REPORT OF GEOTECHNICAL ENGINEERING SERVICES

Pedestrian Bridge – Ewing Young Park
Newberg, Oregon

For
NV5
January 18, 2022

Project: NV5-18-01

January 18, 2022

NV5
9450 SW Commerce Circle, Suite 300
Wilsonville, OR 97070

Attention: Jon Champlin, RLA, ASLA

Report of Geotechnical Engineering Services
Pedestrian Bridge – Ewing Young Park
Newberg, Oregon
Project: NV5-18-01

NV5 is pleased to submit this report of geotechnical engineering services for the new pedestrian bridge at Ewing Young Park in Newberg, Oregon. We appreciate the opportunity to be of service to you. Please call if you have questions regarding this report.

Sincerely,

NV5

Jeffery D. Tucker, P.E., G.E.
Principal Engineer

TAP:JDT:kt
Attachments
One copy submitted (via email only)
Document ID: NV5-18-01-011822-geor.docx
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EXECUTIVE SUMMARY

Our specific recommendations for site development and design of the new pedestrian bridge are provided in this report. The following geotechnical items will have an impact on design and construction of the proposed project:

- Based on the proposed development configuration, the bridge landings can be supported on shallow foundations bearing on firm native clay and silt and structural fill overlying firm native clay and silt.

- Based on the soil and groundwater conditions, liquefaction and lateral spreading potential is not considered a hazard for the site.

- The fine-grained soil present on the site is easily disturbed during the wet season or when above the optimum moisture content required for compaction. The subgrade will be above the optimum moisture content required for compaction and sensitive to disturbance after demolition of surface pavement. If not carefully executed, site earthwork can create extensive soft areas and significant repair costs can result. Subgrade protection consisting of granular haul roads and working blankets and/or the existing pavement sections should be used.

- Because we were unable to access the southern side of the creek for subsurface explorations, NV5 should evaluate all foundation subgrades during construction to confirm removal of unsuitable soil and that the subgrade is consistent with the conditions observed in our exploration. If over-excavation is necessary, the unsuitable material should be replaced with compacted crushed rock.

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ACRONYMS AND ABBREVIATIONS

AASHTO	American Association of State Highway and Transportation Officials
AC	asphalt concrete
ACP	asphalt concrete pavement
ASCE	American Society of Civil Engineers
ASTM	American Society for Testing and Materials
BGS	below ground surface
g	gravitational acceleration (32.2 feet/second^2)
H:V	horizontal to vertical
MCE	maximum considered earthquake
OSHA	Occupational Safety and Health Administration
OSSC	Oregon Standard Specifications for Construction (2021)
pcf	pounds per cubic foot
PG	performance grade
psf	pounds per square foot
psi	pounds per square inch
SPT	standard penetration test

1.0 INTRODUCTION

This report presents the results of our geotechnical engineering services for the new pedestrian bridge at Ewing Young Park located in Newberg, Oregon. The site location relative to surrounding physical features is shown on Figure 1.

We understand the project will include a pedestrian bridge located within Ewing Young Park that crosses Chehalem Creek. Bridge landings will be located on the northeastern and southwestern sides of Chehalem Creek. Structural loads were not provided at the time this report was prepared, but based on experience on similar projects, we assume maximum loads on each landing will be 300 kips.

Acronyms and abbreviations used herein are defined above, immediately following the Table of Contents.

2.0 PURPOSE AND SCOPE

The purpose of this evaluation was to provide geotechnical engineering recommendations for use in design and construction of the proposed pedestrian bridge. Specifically, we completed the following scope of services:

- Reviewed readily available, published geologic data and our in-house files for existing information on subsurface conditions in the site vicinity.
- Drilled one boring using solid-stem auger drilling methods near the northeastern bridge landing to a depth of 16.1 feet BGS.
- Classified the material encountered in the exploration, maintained a detailed log of the exploration, and collected samples at representative intervals.
- Conducted a laboratory testing program that included the following tests:
  - Four moisture content determinations in general accordance with ASTM D2216
  - Two particle-size analyses in general accordance with ASTM D1140
- Provided recommendations for site preparation and grading, including temporary and permanent slopes, fill placement criteria, suitability of on-site soil for fill, and subgrade preparation.
- Provided recommendations for wet weather construction.
- Provided foundation support recommendations for the proposed bridge.
- Evaluated groundwater conditions at the site and provided general recommendations for dewatering during construction and subsurface drainage.
- Provided recommendations for AC pavement design and pavement subgrade preparation for pedestrian walkways.
- Provided ASCE 7-16 seismic design parameters for the site.

3.0 SITE CONDITIONS

3.1 SURFACE CONDITIONS

The site is located within Ewing Young Park, west of the playground. The pedestrian bridge will cross Chehalem Creek in the northeast to southwest direction. The northeastern landing location gently slopes toward the riverbank with the elevation ranging between 105 and 110 feet. The southwestern landing location also gradually slopes toward the riverbank with an approximate elevation between 100 and 105 feet. Both sides of the riverbank steeply slope down to the creek bed, which is at an elevation of approximately 85 feet. Both landings are surfaced with landscaped grass and mature deciduous and coniferous trees.

