Wang Engineering

1145 North Main Street
Lombard, Illinois 60148
Phone (630) 953-9928
www.wangeng.com

August 29, 2018

Mr. M. Michael Okrent, P.E.
AES Services, Inc.
111 South Wacker Drive, Suite 3910
Chicago, Illinois 60606

Re: Geotechnical Engineering Services
Illinois Beach State Park
Zion, Illinois
Wang No. 199-02-02

INTRODUCTION

It is understood that the proposed plan is to move the bike trail to the west (into a landscaped area) and construct a sheet pile retaining wall to protect the bike trail; the trail will be isolated from the parking lot by a gutter. T he expected exposed height of the wall will vary between 2 and 4 feet. The existing South Unit Campground Exit Road (service road) has significant base failure and requires reconstruction. A turnaround will also be constructed at the west end.

Wang Engineering Inc. (Wang) provided Phase 1 Letter Report dated January 15, 2018 which included several potential remedial options for the bike path reconstruction and long-term sustainability of the shoreline.

The purpose of our geotechnical investigation was to determine the site soil and groundwater conditions, provide geotechnical recommendations for the design and construction of the retaining wall and service road reconstruction.

SUBSURFACE INVESTIGATION AND LABORATORY TESTING

Our subsurface investigation consisted of three retaining wall borings, designated as RWB-01 through RWB-03, and three subgrade borings, designated as SGB-01 through SGB-03. The borings were drilled by Wang on June 15, 2018. The borings were drilled from elevations of 586.67 to 587.82 feet to depths of 10.0 and 20.0 feet below the ground surface (bgs).

Borings northing and easting coordinates were surveyed by Wang, and grade elevations were surveyed and provided by AES Services, Inc. The as-drilled boring location is shown in the *Boring Location Plan* (Exhibit 2) and the boring coordinates are provided in the *Boring Logs (*Appendix A).

The borings were completed using a truck-mounted drilling rig equipped with hollow stem augers to advance and maintain an open borehole. Soil sampling was performed in accordance with ASTM D1586, *"Penetration Test and Split Barrel Sampling of Soils."* The soil was sampled at 2.5-foot intervals to boring termination depths for the retaining wall borings, and sampled at 2-foot continuous intervals until termination depth for the subgrade borings. Soil samples collected from each sampling interval were placed in sealed jars and transported to our in-house laboratory in Lombard, Illinois for further evaluations and laboratory testing.

Field boring logs prepared and maintained by a Wang geologist included lithological descriptions, visual-manual classifications, pocket penetrometer and Rimac unconfined compressive strength test results, and results of Standard Penetration Tests (SPT) recorded on the logs as blows per 6 inches of penetration. Groundwater levels were measured while drilling and at the completion of borings. The boreholes were backfilled with bentonite chips and soil cuttings and the surface was restored as close as possible to its original condition.

All soil samples were tested in our laboratory for moisture content (ASTM D 2216). Particle size analysis (ASTM D422) was performed on selected samples. Field visual-manual descriptions of soil samples were verified in the laboratory and index tested soils were classified according to the USCS Soil Classification System. The laboratory test results are shown in the attached *Boring Logs* (Appendix A) and *Laboratory Test Results* (Appendix B).

Subsurface Soil Conditions

Detailed descriptions of the soil conditions encountered by the borings are presented in the attached *Boring Logs.* Retaining wall plan and elevation view; and service road grade profiles were not available at the time of report. Therefore, only gINT *Subsurface Soil Data Profiles* are included. Please note the lithological boundaries shown on the logs and profiles represent approximate boundaries between the soil types. In the field, the actual transition between soil types might be gradual in horizontal and vertical directions. The following sections describe soil profile along the retaining wall and service road.

Retaining Wall

At the surface, the retaining wall borings encountered 3 and 5 inches of asphalt pavement over 7 to 11 inches of aggregate base. At elevations of 585.7 and 587.5 feet, the borings advanced through 20.0 feet of very loose to very dense, damp to saturated, fine to coarse sand, with SPT N values of 1 to 82 blows per foot and moisture content values of 3 to 23%. At elevations of 577.0 to 581.2 feet, borings encountered 2.5-foot thick, medium dense to dense, saturated gravelly sand. The gravelly sand as SPT N values of 16 and 41 blows per foot, and moisture content of 8 and 13%. The gravelly sand is AASHTO classified as A-1-B (0) and A-3 (0). Heaving sand inside of augers was noticed from 10 foot bgs to end of boring depths.

During drilling, groundwater was encountered at 3.75 to 4.75 feet bgs. At the completion of drilling, groundwater was measured at depths of 6.5 to 8.0 feet bgs.

