlement.

Drainage Considerations

Site work grading should be designed in a manner that will provide positive surface drainage and prevent water from ponding within or adjacent to the foundations. Gutters with downspouts are recommended to collect storm waters from the roof and direct them away from the building foundations. In addition, plumbing installations within the building should be inspected and pressure tested to ensure that water leaks are controlled to mitigate potential foundation soil settlements and loss of support below the floor slab and footing elements.

4.2 - Floor Slab Design Considerations

Based on our PVR analysis presented in Section 3.2 of this report we recommend that the proposed building floor slab be supported on a minimum of 72 inches of Select Fill soils in order to reduce potential soil related movements to ¾ inches or less. The total depth of Select Fill support consists of the anticipated raising of the site by approximately 48 inches to meet the finished floor elevation and the overexcavation and removal of at least 24 inches of the Stratum II clay soils below the existing ground elevations.

A modulus of subgrade reaction of 150 psi/in for prepared existing soils and/or compacted Select Fill may be used for design purposes.

The floor may be constructed as a rigid minimum 4-inch thick concrete slab. Reinforcing within the floor slab is recommended to consist of rebar positioned at mid-height within the slab. The actual floor slab design

should be performed by a professional structural engineer.

In moisture sensitive areas and areas where the floor will be covered with moisture sensitive materials (such as tile or carpet), we recommend placing a polyethylene membrane vapor barrier above 4 inches of moist clean sand over Select Fill material or as required by the Architect's specified flooring products.

Monolithically poured foundation/floor slab systems are estimated to settle similar to estimates provided under the foundation recommendations section of this report.

4.3 – General Site Flat Work

We anticipate that the proposed ground-supported flat site work such as sidewalks, walkways, ADA ramps, etc. will be subject to the same magnitude of potential movements as previously discussed in Section 3.2 of this report. Thus, where these types of elements abut rigid suspended structures, differential movements should be anticipated. As a minimum, we recommend that flexible joints be provided where such elements abut the main structures to allow for differential movement. Where the potential for differential movements is objectionable, it may be beneficial to consider methods of reducing anticipated movements to match the adjacent structure performance. As a result, we recommend that a minimum of 24 inches of compacted Select Fill be placed below flat site work for this project.

Site work grading should be designed in a manner that will provide positive surface drainage and prevent water from ponding adjacent to flat work and building foundations. Drainage flumes and areas where storm water will naturally be allowed to "sheet flow" should be appropriately sealed and protected to prevent erosion of the supporting soils.

4.4 – Canopy Shade Structure Foundation Recommendations:

- **Drilled Straight Shaft Concrete Piers:**

Canopy structure columns may be supported by drilled straight shaft cast-in-place reinforced concrete piers. Based on our field data, soil classification test results, and provided structural load information individual piers may be proportioned based on the total allowable pier capacity curves presented in Appendix A, Sheets A13 through A16. Pier capacity curves for circular 18 inch, 24 inch, 30 inch and 36 diameter piers are presented. Based on the structural load information provided, we recommend that piers for the subject canopy structures have a minimum diameter of 24 inches and bear at a minimum depth of 20 feet below the existing ground elevation. The capacity values presented on the curves consider side friction and end bearing capacity. As a result, proper drilled pier excavation and construction techniques that allow for full development on skin friction

will be critical for foundation performance. The pier capacity curves consider a factor of safety of 3 with respect to side friction resistance and greater than 2 with respect to end bearing capacity. It is recommended that at least the top 5 feet of the pier length be excluded from resistance analysis to account for construction disturbance. Construction of the drill piers shall require casing or mud slurry drilling techniques due to the encountered groundwater depth encountered at this site.

Lateral analysis of piers may utilize a soil unit weight of 100 to 115 pcf. A soil angle of internal friction of 30º to 32º may be utilized for the Stratum I sands and a cohesion value of 250 to 480 psf for the Stratum II clays.

Using the L-Pile 5.0 computer program, pile head deflections and maximum bending moments may be determined using the structural loadings provided by our Client design representative. Assuming the use of a minimum 3,600 psi concrete and a shaft diameter of 2 ft, we estimate pile head deflections of approximately less than ¼ inch and a maximum bending moments of 277.2 k-in.. These parameters were evaluated assuming 8 No. 9 steel reinforcement bars. Pile deflection and bending moment curves are provided in Appendix A, Sheets 17 and 18 of this report.

- Allowable Uplift Resistance:

Resistance to uplift forces exerted on the drilled, straight-shaft piers will be provided by the sustained compressive axial force (dead load) plus the allowable uplift resistance provided by the soil. The resistance provided by the soil depends on the shear strength of the soils adjacent to the pier shaft and below the depth of the active zone. An allowable soil uplift resistance of 250 psf for the portion of the shaft extending below a depth of 9 feet may be utilized in analysis.

- Soil Potential Uplift Force:

Based on our laboratory plasticity index tests performed on selected samples of the encountered Stratum II clays a potential swelling force may be estimated from the equation presented below. The equation below considered a uniform solid circular pier, a potential maximum active zone of 9 feet and estimated adhesion factors based on the plasticity index of the soils and assumed normally consolidated to slightly consolidated clay soils.

The uplift force acting on the shaft may be estimated by:

$$Fu = 10 \times D$$

where:

Fu = uplift force in kips; and

D = diameter of the shaft in feet.

Reinforcing steel will be required in each pier shaft to withstand a net force equal to the uplift force minus the uplift resistive force and the sustained compressive load carried by that pier. We recommend that each pier be reinforced to withstand this net force or an amount equal to 1 percent of the cross-sectional area of the shaft, whichever is greater. The final dimensions and steel reinforcement of the concrete pier foundation should be determined by a licensed professional structural engineer.

In general, concrete should be placed from the bottom to the top of the pier hole and should not be allowed to fall into the pier hole and/or through accumulated water seepage within the pier holes. Pier construction should be anticipated to require casing or the use of drilling fluids to maintain the pier holes open and stable during reinforcement installation and concreting.

We recommend that each drilled pier excavation be inspected by a member of CQC who is familiar with the geotechnical aspects of the soil stratigraphy, the structural configuration, foundation design details and assumptions prior to placement of the concrete. CQC shall verify the following requirements have been met:

- The shaft has been excavated to the specified dimensions at the correct depth established by the previously mentioned criteria.
- The shaft has been drilled plumb within specified tolerances along its total length.
- Excessive cuttings, buildup and soft, compressible materials have been removed from the bottom of the excavation.
- In no case should pier holes be left open for more than 24 hours

- **Spread Footing Foundations:**

Alternatively, the canopy structure columns may also be supported by shallow individual spot footings bearing on prepared and compacted Select Fill soils. We recommend that shallow foundations be supported by the minimum amounts of prepared and compacted Select Fill prepared at the recommended compaction and moisture conditions below. The following allowable soil bearing capacity, minimum footing embedment depths, and foundation widths may be used in foundation analysis and design. Our engineering analysis below considered a factor of safety of at least 2 with respect to the soil bearing capacity presented below.

Net Allowable Soil Bearing Capacity: (Spot footing foundations bearing on moisture conditioned and compacted suitable existing soils and/or Select Fill)	1,200 psf
Minimum Footing Embedment Depth:	36-inches

(Below lowest adjacent finished grade)

Minimum Spread footing width (Spot Footing): 36-inches

Minimum Compacted Select Fill Soil Support below Footing Foundation: 24-inches

The footing should be supported by a minimum of 24 inches of Select Fill soils. The Select Fill should extend at least 24 inches beyond the edges of the footing. These soils should be moisture conditioned and compacted to a minimum of 95 percent of maximum dry density in accordance with ASTM D1557 and at ±3 percent of optimum moisture content until finally covered. The fill should be placed in loose lifts not to exceeding 6 inches and should be compacted with no vibratory impacts.

Footing analysis may consider a unit weight of 130.0 pcf, an angle of internal friction of 32 degrees and an allowable coefficient of soil friction of 0.35 for Select Backfill soils. Footing analysis should consider the uplift forces on each footing.

Section 5.0 – Below Grade Lateral Earth Pressures

The proposed below grade structures will be subjected to vertical and lateral earth pressures depending upon the type of backfill soil. The table below presents at-rest (K_o) pressure coefficients for select backfill soils. The K_o pressures are recommended for cases where the structure will experience little yield. Select backfill soils should meet the requirements of Select Fill or as required by the project specifications, whichever is more stringent.

Earth Pressure Coefficients			
Soil Type	**Estimated Total Unit Weight (pcf)**	**Lateral Earth Pressure Coefficients**	**Equivalent Fluid Weight (pcf)**
		At-Rest (K_o)	**At-Rest (K_o)**
Crushed Stone Base Course	148	0.35	52
Select Fill Soils (PI<15)	130	0.45	59
Clays or Sandy Clays	120	0.74	89

The lateral pressure with depth may be estimated with the following equation;

$$P_s = K_o \gamma_s (H-H_w) + K_o(\gamma_s - \gamma_w)H_w + \gamma_w H_w + q\,K_o$$

Where; P = lateral earth pressure at calculated depth, psf
K_o = At-rest lateral earth pressure coefficient (typically used for long-term cases)
γ_s = Total wet unit weight of soil, pcf
H = Depth of structure from ground surface to calculated depth, ft
H_w = Positive vertical downward depth of water from reported highest depth. Note when calculation depth is above reported water depth, then H_w term in equation is considered zero
γ_w = Unit weight of water, pcf
q = Surcharge pressure, psf (typically only considered to 20 feet)
light loads (i.e., pedestrians and soil stockpiles) – 50 psf,
moderate (i.e., light equipment) – 150 psf,
heavy (i.e., heavy duty equipment) – 250 psf or more

Section 6.0 – Pavement Recommendations

Based on our field observations, field tests, and laboratory soil classification test results, the following sections present our flexible and rigid pavement recommendations. The flexible pavement section below also provides an alternative pavement section with geogrid reinforcement for our Clients consideration.

6.1 – Flexible Pavement Structure

The 18-kip ESAL's indicated in Section 1.1 of this report were used in our engineering analysis. Our pavement design is based on American Association of State Highway and Transportation Officials (AASHTO) design procedures for a 20-year design period. A CBR value of 3 was used in our pavement analysis and design. Our analysis was also performed based on the following parameters.

General Pavement Design Parameter	Flexible Pavement Value	Rigid Pavement Value
Initial Serviceability	4.2	4.2
Terminal Serviceability	2.5	2.5
Reliability Level (%)	85	85
Overall Standard Deviation	0.45	0.35
Load Transfer Coefficient	---	2.9
28-day mean PCC modulus of rupture	---	650 psi
Lane Distribution Factor – Two Lanes	0.75	0.75
Directional Distribution Factor	1.0	1.0
Axle Load Truck Factor	1.2 – 1.5	1.2 -1.5
% Trucks, FHWA Class 5 or greater	3.3 – 7.8%	3.3– 7.8%
Truck Growth Factor, %	3%	3%
Design Period	20 yr	20 yr

We anticipate that a routine pavement maintenance program and asphalt pavement rehabilitation may be

required after about 8 to 10 years to obtain the 20-year pavement service life. Our pavement recommendations also assume that positive surface drainage will be provided and that construction materials testing and monitoring will be provided during construction. The following table presents our pavement section recommendations and lists the minimum pavement thicknesses and specifications.

