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HARTCROWSER
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January 28, 2015

Mr. Eric Jacobson
Portland Development Commission (PDC)
222 NW 5th Avenue
Portland, OR 97209

Re: **Updated Limited Geotechnical Site Evaluation**
Old Firehouse – 510 NW 3rd Avenue
Portland, Oregon
15916-06

Dear Mr. Jacobson:

Hart Crowser is pleased to present the results of our limited geotechnical engineering study for the Old Firehouse at 510 NW 3rd Avenue in Portland, Oregon. We performed an additional subsurface exploration boring on the site in January 2015, and this revision of our original report presents the original data along with the information obtained from that boring.

We understand that PDC wishes to sell the property, including the Old Firehouse, which has been damaged by apparent ground settlement. It is not known whether the building will be saved or demolished. To maximize the property value, PDC requested that we evaluate the cause of the building damage and develop possible measures and estimated costs to stabilize it. This information, as well as the geotechnical conditions documented in our explorations, will be used by potential property developers considering purchasing the property. At your request, we have prepared this report based on the scope of work outlined in the Flexible Services Work Order (WO 5 – Contract Number 212072) dated October 29, 2014. Our evaluation included subsurface explorations, research, preliminary analysis of the causes of the building displacement, and evaluation of repair/mitigation alternatives in accordance with WO 5.

Project and Site Description

The existing property includes a two-story brick building with basement surrounded by paved and gravel parking areas to the north and east. The Steel Bridge is adjacent to the property to the south and MAX tracks and facilities boarder the west side. The building has not been used for a number of years, and the prior tenant was vacated due to structural problems with the building. Based on our site observations, the east approximately one-third of the building appears to have settled relative to the rest of the building. The settlement has caused significant cracking through the brick on both the north and south sides of the building. The east end of the building appears to have settled downward relative to the rest of the building. A more recent concrete wall adjacent to the north side of the building has cracked and settled in a manner consistent with settlement of the east end of the building. The project site in relation to the area is shown on Figure 1. The site layout and explorations are included on Figure 2.

A review of historic documents available through the City of Portland (City) provided information that there were several adjacent buildings present at the site previously and that the building experienced settlement during the original construction. The settlement was reported to have occurred following flooding of the area, was repaired during construction, and is described in a similar location and magnitude as the current settlement of the building.

Subsurface Conditions

Geologic Mapping

The subsurface conditions at the site are mapped as Qaf – Artificial fill (Holocene). This unit consists of sand, silt and clay fills with subordinate amounts of gravel and debris, and local concentrations of sawdust and mill ends. Unit Qaf is mapped only where fill has eliminated lakes, sloughs, marshes, or gullies delineated during the 1898 survey of Portland (Beeson and others 1991), the earliest topographic map of the area. Fill of approximately 5 to 15 feet thick is common in developed areas of the Columbia and Willamette River floodplains, but thickness and distribution are highly variable.

Underlying soils are not documented in the mapping.

Site Explorations

We completed subsurface explorations at the site, including exploratory test pits advanced to depths between 11 and 14.5 feet below ground surface (bgs), and two drilled borings to depths of 85 and 135 feet bgs. Explorations were completed on the north and east sides of the building only, due to access constraints. The locations of the explorations are shown on Figure 2. These locations were obtained by hand measuring from existing site features on a plan provided to us and should be considered approximate.

Explorations were observed by engineering geologists from Hart Crowser. The geologists observed the soils encountered in the explorations and reported the findings on field logs. Materials encountered were classified in the field in general accordance with ASTM International (ASTM) Standard Practice D 2488, “Standard Practice for the Classification of Soils (Visual-Manual Procedure).” Representative grab samples of the soil observed in the test pits were obtained from the test pit walls and/or base using the excavator bucket. Disturbed and undisturbed samples were taken at regular intervals within the boring. Soil classifications and sampling intervals are shown on the exploration logs included in Attachment A.

Severe caving was observed in test pits TP-1 and TP-2 on the eastern side of the building after a depth of 11 feet bgs. These test pits were terminated at this depth due to caving. Caving in these test pits revealed pile-supported beams set at an angle (approximately 30 degrees) to the existing building foundation approximately 7 to 8 feet below the existing ground surface. Test pit TP-3 encountered a buried brick wall approximately 3 feet bgs, along the north side of the building. We anticipate that these structures were portions of basements or foundations for previous structures at the site, possibly those noted in our historic research. Photographs of the wall and the beam uncovered in test pit TP-1 are included on Figure 3.

Soil Conditions

We encountered three general units in our explorations: fill, fine-grained alluvium, and coarse-grained alluvium. These three units are described below.

Fill

All test pits encountered fill consisting of loose gravel overlying loose to medium dense sand and very soft to soft silts with variable sand content to the full depths explored (11 to 14.5 feet bgs). Boring B-1 encountered sand and silt fill to a depth of 39 feet bgs. Boring B-2 encountered a similar layer of silt grading to sand fill to approximately 18.5 feet bgs where the boring encountered a layer of silty sandy gravel containing angular basalt ballast rock up to 4-inch dimension down to approximately 25 feet bgs. Standard penetration (SPT) blow counts in these layers ranged between 0 and 11 blows per foot (bpf), with an average of 6 bpf.

Fine Grained Alluvium

The fill is underlain by soft to medium stiff sandy silt, loose silty sand, and traces of soft to medium stiff silt with organics that extend to depths ranging between 73 and 78 feet bgs. Blow counts in these materials range between 3 and 11 bpf and average 5 bpf. Boring B-1 encountered medium dense sand and silty sand underlying the finer-grained alluvial materials from approximately 73 feet bgs to a depth of 131 feet bgs. Blow counts in these materials range between 10 and 15 bpf and averaged 13 bpf. A 5-foot-thick layer of very loose sand (0 bpf) was encountered in B-1 at a depth of 100 feet bgs within the medium dense layers. Occasional gravel was encountered in the alluvial soils (based on drill action) below 72 feet bgs in B-2 and 125 feet bgs in B-1.

Coarse Grained Flood Deposits

Very dense sandy gravel was encountered at a depth of 78 feet bgs in B-2 and 131 feet bgs in B-1. The SPT sampler met refusal in this layer in both borings.

Water Conditions

Groundwater was encountered between 2 and 13.5 feet bgs in our explorations. Based on our observations, we anticipate that groundwater is generally between 7 and 9 feet bgs and fluctuates seasonally.

Analyses

Static Settlement

Based on our explorations, the subsurface soils, both the soft and loose fills, as well as the deeper native soils are highly susceptible to settlement due to increased static loading. Historic documents available from the City archives confirm this with the report that the Firehouse experienced settlement during the original construction. The settlement was reportedly mitigated at the time of construction, and we found no further reports of similar damage.

Although the current settlement and resulting damage appear to be at the same location as the original settlement, we believe that the current distress is due to a separate event, not a continuation of the original settlement. This is due to two primary reasons: 1) the long use of the structure with no reports of damage or problems until it was evacuated approximately 10 or 15 years ago, and 2) the much newer adjacent retaining wall is cracked and displaced in a location and magnitude consistent with the building. This latter reason, in particular, indicates that the settlement and current damage to the building occurred after the newer retaining wall was constructed.

Based on our observations and the subsurface conditions, it is our opinion that the observed settlement of the building and that of the newer retaining wall has occurred after the original construction and over time, most likely due to surcharge loads placed in the open area adjacent to the east side of the building. Based on the site location and our conversations with you, it is highly likely that the area has been used for storage and staging during construction of the infrastructure around the site, including the light rail, bridge structures, and sewer projects. Any loads, even minor loads, placed in the area on these soft soils would cause settlement in the observed pattern in the building and newer retaining wall. Therefore, although both the original and more recent settlements are ultimately related to the soft deep soils, they are essentially from different static loading events. The first event occurred during construction (and possibly exacerbated by flooding) and the second from later construction staging/storage.

Seismic Hazards

A detailed seismic hazard analysis was not included in the scope of this study. However, the site is mapped by the City as being in a zone of high earthquake hazard, and based on the subsurface conditions, the native and fill soils are likely to be highly susceptible to liquefaction under strong earthquake shaking. Based on the depth of the liquefiable soils (greater than 100 feet), our boring data, and a preliminary liquefaction analysis, we anticipate that liquefaction settlement on the order of 2 to 4 feet should be expected at the site. Further, liquefaction can also result in lateral spreading or flow failures toward the Willamette River. Based on our preliminary analysis, lateral displacement on the order of 2 to up to 10 feet towards the river should be expected.

