

November 17, 2020

City of Harrisburg PO Box 378 Harrisburg, Oregon 97446

RE: GEOTECHNICAL INVESTIGATION WATER STORAGE RESERVOIR SITES 795 S. 2<sup>ND</sup> AVENUE & PEORIA ROAD HARRISBURG, OREGON Branch Engineering Inc Project No. 13-007

A Branch Engineering Inc. (BEI) geotechnical engineering staff conducted a subsurface investigation of both sites on September 2 and 3, 2020 to assess the subgrade soil conditions for construction of a water supply reservoir at each location.

#### Site and Project Description

**South Site:** The south site is located within the existing confines of the City's Public Works maintenance facility at 795 S. 2<sup>nd</sup> Avenue. The proposed location of the 0.5-million gallon above ground storage reservoir is in the southeast corner of the fenced parcel at latitude 44.266010° north and longitude 123.172650° west. The flat site is covered with compacted aggregate and two reservoir tanks are located just north of the location.

**North Site:** The north site is located directly west of address 23767 Peoria Road at the location of an existing City water pump station. The proposed reservoir site is south of the pump station building; however, BEI advanced borings on the north side as the final location did not seem to be set at the time of our site work. The area is a relatively flat, grass covered field at latitude 44.286210 north and longitude 123.175642 west. The proposed above ground storage reservoir size for this site is 1.5-million gallons.

#### Site Information Resources

The following site investigation activities were performed and literature was reviewed for pertinent site information.

- Five exploratory mud-rotary borings were advanced, two on the South Site and three on the North Site to a maximum depth of 51.5-feet below ground surface (BGS) at each site. The attached Figure-1 shows the approximate location of the borings at each site.
- Review of the Lane County Area Web Soil Survey, United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS).
- Review of the Geologic Mapping of the site area, United States Geological Survey (USGS) Geologic Map of Oregon, 1991, and Oregon Department of Geology and Mineral Industries (DOGAMI) Digital Geologic Map of the Southern Willamette Valley, Benton, Lane, Linn, Marion, and Polk Counties, Oregon, McClaughry, Wiley, Ferns, and Madin Open File Report (OFR) O-10-03, 2010

EUGENE-SPRINGFIELD ALBANY-CORVALLIS-SALEM

- Review of Oregon Department of Geology and Mineral Industries (DOGAMI) web hazard viewer.
- Review of nearby well logs obtained from the Oregon Water Resources Well Log Query

#### Site Geology

Geologic mapping of both sites is the same and is described as Pleistocene age lacustrine and fluvial sediments of gravels, sand, silt and clay that are unconsolidated to semi-consolidated by Walker and MacLeod, 1991. OFR O-10-03 maps the sites as Quaternary age Terrace and Fan deposits of unconsolidated to semi-consolidated gravels, sand, silt, and clay. The NRCS Web Soil Survey maps the South Site soil as Dayton Silt loam described as a silty and clayey alluvium found on terraces; the North Site is mapped as Willamette Silt loam described as silty alluvium found on terraces. The soil description and geologic description are consistent with our field observations. Well logs near each site show similar soil strata conditions to depths over 100-feet with increased clay zones at depth.

#### Site Soil Conditions

The subsurface soil conditions at each site are similar and are comprised of brown, damp to moist, medium stiff silt with clay to a depth of 10- to 11-feet BGS underlain by wet, dense rounded to sub-rounded gravels with sand to 44-feet BGS at the South Site and 50-feet BGS on the North site before encountering a grey to light brown sandstone.

#### Groundwater

Groundwater was measured at 14-feet BGS upon completion of drilling on the North Site and although a static level was not specifically measured due to hole caving at the South Site, the gravels became wet at about 20-feet BGS. The static water level in South Site City Well 15/4W-16H was measured at 22-feet BGS in August 1966. City Well number 87958 on the North Site had an upper static water level of 6-feet BGS in January 2007.

#### Excavations and Utility Trenching

Excavations for reservoir connections and plumbing are expected to be located within the upper 5-feet of each site and will encounter moist, silt soil that should stand near vertical to a depth of 4-feet. Groundwater is not expected to be encountered in these excavations; however, perched lenses can be expected during the mid to late wet season. The soils are classified as OSHA Type A. Equipment or materials should not be placed within 10-feet of an open trench.

#### **Reservoir Foundation Subgrade Preparation**

The following recommendations are for earthwork in the foundation areas. Earthwork shall be performed in general accordance with the standard of practice as generally described in Appendix J of the 2019 Oregon Structural Specialty Code and as specified in of this report. All areas intended to directly or laterally support structures shall be stripped of vegetation, organic soil, fill, and/or other deleterious material. These strippings shall either be removed from the site or used for foundation backfill.

The pad for the new water reservoir(s) shall be excavated to approximately 3-feet BGS to remove soft soil to expose suitable subgrade. After excavation to suitable subgrade, place a woven geotextile separation fabric on the subgrade and cover with structural backfill consisting of  $1 \frac{1}{2}$ " – (0) compacted aggregate shall be placed in lifts not exceeding 8-inches loose lift thickness and compacted to 95% relative compaction as determined by ASTM 1557 (modified Proctor). The aggregate thickness shall be a minimum of 24-inches thick and compaction testing by nuclear densometer (ASTM 6938) shall be performed to confirm compaction requirements are met. A

smaller diameter aggregate such as  $\frac{3}{4}$ " – (0) is acceptable for placement and compaction in the upper 6-inches of the structural fill if desired by the contractor. Excavation to subgrade and placement of structural fill shall extend horizontally a minimum distance 3-feet beyond the outside of the reservoir pad

Upon preparation of the reservoir pad(s) as described above, the allowable bearing capacity of the pad will be 2,500 psf with a modulus of subgrade reaction of 190 psi/in. The bearing capacity may be increased by 1/3 for short term loading, such as wind or seismic events.

Periodic site observations by a geotechnical representative of BEI are recommended during the construction of the project; the specific phases of construction that should be observed are:

Recommended Construction Phases to be Obs	served by the Geotechnical Engineer
At completion of subgrade excavation	Subgrade observation by the geotechnical engineer before fabric and aggregate placement.
Imported fill material	Observation of material or information on material type and source.
Placement or Compaction of fill material	Observation by geotechnical engineer or test results by qualified testing agency.

#### Table 1: Recommended Construction Observations

#### Drainage

As both proposed reservoir sites are flat, foundation drains are required provided that perimeter grades slope away from the reservoir pad so that surface water is not allowed to pond adjacent to foundations.

#### Site Seismic Classification

Based on the soil properties encountered in our site hand auger boring, on-site test pits and onsite well log information, Site Class D (Table 20.3-1 ASCE 7) is recommended for design of site structures. Site specific seismic spectral response design values generated by the USGS are attached for reference.

#### Conclusions

Based on our field observations, subsurface explorations, and data analyses, we conclude that the site is geologic and geotechnically suitable for the proposed development provided that the recommendations of this report are incorporated into the design and construction of the project. Our investigation did not reveal any specific site features or subsurface conditions that would impede the proposed building design or construction. Please contact our office with any questions.

#### Limitations

This report presents BEI's site observations, site research, site explorations, and recommendations for the proposed site development. The conclusions in this report are based on the conditions

described in this report and are intended for the exclusive use of the City of Harrisburg and their representatives for use in the site development design and construction. The analysis and general recommendations provided herein may not be suitable for structures or purposes other than those described herein. Services performed by the geotechnical engineer for this project have been conducted with the level of care and skill exercised by other current geotechnical professionals in this area under similar budget and time constraints. No warranty is herein expressed or implied. The conclusions in this report are based on the site conditions as they currently exist in the vicinity of the proposed home sites and it is assumed that the limited site locations that were physically investigated generally represent the subsurface conditions at the site. Should site development or site conditions change, or if a substantial amount of time goes by between our site investigation and site development, we reserve the right to review this report for its applicability. If you have any questions regarding the contents of this report, or if we can be of further assistance, please contact our office.

Sincerely, Branch Engineering Inc.,

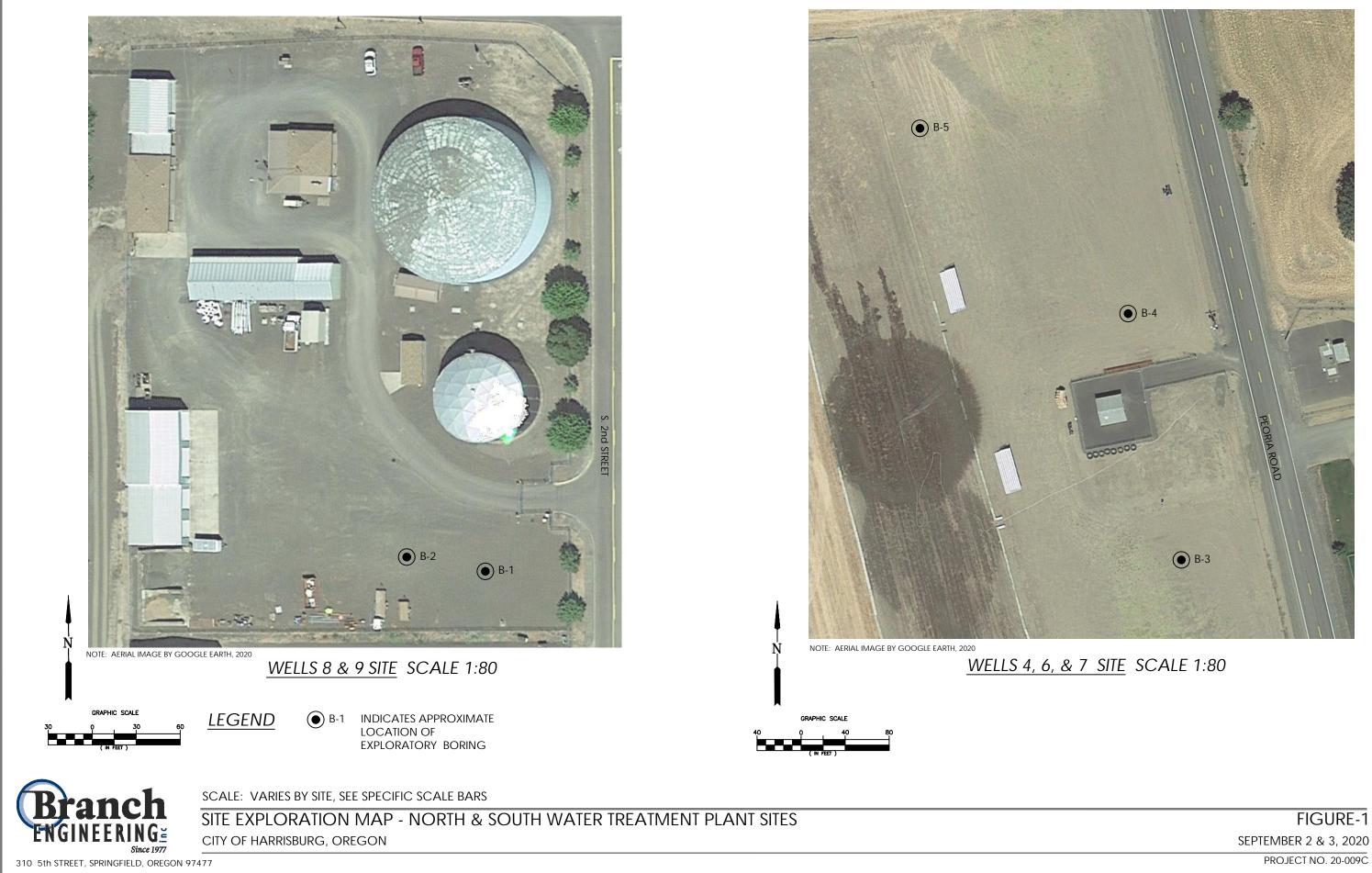


EXPIRES: 12/31/2021

Ronald J. Derrick, P.E., G.E. Principal Geotechnical Engineer

Attachments: Figure-1 Site Exploration Map Appendix A - USCS Soils Key, Exploratory Boring Logs, Well Logs, Soil Survey Appendix B – Geotechnical Specifications

Branch Engineering, Inc.



