ATTACHMENT 15

RILEYGROUP

GEOTECHNICAL ENGINEERING REPORT

PREPARED BY:

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PREPARED FOR:

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RGI PROJECT NO. 2016-189A

CAPITOL CENTER DEVELOPMENT
411 4TH AVENUE WEST
OLYMPIA, WASHINGTON 98501

DECEMBER 19, 2017

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RILEYGROUP

December 19, 2017

Mr. Ken Brogan
Brogan Companies
5020 Joppa Street Southwest
Tumwater, Washington 98512

Subject: **Geotechnical Engineering Report**
Capitol Center Development
411 4th Avenue West
Olympia, Washington 98501
RGI Project No. 2016-189A

Dear Mr. Brogan:

As requested, The Riley Group, Inc. (RGI) has performed a Geotechnical Engineering Report (GER) for the above-referenced subject site. Our services were completed in accordance with our proposal PRP2016-302B dated October 28, 2016 and authorized by you November 9, 2016. The information in this GER is based on our understanding of the proposed construction, and the soil and groundwater conditions encountered in the borings completed by RGI at the site on December 8, 2016.

RGI recommends that you submit the project plans and specifications to RGI for a general review so that we may confirm that the recommendations in this report are interpreted and implemented properly in the construction documents. RGI also recommends that a representative of our firm be present on site during portions of the project construction to confirm that the soil and groundwater conditions are consistent with those that form the basis for the engineering recommendations in this report.

If you have any questions or require additional information, please contact us.

Sincerely yours,

THE RILEY GROUP, INC.

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Licensed Geologist
ERIC L. WOODS
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Executive Summary

This Executive Summary should be used in conjunction with the entire Geotechnical Engineering Report (GER) for design and/or construction purposes. It should be recognized that specific details were not included or fully developed in this section, and the report must be read in its entirety for a comprehensive understanding of the items contained herein. Section 7.0 should be read for an understanding of limitations.

RGI's geotechnical scope of work included the advancement of two test borings to a maximum depth of 76.5 feet below ground surface (bgs).

Based on the information obtained from our subsurface exploration, the site is suitable for development of the proposed project. The following geotechnical considerations were identified:

Soil Conditions: The soils encountered during field exploration include up to 15 feet of fill over native soil. The fill consists of very loose to loose silty sand with gravel trace of wood, organics, and shell fragments. The native soil is very loose to medium dense silty sand with interbedded silt layers over medium dense to very dense sandy gravel to gravely sand at about 55 feet.

Groundwater: Groundwater seepage was encountered at depths of 11 to 15 feet during our subsurface exploration.

Foundations: The building foundation should be supported on piles extending to the suitable dense soils encountered at least 55 feet below the ground surface.

Slab-on-grade: Concrete slab floors should be supported on the grade beam system supported on the piles.

Pavements: The following pavement sections are recommended:

- **For general parking**: 2 inches of asphalt concrete (AC) over 6 inches of crushed rock base (CRB) over 12 inches of structural fill over woven geotextile fabric
- **For driveway and heavy traffic area**: 3 inches of AC over 8 inches of CRB over 12 inches of structural fill over woven geotextile fabric

1.0 Introduction

This Geotechnical Engineering Report (GER) presents the results of the geotechnical engineering services provided for the Capitol Center Development located at 411 4th Avenue West in Olympia, Washington. The approximate location of the site is shown on Figure 1.

The recommendations in the following sections of this GER are based upon our current understanding of the proposed site development as outlined below. If actual features vary or changes are made, we should review them in order to modify our recommendations as required. In addition, RGI requests to review the site grading plan, final design drawings and specifications when available to verify that our project understanding is correct and that our recommendations have been properly interpreted and incorporated into the project design and construction.

2.0 Project description

The project site is located at 411 4th Avenue West in Olympia, Washington. The approximate location of the site is shown on Figure 1.

The site consists of two parcels of land with a total area about 1.06 acres in size. We understand it is proposed to demolish the existing single-story Capitol Center Annex office building and construct a three-story apartment building with half-level of parking on the northwestern portion of the site and renovate the existing nine-story Capitol Center office building on the southern portion of the site. Our understanding of the project is based on a conceptual plan prepared by Nardi Associates LLP forwarded to us on October 28, 2016.

At the time of preparing this report, detailed project plans were not available for our review. Based on our experience with similar construction, RGI anticipates that the proposed building will be supported on perimeter walls with bearing loads of 3 to 6 kips per linear foot, and a series of columns with a maximum load up to 250 kips. Slab-on-grade floor loading of 250 pounds per square foot (psf) are expected. Based on the topography, RGI expects that the site grading will require shallow cuts to achieve finish grade elevations.

3.0 Field Exploration and Laboratory Testing

3.1 Field Exploration

On December 8, 2016, RGI observed the drilling of two test borings to depths up to 76.5 feet bgs. The approximate exploration locations are shown on Figure 2.

Field logs of each exploration were prepared by the geologist that continuously observed the drilling. These logs included visual classifications of the materials encountered during drilling as well as our interpretation of the subsurface conditions between samples. The boring logs included in Appendix A represent an interpretation of the field logs and include modifications based on laboratory observation and analysis of the samples.

3.2 LABORATORY TESTING

During the field investigation, a representative portion of each recovered sample was sealed in containers and transported to our laboratory for further visual and laboratory examination. Selected samples retrieved from the borings were tested for moisture content and grain-size analysis to aid in soil classification and provide input for the recommendations provided in this GER. The results and descriptions of the laboratory tests are enclosed in Appendix A.

4.0 Site Conditions

4.1 SURFACE

The subject site is an L-shaped area located at 411 4th Avenue West in Olympia, Washington. The site is bordered to the north by 4th Avenue Northwest and a paved parking lot, to the east by paved parking lot and Sylvester Street Southwest, to the south by 5th Avenue Northwest, and to the west by Simmons Street Southwest.

The site is occupied by a single-story Capitol Center Annex office building on the northwestern portion of the site and a nine-story Capitol Center office building on the southern portion of the site.

4.2 GEOLOGY

Review of the *Geologic Folio of the Olympia-Lacey-Tumwater Urban Area, Washington – Liquefaction Susceptibility Map* by Steven P, Palmer and etc. (1999) indicates that the soil in the project vicinity is mapped as artificial fill (Map Unit af), which is clay, silt, sand, gravel, organic matters, shells, and construction debris. These descriptions are generally similar to the upper fill encountered during our field explorations.

4.3 SOILS

The soils encountered during field exploration include up to 15 feet of fill over native soil. The fill consists of very loose to loose silty sand with gravel trace of wood, organics, and shell fragments. The native soil is very loose to medium dense silty sand with interbedded silt layer over medium dense to very dense sandy gravel to gravely sand at about 55 feet.

More detailed descriptions of the subsurface conditions encountered are included in Appendix A. Sieve analysis was performed on seven selected soil samples. Grain size distribution curves are included in Appendix A.

4.4 GROUNDWATER

Groundwater seepage was encountered at depths of 11 to 15 feet during our subsurface exploration. The seepage appears to be static groundwater in the area.

It should be recognized that fluctuations of the groundwater table will occur due to seasonal variations in the amount of rainfall, runoff, and other factors not evident at the time the explorations were performed. In addition, perched water can develop within seams and layers contained in fill soils or higher permeability soils overlying less permeable soils following periods of heavy or prolonged precipitation. Therefore, groundwater levels during construction or at other times in the future may be higher or lower than the levels indicated on the logs. Groundwater level fluctuations should be considered when developing the design and construction plans for the project

4.5 SEISMIC CONSIDERATIONS

Based on the 2012 International Building Code (IBC), RGI recommends the follow seismic parameters in Table 1 be used for design.

Table 1 IBC Seismic Parameters

2012 IBC Parameter	Value
Site Soil Class[1]	E[2]
Site Latitude	47.044299 N
Site Longitude	122.90626 W
Maximum considered earthquake spectral response acceleration parameters (g)	S_s =1.331, S_1 =0.547
Spectral response acceleration parameters adjusted for site class (g)	S_{ms} =1.197, S_{m1} =1.312
Design spectral response acceleration parameters (g)	S_{ds} =0.798, S_{d1} =0.875

1 Note: In general accordance with the USGS *2012 International Building Code*. IBC Site Class is based on the average characteristics of the upper 100 feet of the subsurface profile.

2 Note: The *2012 International Building Code* requires a site soil profile determination extending to a depth of 100 feet for seismic site classification. The current scope of our services does not include the required 100 foot soil profile determination. Test borings extended to a maximum depth of 51.5 feet, and this seismic site class definition considers that similar soil continues below the maximum depth of the subsurface exploration.

Liquefaction is a phenomenon where there is a reduction or complete loss of soil strength due to an increase in water pressure induced by vibrations from a seismic event. Liquefaction mainly affects geologically recent deposits of fine-grained sands that are below the groundwater table. Soils of this nature derive their strength from intergranular friction. The generated water pressure or pore pressure essentially separates the soil grains and eliminates this intergranular friction, thus reducing or eliminating the soil's strength.

For liquefaction analysis, soil information obtained from the test borings B-1 and B-2 was used. Analysis indicates the native soil below the groundwater table may liquefy under severe earthquake ground motions (Magnitude 7 and horizontal acceleration 0.25g to 0.4g) or moderate ground shaking of significant duration. However, the soil above groundwater level will not likely be liquefied during an earthquake event.

Total ground settlement from 14 to 21 inches in the eastern portion of the site and 18 to 23 inches in the western portion of the site is possible upon dissipation of excess pore pressures generated during a seismic event. The resulting differential settlement will be approximately 5 to 7 inches along the building length from west to east. The analysis is attached in Appendix B.

4.6 GEOLOGIC HAZARD AREAS

Regulated geologically hazardous areas include erosion, landslide, earthquake, or other geological hazards. Based on the City of Olympia Critical Areas Ordinance (Chapter 18.32.660), the project site is classified as a seismic hazard area.

5.0 Discussion and Recommendations

5.1 GEOTECHNICAL CONSIDERATIONS

Based on the explorations and our analysis, the site is challenging for the proposed development. If the building foundation is supported on shallow footings bearing on existing fill or native soil, it will experience a significant amount of settlements. The settlements include consolidation settlement and earthquake induced liquefaction settlement. The potential differential settlement will be excessive to building structure. To avoid the settlements, the typical solution is to support the building foundation on a deep foundation system bearing on competent native soil.

Slab-on-grade floors for the proposed building can be similarly supported on the grade beam system bearing on piles. Pavements can be supported on at least 12 inches of structural fill with a woven geotextile fabric over existing fill soil.

Detailed recommendations regarding the above issues and other geotechnical design considerations are provided in the following sections. These recommendations should be incorporated into the final design drawings and construction specifications.

5.1.1 EROSION AND SEDIMENT CONTROL

Potential sources or causes of erosion and sedimentation depend on construction methods, slope length and gradient, amount of soil exposed and/or disturbed, soil type, construction sequencing and weather. The impacts on erosion-prone areas can be reduced by implementing an erosion and sedimentation control plan. The plan should be designed in accordance with applicable city and/or county standards.

RGI recommends the following erosion control Best Management Practices (BMPs):

- Scheduling site preparation and grading for the drier summer and early fall months and undertaking activities that expose soil during periods of little or no rainfall
- Retaining existing vegetation whenever feasible
- Establishing a quarry spall construction entrance
- Installing siltation control fencing or anchored straw or coir wattles on the downhill side of work areas
- Covering soil stockpiles with anchored plastic sheeting
- Revegetating or mulching exposed soils with a minimum 3-inch thickness of straw if surfaces will be left undisturbed for more than 1 day during wet weather or 1 week in dry weather
- Directing runoff away from exposed soils and slopes
- Minimizing the length and steepness of slopes with exposed soils and cover excavation surfaces with anchored plastic sheeting (Graded and disturbed slopes should be tracked in place with the equipment running perpendicular to the slope contours so that the track marks provide a texture to help resist erosion and channeling. Some sloughing and raveling of slopes with exposed or disturbed soil should be expected.)
- Decreasing runoff velocities with check dams, straw bales or coir wattles
- Confining sediment to the project site
- Inspecting and maintaining erosion and sediment control measures frequently (The contractor should be aware that inspection and maintenance of erosion control BMPs is critical toward their satisfactory performance. Repair and/or replacement of dysfunctional erosion control elements should be anticipated.)