Settlement and lateral spreading would significantly affect mitigation alternatives for this site. Shallow foundations (footings and grade beams or mat foundations) would need to consider differential settlement and lateral spreading as displacements of the estimated magnitudes could cause severe damage and collapse of structures. Deep foundations would need to consider lateral loading from lateral spread and also vertical downdrag loads from vertical settlement of the liquefied soils. Based on a preliminary code-based analysis, we estimate that preliminary shaft design would require an equivalent fluid pressure (EFP) of 330H pounds per square foot (psf) above the groundwater table (assumed at 10 feet bgs) and an EFP of 36H psf below the groundwater table (greater than 10 feet bgs). This pressure would apply over the shaft to a depth of approximately 60 to 70 feet bgs, based on our assumption of a 40-foot-deep channel. These values were estimated using the force-based approach as presented in the Oregon Department of Transportation (ODOT) *Geotechnical Design Manual* (ODOT 2014).

Design Considerations

Based on the potential for static settlement due to any additional loads placed at the site, the significant seismic hazard at the site, and the depth to competent soils (greater than 75 feet), retrofit and upgrade of the existing structure will be difficult. PDC and their developer will need to discuss the design standard for any retrofits or new structures completed at the site. A “life safety” standard (i.e., that the building does not collapse in the design seismic event) may be more reasonable from a cost perspective than designing the structure to be serviceable after the design event; however, the structure will likely be unusable and possibly unrepairable after the event.

Additionally, any future development and/or retrofit of the existing structure will have to take the potential for static settlement and seismic hazards into consideration for design. A detailed seismic hazard analysis, including the evaluation of liquefaction potential, seismic settlement estimates, and lateral spread potential should be completed.

Mitigation Alternatives

We considered a number of alternatives to support the building and repair the structure. We initially considered small-diameter (less than 12 inches in diameter) foundations; however, we found during site explorations that competent soils were very deep (75 to 130 feet bgs), so such measures are not feasible.

In conjunction with the project structural engineer, KPFF Consulting Engineers (KPFF), we considered other options for mitigation and building retrofit. In considering these options, we included the following criteria:

- Must prevent static settlement so no future static settlement-related damage will occur.
- Must prevent building collapse under the design seismic event, as required by current code, although the building may be heavily damaged and not economically feasible to repair.
- Must be constructible.

Using these criteria and in consultation with KPFF, a summary of the options we considered, including the associated advantages and disadvantages of each are documented in Table 1.

Table 1 – Mitigation Options Summary

Mitigation Option	Structural Considerations	Advantages	Disadvantages
Slab jacking with foam or other injected light weight material to restore the building to a level condition without causing settlement.	■ Structure will have to be tied together once jacking is complete.	■ Can be completed through the basement slab. ■ Would not affect adjacent sites.	■ Provides no mitigation for seismic hazards.
Ground Improvement of the top 30 to 40 feet of material beneath the structure (likely stone columns, soil jetting or mixing).	■ Some slab jacking would likely still be required to meet structural needs ■ Structure will have to be tied together once jacking is complete ■ Potential for static settlement due to increase weight on soils below improved soils would have to be considered.	■ Would reduce overall liquefaction settlement and limit differential settlement across the building footprint.	■ Will only partially mitigate seismic hazards ■ May cause additional static settlement in underlying un-improved soils. ■ Could affect adjacent streets, structures, and utilities. ■ Cannot likely be completed under the structure without lifting or moving the building.
Construction of a mat or grade beam foundation	■ Will require an adequate shoring/support plan for construction. ■ Will require staged excavation and shoring at intervals.	■ Can provide protection against differential static and seismic settlement to allow for design to a “life safety” standard. ■ Would not affect adjacent sites.	■ Does not provide mitigation for lateral spread or liquefaction settlement. ■ Will likely cause some additional static settlement due to increased building loads. Below-grade over-excavation and light weight fill will likely be required to prevent static settlement. ■ May require dewatering. ■ Is not structurally feasible without mitigation against lateral spread.
Support structure on deep drilled shaft foundations (3-4 feet in diameter) connected by grade beams.	■ Structure will have to be tied together and loads transferred to shafts constructed around the perimeter ■ Shafts should be designed to resist lateral loading from lateral spreading and liquefaction loading and downdrag	■ Can provide protection against differential static and seismic settlement to allow for design to a “life safety” standard. ■ Would not affect adjacent sites. ■ Would reduce overall liquefaction settlement and limit differential settlement across the building footprint.	■ Access for drill rigs and long cages will be difficult. ■ Large lateral loads are anticipated during the design level earthquake. Shafts cannot be practically designed to accommodate both lateral spread and downdrag loads. ■ Is not structurally feasible without lateral spread mitigation.

Conclusions

Mitigation Alternatives Summary

Our opinion on the feasibility of the mitigation alternatives considered above, based on our analyses and discussions with KPFF regarding structural considerations can be summarized as follows:

- Small diameter deep foundations (less than 12 inches) will not have adequate lateral capacity to support the structure due to the deep soft soils. Therefore, this option is not feasible.
- Slab jacking will not mitigate for seismic induced damage and building collapse following the design seismic event would be expected. Therefore, this option is not feasible.
- Completing ground improvement beneath the structure would require moving the building to allow access to the complete building footprint. We understand this is not feasible due to the unreinforced masonry (URM) construction of the building. Therefore, this option is not feasible.
- Supporting the structure on drilled shafts alone is not feasible due to the large lateral loads and the depth to non-liquefied material. This option is feasible if liquefaction is mitigated sufficient to stop lateral spread at the site.
- Based on information from KPFF, supporting the structure on a mat foundation alone is not feasible. The large lateral displacements and differential settlement are anticipated to be too severe to develop a mat foundation and structural retrofit of the existing URM building that can be assured will not collapse in the design event. This option may be feasible if liquefaction is mitigated sufficient to stop lateral spread at the site and reduce settlement under the structure. However, as stated above, ground improvement under the structure will be difficult if not impossible. Further analysis would be required in order to determine if this option would be feasible.

Based on our assessment, stabilization of the Old Firehouse must include some form of ground improvement to mitigate seismic-induced lateral spread. Based on our limited analysis, ground improvement within the building footprint alone is not feasible since it would require moving the structure, which it is believed will cause irreparable damage. Therefore ground improvement must be completed outside the structure footprint and in conjunction with another foundation system. If ground improvement is completed to reduce lateral spread movement, based on our evaluation and the structural review by KPFF, then drilled piers would adequately support the structure to preclude future static settlement or collapse in a seismic event.

These systems and their anticipated costs are described below.

Ground Improvement

Based on our knowledge of the site, we anticipate that ground improvement would require the installation of soil columns or soil mixing for a section between the structure and the river. A detailed analysis and design of this system would be needed to provide accurate details and costs. However, we would expect that the system would have to extend to the depth of lateral spreading (estimated to be approximately 60 feet) and require multiple rows of columns along the east property line or near the building.

The cost of the system cannot be estimated without additional design details. However, we discussed the project with a ground improvement contractor who completed a nearby project, a City of Portland Fire Station. That project included stone columns to approximately 30 feet deep to support the building columns and the work cost approximately $1.5 million to complete. Based on their description of the work relative to the Old Firehouse site, we would expect ground improvement at the Old Firehouse site using a similar method to be at least equal in cost and could easily be double that amount. Because of the number of unknowns at this time, we assumed the higher value of $3 million in our estimate. The actual amount could still vary significantly from this assumption, particularly due the small difficult site and surrounding structures. The small irregular site will make access very difficult and the adjacent bridge, light rail line, and existing structure may require special techniques and monitoring to preclude damage to them during the work.

Mat Foundation

A mat foundation would consist of a thick heavily reinforced slab installed beneath the entire structure and connected to the existing building as part of a structural seismic retrofit. Design details of the slab are not known; however, a 4-foot-thick slab has been assumed in our assessment and cost estimate. The new concrete slab would increase the net building/site weight, and therefore, would require approximately 3 to 6 feet of soil removal beneath the mat foundation and replacement with light weight fill. Because the structure is of URM construction and currently in a distressed condition, the foundation would have to be excavated and constructed in sections. Each section would have to be completed before the adjacent section were then excavated to prevent damage. Individual sections would likely be limited to approximately 6 feet wide. This construction process would require staged shoring and possibly dewatering to allow excavation for placement of lightweight fill and construction of the mat foundation.