## **APPENDIX A:**

USCS Soils Key, Exploratory Boring Logs, Well Logs and Soil Survey

VERY LOOSE         < 4	RELATIVE DE	NSILA - COA	RSE GRAINED S	SOILS		USCS GRA	IN SI	٤E			
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GEDIM DENSE         10 - 30         26.7 / 4         10 - 30         26.7 / 4         10 - 30         26.7 / 4         10 - 30         26.7 / 4         10 - 30         26.7 / 4         10 - 30         26.7 / 4         10 - 30         27.6 / 3         10 - 30         27.6 / 3         10 - 30         27.6 / 3         10 - 30         27.6 / 3         10 - 30         27.6 / 3         10 - 30         27.6 / 3         10 - 30         27.6 / 3         10 - 30         27.6 / 3         10 - 30         27.6 / 3         10 - 30         27.6 / 3         10 - 30         27.6 / 3         10 - 30         27.6 / 3         10 - 30         27.6 / 3 <th27.6 3<="" th="">         27.6 / 3         27.6 / 3<td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td><u>/</u>/</td></th27.6>									<u>/</u> /		
DENSE         30-50         74-120         30-47         COBBLES         Understand           VERY DENSE         > 50         > 120         > 47         COBBLES         3-12 inches           CONSISTENCY         FINE GRAINED SOLIS         3-12 inches         3-12 inches         3-12 inches           CONSISTENCY         STIP N-VALUE         D&M SAMPLER         D&M SAMPLER         D&M SAMPLER         DAM SAMPLER         NANUAL PENETRATION TEST           VERY SOFT         < 2						GRAVEL					
VERY DENSE         > 50         > 120         > 47         COULD         OF 2 Inclusion           CONSISTENCY         FINE GRAINED SOLS         D&M SAMPLER         D&M SAMPLER         POCKET PEN. / (140 bbs hammer)         MANUAL PENETRATION TEST           VERY SDFT         < 2							Coo	arse			
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VERY SOFT         <2         <3         <2         <0.25         Easy several inches by flat           SOFT         2 - 4         3 - 6         2 - 5         0.25 - 0.50         Easy several inches by flat           BEUM STIFF         4 - 8         6 - 12         5 - 9         0.50 - 1.00         Moderate several inches by flat           VERY STIFF         8 - 15         12 - 25         9 - 19         1.00 - 2.00         Recally indented by thumbon           VERY STIFF         15 - 30         2 - 65         3 - 31         2 - 400         Recally indented by thumbonal           UNIFIED SOIL CLASSIFICATION CHART           MALOR DIVISIONS         GROUP SYMBOLS AND TYPICAL NAMES           COARSE- GRAINED SOILS: More than         GRAVELS: 50% or more prosing indend on solve         CLEAN GRAVELS WITH         GW Well-graded gravels and gravel-sand-tilty indented by thumbon           SOILS: More than         GRAVELS WITH         GM Stift gravels, gravel-sand-clay mixtures, lifte or no fines.           SOILS: More passing iseve         GRAVELS WITH         GM Stift, sock flow, clay gravels, gravel-sand-sing invely sonds, lifte or no fines.           SOILS: More passing iseve         SULT AND CLAY         GM Well-graded sonds and gravely sonds. lifte or no fines.           SOILS: More passing iseve         SULT AND CLAY         GRAVELS WITH         SM Stift sonds. sond-	CONSISTENCY	SPT N-VALUE				· · · ·					
SOFT     2-4     3-6     2-5     0.25-0.50     Easy vericil inches by thumb       MEDIUM STIFF     4-8     6-12     5-9     0.50-1.00     Moderate several inches by thumb       STIFF     8-15     12-25     9-19     1.00-2.00     Readily indented by thumb       VERY STIFF     15-30     25-65     19-31     2.00-4.00     Readily indented by thumb       VINIFED SOL CLASSIFICATION CHART     MADO DUISIONS     GROUP SYMBOLS AND TYPICAL NAMES       COARSE- GRAINED SOILS:     GRAVELS: 50% or more refatined on the No. 4 sieve     CLEAN GRAVELS     GW     Well-graded gravels and gravel-sand mixtures, liftle or no fines.       SOILS: More thand by refatined on seve     SANDS SUS; or on No. 200     CLEAN SANDS     GW     Well-graded sinds and gravel-sand-mixtures.       SOILS: More thand by refatined on seve     SANDS WITH     SW     SW Well-graded sinds and gravely sands, liftle or no fines.       SOILS: More thand by refatined on seve     SILT AND CLAY     CLEAN SANDS     SW     CLEAN SANDS       SOIL - Coreganic silt and organic silts rotek flour, clays of low plasticity. Lean clays.     CLARY silter on office.     Clays of low plasticity.       SOIL - South     SULT AND CLAY     ML     Inorganic clays of medium plasticity. Lean clays.     CLARY silter on office.       SOIL - Coreganic silt and organic silt and organic silt and organic silt clays of low plasticity.     CLARY sil					. 0						
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STIFF         8 - 15         12 - 25         9 - 19         1.00 - 2.00         Readily indented by thumb           VERY STIFF         15 - 30         25 - 65         19 - 31         2.00 - 4.00         Readily indented by thumb           UNIFIED SOIL CLASSIFICATION CHART         MAJOR DIVISIONS         GROUP SYMBOLS AND TYPICAL NAMES           COARSE- GRAINED SOILS: More than 50% retained on the No.4 sieve         CLEAN GRAVELS WITH         GW Well-graded gravels and gravel-sand mixtures, liftle or no fines.           SOILS: More than 50% retained on the No.4 sieve         CLEAN GRAVELS WITH         GW Well-graded sands and gravelly sands, liftle or no fines.           SANDS: 50% or more passing the No.4 sieve         CLEAN SANDS SW Well-graded sands and gravelly sands, liftle or no fines.           SANDS: 50% or more passing the No.4 sieve         CLEAN SANDS         SW Well-graded sands and gravelly sands, liftle or no fines.           SANDS: 50% or more passing the No.4 sieve         CLEAN SANDS         SW Well-graded sands and gravelly sands, liftle or no fines.           SOW strain solve         SANDS: SW Well-graded sands and gravelly sands, liftle or no fines.         SW Well-graded sands and gravelly sands, liftle or no fines.           SOW strain solve         SILT AND CLAY         ML         Inorganic clays of medium lossicity, lean clays.           UGUD LIMIT 50 ON Recards         LIQUID LIMIT 50 OR GREATER         CH         Inorganic clays of high plasticity, lean											
VERY STIFF         15 - 30         25 - 45         19 - 31         2.00 - 4.00         Readily indented by thumbnall           UNIFIED SOL CLASSIFICATION CHART         MAJOR DIVISIONS         GROUP SYMBOLS AND TYPICAL NAMES           COARSE GRAINED SOLIS: More than More than 50% retained on n No. 200 sieve         GRAVELS: 50% or more possing the No. 4 sieve         CLEAN GRAVELS         GW Well-graded gravels and gravel-sand-all mixtures. GRAVELS         GW Well-graded gravels and gravel-sand-all mixtures. GP Pootly-graded gravels and gravel-sand-all mixtures. The No. 4 sieve         GRAVELS         GP Pootly-graded gravels and gravel-sand-all mixtures. GRAVELS         GW Well-graded gravels and gravel-sand-all mixtures. GRAVELS         GW Well-graded gravels and gravel-sand-all mixtures. The No. 4 sieve         FINES         GC Clayey gravels. GRAVELS         GW Well-graded sands and gravely sands. Iffle or no fines. SANDS: 50% or more possing the No. 4 sieve         SM DIS WITH FINES         SM Silty sands. sand-silt mixtures. SANDS WITH FINES         SM Silty sands. sand-silt mixtures. FINES         GW Organic silts clayey sils. UQUID LIMIT 50 OR GREATER         SM Linorganic silts. clayey sils. UQUID LIMIT 50 OR GREATER         MH Inorganic silts. clayey sils. UQUID LIMIT 50 OR GREATER         MH Inorganic silts. clayey sils. UO Organic silt and organic silt and organic silt and organic silt. Clayey sils. UC With blat can be broken down into sm angular lumps which resist further breakdown. LENSES: Hernating layers < mm thick. FISSURED: Breaks clay gravels of indential or clays > fmethick. FISSURED: Breaks clay gravels and mixture sols. note thicknes HOMOGENEOUS: Same color and appearance throughc ML Med. to High											
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MAJOR DIVISIONS       GROUP SYMBOLS AND TYPICAL NAMES         COARSE GRAVELS       GRAVELS: 50% or more refained on No. 4 sieve       CLEAN GRAVELS       GW       Well-graded gravels and gravel-sand mixtures, little or no file No. 4 sieve         SOUS: More than 50% retained on No. 200 sieve       SANDS: 50% or more possing the No. 4 sieve       CLEAN SANDS       SW       Well-graded sands and gravel-sand-clay mixtures.         SILF GRAINED SOUS: Solts: Uses than Soff retained on No. 200 sieve       SANDS: 50% or more possing the No. 4 sieve       CLEAN SANDS       SW       Well-graded sands and gravel-sand-clay mixtures.         SILF AND CLAY       LIQUID LIMIT LESS THAN 50       ML       Inorganic silts, crock flour, clayey silts.       CL         SOW retained on No. 200 sieve       SILT AND CLAY       LIQUID LIMIT LESS THAN 50       CL       Inorganic silts, crock flour, clayey silts.       CL         HIGHLY ORGANIC SOLS       PT       Pet neat, muck, and other highly plasticity. lean clays.       CL       Inorganic clays of high plasticity. lean clays.         SMDEST Leaves moisture on hand       OR GREATER       OH       Organic clays of high plasticity.       FME         DAMP: Some moisture but leaves no moisture on hand       Nor to Low to Med. None to Site work Med.       Nor to Low to Med. None to Site work Med.       STRUCTURE         SMD No to Low Med. None to Site work Med. Low to Med. None to High None to Site work Med. Low to Med. None to Site wo			•		- 01			Dinioe			
COARSE- GRAINED SOLS: More than Soft relating on No. 200       GRAVELS: 50% or more retrained on the No. 4 sieve       CLEAN GRAVELS       GW       Well-graded gravels and gravel-sand mixtures. little or GRAVELS with GRAVELS with GRAVELS with GRAVELS with GRAVELS with Silv gravels, gravel-sand-clay mixtures.         Soft relating on No. 200 sieve       SANDS: 50% or more passing the No. 4 sieve       CLEAN SANDS FINES       SW       Well-graded gravels and gravel-sand-mixtures.         INE-GRAINED SOLS: were brained on No. 200 sieve       SANDS: 50% or more passing the No. 4 sieve       CLEAN SANDS FINES       SW       Well-graded sands and gravely sands, little or no fines. SP       Poorty-graded sands and gravely sands, little or no fines.         SOLS: brained on No. 200 sieve       SILT AND CLAY       List STHAN 50 CL Organic silts, clock flour, clayey silts. CL Inorganic clays of low to medium plasticity, lean clays. CL Inorganic clays of high plasticity, lean clays. CL Inorganic clays of high plasticity, lean clays. CL Inorganic clays of high plasticity, lean clays. CH Inorganic silts, clayey silts. CH Inorganic clays of high plasticity.         MOISTL CONSENT CL Iow to Med. Med. to High None to Siow Low to Med. CL Iow to Med. Med. to High None to Siow Low to Med. Med. to High None to Siow Low to Med. Med. to High None to Siow Med Med. to High High to VIHAB None to Low to Med. Med. to High None to Siow Med Med. To High High Nort VHAB None SID CARPEVIATION & EXPLANATIONS SPT Standard Penetration Test split barrel sampler Med. Atterberg liquid limit P Pocket Penetrometer V3 Vane Shear       G       Grab sample Med. Ch High High Nort VHAB None SPT Standard Penetration Test split barrel sampler No Moistrue Density VI None Shea				G			TAL N.	AMES			
COARSE- GRAINED SOLS: More than SOW relatined on No. 200 sieve     GRAVELS     GP     Poorty-graded gravels and gravels and divelses.       SANDS: S0% or more passing the No. 4 sieve     GRAVELS     GP     Poorty-graded gravels, gravel-sand-divers.       SANDS: S0% or more passing the No. 4 sieve     SANDS: S0% or more passing the No. 4 sieve     CLEAN SANDS     SW     Well-graded sands and gravelly sands, little or no fines.       SOLS: Less than SOUS: Less than S0% retained on No. 200 sieve     SANDS WITH     SM     SW     Well-graded sands and gravelly sands, little or no fines.       SULT AND CLAY     LIQUID LIMIT LESS THAN 50     SC     Clayey sands, sand-day mixtures.     CL       SW     UQUID LIMIT LESS THAN 50     CL     OL     Organic clays of low to medium plasticity, lean clays.       SW     HIGHLY ORGANIC SOILS     PT     Peot, muck, and other highly organic clays of medium to high plasticity.       MOISTURE CONTENT     LIQUID LIMIT 50 OR GREATER     OH     Organic clays of medium to high plasticity.       DRY: Absence of moisture, dusty, dry to the touch DAMP: Some moisture but leaves no moisture on hand     SILCKENSIDED: Strinated, polished, or glosy fracture planes.       SLICKENSIDED: Versite for thigh. None to Slow Low to ked. Med. to High None to Slow Low to ked. Med. to High Worked. Med. None to Slow Low ked. Med. to High None to Slow Low ked. High     Structure Medium Med. to High high to V.High None to Slow Low ked. High     G     Grab sample MC Moisture Content MC Moisture Content		· · -	7 ΓΙΕΔΝ						and mixtures, little or no fines		
GRAVELS       retained on the No. 4 sieve       GRAVELS WITH FINES       GM       Silly gravels, gravel-sand-silf mixtures.         SOUS: sieve       SANDS: 50% or on No. 200 sieve       CLEAN SANDS: SW       GC       Clayey gravels, ands and gravelly sonds, liftle or no fines.         SOLS: Less than so% retained on No. 200 sieve       SILT AND CLAY       CLEAN SANDS       SW       Pootly-graded sands and gravelly sonds, liftle or no fines.         SOLS: Less than so% retained on No. 200 sieve       SILT AND CLAY       LIQUID LIMIT LOUID LIMIT 50 OR GREATER       ML       Inorganic silts, rock flour, clayey silts.         LIQUID LIMIT 50 or RETAINED SolLS: Less than sieve       LIQUID LIMIT 50 OR GREATER       OH       Organic silt and organic silty clays of low polasticity.         MUSTURE CONTENT       LIQUID LIMIT 50 OR GREATER       OH       Organic clays of medium to high plasticity.       OH         DAMDS the worker, usually saturated       FI       Peat, muck, and other highly organic soil.       STRUCTURE         DRY: Absence of moisture, dusty, dry to the touch DAMP: Some moisture on hand       MC       None to Sow Medium       Structure planes.         ML: Non to low       None to Sow Low to Med.       Low, can't rot Medium       Mc       Structure planes.         ML: Non to low       None to Sow Medium       None to Sow Medium       Low, can't rot Medium       G       Grab sample					•	~	v				
SULS: More than 50% retained on No. 200 sieve       the No. 4 sieve       FINES       GC       Clavy gravels, gravel-sond-clay mixtures.         SANDS: 50% or more passing the No. 4 sieve       SANDS: 50% or more passing the No. 4 sieve       CLEAN SANDS       SW       Well-graded sands and gravelly sands, little or no fines.         SILE-GRAINED SOILS: down No. 200 sieve       SILT AND CLAY       CLEAN SANDS       SW       Mell morganic sills, rock flour, clavy sills.         SILT AND CLAY       LIQUID LIMIT ESS THAN 50       ML       Inorganic clays of low to medium plasticity. lean clays.         MOISTURE CONTENT DAMP: Some moisture but leaves no moisture on hand WET: Visble free water, usually saturated       PT       Peat, muck, and other highly organic soil.         ML Non to Low MM Medium Med. to High None to Slow CL Low to Med. Med. None to Slow CL Low to Med. More sampler ML Metherer Jiayld Limit Med. To High by High to Y-High None       G       Grab sample G       Grab sample G       G Crab sample MC Moisture Content MC Moisture Conten											
