90% DRAFT

METROPOLITAN ST. LOUIS SEWER DISTRICT

CSO - Brentwood and Red Bud Ave CSO Interceptor (I-118) / Outfall (L-111) Elimination and Sewer Separation

12139-015.1

Engineer's Seal

The responsibility of the undersigned Engineer is limited to the technical specifications contained herein, she/he disclaims any responsibility for other documents, including geotechnical reports which do not bear his/her seal and signature.

The Engineer is responsible for Technical Project Specifications Pages 1 thru 52.

Jeffery A Gratzer, P.E.
Professional Engineer
License #: 1999137696
Date: 06/15/2020

90% DRAFT

TECHNICAL PROJECT SPECIFICATIONS

for

SEWER CONSTRUCTION AND PRIVATE INFLOW REMOVAL

in

CSO - Brentwood and Red Bud Ave CSO Interceptor (I-118) / Outfall (L-111) Elimination and Sewer Separation

12139-015.1

INTRODUCTION

1. The work to be done under this contract consists of the construction of approximately 9,200 lineal feet of pipe sanitary sewers, varying in size from 6" to 30" in diameter and 4,200 lineal feet of pipe storm sewers, varying in size from 12" to 21" in diameter , removal of inflow sources from TBD private properties, and appurtenances to be constructed in an area located north of Interstate 64 and east of Interstate 170 in the Cities of Richmond Heights and Clayton, Missouri in St. Louis County.

2. The work consists of furnishing all material, labor, tools, equipment and supervision necessary for the sewer construction, appurtenances, and removal of inflow sources, in accordance with all the requirements of these specifications, and the drawings made a part thereof.

3. A mandatory prebid conference will be held at the Metropolitan St. Louis Sewer District or project site as specified in the Notice to Contractors. All contractors will be required to attend the prebid conference. No bids will be accepted from contractors who do not attend this conference.

4. An additional charge per calendar day of $_____ shall be added to each line of the Charge Per Calendar Day column of the Liquidated Damages Table located in the General Project Specifications for this project.

5. Pay items _____, and _____ is a designated allowance **OR** are designated allowances and will be deducted from the “TOTAL BID PRICE” before calculating the MWBE requirement.

6. This project will be built under the provisions of the "Standard Construction Specifications of The Metropolitan St. Louis Sewer District," dated 2009, except as modified herein.

PART 1 - GENERAL CONDITIONS

Section A, Purpose and Application – the existing paragraph shall become Paragraph 1, and following additions apply:

2. Accompanying these specifications are the following plans and attachments which are to illustrate and to be a part of these specifications and the contract documents:

    a. Cover Sheet - Sheet 1 of 42 Sheets
    b. Plans and Profiles - Sheets 2 through 40 of 42 Sheets
    c. Detail Sheets - Sheets 41 through 42 of 42 Sheets
    d. Attachment A – PIR Location Map (3 Pages)
    e. Attachment B – PIR Quantity Summary (12 Pages)
    f. Attachment C – PIR Site Exhibits (1 Pages)
    g. Attachment C-1 – Unsigned PIR Site Exhibits (68 Pages)
    h. Attachment D – PIR Disconnect Details (39 Pages)
    i. Attachment E – Municipality Agreement (5 Pages)
    j. Attachment F – Utility Letters (1 Pages)
    k. Attachment G – Geotechnical Report (219 Pages)

3. Excel files for the ("PIR Quantity Summary") are available upon request from the MSD Project Manager: Patricia Pride, 314-768-6275, paprid@stlmsd.com.

4. A copy of the subsurface exploration data has been included at the end of the specifications for informational purposes only, and is not a part of the contract documents.

5. Any geological reports provided contain only general and preliminary information which is furnished as an example of soil conditions only, without any express or implied representation, warranty, guarantee, or agreement that the depths or character of materials are correctly shown, or that conditions affecting the work will not differ from those shown.

Section E, Prosecution, Progress and Acceptance of the Work, Paragraph 2, Order of Work – remove the final sentence of the existing paragraph, the existing paragraph shall become Subparagraph a, and the following additions apply:

b. The sewer construction may begin with construction at manhole 1S at the downstream end of the project and proceed upstream.

Section E, Prosecution, Progress and Acceptance of the Work, Paragraph 6, Contractor's Liability for Exceeding the Contract Period – the following additions apply:

c. Should the Contractor fail to complete this project on or before the contract completion date, as set by the Notice to Proceed, or as adjusted by a contract time extension, the Contractor and his surety will become responsible for the cost of any claim of sanitary sewer backup, within the limits of this project, that is judged to be the responsibility of the District that may occur between the contract completion date and the date the project is completed to the extent it will function as it was designed. This responsibility will be in addition to liquidated damages as established by the Contract Agreement.

d. The removal of the combined sewer overflow (CSO) structure L-111 and interceptor I-118 at structure 20K3-063C is an integral part of the project. Failure to remove the specified constructed CSO structures by the contract completion date shall result in the assessment of liquidated damages in the amount of $4,000 per calendar day per constructed CSO structure. This assessment shall be in addition to other liquidated damages as established by the Contract Agreement. The extension of the Contract Time by change order will not relieve the Contractor from this obligation unless so specified by the change order. Contractor shall not proceed with elimination of CSO structure L-111 and interceptor I-118 without authorization from the District.

Section F, Responsibilities of the Contractor, Paragraph 1, Observance of Laws and Regulations, subparagraph e. - add the following sentence:

The District has an **Intergovernmental Reciprocity Agreement Establishing the Mutual Waiver of Fees** with the Cities of Richmond Heights and Clayton. Inspection, Permit or Building fees will not be required from these agencies; however, the Contractor shall obtain all required permits and provide a copy to the District before starting the work. This waiver of fees does not apply to permits required by Unincorporated St. Louis County Building Departments. A copy of the Agreements is attached at the end of the Technical Specifications.

Section F, Responsibilities of the Contractor, Paragraph 6, Overhead High Voltage Power lines - the existing paragraph shall become Subparagraph a, and following addition applies:

b. Except for the locations, timeframes, and situations listed below, all costs involved with providing temporary clearance or safety precautions by the electric utility will be at the Contractor's expense. The District will make payment for required provision of temporary clearance or safety precautions by the electric utility for the following locations, as stipulated. The useful life of initial installations should be at least 60 days unless material is damaged during construction.

Location/Reach	Initial Installation Only	Maximum Duration	Conditions/ Remarks
Overhead electric near 9S	X		
Overhead electric between 21S and 69S and between 47D and 50D	X		4 power poles near pipings
Power Pole near 21S	X		Support poles during construction
Power Pole near 67S	X		Support poles during construction
Power Pole near 49D (in front of 8531 Bryan Avenue)	X		Support poles during construction
Street Light near EX4 on Everett Ave	X		Street light pole replacement
Street Light next to between 14S and 51S	X		Street light pole replacement
Street Light near 23S (in front of 937 S Bemiston Ave)	X		Street light pole replacement
Street Light near 68S	X		Street light pole replacement
Street Light near 39D	X		Street light pole replacement

Section F, Responsibilities of the Contractor - and following addition applies:

15. The Contractor shall be required to attend a Neighborhood Project Meeting with the District, City officials, and property owners in the project area. The District will make arrangements for the meeting that will be held at a location within the local municipality on Saturday or during a weekday evening.

16. The Contractor shall submit a Traffic Control Plan to the District for review, that includes evaluation on-street parking needs, before project construction commences. The Traffic Control Plan shall meet requirements of all applicable jurisdictions.

Section G, Measurement and Payment, Paragraph 1, Measurement of Quantities, Subparagraph c. - add the following sentence:

When the nature of the lump sum work is such that the work cannot be completed within the same month in which the work is to begin, the Contractor shall submit a progress payment schedule when directed to do so by the District. No payment for the lump sum work will be made until a payment schedule acceptable to the District has been submitted.

Section G, Measurement and Payment, Paragraph 4, Payment for Charges and Extra Work, Subparagraph h – the following addition applies:

The total payment for the use of any contractor-owned equipment shall not exceed 75% of the current purchase price of a comparable piece of equipment.

Section G, Measurement and Payment, Paragraph 5, Materials and Labor Bills – the following addition applies:

The Contractor shall also complete and submit MSD Form C regarding vendor utilization, which is included at the end of the Technical Specifications.

Section G, Measurement and Payment, Paragraph 6, Payment on Cash Contracts – the following additions apply:

d. After construction has begun, the first monthly payment to the Contractor will include an amount for starting the project. This lump sum amount will be paid for under Pay Item "Mobilization."

e. The Contractor shall utilize a portion of the “Mobilization” payment amount to make an “Advance Payment” to all subcontractors in the category of “Material/Supplies including Labor or Installation” and/or “Service Provider/Installer” as listed on MSD Form A of the Bid Proposal, and as confirmed by the District. This Advance Payment amount represents a forward payment to the subcontractor in anticipation of starting the work and does not increase the total amount earned by or paid to each subcontractor. The administration and distribution of the subcontractor Advance Payment amounts shall be as follows:

1.) Subcontractors in the category of “Material/Supplies including Labor or Installation” and/or “Service Provider/Installer” as listed on MSD Form A of the Bid Proposal shall be eligible for receipt of the Advance Payment prior to mobilization to the project site. This payment amount shall be subject to the withholding of retainage.

2.) Following Notice of Award, the agreed upon Advance Payment amount shall be stated in the MBE/WBE Subcontractor/Vendor Verification Form. The stated amount for each subcontractor shall not exceed 5% of the subcontractor utilization amount as stated in the Bid Proposal.

3.) The Contractor shall make the Advance Payment to the subcontractor at least five (5) business days prior to the subcontractor's scheduled mobilization date.

4.) As the subcontractor work progresses, the Advance Payment amount shall be deducted from the subcontractor's first regularly scheduled invoice(s).

PART 2 – MATERIALS OF CONSTRUCTION

Section F, Pipe, Paragraph 5, Precast manholes, Paragraph 1, Reinforced Concrete Manholes – the existing paragraph shall become Subparagraph a, and the following additions apply:

c. Antimicrobial Additive for Concrete Manholes and Structures

1) The antimicrobial additive ConmicShield® as manufactured by ConShield Technologies, Inc. of Atlanta, Georgia; ConBlock MIC as manufactured by ConSeal Concrete Sealants, Inc. of New Carlisle, Ohio; or District approved equal shall be used to render the concrete uninhabitable for bacteria growth for all concrete pipe on this Project.

2) The liquid antimicrobial additive shall be an EPA registered material and the registration number shall be submitted for approval prior to use in the project.

3) The amount to be used shall be 1 gallon per cubic yard of concrete, or a higher amount if recommended by the manufacturer of the antimicrobial additive. This amount shall be added in the total water content of the concrete mix design. The additive shall be added into the concrete mix water to insure even distribution of the additive throughout the concrete mixture. The mixing time is a minimum of seven minutes.

4) The antibacterial additive shall have been successfully demonstrated to provide prevention of microbial induced corrosion in sanitary sewers for ten or more years.

5) The antimicrobial additive shall be used by factory certified pre cast concrete plants.

6) Acceptance shall be a letter of certification from the precaster to the District stating that the correct amount and correct mixing procedure was followed for all antimicrobial concrete.

7) Each manhole shall be plainly stenciled with the name of the antimicrobial additive on the interior and exterior.

d. Antimicrobial Additive Verification & Testing

1) The ready-mix supplier shall retain two cured pieces of concrete from each pipe made with antimicrobial additive. The pieces must have a minimum dimension of two square inches and be uniform. The specimens shall be placed in plastic baggies and

clearly labeled with the date, batch number, pipe or manhole dimension and specific project.

2) One set of samples shall be retained by the pre cast producer and one set shall be secured for the District. The District will randomly select and send seven samples to an approved bacteriological laboratory for testing.

3) Before production begins, the manufacturer shall conduct a bacteriological test using an independent bacteriological laboratory for the presence of the approved antimicrobial additive using ASTM D4783. The test shall use the Thiobacillus Thiooxidan strain for testing. The manufacturer shall submit one control sample without antimicrobial additive for testing also. Both samples shall be tested at the same time.

4) All other selected specimens shall be tested by an approved independent bacteriological laboratory for the presence of the District approved antimicrobial additive using ASTM D4783. The District allows modified tests when not specified.

    (a) The report shall be sent to the respective parties.

    (b) Cost for testing shall be included in the installed price of the additive; the District requires a minimum of seven tests for each project

Section G, Pipe, Paragraph 1, Sanitary and Combined Sewer Pipe – the following addition applies:

f. Corrugated Polypropylene Pipe (PP) Sanitary and Combined Sewers - 12 inch-60 inch

Section G, Pipe, Paragraph 2, Stormwater Sewer Pipe – delete subparagraph f in its entirety, the following replacement applies:

f. Corrugated Polypropylene Pipe (PP) Storm Sewers - 12 inch-60 inch

Section G, Pipe, Paragraph 2, Stormwater Sewer Pipe – the following addition applies:

g. Composite sewer pipe (ABS and PVC) – 12 inch – 24 inch

Section G, Pipe, Paragraph 4, Concrete Sewer Pipe – delete subparagraph b. in its entirety and replace with the following:

b. The shape, dimensions and tolerances of the bell and spigot or tongue and groove ends of the pipe shall meet all requirements of the specifications for joints for concrete pipe, ASTM C443 (Storm Only) or ASTM C361, and be subject to the approval of the Director.

Section G, Pipe, Paragraph 5, Reinforced Concrete Pipe – delete the ***first sentence*** of subparagraph a. in its entirety and replace with the following:

It shall be precast and shall conform to the requirements of the Specifications for Reinforced Concrete Culvert, Storm Drain and Sewer Pipe, ASTM C76 (Storm Only) or C655 (Storm Only) or C361, with Shell thickness designated “Wall B or C” and with circular reinforcement in Circular Pipe or to the requirements of Reinforced Concrete Elliptical Culvert Storm Drain and Sewer Pipe ASTM C507 (Storm Only), or ASTM C361.

Section G, Pipe, Paragraph 5, Reinforced Concrete Pipe – the following addition applies:

e. All Reinforced Concrete Pipe (RCP) allowed by the District shall be manufactured in accordance with American Concrete Pipe Association (ACPA) QCAST certification requirements or National Precast Concrete Association (NPCA) ”NPCA Quality Control Manual”, including compliance with QCM-001, Chapter 6, Revision 4 dated 06-01-17. RCP manufacturers shall demonstrate that the RCP is in full compliance with one of the certification requirements above, unless otherwise approved by the Director.

f. Antimicrobial Additive for Concrete Pipe

1) The antimicrobial additive ConmicShield® as manufactured by ConShield Technologies, Inc. of Atlanta, Georgia; ConBlock MIC as manufactured by ConSeal Concrete Sealants, Inc. of New Carlisle, Ohio; or District approved equal shall be used to render the concrete uninhabitable for bacteria growth for all concrete pipe on this Project.

2) The liquid antimicrobial additive shall be an EPA registered material and the registration number shall be submitted for approval prior to use in the project.

3) The amount to be used shall be 1 gallon per cubic yard of concrete, or a higher amount if recommended by the manufacturer of the antimicrobial additive. This amount shall be added in the total water content of the concrete mix design. The additive shall be added into the concrete mix water to insure

even distribution of the additive throughout the concrete mixture. The mixing time is a minimum of seven minutes.

4) The antibacterial additive shall have been successfully demonstrated to provide prevention of microbial induced corrosion in sanitary sewers for ten or more years.

5) The antimicrobial additive shall be used by factory certified pre cast concrete plants.

6) Acceptance shall be a letter of certification from the precaster to the District stating that the correct amount and correct mixing procedure was followed for all antimicrobial concrete.

7) Each piece of pipe shall be plainly stenciled with the name of the antimicrobial additive on the interior and exterior.

g. Antimicrobial Additive Verification & Testing

5) The ready-mix supplier shall retain two cured pieces of concrete from each pipe made with antimicrobial additive. The pieces must have a minimum dimension of two square inches and be uniform. The specimens shall be placed in plastic baggies and clearly labeled with the date, batch number, pipe or manhole dimension and specific project.

6) One set of samples shall be retained by the pre cast producer and one set shall be secured for the District. The District will randomly select and send seven samples to an approved bacteriological laboratory for testing.

7) Before production begins, the manufacturer shall conduct a bacteriological test using an independent bacteriological laboratory for the presence of the approved antimicrobial additive using ASTM D4783. The test shall use the Thiobacillus Thiooxidan strain for testing. The manufacturer shall submit one control sample without antimicrobial additive for testing also. Both samples shall be tested at the same time.

8) All other selected specimens shall be tested by an approved independent bacteriological laboratory for the presence of the District approved antimicrobial additive using ASTM D4783. The District allows modified tests when not specified.

(c) The report shall be sent to the respective parties.

(d) Cost for testing shall be included in the installed price

of the additive; the District requires a minimum of seven tests for each project

Section G, Pipe, Paragraph 7, Corrugated Metal Pipe – the existing paragraph shall become Subparagraph a, and the following additions apply:

b. Corrugations shall be helical.

Section G, Pipe, Paragraph 8, Polyvinyl Chloride Pipe – the existing paragraph shall become Subparagraph a., and the following addition applies:

b. Pipe for gravity sewer installations shall be installed in accordance with ASTM D2321.

Section G, Pipe, Paragraph 11, High Density Polyethylene (HDPE) – the existing Paragraph shall become Subparagraph a., and the following addition applies:

b. Pipe for gravity sewer installations shall be installed in accordance with ASTM D2321.

Section G, Pipe, Paragraph 13, Fiberglass Pipe – the existing paragraph shall be deleted and the following additions apply:

a. Pipe for gravity sewer application shall conform to the requirements of ASTM D3262 for “Fiberglass” (Glass-Fiber-Reinforced Thermosetting-Resin) Sewer Pipe. Pipe for force main applications shall conform to the requirements of ASTM D3754 for “Fiberglass” (Glass-Fiber-Reinforced Thermosetting-Resin) Sewer and Industrial and in accordance with AWWA C950 Fiberglass Pressure Pipe.”

b. Fiberglass Pipe design shall conform to AWWA M45 Fiberglass Pipe Design for the size and class proposed. The minimum pipe stiffness shall be class PS46 (psi) for pipe diameters < 60-Inch and class PS72 (psi) for pipe diameters 60-Inch and greater when tested in accordance with ASTM D2412.

c. Fittings for gravity sewer installations shall conform to ASTM D3840. Fittings for force main installations shall conform to ASTM D5685.

d. Pipe for gravity sewer installations shall be installed in accordance with ASTM D3839. Pipe for force main installations shall be installed in accordance with AWWA M45.

Section G, Pipe, Paragraph 15, Corrugated Polypropylene Pipe–the following addition applies:

15. Corrugated Polypropylene Pipe.

a. For use in sanitary and combined sewers 12 to 60 inches in diameter it shall conform to the requirements of ASTM F2764 “Standard Specification for 6 to 60 in. Polypropylene (PP) Corrugated Double and Triple Wall Pipe and Fittings for Non-Pressure Sanitary Sewer Applications.” Pipe shall have a minimum stiffness of 46psi when tested in accordance with ASTM D2412.

b. For use in storm sewers 12 to 24 inches in diameter it shall conform to the requirements of ASTM F2881 “Standard Specification for 12 to 60 in. Polypropylene (PP) Dual Wall Pipe and Fittings for Non-Pressure Storm Sewer Applications;” or for use in storm sewers 12 to 60 inches in diameter it shall conform to the requirements of ASTM F2764 “Standard Specification for 6 to 60 in. Polypropylene (PP) Corrugated Double and Triple Wall Pipe and Fittings for Non-Pressure Sanitary Sewer Applications.” Pipe shall have a minimum stiffness of 46psi when tested in accordance with ASTM D2412.

c. Pipe for gravity sewer installations shall be installed in accordance with ASTM D2321.

Section H, Joints, Paragraph 1, Joint Selection – under sub paragraph a, the following addition applies to the table “SANITARY AND COMBINED SEWERS”, “Joint Type”:

Corrugated Polypropylene Pipe (PP) D

Section H, Joints, Paragraph 1, Joint Selection – under sub paragraph a, the following addition applies to the table “STORMWATER SEWERS”, “Joint Type”:

Corrugated Polypropylene Pipe (PP) D

Section H, Joints, Paragraph 3, Type B Joints – the existing paragraph shall be deleted and the following additions apply:

a. When used with concrete pipes, they shall be approved compression-type joints and shall conform to the requirements of the Standard Specifications for Reinforced Concrete Low-Head Pressure Pipe ASTM C361with 25 foot head.

b. For pipes 48 inches in diameter and smaller, all gaskets shall be confined in an annular space formed by shoulders on the bell and spigot or in a groove in the spigot of the pipe so that movement of the pipe or hydrostatic or hydrodynamic pressure cannot displace the gasket.

c. When the joint is assembled, the gasket shall be compressed to form a watertight seal.

d. Single offset joints without shoulders on the bell and spigot will not be allowed for sanitary sewers.

Section H, Joints, Paragraph 5, Type D Joints – the following addition applies:

Type D joints shall also apply to all PP pipes.

Section H, Joints, Paragraph 11, Adapters and Couplings—Subparagraphs b and c shall be deleted in their entirety and replaced with the following:

b. The connector or adapter shall conform to ASTM C1173, shall be manufactured of an approved pre-formed elastomeric material, 50 Shore A durometer per ASTM D2240, with 300 series stainless steel shear band, conforming to ASTM A240. The connector or adapter shall be tightened around the connecting pipes by use of 300 series stainless steel nuts, bolts, and clamps.

c. The compression joint connector or adapter and clamps shall be installed as recommended and specified by the manufacturer. Each connector and adapter shall bear the manufacturer's name and required markings.

d. The connector or adapter shall not be backfilled with concrete, flowable fill, or other cement-containing materials in direct contact with the connector or adapter.

Section K, Crushed Limestone and Screenings for Sewer Bedding, Backfill, and Subgrade Replacement, Paragraph 2, Designation: MSD 1 – Bedding – remove the first paragraph in its entirety and replace with the following:

For pipes 27 inches in diameter and smaller, and all flexible pipes of any diameter bedding shall meet the following gradation except as noted in the details:

Section P, Fencing – Tree Protection

Tree protection fencing shall be constructed of plastic mesh and shall stand at least four feet tall. Mesh shall be brightly colored or otherwise highly visible. Standard orange construction fencing is acceptable.

PART 3 – EXCAVATION

Section D, Work Included in Excavation, Paragraph 1, General, Subparagraph g – the following additions apply:

1.) A by-pass pumping plan must be submitted to the Engineer for review before construction may begin. The contractor shall submit complete design data showing method and equipment contractor proposes to utilize in diversion of sewage flow for approval by the Engineer. At a minimum, the submittal shall include the following information
   1. Drawing indicating the scheme and location of pumps, suction piping, discharge piping, temporary sewer plugs.
   2. Capacities and sizes of pumps, standby equipment, and power requirement if applicable
   3. Sewer plugging method and type of plug.

2.) The means and methods of accomplishing and maintaining the bypassing shall be the sole responsibility of the contractor.

3.) No interruption of sewage flow shall be permitted throughout the duration of the project. If the Contractor fails to maintain the sewage flows with the temporary pumping systems, the Contractor shall be responsible for any fines levied on Owner by the Missouri Department of Natural Resources, or any other applicable agency or entity. The Contractor will be responsible for any sewage backups or bypasses (overflows) that occur as a result of the bypass pumping operation and pay all costs for cleanup, repairs, restitution, damage, fines, etc., whether from private or public customers of the Owner or from public agencies.

4.) The contractor is advised that the bypass plans must provide for accessibility to pedestrians and vehicular traffic in accordance with local agency/property owner requirement.

5.) Bypass operation will be required during the period of installation of manholes and/or piping connecting to the existing sanitary sewer system where flows are occurring. The bypass pumps and piping flow shall be continuously monitored by a competent operator.

6.) The by-passing or discharging of sewage into existing storm sewers or natural channels will not be allowed during pumping operations or any other construction procedures.

7.) Wastewater flow received by the existing sewer shall not be disrupted or spilled while constructing the new sewer. By-pass pumping, as required, shall be used throughout the construction period. The new sewer may be used in conjunction with the by-pass, if approved.

8.) Payment for by-pass pumping shall be made at the lump sum price for Bid Item "Bypass Pumping." The lump sum price shall include all costs related to by-pass pumping of all wastewater flow throughout construction of this project.

9.) Dry weather flows in the system range between XXX cfs and XXX cfs. (XXX gpm to XXX gpm). NOTE: Table below will be updated after 90% in coordination with the existing hydraulic model.

EXISTING REACH	AVERAGE DAILY FLOW	PEAK DAILY FLOW
19K3-080S:19K3-079S	0.153 cfs	0.195 cfs

Section E, Unusual Excavation Conditions, Paragraph 1, Extra Payment Requests, Subparagraph a – the following additions apply:

1.) If dewatering is determined to be necessary, the Contractor shall design, furnish, install, operate, maintain and remove a complete temporary dewatering system as necessary to lower and control water levels below sub-grades of excavation to

permit construction in-the-dry.

2.) Dewatering equipment shall not be installed, or dewatering operations began, prior to approval of a plan by the District that shall include coordination with methods of excavation and excavation support. All dewatering operations shall be performed to the satisfaction of the District.

3.) Payment

(a) The costs associated with dewatering shall be reviewed and approved by the District prior to commencement of the work. All costs will be included in the allowance for Pay Item “Dewatering”.

(b) In any pipe reach that is dewatered by the above methods, no additional payment will be made for special pipe bedding/subgrade replacement due to inadequate dewatering unless specifically approved by the District in advance.

Section F, Open Cut Excavation, Paragraph 2, Underground Structures, Pipe Lines, or Utilities – the following additions apply:

d. Information provided on the project plans regarding existing service lateral locations was obtained from TV Inspection, Tope field survey, RJN field survey and record drawings.

e. It shall be the Contractor's responsibility to locate all service laterals not shown on the plans and to verify the location of the existing service laterals which have been shown on the plans. The Contractor shall reconnect all existing service laterals. No separate payment will be made for locating or verifying the location of existing service laterals.

f. It is not the intent to reconnect any inactive service laterals to the new sewer. The Contractor shall be responsible for determining if a service lateral is either active or inactive. No separate payment shall be made for this work.

g. All existing lateral pipes which are to be disconnected shall be plugged. No separate payment will be made.

h. The Contractor shall obtain and complete a "no cost" reconnection permit for each sanitary sewer lateral reconnection from the District's Permit Section. For projects located in unincorporated St.

Louis County, the Contractor shall also obtain a permit from the St. Louis County Department of Public Works for all private lateral construction required more than five feet from the public sewer. The Contractor shall provide the District with the addresses for all properties for which a permit may be required from the County. The District will provide the Contractor with a letter, identifying the project as a District project, to submit to the County when they submit their permit application.

i. Failure to obtain a "no cost" reconnection permit will result in a non-payment for the wye until a permit is obtained.

Section F, Open Cut Excavation, Paragraph 3, Utilities – the following addition applies:

c. In accordance with Missouri Revised Statutes, Section 319.033, “Public right-of-way, installation within, requirements,” the Contractor shall install a tracer wire and an access point within an enclosure over water lines and cleanouts for gravity storm and sanitary laterals if new lateral sewer pipes or water lines are installed and connected to an underground facility within the public right-of-way or if such infrastructure is fully replaced by excavation within the public right-of-way. The Contractor shall comply with the requirements of the Lat. Tracer Wire detail which is included at the end of the technical specifications.

Section F, Open Cut Excavation, Paragraph 3, Utilities – the following addition applies:

d. Comments the District received from Missouri American Water Company, AmerenUE, Laclede Gas, Charter Communications, City of Saint Louis Water Department, City of Richmond Heights and City of Clayton are attached at the end of the technical project specifications. The Contractor shall comply with all requirements stated.

e. FOR INFORMATION ONLY: a budget of $1,710,000 is planned for potential Utility Relocation.

Section F, Open Cut Excavation, Paragraph 4, Limits of Excavation for Pipe Sewers – the following additions apply:

c. The design of the specified pipe(s) is based on the use of the standard MSD Payline Width as the maximum allowable trench width for each of the pipe diameters and/or classes of pipe indicated.

d. The maximum allowable trench width is the anticipated width required to allow for reasonable working room during pipe

installation, bedding placement and compaction, and backfilling of the trench. If the project plans and specifications require sheeting to be left in place, the maximum allowable trench width does not include the width of the sheeting.

e. If the Contractor's means and methods require a trench width greater than the maximum allowable trench width, the Contractor shall submit design calculations prepared by a licensed professional engineer confirming that the specified pipe has adequate strength. If the calculations indicate that pipe of greater strength is required due to the Contractor's means and methods, no additional payment will be made for providing the higher strength pipe.

Section F, Open Cut Excavation, Paragraph 14, Bracing and Shoring – the following additions apply:

e. A shoring plan is required for the work between centerline A, stations 2+00 through 9+60 and 25+64 through 26+83, centerline C, stations 0+00 through 2+50, centerline D, stations 0+00 to 0+18, and centerline L, stations 1+00 to 0+32. The plan must be sealed by a registered professional engineer, and must be submitted to the District for review prior to start of construction. No more than one pipe length of trench shall be left unshored during the excavation process.

f. The Contractor shall leave shoring for the pipe trench from centerline A, stations 2+00 through 9+60 and 25+64 through 26+83, centerline C, stations 0+00 through 2+50, centerline D, stations 0+00 to 0+18, and centerline L, stations 1+00 to 0+32 in place in the pipe trench.

Section H, Methods of Measurement and Basis of Payment, Paragraph 4, Removal and Replacement of Unsuitable Subgrade – the existing paragraph shall become Subparagraph a, and the following addition applies:

b. Payment for compacted crushed limestone shall be made at the unit bid price for "Crushed Limestone, Unsuitable Subgrade" and shall include all materials and labor required for the installation and compaction of crushed limestone, including the geofabric. When there is no contract unit price for "Crushed Limestone, Unsuitable Subgrade", this work shall be paid for at $60.00 per cubic yard.

Section H, Methods of Measurement and Basis of Payment, Paragraph 6, Payment for Shoring Ordered Left in Place – the existing paragraph shall be deleted and the following additions apply:

a. The cost of furnishing and placing all bracing, sheeting, etc., of any kind, shall be included in the bid prices for the various classes of excavation.

b. Payment will be made for shoring left in place at the bid price per square foot for the bid item “Shoring Left in Place”. The area for which payment will be made will be the measured area between an elevation one foot above the top of pipe to two feet below the ground surface for both faces of the trench, for a length equal to the measured horizontal distance between the vertical planes representing the ends of the installed shoring as placed in the trench. The payments made shall include all costs of labor, materials, tools, and equipment; and shall be full payment for furnishing, placing and removing all bracing, sheeting, etc., of any kind, and furnishing and compacting the granular backfill within the measured area as specified. No payment will be made for any shoring left in place at the election of the Contractor with permission of the Director.

Section H, Methods of Measurement and Basis of Payment, Paragraph 8, Payment for Sanitary House Laterals and Utility Removal and Relocation, Subparagraph c – the existing paragraph shall be deleted and replaced with the following:

c. Payment for removal and relocation of water service connections that are in direct conflict with the new sewer shall be made at the unit bid price per place for “Relocation of Water Services” or “Relocation of Water Service-Lead Pipe” as appropriate according to the existing pipe material, and shall include all materials and labor required for the removal and relocation of the water service. When there is no contract unit price for water service relocation, this work will be paid for at $1700 per place for “Relocation of Water Services” or $1700 per place for “Relocation of Water Service-Lead Pipe” as appropriate for the existing water service pipe material.

Section H, Methods of Measurement and Basis of Payment, Paragraph 8, Payment for Sanitary House Laterals and Utility Removal and Relocation, Subparagraph d – the following correction applies:

The last sentence, concerning pay item “Utility Relocation” being included in the total bid price is deleted. There is no pay item for utility relocation.

Section H, Methods of Measurement and Basis of Payment, Paragraph 8, Payment for Sanitary House Laterals and Utility Removal and Relocation – the following additions apply:

e. Nothing in this Paragraph 8 shall increase the extent of Overhead

High Voltage Power line protection to be paid for by the District. The only payment that will be made is as specified in Part 1, Section F, Paragraph 6.b of these Technical Specifications.

f. All costs for the first 5 feet of 6-inch pipe, cleanouts, tracer wire, and couplings/adapters required to reconnect existing laterals to the new pipes shall be included in one of the pay items for the appropriate size wye. The work shall be done in accordance with applicable local plumbing codes.

g. All costs for extension of any sanitary and storm sewer laterals beyond 5 feet shall be paid for at a rate of the $110 per lineal feet. This cost includes all necessary bends, slants, expansions, adapters, tracer wire, and excavation, but excludes the cost of granular fill, paving replacement, and curb replacement.

h. Connection of the service laterals to the new sewer may be made with the installation of "Inserta-Tee" fitting or approved equal, in addition to approved manufactured "Wye" Fittings.

PART 4 – PIPE SEWER CONSTRUCTION

Section B, Pipe Field Tests, Paragraph 1, General – the following addition applies:

f. All field tests described in Part 4, Section B of the Standard Specifications for sanitary sewers shall also apply to combined sewers.

Section B, Pipe Field Tests, Paragraph 2, Reach Integrity Testing – delete the first sentence and the following replacement applies:

All sanitary and combined sewers shall sustain a maximum leakage limit of 100 gallons/inch of pipe diameter/mile of line/day, as required by the Missouri Department of Natural Resources Specifications.

Section B, Pipe Field Tests, Paragraph 2, Reach Integrity Testing, Subparagraph c, Infiltration/Exfiltration Testing – delete the sixth sentence, concerning leakage limits, and the following replacement applies:

The measurement of leakage shall not exceed 100 gallons/inch of pipe diameter/mile of line/day, as required by the Missouri Department of Natural Resources Specifications.

Section B, Pipe Field Tests, Paragraph 4, Manhole Testing, Subparagraph a, Vacuum Testing – after the first sentence, the following addition applies:

The vacuum test must be performed prior to backfilling around the manhole unless the contractor provides documentation from the precast manhole manufacturer stating that the manhole may be vacuum tested after backfilling has taken place. The contractor must submit this documentation prior to backfilling around any manhole.

Section B, Pipe Field Tests, Paragraph 4, Manhole Testing, Subparagraph b, Exfiltration Testing – delete the second sentence, concerning leakage limits, and the following addition applies:

For exfiltration testing, the allowable leakage limit is 100 gallons/inch of pipe diameter/mile of line/day when the average head on the test section is three feet (3’) or less.

Section C, Bedding, Paragraph 1, Bedding, Cradling, or Encasement Types - the following addition applies:

For flexible pipe 18” in diameter or greater, Standard Detail sheet 6 applies.

Section C, Bedding - the following addition applies:

4. Special Bedding – a minimum 6-inch layer of granular bedding material shall be placed on the trench bottom for support under all pipes in this project.

Section D. Pipe Laying, Paragraph 2. Laying of Pipe – the following addition applies:

c. Rubber O-ring gaskets on concrete pipe shall be “equalized” according to manufacturer’s directions before final assembly of the pipe joint so that the gasket tension is equalized before the joint is driven “home.”

Section G, Structures, Paragraph 7, Setting of Castings, Frames, Fittings, and Steps, Subparagraph d – the following additions apply:

3.) Manhole Cover Seals

(a) General - Sanitary manhole covers on all sanitary manholes that are located in the pavement area shall be sealed with manhole cover gaskets such as those manufactured by Cretex Specialty Products (approved equal) or with gasketed manhole lids as manufactured Neenah Enterprises, Inc., EJ Group, Inc., or Deeter Foundry

4.) Manhole Frame Seals

(a) General - An internal rubber seal shall be installed on all sanitary manholes that are located in the pavement area on this project. A rubber seal extension to cover any additional heights of chimney not covered by the seal itself shall be used as directed by the manufacturer's representative or the District. The internal rubber seals shall be as manufactured by Cretex Specialty Products, or approved equal.

(b) Installation – A flexible rubber mastic sealant shall be used in the joint between the manhole frame and chimney or cone. Detailed installation procedures shall be in accordance with the manufacturer's instructions.

Section H, Trench Backfill, Paragraph 4, Backfill - Flowable Fill – the existing paragraph shall be deleted in its entirety and the following replacement applies:

a. When required by the Project Plans and Specifications or jurisdictional agency, this work shall consist of placing flowable fill

to fill trenches for pipe, structures, culverts, utility cuts, and other work under pavement or as designated on the plans or by the jurisdictional agency. See Part 5, Section G of the Standard Specifications, and any modifications to Part 5 Section G in these Technical Specifications, for information on materials, proportions, and placement.

Section I, Methods of Measurement and Basis of Payment, Paragraph 2, Pipe Sewers – the existing paragraph shall become Subparagraph a, and the following addition applies:

b. Payment made shall include Special Bedding depth.

c. Payment also includes approved connectors for dissimilar pipe materials and all costs for connection of the pipe. When manhole tees are used for manhole structures, the distance between the inside faces shall be excluded from the length of completed pipe sewers for which payment will be made.

Section I, Methods of Measurement and Basis of Payment, Paragraph 2, Pipe Sewers – the existing paragraph shall become Subparagraph a and following addition applies:

d. Payment for concrete pipe shall include all costs for the addition of an antimicrobial additive to the concrete mix unless otherwise specified

Section I, Methods of Measurement and Basis of Payment, Paragraph 4, Tees, Wyes, Bends, Stubs, Etc. – the existing paragraph shall become Subparagraph a and following addition applies:

b. Payment for the check valves shall include all costs and labor for providing and installing the check valve, and shall be paid for under the Pay Item “Check Valve.”

Section I, Methods of Measurement and Basis of Payment, Paragraph 6, Manholes – the following additions apply:

e. Payment for manholes, junction chambers and concrete structures shall include all costs for the addition of an antimicrobial additive to the concrete mix unless otherwise specified.

Section I, Methods of Measurement and Basis of Payment, Paragraph 7, Inlet-Manholes – the following addition applies:

c. Structures 14D, 23D, 24D, 30D, 48D, 49D, and 52D shall each be paid as an Inlet-Manhole for the type of inlet-manhole required by the project plans.

Section I, Methods of Measurement and Basis of Payment, Paragraph 8, Inlets – the existing paragraph shall become Subparagraph a, and the following addition applies:

b. Structures 15D, 17D, 18D, 19D, 20D, 23D, 24D, 31D, 32D, 33D, 34D, 35D, 44D, 45D, 46D, 50D, and 55D shall each be paid as an Inlet for the type of inlet required by the project plans.

PART 7 – TRENCHLESS SEWER CONSTRUCTION

Section O, Methods of Measurement and Basis for Payment – Paragraph 1, General – the following addition applies:

c. Payment will be made for all shafts, bore pits, jacking pits, access pits and take-out pits at the lump sum price for Bid Item “Shafts – Pipe in Tunnel.” The lump sum price shall include all costs for excavation, backfilling, labor, materials, equipment and tools to prepare the shafts, jacking pit, guides, jacks, headings, timbering, drainage, lighting, vents and all other necessary appurtenances to construct the shafts.

d. Within ten (10) days after the Notice to Proceed and before construction begins, the Contractor shall provide as a submittal a shaft location plan and a schedule of values for all shafts, bore pits, jacking pits, access pits and take-out pits that when added together equals the Lump Sum bid price for the Bid Item “Shafts – Pipe in Tunnel”. The schedule of values must be acceptable to the District and will be used as the basis for progress payments less any retainage as specified.

Section O, Methods of Measurement and Basis for Payment, Paragraph 2, Pipe Sewers in Earth Tunnel – delete subparagraph a. in its entirety and replace with the following:

a. Payment will be made for the construction of completed pipe sewers in earth tunnel at the respective bid price for each size and type per lineal foot for the bid item “Pipe in Tunnel”. The length for which payment shall be made shall be the measured horizontal distance for each along the centerline of the pipe exclusive of the distance between the inside faces of each connected structure, sewer, manhole, inlet-manhole, inlet, junction chamber, transition section, or other similar structures. The payments made shall include all costs of grouting, all class “C” excavation pipe in place, testing, jointing, bedding, cradling or encasing and any additional costs required to construct the completed pipe sewer in tunnel in earth. If Class “B” excavation is encountered in earth tunnel, payment will be made for the actual volume of Class B” excavation removed with the payline limits, which shall not extend more than twenty-four inches (24”) beyond the diameter of the pipe bell, or the inside diameter of the tunnel liner, whichever is smaller. The minimum payline limits will be that of a four-foot (4’) diameter casing pipe. Payment will be made at the bid price for “Class “B” Excavation in Tunnel” and will be an additional payment to the payment made for completed Pipe in Tunnel.

Section O, Methods of Measurement and Basis for Payment, Paragraph 3, Pipe Sewers

Installed by Tunnel Bore Method – delete paragraph 3 in its entirety and replace with the following:

3. Pipe Sewers Installed by Tunnel Bore Method.

Payment will be made for the construction of completed pipe sewers installed by the Tunnel Bore Method, by the same method outlined for the payment of pipe sewers in earth tunnel, as delineated in these Technical Project Specifications.

Section O, Methods of Measurement and Basis for Payment, Paragraph 4, Pipe Sewers in Bored Holes delete subparagraph b. in its entirety and replace with the following:

b. Payment for completed pipe sewer in a bored hole where specified by the Project Plans and Specifications, or where ordered by the Director, shall be made at the bid price per lineal foot of completed specified sewer constructed in a bored hole. The length for which payment shall be made shall be the measured horizontal distance for each along the centerline of the pipe exclusive of the distance between the inside faces of each connected structure, sewer, manhole, inlet-manhole, inlet, junction chamber, transition section, or other similar structures. Such payment shall cover all costs of labor, materials, equipment, and tools to bore the hole, install the liner pipe, lay and joint the ductile iron pipe, provide concrete collars at the junctions with other types of pipe, completely fill the annular space around the pipe and do all other things necessary or required for constructing the completed pipe sewer in a bored hole.

Section O, Methods of Measurement and Basis for Payment, Paragraph 5, Pipe Sewers in Jacked Liners – delete paragraph 5 in its entirety and replace with the following:

5. Pipe Sewers in Jacked Liners.

Payment for completed pipe sewer in a jacked liner, where permitted by the Project Plans and Specifications as an alternate to a pipe sewer in tunnel in earth, shall be made at the bid price for the construction method originally specified. The length for which payment shall be made shall be the measured horizontal distance for each along the centerline of the pipe exclusive of the distance between the inside faces of each connected structure, sewer, manhole, inlet-manhole, inlet, junction chamber, transition section, or other similar structures. Such payment shall cover all costs of labor, materials, equipment, and tools for the drainage and excavation; furnishing, jointing, and jacking and doing all things necessary to construct the completed pipe sewer by jacking. Permission to use construction involving a jacked liner shall not entitle the contractor to any compensation for any additional expenses,

or for the costs of an unsuccessful or incomplete attempt to use jacking. When permitted as an alternate to open-cut construction, the method shall be approved by the Director.

Section O, Methods of Measurement and Basis for Payment, Paragraph 6, Pipe Sewers Installed by Jacking – delete paragraph 6 in its entirety and replace with the following:

6. Pipe Sewers Installed by Jacking.

Payment for the construction of pipe sewers installed by jacking at the approved request of the Contractor as an alternate to tunneling, will be made at the bid price for the given size of specified pipe sewer in tunnel, unless an agreed price has been established. The length for which payment shall be made shall be the measured horizontal distance for each along the centerline of the pipe exclusive of the distance between the inside faces of each connected structure, sewer, manhole, inlet-manhole, inlet, junction chamber, transition section, or other similar structures. Such payment shall cover all costs of labor, materials, equipment, and tools for the drainage and excavation; furnishing, jointing, and jacking the pipes; and doing all things necessary to construct the completed pipe sewer by jacking. Permission to install a pipe sewer by jacking instead of the construction originally specified, shall not entitle the Contractor to any compensation for additional expenses, or for the costs of an unsuccessful or an incomplete attempt to use jacking.

Section O, Methods of Measurement and Basis for Payment, Paragraph 8, Pipe Sewers Installed by Microtunneling - delete paragraph 8 in its entirety and replace with the following:

8. Pipe Sewers Installed by Microtunneling.

Payment will be made for the construction of completed pipe sewers installed by the Microtunneling method, by the same method outlined for the payment of pipe sewers in earth tunnel, as delineated in these Technical Project Specifications.

Section O, Methods of Measurement and Basis for Payment, Paragraph 9, Pipe Sewers Installed by Directional Drilling – delete subparagraph b. in its entirety and replace with the following:

b. Payment for completed pipe sewer in a directional bored hole where specified by the Project Plans and Specifications, or where ordered by the director, shall be made at the bid price per linear foot of completed specified sewer constructed in a drilled hole. The length for which payment shall be made shall be the measured horizontal distance for each along the centerline of the pipe exclusive of the distance between the inside faces of each

connected structure, sewer, manhole, inlet-manhole, inlet, junction chamber, transition section, or other similar structures. Such payment shall cover all costs of labor, materials, equipment and tools to install the pipe, handle and dispose of drilling fluid and material removed, completely fill the annular space around the pipe if greater than ½ inch, connecting pipe at junctions with other pipe or structures, and do all other things necessary or required for constructing the completed pipe in a directionally drilled hole.

Section O, Methods of Measurement and Basis For Payment, Paragraph 12, Pipe Sewers Installed Using Trenchless Methods – delete subparagraph a. in its entirety and replace with the following:

a. Payment for the construction of pipe sewers installed by trenchless methods price will be at the respective bid price for each size and type per lineal foot. The length for which payment shall be made shall be the measured horizontal distance for each along the centerline of the pipe exclusive of the distance between the inside faces of each connected structure, sewer, manhole, inlet-manhole, inlet, junction chamber, transition section, or other similar structures. . When permitted as an alternate to open-cut construction of tunnel, the method of payment shall be approved by the Director. Permission to install a pipe sewer by trenchless methods instead of the construction originally specified shall not entitle the Contractor to any compensation for any additional expenses or for the costs of an unsuccessful attempt.

PART 8 – PROTECTION AND RESTORATION OF SITE

Section A, Contractor Responsibility, Paragraph 1 – the existing paragraph shall become Subparagraph a, and the following addition applies:

b. The Contractor shall take additional steps to preserve and protect trees as indicated on the Project Plans.

1) The Contractor shall retain a Certified Arborist or other reputable licensed horticultural professional with experience in tree preservation (Arborist) to evaluate the impact construction will have on the trees labeled for Arborist-defined Tree Protection (ATP), outline required tree protection measures and observe implementation of same.

2) A report of this evaluation, including identification of trees depicted for removal on the plans that do not need to be or identified for protection on the plans that will not have a reasonable likelihood of survival, shall be submitted to the District prior to construction.

3) For purposes of this project, the critical root zone (CRZ) of a tree will be considered to be 1.5 times the diameter of the tree at breast height, with the diameter of the tree in inches and the CRZ in feet.

4) As a minimum, the Contractor shall install temporary fencing along the drip line, or CRZ, whichever is larger, of trees to be protected. No equipment, construction materials, spoils, fill nor debris shall be located within these areas. Existing fences that provide the same function may be utilized in lieu of temporary fence. The Arborist shall make recommendations for handling locations where protected areas overlap trench limits.

5) As a minimum, unless preferred methods are recommended by the Arborist, prior to excavation the Contractor shall root prune along the pay line of trenches within the CRZ of trees to be protected in order to minimize damage to tree roots in that area. Root pruning shall be performed by means and methods acceptable to the Arborist. Roots shall be clean cut; under no circumstances, shall the Contractor rip or tear tree roots.

6) The Contractor shall protect the limbs of trees. Any limbs in the area required for operation of construction

equipment shall be pruned in advance of the work. Any identified dying or broken branches should be removed to reduce safety hazards. Branches shall be pruned to an adjacent live lateral branch. No stubs may be left on the tree.

7) Upon completion of the work, the Arborist shall provide a signed and dated letter, on company letterhead, indicating that the tree protection activities were done under his/her supervision, to his/her satisfaction, and will give the affected trees the best chance of survival.

8) All costs associated with evaluation, performance of required work, and reporting on same shall be included in pay item Protection and Restoration of Site.

Section A, Contractor Responsibility – the following additions apply:

3. The Contractor has no working room outside of the temporary construction easements depicted adjacent to new easements.

4. The Contractor may make agreements with property owners for additional working room or access. The District shall be furnished with a copy of each agreement. All costs for agreements or arrangements shall be included in the Pay Item "Protection and Restoration of Site."

5. The Contractor shall be responsible for notifying property owners at least 7 days, but not more than 14 days, in advance of the work.

   a. All properties adjacent to the project alignment shall be notified of the project within 14 calendar days after Notice To Proceed. The letter included at the end of the Technical Specifications shall be mailed to each property. Provide the District with a list of addresses who were sent the notification.

   b. The letter shall indicate a contact person and telephone number for your company.

   c. All properties owners whose house laterals need to be rerouted shall receive a special written notification in advance of the lateral rerouting a minimum of 7 days prior.

6. Sequential Restoration shall be required for this project. (NOTE: MSD and ENGINEER ARE STILL DISCUSSING RESTORATION WITH MUNICIPALITIES. WILL UPDATE IN FUTURE)

   a. The Contractor shall begin site restoration upon substantial

completion, as determined by the District, of any of the reaches defined in the restoration schedule below, and complete the restoration work for this reach within the time allotted in the restoration schedule. Special consideration shall be given to property owners who have to have their laterals rerouted.

b. This restoration shall include, but is not limited to, such items as sodding, replacement of sidewalks, fences, driveways, and street pavement, grouting of sewer scheduled to be abandoned, and any items required as part of any special agreements.

c. Any restoration work damaged or destroyed by the Contractor's subsequent work shall be replaced by the Contractor at his expense. No additional payment shall be made for sequential restoration.

d. If the Contractor exceeds the time of restoration on any reach of pipe, he may be directed to stop work on all other operations until the restoration for that reach is completed.

RESTORATION SCHEDULE			
REACH	DOWNSTREAM STATION	UPSTREAM STATION	RESTORATION COMPLETION TIME (DAYS)
#1	TBD	TBD	TBD
#2			
#3			
#4			

(NOTE: MSD and ENGINEER ARE STILL DISCUSSING RESTORATION WITH MUNICIPALITIES. WILL UPDATE TABLEIN FUTURE)

7. The Contractor shall comply with all the requirements of the Missouri Department of Transportation, St. Louis County Department of Transportation, the City of Richmond Heights and/or the City of Clayton, which are included at the end of these technical specifications. Contractor shall submit traffic control plan to Owner and Engineer for review prior to starting any work.

8. The Contractor shall comply with all the requirements of the Missouri Department of Transportation.

9. It is anticipated that a lane closure on a State maintained route will not be required as a part of this project

10. If the Contractor determines that shoulder work is required, the Contractor is responsible for contacting MoDOT's Work Zone Coordinator Jim Connell (314-565-6717). A copy of the MoDOT St. Louis District Work Zone Coordination Program can be found under Section 616.2.5 of the Engineering Policy Guide (EPG) at http://epg.modot.org/. The Contractor shall comply with this plan in performance of the work. A plan must be prepared for any proposed lane or shoulder closure on a state maintained roadway and the plan must be in compliance with the latest MoDOT Typical Applications (TA's) found in the EPG under MoDOT Traffic Control for Field Operations 616.2.3 at http://epg.modot.mo.gov/index.php?title=616.23_Traffic_Control_for_Field_Operations

11. A copy of the MoDOT Permit and Lane Closure Approval must accompany the Contractor or his crew at all times. If the contractor cannot produce documents upon request, the work zone is subject to immediate removal.

12. All costs for complying with these provisions shall be included in the Pay Item "Protection and Restoration of Site."

13. Property Damage (Structure Condition) Survey

    a. The Contractor shall conduct interior and exterior condition inspection of the properties and structures at the locations listed below prior to the start of, during, and after the completion of excavation and/or tunneling.
        1) 1042 Terrace Drive
        2) 1050 Terrace Drive

    b. Pre-Construction

        1) Prior to beginning the work under this section, request in writing from each property owner permission to conduct the inspection and condition survey. Include a proposed schedule for the inspection and condition survey. Request that the property owner return a signed and dated Contractor pre-printed acknowledgement giving permission to the Contractor to conduct the inspection and condition survey.

        2) In the event that a property owner denies access for the inspection and condition survey, the Contractor shall notify such property owner, by certified mail, on the intent of the survey. If after two (2) weeks access is still denied, the District, upon review of the submitted correspondence may waive the requirement for conducting the inspection

and condition survey at that location.

3) The pre-construction inspection and condition surveys shall produce baseline documentation for comparison against future inspections and condition surveys.

4) The building exteriors, property and environs shall be observed. The exterior condition of, but not limited to, all structures, sidewalks, curbing, pavements, landscaping features, miscellaneous site improvements, and so forth shall be surveyed. Defects such as, but not limited to, evidence of cracking, damage, discoloration, drainage, ponding and so forth shall be documented. Any existing cracks shall be located, measured and recorded at the time of inspection. All existing deficiencies, major or minor, shall be documented. Documentation in the form of digital photographs with a written detailed log of each photograph and narrated video shall be produced. Any supplementary notes, sketches, or diagrams voluntarily produced at the contractors' discretion shall be submitted.

5) Structure interiors including the basement shall be observed. Defects such as, but not limited to, evidence of cracking, damage, discoloration, water intrusion, basement flooding and so forth shall be documented. Any existing cracks shall be located, measured and recorded at the time of inspection. All existing structural deficiencies, major or minor, shall be documented. Documentation in the form of digital photographs with a written detailed log of each photograph and narrated video shall be produced. Any supplementary notes, sketches, diagrams of all walls, partitions, floors and ceilings, voluntarily produced at the contractors' discretion shall be submitted.

6) One calendar week prior to the start of construction, the Contractor shall prepare and deliver to the District two (2) bound copies of the pre-construction inspection and condition survey containing all field notes taken, sketches and diagrams prepared, photographs obtained, digital photographs and/or digital video obtained.

c. During Construction

1) As construction progresses, the Contractor shall re-inspect and conduct a condition survey, in a manner that duplicates the pre-construction inspection, as often as the

Contractor deems necessary to verify the adequacy of the construction methods for prevention of damage and to obtain sufficient evidence for use in defense against possible claims of damage from third parties.

2) Cracks and/or structural damage documented before the start of construction shall be monitored during construction for movement or additional distress.

3) One calendar week after completion of an interim inspection and condition survey, the Contractor shall prepare and deliver to the District two (2) bound copies of an inspection and condition survey report containing all field notes taken, sketches and diagrams prepared, photographs obtained, digital photographs and/or digital video obtained.

d. Post-Construction

1) Prior to completion of sequential restoration for the reach to which this section applies, in a manner that duplicates the pre-construction inspection, the Contractor shall re-inspect and conduct a condition survey.

2) One calendar week after completion of an inspection and condition survey, the Contractor shall prepare and deliver to the District two (2) bound copies of the post-construction inspection and condition survey report containing digital photographs and digital video obtained. Any supplementary notes, sketches, diagrams, voluntarily produced at the contractors' discretion shall be submitted. The results of the post-construction inspection and condition survey shall be compared to the results of the pre-construction inspection and condition survey. Specific similarities and differences shall be noted in the report.

e. Condition Survey Inspector Qualifications

1) Qualified specialists, subject to review by the District, shall perform the inspections and condition surveys.

f. Photograph Requirements

1) Digital photographic images shall be stored on a DVD.

g. Video Requirements

1) Analog format video recordings on VHS tape will not be acceptable.

2) Digital format video recordings shall be stored on a DVD and viewable by standard video software such as Windows Media Player or equal.

3) Submit digital files of the original CCTV inspections to the District; a summary index sheet shall be included with the submittal.

4) Ensure that the entire inspection of a particular condition survey is contained in a single recording.

h. Certifications

1) All copies of the pre-construction, interim, and post-construction inspection and condition survey reports shall be signed and dated by those taking part in the inspection. The execution of the reports shall be documented by an independent witness, such as a District representative or property owner.

i. Nothing contained herein shall relieve the Contractor of responsibility for claims arising from the Contractor's construction operations. Neither failure to inspect any structure, whether or not required under this section, nor the inadequacy of the inspections performed, shall relieve the Contractor of its responsibility.

Section B, Land Disturbance Activity – the content of the existing section shall be deleted in its entirety and the following replacement applies:

The Contractor shall install and maintain adequate sediment and erosion controls to prevent soil erosion and/or deposition of materials off-site in order to protect neighboring properties, downstream drainage facilities, and waterways.

Designation of Subparagraph c is deleted and verbiage following it shall be treated as a continuation of Subparagraph b.

Under Subparagraph b (as corrected from c) – the following additions apply:

10.) Site boundaries and outfalls marked on a site map. An aerial/contour map will be provided by the District, upon request by the Contractor.

11.) A copy of the District's permit and a SWPPP check list are included at the end of the technical project specifications.

The Contractor's SWPPP and activities shall comply with the requirements of the permit and SWPPP check list.

Subparagraphs c and d are added as follows:

c. A minimum of three (3) copies of the SWPPP shall be submitted to the District.

d. The SWPPP Check List attached at the end of these specifications is to be completed and signed by the Contractor, and submitted with the SWPPP.

Section B, Land Disturbance Activity, Paragraph 2, Item 5, Subparagraph b – the following addition applies:

Additional resources are available at the USEPA internet site, http://cfpub.epa.gov/npdes/stormwater/swppp.cfm https://www.epa.gov/npdes/developing-stormwater-pollution-prevention-plan-swppp.

Section B, Land Disturbance Activity – the following additions apply:

The Contractor may be required by MDNR to sample and report as a result of illegal discharges, compliance issues, complaint investigations, or other such evidence of contamination from construction activities on the project site. Settable solids from a stormwater outfall shall not exceed 2.5 ml/L per Standard Method 2540 F for storm events up to but not exceeding the local 2-year, 24-hour storm. Upon request by the District, the Contractor shall obtain a split sample. One sample shall be sent to a testing lab, and the other sample given to the District. The Contractor, at his cost, shall use a testing lab approved by the District.

6. The Contractor shall be subject to the same enforcement action that is imposed on the District, by the state, due to violation of the permit.

Section C, Agreements with Property Owners – the existing paragraph shall become Paragraph 1, and the following additions apply:

2. The Contractor shall comply with the following agreements regarding site access as stated below that were made with .

3. The Contractor shall comply with the following agreements as stated below:

(NOTE: THIS SECTION WILL BE UPDATED IN FUTURE, AFTER NEGTIATIONS WITH PROPERTY OWNERS)

Section E, Fences,– the following additions apply:

4. Temporary fencing shall be placed on the following properties: _____, _____, _____ and _____.

(NOTE: THIS SECTION WILL BE UPDATED IN FUTURE, AFTER NEGTIATIONS WITH PROPERTY OWNERS)Section G, Seeding – the following correction applies:

The designation of a second paragraph is deleted and the verbiage of paragraph 2 is treated as a continuation of paragraph 1.

Section H, Approval and Payment – the following additions apply:

6. Trees and Landscaping

7. Payment for the Structure Condition Surveys will be included in the Pay Item “Protection and Restoration of Site”.

8. Payment for “Modular Block Wall” will be made at the bid price per square foot of front face of wall as computed from the contract documents. The front face area shall extend from the top of the cap unit to the bottom of the base unit. Payment will include all costs of Class “C” excavation, footings, geotextile fabric, geogrid, granular backfill, compaction of granular backfill, drain tile, fencing, and roof/yard drain extension, complete.

Section J, Modular Block Wall – The following addition applies

1. General

   a. Work includes designing, furnishing and installing solid precast modular blocks (PMB) or approved equal to the lines and grades shown on the plans and as specified herein. Also included are excavation for the wall, compaction of backfill, extension of the existing roof/yard drains, installation of toe drains, furnishing and installing appurtenant materials required for construction of the complete system.

   b. The contractor shall provide to the District a retaining wall design (Wall Design) and shop drawings, signed and sealed by a Registered Professional Engineer in the State of Missouri. There shall be no additional cost to the District for providing said design and shop drawings. No work shall be commenced prior to written approval of said design and shop drawings by the District.

   c. The design shall conform to the requirements of the St. Louis County Department of Public Works Division of Code Enforcement: Residential

Retaining Walls Building Permit Requirements.

d. The retaining wall design and shop drawings shall incorporate the requirements shown on the Project Plans and in these specifications.

2. Materials

a. Wall Unit
   1.) Precast modular blocks shall be a solid block style similar to style, size, and color as existing wall. Modular block systems with planting pockets shall not be used.

b. Geogrid
   1.) If geogrid reinforcement is required as a part of the design and construction of precast modular block wall, it shall be as detailed in the shop drawings submitted and approved by the District. If geogrid reinforcement is required, the contractor shall submit the material test data with the design and shop drawings for review by the District.

c. Backfill

   1.) The top 8” of backfill shall consist of good topsoil.

   2.) If granular backfill is used, it shall consist of clean aggregate meeting the following gradation:

US Standard Sieve Size	Percent Passing
3/4"	100
#200	0-5

   3.) MSD Type 1 bedding is an acceptable substitute for the above granular backfill gradation.

   4.) If granular backfill is used, an 18” cap of soil shall be placed on top of the granular backfill.

d. Drain Tile
   1.) Drain tile shall be used. The drain tile should be perforated or slotted PVC or corrugated HDPE pipe. The drain shall be 6” minimum in a sock. The drain tile should be day-lighted at low points and/or periodically along the wall alignment with a 50 foot maximum spacing on outlets.

   2.) Drain tile outfalls shall outfall a minimum of 1 ft above the channel toe of slope.

e. Geotextile Fabric
   1.) Provide a geotextile filter for separation from backfill at the tails of the blocks and at rock/soil interfaces.

f. Roof/yard Drains

1.) Roof/Yard Drain extensions shall be Schedule 40 PVC or equal as approved by the District. The pipe diameter shall match the existing pipe size.

2. Construction Requirement

a. General

1.) Contractor shall construct the modular block wall per the manufacturer's recommendations.

b. Leveling Pad

1.) The Contractor shall be responsible for determining the suitability of the soil conditions. The contractor shall be responsible for the design and construction of the leveling pad required to accommodate the design loads and the soil conditions.

c. Wall Backfill

1.) The gradation, placement, and compaction of the granular wall backfill ("Granular Backfill') shall be in compliance with the Wall Design as defined above.

2.) Geofabric shall be placed in compliance with the Wall Design

3.) Geogrid shall be place in compliance with the Wall Design

d. Roof/Yard Drain Extension

1.) The existing roof/yard drains shall be extended through the proposed retaining wall. The roof/yard drains shall not be connected to the drain tile system.

