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SUBSURFACE SOIL INVESTIGATION

WISCONSIN RAPIDS SITES #1, #2, #3
48TH STREET NORTH
& COMMERCE DRIVE
WISCONSIN RAPIDS
WISCONSIN

NTS 145.27

C09070

PREPARED FOR:

LAMPERT LEE & ASSOCIATES
10968 STATE HWY 54 EAST
WISCONSIN RAPIDS, WI 54494

FIELD INVESTIGATION BY:

NUMMELIN TESTING SERVICES, INC.
STEVENS POINT, WI

DECEMBER 15, 2009

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1. SUMMARY

This section contains summary information only and is limited in detail. Recommendations given in following report sections should be reviewed prior to design and construction.

As requested, Nummelin Testing Services, Inc. (NTS) performed a subsurface soil investigation with 35 standard penetration borings at the three sites to depths of 10 and 30 feet.

In general, the borings encountered 2 to 14 inches of organic silt and sand at the surface over loose to medium-dense sand to the terminal boring depths. Groundwater was encountered at depths of 2.2 to 6.2 feet in all borings.

At all three sites, native sands below the top organic layer are expected to provide adequate support for lightly-loaded footings, floors, pavements, and utilities. Should support for moderately- to heavily-loaded footings be needed, the on-site sands may be compacted to provide adequate support for the heavier loads.

Because of the shallow groundwater table encountered at these sites, below-ground floors are not recommended. The owner may wish to raise the site to keep the building and construction above the groundwater table. Drainage is recommended below floors near or below the existing ground surface at these sites.

Although peat was not encountered in the borings, be aware that soil maps of the area indicate up to 3 feet of peat occurs in places at Sites #1 and #2. Peat generally does not provide adequate support for structures. If peat is found in building or pavement areas, the peat should be removed and replaced with fill meeting the requirements of section 6.4.

2. INTRODUCTION

Nummelin Testing Services, Inc. (NTS) performed this investigation for the purpose of providing soils information for the three sites near the intersection of 48th Street North and Commerce Drive in the City of in Wisconsin Rapids, Wood County, Wisconsin. The results and recommendations reported are based upon information obtained during a field investigation with borings and the geotechnical analysis of that information.

The conclusions and recommendations reported are based on our interpretation of available subsurface and project information. The report may not represent variations that occur between or away from boring locations.

Should the scope of this project be altered, or if subsurface variations become evident during construction, it may be necessary to modify our recommendations. See the attached Geotechnical Engineering Report Information sheet for general information on NTS's geotechnical reports.

3. PROJECT DESCRIPTION

NTS has little information regarding the proposed project. However, construction of several industrial and/or commercial buildings with parking lots and loading docks are anticipated at the three sites. Footing loads are expected to be light to moderate. Little site grading is anticipated.

At the time of the investigation, the three sites were relatively flat/level lots that appeared to have recently been stripped of vegetation. There was an existing building between Sites #2 and #3.

4. FIELD INVESTIGATION

Thirty five standard penetration borings were performed between November 24 and December 1, 2009, approximately at locations shown on the attached sketches. Borings 1 through 20 were performed at Site #1, Borings 21 through 28 were performed at Site #2, and Borings 29 through 35 were performed at Site #3. Lampert Lee & Associates determined the proposed boring locations and depths. All borings in proposed building areas were terminated at the scheduled depth of 30 feet, and all borings elsewhere were terminated at the scheduled depth of 10 feet.

Standard penetration sampling was performed with an automatic-trip hammer according to ASTM Test Procedure D1586 at depths indicated on the boring logs. Drilling between samples was by the hollow stem auger technique. Soil samples taken from the sites have been examined in the lab by this writer to verify soil descriptions. Soil classifications, parameters, and recommendations reported are based on field testing and soil descriptions. No lab tests have been performed.

After completion of the borings, the bore holes were backfilled with bentonite chips to comply with WDNR requirements, and the last few inches were patched with auger cuttings.

Ground elevations at boring locations were determined by Lampert Lee & Associates.

Copies of the soil boring logs and location sketches are appended to the report.

5. SUBSURFACE CONDITIONS

5. 1. Area Geology

Subsoils in this area are mapped as outwash deposits. Outwash deposits typically consist of stratified sand and/or stratified sand with gravel. The underlying rock is mapped as granitic intrusive rock that is present at depths of less than 100 feet below the average surface terrain. The NRCS web soil survey maps most near surface soils at these sites as Friendship, Meehan, and Newson loamy sand. However, areas of Dawson mucky peat are mapped in the east half of Site #1 and in the northwest quadrant of Site #2.