Software         SANDS: 50% or more passing the No. 4 sieve         CLEAN SANDS SANDS: S0% or more passing the No. 4 sieve         SW         Well-graded sands and gravelly sands, little or no fines.           SILT AND CLAY         SANDS: S0% or more passing the No. 4 sieve         CLEAN SANDS         SW         Well-graded sands and gravelly sands, little or no fines.           SOULS: Less than 50% retained on No. 200 sieve         SILT AND CLAY         LIQUID LIMIT LESS THAN 50         ML         Inorganic silts, rock flour, clayey silts.           HIGHLY ORGANIC SOILS         LIQUID LIMIT 50 OR GREATER         ML         Inorganic clays of low to medium plosticity, lean clays.           HIGHLY ORGANIC SOILS         PT         Peat, muck, and other highly organic soil.           MOIST: Leaves moisture on hand WET: Visble free water, usually saturated         PT         Peat, muck, and other highly organic soil.           FLASTICITY         RY STRENGTH DILATANCY TOUGHNESS         TOUGHNESS Low, can't roil wor to Med. Med. to High None to Slow MH Med. to High High to V.High         TOUGHNESS None         SUCKENSIDED: Striated, polished, or glossy fracture planes. SUCKENSIDED: Striated, polished, or glossy fracture plane. High           ST Standard Penetr											
Order No. 200       SANDS: 50% of more possing the No. 4 sieve       CLEAN SANDS       SP       Poorly-graded sands and gravelly sands, little or no fines.         INE-GRAINED SOLLS: Less than SOW retained on No. 200 sieve       IJQUID LIMIT LESS THAN 50       SC       Clayey sands, sand-clay mixtures.         INE-GRAINED SOLLS: Less than SOW retained on No. 200 sieve       SILT AND CLAY       IJQUID LIMIT LESS THAN 50       ML       Inorganic silts, rock flour, clayey silts.         ILIQUID LIMIT 50 or No. 200 sieve       SILT AND CLAY       IJQUID LIMIT 50 OR GREATER       ML       Inorganic clays of high plasticity, lean clays.         MOISTURE CONTENT       DRY: Absence of moisture, dusty, dry to the touch DAMP: Some moisture but leaves no moisture on hand       MH       Inorganic clays of meteriang layers of material or color > 6mm LAMINATED: Alternating layers < 6mm thick.				SV							
sieve     mode passing the No. 4 sieve     SANDS WITH FINES     SM     SIIty sands, sand-slit mixtures.       SINE-GRAINED SOILS:     SILT AND CLAY     IIQUID UMIT LESS THAN 50     SC     Clayey sands, sand-clay mixtures.       Sold Silts rock flow, clayes silts.     SILT AND CLAY     IIQUID UMIT LESS THAN 50     ML     Inorganic clays of low to medium plasticity, lean clays.       Sold Silts rock flow, clayes silts.     SILT AND CLAY     IIQUID UMIT 50 OR GREATER     MH     Inorganic clays of high plasticity, fat clays.       HIGHLY ORGANIC SOLLS     PT     Peat, muck, and other highly organic soil.     MH       MOISTURE CONTENT     STRUCTURE     STRUCTURE       DRY: Absence of moisture, dusty, dry to the touch DAMP: Some moisture on hand     STRUCTURE       VET: Visble free water, usually saturated     STRUCTURE       PLASTICITY DRY STRENGTH DILATANCY TOUGHNESS IL Low to Med. Med. to High None to Slow MH Med. to High to V.High None to Slow Low to Med. CH Med. to High High to V.High None to Slow High To V.High None to Slow High To V.High None to Slow Low to Med. CH Med. to High High to V.High None to Slow High To V.High None to Slow Low to Med. CH Med. to High High to V.High None to Slow High To V.High None to Slow High To V.High None to Slow Low to Med. CH Med. to High High to V.High None to Slow High To V.High None to Slow Low to Med. CH Med. to High High to V.High None to Slow Low to Med. CH Med. to High High to V.High None to Slow Low to Med. CH Med. to High High to V.High None to Slow Low to Med. CH Med. to High High to V.High None to Slow Low to Med. CH Med. to High High to V.High None to Slow Low to Med. CH Med				DS SP							
Ine No. 4 sleve       FINES       SC       Clayey sonds, sand-clay mixtures.         INE-GRAINED SOILS: Less than 50% retained on No. 200 sieve       SILT AND CLAY       LIQUID LIMIT LESS THAN 50       ML       Inorganic silts, rock flour, clayey silts.         UQUID LIMIT Solks: Less than 50% retained on No. 200 sieve       SILT AND CLAY       LIQUID LIMIT LESS THAN 50       ML       Inorganic clays of low to medium plasticity. lean clays.         HIGHLY ORGANIC SOLS       PT       Peal, muck, and other highly organic silt.       MH       Inorganic clays of medium to high plasticity.         MOISTURE CONTENT       IIGHLY ORGANIC solLs       PT       Peal, muck, and other highly organic soil.         STRATIFIED: Alternating layers of material or color > 6mm LAMINATED: Alternating layers of material or color > 6mm LAMINATED: Alternating layers of material or color > 6mm LAMINATED: Alternating layers of different soils, note thick. FISSURED: Striated, polished, or glossy fracture planes. SUCKENSIDED: Striated, polished, or glossy fracture planes. SUCKENSIDED: Striated, polished, or glossy fracture planes. HOMOGENEOUS: Same color and appearance through Medium         MIL Nor to Low Non to Low Slow to Repid Law to High High to V.High None to Slow Low to Med.       Lexis to High sonte to clay the Medium High       Striated, polished, or glossy fracture planes. SUCKENSIDED: Striated, polished, or glossy fracture planes. HOMOGENEOUS: Same color and appearance through Medium         MIL Nor to Low Non to Low Slow to Repid Law to High High to V.High None to Slow CH Med. to High High to V.High None to Slow Law to High       CM				H SN							
Index Name Soll.st       Image of the second s			/e i								
SOILS: Less than SOW retained an No. 200 sieve       SUT AND CLAY       LESS THAN 50       CL       Inorganic clays of low to medium plasticity, lean clays.         USUD LIMIT 50 OR GREATER       DL       Organic silt and organic silty clays of low plasticity.       DL         HIGHLY ORGANIC SOILS       PT       Peat, muck, and other highly organic soil.       DH         MOISTURE CONTENT       DRY: Absence of moisture, dusty, dry to the touch DAMP: Some moisture on hand       PT       Peat, muck, and other highly organic soil.       STRUCTURE         MUSIT: Leaves moisture on hand       TOUGHNESS       SILCKENSIDED: Striated, polished, or glossy fracture planes.       SILCKENSIDED: Striated, polished, or glossy fracture planes.         ML       Non to Low       None to Slow       Medium Medium       Medium Lews to high high to V-High None       Lews can't rol Medium         ML       Non to Low       None to Slow       Low to Med.       None       High         STT       Standard Penetration Test split borrel sampler       G       G arab sample       G       G arab sample         D&       Atterberg Plastic Limit       MD       Moisture Density       UC       UC unconfined Compressive Strength         PLASTICTY       DRY STRUCTION & EXPLANATIONS       EXPLORATION       C       G arab sample       C G arab sample         LL       None	INE-GRAINED			т							
Less than       SILT AND CLAY       OL       Organic silt and organic silty clays of low plasticity.         50% retained       MH       Inorganic silts, clays sil				S THAN 50 CL INORGANIC CIAYS OF IOW TO MEDIUM Plasticity, lean					plasticity, lean clays.		
SUS retrained on No. 200 sieve       LIQUID LIMIT 50 OR GREATER       MH       Inorganic clays of high plasticity, fat clays.         HIGHLY ORGANIC SOILS       PT       Peat, muck, and other highly organic soil.         MOISTURE CONTENT       DRY: Absence of moisture, dusty, dry to the touch DAMP: Some moisture but leaves no moisture on hand       STRUCTURE         MCIST: Leaves moisture on hand       STRUCTURE       STRUCTURE         VET: Visble free water, usually saturated       SUCKY: Cohesive soil that can be broken down into sme angular lumps which resist further breakdown.         LLQUID LIMIT SO DAMP: Some moisture on hand       LOW CKY: Cohesive soil that can be broken down into sme angular lumps which resist further breakdown.         VET: Visble free water, usually saturated       Low, can't roll Medium Low to Med. Med. to High None to Slow MH Med. to High Low to Med. None to Slow Low to Med. High       Low, can't roll Medium Low to Med. High         UST OF ABBREVIATION & EXPLANATIONS       G       Grab sampler MC Moisture Density         LL       Atterberg Plastic Limit       MD Moisture Density         LL       UC Unconfined Compressive Strength         P Pocket Penetrometer       VS Vane Shear	Less than			0	OL Organic silf and organic silfy clays of low plasticity.						
OR GREATER       OH       Inorganic clays of high plasticity, for clays.         Bive       OH       Organic clays of medium to high plasticity.         HIGHLY ORGANIC SOILS       PT       Peat, muck, and other highly organic soil.         MOISTURE CONTENT       STRUCTURE         DAMP: Some moisture but leaves no moisture on hand       STRUCTURE         WET: Visble free water, usually saturated       STRUCTURE         PLASTICITY DRY STRENGTH DILATANCY       TOUGHNESS         ML       Non to Low       Slow to Rapid         Low to Med.       Medium         HI Med. to High I to V.High       None to Slow         Lew to Med.       None to Slow         High       Low to Med.         High       LIST OF ABBREVIATION & EXPLANATIONS         SPT       Standard Penetration Test split barrel sampler         D&M       C         MA       Moore sampler         L       Atterberg Plastic Limit         PL       Atterberg Pla											
Sieve     OH     Organic class of medium to high plasticity.       HIGHLY ORGANIC SOILS     PT     Peat, muck, and other highly organic soil.       MOISTURE CONTENT     Prest, muck, and other highly organic soil.       DRY: Absence of moisture, dusty, dry to the touch     AMINATED: Alternating layers of material or color > 6mm thick.       MOIST: Leaves moisture on hand     STRUCTURE       WET: Visble free water, usually saturated     TOUGHNESS       ML Non to Low     Non to Low       Non to Low     Non to Low       Non to Low     Non to Slow       Low to Med.     Med. to High       High to V.High     None to Slow       Low to Med.     Ketithigh <t< td=""><td></td><td></td><td></td><td></td><td>-</td><td></td><td></td><td></td><td></td></t<>					-						
MOISTURE CONTENT         DRY: Absence of moisture, dusty, dry to the touch         DAMP: Some moisture on hand         WOIST: Leaves moisture on hand         WOIST: Leaves moisture on hand         WET: Visble free water, usually saturated         PLASTICITY DRY STRENGTH DILATANCY         TOUGHNESS         ML         Non to Low       None to Slow to Rapid         Low to Med.       Med. to High None to Slow         MH       Med. to High Low to Med.         CH       Med. to High High to V.High None to Slow         NH       Non to Low None to Slow         NH       Med. to High High to V.High None to Slow         LST OF ABBREVIATION & EXPLANATIONS         SPT       Standard Penetration Test split barrel sampler         D&M Dames and Moore sampler       G         LL       Atterberg Ilauid Limit         PP       Pocket Penetrometer         VS       Vane Shear            EXPLORATORY				0							
DRY: Absence of moisture, dusty, dry to the touch       STRATIFIED: Alternating layers of material or color > 6mm         DAMP: Some moisture but leaves no moisture on hand       STRATIFIED: Alternating layers of material or color > 6mm         MOIST: Leaves moisture on hand       STRATIFIED: Alternating layers of material or color > 6mm         WET: Visble free water, usually saturated       ILAMINATED: Alternating layers of material or color > 6mm         PLASTICITY       DRY STRENGTH       DILATANCY         Num       Non to Low       Non to Low         Non to Low       Non to Low       Slow to Rapid         Low, can't roll       Medium         Low to Med.       Med. None to Slow         CH       Med. to High       None to Slow         LW       None       None         LIST OF ABBREVIATION & EXPLANATIONS       Strandard Penetration Test split barrel sampler       G         D&M       Dames and Moore sampler       MC         LL       Atterberg liquid Limit       MD         PP       Pocket Penetrometer       VS         VS       Vane Shear	Н	GHLY ORGAN	C SOILS	1	Peat, r	nuck, and othe	er high	ly orga	inic soil.		
PLASTICITY       DRY STRENGTH       DILATANCY       TOUGHNESS         ML       Non to Low       Non to Low       Slow to Rapid       Low, can't roll       angular lumps which resist further breakdown.         Low to Med.       Low to Med.       Med. to High       None to Slow       Medium       Low to Med.       Low to Med.       None to Slow       Medium       Low to Med.       Low to Med.       None to Slow       Medium       Low to Med.       High       Low to Med.       Low to Med. <t< td=""><td>DRY: Absence DAMP: Some n MOIST: Leaves</td><td>of moisture, du noisture but lec moisture on ha</td><td>ives no moisture or nd</td><td></td><td>STRATI LAMIN FISSUR SLICKE</td><td colspan="4">STRATIFIED: Alternating layers of material or color &gt; 6mm thick. LAMINATED: Alternating layers &lt; 6mm thick. FISSURED: Breaks along definate fracture planes. SLICKENSIDED: Striated, polished, or glossy fracture planes.</td></t<>	DRY: Absence DAMP: Some n MOIST: Leaves	of moisture, du noisture but lec moisture on ha	ives no moisture or nd		STRATI LAMIN FISSUR SLICKE	STRATIFIED: Alternating layers of material or color > 6mm thick. LAMINATED: Alternating layers < 6mm thick. FISSURED: Breaks along definate fracture planes. SLICKENSIDED: Striated, polished, or glossy fracture planes.					
SPT       Standard Penetration Test split barrel sampler       G       Grab sample         D&M       Dames and Moore sampler       MC       Moisture Content         LL       Atterberg Liquid Limit       MD       Moisture Density         PL       Atterberg Plastic Limit       UC       Unconfined Compressive Strength         PP       Pocket Penetrometer       VS       Vane Shear	ML Non to Low CL Low to Med MH Med. to Hig	angula LENSES	angular lumps which resist further breakdown. LENSES: Has small pockets of different soils, note thickness.								
D&M Dames and Moore sampler MC Moisture Content LL Atterberg Liquid Limit MD Moisture Density PL Atterberg Plastic Limit UC Unconfined Compressive Strength PP Pocket Penetrometer VS Vane Shear EXPLORATOR											
	D&M Dames a LL Atterberg PL Atterberg PP Pocket P	nd Moore sam g Liquid Limit g Plastic Limit enetrometer		oler	MC MD	Moisture Co Moisture Dei	ntent nsity	pressive	e Strength		
	<u> </u>								EXPLORATORY KE		
Branch Engineering	<b>Branc</b> Engineeri	<b>ch</b> NG≝ since 1977									