2.) Where required, pipe extensions shall be incorporated in accordance with the manufacturer's recommendations.

e. Fencing

1.) The existing fencing along the top of modular wall shall be replaced with fencing of similar material and design as existing.

2. PART 9 – MISCELLANEOUS

3. Section D, Removal and Replacement of Pavements and Roadway Wearing Surfaces, Paragraph 4, Asphaltic Concrete Street Pavement, - Subparagraph b shall be deleted in its entirety and the following replacement applies:

    b. Payment will be made for the asphaltic concrete at the bid price per square yard for "Street Pavement – Asphaltic Concrete Removal and Replacement" for the area replaced, which shall not extend beyond two (2) feet each side of the standard payline width of excavation for sewers, manholes and other structures, and shall exclude inlet sumps and curbing. Such payments shall include costs of labor, equipment, primer, saw cutting, and asphaltic concrete required for removing and replacing the completed base and pavement surface.

4. Section D, Removal and Replacement of Pavements and Roadway Wearing Surfaces, Paragraph 5, Rigid Base Pavements, Subparagraph b – subparagraph 1 shall be deleted in its entirety and the following replacement applies:

    1.) Payment will be made for the concrete pavement removed and replaced at the bid price per square yard for "Street Pavement – Concrete Removal and Replacement". The area for which removal and payment will be made shall be full slab from joint-to-joint or edge of pavement, for any disturbed slab located within the payline width for excavation of sewers, manholes and structures, excluding the area for inlet sumps and curbing.

5. Section D, Removal and Replacement of Pavements and Roadway Wearing Surfaces, Paragraph 6, Sidewalks and Driveways, Subparagraph b, Item 1 – the first sentence is deleted in its entirety and the following replacement applies:

Payment will be made at the bid price per square yard for "Sidewalks & Driveways Concrete – Rem. and Rep.".

6. Section D, Removal and Replacement of Pavements and Roadway Wearing Surfaces, Paragraph 6, Sidewalks and Driveways, Subparagraph c, Item 1 – the first sentence is deleted in its entirety and the following replacement applies:

Payment will be made at the bid price per square yard for "Driveways – Asphaltic Concrete".

7. Section D, Removal and Replacement of Pavements and Roadway Wearing

Surfaces, Paragraph 6, Sidewalks and Driveways – the following additions apply:

e. All driveways in the City of Richmond Heights and the City of Clayton right-of-way shall be replaced with pavement similar in material to that removed. Replacement shall be equal to or greater than the thickness of the pavement removed, but not less than 6" thick.

Section D, Removal and Replacement of Pavements and Roadway Wearing Surfaces, Paragraph 8, ADA Access Ramps, Subparagraph a – the last sentence and the word "Two" before it are deleted in their entirety and the following replacement applies:

Two ramps may be required if the inlet is in the rounding.

Section G, Signs – delete existing Paragraph, and replace with following:

1. When required by the Project Specifications, the Contractor shall furnish a sign at each of the major work locations to inform the public of the work under construction. The sign layout shall conform to the SIGNS detail included at the end of the Technical Specifications. The "Project Type" and "Estimated Value $" information to use will be provided by the District with the Notice to Proceed documentation. The sign(s) shall be located as approved by the District and maintained in a neat and orderly condition. No additional payment will be made for the required sign(s).

2. The Contractor shall furnish (1) new sign(s).

Section H, Removal of Interceptor.

1. Payment for the removal of interceptor will be at the lump sum bid price for "Removal of Interceptor", and shall include all cost for labor, equipment, and material for removal of the weir, grout fill trough to structure invert at structure 20K2-063C and plug existing 12" DIP from interceptor structure to existing MH 20K2-119S as indicated on plans.

SECTION P REMOVAL OF INFLOW SOURCES is added as follows:

1. General

a. This work consists of supplying all materials, labor and equipment necessary to complete removal of private inflow sources from the sanitary sewer as described on each Site Exhibit including but not limited to, replacement of pavement, retaining walls, and sodding, in kind, to equal or better condition, for TBD properties. The Site Exhibits are attached at the end of the Technical Specifications in Attachments C and C-1.

b. Contractor shall start work immediately on properties included on Site Exhibit No. TBD through No. TBD in Attachment C per the specification requirements

c. Contractor shall NOT start work on any properties included on Site Exhibit No. TBD through No. TBD in Attachment C-1 until written notification to proceed with work on these properties is provided by the District. Contractor shall not enter any of these properties in Attachment C-1 for inspections or evaluations until directed and approved in writing by the District.

d. Contractor shall make provisions in the schedule and sequence of work for properties in Attachment C and C-1 appropriately.

e. Contractors are required to bid on every site and item in the bid package. If a Contractor does not bid on all sites, the total bid package will be rejected as “non-responsive.”

f. When work is started on a site, the Contractor has 7 days to complete work on that site.

g. All homeowners/tenants shall be notified of work on their property no later than seven (7) calendar days prior to the actual commencement of construction on their property. The contractor shall send a homeowner notification letter to each private property included in the project. A copy of the notification letter is attached at the end of the Technical Specifications. Any interior work done on private property must be coordinated with the property owner in advance to obtain access.

h. Any Contractor performing plumbing work on private property must have appropriate licenses and permits as required by the local jurisdiction and Metropolitan St. Louis Sewer District.

i. The Contractor is responsible for obtaining all permits and paying all Permit Fees. The Contractor shall submit a copy of all permits to the MSD inspector.

j. The Contractor shall inspect all vented cleanouts and drains proposed for solid caps or plugs before proceeding with any improvement work. The Contractor shall determine from the inspection if the vented cleanout or drain is the air vent and/or master trap for the building. After approval from the MSD inspector any cleanouts or drains that are the building vent and/or master trap shall not be capped or plugged, but shall be raised per the contract documents. Costs for work to be completed may require a

field change.

k. For sites that require new MSD storm sewer, the Contractor shall not begin work on that site until the storm sewer required for connection has been completed and accepted by the District.

l. Prior to the start of construction on any site, the Contractor shall take photographs of existing conditions and provide a copy of the photographs to the District.

m. The Contractor shall obtain and complete a “no cost” reconnection permit for each storm lateral pipe reconnection from the District’s Permit Section.

2. Private Drain Disconnects

a. Materials

1.) Cleanout cap must be solid (no vent holes), opening to 90 degrees, if hinged. Cap to be PVC in grassy areas, heavy duty cast iron in vehicular pavement areas and light duty cast iron in sidewalk areas.

2.) Cleanout top section to be of SDR-35 PVC. For cleanout connection, use Elastomeric Coupler with clamps. If grade is 20% or greater, use stainless steel shielded Elastomeric Coupler. Construct in accordance with the cleanout detail, which is attached at the end of the Technical Specifications.

3.) Pipe plugs shall be ETCO Expandable Pipe Plugs, ETCO T Cone Expandable Pipe Plugs or approved equal.

4.) Pipe conforming to the following requirements shall be used for underground drainage of downspouts, driveway drains, etc:

i. ASTM D3034 Standard Specifications for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings, SDR 35. Joints and jointing material shall conform to ASTM D3212 Standard Specifications for Joints for Drain and Sewer Plastic Pipes using Flexible Elastomeric Seals.

ii. ASTM D2729 Standard Specification for Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings, Schedule 40. Joints and jointing material shall conform to ASTM D2855 Standard Practice for Making Solvent-Cement Joints with Poly(Vinyl Chloride) (PVC) Pipe

and Fittings.

iii. Fittings shall be of the same material and strength requirements of the pipe as well as monolithic in construction.

5.) Black corrugated piping for surface drainage shall have a smooth interior and annular exterior corrugations and shall conform to the requirements of ASTM F2648 Standard Specifications for 2 to 60 inch Annular Corrugated Profile Wall Polyethylene (PE) Pipe and Fittings for Land Drainage Applications. Fittings shall be of the same material and strength requirements of the pipe. Pipe shall be joined using a bell and spigot joint meeting ASTM F2648.

6.) If draining to the street, an approved curb opening must be used, as is requested by the City of Clayton or Richmond Heights. Variances may be required.

7.) Replacement gutters should be of same material as those they are replacing.

8.) When replacing concrete or asphalt, new material must blend with the existing surrounding material, and thickness of new concrete or asphalt shall match existing material. Asphalt pavement shall be saw-cut and replaced the trench width and length required to be removed for construction, unless otherwise noted. Concrete pavement shall be replaced joint-to-joint of each section required to be removed for construction.

9.) All lawn areas disturbed by construction shown on the site exhibit shall be replaced with sod. Replace zoysia areas with zoysia sod. All other lawn areas shall be replaced with bluegrass sod, unless noted otherwise on the site exhibit or these Technical Specifications.

10.) Connection of storm laterals to the storm sewer main may be made through the installation of “Inserta-Tee,” “Fernco QwikSeal,” or approved equal taps, in addition to approved manufactured “wye” or “tee” fittings.

11.) All other materials supplied shall comply with the provisions of the Standard Construction Specifications of the Metropolitan St. Louis Sewer District, dated 2009.

b. Downspout Disconnection

1.) Downspouts shall be disconnected as indicated on the

various Site Exhibits, and in accordance with the following descriptions of work for each item listed on the exhibit:

2.) Disconnect downspout from boot - Cut downspout a few inches above the boot, making sure there is enough room for the new downspout material "elbow" or other end of pipe device. Orient elbow to direct storm water away from existing building and in the direction of drainage.

3.) Remove the boot - Cut below grade, removing any sharp edges. Patch area with surrounding material (i.e. grass, concrete, asphalt).

4.) Seal the boot - Seal the existing downspout pipe below grade with grout or other material that makes a permanent, weatherproof seal. Smooth the top surface.

5.) Downspout "T" cleanout and plug - Use rectangular to round PVC coupler to connect existing downspout to a 45 degree PVC tee with screw type cleanout plug.

6.) Downspout leaders, elbows, and fittings shall match existing color, size, material, and type of existing downspouts and guttering.

3. Sump Pump Discharges

a. All work shall comply with St. Louis County and/or the City of Clayton or Richmond Heights requirements and applicable plumbing codes.

b. Materials

1.) PVC Pipe and Fittings

i. Sump pump discharge piping and appurtenances shall comply with applicable plumbing codes.

ii. All other materials supplied shall comply with the latest version of the Standard Construction Specifications of the Metropolitan St. Louis Sewer District.

c. Removal of existing connections between sump pump and the sanitary sewer system.

1.) Existing sanitary sewer Services to Remain: Maintain

services which will remain and protect them against damage.

2.) Existing sanitary sewer connections To Be Removed or Relocated: Locate, identify, disconnect, and seal or cap off sump pump to sanitary sewer connections as required.

3.) Disconnect, demolish, and remove existing connection between the sump pump and the sanitary sewer.

4.) Piping to Be Removed: Remove as much as possible of the existing; and cap, repair or plug remaining piping with same or compatible piping material.

d. Piping Installation

1.) Site Exhibits indicate general location and alignment of piping systems. Install piping as required to generally discharge sump pumps to grade in the approximate locations show.

2.) Install piping indicated to be exposed at right angles or parallel to building walls. Diagonal runs are prohibited.

3.) Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

4.) Install piping to permit valve servicing.

5.) Install piping at slopes required by plumbing code.

6.) Install piping free of sags and bends.

7.) Install fittings for changes in direction and branch connections.

8.) Make changes in direction for storm drainage piping using appropriate branches, bends, and long-sweep bends. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

9.) Lay buried building storm drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab

in piping and pull past each joint as completed.

10.) Install gravity storm drainage piping at the following minimum slopes unless otherwise approved:

i. Sump pump Drains: 2 percent downward in direction of flow for piping NPS 3” and smaller.

ii. Sump pump Drains: 1 percent downward in direction of flow for piping NPS 4” and larger.

11.) Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

12.) Install sleeves for piping penetrations of walls, ceilings, and floors.

i. Galvanized-Steel Wall Pipes: ASTM A53/A53M, Schedule 40, with plain ends and welded steel collar; zinc coated.

ii. Galvanized-Steel Pipe Sleeves: ASTM A53/A53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.

iii. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.

13.) Install sleeve seals for piping penetrations of concrete walls and slabs. Subject to compliance with plumbing codes, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

(a.) Advance Products & Systems, Inc.

(b.) CALPICO, Inc.

(c.) Metraflex Company (The)

(d.) Pipeline Seal and Insulator, Inc.

e. Field Quality Control

1.) During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.

i. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in.

ii. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

2.) Re-inspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for re-inspection.

3.) Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

4.) Test sump pump discharge piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

i. Leave uncovered and unconcealed new, altered, extended, or replaced force-main piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.

ii. Cap and subject piping to static-water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.

iii. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.

iv. Prepare reports for tests and required corrective action.

f. Cleaning

1.) Clean interior of piping. Remove dirt and debris as work progresses.

2.) Place plugs in ends of uncompleted piping at end of day and when work stops

4. Measurement and Payment

a. The work will not be measured for payment. No separate payment will be made for any work involved for the TBD, even when there is a bid item for such work. All work will be paid for at the lump sum price per each “Site”.

b. The lump sum for each “Site” will include the cost for that Site as identified in Attachments C and C-1 of the Contract Documents. Each PIR Site Exhibit sheet describes a “Site.” Payment for each “Site” will include all labor, materials, permits, inspections, and restoration to complete the Site as specified and as shown on the Exhibits. All work on a “Site” shall be completed before including on a pay application request.

c. Connections to the storm sewer main and corresponding storm sewer laterals shall be included at the lump sum price for each respective site.

SECTION J MANHOLE REHABILITATION

1. General.

a. The Contractor shall replace the existing manholes with slotted covers with solid covers at the locations listed below.

1.) TBD

b. When excavation in pavements is required, removal and restoration of the pavements shall be as specified by the municipality or agency with jurisdiction.

2. Submittals.

a. The Contractor shall provide a minimum of three copies of each shop drawing, material certification, or manufacturer's literature for review and approval by the District prior to the start of Work. The Contractor shall be required to provide submittals for all materials to be incorporated in the project.

b. The District shall review and approve all materials before the work begins. The District may approve substitution of materials, requested by the Contractor.

3. Install New Manhole Cover.

a. The work includes installing a new cover seal and locking cover, and cleaning the existing frame. The existing frame shall be cleaned with high pressure water blasting with a minimum of 3500 psi. If needed, the casting shall be ground to remove any debris or frame material that prevents proper seating of the cover in the frame.

b. Unit bid price for Pay Item "Install Manhole Covers (Only)" shall include total costs for removing and disposing of the existing manhole cover and installing new cover seal and locking cover, and for furnishing all labor, materials, equipment, and all necessary incidentals needed to complete the work.

CONTRACTOR LETTERHEAD

Date: _____

RE: _____

Contract No. _____

Dear Property Owner or Resident:

Our Company has been selected by the Metropolitan St. Louis Sewer District to construct the above referenced sewer project that may be on, adjacent to, or abutting your property.

This letter is to inform you that construction on this sewer project will begin in the near future. We suggest that you remove any trees, shrubs or improvements located in the permanent easement that you wish to save prior to the start of construction. Also, if you have any underground improvements, such as sprinkler systems or invisible fences for dogs, we would appreciate you contacting us.

Contact_____ with our company at _____-_____-_____ if you have questions concerning the construction activity planned on your property. For after hour's emergency information, please contact the Metropolitan St. Louis Sewer District Customer Service Department at (314)768-6260.

Sincerely,

(COMPANY NAME)

_____
Project Manager

ATTACHMENT E:

MUNICIPALITY AGREEMENTS

INTERGOVERNMENTAL RECIPROCITY AGREEMENT
ESTABLISHING THE MUTUAL WAIVER OF FEES

WHEREAS, the Metropolitan St. Louis Sewer District ("MSD") values the relationship it has built with other governmental entities, and intends to comply with all relevant governmental ordinances;

WHEREAS, MSD appreciates that, as governmental entities, both MSD and The City of Clayton are political subdivisions of the State of Missouri, and that both are clothed with sovereign immunity;

WHEREAS, MSD recognizes that it is in the best interest of the public that additional fees not be imposed upon governmental entities, including MSD, when such entities undertake repairs, maintenance or new construction:

NOW, THEREFORE, the parties agree as follows:

1. Neither MSD nor The City of Clayton shall charge the other party to this Agreement plan review, inspection or permit fees or building fees for projects that involve repairs, maintenance or new construction;

2. This Agreement does not affect the applicability of sewer connection fees and Caulks Creek or Williams Creek impact fees which are necessary to join new or existing facilities to MSD's system of sewers.

WHEREFORE, the Parties have hereto set their hands on the dates noted below.

Brian Hucker

Metropolitan St. Louis Sewer District — Dated: 11/20/2007
Director of Engineering

Mark A. Schwartz — Title: City Manager

Name of Governmental Entity — Dated: 11/14/07
City of Clayton

INTERGOVERNMENTAL RECIPROCITY AGREEMENT ESTABLISHING THE MUTUAL WAIVER OF FEES

WHEREAS, the Metropolitan St. Louis Sewer District ("MSD") values the relationship it has built with other governmental entities, and intends to comply with all relevant governmental ordinances;

WHEREAS, MSD appreciates that, as governmental entities, both MSD and the CITY OF RICHMOND HEIGHTS are political subdivisions of the State of Missouri, and that both are clothed with sovereign immunity;

WHEREAS, MSD recognizes that it is in the best interest of the public that additional fees not be imposed upon governmental entities, including MSD, when such entities undertake repairs, maintenance or new construction;

NOW, THEREFORE, the parties agree as follows:

1. Neither MSD nor RICHMOND HEIGHTS shall charge the other party to this Agreement plan review, inspection or permit fees or building fees for projects that involve repairs, maintenance or new construction;

2. This Agreement does not affect the applicability of sewer connection fees and Caulks Creek or Williams Creek impact fees which are necessary to join new or existing facilities to MSD's system of sewers.

3. This agreement also will require MSD to notified the CITY OF RICHMOND HEIGHTS PUBLIC WORKS DEPARTMENT a minimum of 7days prior to the start of planned projects. In the case of emergency repair, MSD will notify the city within 24 hrs.

WHEREFORE, the Parties have hereto set their hands on the dates noted below.

Metropolitan St. Louis Sewer District Dated: 7/14/2008
Director of Engineering

Mayor, Dated: 7-3-08
City of Richmond Heights

BILL NO. 5200 ORDINANCE NO. 5064

AN ORDINANCE APPROVING AN INTERGOVERNMENTAL RECIPROCITY AGREEMENT BETWEEN THE CITY OF RICHMOND HEIGHTS, MISSOURI AND THE METROPOLITAN SEWER DISTRICT ("MSD") ESTABLISHING A MUTUAL WAIVER OF FEES.

WHEREAS, the City of Richmond Heights, Missouri and "MSD" recognize that it is in the best interest of the public that additional fees not be imposed upon governmental entities, including MSD, when such entities undertake repairs, maintenance or new construction.

NOW, THEREFORE, BE IT ORDAINED BY THE CITY COUNCIL OF THE CITY OF RICHMOND HEIGHTS, MISSOURI, as follows:

SECTION 1. The Mayor of the City of Richmond Heights, Missouri, is authorized to execute on behalf of the City, an intergovernmental agreement with the Metropolitan Sewer District ("MSD"), for the purpose as follows:

1. Neither MSD or the City of Richmond Heights shall charge the other party in this agreement, fees or charges for plan review, inspection or permit fees or building fees for projects that involve repairs, maintenance or new construction.

2. This Agreement, as in the form attached hereto as Exhibit "A", and incorporated herein by reference, does not affect the applicability of sewer connection fees and Caulks Creek or Williams Creek impact fees which are necessary to join new or existing facilities to MSD's system of sewers.

SECTION 2. The City Clerk is authorized and directed to attest such signature and to attach the official seal of the City of Richmond Heights to said Agreement.

SECTION 3. This Ordinance shall be in full force and effect on the 31st day from and after its passage by the City Council.

PASSED and SIGNED this 3rd day of March, 2008.

BETTY J. HUMPHREY
MAYOR

ATTEST:

PATRICIA S. VILLMER
DEPUTY CITY CLERK

APPROVED AS TO FORM:

KENNETH J. HEINZ
CITY ATTORNEY

First reading: February 19, 2008
Second reading: March 3, 2008

ATTACHMENT F:

UTILITY LETTERS

ATTACHMENT G:

GEOTECHNICAL REPORT

7NT

Integrity. Reliability. Performance.

1033 CORPORATE SQUARE DRIVE
ST LOUIS, MISSOURI 63132

April 10, 2020

Mr. Jeffrey Gratzer, PE
HDR
401 South 18th Street, Suite 300
St. Louis, MO 63103

Re: Geotechnical Data Report for the Brentwood and Red Bud Avenue CSO Interceptor/Outfall Elimination
Project Number: 11153
St. Louis, Missouri
7NT Number: D142-MO

Dear Mr. Gratzer,

7NT is pleased to submit the Geotechnical Data Report for the Brentwood and Red Bud Avenue CSO Elimination project in St. Louis, Missouri.

Field Investigations

The geotechnical field exploration was conducted by **7NT** in December 2018; June, July, October, and November 2019, and March 2020. Twenty (20) borings were drilled to maximum depths of 32.0 feet below ground surface (bgs). The boring depths are summarized in the *Boring Depths* table. The boring locations are shown in the attached boring location plan. Boring logs are attached.

The borings were drilled utilizing hollow stem augers powered by a drill rig. Standard Penetration Testing (SPT), utilizing a split spoon sampler, was conducted at 5.0-foot intervals. Soil samples were collected at the borings and sealed in jars to prevent moisture loss. The soil samples were transported to the **7NT** Laboratory for visual classification.

Bedrock was cored using diamond bits and triple tube, swivel type, M design barrels with split inner barrel, and water as a drilling fluid. The inner barrel was retrieved and split open to expose the core for logging after each run. The cores were placed in wooden boxes with hooked lids. Core samples were collected from the rock for testing.

Each core run was logged while still in one-half of the split inner core barrel, and the Rock Quality Designation was determined according to ASTM D6032.

The groundwater conditions were monitored during drilling and after removal of augers. The groundwater levels are provided in the individual boring logs attached to this report.

Boring Depths

Boring No.	Total Depth (feet)	Boring No.	Total Depth (feet)
L19-1	24.3	L19-2	19.3
RB19-1	21.7	RB19-2	23.0
RB19-3	32.0	RB19-7	25.0
RB19-8	29.1	RB19-9	29.0
RB19-11	20.0	RB19-12	18.0
RB19-14	18.0	RB19-15	17.0
RB19-16	15.0	RB19-17	14.1
RB19-18	15.0	RB19-19	16.4
RB20-1	20.0	RB20-2	19.5
RB20-3	30.5	RB20-4	31.5

Subsurface Soil Conditions

The subsurface conditions encountered consisted of topsoil and pavement overlaying predominantly lean and fat Clay soils. Bedrock was encountered in borings L19-1, L19-2, RB19-1, RB19-7, RB19-9, and RB20-1.

Lean Clay soils were encountered from immediately below the surface conditions to depths up to 25.0 feet below grade. SPT blow counts (N values) in the lean Clay ranged from 2 to 37 blows per foot (bpf) indicating a soft to hard consistency. The lean Clay was classified as CL under the Unified Soil Classification System (USCS).

Fat Clay soils were encountered from immediately below the surface conditions to depths up to 32.0 feet below grade. N values in the fat Clay ranged from 7 bpf to sampler refusal indicating a medium stiff to hard consistency. The fat Clay was classified as CH under the USCS.

Cobbles were encountered in RB20-4 from 25.0 to 30.0 feet bgs.

Shale bedrock was encountered in borings L19-1 at 17.0 feet bgs, L19-2 at 18.5 feet bgs, RB-1 at 18.0 feet bgs, and RB19-7 at 17.0 feet bgs. Limestone bedrock was encountered in boring RB19-9 at 18.5 feet bgs. N values in the Shale and Limestone bedrock where sampler refusal. Bedrock was encountered and cored in boring RB20-1 at 9.9 feet bgs. The bedrock consisted of 1.2 feet of Limestone over 8.9 feet of Claystone. The bedrock was light gray to gray in color, moderately strong. A void was encountered from 13.0 to 18.0 feet bgs.

Groundwater was encountered while drilling or at the completion of drilling and removal of augers in RB19-3 at 27 feet and in RB19-9 and RB19-19 at 16.0 feet. The groundwater conditions observed reflect the conditions at the time of our exploration only. Fluctuations of the groundwater table should be expected to occur both seasonally and annually due to variations in rainfall, evaporation, transpiration, construction activities, and other site-specific factors.

Generalized descriptions of the subsurface conditions encountered at the project site are given above. More detailed descriptions are given in the attached boring logs. The stratification lines shown on the soil boring logs do not represent exact geological planes but approximate transitions between soil types.

Assessment of site environmental conditions, including the detection of pollutants in the soil or groundwater, were beyond the scope of this exploration. However, had any contaminated soils been encountered, or any peculiar odors detected, the client would have been notified immediately.

Laboratory Test Results

Moisture content tests per ASTM D 2216, eighteen (18) Atterberg Limits test per ASTM D 4318, and five (5) sieve and hydrometer analysis tests per ASTM D 422 & ASTM D 1140 were conducted on selected representative split spoon samples. The *Soil Classification Test Results* table lists the Atterberg Limits and sieve and hydrometer analysis test results.

Soil Classification Test Results

Boring No.	Depth, ft	Soil Classification	Particle Size Distribution				Atterberg Limits		
		USCS	Gravel %	Sand %	Silt %	Clay %	LL	PL	PI
RB19-1	8.5 – 10.0	Lean CLAY (CL)	--	--	--	--	45	18	27
RB19-1	13.5 – 15.0	Fat CLAY (CH)	--	--	--	--	53	21	32
RB19-3	13.5 – 15.0	Fat CLAY (CH)	0.0	6.5	33.0	60.5	52	29	23
RB19-8	8.5 – 10.0	Lean CLAY (CL)	--	--	--	--	40	21	19
RB19-8	18.5 – 20.0	Fat CLAY (CH)	--	--	--	--	51	28	23
RB19-12	3.5 – 5.0	Lean Clay (CL)	0.0	2.4	42.5	55.1	38	20	18
RB19-14	16.5 – 18.0	Fat CLAY (CH)	--	--	--	--	75	27	48
RB19-15	8.5 – 10.0	Fat CLAY (CH)	0.0	1.7	42.9	55.4	72	21	51
RB19-16	8.5 – 10.0	Lean CLAY (CL)	--	--	--	--	43	18	25
RB19-17	8.5 – 10.0	Fat CLAY (CH)	--	--	--	--	91	28	63
RB20-1	3.5 – 5.0	Fat CLAY (CH)	--	--	--	--	72	21	51
RB20-2	18.0 – 19.5	Fat CLAY (CH)	--	--	--	--	52	14	38
RB20-3	3.5 – 5.0	Lean CLAY (CL)	0.0	1.3	66.7	32.0	38	18	20
RB20-3	29.0 – 30.5	Fat CLAY (CH)	--	--	--	--	50	18	32
RB20-4	10.0 – 11.5	Fat CLAY (CH)	--	--	--	--	93	17	76
RB20-4	20.0 – 21.5	Fat CLAY (CH)	--	--	--	--	52	24	28
L19-1	8.5 – 10.0	Lean CLAY (CL)	0.0	1.8	71.7	26.5	35	21	14
L19-2	13.5 – 15.0	Fat CLAY (CH)	--	--	--	--	51	18	33

One (1) Uniaxial Compressive Strength tests per ASTM D 7012 Method C were conducted on selected representative rock core samples. The *Rock Test Results* table lists the rock core test results.

Rock Test Results

Boring No.	Depth (feet)	Uniaxial Compressive Strength (psi)
RB20-1	10.1 – 10.5	16,959

Limitations of Liability

Discontinuities in soil type and geology may exist, including abrupt strata changes and soil strength variations. The extent of these variations may not be fully determined from the boring or site reconnaissance. Additional variations may not become apparent until mass excavation commences.

We appreciate the opportunity to offer these services. If you have any questions regarding this report or if we may be of further assistance to you, please contact our office at 937-435-3200.

Respectfully,
7NT

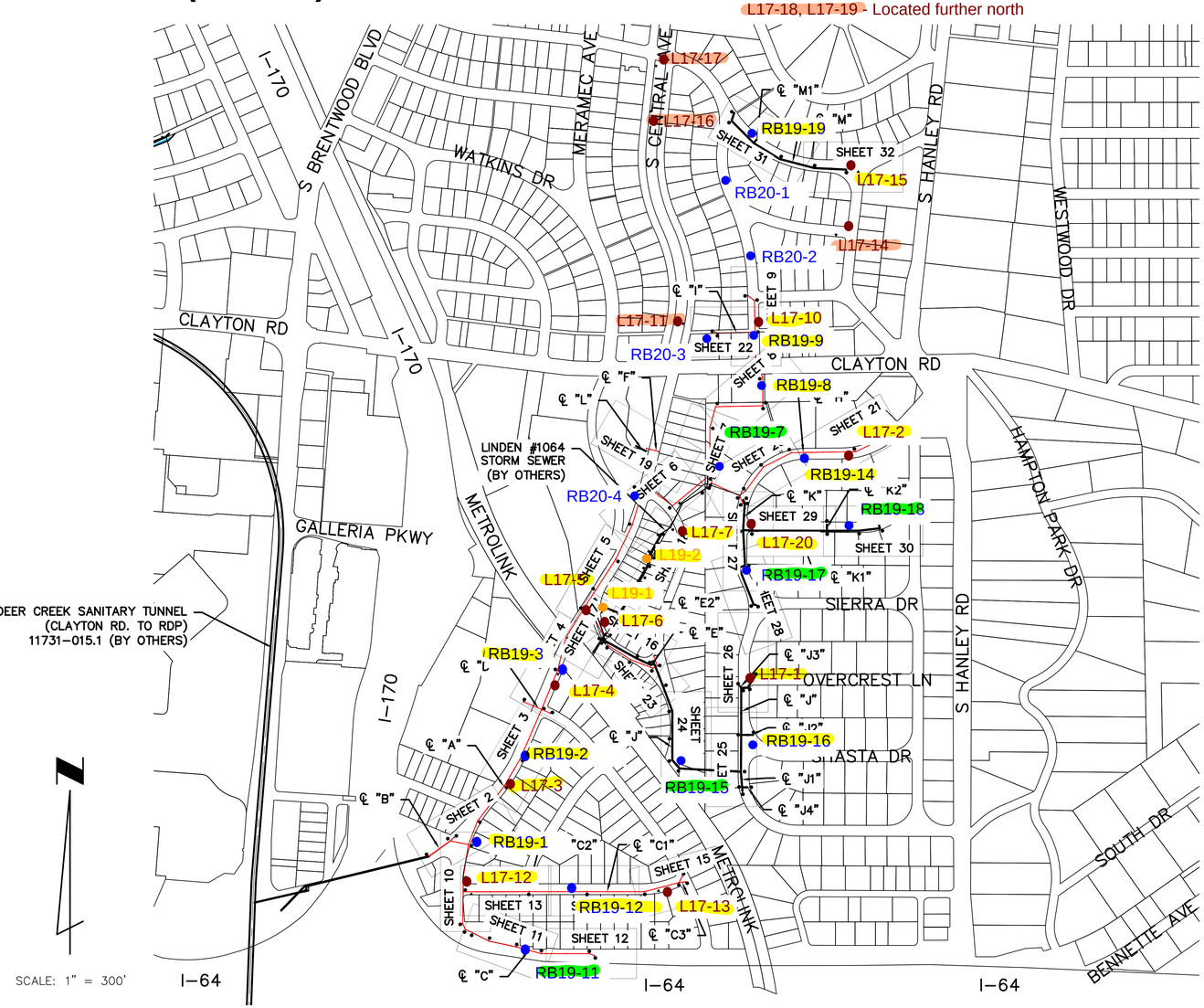
Lauren M Hucek
Engineering Technician

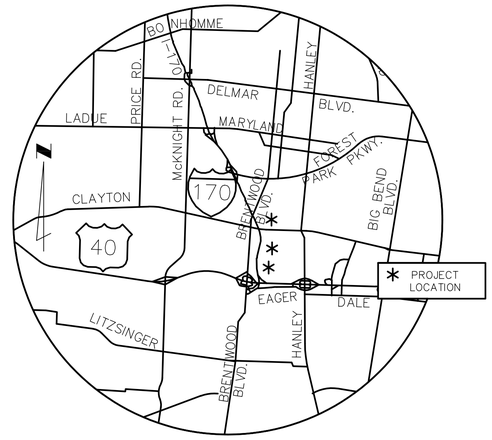
Monica M. Oakes
Project Manager

Attachments: Boring Location Plan
Logs of Test Borings
Laboratory Test Results

METROPOLITAN ST. LOUIS SEWER DISTRICT

CSO - BRENTWOOD AND REDBUD AVE CSO INTERCEPTOR (L-118)/ OUTFALL (L-111) ELIMINATION AND SEWER SEPARATION (12139)





LOCATION MAP
NOT TO SCALE

On plans at 60%

Adding to plans

Outside plan areas

NOTE:

UNDERGROUND FACILITIES, STRUCTURES AND UTILITIES HAVE BEEN PLOTTED FROM AVAILABLE SURVEYS AND RECORDS. THEREFORE; THEIR LOCATIONS MUST BE CONSIDERED APPROXIMATE ONLY. THERE MAY BE OTHERS, THE EXISTENCE OF WHICH IS NOT PRESENTLY KNOWN. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO HAVE ALL UTILITIES LOCATED IN THE FIELD PRIOR TO EXCAVATION OR CONSTRUCTION.

60% DESIGN

HDR Engineering, Inc.
401 S. 18th St., Suite 300
St. Louis, Missouri 63103
(314) 425-8300
ENGINEERING LICENSE NO. 000856

Engineer Seal

JEFFERY A. GRATZER, P.E.
CIVIL ENGINEER
P.E. No. 1999137696
DATE:

REV.	DATE	DESCRIPTION	BY

METROPOLITAN ST. LOUIS SEWER DISTRICT

RDP TRIBUTARIES (DEER CREEK)
CSO TUNNEL
12441-015.1
ST. LOUIS CITY &
ST. LOUIS COUNTY, MISSOURI

CSO L-111 (LINDEN) SEWER SEPARATION COVER SHEET

Designed J.A.G.
Drawn R.K.F.
Checked D.D.H.
Date MAY 2019
Sheet No 1 of 33

LOG OF TEST BORING

7NT

BORING NO.: L19-1 (Sheet 1/1)

CLIENT: HDR
PROJECT: Brentwood & Red Bud
LOCATION: St. Louis, MO
PROJECT NO: D142-MO DRILLER/INSP: CB
BORING METHOD: HSA RIG TYPE: CME 650

DATE STARTED: 12-4-18 COMPLETED: 12-4-18
TEMPERATURE/WEATHER: Snowy, 30 Degrees
NORTH: EAST:
ELEVATION: LINE:
CORE SIZE: HAMMER: Auto

ELEV. (FEET)	DEPTH SCALE (FEET)	LAYER THICK-NESS	GRAPHIC LOG	SAMPLE DESCRIPTION	SAMPLE NO.	SAMPLE TYPE REC	SAMPLE DEPTH (FEET)	BLOWS PER 6 INCHES	SPT N	M/C (%)	RQD PP*
		0.6		CONCRETE (7")							
		0.4		AGGREGATE BASE (5")							
	1–4	6.0		Medium Stiff Gray CLAY, moist, little fine to coarse grain sand, trace gravel (CL)	1	SS	3.5 5	3 - 4 - 4	8	16.4	
	5–9	5.0		Very Soft Brown CLAY, moist, few fine to coarse grain sand (CL)	2	SS	8.5 10	1 - 1 - 1	2		
	10–14	5.0		Stiff Dark Gray CLAY, moist, little fine to coarse grain sand (CL)	3	SS	13.5 15	4 - 6 - 8	14		
	15–19	7.3		Reddish Gray SHALE	4	SS	18.5 19.7	36 - 48 - 50/2"	50+	11.8	
	20–24				5	SS	23.5 24.3	36 - 50/4" -	50+		
	25–29			Boring Terminated at 24.3 feet							

* Pocket Penetrometer Reading - Unconfined Compressive Strength, Tons/Sq.Ft.

Ground Water Observations:

DATE	TIME	CASING DEPTH	CAVE-IN	BAILED	WATER LEVEL
12/4/18	12:00	23.5			None ▽
12/4/18	12:15	23.5	15.0		None ▼
					▼

BORING METHOD
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
DC - Driving Casings
MD - Mud Drillings

SAMPLE TYPE
SS - Split Spoon
ST - Shelby Tube
CA - Continuous Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Remarks:

BORING LOG REPORT D142-MO.GPJ 7NT TEMPLATE.GDT 4/10/20

LOG OF TEST BORING

7NT

BORING NO.: L19-2 (Sheet 1/1)

CLIENT: HDR
PROJECT: Brentwood & Red Bud
LOCATION: St. Louis, MO
PROJECT NO: D142-MO DRILLER/INSP: FS/CC
BORING METHOD: HSA RIG TYPE: CME 55 Track

DATE STARTED: 12-17-18 COMPLETED: 12-17-18
TEMPERATURE/WEATHER: Overcast, 40 Degrees
NORTH: EAST:
ELEVATION: LINE:
CORE SIZE: HAMMER: Auto

ELEV. (FEET)	DEPTH SCALE (FEET)	LAYER THICK-NESS	GRAPHIC LOG	SAMPLE DESCRIPTION	SAMPLE NO.	SAMPLE TYPE REC	SAMPLE DEPTH (FEET)	BLOWS PER 6 INCHES	SPT N	M/C (%)	RQD PP*
	0	0.2		ASPHALT (2")							
		0.1		AGGREGATE BASE (2")							
	1			Soft Brown CLAY, moist (CL)							
	2	3.2									
	3										
	4			Medium Stiff Brown Sandy CLAY, moist (CL)	1	SS	3.5 5	2 - 2 - 2	4	18.2	
	5										
	6										
	7	6.5									
	8										
	9				2	SS	8.5 10	2 - 3 - 3	6		
	10			Very Stiff Brown/Gray CLAY, moist (CH)							
	11										
	12										
	13										
	14				3	SS	13.5 15	4 - 7 - 10	17	14.9	
	15	8.5									
	16										
	17										
	18										
	19	0.8		Reddish Gray SHALE	4	SS	18.5 19.3	10 - 50/4" -	50+		
	20			Boring Terminated at 19.3 feet							
	21										
	22										
	23										
	24										
	25										
	26										
	27										
	28										
	29										

* Pocket Penetrometer Reading - Unconfined Compressive Strength, Tons/Sq.Ft.

Ground Water Observations:

DATE	TIME	CASING DEPTH	CAVE-IN	BAILED	WATER LEVEL
12/17/18	9:00	18.5			None ▽
12/17/18	10:00	18.5	14.5		None ▼
					▼

BORING METHOD
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
DC - Driving Casings
MD - Mud Drillings

SAMPLE TYPE
SS - Split Spoon
ST - Shelby Tube
CA - Continuous Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Remarks:

BORING LOG REPORT D142-MO.GPJ 7NT TEMPLATE.GDT 4/10/20

LOG OF TEST BORING

7NT

BORING NO.: RB19-01 (Sheet 1/1)

CLIENT: HDR
PROJECT: Brentwood & Red Bud
LOCATION: St. Louis, MO
PROJECT NO: D142-MO DRILLER/INSP: JS/CC
BORING METHOD: HSA RIG TYPE: CME 45

DATE STARTED: 6-27-19 COMPLETED: 6-27-19
TEMPERATURE/WEATHER: Sunny
NORTH: EAST:
ELEVATION: LINE:
CORE SIZE: HAMMER: Auto

ELEV. (FEET)	DEPTH SCALE (FEET)	LAYER THICK-NESS	GRAPHIC LOG	SAMPLE DESCRIPTION	SAMPLE NO.	SAMPLE TYPE REC	SAMPLE DEPTH (FEET)	BLOWS PER 6 INCHES	SPT N	M/C (%)	RQD PP*
		0.5		TOPSOIL (6")	1	SS	0 1.5	1 - 1 - 1	2		
	1	1.0		Soft Brown CLAY, few sand, moist (CL)							
	2			Medium Stiff Brown CLAY, some silt, moist (CL)							
	3										
	4				2	SS	3.5 5	2 - 2 - 2	4	25.1	
	5										
	6										
	7										
		12.0									
	8										
	9				3	SS	8.5 10	2 - 3 - 5	8	22.1	
	10										
	11										
	12										
	13										
	14			Stiff Brown and Gray CLAY, moist (CH)	4	SS	13.5 15	6 - 7 - 9	16	20.5	
	15										
	16	4.5									
	17										
	18			Gray SHALE, weathered							
	19				5	SS	18.5 20	48 - 50/4" -	50+		
	20	4.0									
	21										
	22				6	SS	21.5 21.7	50/2" - -	50+		
	23			Boring Terminated at 21.7 feet							
	24										
	25										
	26										
	27										
	28										
	29										

* Pocket Penetrometer Reading - Unconfined Compressive Strength, Tons/Sq.Ft.

Ground Water Observations:

DATE	TIME	CASING DEPTH	CAVE-IN	BAILED	WATER LEVEL
					▽
					▼
					▼

BORING METHOD
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
DC - Driving Casings
MD - Mud Drillings

SAMPLE TYPE
SS - Split Spoon
ST - Shelby Tube
CA - Continuous Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Remarks:

BORING LOG REPORT D142-MO.GPJ 7NT TEMPLATE.GDT 4/10/20

LOG OF TEST BORING

7NT

BORING NO.: RB19-02 (Sheet 1/1)

CLIENT: HDR
PROJECT: Brentwood & Red Bud
LOCATION: St. Louis, MO
PROJECT NO: D142-MO DRILLER/INSP: JS/CC
BORING METHOD: HSA RIG TYPE: CME 45

DATE STARTED: 6-27-19 COMPLETED: 6-27-19
TEMPERATURE/WEATHER: Sunny
NORTH: EAST:
ELEVATION: LINE:
CORE SIZE: HAMMER: Auto

ELEV. (FEET)	DEPTH SCALE (FEET)	LAYER THICK-NESS	GRAPHIC LOG	SAMPLE DESCRIPTION	SAMPLE NO.	SAMPLE TYPE REC	SAMPLE DEPTH (FEET)	BLOWS PER 6 INCHES	SPT N	M/C (%)	RQD PP*
		0.5		TOPSOIL (6")	1	SS	0 1.5	2 - 2 - 4	6	23.7	
	1			Medium Stiff Brown CLAY, few sand, moist (CL)							
	2										
	3										
	4				2	SS	3.5 5	2 - 3 - 3	6		
	5										
	6										
	7	13.0									
	8										
	9				3	SS	8.5 10	3 - 4 - 4	8		
	10										
	11										
	12										
	13										
	14			Very Stiff Light Brown CLAY, moist (CL)	4	SS	13.5 15	3 - 5 - 12	17		
	15										
	16										
	17										
	18	8.0									
	19				5	SS	18.5 20	20 - 39 - 40	79	12.3	
	20										
	21										
	22	1.5		Hard Gray Silty CLAY, moist (CL)	6	SS	21.5 23	10 - 11 - 26	37	20.0	
	23			Boring Terminated at 23.0 feet							
	24										
	25										
	26										
	27										
	28										
	29										

* Pocket Penetrometer Reading - Unconfined Compressive Strength, Tons/Sq.Ft.

Ground Water Observations:

DATE	TIME	CASING DEPTH	CAVE-IN	BAILED	WATER LEVEL
					▽
					▼
					▼

BORING METHOD
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
DC - Driving Casings
MD - Mud Drillings

SAMPLE TYPE
SS - Split Spoon
ST - Shelby Tube
CA - Continuous Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Remarks:

BORING LOG REPORT D142-MO.GPJ 7NT TEMPLATE.GDT 4/10/20

LOG OF TEST BORING

7NT

BORING NO.: RB19-03 (Sheet 1/1)

CLIENT: HDR
PROJECT: Brentwood & Red Bud
LOCATION: St. Louis, MO
PROJECT NO: D142-MO DRILLER/INSP: JS/DA
BORING METHOD: HSA RIG TYPE: CME 45

DATE STARTED: 7-2-19 COMPLETED: 7-3-19
TEMPERATURE/WEATHER: Overcast, 80 Degrees
NORTH: EAST:
ELEVATION: LINE:
CORE SIZE: HAMMER: Auto

ELEV. (FEET)	DEPTH SCALE (FEET)	LAYER THICK-NESS	GRAPHIC LOG	SAMPLE DESCRIPTION	SAMPLE NO.	SAMPLE TYPE REC	SAMPLE DEPTH (FEET)	BLOWS PER 6 INCHES	SPT N	M/C (%)	RQD PP*
	1–34	13.0		Soft to Medium Stiff Brown CLAY, little sand, moist (CL)	1	SS	0 1.5	3 - 4 - 5	9	20.9	
					2	SS	3.5 5	1 - 1 - 2	3		
					3	SS	8.5 10	3 - 4 - 5	9	24.8	
		19.0		Hard Redish Brown CLAY, few fine to coarse sand, moist (CH)	4	SS	13.5 15	4 - 14 - 16	30	15.8	
					5	SS	18.5 20	26 - 50/4" -	50+		
					6	SS	23.5 25	33 - 50/5" -	50+	10.0	
					7	SS	28.5 30	17 - 50/2" -	50+		
					8	SS	30.5 31.9	20 - 38 - 50/4"	50+		
				Boring Terminated at 32.0 feet							

▽ Water level at 27 feet

* Pocket Penetrometer Reading - Unconfined Compressive Strength, Tons/Sq.Ft.

Ground Water Observations:

DATE	TIME	CASING DEPTH	CAVE-IN	BAILED	WATER LEVEL
7/3/2019					27 ▽
					▼
					▼

BORING METHOD
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
DC - Driving Casings
MD - Mud Drillings

SAMPLE TYPE
SS - Split Spoon
ST - Shelby Tube
CA - Continuous Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Remarks:

BORING LOG REPORT D142-MO.GPJ 7NT TEMPLATE.GDT 4/10/20

LOG OF TEST BORING

7NT

BORING NO.: RB19-07 (Sheet 1/1)

CLIENT: HDR
PROJECT: Brentwood & Red Bud
LOCATION: St. Louis, MO
PROJECT NO: D142-MO DRILLER/INSP: CPIII/DS
BORING METHOD: HSA RIG TYPE: CME 550X

DATE STARTED: 11-7-19 COMPLETED: 11-7-19
TEMPERATURE/WEATHER: Sunny, Windy, 40 Degrees
NORTH: EAST:
ELEVATION: LINE:
CORE SIZE: HAMMER: Auto

ELEV. (FEET)	DEPTH SCALE (FEET)	LAYER THICK-NESS	GRAPHIC LOG	SAMPLE DESCRIPTION	SAMPLE NO.	SAMPLE TYPE REC	SAMPLE DEPTH (FEET)	BLOWS PER 6 INCHES	SPT N	M/C (%)	RQD PP*
		0.6		TOPSOIL (7")							
	1			Soft Brown CLAY, few sand, trace gravel, moist (CL)	1	SS	1 2.5	WOH - 2 - 2	4		
	2				2	SS	3.5 5	1 - 2 - 2	4		
	3				3	SS	6 7.5	3 - 3 - 2	5		
	4	7.4									
	5										
	6										
	7										
	8			Stiff Brown CLAY, trace sand, trace gravel, moist (CL)	4	SS	8.5 10	2 - 4 - 7	11		
	9										
	10										
	11	6.5									
	12										
	13										
	14				5	SS	13.5 15	6 - 8 - 10	18		
	15			Very Stiff Brown CLAY, trace sand, trace gravel, moist (CL)							
	16	2.5									
	17			Brown and Gray SHALE, weathered							
	18										
	19				6	SS	18.5 20	21 - 37 - 37	74		
	20										
	21	8.0									
	22										
	23										
	24				7	SS	23.5 25	45 - 49 - 50/5"			
	25			Boring Terminated at 25.0 feet							
	26										
	27										
	28										
	29										

* Pocket Penetrometer Reading - Unconfined Compressive Strength, Tons/Sq.Ft.

Ground Water Observations:

DATE	TIME	CASING DEPTH	CAVE-IN	BAILED	WATER LEVEL
11/7/2019		23.5			None ▽
11/7/2019			20.1		None ▼
					▼

BORING METHOD
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
DC - Driving Casings
MD - Mud Drillings

SAMPLE TYPE
SS - Split Spoon
ST - Shelby Tube
CA - Continuous Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Remarks:

BORING LOG REPORT D142-MO.GPJ 7NT TEMPLATE.GDT 4/10/20

LOG OF TEST BORING

7NT

BORING NO.: RB19-08 (Sheet 1/1)

CLIENT: HDR
PROJECT: Brentwood & Red Bud
LOCATION: St. Louis, MO
PROJECT NO: D142-MO DRILLER/INSP: CC/CPIII
BORING METHOD: HSA RIG TYPE: CME 45

DATE STARTED: 7-11-19 COMPLETED: 7-11-19
TEMPERATURE/WEATHER: Sunny, 88 Degrees
NORTH: EAST:
ELEVATION: LINE:
CORE SIZE: HAMMER: Auto

ELEV. (FEET)	DEPTH SCALE (FEET)	LAYER THICK-NESS	GRAPHIC LOG	SAMPLE DESCRIPTION	SAMPLE NO.	SAMPLE TYPE REC	SAMPLE DEPTH (FEET)	BLOWS PER 6 INCHES	SPT N	M/C (%)	RQD PP*
		0.6		ASPHALT (7")							
		0.2		AGGREGATE BASE (2.5")							
	1			Soft Brown CLAY, some sand, trace gravel, moist (CL)							
	2										
	3										
	4				1	SS	3.5 5	2 - 2 - 2	4		
	5	7.7									
	6										
	7										
	8										
	9			Medium Stiff Brown CLAY, little silt, trace sand, moist (CL)	2	SS	8.5 10	3 - 3 - 4	7	26.0	
	10										
	11	5.0									
	12										
	13										
	14			Stiff Brown CLAY, little silt, little sand, moist (CL)	3	SS	13.5 15	4 - 5 - 5	10		
	15										
	16	5.0									
	17										
	18										
	19			Very Stiff Brown CLAY, trace fine to medium sand, moist (CH)	4	SS	18.5 20	5 - 9 - 10	19	23.6	
	20										
	21	5.0									
	22										
	23										
	24			Hard Brown Silty CLAY, trace sand, trace gravel, moist (CL)	5	SS	23.5 25	10 - 50/5" -	50+	13.6	
	25										
	26	5.6									
	27										
	28										
	29	0.1			6	SS	28.5 29.1	39 - 50/1" -	50+		
	30			Gray LIMESTONE							
	31										
	32										
	33										
	34										

* Pocket Penetrometer Reading - Unconfined Compressive Strength, Tons/Sq.Ft.

Ground Water Observations:

DATE	TIME	CASING DEPTH	CAVE-IN	BAILED	WATER LEVEL
7/11/2019	20:35	29.1			None ▽
7/11/2019	20:50		27.3		None ▼
					▼

BORING METHOD
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
DC - Driving Casings
MD - Mud Drillings

SAMPLE TYPE
SS - Split Spoon
ST - Shelby Tube
CA - Continuous Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Remarks:

BORING LOG REPORT D142-MO.GPJ 7NT TEMPLATE.GDT 4/10/20

LOG OF TEST BORING

7NT

BORING NO.: RB19-09 (Sheet 1/1)

CLIENT: HDR
PROJECT: Brentwood & Red Bud
LOCATION: St. Louis, MO
PROJECT NO: D142-MO DRILLER/INSP: JS
BORING METHOD: HSA RIG TYPE: CME 45

DATE STARTED: 7-9-19 COMPLETED: 7-10-19
TEMPERATURE/WEATHER: Partly Cloudy, 90 Degrees
NORTH: EAST:
ELEVATION: LINE:
CORE SIZE: HAMMER: Auto

ELEV. (FEET)	DEPTH SCALE (FEET)	LAYER THICK-NESS	GRAPHIC LOG	SAMPLE DESCRIPTION	SAMPLE NO.	SAMPLE TYPE REC	SAMPLE DEPTH (FEET)	BLOWS PER 6 INCHES	SPT N	M/C (%)	RQD PP*
	1–34	5.0		Medium Stiff Gray CLAY, few sand, moist (CL)	1	SS	0 1.5	2 - 3 - 4	7		
					2	SS	3.5 5	3 - 3 - 4	7		
		13.5		Stiff Brown CLAY, trace sand, moist (CL)	3	SS	8.5 10	3 - 5 - 7	12		
					4	SS	13.5 15	5 - 6 - 7	13		
		10.5		LIMESTONE	5 1	SS RC	18.5 18.9 19 29	50/5" - - - -			
				Boring Terminated at 29.0 feet							

* Pocket Penetrometer Reading - Unconfined Compressive Strength, Tons/Sq.Ft.

Ground Water Observations:

DATE	TIME	CASING DEPTH	CAVE-IN	BAILED	WATER LEVEL
7/10/2019					16 ▽
					▼
					▼

BORING METHOD
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
DC - Driving Casings
MD - Mud Drillings

SAMPLE TYPE
SS - Split Spoon
ST - Shelby Tube
CA - Continuous Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Remarks:

BORING LOG REPORT D142-MO.GPJ 7NT TEMPLATE.GDT 4/10/20

LOG OF TEST BORING

7NT

BORING NO.: RB19-11 (Sheet 1/1)

CLIENT: HDR
PROJECT: Brentwood & Red Bud
LOCATION: St. Louis, MO
PROJECT NO: D142-MO DRILLER/INSP: DS
BORING METHOD: HSA RIG TYPE: CME 55

DATE STARTED: 10-18-19 COMPLETED: 10-18-19
TEMPERATURE/WEATHER: Sunny, 55 Degrees
NORTH: EAST:
ELEVATION: LINE:
CORE SIZE: HAMMER: Auto

ELEV. (FEET)	DEPTH SCALE (FEET)	LAYER THICK-NESS	GRAPHIC LOG	SAMPLE DESCRIPTION	SAMPLE NO.	SAMPLE TYPE REC	SAMPLE DEPTH (FEET)	BLOWS PER 6 INCHES	SPT N	M/C (%)	RQD PP*
	0	0.4		ASPHALT (5")							
		0.5		CONCRETE (6")							
	1	0.9		AGGREGATE (11")							
	2			Stiff Brown CLAY, few sand, few gravel, moist (CL)	1	SS	2 3.5	4 - 8 - 4	12		
	3	1.7									
	4	1.5		Medium Stiff Brown CLAY, few gravel, trace sand, moist (CL)	2	SS	3.5 5	2 - 3 - 4	7		
	5			Stiff Brown CLAY, trace sand, trace gravel, moist (CL)							
	6										
	7										
	8	5.0			3	SS	8.5 10	4 - 6 - 9	15		
	9										
	10			Hard Brown CLAY, trace sand, trace gravel, moist (CL)							
	11										
	12										
	13	5.0			4	SS	13.5 15	9 - 15 - 22	37		
	14										
	15			Very Stiff Brown CLAY, trace sand, trace gravel, moist (CL)							
	16										
	17										
	18	5.0			5	SS	18.5 20	6 - 8 - 12	20		
	19										
	20			Boring Terminated at 20.0 feet							
	21										
	22										
	23										
	24										
	25										
	26										
	27										
	28										
	29										

* Pocket Penetrometer Reading - Unconfined Compressive Strength, Tons/Sq.Ft.

Ground Water Observations:

DATE	TIME	CASING DEPTH	CAVE-IN	BAILED	WATER LEVEL
10/18/2019		18.5			None ▽
10/18/2019			14.2		None ▼
					▼

BORING METHOD
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
DC - Driving Casings
MD - Mud Drillings

SAMPLE TYPE
SS - Split Spoon
ST - Shelby Tube
CA - Continuous Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Remarks:

BORING LOG REPORT D142-MO.GPJ 7NT TEMPLATE.GDT 4/10/20

LOG OF TEST BORING

7NT

BORING NO.: RB19-12 (Sheet 1/1)

CLIENT: HDR
PROJECT: Brentwood & Red Bud
LOCATION: St. Louis, MO
PROJECT NO: D142-MO DRILLER/INSP: JS/CC
BORING METHOD: HSA RIG TYPE: CME 45

DATE STARTED: 6-28-19 COMPLETED: 6-28-19
TEMPERATURE/WEATHER: Sunny
NORTH: EAST:
ELEVATION: LINE:
CORE SIZE: HAMMER: Auto

ELEV. (FEET)	DEPTH SCALE (FEET)	LAYER THICK-NESS	GRAPHIC LOG	SAMPLE DESCRIPTION	SAMPLE NO.	SAMPLE TYPE REC	SAMPLE DEPTH (FEET)	BLOWS PER 6 INCHES	SPT N	M/C (%)	RQD PP*
	0	0.5		TOPSOIL (6")	1	SS	0 1.5	2 - 3 - 4	7		
	1			Medium Stiff Brown CLAY, few sand, moist (CL)							
	2	3.0									
	3										
	4			Stiff Gray CLAY, little sand, moist (CL)	2	SS	3.5 5	3 - 4 - 6	10	22.4	
	5										
	6	5.0									
	7										
	8										
	9			Medium Stiff Tan CLAY, few sand, moist (CL)	3	SS	8.5 10	2 - 4 - 5	9	27.7	
	10										
	11	5.0									
	12										
	13										
	14			Very Stiff Tan CLAY, moist (CL)	4	SS	13.5 15	5 - 10 - 15	25		
	15	3.0									
	16										
	17	1.5		Hard Tan and Brown CLAY, moist (CL)	5	SS	16.5 18	10 - 18 - 26	44		
	18			Boring Terminated at 18.0 feet							
	19										
	20										
	21										
	22										
	23										
	24										
	25										
	26										
	27										
	28										
	29										

* Pocket Penetrometer Reading - Unconfined Compressive Strength, Tons/Sq.Ft.

Ground Water Observations:

DATE	TIME	CASING DEPTH	CAVE-IN	BAILED	WATER LEVEL
					▽
					▼
					▼

BORING METHOD
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
DC - Driving Casings
MD - Mud Drillings

SAMPLE TYPE
SS - Split Spoon
ST - Shelby Tube
CA - Continuous Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Remarks:

BORING LOG REPORT D142-MO.GPJ 7NT TEMPLATE.GDT 4/10/20

LOG OF TEST BORING

7NT

BORING NO.: RB19-14 (Sheet 1/1)

CLIENT: HDR
PROJECT: Brentwood & Red Bud
LOCATION: St. Louis, MO
PROJECT NO: D142-MO DRILLER/INSP: CC/CPIII
BORING METHOD: HSA RIG TYPE: CME 45

DATE STARTED: 7-17-19 COMPLETED: 7-17-19
TEMPERATURE/WEATHER: Sunny, 83 Degrees
NORTH: EAST:
ELEVATION: LINE:
CORE SIZE: HAMMER: Auto

ELEV. (FEET)	DEPTH SCALE (FEET)	LAYER THICK-NESS	GRAPHIC LOG	SAMPLE DESCRIPTION	SAMPLE NO.	SAMPLE TYPE REC	SAMPLE DEPTH (FEET)	BLOWS PER 6 INCHES	SPT N	M/C (%)	RQD PP*
		0.5		ASPHALT (6")							
		0.5		CONCRETE (6")							
	1			Stiff Brown CLAY, some silt, trace sand, moist (CL)							
	2										
	3										
	4				1	SS	3.5 5	5 - 7 - 6	13	22.2	
	5	7.5									
	6										
	7										
	8										
	9			Medium Stiff Brown and Gray CLAY, some silt, trace sand, moist (CL)	2	SS	8.5 10	3 - 4 - 5	9		
	10										
	11										
	12										
	13	8.0									
	14				3	SS	13.5 15	3 - 4 - 5	9		
	15										
	16										
	17			Stiff Gray CLAY, little silt, little sand, trace gravel, moist (CH)	4	SS	16.5 18	4 - 6 - 9	15	28.7	
	18	1.5		Boring Terminated at 18.0 feet							
	19										
	20										
	21										
	22										
	23										
	24										
	25										
	26										
	27										
	28										
	29										

* Pocket Penetrometer Reading - Unconfined Compressive Strength, Tons/Sq.Ft.

Ground Water Observations:

DATE	TIME	CASING DEPTH	CAVE-IN	BAILED	WATER LEVEL
7/17/2019	9:47	16.5			None ▽
7/17/2019	9:59		13.3		None ▼
					▼

BORING METHOD
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
DC - Driving Casings
MD - Mud Drillings

SAMPLE TYPE
SS - Split Spoon
ST - Shelby Tube
CA - Continuous Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Remarks:

BORING LOG REPORT D142-MO.GPJ 7NT TEMPLATE.GDT 4/10/20

LOG OF TEST BORING

7NT

BORING NO.: RB19-15 (Sheet 1/1)

CLIENT: HDR
PROJECT: Brentwood & Red Bud
LOCATION: St. Louis, MO
PROJECT NO: D142-MO DRILLER/INSP: JS/CC
BORING METHOD: HSA RIG TYPE: CME 45

DATE STARTED: 6-28-19 COMPLETED: 6-28-19
TEMPERATURE/WEATHER: Sunny
NORTH: EAST:
ELEVATION: LINE:
CORE SIZE: HAMMER: Auto

ELEV. (FEET)	DEPTH SCALE (FEET)	LAYER THICK-NESS	GRAPHIC LOG	SAMPLE DESCRIPTION	SAMPLE NO.	SAMPLE TYPE REC	SAMPLE DEPTH (FEET)	BLOWS PER 6 INCHES	SPT N	M/C (%)	RQD PP*
		0.5		TOPSOIL (6")	1	SS	0 1.5	2 - 2 - 3	5		
	1			Soft Brown CLAY, moist (CL)							
	2	3.0									
	3										
	4			Medium Stiff Brown CLAY, trace fine to coarse sand, moist (CH)	2	SS	3.5 5	2 - 3 - 4	7	24.0	
	5										
	6										
	7										
	8										
	9	10.0			3	SS	8.5 10	2 - 4 - 5	9	24.7	
	10										
	11										
	12										
	13										
	14			Hard Gray and Tan Silty CLAY, moist (CL)	4	SS	13.5 15	49 - 25 - 15	40		
	15	3.5									
	16				5	SS	15.5 17	8 - 11 - 9	20		
	17			Boring Terminated at 17.0 feet							
	18										
	19										
	20										
	21										
	22										
	23										
	24										
	25										
	26										
	27										
	28										
	29										

* Pocket Penetrometer Reading - Unconfined Compressive Strength, Tons/Sq.Ft.