Service Road

At the surface, the subgrade borings encountered 3 inches of asphalt pavement over 6 to 9 inches of aggregate base, and 9-inch thick silty loam topsoil. At elevations of 584.1 and 587.3 feet, the borings advanced through 10.0 to 11.0 feet of very loose to medium dense, damp to saturated, fine to medium sand, with SPT N values of 3 to 26 blows per foot and moisture content values of 10 to 23%. The sand is AASHTO classified as A-3 (0). At elevation of 586.8 feet, Boring SGB-02 encountered 2.75-foot thick very loose to loose, wet to saturated gravelly sand. The gravelly sand has SPT N values of 3 and 8 blows per foot, and moisture content of 16 and 21%. The gravelly sand is AASHTO classified as A-3 (0). At elevation of 579.1 feet, Boring SGB-03 encountered 2.75-foot thick, very dense, saturated gravelly sand. The gravelly sand has SPT N values of 75 blows per foot, and moisture content of 6 and 8%.

During drilling, groundwater was encountered at 1.5 to 2.75 feet bgs. At the completion of drilling, groundwater was measured depths of 2.0 to 3.5 feet bgs.

ENGINEERING ANALYSES AND RECOMMENDATIONS

RETAINING WALL

We understood from AES that the new retaining wall will be a steel sheet pile wall with maximum retained height of four feet with metal cap and no concrete facing. Considering the maximum retained height of 4 feet, the proposed wall can be designed as a cantilever wall.

Design Soil Parameters

For the design of the wall we recommend the soil parameters summarized in Table 1 estimated based on the soil conditions encountered in the borings and field and laboratory test results. The design of the steel sheet pile wall should ignore three feet of soil in front of the wall measured from the finished ground surface elevation in providing passive pressure due to excavation required for installation of riprap and possibility of future excavation and frost-heave condition. In developing the design lateral pressure, the lateral pressure due to construction equipment surcharge should be added to the lateral earth pressure. We recommend using granular backfill, if required behind the walls. The water pressure should be added to the earth pressure if a positive drainage is not provided. The earth pressure distributions shown in AASHTO Standard Specifications for Highway Bridges, or other suitable earth pressure distributions should be used. We recommend a linearly increasing lateral active earth pressure at 40 pounds per square foot per foot of depth below the grade behind the wall for a drain condition. The lateral deflection limitation may control the pile size.

Table 1: Geotechnical Parameters for Sheet Pile Wall Design

Approximate Elevation Range (feet)	Soil Description	Unit Weight (pcf)	Shear Strength Properties Short Term and Long Term Friction Angle, Ø (degree)
587 to 584	Very loose to Medium Dense Sand	115	32
584 to 577	Very loose to Medium Dense Sand	53**	
577 to 574.5	Medium Dense Gravelly Sand	53**	34
574.5 to 572	Medium Dense Sand	53**	35
572 to 567*	Dense to Very Dense Sand	63**	37

* Boring termination depth. ** Submerged Unit Weight

- Granular soils are classified as Sand and Gravelly Sand on boring logs.
- Unit weight and Friction Angle are estimated from SPT N value.

Full groundwater drainage through interlocks may not be possible for a permanent condition. Therefore, we recommend that weep holes with screen be provided or hydrostatic pressure be considered in the design. Based on the borings, groundwater can be considered at elevation 584 feet. We recommend that effective section modulus be considered in the design by taking the effect of corrosion.

Global Stability

Global stability analyses were performed considering typical section provided by AES for a maxium retained height of 6 feet. Analyses were performed with SLIDE v6 computer software. We considered retained height of six feet for a temporary excavation in front of the wall and surcharge of 240 psf. The minimum factor of safety (FOS) calculated was less than the minimum required of 1.5 without considering pile embedment. We performed global stability analysis considering pile embedment to obtain FOS of at least 1.5. The embedded portion of the piles will provide resistance against the slope instability above the tip of the sheet piles. We recommend providing minimum embedment of eight feet (six feet embedment plus two feet of riprap) below finished grade in front of the pile for a maximum retained height of four feet. Details of the global slope stability analysis with critical failure surfaces and results are presented in Exhibits.

SERVICE ROAD

Existing Pavement Stripping

Prior to roadway reconstruction, exiting pavement should be stripped. Based on pavement thickness measurements in bore holes, for quantity estimating purposes the average asphalt pavement thickness to be stripped is three inches. The actual depth of stripping should be determined in the field during construction.

Subgrade Preparation and Treatment

After stripping of pavement and excavating to the proposed subgrade level, the exposed excavation should be prepared in accordance with Section 301 (IDOT 2016). After preparing subgrade, a fabric for ground stabilization (Article 1080.02) in accordance with Section 210 (IDOT 2016) should be placed. We assumed that a layer of 12-inch *Aggregate Subgrade Improvement* as per IDOT District One Special Provision will be provided as part of the pavement structure.