		Branch					Borehole ID: B-1
							Sheet 1 of 2
		civil - transportation structural - geotechnical SURVEYING					
Client:			ject Name:		rg WTP Sites		
	t Numbe tarted:		ject Location:	S. 2nd MWR	d Street & Pe		
1	g Contra		ged By: tude: 44.266			hecked By: L23.172659	
	g Metho		und Water Levels			2000	
Equipr		CME 75	-				
1	er Type						
Notes:			_	_			
Depth	Graphic	Material Description	Sample	Recovery % RQD	Blow Counts (N Value)	Pocket Pen. (tsf)	SPT N-Value PL MC LL Fines Content
				~		4	10 20 30 40 50 60 70 80 90
	<u>~~</u> ~	(GP) Angular open-graded quarry rock on ground surface					
1	Î	(ML) Brown, dry, medium stiff Clayey Silt					
2							
3			SPT	67	3-4-8	1.50	
				07	5-4-8		
			SPT				
5		(ML) Brown, moist, Clayey Silt with trace fine grain sand, san	id SPT	67	5-6-8		
6		content increasing with depth		0,		1.50	
7			SPT				
8				67	4-5-6	1.50	
9				_			
10			SPT				
11				67	67 4-11-31		
=		(GW) Brown-gray, dense, sandy rounded to sub-rounded Gra					
12   13   14   14   14   14   14   14   14		becomes wet at approximately 20-feet, routine caving during sampling with loss of drilling fluid at 30 to 35-feet	g				
13							
14							
15			SPT				
16 -				33	17-30-30		
17							
18							
19							
			SPT				
20				33	17-23-26		
21							
22							<u>+++++++++++++++++++++++++++++++++++++</u>
23							
24							
25			SPT				
26				33	10-30-45		
27							<u></u>
28							<u>++++++</u> ++++++++++++++++++++++++++++++
29							
30 _=			SPT				