Ground Water Observations:

DATE	TIME	CASING DEPTH	CAVE-IN	BAILED	WATER LEVEL
					▽
					▼
					▼

BORING METHOD
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
DC - Driving Casings
MD - Mud Drillings

SAMPLE TYPE
SS - Split Spoon
ST - Shelby Tube
CA - Continuous Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Remarks:

BORING LOG REPORT D142-MO.GPJ 7NT TEMPLATE.GDT 4/10/20

LOG OF TEST BORING

7NT

BORING NO.: RB19-16 (Sheet 1/1)

CLIENT: HDR
PROJECT: Brentwood & Red Bud
LOCATION: St. Louis, MO
PROJECT NO: D142-MO DRILLER/INSP: CC/CPIII
BORING METHOD: HSA RIG TYPE: CME 45

DATE STARTED: 7-17-19 COMPLETED: 7-17-19
TEMPERATURE/WEATHER: Sunny, 90 Degrees
NORTH: EAST:
ELEVATION: LINE:
CORE SIZE: HAMMER: Auto

ELEV. (FEET)	DEPTH SCALE (FEET)	LAYER THICK-NESS	GRAPHIC LOG	SAMPLE DESCRIPTION	SAMPLE NO.	SAMPLE TYPE REC	SAMPLE DEPTH (FEET)	BLOWS PER 6 INCHES	SPT N	M/C (%)	RQD PP*
		0.4		ASPHALT (5")							
		0.3		AGGREGATE BASE (4")							
	1			Medium Stiff Brown and Gray CLAY, some silt, trace sand, moist (CL)							
	2										
	3										
	4				1	SS	3.5 5	3 - 3 - 5	8	25.6	
	5	7.8									
	6										
	7										
	8										
	9			Medium Stiff Brown CLAY, some silt, trace sand, moist (CL)	2	SS	8.5 10	2 - 3 - 3	6		
	10										
	11	5.0									
	12										
	13										
	14			Stiff Brown CLAY, some silt, trace sand, moist (CL)	3	SS	13.5 15	3 - 4 - 6	10		
	15	1.5		Boring Terminated at 15.0 feet							
	16										
	17										
	18										
	19										
	20										
	21										
	22										
	23										
	24										
	25										
	26										
	27										
	28										
	29										

* Pocket Penetrometer Reading - Unconfined Compressive Strength, Tons/Sq.Ft.

Ground Water Observations:

DATE	TIME	CASING DEPTH	CAVE-IN	BAILED	WATER LEVEL
7/17/2019	12:23	13.5			None ▽
7/17/2019	12:42		12.8		None ▼
					▼

BORING METHOD
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
DC - Driving Casings
MD - Mud Drillings

SAMPLE TYPE
SS - Split Spoon
ST - Shelby Tube
CA - Continuous Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Remarks:

BORING LOG REPORT D142-MO.GPJ 7NT TEMPLATE.GDT 4/10/20

LOG OF TEST BORING

7NT

BORING NO.: RB19-17 (Sheet 1/1)

CLIENT: HDR
PROJECT: Brentwood & Red Bud
LOCATION: St. Louis, MO
PROJECT NO: D142-MO DRILLER/INSP: CC/CPIII
BORING METHOD: HSA RIG TYPE: CME 45

DATE STARTED: 7-17-19 COMPLETED: 7-17-19
TEMPERATURE/WEATHER: Sunny, 90 Degrees
NORTH: EAST:
ELEVATION: LINE:
CORE SIZE: HAMMER: Auto

ELEV. (FEET)	DEPTH SCALE (FEET)	LAYER THICK-NESS	GRAPHIC LOG	SAMPLE DESCRIPTION	SAMPLE NO.	SAMPLE TYPE REC	SAMPLE DEPTH (FEET)	BLOWS PER 6 INCHES	SPT N	M/C (%)	RQD PP*
	0	0.5		ASPHALT (6")							
		0.5		CONCRETE (6")							
	1			Stiff Brown CLAY, some silt, trace sand, moist (CL)							
	2										
	3										
	4				1	SS	3.5 5	4 - 5 - 5	10		
	5	7.5									
	6										
	7										
	8										
	9			Medium Stiff Brown CLAY, some silt, little sand, trace gravel, moist (CH)	2	SS	8.5 10	3 - 4 - 5	9		
	10										
	11	5.0									
	12										
	13										
	14	0.6		Hard Brown CLAY, some sand, trace silt, trace gravel, moist (CL)	3	SS	13.5 14.1	8 - 50/1" -	50+		
	15			Boring Terminated at 14.1 feet							
	16										
	17										
	18										
	19										
	20										
	21										
	22										
	23										
	24										
	25										
	26										
	27										
	28										
	29										

* Pocket Penetrometer Reading - Unconfined Compressive Strength, Tons/Sq.Ft.

Ground Water Observations:

DATE	TIME	CASING DEPTH	CAVE-IN	BAILED	WATER LEVEL
7/17/2019	11:25	13.5			None ▽
7/17/2019	11:39				None ▼
					▼

BORING METHOD
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
DC - Driving Casings
MD - Mud Drillings

SAMPLE TYPE
SS - Split Spoon
ST - Shelby Tube
CA - Continuous Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Remarks:

BORING LOG REPORT D142-MO.GPJ 7NT TEMPLATE.GDT 4/10/20

LOG OF TEST BORING

7NT

BORING NO.: RB19-18 (Sheet 1/1)

CLIENT: HDR
PROJECT: Brentwood & Red Bud
LOCATION: St. Louis, MO
PROJECT NO: D142-MO DRILLER/INSP: CC/CPIII
BORING METHOD: HSA RIG TYPE: CME 45

DATE STARTED: 7-17-19 COMPLETED: 7-17-19
TEMPERATURE/WEATHER: Sunny, 90 Degrees
NORTH: EAST:
ELEVATION: LINE:
CORE SIZE: HAMMER: Auto

ELEV. (FEET)	DEPTH SCALE (FEET)	LAYER THICK-NESS	GRAPHIC LOG	SAMPLE DESCRIPTION	SAMPLE NO.	SAMPLE TYPE REC	SAMPLE DEPTH (FEET)	BLOWS PER 6 INCHES	SPT N	M/C (%)	RQD PP*
		0.2		ASPHALT (2")							
		0.6		CONCRETE (7")							
	1			Medium Stiff Brown and Gray CLAY, some silt, trace sand, moist (CL)							
	2										
	3										
	4				1	SS	3.5 5	3 - 4 - 4	8		
	5										
	6										
	7	12.8									
	8										
	9				2	SS	8.5 10	3 - 3 - 4	7		
	10										
	11										
	12										
	13										
	14	1.5		Medium Stiff Gray and Brown CLAY, some silt, trace sand, moist (CL)	3	SS	13.5 15	2 - 4 - 5	9	31.7	
	15			Boring Terminated at 15.0 feet							
	16										
	17										
	18										
	19										
	20										
	21										
	22										
	23										
	24										
	25										
	26										
	27										
	28										
	29										

* Pocket Penetrometer Reading - Unconfined Compressive Strength, Tons/Sq.Ft.

Ground Water Observations:

DATE	TIME	CASING DEPTH	CAVE-IN	BAILED	WATER LEVEL
7/17/2019	14:31	13.5			None ▽
7/17/2019	14:49		13.1		None ▼
					▼

BORING METHOD
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
DC - Driving Casings
MD - Mud Drillings

SAMPLE TYPE
SS - Split Spoon
ST - Shelby Tube
CA - Continuous Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Remarks:

BORING LOG REPORT D142-MO.GPJ 7NT TEMPLATE.GDT 4/10/20

LOG OF TEST BORING

7NT

BORING NO.: RB19-19 (Sheet 1/1)

CLIENT: HDR
PROJECT: Brentwood & Red Bud
LOCATION: St. Louis, MO
PROJECT NO: D142-MO DRILLER/INSP: JS/DA
BORING METHOD: HSA RIG TYPE: CME 45

DATE STARTED: 7-2-19 COMPLETED: 7-2-19
TEMPERATURE/WEATHER: Sunny, 80 Degrees
NORTH: EAST:
ELEVATION: LINE:
CORE SIZE: HAMMER: Auto

ELEV. (FEET)	DEPTH SCALE (FEET)	LAYER THICK-NESS	GRAPHIC LOG	SAMPLE DESCRIPTION	SAMPLE NO.	SAMPLE TYPE REC	SAMPLE DEPTH (FEET)	BLOWS PER 6 INCHES	SPT N	M/C (%)	RQD PP*
	1–29	13.0		Medium Stiff Brown CLAY, little sand, moist (CL)	1	SS	0 1.5	3 - 4 - 4	8		
					2	SS	3.5 5	5 - 4 - 3	7	28.0	
					3	SS	8.5 10	2 - 4 - 5	9		
		3.4		Hard Gray CLAY, few sand, few silt, moist (CL)	4	SS	13.5 15	46 - 14 - 15	29	5.5	
				▽	5	SS	15.5 16.4	44 - 50/4" -	50+		
				Boring Terminated at 16.4 feet							

* Pocket Penetrometer Reading - Unconfined Compressive Strength, Tons/Sq.Ft.

Ground Water Observations:

DATE	TIME	CASING DEPTH	CAVE-IN	BAILED	WATER LEVEL
7/2/2019					16 ▽
					▼
					▼

BORING METHOD
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
DC - Driving Casings
MD - Mud Drillings

SAMPLE TYPE
SS - Split Spoon
ST - Shelby Tube
CA - Continuous Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Remarks:

BORING LOG REPORT D142-MO.GPJ 7NT TEMPLATE.GDT 4/10/20

LOG OF TEST BORING

7NT

BORING NO.: RB20-1 (Sheet 1/1)

CLIENT: HDR
PROJECT: Brentwood & Red Bud
LOCATION: St. Louis, MO
PROJECT NO: D142-MO DRILLER/INSP: DS/DS
BORING METHOD: HSA RIG TYPE: CME 550 Black

DATE STARTED: 3-25-20 COMPLETED: 3-25-20
TEMPERATURE/WEATHER: Sunny, 60 Degrees
NORTH: EAST:
ELEVATION: LINE:
CORE SIZE: HAMMER: Auto

ELEV. (FEET)	DEPTH SCALE (FEET)	LAYER THICK-NESS	GRAPHIC LOG	SAMPLE DESCRIPTION	SAMPLE NO.	SAMPLE TYPE REC	SAMPLE DEPTH (FEET)	BLOWS PER 6 INCHES	SPT N	M/C (%)	RQD PP*
		0.2		ASPHALT (2.5")							
		0.6		CONCRETE (7")							
	1	0.4		AGGREGATE (4")							
	2			Medium Stiff Brown Fat CLAY, trace sand, trace gravel, moist (CH)							
	3										
	4				1	SS	3.5 5	3 - 3 - 4	7		1.5
	5	7.9									
	6										
	7										
	8										
	9				2	SS	8.5 10	7 - 12 - 50/4"			3.0
		0.7		Very Stiff Brown CLAY, trace sand, trace gravel, moist (CL)							
	10	0.2		Weathered LIMESTONE	1	RC	9.9 13	- -			42%
		1.2		Light Gray LIMESTONE, small shell fossils, small vertical cracks							
	11										
	12	1.9		Gray CLAYSTONE							
	13			VOID (5')							
	14										
	15										
		5.0									
	16										
	17										
	18			Weathered CLAYSTONE							
	19	2.0			3	SS	18.5 20	3 - 6 - 6	12		4.5+
	20			Boring Terminated at 20.0 feet							
	21										
	22										
	23										
	24										
	25										
	26										
	27										
	28										
	29										

* Pocket Penetrometer Reading - Unconfined Compressive Strength, Tons/Sq.Ft.

Ground Water Observations:

DATE	TIME	CASING DEPTH	CAVE-IN	BAILED	WATER LEVEL
					▽
					▼
					▼

BORING METHOD
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
DC - Driving Casings
MD - Mud Drillings

SAMPLE TYPE
SS - Split Spoon
ST - Shelby Tube
CA - Continuous Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Remarks: Backfilled with bentonite chips & cement grout

BORING LOG REPORT D142-MO.GPJ 7NT TEMPLATE.GDT 4/13/20

LOG OF TEST BORING

BORING NO.: RB20-2 (Sheet 1/1)

CLIENT: HDR
PROJECT: Brentwood & Red Bud
LOCATION: St. Louis, MO
PROJECT NO: D142-MO DRILLER/INSP: DS/DS
BORING METHOD: HSA RIG TYPE: CME 550 Black

DATE STARTED: 3-25-20 COMPLETED: 3-25-20
TEMPERATURE/WEATHER: Sunny, 60 Degrees
NORTH: EAST:
ELEVATION: LINE:
CORE SIZE: HAMMER: Auto

ELEV. (FEET)	DEPTH SCALE (FEET)	LAYER THICK-NESS	GRAPHIC LOG	SAMPLE DESCRIPTION	SAMPLE NO.	SAMPLE TYPE REC	SAMPLE DEPTH (FEET)	BLOWS PER 6 INCHES	SPT N	M/C (%)	RQD PP*
		0.2		ASPHALT (2.5")							
		0.5		CONCRETE (6")							
	1–29	13.3		Medium Stiff Brown CLAY, trace sand, race gravel, moist (CL)	1	SS	3.5 5	2 - 3 - 2	5		1.0
					2	SS	8.5 10	3 - 4 - 4	8		1.0
		5.5		Very Stiff Brown Fat CLAY, trace sand, trace gravel, moist (CH)	3	SS	13.5 15	5 - 8 - 10	18		2.75
					4	SS	18 19.5	5 - 5 - 8	13		3.0
				Boring Terminated at 19.5 feet							

* Pocket Penetrometer Reading - Unconfined Compressive Strength, Tons/Sq.Ft.

Ground Water Observations:

DATE	TIME	CASING DEPTH	CAVE-IN	BAILED	WATER LEVEL
3/25/2020		18.0			None ▽
3/25/2020			10.0		None ▼
					▼

BORING METHOD
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
DC - Driving Casings
MD - Mud Drillings

SAMPLE TYPE
SS - Split Spoon
ST - Shelby Tube
CA - Continuous Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Remarks: Backfilled with cuttings

BORING LOG REPORT D142-MO.GPJ 7NT TEMPLATE.GDT 4/10/20

LOG OF TEST BORING

7NT

BORING NO.: RB20-3 (Sheet 1/1)

CLIENT: HDR
PROJECT: Brentwood & Red Bud
LOCATION: St. Louis, MO
PROJECT NO: D142-MO DRILLER/INSP: DS/DS
BORING METHOD: HSA RIG TYPE: CME 550 Black

DATE STARTED: 3-25-20 COMPLETED: 3-25-20
TEMPERATURE/WEATHER: Sunny, 60 Degrees
NORTH: EAST:
ELEVATION: LINE:
CORE SIZE: HAMMER: Auto

ELEV. (FEET)	DEPTH SCALE (FEET)	LAYER THICK-NESS	GRAPHIC LOG	SAMPLE DESCRIPTION	SAMPLE NO.	SAMPLE TYPE REC	SAMPLE DEPTH (FEET)	BLOWS PER 6 INCHES	SPT N	M/C (%)	RQD PP*
	0	0.6		ASPHALT (7.5")							
	1			Medium Stiff Brown CLAY, trace sand, moist (CL)							
	2										
	3	4.4									
	4				1	SS	3.5 5	3 - 3 - 4	7		2.25
	5			Medium Stiff Brown CLAY, trace sand, trace gravel, moist (CL)							
	6										
	7										
	8										
	9				2	SS	8.5 10	2 - 3 - 4	7		2.0
	10										
	11										
	12	14.0									
	13										
	14				3	SS	13.5 15	3 - 3 - 3	6		1.5
	15										
	16										
	17										
	18										
	19				4	SS	18.5 20	3 - 4 - 7	11		1.25
	20			Stiff Brown CLAY, trace sand, trace gravel, moist (CL)							
	21										
	22	6.0									
	23										
	24				5	SS	23.5 25	4 - 6 - 8	14		3.25
	25										
	26			Very Stiff Brown Fat CLAY, weathered Claystone residual soil (CH)							
	27										
	28	5.5									
	29				6	SS	29 30.5	7 - 10 - 16	26		3.5
	30										
	31			Boring Terminated at 30.5 feet							
	32										
	33										
	34										

* Pocket Penetrometer Reading - Unconfined Compressive Strength, Tons/Sq.Ft.

Ground Water Observations:

DATE	TIME	CASING DEPTH	CAVE-IN	BAILED	WATER LEVEL
3/25/2020		29.0			None ▽
3/25/2020			14.5		None ▼
					▼

BORING METHOD
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
DC - Driving Casings
MD - Mud Drillings

SAMPLE TYPE
SS - Split Spoon
ST - Shelby Tube
CA - Continuous Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Remarks: Backfilled with cuttings

BORING LOG REPORT D142-MO.GPJ 7NT TEMPLATE.GDT 4/10/20

LOG OF TEST BORING

7NT

BORING NO.: RB20-4 (Sheet 1/1)

CLIENT: HDR
PROJECT: Brentwood & Red Bud
LOCATION: St. Louis, MO
PROJECT NO: D142-MO DRILLER/INSP: DS/DS
BORING METHOD: HSA RIG TYPE: CME 550 Black

DATE STARTED: 3-24-20 COMPLETED: 3-24-20
TEMPERATURE/WEATHER: Partly Cloudy, 40 Degrees
NORTH: EAST:
ELEVATION: LINE:
CORE SIZE: HAMMER: Auto

ELEV. (FEET)	DEPTH SCALE (FEET)	LAYER THICK-NESS	GRAPHIC LOG	SAMPLE DESCRIPTION	SAMPLE NO.	SAMPLE TYPE REC	SAMPLE DEPTH (FEET)	BLOWS PER 6 INCHES	SPT N	M/C (%)	RQD PP*
	0	0.3		TOPSOIL (4")	1	SS	0	1 - 2 - 2	4		0.5
	1			Soft Brown CLAY, trace sand, trace gravel, moist (CL)			1.5				
	2	4.7									
	5			Medium Stiff Brown CLAY, trace sand, trace gravel, moist (CL)	2	SS	5	4 - 4 - 4	8		1.5
	7	5.0					6.5				
	10			Stiff to Very Stiff Brown Fat CLAY, trace sand, trace gravel, moist (CH)	3	SS	10	4 - 5 - 6	11		2.5
	15				4	SS	11.5	4 - 5 - 7	12		3.25
	17	15.0					15				
	21				5	SS	16.5	6 - 8 - 11	19		3.25
	25			Cobbles in Split Spoon, little recovery	6	SS	21	50/4" - -			
	27	5.0					21.5				
	30			Weathered CLAYSTONE	7	SS	25	15 - 17 - 20	37		4.5+
	31	1.5					26.5				
	32			Boring Terminated at 31.5 feet			30				
	34						31.5				

* Pocket Penetrometer Reading - Unconfined Compressive Strength, Tons/Sq.Ft.

Ground Water Observations:

DATE	TIME	CASING DEPTH	CAVE-IN	BAILED	WATER LEVEL
3/24/2020		30.0			None ▽
3/24/2020			16.5		None ▼
					▼

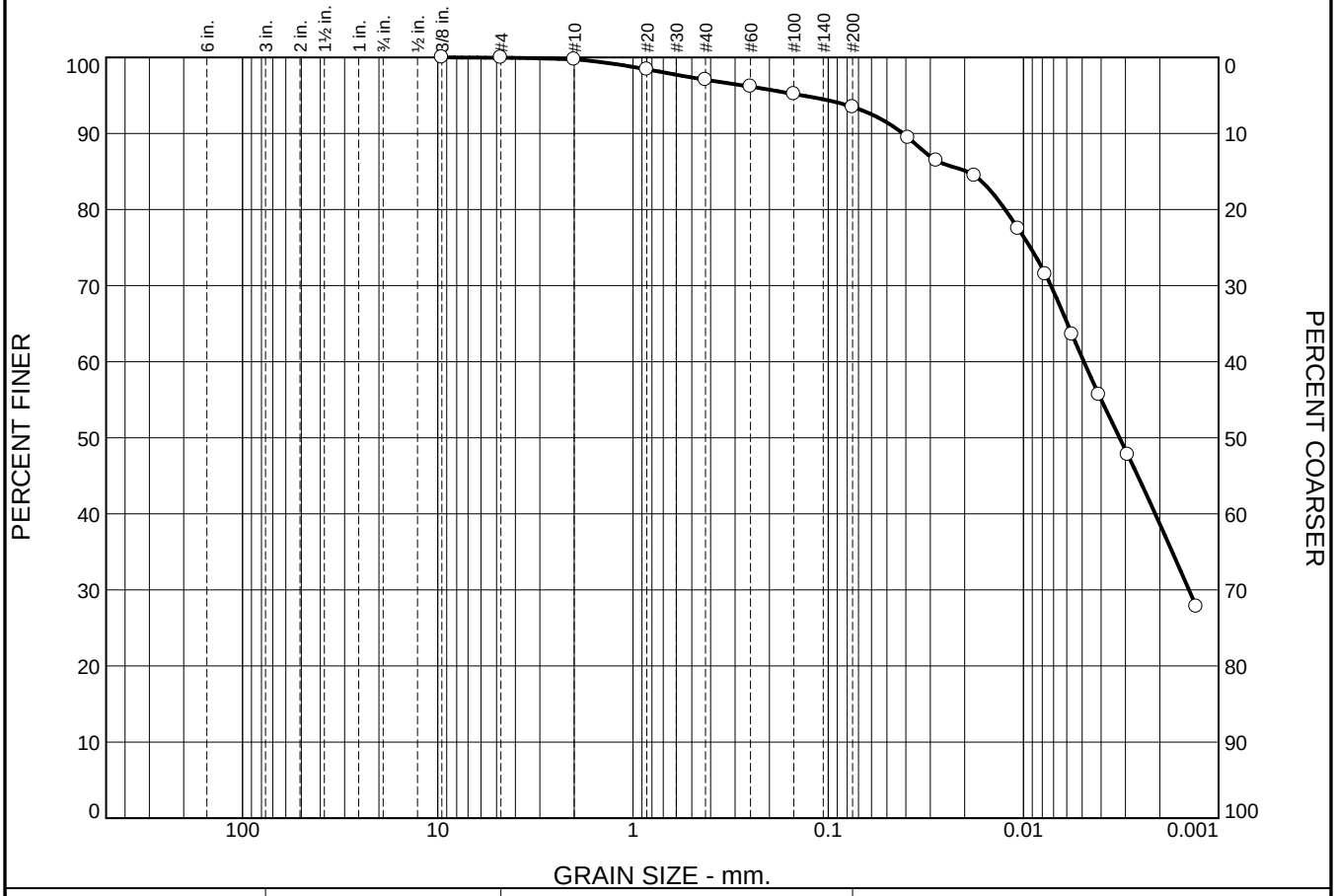
BORING METHOD
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
DC - Driving Casings
MD - Mud Drillings

SAMPLE TYPE
SS - Split Spoon
ST - Shelby Tube
CA - Continuous Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Remarks: Backfilled with cuttings

BORING LOG REPORT D142-MO.GPJ 7NT TEMPLATE.GDT 4/10/20

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.3	2.6	3.6	33.0	60.5

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.375	100.0		
#4	100.0		
#10	99.7		
#20	98.4		
#40	97.1		
#60	96.2		
#100	95.2		
#200	93.5		

* (no specification provided)

Material Description

brown/red fat CLAY

Atterberg Limits

PL= 29 LL= 52 PI= 23

Coefficients

D_{90}= 0.0414 D_{85}= 0.0195 D_{60}= 0.0049
D_{50}= 0.0032 D_{30}= 0.0014 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= CH AASHTO= A-7-6(26)

Remarks

Lab No.: 0160

Location: RB-3 SS-4
Sample Number: 0160 **Depth:** 13.5' - 15.0' **Date:** 8/27/19

7NT

Client: HDR Engineering, Inc.
Project: Brentwood/Red Bud CSO Interceptor - St. Louis, MO

Project No: D142-MO **Figure**

GRAIN SIZE DISTRIBUTION TEST DATA

8/28/2019

Client: HDR Engineering, Inc.
Project: Brentwood/Red Bud CSO Interceptor - St. Louis, MO
Project Number: D142-MO
Location: RB-3 SS-4
Depth: 13.5' - 15.0' **Sample Number:** 0160
Material Description: brown/red fat CLAY
Date: 8/27/19 **PL:** 29 **LL:** 52 **PI:** 23
USCS Classification: CH **AASHTO Classification:** A-7-6(26)
Testing Remarks: Lab No.: 0160

Sieve Test Data

Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer	Percent Retained
356.90	15.82	0.00	0.375	0.00	100.0	0.0
			#4	0.12	100.0	0.0
			#10	0.87	99.7	0.3
52.30	0.00	0.00	#20	0.69	98.4	1.6
			#40	1.41	97.1	2.9
			#60	1.88	96.2	3.8
			#100	2.39	95.2	4.8
			#200	3.28	93.5	6.5

Hydrometer Test Data

Hydrometer test uses material passing #10
Percent passing #10 based upon complete sample = 99.7
Weight of hydrometer sample =52.30
Hygroscopic moisture correction:
Moist weight and tare = 44.40
Dry weight and tare = 43.79
Tare weight = 29.96
Hygroscopic moisture = 4.4%
Automatic temperature correction
Composite correction (fluid density and meniscus height) at 20 deg. C = -5.0
Meniscus correction only = 0.0
Specific gravity of solids = 2.65
Hydrometer type = 152H
Hydrometer effective depth equation: L = 16.294964 **-** 0.164 **x Rm**

Elapsed Time (min.)	Temp. (deg. C.)	Actual Reading	Corrected Reading	K	Rm	Eff. Depth	Diameter (mm.)	Percent Finer	Percent Retained
1.00	19.8	50.0	44.9	0.0137	50.0	8.1	0.0389	89.4	10.6
2.00	19.8	48.5	43.4	0.0137	48.5	8.3	0.0279	86.5	13.5
5.00	19.8	47.5	42.4	0.0137	47.5	8.5	0.0178	84.5	15.5
15.00	19.8	44.0	38.9	0.0137	44.0	9.1	0.0106	77.5	22.5
30.00	19.8	41.0	35.9	0.0137	41.0	9.6	0.0077	71.5	28.5
60.00	19.9	37.0	31.9	0.0137	37.0	10.2	0.0056	63.6	36.4
120.00	20.0	33.0	28.0	0.0136	33.0	10.9	0.0041	55.7	44.3
250.00	20.2	29.0	24.0	0.0136	29.0	11.5	0.0029	47.8	52.2
1440.00	20.1	19.0	14.0	0.0136	19.0	13.2	0.0013	27.8	72.2

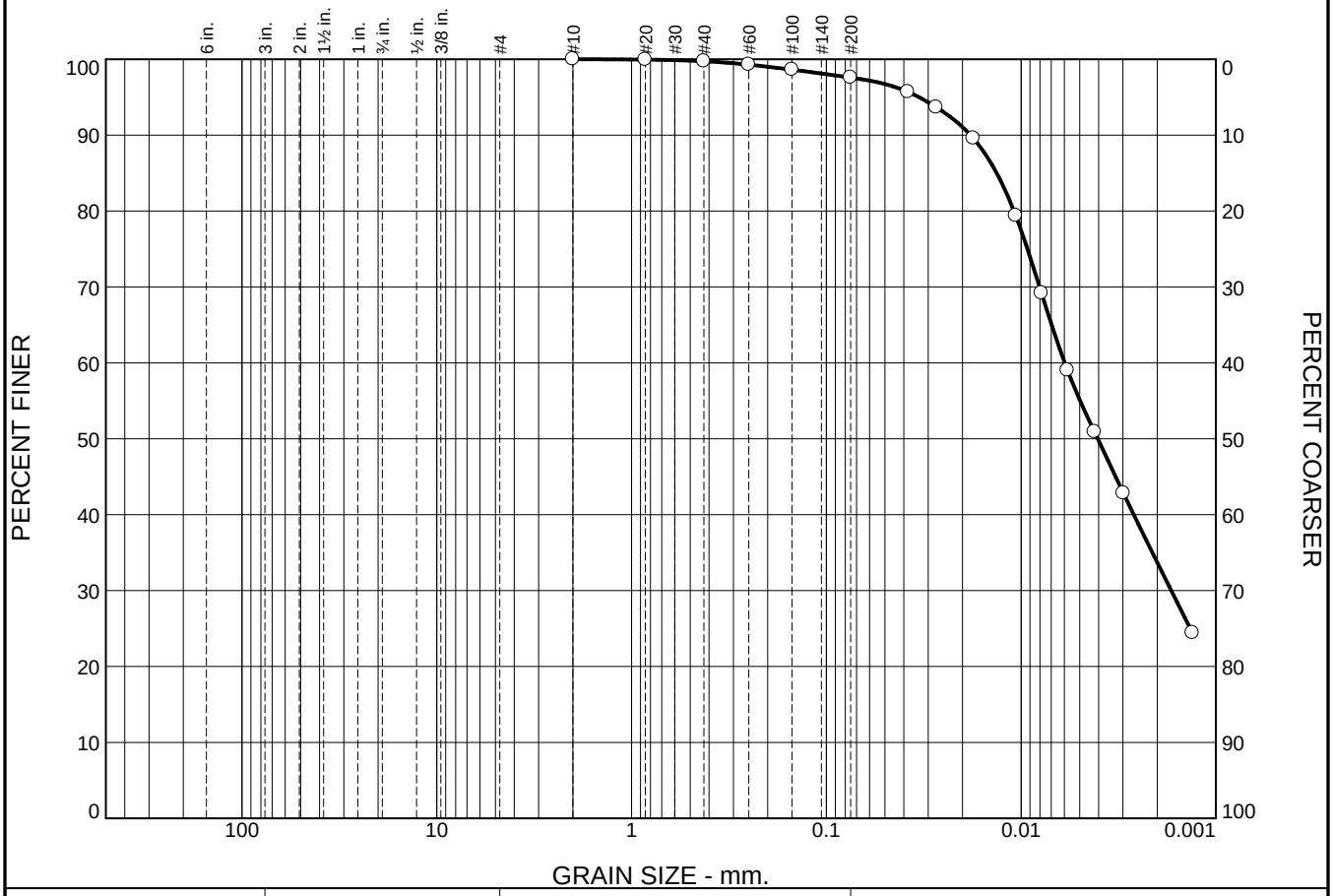
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	0.0	0.0	0.0	0.3	2.6	3.6	6.5	33.0	60.5	93.5

D_5	D_{10}	D_{15}	D_{20}	D_{30}	D_{40}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
				0.0014	0.0021	0.0032	0.0049	0.0124	0.0195	0.0414	0.1360

Fineness Modulus
0.12

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.3	2.1	42.5	55.1

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	100.0		
#20	99.9		
#40	99.7		
#60	99.3		
#100	98.6		
#200	97.6		

* (no specification provided)

Material Description

brown fat CLAY

Atterberg Limits

PL= 28 LL= 51 PI= 23

Coefficients

D_{90}= 0.0182 D_{85}= 0.0133 D_{60}= 0.0060
D_{50}= 0.0040 D_{30}= 0.0017 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= CH AASHTO= A-7-6(27)

Remarks

Lab No.: 0160

Location: RB-8 SS-4
Sample Number: 0160 **Depth:** 18.5' - 20.0' **Date:** 8/27/19

7NT

Client: HDR Engineering, Inc.
Project: Brentwood/Red Bud CSO Interceptor - St. Louis, MO

Project No: D142-MO **Figure**

GRAIN SIZE DISTRIBUTION TEST DATA

8/28/2019

Client: HDR Engineering, Inc.
Project: Brentwood/Red Bud CSO Interceptor - St. Louis, MO
Project Number: D142-MO
Location: RB-8 SS-4
Depth: 18.5' - 20.0' **Sample Number:** 0160
Material Description: brown fat CLAY
Date: 8/27/19 **PL:** 28 **LL:** 51 **PI:** 23
USCS Classification: CH **AASHTO Classification:** A-7-6(27)
Testing Remarks: Lab No.: 0160

Sieve Test Data

Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer	Percent Retained
399.74	15.84	0.00	#10	0.00	100.0	0.0
52.88	0.00	0.00	#20	0.03	99.9	0.1
			#40	0.14	99.7	0.3
			#60	0.38	99.3	0.7
			#100	0.73	98.6	1.4
			#200	1.28	97.6	2.4

Hydrometer Test Data

Hydrometer test uses material passing #10
Percent passing #10 based upon complete sample = 100.0
Weight of hydrometer sample =52.88
Hygroscopic moisture correction:
Moist weight and tare = 57.87
Dry weight and tare = 55.65
Tare weight = 27.43
Hygroscopic moisture = 7.9%
Automatic temperature correction
Composite correction (fluid density and meniscus height) at 20 deg. C = -5.0
Meniscus correction only = 0.0
Specific gravity of solids = 2.65
Hydrometer type = 152H
Hydrometer effective depth equation: L = 16.294964 **-** 0.164 **x Rm**

Elapsed Time (min.)	Temp. (deg. C.)	Actual Reading	Corrected Reading	K	Rm	Eff. Depth	Diameter (mm.)	Percent Finer	Percent Retained
1.00	19.8	52.0	46.9	0.0137	52.0	7.8	0.0381	95.7	4.3
2.00	19.8	51.0	45.9	0.0137	51.0	7.9	0.0272	93.7	6.3
5.00	19.8	49.0	43.9	0.0137	49.0	8.3	0.0176	89.6	10.4
15.00	19.8	44.0	38.9	0.0137	44.0	9.1	0.0106	79.4	20.6
30.00	19.8	39.0	33.9	0.0137	39.0	9.9	0.0079	69.2	30.8
60.00	19.9	34.0	28.9	0.0137	34.0	10.7	0.0058	59.0	41.0
120.00	20.0	30.0	25.0	0.0136	30.0	11.4	0.0042	50.9	49.1
250.00	20.2	26.0	21.0	0.0136	26.0	12.0	0.0030	42.8	57.2
1440.00	20.1	17.0	12.0	0.0136	17.0	13.5	0.0013	24.4	75.6

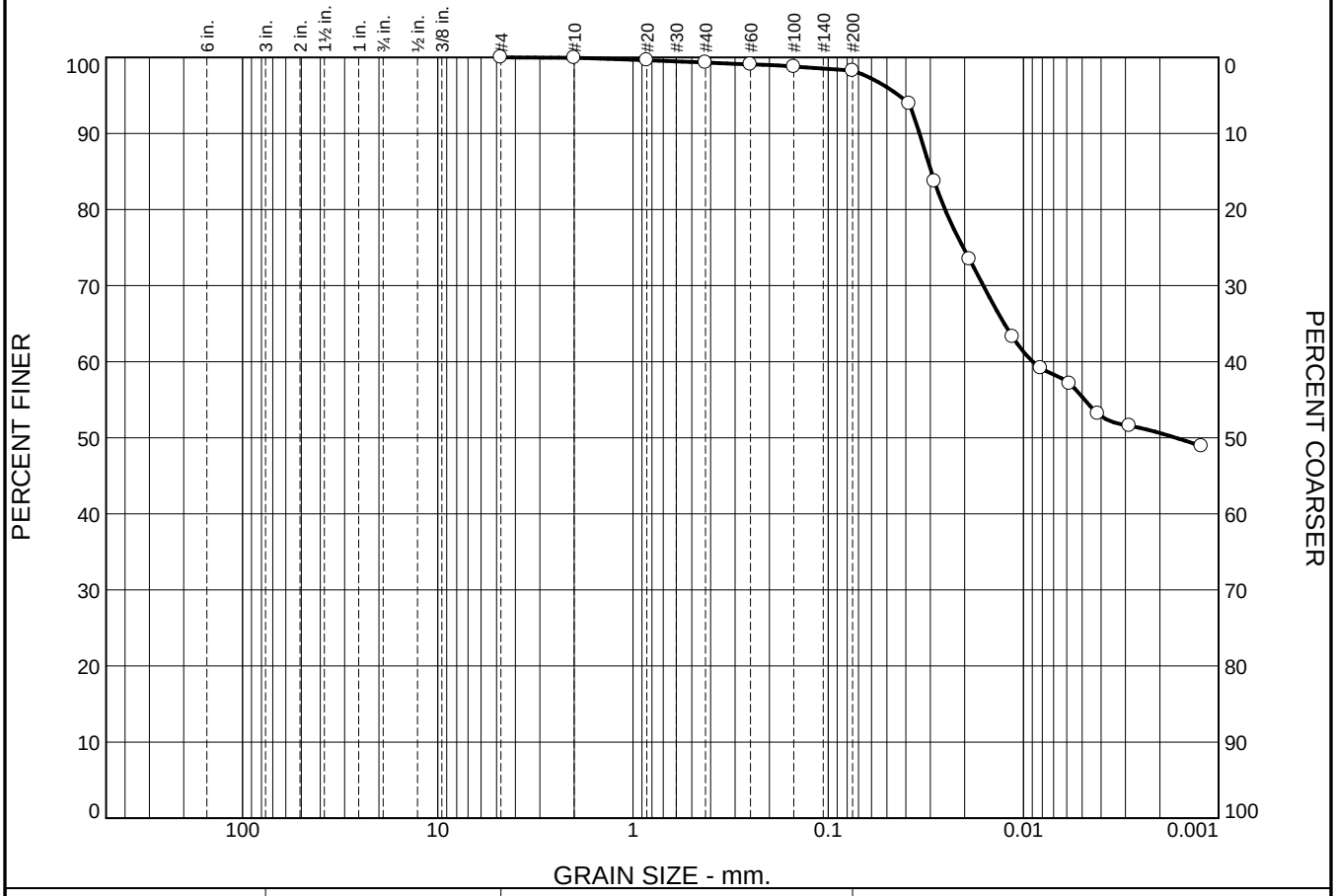
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	0.0	0.0	0.0	0.0	0.3	2.1	2.4	42.5	55.1	97.6

D_5	D_{10}	D_{15}	D_{20}	D_{30}	D_{40}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
				0.0017	0.0026	0.0040	0.0060	0.0109	0.0133	0.0182	0.0334

Fineness Modulus
0.02

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.1	0.6	1.0	42.9	55.4

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	99.9		
#20	99.6		
#40	99.3		
#60	99.1		
#100	98.8		
#200	98.3		

* (no specification provided)

Material Description

brown fat CLAY

Atterberg Limits

PL= 21 LL= 72 PI= 51

Coefficients

D_{90}= 0.0341 D_{85}= 0.0297 D_{60}= 0.0090
D_{50}= 0.0017 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= CH AASHTO= A-7-6(57)

Remarks

Lab No.: 0160

Location: RB-15 SS-3
Sample Number: 0160 **Depth:** 8.5' - 10.0' **Date:** 8/27/19

7NT

Client: HDR Engineering, Inc.
Project: Brentwood/Red Bud CSO Interceptor - St. Louis, MO

Project No: D142-MO **Figure**

GRAIN SIZE DISTRIBUTION TEST DATA

8/28/2019

Client: HDR Engineering, Inc.
Project: Brentwood/Red Bud CSO Interceptor - St. Louis, MO
Project Number: D142-MO
Location: RB-15 SS-3
Depth: 8.5' - 10.0' **Sample Number:** 0160
Material Description: brown fat CLAY
Date: 8/27/19 **PL:** 21 **LL:** 72 **PI:** 51
USCS Classification: CH **AASHTO Classification:** A-7-6(57)
Testing Remarks: Lab No.: 0160

Sieve Test Data

Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer	Percent Retained
242.16	15.76	0.00	#4	0.00	100.0	0.0
			#10	0.14	99.9	0.1
53.39	0.00	0.00	#20	0.17	99.6	0.4
			#40	0.33	99.3	0.7
			#60	0.46	99.1	0.9
			#100	0.62	98.8	1.2
			#200	0.90	98.3	1.7

Hydrometer Test Data

Hydrometer test uses material passing #10
Percent passing #10 based upon complete sample = 99.9
Weight of hydrometer sample =53.39
Hygroscopic moisture correction:
Moist weight and tare = 46.24
Dry weight and tare = 44.91
Tare weight = 30.52
Hygroscopic moisture = 9.2%
Automatic temperature correction
Composite correction (fluid density and meniscus height) at 20 deg. C = -5.0
Meniscus correction only = 0.0
Specific gravity of solids = 2.65
Hydrometer type = 152H
Hydrometer effective depth equation: L = 16.294964 **-** 0.164 **x Rm**

Elapsed Time (min.)	Temp. (deg. C.)	Actual Reading	Corrected Reading	K	Rm	Eff. Depth	Diameter (mm.)	Percent Finer	Percent Retained
1.00	19.9	51.0	45.9	0.0137	51.0	7.9	0.0385	93.9	6.1
2.00	19.9	46.0	40.9	0.0137	46.0	8.8	0.0286	83.7	16.3
5.00	19.9	41.0	35.9	0.0137	41.0	9.6	0.0189	73.5	26.5
15.00	19.9	36.0	30.9	0.0137	36.0	10.4	0.0114	63.3	36.7
30.00	19.9	34.0	28.9	0.0137	34.0	10.7	0.0082	59.2	40.8
60.00	19.9	33.0	27.9	0.0137	33.0	10.9	0.0058	57.1	42.9
120.00	20.2	31.0	26.0	0.0136	31.0	11.2	0.0042	53.2	46.8
250.00	21.2	30.0	25.2	0.0134	30.0	11.4	0.0029	51.6	48.4
1440.00	19.8	29.0	23.9	0.0137	29.0	11.5	0.0012	48.9	51.1

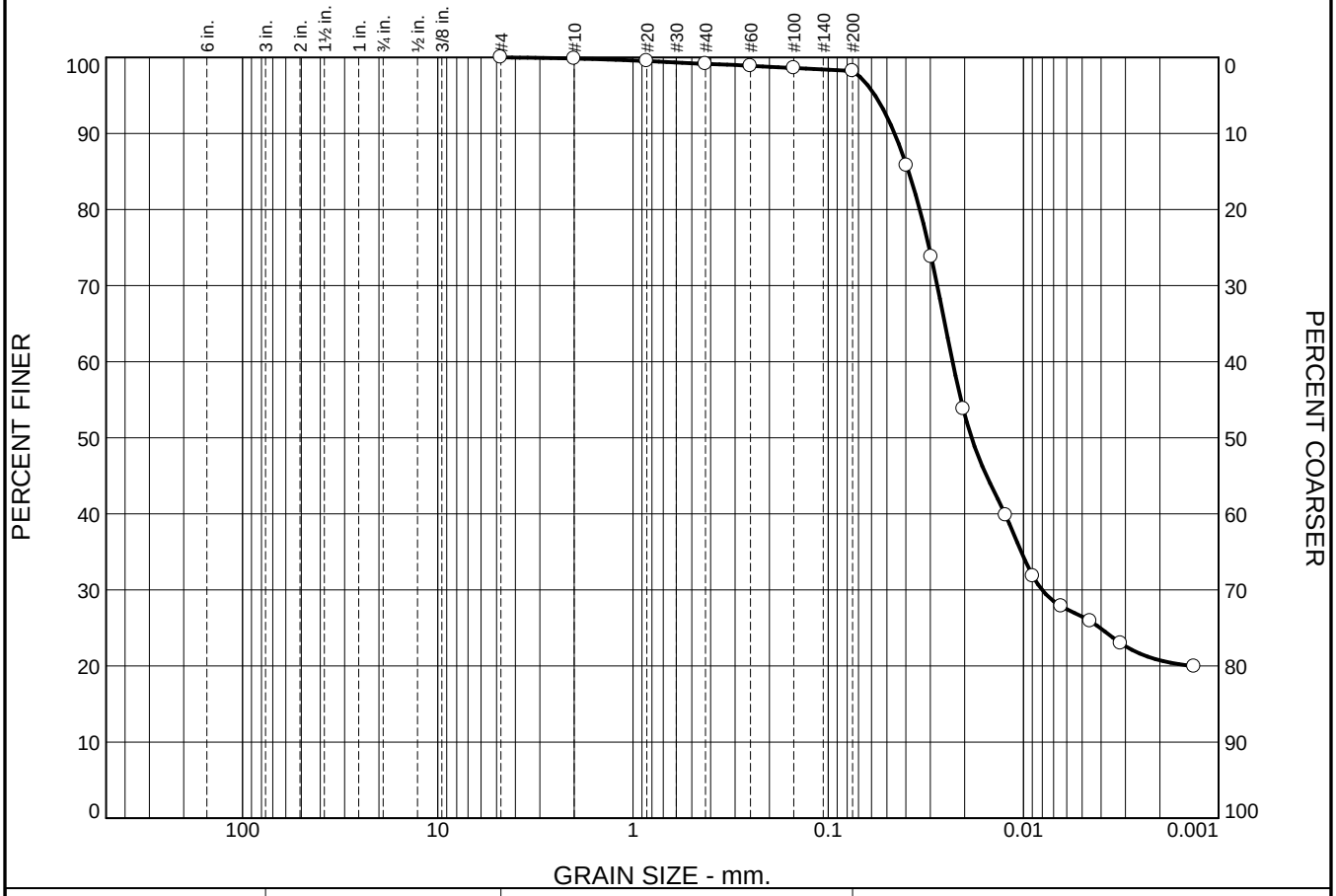
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	0.0	0.0	0.0	0.1	0.6	1.0	1.7	42.9	55.4	98.3

D_5	D_{10}	D_{15}	D_{20}	D_{30}	D_{40}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
						0.0017	0.0090	0.0252	0.0297	0.0341	0.0434

Fineness Modulus
0.03

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.2	0.7	0.9	71.7	26.5

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	99.8		
#20	99.5		
#40	99.1		
#60	98.9		
#100	98.6		
#200	98.2		

* (no specification provided)

Material Description

brown lean CLAY

Atterberg Limits

PL= 21 LL= 35 PI= 14

Coefficients

D_{90}= 0.0457 D_{85}= 0.0388 D_{60}= 0.0231
D_{50}= 0.0184 D_{30}= 0.0080 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= CL AASHTO= A-6(14)

Remarks

Lab No.: 0160

Location: L19-1 SS-2
Sample Number: 0160 **Depth:** 8.5' - 10.0' **Date:** 8/27/19

7NT

Client: HDR Engineering, Inc.
Project: Brentwood/Red Bud CSO Interceptor - St. Louis, MO

Project No: D142-MO **Figure**

GRAIN SIZE DISTRIBUTION TEST DATA

8/28/2019

Client: HDR Engineering, Inc.
Project: Brentwood/Red Bud CSO Interceptor - St. Louis, MO
Project Number: D142-MO
Location: L19-1 SS-2
Depth: 8.5' - 10.0' **Sample Number:** 0160
Material Description: brown lean CLAY
Date: 8/27/19 **PL:** 21 **LL:** 35 **PI:** 14
USCS Classification: CL **AASHTO Classification:** A-6(14)
Testing Remarks: Lab No.: 0160

Sieve Test Data

Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer	Percent Retained
467.15	13.48	0.00	#4	0.00	100.0	0.0
			#10	0.71	99.8	0.2
51.43	0.00	0.00	#20	0.17	99.5	0.5
			#40	0.36	99.1	0.9
			#60	0.50	98.9	1.1
			#100	0.64	98.6	1.4
			#200	0.84	98.2	1.8

Hydrometer Test Data

Hydrometer test uses material passing #10
Percent passing #10 based upon complete sample = 99.8
Weight of hydrometer sample =51.43
Hygroscopic moisture correction:
Moist weight and tare = 62.95
Dry weight and tare = 62.02
Tare weight = 30.71
Hygroscopic moisture = 3.0%
Automatic temperature correction
Composite correction (fluid density and meniscus height) at 20 deg. C = -5.0
Meniscus correction only = 0.0
Specific gravity of solids = 2.65
Hydrometer type = 152H
Hydrometer effective depth equation: L = 16.294964 **-** 0.164 **x Rm**

Elapsed Time (min.)	Temp. (deg. C.)	Actual Reading	Corrected Reading	K	Rm	Eff. Depth	Diameter (mm.)	Percent Finer	Percent Retained
1.00	19.8	48.0	42.9	0.0137	48.0	8.4	0.0397	85.8	14.2
2.00	19.8	42.0	36.9	0.0137	42.0	9.4	0.0297	73.8	26.2
5.00	19.8	32.0	26.9	0.0137	32.0	11.0	0.0203	53.8	46.2
15.00	19.8	25.0	19.9	0.0137	25.0	12.2	0.0123	39.8	60.2
30.00	19.8	21.0	15.9	0.0137	21.0	12.9	0.0090	31.8	68.2
60.00	19.9	19.0	13.9	0.0137	19.0	13.2	0.0064	27.9	72.1
120.00	20.0	18.0	13.0	0.0136	18.0	13.3	0.0046	25.9	74.1
250.00	20.2	16.5	11.5	0.0136	16.5	13.6	0.0032	23.0	77.0
1440.00	20.1	15.0	10.0	0.0136	15.0	13.8	0.0013	20.0	80.0

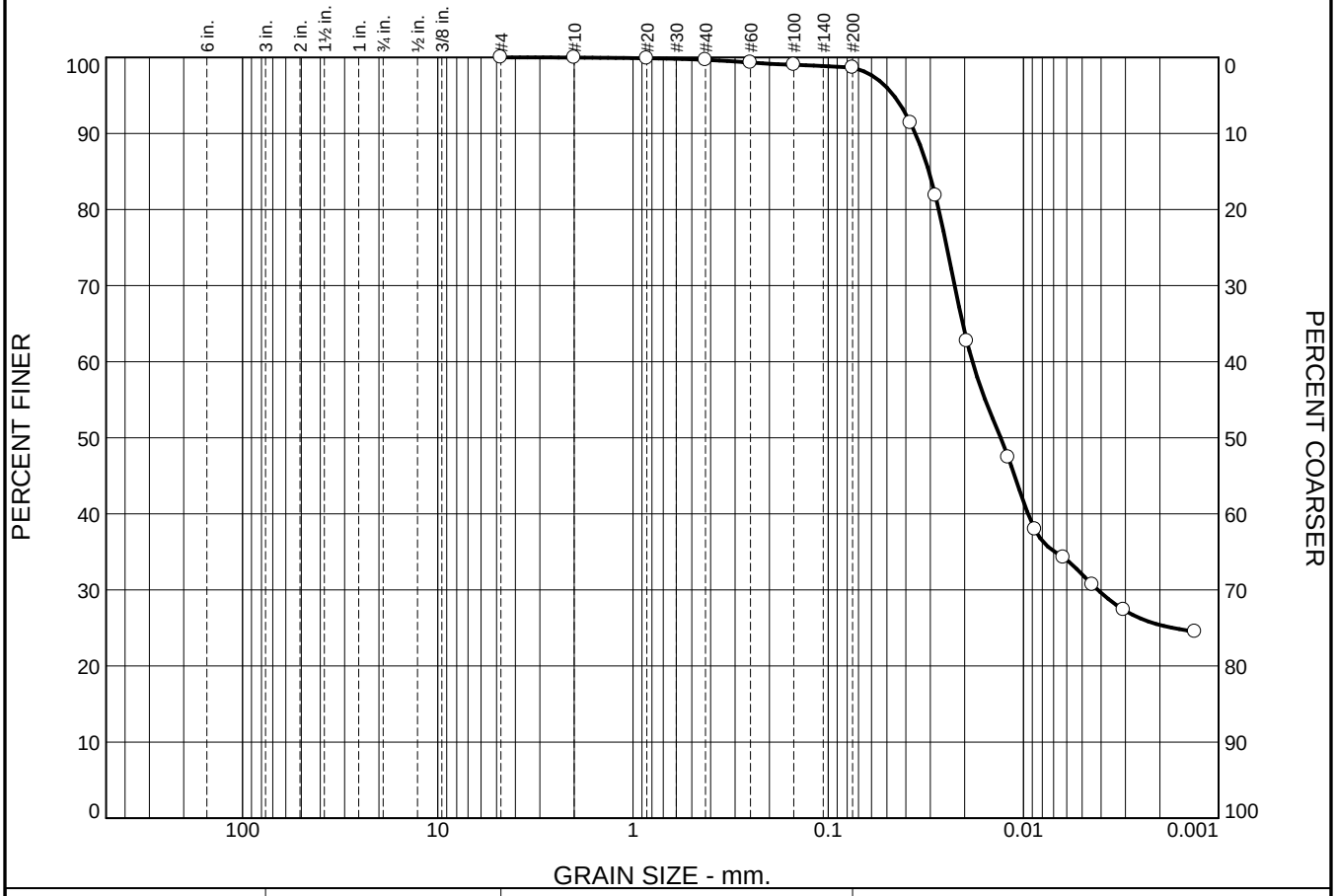
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	0.0	0.0	0.0	0.2	0.7	0.9	1.8	71.7	26.5	98.2

D_5	D_{10}	D_{15}	D_{20}	D_{30}	D_{40}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
			0.0014	0.0080	0.0124	0.0184	0.0231	0.0340	0.0388	0.0457	0.0575

Fineness Modulus
0.04

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.3	1.0	66.7	32.0

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	100.0		
#20	99.9		
#40	99.7		
#60	99.3		
#100	99.0		
#200	98.7		

* (no specification provided)

Material Description

brown lean CLAY

Atterberg Limits

PL= 18 LL= 38 PI= 20

Coefficients

D_{90}= 0.0358 D_{85}= 0.0305 D_{60}= 0.0183
D_{50}= 0.0131 D_{30}= 0.0042 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= CL AASHTO= A-6(21)

Remarks

Lab NO:291

Location: RB20-3 SS-1
Sample Number: 0291 **Depth:** 3.5'-5.0' **Date:** 4/9/2020

7NT

Client: HDR Engineering, Inc.
Project: Brentwood/Red Bud CSO Interceptor - St. Louis, MO

Project No: D142-MO **File**

GRAIN SIZE DISTRIBUTION TEST DATA

4/9/2020

Client: HDR Engineering, Inc.
Project: Brentwood/Red Bud CSO Interceptor - St. Louis, MO
Project Number: D142-MO
Location: RB20-3 SS-1
Depth: 3.5'-5.0' **Sample Number:** 0291
Material Description: brown lean CLAY
Date: 4/9/2020 **PL:** 18 **LL:** 38 **PI:** 20
USCS Classification: CL **AASHTO Classification:** A-6(21)
Testing Remarks: Lab NO:291

Sieve Test Data

Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer	Percent Retained
319.82	13.85	0.00	#4	0.00	100.0	0.0
			#10	0.08	100.0	0.0
53.80	0.00	0.00	#20	0.05	99.9	0.1
			#40	0.16	99.7	0.3
			#60	0.35	99.3	0.7
			#100	0.50	99.0	1.0
			#200	0.71	98.7	1.3

Hydrometer Test Data

Hydrometer test uses material passing #10
Percent passing #10 based upon complete sample = 100.0
Weight of hydrometer sample =53.80
Hygroscopic moisture correction:
Moist weight and tare = 41.28
Dry weight and tare = 40.90
Tare weight = 27.43
Hygroscopic moisture = 2.8%
Automatic temperature correction
Composite correction (fluid density and meniscus height) at 20 deg. C = -5.0
Meniscus correction only = 0.0
Specific gravity of solids = 2.65
Hydrometer type = 152H
Hydrometer effective depth equation: L = 16.294964 **-** 0.164 **x Rm**

Elapsed Time (min.)	Temp. (deg. C.)	Actual Reading	Corrected Reading	K	Rm	Eff. Depth	Diameter (mm.)	Percent Finer	Percent Retained
1.00	19.4	53.0	47.8	0.0137	53.0	7.6	0.0379	91.4	8.6
2.00	19.4	48.0	42.8	0.0137	48.0	8.4	0.0282	81.8	18.2
5.00	19.4	38.0	32.8	0.0137	38.0	10.1	0.0195	62.7	37.3
15.00	19.4	30.0	24.8	0.0137	30.0	11.4	0.0120	47.4	52.6
30.00	19.6	25.0	19.9	0.0137	25.0	12.2	0.0087	38.0	62.0
60.00	19.9	23.0	17.9	0.0137	23.0	12.5	0.0062	34.3	65.7
120.00	20.5	21.0	16.1	0.0136	21.0	12.9	0.0044	30.7	69.3
250.00	21.7	19.0	14.3	0.0134	19.0	13.2	0.0031	27.4	72.6
1440.00	19.4	18.0	12.8	0.0137	18.0	13.3	0.0013	24.5	75.5

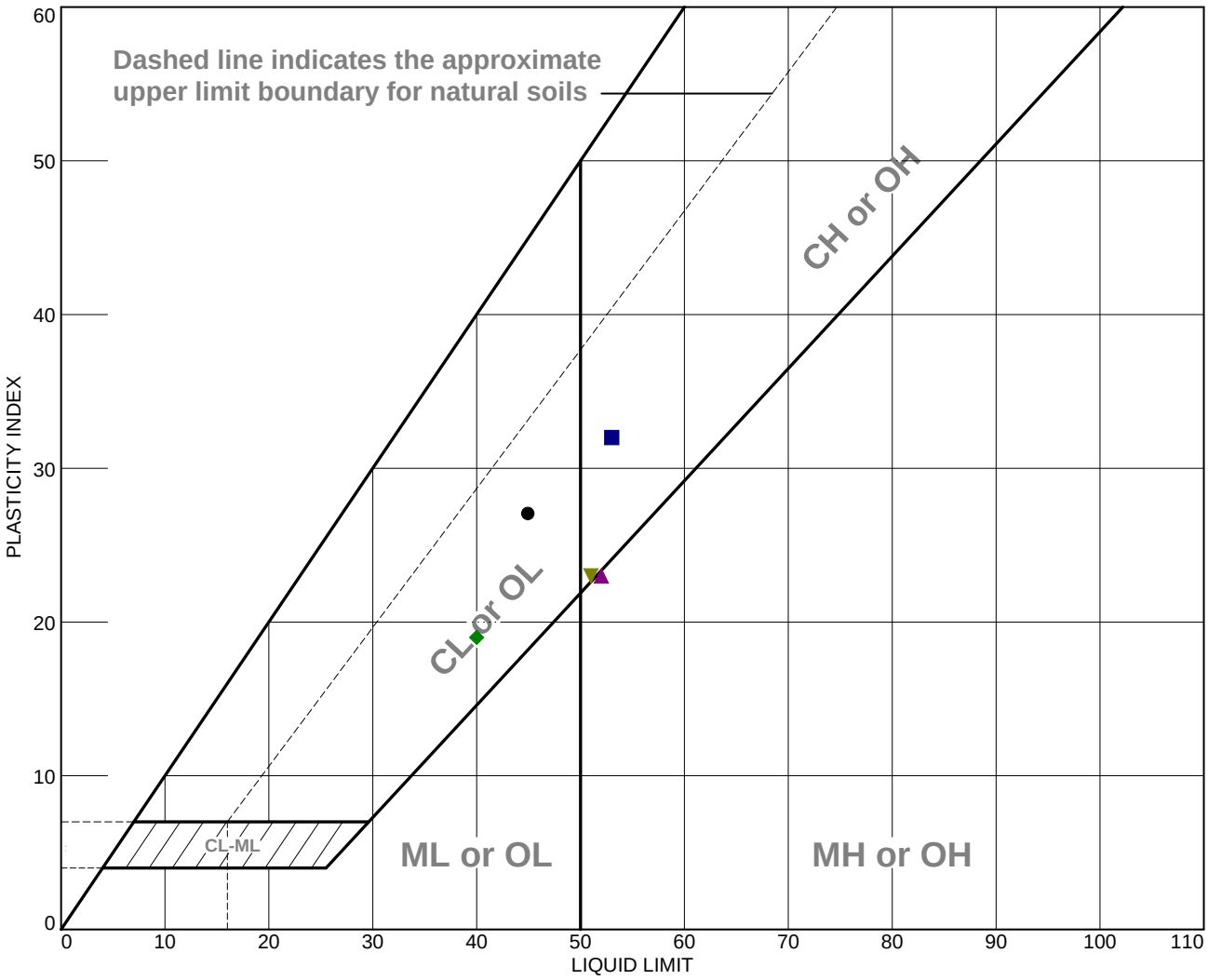
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	0.0	0.0	0.0	0.0	0.3	1.0	1.3	66.7	32.0	98.7

D_5	D_{10}	D_{15}	D_{20}	D_{30}	D_{40}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
				0.0042	0.0095	0.0131	0.0183	0.0271	0.0305	0.0358	0.0462

Fineness Modulus
0.02

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	brown lean CLAY (visual)	45	18	27			
■	gray/brown fat CLAY (visual)	53	21	32			
▲	brown/red fat CLAY	52	29	23	97.1	93.5	CH
◆	brown lean CLAY (visual)	40	21	19			
▼	brown fat CLAY	51	28	23	99.7	97.6	CH

Project No. D142-MO **Client:** HDR Engineering, Inc.