Traditional Asphaltic-Concrete Pavement Structure
Toll Facility - Standard Vehicle Parking Lot Area
Min. Design ESAL Value 80,000 ESAL's, Max. Value 630,000

Material Section Type	Minimum Thickness (in.)	Specified Compaction, %, ASTM Method
Hot Mix Asphaltic Concrete (HMAC), TxDOT – Item 341 - Type C	2-1/2	Per TXDOT Standards (See Report Section 6.3)
Crushed Stone Base Coarse, TxDOT – Item 247 Type A, Grade 2	6	100% Min., TEX 113 E
Prepared and Compacted Select Fill Soil Material	18	95% Min., TEX 114 E
Scarified, Moisture Conditioned and Compacted Subgrade Soils	6	90% Min., TEX 114 E

Alternative Geogrid Asphaltic-Concrete Pavement Structure
Toll Facility - Standard Vehicle Parking Lot Area
Min. Design ESAL Value 80,000 ESAL's, Max. Value 630,000

Material Section Type	Minimum Thickness (in.)	Specified Compaction, %, ASTM Method
Hot Mix Asphaltic Concrete (HMAC), TxDOT – Item 341 - Type C	2-1/2	Per TXDOT Standards (See Report Section 6.3)
Crushed Stone Base Coarse, TxDOT – Item 247 Type A, Grade 2	6	100% Min., TEX 113 E
Tensar Tri-AX – TX-5 Geogrid or Approved Equal Below Base Coarse Material	-	-
Prepared and Compacted Select Fill Soil Material	12	95% Min., TEX 114 E
Scarified, Moisture Conditioned and Compacted Subgrade Soils	6	90% Min., TEX 114 E

Traditional Asphaltic-Concrete Pavement Structure
Toll Facility – Main Driveway Lanes
Design ADT in 2012 – 4,488 vpd, Max. Design ESAL Value: 4,980,000 ESAL's

Material Section Type	Minimum Thickness (in.)	Specified Compaction, %, ASTM Method
Hot Mix Asphaltic Concrete (HMAC), TxDOT – Item 341 - Type C	3	Per TXDOT Standards (See Report Section 6.3)
Hot Mix Asphaltic Concrete (HMAC), TxDOT – Item 341 - Type B	5	Per TXDOT Standards (See Report Section 6.3)
Crushed Stone Base Coarse, TxDOT – Item 247 Type A, Grade 2	6	100% Min., TEX 113 E
Prepared and Compacted Select Fill Soil Material	18	95% Min., TEX 114 E
Scarified, Moisture Conditioned and Compacted Subgrade Soils	8	90% Min., TEX 114 E

Alternative Geogrid Asphaltic-Concrete Pavement Structure
Toll Facility – Main Driveway Lanes
Design ADT in 2012 – 4,488 vpd, Max. Design ESAL Value: 4,980,000 ESAL's

Material Section Type	Minimum Thickness (in.)	Specified Compaction, %, ASTM Method
Hot Mix Asphaltic Concrete (HMAC), TxDOT – Item 341 - Type C	3	Per TXDOT Standards (See Report Section 6.3)
Hot Mix Asphaltic Concrete (HMAC), TxDOT – Item 341 - Type B	3	Per TXDOT Standards (See Report Section 6.3)
Crushed Stone Base Coarse, TxDOT – Item 247 Type A, Grade 2	6	100% Min., TEX 113 E
Prepared and Compacted Select Fill Soil Material	10	95% Min., TEX 114 E
Tensar Tri-AX TX-5 Geogrid or Approved Equal Below Select Fill	-	-
Scarified, Moisture Conditioned and Compacted Subgrade Soils	6	90% Min., TEX 114 E

6.2 – Pavement Subgrade Preparation

The existing soils that will support compacted Select Fill should be cleared of all vegetation, organic matter, topsoil, construction debris, and/or any foreign matter. The subgrade soils should be scarified to a minimum depth of 6 to 8 inches and recompacted to 90 percent of maximum dry density determined by Tex-114-E. The moisture content of the subgrade soils should be maintained within the range of +/-2% of optimum moisture content. Weak or compressible soil zones identified during earthwork operations should be removed and replaced with properly compacted Select Fill to a minimum depth of 8 inches or as required to appropriately bridge over these soils, whichever is deeper. Proofrolling operations should be observed by a member of CQC to document subgrade preparation.

Landscaping islands that shall be located within the parking lot or adjacent to paved areas should also be properly designed to limit infiltration of water seepage behind curb structures into the supporting pavement section materials (i.e., base coarse, select fill and subgrade).

6.3 - Asphaltic-Concrete Paving Materials

The Hot-Mix Asphaltic Concrete (HMAC) should be designed in conformance with the gradation requirements of a surface course, Type C and B in accordance with Item 341 of the TxDOT Standard Specifications. The asphaltic-concrete mix design should meet the quality control field production and laboratory testing requirements of Item 341 and applicable material quality tolerances. The performance graded binder should be a PG 70-22 or as required by the County of El Paso.

6.4 - Flexible Base Course

The flexible base course should be crushed limestone conforming to TxDOT Standard Specifications, Item 247, Type A, Grade 2. Base course should be placed in lifts with a maximum thickness of 8 in. and compacted to a minimum of 100 percent of the maximum density at a moisture content within the range of 2 percentage points below to 2 percentage points above the optimum moisture content as determined by Tex-113-E.

6.5 – Rigid Concrete Pavement Section

The pavement section for the toll facility main lanes may also consist of a rigid concrete pavement section. The following table presents our rigid pavement recommendations and lists the minimum thicknesses and specifications based on soil classification test results and estimated ESAL values indicated in Section 1.1 of this report.

Reinforced Concrete Pavement Section

Material Section Type	Minimum Thickness (in.)
Reinforced Portland Cement Concrete Pavement, TXDOT Item 360, Class P	9
Crushed Stone Base Coarse, TxDOT – Item 247 Type A, Grade 2	8
Prepared and Compacted Select Fill Soils	18
Scarified, Moisture Conditioned and Compacted Subgrade Soils	8

In general concrete pavement should have a minimum 28-day compressive strength of 4,400 psi, minimum flexural strength of 680 psi and meet the requirements of a TXDOT Class P concrete mix design. We also recommend that the concrete pavement be continuously reinforced to improve the flexural resistance and load transfer of the concrete pavement.

The PCC should be air entrained to increase freeze-thaw durability. If air entrapment is desired, we recommend that the concrete be designed with 4% ± 1% air. The concrete should have a maximum slump of 4 inches and should be consolidated with mechanical vibrators. A liquid membrane-forming curing compound should be applied as soon as practical after broom finishing the concrete surface. The curing compound will reduce the loss of water from the concrete. The reduction in the rapid loss of water will reduce shrinkage cracking of the concrete.

Reinforcing is recommended to consist of rebar. The concrete reinforcing should be placed approximately ½ the slab thickness below the surface of the slab, but not less than 2 inches. The reinforcing should not extend across expansion joints.

Joints in concrete pavements aid in construction phasing and control the location and magnitude of cracks. Joints should be carefully designed and constructed to ensure a good performing pavement system, which will keep stresses within safe limits and control the formation of irregular cracks. Where practical, lay out the construction, expansion, control and sawed joints to form square panels, but not to exceed ACI 302.69 construction guidelines (maximum 30 times the pavement thickness). The ratio of slab length-to-width should not exceed 1.25. It is recommended that maximum joint spacing be 15 feet longitudinal and 15 feet transverse.

All control joints should be formed or sawed to a depth of at least 1/4 the thickness of the concrete slab and should have a minimum width of 1/8 inch and a maximum width of 1/4 inches. Sawing of control joints should begin as soon as the concrete will not ravel and within 8 hours of placement. Saw cut joints should be cleaned with a high-pressure air jet and sealed with an elastomeric sealant conforming to the TxDOT standard specifications. Appropriate backer rods or backer materials should be used in each joint and meet the requirements of the sealant manufacturer.

Tie bars should be placed at all construction joints parallel to traffic and may consist of No. 5 reinforcing bars 18 inches in length and placed at no more than 30 inches on-center. Lubricated smooth (i.e., one end) dowel bars should be placed at all control joints (dummy and construction) perpendicular to traffic to promote load transfer. Dowels should be supported in an appropriate dowel basket. The dowel bars should be 18 inches long and spaced at 12 inches on-center and placed in the middle of the slab. Typical dowel size should be 1/8 inch diameter for each inch of pavement thickness. (i.e., an 8-inch pavement section would require a 1 inch diameter dowel bar).

Isolation joints should be provided only where pavement abuts fixed objects, such as the drop inlets, buildings and light pole standards, etc. Expansion joint spacing is not to exceed a maximum of 60 feet and no expansion or construction joints should be located in a swale or drainage collection location.

If possible, the pavement should develop a minimum slope of ¾ percent to provide surface drainage. Reinforced concrete pavement should cure a minimum of 3 days before allowing automobile and truck traffic to

load the pavement. Concrete pavements should meet the quality control laboratory and field production requirements and be constructed in accordance with the TxDOT Standard Specifications, Item 360.

In addition, we recommend that our Client and owner consider implementing the minimum concrete quality assurance testing specifications to ensure that the pavement meets the minimum design requirements.

Guideline Concrete Paving – Quality Assurance Testing Specification

Test Type	Concrete QA Testing Frequency per TxDOT Guidelines	Applicable TxDOT Specifications
Compressive Strength*	-1 Set of 5 Cylinders (6"x12") every 60 cu. yds. of Concrete Placement -Test 2 cylinders at 7 days and 2 cylinders at 28 days. The remaining cylinder shall be held for additional testing as required.	Tex-418-A
Slump*	- 1 per 60 yds. of concrete placement. Test on the first few loads of concrete until desired consistency is obtained. Thereafter, test each third load. Perform test on the same load from which strength test specimens are made.	Tex-415-A
Entrained Air*	- 1 per 60 yds. of concrete placement. Test on the first few loads of concrete until desired consistency is obtained. Thereafter, test each third load. Perform test on the same load from which strength test specimens are made.	Tex-416-A
Temperature of Concrete*	- 1 per 60 yds. of concrete placement. Test on the first few loads of concrete until desired consistency is obtained. Check temperature of every load for bridge slabs and mass concrete placements.	Tex-422-A

Note: * Each paving lot may be defined as 2,000 linear feet of roadway construction, per 8" lift of soil or lay down wet thickness (based on a 12' min. lane width). Each sublot may be defined as 500 linear feet of roadway construction, per 8" lift of soil or lay down wet thickness (based on a 12' min. lane width). Sampling shall be performed according to Tex-407-A entitled "Sampling Freshly Mixed Concrete".

Section 7.0 – Additional Investigation Considerations

Based on the encountered Stratum II clays at this site, our Client may consider performing additional soil borings across the site to further delineate the lateral extent of the encountered clay soils, if necessary. This may mitigate the potential poor performance of foundation systems or pavement structures as a result of soil related vertical movements.

Section 8.0 – Project Specifications Information

8.1 - Select Fill

Materials used as select fill soils for final site grading preferably should be crushed stone or gravel aggregate. We recommend that materials specified for use as select fill meet the current TxDOT Standard Specification for Construction of Highways, Streets and Bridges, Item 247, Flexible Base, Type A Grade 2.

Alternatively, Select Fill materials should be granular and free of clay lumps, deleterious materials, cobbles or boulders over 3 inches in nominal size. The Select Fill should have a liquid limit less than 40 and a plasticity index between 4 to 15. The Select Fill shall also exhibit an optimum dry density of at least 120 pcf.

Soils classified in the following list according to the USCS can be considered satisfactory for use as Select Fill: SC, SC-SM, GW, GP, GM, GC, GP-GM and GP-GC, provided that these soils also meet the requirements above.

Soils classified as SP, SM, SP-SM, CH, CL, MH, ML, OH, OL and PT or a combinations of these under the USCS classification are not considered suitable for use as Select Fill soil materials, unless approved by the project engineer and/or County of El Paso.

Select Fill materials should be placed at a minimum of 95 percent of maximum dry density and at ±2 percent of optimum moisture content in accordance with ASTM D-1557 for the building earthwork fill requirements and per Tex-114-E for the pavement system earthwork requirements until permanently covered. Select Fill should be placed in loose lifts not to exceed 8 inches. Select Fill should also meet the minimum gradation requirements tabulated below:

TXDOT Type A, Grade 2, Base Material Gradation Requirements

Sieve Size (square opening)	% Passing by Weight
2-1/2 inch	100
1-3/4 inch	90 – 100
7/8 inch	–
3/8 inch	–
No. 4	25 – 55
No. 40	15 – 40

Select Fill Material Gradation Requirements

Sieve Size (square opening)	% Passing by Weight
3-inch	100
3/4-inch	70 – 100
No. 4	45 – 100
No. 200	13 – 45

Prior to Select Fill placement, the on-site subgrade soils should be scarified and recompacted as indicated in this report.

For utility line embedment and backfill, soils are typically specified as Class I through IV as indicated below. Class I, Class II, Class III and Class IV materials may be defined as follows:

- CLASS I material may be manufactured angular, well-graded, crushed stone per ASTM D-2321 with a

maximum particle size of 1½ inches. The following materials shall be acceptable under this class designation: ASTM D-448 – Stone Sizes 4, 46, 5, 56, 57, and 6. Pea Gravel and other uniformly graded material are not acceptable under this class. A gradation of Class I material shall be submitted by the Contractor to the Engineer for approval prior to use.

- CLASS II material may be coarse sands and gravels per ASTM D-2487 with maximum particle size of 1½ inches, including variously graded sands and gravels, containing less than 12 percent fines (material passing the #200 sieve) generally granular and non-cohesive, either wet or dry. Soil types GW, GP, SW and SP are included in this class. (i.e., typically required within pipe zone)

- CLASS III material may be fine sand and clayey (clay filled) gravels, per ASTM D-2487, including fine sands, sand-clay mixtures, and gravel-clay mixtures. Soil types GM, GC, SM and SC are included in this class. (i.e., typically suitable above the pipe zone)

- CLASS IV and V material may be classified as CH, CL, MH, ML, OH, OL and PT under the USCS.

8.2 - Construction Materials Testing

We recommend that construction materials inspection and testing of site work, fill placement, footing excavations, concrete placement, and all other applicable materials and structures be performed by CQC. The specification testing program should include the following testing frequencies as a minimum or as required by the project specifications and plans, which ever is more stringent:

1. At least one (1) Moisture-Density Relationship test (Proctor) for each type of in-situ soil and/or imported soil material to be used, according to ASTM D 1557 or applicable TXDOT standards.

2. At least one (1) Soil Classification (Sieve Analysis and Atterberg Limits Test) for each type of in-situ soil and/or imported soil material to be used, according to ASTM D 6913 and D 4318.

3. A minimum of three (3) nuclear density tests for each lift (8-inch loose) of in-situ soil and/or select fill material placed within the proposed building pad, according to ASTM D 6938 or ASTM D 1556.

4. A minimum of one nuclear density tests for each lift (8-inch loose) of in-situ soil, select fill or base material placed every 150 linear feet of paving, according to ASTM D 6938 or ASTM D 1556 or applicable TXDOT standards.