Permanent erosion protection should be provided by reestablishing vegetation using hydroseeding and/or landscape planting. Until the permanent erosion protection is established, site monitoring should be performed by qualified personnel to evaluate the effectiveness of the erosion control measures. Provisions for modifications to the erosion control system based on monitoring observations should be included in the erosion and sedimentation control plan.

5.1.2 STRIPPING

Stripping efforts should include removal of pavements, vegetation, organic materials, and deleterious debris from areas slated for building, pavement, and utility construction. Based on the thickness of the pavement at the boring locations, we anticipate stripping depths of about 8 inches across the site.

5.1.3 EXCAVATIONS

All temporary cut slopes associated with the site and utility excavations should be adequately inclined to prevent sloughing and collapse. Based on OSHA regulations, the native soil classifies as a Group C soil.

Accordingly, for excavations more than 4 feet but less than 20 feet in depth, the temporary side slopes should be laid back with a minimum slope inclination of 1.5H:1V (Horizontal:Vertical) in native soil. If there is insufficient room to complete the excavations in this manner, or excavations greater than 20 feet in depth are planned, using temporary shoring to support the excavations should be considered. For open cuts at the site, RGI recommends:

- No traffic, construction equipment, stockpiles or building supplies are allowed at the top of cut slopes within a distance of at least 5 feet from the top of the cut.
- Exposed soil along the slope is protected from surface erosion using waterproof tarps and/or plastic sheeting.
- Construction activities are scheduled so that the length of time the temporary cut is left open is minimized.
- Surface water is diverted away from the excavation.
- The general condition of slopes should be observed periodically by a geotechnical engineer to confirm adequate stability and erosion control measures.

In all cases, however, appropriate inclinations will depend on the actual soil and groundwater conditions encountered during earthwork. Ultimately, the site contractor must be responsible for maintaining safe excavation slopes that comply with applicable OSHA or WISHA guidelines.

5.2 EARTHWORK

Based on the site grades, RGI anticipates the earthwork will include cuts up to 10 feet to reach subgrade elevations for the building grades, installing underground utilities and excavating and backfilling the building foundations.

5.2.1 SITE PREPARATION

RGI anticipates that some areas of loose or soft soil will be exposed upon completion of stripping and grubbing. Subgrade verification should be considered an essential step in site preparation. After stripping, grubbing, and prior to placement of structural fill for the pavement areas, RGI recommends proofrolling the subgrades. The existing fill or native soils in these areas should moisture conditioned and compacted to a firm and unyielding condition in order to achieve a minimum compaction level of 95 percent of the modified proctor maximum dry density as determined by the American Society of Testing and

Materials D1557-09 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (ASTM D1557).

Proofrolling and adequate subgrade compaction can only be achieved when the soils are within approximately ± 2 percent moisture content of the optimum moisture content. Soils which appear firm after stripping and grubbing may be proofrolled with a heavy compactor, loaded double-axle dump truck, or other heavy equipment under the observation of an RGI representative. This observer will assess the subgrade conditions prior to placement of the geotextile fabric and structural fill for the pavement section.

Subgrade soils that become disturbed due to elevated moisture conditions should be overexcavated to reveal firm, non-yielding, non-organic soils and backfilled with compacted structural fill. To limit overexcavations, RGI recommends that the earthwork portion of this project be completed during extended periods of warm and dry weather if possible. If earthwork is completed during the wet season (typically November through May) it will be necessary to take extra precautionary measures to protect subgrade soils. Wet season earthwork will require additional mitigative measures beyond what would be expected during the drier summer and fall months.

5.2.2 STRUCTURAL FILL

RGI recommends fill below the foundation and floor slab, behind retaining walls, and below pavement and hardscape surfaces be placed in accordance with the following recommendations for structural fill. The structural fill in should be placed after completion of site preparation procedures as described above.

RGI recommends placing structural fill in lifts not exceeding 12 inches in loose thickness and thoroughly compacted as specified in Table 3. The suitability of soils for compacted structural fill use will depend on the gradation and moisture content of the soil when it is placed. As the amount of fines (that portion passing the US. No. 200 sieve) increases, soil becomes increasingly sensitive to small changes in moisture content and adequate compaction becomes more difficult or impossible to achieve. Soils containing more than about 5 percent fines cannot be consistently compacted to a dense, non-yielding condition when the moisture content is more than 2 percent above or below optimum. Optimum moisture content is that moisture which results in the greatest compacted dry density with a specified compactive effort.

The native soil and existing fill encountered is not suitable for re-use as structural fill in its present condition. RGI recommends import structural fill be used for all grading and backfill. The import material should meet the grading requirements listed in Table 2 in order to be used as structural fill.

Table 2 Structural Fill Gradation

U.S. Sieve Size	Percent Passing
3 inches	100
No. 4 sieve	75 percent
No. 200 sieve	5 percent *

*Based on minus 3/4 inch fraction.

Prior to use, an RGI representative should observe and test all materials imported to the site for use as structural fill. Structural fill materials should be placed in uniform loose layers not exceeding 12 inches and compacted as specified in Table 3. The soil's maximum density and optimum moisture should be determined by ASTM D1557.

Table 3 Structural Fill Compaction ASTM D1557

Location	Material Type	Minimum Compaction Percentage	Moisture Content Range	
Foundations	On-site granular or approved imported fill soils:	95	+2	-2
Retaining Wall Backfill	On-site granular or approved imported fill soils:	92	+2	-2
Slab-on-grade	On-site granular or approved imported fill soils:	95	+2	-2
General Fill (non-structural areas)	On-site granular or approved imported fill soils:	90	+3	-2
Pavement – Subgrade and Base Course	On-site granular or approved imported fill soils:	95	+2	-2

Placement and compaction of structural fill should be observed by RGI. A representative number of in-place density tests should be performed as the fill is being placed to confirm that the recommended level of compaction is achieved.

5.2.3 CUT AND FILL SLOPES

All permanent cut and fill slopes should be graded with a finished inclination no greater than 2H:1V. Upon completion of construction, the slope face should be trackwalked, compacted and vegetated, or provided with other physical means to guard against erosion. All fill placed for slope construction should meet the structural fill requirements as described in Section 5.2.2.

Final grades at the top of the slopes must promote surface drainage away from the slope crest. Water must not be allowed to flow in an uncontrolled fashion over the slope face. If it is necessary to direct surface runoff towards the slope, it should be controlled at the top of the slope, piped in a closed conduit installed on the slope face, and taken to an appropriate point of discharge beyond the toe of the slope.

5.2.4 WET WEATHER CONSTRUCTION CONSIDERATIONS

RGI recommends that preparation for site grading and construction include procedures intended to drain ponded water, control surface water runoff, and to collect shallow subsurface seepage zones in excavations where encountered. It will not be possible to successfully compact the subgrade or utilize on-site soils as structural fill if accumulated water is not drained prior to grading or if drainage is not controlled during construction. Attempting to grade the site without adequate drainage control measures will reduce the amount of on-site soil effectively available for use, increase the amount of select import fill materials required, and ultimately increase the cost of the earthwork phases of the project. Free water should not be allowed to pond on the subgrade soils. RGI anticipates that the use of berms and shallow drainage ditches, with sumps and pumps in utility trenches, will be required for surface water control during wet weather and/or wet site conditions.

5.3 FOUNDATIONS

As discussed, the major geotechnical concern with this project is that the site will be subject to both static settlement and liquefaction induced settlement during a seismic event. If the foundations are directly supported on the existing fill or native soil, the building will experience unacceptable settlement that will likely damage the building structure. RGI suggests that the proposed building be supported on deep foundation bearing in firm native soil.

RGI recommends that steel pipe piles be used. If this option is selected, RGI recommends that two test piles (one at end of the building) be installed before construction. The test piles will provide the necessary information for pile capacity and pile depth.

RGI expects 6- to 8- inch-diameter steel pipe piles may be used for supporting the proposed building foundation. The piles should be driven to refusal in the competent native soil (dense sandy gravel) below the loose soils.

Based on our experience with similar projects, the pile capacities listed in Table 4 can be used for project planning and preliminary structural design. Based on the soil information, RGI expects that the pile termination depth will be from 55 to 60 feet in the eastern portion of the building to over 75 feet in the western portion of the building. The actual pile depth will be determined in the field based on actual driving condition.

Table 4 Driven Pile Capacities (kips)

Pile Type	Pile Diameter (inches)	Compression	Uplift	Lateral*
Steel Pipe	8	45	20	5
Steel Pipe	6	30	14	3

*Lateral load assumes 1" top deflection and uplift can only be achieved by welding the pile couplers.

5.4 RETAINING WALLS

If retaining walls are needed in the building area, RGI recommends cast-in-place concrete walls be used. The magnitude of earth pressure development on retaining walls will partly depend on the quality of the wall backfill. RGI recommends that the basement wall be supported on the piles designed in accordance with the above table to avoid settlement.

For retaining walls outside building area that are able to tolerate some settlement, it can be supported on two feet of structural fill. RGI recommends placing and compacting wall backfill as structural fill. Wall drainage will be needed behind the wall face. A typical retaining wall drainage detail is shown in Figure 3.

With wall backfill placed and compacted as recommended, and drainage properly installed, RGI recommends using the values in the following table for design of retaining walls. The bearing capacity may only be used for retaining walls not associated with the building and that are able to tolerate settlement. Retaining walls supported on structural fill may not be functional after an earthquake that induces the liquefaction settlements.

Table 5 Retaining Wall Design

Design Parameter	Value
Allowable Bearing Capacity - Structural Fill	2,500 psf[1]*
Active Earth Pressure (unrestrained walls)	35 pcf
At-rest Earth Pressure (restrained walls)	50 pcf
Friction Coefficient	0.30
Passive pressure (equivalent fluid pressure)	250 pcf[2]

*For basement wall supported on pile, use pile capacities listed in Table 4.
1. psf = pounds per square foot
2. pcf = pounds per cubic foot

For seismic design, an additional uniform load of 7 times the wall height (H) for unrestrained walls and 14H for restrained walls should be applied to the wall surface.

Friction at the base of foundations and passive earth pressure will provide resistance to these lateral loads. The allowable bearing pressures apply to dead loads plus design live load conditions. For short-term loads, such as wind and seismic, a 1/3 increase in this allowable capacity may be used. At perimeter locations, RGI recommends not including the upper 12 inches of soil in the computation of passive pressures because they can be affected by weather or disturbed by future grading activity. The passive pressure value assumes the foundation will be constructed neat against competent soil or backfilled with structural fill as described in Section 5.2.2. The recommended base friction and passive resistance value includes a safety factor of about 1.5.

5.5 SLAB-ON-GRADE CONSTRUCTION

As described above, the slab-on-grade supported on existing fill will be subject to a significant amount of settlement. RGI recommends that the floor slab be supported on grade beams and piles.

Immediately below the floor slab, RGI recommends placing a 4-inch-thick capillary break layer of clean, free-draining pea gravel, washed rock, or crushed rock that has less than 5 percent passing the U.S. No. 200 sieve. This material will reduce the potential for upward capillary movement of water through the underlying soil and subsequent wetting of the floor slab. Where moisture by vapor transmission is undesirable, an 8- to 10-millimeter thick plastic membrane should be placed on the 4-inch-thick layer of clean gravel or rock.

5.6 DRAINAGE

5.6.1 SURFACE DRAINAGE

Final exterior grades should promote free and positive drainage away from the building area. Water must not be allowed to pond or collect adjacent to foundations or within the immediate building area. For non-pavement locations, RGI recommends providing a minimum drainage gradient of 3 percent for a minimum distance of 10 feet from the building perimeter. In paved locations, a minimum gradient of 1 percent should be provided unless provisions are included for collection and disposal of surface water adjacent to the structure.

5.6.2 SUBSURFACE DRAINAGE

RGI recommends installing perimeter foundation drains. A typical footing drain detail is shown on Figure 4. The foundation drains and roof downspouts should be tightlined separately to an approved discharge facility. Subsurface drains must be laid with a gradient sufficient to promote positive flow to a controlled point of approved discharge. The footing drain may be eliminated if the area sounding the building will be covered with sidewalk and pavement.