Project: Brentwood/Red Bud CSO Interceptor - St. Louis, MO

●	**Location:** RB-1 SS-3	**Depth:** 8.5' - 10.0'	**Sample Number:** 0160
■	**Location:** RB-1 SS-4	**Depth:** 13.5' - 15.0'	**Sample Number:** 0160
▲	**Location:** RB-3 SS-4	**Depth:** 13.5' - 15.0'	**Sample Number:** 0160
◆	**Location:** RB-8 SS-2	**Depth:** 8.5' - 10.0'	**Sample Number:** 0160
▼	**Location:** RB-8 SS-4	**Depth:** 18.5' - 20.0'	**Sample Number:** 0160

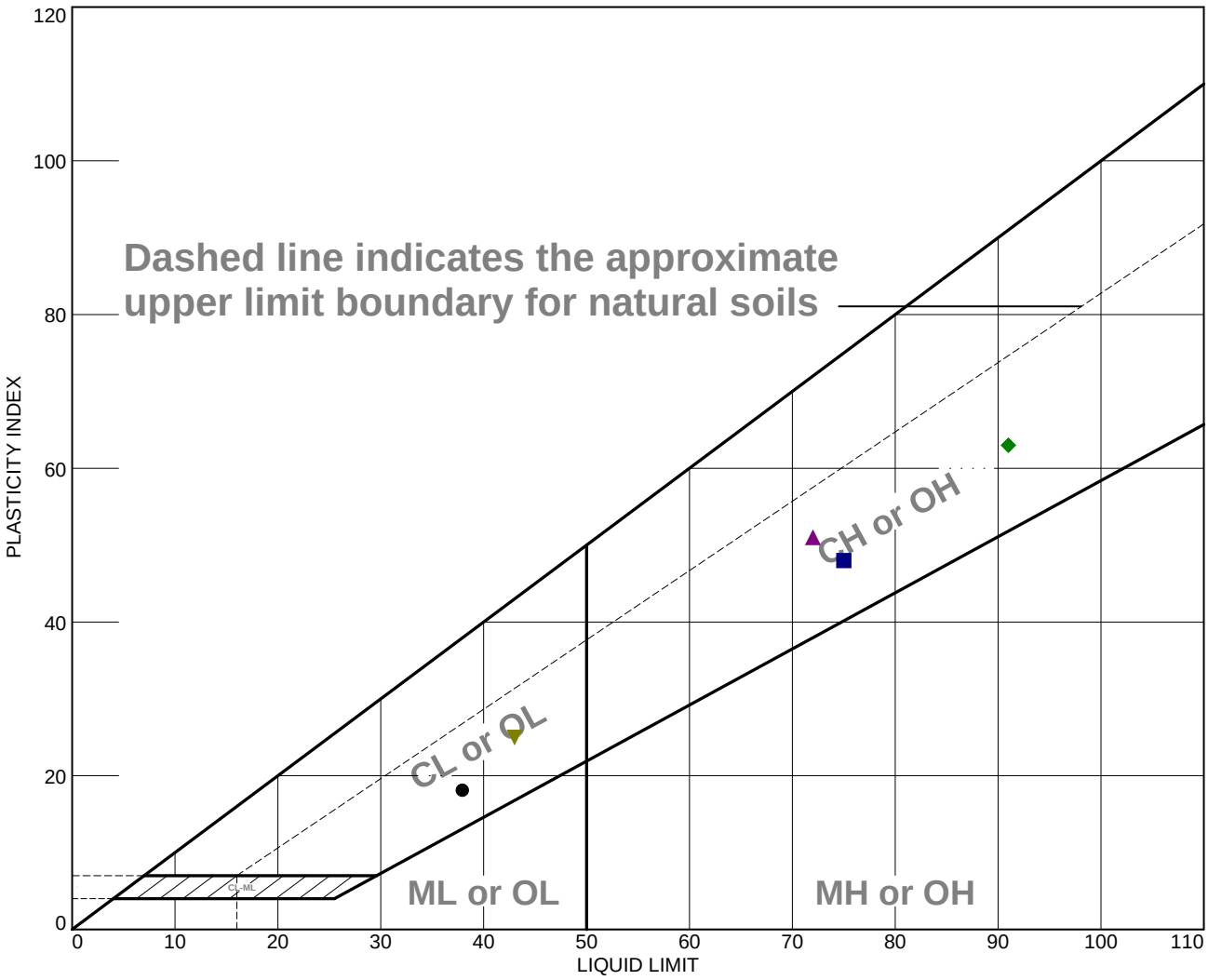
7NT

Remarks:

●Lab No.: 0160
■Lab No.: 0160
▲Lab No.: 0160
◆Lab No.: 0160
▼Lab No.: 0160

Figure

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	gray lean CLAY (visual)	38	20	18			
■	gray fat CLAY (visual)	75	27	48			
▲	brown fat CLAY	72	21	51	99.3	98.3	CH
◆	brown fat CLAY (visual)	91	28	63			
▼	brown lean CLAY (visual)	43	18	25			

Project No. D142-MO **Client:** HDR Engineering, Inc.

Project: Brentwood/Red Bud CSO Interceptor - St. Louis, MO

● **Location:** RB-12 SS-2 **Depth:** 3.5' - 5.0' **Sample Number:** 0160

■ **Location:** RB-14 SS-4 **Depth:** 16.5' - 18.0' **Sample Number:** 0160

▲ **Location:** RB-15 SS-3 **Depth:** 8.5' - 10.0' **Sample Number:** 0160

◆ **Location:** RB-17 SS-2 **Depth:** 8.5' - 10.0' **Sample Number:** 0160

▼ **Location:** RB-16 SS-2 **Depth:** 8.5' - 10.0' **Sample Number:** 0160

7NT

Remarks:

● Lab No.: 0160

■ Lab No.: 0160

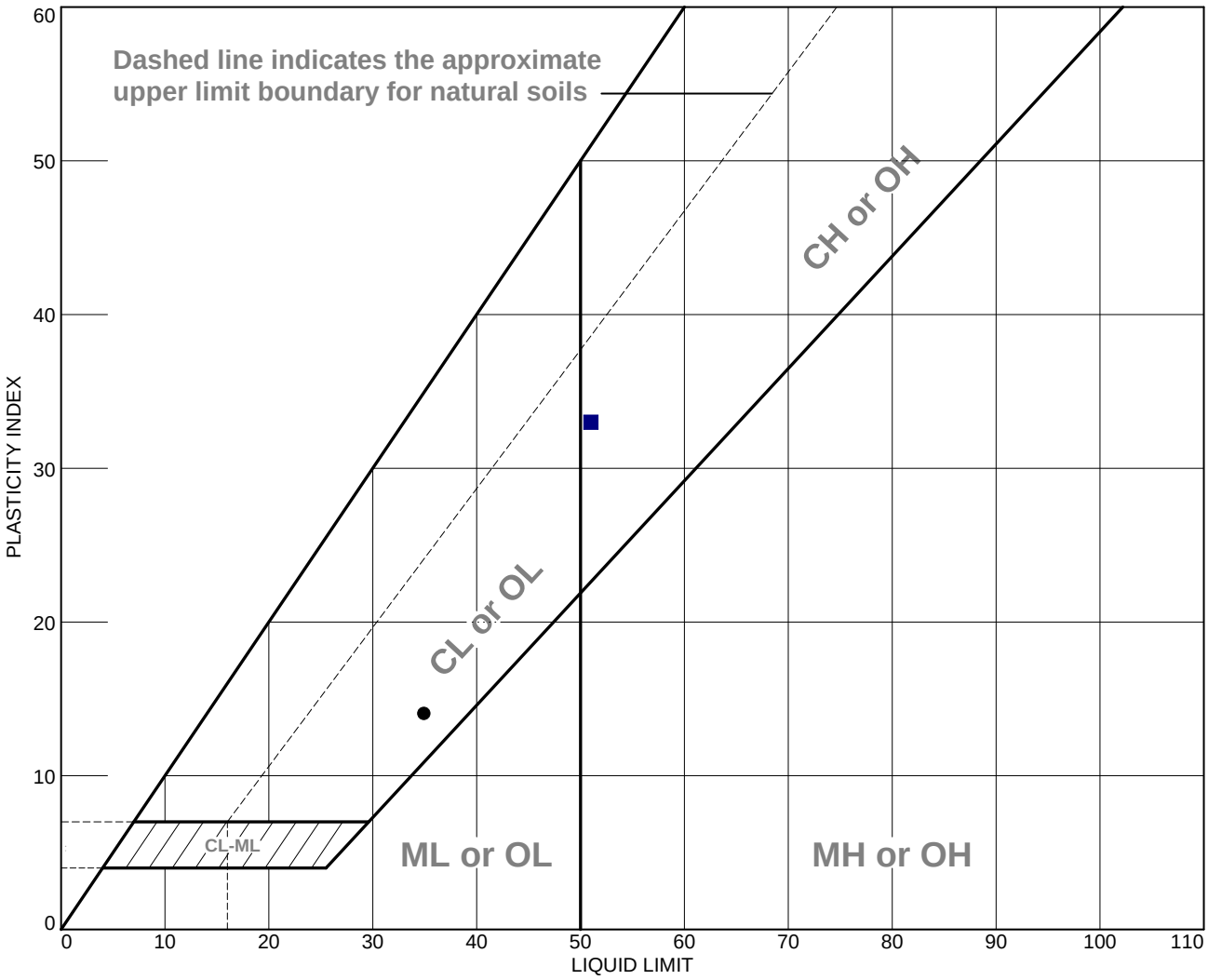
▲ Lab No.: 0160

◆ Lab No.: 0160

▼ Lab No.: 0160

Figure

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	brown lean CLAY	35	21	14	99.1	98.2	CL
■	brown/gray fat CLAY (visual)	51	18	33			

Project No. D142-MO **Client:** HDR Engineering, Inc.

Project: Brentwood/Red Bud CSO Interceptor - St. Louis, MO

●**Location:** L19-1 SS-2 **Depth:** 8.5' - 10.0' **Sample Number:** 0160

■**Location:** L19-2 SS-3 **Depth:** 13.5' - 15.0' **Sample Number:** 0160

Remarks:

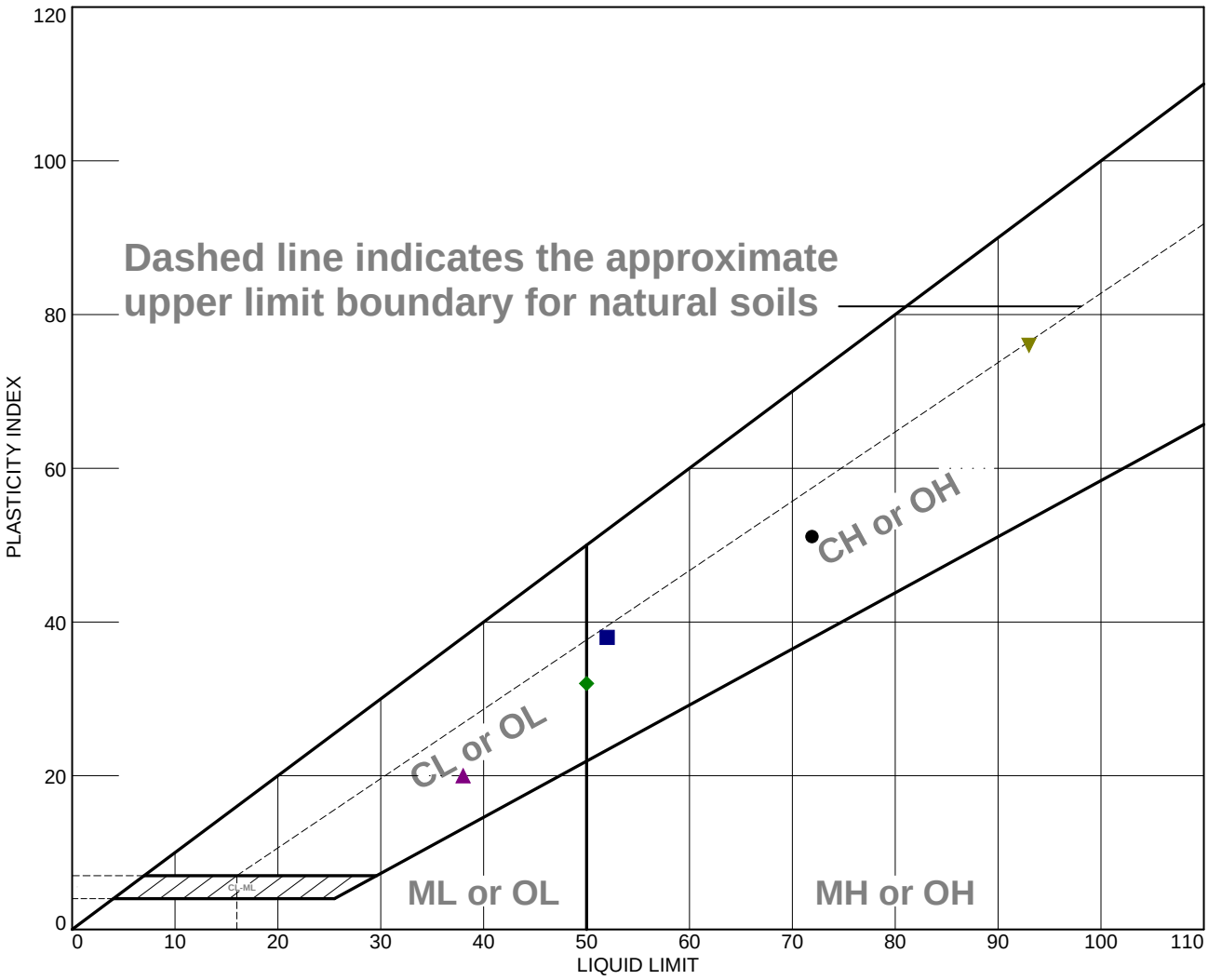
●Lab No.: 0160

■Lab No.: 0160

7NT

Figure

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●		72	21	51			
■		52	14	38			
▲	brown lean CLAY	38	18	20	99.7	98.7	CL
◆		50	18	32			
▼		93	17	76			

Project No. D142-MO **Client:** HDR Engineering, Inc.

Project: Brentwood/Red Bud CSO Interceptor - St. Louis, MO

● **Location:** RB20-1 SS-1 **Depth:** 3.5'-5.0' **Sample Number:** 0291

■ **Location:** RB20-2 SS-4 **Depth:** 18.0'-19.5' **Sample Number:** 0291

▲ **Location:** RB20-3 SS-1 **Depth:** 3.5'-5.0' **Sample Number:** 0291

◆ **Location:** RB20-3 SS-6 **Depth:** 29.0'-30.5' **Sample Number:** 0291

▼ **Location:** RB20-4 SS-3 **Depth:** 10.0'-11.5' **Sample Number:** 0291

7NT

Remarks:

● Lab NO:291

■ Lab NO:291

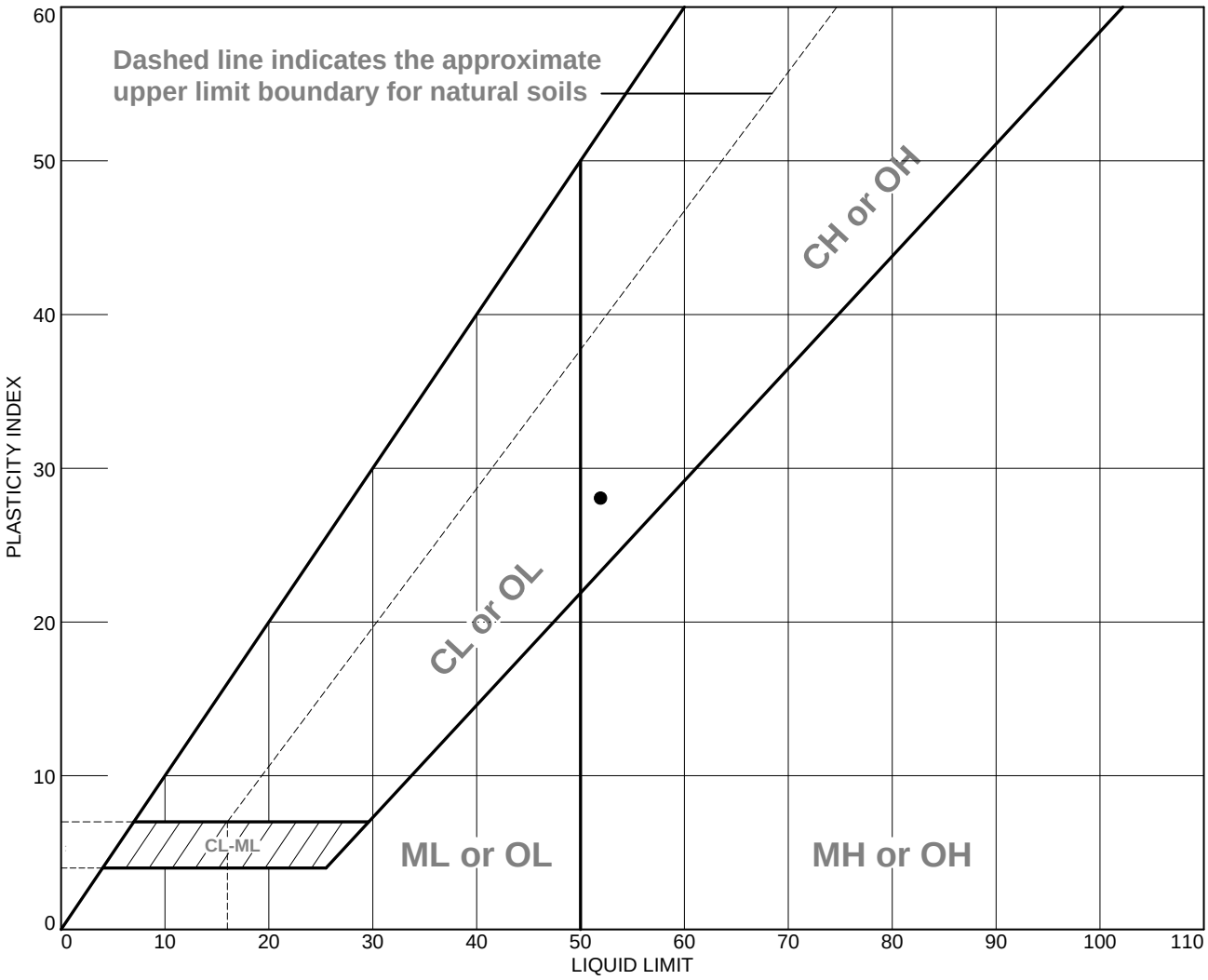
▲ Lab NO:291

◆ Lab NO:291

▼ Lab NO:291

File

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●		52	24	28			

Project No. D142-MO **Client:** HDR Engineering, Inc.

Project: Brentwood/Red Bud CSO Interceptor - St. Louis, MO

●**Location:** RB20-4 SS-5 **Depth:** 20.0'-21.5' **Sample Number:** 0291

Remarks:

●Lab NO:291

7NT

File

ASTM D7012, Method C - Compressive Strength of Intact Rock Core Specimen

Client HDR Engineering Inc. | Project No. D142-MO

Project Brentwood/Red Bud CSO Interceptor | Test Date: 4/8/2020

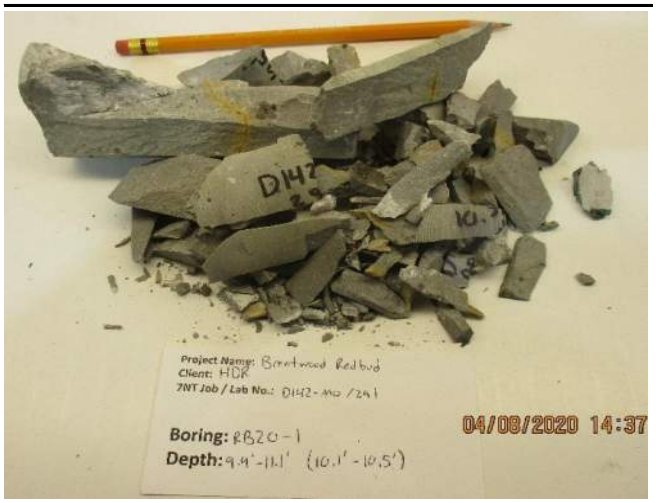
Location/ ID: **RB20-1 9.9'-11.1' (10.1'-10.5')**

Specimen Properties

Average Diameter, in:	1.9760
Average Height, in:	4.8370
Area, in^2:	3.067
Volume, in^3:	14.83
Wet Mass of Specimen, lb:	674.50
Moisture Content, %:	0.57
Dry Mass of Specimen, lb:	670.70
Wet Unit Weight, γ (lb/ft^3):	78575.3
Dry Unit Weight, γ_d (lb/ft^3):	78132.6

Description: Light gray LIMESTONE, small shell fossils, small vertical cracks.

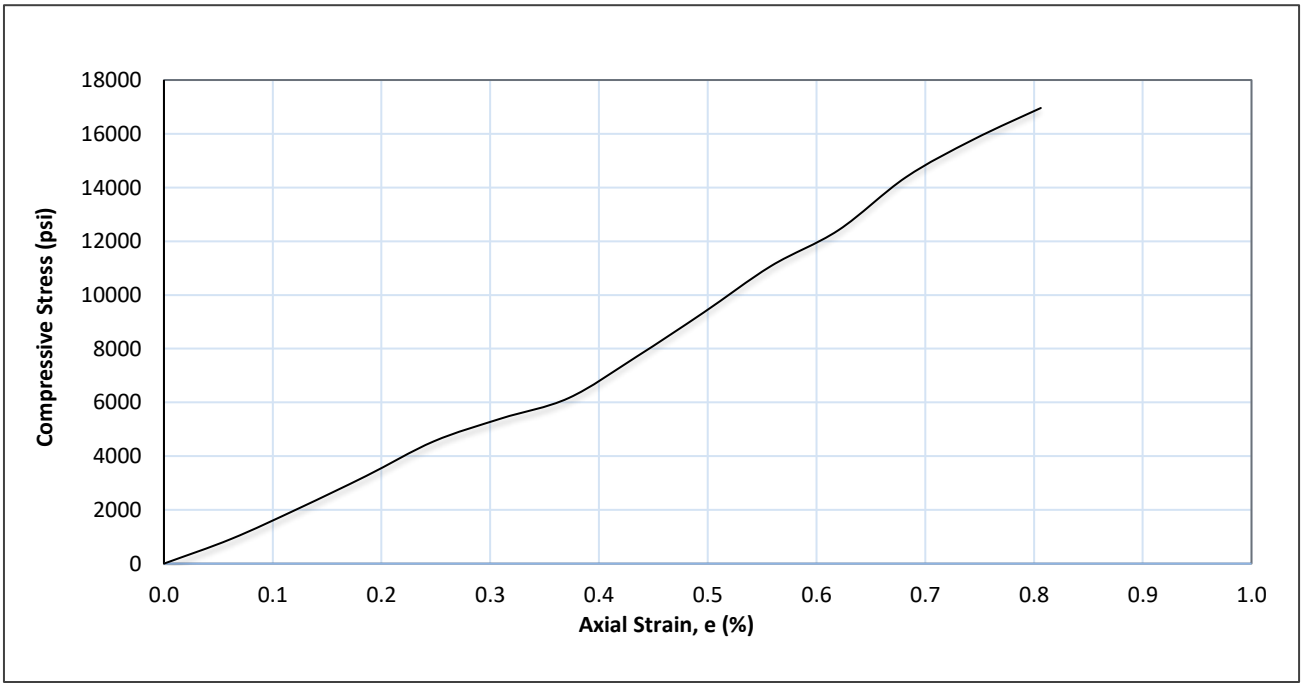
Final Specimen Figure



Result

Compressive Strength of Rock Core, psi:	16959
Strain (%):	0.8

Bedrock Strength: **Very Strong**



Notes:

7NT

ASTM D2216 - Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass

Client: HDR Engineering, Inc.
Project: Brentwood/Red Bud CSO Interceptor - St. Louis, MO

Lab No.: 160
Project No.: D142-MO
Date: 8/27/2019

Boring Number	Sample Number	Depth (ft)	Depth (m)	Moisture Content (%)	Comments
RB-1	SS-2	3.5 - 5.0	1.1 - 1.5	25.1	
RB-1	SS-3	6.0 - 7.5	1.8 - 2.3	22.1	
RB-1	SS-4	8.5 - 10.0	2.6 - 3.0	20.5	
RB-2	SS-1	0.0 - 1.5	0.0 - 0.5	23.7	
RB-2	SS-5	18.5 - 20.0	5.6 - 6.1	12.3	
RB-2	SS-6	21.5 - 23.0	6.6 - 7.0	20.0	
RB-3	SS-1	0.0 - 1.5	0.0 - 0.5	20.9	
RB-3	SS-3	8.5 - 10.0	2.6 - 3.0	24.8	
RB-3	SS-4	13.5 - 15.0	4.1 - 4.6	15.8	
RB-3	SS-6	23.5 - 25.0	7.2 - 7.6	10.0	
RB-8	SS-2	8.5 - 10.0	2.6 - 3.0	26.0	
RB-8	SS-4	18.5 - 20.0	5.6 - 6.1	23.6	
RB-8	SS-5	23.5 - 25.0	7.2 - 7.6	13.6	
RB-12	SS-2	3.5 - 5.0	1.1 - 1.5	22.4	
RB-12	SS-3	8.5 - 10.0	2.6 - 3.0	27.7	
RB-13	SS-1	0.0 - 1.5	0.0 - 0.5	22.7	
RB-13	SS-2	3.5 - 5.0	1.1 - 1.5	27.6	
RB-13	SS-3	8.5 - 10.0	2.6 - 3.0	27.0	
RB-14	SS-1	3.5 - 5.0	1.1 - 1.5	22.2	
RB-14	SS-4	16.5 - 18.0	5.0 - 5.5	28.7	
RB-15	SS-2	3.5 - 5.0	1.1 - 1.5	24.0	
RB-15	SS-3	8.5 - 10.0	2.6 - 3.0	24.7	
RB-16	SS-1	3.5 - 5.0	1.1 - 1.5	25.6	
RB-18	SS-3	13.5 - 15.0	4.1 - 4.6	31.7	
RB-19	SS-2	3.5 - 5.0	1.1 - 1.5	28.0	
RB-19	SS-4	13.5 - 15.0	4.1 - 4.6	5.5	
L19-1	SS-1	3.5 - 5.0	1.1 - 1.5	16.4	
L19-1	SS-4	18.5 - 20.0	5.6 - 6.1	11.8	
L19-2	SS-1	3.5 - 5.0	1.1 - 1.5	18.2	
L19-2	SS-3	13.5 - 15.0	4.1 - 4.6	14.9	

7NT

ASTM D2216 - Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass

Client: HDR Engineering Inc.
Project: Brentwood/Red Bud CSO Interceptor

Lab No.: 291
Project No.: D142-MO
Date: 4/9/2020

Boring Number	Sample Number	Depth (ft)	Depth (m)	Moisture Content (%)	Comments
RB20-1	SS-1	3.5 - 5.0	1.1 - 1.5	32.5	
RB20-1	SS-2	8.5 - 10.0	2.6 - 3.0	15.3	
RB20-2	SS-2	8.5 - 10.0	2.6 - 3.0	28.5	
RB20-2	SS-4	18.0 - 19.5	5.5 - 5.9	19.9	
RB20-3	SS-1	3.5 - 5.0	1.1 - 1.5	22.1	
RB20-3	SS-3	13.5 - 15.0	4.1 - 4.6	25.1	
RB20-3	SS-6	29.0 - 30.5	8.8 - 9.3	15.9	
RB20-4	SS-3	10.0 - 11.5	3.0 - 3.5	28.0	
RB20-4	SS-4	15.0 - 16.5	4.6 - 5.0	26.6	
RB20-4	SS-5	20.0 - 21.5	6.1 - 6.6	24.2	

SHANNON & WILSON, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

April 13, 2018

Mr. Doug Hickey, Project Manager
HDR Engineering
401 South 18th Street, Suite 300
St. Louis, MO 63103
Doug.Hickey@hdrinc.com

RE: GEOTECHNICAL DATA REPORT
L-111 (LINDEN) SEWER SEPARATION, RDP TRIBUTARIES
(DEER CREEK) CSO TUNNEL (MSD NO. 12441)

Dear Mr. Hickey:

Our geotechnical data report for the referenced project is attached. We have appreciated this opportunity to assist you on this project and look forward to working with you again. Please contact us if you have questions concerning this report.

Sincerely,

SHANNON & WILSON, INC.

William B. Kremer, P.E.
Senior Associate

VMC:WBK/tad

Enc: Geotechnical Data Report, L-111 (Linden) Sewer Separation, RDP Tributaries (Deer Creek) CSO Tunnel (MSD No. 12441)

c: Darcy Riegel, HDR, 401 South 18th Street, Suite 300, St. Louis, MO, 63103, Darcy.Riegel@hdrinc.com

Everett Litton, WSP USA, 211 N. Broadway, Suite 2800, St. Louis, MO 63102, everett.litton@wsp.com

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www.shannonwilson.com

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GEOTECHNICAL DATA REPORT
L-111 (LINDEN) SEWER SEPARATION
RDP TRIBUTARIES (DEER CREEK) CSO TUNNEL
MSD NO. 12441

April 13, 2018

Prepared for

METROPOLITAN ST. LOUIS SEWER DISTRICT

And

Prepared by

SHANNON & WILSON, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

2043 Westport Center Drive
Saint Louis, MO 63141

Revision 2

41-1-37530-005

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TABLE OF CONTENTS

APPENDICES

REVISION HISTORY

Revision No. 0	**Date: June 23, 2017**
Initial issuance. No revisions applicable.	

Revision No. 1	**Date: July 28, 2017**
Revised per WSP comments.	

Revision No. 2	**Date: April 13, 2018**
Add borings L17-8 and L17-9, borings backfill reports and restoration photos.	

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GEOTECHNICAL DATA REPORT
L-111 (LINDEN) SEWER SEPARATION
RDP TRIBUTARIES CSO TUNNEL
MSD NUMBER 12441

1.0 SCOPE OF WORK

This Geotechnical Data Report (GDR) for the proposed L-111 (Linden) Separation Sewer was prepared for the Metropolitan St. Louis Sewer District (MSD); HDR, Inc. (HDR); and WSP by Shannon & Wilson, Inc. (S&W). This GDR presents geotechnical data collected during the FY17 geotechnical exploration program for use in designing and constructing the sewer. We understand that MSD may provide this GDR to Contractors for their use to plan construction and to develop designs for work elements for which they are responsible.

S&W's services are provided under the master subconsultant agreement (MSA) between HDR and S&W for professional services related to the RDP Tributaries & Upper RDP CSO Controls & Lower Meramec System Improvements (MSD Project No. 11153). The master subconsultant agreement is subject to MSD Contract No. 20202 which serves as the prime agreement between MSD and HDR. Services for the L-111 (Linden) Separation Sewer were authorized by Task Order 5 of the MSA. Specific exploration details are discussed within the Task Order. In brief, S&W's services included field oversight and logging of exploratory drilling and other field work for this study; assistance with coordination of site access and right-of-entry for drilling sites; laboratory testing; assembly of subsurface data; and GDR preparation. Exploratory drilling was provided by 7NT Enterprises, LLC (7NT) under separate contract through HDR.

2.0 PROJECT DESCRIPTION

The Linden Separation Sewer (MSD project #12441) is part of the Brentwood and Linden Combined Sewer System and part of the RDP Tributaries CSO Tunnel Project within the Deer Creek Watershed. The combined sewer system will be soft separated with cost effective private inflow removal. Soft separation will have sanitary flow to Black Creek Trunk sewer and peak sanitary overflow to Deer Creek Sanitary Tunnel.

The project area includes a 1,000-foot-wide belt originating in the northeast quadrant of the I-170/I-64 interchange and extending for about a mile north-northeast. The heavily urbanized area includes residences, high-rise buildings, and an interstate highway interchange. The project area occupies a portion of the west facing bluff of the Black Creek Valley. The upland is split by a northeast trending tributary valley that enters the Black Creek Valley near the I-170/I-64

interchange. The upland east of this tributary valley is bounded by Hampton Branch Creek. The project area varies from an elevation of about 590 feet at its northern end to about elevation 480 feet near the southwest corner.

3.0 EXPLORATION AND TESTING

The exploration program included 20 soil borings, designated L17-1 through L17-20, and laboratory testing of collected samples. Boring locations are shown in Appendix A. Boring coordinates surveyed by Kowelman Engineering of St. Louis are provided in Table 1. Northings and Eastings are based on Modified State Plane. Ground surface elevations are based on NAVD 1988.

TABLE 1
BORING COORDINATES

Boring	Northing	Easting	GS Elevation, feet
L17-1	1019627.6	866415.6	539.6
L17-2	1020696.8	866889.5	536.3
L17-3	1019123.2	865206.0	480.9
L17-4	1019666.7	865518.8	490.3
L17-5	1019924.8	865645.1	494.2
L17-6	1019868.2	865702.5	491.8
L17-7	1020305.4	866099.8	498.2
L17-8	1020919.5	866336.5	511.8
L17-9	1021027.6	866457.3	518.4
L17-10	1021289.2	866434.6	519.8
L17-11	1021271.3	866095.0	525.3
L17-12	1018658.2	865123.0	478.0
L17-13	1018673.3	865982.3	498.5
L17-14	1021679.5	866797.0	542.5
L17-15	1021972.4	866898.4	548.9
L17-16	1022250.0	865945.9	536.3
L17-17	1022454.4	865971.2	540.6
L17-18	1023112.4	866514.1	588.7
L17-19	1023775.3	866608.7	586.4
L17-20	1020328.1	866421.4	523.2

Soil logs and other drilling-related measurements and observations are provided in Appendix B. Borings backfill reports and restoration photos are provided in Appendix C. Laboratory test results and details are provided in Appendix D. Exploration and testing were completed as

generally defined in the Geotechnical Investigation Work Plan for the RDP Tributaries & Upper CSO Controls & Lower Meramec Systems Improvements Near Surface Sewers (GIWP Near Surface Sewers) prepared by WSP and S&W. A copy of the GIWP is provided in Appendix E.

Borings were extended in soil to auger refusal or a depth of 5 feet below the planned sewer invert, whichever came first. Borings were advanced using 4-1/4-inch hollow-stem augers. Soil samples were collected using a split-spoon sampler on 5-foot centers along the boring length, and at 2.5-foot centers from 5 feet above to 5 feet below the proposed sewer invert. Standard Penetration Tests were completed with each split-spoon sample, in general accordance with ASTM Standard D1586. No rock coring was performed since none of the borings refused before reaching the target depth.

Collected soil samples were taken to S&W for laboratory determination of in-situ moisture content and Atterberg liquid and plastic limits, in general accordance with ASTM Standards D2216 and D4318, respectively. A summary of the laboratory test results is included in Table 2.

TABLE 2
LABORATORY TEST RESULTS SUMMARY

Boring	Depth, feet	USCS	Water Content, %	Atterberg Limits		Undrained Shear Strength, tsf
				Liquid Limit, %	Plastic Limit, %	
L17-1	4.3	CH	24.9	-	-	-
L17-1	6.8	CH	24.6	-	-	-
L17-1	9.3	CH	24.3	60.9	21.8	-
L17-1	11.8	CH	29.6	-	-	-
L17-2	6.8	CL	28.0	40.7	17.8	-
L17-2	9.3	CH	37.7	-	-	-
L17-2	11.8	CH	23.1	-	-	-
L17-3	1.8	CL [Fill]	22.6	-	-	-
L17-3	4.3	CL	22.1	47.1	20.3	-
L17-3	9.3	CH	24.8	-	-	-
L17-3	14.3	CH	21.0	-	-	-
L17-3	16.8	CH	24.4	-	-	-
L17-3	19.3	CH	34.8	-	-	-
L17-3	21.8	CLAYSTONE	11.2	-	-	-
L17-3	24.3	CLAYSTONE	13.6	-	-	-
L17-4	3.6	CL	23.6	-	-	-
L17-4	4.8	CL	24.5	-	-	0.69
L17-4	5.3	CL	24.5	-	-	-

Boring	Depth, feet	USCS	Water Content, %	Atterberg Limits		Undrained Shear Strength, tsf
				Liquid Limit, %	Plastic Limit, %	
L17-4	9.3	CH	23.0	55.9	19.6	-
L17-4	16.7	SHALE	12.8	-	-	-
L17-4	19.2	SHALE	11.7	-	-	-
L17-4	21.8	SHALE	12.7	-	-	-
L17-4	24.3	SHALE	15.7	-	-	-
L17-5	4.3	ML	23.9	-	-	-
L17-5	8.1	CH	24.1	-	-	-
L17-5	9.2	CH	23.6	60.9	21.8	-
L17-5	9.8	CH	22.1	-	-	-
L17-5	14.3	SHALE	14.6	-	-	-
L17-5	16.8	SHALE	14.2	-	-	-
L17-5	19.3	SHALE	14.3	-	-	-
L17-5	21.8	SHALE	10.1	-	-	-
L17-5	24.3	SHALE	10.9	-	-	-
L17-6	4.3	CL [Fill]	25.5	-	-	-
L17-6	9.3	CL	31.6	-	-	-
L17-6	11.8	CL	26.5	39.6	20.4	-
L17-6	12.6	CL	23.2	-	-	-
L17-6	13.8	CL	24.1	-	-	-
L17-6	16.8	SHALE	12.0	-	-	-
L17-6	19.3	SHALE	12.7	-	-	-
L17-6	21.8	SHALE	13.9	-	-	-
L17-7	4.3	CL	24.4	-	-	-
L17-7	9.3	CH	28.0	68.3	20.8	-
L17-7	14.3	CH	22.1	-	-	-
L17-7	16.5	SHALE	11.8	-	-	-
L17-7	19.3	SHALE	10.5	-	-	-
L17-7	24.3	SHALE	7.0	-	-	-
L17-8	4.3	CL	20.1	-	-	-
L17-8	6.1	CL	27.9	-	-	-
L17-8	7.1	CL	28.7	-	-	-
L17-8	7.6	CL	29.8	-	-	-
L17-8	9.3	CL	26.2	-	-	-
L17-8	14.3	CH	28.8	-	-	-
L17-8	16.8	CH	27.0	-	-	-
L17-8	19.2	CH	36.0	-	-	-
L17-8	21.8	CH	15.1	-	-	-

Boring	Depth, feet	USCS	Water Content, %	Atterberg Limits		Undrained Shear Strength, tsf
				Liquid Limit, %	Plastic Limit, %	
L17-8	24.3	CH	15.6	-	-	-
L17-9	4.3	CH	154	-	-	-
L17-9	8.1	CL	26.5	-	-	-
L17-9	9.4	CL	26.2	-	-	0.73
L17-9	9.8	CL	26.3	-	-	-
L17-9	10.8	CL	25.3	-	-	-
L17-9	14.3	CH	24.4	-	-	-
L17-9	16.8	CH	26.1	-	-	-
L17-9	19.3	CH	22.0	-	-	-
L17-9	21.8	CH	23.8	-	-	-
L17-9	24.3	CH	9.7	-	-	-
L17-9	26.2	CH	15.6	-	-	-
L17-10	4.3	CL	24.6	-	-	-
L17-10	9.3	CH	25.0	-	-	-
L17-10	14.3	CH	30.6	-	-	-
L17-10	16.8	CH	19.1	-	-	-
L17-10	19.1	CH	5.0	-	-	-
L17-10	21.8	CH	19.0	-	-	-
L17-10	24.3	CLAYSTONE	20.0	-	-	-
L17-11	1.8	CL [Fill]	21.0	-	-	-
L17-11	3.6	CL	10.8	-	-	-
L17-11	6.8	CL	16.6	-	-	-
L17-11	9.3	CL	18.3	-	-	-
L17-11	11.8	CH	30.8	85.0	26.5	-
L17-11	14.3	CH	33.3	-	-	-
L17-11	16.8	GC	13.5	-	-	-
L17-11	19.3	CL	21.2	-	-	-
L17-12	4.3	CL	26.2	-	-	-
L17-12	9.3	CL	21.8	43.2	19.4	-
L17-12	11.8	CL	20.8	-	-	-
L17-12	14.3	CL	18.7	-	-	-
L17-12	16.8	CLAYSTONE	14.6	-	-	-
L17-12	19.3	CLAYSTONE	14.3	-	-	-
L17-13	4.3	CL	28.9	-	-	-
L17-13	9.3	CH	23.1	-	-	-
L17-13	11.8	CH	23.3	55.5	19.2	-
L17-13	14.3	CH	19.7	-	-	-

Boring	Depth, feet	USCS	Water Content, %	Atterberg Limits		Undrained Shear Strength, tsf
				Liquid Limit, %	Plastic Limit, %	
L17-13	16.8	CH	19.6	-	-	-
L17-13	19.3	CLAYSTONE	24.1	-	-	-
L17-14	4.3	CL	26.3	-	-	-
L17-14	6.8	CH	24.9	-	-	-
L17-14	9.3	CH	30.9	-	-	-
L17-14	11.8	CH	28.4	-	-	-
L17-14	14.3	CH	20.3	-	-	-
L17-14	16.2	CH	4.2	-	-	-
L17-15	4.3	CL	27.2	-	-	-
L17-15	6.8	CH	23.1	-	-	-
L17-15	9.3	CL	21.7	-	-	-
L17-15	11.8	CL	24.9	46.8	20.1	-
L17-15	14.3	CH	27.7	-	-	-
L17-15	16.8	CH	18.8	-	-	-
L17-16	1.8	CL [Fill]	22.7	-	-	-
L17-16	4.3	CH	21.4	-	-	-
L17-16	6.8	CH	26.7	-	-	-
L17-16	9.3	GC	22.7	-	-	-
L17-16	13.9	GC	3.4	-	-	-
L17-17	1.8	CL [Fill]	11.9	-	-	-
L17-17	4.3	CL [Fill]	37.4	-	-	-
L17-17	6.8	CL [Fill]	26.7	37.9	19.9	-
L17-17	9.3	CL [Fill]	9.9	-	-	-
L17-17	14.3	CL [Fill]	26.6	-	-	-
L17-18	4.3	CL	30.5	-	-	-
L17-18	6.1	CL	26.6	-	-	-
L17-18	7.3	CL	23.5	35.8	19.3	1.23
L17-18	7.9	CL	24.6	-	-	-
L17-18	8.8	CH	26.6	-	-	-
L17-18	11.8	CH	36.3	-	-	-
L17-18	14.3	CH	5.9	-	-	-
L17-18	16.8	CH	7.6	-	-	-
L17-19	4.3	CH	28.4	-	-	-
L17-19	6.8	CL	25.7	-	-	-
L17-19	9.3	CL	25.2	37.9	17.0	-
L17-19	11.8	CL	23.0	-	-	-
L17-19	14.3	CH	36.6	-	-	-

Boring	Depth, feet	USCS	Water Content, %	Atterberg Limits		Undrained Shear Strength, tsf
				Liquid Limit, %	Plastic Limit, %	
L17-20	4.3	CH	23.7	-	-	-
L17-20	11.8	CH	30.4	-	-	-
L17-20	14.3	CH	32.1	-	-	-
L17-20	16.8	CH	28.9	70.5	32.2	-
L17-20	19.3	CH	18.6	-	-	-

Composite samples were prepared from soil samples recovered at various depths for each boring and sent to Teklab, Inc. of Collinsville, Illinois for determination of soil corrosivity parameters. A summary of the corrosivity test results is included in Table 3.

No piezometers were installed for this project. Upon completion of drilling and sampling, the borings were backfilled with cement-bentonite grout placed through a grout pipe inserted to the boring bottom. The drill sites were then restored.

TABLE 3
CORROSIVITY TEST RESULTS

Boring	Chloride, mg/Kg-dry	Sulfate, mg/Kg-dry	Sulfide, Total, mg/Kg-dry	pH (1:1)	Resistivity, Solid, Ohms/cm	Percent Moisture, %
L17-1	354	130	< 35	7.08	891	22.2
L17-2	428	120 J	< 36	6.86	1200	27.4
L17-3	89	1680 S	52	4.44	690	14.6
L17-4	25 J	504	< 31	6.73	1400	11.7
L17-5	59	126	< 35	8.26	2540	14.8
L17-6	106	332	64	7.87	870	14.1
L17-7	42 J	125	< 33	8.25	2700	14.3
L17-8	Not tested.					
L17-9	74	147	< 37	7.08	1190	19.3
L17-10	60	129	< 34	8.37	1990	15.0
L17-11	36 J	87 J	< 34	8.1	2790	15.3
L17-12	37 J	178	< 31	6.05	2850	13.9
L17-13	205	1410	< 35	7.56	565	17.1
L17-14	113	110 J	< 38	8.57	1170	21.5
L17-15	227	140	< 37	7.89	1080	20.4
L17-16	88	181	< 36	8.46	1570	19.9
L17-17	73	237	< 35	8.47	2140	14.0
L17-18	224	145	< 36	7.11	1990	21.8
L17-19	277	179	< 38	7.11	1310	21.7
L17-20	152	223	< 38	8.05	1310	22.8

4.0 LOCAL GEOLOGY

In upland, the overburden soil consists of a cover of Quaternary loess consisting of wind-blown silt carried from the floodplains of the Missouri and Mississippi Rivers and deposited on the surrounding areas during the later stages of the last glacial period. The silt has been modified by weathering to lean clay in most areas. In areas where the bedrock surface is formed in carbonate rocks, residual fat clay formed by weathering of the carbonate bedrock is typically present beneath the loess. In areas where the bedrock surface is formed in fine-grained clastic rocks such as claystone and shale, the overlying loess grades into a fat clay that in turn, grades into the underlying clastic bedrock.

In the main stream valleys, the overburden consists of silty alluvium containing varying amounts of clay and organic matter derived from the adjacent uplands. This material overlays sand, silt,

clay, and gravel. Shorter, tributary stream valleys contain lesser amounts of alluvium and may have no alluvium other than that found in the existing channel. In some cases, the original stream valleys have been narrowed by artificial fill placed along the original valley margins.

The uppermost rock is Pennsylvanian System clastic rocks that are predominantly shale, but can also include: claystone, siltstone, sandstone, coal, and limestone. The Pennsylvanian System rocks are present over most of the site and may vary in thickness from tens of feet to absent. The Pennsylvanian System rocks overlie limestone of the Mississippian System. The Mississippian System rocks underlie the entire site and are greater than 100 feet thick. The bedrock strata dip is generally less than about 5 degrees and no known faults cross the project site.

Within the project area the Mississippian System limestone has been partially dissolved by slightly acidic, meteoric water. The resultant solution cavities allow soil material from the overburden to be washed into the subsurface voids creating a depression in the land surface known as a "sinkhole". When many sinkholes are present the resultant topography is known as "karst" topography.

Since the Pennsylvanian System rocks are not solution prone, they form a protective cap over the Mississippian System rocks thereby reducing the likelihood of dissolution in the underlying Mississippian System limestone. Based on the 1930s topography, Figure A2 in Appendix A, only a few sinkholes are present in the project vicinity which indicates Pennsylvanian System rocks are likely present over much of the project area.

The natural soil washed into a sinkhole typically reflect the characteristics of the nearby in-place natural soil, however, the washed-in soil commonly exhibits less strength than the in-place soil. Bowl-shaped sinkholes may form gradually over long periods but in some cases sinkholes form rapidly when soil or rock bridging a void can no longer span the growing void and collapses.

5.0 SUBSURFACE PROFILE

Nine borings (L17-1, L17-2, L17-4, L17-6 to L17-9, L17-13, and L17-20) were drilled on asphalt or concrete pavement. Observed pavement thicknesses varied between 0.2 and 1.1 feet. The overburden soil observed in the borings consisted primarily of medium stiff to stiff, lean to fat clay becoming very stiff to hard at depth. Notable observed differences include:

- L17-3 – several feet of clay fill;
- L17-5 – a soft silt layer;

- L17-6 – several feet of clay fill and soft clay;
- L17-7 and L17-13 – several feet of soft clay;
- L17-11 and L17-16 – several feet of clay fill and several feet of clayey gravel; and
- L17-17 – 15 feet of clay fill.

Ten borings encountered Pennsylvanian System claystone and shale that are considerably harder than the overlying soil but still augerable. Depth to the observed Pennsylvanian System rock varied from depths of 11.0 to 20.0 feet below the ground surface. Table 4 lists the observed top of rock depths for the Pennsylvanian System rock. The top of bedrock, as defined by auger refusal, was not encountered in any of the borings. Auger refusal in the project area is typically associated with Mississippian System limestone.

TABLE 4
TOP OF ROCK DATA

Boring	Top of Pennsylvanian System	Top of Mississippian System
L17-1	Not encountered	Not encountered
L17-2	Not encountered	Not encountered
L17-3	19.5 feet below grade	Not encountered
L17-4	14.0 feet below grade	Not encountered
L17-5	11.0 feet below grade	Not encountered
L17-6	15.0 feet below grade	Not encountered
L17-7	16.2 feet below grade	Not encountered
L17-8	19.5 feet below grade	Not encountered
L17-9	18.0 feet below grade	Not encountered
L17-10	20.0 feet below grade	Not encountered
L17-11	Not encountered	Not encountered
L17-12	15.5 feet below grade	Not encountered
L17-13	18.0 feet below grade	Not encountered
L17-14	16.5 feet below grade	Not encountered
L17-15	Not encountered	Not encountered
L17-16	14.2 feet below grade	Not encountered
L17-17	Not encountered	Not encountered
L17-18	Not encountered	Not encountered
L17-19	Not encountered	Not encountered
L17-20	Not encountered	Not encountered

Groundwater was encountered in 7 of the 20 borings during drilling. Groundwater depth varied from 3.8 to 20.0 feet below grade. Recorded groundwater levels are shown in Table 5. None of the other borings encountered groundwater. The absence or presence of groundwater should not be construed to represent an exact or permanent condition. There is uncertainty with interpretation of short-term groundwater level readings in borings, particularly when the soil is of relatively low permeability such as the material overlying this site. Groundwater levels should be expected to fluctuate with variations in precipitation, site grading, and drainage conditions.

TABLE 5
WATER LEVEL DATA

Boring	Depth During Drilling
L17-6	20.0 feet
L17-8	16.0 feet
L17-10	18.5 feet
L17-11	15.5 feet
L17-17	6.5 feet
L17-18	3.8 feet
L17-19	11.0 feet

6.0 LIMITATIONS OF REPORT

The purpose of this GDR is to present information collected during the geotechnical investigation program for the L-111 (Linden) Sewer Separation, RDP Tributaries (Deer Creek) CSO Tunnel (MSD No. 12441) Project. This GDR does not attempt to interpret the data or provide conclusions regarding design recommendations or construction considerations for the project.

Site exploration and testing identifies actual surface and subsurface conditions at the specific locations taken, at the time obtained, and only to the depths penetrated. Discrete sampling and testing should not be relied upon to accurately reflect natural variations that exist between borehole locations. S&W has attempted to conduct the services reported herein in a manner consistent with that level of care and skill ordinarily exercised by members of the profession currently practicing in the same locality and under similar conditions as this project.

The lines designating changes in soil and rock stratigraphy represent approximate boundaries. The actual interface or transition between materials may occur higher, lower, or more gradually

than indicated. Subsurface conditions may be affected over time by natural processes and events such as floods, earthquakes, groundwater fluctuations or human activities.

The work scope did not include environmental assessment or investigation for the presence of wetlands or hazardous or toxic material in the water, soil or air on, below or around the site.

SHANNON & WILSON, INC.

4/13/2018

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VMC:WBK/tad

Appendix A
Figures

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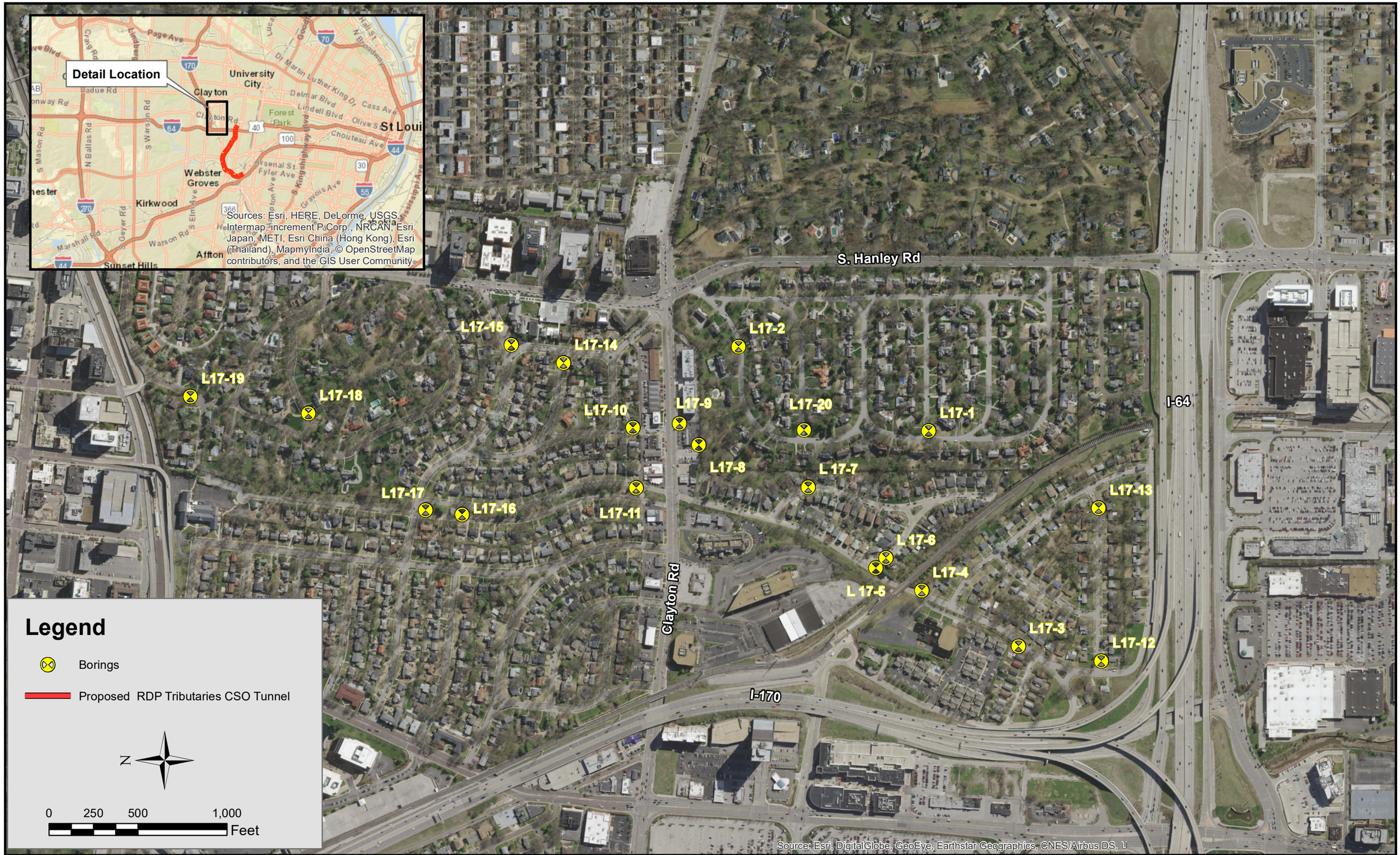
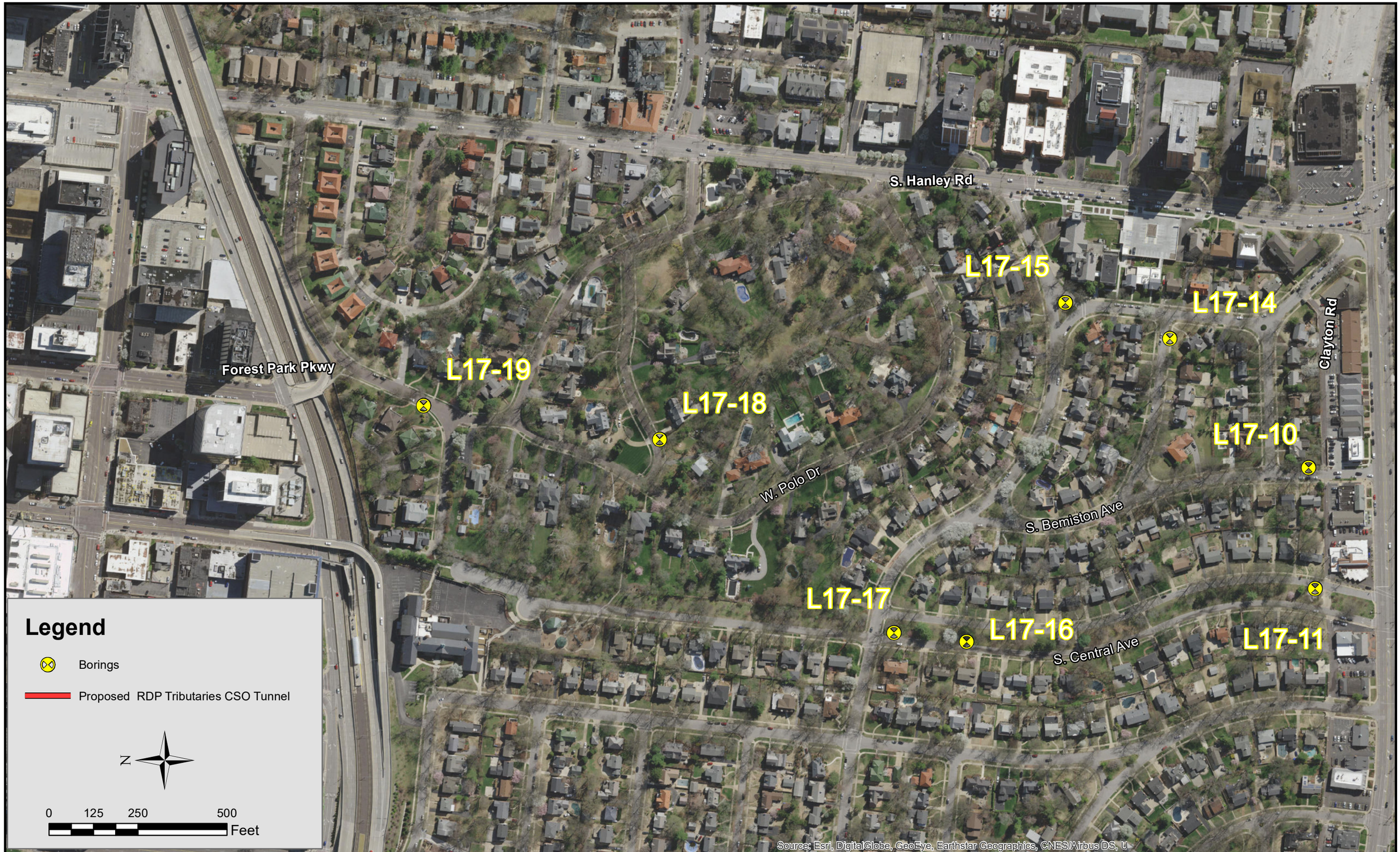


SHANNON & WILSON, INC. GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS	41-1-37530-005	L-111 (Linden) Sewer Separation, RDP Tributaries (Deer Creek) CSO Tunnel	MSD No. 12441	Overview Map	Figure A1



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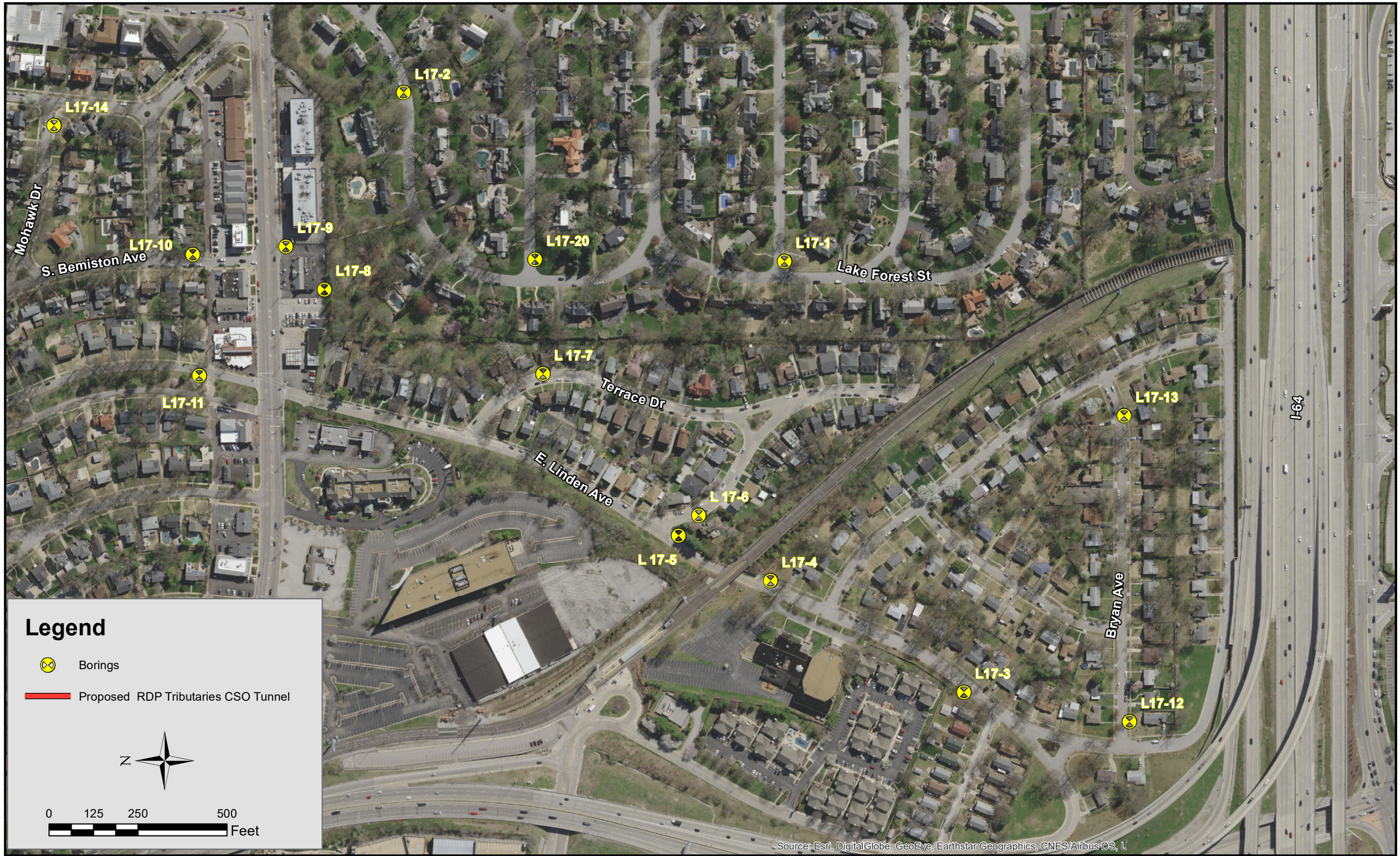
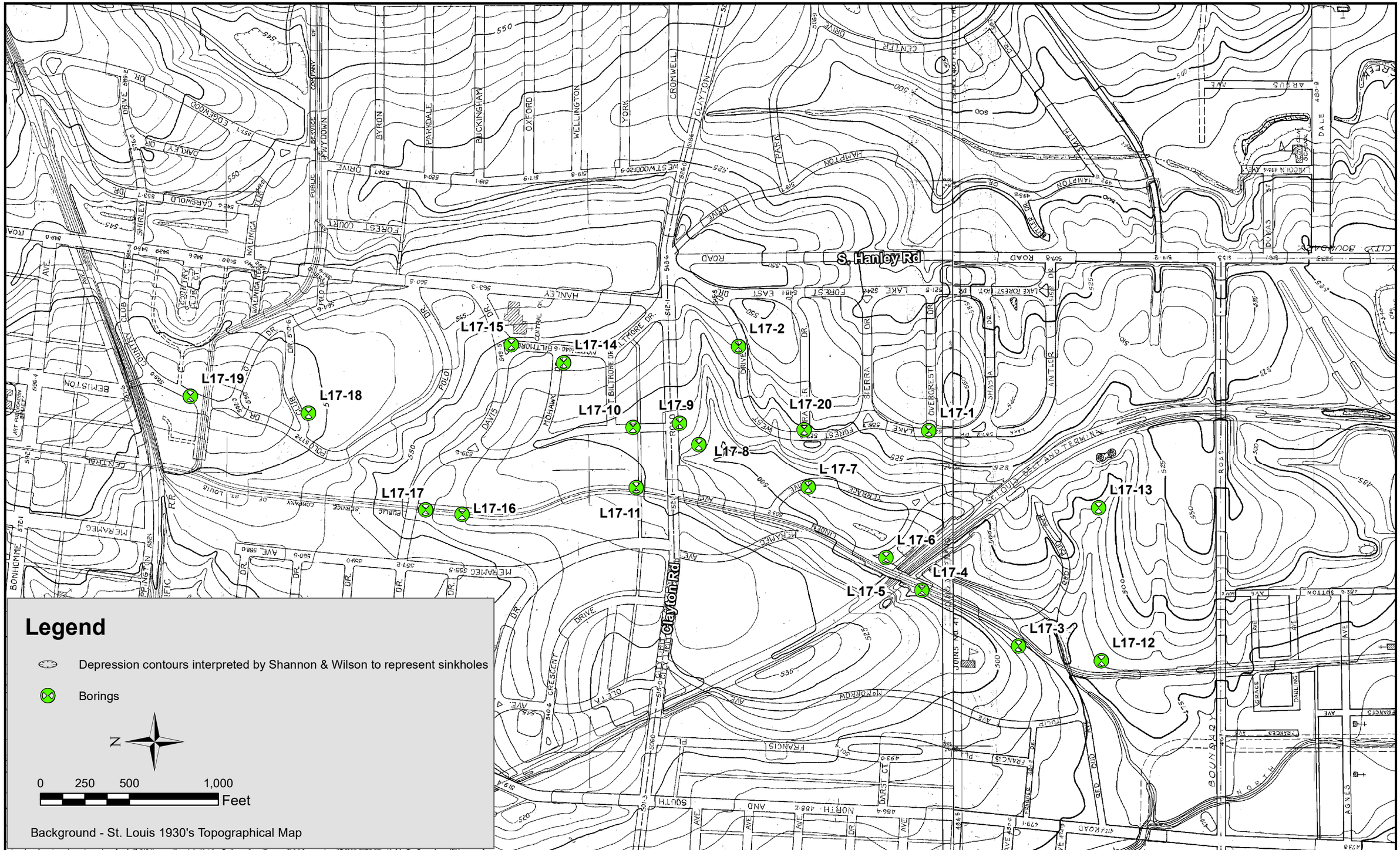


SHANNON & WILSON, INC. GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS	41-1-37530-005	L-111 (Linden) Sewer Separation, RDP Tributaries (Deer Creek) CSO Tunnel	MSD No. 12441	Boring Detail Map	Figure A1-2



SHANNON & WILSON, INC. GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS	41-1-37530-005	L-111 (Linden) Sewer Separation, RDP Tributaries (Deer Creek) CSO Tunnel	MSD No. 12441	1930's Topographical Map	Figure A2

Appendix B
Soil Classification Criteria and Exploratory Borings

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Soil logs presented in this GDR are a compilation of subsurface conditions and soil classifications determined from field and laboratory data as interpreted by the Geotechnical/Civil Engineer and/or Scientist. Observations, test results and measurements listed on the logs refer only to the identified interval or sample and only within the limits of the boring. Soil classifications are based on the Unified Soil Classification System (USCS) as provided in ASTM D2487 and visual-manual procedures as provided in ASTM D2488. Elements of the USCS criteria are given below. ASTM D2487 and ASTM D2488 should be referred to for additional criteria and information concerning the USCS.