5. A minimum of one (1) nuclear density test per each excavated wall footing from the bottom of the footing excavation and each lift of fill, according to ASTM D 6938 or D 1556.

6. A minimum of one (1) nuclear density test for each column footing excavation and for each lift of fill according to ASTM D 6938 or D 1556.

7. A minimum of one (1) nuclear density test per lift at 50 lineal feet spacings for pipe bedding and backfill operations, according to ASTM D 6938 or D 1556.

8. A minimum of one (1) nuclear density test per each lift of subgrade preparation and/or fill placement for each drainage structure according to ASTM D 6938 or D 1556.

9. **HMAC** paving materials should be tested during construction production for mix design verification. The plant produced HMAC should be sampled for each day's production or every 500 tons of material produced and tested for compliance with the approved Mix Design and to determine the laboratory density of the material. The placed HMAC mat should be tested by conducting a minimum of three field density test every 150 lf or as directed by the project engineer. The hot-mix asphaltic concrete (HMAC) should be designed in conformance with the gradation requirements of Item 341 of the TxDOT Standard Specifications.

10. Sampling and testing for quality assurance of placed **concrete** materials should be performed for the project. Concrete field testing shall include testing for temperature, slump and air content (if required). The design strength of the concrete mix shall be evaluated by collecting cylindrical concrete compression test specimens for lab curing and testing in accordance with applicable ASTM or TXDOT procedures. At least one set of four (4) 6-inch x 12-inch or 4-inch x 8-inch concrete cylinders should be collected for every 50 or 60 cubic yards or less of poured concrete or as directed by the project engineer. The concrete specimens should be tested at 7 days (1 cylinder) and 28 days (3 cylinders) for verification of the specified design strength or as directed by the project plans and specifications. The ACI guidelines for hot weather and cold weather concreting should be followed to mitigate the potential poor performance of the concrete materials during significant periods of high (above 90° F) and low (below 50° F) temperatures.

11. Sampling and testing for quality assurance of placed **mortar**, Type S (minimum compressive strength of 1800 psi) should be performed for the project. The design strength of the mortar mix shall be evaluated by collecting 3-cube specimens for lab curing and testing in accordance with applicable ASTM procedures. At least one set of 3 mortar cubes should be collected for every day of mortar placement or as directed by the project engineer. The mortar specimens should be tested at 7 days (1 cube) and 28 days (2 cubes) for verification of the specified design strength or as directed by the project plans and specifications.

12. Sampling and testing for quality assurance of placed **grout** materials (3/8" maximum aggregate with a minimum compressive strength of 3,000 psi) should be performed for the project. Grout field testing shall include testing for temperature and slump (8 to 10 inches maximum). The design strength of the grout mix shall be evaluated by collecting prisms specimens molded with on site CMU blocks for lab curing and testing in accordance with applicable ASTM procedures. At least one set of four (4) grout prisms should be collected for each day's batching or as directed by the project engineer. Grout with additives should be batched and placed in not more than 2 cubic yard volumes. The grout specimens should be tested at 7 days (1 prism) and 28 days (3 prisms) for verification of the specified design strength or as directed by the project plans and specifications.

13. The erection of structural members and connections should be observed and inspected in accordance with the applicable guidelines of American Institute of Steel Construction (AISC), Steel Decking Institute (SDI), American Welding Society (AWS), Steel Joist Institute (SJI), currently adopted International Building Code (IBC) by the County of El Paso, Concrete Reinforcing Steel Institute (CRSI), American Lumber Standard Committee (ALSC), Architectural Woodworks Institute (AWI) and/or the project plans

and specifications, whichever is more stringent or as directed by the project engineer. The provisions for special inspections within the code should also be considered as they relate to applicable design of structures on this project.

Section 9.0 – Soils Investigation Considerations and Limitations

As requested by our Client, the analysis and recommendations in this report are based on the data obtained from three (3) exploration soil borings performed at the approximate locations indicated on the attached General Boring and Percolation Test Location Plan, Sheet A1. This report may not reflect all the variations that may occur within the project site. The nature and extent of the variations may not become evident until during the course of construction. If variations appear during construction, CQC should be contacted immediately, it may be necessary for a reevaluation of our recommendations provided within this report to be made after performing on-site observations during the construction period and noting the characteristics of any variations. No other information relevant to the project site history or known conditions of concern were discussed or disclosed to CQC by our Client or design representatives.

The scope of our soil evaluation study did not include an environmental assessment of the property's air, soil, water, delineation of potential subsurface flowing water, fluids, or rock conditions either on or adjacent to the site, therefore no environmental opinions are presented in this report.

Section 10.0 – General List of Technical References

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7.) U.S. Department of Labor-Occupational Safety and Health Administration (OSHA). *Part 1926 – Safety and Health Regulations for Construction.* Washington, DC.

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9.) American Society for Testing and Materials Standard D 422. *Standard Test Method for Particle-Size Analysis*

*of Soil.*Volume 04.08. West Conshohocken, PA: ASTM International

10.) American Society for Testing and Materials Standard D 698. *Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600 kN-m/m^3).* Volume 04.08. West Conshohocken, PA: ASTM International

11.) American Society for Testing and Materials Standard D 1140. *Standard Test Method for Amount of Material in Soils Finer than No. 200 (75µm) Sieve.* Volume 04.08. West Conshohocken, PA: ASTM International

12.) American Society for Testing and Materials Standard D 1556. *Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone.* Volume 04.08. West Conshohocken, PA: ASTM International

13.) American Society for Testing and Materials Standard D 1557. *Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3 (2,700 kN-m/m^3).* Volume 04.08. West Conshohocken, PA: ASTM International

14.) American Society for Testing and Materials Standard D 2216. *Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass.* Volume 04.08. West Conshohocken, PA: ASTM International

15.) American Society for Testing and Materials Standard D 4318. *Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.* Volume 04.08. West Conshohocken, PA: ASTM International

16.) American Society for Testing and Materials Standard D 6913. *Standard Test Methods for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis.* Volume 04.08. West Conshohocken, PA: ASTM International

17.) American Society for Testing and Materials Standard D 6938. *Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).* Volume 04.08. West Conshohocken, PA: ASTM International

18.) American Society for Testing and Materials Standard C136. *Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.* Volume 04.02. West Conshohocken, PA: ASTM International
19.) American Society for Testing and Materials Standard C131. *Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.* Volume 04.02. West Conshohocken, PA: ASTM International

20.) American Society for Testing and Materials Standard C117. *Standard Test Method for Materials Finer than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing.* Volume 04.02. West Conshohocken, PA: ASTM International

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29.) American Association of State Highway and Transportation Officials. (2010). *Standard Specifications for Transportation Materials and Methods of Sampling and Testing, Part 2B: Tests.* 30th Edition. Washington, DC: American Association of State Highway and Transportation Officials

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construction quality control
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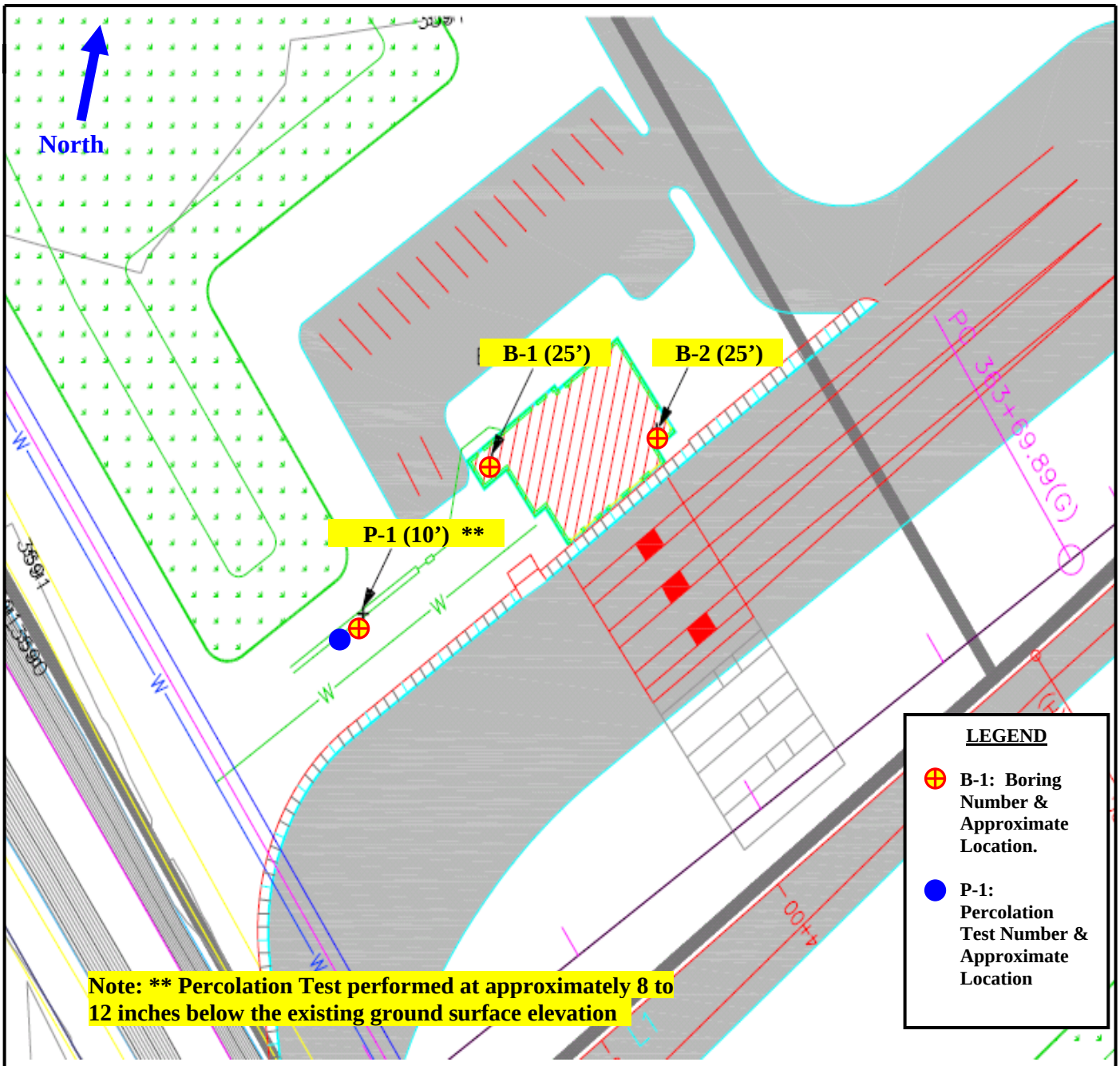
Construction Materials Testing
Geotechnical Engineering
Environmental Site Assessments
Forensic Analysis/Testing

ATTACHMENT A

- **General Boring/Percolation Test Location Plan – A1**
- **Field Boring Logs – A2-A4**
- **Selected Soil Sieve Analysis Test Reports - A5-A8**
- **Summary of Field and Laboratory Soil classification Test Results – A9**
- **Moisture Density Relationship Test Results – A10**
- **California Bearing Ratio Test Results –A11**
- **Percolation Test Results – A12**
- **Total Allowable Pier Capacity Curves – A13 – A16**
- **L-Pile – Pier Deflection and Bending Moment Curves – A17 – A18**



construction quality control
testing and engineering

General Boring/Percolation Test Location Plan
Proposed Toll Plaza for Tornillo/Guadalupe International Bridge Major Arterial Roadway
Tornillo, El Paso County, Texas

Client: El Paso County Road and Bridge Department	
Project No. AGCQC11-034 / ATCQC11-021-01	
Scale: NTS	Check by: JR
Date: 9/27/11	Sheet A1

CQC Testing and Engineering, LLC. - TBPE Firm No. F-10632
6802 Commerce, Unit A
El Paso, Texas 79915
Telephone: (915) 771-7766
Fax: (915) 771-7786

BORING NUMBER B-1

CLIENT El Paso County Road and Bridge Department
PROJECT NAME Proposed Toll Plaza for Tornillo/Guadalupe Int'l Bridge
PROJECT NUMBER AGCQC11-034 / ATCQC11-021-01
PROJECT LOCATION El Paso, El Paso County, Texas
DATE STARTED 7/18/11 **COMPLETED** 7/18/11
GROUND ELEVATION 3590.73 ft **HOLE SIZE** 6 inches
DRILLING CONTRACTOR Spee Soil
GROUND WATER LEVELS:
DRILLING METHOD CME 55 with 3-1/4 ID HSA
AT TIME OF DRILLING 9.0 ft / Elev 3581.7 ft
LOGGED BY FM **CHECKED BY** HH
AT END OF DRILLING ---
NOTES Boring Location: See Sheet A1
AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	GRAPHIC LOG	MATERIAL DESCRIPTION	BLOW COUNTS (N VALUE)	% -200	PI (LL-PL)	USCS
0	SS 1		CLAY, Moderately Plastic, Sandy, Brown, Medium Stiff, Slightly Moist	1-3-4 (7)	58	19	CL
	SS 2		SAND, Fine Grained, Silty, Light Brown, Loose, Moist with traces of clay	2-3-3 (6)	30		SM
5	SS 3		CLAY, Plastic, Dark Brown, Medium Stiff, Moist to Very Moist Average Pocket Penetrometer Soil Shear Strength: 1.25 tsf at approximately 5 to 6-1/2 feet	2-2-3 (5)			
	SS 4		-clay soils below 7-1/2 feet may be susceptible to consolidation settlement	1-2-4 (6)	87	40	CH
10	SS 5		SAND, Fine to Medium Grained, Poorly Graded, Multicolored, Loose to Medium Dense, Wet	3-4-5 (9)			
15	SS 6			5-2-5 (7)			
20	SS 7			4-8-10 (18)	4		SP
25	SS 8			18-10-10 (20)			
			NOTE: SS - Split Spoon Sample Bottom of hole at 25.0 feet.				