Constructing this system would require significant coordination and efforts beyond a typical mat foundation at a new construction site, therefore it is difficult to estimate the cost. However, in order to develop a ballpark estimate for PDC’s preliminary planning, we used information from various sources supplemented by our own experience. A copy of the spreadsheet we developed is attached (see Attachment B). Unusual or difficult to estimate items note the basis of the estimate for that specific item in the spreadsheet. We estimate that a mat foundation for the building will be on the order of $2.5 million.

We note that KPFF has concerns about differential settlement of the building in a seismic event if a mat foundation is used. Although lateral spread would be mitigated by ground improvement, seismic-induced settlement would still occur. A detailed analysis is still required to confirm that a mat foundation will adequately support the Old Firehouse under seismic-induced settlement before selection of this option can be finalized.

Drilled Piers

As with the ground improvement and mat foundation components, an accurate estimate for drilled piers cannot be formulated, as design is not complete. Additionally, the difficult access, staged construction and site subsurface conditions make estimating such a project inherently inaccurate. However, in order to develop a ballpark estimate for PDC's preliminary planning, we discussed the project with a drilled shaft contractor. We assumed 12 drilled shafts of 2 to 3 feet diameter embedded in the dense gravels at depths of approximately 75 to 135 feet bgs. Based on these assumptions and our discussions, the drilled shafts would be on the order of $0.6 to $1 million. In addition to the shafts, grade beams would be required between the shafts, which transfer the building loads to the shafts. Again, detailed design of the grade beams is not complete. However, assuming 4-foot-thick grade beams and using typical unit prices (as shown in Attachment B) grade beams would cost at least approximately $0.8 million. This brings the total estimate to $2.3 million using the higher drilled shaft estimated cost.

Summary

Based on our estimates above, ballpark costs for the mat and drilled shaft foundations are as follows:

- **Mat Foundation with Ground Improvement**: $5.5 million ($3 million ground improvement and $2.5 million mat foundation)

- **Drilled Shafts with Ground Improvement**: $5.3 million ($3 million ground improvement and $2.3 million drilled shafts and grade beams

It is our opinion that the drilled shaft with ground improvement option is the preferred option. We estimate it will be approximately $0.3 million less than the mat foundation option. Additionally, it will support the building against settlement under static and seismic conditions, while some uncertainty remains regarding the seismic performance of the mat foundation option.

We caution that these estimates are very preliminary, order of magnitude costs, as the difficult site makes applying unit prices and comparisons to other sites highly inaccurate. Additionally significant detailed design is needed before more accurate costs can be developed.

Our estimates include the foundation and ground improvements only and do not include repair of the building distress, structural upgrades to meet current seismic codes, or interior or exterior improvements or cosmetic enhancements.

Construction Considerations

We do not anticipate that further static settlement at the site will occur unless additional loading is placed at the site. Therefore, we recommend that the lot not be used for staging, storage, or other uses that may increase loads on the underlying soft soils, and cause additional settlement and building distress during construction, if the building is to be preserved. Future development will have to take static settlement into consideration in the vicinity of the existing building if it is to remain in place, depending on if drilled piers or a mat foundation are selected. New construction should not increase loads on the surrounding soils unless the anticipated settlement is mitigated.

Limitations

Our report is for the exclusive use of Portland Development Commission and their consultants for specific application to the subject project and site. We completed this study in accordance with generally accepted geotechnical practices for the nature and conditions of the work completed in the same or similar localities, at the time the work was performed. We make no other warranty, express or implied.

We trust that this report meets your project needs. If you have questions or if we can be of further assistance, please call.

Sincerely,

HART CROWSER, INC.

REGISTERED PROFESSIONAL ENGINEER
52838
OREGON
JAN. 12, 1999
TIMOTHY W. BLACKWOOD
EXPIRES 12/31/2015

ALLISON M PYRCH, PE, GE
Senior Project, Geotechnical Engineer

TIMOTHY W. BLACKWOOD, PE, GE, CEG
Principal, Geotechnical Engineer

Attachments:
Figure 1 – Vicinity Map
Figure 2 – Site Plan
Figure 3 – Site Photographs
Attachment A – Field Explorations and Laboratory Testing
Attachment B – Cost Estimate Spreadsheet

References

Beeson, M.H., T.L. Tolan, and I.P. Madin 1991. *Geologic map of the Portland quadrangle, Multnomah and Washington Counties, Oregon, and Clark County, Washington*. Oregon Department of Geology and Mineral Industries, Geological Map Series 75, scale 1:24,000.

Oregon Department of Transportation (ODOT) 2014. *Geotechnical Design Manual (GDM),* 2014.

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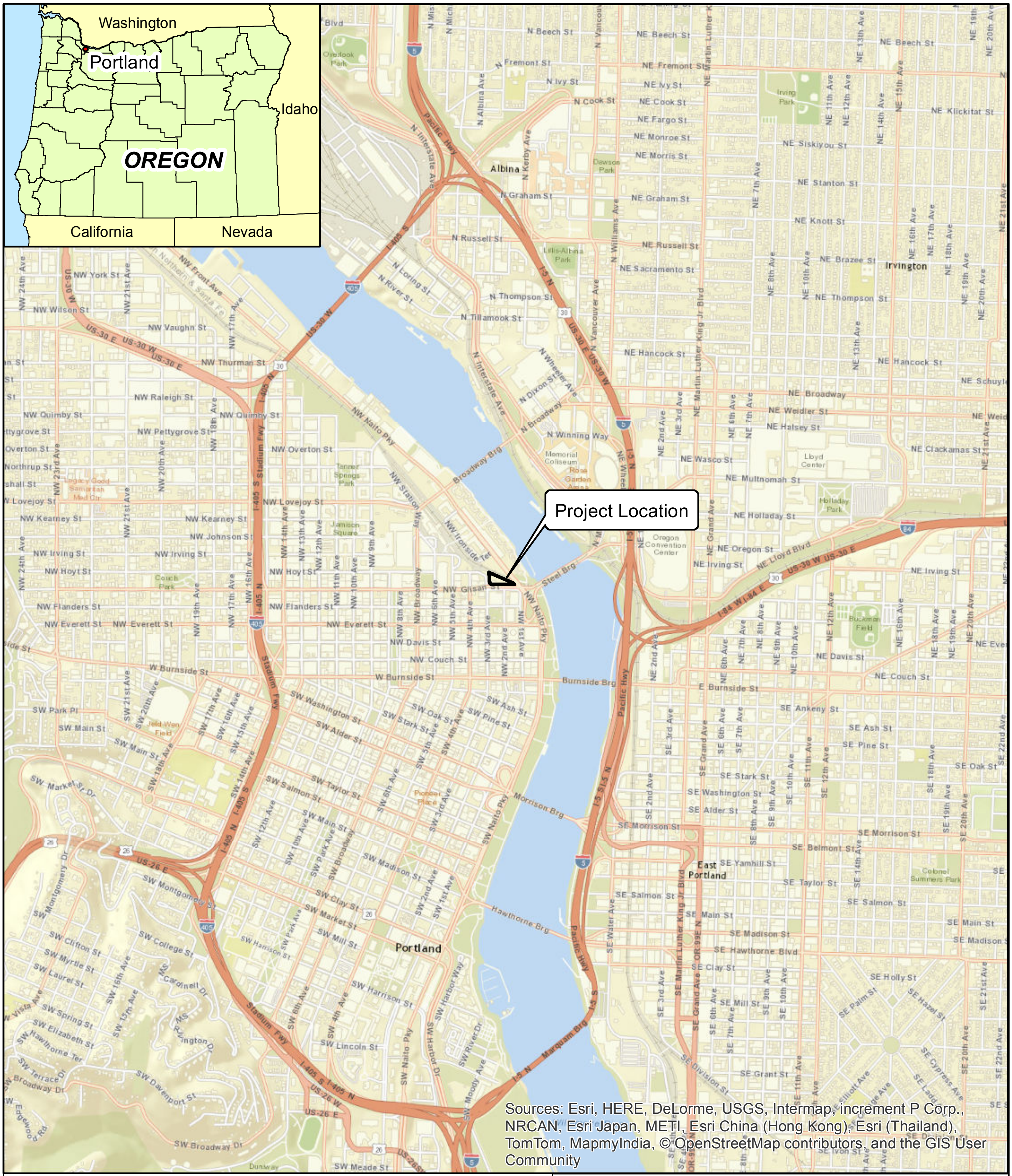

Sources: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

510 NW 3rd Ave. Geotechnical Evaluation
Portland, Oregon

Vicinity Map

15916-06
1/15

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Figure
1

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Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

LEGEND

TP-1 **9/M-R**	▣	Test Pit Seepage Depth (feet)/Seepage Rate
B-1 **7.5-10**	●	Boring Depth to Groundwater (feet)
	▭	Property Boundary

Seepage Rates
R = Rapid Seepage (greater than 3 gpm)
M = Moderate Seepage (1-3 gpm)
S = Slow Seepage (less than 1 gpm)

Note: Locations of explorations are approximate.