General Order of Classification Terms

Relative density or consistency, color, soil constituents, moisture condition, structure, plasticity, gradation, grain shape, cementation, organics, odor, other; (Geologic Name: FILL, TILL, ALLUVIUM, etc.) (USCS group symbol)

i. e. ... *Medium stiff, dark gray, lean CLAY, trace fine sand; moist; laminated (<2 mm) with light gray silt, occasional slickensides; (GLACIOLACUSTRINE)(CL-ML).*

Relative Density of Coarse-Grained Soils

(Nonplastic Silt, Sand, and Gravel)

N, SPT blows/foot	Relative Density
0-4	Very loose
4-10	Loose
10-30	Medium dense
30-50	Dense
over 50	Very dense

Relative Consistency of Fine-Grained Soils

(Plastic Silt and Clay)

N, SPT blows/foot	Shear strength, tsf (kPa)	Unconfined strength, tsf (kPa)	Relative Consistency
< 2	< 0.13 (<12)	< 0.25 (<24)	Very soft
2 - 4	0.13 - 0.25 (12-24)	0.25 - 0.5 (24-48)	Soft
4 - 8	0.25 - 0.5 (24-48)	0.5 - 1 (48-96)	Medium stiff
8 - 15	0.5 - 1 (48-96)	1 - 2 (96-192)	Stiff
15 - 30	1 - 2 (96-192)	2 - 4 (192-383)	Very stiff
over 30	> 2 (>192)	> 4 (>383)	Hard

Standard Penetration Resistance (SPT or N value) is the sum of the blows required to drive a 2-inch OD by 1.375-inch ID (5 cm x 3.5 cm) split-spoon sampler 1 foot (30.5 cm) after seating 6 inches (15.2 cm) into undisturbed soil using a 140-pound (623 N) hammer free-falling 30 inches (76 cm) in accordance with ASTM D 1586-84. Driving is limited to 50 blows within any 6-inch interval. Samplers which have not driven the full 6-inch interval upon completing 50 blows (or 10 blows for 0 inches) are considered to have reached " split-spoon refusal ".

Terms and Definitions

Structure	*Criteria*
Partings	< 1/16" thickness (1.6 mm)
Seam	1/16" -1/2" thickness (1.6 to 12.7 mm)
Layer	>1/2" thickness (12.7 mm)
Pocket	irregular inclusion < 1 per foot (30.5 cm)
Occasional	≤ 1 inclusion or layer per foot (30.5 cm)
Frequent	> 1 inclusion or layer per foot (30.5 cm)
Laminated	Alternating layers < 1/4" (6 mm) thick
Stratified	Alternating layers ≥ 1/4" (6 mm) thick
Lensed	Small pockets of different soils
Fissured	Breaks easily along definite planes
Slickensided	Polished, glossy, striated fracture planes
Blocky	Easily breaks into small angular lumps
Sheared	Disturbed texture, mix of strengths
Homogeneous	Uniform color and appearance
Trace	Material comprises < 5% of sample
Few	Material comprises ≈ 5 to 10% of sample
Little	Material comprises ≈ 15 to 25% of sample
Some	Material comprises ≈ 30 to 45% of sample
Mostly	Material comprises ≈ 50 to 100% of sample

Cementation	*Criteria*
Weak	Crumbles with little finger pressure
Moderate	Breaks with considerable finger pressure
Strong	Will not crumble or break with finger pressure

Particle Angularity	*Criteria*
Angular	Sharp edges and unpolished plane surfaces
Subangular	Similar to Angular but with rounded edges
Subrounded	Nearly plane sides with well-rounded edges
Rounded	Smoothly curved sides and no edges

Particle Shape	*Criteria*
Flat	Particles with width/thickness > 3
Elongated	Particles with length/width > 3
Flat and elongated	Meets criteria for both flat and elongated

Reaction with HCl	*Criteria*
None	No visible reaction
Weak	Some reaction, bubbles form slowly
Strong	Violent reaction, bubbles form immediately

Plasticity	*Criteria*
Nonplastic	Cannot roll 1/8-in. (3 mm) thread
Low	Can barely roll thread and cannot form lump when drier than plastic limit (PL)
Medium	Easy to roll thread. Need little rolling and kneading to reach PL. Cannot re-roll thread after PL reached. Lump crumbles when drier than PL
High	Need considerable rolling and kneading to reach PL. Can re-roll thread several times after PL reached. Lump can be formed without crumbling when drier than PL

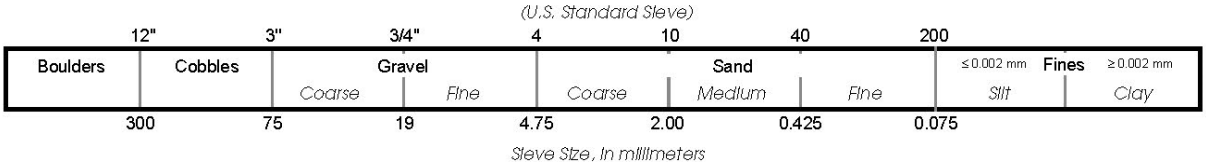
Dilatancy	*Criteria*
None	No visible change in specimen.
Slow	Water appears slowly on specimen surface when shaken, disappears slowly when squeezed
Rapid	Water appears quickly on specimen surface when shaken, disappears quickly when squeezed

Dry Strength	*Criteria*
None	Crumbles with handling
Low	Crumbles with little finger pressure
Medium	Breaks with considerable finger pressure
High	Will not crumble or break with finger pressure. Will break between thumb and hard surface
Very high	Will not break between thumb and hard surface

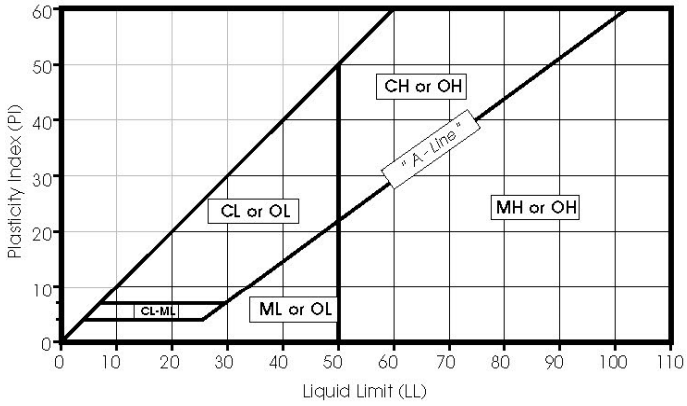
Toughness	*Criteria*
Low	Slight pressure required to roll thread near PL. Weak, soft thread and lump
Medium	Medium pressure required to roll thread near PL. Medium stiff thread and lump
High	Considerable pressure required to roll thread near PL. Very stiff thread and lump

Moisture Condition	*Criteria*
Dry	Absence of moisture, dusty, dry to touch
Moist	Damp but no visible water
Wet	Visible free water, usually soil below water table

Soil Grain Size



Plasticity Chart *(from ASTM D 2487-93)*

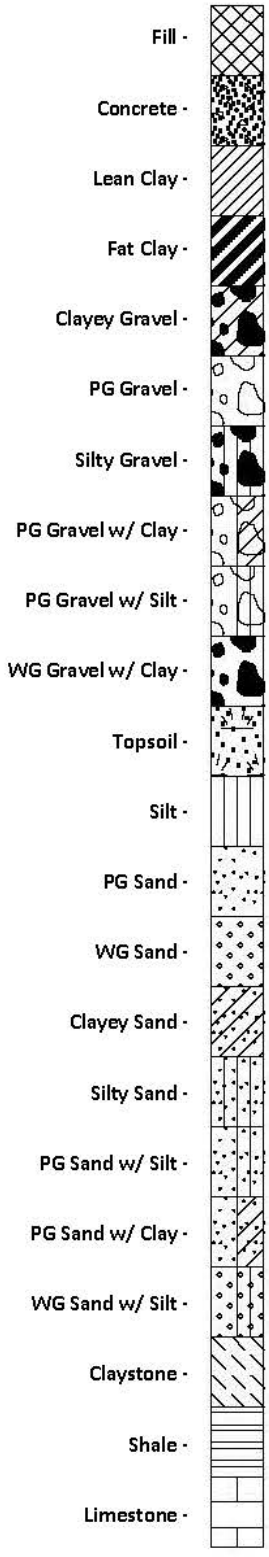


Coarse-Grained Soils (> 50% Retained on No. 200 Sieve) *(from ASTM D 2487-93)*

					Group Name	USCS Group Symbol
GRAVEL % gravel > % sand	< 5 % fines	$C_u \geq 4$ and $1 \leq C_c \leq 3$		< 15% sand ≥ 15% sand	well-graded GRAVEL well-graded GRAVEL, with sand	GW
		$C_u < 4$ or $C_c < 1$ or $C_c > 3$		< 15% sand ≥ 15% sand	poorly graded GRAVEL poorly graded GRAVEL, with sand	GP
	5 - 12% fines	$C_u \geq 4$ and $1 \leq C_c \leq 3$	fines = ML or MH	< 15% sand ≥ 15% sand	well-graded GRAVEL, with silt well-graded GRAVEL, with silt and sand	GW-GM
			fines = CL, CH, (or CL-ML)	< 15% sand ≥ 15% sand	well-graded GRAVEL, with clay (or silty clay) well-graded GRAVEL, with clay and sand (or silty clay and sand)	GW-GC
		$C_u < 4$ or $C_c < 1$ or $C_c > 3$	fines = ML or MH	< 15% sand ≥ 15% sand	poorly graded GRAVEL, with silt poorly graded GRAVEL, with silt and sand	GP-GM
			fines = CL, CH, (or CL-ML)	< 15% sand ≥ 15% sand	poorly graded GRAVEL, with clay (or silty clay) poorly graded GRAVEL, with clay and sand (or silty clay and sand)	GP-GC
	> 12% fines		fines = ML or MH	< 15% sand ≥ 15% sand	silty GRAVEL silty GRAVEL, with sand	GM
			fines = CL or CH	< 15% sand ≥ 15% sand	clayey GRAVEL clayey GRAVEL, with sand	GC
			fines = CL–ML	< 15% sand ≥ 15% sand	silty, clayey GRAVEL silty, clayey GRAVEL, with sand	GC-GM
SAND % sand ≥ % gravel	< 5 % fines	$C_u \geq 6$ and $1 \leq C_c \leq 3$		< 15% gravel ≥ 15% gravel	well-graded SAND well-graded SAND, with gravel	SW
		$C_u < 6$ or $C_c < 1$ or $C_c > 3$		< 15% gravel ≥ 15% gravel	poorly graded SAND poorly graded SAND, with gravel	SP
	5 - 12% fines	$C_u \geq 6$ and $1 \leq C_c \leq 3$	fines = ML or MH	< 15% gravel ≥ 15% gravel	well-graded SAND, with silt well-graded SAND, with silt and gravel	SW-SM
			fines = CL, CH, (or CL-ML)	< 15% gravel ≥ 15% gravel	well-graded SAND, with clay (or silty clay) well-graded SAND, with clay and gravel (or silty clay and gravel)	SW-SC
		$C_u < 6$ or $C_c < 1$ or $C_c > 3$	fines = ML or MH	< 15% gravel ≥ 15% gravel	poorly graded SAND, with silt poorly graded SAND, with silt and gravel	SP-SM
			fines = CL, CH, (or CL-ML)	< 15% gravel ≥ 15% gravel	poorly graded SAND, with clay (or silty clay) poorly graded SAND, with clay and gravel (or silty clay and gravel)	SP-SC
	> 12% fines		fines = ML or MH	< 15% gravel ≥ 15% gravel	silty SAND silty SAND, with gravel	SM
			fines = CL or CH	< 15% gravel ≥ 15% gravel	clayey SAND clayey SAND, with gravel	SC
			fines = CL–ML	< 15% gravel ≥ 15% gravel	silty, clayey SAND silty, clayey SAND, with gravel	SC-SM

Note: $C_u = D_{60}/D_{10}$ $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Where D_{60}, D_{30}, and D_{10} are the particle diameters corresponding to 60, 30, and 10% finer on the cumulative particle size distribution curve, respectively *(See ASTM C 136-93)*.

Soil Log Graphics



PG – Poorly Graded

WG – Well Graded

Fine-Grained Soils (≤ 50% Retained on No. 200 Sieve) *(from ASTM D 2487-93)*

							USCS
						Group Name	Group Symbol
Liquid Limit (LL) < 50	Inorganic	PI > 7 and plots on or above "A - Line"	< 15% > No. 200			lean CLAY	CL
			15 to 29% > No. 200	% sand ≥ % gravel		lean CLAY, with sand	
				% sand < % gravel		lean CLAY, with gravel	
			≥ 30% > No. 200	% sand ≥ % gravel	< 15% gravel	sandy, lean CLAY	
					≥ 15% gravel	sandy, lean CLAY, with gravel	
				% sand < % gravel	< 15% sand	gravelly, lean CLAY	
					≥ 15% sand	gravelly, lean CLAY, with sand	
		4 ≤ PI ≤ 7 and plots on or above "A - Line"	< 15% > No. 200			silty CLAY	CL-ML
			15 to 29% > No. 200	% sand ≥ % gravel		silty CLAY, with sand	
				% sand < % gravel		silty CLAY, with gravel	
			≥ 30% > No. 200	% sand ≥ % gravel	< 15% gravel	sandy, silty CLAY	
					≥ 15% gravel	sandy, silty CLAY, with gravel	
				% sand < % gravel	< 15% sand	gravelly, silty CLAY	
					≥ 15% sand	gravelly, silty CLAY, with sand	
		PI < 4 and plots below "A - Line"	< 15% > No. 200			SILT	ML
			15 to 29% > No. 200	% sand ≥ % gravel		SILT, with sand	
				% sand < % gravel		SILT, with gravel	
			≥ 30% > No. 200	% sand ≥ % gravel	< 15% gravel	sandy SILT	
					≥ 15% gravel	sandy, SILT, with gravel	
				% sand < % gravel	< 15% sand	gravelly SILT	
					≥ 15% sand	gravelly SILT, with sand	
	Organic (oven dried - LL / not dried - LL < 0.75)	PI ≥ 4 and plots on or above "A - Line"	< 15% > No. 200			organic CLAY	OL
			15 to 29% > No. 200	% sand ≥ % gravel		organic CLAY, with sand	
				% sand < % gravel		organic CLAY, with gravel	
			≥ 30% > No. 200	% sand ≥ % gravel	< 15% gravel	sandy, organic CLAY	
					≥ 15% gravel	sandy, organic CLAY, with gravel	
				% sand < % gravel	< 15% sand	gravelly, organic CLAY	
					≥ 15% sand	gravelly, organic CLAY, with sand	
		PI < 4 and plots below "A - Line"	< 15% > No. 200			organic SILT	
			15 to 29% > No. 200	% sand ≥ % gravel		organic SILT, with sand	
				% sand < % gravel		organic SILT, with gravel	
			≥ 30% > No. 200	% sand ≥ % gravel	< 15% gravel	sandy, organic SILT	
					≥ 15% gravel	sandy, organic SILT, with gravel	
				% sand < % gravel	< 15% sand	gravelly, organic SILT	
					≥ 15% sand	gravelly, organic SILT, with sand	
Liquid Limit (LL) ≥ 50	Inorganic	PI plots on or above "A - Line"	< 15% > No. 200			fat CLAY	CH
			15 to 29% > No. 200	% sand ≥ % gravel		fat CLAY, with sand	
				% sand < % gravel		fat CLAY, with gravel	
			≥ 30% > No. 200	% sand ≥ % gravel	< 15% gravel	sandy, fat CLAY	
					≥ 15% gravel	sandy, fat CLAY, with gravel	
				% sand < % gravel	< 15% sand	gravelly, fat CLAY	
					≥ 15% sand	gravelly, fat CLAY, with sand	
		PI plots below "A - Line"	< 15% > No. 200			elastic SILT	MH
			15 to 29% > No. 200	% sand ≥ % gravel		elastic SILT, with sand	
				% sand < % gravel		elastic SILT, with gravel	
			≥ 30% > No. 200	% sand ≥ % gravel	< 15% gravel	sandy, elastic SILT	
					≥ 15% gravel	sandy, elastic SILT, with gravel	
				% sand < % gravel	< 15% sand	gravelly, elastic SILT	
					≥ 15% sand	gravelly, elastic SILT, with sand	
	Organic (oven dried - LL / not dried - LL < 0.75)	PI plots on or above "A - Line"	< 15% > No. 200			organic CLAY	OH
			15 to 29% > No. 200	% sand ≥ % gravel		organic CLAY, with sand	
				% sand < % gravel		organic CLAY, with gravel	
			≥ 30% > No. 200	% sand ≥ % gravel	< 15% gravel	sandy, organic CLAY	
					≥ 15% gravel	sandy, organic CLAY, with gravel	
				% sand < % gravel	< 15% sand	gravelly, organic CLAY	
					≥ 15% sand	gravelly, organic CLAY, with sand	
		PI plots below "A - Line"	< 15% > No. 200			organic SILT	
			15 to 29% > No. 200	% sand ≥ % gravel		organic SILT, with sand	
				% sand < % gravel		organic SILT, with gravel	
			≥ 30% > No. 200	% sand ≥ % gravel	< 15% gravel	sandy, organic SILT	
					≥ 15% gravel	sandy, organic SILT, with gravel	
				% sand < % gravel	< 15% sand	gravelly, organic SILT	
					≥ 15% sand	gravelly, organic SILT, with sand	

Note: For LL (Liquid Limit) and PI (Plasticity Index) see Plasticity Chart (ASTM D 2487-93).

Highly Organic Soils *(from ASTM D 4427-92)*

	Group Name	Group Symbol
Primarily organic matter, dark in color with organic odor	PEAT	PT

Coarse-Grained Soils (< 50% fines) *(from ASTM D 2488-93)*

					Visual - Manual	
					Group Name	Group Symbol
GRAVEL % gravel > % sand	≤ 5 % fines	Well-graded		< 15% sand	well-graded GRAVEL	GW
				≥ 15% sand	well-graded GRAVEL, with sand	
		Poorly graded		< 15% sand	poorly graded GRAVEL	GP
				≥ 15% sand	poorly graded GRAVEL, with sand	
	10 % fines	Well-graded	fines = ML or MH	< 15% sand	well-graded GRAVEL, with silt	GW-GM
				≥ 15% sand	well-graded GRAVEL, with silt and sand	
			fines = CL or CH	< 15% sand	well-graded GRAVEL, with clay	GW-GC
				≥ 15% sand	well-graded GRAVEL, with clay and sand	
		Poorly graded	fines = ML or MH	< 15% sand	poorly graded GRAVEL, with silt	GP-GM
				≥ 15% sand	poorly graded GRAVEL, with silt and sand	
			fines = CL or CH	< 15% sand	poorly graded GRAVEL, with clay	GP-GC
				≥ 15% sand	poorly graded GRAVEL, with clay and sand	
	≥ 15 % fines		fines = ML or MH	< 15% sand	silty GRAVEL	GM
				≥ 15% sand	silty GRAVEL, with sand	
			fines = CL or CH	< 15% sand	clayey GRAVEL	GC
				≥ 15% sand	clayey GRAVEL, with sand	
SAND % sand ≥ % gravel	≤ 5 % fines	Well-graded		< 15% gravel	well-graded SAND	SW
				≥ 15% gravel	well-graded SAND, with gravel	
		Poorly graded		< 15% gravel	poorly graded SAND	SP
				≥ 15% gravel	poorly graded SAND, with gravel	
	10 % fines	Well-graded	fines = ML or MH	< 15% gravel	well-graded SAND, with silt	SW-SM
				≥ 15% gravel	well-graded SAND, with silt and gravel	
			fines = CL or CH	< 15% gravel	well-graded SAND, with clay	SW-SC
				≥ 15% gravel	well-graded SAND, with clay and gravel	
		Poorly graded	fines = ML or MH	< 15% gravel	poorly graded SAND, with silt	SP-SM
				≥ 15% gravel	poorly graded SAND, with silt and gravel	
			fines = CL or CH	< 15% gravel	poorly graded SAND, with clay	SP-SC
				≥ 15% gravel	poorly graded SAND, with clay and gravel	
	≥ 15 % fines		fines = ML or MH	< 15% gravel	silty SAND	SM
				≥ 15% gravel	silty SAND, with gravel	
			fines = CL or CH	< 15% gravel	clayey SAND	SC
				≥ 15% gravel	clayey SAND, with gravel	

Inorganic and Organic Fine-Grained Soils (≤ 50% fines) *(from ASTM D 2488-93)*

					Visual - Manual	
					Group Name	Group Symbol
		< 15% > No. 200			lean CLAY	CL
Dilatancy	*None to slow*	15 to 25% > No. 200	% sand ≥ % gravel		lean CLAY, with sand	
Dry Strength	*Medium to high*		% sand < % gravel		lean CLAY, with gravel	
Toughness	*Medium*	≥ 30% > No. 200	% sand ≥ % gravel	< 15% gravel	sandy, lean CLAY	
				≥ 15% gravel	sandy, lean CLAY, with gravel	
			% sand < % gravel	< 15% sand	gravelly, lean CLAY	
				≥ 15% sand	gravelly, lean CLAY, with sand	
		< 15% > No. 200			SILT	ML
Dilatancy	*Slow to Rapid*	15 to 25% > No. 200	% sand ≥ % gravel		SILT, with sand	
Dry Strength	*None to low*		% sand < % gravel		SILT, with gravel	
Toughness	*Low or*	≥ 30% > No. 200	% sand ≥ % gravel	< 15% gravel	sandy SILT	
	nonplastic			≥ 15% gravel	sandy, SILT, with gravel	
			% sand < % gravel	< 15% sand	gravelly SILT	
				≥ 15% sand	gravelly SILT, with sand	
		< 15% > No. 200			fat CLAY	CH
Dilatancy	*None*	15 to 25% > No. 200	% sand ≥ % gravel		fat CLAY, with sand	
Dry Strength	*High to very high*		% sand < % gravel		fat CLAY, with gravel	
Toughness	*High*	≥ 30% > No. 200	% sand ≥ % gravel	< 15% gravel	sandy, fat CLAY	
				≥ 15% gravel	sandy, fat CLAY, with gravel	
			% sand < % gravel	< 15% sand	gravelly, fat CLAY	
				≥ 15% sand	gravelly, fat CLAY, with sand	
		< 15% > No. 200			elastic SILT	MH
Dilatancy	*None to slow*	15 to 25% > No. 200	% sand ≥ % gravel		elastic SILT, with sand	
Dry Strength	*Low to medium*		% sand < % gravel		elastic SILT, with gravel	
Toughness	*Low to medium*	≥ 30% > No. 200	% sand ≥ % gravel	< 15% gravel	sandy, elastic SILT	
				≥ 15% gravel	sandy, elastic SILT, with gravel	
			% sand < % gravel	< 15% sand	gravelly, elastic SILT	
				≥ 15% sand	gravelly, elastic SILT, with sand	
Dilatancy	*Slow to Rapid*	< 15% > No. 200			organic soil	OL-OH
Dry Strength	*None to low*	15 to 25% > No. 200	% sand ≥ % gravel		organic soil, with sand	
Toughness	*Low or*		% sand < % gravel		organic soil, with gravel	
	nonplastic	≥ 30% > No. 200	% sand ≥ % gravel	< 15% gravel	sandy, organic soil	
Significant organic content				≥ 15% gravel	sandy, organic soil, with gravel	
			% sand < % gravel	< 15% sand	gravelly, organic soil	
				≥ 15% sand	gravelly, organic soil, with sand	
Soil composed primarily of vegetable tissue in various stages of decomposition usually with an organic odor, a dark brown to black color, a spongy consistency, and a texture ranging from fibrous to amorphous.					PEAT	PT

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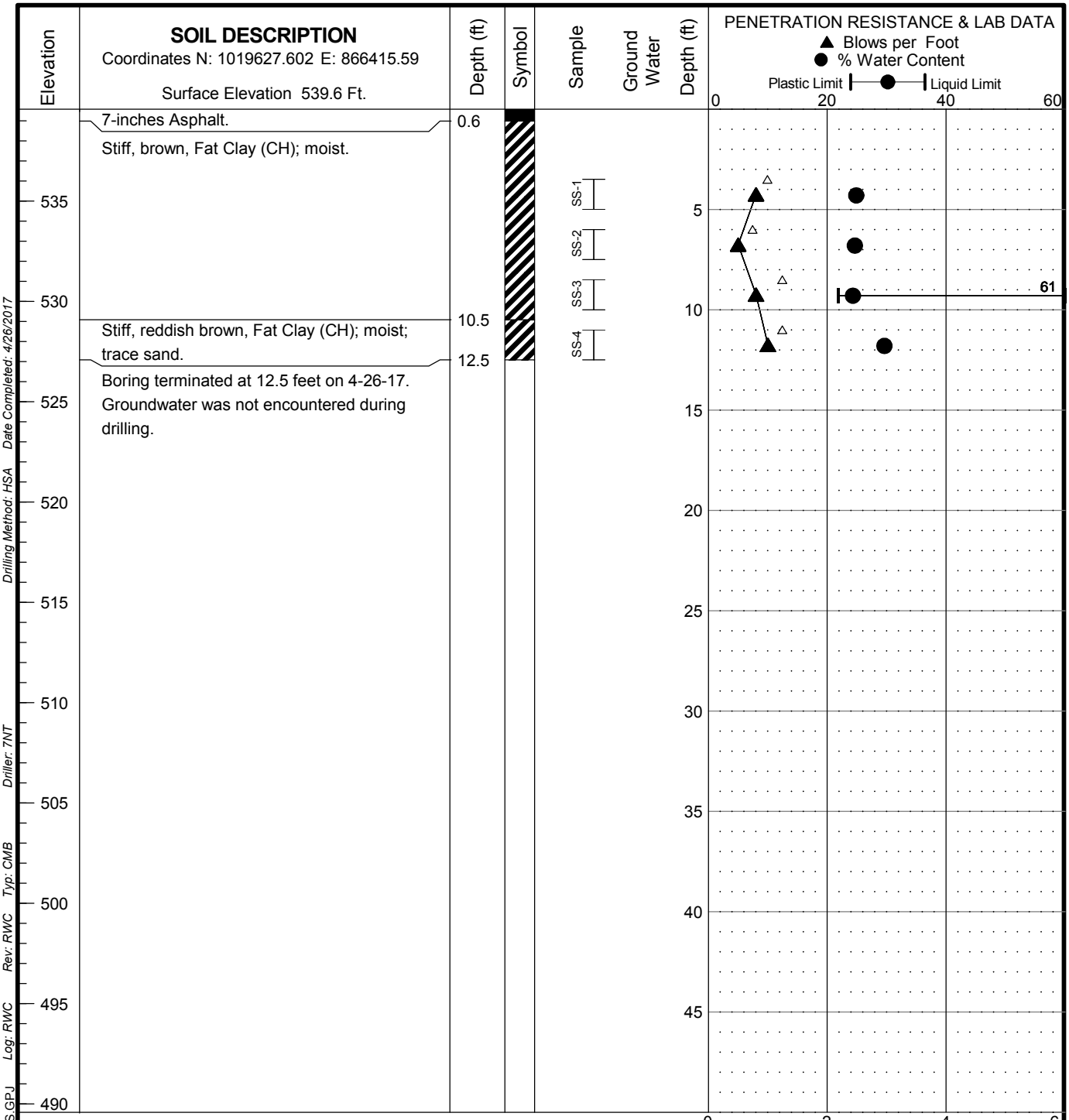

LEGEND

- * Sample Not Recovered
- 2-inch O.D. Split Spoon Sample
- 3-inch O.D. Shelby Tube Sample
- REC% / RQD% Rock Core
- Ground Water Level - DD - During Drilling X.X - Time In Hours
- △ Pocket Penetrometer Shear Strength
- □ Vane Shear Strength
- ◆ Torvane Shear Strength
- ◇ Unconfined Compression Shear Strength
- ○ Unconsolidated Undrained Shear Strength

NOTES

1. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of the subsurface materials.
3. Groundwater level, if indicated above, is for the date specified, and may vary.
4. Refer to KEY for explanation of "Symbols" and definitions.
5. USCS designation is based on visual-manual classification and selected laboratory index testing.
6. Approximate Street Address: 73 LAKE FOREST DR

L-111 (Linden) Sewer Separation
RDP Tributaries CSO Tunnel
MSD Project Number 12441

LOG OF BORING L17-1

April 2018 41-1-37530-005

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

TRIBS SOIL BORING LOG 41-1-37530-005 RDP TRIBS SOIL LOGS.GPJ Log: RWC Rev: RWC Typ: CMB Driller: 7NT Drilling Method: HSA Date Completed: 4/26/2017

SOIL DESCRIPTION

Coordinates N: 1020696.804 E: 866889.497

Surface Elevation 536.3 Ft.

Elevation	Depth (ft)	Symbol	Sample	Ground Water Depth (ft)
535	0.4			
	0.8			
530			SS-1	
			SS-2	
	8.0		SS-3	
525			SS-4	
	12.5			
520				
515				
510				
505				
500				
495				
490				

4-inches Asphalt.

5-inches Concrete.

Stiff, brown, Lean Clay (CL); moist.

Stiff, yellowish brown and gray mottled, Fat Clay (CH); moist.

Boring terminated at 12.5 feet on 4-26-17. Groundwater was not encountered during drilling.

PENETRATION RESISTANCE & LAB DATA

▲ Blows per Foot

● % Water Content

Plastic Limit — Liquid Limit

0 20 40 60

5 10 15 20 25 30 35 40 45

0 2 4 6

Undrained Shear Strength, tsf

△ Pocket Penetrometer Shear Strength

□ Vane Shear Strength

◆ Torvane Shear Strength

◇ Unconfined Compression Shear Strength

○ Unconsolidated Undrained Shear Strength

LEGEND

* Sample Not Recovered

2-inch O.D. Split Spoon Sample

3-inch O.D. Shelby Tube Sample

REC% / RQD% Rock Core

Ground Water Level - DD - During Drilling X.X - Time In Hours

NOTES

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2. The discussion in the text of this report is necessary for a proper understanding of the nature of the subsurface materials.
3. Groundwater level, if indicated above, is for the date specified, and may vary.
4. Refer to KEY for explanation of "Symbols" and definitions.
5. USCS designation is based on visual-manual classification and selected laboratory index testing.
6. Approximate Street Address: 5 LAKE FOREST DR

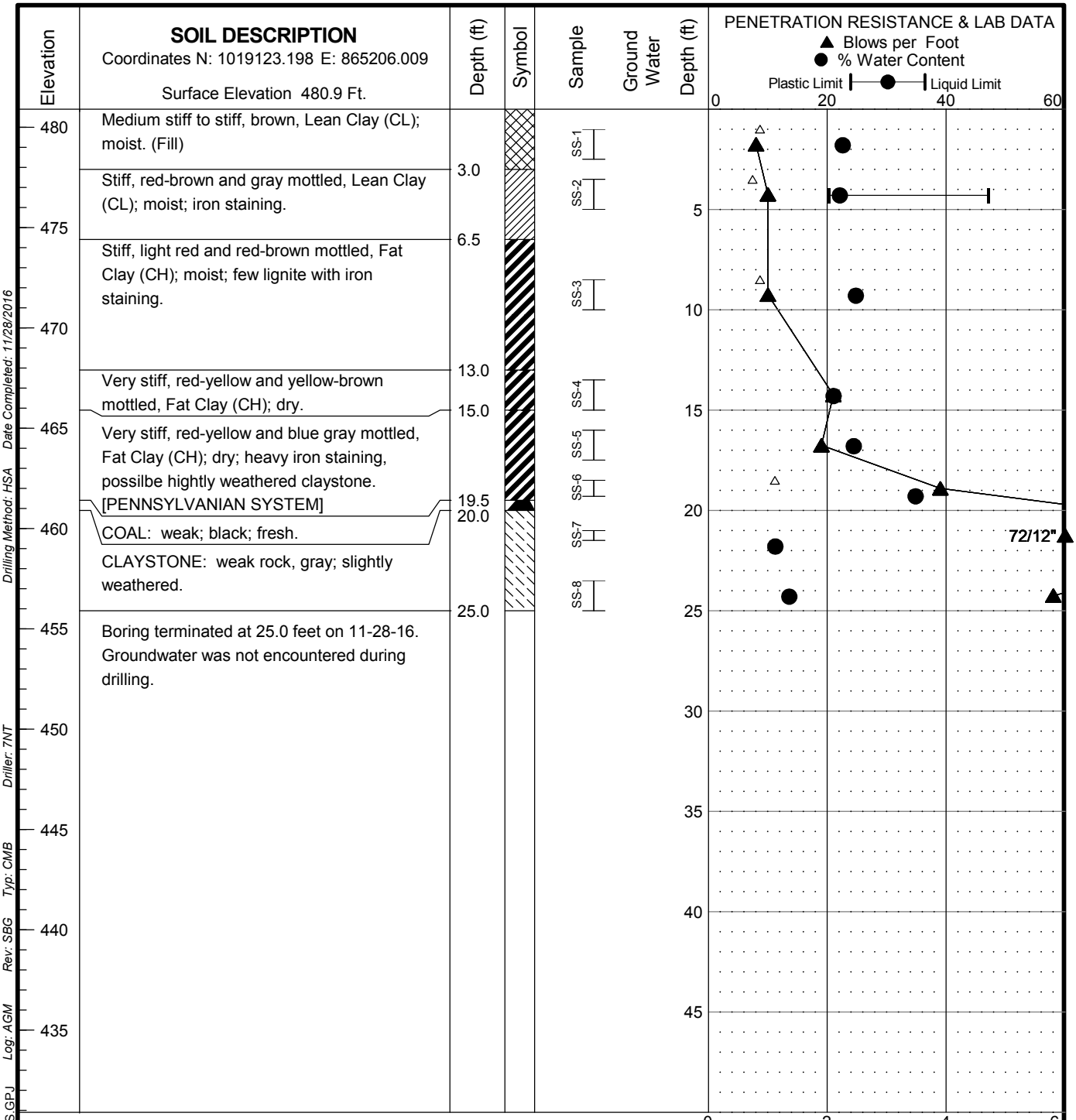
L-111 (Linden) Sewer Separation
RDP Tributaries CSO Tunnel
MSD Project Number 12441

LOG OF BORING L17-2

April 2018 41-1-37530-005

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

TRIBS SOIL BORING LOG 41-1-37530-005 RDP TRIBS SOIL LOGS.GPJ Log: RWC Rev: RWC Typ: CMB Driller: 7NT Drilling Method: HSA Date Completed: 4/26/2017



LEGEND

- * Sample Not Recovered
- 2-inch O.D. Split Spoon Sample
- 3-inch O.D. Shelby Tube Sample
- REC% / RQD% Rock Core
- Ground Water Level - DD - During Drilling, X.X - Time In Hours
- △ Pocket Penetrometer Shear Strength
- □ Vane Shear Strength
- ◆ Torvane Shear Strength
- ◇ Unconfined Compression Shear Strength
- ○ Unconsolidated Undrained Shear Strength

NOTES

1. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of the subsurface materials.
3. Groundwater level, if indicated above, is for the date specified, and may vary.
4. Refer to KEY for explanation of "Symbols" and definitions.
5. USCS designation is based on visual-manual classification and selected laboratory index testing.
6. Approximate Street Address: 8501 ANTLER DR

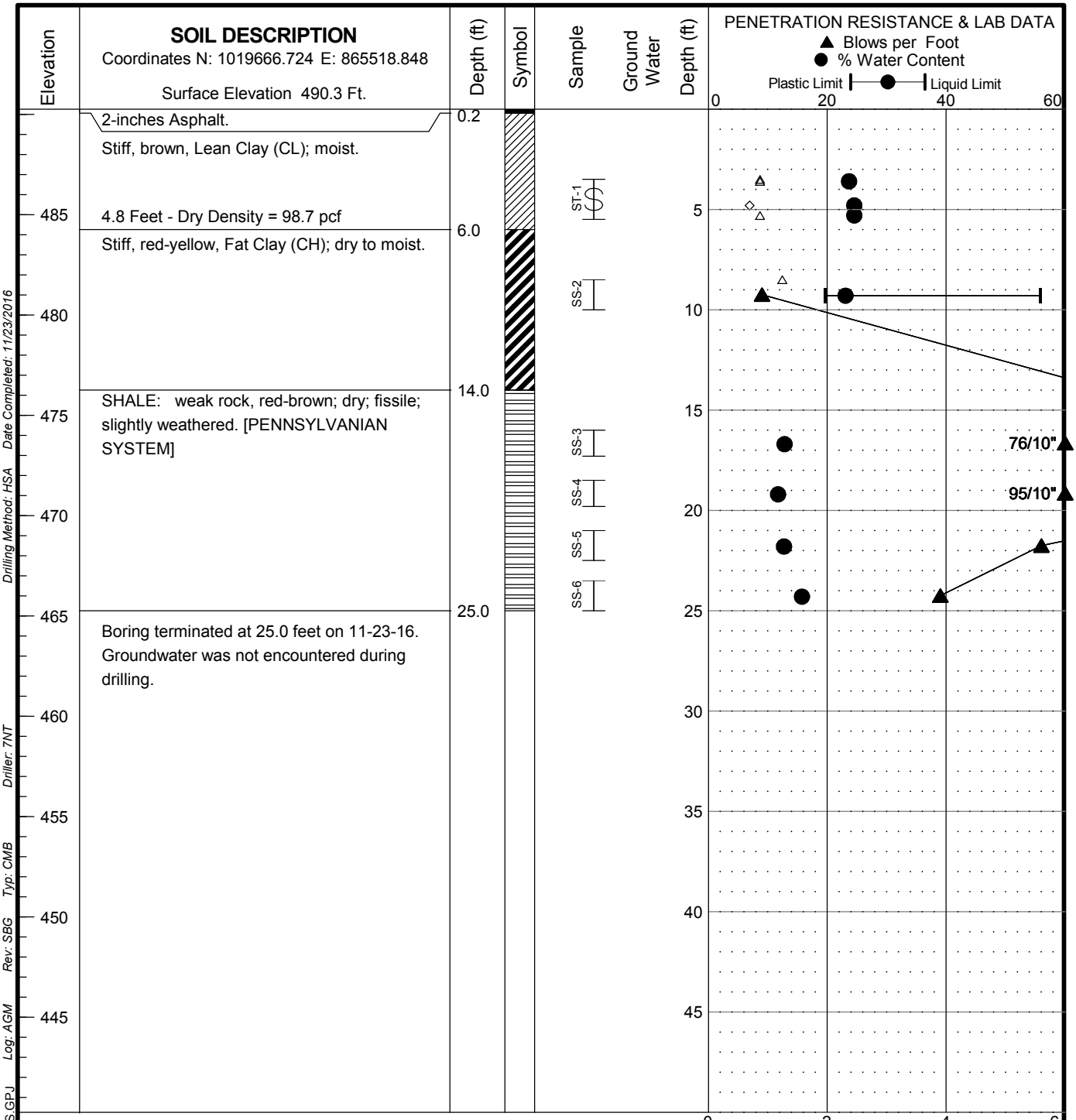
L-111 (Linden) Sewer Separation
RDP Tributaries CSO Tunnel
MSD Project Number 12441

LOG OF BORING L17-3

April 2018 41-1-37530-005

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

TRIBS SOIL BORING LOG 41-1-37530-005 RDP TRIBS SOIL LOGS.GPJ Log: AGM Rev: SBG Typ: CMB Driller: 7NT Drilling Method: HSA Date Completed: 11/28/2016



LEGEND

* Sample Not Recovered
2-inch O.D. Split Spoon Sample
3-inch O.D. Shelby Tube Sample
REC% / RQD% Rock Core
Ground Water Level - DD - During Drilling X.X - Time In Hours
Pocket Penetrometer Shear Strength
Vane Shear Strength
Torvane Shear Strength
Unconfined Compression Shear Strength
Unconsolidated Undrained Shear Strength

NOTES

1. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of the subsurface materials.
3. Groundwater level, if indicated above, is for the date specified, and may vary.
4. Refer to KEY for explanation of "Symbols" and definitions.
5. USCS designation is based on visual-manual classification and selected laboratory index testing.
6. Approximate Street Address: 1100 E LINDEN AVE

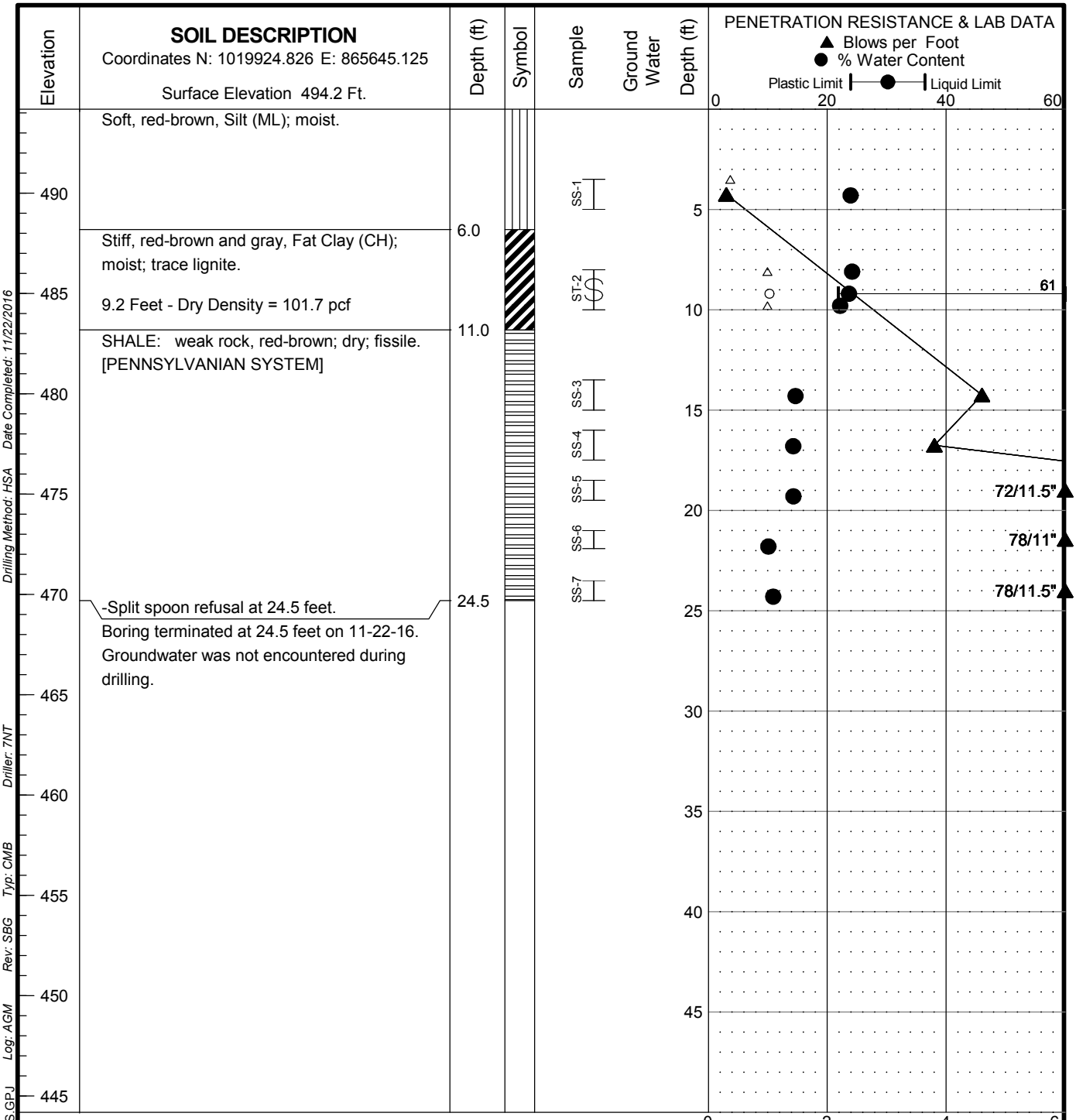
L-111 (Linden) Sewer Separation
RDP Tributaries CSO Tunnel
MSD Project Number 12441

LOG OF BORING L17-4

April 2018 41-1-37530-005

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

Drilling Method: HSA Date Completed: 11/23/2016 Driller: 7NT Typ: CMB Rev: SBG Log: AGM TRIBS SOIL BORING LOG 41-1-37530-005 RDP TRIBS SOIL LOGS.GPJ



LEGEND

- * Sample Not Recovered
- 2-inch O.D. Split Spoon Sample
- 3-inch O.D. Shelby Tube Sample
- REC% / RQD% Rock Core
- Ground Water Level - DD - During Drilling, X.X - Time In Hours
- △ Pocket Penetrometer Shear Strength
- □ Vane Shear Strength
- ◆ Torvane Shear Strength
- ◇ Unconfined Compression Shear Strength
- ○ Unconsolidated Undrained Shear Strength

NOTES

1. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of the subsurface materials.
3. Groundwater level, if indicated above, is for the date specified, and may vary.
4. Refer to KEY for explanation of "Symbols" and definitions.
5. USCS designation is based on visual-manual classification and selected laboratory index testing.
6. Approximate Street Address: 8420 Winzenburg Dr

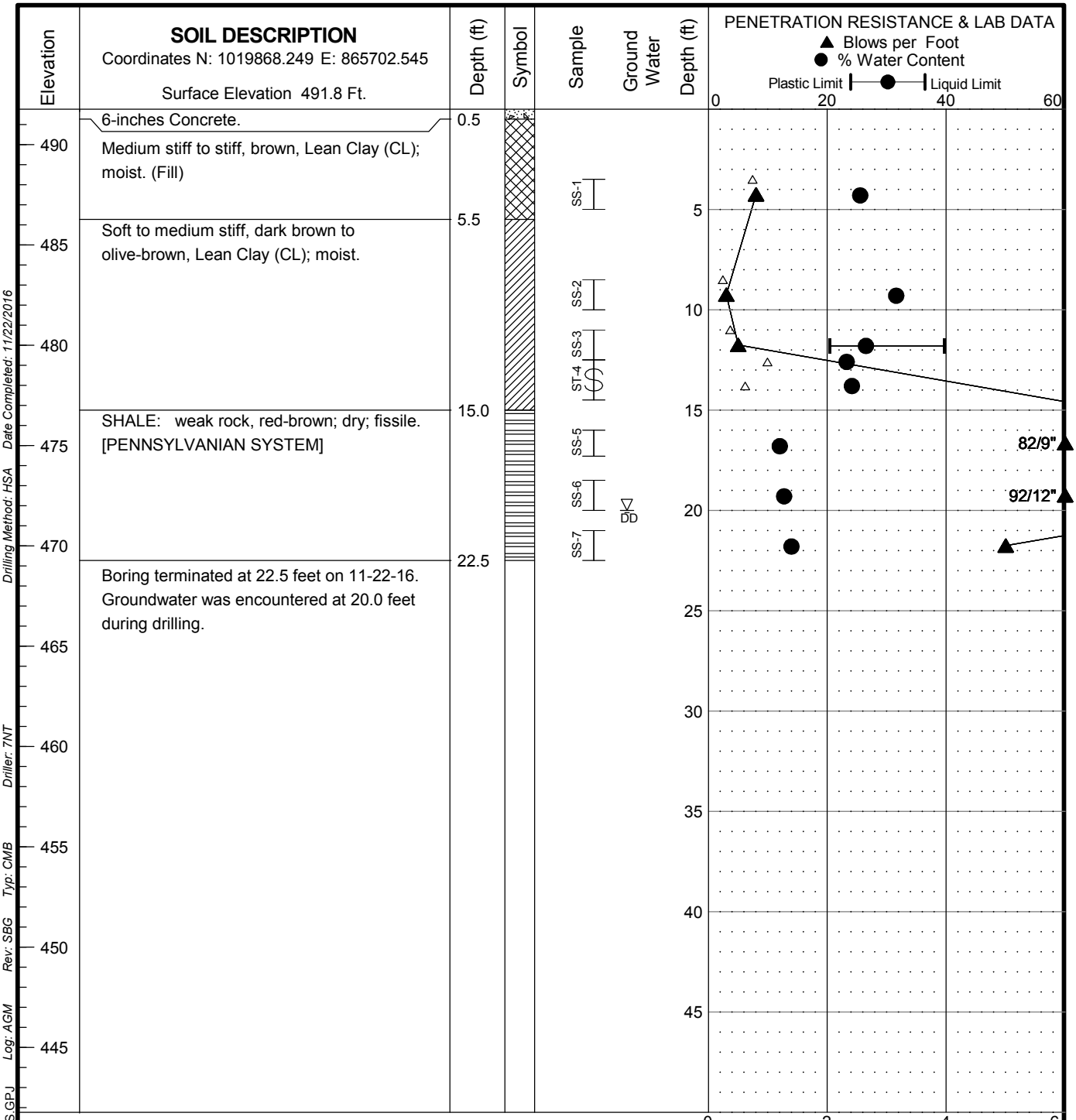
L-111 (Linden) Sewer Separation
RDP Tributaries CSO Tunnel
MSD Project Number 12441

LOG OF BORING L17-5

April 2018 41-1-37530-005

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

TRIBS SOIL BORING LOG 41-1-37530-005 RDP TRIBS SOIL LOGS.GPJ Log: AGM Rev: SBG Typ: CMB Driller: 7NT Drilling Method: HSA Date Completed: 11/22/2016



LEGEND

- * Sample Not Recovered
- 2-inch O.D. Split Spoon Sample
- 3-inch O.D. Shelby Tube Sample
- REC% / RQD% Rock Core
- Ground Water Level - DD - During Drilling, X.X - Time In Hours

NOTES

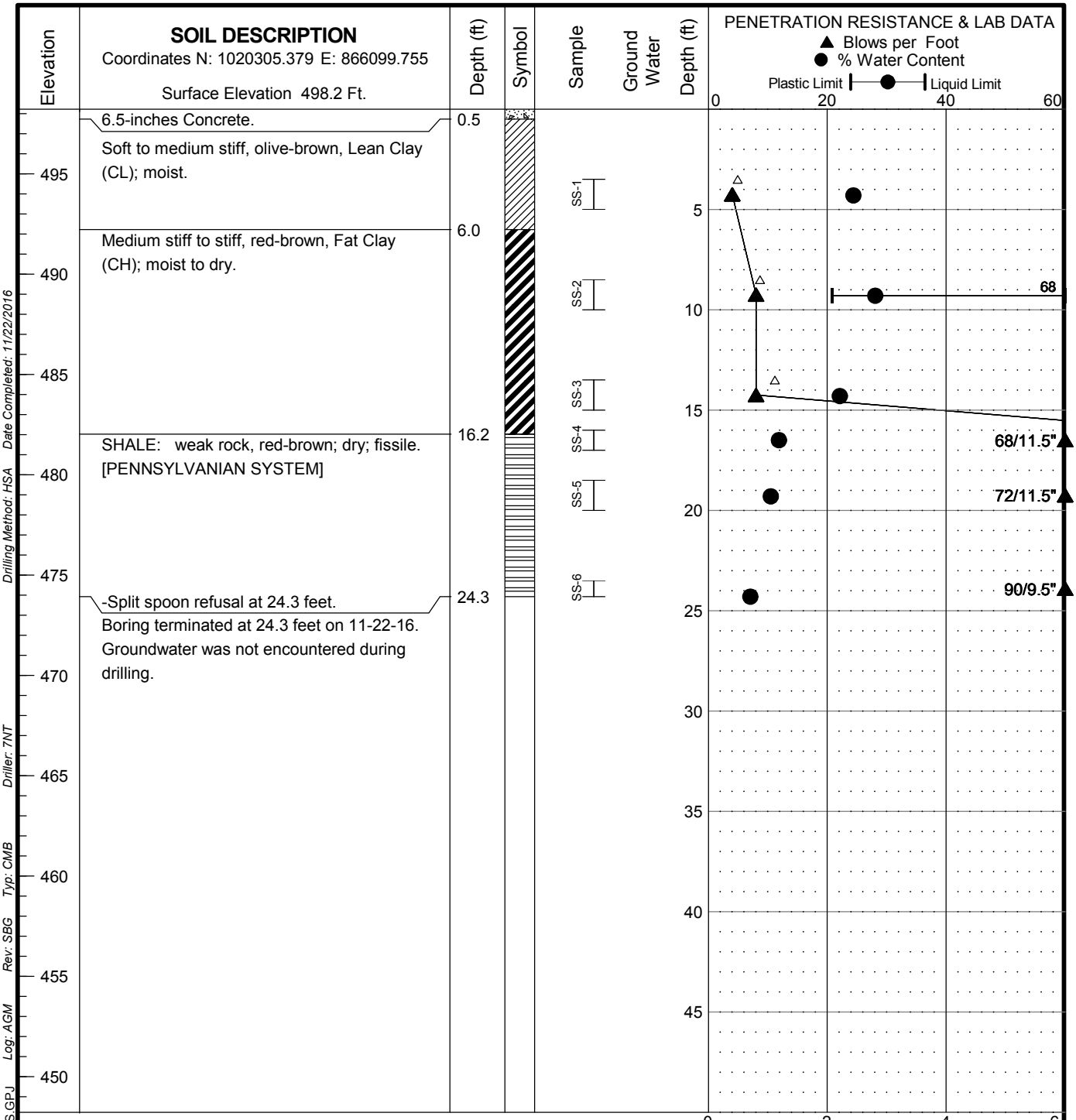
1. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of the subsurface materials.
3. Groundwater level, if indicated above, is for the date specified, and may vary.
4. Refer to KEY for explanation of "Symbols" and definitions.
5. USCS designation is based on visual-manual classification and selected laboratory index testing.
6. Approximate Street Address: 8420 Winzenburg Dr

L-111 (Linden) Sewer Separation
RDP Tributaries CSO Tunnel
MSD Project Number 12441

LOG OF BORING L17-6

April 2018 41-1-37530-005

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants



LEGEND

- * Sample Not Recovered
- 2-inch O.D. Split Spoon Sample
- 3-inch O.D. Shelby Tube Sample
- REC% / RQD% Rock Core
- Ground Water Level - DD - During Drilling, X.X - Time In Hours

NOTES

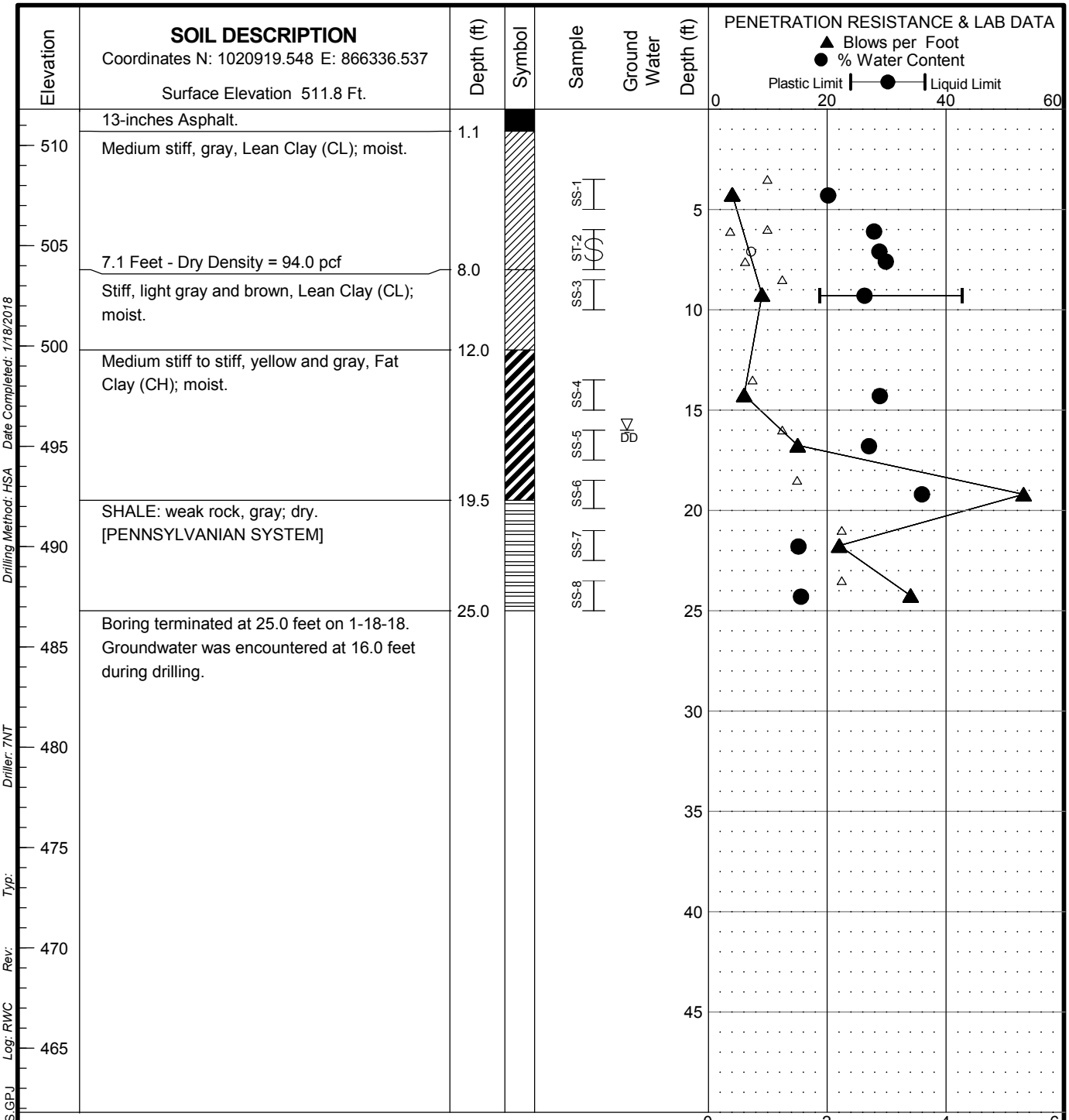
1. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of the subsurface materials.
3. Groundwater level, if indicated above, is for the date specified, and may vary.
4. Refer to KEY for explanation of "Symbols" and definitions.
5. USCS designation is based on visual-manual classification and selected laboratory index testing.
6. Approximate Street Address: 1054 Errace Dr

L-111 (Linden) Sewer Separation
RDP Tributaries CSO Tunnel
MSD Project Number 12441

LOG OF BORING L17-7

April 2018 41-1-37530-005

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants



TRIBS SOIL BORING LOG 41-1-37530-005 RDP TRIBS SOIL LOGS.GPJ Log: RWC Rev: Typ: Driller: 7NT Drilling Method: HSA Date Completed: 1/18/2018

LEGEND

- * Sample Not Recovered
- 2-inch O.D. Split Spoon Sample
- 3-inch O.D. Shelby Tube Sample
- REC% / RQD% Rock Core
- Ground Water Level - DD - During Drilling X.X - Time In Hours

NOTES

1. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of the subsurface materials.
3. Groundwater level, if indicated above, is for the date specified, and may vary.
4. Refer to KEY for explanation of "Symbols" and definitions.
5. USCS designation is based on visual-manual classification and selected laboratory index testing.
6. Approximate Street Address:

L-111 (Linden) Sewer Separation
RDP Tributaries CSO Tunnel
MSD Project Number 12441

LOG OF BORING L17-8

April 2018 41-1-37530-005

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

SOIL DESCRIPTION

Coordinates N: 1021027.643 E: 866457.276

Surface Elevation 518.4 Ft.