The stability of prepared roadway subgrade will depend upon such factors as surface drainage provided by the contractor as well as prevailing temperature and precipitation experienced during construction. The amount of construction traffic and subgrade disturbance created by heavy vehicles will also have an influence on subgrade stability. The contractor should try to make full use of ditches in order to maintain positive drainage for subgrade areas. Temporary drainage ditches or pumping from depressed areas should be provided as needed during construction in order to prevent ponded water from affecting the stability of the roadway.

Subgrade Support Rating

Based on the soil types and conditions encountered in boring, we recommend an estimated Illinois Bearing Ratio (CBR) value of 3 for the pavement design purposes.

Pavement Design

Wang understand that the new pavement structure based on 20-year pavement design will be as follow:

7-inch thick Hot Mix Asphalt (HMA)
12-inch Aggregate Subgrade Improvement

CONSTRUCTION CONSIDERATIONS

Excavation and Dewatering

Excavations should be performed in accordance with local, state, and federal regulations including current OSHA regulations. The potential effect of ground movements upon nearby utilities should also be taken into consideration. The existing pavement and vegetation would require to be removed at the wall location. Depending on the season, groundwater may be encountered at a shallower depth than encountered in the borings.

Wall Construction

The backfill if required between the new wall and the proposed grade behind the wall should be dry granular material such as IDOT gradation FA-1, FA-2 or clean beach sand. The steel sheet piling could be installed by driving to the required penetration using a vibratory hammer. The rockfill or riprap should be provided in front of the wall at the wall base as a toe protection and should include a separation geofabric at the base.

Reuse of Excavated Material

Excavated soils meeting the requirements of Specifications Sections 202, 204 and 205 (IDOT 2016a) can be reused as an embankment, to backfill utility trenches or in the general grading areas. Excavated uncontaminated granular base can be stripped and stockpiled and reused as a new granular base if meets the requirements of *Subgrade Improvement* or in embankment. Excavated asphalt pavement can be reused as a fill/backfill as specified in Specification Sections 202, 204 and 205 (IDOT 2016a).

If you have any questions, or if you would like to discuss further, please contact us at (630) 953-9928.