3.2 SUBSURFACE CONDITIONS

3.2.1 General

Subsurface conditions were explored by drilling one boring (B-1) to a depth of 16.1 feet BGS on the northeastern side of the creek. The boring location is shown on Figure 2. We were unable to access the southwestern side of the creek. The exploration log and results of laboratory testing are presented in the Appendix.

Subsurface conditions consist of stiff to very stiff clay and silt with trace sand to a depth of 13 feet BGS. Beneath the silt and clay, very dense, cemented, clayey sand with gravel was encountered to the maximum depth explored (16.1 feet BGS). Based on laboratory testing, the clay and silt had a moisture content between 24 and 30 percent at the time of our exploration. The moisture content of the clayey sand was 19 percent at the time of our exploration.

3.2.2 Groundwater

Groundwater was not observed in our boring. A review of published water well logs in the site vicinity indicates seasonal groundwater levels are generally encountered at depths greater than 75 feet BGS and closer to the creek, groundwater may raise as high as within 25 feet BGS. The depth to groundwater will fluctuate in response to seasonal changes and the water level in Chehalem Creek.

4.0 DESIGN

4.1 SEISMIC DESIGN PARAMETERS

Based on our investigation, the parameters in Table 1 should be used to compute seismic base shear forces if the bridge structure is designed using the applicable provisions of ASCE 7-16. We selected Site Class C based on the results of our exploration.

Table 1. ASCE 7-16 Seismic Design Parameters

Seismic Design Parameter	Short Period (T_s = 0.2 second)	1 Second Period (T_1 = 1.0 second)
MCE Spectral Acceleration	S_s = 0.855 g	S_1 = 0.415 g
Site Class	C	
Site Coefficient	F_a = 1.200	F_v = 1.500
Adjusted Spectral Acceleration	S_{MS} = 1.026 g	S_{M1} = 0.623 g
Design Spectral Response Acceleration Parameters	S_{DS} = 0.684 g	S_{D1} = 0.415 g

4.1.1 Liquefaction and Lateral Spreading

Liquefaction is caused by earthquake-induced ground shaking, which creates a rapid increase in pore water pressure that reduces the effective stress between soil particles to near zero. Granular soil, which relies on interparticle friction for strength, is susceptible to liquefaction until the excess pore pressures can dissipate. In general, loose, saturated sand soil with low silt and clay content is the most susceptible to liquefaction. Silty soil with low plasticity is moderately susceptible to liquefaction under relatively higher levels of ground shaking. Soil susceptible to liquefaction was not encountered in our exploration. Consequently, liquefaction and lateral spreading are not considered site hazards.

4.2 SHALLOW FOUNDATIONS

In our opinion, the structure can be supported on conventional spread footings established in firm native silt and clay. If loose or soft material, organic material, tilled soil, or prior topsoil zones are encountered at footing subgrades, over-excavation for granular pads may be necessary. Granular pads should extend 6 inches beyond the margins of the footings for every foot excavated below the footing's base grade. The granular pads should consist of imported granular material, as defined in the "Structural Fill" section. The imported granular material should be compacted to not less than 95 percent of the maximum dry density, as determined by ASTM D1557, or until well keyed, as determined by one of our geotechnical staff. We recommend that a member of our geotechnical staff observe the prepared footing subgrade.

During periods of wet weather, we recommend a thin layer of crushed rock be placed over footing subgrades to prevent disturbance from foot traffic.

4.2.1 Bearing Capacity

Foundations bearing on firm, undisturbed native silt and clay can be proportioned for a maximum allowable bearing pressure of 2,500 psf. This bearing pressure is a net bearing pressure and applies to the total of dead and long-term live loads and may be doubled when considering seismic or wind loads. The weight of the footing and any overlying backfill can be ignored when calculating footing loads.

We recommend that isolated column and continuous wall footings have minimum widths of 24 and 18 inches, respectively. The bottom of exterior footings should be founded at least 18 inches below the lowest adjacent grade. Interior footings should be founded at least 12 inches below the top of the floor slab. The recommended minimum footing depth is greater than the anticipated frost depth.

4.2.2 Settlement

Based on our analysis and experience with similar soil, total post-construction consolidation-induced settlement should be less than 1 inch, with differential settlement less than one-half over a 50-foot span.

4.2.3 Lateral Resistance

Lateral loads on footings can be resisted by passive earth pressure on the sides of the foundations and by friction on the base of the foundations. Our analysis indicates that the available passive earth pressure for footings confined by structural fill or footings constructed in direct contact with the undisturbed native soil or structural fill is 350 pcf. Typically, the movement required to develop the available passive resistance may be relatively large; therefore, we recommend using a reduced passive pressure of 270 pcf equivalent fluid pressure. Adjacent pavement or upper 12-inch depth of adjacent areas should not be considered when calculating passive resistance. For unrestrained structures (allowed to rotate), an active equivalent fluid pressure of 35 pcf should be used for design. In addition, in order to rely on the recommended resistance, the groundwater level must be below the base of the footing and a minimum of 5 feet of horizontal clearance must exist between the face of the footings and any adjacent downslopes.

A friction coefficient of 0.30 can be used for footings established on native silt and clay or 0.40 for foundations established on a thin layer of crushed rock.

4.2.4 Construction Considerations

Because we were unable to access the southern side of the creek for subsurface explorations, NV5 should evaluate all foundation subgrades during construction to confirm removal of unsuitable soil and that the subgrade is consistent with the conditions observed in our exploration. If over-excavation is necessary, the unsuitable material should be replaced with compacted crushed rock.