5.7 Utilities

Utility pipes should be bedded and backfilled in accordance with American Public Works Association (APWA) specifications. For site utilities located within the right-of-ways, bedding and backfill should be completed in accordance with City of Olympia specifications. At a minimum, trench backfill should be placed as structural fill, as described in Section 5.2.2 and compacted to at least 95 percent of the maximum dry density per ASTM D1557. Where utilities occur below unimproved areas, the degree of compaction can be reduced to a minimum of 90 percent of the soil's maximum density as determined by ASTM D1557.

As noted, soils excavated on site will not be suitable for use as backfill material in their present condition. Imported structural fill meeting the gradation provided in Table 2 should be used for trench backfill. Since the site will subject to liquefaction induced settlements, all utilities pipes should use flexible joints for connections to structures.

5.8 Pavements

Pavement subgrades should be prepared as described in the Section 5.2 and as discussed below. The subgrade should consist of 12 inches of structural fill over native soil. RGI recommends that a geotextile fabric such as Propex Geotex 200ST or equivalent be placed on the subgrade. Regardless of the relative compaction achieved, the subgrade must be firm and relatively unyielding before paving. This condition should be verified by proofrolling with heavy construction equipment.

With the pavement subgrade prepared as described above, RGI recommends the following pavement sections for parking and drive areas paved with flexible asphalt concrete surfacing.

- **For heavy truck traffic areas**: 3 inches of hot mix asphalt (HMA) over 8 inches of crushed rock base (CRB) over 12 inches of structural fill over woven geotextile fabric
- **For general parking areas**: 2 inches of HMA over 6 inches of CRB over 12 inches of structural fill over woven geotextile fabric

The asphalt paving materials used should conform to the Washington State Department of Transportation (WSDOT) specifications for Hot Mix Asphalt Class 1/2 inch and CRB surfacing.

Long-term pavement performance will depend on surface drainage. A poorly-drained pavement section will be subject to premature failure as a result of surface water infiltrating into the subgrade soils and reducing their supporting capability.

For optimum pavement performance, surface drainage gradients of no less than 2 percent are recommended. Also, some degree of longitudinal and transverse cracking of the pavement surface should be expected over time. Regular maintenance should be planned to seal cracks when they occur.

6.0 Additional Services

RGI is available to provide further geotechnical consultation throughout the design phase of the project. RGI should review the final design and specifications in order to verify that earthwork and foundation recommendations have been properly interpreted and incorporated into project design and construction.

RGI is also available to provide geotechnical engineering and construction monitoring services during construction. The integrity of the earthwork and construction depends on proper site preparation and procedures. In addition, engineering decisions may arise in the field in the event that variations in subsurface conditions become apparent. Construction monitoring services are not part of this scope of work. If these services are desired, please let us know and we will prepare a cost proposal.

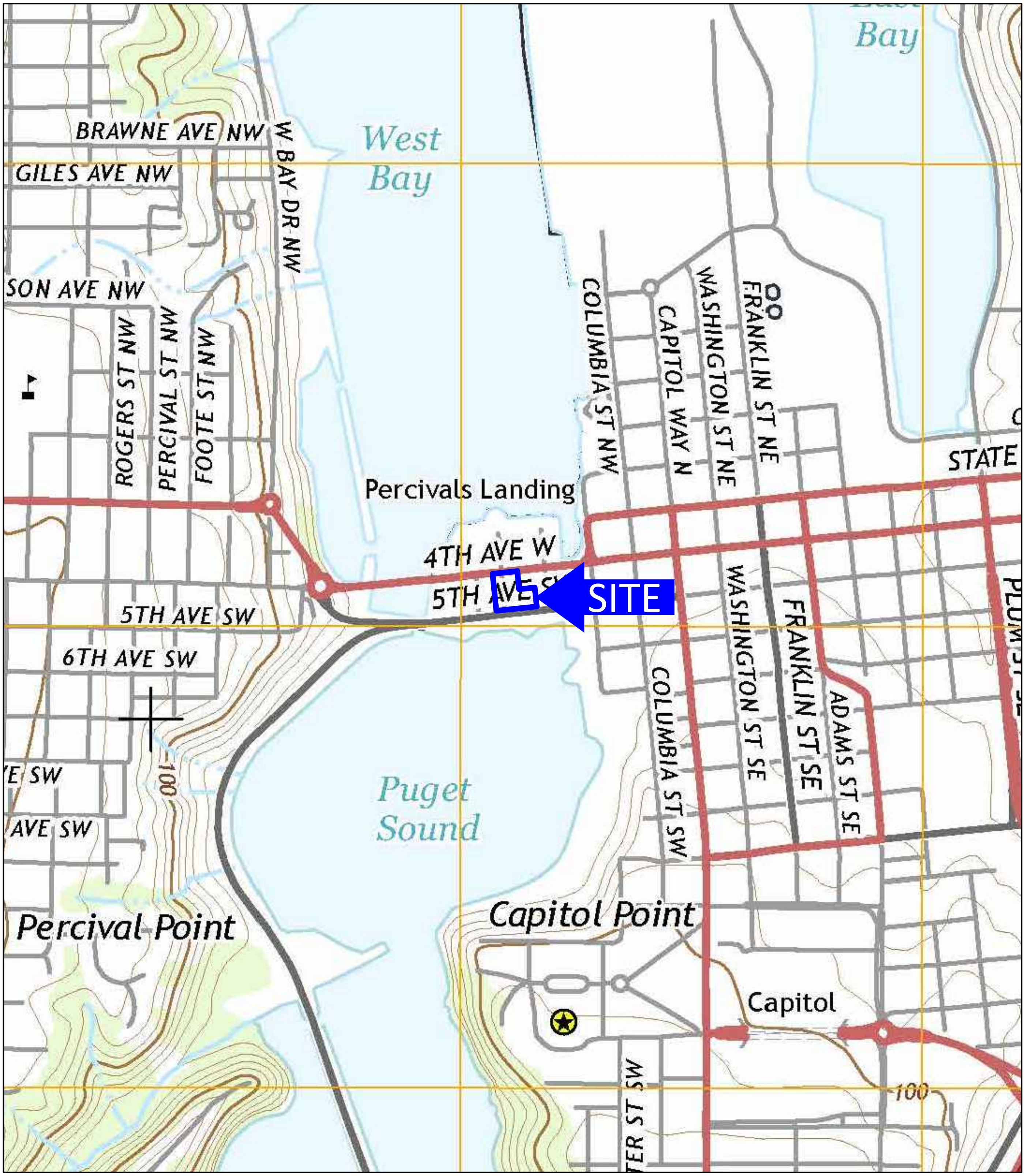
Li itation

This report is the property of RGI, Brogan Companies, and their designated agents. Within the limits of the scope and budget, this report was prepared in accordance with generally accepted geotechnical engineering practices in the area at the time this report was issued. This report is intended for specific application to Capitol Center Development in Olympia, Washington, and for the exclusive use of Brogan Companies, and their authorized representatives. No other warranty, expressed or implied, is made. Site safety, excavation support, and dewatering requirements are the responsibility of others.

The scope of services for this project does not include either specifically or by implication any environmental or biological (for example, mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions.

The analyses and recommendations presented in this report are based upon data obtained from the test exploration performed on-site. Variations in soil conditions can occur, the nature and extent of which may not become evident until construction. If variations appear evident, RGI should be requested to reevaluate the recommendations in this report prior to proceeding with construction.

It is the client's responsibility to see that all parties to the project, including the designers, contractors, subcontractors, are made aware of this report in its entirety. The use of information contained in this report for bidding purposes should be done at the contractor's option and risk.



USGS, 2014, Tumwater, Washington
7.5-Minute Quadrangle

Approximate Scale: 1"=1000'

0 500 1000 2000

N

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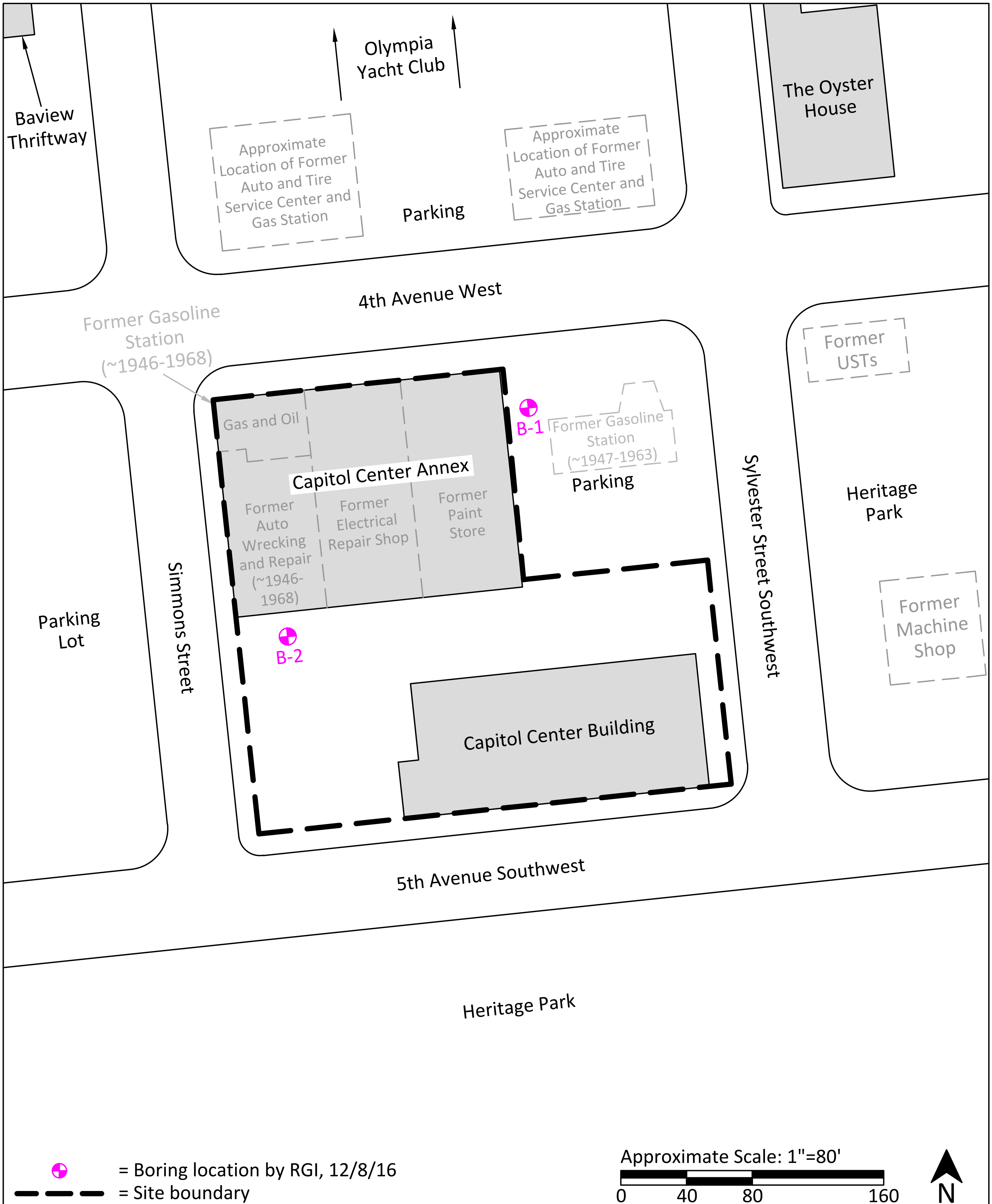
Capitol Center Building		Figure 1
RGI Project Number 2016-189A	Site Vicinity Map	Date Drawn: 06/2017
Address: 410 5th Avenue Southwest & 411 4th Avenue West, Olympia, Washington 98501		