SPT N VALUE
10 20 30 40
PL MC LL
20 40 60 80
% - 200
20 40 60 80

CQC Testing and Engineering, LLC. - TBPE Firm No. F-10632
6802 Commerce, Unit A
El Paso, Texas 79915
Telephone: (915) 771-7766
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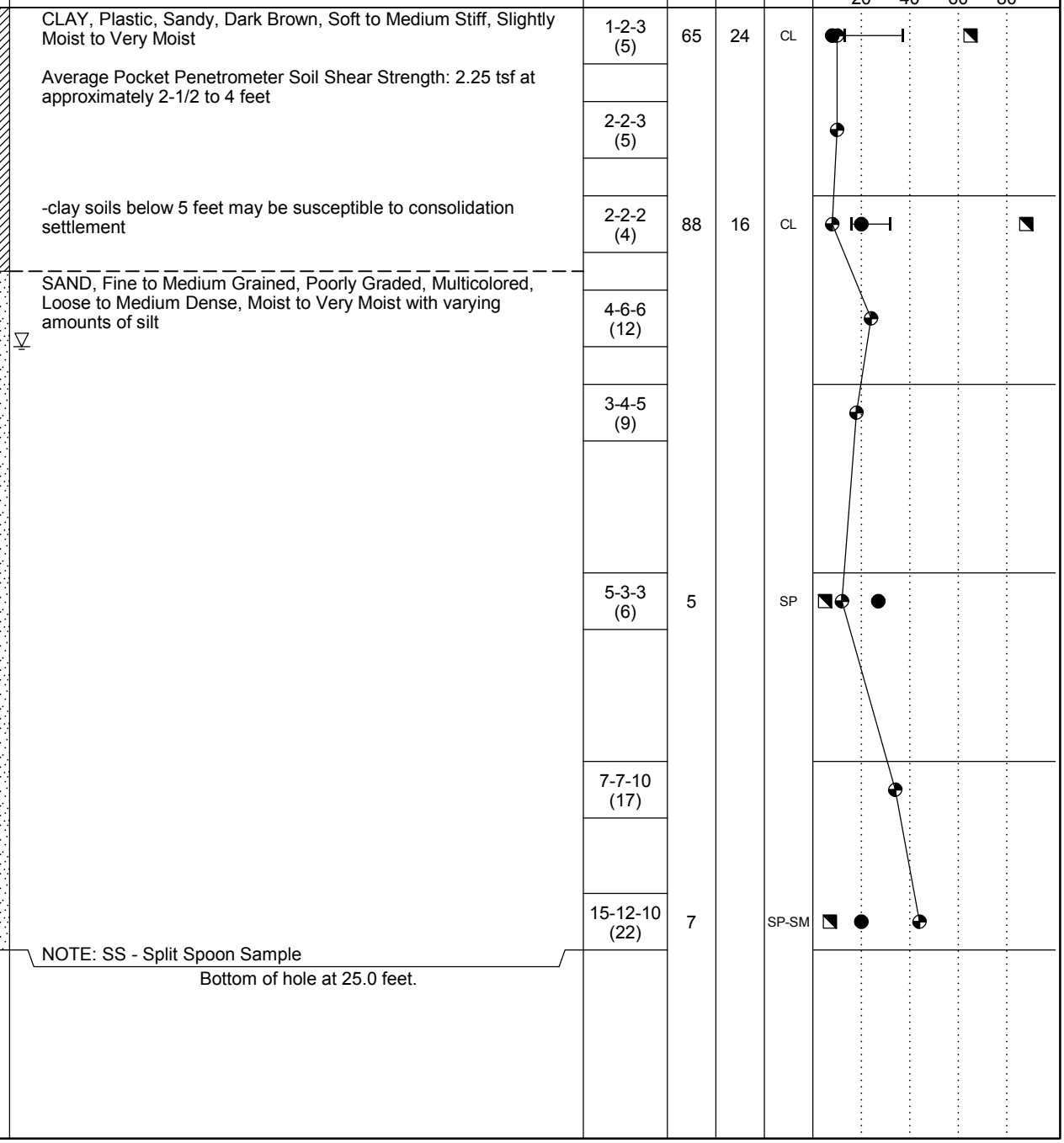
BORING NUMBER B-2

CLIENT El Paso County Road and Bridge Department
PROJECT NAME Proposed Toll Plaza for Tornillo/Guadalupe Int'l Bridge
PROJECT NUMBER AGCQC11-034 / ATCQC11-021-01
PROJECT LOCATION El Paso, El Paso County, Texas
DATE STARTED 7/18/11 **COMPLETED** 7/18/11
GROUND ELEVATION 3590.44 ft **HOLE SIZE** 6 inches
DRILLING CONTRACTOR Spee Soil
GROUND WATER LEVELS:
DRILLING METHOD CME 55 with 3-1/4 ID HSA
▽ **AT TIME OF DRILLING** 9.0 ft / Elev 3581.4 ft
LOGGED BY FM **CHECKED BY** HH
AT END OF DRILLING ---
NOTES Boring Location: See Sheet A1
AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	GRAPHIC LOG	MATERIAL DESCRIPTION	BLOW COUNTS (N VALUE)	% -200	PI (LL-PL)	USCS
0	SS 1		CLAY, Plastic, Sandy, Dark Brown, Soft to Medium Stiff, Slightly Moist to Very Moist Average Pocket Penetrometer Soil Shear Strength: 2.25 tsf at approximately 2-1/2 to 4 feet	1-2-3 (5)	65	24	CL
	SS 2			2-2-3 (5)			
5	SS 3		-clay soils below 5 feet may be susceptible to consolidation settlement	2-2-2 (4)	88	16	CL
	SS 4		SAND, Fine to Medium Grained, Poorly Graded, Multicolored, Loose to Medium Dense, Moist to Very Moist with varying amounts of silt	4-6-6 (12)			
10	SS 5			3-4-5 (9)			
15	SS 6			5-3-3 (6)	5		SP
20	SS 7			7-7-10 (17)			
25	SS 8			15-12-10 (22)	7		SP-SM
			NOTE: SS - Split Spoon Sample Bottom of hole at 25.0 feet.				

SPT N VALUE
10 20 30 40
PL MC LL
20 40 60 80
% - 200
20 40 60 80



THE BORING LOGS PRESENTED SHOULD NOT BE SEPERATED FROM THE REPORT

CQCLOG2 034-BORING LOGS.GPJ GINT US.GDT

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Fax: (915) 771-7786

BORING NUMBER P-1

CLIENT El Paso County Road and Bridge Department
PROJECT NAME Proposed Toll Plaza for Tornillo/Guadalupe Int'l Bridge
PROJECT NUMBER AGCQC11-034 / ATCQC11-021-01
PROJECT LOCATION El Paso, El Paso County, Texas
DATE STARTED 7/18/11 **COMPLETED** 7/18/11
GROUND ELEVATION 3590.81 ft **HOLE SIZE** 6 inches
DRILLING CONTRACTOR Spee Soil
GROUND WATER LEVELS:
DRILLING METHOD CME 55 with 3-1/4 ID HSA
AT TIME OF DRILLING Not Encountered
LOGGED BY FM **CHECKED BY** HH
AT END OF DRILLING ---
NOTES Boring Location: See Sheet A1
AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	GRAPHIC LOG	MATERIAL DESCRIPTION	BLOW COUNTS (N VALUE)	% -200	PI (LL-PL)	USCS
0.0	SS 1		CLAY, Moderately Plastic, Brown to Dark Brown, Soft to Stiff, Slightly Moist to Very Moist Average Pocket Penetrometer Soil Shear Strength: 0.75 tsf at approximately 1/2 to 1-1/2 feet	4-5-4 (9)	56	16	CL
2.5	SS 2		-with seams of silty sand from approximately 2-1/2 to 3 feet	1-1-1 (2)			
5.0	SS 3			1-2-3 (5)	68		
7.5	SS 4		-very moist below 8-1/2 feet and clay soils may be susceptible to consolidation settlement	2-1-2 (3)	82	40	CH
10.0			NOTE: SS - Split Spoon Sample Bottom of hole at 10.0 feet.				

SPT N VALUE
10 20 30 40
PL MC LL
20 40 60 80
% - 200
20 40 60 80

SIEVE ANALYSIS TEST REPORT

PROJECT NO.: AGCQC11-034 / ATCQC11-021-01 **REPORT DATE:** 09/27/11

PROJECT NAME: General Soils Investigation
Proposed Toll Plaza for Tornillo/Guadalupe
New International Bridge Major Arterial Roadway
Tornillo, El Paso County, Texas

SAMPLE INFORMATION

SAMPLE DATE: 7/18/2011 **SAMPLE NO.:** S-1

BORING NO.: B-1 **SAMPLE DEPTH:** 0' - 1½'

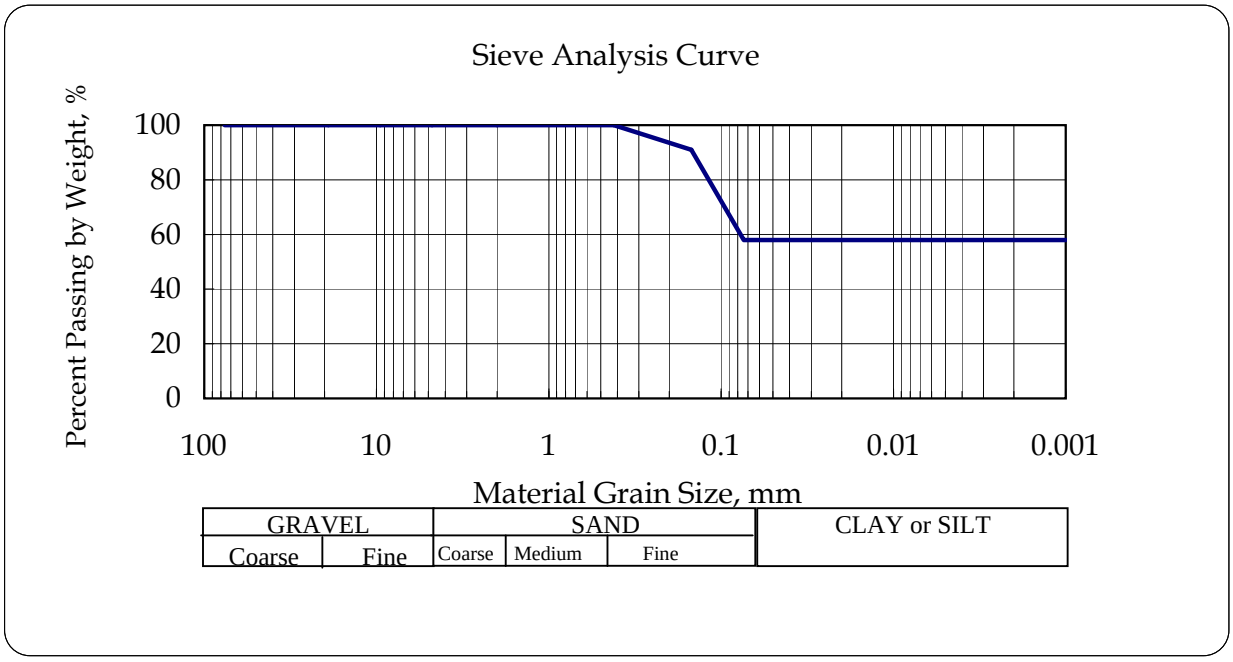
SOIL TYPE/DESCRIPTION: On-Site Subsurface Soils / CLAY, Sandy, Moderately Plastic, Brown

ANALYSIS TEST RESULTS

Sieve Analysis Test:

Test Method: ASTM D 6913

Sieve Size/No.	Percent Retained	Percent Passing
3 inch	0	100
3/4 inch	0	100
3/8 inch	0	100
No. 4	0	100
No. 10	0	100
No. 40	0	100
No. 100	9	91
No. 200	42	58
0.005 mm	-	-
0.001 mm	-	-



SIEVE ANALYSIS TEST REPORT

PROJECT NO.: AGCQC11-034 / ATCQC11-021-01 **REPORT DATE:** 09/27/11

PROJECT NAME: General Soils Investigation
Proposed Toll Plaza for Tornillo/Guadalupe
New International Bridge Major Arterial Roadway
Tornillo, El Paso County, Texas

SAMPLE INFORMATION

SAMPLE DATE: 7/18/2011 **SAMPLE NO.:** S-2

BORING NO.: B-1 **SAMPLE DEPTH:** 2½' - 4'