4.3 PAVEMENT

Pedestrian walkways will be paved with AC and will primarily be used by pedestrian traffic, but occasionally light-duty trucks may traffic the AC. Pavement subgrade should be prepared in accordance with the “Site Preparation” section. Our pavement recommendations are based on the following assumptions:

- The top 12 inches of soil subgrade below the pavement section are compacted to at least 92 percent of its maximum density, per ASTM D1557, or observations indicate that it is in a firm, unyielding condition.
- Resilient moduli of 3,000 psi and 20,000 psi were estimated for the prepared subgrade and base rock, respectively.
- Initial and terminal serviceability indices of 4.2 and 2.0, respectively.
- Reliability of 75 percent and standard deviation of 0.45.
- Structural coefficients of 0.42 and 0.10 for the AC and base rock, respectively.
- A 20-year design life with no planned growth.
- Traffic loading as follows:
  - Pedestrian only
  - Light duty (access roads for walkways with occasional light-duty trucks, up to five trips per day, or similar)

If any of these assumptions are incorrect, our office should be contacted with the appropriate information so that the pavement designs can be revised. Our recommendations are provided in Table 2.

Table 2. Minimum Pavement Thicknesses with Compacted Soil Subgrade

Traffic Loading	AC (inches)	Aggregate Base (inches)
Pedestrian Only	2.0	5.0
Light Duty	3.0	8.0

All of the recommended pavement sections with subgrades prepared as recommended are suitable to support an occasional 75,000-pound fire truck.

The AC and aggregate base should meet the requirements outlined in the "Materials" section. Our design assumes that construction will be completed during an extended period of dry weather and with subgrade soil prepared as described in this report. Wet weather construction may require an increased thickness of aggregate base.

The pavement sections recommended above are designed to support post-construction traffic. Heavy construction traffic should not be allowed on prepared subgrade or new pavement but kept on haul roads or non-structural areas. If construction traffic is allowed on new pavement, allowance for the additional loading and wear should be included in the design section.

4.4 PERMANENT SLOPES

Permanent cut or fill slopes should not exceed a gradient of 2H:1V, unless specifically evaluated for stability. Slopes that will be maintained by mowing should not be constructed steeper than 3H:1V. Slopes should be planted with appropriate vegetation to provide protection against erosion as soon as possible after grading. Surface water runoff should be collected and directed away from slopes to prevent water from running down the face of the slope.

4.5 DRAINAGE CONSIDERATIONS

4.5.1 Temporary

During earthwork at the site, the contractor should be responsible for temporary drainage of surface water as necessary to prevent standing water and/or erosion at the working surface.

4.5.2 Surface

The ground surface around the finished foundations should be sloped away from at a minimum 2 percent gradient for a distance of at least 5 feet. Surface and subsurface drainage systems should not be tied to one another, unless special provisions are taken to prevent backflow of surface water into the subsurface drainage system.

4.5.3 Foundation Drains

Provided surface drainage recommendations are met, it is our opinion that perimeter foundation drains are not required for shallow foundations of at-grade structures. If perimeter foundation drains will be constructed, they should slope at a minimum of approximately ½ percent and drain by gravity or be pumped to a suitable discharge. The perforated drainpipe should not be tied to a stormwater drainage system without backflow provisions. The foundation drains should consist of 4-inch-diameter, perforated drainpipe embedded in a minimum 2-foot-wide zone of crushed drain rock wrapped in drainage geotextile that extends to within 12 inches of the ground surface.

The invert elevation of the drainpipe should be installed at least 18 inches below the elevation of the floor slab. The drain rock and geotextile should meet the requirements specified in the "Materials" section.

5.0 SITE DEVELOPMENT RECOMMENDATIONS

5.1 SITE PREPARATION

5.1.1 Stripping and Grubbing

If present, trees, shrubs, and topsoil should be removed from all proposed structural fill, pavement, and foundation areas and for a 5-foot margin around these areas. Stripped material should be transported off site for disposal or used in landscaped areas. In addition, root balls should be grubbed out to the depth of the roots, which could exceed 3 feet BGS. Depending on the methods used to remove root balls, considerable disturbance and loosening of the subgrade could occur during site grubbing. We recommend that soil disturbed during grubbing operations be removed to expose firm, undisturbed subgrade. The resulting excavations should be backfilled with structural fill.

5.1.2 Subgrade Evaluation

Upon completion of site stripping and grubbing, and prior to the placement of fill or pavement improvements, the exposed subgrade should be evaluated by probing or proof rolling. During wet weather, subgrade evaluation should be performed by probing with a foundation probe rather than proof rolling. Proof rolling, where used, should be conducted with a fully loaded dump truck or similarly heavy, rubber-tire construction equipment to identify soft, loose, or unsuitable areas. A member of our geotechnical staff should observe the proof rolling to evaluate yielding of the ground surface and/or conduct the probing. Areas that appear soft or loose should be improved in accordance with subsequent sections of this report.