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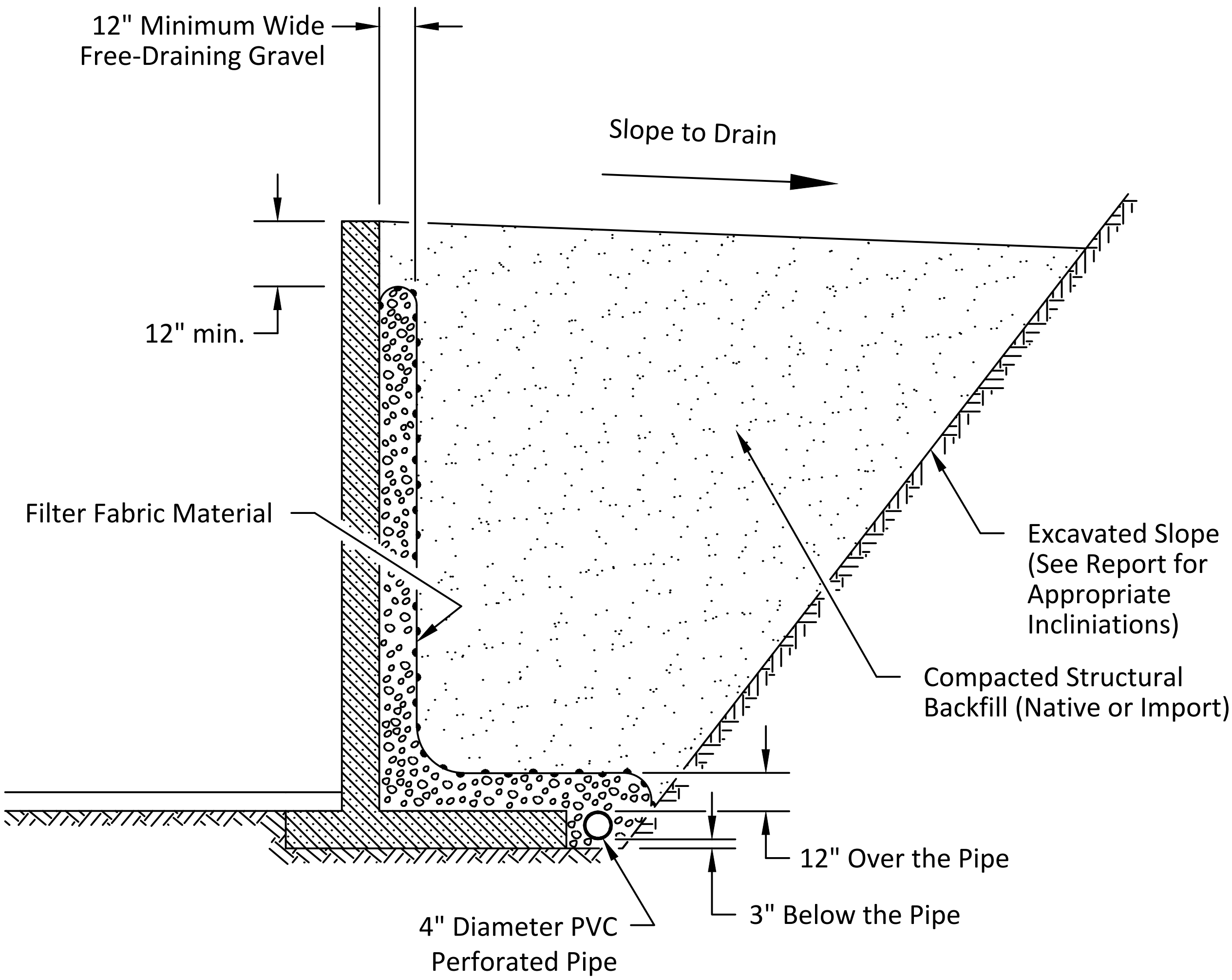
Capitol Center Building		Figure 2
RGI Project Number 2016-189A	Geotechnical Exploration Plan	Date Drawn: 06/2017
Address: 410 5th Avenue Southwest & 411 4th Avenue West, Olympia, Washington 98501		



Not to Scale

RILEYGROUP
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17522 Bothell Way Northeast
Bothell, Washington 98011
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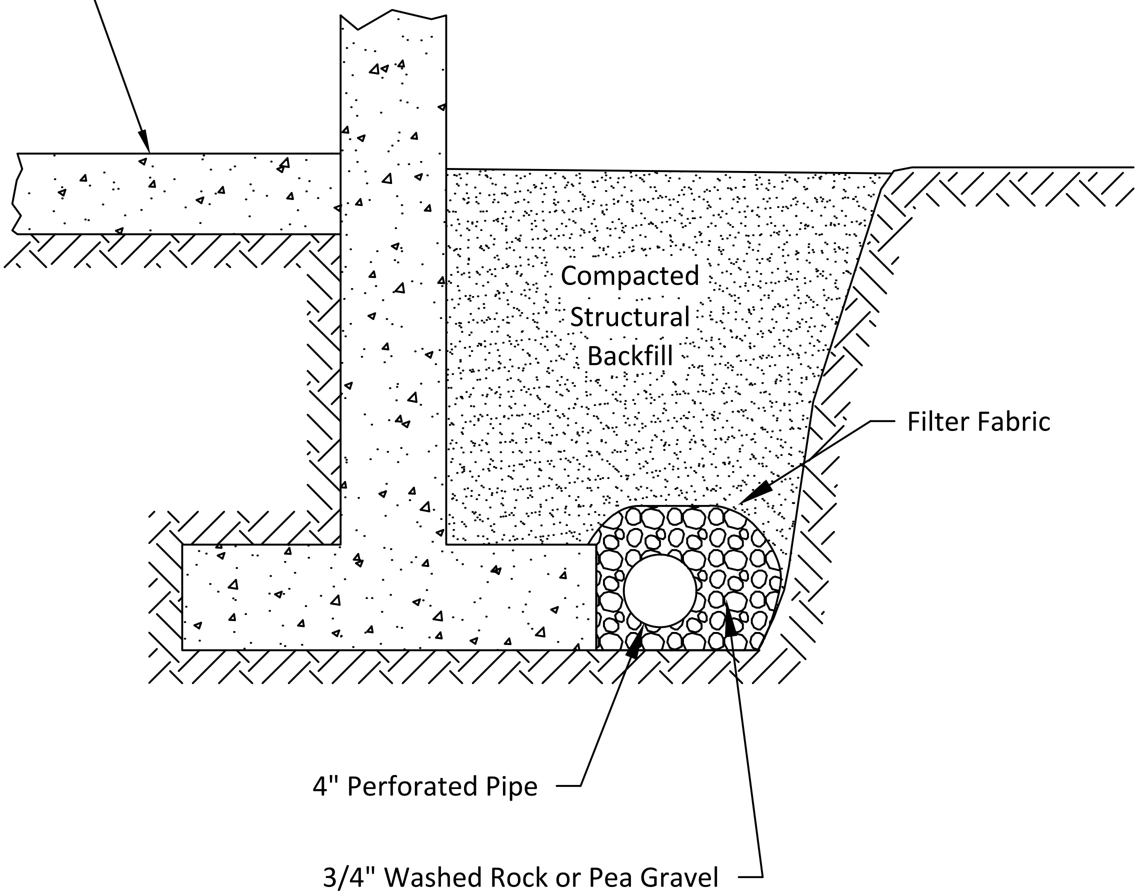
Fax: 425.415.0311

Capitol Center Building		Figure 3
RGI Project Number 2016-189A	Retaining Wall Drainage Detail	Date Drawn: 06/2017
Address: 410 5th Avenue Southwest & 411 4th Avenue West, Olympia, Washington 98501		



Not to Scale

RILEYGROUP Corporate Office 17522 Bothell Way Northeast Bothell, Washington 98011 Phone: 425.415.0551 Fax: 425.415.0311	Capitol Center Building		Figure 4
	RGI Project Number 2016-189A	Typical Footing Drain Detail	Date Drawn: 06/2017
	Address: 410 5th Avenue Southwest & 411 4th Avenue West, Olympia, Washington 98501		

APPENDIX A
FIELD EXPLORATION AND LABORATORY TESTING

On December 8, 2016, RGI explored the subsurface soil conditions at the site by observing the drilling of two borings to a maximum depth of 76.5 feet below existing grade. The borings locations are shown on Figure 2. The boring locations were approximately determined by measurements from existing property lines and paved roads.

A geologist from our office conducted the field exploration and classified the soil conditions encountered, maintained a log of each exploration, obtained representative soil samples, and observed pertinent site features. All soil samples were visually classified in accordance with the Unified Soil Classification System (USCS) described in Appendix A.

Representative soil samples obtained from the explorations were placed in closed containers and taken to our laboratory for further examination and testing. As a part of the laboratory testing program, the soil samples were classified in our in house laboratory based on visual observation, texture, and the limited laboratory testing described below.

Moisture Content Determinations

Moisture content determinations were performed in accordance with the American Society of Testing and Materials D2216-10 Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass (ASTM D2216) on representative samples obtained from the exploration in order to aid in identification and correlation of soil types. The moisture content of typical sample was measured and is reported on the test boring logs.

Grain Size Analysis

A grain size analysis indicates the range in diameter of soil particles included in a particular sample. Grain size analyses for the greater than 75 micrometer portion of the samples were performed in accordance with American Society of Testing and Materials D422 Standard Test Method for Particle-Size Analysis of Soils (ASTM D422) on seven of the samples, the results of which are attached in Appendix A.

Project Name: **Capitol Center Development**	Boring No.: **B-1**
Project Number: **2016-189A**	**Sheet 1 of 3**
Client: **Brogan Companies**	RILEYGROUP

Date(s) Drilled: **12/8/2016**	Logged By: **ELW**	Surface Conditions: **Asphalt**
Drilling Method(s): **Hollow Stem Auger**	Drill Bit Size/Type: **6" auger**	Total Depth of Borehole: **66.5 feet bgs**
Drill Rig Type: **Trailer Rig**	Drilling Contractor: **Boretec**	Approximate Surface Elevation: **N/A**
Groundwater Level: **15'**	Sampling Method(s): **SPT**	Hammer Data : **140 lb, 30" drop, rope and cathead**
Borehole Backfill: **Bentonite Chips**	Location: **411 4th Avenue West, Olympia, Washington**	

Elevation (feet)	Depth (feet)	Sample Type	Sample ID	Sampling Resistance, blows/ft	Recovery (%)	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	Moisture (%)
	0					Asphalt		8" asphalt	
						Fill		Brown silty SAND with some gravel, very loose to loose, moist (Fill)	
	5	SPT		4					7
	10	SPT		1				Becomes brown to black, very loose, moist to wet, contains wood, organics, shell fragments 13% fines Light groundwater seepage	80
	15 (▽)	SPT		6		SM		Gray silty SAND, loose, water bearing Contains shell fragments and wood debris	29
	20	SPT		3				Becomes black, very loose 20% fines Contains shell fragments	34
	25	SPT		10				Becomes loose to medium dense	26
	30								

Elevation (feet)	Depth (feet)	Sample ID	Sampling Resistance, blows/ft	Recovery (%)	USCS Symbol	MATERIAL DESCRIPTION	Moisture (%)
	30		11		SW-SM	Gray SAND with some silt, medium dense, water bearing 9% fines Contains shell debris, sand and silt interbeds	21
	35		4		SM	Gray silty SAND, very loose to loose, water bearing Trace shell fragments	26
	40		7			Becomes loose, contains wood debris, occasional clean sand interbed 13% fines	26
	45		28		SP-SM	Gray SAND with some silt, medium dense, water bearing	19
	50		4		SM	Gray silty SAND, very loose to loose, water bearing 45% fines	35
	55		82		GP	Gray sandy GRAVEL with trace silt, very dense, water bearing	12
	60						

Project Name: **Capitol Center Development**
Project Number: **2016-189A**
Client: **Brogan Companies**

Boring No.: **B-1**
Sheet 3 of 3

Elevation (feet)	Depth (feet)	Sample Type	Sample ID	Sampling Resistance, blows/ft	Recovery (%)	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	Moisture (%)
	60			38		SP-SM		Gray SAND with some silt and gravel, dense, water bearing 6% fines	14
	65			19		ML		Gray SILT with trace sand, very stiff, moist to wet	31
								Boring terminated at 66.5'	
	70								
	75								
	80								
	85								
	90								

Project Name: **Capitol Center Development**	RILEYGROUP **Boring No.: B-2**
Project Number: **2016-189A**	**Sheet 1 of 3**
Client: **Brogan Companies**	

Date(s) Drilled: **12/8/2016**	Logged By: **ELW**	Surface Conditions: **Asphalt**
Drilling Method(s): **Hollow Stem Auger**	Drill Bit Size/Type: **6" auger**	Total Depth of Borehole: **76.5 feet bgs**
Drill Rig Type: **Trailer Rig**	Drilling Contractor: **Boretec**	Approximate Surface Elevation: **N/A**
Groundwater Level: **11'**	Sampling Method(s): **SPT**	Hammer Data : **140 lb, 30" drop, rope and cathead**
Borehole Backfill: **Bentonite Chips**	Location: **411 4th Avenue West, Olympia, Washington**	