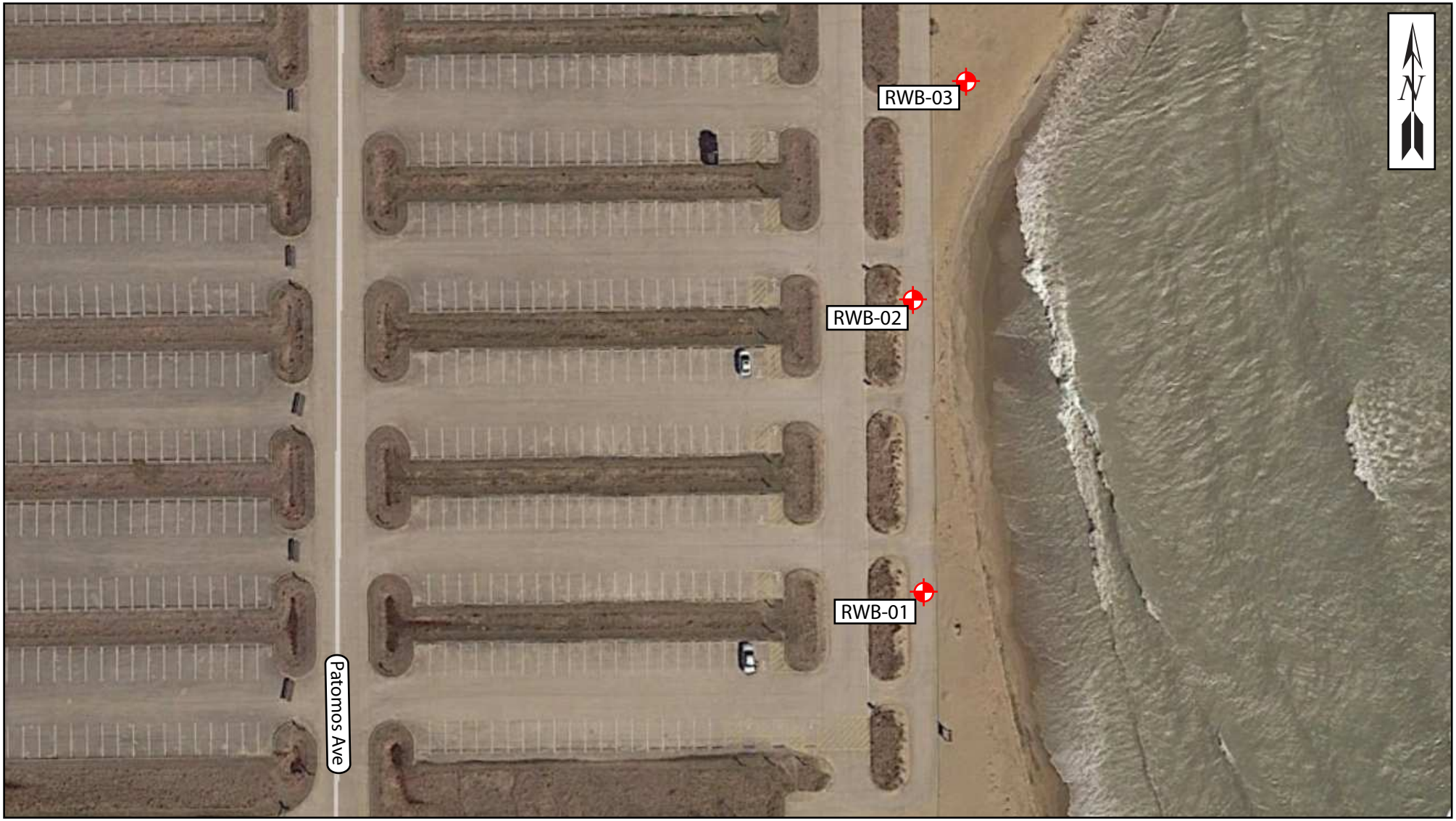
Sincerely,

WANG ENGINEERING, INC.

Mohammed (Mike) Kothawala, P.E., D.GE
Sr. Project Manager

Corina T. Farez, P.E., P.G.
Vice President

Attachments
1. Boring Location Plan
2. Subsurface Soil Data Profile
3. Boring Logs
4. Global Slope Stability Analysis Results



0 100 200 Feet

Legend

Soil Boring

BORING LOCATION PLAN: ILLINOIS BEACH STATE PARK ROAD, ZION, ILLINOIS