0 30 60 120
Feet

N

510 NW 3rd Ave. Geotechnical Evaluation
Portland, Oregon

Site Plan

15916-06
1/15

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Figure
2

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Buried Pile Supported Beam in TP-1

Buried Wall Encountered in TP-3

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Site Photographs

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Figure

3

####

ATTACHMENT A
Field Exploration and Laboratory Testing

Field Explorations

This attachment documents the processes Hart Crowser used to determine the nature (and quality) of the soil and groundwater underlying the project site addressed by this report. The discussion includes information on the following subjects.

- Explorations and Their Locations,
- Boring Explorations,
- Test Pit Explorations, and
- Sampling Procedures.

Explorations and Their Location

Observed subsurface explorations for this project included two drilled borings (B-1 and B-2) and five test pit explorations (TP-1 through TP-5). The exploration logs in this attachment show our interpretation of the explorations, sampling, and testing data. The exploration logs indicate the depths where the soils change. Note that the change may be gradual. In the field, we classified the samples taken from the explorations according to the methods presented on the Key to Exploration Logs. This key also provides a legend explaining the symbols and abbreviations used in the logs. Figure 2 of the report shows the locations of explorations.

Boring Explorations

Borings B-1 and B-2 were drilled on November 4, 2014 and January 2, 2015, respectively. Both were drilled by advancing a 4-7/8-inch-diameter tricone bit and mud rotary methods on a truck-mounted drill rig subcontracted by Hart Crowser; B-1 was drilled by Subsurface Technologies of Banks, Oregon and B-2 by Western States Drilling of Hubbard, Oregon. The drilling was observed by geologic staff members from Hart Crowser and a detailed field log of the boring was prepared.

Test Pit Explorations

Five test pits designated TP-1 through TP-5 were advanced on October 30, 2014, with a rubber-tired excavator subcontracted by Hart Crowser to Dan Fischer Excavating of Aloha, Oregon. The test pits were observed by a geologic staff member from Hart Crowser and detailed field logs were prepared.

Sampling Procedures

Disturbed samples were obtained from the boring using 1-1/2-inch-inner diameter split-spoon sampler (SPT sampler) and a 3.0-inch-inner diameter split-spoon sampler (D&M sampler) in general accordance with guidelines presented in ASTM D 1586. The split-barrel samplers were driven into the soil with a 140-pound hammer free falling 30 inches. The samplers were driven a total distance of 18 inches. Soil samples were recovered from the split-barrel samplers, field classified, and placed into watertight bags.

Relatively undisturbed samples were obtained using a thin wall "Shelby Tube" sampler in general accordance with ASTM D 1587. The sampler was lowered on the drill string to the bottom of the drilled hole. The tube was then slowly pushed with the weight of the drill rig as needed to collect the sample. The sampler was removed from the hole and the ends sealed to prevent soil or moisture loss.

Both disturbed and undisturbed samples were taken to Hart Crowser's laboratory for future testing.

Laboratory Testing

A geotechnical laboratory testing program was performed for this study to evaluate the basic index and geotechnical engineering properties of the site soil. Disturbed samples were tested. The tests performed and the procedures followed are outlined below.

Soil Classification

Soil samples from the explorations were visually classified in the field and then taken to our laboratory where the classifications were verified in a relatively controlled laboratory environment. Field and laboratory observations include density/consistency, moisture condition, and grain size and plasticity estimates.

The classifications of selected samples were checked by laboratory tests, such as water content determinations and grain size analyses. Classifications were made in general accordance with the Unified Soil Classification System and ASTM Test Method D 2487.

Water Content Determinations

Water contents were determined for samples recovered in the explorations in general accordance with ASTM Test Method D 2216 as soon as possible following their arrival in our laboratory. The results of these tests are plotted at the respective sample depth on the exploration logs and in the Summary of Laboratory Results included in this attachment.

Atterberg Limits

Atterberg limits (liquid limit, plastic limit and plasticity index) of fine-grained soil samples were completed by Northwest Testing, Inc. of Wilsonville, Oregon, in general accordance with ASTM Test Method D 4318-02. The results of the Atterberg limits tests completed on samples from the explorations are presented in the Summary of Laboratory Results included in this attachment.

KEY TO EXPLORATION LOGS

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SOIL CLASSIFICATION CHART

MATERIAL TYPES	MAJOR DIVISIONS		GROUP SYMBOL	SOIL GROUP NAMES & LEGEND	
COARSE-GRAINED SOILS >50% RETAINED ON NO. 200 SIEVE	GRAVELS >50% OF COARSE FRACTION RETAINED ON NO 4. SIEVE	CLEAN GRAVELS <5% FINES	GW	WELL-GRADED GRAVEL	▨
			GP	POORLY-GRADED GRAVEL	▨
		GRAVELS WITH FINES, >12% FINES	GM	SILTY GRAVEL	▨
			GC	CLAYEY GRAVEL	▨
	SANDS >50% OF COARSE FRACTION PASSES ON NO 4. SIEVE	CLEAN SANDS <5% FINES	SW	WELL-GRADED SAND	▨
			SP	POORLY-GRADED SAND	▨
		SANDS AND FINES >12% FINES	SM	SILTY SAND	▨
			SC	CLAYEY SAND	▨
FINE-GRAINED SOILS >50% PASSES NO. 200 SIEVE	SILTS AND CLAYS LIQUID LIMIT<50	INORGANIC	CL	LEAN CLAY	▨
			ML	SILT	▥
		ORGANIC	OL	ORGANIC CLAY OR SILT	▤
	SILTS AND CLAYS LIQUID LIMIT>50	INORGANIC	CH	FAT CLAY	▨
			MH	ELASTIC SILT	▥
		ORGANIC	OH	ORGANIC CLAY OR SILT	▨
HIGHLY ORGANIC SOILS			PT	PEAT	▨

Note: Multiple symbols are used to indicate borderline or dual classifications

OTHER MATERIAL SYMBOLS	
▨	Concrete
■	Asphalt
▨	Topsoil

MOISTURE MODIFIERS

Dry	-	Absence of moisture, dusty, dry to the touch
Moist	-	Damp, but no visible water
Wet	-	Visible free water or saturated, usually soil is obtained from below the water table

SEEPAGE MODIFIERS

None	-	
Slow	-	< 1 gpm
Moderate	-	1-3 gpm
Heavy	-	> 3 gpm

CAVING MODIFIERS

None	-	
Minor	-	isolated
Moderate	-	frequent
Severe	-	general

MINOR CONSTITUENTS

Trace	-	< 5% (silt/clay)
Occasional	-	< 15% (sand/gravel)
With	-	5-15% (silt/clay) in sand or gravel 15-30% (sand/gravel) in silt or clay

SAMPLE TYPES

⧗	Dames & Moore
☒	Standard Penetration Test (SPT)
■	Shelby Tube
▩	Bulk or Grab

LABORATORY/ FIELD TESTS

ATT	-	Atterberg Limits
CP	-	Laboratory Compaction Test
CA	-	Chemical Analysis (Corrosivity)
CN	-	Consolidation
DD	-	Dry Density
DS	-	Direct Shear
HA	-	Hydrometer Analysis
OC	-	Organic Content
PP	-	Pocket Penetrometer (TSF)
P200	-	Percent Passing No. 200 Sieve
SA	-	Sieve Analysis
SW	-	Swell Test
TV	-	Torvane Shear
UC	-	Unconfined Compression

GROUNDWATER SYMBOLS

▽	Water Level (at time of drilling)
▼	Water Level (at end of drilling)
▽	Water Level (after drilling)

STRATIGRAPHIC CONTACT

———	Distinct contact between soil strata or geologic units
— — —	Gradual or approximate change between soil strata or geologic units

Notes:

Blowcount (N) is recorded for driven samplers as the number of blows required to advance sampler 12 inches (or distance noted) per ASTM D-1586. See exploration log for hammer weight and drop.