Elevation (feet)	Depth (feet)	Sample Type	Sample ID	Sampling Resistance, blows/ft	Recovery (%)	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	Moisture (%)
	0					Asphalt		1.5" asphalt	
						SP-SM		Brown SAND with some silt, medium dense, moist	
	5	SPT		8				Contains shell fragments	24
	10	SPT		7				Becomes brown to gray, wet Contains shell fragments Becomes water bearing	21
	11 (groundwater ▽)								
	15	SPT		7		SM		Gray silty SAND, loose, water bearing Abundant shell fragments	27
	20	SPT		7		ML		Dark gray sandy SILT, medium stiff, wet Contains sand and silt interbeds, shell fragments, trace organic stringers	55
	25	SPT		11		SP-SM		Gray SAND with some silt, medium dense, water bearing Contains sand and silt interbeds, shell fragments	36
	30								

Project Name: **Capitol Center Development**
Project Number: **2016-189A**
Client: **Brogan Companies**

Boring No.: **B-2**
Sheet 2 of 3

Depth (feet)	Sample Resistance, blows/ft	USCS Symbol	MATERIAL DESCRIPTION	Moisture (%)
30	29	SP-SM	Gray SAND with some silt, medium dense, water bearing Contains sand and silt interbeds, shell fragment, trace wood debris	16
35	2	SM	Gray silty SAND, very loose, wet Trace shell fragments	27
40	6	SP-SM	Gray SAND with some silt, loose, water bearing	21
45	21	SP-SM	Gray SAND with some silt and trace gravel, medium dense, water bearing	13
50	7	SM	Gray silty SAND, loose, saturated	28
55	20		Becomes medium dense	26
60				

Column headings: Elevation (feet), Depth (feet), Sample Type, Sample ID, Sampling Resistance, blows/ft, Recovery (%), USCS Symbol, Graphic Log, MATERIAL DESCRIPTION, Moisture (%)

Project Name: **Capitol Center Development**
Project Number: **2016-189A**
Client: **Brogan Companies**

Boring No.: **B-2**

Elevation (feet)	Depth (feet)	Sample Type	Sample ID	Sampling Resistance, blows/ft	Recovery (%)	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	Moisture (%)
	60			14		GP-GM		Gray gravelly SAND with some silt, medium dense, water bearing	19
	65			8		ML		Gray SILT with trace sand, medium stiff to stiff, saturated	37
	70			10				Becomes stiff, 94% fines	36
	75			16				Becomes very stiff	37
								Boring terminated at 76.5'	
	80								
	85								
	90								

Project Name: **Capitol Center Development**

Project Number: **2016-189A**

Client: **Brogan Companies**

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Key to Log of Boring

Sheet 1 of 1

Elevation (feet)	Depth (feet)	Sample Type	Sample ID	Sampling Resistance, blows/ft	Recovery (%)	USCS Symbol	Graphic Log	MATERIAL DESCRIPTION	Moisture (%)
1	2	3	4	5	6	7	8	9	10

COLUMN DESCRIPTIONS

1 Elevation (feet): Elevation (MSL, feet).
2 Depth (feet): Depth in feet below the ground surface.
3 Sample Type: Type of soil sample collected at the depth interval shown.
4 Sample ID: Sample identification number.
5 Sampling Resistance, blows/ft: Number of blows to advance driven sampler one foot (or distance shown) beyond seating interval using the hammer identified on the boring log.
6 Recovery (%): Core Recovery Percentage is determined based on a ratio of the length of core sample recovered compared to the cored interval length.
7 USCS Symbol: USCS symbol of the subsurface material.
8 Graphic Log: Graphic depiction of the subsurface material encountered.
9 MATERIAL DESCRIPTION: Description of material encountered. May include consistency, moisture, color, and other descriptive text.
10 Moisture (%): Moisture, expressed as a water content.

FIELD AND LABORATORY TEST ABBREVIATIONS

CHEM: Chemical tests to assess corrosivity
COMP: Compaction test
CONS: One-dimensional consolidation test
LL: Liquid Limit, percent
PI: Plasticity Index, percent
SA: Sieve analysis (percent passing No. 200 Sieve)
UC: Unconfined compressive strength test, Qu, in ksf
WA: Wash sieve (percent passing No. 200 Sieve)

MATERIAL GRAPHIC SYMBOLS

Asphaltic Concrete (AC)
AF
Poorly graded GRAVEL (GP)
Poorly graded GRAVEL with Silt (GP-GM)
SILT, SILT w/SAND, SANDY SILT (ML)
Silty SAND (SM)
Poorly graded SAND with Silt (SP-SM)
Well graded SAND with Silt (SW-SM)

TYPICAL SAMPLER GRAPHIC SYMBOLS

Auger sampler
Bulk Sample
3-inch-OD California w/ brass rings
CME Sampler
Grab Sample
2.5-inch-OD Modified California w/ brass liners
Pitcher Sample
2-inch-OD unlined split spoon (SPT)
Shelby Tube (Thin-walled, fixed head)

OTHER GRAPHIC SYMBOLS

Water level (at time of drilling, ATD)
Water level (after waiting)
Minor change in material properties within a stratum
Inferred/gradational contact between strata
Queried contact between strata

GENERAL NOTES

1: Soil classifications are based on the Unified Soil Classification System. Descriptions and stratum lines are interpretive, and actual lithologic changes may be gradual. Field descriptions may have been modified to reflect results of lab tests.
2: Descriptions on these logs apply only at the specific boring locations and at the time the borings were advanced. They are not warranted to be representative of subsurface conditions at other locations or times.

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GRAIN SIZE ANALYSIS
ASTM D421, D422, D1140, D2487, D6913

PROJECT TITLE	Capitol Center Development	**SAMPLE ID/TYPE**	B-1
PROJECT NO.	2016-189A	**SAMPLE DEPTH**	10'
TECH/TEST DATE	EW 12/12/2016	**DATE RECEIVED**	12/9/2016

WATER CONTENT (Delivered Moisture)

Wt Wet Soil & Tare (gm)	(w1)	306.7
Wt Dry Soil & Tare (gm)	(w2)	177.3
Weight of Tare (gm)	(w3)	16.0
Weight of Water (gm)	(w4=w1-w2)	129.4
Weight of Dry Soil (gm)	(w5=w2-w3)	161.3
Moisture Content (%)	(w4/w5)*100	80

Total Weight Of Sample Used For Sieve Corrected For Hygroscopic Moisture

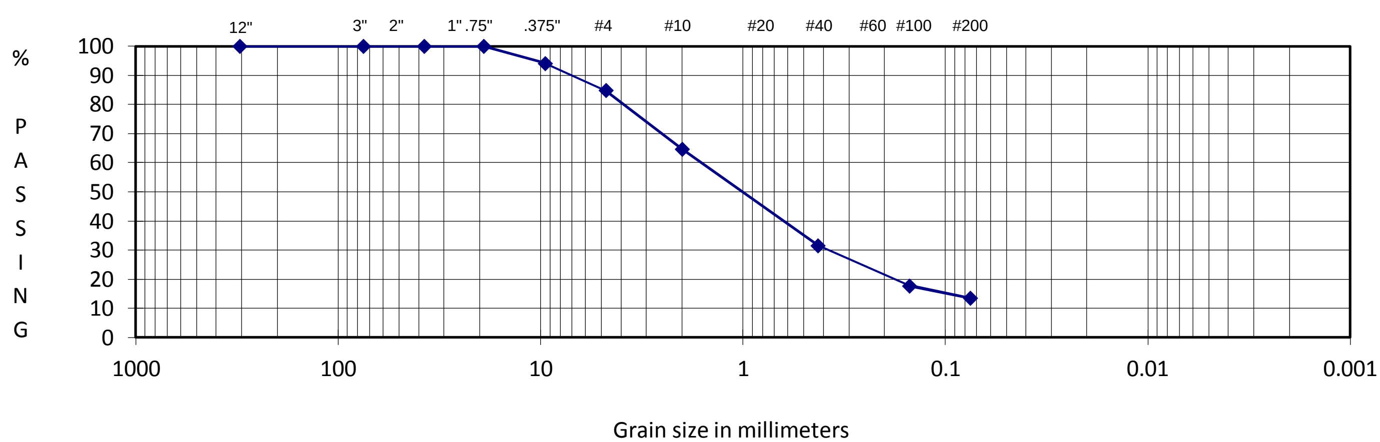
	Weight Of Sample (gm)	177.3
	Tare Weight (gm)	16.0
(W6)	Total Dry Weight (gm)	161.3

% COBBLES	**0.0**
% C GRAVEL	**0.0**
% F GRAVEL	**15.3**
% C SAND	**20.0**
% M SAND	**33.1**
% F SAND	**18.2**
% FINES	**13.4**
% TOTAL	**100.0**

D10 (mm)	
D30 (mm)	
D60 (mm)	
Cu	
Cc	

SIEVE ANALYSIS

	Wt Ret +Tare	(Wt-Tare)	Cumulative (%Retained) {(wt ret/w6)*100}	% PASS (100-%ret)	
12.0"	16.0	0.00	0.00	100.00	cobbles
3.0"	16.0	0.00	0.00	100.00	coarse gravel
2.5"					coarse gravel
2.0"					coarse gravel
1.5"	16.0	0.00	0.00	100.00	coarse gravel
1.0"					coarse gravel
0.75"	16.0	0.00	0.00	100.00	fine gravel
0.50"					fine gravel
0.375"	25.5	9.50	5.89	94.11	fine gravel
#4	40.7	24.70	15.31	84.69	coarse sand
#10	73.0	57.00	35.34	64.66	medium sand
#20					medium sand
#40	126.4	110.40	68.44	31.56	fine sand
#60					fine sand
#100	148.8	132.80	82.33	17.67	fine sand
#200	155.7	139.70	86.61	13.39	fines
PAN	177.3				silt/clay



DESCRIPTION	Silty SAND with some gravel
USCS	SM

Prepared For: Brogan Companies

Reviewed By: KMW

RILEYGROUP

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GRAIN SIZE ANALYSIS
ASTM D421, D422, D1140, D2487, D6913

PROJECT TITLE	Capitol Center Development	SAMPLE ID/TYPE	B-1
PROJECT NO.	2016-189A	SAMPLE DEPTH	20'
TECH/TEST DATE	EW 12/12/2016	DATE RECEIVED	12/9/2016

WATER CONTENT (Delivered Moisture)

Wt Wet Soil & Tare (gm)	(w1)	372.9
Wt Dry Soil & Tare (gm)	(w2)	282.0
Weight of Tare (gm)	(w3)	16.0
Weight of Water (gm)	(w4=w1-w2)	90.9
Weight of Dry Soil (gm)	(w5=w2-w3)	266.0
Moisture Content (%)	(w4/w5)*100	34

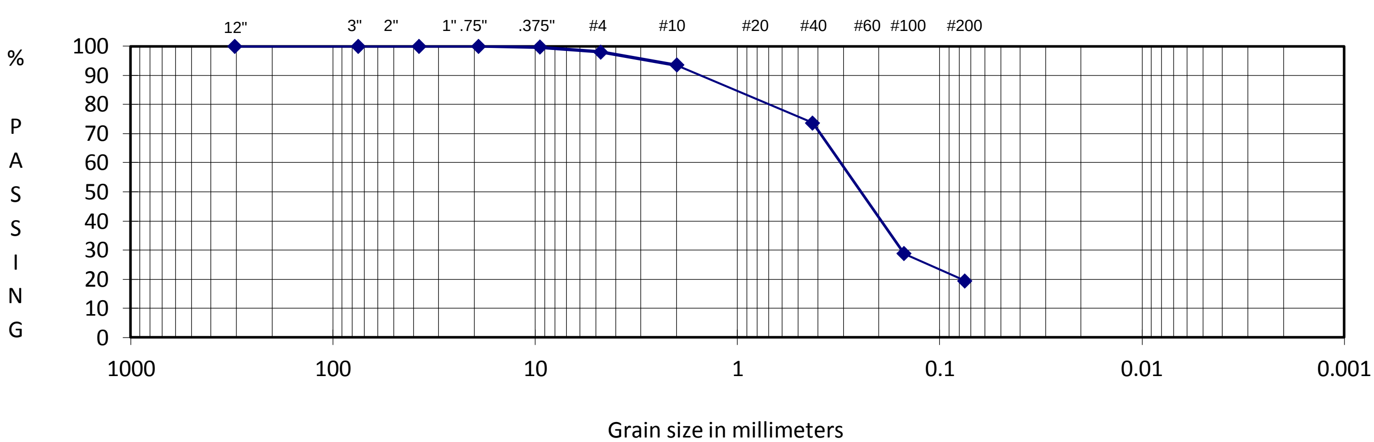
Total Weight Of Sample Used For Sieve Corrected For Hygroscopic Moisture