SCALE: GRAPHICAL | EXHIBIT 3-1 | DRAWN BY: J. Rowells CHECKED BY: M. Kothawala

Wang Engineering
1145 N. Main Street
Lombard, IL 60148
www.wangeng.com

FOR AES SERVICES, INC. | 199-02-02

0 100 200 Feet

Legend

Soil Boring

BORING LOCATION PLAN: ILLINOIS BEACH STATE PARK ROAD, ZION, ILLINOIS

SCALE: GRAPHICAL

EXHIBIT 3-2

DRAWN BY: J. Rowells
CHECKED BY: M. Kothawala

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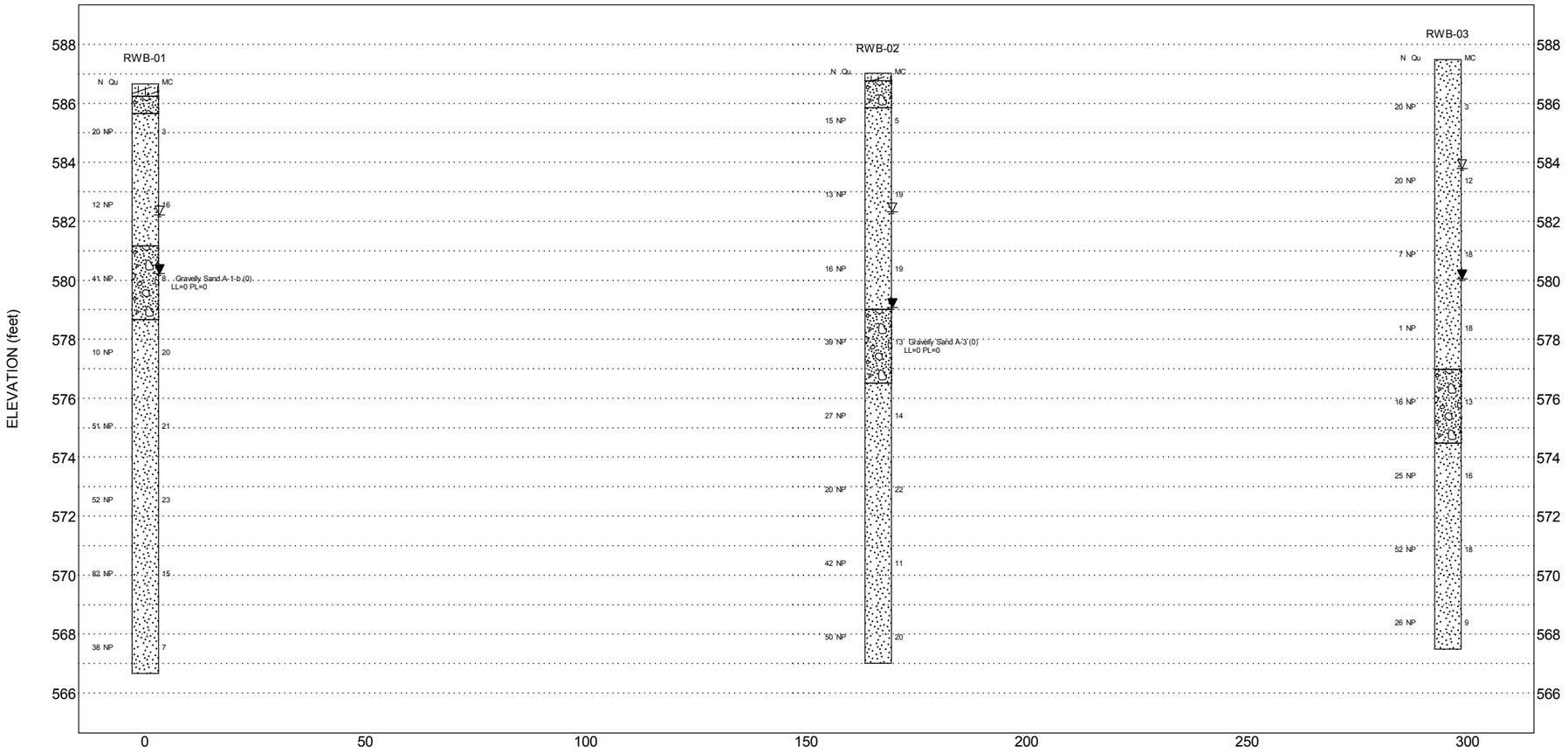
FOR AES SERVICES, INC.