5.2 CONSTRUCTION CONSIDERATIONS

The fine-grained soil present on this site is easily disturbed. If not carefully executed, site preparation can create extensive soft areas and significant subgrade repair costs can result. If construction is planned when the surficial fine-grained soil is wet or above the optimum moisture content required for compaction, the construction methods and schedule should be carefully considered with respect to protecting the subgrade to reduce the need to over-excavate disturbed or softened soil. The project budget should reflect the recommendations below if construction is planned during wet weather or when the surficial soil is above the optimum moisture content required for compaction.

If construction occurs when the fine-grained subgrades may be exposed to wet weather or are above the optimum moisture content, site preparation activities may need to be accomplished using track-mounted excavating equipment that loads removed material into trucks supported on granular haul roads. The thickness of the stabilization material for haul roads and staging areas will depend on the amount and type of construction traffic. In general, a 12- to 18-inch-thick mat of stabilization material is sufficient for light staging areas and the basic building pad but is generally not expected to be adequate to support heavy equipment or truck traffic. The granular mat for haul roads and areas with repeated heavy construction traffic typically needs to be increased to between 18 and 24 inches. The actual thickness of haul roads and staging areas should be based on the contractor's approach to site development and the amount and type of construction traffic. The imported granular material should be placed in one lift over the prepared, undisturbed subgrade and compacted using a smooth-drum, non-vibratory roller. In addition, a geotextile fabric should be placed as a barrier between the subgrade and imported granular material in areas of repeated construction traffic. The imported granular material and the geotextile fabric should meet the specifications in the "Materials" section. It is possible to use the existing AC and/or aggregate base as part of haul roads and staging areas for subgrade protection.

5.3 EXCAVATION

5.3.1 Temporary Excavations and Slopes

Excavations will be required for the installation of new foundations, pavement, and other earthwork activities. Conventional earthmoving equipment in proper working condition should be capable of making the necessary excavations. Temporary excavation sidewalls in silty soil may stand vertical to a depth of approximately 4 feet, provided groundwater seepage does not occur. Excavations deeper than 4 feet will require shoring or should be sloped. Sloped excavations may be used to vertical depths of 10 feet BGS and should have side slopes no steeper than 1H:1V, provided groundwater seepage does not occur. If slopes greater than 10 feet high are required, NV5 should be contacted to make additional recommendations. Deeper excavations will contain gravel and debris, which could result in excavations being larger than anticipated because of caving. All cut slopes should be protected from erosion by covering them during wet weather. If seepage, sloughing, or instability is observed, slopes should be flattened or shored.

5.3.2 Temporary Dewatering

While groundwater is expected at depths greater than 25 feet BGS, perched water will likely be encountered shallower, especially during the wet season. A sump located within the excavations may remove accumulated water, depending on the amount and persistence of water seepage and the length of time the trench is left open. In addition, the sidewalls of trench excavations will need to be flattened or shored if seepage is encountered. Where perched groundwater and fine-grained subgrades are present in excavations, we recommend placing at least 1 foot to 2 feet of stabilization material at the base of the excavations.

5.3.3 Safety

All excavations should be made in accordance with applicable OSHA and state regulations. While this report describes certain approaches to excavation, the contractor should be responsible for selecting excavation and dewatering methods, monitoring the excavations for safety, and providing shoring as required to protect personnel and adjacent utilities and structures.

5.4 MATERIALS

5.4.1 Structural Fill

Structural fill includes fill beneath foundations and any other areas intended to support structures, or within the influence zones of structures. Structural fill should be free of organic material and other deleterious materials and, in general, should consist of particles no larger than 4 inches in diameter. Recommendations for suitable fill material are provided in the following sections.

5.4.1.1 *On-Site Soil*

The native fine-grained soil is suitable for use as structural fill, provided it can be adequately moisture conditioned. Based on laboratory test results, the moisture content of the on-site soil was above optimum at the time of our explorations. We anticipate that moisture conditioning will be required to dry the soil to a moisture content near optimum. This will require an extended period of dry weather, typically experienced between June and mid-October. It will be difficult, if not impossible, to use the on-site soil during the wet season.

When used as structural fill, the on-site soil should be placed in lifts with a maximum uncompacted thickness of 8 inches. The soil should be compacted to not less than 92 percent of the maximum dry density, as determined by ASTM D1557.

5.4.1.2 *Imported Granular Material*

Imported granular material should be pit- or quarry-run rock, crushed rock, or crushed gravel and sand that is fairly well graded between coarse and fine and has less than 5 percent by dry weight passing the U.S. Standard No. 200 sieve. All granular material must be durable such that there is no degradation of the material during and after installation as structural fill. The percentage of fines can be increased to 12 percent if the fill is placed during dry weather and provided the fill material is moisture conditioned for proper compaction. The material should be placed in lifts with a maximum uncompacted thickness of 12 inches and compacted to not less than 95 percent of the maximum dry density, as determined by ASTM D1557. During the wet season or when wet subgrade conditions exist, the initial lift should have a maximum thickness of 18 inches and should be compacted by rolling with a smooth-drum, non-vibratory roller.

5.4.1.3 *Stabilization Material*

Stabilization material used in staging or haul road areas or in trenches should consist of 4- or 6-inch-minus pit- or quarry-run rock, crushed rock, or crushed gravel and sand. The material should have a maximum particle size of 6 inches, should have less than 5 percent by dry weight passing the U.S. Standard No. 4 sieve, and should have at least two mechanically fractured faces. The material should be free of organic material and other deleterious material. Stabilization material should be placed in lifts between 12 and 24 inches thick and compacted to a well-keyed, firm condition.