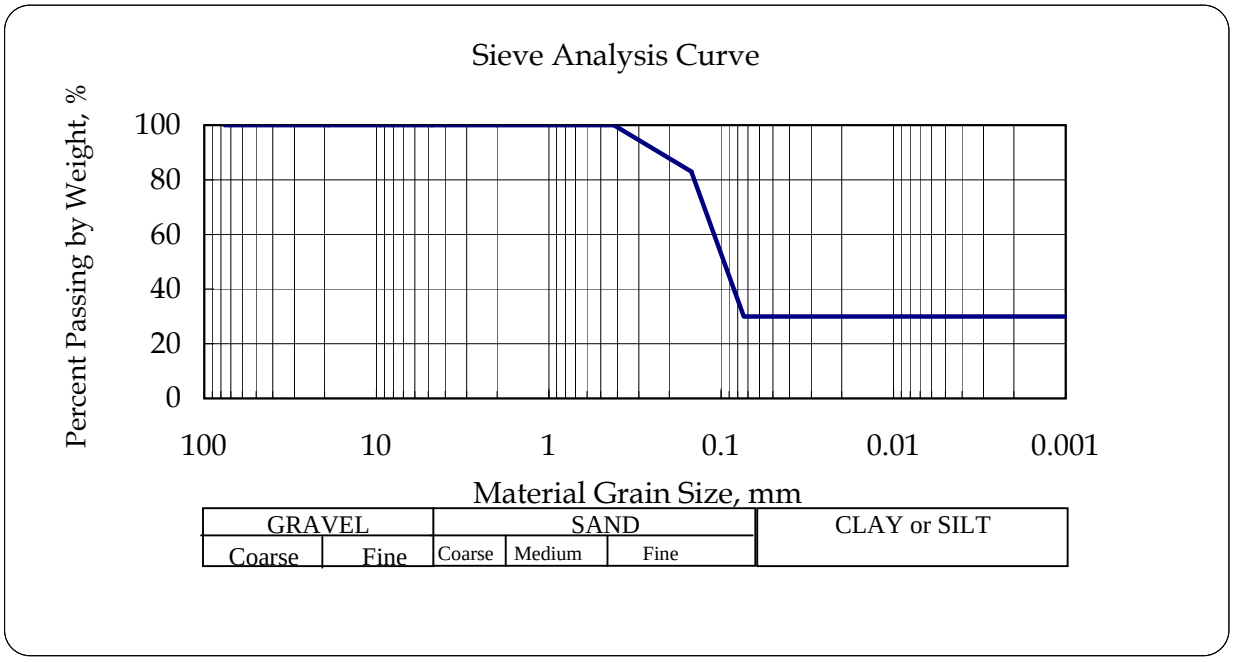
SOIL TYPE/DESCRIPTION: On-Site Subsurface Soils / SAND, Fine Grained, Silty, Light Brown

ANALYSIS TEST RESULTS

Sieve Analysis Test:

Test Method: ASTM D 6913

Sieve Size/No.	Percent Retained	Percent Passing
3 inch	0	100
3/4 inch	0	100
3/8 inch	0	100
No. 4	0	100
No. 10	0	100
No. 40	0	100
No. 100	17	83
No. 200	70	30
0.005 mm	-	-
0.001 mm	-	-



SIEVE ANALYSIS TEST REPORT

PROJECT NO.: AGCQC11-034 / ATCQC11-021-01 **REPORT DATE:** 09/27/11

PROJECT NAME: General Soils Investigation
Proposed Toll Plaza for Tornillo/Guadalupe
New International Bridge Major Arterial Roadway
Tornillo, El Paso County, Texas

SAMPLE INFORMATION

SAMPLE DATE: 7/18/2011 **SAMPLE NO.:** S-7

BORING NO.: B-1 **SAMPLE DEPTH:** 20'-21½'

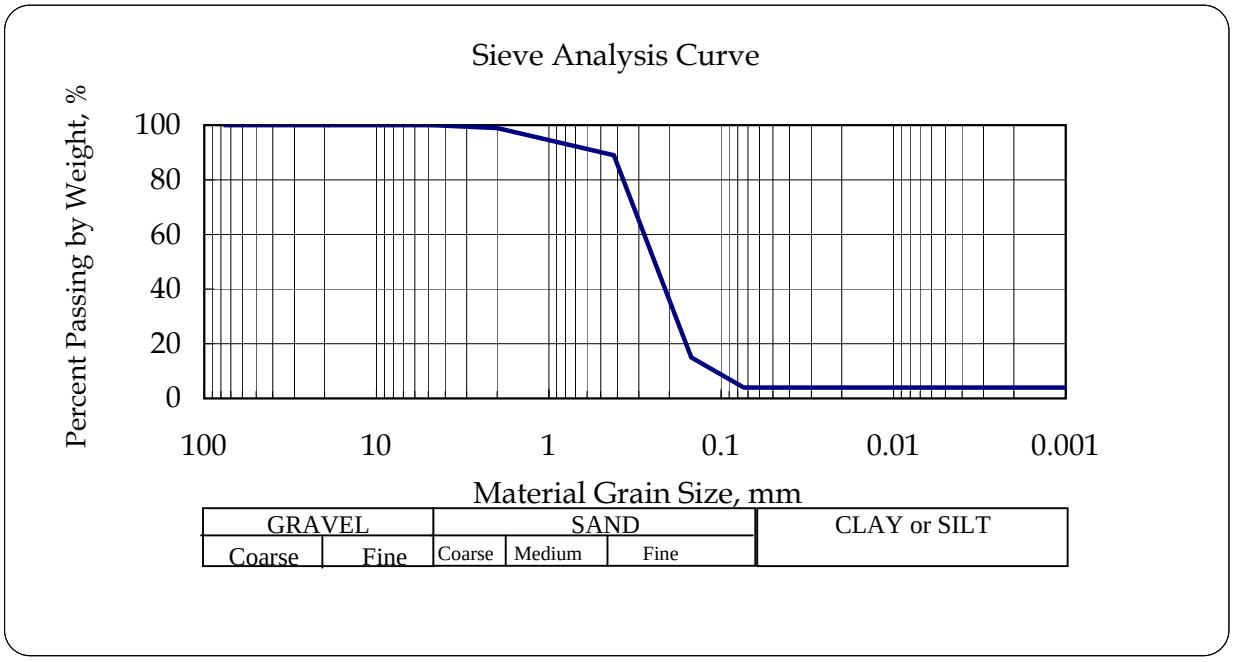
SOIL TYPE/DESCRIPTION: On-Site Subsurface Soils / SAND, Fine to Medium Grained, Poorly Graded, Multicolored

ANALYSIS TEST RESULTS

Sieve Analysis Test:

Test Method: ASTM D 6913

Sieve Size/No.	Percent Retained	Percent Passing
3 inch	0	100
3/4 inch	0	100
3/8 inch	0	100
No. 4	0	100
No. 10	1	99
No. 40	11	89
No. 100	85	15
No. 200	96	4
0.005 mm	-	-
0.001 mm	-	-



SIEVE ANALYSIS TEST REPORT

PROJECT NO.: AGCQC11-034 / ATCQC11-021-01 **REPORT DATE:** 09/27/11

PROJECT NAME: General Soils Investigation
Proposed Toll Plaza for Tornillo/Guadalupe
New International Bridge Major Arterial Roadway
Tornillo, El Paso County, Texas

SAMPLE INFORMATION

SAMPLE DATE: 7/18/2011 **SAMPLE NO.:** S-8

BORING NO.: B-2 **SAMPLE DEPTH:** 23½'-25'

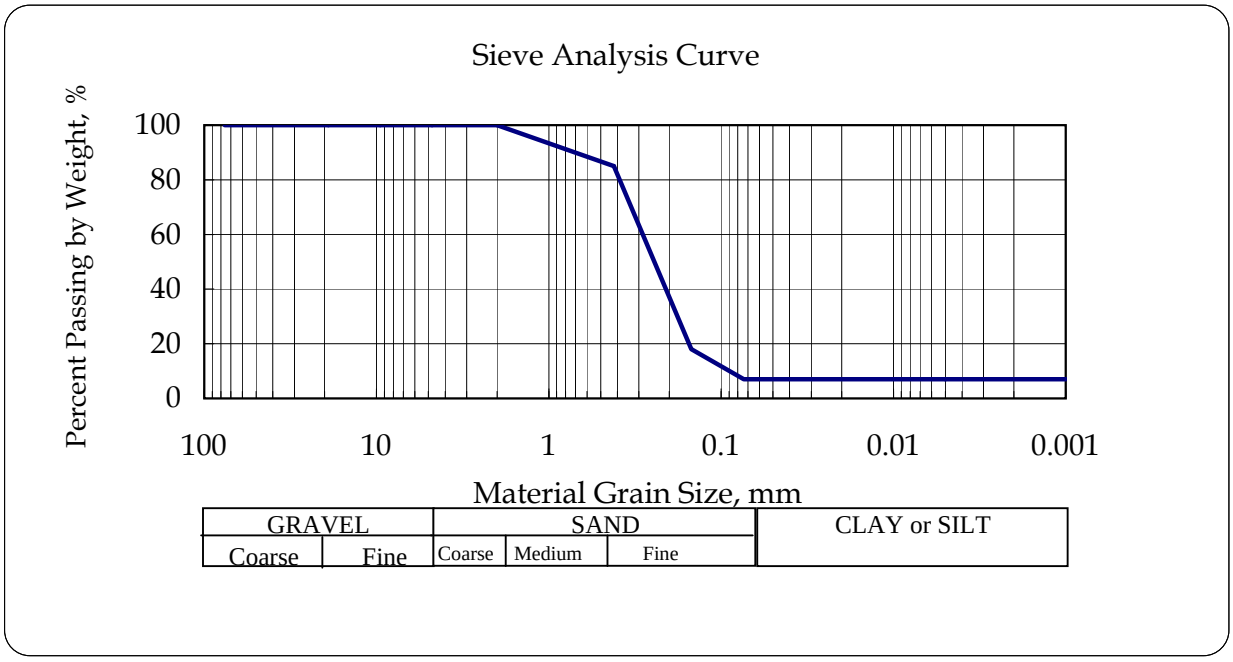
SOIL TYPE/DESCRIPTION: On-Site Subsurface Soils / SAND, Fine to Medium Grained, Poorly Graded, Multicolored with silt

ANALYSIS TEST RESULTS

Sieve Analysis Test:

Test Method: ASTM D 6913

Sieve Size/No.	Percent Retained	Percent Passing
3 inch	0	100
3/4 inch	0	100
3/8 inch	0	100
No. 4	0	100
No. 10	0	100
No. 40	15	85
No. 100	82	18
No. 200	93	7
0.005 mm	-	-
0.001 mm	-	-



SUMMARY OF FIELD AND LABORATORY SOIL CLASSIFICATION TEST RESULTS

PROJECT NAME: General Soils Investigation
Proposed Toll Plaza for Tornillo/Guadalupe New International Bridge
Major Arterial Roadway
North of Proposed New Port of Entry
Tornillo, El Paso County, Texas

DATE: 9/27/11

PROJECT NO.: AGCQC11-034 / ATCQC11-021-01

CLIENT: El Paso County Road and Bridge Department

Boring No.	Sample No.	Sample Type	Approx. Sample Depth (ft.)	N-Value	Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	% Passing No. 4 Sieve	% Passing No. 200 Sieve	USCS
B-1	1	SS	0-1½'	7	5.7	32	13	19	100	58	CL
Elev.	2	SS	2½-4'	6	8.1				100	30	SM
3590.73	3	SS	5-6½'	5							
	4	SS	7½-9'	6	27.8	57	17	40	100	87	CH
	5	SS	10-11½'	9							
	6	SS	15-16½'	7							
	7	SS	20-21½'	18	22.9				100	4	SP
	8	SS	23½-25	20							
B-2	1	SS	0-1½'	5	8.2	37	13	24	100	65	CL
Elev.	2	SS	2½-4'	5							
3590.44	3	SS	5-6½'	4	20.1	32	16	16	100	88	CL
	4	SS	7½-9'	12							
	5	SS	10-11½'	9							
	6	SS	15-16½'	6	26.7				100	5	SP
	7	SS	20-21½'	17							
	8	SS	23½-25	22	20.2				100	7	SP-SM
P-1	1	SS	0-1½'	9	6.9	29	13	16	100	56	CL
Elev.	2	SS	2½-4'	2							
3590.81	3	SS	5-6½'	5	18.9				100	68	
	4	SS	8½-10'	3	28.9	59	19	40	100	82	CH

Note: SS – Split Spoon Auger Sample

MOISTURE - DENSITY RELATIONSHIP TEST REPORT

PROJECT NO.: AGCQC11-034 / ATCQC11-021-01 **REPORT DATE:** 09/27/11

PROJECT NAME: General Soils Investigation
Proposed Toll Plaza for Tornillo/Guadalupe
New International Bridge Major Arterial Roadway
Tornillo, El Paso County, Texas

SAMPLE INFORMATION

PROCTOR NO.: 1 **SAMPLED BY:** AO

SAMPLE DATE: 7/18/2011

SOIL SAMPLE LOCATION: B-2

SOIL TYPE/DESCRIPTION: On-Site Subsurface Soils/ CLAY, Plastic, Dark Brown with sand