Note that mapped soil and bedrock conditions are provided for some additional information only. We do not recommend basing any design on mapped or assumed conditions.

5. 2. Soils and Water Levels at the Boring Locations

Similar soil and groundwater conditions were encountered at all three sites. The general soil profile encountered by the borings was 2 to 14 inches of dark brown / black organic silt and sand over native loose to medium-dense sand to the terminal boring depths. Sands just below the organic layer were generally fine grained sands with little silt to depths of 2 to 3 feet, then generally fine- to medium-grained sand, with some fine- to coarse-grained sand layers, occurred to the terminal boring depths. Soil in the top 2 feet of Boring 29 were comprised of sand and gravel, apparent existing fill.

Groundwater was encountered in the borings at Site #1 at depths of 2.2 to 5 feet (elevations 1036.3 to 1039.9), at Site #2 at depths of 4 to 6.1 feet (elevations 1035.2 to 1036.3), and at Site #3 at depths of 3.2 to 6.2 feet (elevations 1035.1 to 1036.4). These water levels should be considered as representative of the site at the time of boring only.

The water table elevation is expected to fluctuate seasonally by as much as several feet and may at times occur very near the ground surface at these sites.

A summary of groundwater depths, thicknesses of organic soils occurring at the surface, and end of boring (E.O.B.) depths are shown in Table 1.

Table 1. Boring elevations, water depths, organic soils, and end depths.

Boring	Surface Elevation	Water Depth	Organics @Surface	E.O.B.	Boring	Surface Elevation	Water Depth	Organics @Surface	E.O.B.
1	1042.90	3'	5"	10'	19	1040.30	4'	5"	10'
2	1041.10	2.8'	12"	10'	20	1041.40	3.5'	2"	10'
3	1041.30	2.2'	8"	30'	21	1040.50	5'	4"	10'
4	1041.90	2.3'	7"	30'	22	1040.85	4.8'	14"	10'
5	1042.90	4'	4"	30'	23	1040.60	~5'	5"	30'
6	1042.30	3.5'	3"	10'	24	1040.50	4.2'	14"	30'
7	1042.70	4'	5.5"	10'	25	1041.35	6.1'	2.5"	30'
8	1041.70	3.1'	4"	30'	26	1039.50	4.3'	4"	30'
9	1042.00	4'	6"	30'	27	1040.55	5'	5.5"	10'
10	1041.25	3.2'	4"	30'	28	1039.30	4'	8"	10'
11	1042.35	5.2'	7"	10'	29	1042.35	6.2'	-	10'
12	1041.40	3.5'	10"	30'	30	1042.38	6'	8"	10'
13	1043.30	5'	5"	30'	31	1039.80	4'	5"	30'
14	1042.60	5'	4"	30'	32	1039.50	4.4'	9"	10'
15	1042.00	4'	4"	10'	33	1038.40	3.2'	2"	10'
16	1040.50	3'	-	30'	34	1039.50	4'	7"	10'
17	1041.65	5'	7"	30'	35	1038.90	3.4'	7"	10'
18	1040.90	3'	8"	30'					

See the boring logs for more detailed soil descriptions.

6. DISCUSSION AND RECOMMENDATIONS

6. 1. General

Although the sites had been stripped of vegetation prior to the investigation, 2 to 14 inches of silt and sand with significant organics occurred at the surface at most borings locations. Plan to remove these organic soils from pavement and building footprints prior to further site grading and construction.

At all three sites, native sands below the top organic layer were loose to medium-dense, and are expected to provide adequate support for lightly-loaded footings, floors, pavements, and utilities. Should support for moderately- to heavily-loaded footings be needed, the on-site sands may be compacted to provide adequate support for the heavier loads.

Although peat was not encountered in the borings, be aware that soil maps of the area indicate peat occurs at Sites #1 and #2. Peat generally does not provide adequate support for structures. If peat is found in building or pavement areas, the peat should be removed and replaced with fill meeting the requirements of section 6.4.

Groundwater is likely to be encountered in excavations near or below depths of 2.2 to 6.2 feet at all three sites.