Elevation	Depth (ft)	Description
	0.9	10-inches Asphalt.
515		Medium stiff, brown, Fat Clay (CH); moist.
	7.0	
510		Stiff, gray and brown, Lean Clay (CL); moist.
		9.4 Feet - Dry Density = 97.0 pcf
	12.0	
505		Stiff, yellowish brown, Fat Clay (CH); moist.
	15.5	
		Stiff, light gray and yellow, Fat Clay (CH); moist.
500	18.0	SHALE: weak rock, yellow to yellow and gray; moist to dry; trace limestone gravel. [PENNSYLVANIAN SYSTEM]
495		
490	28.6	Boring terminated at 28.6 feet on 1-18-18. Groundwater was not encountered during drilling.
485		
480		
475		
470		

Symbol

Sample: SS-1, ST-2, SS-3, SS-4, SS-5, SS-6, SS-7, SS-8, SS-9, SS-10

Ground Water

Depth (ft)

PENETRATION RESISTANCE & LAB DATA

▲ Blows per Foot

● % Water Content

Plastic Limit — Liquid Limit

0 20 40 60

5 10 15 20 25 30 35 40 45

66

50/5"

50/1"

0 2 4 6

Undrained Shear Strength, tsf

△ Pocket Penetrometer Shear Strength

□ Vane Shear Strength

◆ Torvane Shear Strength

◇ Unconfined Compression Shear Strength

○ Unconsolidated Undrained Shear Strength

LEGEND

* Sample Not Recovered

2-inch O.D. Split Spoon Sample

3-inch O.D. Shelby Tube Sample

REC% / RQD% Rock Core

Ground Water Level - DD - During Drilling X.X - Time In Hours

NOTES

1. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of the subsurface materials.
3. Groundwater level, if indicated above, is for the date specified, and may vary.
4. Refer to KEY for explanation of "Symbols" and definitions.
5. USCS designation is based on visual-manual classification and selected laboratory index testing.
6. Approximate Street Address:

L-111 (Linden) Sewer Separation
RDP Tributaries CSO Tunnel
MSD Project Number 12441

LOG OF BORING L17-9

April 2018

41-1-37530-005

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

Drilling Method: HSA Date Completed: 1/18/2018 Driller: TNT Typ: Rev: Log: RWC TRIBS SOIL BORING LOG 41-1-37530-005 RDP TRIBS SOIL LOGS.GPJ

SOIL DESCRIPTION

Coordinates N: 1021289.214 E: 866434.611

Surface Elevation 519.8 Ft.

Elevation	Depth (ft)	Soil Description
	0	Medium stiff, red-yellow, Lean Clay (CL); moist.
515	4.8	Stiff to very stiff, red-yellow to yellow, Fat Clay (CH); moist to dry; iron staining at depth. [PENNSYLVANIAN SYSTEM]
500	19.2	Hard, olive-brown, Fat Clay with Gravel (CH); dry; highly weathered limestone.
	21.9	SHALE: weak rock, olive-brown; fissile; iron stained; slightly weathered.
495	23.0	CLAYSTONE: weak rock, blue-gray and olive mottled; slightly weathered; 1/2-inch thin coal layer at 23.9 feet.
	25.0	Boring terminated at 25.0 feet on 11-29-16. Groundwater was encountered at 18.5 feet during drilling.

Symbol | Sample | Ground Water | Depth (ft)

SS-1, SS-2, SS-3, SS-4, SS-5, SS-6, SS-7

DD

PENETRATION RESISTANCE & LAB DATA

▲ Blows per Foot

● % Water Content

Plastic Limit — Liquid Limit

0 20 40 60

88/9"

0 2 4 6

Undrained Shear Strength, tsf

△ Pocket Penetrometer Shear Strength

□ Vane Shear Strength

◆ Torvane Shear Strength

◇ Unconfined Compression Shear Strength

○ Unconsolidated Undrained Shear Strength

LEGEND

* Sample Not Recovered

2-inch O.D. Split Spoon Sample

3-inch O.D. Shelby Tube Sample

REC% / RQD% Rock Core

Ground Water Level - DD - During Drilling X.X - Time In Hours

NOTES

1. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of the subsurface materials.
3. Groundwater level, if indicated above, is for the date specified, and may vary.
4. Refer to KEY for explanation of "Symbols" and definitions.
5. USCS designation is based on visual-manual classification and selected laboratory index testing.
6. Approximate Street Address: 7736 W Biltmore Dr

L-111 (Linden) Sewer Separation
RDP Tributaries CSO Tunnel
MSD Project Number 12441

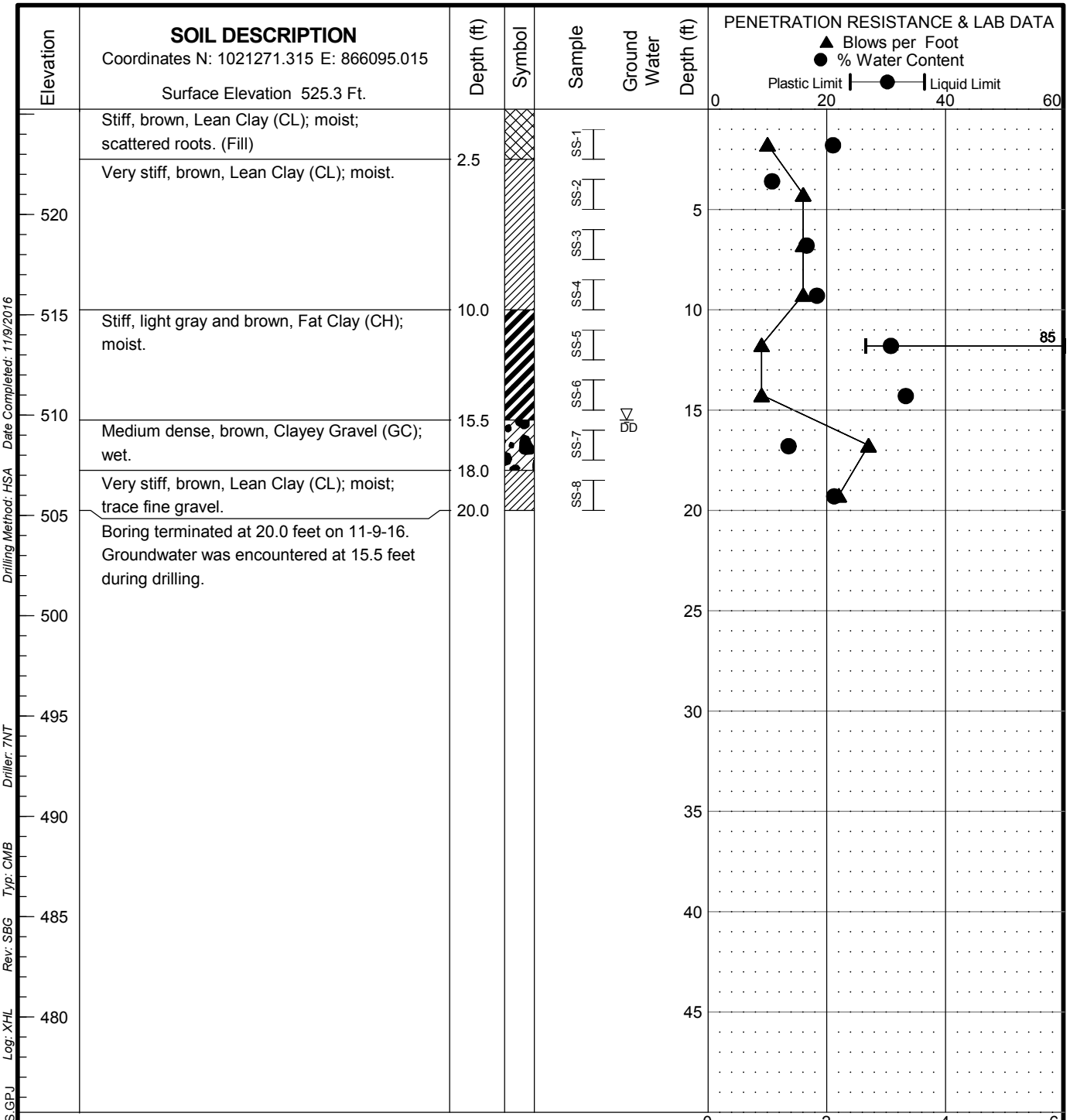
LOG OF BORING L17-10

April 2018 41-1-37530-005

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

Drilling Method: HSA Date Completed: 11/29/2016 Driller: 7NT Typ: CMB Rev: SBG Log: AGM

TRIBS SOIL BORING LOG 41-1-37530-005 RDP TRIBS SOIL LOGS.GPJ



LEGEND

- * Sample Not Recovered
- 2-inch O.D. Split Spoon Sample
- 3-inch O.D. Shelby Tube Sample
- REC% / RQD% Rock Core
- Ground Water Level - DD - During Drilling, X.X - Time In Hours

NOTES

1. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of the subsurface materials.
3. Groundwater level, if indicated above, is for the date specified, and may vary.
4. Refer to KEY for explanation of "Symbols" and definitions.
5. USCS designation is based on visual-manual classification and selected laboratory index testing.
6. Approximate Street Address: 938 S CENTRAL AVE

L-111 (Linden) Sewer Separation
RDP Tributaries CSO Tunnel
MSD Project Number 12441

LOG OF BORING L17-11

April 2018 41-1-37530-005

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

Drilling Method: HSA Date Completed: 11/9/2016 Driller: 7NT Typ: CMB Rev: SBG Log: XHL TRIBS SOIL BORING LOG 41-1-37530-005 RDP TRIBS SOIL LOGS.GPJ

SOIL DESCRIPTION

Coordinates N: 1018658.22 E: 865122.986

Surface Elevation 478 Ft.

Elevation	Depth (ft)	Symbol	Sample	Ground Water Depth (ft)
475	0		SS-1	
470			SS-2	
465			SS-3	
460			SS-4	
455			SS-5	
450			SS-6	
445				
440				
435				
430				

Stiff, red-brown and gray mottled, Lean Clay (CL); moist to dry; few lignite and iron staining.

15.5

CLAYSTONE: weak rock, gray; iron staining; slightly weathered. [PENNSYLVANIAN SYSTEM]

20.0

Boring terminated at 20.0 feet on 11-28-16. Groundwater was not encountered during drilling.

PENETRATION RESISTANCE & LAB DATA

▲ Blows per Foot

● % Water Content

Plastic Limit — Liquid Limit

0 20 40 60

5 10 15 20 25 30 35 40 45

0 2 4 6

Undrained Shear Strength, tsf

△ Pocket Penetrometer Shear Strength

□ Vane Shear Strength

◆ Torvane Shear Strength

◇ Unconfined Compression Shear Strength

○ Unconsolidated Undrained Shear Strength

LEGEND

* Sample Not Recovered

2-inch O.D. Split Spoon Sample

3-inch O.D. Shelby Tube Sample

REC% / RQD% Rock Core

Ground Water Level - DD - During Drilling X.X - Time In Hours

NOTES

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2. The discussion in the text of this report is necessary for a proper understanding of the nature of the subsurface materials.
3. Groundwater level, if indicated above, is for the date specified, and may vary.
4. Refer to KEY for explanation of "Symbols" and definitions.
5. USCS designation is based on visual-manual classification and selected laboratory index testing.
6. Approximate Street Address: 1216 E Linden Ave

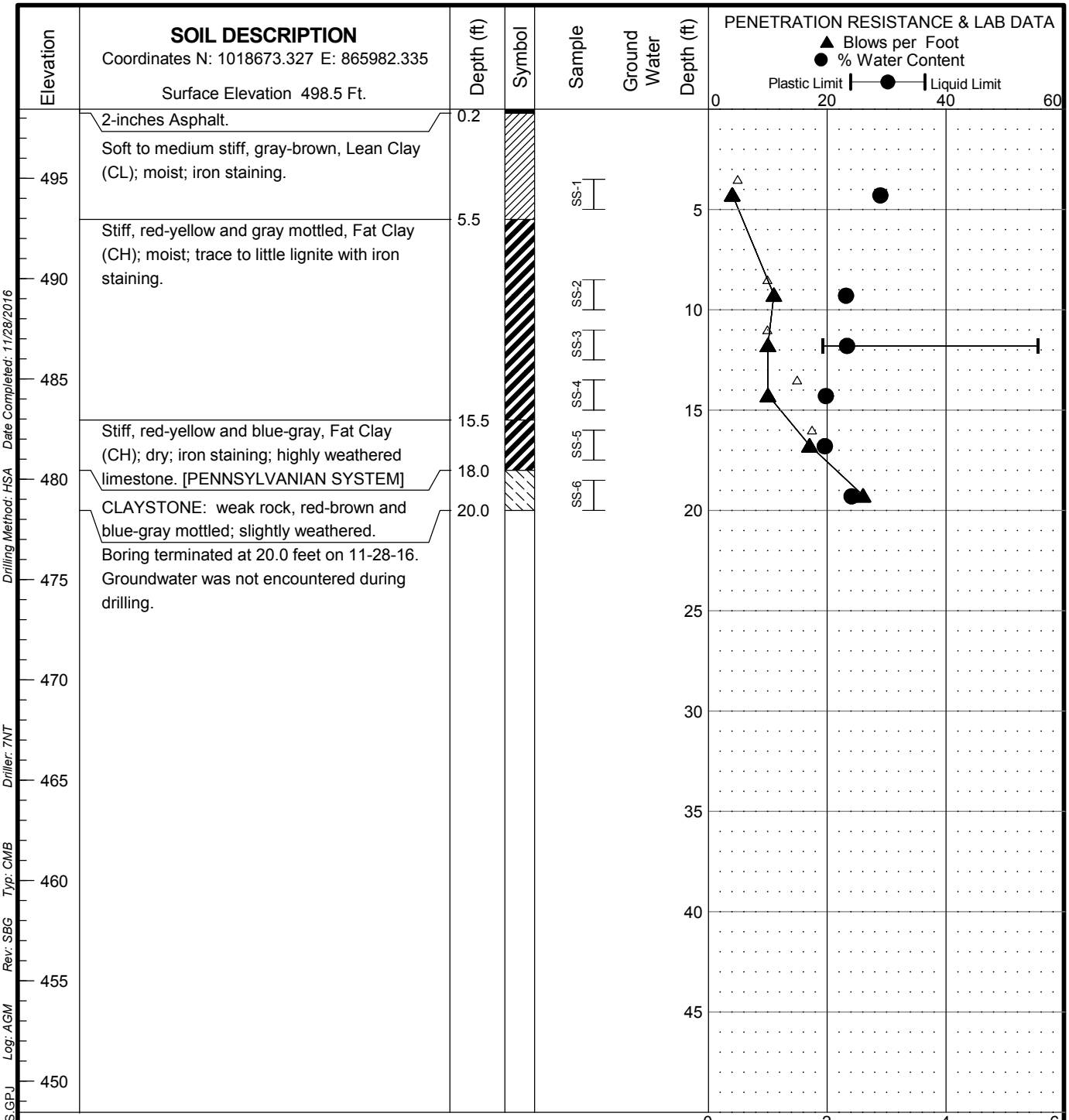
L-111 (Linden) Sewer Separation
RDP Tributaries CSO Tunnel
MSD Project Number 12441

LOG OF BORING L17-12

April 2018 41-1-37530-005

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

Drilling Method: HSA Date Completed: 11/28/2016 Driller: 7NT Typ: CMB Rev: SBG Log: AGM TRIBS SOIL BORING LOG 41-1-37530-005 RDP TRIBS SOIL LOGS.GPJ



LEGEND

- * Sample Not Recovered
- 2-inch O.D. Split Spoon Sample
- 3-inch O.D. Shelby Tube Sample
- REC% / RQD% Rock Core
- Ground Water Level - DD - During Drilling, X.X - Time In Hours
- △ Pocket Penetrometer Shear Strength
- □ Vane Shear Strength
- ◆ Torvane Shear Strength
- ◇ Unconfined Compression Shear Strength
- ○ Unconsolidated Undrained Shear Strength

NOTES

1. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of the subsurface materials.
3. Groundwater level, if indicated above, is for the date specified, and may vary.
4. Refer to KEY for explanation of "Symbols" and definitions.
5. USCS designation is based on visual-manual classification and selected laboratory index testing.
6. Approximate Street Address: 8504 BRYAN AVE

L-111 (Linden) Sewer Separation
RDP Tributaries CSO Tunnel
MSD Project Number 12441

LOG OF BORING L17-13

April 2018 41-1-37530-005

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

SOIL DESCRIPTION

Coordinates N: 1021679.476 E: 866796.965

Surface Elevation 542.5 Ft.

Elevation	Depth (ft)	Symbol	Sample	Ground Water Depth (ft)
540				
	0			
	Medium stiff, red-brown and gray mottled, Lean Clay (CL); moist.			
	5.5		SS-1	
535	Medium stiff, red-brown and gray mottled, Fat Clay (CH); moist; trace organics and iron staining.		SS-2	
	8.0		SS-3	
	Stiff, red-brown to yellow and gray mottled, Fat Clay (CH); moist; with iron staining.		SS-4	
530	13.0		SS-5	
	Stiff, yellow and gray mottled, Fat Clay (CH); dry; with grey claystone fragments. [PENNSYLVANIAN SYSTEM]		SS-6	
	16.5			
525	Hard drilling below 16.5 feet, presumably claystone.			
	20.0			
520	Boring terminated at 20.0 feet on 11-29-16. Groundwater was not encountered during drilling.			
515				
510				
505				
500				
495				

PENETRATION RESISTANCE & LAB DATA

▲ Blows per Foot

● % Water Content

Plastic Limit — Liquid Limit

0 20 40 60

0 5 10 15 20 25 30 35 40 45

50/5"

0 2 4 6

Undrained Shear Strength, tsf

△ Pocket Penetrometer Shear Strength

□ Vane Shear Strength

◆ Torvane Shear Strength

◇ Unconfined Compression Shear Strength

○ Unconsolidated Undrained Shear Strength

LEGEND

* Sample Not Recovered

2-inch O.D. Split Spoon Sample

3-inch O.D. Shelby Tube Sample

REC% / RQD% Rock Core

Ground Water Level - DD - During Drilling X.X - Time In Hours

NOTES

1. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of the subsurface materials.
3. Groundwater level, if indicated above, is for the date specified, and may vary.
4. Refer to KEY for explanation of "Symbols" and definitions.
5. USCS designation is based on visual-manual classification and selected laboratory index testing.
6. Approximate Street Address: 7726 MOHAWK PL

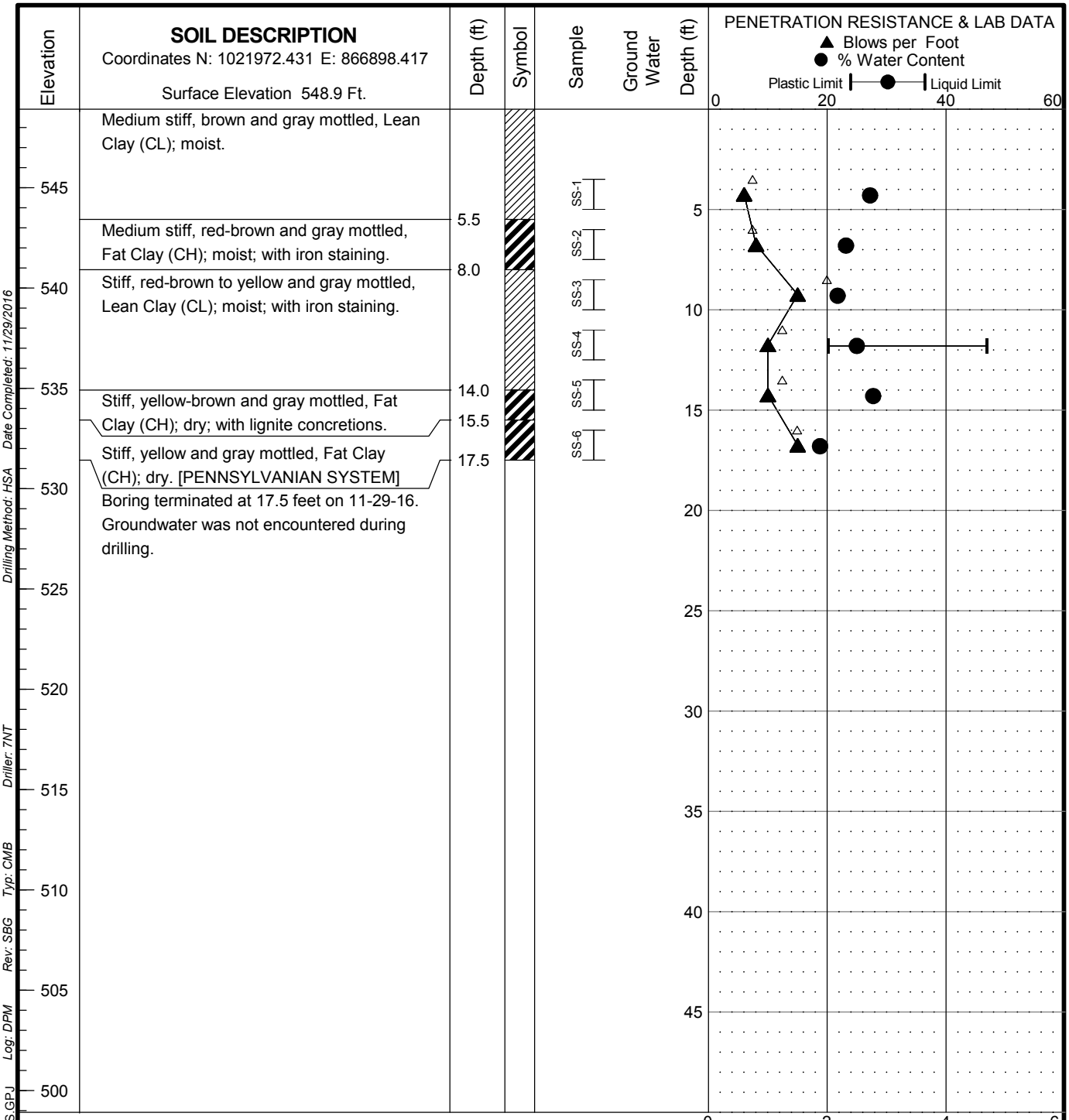
L-111 (Linden) Sewer Separation
RDP Tributaries CSO Tunnel
MSD Project Number 12441

LOG OF BORING L17-14

April 2018 41-1-37530-005

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

Drilling Method: HSA Date Completed: 11/29/2016 Driller: 7NT Typ: CMB Rev: SBG Log: DPM TRIBS SOIL BORING LOG 41-1-37530-005 RDP TRIBS SOIL LOGS.GPJ



LEGEND

- * Sample Not Recovered
- 2-inch O.D. Split Spoon Sample
- 3-inch O.D. Shelby Tube Sample
- REC% / RQD% Rock Core
- Ground Water Level - DD - During Drilling, X.X - Time In Hours

NOTES

1. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of the subsurface materials.
3. Groundwater level, if indicated above, is for the date specified, and may vary.
4. Refer to KEY for explanation of "Symbols" and definitions.
5. USCS designation is based on visual-manual classification and selected laboratory index testing.
6. Approximate Street Address: 7727 DAVIS DR

L-111 (Linden) Sewer Separation
RDP Tributaries CSO Tunnel
MSD Project Number 12441

LOG OF BORING L17-15

April 2018 41-1-37530-005

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

Drilling Method: HSA Date Completed: 11/29/2016 Driller: 7NT Typ: CMB Rev: SBG Log: DPM TRIBS SOIL BORING LOG 41-1-37530-005 RDP TRIBS SOIL LOGS.GPJ

SOIL DESCRIPTION

Coordinates N: 1022249.958 E: 865945.887

Surface Elevation 536.3 Ft.

Elevation	Depth (ft)	Symbol	Sample	Ground Water	Depth (ft)
535	0		SS-1		0
			SS-2		
530	5.0		SS-3		5
			SS-4		
525	9.0				10
			SS-5		
520	14.2				15
515					20
510					25
505					30
500					35
495					40
490					45

Soft, dark brown, Lean Clay (CL); moist; trace concrete fragments. (Fill)

Medium stiff, light gray and brown, Fat Clay (CH); moist.

Dense to very dense, light gray and brown, Clayey Gravel (GC); moist to dry. [PENNSYLVANIAN SYSTEM]

-Split spoon refusal at 14.2 feet.

Boring terminated at 14.2 feet on 11-9-16. Groundwater was not encountered during drilling.

80/8"

PENETRATION RESISTANCE & LAB DATA

▲ Blows per Foot

● % Water Content

Plastic Limit — Liquid Limit

0 20 40 60

0 2 4 6

Undrained Shear Strength, tsf

△ Pocket Penetrometer Shear Strength

□ Vane Shear Strength

◆ Torvane Shear Strength

◇ Unconfined Compression Shear Strength

○ Unconsolidated Undrained Shear Strength

LEGEND

* Sample Not Recovered

2-inch O.D. Split Spoon Sample

3-inch O.D. Shelby Tube Sample

REC% / RQD% Rock Core

▽ Ground Water Level - DD - During Drilling X.X - Time In Hours

NOTES

1. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of the subsurface materials.
3. Groundwater level, if indicated above, is for the date specified, and may vary.
4. Refer to KEY for explanation of "Symbols" and definitions.
5. USCS designation is based on visual-manual classification and selected laboratory index testing.
6. Approximate Street Address: 717 S CENTRAL AVE

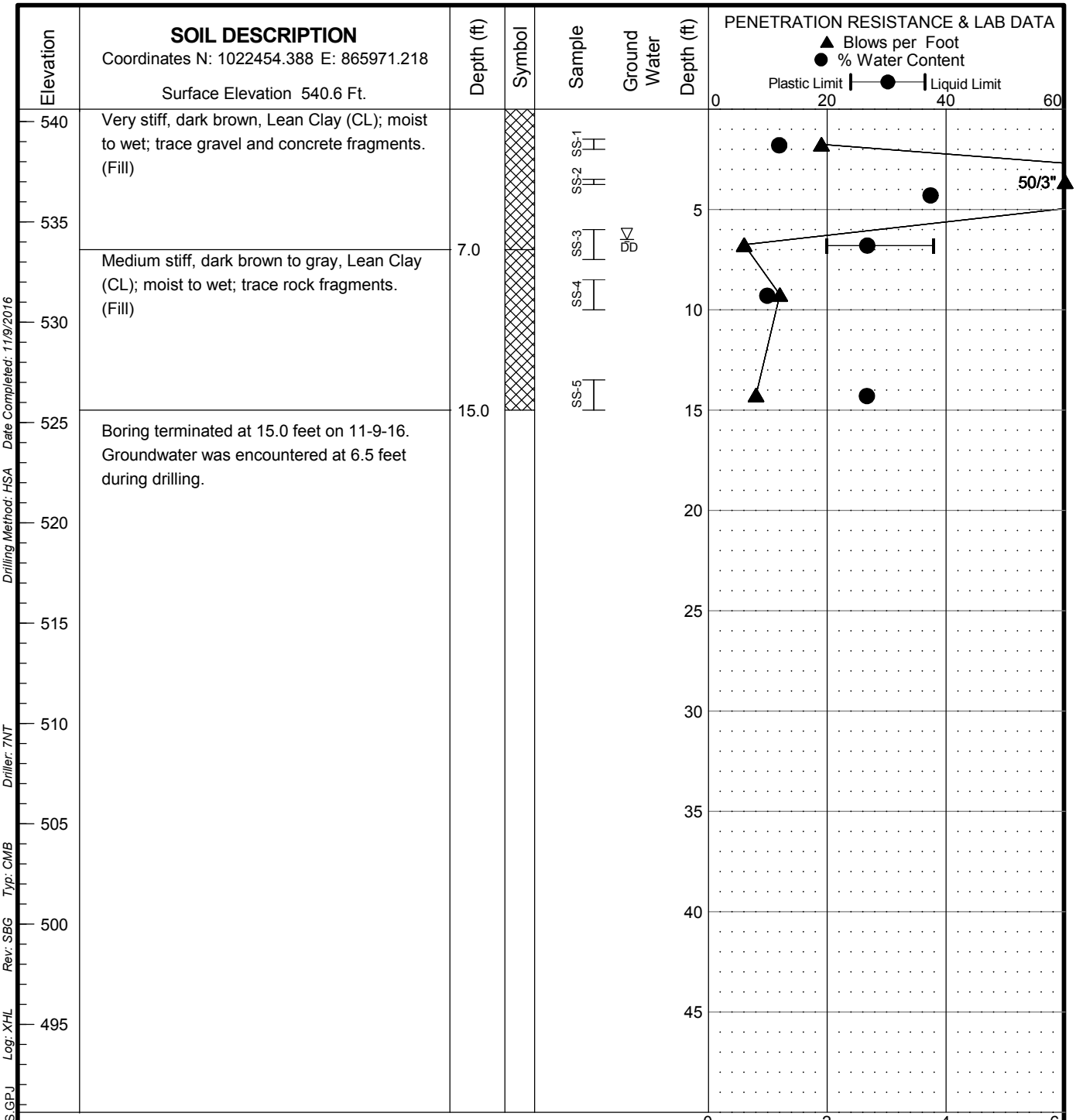
L-111 (Linden) Sewer Separation
RDP Tributaries CSO Tunnel
MSD Project Number 12441

LOG OF BORING L17-16

April 2018 41-1-37530-005

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

Drilling Method: HSA Date Completed: 11/9/2016 Driller: 7NT Typ: CMB Rev: SBG Log: XHL TRIBS SOIL BORING LOG 41-1-37530-005 RDP TRIBS SOIL LOGS.GPJ



LEGEND

- * Sample Not Recovered
- 2-inch O.D. Split Spoon Sample
- 3-inch O.D. Shelby Tube Sample
- REC% / RQD% Rock Core
- Ground Water Level - DD - During Drilling X.X - Time In Hours

NOTES

1. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of the subsurface materials.
3. Groundwater level, if indicated above, is for the date specified, and may vary.
4. Refer to KEY for explanation of "Symbols" and definitions.
5. USCS designation is based on visual-manual classification and selected laboratory index testing.
6. Approximate Street Address: 7900 DAVIS DR

L-111 (Linden) Sewer Separation
RDP Tributaries CSO Tunnel
MSD Project Number 12441

LOG OF BORING L17-17

April 2018 41-1-37530-005

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

Drilling Method: HSA Date Completed: 11/9/2016 Driller: 7NT Typ: CMB Rev: SBG Log: XHL TRIBS SOIL BORING LOG 41-1-37530-005 RDP TRIBS SOIL LOGS.GPJ

Elevation	SOIL DESCRIPTION	Depth (ft)
	Coordinates N: 1023112.438 E: 866514.076 Surface Elevation 588.7 Ft.	
585	Medium stiff, gray and yellowish brown mottled, Lean Clay (CL); moist.	
	7.3 Feet - Dry Density = 102.0 pcf	8.0
580	Medium stiff, brown, Fat Clay (CH); moist.	10.0
	Medium stiff, gray and brown mottled, Fat Clay (CH); moist.	13.0
575	Medium stiff, yellowish brown, Fat Clay (CH); moist.	15.5
	Stiff, gray and yellowish brown mottled, Fat Clay (CH); moist.	17.5
570	Boring terminated at 17.5 feet on 5-2-17. Groundwater was encountered at 3.8 feet during drilling.	
565		
560		
555		
550		
545		
540		

Symbol | Sample | Ground Water | Depth (ft)

SS-1, ST-2, SS-3, SS-4, SS-5, SS-6; DD

PENETRATION RESISTANCE & LAB DATA
▲ Blows per Foot
● % Water Content
Plastic Limit — Liquid Limit
0 20 40 60
5 10 15 20 25 30 35 40 45

0 2 4 6
Undrained Shear Strength, tsf
△ Pocket Penetrometer Shear Strength
□ Vane Shear Strength
◆ Torvane Shear Strength
◇ Unconfined Compression Shear Strength
○ Unconsolidated Undrained Shear Strength

LEGEND

* Sample Not Recovered
2-inch O.D. Split Spoon Sample
3-inch O.D. Shelby Tube Sample
REC% / RQD% Rock Core
Ground Water Level - DD - During Drilling X.X - Time In Hours

NOTES

1. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of the subsurface materials.
3. Groundwater level, if indicated above, is for the date specified, and may vary.
4. Refer to KEY for explanation of "Symbols" and definitions.
5. USCS designation is based on visual-manual classification and selected laboratory index testing.
6. Approximate Street Address: 730 MIDDLE POLO DR

L-111 (Linden) Sewer Separation
RDP Tributaries CSO Tunnel
MSD Project Number 12441

LOG OF BORING L17-18

April 2018 41-1-37530-005

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

Drilling Method: HSA Date Completed: 5/2/2017 Driller: 7NT Typ: CMB Rev: SBG Log: RWC TRIBS SOIL BORING LOG 41-1-37530-005 RDP TRIBS SOIL LOGS.GPJ

SOIL DESCRIPTION

Coordinates N: 1023775.311 E: 866608.743

Surface Elevation 586.4 Ft.

Elevation	Depth (ft)	Symbol	Sample	Ground Water
585				
	Medium stiff, brown, Fat Clay (CH); moist.			
	5.5			
580	Stiff, gray and brown mottled, Lean Clay (CL); moist.		SS-1, SS-2, SS-3	
575			SS-4	DD
	13.0			
	Medium stiff, yellowish brown, Fat Clay (CH); moist; trace sand.		SS-5	
	15.0			
570	Boring terminated at 15.0 feet on 5-2-17. Groundwater was encountered at 11.0 feet during drilling.			
565				
560				
555				
550				
545				
540				

PENETRATION RESISTANCE & LAB DATA

▲ Blows per Foot

● % Water Content

Plastic Limit — Liquid Limit

0 20 40 60

Depth (ft): 5, 10, 15, 20, 25, 30, 35, 40, 45

0 2 4 6

Undrained Shear Strength, tsf

△ Pocket Penetrometer Shear Strength
□ Vane Shear Strength
◆ Torvane Shear Strength
◇ Unconfined Compression Shear Strength
○ Unconsolidated Undrained Shear Strength

LEGEND

* Sample Not Recovered
2-inch O.D. Split Spoon Sample
3-inch O.D. Shelby Tube Sample
REC% / RQD% Rock Core

Ground Water Level -
DD - During Drilling
X.X - Time In Hours

NOTES

1. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of the subsurface materials.
3. Groundwater level, if indicated above, is for the date specified, and may vary.
4. Refer to KEY for explanation of "Symbols" and definitions.
5. USCS designation is based on visual-manual classification and selected laboratory index testing.
6. Approximate Street Address: 419 POLO DR

L-111 (Linden) Sewer Separation
RDP Tributaries CSO Tunnel
MSD Project Number 12441

LOG OF BORING L17-19

April 2018 41-1-37530-005

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

Drilling Method: HSA Date Completed: 5/2/2017 Driller: TNT Typ: CMB Rev: SBG Log: RWC TRIBS SOIL BORING LOG 41-1-37530-005 RDP TRIBS SOIL LOGS.GPJ

SOIL DESCRIPTION

Coordinates N: 1020328.055 E: 866421.376

Surface Elevation 523.2 Ft.

Elevation	Depth (ft)	Description
523.2	0.0	5-inches Asphalt over 6-inches Gravel base.
	0.9	Stiff, greenish gray, Fat Clay (CH); moist.
515	8.0	Stiff, yellowish brown and gray mottled, Fat Clay (CH); moist.
	15.5	Stiff, yellow, Fat Clay (CH); moist.
505	18.0	Hard, gray and yellow, Fat Clay (CH); dry. [PENNSYLVANIAN SYSTEM]
	20.0	Boring terminated at 20.0 feet on 4-26-17. Groundwater was not encountered during drilling.

Sample: SS-1, SS-2, SS-3, SS-4, SS-5, SS-6

Ground Water Depth (ft)

PENETRATION RESISTANCE & LAB DATA

▲ Blows per Foot

● % Water Content

Plastic Limit — Liquid Limit

0 20 40 60

70

0 2 4 6

Undrained Shear Strength, tsf

△ Pocket Penetrometer Shear Strength

□ Vane Shear Strength

◆ Torvane Shear Strength

◇ Unconfined Compression Shear Strength

○ Unconsolidated Undrained Shear Strength

LEGEND

* Sample Not Recovered

2-inch O.D. Split Spoon Sample

3-inch O.D. Shelby Tube Sample

REC% / RQD% Rock Core

Ground Water Level - DD - During Drilling X.X - Time In Hours

NOTES

1. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of the subsurface materials.
3. Groundwater level, if indicated above, is for the date specified, and may vary.
4. Refer to KEY for explanation of "Symbols" and definitions.
5. USCS designation is based on visual-manual classification and selected laboratory index testing.
6. Approximate Street Address: 32 LAKE FOREST DR

L-111 (Linden) Sewer Separation
RDP Tributaries CSO Tunnel
MSD Project Number 12441

LOG OF BORING L17-20

April 2018 41-1-37530-005

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

Drilling Method: HSA Date Completed: 4/26/2017 Driller: 7NT Typ: CMB Rev: RWC Log: RWC TRIBS SOIL BORING LOG 41-1-37530-005 RDP TRIBS SOIL LOGS.GPJ

Appendix C
Borings Backfill Reports and Restoration Photos

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MSD - TRIBS Borings

Boring Designation: L17-1
Date: 4/26/17
Observer: RWC

Backfill Grout Quantity Worksheet

Depth to water(ft): DRY

Hole Volume

Diameter (in.)	Volume (per Foot)	
	Cubic Feet	Gallons
1.0	0.0055	0.04
2.0	0.0218	0.16
3.0	0.0491	0.37
3.78	0.0780	0.58
4.0	0.0873	0.65
5.0	0.1364	1.02
6.0	0.1963	1.47
7.0	0.2673	2.00
8.0	0.3491	2.61
9.0	0.4418	3.31

Quantity Components Placed (per batch)				
Date:				
Portland Cement:				Pounds
Bentonite:				Pounds
Water:				Gallons
Batches:				

Quantity Components Placed (Total)		
Portland Cement:		Pounds
Powdered Bentonite:		Pounds
Water:		Gallons^
(^ gals. x 8.33lbs./gal)Water:		Pounds

Open Hole Volume: _____ Cu. Ft.

Specific Gravity	
Portland T1 Cement:	3.15
Powdered Bentonite:	2.65
Potable Water:	1.00

Total Grout Volume Placed in Cubic Feet*	
Portland Cement:	
Bentonite:	
Water:	
Total:	

1 cu.ft. H2O = 62.4 lbs.
1 gal. H2O = 8.33 lbs.
1 cu.ft. H2O = 7.48 gals.

Completion Details: 75 LBS
BENTONITE CHIPS TO 2.5' BGS
PLACE GRAVEL TO 0.6' BGS
PLACE ASPHALT TO SURFACE

*To compute vol.(cu.ft.) from weight
Cement Volume = Pounds/(3.15 x 62.4)
Bentonite Volume= Pounds/(2.65 x 62.4)
Water Volume= pounds/(1.0 x 62.4)

Notes: 2¼" ID HSA TO ~~10.5~~ 11.0' BGS

7NT Crew Chief: JOHN GILBERT

Misc. Calcs:

Boring: L17-1

MSD - TRIBS Borings

Boring Designation: L17-2
Date: 4/26/17
Observer: RWC

Backfill Grout Quantity Worksheet

Depth to water(ft): DRY

Hole Volume

Diameter (in.)	Volume (per Foot) Cubic Feet	Gallons
1.0	0.0055	0.04
2.0	0.0218	0.16
3.0	0.0491	0.37
3.78	0.0780	0.58
4.0	0.0873	0.65
5.0	0.1364	1.02
6.0	0.1963	1.47
7.0	0.2673	2.00
8.0	0.3491	2.61
9.0	0.4418	3.31

Open Hole Volume: _____ Cu. Ft.

Quantity Components Placed (per batch)				
Date:				
Portland Cement:				Pounds
Bentonite:				Pounds
Water:				Gallons
Batches:				

Quantity Components Placed (Total)		
Portland Cement:		Pounds
Powdered Bentonite:		Pounds
Water:		Gallons^
(^ gals. x 8.33lbs./gal)Water:		Pounds

Specific Gravity	
Portland T1 Cement:	3.15
Powdered Bentonite:	2.65
Potable Water:	1.00

Total Grout Volume Placed in Cubic Feet*	
Portland Cement:	
Bentonite:	
Water:	
Total:	

1 cu.ft. H2O = 62.4 lbs.
1 gal. H20 = 8.33 lbs.
1 cu.ft. H20 = 7.48 gals.

*To compute vol.(cu.ft.) from weight
Cement Volume = Pounds/(3.15 x 62.4)
Bentonite Volume= Pounds/(2.65 x 62.4)
Water Volume= pounds/(1.0 x 62.4)

7NT Crew Chief: _____

Completion Details: PLACE
75LBS BENTONITE CHIPS TO 3' BGS
PLACE GRAVEL TO 0.8' BGS
PLACE ASPHALT TO SURFACE

Notes: 2 1/4" ID HSA TO 11.0' BGS

Misc. Calcs:

Boring: L17-2

MSD - LMT 2017 Borings

Backfill Grout Quantity Worksheet

Boring Designation: L17-3
Date: 11-28-16
Observer: AGM

Depth to water(ft): —

Hole Volume

Diameter (in.)	Volume (per Foot)	
	Cubic Feet	Gallons
1.0	0.0055	0.04
2.0	0.0218	0.16
3.0	0.0491	0.37
3.78	0.0780	0.58
4.0	0.0873	0.65
5.0	0.1364	1.02
6.0	0.1963	1.47
7.0	0.2673	2.00
8.0	0.3491	2.61
9.0	0.4418	3.31

Open Hole Volume: 4.61 Cu. Ft.

Quantity Components Placed (per batch)				
Date:	11-28			
Portland Cement:	47			Pounds
Bentonite:	25			Pounds
Water:	~~37~~			Gallons
Batches:	1			

Quantity Components Placed (Total)		
Portland Cement:	47	Pounds
Powdered Bentonite:	25	Pounds
Water:	~~37~~	Gallons^
(^ gals. x 8.33lbs./gal)Water:	~~0.5~~ 308.21	Pounds

Specific Gravity	
Portland T1 Cement:	3.15
Powdered Bentonite:	2.65
Potable Water:	1.00

Total Grout Volume Placed in Cubic Feet*	
Portland Cement:	0.239
Bentonite:	0.151
Water:	~~0~~ 4.939
Total:	5.329

1 cu.ft. H2O = 62.4 lbs.
1 gal. H20 = 8.33 lbs.
1 cu.ft. H20 = 7.48 gals.

*To compute vol.(cu.ft.) from weight
Cement Volume = Pounds/(3.15 x 62.4) 146.7
Bentonite Volume= Pounds/(2.65 x 62.4) 165.36
Water Volume= pounds/(1.0 x 62.4)

7NT Crew Chief: Dale Meyer

Completion Details:
will place soil plug & grass plug at a later time.

Notes: ≈ 2 Gallons of grout remaining.

Misc. Calcs:

Boring: L17-3

MSD - LMT 2017 Borings

Backfill Grout Quantity Worksheet

Boring Designation: L17-4
Date: 11-23-16
Observer: AGM

Depth to water(ft): —

Hole Volume

Diameter (in.)	Volume (per Foot)	
	Cubic Feet	Gallons
1.0	0.0055	0.04
2.0	0.0218	0.16
3.0	0.0491	0.37
3.78	0.0780	0.58
4.0	0.0873	0.65
5.0	0.1364	1.02
6.0	0.1963	1.47
7.0	0.2673	2.00
8.0	0.3491	2.61
9.0	0.4418	3.31

Open Hole Volume: 4.91 Cu. Ft.

Quantity Components Placed (per batch)				
Date:	11-23-16			
Portland Cement:	94			Pounds
Bentonite:	16			Pounds
Water:	30			Gallons
Batches:	1			

Quantity Components Placed (Total)		
Portland Cement:	94	Pounds
Powdered Bentonite:	16	Pounds
Water:	30	Gallons^
(^ gals. x 8.33lbs./gal)Water:	250	Pounds

Specific Gravity	
Portland T1 Cement:	3.15
Powdered Bentonite:	2.65
Potable Water:	1.00

Total Grout Volume Placed in Cubic Feet*	
Portland Cement:	0.478
Bentonite:	0.097
Water:	4.006
Total:	4.581

1 cu.ft. H2O = 62.4 lbs.
1 gal. H20 = 8.33 lbs.
1 cu.ft. H20 = 7.48 gals.

*To compute vol.(cu.ft.) from weight	
Cement Volume = Pounds/(3.15 x 62.4)	=196.56
Bentonite Volume= Pounds/(2.65 x 62.4)	=15.36
Water Volume= pounds/(1.0 x 62.4)	=62.4

Completion Details:
will finish backfilling hole w/ gravel & asphalt once grout sets up.
- left grout 6" below grade.

Notes:

7NT Crew Chief: Dale Meyer

Misc. Calcs: 25' x 0.1963 ft3 = 4.91 ft3

Boring: L17-4

MSD - LMT 2017 Borings

Backfill Grout Quantity Worksheet

Boring Designation: L17-5
Date: 11-22-16
Observer: AGM

Depth to water(ft): —

Hole Volume

Diameter (in.)	Volume (per Foot)	
	Cubic Feet	Gallons
1.0	0.0055	0.04
2.0	0.0218	0.16
3.0	0.0491	0.37
3.78	0.0780	0.58
4.0	0.0873	0.65
5.0	0.1364	1.02
6.0	0.1963	1.47
7.0	0.2673	2.00
8.0	0.3491	2.61
9.0	0.4418	3.31

Open Hole Volume: 4.91 Cu. Ft.

Quantity Components Placed (per batch)				
Date:	11-22-16			
Portland Cement:	94			Pounds
Bentonite:	16			Pounds
Water:	30			Gallons
Batches:	1			

Quantity Components Placed (Total)		
Portland Cement:	94	Pounds
Powdered Bentonite:	16	Pounds
Water:	30	Gallons^
(^ gals. x 8.33lbs./gal)Water:	250	Pounds

Specific Gravity	
Portland T1 Cement:	3.15
Powdered Bentonite:	2.65
Potable Water:	1.00

Total Grout Volume Placed in Cubic Feet*	
Portland Cement:	0.478
Bentonite:	0.097
Water:	4.006
Total:	4.581

1 cu.ft. H2O = 62.4 lbs.
1 gal. H20 = 8.33 lbs.
1 cu.ft. H20 = 7.48 gals.

*To compute vol.(cu.ft.) from weight
Cement Volume = Pounds/(3.15 x 62.4)
Bentonite Volume= Pounds/(2.65 x 62.4)
Water Volume= pounds/(1.0 x 62.4)

Completion Details:
finished backfilling w/ ≈8" of soil and grass plug on 11-23-15

Notes:
backfilled grout to within 6" of top of ground surface.

7NT Crew Chief: Dale Meyer

Misc. Calcs:
25' x 0.1963' = 4.91 ft³

Boring: L17-5

MSD - LMT 2017 Borings

Backfill Grout Quantity Worksheet

Boring Designation: L 17-6
Date: 11-22-16
Observer: AGM

Depth to water(ft): ~ 18'

Hole Volume

Diameter (in.)	Volume (per Foot)	
	Cubic Feet	Gallons
1.0	0.0055	0.04
2.0	0.0218	0.16
3.0	0.0491	0.37
3.78	0.0780	0.58
4.0	0.0873	0.65
5.0	0.1364	1.02
6.0	0.1963	1.47
7.0	0.2673	2.00
8.0	0.3491	2.61
9.0	0.4418	3.31

Open Hole Volume: 4.42 Cu. Ft.

Quantity Components Placed (per batch)				
Date:	11-22-16			
Portland Cement:	94			Pounds
Bentonite:	16			Pounds
Water:	25			Gallons
Batches:	1			

Quantity Components Placed (Total)		
Portland Cement:	94	Pounds
Powdered Bentonite:	16	Pounds
Water:	25	Gallons^
(^ gals. x 8.33lbs./gal)Water:	208	Pounds

Specific Gravity	
Portland T1 Cement:	3.15
Powdered Bentonite:	2.65
Potable Water:	1.00

Total Grout Volume Placed in Cubic Feet*	
Portland Cement:	0.478
Bentonite:	0.097
Water:	3.333
Total:	3.908

1 cu.ft. H2O = 62.4 lbs.
1 gal. H20 = 8.33 lbs.
1 cu.ft. H20 = 7.48 gals.

*To compute vol.(cu.ft.) from weight
Cement Volume = Pounds/(3.15 x 62.4)
Bentonite Volume= Pounds/(2.65 x 62.4)
Water Volume= pounds/(1.0 x 62.4)

Completion Details:
grouted to within ± 3' of surface, gravel placed from 6' bgs. to 6" bgs. placed concrete - 6".

Notes: grout had settled out to 6' below ground surface on 11-23-16

7NT Crew Chief: Dale Meyer

Misc. Calcs: 22.5' x 0.1963 = 4.42 ft³

Boring: L-17-6

MSD - LMT 2017 Borings

Backfill Grout Quantity Worksheet

Boring Designation: L17-7
Date: 11-22-16
Observer: AGM

Depth to water(ft): —

Hole Volume

Diameter (in.)	Volume (per Foot)	
	Cubic Feet	Gallons
1.0	0.0055	0.04
2.0	0.0218	0.16
3.0	0.0491	0.37
3.78	0.0780	0.58
4.0	0.0873	0.65
5.0	0.1364	1.02
6.0	0.1963	1.47
7.0	0.2673	2.00
8.0	0.3491	2.61
9.0	0.4418	3.31

Open Hole Volume: 4.91 Cu. Ft.

Quantity Components Placed (per batch)				
Date:	11-22-16			
Portland Cement:	94			Pounds
Bentonite:	16			Pounds
Water:	30			Gallons
Batches:	1			

Quantity Components Placed (Total)		
Portland Cement:	94	Pounds
Powdered Bentonite:	16	Pounds
Water:	30	Gallons^
(^ gals. x 8.33lbs./gal)Water:	250	Pounds

Specific Gravity	
Portland T1 Cement:	3.15
Powdered Bentonite:	2.65
Potable Water:	1.00

Total Grout Volume Placed in Cubic Feet*	
Portland Cement:	0.478
Bentonite:	0.093
Water:	4.006
Total:	4.581

1 cu.ft. H2O = 62.4 lbs.
1 gal. H20 = 8.33 lbs.
1 cu.ft. H20 = 7.48 gals.

*To compute vol.(cu.ft.) from weight
Cement Volume = Pounds/(3.15 x 62.4)
Bentonite Volume= Pounds/(2.65 x 62.4)
Water Volume= pounds/(1.0 x 62.4)

7NT Crew Chief: Dale Meyer

Completion Details:
finished backfilling hole 11-23-16 w/ 6" concrete

Notes:
backfilled grout to within 6" of top of ground surface.

Misc. Calcs: 25 x 0.1963 = 4.91

Boring: L17-7

MSD - Tribs Borings

Boring Designation: L17-8

Date: 1/19/18

Observer:

Backfill Quantity Worksheet

Depth to water(ft): 9.8

Hole Volume

Diameter (in.)	Volume (per Foot) Cubic Feet	Gallons
2.0	0.0218	0.16
3.0	0.0491	0.37
3.8	0.078	0.58
4.0	0.0873	0.65
5.0	0.1364	1.02
6.0	0.1963	1.47
7.0	0.2673	2.00
8.0	0.3491	2.61

4" DIA HOLE

Hole Volume(Ft^3): 2.2

Quantity Components Placed (per batch)				
Date:				
Portland Cement:				Pounds
Bentonite:				Pounds
Water:				Gallons
Batches:				

Quantity Components Placed (Total)		
Portland Cement:		Pounds
Powdered Bentonite:		Pounds
Water:		Gallons^
(^ gals.x8.33lbs./gal)Water:		Pounds

Total Grout Volume Placed in Cubic Feet*	
Portland Cement:	
Bentonite:	
Water:	
Total:	

Specific Gravity	
Portland T1 Cement:	3.15
Powdered Bentonite:	2.65
Potable Water:	1.00

Low-Mobility Backfill (lbs/linear foot of boring)				
Hole Diameter(in.):	4	6	8	10
Bentonite chips:	6	14	24	37.5
Pea gravel:	9.7	22	39	-

1 cu.ft. H2O = 62.4 lbs.
1 gal. H20 = 8.33 lbs.
1 cu.ft. H20 = 7.48 gals.

*Compute volume (Ft^3) from weight
Cement = Pounds/(3.15 x 62.4)
Bentonite = Pounds/(2.65 x 62.4)
Water = pounds/(1.0 x 62.4)

Notes: BOH 25'
PLACE 3 SACKS (150 LBS) BENTONITE CHIPS TO 3' BGS. PLACE GRAVEL TO 1.1' PLACE ASPHALT TO SURFACE

7NT Chief: DALE MEYER

Misc. Calcs:

Boring: L17-8

MSD - Tribs Borings

Boring Designation: L17-9
Date: 1/19/18
Observer: RMC

Backfill Quantity Worksheet

Depth to water(ft): 7.9'

Hole Volume

Diameter (in.)	Volume (per Foot) Cubic Feet	Gallons
2.0	0.0218	0.16
3.0	0.0491	0.37
3.8	0.078	0.58
4.0	0.0873	0.65
5.0	0.1364	1.02
6.0	0.1963	1.47
7.0	0.2673	2.00
8.0	0.3491	2.61

4" DIAM HOLE

Hole Volume(Ft^3): 2.5

Quantity Components Placed (per batch)				
Date:				
Portland Cement:				Pounds
Bentonite:				Pounds
Water:				Gallons
Batches:				

Quantity Components Placed (Total)		
Portland Cement:		Pounds
Powdered Bentonite:		Pounds
Water:		Gallons^
(^ gals.x8.33lbs./gal)Water:		Pounds

Specific Gravity	
Portland T1 Cement:	3.15
Powdered Bentonite:	2.65
Potable Water:	1.00

Total Grout Volume Placed in Cubic Feet*	
Portland Cement:	
Bentonite:	
Water:	
Total:	

1 cu.ft. H2O = 62.4 lbs.
1 gal. H20 = 8.33 lbs.
1 cu.ft. H20 = 7.48 gals.

Low-Mobility Backfill (lbs/linear foot of boring)				
Hole Diameter(in.):	4	6	8	10
Bentonite chips:	6	14	24	37.5
Pea gravel:	9.7	22	39	-

*Compute volume (Ft^3) from weight
Cement = Pounds/(3.15 x 62.4)
Bentonite = Pounds/(2.65 x 62.4)
Water = pounds/(1.0 x 62.4)

Notes: PLACE 4 SACKS (200 LBS) BENTONITE CHIPS TO 2' BGS
PLACE GRAVEL TO 0.9'
PLACE ASPHALT TO SURFACE

7NT Chief: DALE MEYER

Misc. Calcs:

Boring: L17-9

MSD - LMT 2017 Borings

Backfill Grout Quantity Worksheet

Boring Designation: L17-10
Date: 11-29-16
Observer: AGM

Depth to water(ft): 16.34'

Hole Volume

Diameter (in.)	Volume (per Foot)	
	Cubic Feet	Gallons
1.0	0.0055	0.04
2.0	0.0218	0.16
3.0	0.0491	0.37
3.78	0.0780	0.58
4.0	0.0873	0.65
5.0	0.1364	1.02
6.0	0.1963	1.47
7.0	0.2673	2.00
8.0	0.3491	2.61
9.0	0.4418	3.31

Open Hole Volume: 4.81 Cu. Ft.

Quantity Components Placed (per batch)				
Date:	11-29-16			
Portland Cement:	46			Pounds
Bentonite:	25			Pounds
Water:	30			Gallons
Batches:	1			

Quantity Components Placed (Total)		
Portland Cement:	46	Pounds
Powdered Bentonite:	25	Pounds
Water:	30	Gallons^
(^ gals. x 8.33lbs./gal)Water:	249.9	Pounds

Specific Gravity	
Portland T1 Cement:	3.15
Powdered Bentonite:	2.65
Potable Water:	1.00

Total Grout Volume Placed in Cubic Feet*	
Portland Cement:	0.234
Bentonite:	0.151
Water:	4.005
Total:	4.39

1 cu.ft. H2O = 62.4 lbs.
1 gal. H20 = 8.33 lbs.
1 cu.ft. H20 = 7.48 gals.

*To compute vol.(cu.ft.) from weight
Cement Volume = Pounds/(3.15 x 62.4) 196.56
Bentonite Volume= Pounds/(2.65 x 62.4) 165.36
Water Volume= pounds/(1.0 x 62.4)

Completion Details:

7NT Crew Chief: Dale Meyer

Notes: used tremie pipe to pour grout into hole. will place soil plug at a later time ✓ Displaced water in hole as grout was placed. ✓

Misc. Calcs: 24' x 0.1963 = 4.809

Boring: L17-10

MSD - TRIBS Borings

Backfill Grout Quantity Worksheet

Boring Designation: L17-11

Date: 11/9/16

Observer: XHL

Depth to water(ft): 15.5'

Hole Volume

Diameter (in.)	Volume (per Foot)	
	Cubic Feet	Gallons
1.0	0.0055	0.04
2.0	0.0218	0.16
3.0	0.0491	0.37
3.78	0.0780	0.58
4.0	0.0873	0.65
5.0	0.1364	1.02
6.0	0.1963	1.47
7.0	0.2673	2.00
8.0	0.3491	2.61
9.0	0.4418	3.31

Quantity Components Placed (per batch)				
Date:				
Portland Cement:				Pounds
Bentonite:				Pounds
Water:				Gallons
Batches:				

Quantity Components Placed (Total)		
Portland Cement:		Pounds
Powdered Bentonite:		Pounds
Water:		Gallons^
(^ gals. x 8.33lbs./gal)Water:		Pounds

Open Hole Volume: 7.0 Cu. Ft.

Specific Gravity	
Portland T1 Cement:	3.15
Powdered Bentonite:	2.65
Potable Water:	1.00

Total Grout Volume Placed in Cubic Feet*	
Portland Cement:	
Bentonite:	
Water:	
Total:	

1 cu.ft. H2O = 62.4 lbs.
1 gal. H20 = 8.33 lbs.
1 cu.ft. H20 = 7.48 gals.

Completion Details:
REINSTALLED GLASS PLUG.

*To compute vol.(cu.ft.) from weight
Cement Volume = Pounds/(3.15 x 62.4)
Bentonite Volume= Pounds/(2.65 x 62.4)
Water Volume= pounds/(1.0 x 62.4)

Notes: BACKFILLED WITH SOIL CUTTINGS

7NT Crew Chief: CHARLIE BROUGH.

Misc. Calcs:

20' x 0.35 cuft/ft = 7.0 cuft.

Boring: L17-11

MSD - LMT 2017 Borings

Backfill Grout Quantity Worksheet

Boring Designation: L17-12

Date: 11-28-16

Observer: AGM

Depth to water(ft): —

Hole Volume

Diameter (in.)	Volume (per Foot)	
	Cubic Feet	Gallons
1.0	0.0055	0.04
2.0	0.0218	0.16
3.0	0.0491	0.37
3.78	0.0780	0.58
4.0	0.0873	0.65
5.0	0.1364	1.02
6.0	0.1963	1.47
7.0	0.2673	2.00
8.0	0.3491	2.61
9.0	0.4418	3.31

Open Hole Volume: 3.83 Cu. Ft.

Quantity Components Placed (per batch)				
Date:	11-28-16			
Portland Cement:	46			Pounds
Bentonite:	25			Pounds
Water:	30			Gallons
Batches:	1			

Quantity Components Placed (Total)		
Portland Cement:	46	Pounds
Powdered Bentonite:	25	Pounds
Water:	25	Gallons^
(^ gals. x 8.33lbs./gal)Water:	208.25	Pounds

Specific Gravity	
Portland T1 Cement:	3.15
Powdered Bentonite:	2.65
Potable Water:	1.00

Total Grout Volume Placed in Cubic Feet*	
Portland Cement:	0.234
Bentonite:	0.151
Water:	3.332
Total:	3.72

1 cu.ft. H2O = 62.4 lbs.
1 gal. H20 = 8.33 lbs.
1 cu.ft. H20 = 7.48 gals.

*To compute vol.(cu.ft.) from weight
Cement Volume = Pounds/(3.15 x 62.4) 196.56
Bentonite Volume= Pounds/(2.65 x 62.4) 165.8
Water Volume= pounds/(1.0 x 62.4)

Completion Details:

Will place soil & grass plug at another time.

Notes:

7NT Crew Chief: Dale Meyer

Misc. Calcs: 19.5 x 0.1963 = 3.828

Boring: L17-12

MSD - LMT 2017 Borings

Backfill Grout Quantity Worksheet

Boring Designation: L17-13

Date: 11-28-16

Observer: AGM

Depth to water(ft): —

Hole Volume

Diameter (in.)	Volume (per Foot)	
	Cubic Feet	Gallons
1.0	0.0055	0.04
2.0	0.0218	0.16
3.0	0.0491	0.37
3.78	0.0780	0.58
4.0	0.0873	0.65
5.0	0.1364	1.02
6.0	0.1963	1.47
7.0	0.2673	2.00
8.0	0.3491	2.61
9.0	0.4418	3.31

Open Hole Volume: 3.73 Cu. Ft.

Quantity Components Placed (per batch)				
Date:	11-28-16			
Portland Cement:	46			Pounds
Bentonite:	25			Pounds
Water:	25			Gallons
Batches:	1			

Quantity Components Placed (Total)		
Portland Cement:	46	Pounds
Powdered Bentonite:	25	Pounds
Water:	25	Gallons^
(^ gals. x 8.33lbs./gal)Water:	208.25	Pounds

Specific Gravity	
Portland T1 Cement:	3.15
Powdered Bentonite:	2.65
Potable Water:	1.00

Total Grout Volume Placed in Cubic Feet*	
Portland Cement:	0.234
Bentonite:	0.151
Water:	3.337
Total:	3.72

1 cu.ft. H2O = 62.4 lbs.
1 gal. H20 = 8.33 lbs.
1 cu.ft. H20 = 7.48 gals.