					Borehole ID: B-1 Sheet 2 of 2
Client:       City of Harrisburg       Project Name         Project Number:       20-009C       Project Locati         Date Started:       Sep 02 2020       Completed:       Sep 02 2020       Logged By:         Drilling Contractor:       Western States       Latitude:         Drilling Method:       Mud Rotary       Ground Wate         Equipment:       CME 75       V         Notes:       V       V	ion: 44.26605	S. 2nd MWR	g WTP Sites I Street & Per C ngitude:	hecked By:	RJD Elevation:
H S S S S S S S S S S S S S S S S S S S	Sample	Recovery % RQD	Blow Counts (N Value)	Pocket Pen. (tsf)	SPT N-Value PL MC LL Fines Content
(GW) Brown-gray, dense, sandy rounded to sub-rounded Gravel, becomes wet at approximately 20-feet, routine caving during sampling with loss of drilling fluid at 30 to 35-feet sampling with loss of drilling fluid at 30 to 35-feet sampling with loss of drilling fluid at 30 to 35-feet sampling with loss of drilling fluid at 30 to 35-feet sampling with loss of drilling fluid at 30 to 35-feet sampling with loss of drilling fluid at 30 to 35-feet sampling with loss of drilling fluid at 30 to 35-feet sampling with loss of drilling fluid at 30 to 35-feet sampling with loss of drilling fluid at 30 to 35-feet sampling with loss of drilling fluid at 30 to 35-feet sampling from 35-feet to 50-feet due to caving gravel sampling from 35-feet to 50-feet due to caving gravel sampling from 35-feet to 50-feet due to caving gravel sampling fluid at 30 to 35-feet due to caving gravel sampling fluid at 30 to 35-feet due to caving gravel sampling fluid at 30 to 35-feet due to caving gravel sampling fluid at 30 to 35-feet due to caving gravel sampling fluid at 30 to 35-feet due to caving gravel sampling fluid at 30 to 35-feet due to caving gravel sampling fluid at 30 to 35-feet due to caving gravel sampling fluid at 30 to 35-feet due to caving gravel sampling fluid at 30 to 35-feet due to caving gravel sampling fluid at 30 to 35-feet due to caving gravel sampling fluid at 30 to 35-feet due to caving gravel sampling fluid at 30 to 35-feet due to caving gravel sampling fluid at 30 to 35-feet due to caving gravel sampling fluid at 30 to 35-feet due to caving gravel sampling fluid at 30 to 35-feet due to caving gravel sampling fluid at 30 to 35-feet due to caving due to 35-feet due to	SPT	33	12-27-27 14-15-19 15-21-28		

Hate         Material Description			ENGINEERING SURVEYNE SURVEYNE						Borehole ID: B-2 Sheet 1 of 1
Notes:       Material Description       Image: Second seco	Projec Date S Drillin Drillin Equip	t Numbe started: g Contra g Metho ment:	20-009C         Completed:         Sep 02 2020           Step 02 2020         Completed:         Sep 02 2020           Ctor:         Western States         I           d:         Mud Rotary         CME 75         Sep 02 2020	Project Location Logged By: Latitude: Ground Water	on: 44.2660	S. 2nd MWR	l Street & Pe	hecked By:	
1       (GP) Angular open-graded quarry rock on ground surface         2       (ML) Brown, dry-damp, medium stiff Clayey Silt         3       67       2-3-4         5       67       2-3-4         6       7       67       3-4-7         7       67       3-4-7         8       (ML-SC) Brown, moist, stiff Clayey Silt with trace fine-grain sand, sand content increases with depth, trace rounded gravel       SPT         9       67       6-7-7         11       67       9-9-8         (GW) Brown-gray, dense, sandy rounded to sub-rounded Gravel       SPT         13       (GW) Brown-gray, dense, sandy rounded to sub-rounded Gravel       67				V.	Sample	Recovery % RQD	Blow Counts (N Value)	Pocket Pen. (tsf)	SPT N-Value PL MC LL Fines Content
24       1	12		(ML) Brown, dry-damp, medium stiff Clayey Silt (ML-SC) Brown, moist, stiff Clayey Silt with trace fine-grai sand content increases with depth, trace rounded gravel	in sand,	SPT SPT SPT	67 67 67	3-4-7 6-7-7 9-9-8	1.50	

#### Branch ENGINEERING Buc 1977 Structural \* geochaitain structural \* geochaitain structural \* geochaitain structural \* geochaitain

#### Borehole ID: B-3

Sheet 1 of 2

		f Harrisburg	Project Nam			rg WTP Sites		
	Number		Project Loca	tion:		d Street & P		
	rted:	Sep 03 2020 Completed: Sep 03 2020	Logged By:	44.2000	MWR		Checked By:	RJD
	Contract		Latitude:	44.28604	42 <b>Lo</b>	ngitude:	-123.175553	Elevation:
	Method		_Ground Wat					
ipme		CME 75		ne of drillir	ng <u>1</u> 4	4.00 on Sep	03 2020	
	Type:	Automatic			_			
tes:					_			
								SPT N-Value
					%		Ľ.	PL MC LL
	Graphic			Sample	Recovery RQD	Blow Counts (N Value)	Pocket Pen. (tsf)	Fines Content
	irap	Material Description		am	RQD	Blow Counts I Value	cket P (tsf)	
-	6			S	Rec	0 <u>2</u>	Рос	10 20 30 40 50 60 70 80 90
								10 20 30 40 50 60 70 80 90
E		(ML) Brown, stiff, dry Clayey Silt						
킠								
				SPT				
-					67	4-5-6		+_
					67	4-5-0	-	
<u>ալիպիտիտիտիտիտիտիտիտիտիտիտիտիտիտիստիստիստիստ</u>	-			SPT				┼┼┼┼┼┼┼┼┼┼┼┼┼
킠		(ML) Brown-gray, stiff, damp Clayey Silt			67	7-11-15	2.00	
-								
				SPT			-	
					67	9-14-20		
-		(SM) Brown, moist, fine-grain Sand with silt						
=::::								
		(GW) Brown-gray, dense, sandy rounded to sub-rounded	d Gravel	SPT				
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	$\geq$							
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	(	Branch ENGINEERING							Boreh	ole ID: B-3
										Sheet 2 of 2
		structural - geotechnical S U R V E Y I N G								
Client		of Harrisburg		Project Name			rg WTP Sites			
-	t Numbe			Project Locat	ion:		d Street & Pe			
	tarted:	Sep 03 2020	<b>Completed:</b> Sep 03 2020	Logged By:		MWR		Checked By:		JD
	g Contrac		25	Latitude:	44.2860	42 <b>Lo</b>	ngitude:	123.175553	Elevation:	
	g Methoo			Ground Wate				~ ~ ~ ~ ~ ~		
Equip	nent: Ier Type:	CME 75			ne of drillin	ng <u>1</u> 4	4.00 on Sep	J3 2020		
Hamm Notes:		Automatic				_				
					1					
						<b>。</b>		-	SPT N-	
Ŀ.	j				e	Recovery % RQD	Blow Counts (N Value)	Pocket Pen. (tsf)	PL M Fines C	
Depth	Graphic		Material Description		Sample	RQD	slov oun Valı	ket P (tsf)	- Filles C	ontent
	5				Sa	F	۳ ٽ خ	oct	10 20 30 40 5	0 60 70 80 90
						<b>"</b>			10 20 30 40 5	
	•	(GW) Brown-gray, de	ense, sandy rounded to sub-rour	nded Gravel						
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_	× × × × × × × × × × × × × × × × × ×	Siltstone: Transition	to light brown Siltstone			100	15-11-16		$++++ \mathbf{A} ++++$	
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Branch ENGINEERING
civil • transportation structural • geotechnical SURVEVING