5.4.1.4 *Drain Rock*

Drain rock should consist of granular material that meets the specifications provided in OSSC 00430.11 (Granular Drain Backfill Material). In addition, the drain rock should be angular, should be well graded between coarse and fine material, should have less than 2 percent by dry weight passing the U.S. Standard No. 200 sieve, and should have at least two mechanically fractured faces. The drain rock should be wrapped in a drainage geotextile that meets the specifications provided below for drainage geotextiles.

5.4.1.4 *Pavement Aggregate Base*

Imported granular material used as base rock for aggregate base beneath pavement should consist of ¾- or 1½-inch-minus material (depending on the application) and meet the requirements in OSSC 00641 (Aggregate Subbase, Base, and Shoulders). In addition, the aggregate should have less than 5 percent by dry weight passing the U.S. Standard No. 200 sieve. The aggregate base should be compacted to not less than 95 percent of the maximum dry density, as determined by ASTM D1557.

5.4.2 Geotextile Fabric

5.4.2.1 Separate Geotextile Fabric

A separation geotextile fabric can be placed as a barrier between silty subgrade and granular material in staging areas, haul road areas, or in areas of repeated construction traffic. The subgrade geotextile should meet the requirements in OSSC 02320 (Geosynthetics) for subgrade geotextiles and be installed in conformance with OSSC 00350 (Geosynthetic Installation).

5.4.2.2 Drainage Geotextile Fabric

Drain rock and other granular material used for subsurface drains should be wrapped in a geotextile fabric that meets the specifications provided in OSSC 00350 (Geosynthetic Installation) and OSSC 02320 (Geosynthetics) for drainage geotextiles and installed in conformance with OSSC 00350 (Geosynthetic Installation).

5.4.3 AC

5.4.3.1 ACP

The AC should be Level 2, ½-inch, dense ACP according to OSSC 00745 (Asphalt Concrete Pavement – Statistical Acceptance) and compacted to 92 percent of the maximum specific gravity of the mix, as determined by AASHTO T 209. The minimum and maximum lift thicknesses are 2.0 and 3.5 inches, respectively, for ½-inch ACP. Asphalt binder should be performance graded and conform to PG 64-22 or better. If a thin asphalt overlay is selected, the nominal aggregate size should be reduced to 3/8 inch.

5.4.3.2 Cold Weather Paving Considerations

In general, AC paving is not recommended during the cold weather (temperatures less than 40 degrees Fahrenheit). Compacting under these conditions can result in low compaction and premature pavement distress.

Each AC mix design has a recommended compaction temperature range that is specific for the particular AC binder used. In colder temperatures, it is more difficult to maintain the temperature of the AC mix as it can lose heat while stored in the delivery truck, as it is placed, and in the time between placement and compaction. In Oregon, the AC surface temperature during paving should be at least 40 degrees Fahrenheit for lift thickness greater than 2.5 inches and at least 50 degrees Fahrenheit for lift thickness between 2.0 and 2.5 inches.

If paving activities must take place during cold-weather construction as defined above, the project team should be consulted and a site meeting should be held to discuss ways to lessen low compaction risks.

5.5 EROSION CONTROL

The on-site soil is susceptible to erosion. Consequently, we recommend that slopes be covered with an appropriate erosion control product if construction occurs during periods of wet weather. We recommend that all slope surfaces be planted as soon as practical to minimize erosion.

Surface water runoff should be collected and directed away from slopes to prevent water from running down the slope face. Erosion control measures such as straw bales, sediment fences, and temporary detention and settling basins should be used in accordance with local and state ordinances.

6.0 OBSERVATION OF CONSTRUCTION

Satisfactory foundation and earthwork performance depends to a large degree on quality of construction. Sufficient observation of the contractor's activities is a key part of determining that the work is completed in accordance with the construction drawings and specifications. Subsurface conditions observed during construction should be compared with those encountered during the subsurface exploration. Recognition of changed conditions often requires experience; therefore, qualified personnel should visit the site with sufficient frequency to detect if subsurface conditions change significantly from those anticipated.

We recommend that NV5 be retained to observe earthwork activities. We anticipate that this will consist of evaluating footing, floor slab, sidewalk, and pavement subgrade; observing the placement of structural fill; evaluating subgrade repairs; observing ground improvement; testing trench backfill; and performing laboratory compaction and field moisture-density tests.

7.0 LIMITATIONS

We have prepared this report for use by members of the design and construction team for the proposed project. The data and report can be used for bidding or estimating purposes, but our report, conclusions, and interpretations should not be construed as warranty of the subsurface conditions and are not applicable to other sites.

Exploration observations indicate soil conditions only at specific locations and only to the depths penetrated. They do not necessarily reflect soil strata or water level variations that may exist between exploration locations. If subsurface conditions differing from those described are noted during the course of excavation and construction, re-evaluation will be necessary.

The site development plans and design details were preliminary at the time this report was prepared. When the design has been finalized and if there are changes in the site grades or location, configuration, design loads, or type of construction, the conclusions and recommendations presented may not be applicable. If design changes are made, we request that we be retained to review our conclusions and recommendations and to provide a written modification or verification.