*To compute vol.(cu.ft.) from weight
Cement Volume = Pounds/(3.15 x 62.4)
Bentonite Volume= Pounds/(2.65 x 62.4)
Water Volume= pounds/(1.0 x 62.4)

Completion Details:

Will place soil + grass plug at a later date

Notes:

7NT Crew Chief: Dale Meyer

Misc. Calcs: 19 x 0.1963 = 3.7297

Boring: L17-13

Shannon & Wilson, Inc. MSD- ~~LMT~~ T.I.B.S 41-1-37530 HDR

MSD - LMT 2017 Borings

Backfill Grout Quantity Worksheet

Boring Designation: L17-14

Date: 11/29/16

Observer: DPM

Depth to water(ft): —

Hole Volume

Diameter (in.)	Volume (per Foot) Cubic Feet	Gallons
1.0	0.0055	0.04
2.0	0.0218	0.16
3.0	0.0491	0.37
3.78	0.0780	0.58
4.0	0.0873	0.65
5.0	0.1364	1.02
6.0	0.1963	1.47
7.0	0.2673	2.00
8.0	0.3491	2.61
9.0	0.4418	3.31

20(0.1364)=

Open Hole Volume: 2.73 Cu. Ft.

Quantity Components Placed (per batch)				
Date:	11/29/16	11/29/16		
Portland Cement:	~5	~5		Pounds quikrete Type I/II
Bentonite:	~5	~5		Pounds Puregold gel
Water:	~10	~10		Gallons
Batches:	1	2		

Quantity Components Placed (Total)		
Portland Cement:	10	Pounds
Powdered Bentonite:	10	Pounds
Water:	20	Gallons^
(^ gals. x 8.33lbs./gal)Water:	166.6	Pounds

Specific Gravity	
Portland T1 Cement:	3.15
Powdered Bentonite:	2.65
Potable Water:	1.00

Total Grout Volume Placed in Cubic Feet*	
Portland Cement:	0.051
Bentonite:	0.060
Water:	2.67
Total:	2.78

1 cu.ft. H2O = 62.4 lbs.
1 gal. H20 = 8.33 lbs.
1 cu.ft. H20 = 7.48 gals.

*To compute vol.(cu.ft.) from weight
Cement Volume = Pounds/(3.15 x 62.4)
Bentonite Volume= Pounds/(2.65 x 62.4)
Water Volume= pounds/(1.0 x 62.4)

Completion Details: grout/soil mix to approx. 6" below ground surface by 0910 on 11/29/16.

Notes: grout mixed in 55 gal. drum - grout pumped through treme pipe, as cuttings added to the hole, bucket placed over hole so grout could set. final soil topping to be placed later.

7NT Crew Chief: Dale Meyer

Misc. Calcs:

Boring: L17-14

MSD - LMT 2017 Borings

Backfill Grout Quantity Worksheet

Boring Designation: L17-15
Date: 11-29-16
Observer: AGM

Depth to water(ft): —

Hole Volume

Diameter (in.)	Volume (per Foot)	
	Cubic Feet	Gallons
1.0	0.0055	0.04
2.0	0.0218	0.16
3.0	0.0491	0.37
3.78	0.0780	0.58
4.0	0.0873	0.65
5.0	0.1364	1.02
6.0	0.1963	1.47
7.0	0.2673	2.00
8.0	0.3491	2.61
9.0	0.4418	3.31

Open Hole Volume: 3.34 Cu. Ft.

Quantity Components Placed (per batch)				
Date:	11-29-16			
Portland Cement:	35			Pounds
Bentonite:	20			Pounds
Water:	20			Gallons
Batches:	1			

Quantity Components Placed (Total)		
Portland Cement:	35	Pounds
Powdered Bentonite:	20	Pounds
Water:	20	Gallons^
(^ gals. x 8.33lbs./gal)Water:	166.6	Pounds

Specific Gravity	
Portland T1 Cement:	3.15
Powdered Bentonite:	2.65
Potable Water:	1.00

Total Grout Volume Placed in Cubic Feet*	
Portland Cement:	0.178
Bentonite:	0.121
Water:	2.670
Total:	2.97

1 cu.ft. H2O = 62.4 lbs.
1 gal. H20 = 8.33 lbs.
1 cu.ft. H20 = 7.48 gals.

*To compute vol.(cu.ft.) from weight	
Cement Volume = Pounds/(3.15 x 62.4)	196.56
Bentonite Volume= Pounds/(2.65 x 62.4)	165.36
Water Volume= pounds/(1.0 x 62.4)	

7NT Crew Chief: Dale Meyer

Completion Details:

Notes: grouted with tremic pipe up to surface of ground. -allowed to set up w/ a bucket over hole. Will place soil + grass plug at a later time.

Misc. Calcs: 17' x 0.1963 = 3.337

Boring: L17-15

MSD - TRIBS Borings

Backfill Grout Quantity Worksheet

Boring Designation: L17-16
Date: 11/9/16
Observer: XHL

Depth to water(ft): DRY

Hole Volume

Diameter (in.)	Volume (per Foot)	
	Cubic Feet	Gallons
1.0	0.0055	0.04
2.0	0.0218	0.16
3.0	0.0491	0.37
3.78	0.0780	0.58
4.0	0.0873	0.65
5.0	0.1364	1.02
6.0	0.1963	1.47
7.0	0.2673	2.00
8.0	0.3491	2.61
9.0	0.4418	3.31

Quantity Components Placed (per batch)				
Date:				
Portland Cement:				Pounds
Bentonite:				Pounds
Water:				Gallons
Batches:				

Quantity Components Placed (Total)		
Portland Cement:		Pounds
Powdered Bentonite:		Pounds
Water:		Gallons^
(^ gals. x 8.33lbs./gal)Water:		Pounds

Open Hole Volume: 5.0 Cu. Ft.

Specific Gravity	
Portland T1 Cement:	3.15
Powdered Bentonite:	2.65
Potable Water:	1.00

Total Grout Volume Placed in Cubic Feet*	
Portland Cement:	
Bentonite:	
Water:	
Total:	

1 cu.ft. H2O = 62.4 lbs.
1 gal. H20 = 8.33 lbs.
1 cu.ft. H20 = 7.48 gals.

Completion Details:
REINSTALLED GRASS PLUG

*To compute vol.(cu.ft.) from weight
Cement Volume = Pounds/(3.15 x 62.4)
Bentonite Volume= Pounds/(2.65 x 62.4)
Water Volume= pounds/(1.0 x 62.4)

Notes:
BACKFILLED WITH SOIL CUTTINGS.

7NT Crew Chief: CHARLIE BROUGH

Misc. Calcs:
14.2' x 0.35 cuft/ft = 5.0 cuft.

Boring: L17-16

MSD - TRIBS Borings

Backfill Grout Quantity Worksheet

Boring Designation: L17-17
Date: 11/9/16
Observer: KHL

Depth to water(ft): 16.5'

Hole Volume

Diameter (in.)	Volume (per Foot)	
	Cubic Feet	Gallons
1.0	0.0055	0.04
2.0	0.0218	0.16
3.0	0.0491	0.37
3.78	0.0780	0.58
4.0	0.0873	0.65
5.0	0.1364	1.02
6.0	0.1963	1.47
7.0	0.2673	2.00
8.0	0.3491	2.61
9.0	0.4418	3.31

Quantity Components Placed (per batch)				
Date:				
Portland Cement:				Pounds
Bentonite:				Pounds
Water:				Gallons
Batches:				

Quantity Components Placed (Total)		
Portland Cement:		Pounds
Powdered Bentonite:		Pounds
Water:		Gallons^
(^ gals. x 8.33lbs./gal)Water:		Pounds

Open Hole Volume: 5.2 Cu. Ft.

Specific Gravity	
Portland T1 Cement:	3.15
Powdered Bentonite:	2.65
Potable Water:	1.00

Total Grout Volume Placed in Cubic Feet*
Portland Cement:
Bentonite:
Water:
Total:

1 cu.ft. H2O = 62.4 lbs.
1 gal. H20 = 8.33 lbs.
1 cu.ft. H20 = 7.48 gals.

Completion Details:
REINSTALLED GRASS
PLUG.

*To compute vol.(cu.ft.) from weight
Cement Volume = Pounds/(3.15 x 62.4)
Bentonite Volume= Pounds/(2.65 x 62.4)
Water Volume= pounds/(1.0 x 62.4)

Notes:
BACKFILLED WITH SOIL CUTTINGS.

7NT Crew Chief: CHARLIE BROUGH

Misc. Calcs:
15' x 0.3491 = 5.2 cu ft.

Boring: L17-17

MSD - TRIBS Borings

Boring Designation: L17 - 18
Date: 5/2/17
Observer: RWC

Backfill Grout Quantity Worksheet

Depth to water(ft): 3.8'

Hole Volume

Diameter (in.)	Volume (per Foot)	
	Cubic Feet	Gallons
1.0	0.0055	0.04
2.0	0.0218	0.16
3.0	0.0491	0.37
3.78	0.0780	0.58
4.0	0.0873	0.65
5.0	0.1364	1.02
6.0	0.1963	1.47
7.0	0.2673	2.00
8.0	0.3491	2.61
9.0	0.4418	3.31

Quantity Components Placed (per batch)				
Date:				
Portland Cement:				Pounds
Bentonite:				Pounds
Water:				Gallons
Batches:				

Quantity Components Placed (Total)		
Portland Cement:		Pounds
Powdered Bentonite:		Pounds
Water:		Gallons^
(^ gals. x 8.33lbs./gal)Water:		Pounds

Open Hole Volume: _____ Cu. Ft.

Specific Gravity	
Portland T1 Cement:	3.15
Powdered Bentonite:	2.65
Potable Water:	1.00

Total Grout Volume Placed in Cubic Feet*	
Portland Cement:	
Bentonite:	
Water:	
Total:	

1 cu.ft. H2O = 62.4 lbs.
1 gal. H20 = 8.33 lbs.
1 cu.ft. H20 = 7.48 gals.

Completion Details: B/F WITH
100 LBS BENTONITE CHIPS TO 1'
TOP TO SURFACE WITH SOIL
CUTTINGS

*To compute vol.(cu.ft.) from weight
Cement Volume = Pounds/(3.15 x 62.4)
Bentonite Volume= Pounds/(2.65 x 62.4)
Water Volume= pounds/(1.0 x 62.4)

Notes: 2 1/4" ID HSA TO 16' BGS

7NT Crew Chief: JOHN GILBERT

Misc. Calcs:

Boring: L17-18

MSD - TRIBS Borings

Backfill Grout Quantity Worksheet

Boring Designation: L17-19

Date: 5/2/17

Observer: RWC

Depth to water(ft): 11

Hole Volume

Diameter (in.)	Volume (per Foot)	
	Cubic Feet	Gallons
1.0	0.0055	0.04
2.0	0.0218	0.16
3.0	0.0491	0.37
3.78	0.0780	0.58
4.0	0.0873	0.65
5.0	0.1364	1.02
6.0	0.1963	1.47
7.0	0.2673	2.00
8.0	0.3491	2.61
9.0	0.4418	3.31

Quantity Components Placed (per batch)				
Date:				
Portland Cement:				Pounds
Bentonite:				Pounds
Water:				Gallons
Batches:				

Quantity Components Placed (Total)		
Portland Cement:		Pounds
Powdered Bentonite:		Pounds
Water:		Gallons^
(^ gals. x 8.33lbs./gal)Water:		Pounds

Open Hole Volume: _____ Cu. Ft.

Specific Gravity	
Portland T1 Cement:	3.15
Powdered Bentonite:	2.65
Potable Water:	1.00

Total Grout Volume Placed in Cubic Feet*	
Portland Cement:	
Bentonite:	
Water:	
Total:	

1 cu.ft. H2O = 62.4 lbs.
1 gal. H20 = 8.33 lbs.
1 cu.ft. H20 = 7.48 gals.

*To compute vol.(cu.ft.) from weight
Cement Volume = Pounds/(3.15 x 62.4)
Bentonite Volume= Pounds/(2.65 x 62.4)
Water Volume= pounds/(1.0 x 62.4)

Completion Details: BACKFILL WITH 100 LBS BENTONITE CHIPS TO 1' BGS TOP WITH SOIL CUTTINGS

Notes: 2¼" ID HSA TO 13.5'

7NT Crew Chief: JOHN GILBERT

Misc. Calcs:

Boring: L17-19

Appendix D
Laboratory Test Reports

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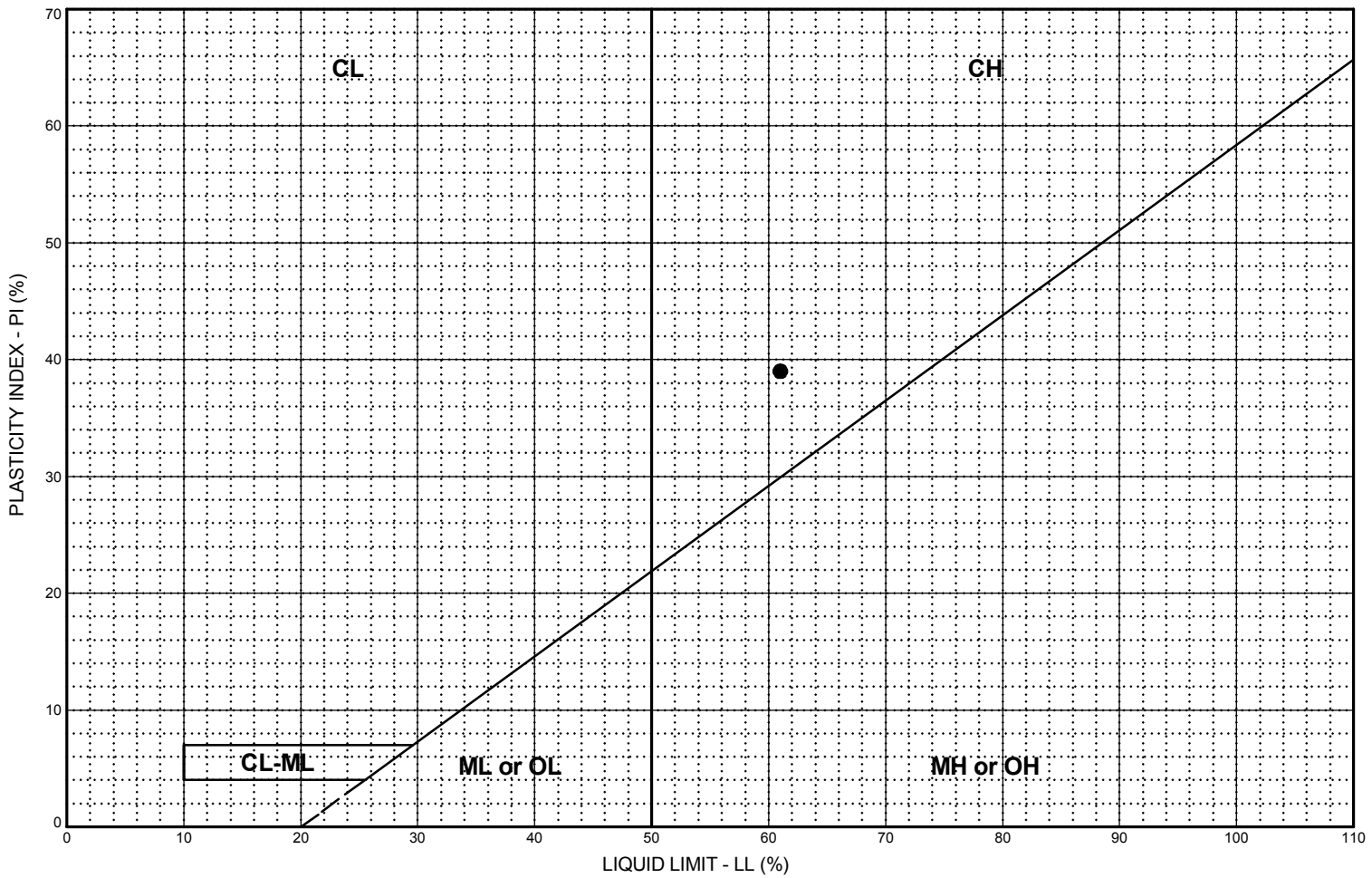


LEGEND

CL: Low plasticity inorganic clays; sandy and silty clays

CH: High plasticity inorganic clays

ML or OL: Inorganic and organic silts and clayey silts of low plasticity

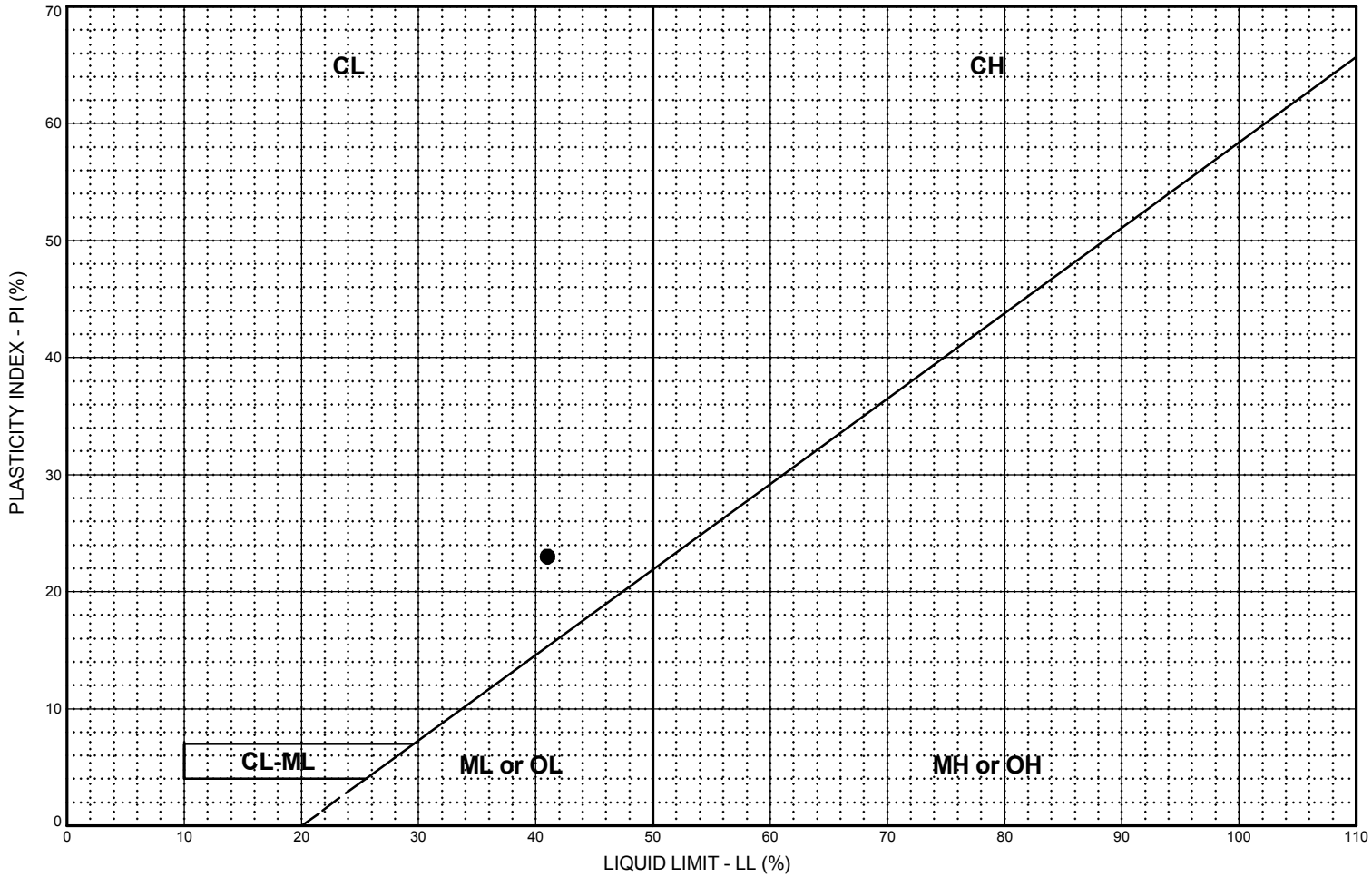
MH or OH: Inorganic and organic silts and clayey silts of high plasticity

CL-ML: Silty clays and clayey silts

BORING AND SAMPLE NO.	DEPTH (feet)	U.S.C.S. SYMBOL	SOIL CLASSIFICATION	LL %	PL %	PI %	NAT. W.C. %	PASS. #200, %
● L17-1, SS-3	9.3	CH	Brown, Fat Clay.	61	22	39	24.3	

PLASTICITY CHART

BORING L17-1



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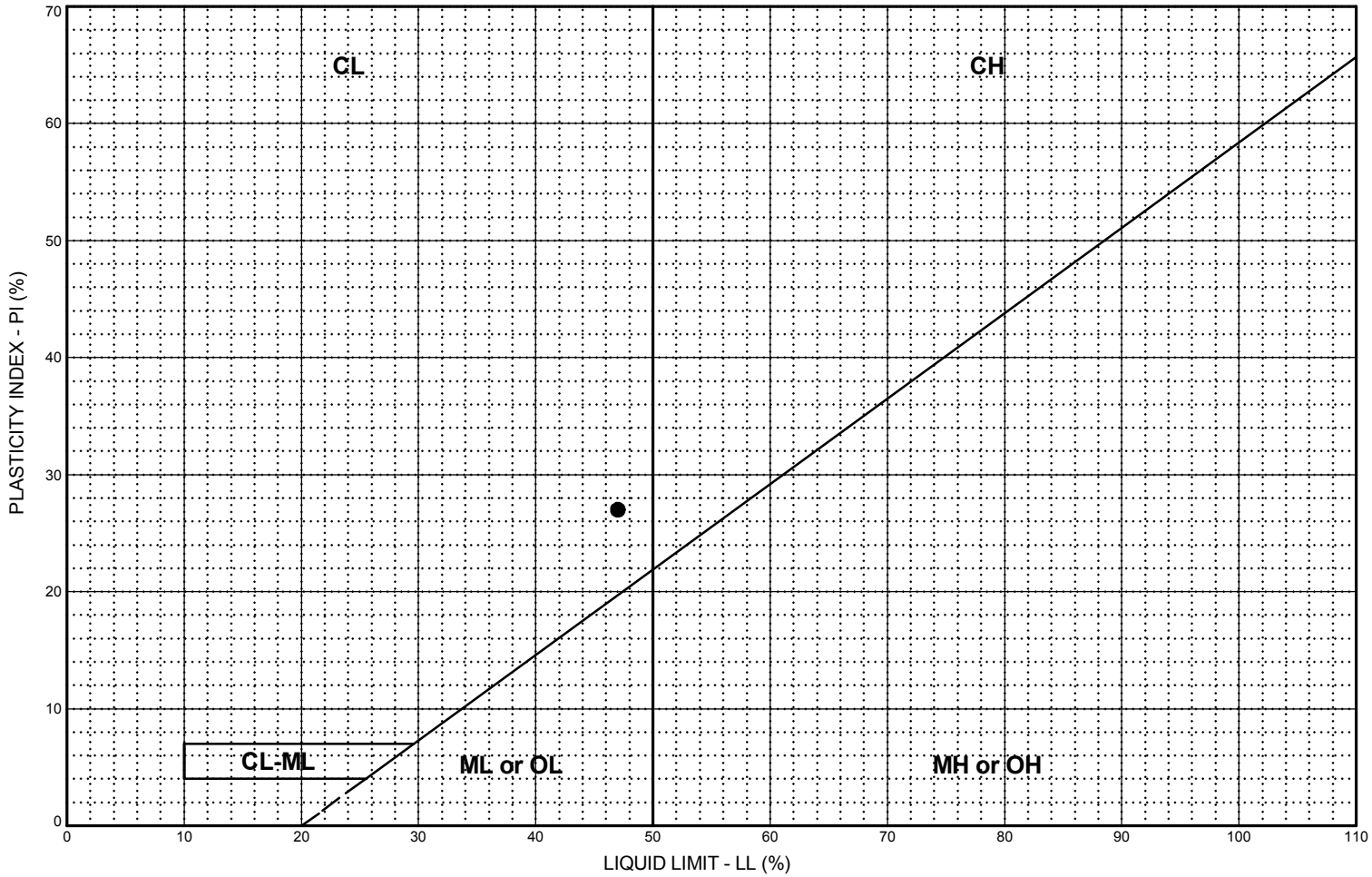
CL-ML: Silty clays and clayey silts

BORING AND SAMPLE NO.	DEPTH (feet)	U.S.C.S. SYMBOL	SOIL CLASSIFICATION	LL %	PL %	PI %	NAT. W.C. %	PASS. #200, %
● L17-2, SS-2	6.8	CL	Brown, Lean Clay.	41	18	23	28.0	

PLASTICITY CHART

BORING L17-2



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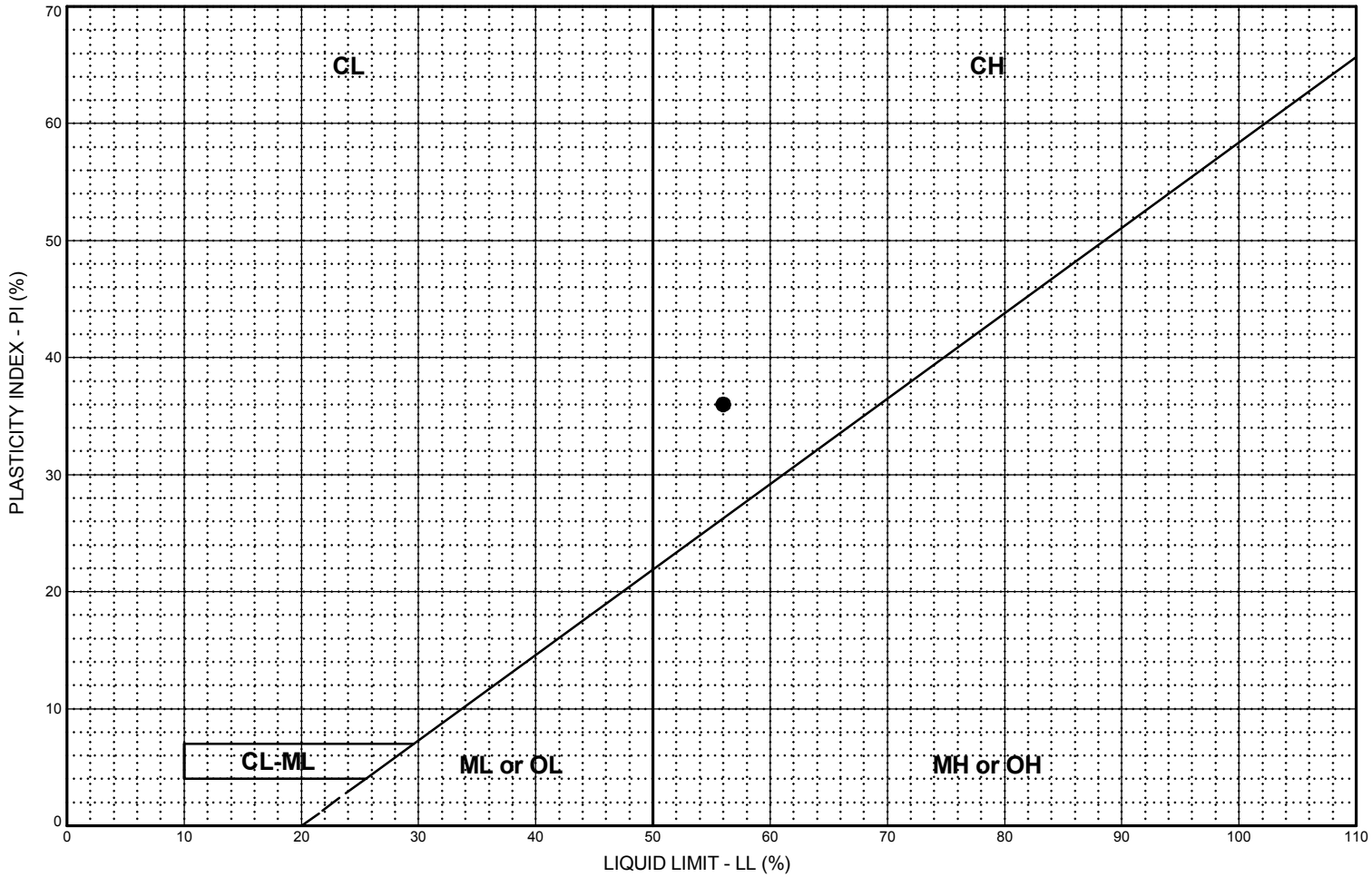
MH or OH: Inorganic and organic silts and clayey silts of high plasticity

CL-ML: Silty clays and clayey silts

BORING AND SAMPLE NO.	DEPTH (feet)	U.S.C.S. SYMBOL	SOIL CLASSIFICATION	LL %	PL %	PI %	NAT. W.C. %	PASS. #200, %
● L17-3, SS-2	4.3	CL	Red-brown and gray mottled, Lean Clay.	47	20	27	22.1	

PLASTICITY CHART

BORING L17-3



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ML or OL: Inorganic and organic silts and clayey silts of low plasticity

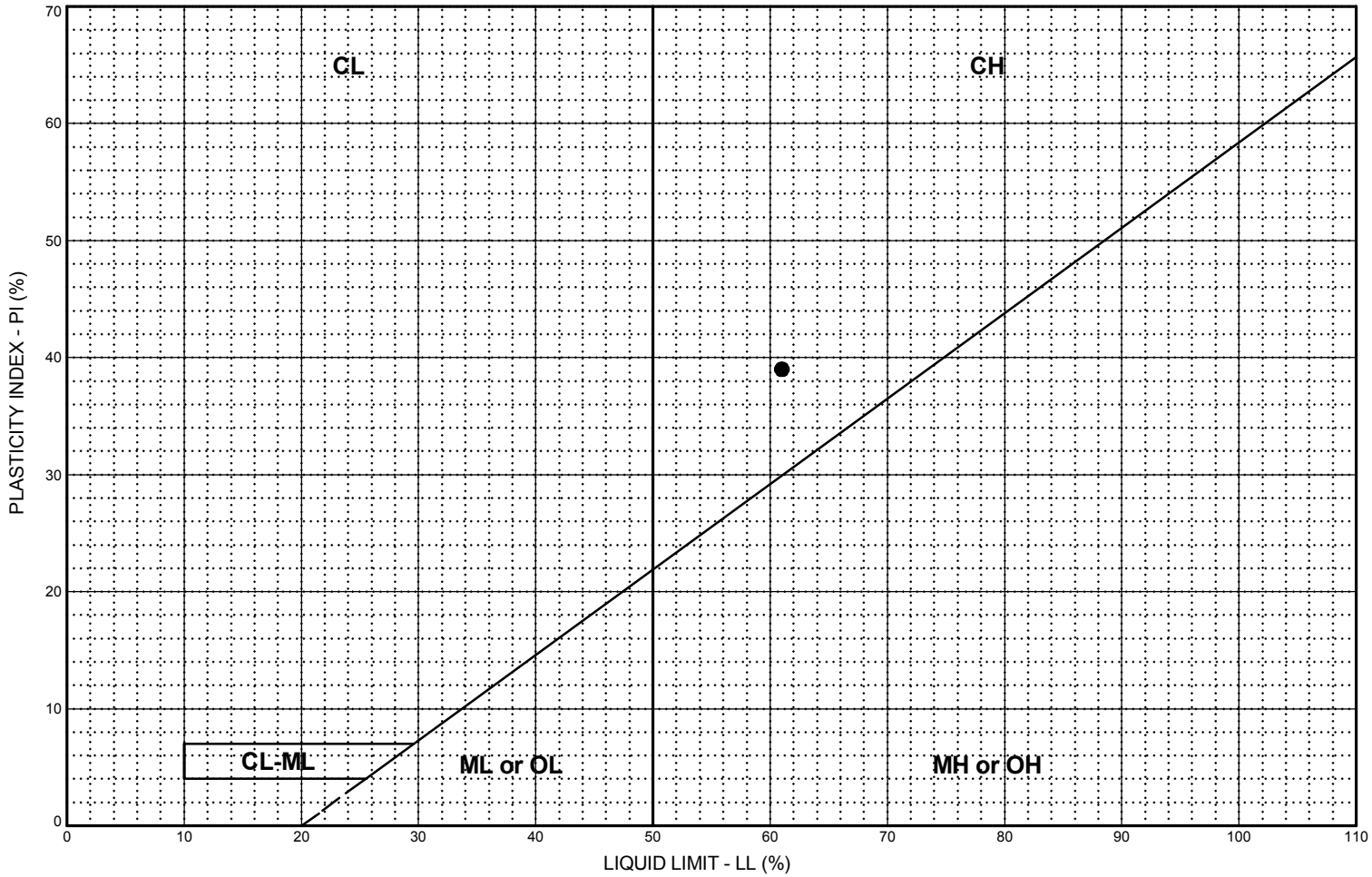
MH or OH: Inorganic and organic silts and clayey silts of high plasticity

CL-ML: Silty clays and clayey silts

BORING AND SAMPLE NO.	DEPTH (feet)	U.S.C.S. SYMBOL	SOIL CLASSIFICATION	LL %	PL %	PI %	NAT. W.C. %	PASS. #200, %
● L17-4, SS-2	9.3	CH	Red-yellow, Fat Clay.	56	20	36	23.0	

PLASTICITY CHART

BORING L17-4



LEGEND

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CH: High plasticity inorganic clays

ML or OL: Inorganic and organic silts and clayey silts of low plasticity

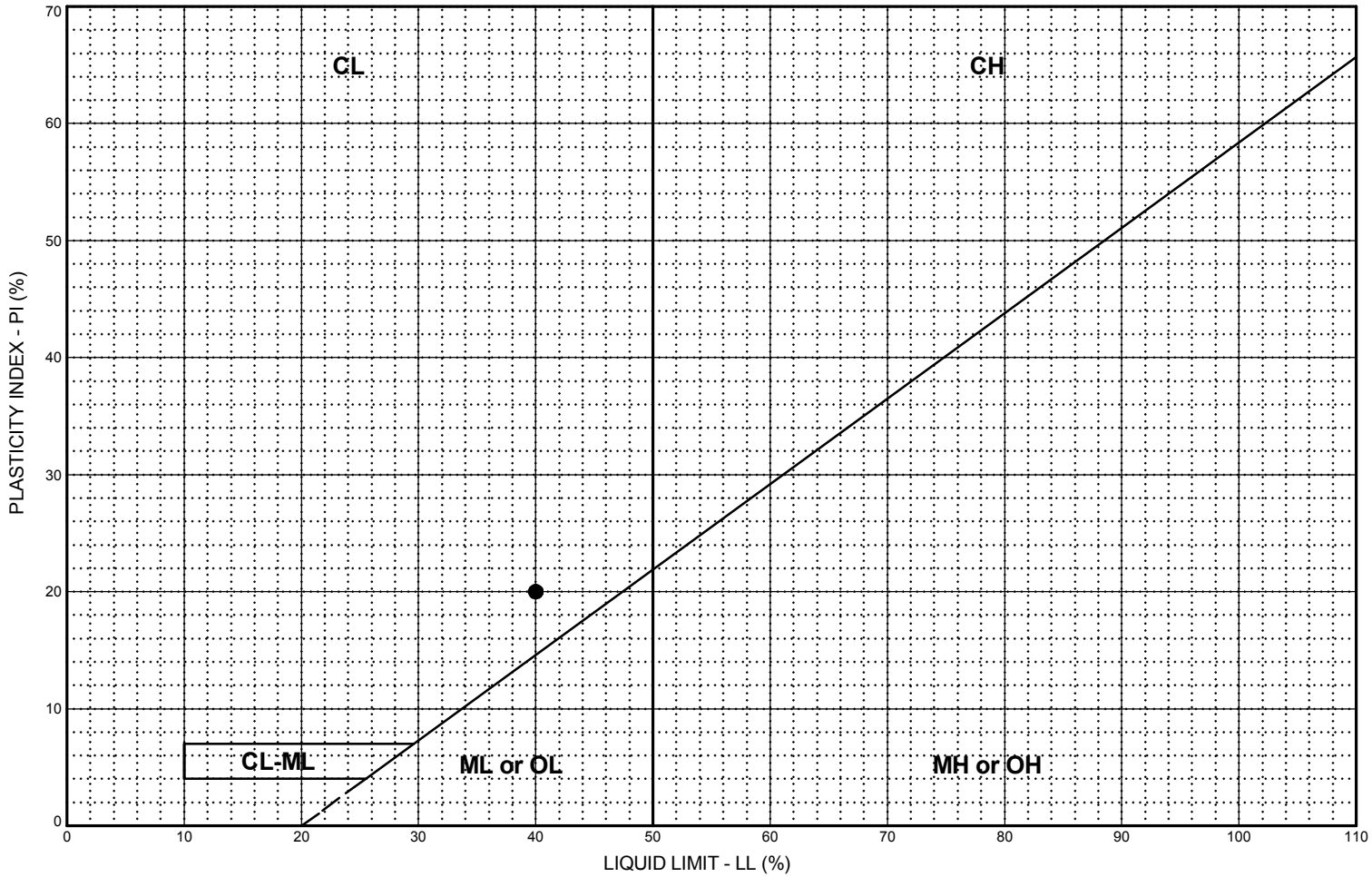
MH or OH: Inorganic and organic silts and clayey silts of high plasticity

CL-ML: Silty clays and clayey silts

BORING AND SAMPLE NO.	DEPTH (feet)	U.S.C.S. SYMBOL	SOIL CLASSIFICATION	LL %	PL %	PI %	NAT. W.C. %	PASS. #200, %
● L17-5, ST-2	9.2	CH	Red-brown and gray, Fat Clay.	61	22	39	23.6	

PLASTICITY CHART

BORING L17-5



LEGEND

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CH: High plasticity inorganic clays

ML or OL: Inorganic and organic silts and clayey silts of low plasticity

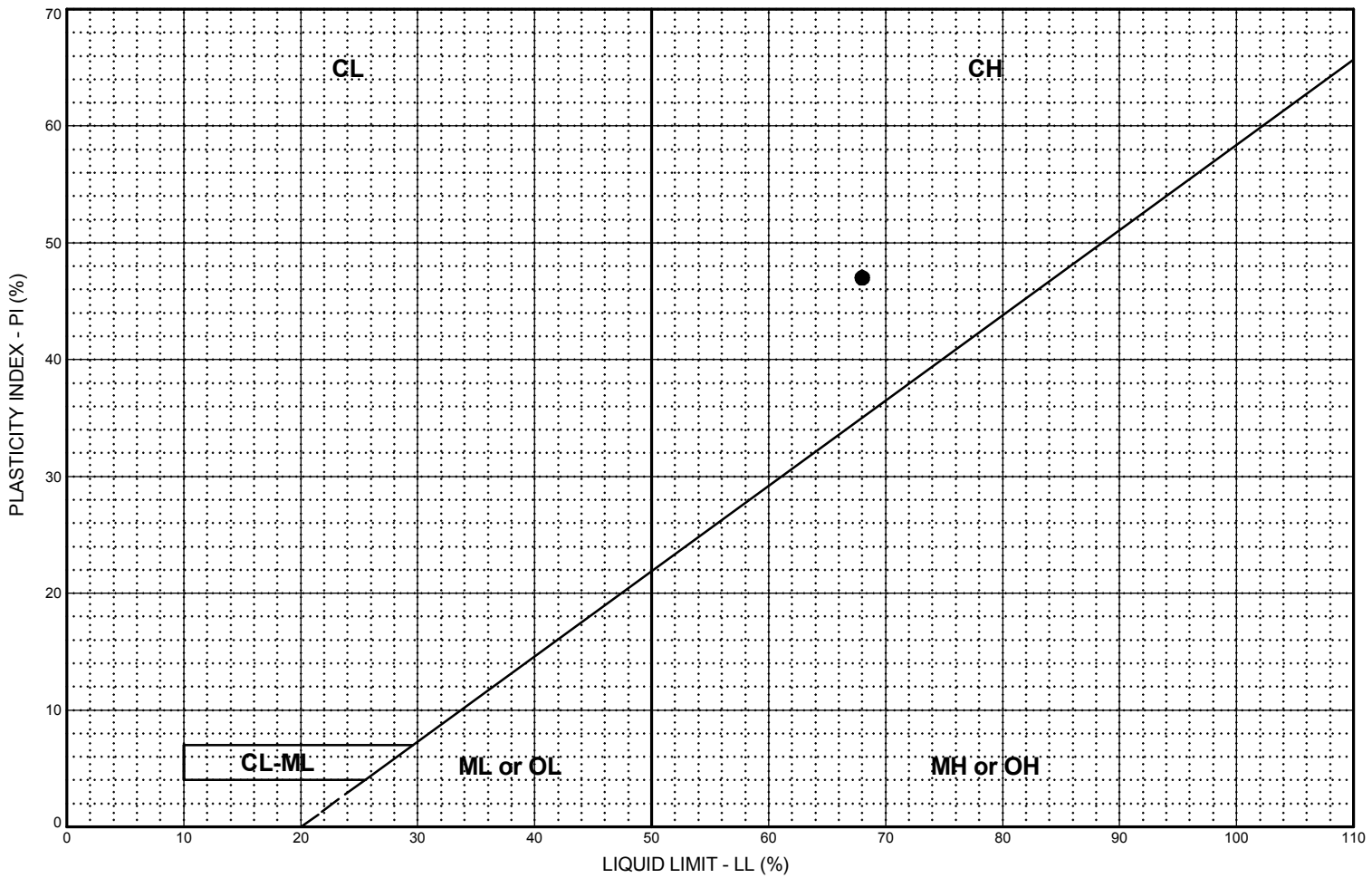
MH or OH: Inorganic and organic silts and clayey silts of high plasticity

CL-ML: Silty clays and clayey silts

BORING AND SAMPLE NO.	DEPTH (feet)	U.S.C.S. SYMBOL	SOIL CLASSIFICATION	LL %	PL %	PI %	NAT. W.C. %	PASS. #200, %
● L17-6, SS-3	11.8	CL	Dark brown to olive-brown, Lean Clay.	40	20	20	26.5	

PLASTICITY CHART

BORING L17-6



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ML or OL: Inorganic and organic silts and clayey silts of low plasticity

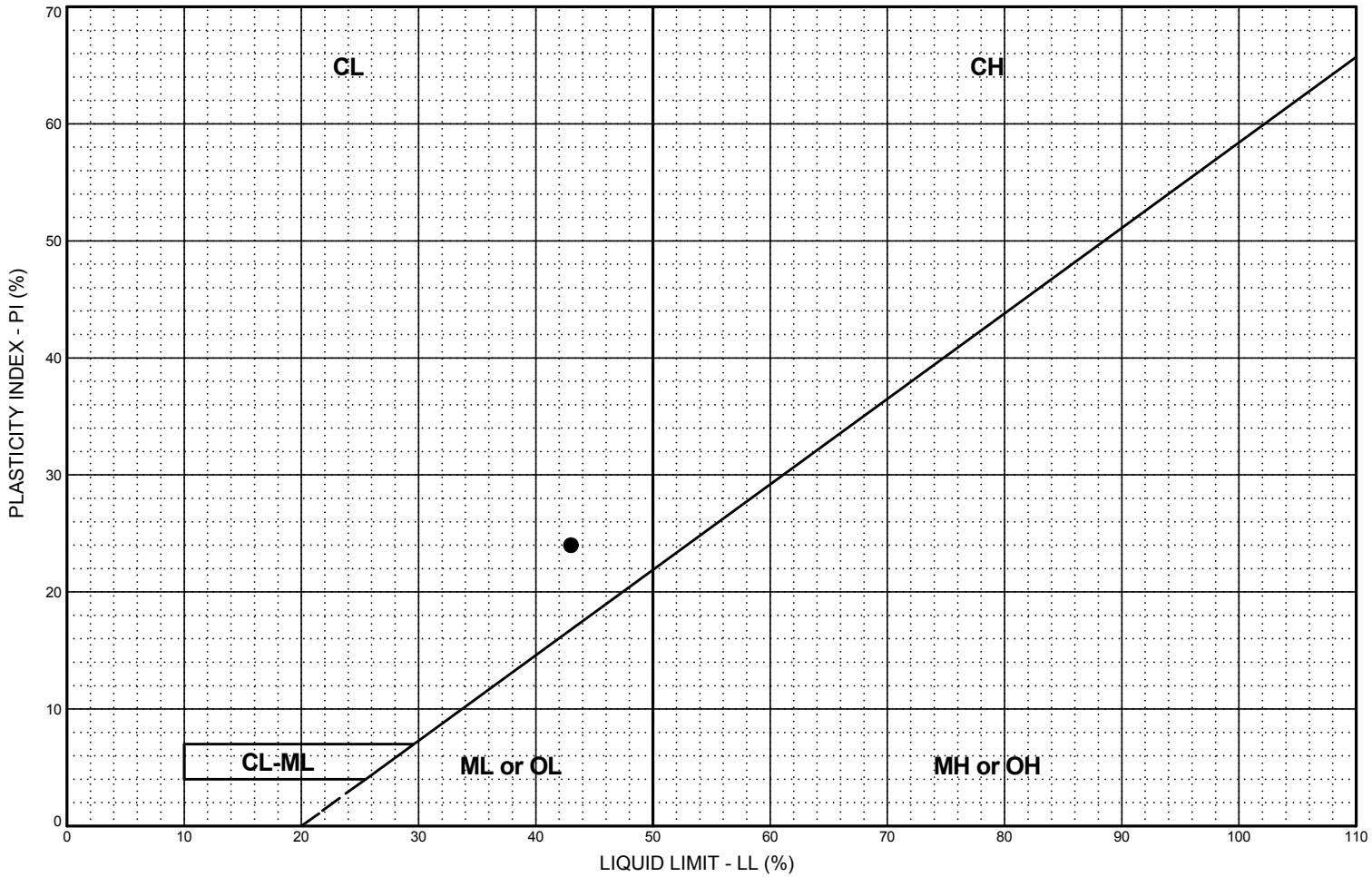
MH or OH: Inorganic and organic silts and clayey silts of high plasticity

CL-ML: Silty clays and clayey silts

BORING AND SAMPLE NO.	DEPTH (feet)	U.S.C.S. SYMBOL	SOIL CLASSIFICATION	LL %	PL %	PI %	NAT. W.C. %	PASS. #200, %
● L17-7, SS-2	9.3	CH	Red-brown, Fat Clay.	68	21	47	28.0	

PLASTICITY CHART

BORING L17-7



LEGEND

CL: Low plasticity inorganic clays; sandy and silty clays

CH: High plasticity inorganic clays

ML or OL: Inorganic and organic silts and clayey silts of low plasticity

MH or OH: Inorganic and organic silts and clayey silts of high plasticity

CL-ML: Silty clays and clayey silts

BORING AND SAMPLE NO.	DEPTH (feet)	U.S.C.S. SYMBOL	SOIL CLASSIFICATION	LL %	PL %	PI %	NAT. W.C. %	PASS. #200, %
● L17-8, SS-3	9.3	CL	Light gray and brown, Lean Clay.	43	19	24	26.2	

PLASTICITY CHART

BORING L17-8

UNCONSOLIDATED, UNDRAINED STRENGTH IN TRIAXIAL COMPRESSION
SUMMARY OF TEST DATA

Boring	L17-8		Tested by / Date	CMB	01/30/18
Sample	ST-2		Calculated by / Date	CMB	01/31/18
Depth (ft)	7.1		Checked by / Date	DPM	2/2/18
Description	Medium stiff to stiff, gray, Lean Clay (CL).				

Specimen Data			Instrument Constants		
Height	5.981	inches	Deformation	0.001	inches/div
Diameter	2.887	inches	Load	1	lb/div.
H/D ratio	2.072		Confinment	7.1	psi
Volume	641.6	cc			
Wet wt.	1243.99	grams	Peak values		
Bulk Density	121.0	pcf	p	1.223	tsf
Dry Density	94.0	pcf	q	0.712	tsf
M.C.	28.8%	percent	strain	15.0%	%
Saturation	97.9%	percent	strain rate	0.040	in. per min.
Void ratio	0.793				
Gs	2.7	assumed			

Deformation div.	Load div.	Strain %	Load lb	Stress tsf	p tsf	q tsf
0.000	0.0	0.0%	0.0	0.000	0.511	0.000
0.005	9.2	0.1%	9.2	0.101	0.562	0.051
0.010	14.9	0.2%	14.9	0.164	0.593	0.082
0.015	20.6	0.3%	20.6	0.226	0.624	0.113
0.020	24.8	0.3%	24.8	0.272	0.647	0.136
0.030	33.3	0.5%	33.3	0.364	0.693	0.182
0.050	44.2	0.8%	44.2	0.482	0.752	0.241
0.075	58.8	1.3%	58.8	0.639	0.831	0.319
0.100	71.4	1.7%	71.4	0.772	0.897	0.386
0.125	79.9	2.1%	79.9	0.861	0.942	0.430
0.150	86.2	2.5%	86.2	0.925	0.974	0.462
0.175	89.2	2.9%	89.2	0.953	0.988	0.477
0.200	93.0	3.3%	93.0	0.990	1.006	0.495
0.225	97.3	3.8%	97.3	1.031	1.027	0.516
0.250	100.1	4.2%	100.1	1.057	1.040	0.528
0.300	105.8	5.0%	105.8	1.108	1.065	0.554
0.350	111.3	5.9%	111.3	1.156	1.089	0.578
0.400	116.8	6.7%	116.8	1.204	1.113	0.602
0.450	118.9	7.5%	118.9	1.216	1.119	0.608
0.500	123.6	8.4%	123.6	1.255	1.138	0.627
0.550	126.6	9.2%	126.6	1.275	1.149	0.638
0.600	131.1	10.0%	131.1	1.310	1.166	0.655
0.650	134.7	10.9%	134.7	1.336	1.179	0.668
0.700	135.7	11.7%	135.7	1.336	1.179	0.668
0.750	139.5	12.5%	139.5	1.363	1.193	0.682
0.800	142.5	13.4%	142.5	1.382	1.202	0.691
0.850	145.4	14.2%	145.4	1.400	1.211	0.700
0.900	149.0	15.0%	149.0	1.424	1.223	0.712

RDP Tributaries (Deer Creek)
CSO Tunnel (MSD 12441)
Saint Louis, Missouri

UNCONSOLIDATED, UNDRAINED STRENGTH IN TRIAXIAL COMPRESSION

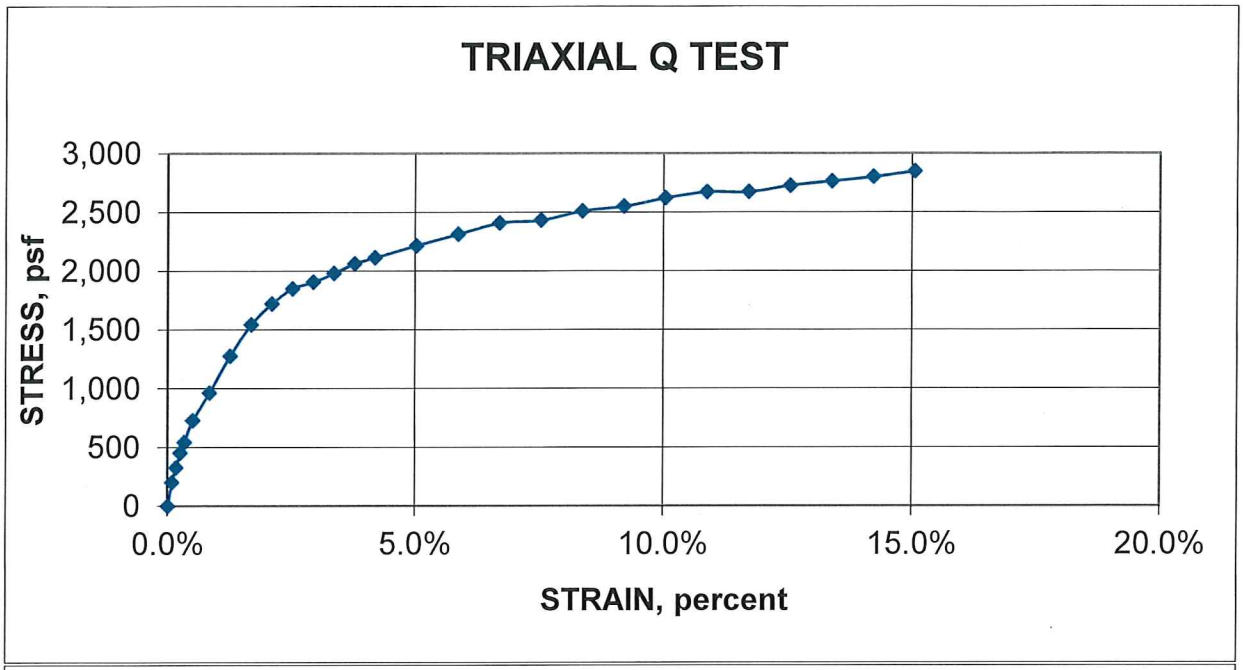
BORING - L17-8 : SAMPLE - ST-2

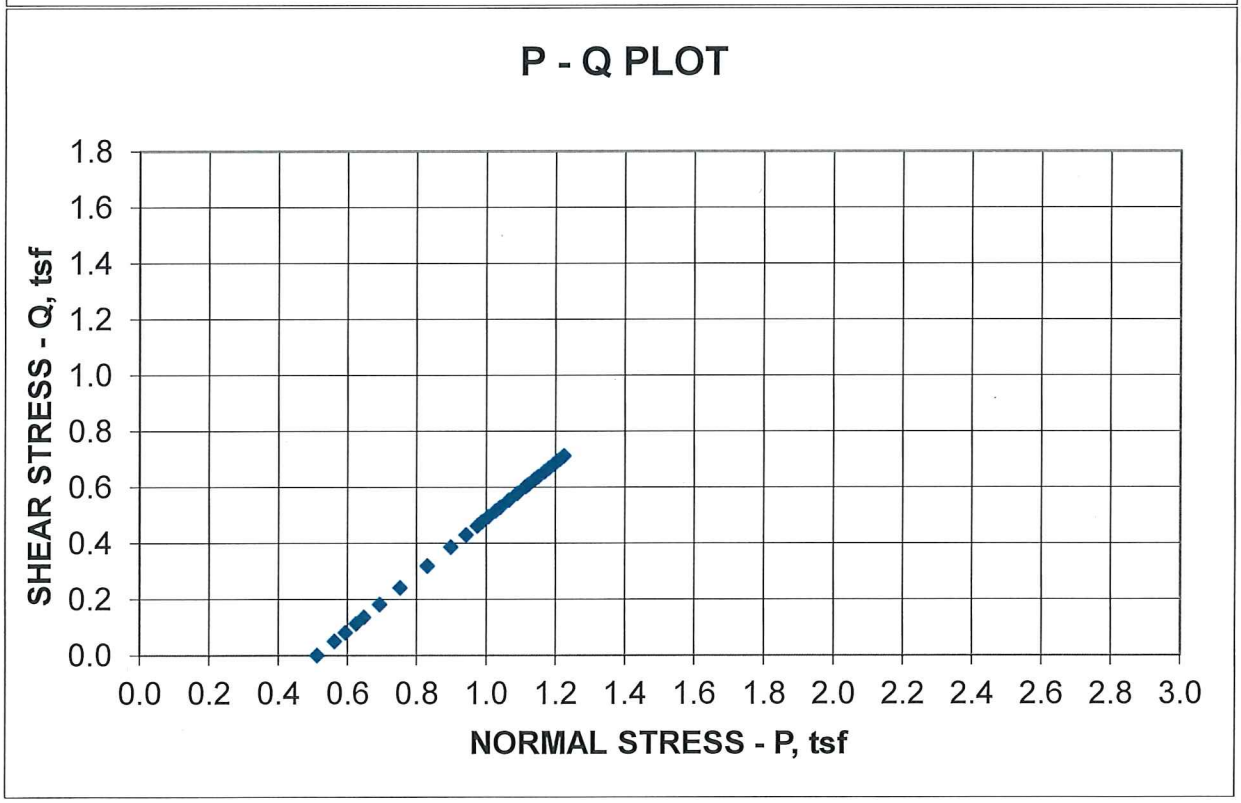
January 2018 41-1-37530-005

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG.

UNCONSOLIDATED, UNDRAINED STRENGTH IN TRIAXIAL COMPRESSION
PLOT OF TEST DATA





Photograph of Failure

RDP Tributaries (Deer Creek)
CSO Tunnel (MSD 12441)
Saint Louis, Missouri

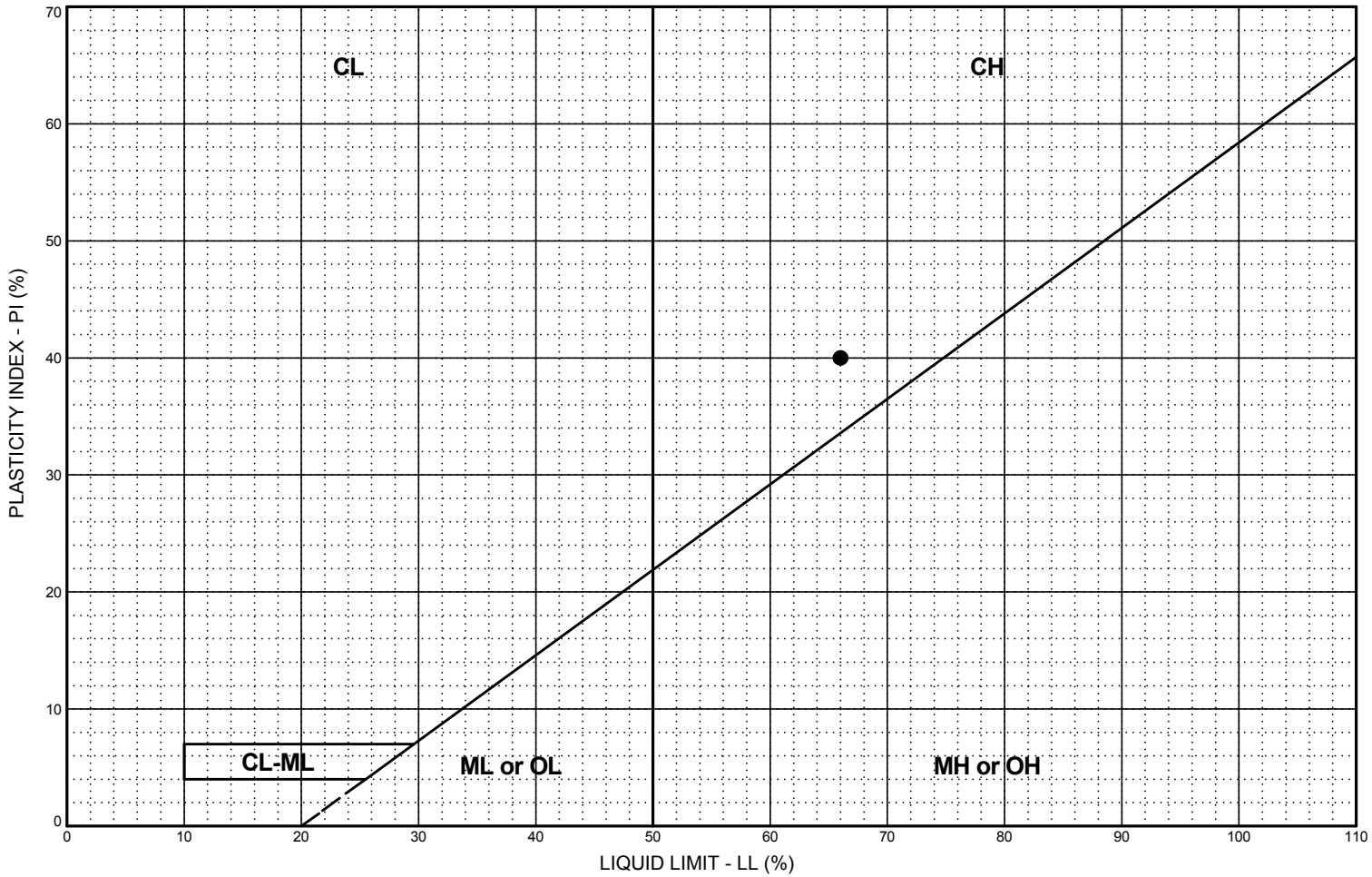
UNCONSOLIDATED, UNDRAINED STRENGTH IN TRIAXIAL COMPRESSION

BORING - L17-8 : SAMPLE - ST-2

January 2018 41-1-37530-005

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG.