6. 2. Foundations and Floors

Conventional strip and/or spread footings would be an acceptable foundation type at these sites. At all three sites, the native sands below the top organic layer are expected to provide adequate support for lightly-loaded footings, but this should be verified at the time of construction. A presumptive allowable bearing capacity of 2,500 pounds per square foot (psf) may be used in the design of spread and strip footings bearing on these sands or on fill that meets the requirements of section 6.4 and that bears on the native sands. Should higher bearing be needed, the on-site sands may be compacted. A presumptive allowable bearing capacity of 4,000 psf may be used in the design of spread and strip footings bearing on a layer of soil that meets the requirements of section 6.4 and that has thickness of at least one footing's width or 18 inches, whichever is greater.

Native sands below the organic layer at all three sites are expected to provide adequate support for floor slabs, but this should be verified at the time of construction. Subgrades for floors should be firm when proof-rolled. An acceptable proof-roller for sand would be a smooth-drum, vibratory roller.

Existing fill was encountered in Boring 29 to a depth of 2 feet, and it is expected that some fill may occur elsewhere at these sites. Although the fill appeared suitable for support of foundations and floors at the boring location, be aware that fill placed by unknown methods occasionally contains pockets of loose, soft, or deleterious materials that may not be suitable for support of foundations and floors. Pockets of such materials may occur between boring locations. The bearing capacity of the soils on which the foundations will rest should be field verified at the time of construction by NTS or another qualified soils engineering firm. This firm should provide alternate recommendations if adequate bearing capacity is not present. The recommendations may include undercutting or compacting existing soils.

For foundation construction purposes, the frost line in this part of Wisconsin should be considered to be 4 feet below the ground surface. However, constructing footings at a depth of 4 feet will likely put most footing excavations into the water table. The owner may wish to add grade-raising fill to keep footing excavations above the water table and floor slabs well above the water table. As an alternative to adding fill and deeper footings, a thickened-edge slab-on-grade in conjunction with insulation may also be used.

If a slab-on-grade is used, several inches of closed-cell insulation should be placed below the edges of the slab, buried at a depth of roughly 1 foot below the ground surface. This insulation should begin several feet inside the edges of the slab and extend out away from the slab a minimum distance of 4 feet. Where insulation is used below a slab-on-grade for an unheated building, the insulation should occur below the entire slab area. The below-ground concrete should also be covered with insulation.

If the recommendations in this report are followed, total and differential settlements of the footings and floor are not expected to exceed one inch and one-half inch, respectively.

At the time of this report, NTS was unaware of any planned below-ground floors. Because of the shallow water table and potential for flooding, NTS does not recommend below-ground floors.

6. 3. Excavation

All excavations should comply with OSHA standards. This includes reducing the slope of excavation sidewalls to 1.5 horizontal to 1 vertical or less. Where steeper excavation sidewall slopes are necessary or more convenient, the excavation will need to be braced using full bracing, not spaced braces.

Undercutting is not expected to be required, unless a high bearing capacity is needed or unsuitable materials are encountered. When planning an undercut, the sixty-degree approximation may be used to determine the resulting pressure at the base of an undercut. To remove soils within the zone of influence of a load-bearing area, the recommended width of undercut is twice the undercut depth plus the width of the load-bearing area, measured at the bottom of cut. If the load-bearing area is accurately marked and centered in base of the undercut, then the minimum width of the undercut is the depth to the bottom of the undercut below the load-bearing area plus the width of that area, measured at the base of the cut. A good practice is to add at least one foot to this width. Replace all undercut soils with properly compacted fill (see section 6.4 “Compaction and Fill Requirements”).

6. 3. 1. Dewatering for Excavations

Dewatering may be required for excavations below depths of 2 feet at these sites. Where dewatering is expected to be required, dewatering prior to excavating is recommended. Dewater using a method that is not based inside the excavation, such as with deepwells or well points placed outside the excavation. Removing water using a method based from within the excavation may loosen the soil at the excavation bottom as water flows upward to pumps. This loosening may occur at deeper depths and may not be obvious during construction. It is important that the loosening be avoided because the loosened soils may settle significantly below the weight of backfill and the structure.

Where excavations will extend to significant depths below the water table, sheet piling may be used to help control the flow of water into the excavation in the event there is a problem with the dewatering system, such as from a power outage. The sheet piling (or other bracing system) should be capable of reducing the hydraulic gradient to 0.5 or less in the zone below the excavation.

Excavations should be performed with a flat plate attached to the bucket teeth of the backhoe to minimize the disturbance at the base of the excavation. Where a toothed bucket is used, the last six inches (roughly) should be excavated by turning the bucket so that the teeth are parallel to the proposed grade, thus minimizing the disturbance of footing-grade soils. Any soil loosened during excavation should be compacted.