When the Dames & Moore (D&M) sampler was driven with a 140-pound hammer (denoted on logs as D+M 140), the field blow counts (N-value) shown on the logs have been reduced by 50% to approximate SPT N-values.

Refer to the report text and exploration logs for a proper understanding of subsurface conditions. Descriptions on the logs apply only at the exploration locations at the time the explorations were made. The logs are not warranted to be representative of the subsurface conditoins at other locations or times.

KEY TO EXPLORATION LOGS - F:\DATA\GINT\OREGON_LIBRARY.GLB - 11/3/14 13:02 - F:\DATA\JOBS\15916 PDC\-06 3RD AVE OLD FIREHOUSE\GINT\15916-06-TP1-5.GPJ

BORING B-1

PAGE 1 OF 2

HARTCROWSER

CLIENT Portland Development Commission

PROJECT NAME 510 NW 3rd Ave. Geotechnical Evaluation

PROJECT NUMBER 15916-06

PROJECT LOCATION Portland, Oregon

DATE STARTED 11/4/2014 **COMPLETED** 11/4/2014

GROUND ELEVATION ~32 ft **SIZE** 4 7/8-inch

DRILLING CONTRACTOR Subsurface Technologies

GROUND WATER LEVELS:

DRILLING METHOD Mud Rotary

▽ **AT TIME OF DRILLING** 7.50 ft - 10.00 ft

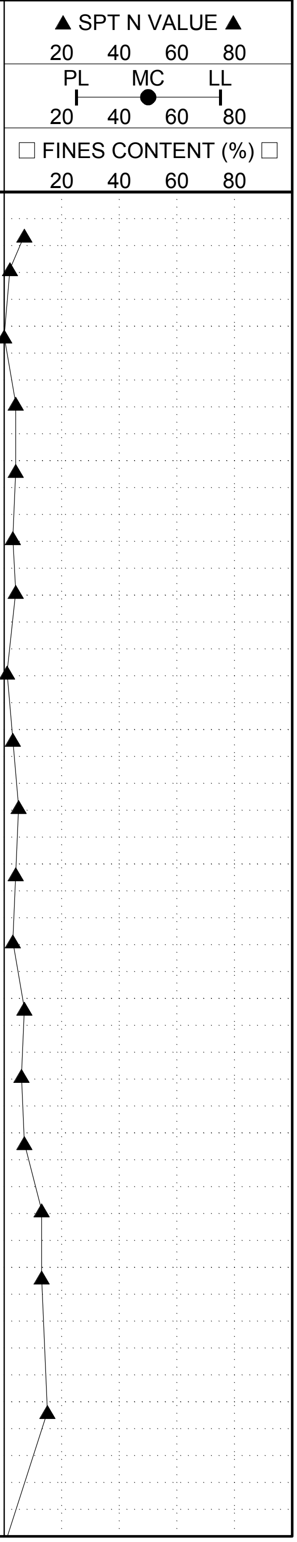
LOGGED BY R. Pirot **CHECKED BY** A. Pyrch

AT END OF DRILLING ---

NOTE:

AFTER DRILLING ---

DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)
0	(SP) Loose, moist to wet, gray, gravelly SAND, trace silt, medium to coarse subrounded to angular sand, medium to coarse subrounded to subangular gravel. (Fill)	SPT S-1	47	8-5-2 (7)		
	▽ (SM-SP) Very loose, moist to wet, gray to brown, silty SAND.	SPT S-2	0	3-1-1 (2)		
10	(ML/SM) Very soft to soft, wet, gray, sandy SILT to silty SAND, occasional trace gravel, low plasticity, fine subangular sand, fine subangular to angular gravel, organic odor, scattered fine woody debris, micaceous.	SPT S-3	40	0-0-0 (0)		
		SH S-4	100			
		SPT S-5	100	0-2-2 (4)		
20	Scattered to numerous wood debris	SPT S-6	33	0-0-4 (4)		
		SPT S-7	0	1-1-2 (3)		
		SH S-8	50			
30		SPT S-9	0	4-1-3 (4)		
		SH S-10	100			
		SPT S-11	20	0-0-1 (1)		
40	(ML) Soft to medium stiff, moist to wet, gray-brown, sandy SILT, low plasticity, fine subangular sand, stratified with occasional layers of silt with sand, scattered to numerous fine rootlets and organic material, organic odor, occasional shell fragments. (Fine-grained Alluvium)	SPT S-12	100	1-2-1 (3)		
		SPT S-13	100	0-2-3 (5)		
50		SPT S-14		2-2-2 (4)		
		SPT S-15	100	2-1-2 (3)		
60	(ML/SM) Medium stiff, moist to wet, gray, sandy SILT to silty SAND, low plasticity, fine subangular sand, slight mica, scattered rootlets and organic material, organic odor.	SPT S-16	100	2-3-4 (7)		
		SPT S-17	67	2-2-4 (6)		
70		SPT S-18	67	4-4-3 (7)		
	(SP) Medium dense, wet, gray, SAND, trace silt, low plasticity fines, fine to medium subangular sand, stratified with occasional layers of silty sand, micaceous.	SPT S-19	60	16-6-7 (13)		
80		SPT S-20	60	7-7-6 (13)		
90		SPT S-21	80	4-5-10 (15)		
100						



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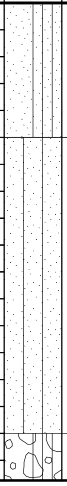
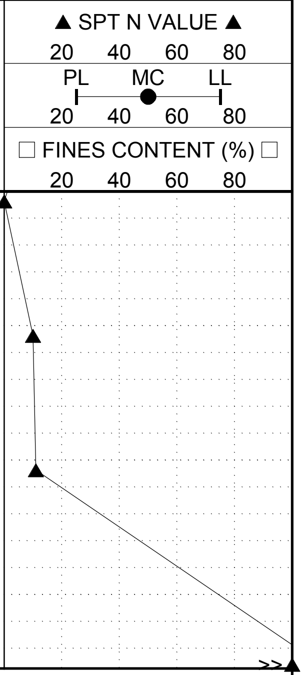
CLIENT Portland Development Commission
PROJECT NAME 510 NW 3rd Ave. Geotechnical Evaluation
PROJECT NUMBER 15916-06
PROJECT LOCATION Portland, Oregon



DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)
100	(SP-SM) Very loose, wet, gray, SAND, trace to with silt, fine to medium subangular sand, micaceous.	SPT S-22	93	3-0-0 (0)		
110	(SM) Medium dense, wet, gray, silty SAND, fine subangular sand, micaceous.	SPT S-23	100	2-4-6 (10)		
120		SPT S-24	100	6-6-5 (11)		
	Occasional pockets of gravel					
130						
	(GP-GM) Very dense, moist to wet, red and gray-brown, sandy GRAVEL with silt, coarse round to subrounded gravel in fine grained matrix, weathered clasts. (Coarse-grained Flood Deposits)	SPT S-25	100	50/5"		

Boring completed at 135.5 feet.