The scope of our services does not include services related to construction safety precautions, and our recommendations are not intended to direct the contractor's methods, techniques, sequences, or procedures, except as specifically described in this report for consideration in design.

Within the limitations of scope, schedule, and budget, our services have been executed in accordance with generally accepted practices in this area at the time this report was prepared. No warranty, express or implied, should be understood.

♦ ♦ ♦

We appreciate the opportunity to be of continued service to you. Please call if you have questions concerning this report or if we can provide additional services.

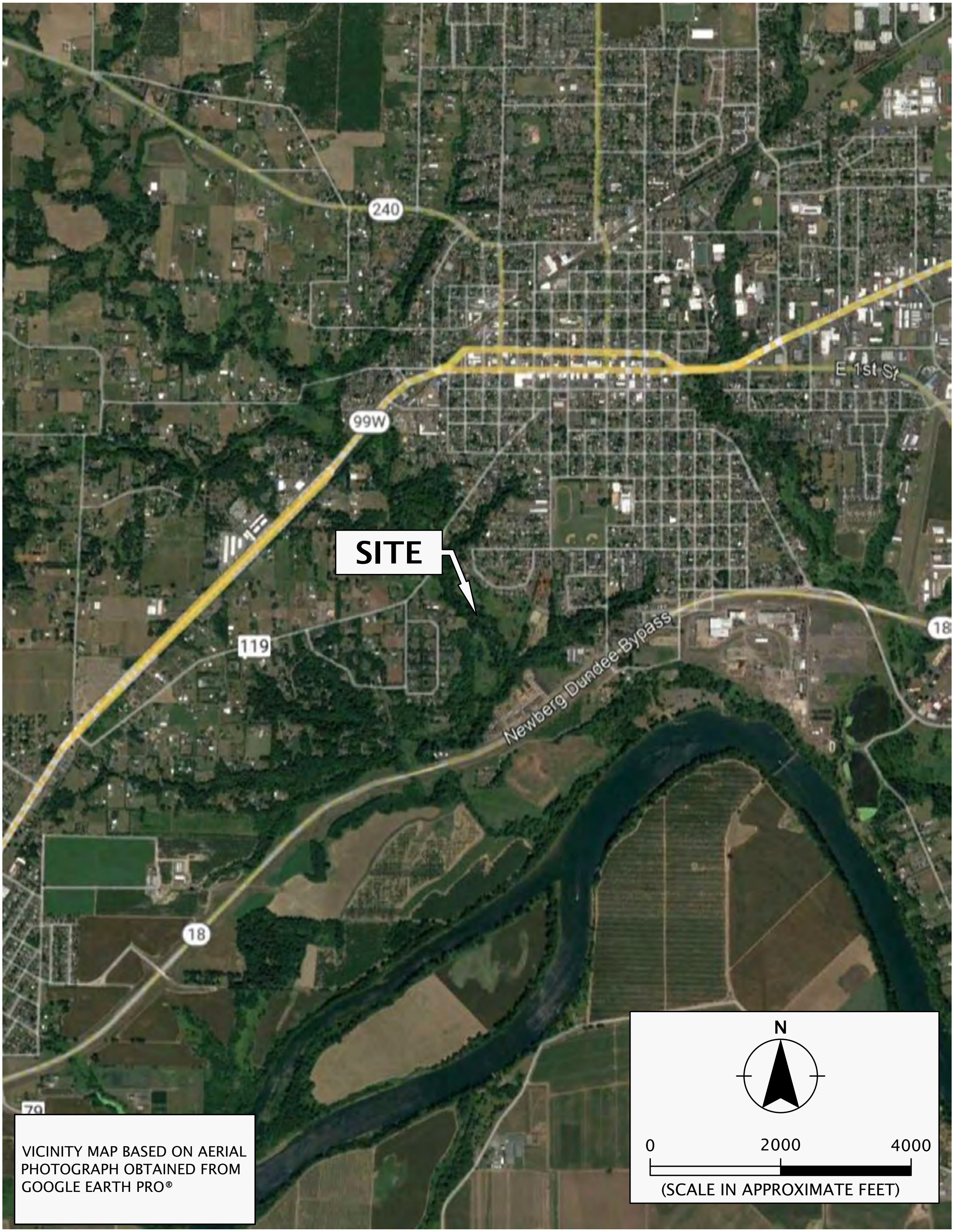
Sincerely,

NV5

Tyler A Pierce, P.E.
Project Engineer

Jeffery D. Tucker, P.E., G.E.
Principal Engineer

FIGURES



VICINITY MAP BASED ON AERIAL PHOTOGRAPH OBTAINED FROM GOOGLE EARTH PRO®

NV5	NV5-18-01	**VICINITY MAP**
	JANUARY 2022	PEDESTRIAN BRIDGE - EWING YOUNG PARK NEWBERG, OR — **FIGURE 1**

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LEGEND:

APPROXIMATE PEDESTRIAN BRIDGE LOCATION

B-1 BORING

N

0 50 100

(SCALE IN FEET)

SITE PLAN BASED ON AERIAL PHOTOGRAPH
OBTAINED FROM GOOGLE EARTH PRO®
DECEMBER 6, 2021

FIGURE 2

SITE PLAN

PEDESTRIAN BRIDGE - EWING YOUNG PARK
NEWBERG, OR

NV5-18-01

JANUARY 2022

NV5

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APPENDIX

APPENDIX

FIELD EXPLORATIONS

GENERAL

The site was explored by drilling one boring (B-1) on November 22, 2021, to a depth of 16.1 feet BGS. Drilling services were provided by Dan J. Fischer Excavating, Inc. of Forest Grove, Oregon. Figure 2 shows the approximate exploration location. The exploration location was determined by pacing from existing site features and should be accurate to the degree implied by the methods used. The exploration was observed by a member of NV5's staff. The exploration log is presented in this appendix.