	Weight Of Sample (gm)	282.0
	Tare Weight (gm)	16.0
(W6)	Total Dry Weight (gm)	266.0

% COBBLES	0.0
% C GRAVEL	0.0
% F GRAVEL	2.0
% C SAND	4.4
% M SAND	19.9
% F SAND	54.1
% FINES	19.5
% TOTAL	100.0
D10 (mm)	
D30 (mm)	
D60 (mm)	
Cu	
Cc	

SIEVE ANALYSIS

Sieve	Wt Ret +Tare	(Wt-Tare)	Cumulative (%Retained) {(wt ret/w6)*100}	% PASS (100-%ret)	
12.0"	16.0	0.00	0.00	100.00	cobbles
3.0"	16.0	0.00	0.00	100.00	coarse gravel
2.5"					coarse gravel
2.0"					coarse gravel
1.5"	16.0	0.00	0.00	100.00	coarse gravel
1.0"					coarse gravel
0.75"	16.0	0.00	0.00	100.00	fine gravel
0.50"					fine gravel
0.375"	17.0	1.00	0.38	99.62	fine gravel
#4	21.4	5.40	2.03	97.97	coarse sand
#10	33.2	17.20	6.47	93.53	medium sand
#20					medium sand
#40	86.2	70.20	26.39	73.61	fine sand
#60					fine sand
#100	205.5	189.50	71.24	28.76	fine sand
#200	230.2	214.20	80.53	19.47	fines
PAN	282.0				silt/clay



DESCRIPTION	Silty SAND
USCS	SM

Prepared For: Brogan Companies

Reviewed By: KMW

RILEYGROUP

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GRAIN SIZE ANALYSIS
ASTM D421, D422, D1140, D2487, D6913

PROJECT TITLE	Capitol Center Development	**SAMPLE ID/TYPE**	B-1
PROJECT NO.	2016-189A	**SAMPLE DEPTH**	30'
TECH/TEST DATE	EW 12/12/2016	**DATE RECEIVED**	12/9/2016

WATER CONTENT (Delivered Moisture)

Wt Wet Soil & Tare (gm)	(w1)	457.1
Wt Dry Soil & Tare (gm)	(w2)	380.2
Weight of Tare (gm)	(w3)	15.9
Weight of Water (gm)	(w4=w1-w2)	76.9
Weight of Dry Soil (gm)	(w5=w2-w3)	364.3
Moisture Content (%)	(w4/w5)*100	21

Total Weight Of Sample Used For Sieve Corrected For Hygroscopic Moisture

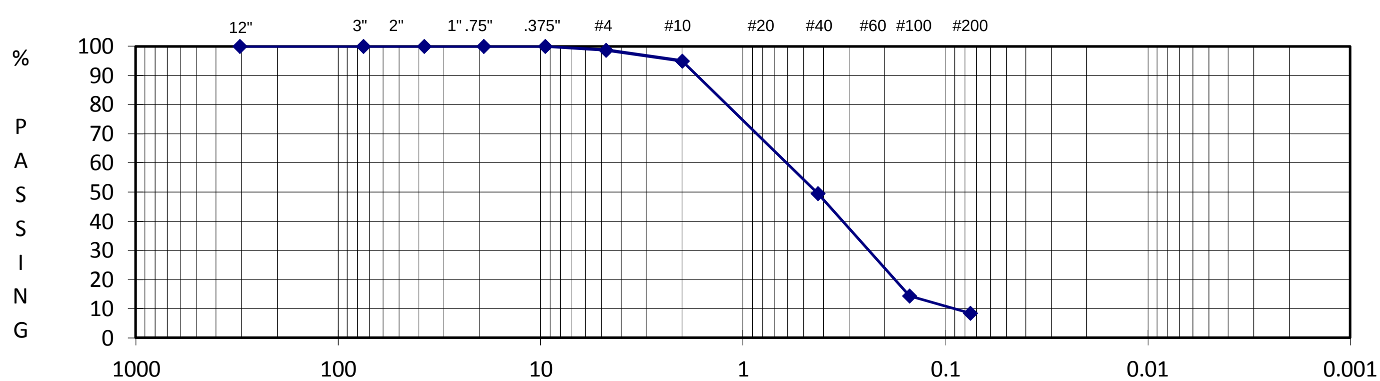
	Weight Of Sample (gm)	380.2
	Tare Weight (gm)	15.9
(W6)	Total Dry Weight (gm)	364.3

% COBBLES	**0.0**
% C GRAVEL	**0.0**
% F GRAVEL	**1.3**
% C SAND	**3.7**
% M SAND	**45.6**
% F SAND	**40.9**
% FINES	**8.5**
% TOTAL	**100.0**

D10 (mm)	0.09
D30 (mm)	0.24
D60 (mm)	0.6
Cu	6.7
Cc	1.1

SIEVE ANALYSIS

Sieve	Wt Ret +Tare	(Wt-Tare)	Cumulative (%Retained) {(wt ret/w6)*100}	% PASS (100-%ret)	
12.0"	15.9	0.00	0.00	100.00	cobbles
3.0"	15.9	0.00	0.00	100.00	coarse gravel
2.5"					coarse gravel
2.0"					coarse gravel
1.5"	15.9	0.00	0.00	100.00	coarse gravel
1.0"					coarse gravel
0.75"	15.9	0.00	0.00	100.00	fine gravel
0.50"					fine gravel
0.375"	15.9	0.00	0.00	100.00	fine gravel
#4	20.6	4.70	1.29	98.71	coarse sand
#10	34.2	18.30	5.02	94.98	medium sand
#20					medium sand
#40	200.3	184.40	50.62	49.38	fine sand
#60					fine sand
#100	328.1	312.20	85.70	14.30	fine sand
#200	349.4	333.50	91.55	8.45	fines
PAN	380.2				silt/clay



Grain size in millimeters

DESCRIPTION	SAND with some silt
USCS	SW-SM

Prepared For: Brogan Companies

Reviewed By: KMW

RILEYGROUP

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GRAIN SIZE ANALYSIS
ASTM D421, D422, D1140, D2487, D6913

PROJECT TITLE	Capitol Center Development	**SAMPLE ID/TYPE**	B-1
PROJECT NO.	2016-189A	**SAMPLE DEPTH**	40'
TECH/TEST DATE	EW 12/12/2016	**DATE RECEIVED**	12/9/2016

WATER CONTENT (Delivered Moisture)

Wt Wet Soil & Tare (gm)	(w1)	314.5
Wt Dry Soil & Tare (gm)	(w2)	252.8
Weight of Tare (gm)	(w3)	15.9
Weight of Water (gm)	(w4=w1-w2)	61.7
Weight of Dry Soil (gm)	(w5=w2-w3)	236.9
Moisture Content (%)	(w4/w5)*100	26

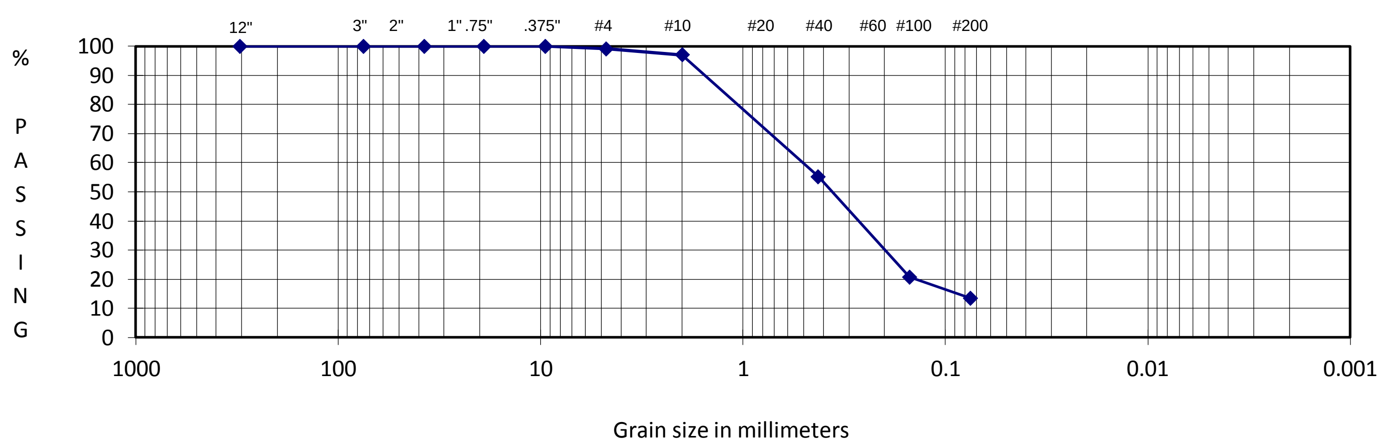
Total Weight Of Sample Used For Sieve Corrected For Hygroscopic Moisture

	Weight Of Sample (gm)	252.8
	Tare Weight (gm)	15.9
(W6)	Total Dry Weight (gm)	236.9

% COBBLES	**0.0**
% C GRAVEL	**0.0**
% F GRAVEL	**0.9**
% C SAND	**2.1**
% M SAND	**41.9**
% F SAND	**41.8**
% FINES	**13.4**
% TOTAL	**100.0**
D10 (mm)	
D30 (mm)	
D60 (mm)	
Cu	
Cc	

SIEVE ANALYSIS

Sieve	Wt Ret +Tare	(Wt-Tare)	Cumulative (%Retained) {(wt ret/w6)*100}	% PASS (100-%ret)	
12.0"	15.9	0.00	0.00	100.00	cobbles
3.0"	15.9	0.00	0.00	100.00	coarse gravel
2.5"					coarse gravel
2.0"					coarse gravel
1.5"	15.9	0.00	0.00	100.00	coarse gravel
1.0"					coarse gravel
0.75"	15.9	0.00	0.00	100.00	fine gravel
0.50"					fine gravel
0.375"	15.9	0.00	0.00	100.00	fine gravel
#4	18.0	2.10	0.89	99.11	coarse sand
#10	22.9	7.00	2.95	97.05	medium sand
#20					medium sand
#40	122.1	106.20	44.83	55.17	fine sand
#60					fine sand
#100	204.0	188.10	79.40	20.60	fine sand
#200	221.1	205.20	86.62	13.38	fines
PAN	252.8				silt/clay



DESCRIPTION	Silty SAND
USCS	SM

Prepared For: Brogan Companies

Reviewed By: KMW

RILEYGROUP

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GRAIN SIZE ANALYSIS
ASTM D421, D422, D1140, D2487, D6913

PROJECT TITLE	Capitol Center Development	SAMPLE ID/TYPE	B-1
PROJECT NO.	2016-189A	SAMPLE DEPTH	50'
TECH/TEST DATE	EW 12/12/2016	DATE RECEIVED	12/9/2016

WATER CONTENT (Delivered Moisture)

Wt Wet Soil & Tare (gm)	(w1)	317.0
Wt Dry Soil & Tare (gm)	(w2)	238.4
Weight of Tare (gm)	(w3)	16.0
Weight of Water (gm)	(w4=w1-w2)	78.6
Weight of Dry Soil (gm)	(w5=w2-w3)	222.4
Moisture Content (%)	(w4/w5)*100	35