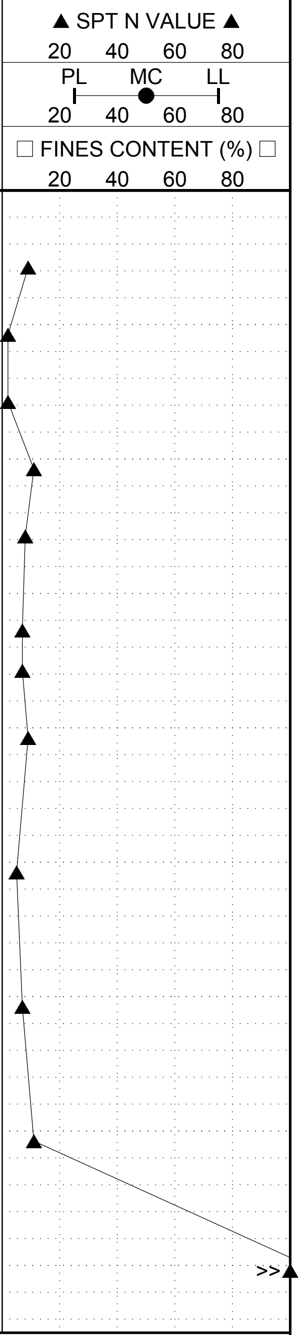
GEOTECH BH PLOTS - F:\DATA\GINT\OREGON_LIBRARY.GLB - 1/16/15 14:35 - F:\NOTEBOOKS\1591606_3RD AVE OLD FIREHOUSE\FIELD DATA\PERM_GINT\15916-06 BORING AND TEST PIT LOGS.GPJ

HARTCROWSER

BORING B-2

CLIENT Portland Development Commission
PROJECT NAME 510 NW 3rd Ave. Geotechnical Evaluation
PROJECT NUMBER 15916-06
PROJECT LOCATION Portland, Oregon
DATE STARTED 1/2/2015 **COMPLETED** 1/2/2015
GROUND ELEVATION ~32 ft **SIZE** 4.875"
DRILLING CONTRACTOR Western States Drilling
GROUND WATER LEVELS:
DRILLING METHOD Mud Rotary
▽ **AT TIME OF DRILLING** 12.00 ft
LOGGED BY J. Lawes **CHECKED BY** A. Pyrch
AT END OF DRILLING ---
NOTE: Hammer Efficiency = 73%; D&M blow counts reduced by 50%
AFTER DRILLING ---

DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)
0	3-inch thick asphalt pavement					
	(GP) 4-inch thick round aggregate base					
	(ML) Stiff, moist, gray, black, and red-brown fine to medium SANDY SILT with rounded and angular gravel, low plasticity, trace brick and wood fragments [Fill]	SPT 1	28	7-7-2 (9)		
10	▽ grades to soft	SPT 2	22	0-0-2 (2)		
	(SM) Very loose, wet, dark gray SILTY fine SAND with gravel, angular basalt gravel to 4"	SPT 3	6	2-1-1 (2)		
20	(GM) Medium dense, wet, dark gray SILTY SANDY GRAVEL, angular basalt gravel in silt and fine to medium sand matrix	DM140 4	17	2-6-5 (11)		
	(ML/SM/Pt) Interbedded medium stiff, moist, dark gray fine SANDY SILT, low plasticity with loose, moist to wet, dark gray SILTY fine SAND and medium stiff, moist, black to dark brown PEAT with charcoal and wood fragments [Fine-grained Alluvium]	SPT 5	56	4-4-4 (8)		
30		SHELBY 6	100			
	(ML/SM) Interbedded medium stiff, moist, dark gray fine SANDY SILT, low plasticity with loose, moist to wet, dark gray SILTY fine to medium SAND, trace white shell fragments	SPT 7	100	2-3-4 (7)		
		SPT 8	89	1-3-4 (7)		
40	(ML) Medium stiff, moist, dark gray SILT, low to moderate plasticity, trace fine sand, white shell, and organic fragments	DM140 9	89	3-4-5 (9)		
	(OL) Soft to medium stiff, moist, brown to gray-brown SILT to ORGANIC SILT, low plasticity, trace reed stems and shell fragments					
50	(MH) Medium stiff, moist to wet, dark gray SILT to ELASTIC SILT, moderate plasticity, trace wood fibers and shell fragments	SPT 10	89	1-3-2 (5)		
60		SPT 11	100	2-3-4 (7)		
70	grades to stiff	SPT 12	89	7-5-6 (11)		
	(GM) Drill action indicates gravel to cobble-sized particles 72-74'					
	(MH) Smooth, rapid drilling 74-78'					
80	(GP-GM) Very dense, wet, gray-green SANDY GRAVEL with silt, medium sand and rounded gravels to 2" [Coarse-grained Flood Deposits]	SPT 13	67	40-50/3"		



Boring completed at 85'
Groundwater at 12' while drilling

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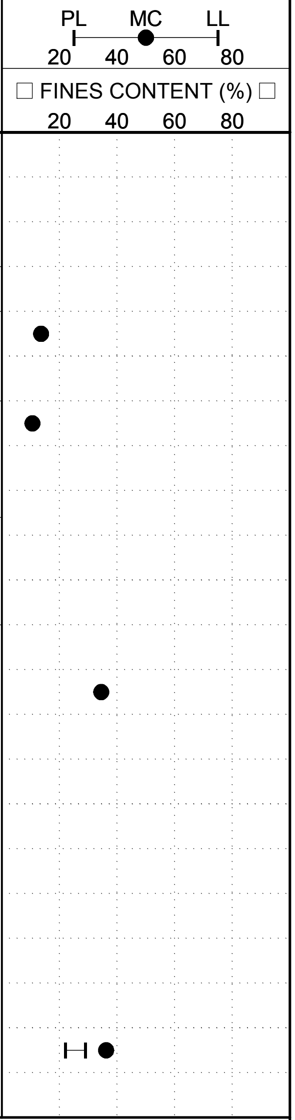
HARTCROWSER

TEST PIT TP-1
PAGE 1 OF 1

CLIENT Portland Development Commission
PROJECT NAME 510 NW 3rd Ave. Geotechnical Evaluation
PROJECT NUMBER 15916-06
PROJECT LOCATION Portland, Oregon
DATE STARTED 10/30/2014 **COMPLETED** 10/30/2014
GROUND ELEVATION 32 ft **SIZE** N/A
EXCAVATION CONTRACTOR Dan J Fischer Excavating, Inc.
GROUND WATER LEVELS:
EXCAVATION METHOD Rubber-tired Backhoe
∇ **AT TIME OF EXCAVATION** 9.00 ft / Elev 23.00 ft Moderate seepage (1-3
LOGGED BY R. Pirot **CHECKED BY** A. Pyrch
AT END OF EXCAVATION ---
NOTE:
AFTER EXCAVATION ---

DEPTH (ft)	SAMPLE TYPE NUMBER	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0.0	GRAB S-1	GM		(GM) (Loose to medium dense), moist, dark brown, sandy silty GRAVEL, fine to coarse subrounded to angular gravel. (Fill)
		SP		(SP) (Loose), moist, gray and white, SAND with brick, nonplastic fines, medium to coarse angular sand. (Fill - Old Pavement)
2.5	GRAB S-2 GRAB S-3	GP		(GP) (Loose), moist, gray-brown, sandy GRAVEL, nonplastic fines, medium to coarse angular sand. (Fill)
	GRAB S-4	SP		(SP) (Loose), moist, brown, SAND, trace gravel, nonplastic fines, medium to coarse subangular sand, fine rounded gravel, contains lenses of dark gray, coarse sand. (Fill)
5.0	GRAB S-5	ML		(ML) (Very soft), moist, brown with orange mottles, SILT with sand, low plasticity, iron oxide stains, slight mica. (Fill)
	GRAB S-6	CL-ML		(CL-ML) (Very soft), moist to wet, gray, silty CLAY with sand, low plasticity, slight mica, petroleum-like odor, contains organics and small woody debris. (Fill)
7.5				Wood beam observed in side of test pit at approximately 7.0 feet.
			∇	
10.0	GRAB S-7			



Hole terminated at 11.0 feet due to excessive caving.

HARTCROWSER

TEST PIT TP-2

PAGE 1 OF 1

CLIENT Portland Development Commission

PROJECT NAME 510 NW 3rd Ave. Geotechnical Evaluation

PROJECT NUMBER 15916-06

PROJECT LOCATION Portland, Oregon

DATE STARTED 10/30/2014 **COMPLETED** 10/30/2014

GROUND ELEVATION 32 ft **SIZE** N/A

EXCAVATION CONTRACTOR Dan J Fischer Excavating, Inc.