SOIL SAMPLING

We collected representative samples of the various soils encountered during drilling for geotechnical laboratory testing. Samples were collected from the boring using 1½-inch-inside diameter split-spoon samplers (SPT) in general accordance with ASTM D1586. The sampler was driven into the soil with a 140-pound hammer free falling 30 inches. The sampler was driven a total distance of 18 inches. The number of blows required to drive the sampler the final 12 inches is recorded on the exploration log, unless otherwise noted. Sampling methods and intervals are shown on the exploration log.

The hammer used to conduct the SPTs was lifted using a rope and cathead system. The hammer was raised using two wraps of the rope around the cathead to conduct the SPTs.

SOIL CLASSIFICATION

The soil samples were classified in accordance with the "Exploration Key" (Table A-1) and "Soil Classification System" (Table A-2), which are presented in this appendix. The exploration log indicates the depths at which the soil or its characteristics change, although the change actually could be gradual. If the change occurred between sample locations, the depth was interpreted. Classifications are shown on the exploration log.

LABORATORY TESTING

CLASSIFICATION

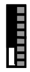
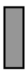
The soil samples were classified in the laboratory to confirm field classifications. The laboratory classifications are shown on the exploration log if those classifications differed from the field classifications.

MOISTURE CONTENT

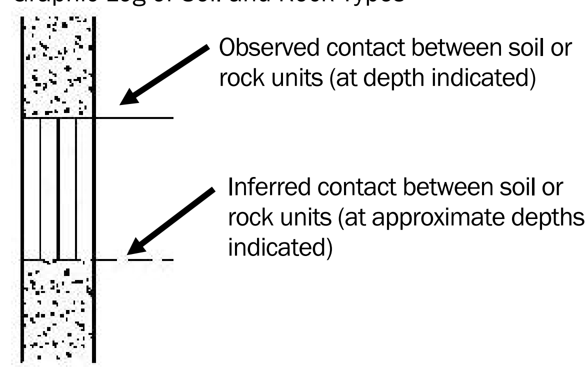
We tested the natural moisture content of select soil samples in general accordance with ASTM D2216. The test results are presented in this appendix.

PARTICLE-SIZE ANALYSIS

We completed particle-size analysis on select soil samples in order to determine the particle-size distribution in general accordance with ASTM D1140. The test results are presented in this appendix.

SYMBOL	SAMPLING DESCRIPTION
	Location of sample collected in general accordance with ASTM D1586 using Standard Penetration Test (SPT) with recovery
	Location of sample collected using thin-wall Shelby tube or Geoprobe® sampler in general accordance with ASTM D1587 with recovery
	Location of sample collected using Dames & Moore sampler and 300-pound hammer or pushed with recovery
	Location of sample collected using Dames & Moore sampler and 140-pound hammer or pushed with recovery
	Location of sample collected using 3-inch-outside diameter California split-spoon sampler and 140-pound hammer with recovery
	Location of grab sample
	Rock coring interval
	Water level during drilling
	Water level taken on date shown

Graphic Log of Soil and Rock Types



GEOTECHNICAL TESTING EXPLANATIONS

ATT	Atterberg Limits	P	Pushed Sample
CBR	California Bearing Ratio	PP	Pocket Penetrometer
CON	Consolidation	P200	Percent Passing U.S. Standard No. 200 Sieve
DD	Dry Density		
DS	Direct Shear	RES	Resilient Modulus
HYD	Hydrometer Gradation	SIEV	Sieve Gradation
MC	Moisture Content	TOR	Torvane
MD	Moisture-Density Relationship	UC	Unconfined Compressive Strength
NP	Non-Plastic	VS	Vane Shear
OC	Organic Content	kPa	Kilopascal

ENVIRONMENTAL TESTING EXPLANATIONS

CA	Sample Submitted for Chemical Analysis	ND	Not Detected
P	Pushed Sample	NS	No Visible Sheen
PID	Photoionization Detector Headspace Analysis	SS	Slight Sheen
		MS	Moderate Sheen
ppm	Parts per Million	HS	Heavy Sheen

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EXPLORATION KEY

TABLE A-1

RELATIVE DENSITY - COARSE-GRAINED SOIL

Relative Density	Standard Penetration Test (SPT) Resistance	Dames & Moore Sampler (140-pound hammer)	Dames & Moore Sampler (300-pound hammer)
Very loose	0 – 4	0 – 11	0 – 4
Loose	4 – 10	11 – 26	4 – 10
Medium dense	10 – 30	26 – 74	10 – 30
Dense	30 – 50	74 – 120	30 – 47
Very dense	More than 50	More than 120	More than 47