6. 4. Compaction and Fill Requirements

The organic soils encountered at the surface of these sites should not be used as structural fill. The sands below, if unsaturated at the time of construction, may be reused as structural fill. If imported fill is required, clean (less than 5% passing the number 200 sieve), unsaturated, granular soil is recommended. At the time of construction, NTS or another qualified soils engineering firm should verify that the proposed fill soils are acceptable. This firm should verify that the moisture content is appropriate for proper compaction and that the fill contains no deleterious materials. Frozen soil should not be used as structural fill.

Any required fill should be placed in lifts not exceeding 1 foot in uncompacted thickness.

Compact all structural fill placed to at least 95% of the maximum dry density (modified Proctor method - ASTM D-1557). Site or soil conditions at the time of construction may warrant a change in the recommended compaction levels and/or techniques. However, no changes should be made without review by NTS or another qualified soils engineering firm.

Compaction of sand near the water table at this site may cause the sand to become quick (liquefaction). Prior to compaction of sand near the water table, lower the water table to a depth of at least 18 inches below the exposed grade prior to compacting. Lighter compaction equipment in conjunction with thinner lifts may also be necessary.

6. 5. Drainage

Groundwater occurred as shallow as 2.2 feet in some borings, and it is expected that the groundwater table at times may occur very near the ground surface in some places.

Where floors will be located near the water table, it is recommended that drains be installed below the floor.

Drain tile for drainage systems at these sites should be spaced at a frequency of no less than one drain per 15 feet, and all drain tiles should be part of one system. Several inches of sand conforming to ASTM C33 should be used as a filter around the drain tile and as the layer just beneath the floor. Drain tile with sock alone tends to rapidly plug up. Clear stone and/or pea gravel do not work as a filter, and, although some codes require gravel for drains, neither stone nor gravel should be used for drains at these sites.

Do not connect the outlet of a gravity-flow drainage system to any other storm drain systems because water may flow backward through the drains and into the building during periods of heavy stormwater flow. Consider directing the flow to an exterior manhole where the water could be pumped out with a portable pump during periods when the water table is high.

6. 6. Construction Near Existing Structures

Take care when excavating and placing fill near existing structures. Monitor existing structures for movement during the construction process. Vibratory compacting equipment, particularly high-energy compactors, may cause some settling in adjacent soils below existing structures.

Do not excavate soil under a line drawn out (away from existing structure) and down from the top of a footing at a 45-degree angle, unless proper precautions are taken. If excavations will extend below the elevation of the existing footings, the soil under the existing structure may have to be shored. This may be done using sheet piling, properly braced or tied back. Allow for imposed lateral loads from nearby footings in designing the system. Be aware that vibrations during driving of sheet piles may cause loose soils below the existing structure to settle. Monitor the existing structure for possible movement during the construction process. Excavating small sections at a time may reduce the potential for seriously undermining the existing footing, and may allow construction to continue without the need to brace or use sheet piles.

6. 7. Corrosion Potential

Any construction materials that will be placed in contact with organic soils should be protected against corrosion.

6. 8. Lateral Earth Pressures

The following lateral earth pressures were estimated using Rankine's approximations. The pressures are for on-site sands and imported sand fill in a compacted and unsaturated condition. The pressures do not include the effects of cohesion. However, the soils encountered at these sites should be considered as cohesionless.

The on-site sands and imported, firm, clean sand fill will exert approximately 35 pounds per cubic foot (pcf) equivalent fluid pressure in the active state, approximately 55 pcf equivalent fluid pressure in the at-rest state, and up to 330 pcf equivalent fluid pressure in the passive state.

Pressures exerted by saturated soils can vary depending on site conditions. In the active and at-rest cases, saturated soils may exert up to three times the pressure of a non-saturated soil. In the passive case, the pressure exerted by a saturated soil may be half of the pressure exerted by a non-saturated soil.

Lateral earth pressures on retaining structures during compaction may be higher than those stated above.

6. 9. Pavement Design Considerations

Pavement design in Wisconsin is generally controlled by the soils within the frost zone. Soils encountered within the frost zone at these sites were generally native sands with little silt. These sands are expected to form the subgrade for pavement.

The existing sands are slightly frost-susceptible with a Frost Group Designation of F-2 and estimated Design Group Index (DGI) of 4. A Soil Support Value (SSV) of 5.2 is appropriate for a subgrade with a DGI of 4 considering a Regional Factor of 2. The sands are AASHTO Classified as A-3 or A-2-4 and USCS Classified as SP-SM or SP. CBR tests were not performed. However, the CBR factor for the sands is estimated to be at least 10. A subgrade modulus of not more than 200 pounds per square inch per inch should be used for pavement and slab design on the sands.