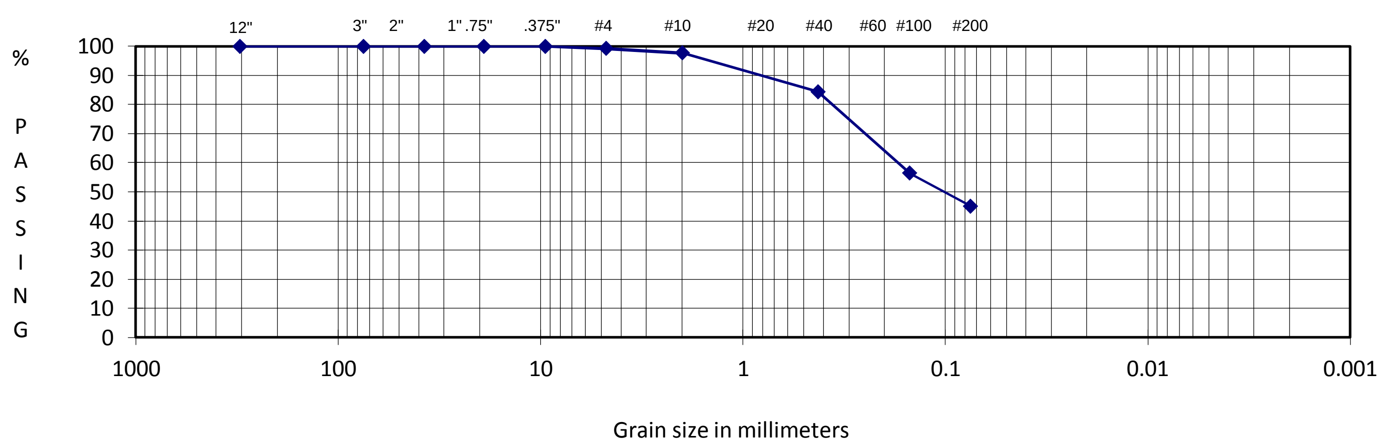
Total Weight Of Sample Used For Sieve Corrected For Hygroscopic Moisture

	Weight Of Sample (gm)	238.4
	Tare Weight (gm)	16.0
(W6)	Total Dry Weight (gm)	222.4

SIEVE ANALYSIS

% COBBLES	0.0
% C GRAVEL	0.0
% F GRAVEL	0.8
% C SAND	1.6
% M SAND	13.4
% F SAND	39.2
% FINES	45.1
% TOTAL	100.0
D10 (mm)	
D30 (mm)	
D60 (mm)	
Cu	
Cc	

Sieve	Wt Ret +Tare	(Wt-Tare)	Cumulative (%Retained) {(wt ret/w6)*100}	% PASS (100-%ret)	
12.0"	16.0	0.00	0.00	100.00	cobbles
3.0"	16.0	0.00	0.00	100.00	coarse gravel
2.5"					coarse gravel
2.0"					coarse gravel
1.5"	16.0	0.00	0.00	100.00	coarse gravel
1.0"					coarse gravel
0.75"	16.0	0.00	0.00	100.00	fine gravel
0.50"					fine gravel
0.375"	16.0	0.00	0.00	100.00	fine gravel
#4	17.7	1.70	0.76	99.24	coarse sand
#10	21.2	5.20	2.34	97.66	medium sand
#20					medium sand
#40	50.9	34.90	15.69	84.31	fine sand
#60					fine sand
#100	112.9	96.90	43.57	56.43	fine sand
#200	138.0	122.00	54.86	45.14	fines
PAN	238.4				silt/clay



DESCRIPTION	Silty SAND
USCS	SM

Prepared For: Brogan Companies

Reviewed By: KMW

RILEYGROUP

THE RILEY GROUP, INC.
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Bothell, WA 98011

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GRAIN SIZE ANALYSIS
ASTM D421, D422, D1140, D2487, D6913

PROJECT TITLE	Capitol Center Development	**SAMPLE ID/TYPE**	B-1
PROJECT NO.	2016-189A	**SAMPLE DEPTH**	60'
TECH/TEST DATE	EW 12/12/2016	**DATE RECEIVED**	12/9/2016

WATER CONTENT (Delivered Moisture)

Wt Wet Soil & Tare (gm)	(w1)	427.5
Wt Dry Soil & Tare (gm)	(w2)	377.5
Weight of Tare (gm)	(w3)	16.4
Weight of Water (gm)	(w4=w1-w2)	50.0
Weight of Dry Soil (gm)	(w5=w2-w3)	361.1
Moisture Content (%)	(w4/w5)*100	14

Total Weight Of Sample Used For Sieve Corrected For Hygroscopic Moisture

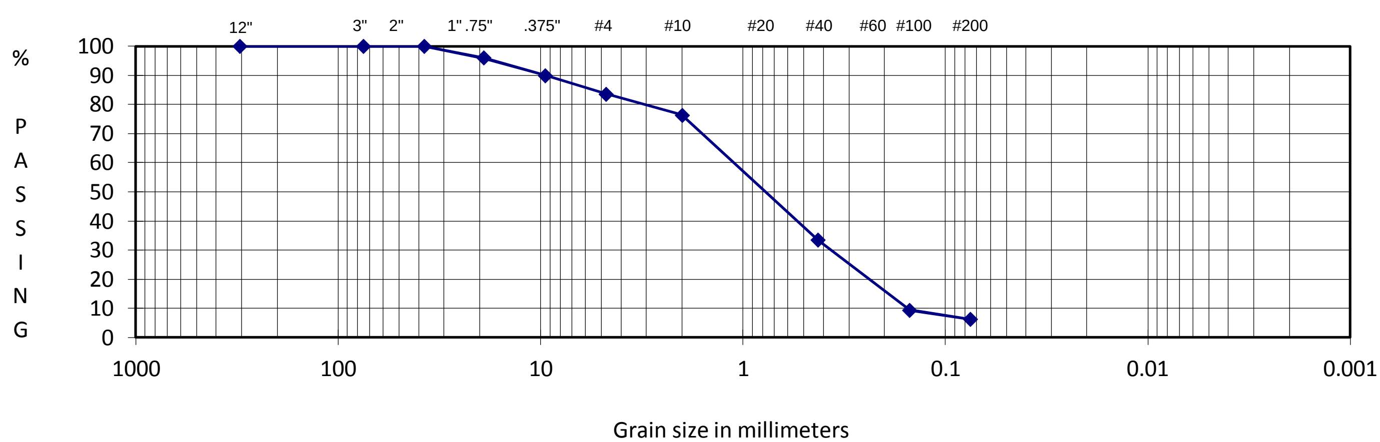
	Weight Of Sample (gm)	377.5
	Tare Weight (gm)	16.4
(W6)	Total Dry Weight (gm)	361.1

% COBBLES	**0.0**
% C GRAVEL	**4.1**
% F GRAVEL	**12.4**
% C SAND	**7.3**
% M SAND	**42.8**
% F SAND	**27.2**
% FINES	**6.2**
% TOTAL	**100.0**

D10 (mm)	0.17
D30 (mm)	0.38
D60 (mm)	1.1
Cu	6.5
Cc	0.8

SIEVE ANALYSIS

Sieve	Wt Ret +Tare	(Wt-Tare)	Cumulative (%Retained) {(wt ret/w6)*100}	% PASS (100-%ret)	
12.0"	16.4	0.00	0.00	100.00	cobbles
3.0"	16.4	0.00	0.00	100.00	coarse gravel
2.5"					coarse gravel
2.0"					coarse gravel
1.5"	16.4	0.00	0.00	100.00	coarse gravel
1.0"					coarse gravel
0.75"	31.1	14.70	4.07	95.93	fine gravel
0.50"					fine gravel
0.375"	52.9	36.50	10.11	89.89	fine gravel
#4	75.8	59.40	16.45	83.55	coarse sand
#10	102.2	85.80	23.76	76.24	medium sand
#20					medium sand
#40	256.9	240.50	66.60	33.40	fine sand
#60					fine sand
#100	344.0	327.60	90.72	9.28	fine sand
#200	355.0	338.60	93.77	6.23	fines
PAN	377.5				silt/clay



DESCRIPTION	SAND with some silt and gravel
USCS	SP-SM

Prepared For: Brogan Companies

Reviewed By: KMW

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GRAIN SIZE ANALYSIS
ASTM D421, D422, D1140, D2487, D6913

PROJECT TITLE	Capitol Center Development	**SAMPLE ID/TYPE**	B-2
PROJECT NO.	2016-189A	**SAMPLE DEPTH**	70'
TECH/TEST DATE	EW 12/12/2016	**DATE RECEIVED**	12/9/2016

WATER CONTENT (Delivered Moisture)

Wt Wet Soil & Tare (gm)	(w1)	246.9
Wt Dry Soil & Tare (gm)	(w2)	186.2
Weight of Tare (gm)	(w3)	15.9
Weight of Water (gm)	(w4=w1-w2)	60.7
Weight of Dry Soil (gm)	(w5=w2-w3)	170.3
Moisture Content (%)	(w4/w5)*100	36

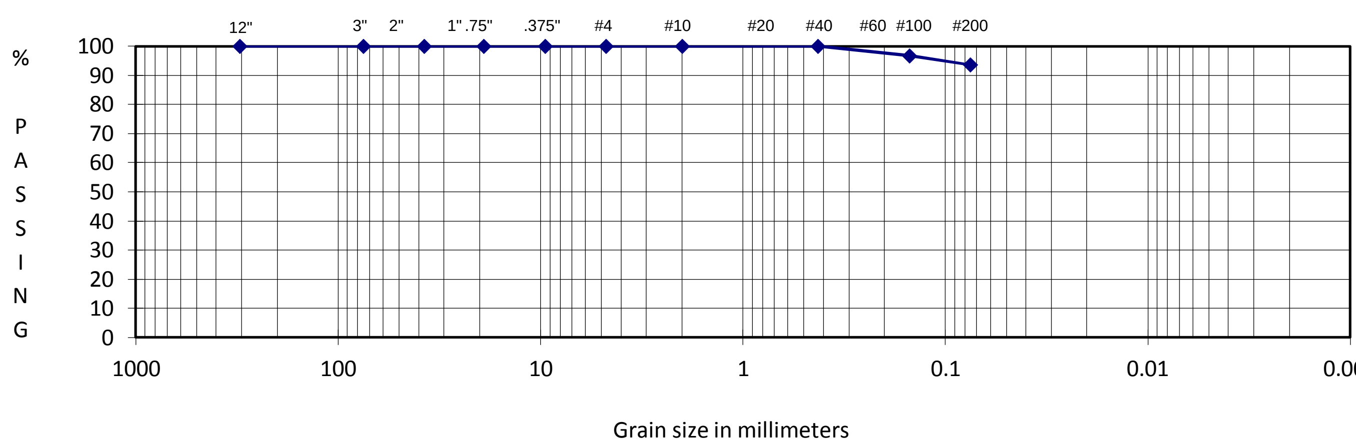
Total Weight Of Sample Used For Sieve Corrected For Hygroscopic Moisture

	Weight Of Sample (gm)	186.2
	Tare Weight (gm)	15.9
(W6)	Total Dry Weight (gm)	170.3

% COBBLES	0.0
% C GRAVEL	0.0
% F GRAVEL	0.0
% C SAND	0.0
% M SAND	0.1
% F SAND	6.3
% FINES	93.6
% TOTAL	100.0
D10 (mm)	
D30 (mm)	
D60 (mm)	
Cu	
Cc	

SIEVE ANALYSIS

Sieve	Wt Ret +Tare	(Wt-Tare)	Cumulative (%Retained) {(wt ret/w6)*100}	% PASS (100-%ret)	
12.0"	15.9	0.00	0.00	100.00	cobbles
3.0"	15.9	0.00	0.00	100.00	coarse gravel
2.5"					coarse gravel
2.0"					coarse gravel
1.5"	15.9	0.00	0.00	100.00	coarse gravel
1.0"					coarse gravel
0.75"	15.9	0.00	0.00	100.00	fine gravel
0.50"					fine gravel
0.375"	15.9	0.00	0.00	100.00	fine gravel
#4	15.9	0.00	0.00	100.00	coarse sand
#10	15.9	0.00	0.00	100.00	medium sand
#20					medium sand
#40	16.0	0.10	0.06	99.94	fine sand
#60					fine sand
#100	21.6	5.70	3.35	96.65	fine sand
#200	26.8	10.90	6.40	93.60	fines
PAN	186.2				silt/clay