SAMPLE TEST RESULTS

Sieve Analysis Test
Test Method: ASTM D 6913

Sieve Size/No.	Percent Retained	Percent Passing	Project Specifications
3	0	100	NS
1-3/4"	0	100	NS
1-1/2"	0	100	NS
1"	0	100	NS
1/2"	0	100	NS
3/8"	0	100	NS
No. 4	0	100	NS
No. 10	0	100	NS
No. 40	0	100	NS
No. 100	3	97	NS
No. 200	22	78	NS

NS- Not Specified

Atterberg Limits Test
Test Method: ASTM D 4318

Limit Test	Index Test Result	Specified
LL	39	NS
PL	15	NS
PI	24	NS

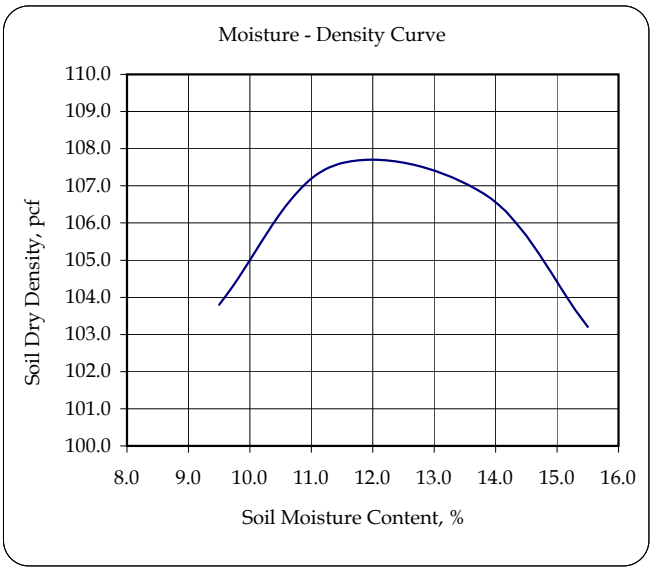
NS - Not Specified

Soil Classification: **CL**
Test Method: ASTM D 2487

Moisture-Density Relationship Test
Test Method: ASTM D 698, Method " A "

Test Sample No.	Moisture Content (%)	Sample Dry Density (pcf)
1	9.5	103.8
2	11.3	107.5
3	13.8	106.8
4	15.5	103.2

Maximum Dry Density, pcf: **108.3**
Optimum Moisture Content, %: **12.4**



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CALIFORNIA BEARING RATIO (CBR) TEST RESULTS
ASTM D - 1883

PROJECT NO.: AGCQC11-034 / ATCQC11-021-01 **REPORT DATE:** 09/27/11

PROJECT NAME: General Soils Investigation
Proposed Toll Plaza for Tornillo/Guadalupe
New International Bridge Major Arterial Roadway
Tornillo, El Paso County, Texas

SAMPLE INFORMATION

PROCTOR NO.: 1 **SAMPLED BY:** AO

SAMPLE DATE: 7/18/2011

SOIL SAMPLE LOCATION: B-2

SOIL TYPE/DESCRIPTION: On-Site Subsurface Soils/ CLAY, Plastic, Dark Brown with Sand

SAMPLE TEST RESULTS:

TEST SPECIMEN INFORMATION:

Soil Sample Height, in.	4-1/2"
Soil Sample Approx. Diameter, in.	6"
Soil Optimum Dry Density, pcf	108.3
Soil Optimum Moisture Content, %	12.4

CBR Test Data:

Stress Contact Area, in^2	3.01
Sample Surcharge Load, lbs.	12.5
Soaking Period, hr's.	96

SPECIMEN SWELL TEST INFORMATION:

Intial Swell Reading:	0.0454
Final Swell Reading:	0.0580
Sample Vertical Swell, %	0.2800

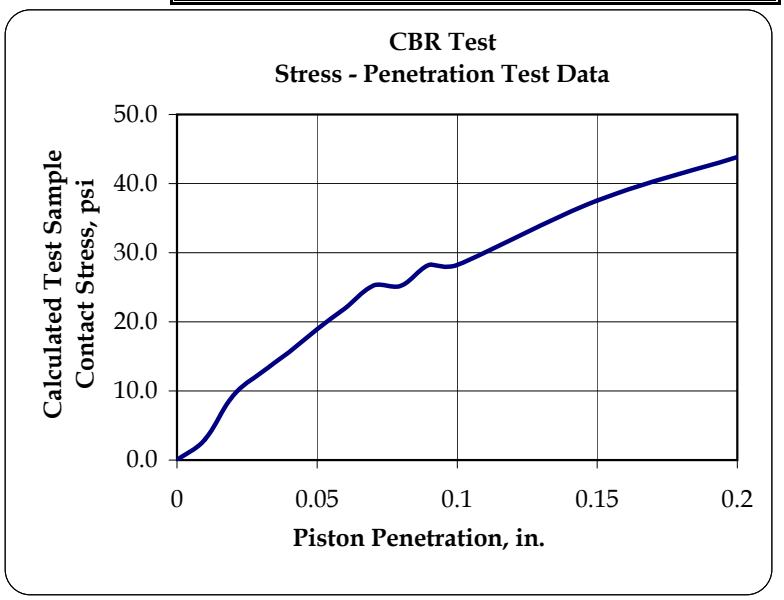
	Before Soaking	After Soaking
Dry Density, pcf	104.4	95.4
Moisture, %	15.9	26.8
% Compaction	96.4	88.1

CALCULATED SOAKED CBR VALUES:

CBR @ 0.1" Penetration	3
CBR @ 0.2" Penetration	3

Stress Versus Penetration Data

PEN.	Load, lbs.	Stress, psi
0	0	0.0
0.01	9	3.0
0.02	28	9.3
0.03	38	12.6
0.04	47	15.6
0.05	57	18.9
0.06	66	21.9
0.07	76	25.2
0.08	76	25.2
0.09	85	28.2
0.1	85	28.2
0.15	113	37.5
0.2	132	43.9
0.25	142	47.2



SOIL PERCOLATION TEST RESULTS

DATE: September 27, 2011

CQC PROJECT NO.: AGCQC11-034 / ATCQC11-021-01

PROJECT NAME: Proposed Toll Plaza for Tornillo/Guadalupe New Int'l Bridge Major Arterial Roadway
North of Proposed New Port of Entry
Tornillo, El Paso County, Texas

TEST INFORMATION

TEST DATE: August 4, 2011

TEST HOLE CLOSURE: Backfilled with Existing Soil Material

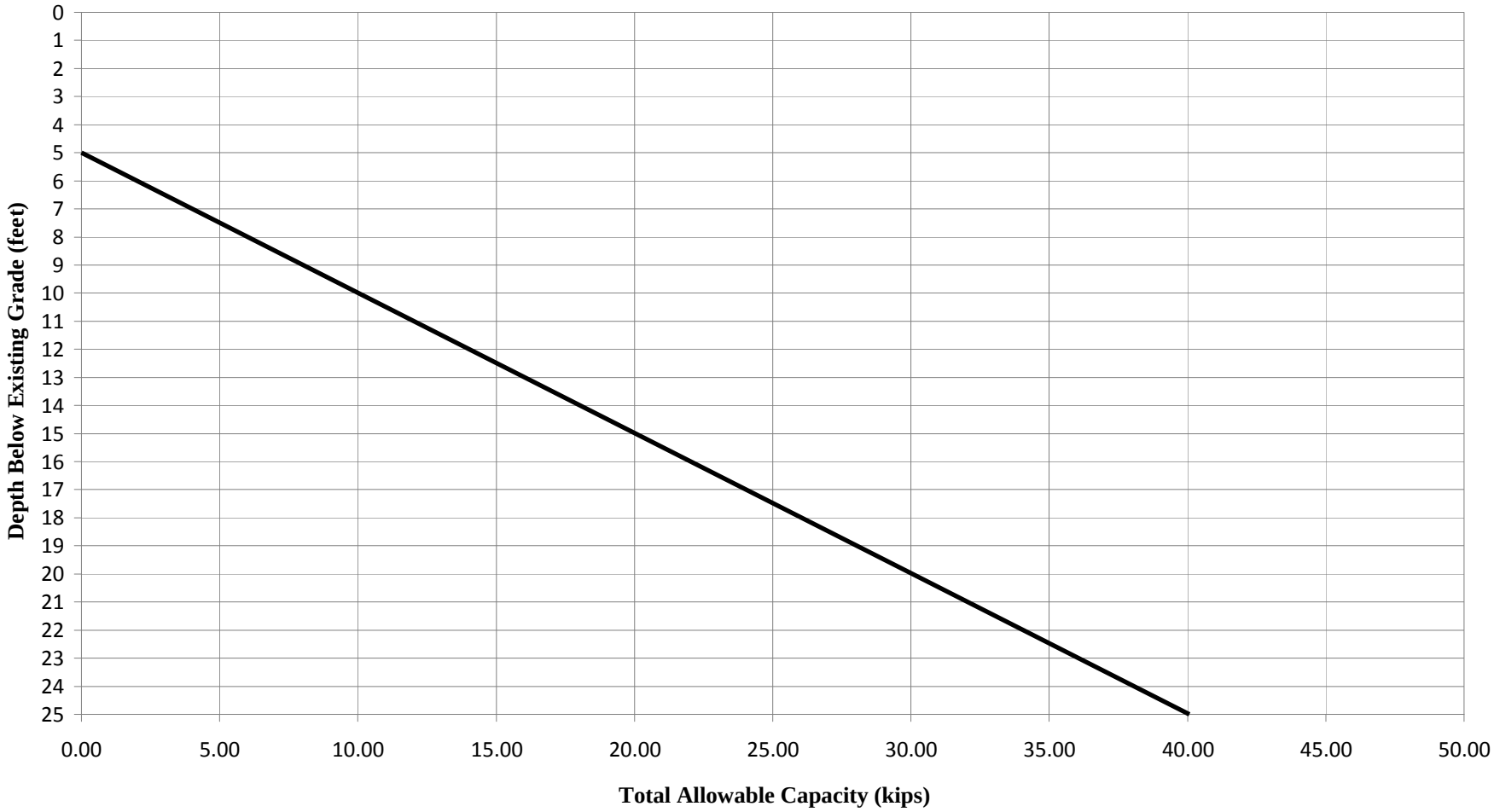
GROUNDWATER DEPTH: Approximately 9 feet

READING INTERVAL / TOTAL TEST TIME: 10 minutes / 60 minutes

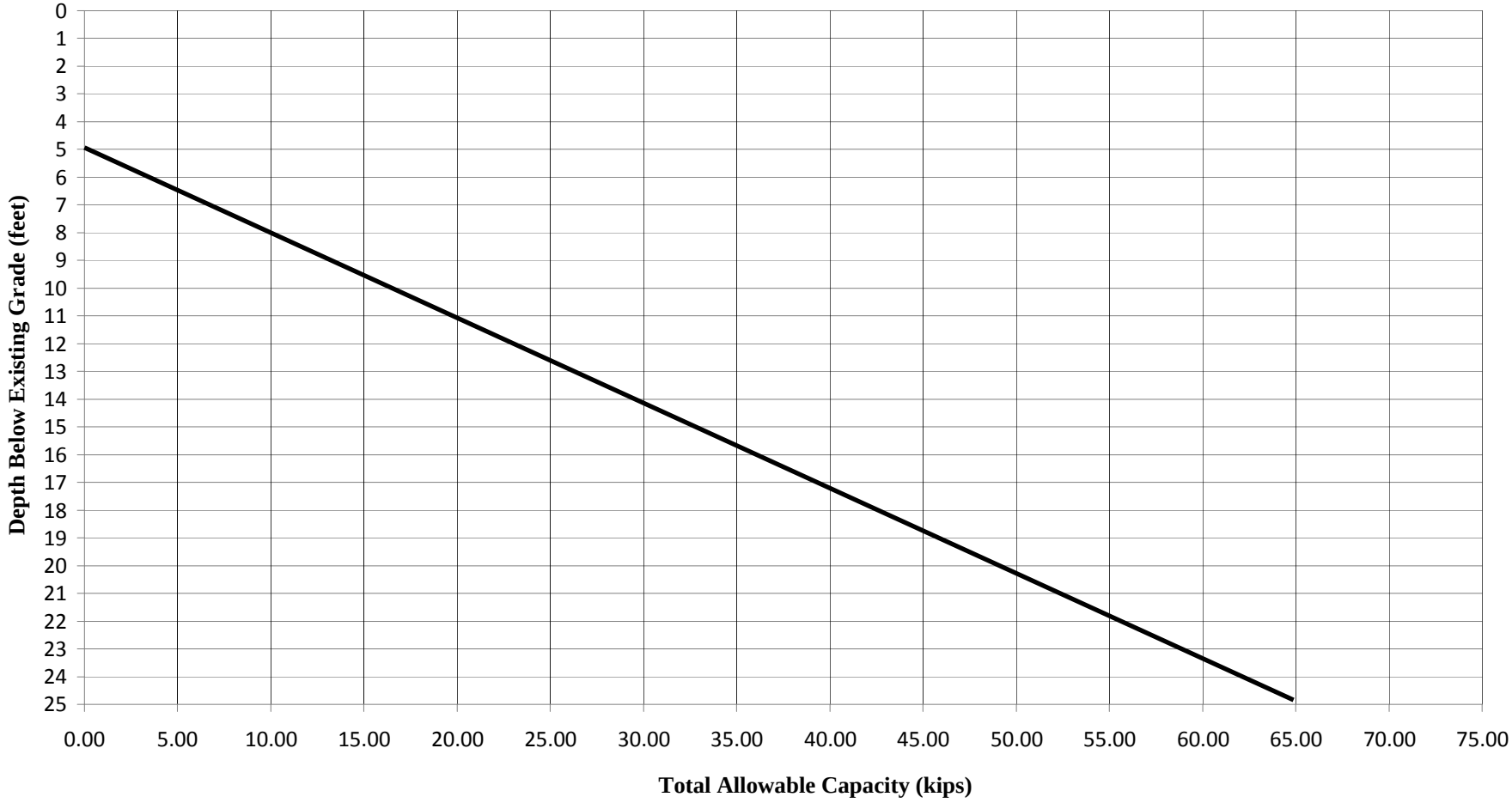
Hole No.	Approx. Test Depth	Visual Soil Description at Bottom of Borehole	Estimated Avg. Percolation Rate at Test Depth: min./in.
PT-1	8"	CLAY, Moderately Plastic, Sandy, Brown to Dark Brown	20