#### Borehole ID: B-4

Sheet 1 of 1

	of Harrisburg	Project Name			rg WTP Site		
oject Numbe		Project Locat	ion:		d Street & P		
te Started:	Sep 03 2020         Completed:         Sep 03 2020	Logged By:		MWR		Checked By:	RJD
illing Contra		Latitude:	44.28604	12 <b>Lo</b>	ngitude:	-123.175553	Elevation:
illing Metho		Ground Wate		- 11	- 00 6	02 2020	
uipment: ammer Type:	CME 75 Automatic	At tim	e of drillir	ng <u>1</u>	5.00 on Sep	03 2020	
otes:				_			
							SPT N-Value
r is			<u>e</u>	× ∼	Blow Counts (N Value)	Pocket Pen. (tsf)	PL MC LL
Graphic	Material Description		Sample	RQD	Slov Valı Valı	ket P (tsf)	Fines Content
ם   ס			Sa	Recovery RQD	ΞŭΖ	oc	10 20 30 40 50 60 70 80
						- <b>-</b> -	10 20 30 40 50 60 70 80
	(ML) Brown, dry, stiff Clayey Silt						
1							
2 =			SPT			-	
3 =				67	3-5-6		
			SPT				
5			571	67	3-3-4		
5	(ML-SM) Brown, soft, moist Clayey Silt with fine-grain	sand. becomes		07	5-5-4	0.50	
7	wet and soft						
			SPT				
3				100	2-2-3		
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			SPT				
				67	2-12-21		
	(GW) Wet, dense Sandy Gravel						
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Branch ENGINEERING
civil • transportation structural • geotechnical SURVEVING

#### Borehole ID: B-5

Sheet 1 of 1

roject Number: 20.090C Complete: 5.00.03202 Complete: 5.00.03202 Lastitude: 4.20042 Loncide By: AU Hilling Contractor: Wextern States pulpment: Wextern States The Automatic Material Description M	Client:	City	of Harrisburg	Project Nam	e: ⊦	larrisbu	rg WTP Site	S		
utiling Method:       utilities Method:       util	Project									
willing Mutches:       is "1:5.0       Ground Water Levels       Discourt Sep 01 2020         annuer Type:       Automatic       Automatic       So on Sep 01 2020       Is 00 an Sep 01 2020         geographics:       Material Description       geographics       geographics       Is 00 an Sep 01 2020         1       (ML) Brown, dry, medium stiff Clayey Silt       Is 00 an Sep 01 2020       geographics       Is 00 an Sep 01 2020         1       (ML-Shri) Brown, moist Clayey Silt with trace fine grain sand, sand       SPT       67       3.3.44       Is 00         1       (ML-Shri) Brown, moist Clayey Silt with trace fine grain sand, sand       SPT       100       2.4.5       1.00         1       (GW) Wet, medium dense, Sandy Gravel       SPT       100       2.3.8       Is 00       Is 00         1       (GW) Wet, medium dense, Sandy Gravel       SPT       100       2.3.8       Is 00       Is 00       Is 00         1       Is 00       SPT       100       2.3.8       Is 00       Is 00       Is 00       Is 00       Is 00         1       Is 00       SPT       100       2.3.8       Is 00	Date St	arted:	Sep 03 2020 Completed: Sep 03 2020	Logged By:		MWR		Checked By:	RJD	
pulpment:       CME 75       Automatic         inter       Automatic       1000 ns sqn 03 2020         inter       Material Description       interview       interview         (ML) Brown, dry, medium stiff Clayey Silt       Interview       SPT       57         (ML-SM) Brown, moist Clayey Silt with trace fine grain sand, sand       SPT       100       2.4.45       1.00         (ML-SM) Brown, moist Clayey Silt with trace fine grain sand, sand       SPT       100       2.4.45       1.00         (ML-SM) Brown, moist Clayey Silt with trace fine grain sand, sand       SPT       100       2.4.45       1.00         (GW) Wet, medium dense, Sandy Gravel       SPT       100       2.3.2       0.50       Interview         SPT       100       2.3.8       Interview       Interview       Interview       Interview         SPT       100       2.3.8       Interview       Interview       Interview       Interview         SPT       100       2.3.8       Interview       Interview       Interview       Interview       Interview       Interview         SPT       100       2.3.8       Interview       Interview       Interview       Interview       Interview       Interview         Interview       Intervie	Drilling	Contra	ctor: Western States	Latitude:	44.28604	2 <b>Lo</b>	ongitude:	-123.175553	Elevation:	
Automatic         Automatic           uter         Material Description         g         y         g	Drilling	Metho	d: 8" HSA	Ground Wat	er Levels		_			
Vite         Vite         Material Description         g         y         g </th <th>Equipm</th> <th>ent:</th> <th>CME 75</th> <th>📈 🛛 At tir</th> <th>ne of drillin</th> <th>g <u>1</u></th> <th>5.00 on Sep</th> <th>03 2020</th> <th></th> <th></th>	Equipm	ent:	CME 75	📈 🛛 At tir	ne of drillin	g <u>1</u>	5.00 on Sep	03 2020		
understand         underst	Hamme	er Type								
under a low       material Description       under a low       under low       under a lo	Notes:		7							
under a low       material Description       under a low       under low       under a lo									SPT N Value	
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1       (ML) Brown, dry, medium stiff Clayey Silt       SPT       67       3:3:4       4	Ę	hic			ble	م چ	w hts lue	, Be		
1       (ML) Brown, dry, medium stiff Clayey Silt       SPT       67       3:3:4       4	de l	rap	Material Description			N N	our our	tsi (tsi		
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3       4       5       5       5       7       17-14-14       67       17-14-14       67       17-14-14         9       9       10 <td>11 글</td> <td></td> <td>(GW) wet, medium dense, Sandy Gravel</td> <td></td> <td></td> <td>100</td> <td>2-3-0</td> <td></td> <td></td> <td></td>	11 글		(GW) wet, medium dense, Sandy Gravel			100	2-3-0			
3       4       5       5       5       7       17-14-14       67       17-14-14       67       17-14-14         9       9       10 <td>12 큭</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td>	12 큭									
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NOTICE TO WATER WELL CONTRACTOR The original and first copy of this report are to be filed with the AUG 2 2 1966 STATE OF	LL REPORT 14186 State Well No. 15	14W	-16 H
STATE ENGINEER, SALEM, OREGON 97310 within 30 days from the date A TE ENGINE Prove type of well completion.	' OREGON		
(1) OWNER: SALLM OREGON	(11) WELL TESTS: Drawdown is amount of low static levered below static l	vater leve	el is
Cither of Honorichiana	Was a pump test made? Y Yes $\Box$ No If yes, by whom		nilling
Tranni abuma Anagon	Yield: 300 gal./min. with 120ft. drawdow		27 hrs.
Address Harrisburg, Oregon	" " " " "		<del>~/ </del> "
(A) LOCATION OF WELL.	" " "		"
(2) LOCATION OF WELL:	Bailer test gal./min. with ft. drawdo	wn after	hrs.
County Lens Li W Driller's well number	Artesian flow g.p.m. Date		
1/4 1/4 Section /6 T. 185 R. 4 W. M.	Temperature of water 56 Was a chemical analysis r	nade? 🔲	Yes 🙀 No
Bearing and distance from section or subdivision corner	(12) WELL LOG: Diameter of well below ca	sing 1	2
		21.6	
	Depth drilled 400 ft. Depth of completed we		<u>it.</u>
	Formation: Describe by color, character, size of materia show thickness of aquifers and the kind and nature of t stratum penetrated, with at least one entry for each c	l and stru he mater lange of	cture, and ial in each formation.
	MATERIAL	FROM	то
(3) TYPE OF WORK (check):	Gray white clay	0	10
New Well Deepening 🗌 Reconditioning 🗌 Abandon 🗌	Gray clay	10	14
andonment, describe material and procedure in Item 12.	Brown clay - pea gravel	14	47
(4) PROPOSED USE (check): (5) TYPE OF WELL:	Blue clay	47	65
	Soft brown clay- very fine	•	
Domestic Industrial Municipal Cable M Jetted	sand- water bearing	65	_78
Irrigation 📋 Test Well 🗋 Other 🔹 Dug 📋 Bored 🗍	Soft blue clav	78	115
(6) CASING INSTALLED: Threaded [] Welded	Black sand & gravel-(W B)	115	125
12 " Diam. from ft. to ft. Gage	Blue clay	125	135
"Diam. from ft. to ft. Gage	Gray green clay	135	150
"Diam. fromft. toft. Gage	Blue clay	150	178
	Black sand very fine some		·
(7) PERFORATIONS: Perforated? Yes 🗌 No	water - static head 251	178	190
Type of perforator used Mills knife	Blue clay - very sticky	190	250
Size of perforations in. by 2 in.	Very fine sand, blue clay		
320 perforations from 110 ft to 130 ft	some_water, lots of wood	250	275 -
80 perforations from 335 ft. to 340 ft.	Dark gray clay - fine sand	275	290
	Blue clay very sticky	290	335
perforations from ft. to ft.	Coarse black sand with	335	337
perforations from ft. to ft.	buck shot gravel	337	400
(8) SCREENS: Well screen installed?  Yes No	Blue clay	1357	
Manufacturer's Name			
Model No		4	ļ,,
Slot size Set from ft. to ft.	Work started 6/29/66 19 Completed 8/	6/66	19
Diam Slot size Set from ft. to ft.		/66	19
(9) CONSTRUCTION:	(13) PUMP:		
Well seal-Material used in seal	Manufacturer's Name		
Depth of seal	Type:	H.P	
Diameter of well bore to bottom of seal	Water Well Contractor's Certification:		ففت
Were any loose strata cemented off? [] Yes [XNo Depth	Water Wen Contractor & Certification.		
Was a drive shoe used? 🖾 Yes 📋 No	This well was drilled under my jurisdiction	and this	report is
Was well gravel packed? 🗌 Yes 🖾 No 🦳 Size of gravel:	true to the best of my knowledge and belief.		
Gravel placed from ft. to ft.	NAME W. W. Drilling and Pump (Person, firm or corporation)	Ser	7.i.ce
Did any strata contain unusable water? 🔁 Yes 🔲 No	LIET Moin Qt Conting		
Type of water? Sulfur depth of strata 400			i, Ore.
Method of sealing strata off cement plug @ 346	Drilling Machine Operator's License No	-	
(10) WATER LEVELS:	[Signed] Watt Wilson (Water Well Contractor)	By L	ke.)
Static level 22 ft. below land surface Date 8/5/66			
Artesian pressure lbs. per square inch Date	Contractor's License No.268 Date		, 19
	HEETS IF NECESSARY)	-	