CONSISTENCY - FINE-GRAINED SOIL

Consistency	Standard Penetration Test (SPT) Resistance	Dames & Moore Sampler (140-pound hammer)	Dames & Moore Sampler (300-pound hammer)	Unconfined Compressive Strength (tsf)
Very soft	Less than 2	Less than 3	Less than 2	Less than 0.25
Soft	2 – 4	3 – 6	2 – 5	0.25 – 0.50
Medium stiff	4 – 8	6 – 12	5 – 9	0.50 – 1.0
Stiff	8 – 15	12 – 25	9 – 19	1.0 – 2.0
Very stiff	15 – 30	25 – 65	19 – 31	2.0 – 4.0
Hard	More than 30	More than 65	More than 31	More than 4.0

PRIMARY SOIL DIVISIONS			GROUP SYMBOL	GROUP NAME
COARSE-GRAINED SOIL (more than 50% retained on No. 200 sieve)	GRAVEL (more than 50% of coarse fraction retained on No. 4 sieve)	CLEAN GRAVEL (< 5% fines)	GW or GP	GRAVEL
		GRAVEL WITH FINES (≥ 5% and ≤ 12% fines)	GW-GM or GP-GM	GRAVEL with silt
			GW-GC or GP-GC	GRAVEL with clay
		GRAVEL WITH FINES (> 12% fines)	GM	silty GRAVEL
			GC	clayey GRAVEL
			GC-GM	silty, clayey GRAVEL
	SAND (50% or more of coarse fraction passing No. 4 sieve)	CLEAN SAND (<5% fines)	SW or SP	SAND
		SAND WITH FINES (≥ 5% and ≤ 12% fines)	SW-SM or SP-SM	SAND with silt
			SW-SC or SP-SC	SAND with clay
		SAND WITH FINES (> 12% fines)	SM	silty SAND
			SC	clayey SAND
			SC-SM	silty, clayey SAND
FINE-GRAINED SOIL (50% or more passing No. 200 sieve)	SILT AND CLAY	Liquid limit less than 50	ML	SILT
			CL	CLAY
			CL-ML	silty CLAY
			OL	ORGANIC SILT or ORGANIC CLAY
		Liquid limit 50 or greater	MH	SILT
			CH	CLAY
			OH	ORGANIC SILT or ORGANIC CLAY
HIGHLY ORGANIC SOIL			PT	PEAT

MOISTURE CLASSIFICATION

Term	Field Test
dry	very low moisture, dry to touch
moist	damp, without visible moisture
wet	visible free water, usually saturated

ADDITIONAL CONSTITUENTS

Secondary granular components or other materials such as organics, man-made debris, etc.

Percent	Silt and Clay In: Fine-Grained Soil	Silt and Clay In: Coarse-Grained Soil	Percent	Sand and Gravel In: Fine-Grained Soil	Sand and Gravel In: Coarse-Grained Soil
< 5	trace	trace	< 5	trace	trace
5 – 12	minor	with	5 – 15	minor	minor
> 12	some	silty/clayey	15 – 30	with	with
			> 30	sandy/gravelly	Indicate %

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SOIL CLASSIFICATION SYSTEM

TABLE A-2

BORING LOG - NV5 - 1 PER PAGE NV5-18-01-B1.GPJ GDI_NV5.GDT PRINT DATE: 1/17/22:SN:KT

DEPTH FEET	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION DEPTH	TESTING	SAMPLE	▲ BLOW COUNT ● MOISTURE CONTENT % RQD% CORE REC% (0 – 50 – 100)	INSTALLATION AND COMMENTS
0.0		Stiff, brown with orange mottled and black streaked CLAY (CL/CH), trace sand and organics; moist (2-inch-thick root zone).					
2.5				PP		▲ 12 ●	PP = 3.0 tsf
5.0		very stiff at 5.0 feet		P200 PP		▲ 23 ●	P200 = 95% PP = 4.5 tsf
7.5				PP		▲ 17 ●	PP = 2.75 tsf
		Very stiff, brown with orange mottled SILT (ML), trace sand; moist.	9.5				
10.0				PP		▲ 18	PP = 3.0 tsf
12.5							
		Very dense, brown with orange mottled, clayey SAND with gravel (SC); moist, weak to moderate cementation.	13.0				
15.0				P200		● 28-50-50/1" ▲	P200 = 41%
		Exploration terminated at a depth of 16.1 feet due to refusal. SPT completed using two wraps with a cathead.	16.1				Surface elevation was not measured at the time of exploration.
17.5							
20.0							

DRILLED BY: Dan J. Fischer Excavating, Inc. LOGGED BY: H. Herinckx COMPLETED: 11/22/21

BORING METHOD: solid-stem auger (see document text) BORING BIT DIAMETER: 4 inches

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JANUARY 2022

BORING B-1

PEDESTRIAN BRIDGE - EWING YOUNG PARK
NEWBERG, OR

FIGURE A-1

SAMPLE INFORMATION			MOISTURE CONTENT (PERCENT)	DRY DENSITY (PCF)	SIEVE			ATTERBERG LIMITS		
EXPLORATION NUMBER	SAMPLE DEPTH (FEET)	ELEVATION (FEET)			GRAVEL (PERCENT)	SAND (PERCENT)	P200 (PERCENT)	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
B-1	2.5		30							
B-1	5.0		24				95			
B-1	7.5		28							
B-1	15.0		19				41			

NV5

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