199-02-02

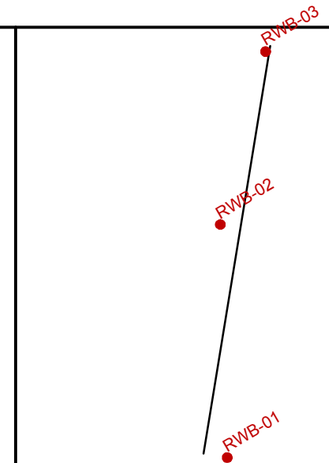


Lithology Graphics

Pavement

Gravelly sand, sandy gravel

IDH Sand, Sandy Loam



Site Map Scale 1 inch equals 110 feet

Explanation:

RWB-01 — Borehole Number Station

Borehole Lithology

N--N-value, (blw/12 in)
Qu--UC Strength, (tsf)
MC--Moisture Content, (%)

Water Level Reading at time of drilling.

Water Level Reading 24-hr after drilling or at end of drilling

0 30

Horizontal Scale (feet)

Vertical Exaggeration: 6.5x

Wang Engineering Inc
1145 N Main Street
Lombard, Illinois 60148

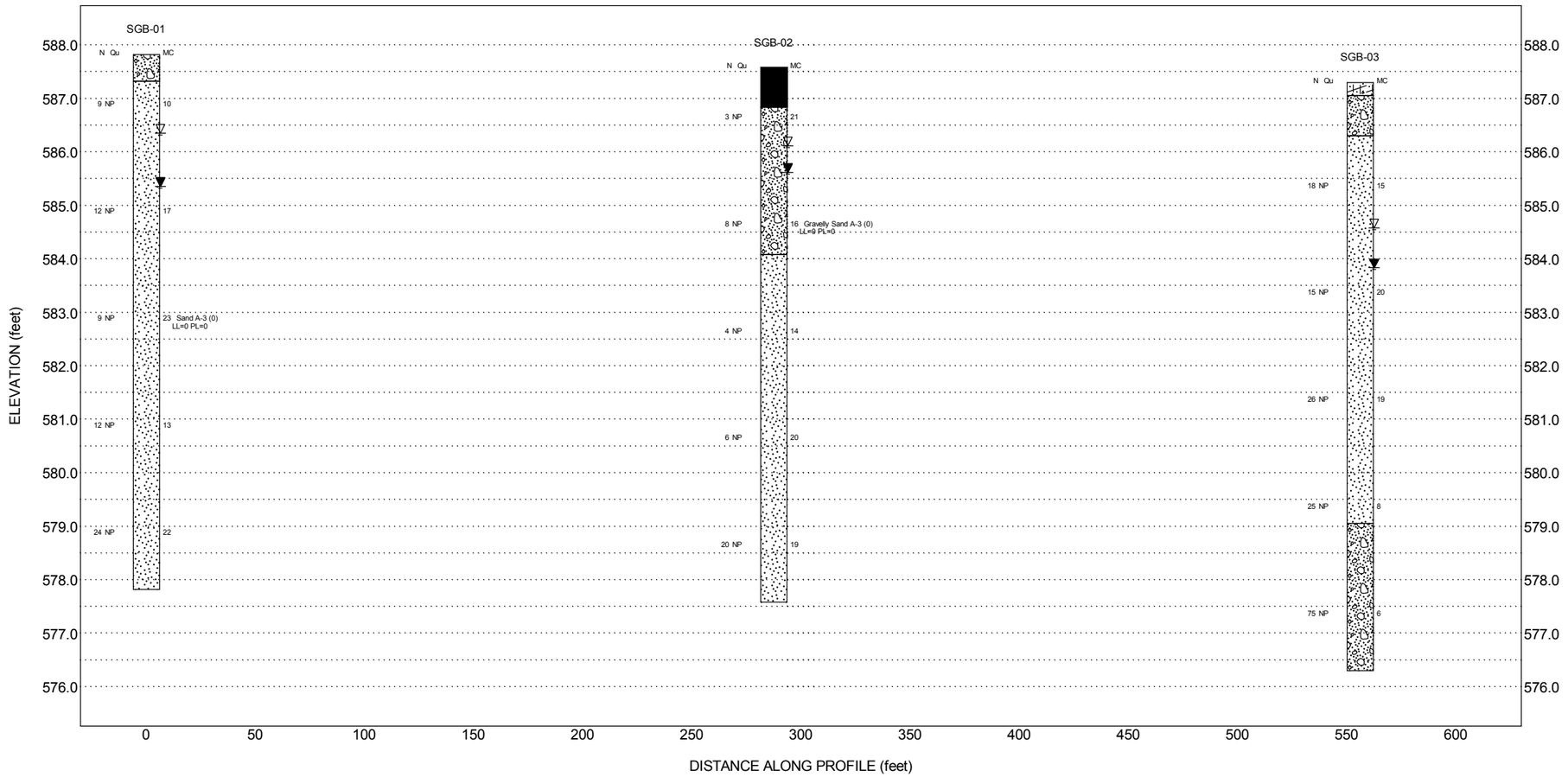
Retaining Wall
Subsurface Soil Data profile

WEI SINCE 1982

Illinois Beach State Park Road
Zion, IL

JOB NUMBER	PLATE NUMBER
199-02-02	EXHIBIT 2

WEI 11X17 1990202.GPJ WANGENG.GDT 6/27/18



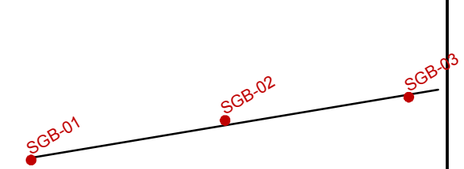
Lithology Graphics

Gravelly sand, sandy gravel

IDH Sand, Sandy Loam

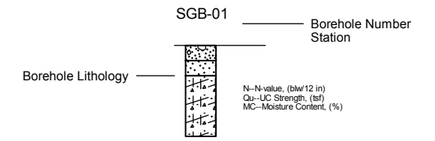
Topsoil

Pavement



Site Map Scale 1 inch equals 220 feet

Explanation:



Water Level Reading at time of drilling.

Water Level Reading 24-hr after drilling or at end of drilling

0 60

Horizontal Scale (feet)

Vertical Exaggeration: 24.5x

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Service Road
Subsurface Soil Data profile

Illinois Beach State Park Road
Zion, IL

JOB NUMBER	PLATE NUMBER
199-02-02	EXHIBIT 2

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Wang Engineering
wangeng@wangeng.com
1145 N Main Street
Lombard, Illinois 60148
Telephone: 630-953-9928
Fax: 630-953-9938

BORING LOG RWB-01

WEI Job No.: 199-02-02

Client: **AES Services, Inc.**
Project: **Illinois Beach State Park Road**
Location: **Zion, IL**

Datum: NAVD 88
Elevation: 586.67 ft
North: 2099880.07 ft
East: 1126939.35 ft
Station:
Offset:

Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type / recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
586.3	5-inch thick ASPHALT						
585.7	--PAVEMENT--						
	7-inch thick, brown SANDY GRAVEL			1	12 10 10	NP	3
	--AGGREGATE BASE--						
	Medium dense, brown, fine SAND; moist to wet						
	--RDR 2--	5		2	6 6 6	NP	16
581.2	Dense, brown GRAVELLY SAND; saturated			3	8 15 26	NP	8
	--RDR 2--						
	--%Gravel=53.7--						
578.7	--%Sand=40.0--						
	--%Silt=5.9--						
	--%Clay=0.4--						
	--A-1-B (0)--	10		4	3 3 7	NP	20
	Medium dense to very dense, brown to gray, fine to coarse SAND; saturated						
	--RDR 2--			5	14 20 31	NP	21
	--gravel seams--						
		15		6	9 19 33	NP	23
	--sand heaving inside augers--						
	--trace gravel--			7	31 35 47	NP	15
	--little gravel--			8	13 18 20	NP	7
566.7		20					
	Boring terminated at 20.00 ft						
		25					