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. REVISED 3-16-07	INN 576	<b>656</b>		
	LINN 5	7656	Pag	e 1 of 1
STATE OF OREGON	03-15-20	07	-	,
WATER SUPPLY WELL REPORT (as required by ORS 537.765 & OAR 690-205-0210)	05-15-20	WELL LABEL # L	87958	
(as required by OKS 557.765 & OAK 090-205-0210)		START CARD #	1000475	
(1) LAND OWNER Owner Well 1.D.		(0) LOCATION OF WELL (Inco	I decembration (	
First Name Last Name		(9) LOCATION OF WELL (lega County Linn Twp 15.00 S	the state of the s	PAU NA /
Company City of Harrisburg		Sec 9 NW 1/4 of the NE	N/S Range 4.00 W 1/4 Tax Lot 700	E/W WM
Address 354 Smith Street		Tax Map Number	Lot	
City Harrisburg State OR Zip 974	46	Lat °0 ' "or		MS or DD
(2) TYPE OF WORK New Well Deepening	Conversion	Long °0 ' "or	D	MS or DD
Alteration (repair/recondition)	Contention	C Street address of well	Nearest address	
		Just north of 23690 Peoria Road Harrisburg,	OR	
(3) DRILL METHOD Rotary Air Rotary Mud Cable Auger Cable !	Mud			
Reverse Rotary Other	, in the second s	(10) STATIC WATER LEVEL D	ate SWL(psi) + S	WL(ft)
		Existing Well / Predeepening		WE(R)
(4) PROPOSED USE Domestic Inrigation Comm	nunity	Completed Well 03-12-20	007	18
Industrial/ Commercial Livestock Dewatering		Flowing Artesian?	Dry Hole?	
Thermal Injection Other			water was first found	
(5) BORE HOLE CONSTRUCTION Special Standard	Attach copy)	SWL Date         From         To           01-19-2007         9         90	Est Flow SWL(psi) + S	WL(ft)
Depth of Completed Well 236.00 ft. BORE HOLE SEAL	an about	01-19-2007 9 90	300	110
	sacks/	01-24-2007 214 231	400	18
12 0 236 Cement 0 184	4 196 S			
Bentonite 184 184 Sand 189 21				
Sand 189 23	36 401 s	(11) WELL LOG Ground Eleva	tion	
How was seal placed: Method A B C		Material	From	To
Other		Crushed rock	0	1
Backfill placed from 189 ft. to 191 ft. Material 20/40 s	and	Brown sandy clay	1	9
	Size 10/20	Brown sand and small gravels	9	38 50
Explosives used: Yes Type Amount		Brown and gray sand and gravel Brown sand and gravel	38	61
(6) CASING/LINER		Brown sand (heaving)	61	90
(6) CASING/LINER Casing Liner Dia + From To Gauge Stl 1	Plstc Wld Thrd	Blue sandy clay	90	120
8 3 211 .250		Black heaving sand	120	155
8 231 236 .250		Blue claystone Black heaving sand	214	214 231
		Blue clay	214	236
		RECEIVE		
Shoe Inside Outside Other Location of shoe				
Find	236	MAR 1 9 2007		1
(7) PERFORATIONS/SCREENS Perforations Method				
	304 SS	WATER RESOURCES DI	EPT	
Perf/ Casing/Screen Scrn/slot Slot	# of Tele/	SALEM OREGON		
Screen Liner Dia From To width length	slots pipe size	Date Started 01-15-2007 C	ompleted 03-12-2007	
Screen Casing 8 211 231 .03	1,000 8	(unbonded) Water Well Constructor Cen	tification	
		I certify that the work I performed on the		
		abandonment of this well is in compli- construction standards. Materials used and		
		the best of my knowledge and belief.	i intornitation reported abov	e are true to
(8) WELL TESTS: Minimum testing time is 1 hour		License Number 1776	Date 03-15-2007	
	ing Artesian	Electronically Filed		
0 0 0	tion (hr)	Signed DOUGLAS D TUCKER (E-filed	)	
400 218 236	1	(bonded) Water Well Constructor Certifi	ication	
	1	I accept responsibility for the construction		abandonmen
275 132 150	1	work performed on this well during the con	struction dates reported abo	ve. All work
Temperature 57 °F Lab analysis Yes By		performed during this time is in compli-		
Water quality concerns? Yes (describe below)	ount Units	construction standards. This report is true t	SALE S IN A 1995 STOLEN STOLEN STOLEN	and benef.
From To Description Am	iount Onits	License Number 1541 Electronically Filed	Date03-15-2007	
		Signed CASEY JONES JR (E-filed)		
		Contact Info (optional) Casey Jones Well D	rilling 541-747-280	

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ORIGINAL - WATER RESOURCES DEPARTMENT THIS REPORT MUST BE SUBMITTED TO THE WATER RESOURCES DEPARTMENT WITHIN 30 DAYS OF COMPLETION OF WORK Form Version: 0.88

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### **LINN 57656**

### WATER SUPPLY WELL REPORT continuation page

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#### WELL I.D. # L 0 87958

#### START CARD #0 1000475

5) BORE BORE	HOLE			SE	1010410		sacks/
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7) PERFO	RATIO	NS/SCE	EENS				
ert/ Casing			EB. IS	Scrn/slot	Slot	# of	Tele/
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creen miner	Dia	riom	10	width	length	31013	npe siza
		-	-	-			
				-			
				+ +			
			-	-	-		

#### WELL TESTS: Minimum testing time is 1 hour

Yield gal/min	Drawdown	Drill stem/Pump depth	Duration (hr)
200	82	100	_ 1

#### Water Quality Concerns

From	То	Description	Amount Units
		33 <del>5</del> 6 7	

#### (10) STATIC WATER LEVEL

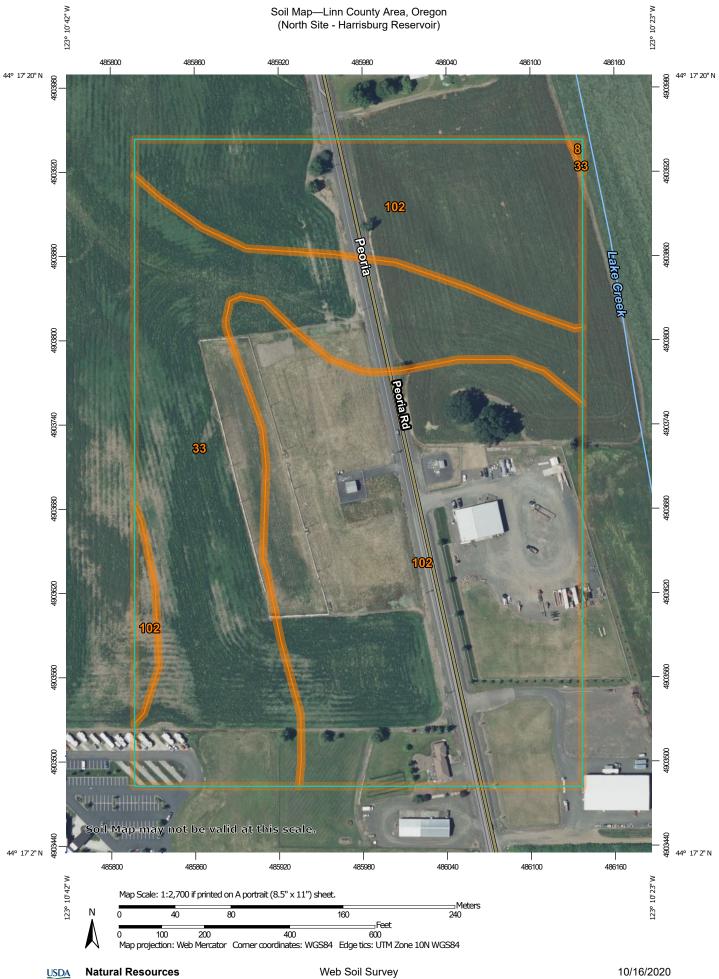
#### Water Bearing Zones

SWL Date	From	То	Est Flow	SWL(psi)	+ SWL(ft)
			1	1	
			-		
	-		_		
			-		
			-		
			_	1	

#### (11) WELL LOG

Material	From	To
		-
		-
		-
		_
		-
DECEN	1000	_
RECEIV	ED	_
MAR 10 2	107	_
The second se		-
WATER RESOURCE	SPEPT	
SALEM, OREG	ON	

#### **Comments/Remarks**



National Cooperative Soil Survey

**Conservation Service** 

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Area of Interest (AOI)       Spoil Area       The soil surveys that comprise your AOI were mapped a 1:20,000.         Soils       Soil Map Unit Polygons       Very Stony Spot         Soil Map Unit Polygons       Wet Spot         Soil Map Unit Points       Other         Soil Map Unit Points       Other         Soil Map Unit Points       Special Line Features         Special Point Features       Streams and Canals         Borrow Pit       Transportation         Clay Spot       Heinestion         Clay Spot       Heinestion         Clay Spot       Heinestion         Closed Depression       Interctate Highways
Coordinate System:       Web Mercator (EPSG:3857)         Gravel Pit       US Routes         Gravel Pit       US Routes         Gravely Spot       Major Roads         Landfill       Local Roads         Lava Flow       Background         Marsh or swamp       Merial Photography         Mine or Quarry       Miscellaneous Water         Perennial Water       Soil Survey Area Data:         Version Export       Saline Spot         Saline Spot       Sandy Spot         Severely Eroded Spot       Sandy Spot



## Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
8	Bashaw silty clay	0.0	0.1%
33	Dayton silt loam	12.3	33.7%
102	Willamette silt loam	24.2	66.2%
Totals for Area of Interest		36.6	100.0%



### Linn County Area, Oregon

#### 102—Willamette silt loam

#### Map Unit Setting

National map unit symbol: 24vl Elevation: 200 to 400 feet Mean annual precipitation: 40 to 50 inches Mean annual air temperature: 52 to 54 degrees F Frost-free period: 165 to 210 days Farmland classification: All areas are prime farmland

#### Map Unit Composition

*Willamette and similar soils:* 85 percent *Minor components:* 6 percent *Estimates are based on observations, descriptions, and transects of the mapunit.* 

#### **Description of Willamette**

#### Setting

Landform: Terraces Landform position (three-dimensional): Tread Down-slope shape: Convex, linear Across-slope shape: Convex, linear Parent material: Silty alluvium derived from mixed materials

#### **Typical profile**

H1 - 0 to 24 inches: silt loam H2 - 24 to 53 inches: silty clay loam H3 - 53 to 60 inches: silty clay loam

#### **Properties and qualities**

Slope: 0 to 3 percent Depth to restrictive feature: More than 80 inches Drainage class: Well drained Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr) Depth to water table: More than 80 inches Frequency of flooding: None Frequency of ponding: None Available water capacity: High (about 12.0 inches)

#### Interpretive groups

Land capability classification (irrigated): 1 Land capability classification (nonirrigated): 1 Hydrologic Soil Group: B Hydric soil rating: No

#### **Minor Components**

#### Concord

Percent of map unit: 3 percent

USDA

Landform: Terraces Landform position (three-dimensional): Tread Down-slope shape: Concave, linear Across-slope shape: Concave, linear Other vegetative classification: Poorly Drained (G002XY006OR) Hydric soil rating: Yes