If flexible (asphaltic concrete) pavement is used, the following asphaltic concrete and crushed aggregate base course thicknesses from the "Wisconsin Asphalt Pavement Association Design Guide" may be used. The thicknesses are based on the expected design daily ESALs (18,000 pound Equivalent Single Axle Loads) for pavement over a 'good' subgrade. Subgrades with CBRs between 10 and 20 are classified as 'good' according to the Wisconsin Asphalt Pavement Association Design Guide.

In general, traffic pavements with loads in the 1 to 5 design daily ESALs range include car parking lots, light traffic roadways, and similar traffic loads. Traffic pavements with loads in the 6 to 50 design daily ESALs range include collector streets, industrial lots, loading zones, and similar traffic loads. Traffic pavements in the 51 to 275 design daily ESALs range include arterial streets, industrial streets, and major service drives/entrances, and similar traffic loads.

6. 9. 1. Flexible Pavement, 1 to 5 Design Daily ESALs

Use a minimum of 8 inches of crushed aggregate base course with a minimum of 3 inches of asphaltic concrete.

6. 9. 2. Flexible Pavement, 6 to 50 Design Daily ESALs

Use a minimum of 9 inches of crushed aggregate base course with a minimum of 4 inches of asphaltic concrete.

6. 9. 3. Flexible Pavement, 51 to 275 Design Daily ESALs

Use a minimum of 10 inches of crushed aggregate base course with a minimum of 6 inches of asphaltic concrete.

If the expected daily ESALs are greater, plan to increase these thicknesses.

Should use of the recommended asphaltic concrete thickness be cost-prohibitive, crushed aggregate base course may be substituted for asphaltic concrete. For every 1 inch of reduction in the asphaltic concrete thickness, add 3 inches to the crushed aggregate base course thickness. However, under no circumstances should the thickness of the asphaltic concrete layer be reduced to less than 3 inches.

Rigid (Portland cement concrete - PCC) pavement may also be used, and rigid pavement is recommended in areas experiencing high shear stresses from traffic, such as at loading dock and trash dumpster locations. Below normal car parking areas, a slab thickness of at least 6 inches is recommended. A PCC slab thickness of at least 8 inches is recommended for heavy traffic loads. There is no specified numerical thickness for the base course layer below a PCC slab, but the base course layer should be thick enough to provide stability for the slab.

Regardless of the pavement type chosen, the pavement construction should meet the requirements of the Wisconsin DOT Standard Specifications for Road and Bridge Construction.

A prime requirement for successful pavement is preparation of the subgrade soil. At the time the base course is being placed, the subgrade should be firm when proof-rolled. An acceptable proof-roller for sands or gravels would be a smooth-drum, vibratory roller. The subgrade may yield slightly to the proof-roller, but after base course placement, the base grade should be unyielding to fully-loaded, tandem-axle, dump trucks. This requirement also applies after the completion of any undercut.

It may be necessary to undercut and replace soft or loose soils with crushed rock or breaker-run rock. Any rock used to stabilize a soft subgrade should not be considered as part of the base course thickness.

6. 10. Potential 'Floating' Problem

The portions of enclosed underground structures, such as storage tanks, which are below the groundwater table will experience buoyancy effects and may tend to 'float', especially when empty. Consider any such buoyant forces when designing underground structures.

It is recommended that only submerged unit weights of the soils around underground structures and the submerged unit weight of the concrete be used in uplift resistance calculations. The submerged unit weight of on-site soils and of imported, clean, sand fill is approximately 60 pcf, and the submerged unit weight of concrete is approximately 85 pcf.

When calculating the soil's contribution to uplift resistance, consider only the weight of the soil above a line extending out from the edges of the base of the structure. The angle of this line from the vertical in compacted fill or bedrock should be considered as 20 degrees or two-thirds of the soil's friction angle, whichever is greater. The friction angle for on-site sands and imported, firm, clean, sand fill may be considered as 30 degrees.

6. 11. Site Classification for Seismic Design

Most soil encountered at these sites were loose to medium-dense, fine to medium-grained sands below the water table. These sands are a potentially liquefiable soil type. The site classification for these sites is Site Class 'F' according to Table 1615.1.1 of the 2002 Wisconsin Enrolled Commercial Building Code because of the potentially liquefiable sands.

Respectfully,

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bkn/cerl/bn

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