GROUND WATER LEVELS:

EXCAVATION METHOD Rubber-tired Backhoe

▽ **AT TIME OF EXCAVATION** 7.50 ft / Elev 24.50 ft Moderate to rapid seepa

LOGGED BY R. Pirot **CHECKED BY** A. Pyrch

AT END OF EXCAVATION ---

NOTE:

AFTER EXCAVATION ---

DEPTH (ft)	SAMPLE TYPE NUMBER	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	PL MC LL (20 40 60 80) / ☐ FINES CONTENT (%) ☐ (20 40 60 80)
0.0		GP		(GP) (Loose to medium dense), moist, brown, GRAVEL with sand and silt, nonplastic fines, fine to coarse subrounded to angular sand, fine to coarse rounded to subangular gravel, minor rootlets. (Fill)	
		GP-SP		(GP-SP) (Loose), moist, brown, sandy GRAVEL to gravelly SAND with cobbles and wood debris, nonplastic fines, fine to coarse subrounded to subangular sand, fine to coarse subrounded to subangular gravel. (Fill)	
2.5		SP		(SP) (Loose), moist, black and gray, cinder and gravelly SAND, nonplastic fines, angular cinders, medium to coarse angular sand. (Fill)	
	GRAB S-1	SP		(SP) (Loose), moist, brown, SAND, trace gravel, fine to medium subangular sand, poorly graded. (Fill)	
		SP		(SP) (Loose), moist, black, lightweight sand, cinder and gravelly SAND, nonplastic fines, medium to coarse angular sand. (Fill)	
5.0	GRAB S-2	ML		(ML) (Very soft to soft), moist, brown with orange and brown mottles, SILT with sand, low plasticity. (Fill)	●
		CL-ML		(CL-ML) (Very soft), wet, gray, silty CLAY to clayey SILT with sand, trace gravel and cobbles, low to medium plasticity, hydrocarbon-like odor. (Fill)	
7.5	GRAB S-3		▽	Wood beams observed in side of test pit at 7.5 to 8.5 feet.	
10.0					

Hole terminated at 11.0 feet due to severe caving.

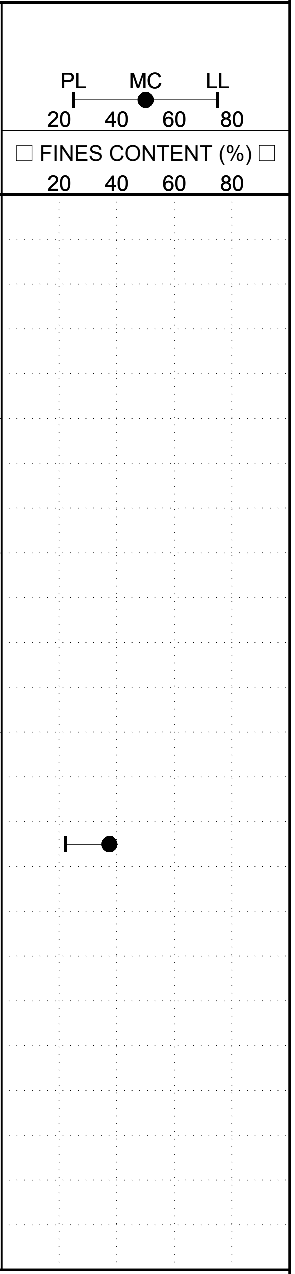
HARTCROWSER

TEST PIT TP-3

PAGE 1 OF 1

CLIENT Portland Development Commission
PROJECT NAME 510 NW 3rd Ave. Geotechnical Evaluation
PROJECT NUMBER 15916-06
PROJECT LOCATION Portland, Oregon
DATE STARTED 10/30/2014 **COMPLETED** 10/30/2014
GROUND ELEVATION 32 ft **SIZE** N/A
EXCAVATION CONTRACTOR Dan J Fischer Excavating, Inc.
GROUND WATER LEVELS:
EXCAVATION METHOD Rubber-tired Backhoe
▽ **AT TIME OF EXCAVATION** 7.00 ft / Elev 25.00 ft Moderate seepage (1-3
LOGGED BY R. Pirot **CHECKED BY** A. Pyrch
AT END OF EXCAVATION ---
NOTE:
AFTER EXCAVATION ---

DEPTH (ft)	SAMPLE TYPE NUMBER	U.S.C.S.	MATERIAL DESCRIPTION
0.0	GRAB S-1	ML-SM	(ML-SM) (Loose to medium dense), moist, brown, gravelly sandy SILT to gravely silty SAND, low plasticity, medium subangular sand, fine rounded gravel. (Fill)
2.5		SP	(SP) (Loose), moist, gray and brown, gravelly SAND, nonplastic, medium to coarse angular sand, charcoal, some debris (shells and bricks). (Fill) Brick wall encountered between 3-5 feet (see Figure 3).
5.0	GRAB S-2	ML	(ML) (Soft to very soft), moist, brown with orange and brown mottled, SILT with sand, low plasticity. (Fill)
7.5 10.0	GRAB S-3 GRAB S-4	CL	(CL) (Very soft), wet, gray, LEAN CLAY with sand, trace gravel, organic odor, organic debris present. (Fill) ▽



Hole completed at 12.0 feet.

HARTCROWSER

TEST PIT TP-4

PAGE 1 OF 1

CLIENT Portland Development Commission

PROJECT NAME 510 NW 3rd Ave. Geotechnical Evaluation

PROJECT NUMBER 15916-06

PROJECT LOCATION Portland, Oregon

DATE STARTED 10/30/2014 **COMPLETED** 10/30/2014

GROUND ELEVATION 32 ft **SIZE** N/A

EXCAVATION CONTRACTOR Dan J Fischer Excavating, Inc.

GROUND WATER LEVELS:

EXCAVATION METHOD Rubber-tired Backhoe

▽ **AT TIME OF EXCAVATION** 2.00 ft / Elev 30.00 ft Slow seepage (<1 gpm)

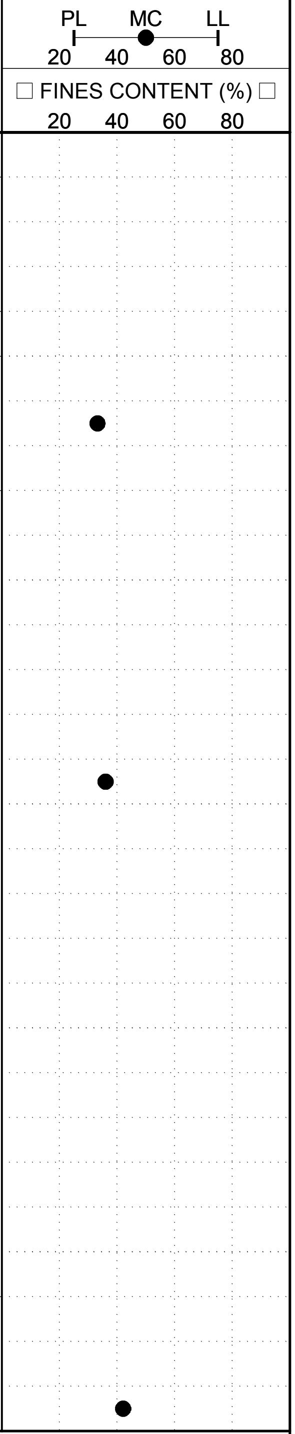
LOGGED BY R. Pirot **CHECKED BY** A. Pyrch

AT END OF EXCAVATION ---

NOTE:

AFTER EXCAVATION ---

DEPTH (ft)	SAMPLE TYPE NUMBER	U.S.C.S.	MATERIAL DESCRIPTION
0.0		GP	(GP) (Loose to medium dense), moist, brown, sandy GRAVEL with silt, low plasticity fines, fine to medium subangular sand, coarse subrounded gravel. (Fill)
	GRAB S-1	ML	(ML) (Very soft to soft), moist, brown with gray mottles, SILT with sand, trace coarse rounded gravel, slight iron oxide staining. (Fill)
		SP	(SP) (Loose), wet, black, SAND with gravel, medium to coarse angular sand. (Fill)
2.5	GRAB S-2	ML	(ML) (Soft), moist, brown, SILT with sand, low plasticity, fine subangular sand, micaceous, faint iron oxide staining. (Fill)
5.0	GRAB S-3	CL-ML	(CL-ML) (Soft), gray, SILT to silty CLAY with sand, trace gravel, low plasticity, fine subangular sand, micaceous. (Fill)
7.5	GRAB S-4		
10.0			
12.5			
	BAG S-5	ML	(ML) (Soft), wet, brown, SILT with sand, trace gravel, low to medium plasticity, fine to medium subangular sand. (Fill)



Hole completed at 14.5 feet.