Notes:
1. Test bore hole was saturated for a period of at least 3 hours before testing.
2. A minimum of 4 inches of fine gravel was placed at the bottom of the test hole.
3. Percolation Test was performed within the approximate location indicated on the boring location plan (See General Boring/Percolation Test Location Plan, Sheet A1)

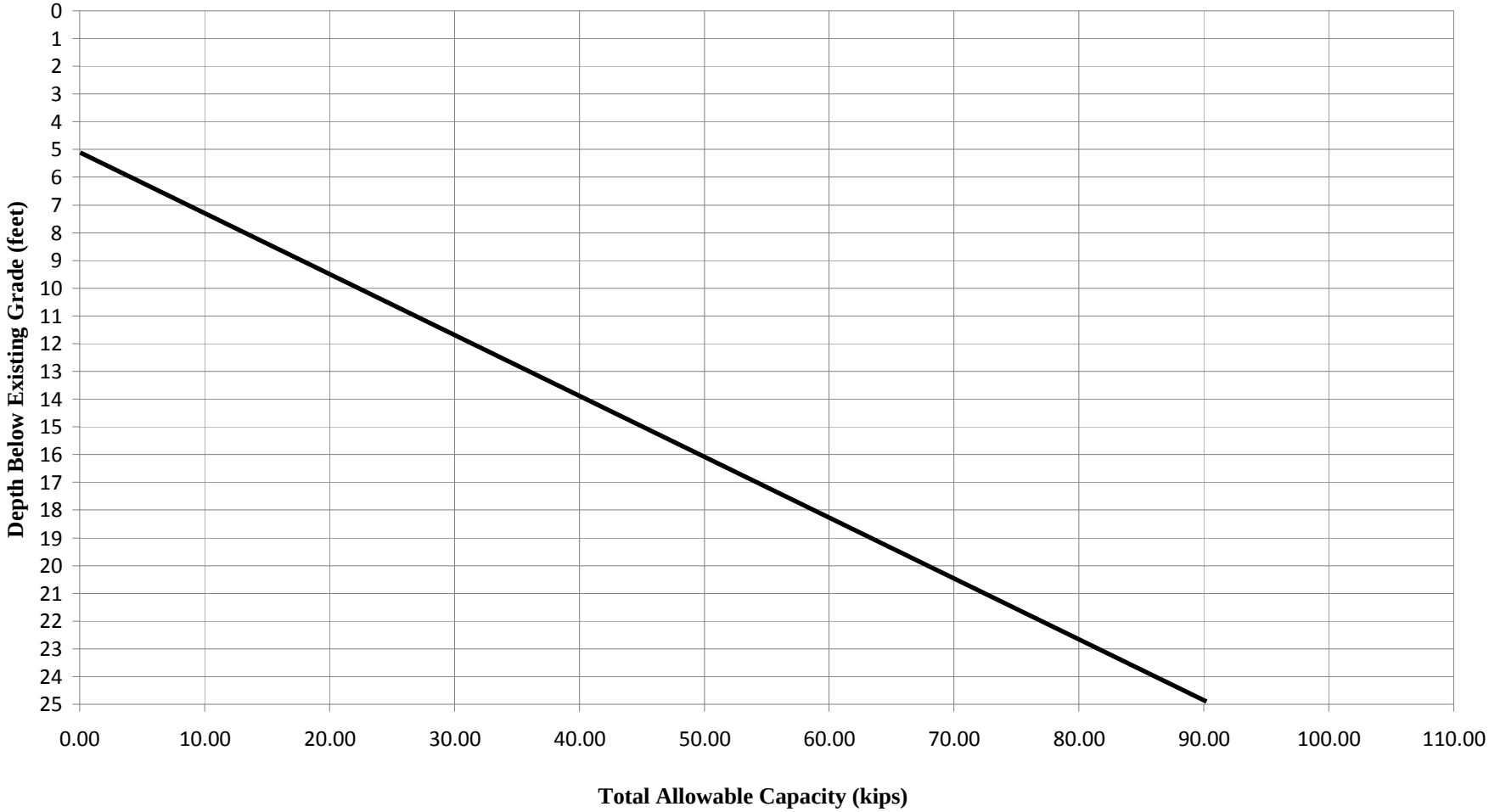
Total Allowable Capacity - 18 in. Diameter Drilled Shaft



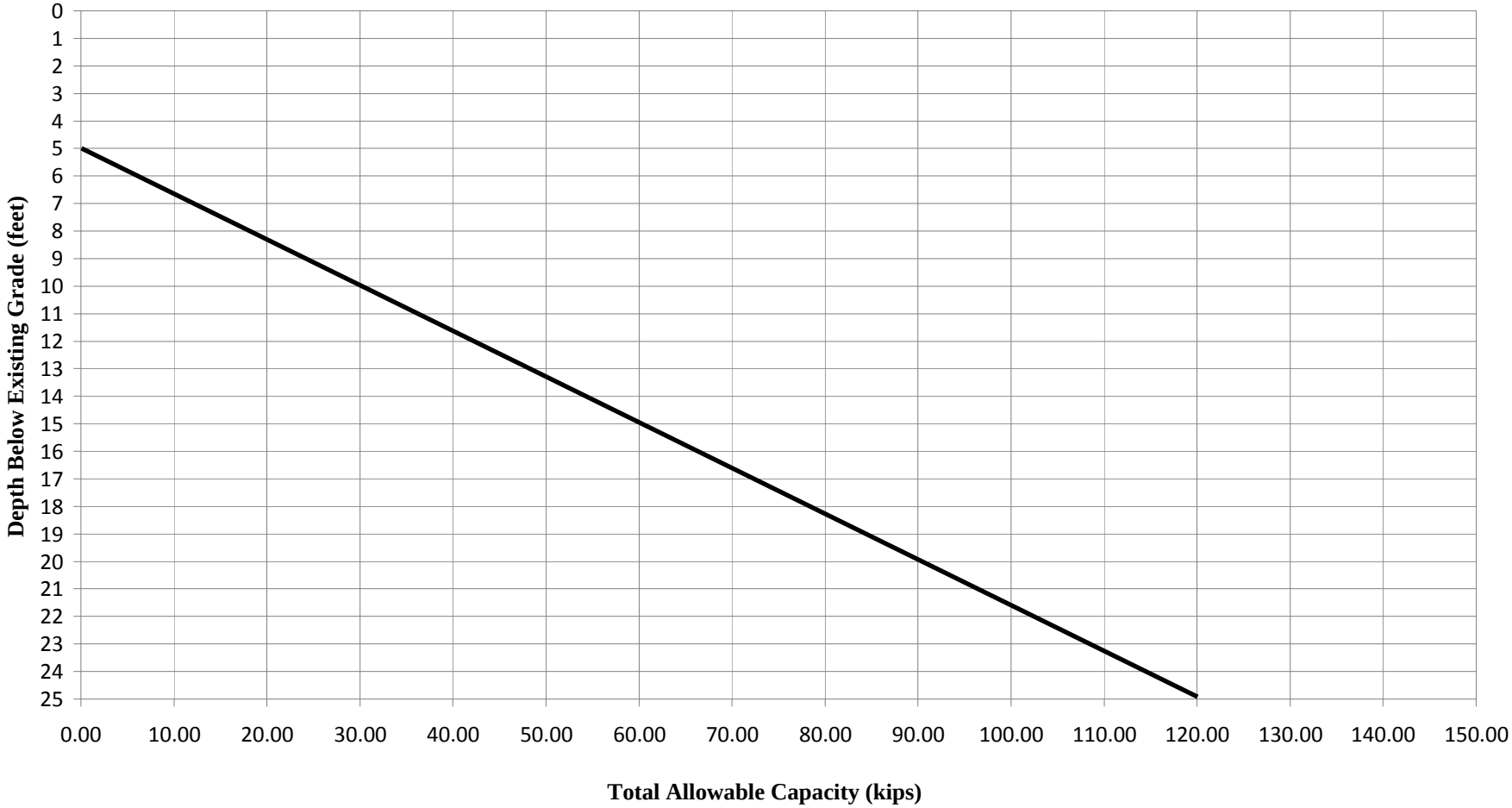
Total Allowable Capacity - 24 in. Diameter Drilled Shaft