LEGEND

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MH or OH: Inorganic and organic silts and clayey silts of high plasticity

CL-ML: Silty clays and clayey silts

BORING AND SAMPLE NO.	DEPTH (feet)	U.S.C.S. SYMBOL	SOIL CLASSIFICATION	LL %	PL %	PI %	NAT. W.C. %	PASS. #200, %
● L17-9, SS-5	16.8	CH	Light gray and yellow, Fat Clay.	66	26	40	26.1	

PLASTICITY CHART

BORING L17-9

UNCONFINED COMPRESSIVE STRENGTH

Project	RDP Tributaries (Deer Creek)	Client	HDR/MSD/WSP	
Location	CSO Tunnel (MSD 12441)	Tested By / Date	CMB	01/30/18
Job No.	41-1-37530-005	Calculated By / Date	CMB	01/31/18
Boring No.	L17-9	Checked By / Date	DPM	2/2/18
Sample	ST-2	File	41-1-37530-005 L17-9 ASTM D2166	
Depth (ft)	9.4	Procedure	ASTM D2166	
Description (D 2488 + symbol)	Stiff, gray and brown, Lean Clay (CL).			
Undisturbed/ Remolded	Undisturbed			

SAMPLE DATA

Diameter	2.885	inches	73.3	mm
Length	5.992	inches	152.2	mm
Wet Wt.	1259.20	grams		

AFTER TEST WATER CONTENT

Tare No.	9	
Tare Wt.	178.50	grams
Wet & Tare	1434.45	grams
Dry & Tare	1173.55	grams

Deflection	0.001	inch/division
Load	1	lb/division

Photograph of Failure

TEST DATA

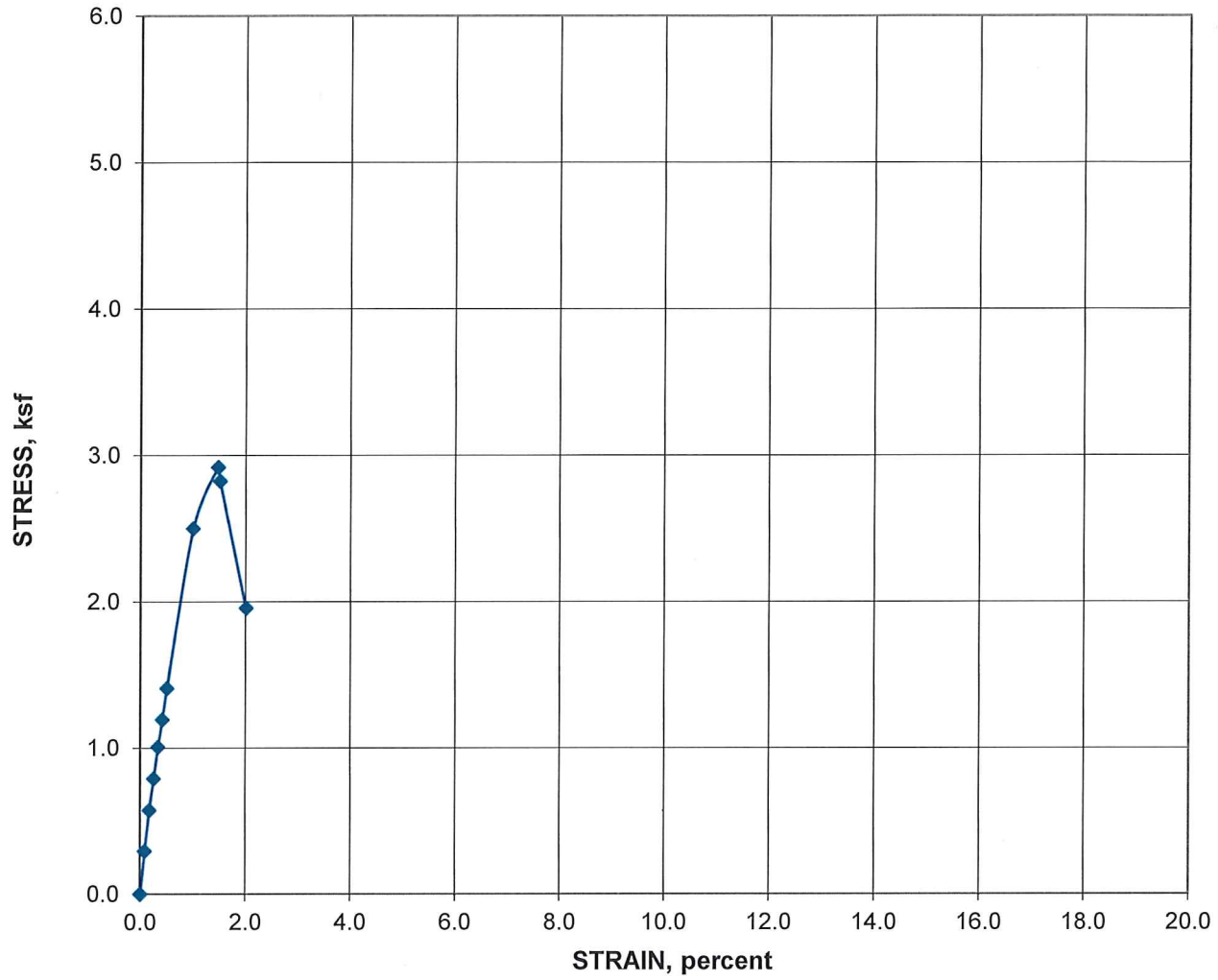
Time	Deflection	Load
hr-min-sec	divisions	divisions
0:00:00	0	0
0:00:05	5	13.4
0:00:10	10	26.1
0:00:15	15	36.0
0:00:20	20	45.9
0:00:25	25	54.4
0:00:30	30	64.3
0:01:00	60	114.7
0:01:28	88	134.5
0:01:30	90	130.2
0:02:00	120	90.6
0:03:00	180	
0:04:00	240	
0:05:00	300	
0:06:00	360	
0:07:00	420	
0:08:00	480	
0:09:00	540	
0:10:00	600	
0:11:00	660	
0:12:00	720	
0:13:00	780	
0:14:00	840	
0:15:00	900	

REMARKS: _____

NOTE: The moisture content is taken from the entire sample after the test is run

Shannon & Wilson, Inc.
2043 Westport Center Drive
St. Louis, Missouri 63146

UNCONFINED COMPRESSION STRENGTH



SHEAR STRENGTH	*H-D RATIO*	AVG STRAIN RATE	*STRENGTH*	*STRAIN*	*MOISTURE*	*DRY DENSITY*
ksf		in per min	ksf			pcf
1.460	2.08	0.006	2.920	1.5%	26.2%	97.0

Sample Identification: Boring L17-9, Sample ST-2, at 9.4 feet

DESCRIPTION
Stiff, gray and brown, Lean Clay (CL).

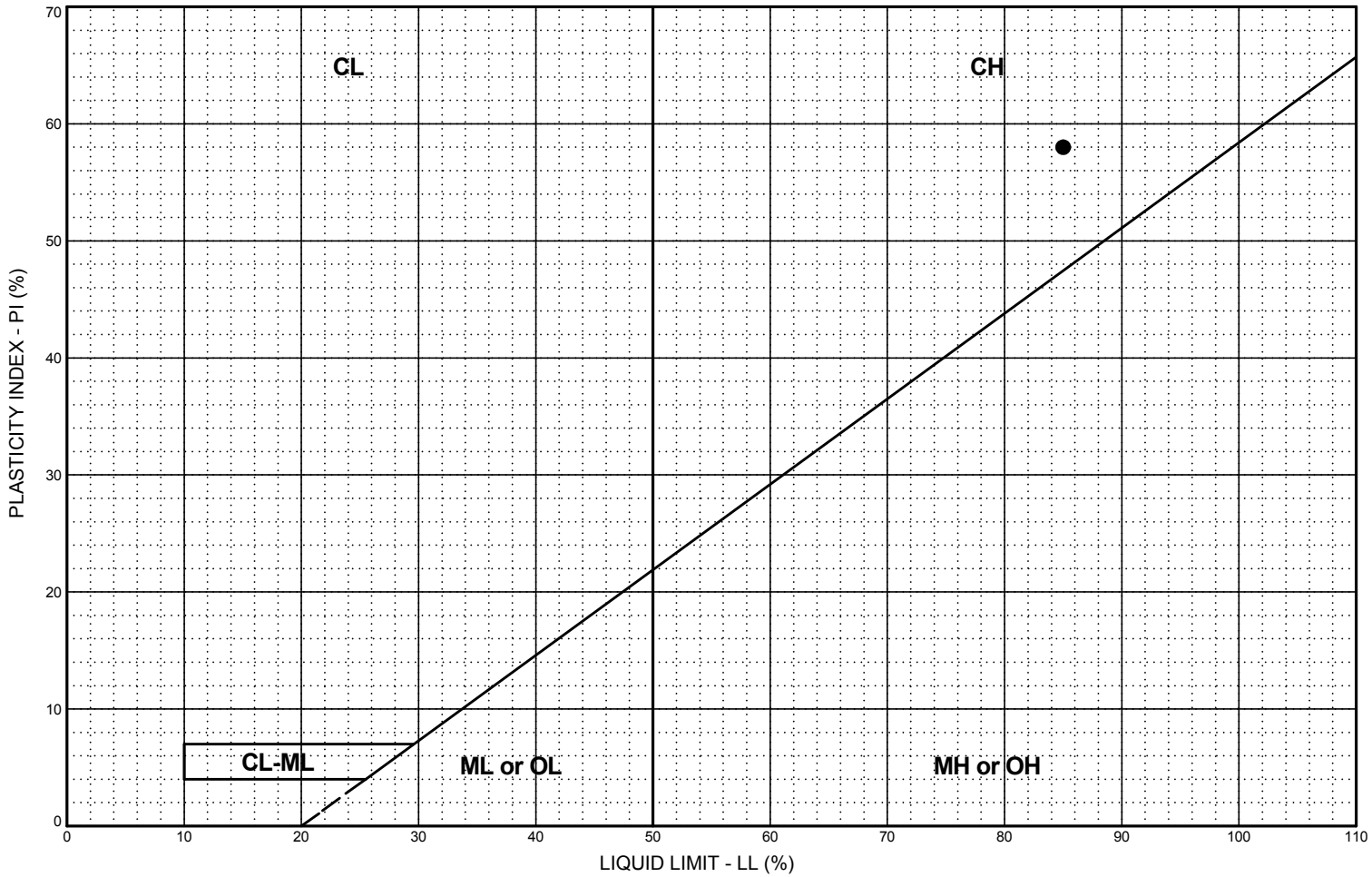
RDP Tributaries (Deer Creek)
CSO Tunnel (MSD 12441)

UNCONFINED COMPRESSION TEST
L17-9
ST-2

January 2018 41-1-37530-005

SHANNON & WILSON, INC.
Geotechnical and Environmental

FIG.



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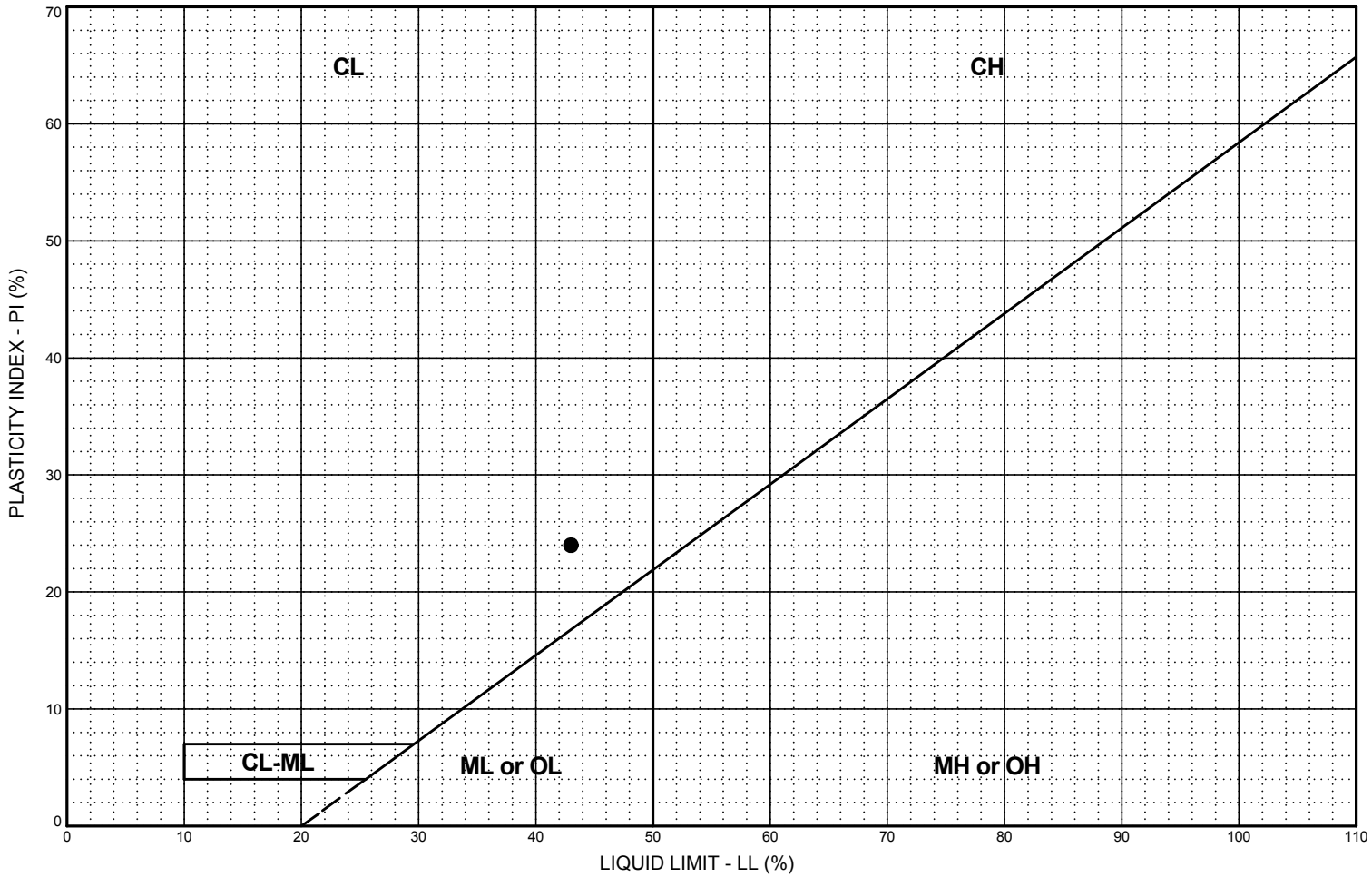
MH or OH: Inorganic and organic silts and clayey silts of high plasticity

CL-ML: Silty clays and clayey silts

BORING AND SAMPLE NO.	DEPTH (feet)	U.S.C.S. SYMBOL	SOIL CLASSIFICATION	LL %	PL %	PI %	NAT. W.C. %	PASS. #200, %
● L17-11, SS-5	11.8	CH	Light gray and brown, Fat Clay.	85	27	58	30.8	

PLASTICITY CHART

BORING L17-11



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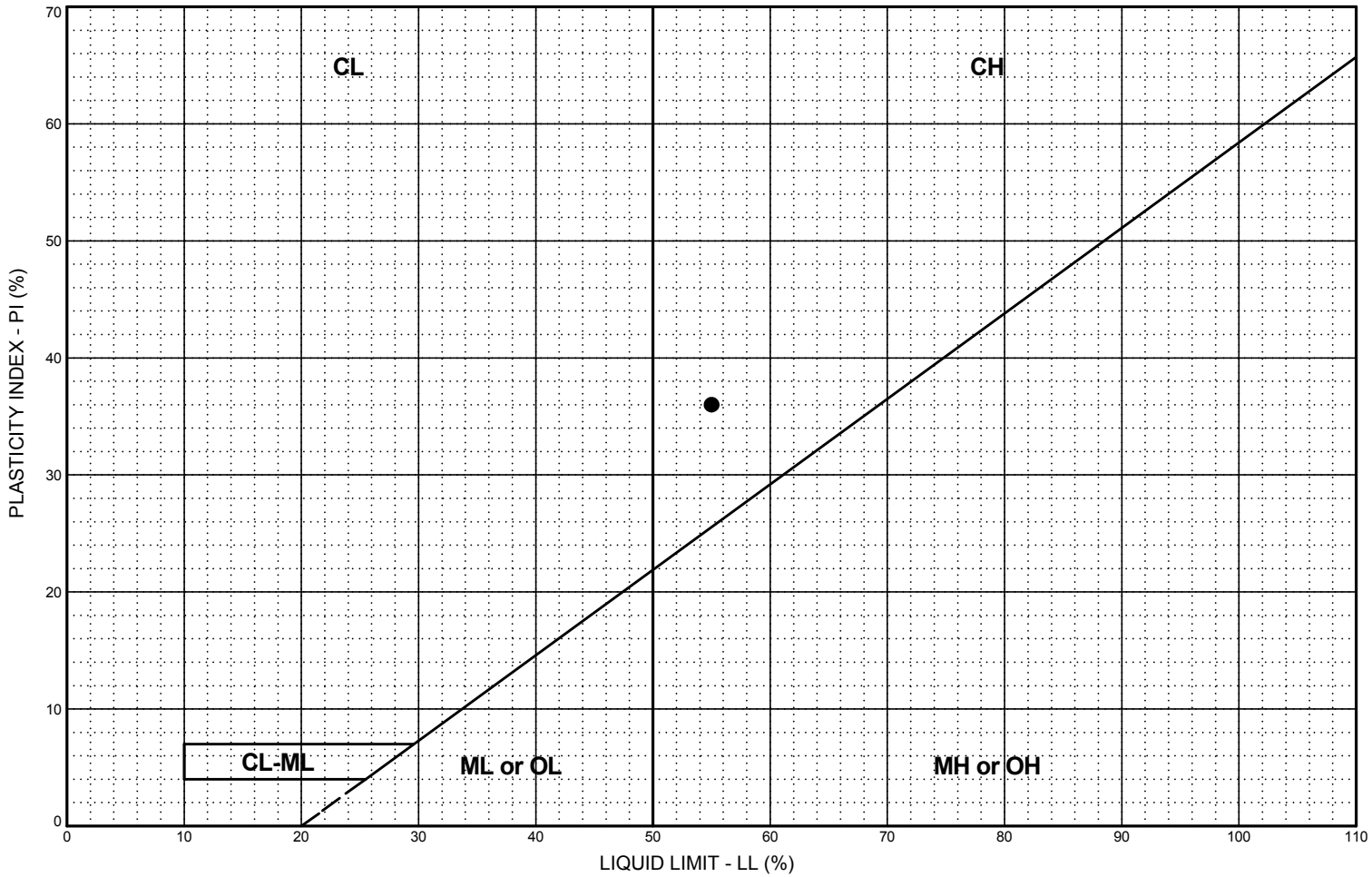
BORING AND SAMPLE NO.	DEPTH (feet)	U.S.C.S. SYMBOL	SOIL CLASSIFICATION	LL %	PL %	PI %	NAT. W.C. %	PASS. #200, %
● L17-12, SS-2	9.3	CL	Red-brown and gray mottled, Lean Clay.	43	19	24	21.8	

PLASTICITY CHART

BORING L17-12



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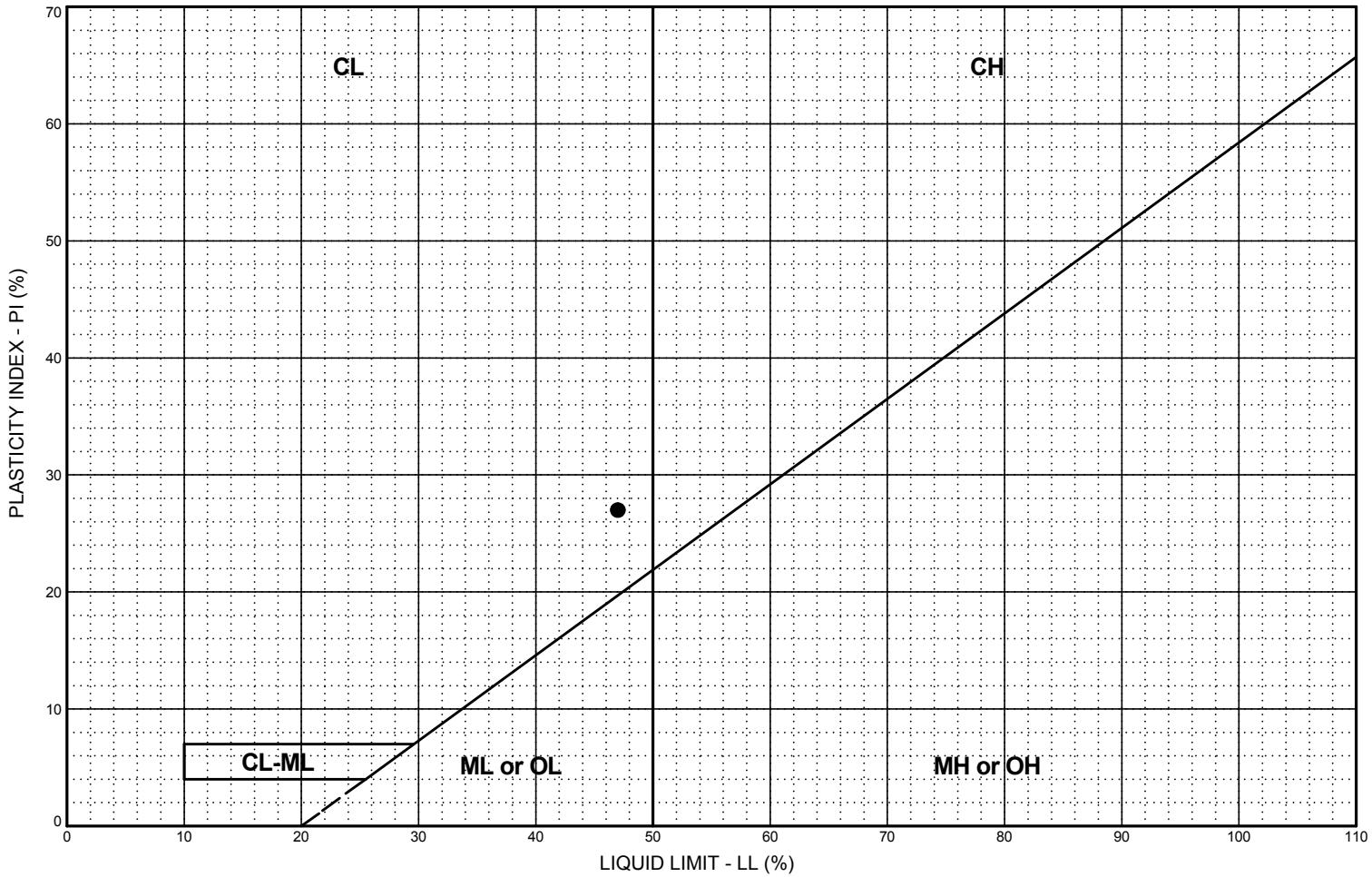
BORING AND SAMPLE NO.	DEPTH (feet)	U.S.C.S. SYMBOL	SOIL CLASSIFICATION	LL %	PL %	PI %	NAT. W.C. %	PASS. #200, %
● L17-13, SS-3	11.8	CH	Red-yellow and gray mottled, Fat Clay.	55	19	36	23.3	

PLASTICITY CHART

BORING L17-13



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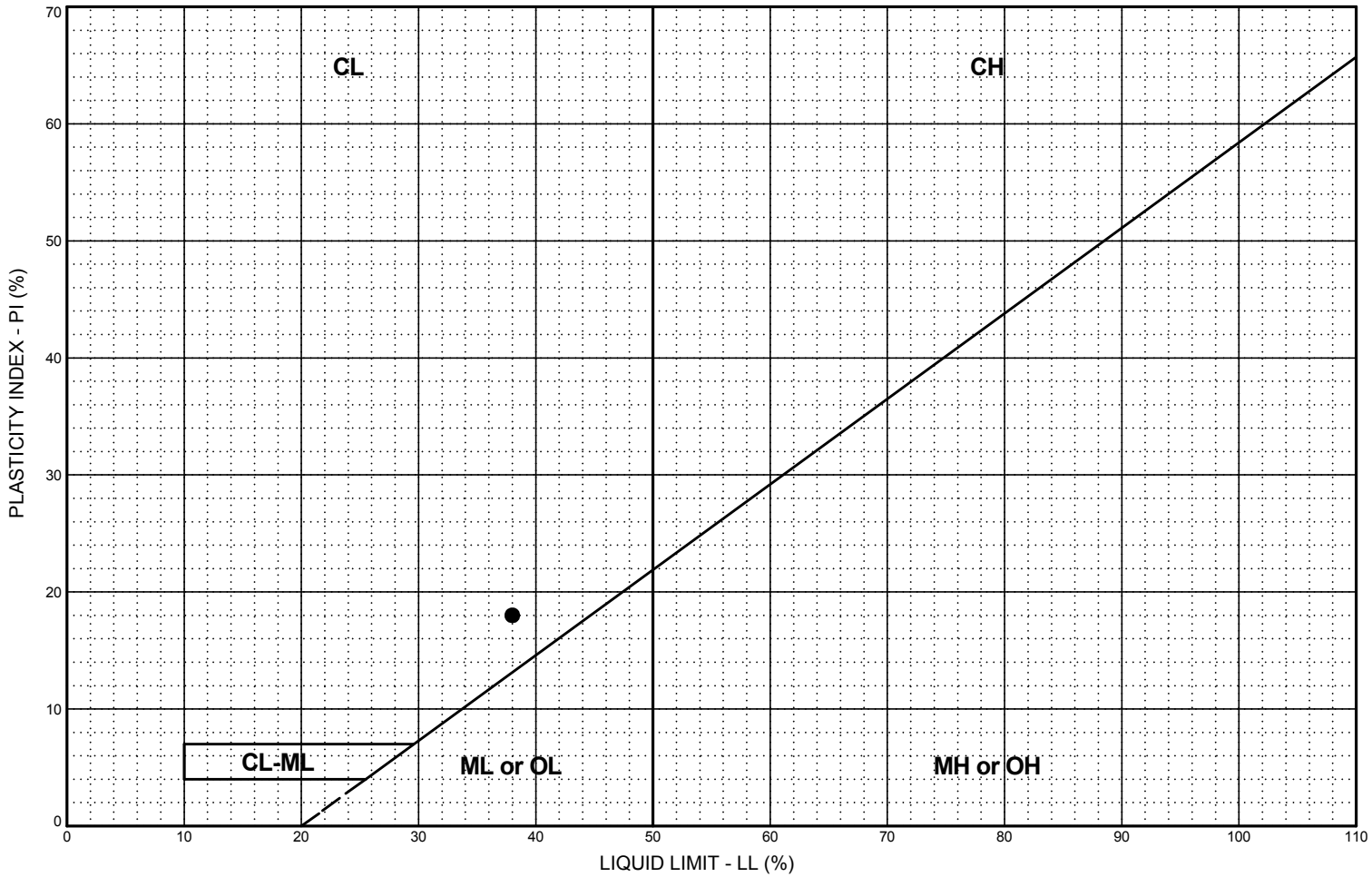
BORING AND SAMPLE NO.	DEPTH (feet)	U.S.C.S. SYMBOL	SOIL CLASSIFICATION	LL %	PL %	PI %	NAT. W.C. %	PASS. #200, %
● L17-15, SS-4	11.8	CL	Red-brown to yellow and gray mottled, Lean Clay.	47	20	27	24.9	

PLASTICITY CHART

BORING L17-15



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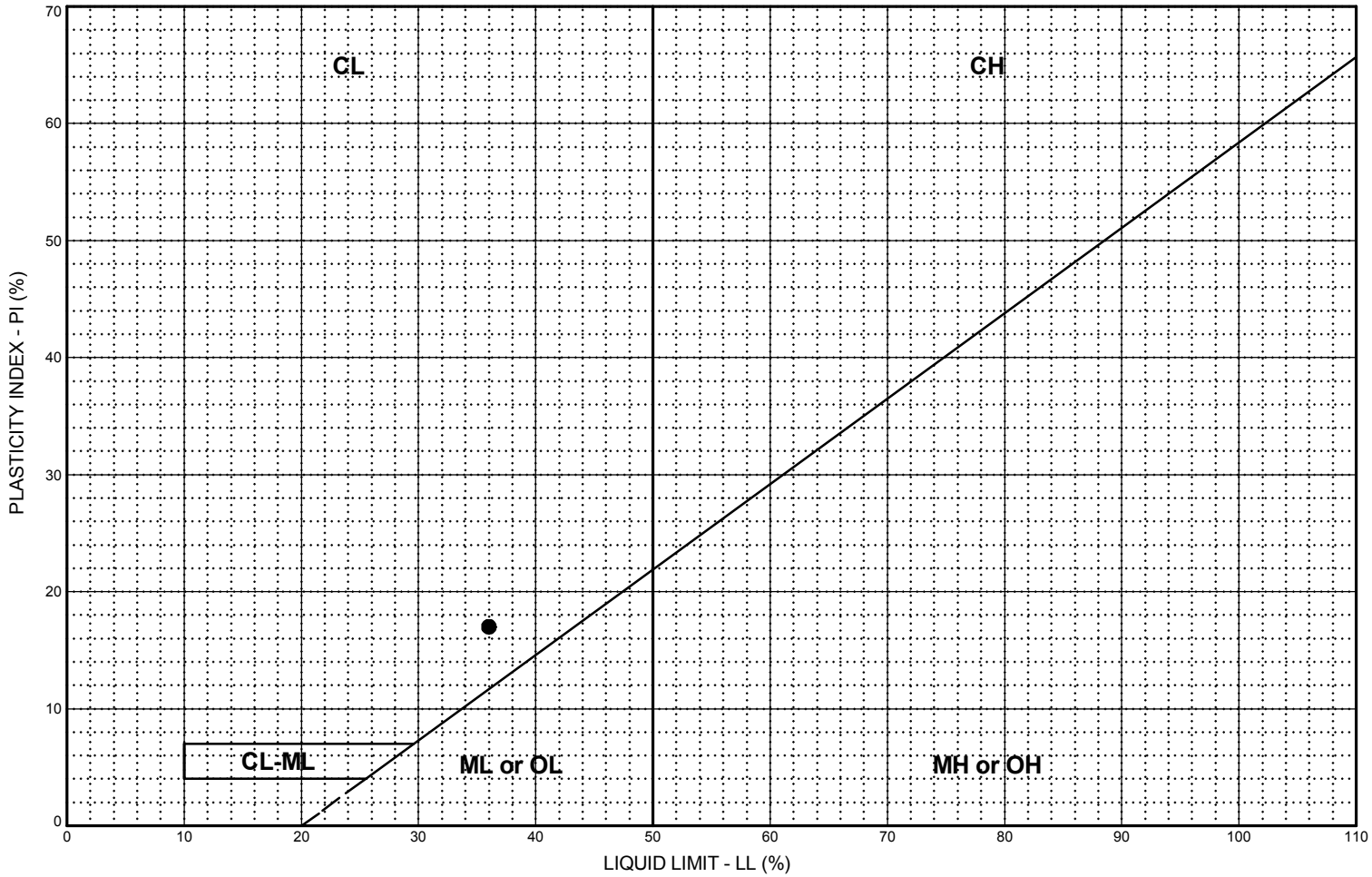
BORING AND SAMPLE NO.	DEPTH (feet)	U.S.C.S. SYMBOL	SOIL CLASSIFICATION	LL %	PL %	PI %	NAT. W.C. %	PASS. #200, %
● L17-17, SS-3	6.8	CL	Dark brown, Lean Clay.	38	20	18	26.7	

PLASTICITY CHART

BORING L17-17



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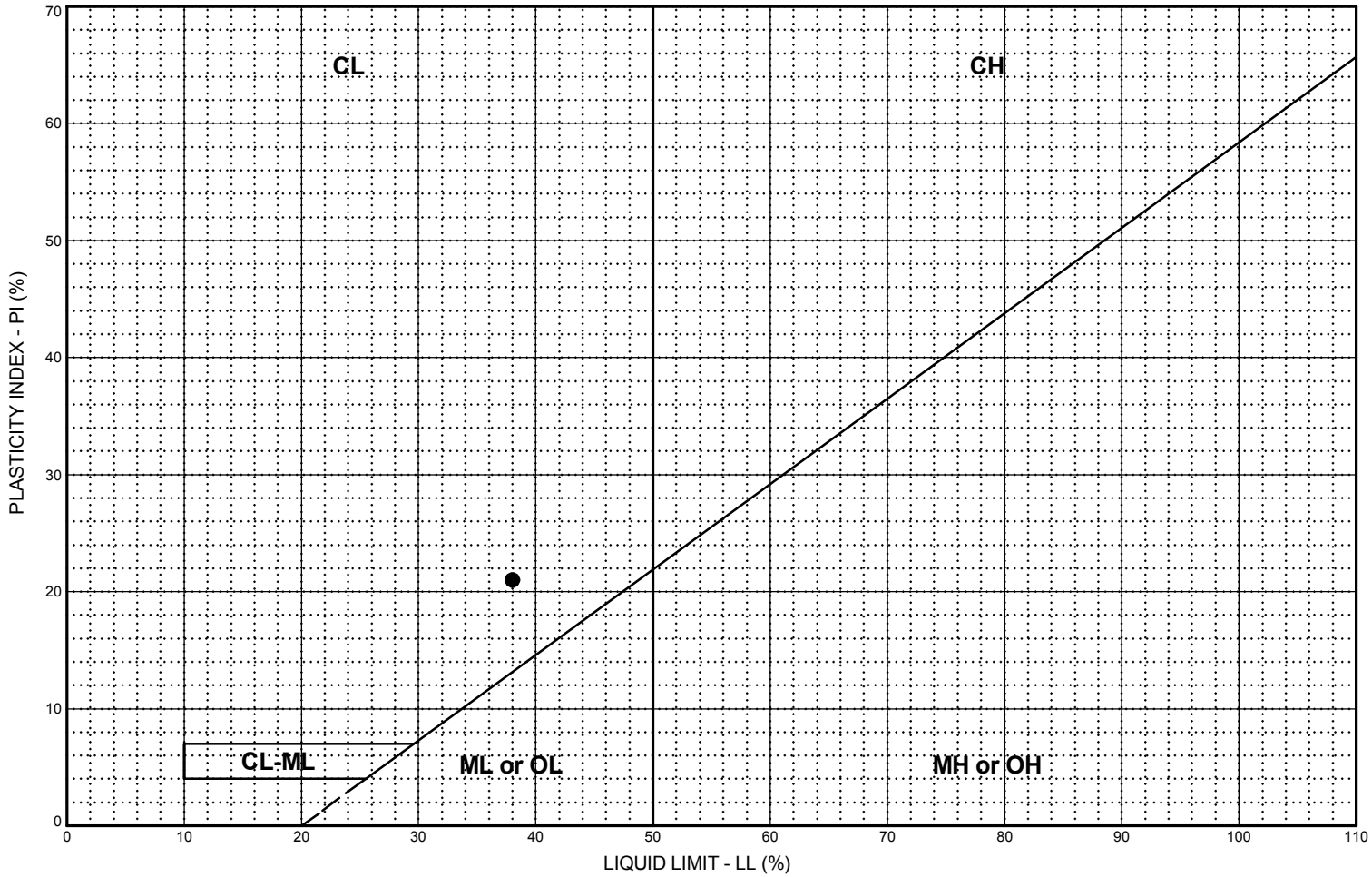
BORING AND SAMPLE NO.	DEPTH (feet)	U.S.C.S. SYMBOL	SOIL CLASSIFICATION	LL %	PL %	PI %	NAT. W.C. %	PASS. #200, %
● L17-18, ST-2	7.3	CL	Gray and yellowish brown mottle, Lean Clay.	36	19	17	23.5	

PLASTICITY CHART

BORING L17-18



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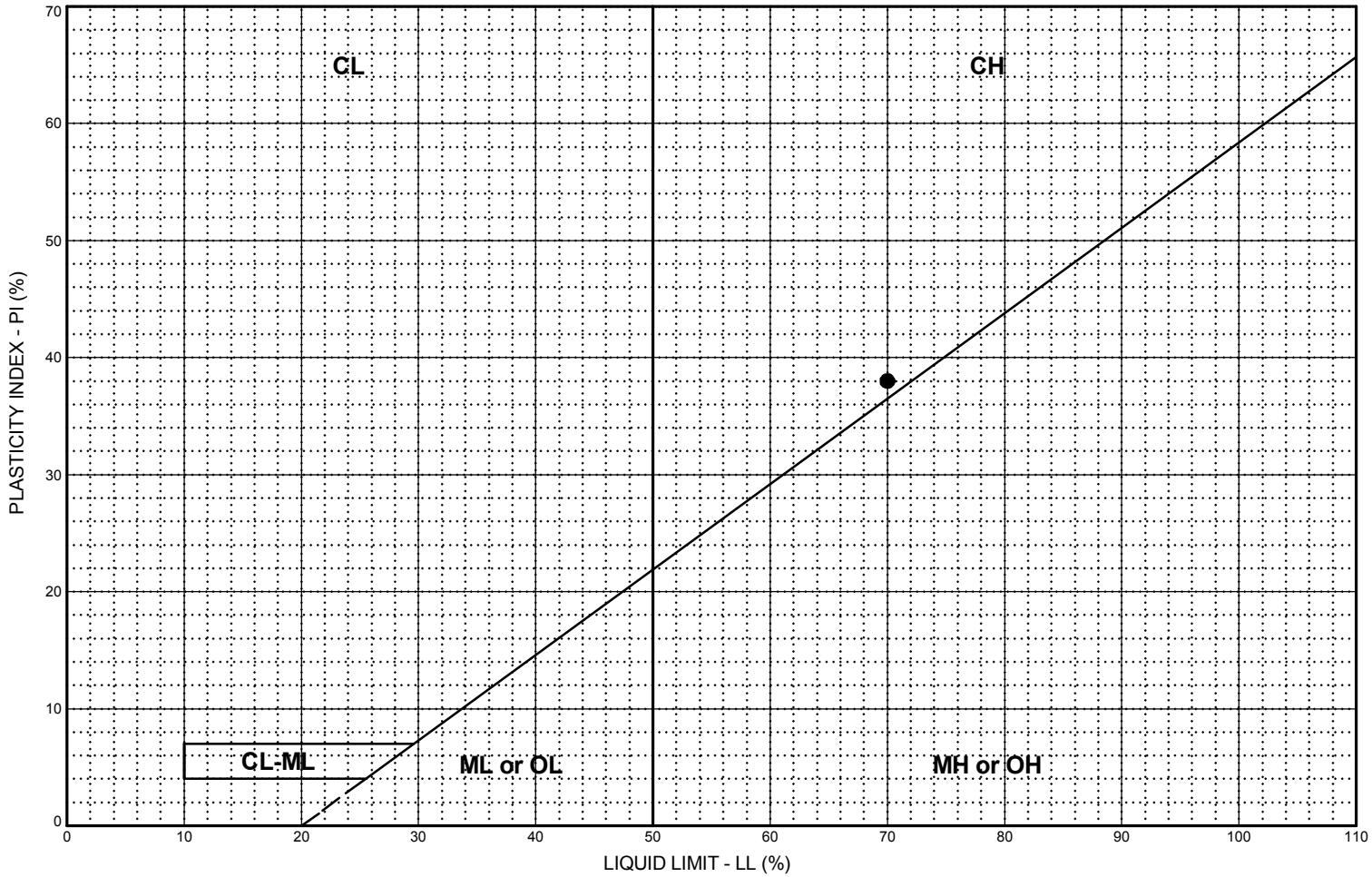
BORING AND SAMPLE NO.	DEPTH (feet)	U.S.C.S. SYMBOL	SOIL CLASSIFICATION	LL %	PL %	PI %	NAT. W.C. %	PASS. #200, %
● L17-19, SS-3	9.3	CL	Gray and brown mottle, Lean Clay.	38	17	21	25.2	

PLASTICITY CHART

BORING L17-19



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BORING AND SAMPLE NO.	DEPTH (feet)	U.S.C.S. SYMBOL	SOIL CLASSIFICATION	LL %	PL %	PI %	NAT. W.C. %	PASS. #200, %
● L17-20, SS-5	16.8	CH	Yellow, Fat Clay.	70	32	38	28.9	

PLASTICITY CHART

BORING L17-20

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Client: Shannon & Wilson, Inc. **Work Order:** 17050416

Client Project: RPD Tribs 41-1-37530-005 **Report Date:** 12-May-17

Lab ID: 17050416-013 **Client Sample ID:** L17-1

Matrix: SOLID **Collection Date:** 05/05/2017 10:30

Analyses	Certification	RL	Qual	Result	Units	DF	Date Analyzed	Batch
EPA 600 2-78-054 METHOD 3.2.18.1								
Resistivity, Solid		150		**891**	Ohms/cm	1	05/10/2017 12:46	R232615
EPA SW846 3550C, 5035A, ASTM D2974								
Percent Moisture		0.1		**22.2**	%	1	05/08/2017 16:41	R232551
STANDARD METHODS 4500-CL E (TOTAL)								
Chloride	NELAP	62		**354**	mg/Kg-dry	1	05/10/2017 17:06	130109
SW-846 9030B, 9034								
Sulfide, Total	NELAP	35		**< 35**	mg/Kg-dry	1	05/09/2017 16:46	129995
SW-846 9036 (TOTAL)								
Sulfate	NELAP	123		**130**	mg/Kg-dry	1	05/10/2017 17:08	130108
SW-846 9045C								
pH (1:1)	NELAP	1.00		**7.08**		1	05/09/2017 20:12	R232584

Client: Shannon & Wilson, Inc. **Work Order:** 17050416

Client Project: RPD Tribs 41-1-37530-005 **Report Date:** 12-May-17

Lab ID: 17050416-011 **Client Sample ID:** L17-2

Matrix: SOLID **Collection Date:** 05/05/2017 10:30

Analyses	Certification	RL	Qual	Result	Units	DF	Date Analyzed	Batch
EPA 600 2-78-054 METHOD 3.2.18.1								
Resistivity, Solid		150		**1200**	Ohms/cm	1	05/10/2017 12:40	R232615
EPA SW846 3550C, 5035A, ASTM D2974								
Percent Moisture		0.1		**27.4**	%	1	05/08/2017 16:41	R232551
STANDARD METHODS 4500-CL E (TOTAL)								
Chloride	NELAP	67		**428**	mg/Kg-dry	1	05/10/2017 16:57	130109
SW-846 9030B, 9034								
Sulfide, Total	NELAP	36		**< 36**	mg/Kg-dry	1	05/09/2017 16:44	129995
SW-846 9036 (TOTAL)								
Sulfate	NELAP	133	J	**120**	mg/Kg-dry	1	05/10/2017 17:00	130108
SW-846 9045C								
pH (1:1)	NELAP	1.00		**6.86**		1	05/09/2017 20:06	R232584

Client: Shannon & Wilson, Inc. **Work Order:** 17020225

Client Project: RPD Tribs 41-1-37530-005 **Report Date:** 13-Feb-17

Lab ID: 17020225-012 **Client Sample ID:** L17-3

Matrix: SOLID **Collection Date:** 01/27/2017 9:00

Analyses	Certification	RL	Qual	Result	Units	DF	Date Analyzed	Batch
EPA 600 2-78-054 METHOD 3.2.18.1								
Resistivity, Solid		150		**690**	Ohms/cm	1	02/06/2017 11:05	R228915
EPA SW846 3550C, 5035A, ASTM D2974								
Percent Moisture		0.1		**14.6**	%	1	02/07/2017 20:21	R228924
STANDARD METHODS 4500-CL E (TOTAL)								
Chloride	NELAP	59		**89**	mg/Kg-dry	1	02/07/2017 19:03	126885
SW-846 9030B, 9034								
Sulfide, Total	NELAP	35		**52**	mg/Kg-dry	1	02/07/2017 16:15	126917
SW-846 9036 (TOTAL)								
Sulfate	NELAP	1170	S	**1680**	mg/Kg-dry	10	02/07/2017 19:17	126887
MS and/or MSD did not recover within control limits. Result is verified by re-analysis at greater dilution.								
SW-846 9045C								
pH (1:1)	NELAP	1.00		**4.44**		1	02/06/2017 22:08	R228848

Client: Shannon & Wilson, Inc. **Work Order:** 17020225

Client Project: RPD Tribs 41-1-37530-005 **Report Date:** 13-Feb-17

Lab ID: 17020225-013 **Client Sample ID:** L17-4

Matrix: SOLID **Collection Date:** 01/27/2017 9:00

Analyses	Certification	RL	Qual	Result	Units	DF	Date Analyzed	Batch
EPA 600 2-78-054 METHOD 3.2.18.1								
Resistivity, Solid		150		**1400**	Ohms/cm	1	02/06/2017 11:05	R228915
EPA SW846 3550C, 5035A, ASTM D2974								
Percent Moisture		0.1		**11.7**	%	1	02/07/2017 20:22	R228924
STANDARD METHODS 4500-CL E (TOTAL)								
Chloride	NELAP	55	J	**25**	mg/Kg-dry	1	02/07/2017 19:41	126885
SW-846 9030B, 9034								
Sulfide, Total	NELAP	31		**< 31**	mg/Kg-dry	1	02/06/2017 15:24	126818
SW-846 9036 (TOTAL)								
Sulfate	NELAP	110		**504**	mg/Kg-dry	1	02/07/2017 19:44	126887
SW-846 9045C								
pH (1:1)	NELAP	1.00		**6.73**		1	02/03/2017 18:24	R228793

Client: Shannon & Wilson, Inc. **Work Order:** 17020225

Client Project: RPD Tribs 41-1-37530-005 **Report Date:** 13-Feb-17

Lab ID: 17020225-018 **Client Sample ID:** L17-5

Matrix: SOLID **Collection Date:** 01/27/2017 9:00

Analyses	Certification	RL	Qual	Result	Units	DF	Date Analyzed	Batch
EPA 600 2-78-054 METHOD 3.2.18.1								
Resistivity, Solid		150		**2540**	Ohms/cm	1	02/06/2017 11:05	R228915
EPA SW846 3550C, 5035A, ASTM D2974								
Percent Moisture		0.1		**14.8**	%	1	02/07/2017 20:23	R228924
STANDARD METHODS 4500-CL E (TOTAL)								
Chloride	NELAP	58		**59**	mg/Kg-dry	1	02/07/2017 20:35	126885
SW-846 9030B, 9034								
Sulfide, Total	NELAP	35		**< 35**	mg/Kg-dry	1	02/06/2017 15:30	126818
SW-846 9036 (TOTAL)								
Sulfate	NELAP	115		**126**	mg/Kg-dry	1	02/07/2017 20:38	126887
SW-846 9045C								
pH (1:1)	NELAP	1.00		**8.26**		1	02/03/2017 18:46	R228793

Client: Shannon & Wilson, Inc. **Work Order:** 17020225

Client Project: RPD Tribs 41-1-37530-005 **Report Date:** 13-Feb-17

Lab ID: 17020225-029 **Client Sample ID:** L17-6

Matrix: SOLID **Collection Date:** 01/27/2017 9:00

Analyses	Certification	RL	Qual	Result	Units	DF	Date Analyzed	Batch
EPA 600 2-78-054 METHOD 3.2.18.1								
Resistivity, Solid		150		**870**	Ohms/cm	1	02/06/2017 11:05	R228915
EPA SW846 3550C, 5035A, ASTM D2974								
Percent Moisture		0.1		**14.1**	%	1	02/07/2017 20:27	R228924
STANDARD METHODS 4500-CL E (TOTAL)								
Chloride	NELAP	56		**106**	mg/Kg-dry	1	02/07/2017 22:50	126885
SW-846 9030B, 9034								
Sulfide, Total	NELAP	33		**64**	mg/Kg-dry	1	02/06/2017 15:44	126819
SW-846 9036 (TOTAL)								
Sulfate	NELAP	112		**332**	mg/Kg-dry	1	02/07/2017 22:53	126887
SW-846 9045C								
pH (1:1)	NELAP	1.00		**7.87**		1	02/03/2017 19:31	R228793

Client: Shannon & Wilson, Inc. **Work Order:** 17020225

Client Project: RPD Tribs 41-1-37530-005 **Report Date:** 13-Feb-17

Lab ID: 17020225-019 **Client Sample ID:** L17-7

Matrix: SOLID **Collection Date:** 01/27/2017 9:00

Analyses	Certification	RL	Qual	Result	Units	DF	Date Analyzed	Batch
EPA 600 2-78-054 METHOD 3.2.18.1								
Resistivity, Solid		150		**2700**	Ohms/cm	1	02/06/2017 11:05	R228915
EPA SW846 3550C, 5035A, ASTM D2974								
Percent Moisture		0.1		**14.3**	%	1	02/07/2017 20:24	R228924
STANDARD METHODS 4500-CL E (TOTAL)								
Chloride	NELAP	55	J	**42**	mg/Kg-dry	1	02/07/2017 20:43	126885
SW-846 9030B, 9034								
Sulfide, Total	NELAP	33		**< 33**	mg/Kg-dry	1	02/06/2017 15:32	126818
SW-846 9036 (TOTAL)								
Sulfate	NELAP	109		**125**	mg/Kg-dry	1	02/07/2017 20:46	126887
SW-846 9045C								
pH (1:1)	NELAP	1.00		**8.25**		1	02/03/2017 18:50	R228793

Client: Shannon & Wilson, Inc. **Work Order:** 18020088

Client Project: RPD Tribs 41-1-37530-005 **Report Date:** 07-Feb-18

Lab ID: 18020088-002 **Client Sample ID:** L17-9 Composite

Matrix: SOLID **Collection Date:** 01/30/2018 13:00

Analyses	Certification	RL	Qual	Result	Units	DF	Date Analyzed	Batch
EPA 600 2-78-054 METHOD 3.2.18.1								
Resistivity, Solid	*	150		**1190**	Ohms/cm	1	02/06/2018 17:05	R243206
EPA SW846 3550C, 5035A, ASTM D2974								
Percent Moisture	*	0.1		**19.3**	%	1	02/05/2018 14:56	R243164
STANDARD METHODS 4500-CL E (TOTAL) 1997								
Chloride	NELAP	62		**74**	mg/Kg-dry	1	02/06/2018 16:20	138761
SW-846 9030B, 9034								
Sulfide, Total	NELAP	37		**< 37**	mg/Kg-dry	1	02/07/2018 16:15	138799
SW-846 9036 (TOTAL)								
Sulfate	NELAP	123		**147**	mg/Kg-dry	1	02/06/2018 16:22	138760
SW-846 9045C								
pH (1:1)	NELAP	1.00		**7.08**		1	02/02/2018 13:40	R243064

Client: Shannon & Wilson, Inc. **Work Order:** 17020225

Client Project: RPD Tribs 41-1-37530-005 **Report Date:** 13-Feb-17

Lab ID: 17020225-020 **Client Sample ID:** L17-10

Matrix: SOLID **Collection Date:** 01/27/2017 9:00

Analyses	Certification	RL	Qual	Result	Units	DF	Date Analyzed	Batch
EPA 600 2-78-054 METHOD 3.2.18.1								
Resistivity, Solid		150		**1990**	Ohms/cm	1	02/06/2017 11:05	R228915
EPA SW846 3550C, 5035A, ASTM D2974								
Percent Moisture		0.1		**15.0**	%	1	02/07/2017 20:24	R228924
STANDARD METHODS 4500-CL E (TOTAL)								
Chloride	NELAP	59		**60**	mg/Kg-dry	1	02/07/2017 20:54	126885
SW-846 9030B, 9034								
Sulfide, Total	NELAP	34		**< 34**	mg/Kg-dry	1	02/06/2017 15:32	126818
SW-846 9036 (TOTAL)								
Sulfate	NELAP	118		**129**	mg/Kg-dry	1	02/07/2017 20:57	126887
SW-846 9045C								
pH (1:1)	NELAP	1.00		**8.37**		1	02/03/2017 18:54	R228793

Client: Shannon & Wilson, Inc. **Work Order:** 17020225

Client Project: RPD Tribs 41-1-37530-005 **Report Date:** 13-Feb-17

Lab ID: 17020225-021 **Client Sample ID:** L17-11

Matrix: SOLID **Collection Date:** 01/27/2017 9:00

Analyses	Certification	RL	Qual	Result	Units	DF	Date Analyzed	Batch
EPA 600 2-78-054 METHOD 3.2.18.1								
Resistivity, Solid		150		**2790**	Ohms/cm	1	02/06/2017 11:05	R228915
EPA SW846 3550C, 5035A, ASTM D2974								
Percent Moisture		0.1		**15.3**	%	1	02/07/2017 20:24	R228924
STANDARD METHODS 4500-CL E (TOTAL)								
Chloride	NELAP	56	J	**36**	mg/Kg-dry	1	02/07/2017 21:32	126885
SW-846 9030B, 9034								
Sulfide, Total	NELAP	34		**< 34**	mg/Kg-dry	1	02/06/2017 15:35	126819
SW-846 9036 (TOTAL)								
Sulfate	NELAP	111	J	**87**	mg/Kg-dry	1	02/07/2017 21:34	126887
SW-846 9045C								
pH (1:1)	NELAP	1.00		**8.10**		1	02/03/2017 19:01	R228793

Client: Shannon & Wilson, Inc. **Work Order:** 17020225

Client Project: RPD Tribs 41-1-37530-005 **Report Date:** 13-Feb-17

Lab ID: 17020225-026 **Client Sample ID:** L17-12

Matrix: SOLID **Collection Date:** 01/27/2017 9:00

Analyses	Certification	RL	Qual	Result	Units	DF	Date Analyzed	Batch
EPA 600 2-78-054 METHOD 3.2.18.1								
Resistivity, Solid		150		**2850**	Ohms/cm	1	02/06/2017 11:05	R228915
EPA SW846 3550C, 5035A, ASTM D2974								
Percent Moisture		0.1		**13.9**	%	1	02/07/2017 20:26	R228924
STANDARD METHODS 4500-CL E (TOTAL)								
Chloride	NELAP	55	J	**37**	mg/Kg-dry	1	02/07/2017 22:26	126885
SW-846 9030B, 9034								
Sulfide, Total	NELAP	31		**< 31**	mg/Kg-dry	1	02/06/2017 15:42	126819
SW-846 9036 (TOTAL)								
Sulfate	NELAP	110		**178**	mg/Kg-dry	1	02/07/2017 22:28	126887
SW-846 9045C								
pH (1:1)	NELAP	1.00		**6.05**		1	02/03/2017 19:16	R228793

Client: Shannon & Wilson, Inc. **Work Order:** 17020225

Client Project: RPD Tribs 41-1-37530-005 **Report Date:** 13-Feb-17

Lab ID: 17020225-022 **Client Sample ID:** L17-13

Matrix: SOLID **Collection Date:** 01/27/2017 9:00

Analyses	Certification	RL	Qual	Result	Units	DF	Date Analyzed	Batch
EPA 600 2-78-054 METHOD 3.2.18.1								
Resistivity, Solid		150		**565**	Ohms/cm	1	02/06/2017 11:05	R228915
EPA SW846 3550C, 5035A, ASTM D2974								
Percent Moisture		0.1		**17.1**	%	1	02/07/2017 20:25	R228924
STANDARD METHODS 4500-CL E (TOTAL)								
Chloride	NELAP	56		**205**	mg/Kg-dry	1	02/07/2017 21:40	126885
SW-846 9030B, 9034								
Sulfide, Total	NELAP	35		**< 35**	mg/Kg-dry	1	02/06/2017 15:37	126819
SW-846 9036 (TOTAL)								
Sulfate	NELAP	1110		**1410**	mg/Kg-dry	10	02/07/2017 21:48	126887
SW-846 9045C								
pH (1:1)	NELAP	1.00		**7.56**		1	02/03/2017 19:04	R228793

Client: Shannon & Wilson, Inc. **Work Order:** 17020225

Client Project: RPD Tribs 41-1-37530-005 **Report Date:** 13-Feb-17

Lab ID: 17020225-023 **Client Sample ID:** L17-14

Matrix: SOLID **Collection Date:** 01/27/2017 9:00

Analyses	Certification	RL	Qual	Result	Units	DF	Date Analyzed	Batch
EPA 600 2-78-054 METHOD 3.2.18.1								
Resistivity, Solid		150		**1170**	Ohms/cm	1	02/06/2017 11:05	R228915
EPA SW846 3550C, 5035A, ASTM D2974								
Percent Moisture		0.1		**21.5**	%	1	02/07/2017 20:25	R228924
STANDARD METHODS 4500-CL E (TOTAL)								
Chloride	NELAP	61		**113**	mg/Kg-dry	1	02/07/2017 21:48	126885
SW-846 9030B, 9034								
Sulfide, Total	NELAP	38		**< 38**	mg/Kg-dry	1	02/06/2017 15:37	126819
SW-846 9036 (TOTAL)								
Sulfate	NELAP	121	J	**110**	mg/Kg-dry	1	02/07/2017 21:51	126887
SW-846 9045C								
pH (1:1)	NELAP	1.00		**8.57**		1	02/03/2017 19:06	R228793

Client: Shannon & Wilson, Inc. **Work Order:** 17020225

Client Project: RPD Tribs 41-1-37530-005 **Report Date:** 13-Feb-17

Lab ID: 17020225-024 **Client Sample ID:** L17-15

Matrix: SOLID **Collection Date:** 01/27/2017 9:00

Analyses	Certification	RL	Qual	Result	Units	DF	Date Analyzed	Batch
EPA 600 2-78-054 METHOD 3.2.18.1								
Resistivity, Solid		150		**1080**	Ohms/cm	1	02/06/2017 11:05	R228915
EPA SW846 3550C, 5035A, ASTM D2974								
Percent Moisture		0.1		**20.4**	%	1	02/07/2017 20:25	R228924
STANDARD METHODS 4500-CL E (TOTAL)								
Chloride	NELAP	63		**227**	mg/Kg-dry	1	02/07/2017 21:56	126885
SW-846 9030B, 9034								
Sulfide, Total	NELAP	37		**< 37**	mg/Kg-dry	1	02/06/2017 15:41	126819
SW-846 9036 (TOTAL)								
Sulfate	NELAP	125		**140**	mg/Kg-dry	1	02/07/2017 21:58	126887
SW-846 9045C								
pH (1:1)	NELAP	1.00		**7.89**		1	02/03/2017 19:09	R228793

Client: Shannon & Wilson, Inc. **Work Order:** 17020225

Client Project: RPD Tribs 41-1-37530-005 **Report Date:** 13-Feb-17

Lab ID: 17020225-025 **Client Sample ID:** L17-16

Matrix: SOLID **Collection Date:** 01/27/2017 9:00

Analyses	Certification	RL	Qual	Result	Units	DF	Date Analyzed	Batch
EPA 600 2-78-054 METHOD 3.2.18.1								
Resistivity, Solid		150		**1570**	Ohms/cm	1	02/06/2017 11:05	R228915
EPA SW846 3550C, 5035A, ASTM D2974								
Percent Moisture		0.1		**19.9**	%	1	02/07/2017 20:26	R228924
STANDARD METHODS 4500-CL E (TOTAL)								
Chloride	NELAP	59		**88**	mg/Kg-dry	1	02/07/2017 22:04	126885
SW-846 9030B, 9034								
Sulfide, Total	NELAP	36		**< 36**	mg/Kg-dry	1	02/06/2017 15:41	126819
SW-846 9036 (TOTAL)								
Sulfate	NELAP	118		**181**	mg/Kg-dry	1	02/07/2017 22:07	126887
SW-846 9045C								
pH (1:1)	NELAP	1.00		**8.46**		1	02/03/2017 19:12	R228793

Client: Shannon & Wilson, Inc. **Work Order:** 17020225

Client Project: RPD Tribs 41-1-37530-005 **Report Date:** 13-Feb-17

Lab ID: 17020225-003 **Client Sample ID:** L17-17

Matrix: SOLID **Collection Date:** 01/27/2017 9:00

Analyses	Certification	RL	Qual	Result	Units	DF	Date Analyzed	Batch
EPA 600 2-78-054 METHOD 3.2.18.1								
Resistivity, Solid		150		**2140**	Ohms/cm	1	02/06/2017 11:05	R228915
EPA SW846 3550C, 5035A, ASTM D2974								
Percent Moisture		0.1		**14.0**	%	1	02/06/2017 15:46	R228849
STANDARD METHODS 4500-CL E (TOTAL)								
Chloride	NELAP	58		**73**	mg/Kg-dry	1	02/07/2017 17:18	126885
SW-846 9030B, 9034								
Sulfide, Total	NELAP	35		**< 35**	mg/Kg-dry	1	02/06/2017 15:08	126818
SW-846 9036 (TOTAL)								
Sulfate	NELAP	116		**237**	mg/Kg-dry	1	02/07/2017 17:20	126887
SW-846 9045C								
pH (1:1)	NELAP	1.00		**8.47**		1	02/03/2017 17:47	R228793

Client: Shannon & Wilson, Inc. **Work Order:** 17050416

Client Project: RPD Tribs 41-1-37530-005 **Report Date:** 12-May-17

Lab ID: 17050416-012 **Client Sample ID:** L17-18

Matrix: SOLID **Collection Date:** 05/05/2017 10:30

Analyses	Certification	RL	Qual	Result	Units	DF	Date Analyzed	Batch
EPA 600 2-78-054 METHOD 3.2.18.1								
Resistivity, Solid		150		**1990**	Ohms/cm	1	05/10/2017 12:43	R232615
EPA SW846 3550C, 5035A, ASTM D2974								
Percent Moisture		0.1		**21.8**	%	1	05/08/2017 16:41	R232551
STANDARD METHODS 4500-CL E (TOTAL)								
Chloride	NELAP	56		**224**	mg/Kg-dry	1	05/10/2017 17:03	130109
SW-846 9030B, 9034								
Sulfide, Total	NELAP	36		**< 36**	mg/Kg-dry	1	05/09/2017 16:44	129995
SW-846 9036 (TOTAL)								
Sulfate	NELAP	112		**145**	mg/Kg-dry	1	05/10/2017 17:05	130108
SW-846 9045C								
pH (1:1)	NELAP	1.00		**7.11**		1	05/09/2017 20:09	R232584

Client: Shannon & Wilson, Inc. **Work Order:** 17050416

Client Project: RPD Tribs 41-1-37530-005 **Report Date:** 12-May-17

Lab ID: 17050416-001 **Client Sample ID:** L17-19

Matrix: SOLID **Collection Date:** 05/05/2017 10:30

Analyses	Certification	RL	Qual	Result	Units	DF	Date Analyzed	Batch
EPA 600 2-78-054 METHOD 3.2.18.1								
Resistivity, Solid		150		**1310**	Ohms/cm	1	05/10/2017 12:02	R232615
EPA SW846 3550C, 5035A, ASTM D2974								
Percent Moisture		0.1		**21.7**	%	1	05/08/2017 16:37	R232551
STANDARD METHODS 4500-CL E (TOTAL)								
Chloride	NELAP	58		**277**	mg/Kg-dry	1	05/10/2017 15:15	130109
SW-846 9030B, 9034								
Sulfide, Total	NELAP	38		**< 38**	mg/Kg-dry	1	05/09/2017 16:36	129995
SW-846 9036 (TOTAL)								
Sulfate	NELAP	115		**179**	mg/Kg-dry	1	05/10/2017 15:17	130108
SW-846 9045C								
pH (1:1)	NELAP	1.00		**7.11**		1	05/08/2017 21:43	R232538

Client: Shannon & Wilson, Inc. **Work Order:** 17050416

Client Project: RPD Tribs 41-1-37530-005 **Report Date:** 12-May-17

Lab ID: 17050416-010 **Client Sample ID:** L17-20

Matrix: SOLID **Collection Date:** 05/05/2017 10:30

Analyses	Certification	RL	Qual	Result	Units	DF	Date Analyzed	Batch
EPA 600 2-78-054 METHOD 3.2.18.1								
Resistivity, Solid		150		**1310**	Ohms/cm	1	05/10/2017 12:32	R232615
EPA SW846 3550C, 5035A, ASTM D2974								
Percent Moisture		0.1		**22.8**	%	1	05/08/2017 16:40	R232551
STANDARD METHODS 4500-CL E (TOTAL)								
Chloride	NELAP	62		**152**	mg/Kg-dry	1	05/10/2017 16:55	130109
SW-846 9030B, 9034								
Sulfide, Total	NELAP	38		**< 38**	mg/Kg-dry	1	05/09/2017 16:42	129995
SW-846 9036 (TOTAL)								
Sulfate	NELAP	123		**223**	mg/Kg-dry	1	05/10/2017 16:57	130108
SW-846 9045C								
pH (1:1)	NELAP	1.00		**8.05**		1	05/09/2017 20:04	R232584

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Appendix E
Geotechnical Investigation Work Plan - Near Surface Sewers