HARTCROWSER

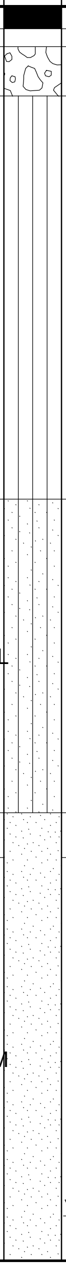
TEST PIT TP-5

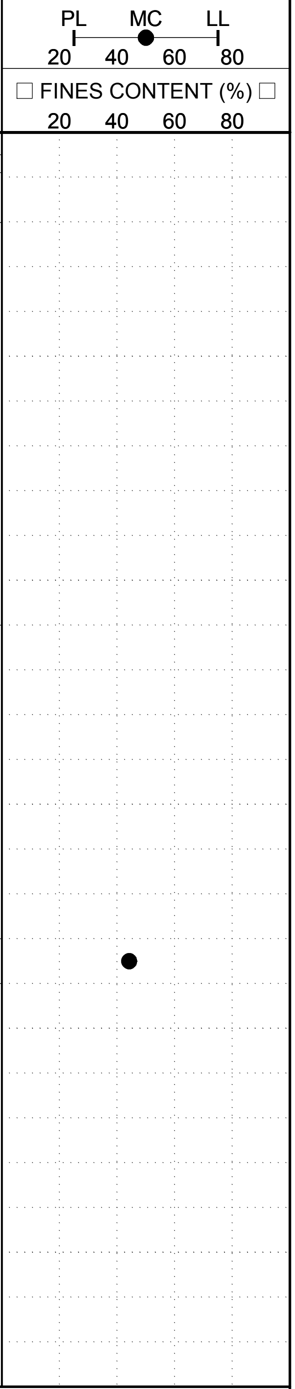
PAGE 1 OF 1

CLIENT Portland Development Commission
PROJECT NAME 510 NW 3rd Ave. Geotechnical Evaluation
PROJECT NUMBER 15916-06
PROJECT LOCATION Portland, Oregon
DATE STARTED 10/30/2014 **COMPLETED** 10/30/2014
GROUND ELEVATION 32 ft **SIZE** N/A
EXCAVATION CONTRACTOR Dan J Fischer Excavating, Inc.
GROUND WATER LEVELS:
EXCAVATION METHOD Rubber-tired Backhoe
▽ **AT TIME OF EXCAVATION** 13.50 ft / Elev 18.50 ft Slow seepage (<1 gpm
LOGGED BY R. Pirot **CHECKED BY** A. Pyrch
AT END OF EXCAVATION ---
NOTE:
AFTER EXCAVATION ---

DEPTH (ft)	SAMPLE TYPE NUMBER	U.S.C.S.	MATERIAL DESCRIPTION
0.0			ASPHALT
			Base Aggregate, fine angular gravel. (Fill)
		GP	(GP) (Loose), brown, sandy GRAVEL with to trace silt, coarse rounded to subrounded gravel. (Fill)
2.5 5.0	GRAB S-1	ML	(ML) (Loose to medium dense), moist, brown, SILT with sand, trace gravel, orange iron oxide stains and mottles, occasional pockets of black sand or gray silt, low plasticity sandy silt to silty sand, occasional large rounded cobbles or angular coarse gravel, faint organic odor. (Fill)
7.5	GRAB S-2	SM/ML	(SM/ML) (Loose to soft), gray, sandy SILT to silty SAND with organic and woody debris, trace gravel, organic odor. (Fill)
	GRAB S-3	SP	(SP) (Loose), black and gray charcoal and sandy lense. (Fill)
10.0 12.5	GRAB S-4	SP/SM	(SP/SM) (Loose), wet, brown, SAND with silt, trace gravel, nonplastic fines, fine to medium sand. (Fill) ▽

GRAPHIC LOG





Hole completed at 14.0 feet.

HARTCROWSER

SUMMARY OF LABORATORY RESULTS

PAGE 1 OF 1

CLIENT Portland Development Commission

PROJECT NAME 510 NW 3rd Ave. Geotechnical Evaluation

PROJECT NUMBER 15916-06

PROJECT LOCATION Portland, Oregon

Borehole	Depth	Liquid Limit	Plastic Limit	Plasticity Index	Maximum Size (mm)	%<#200 Sieve	Class-ification	Water Content (%)	Dry Density (pcf)	Remarks
TP-1	2.0							13.6		
TP-1	3.0							10.6		
TP-1	6.0							34.5		
TP-1	10.0	29	22	7				36.2		
TP-2	5.0							39.5		
TP-3	7.0	38	22	16				37.4		
TP-4	3.0							33.2		
TP-4	7.0							36.0		
TP-4	14.0							42.1		
TP-5	9.0							44.2		

Northwest Testing, Inc.
A Division of Northwest Geotech, Inc.
9120 SW Pioneer Court, Suite B • Wilsonville, Oregon 97070 503/682-1880 FAX: 503/682-2753

TECHNICAL REPORT

Report To:	Mr. Allison Pyrch Hart Crowser 8910 S.W. Gemini Drive Beaverton, Oregon 97008	**Date:** **Lab No.:**	11/10/14 14-448
Project:	Laboratory Testing	**Project No.:**	2736.1.1

Report of: Moisture content and Atterberg limits

Sample Identification

As requested, NTI determined the moisture content and Atterberg limits testing on two soil samples. A Hart Crowser representative delivered the samples on November 3, 2014. Testing was performed in general accordance with the indicated standard. Our laboratory's test results are summarized on the following tables.

Laboratory Testing

Moisture Content of Soil – Method B
(ASTM D 2216)

Sample ID	Moisture Content (Percent)	Sample ID	Moisture Content (Percent)
TP-1 S-7 @ 10 ft.	36.2	TP-3 S-3 7 ft.	37.4

Atterberg Limits
(ASTM D 4318)

Sample ID	Liquid Limit	Plastic Limit	Plasticity Index
TP-1 S-7 @ 10 ft.	29	22	7
TP-3 S-3 @ 7 ft.	38	22	16

Copies: Addressee

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SHEET 1 of 1 REVIEWED BY: Bridgett Adame

ATTACHMENT B

Cost Estimate Spreadsheet

PDC OLD FIREHOUSE COST ESTIMATE

Item	units	quantity	cost/unit	total	**Explanation/Basis**
GROUND IMPROVEMENT COSTS					
Ground Improvement	ls	1	$ 3,000,000	$3,000,000	Based on contractor verbal estimate of previous similar site costs
Subtotal itemized costs				**$3,000,000**	
MAT FOUNDATION HARD COSTS					
Mob	ls	1	$ 150,000	$150,000	Per contractor verbal estimate
Excavation (3,200 sq ft x 8'deep ave.)	yards	948	$ 100	$95,000	Assume $100/yd due to difficult excavation and multiple handling
Shoring (80'x40'x20' all 4 sides plus intermediate)	sq ft	8000	$ 50	$400,000	Assumes 20 feet deep around structure to allow for subgrade overex.
Demo	ls	1	$ 50,000	$50,000	HC ballpark cost
Dewatering	ls	1	$ 10,000	$10,000	Assumes summertime construction with only minor shallow perched water
Mat foundation (3200 sq ft x 4 ft)					
Concrete	cu. Yds.	474	$ 600	$285,000	With pumper, difficult access
Premium for staged construction	= 2x standard labor			$570,000	Assume 200% premium due to staged construction
Lightweight fill	yards	400	$ 150	$60,000	
Subtotal itemized costs				**$1,620,000**	
DRILLED SHAFT FOUNDATION HARD COSTS					
Mob	ls	1	$ 250,000	$250,000	Per contractor verbal estimate
12 - 24" to 30" drilled shafts	shafts	12	$ 40,000	$480,000	Per contractor verbal estimate and KPFF information
Grade Beams	cu yd	120	$ 600	$72,000	Per KPFF Information
Replace Mat	sq ft	3200	$ 50	$160,000	Per KPFF Information
Shoring (80'x40'x20' all 4 sides plus intermediate)	sq ft	8000	$ 50	$400,000	Assumes 20 feet deep around structure to allow for subgrade overex.
Demo	ls	1	$ 50,000	$50,000	HC ballpark cost
Dewatering	ls	1	$ 10,000	$10,000	Assumes summertime construction with only minor shallow perched water
Light Weight Fill	yards	40	$ 150	$6,000	
Subtotal itemized costs				**$1,428,000**	
AVERAGE SOFT COSTS					
Engineering	15%			$225,000	
Permits	10%			$150,000	
CM	10%			$150,000	
Subtotal soft costs				**$525,000**	
OTHER					
Average Contingency	20%			**$415,000**	
TOTAL MAT FOUNDATION				**$5,560,000**	**Includes Ground Improvement and Soft Costs and 20% Contingency**
TOTAL DRILLED SHAFTS				**$5,368,000**	**Includes Ground Improvement and Soft Costs and 20% Contingency**