DESCRIPTION	SILT with trace sand
USCS	ML

Prepared For: Brogan Companies

Reviewed By: KMW

RILEYGROUP

APPENDIX B
LIQUEFACTION ANALYSIS

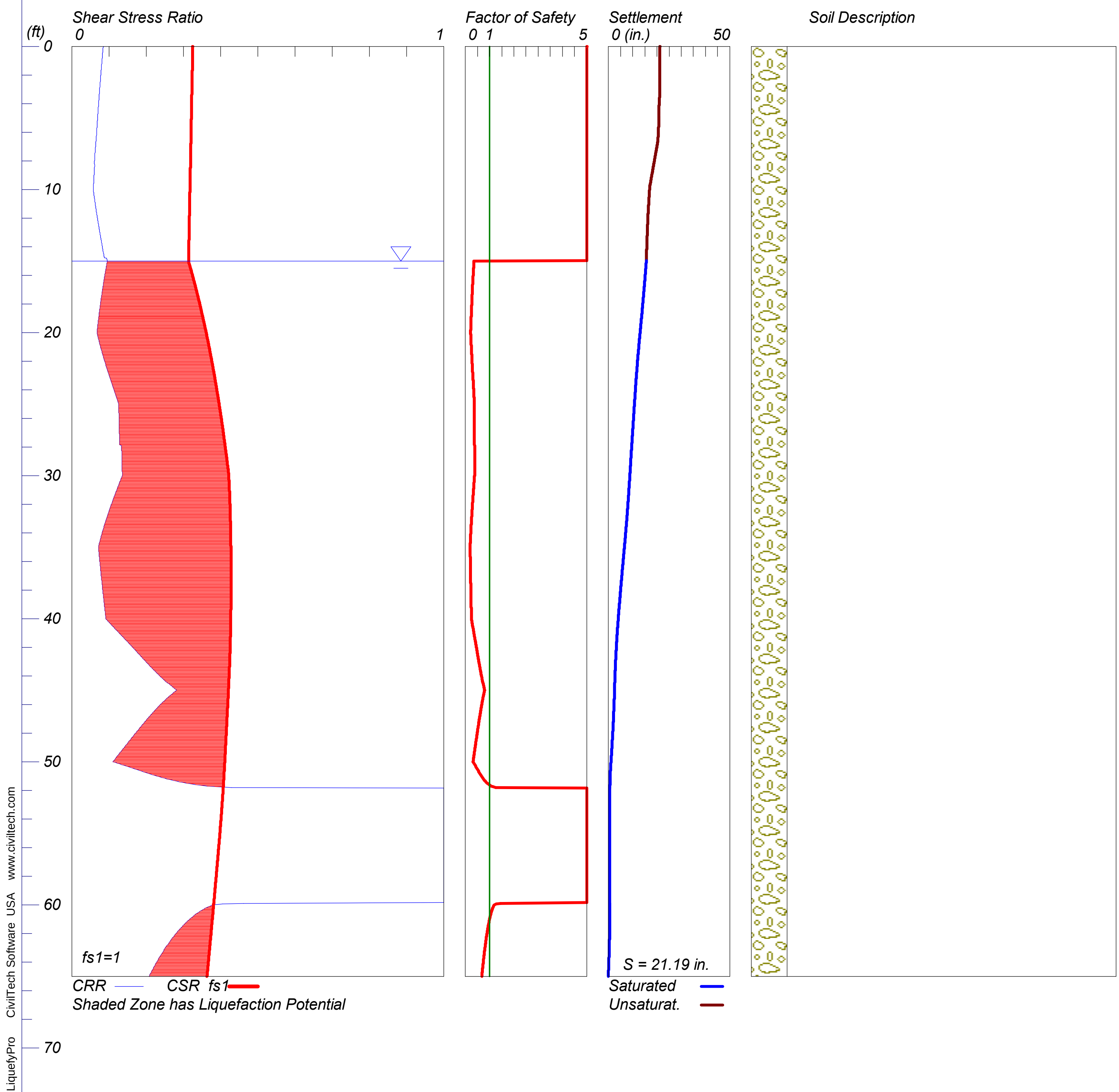
Liquefaction analysis was completed using the LiquefyPro software from CivilTech Software USA. Soil and groundwater conditions from borings B-1 and B-2 were used and the printout is attached.

LIQUEFACTION ANALYSIS

Capitol Center

Hole No.=B-1 Water Depth=15 ft

Magnitude=7
Acceleration=0.5g

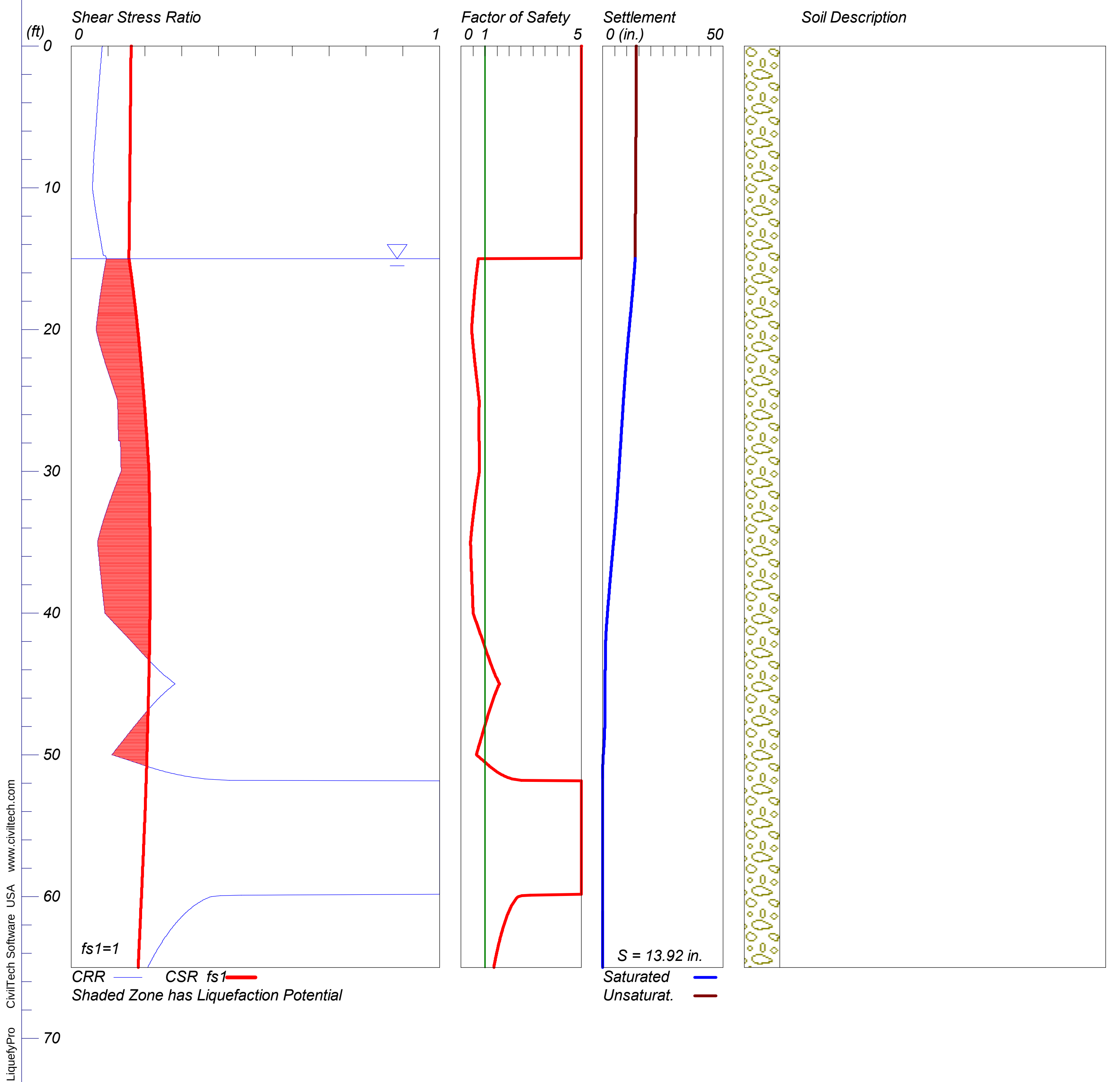


LIQUEFACTION ANALYSIS

Capitol Center

Hole No.=B-1 Water Depth=15 ft

Magnitude=7
Acceleration=0.25g

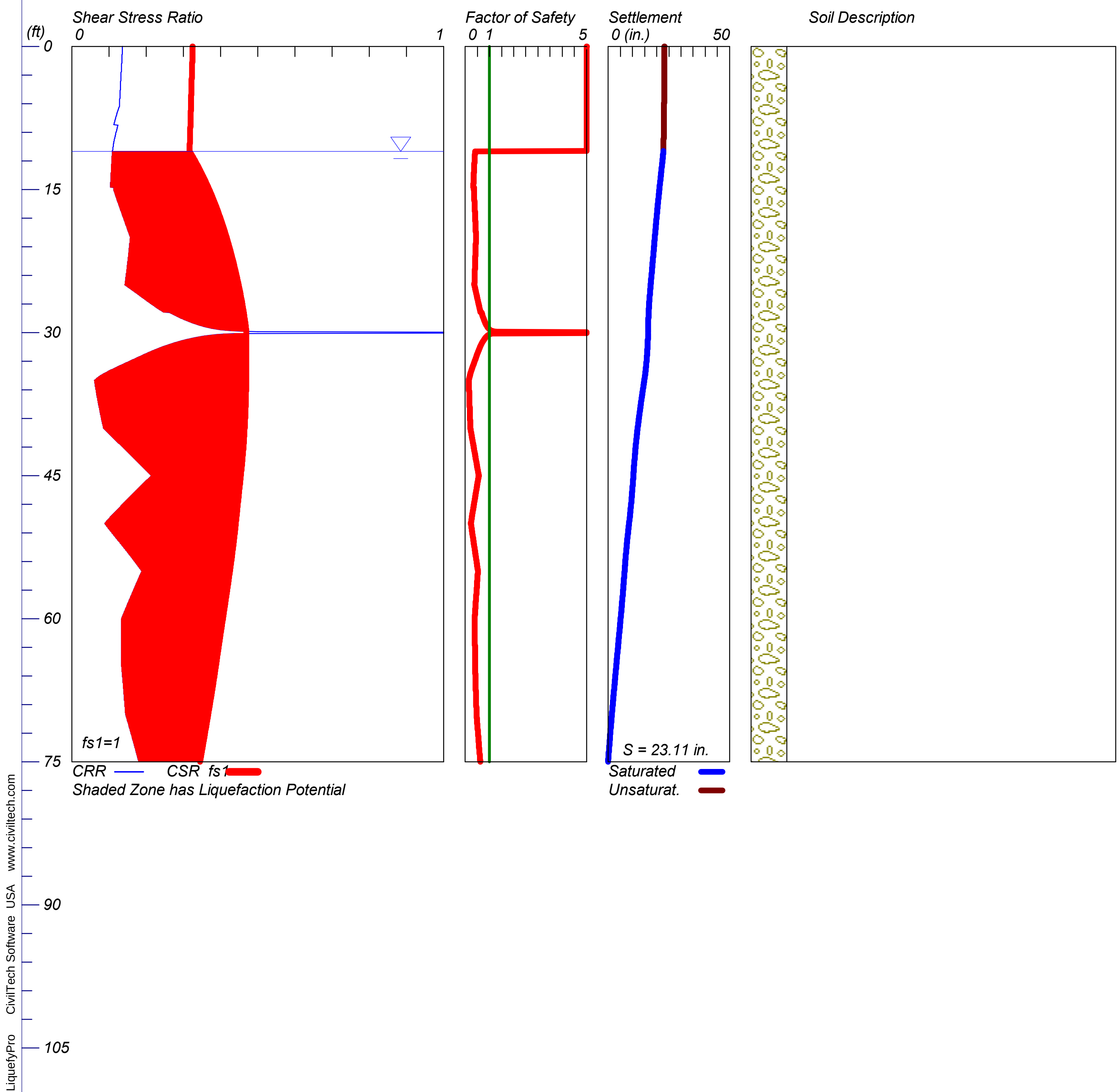


LIQUEFACTION ANALYSIS

Capitol Center

Hole No.=B-2 Water Depth=11 ft

Magnitude=7
Acceleration=0.5g



LIQUEFACTION ANALYSIS

Capitol Center

Hole No.=B-2   Water Depth=11 ft

Magnitude=7
Acceleration=0.25g