#### Dayton

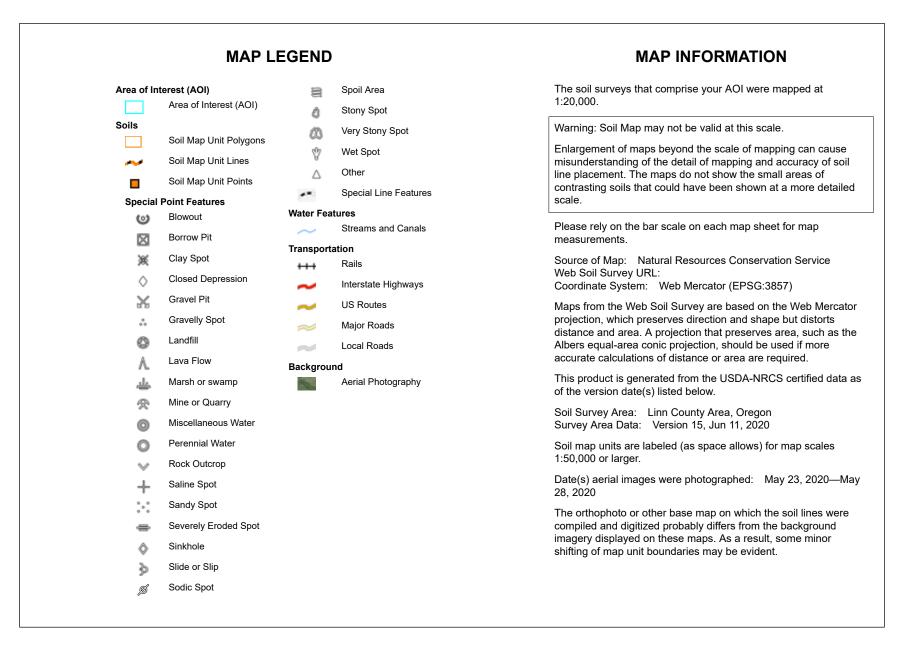
Percent of map unit: 3 percent Landform: Terraces Landform position (three-dimensional): Tread Down-slope shape: Linear, concave Across-slope shape: Linear, concave Other vegetative classification: Poorly Drained (G002XY006OR) Hydric soil rating: Yes

### **Data Source Information**

Soil Survey Area: Linn County Area, Oregon Survey Area Data: Version 15, Jun 11, 2020



USDA Natural Resources Conservation Service Web Soil Survey National Cooperative Soil Survey



USDA

## Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
3	Amity silt loam	2.4	19.3%
33	Dayton silt loam	7.3	59.1%
46	Holcomb silt loam	1.6	13.1%
85	Riverwash	0.0	0.0%
W	Water	1.1	8.5%
Totals for Area of Interest	·	12.4	100.0%



### Linn County Area, Oregon

#### 33—Dayton silt loam

#### Map Unit Setting

National map unit symbol: 24x2 Elevation: 200 to 400 feet Mean annual precipitation: 40 to 50 inches Mean annual air temperature: 52 to 54 degrees F Frost-free period: 165 to 210 days Farmland classification: Farmland of statewide importance

#### Map Unit Composition

Dayton and similar soils: 85 percent Minor components: 5 percent Estimates are based on observations, descriptions, and transects of the mapunit.

#### **Description of Dayton**

#### Setting

Landform: Terraces Landform position (three-dimensional): Tread Down-slope shape: Linear, concave Across-slope shape: Linear, concave Parent material: Silty and clayey alluvium and lacustrine deposits

#### **Typical profile**

H1 - 0 to 9 inches: silt loam H2 - 9 to 15 inches: silt loam H3 - 15 to 40 inches: silty clay H4 - 40 to 76 inches: silt loam

#### **Properties and qualities**

Slope: 0 to 2 percent
Depth to restrictive feature: 12 to 24 inches to abrupt textural change
Drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: About 0 to 18 inches
Frequency of flooding: None
Frequency of ponding: Frequent

Available water capacity: Low (about 3.2 inches)

#### Interpretive groups

Land capability classification (irrigated): 4w Land capability classification (nonirrigated): 4w Hydrologic Soil Group: D Forage suitability group: Poorly Drained (G002XY006OR) Other vegetative classification: Poorly Drained (G002XY006OR) Hydric soil rating: Yes

USDA

#### **Minor Components**

#### Concord

Percent of map unit: 3 percent Landform: Terraces Landform position (three-dimensional): Tread Down-slope shape: Concave, linear Across-slope shape: Concave, linear Other vegetative classification: Poorly Drained (G002XY006OR) Hydric soil rating: Yes

Dayton, gravelly clay substratum

Percent of map unit: 2 percent Landform: Terraces Hydric soil rating: Yes

### **Data Source Information**

Soil Survey Area: Linn County Area, Oregon Survey Area Data: Version 15, Jun 11, 2020

# **APPENDIX B:**

**Recommended Earthwork Specifications** 

#### **GEOTECHNICAL SPECIFICATIONS**

#### **General Earthwork**

- 1. All areas where structural fills, fill slopes, structures, or roadways are to be constructed shall be stripped of organic topsoil and cleared of surface and subsurface deleterious material, including but limited to vegetation, roots, or other organic material, undocumented fill, construction debris, soft or unsuitable soils as directed by the Geotechnical Engineer of Record. These materials shall be removed from the site or stockpiled in a designated location for reuse in landscape areas if suitable for that purpose. Existing utilities and structures that are not to be used as part of the project design or by neighboring facilities, shall be removed or properly abandoned, and the associated debris removed from the site.
- 2. Upon completion of site stripping and clearing, the exposed soil and/or rock shall be observed by the Geotechnical Engineer of Record or a designated representative to assess the subgrade condition for the intended overlying use. Pits, depressions, or holes created by the removal of root wads, utilities, structures, or deleterious material shall be properly cleared of loose material, benched and backfilled with fill material approved by the Geotechnical Engineer of Record compacted to the project specifications.
- 3. In structural fill areas, the subgrade soil shall be scarified to a depth of 4-inches, if soil fill is used, moisture conditioned to within 2% of the materials optimum moisture for compaction, and blended with the first lift of fill material. The fill placement and compaction equipment shall be appropriate for fill material type, required degree of blending, and uncompacted lift thickness. Assuming proper equipment selection, the total uncompacted thickness of the scarified subgrade and first fill lift shall not exceed 8-inches, subsequent lifts of uncompacted fill shall not exceed 8-inches unless otherwise approved by the Geotechnical Engineer of Record. The uncompacted lift thickness shall be assessed based on the type of compaction equipment used and the results of initial compaction testing. Fine-grain soil fill is generally most effectively compacted using a kneading style compactor, such as a sheeps-foot roller; granular materials are more effectively compacted using a smooth, vibratory roller or impact style compactor.
- 4. All structural soil fill shall be well blended, moisture conditioned to within 2% of the material's optimum moisture content for compaction and compacted to at least 90% of the material's maximum dry density as determined by ASTM Method D-1557, or an equivalent method. Soil fill shall not contain more than 10% rock material and no solid material over 3-inches in diameter unless approved by the Geotechnical Engineer of Record. Rocks shall be evenly distributed throughout each lift of fill that they are contained within and shall not be clumped together in such a way that voids can occur.
- 5. All structural granular fill shall be well blended, moisture conditioned at or up to 3% above of the material's optimum moisture content for compaction and compacted to at least 90% of the material's maximum dry density as determined by ASTM Method D-1557, or an equivalent method. 95% relative compaction may be required for pavement base rock or in upper lifts of the granular structural fill where a sufficient thickness of the fill section allows for higher compaction percentages to be achieved. The granular fill shall not contain solid particles over 2-inches in diameter unless special density testing methods or proof-rolling is approved by the Geotechnical Engineer of Record. Granular fill is generally considered to be a crushed aggregate with a fracture surface of at least 70% and a maximum size not exceeding 1.5-inches in diameter, well-graded with less than 10%, by weight, passing the No. 200 Sieve.
- 6. Structural fill shall be field tested for compliance with project specifications for every 2-feet in vertical rise or 500 cy placed, whichever is less. In-place field density testing shall be performed by a competent individual, trained in the testing and placement of soil and aggregate fill placement, using either ASTM Method D-1556/4959/4944 (Sand Cone), D-6938 (Nuclear Densometer), or D-2937/4959/4944 (Drive Cylinder). Should the fill materials not be suitable for testing by the above methods, then observation of placement, compaction and proof-rolling with a loaded 10 cy dump-truck, or equivalent ground pressure equipment, by a trained individual may be used to assess and document the compliance with structural fill specifications.

### **Utility Excavations**

- 1. Utility excavations are to be excavated to the design depth for bedding and placement and shall not be over-excavated. Trench widths shall only be of sufficient width to allow placement and proper construction of the utility and backfill of the trench.
- 2. Backfilling of a utility trench will be dependent on its location, use, depth, and utility line material type. Trenches that are required to meet structural fill specifications, such as those under or near buildings, or within pavement areas, shall have granular material strategically compacted to at least the spring-line of the utility conduit to mitigate pipeline movement and deformation. The initial lift thickness of backfill overlying the pipeline will be dependent on the pipeline material, type of backfill, and the compaction equipment, so as not to cause deflection or deformation of the pipeline. Trench backfill shall conform to the General Earthwork specifications for placement, compaction, and testing of structural fill.

#### Geotextiles

1. All geotextiles shall be resistant to ultraviolet degradation, and to biological and chemical environments normally found in soils. Geotextiles shall be stored so that they are not in direct sunlight or exposed to chemical products. The use of a geotextile shall be specified and shall meet the following specification for each use.

#### Subgrade/Aggregate Separation

Woven or nonwoven fabric conforming to the following physical properties:

•	Minimum grab tensile strength	ASTM Method D-4632	180 lb
•	Minimum puncture strength (CBR)	ASTM Method D-6241	371 lb
•	Elongation	ASTM Method D-4632	15%
•	Maximum apparent opening size	ASTM Method D-4751	No. 40
•	Minimum permittivity	ASTM Method D-4491	$0.05  \mathrm{S}^{-1}$

#### Drainage Filtration

Woven fabric conforming to the following physical properties:

•	Minimum grab tensile strength	ASTM Method D-4632	110 lb
•	Minimum puncture strength (CBR)	ASTM Method D-6241	220 lb
•	Elongation	ASTM Method D-4632	50%
•	Maximum apparent opening size	ASTM Method D-4751	No. 40
•	Minimum permittivity	ASTM Method D-4491	0.5 s <sup>-1</sup>

#### Geogrid Base Reinforcement

Extruded biaxially or triaxially oriented polypropylene conforming to the following physical properties:

•	Peak tensile strength lb/ft	ASTM Method D-6637	925
•	Tensile strength at 2% strain lb/ft	ASTM Method D-6637	300
•	Tensile strength at 5% strain lb/ft	ASTM Method D-6637	600
•	Flexural Rigidity Effective Opening Size rock size	ASTM Method D-1388 ASTM Method D-4751	250,000 mg-cm 1.5x