GENERAL NOTES

Begin Drilling: **06-15-2018** Complete Drilling: **06-15-2018**
Drilling Contractor: **Wang Testing Services** Drill Rig:
Driller: **K&R** Logger: **J. Rowells** Checked by: **E. Datz**
Drilling Method: **2.25" HSA; boring backfilled upon completion**

WATER LEVEL DATA

While Drilling: **4.50 ft**
At Completion of Drilling: **6.50 ft**
Time After Drilling: **NA**
Depth to Water: **NA**

The stratification lines represent the approximate boundary between soil types; the actual transition may be gradual.

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Wang Engineering
wangeng@wangeng.com
1145 N Main Street
Lombard, Illinois 60148
Telephone: 630-953-9928
Fax: 630-953-9938

BORING LOG RWB-02

WEI Job No.: 199-02-02

Client: **AES Services, Inc.**
Project: **Illinois Beach State Park Road**
Location: **Zion, IL**

Datum: NAVD 88
Elevation: 587.02 ft
North: 2100049.29 ft
East: 1126934.37 ft
Station:
Offset:

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type / recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
	586.8	3-inch thick ASPHALT --PAVEMENT--						
	585.9	11-inch thick, brown SANDY GRAVEL --AGGREGATE BASE--			1	15 7 8	NP	5
		Medium dense, brown, fine SAND, trace gravel; damp to saturated			2	4 6 7	NP	19
		--RDR 2--	5					
		--sandy gravel seams--			3	5 6 10	NP	19
	579.0							
		Dense, brown GRAVELLY SAND; saturated			4	6 15 24	NP	13
		--RDR 2-- --%Gravel=20.4--	10					
	576.5	--%Sand=75.1-- --%Silt=3.8-- --%Clay=0.8-- --A-3 (0)-- --sand heaving inside augers--			5	11 12 15	NP	14
		Medium dense to dense, gray, fine to medium SAND; saturated			6	4 8 12	NP	22
		--RDR 2-- --gravel seams--	15					
					7	14 12 30	NP	11
					8	11 21 29	NP	20
	567.0		20					
		Boring terminated at 20.00 ft						
			25					

GENERAL NOTES

Begin Drilling: **06-15-2018** Complete Drilling: **06-15-2018**
Drilling Contractor: **Wang Testing Services** Drill Rig:
Driller: **K&R** Logger: **J. Rowells** Checked by: **E. Datz**
Drilling Method: **2.25" HSA; boring backfilled upon completion**

WATER LEVEL DATA

While Drilling: **4.75 ft**
At Completion of Drilling: **8.00 ft**
Time After Drilling: **NA**
Depth to Water: **NA**

The stratification lines represent the approximate boundary between soil types; the actual transition may be gradual.

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Wang Engineering
wangeng@wangeng.com
1145 N Main Street
Lombard, Illinois 60148
Telephone: 630-953-9928
Fax: 630-953-9938

BORING LOG RWB-03

WEI Job No.: 199-02-02

Client: **AES Services, Inc.**
Project: **Illinois Beach State Park Road**
Location: **Zion, IL**

Datum: NAVD 88
Elevation: 587.49 ft
North: 2100174.83 ft
East: 1126967.15 ft
Station:
Offset:

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type / recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
		Very loose to medium dense, brown, fine to medium SAND, trace gravel; damp to saturated --RDR 2--			1	14 9 11	NP	3
			5		2	8 11 9	NP	12
					3	2 4 3	NP	18
			10		4	3 0 1	NP	18
	577.0	--sand heaving inside augers--						
		Medium dense, brown GRAVELLY SAND; saturated --RDR 2--			5	16 12 4	NP	13
	574.5	--sand heaving inside augers--						
		Medium dense to very dense, brown to gray, fine to coarse SAND; saturated --RDR 2--	15		6	2 8 17	NP	16
		--sand heaving inside augers--						
					7	21 22 30	NP	18
		--sand heaving inside augers-- --little gravel--			8	10 10 16	NP	9
	567.5		20					
		Boring terminated at 20.00 ft						
			25					