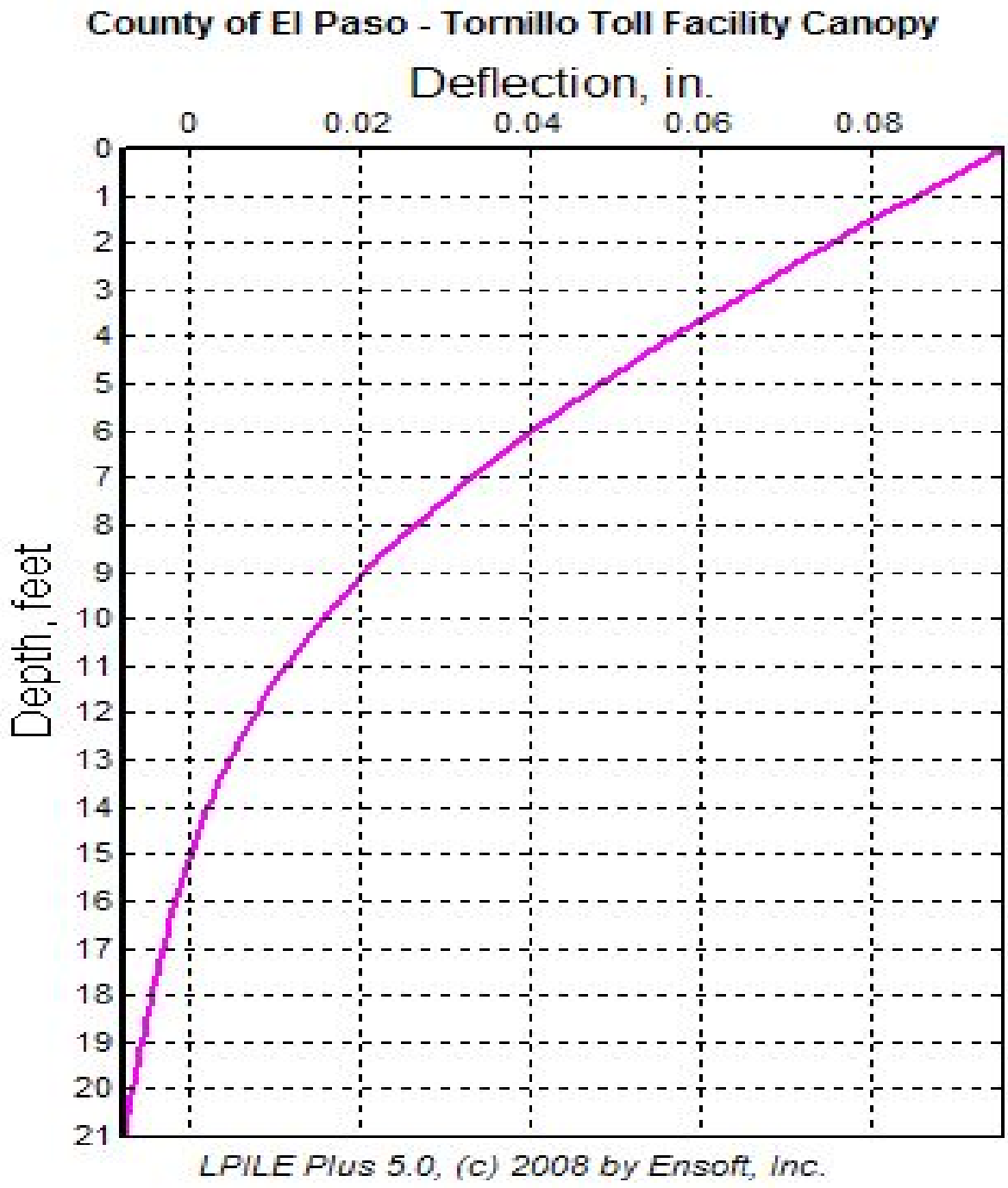


Total Allowable Capacity - 30 in. Diameter Drilled Shaft



Total Allowable Capacity - 36 in. Diameter Drilled Shaft





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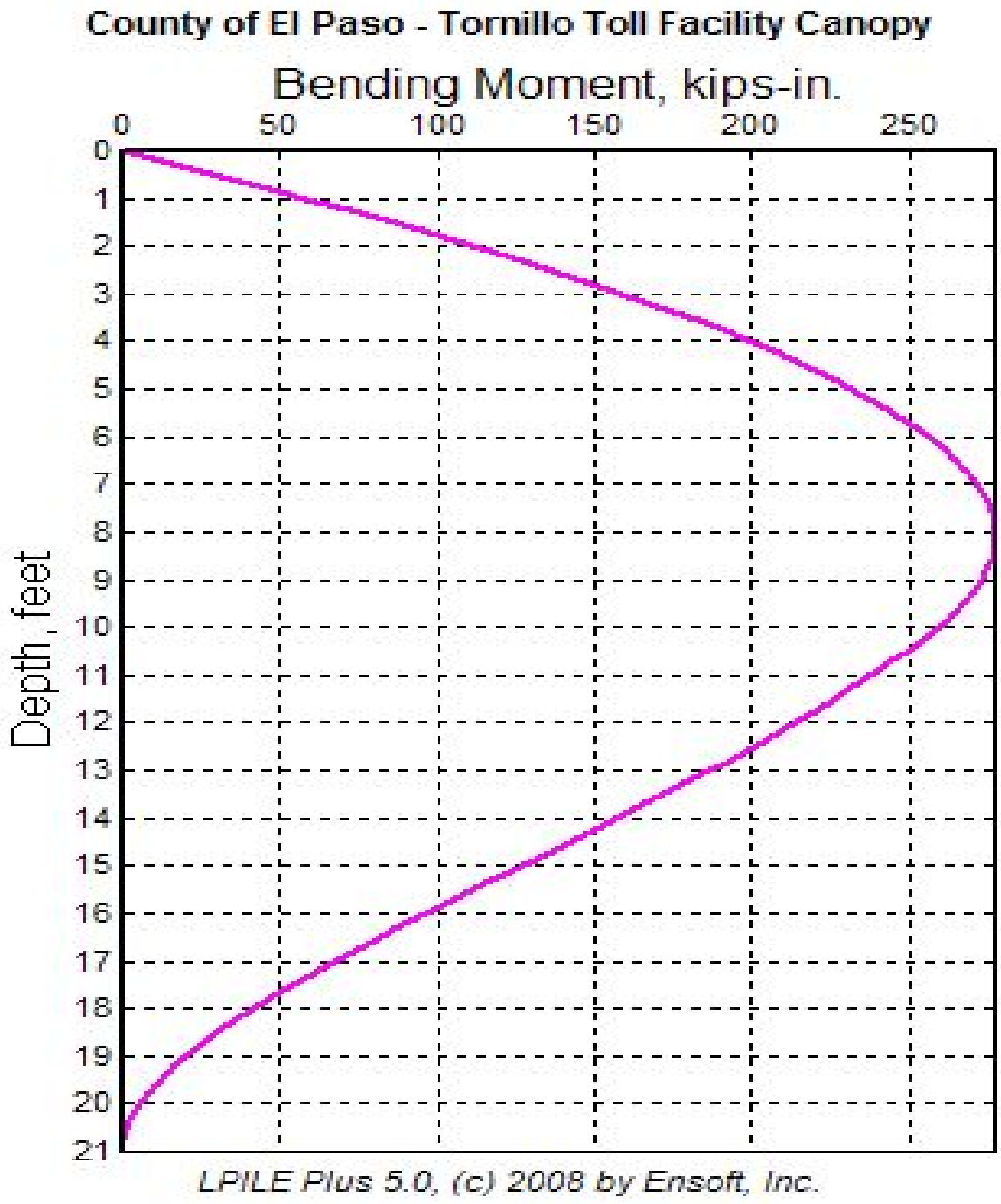
Pile Deflection Curve
24" Dia. Drilled Pier
Proposed Toll Plaza for Tornillo/Guadalupe
New International Bridge Major
Arterial Roadway
Tornillo, El Paso County, Texas

Client: County of El Paso	
Project No. AGCQC11-034	
Scale: NTS	Check by: JR
Date: 9/27/11	Sheet 17



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testing and engineering

Bending Moment Curve
24" Dia. Drilled Pier
Proposed Toll Plaza for Tornillo/Guadalupe
New International Bridge Major
Arterial Roadway
Tornillo, El Paso County, Texas

Client: County of El Paso	
Project No. AGCQC11-034	
Scale: NTS	Check by: JR
Date: 9/27/11	Sheet 18

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ATTACHMENT B

- **Geotechnical Report Technical Reference Information – B1**
- **Soil Classification Chart – B2**
- **Geotechnical Report Soil Classification Reference Information – B3**

GEOTECHNICAL REPORT
TECHNICAL REFERENCE INFORMATION

DEFINITION OF DESCRIPTIVE TERMS

DENSITY OF GRANULAR SOILS

SPT N Value	Relative Density
< 4	Very Loose
4 – 10	Loose
11 – 30	Med. Dense
31 – 50	Dense
50 – 80	Very Dense
> 80	Hard

CONSISTENCY OF COHESIVE SOILS

SPT N Value	Consistency
< 2	Very Soft
2 – 4	Soft
5 – 8	Medium Stiff
9 – 15	Stiff
16 – 50	Very Stiff
> 80	Very Hard

DEGREE OF PLASTICITY

Nonplastic –	Has no cohesion; will not roll into a thread.
Trace of Plasticity –	Barely hold its shape when rolled into a thread.
Low Plasticity –	Has sufficient cohesion to form a thread but will quickly rupture when deformed.
Med. Plasticity –	Has considerable cohesion. Can be molded into a thread and will withstand considerable deformation without rupture.
High Plasticity –	Can be kneaded like dough without trace of rupture.

MOISTURE DESCRIPTIONS

	GRANULAR SOILS	COHESIVE SOILS
Dry	No Apparent Moisture	No Apparent Moisture
Slightly Moist	< Than 3% by Weight	< Less Than Plastic Limit
Moist	3% to 9% by Weight	Approximately Plastic Limit
Very Moist	> 9% by Weight	> than PL but < than LL
Wet	Submerged or Saturated	Submerged or Saturated

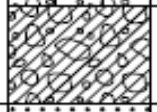
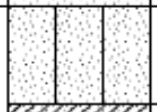
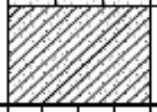
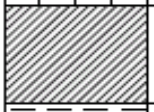
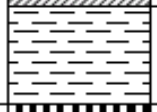
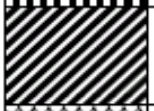
PLASTICITY

Cohesion TSF	Plasticity Index	Degree of Plasticity
0-0.125	0-5	None
0.125-0.25	5-10	Low
0.25-0.5	10-20	Moderate
0.5-1.0	20-40	Plastic
1.0-2.0	> 40	Highly Plastic
> 2.0		

ABBREVIATIONS

V. – Very	Fl. – Fairly	Sl. – Slightly	Med. – Medium
Tr. – Trace	< - Less Than	> - Greater Than	PL – Plastic Limit
Mod. – Moderately			

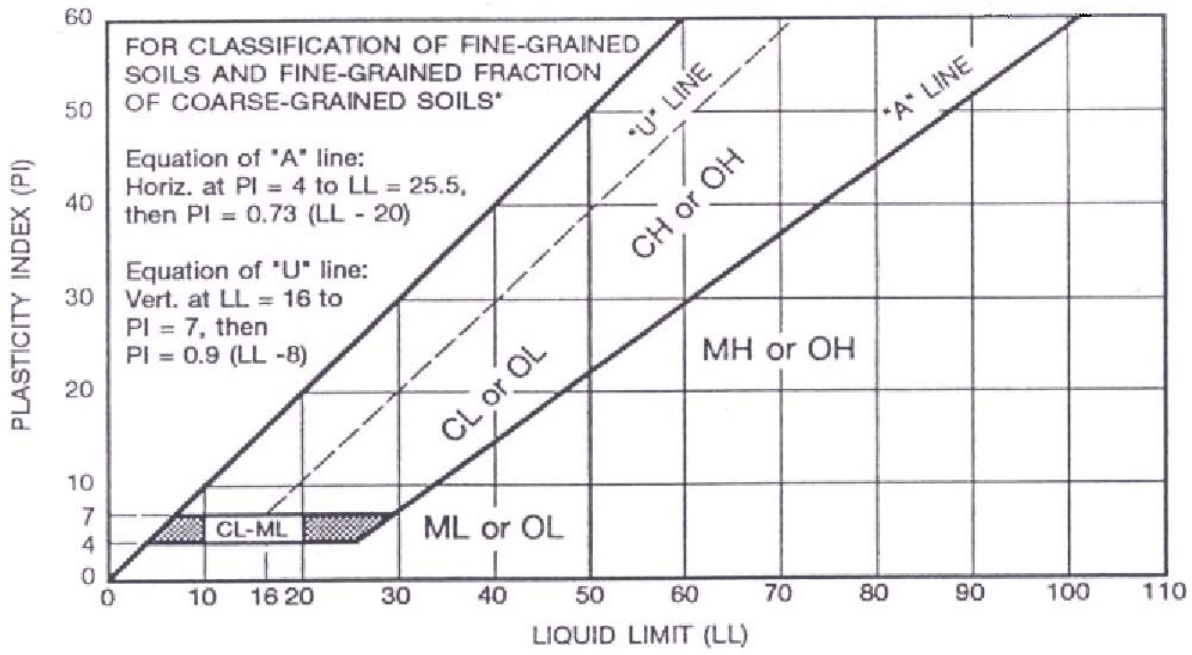
SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS		TYPICAL DESCRIPTIONS
			GRAPH	LETTER	
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	CLEAN GRAVELS		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		(LITTLE OR NO FINES)		GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
	MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	GRAVELS WITH FINES		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
		(APPRECIABLE AMOUNT OF FINES)		GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	SAND AND SANDY SOILS	CLEAN SANDS		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
		(LITTLE OR NO FINES)		SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
	MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	SANDS WITH FINES		SM	SILTY SANDS, SAND - SILT MIXTURES
		(APPRECIABLE AMOUNT OF FINES)		SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS	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 SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	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
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

GEOTECHNICAL REPORT
SOIL CLASSIFICATION REFERENCE INFORMATION

Cohesive Soil Classification Chart



U.S.STANDARD SIEVE

	12"	3"	¾"	4	10	40	200		
BOULDERS	COBBLES	GRAVEL		SAND				SILT	CLAY
		COARSE	FINE	COARSE	MEDIUM	FINE			
152	76.2	19.1	4.76	2.00	0.420	0.074	0.002		

SOIL GRAIN SIZE IN MILLIMETERS

Laboratory Test Methods:

Moisture Content Tests:

Moisture Contents are determined from representative portions of a soil sample. The samples initial weight is recorded and it is then dried to a constant weight. From this data the moisture content is calculated.

Atterberg Limit Tests:

Liquid Limit (LL), Plastic Limit (PL) and Shrinkage Limit (SL) tests are performed to aid in the classification of soils and to determine the plasticity and volume change characteristics of the materials. The Liquid Limit is the minimum moisture content at which a soil will flow as a heavy viscous fluid. The Plastic Limit is the minimum moisture content at which the soil behaves as a plastic material. The Shrinkage Limit is the moisture content below which no further volume change will take place with continued drying. The Plasticity Index (PI) is the numeric difference between the Liquid Limit and the Plastic Limit and indicates the range of moisture content over which a soil remains plastic.

Grain Size Distribution Test (Particle Size Analysis, Sieve Analysis):

The distribution of soils finer than the No. 200 sieve is determined by passing a representative soil sample through a standard set of nested sieves. The weight of material retained on each sieve is determined and the percentage passing (or retained) is calculated. For determination of the percentage of material finer than the No. 200 sieve, the specimen is first washed through the sieve. The distribution of the materials finer than the No. 200 is determined by use of the different size particles while suspended in water.

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ATTACHMENT C

- **Selected Existing Site Conditions Photographs – C1**

PROJECT NO.: AGCQC11-034 / ATCQC11-021-01
CLIENT: El Paso County Road and Bridge Department
PROJECT NAME: General Soils Investigation Report
Proposed Toll Plaza for Tornillo /Guadalupe
International Bridge Major Arterial Roadway
Tornillo, El Paso County, Texas

PHOTO NO. 1 View of the existing conditions of the south-access road to the project site.

PHOTO NO. 2 View of existing conditions of the north-access road to the project site.

PHOTO NO. 3 General view of existing site conditions towards the northeast.

PHOTO NO. 4 View of the existing site conditions towards the north.

PHOTO NO. 5 View of the existing site conditions towards the northeast.

PHOTO NO. 6 View of existing site conditions and access roadway.