GENERAL NOTES

Begin Drilling: **06-15-2018** Complete Drilling: **06-15-2018**
Drilling Contractor: **Wang Testing Services** Drill Rig:
Driller: **K&R** Logger: **J. Rowells** Checked by: **E. Datz**
Drilling Method: **2.25" HSA; boring backfilled upon completion**

WATER LEVEL DATA

While Drilling: **3.75 ft**
At Completion of Drilling: **7.50 ft**
Time After Drilling: **NA**
Depth to Water: **NA**

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Wang Engineering
wangeng@wangeng.com
1145 N Main Street
Lombard, Illinois 60148
Telephone: 630-953-9928
Fax: 630-953-9938

BORING LOG SGB-01

WEI Job No.: 199-02-02

Client: **AES Services, Inc.**
Project: **Illinois Beach State Park Road**
Location: **Zion, IL**

Datum: NAVD 88
Elevation: 587.82 ft
North: 2099734.29 ft
East: 1124943.63 ft
Station:
Offset:

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type / recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
	587.3	6-inch thick, brown GRAVELLY SAND						
		--AGGREGATE BASE--			1	7 5 4 6	NP	10
		Loose to medium dense, brown to gray, fine to medium SAND; damp to saturated			2	4 5 7 7	NP	17
		--RDR 2--						
		--%Gravel=0.2--						
		--%Sand=96.7--	5		3	3 5 4 4	NP	23
		--%Silt=2.6--						
		--%Clay=0.5--						
		--A-3 (0)--						
		--trace gravel--			4	1 6 6 13	NP	13
		--less than 1-inch thick, dark brown peat seam--						
					5	4 9 15 10	NP	22
	577.8		10					
		Boring terminated at 10.00 ft						
			15					
			20					
			25					

GENERAL NOTES

Begin Drilling: **06-15-2018** Complete Drilling: **06-15-2018**
Drilling Contractor: **Wang Testing Services** Drill Rig:
Driller: **K&R** Logger: **J. Rowells** Checked by: **E. Datz**
Drilling Method: **2.25" HSA; boring backfilled upon completion**

WATER LEVEL DATA

While Drilling: **1.50 ft**
At Completion of Drilling: **2.50 ft**
Time After Drilling: **NA**
Depth to Water: **NA**

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Wang Engineering
wangeng@wangeng.com
1145 N Main Street
Lombard, Illinois 60148
Telephone: 630-953-9928
Fax: 630-953-9938

BORING LOG SGB-02

WEI Job No.: 199-02-02

Client: **AES Services, Inc.**
Project: **Illinois Beach State Park Road**
Location: **Zion, IL**

Datum: NAVD 88
Elevation: 587.58 ft
North: 2099791.91 ft
East: 1125225.40 ft
Station:
Offset:

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type / recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
	586.8	9-inch thick, black SILTY LOAM; moist						
		--TOPSOIL--			1	1 1 2 3	NP	21
		Very loose to loose, brown GRAVELLY SAND; wet to saturated			2	2 4 4 3	NP	16
	584.1	--RDR 2-- --%Gravel=19.8-- --%Sand=78.2-- --%Silt=1.6-- --%Clay=0.4-- --A-3 (0)--	5		3	2 2 2 3	NP	14
		Loose to medium dense, brown to gray, fine to medium SAND, trace gravel; saturated			4	4 3 3 4	NP	20
		--RDR 2--			5	5 9 11 9	NP	19
	577.6		10					
		Boring terminated at 10.00 ft						
			15					
			20					
			25					

GENERAL NOTES

Begin Drilling: **06-15-2018** Complete Drilling: **06-15-2018**
Drilling Contractor: **Wang Testing Services** Drill Rig:
Driller: **K&R** Logger: **J. Rowells** Checked by: **E. Datz**
Drilling Method: **2.25" HSA; boring backfilled upon completion**

WATER LEVEL DATA

While Drilling: **1.50 ft**
At Completion of Drilling: **2.00 ft**
Time After Drilling: **NA**
Depth to Water: **NA**

The stratification lines represent the approximate boundary between soil types; the actual transition may be gradual.

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Fax: 630-953-9938

BORING LOG SGB-03

WEI Job No.: 199-02-02

Client: **AES Services, Inc.**
Project: **Illinois Beach State Park Road**
Location: **Zion, IL**

Datum: NAVD 88
Elevation: 587.30 ft
North: 2099825.71 ft
East: 1125492.05 ft
Station:
Offset:

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type / recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
	587.1	3-inch thick ASPHALT						
	586.8	--PAVEMENT--						
		9-inch thick, brown SANDY GRAVEL			1	7 7 11 13	NP	15
		--AGGREGATE BASE--						
		Medium dense, brown to gray, fine SAND; moist to saturated			2	3 7 8 10	NP	20
		--RDR 2--	5		3	10 11 15 15	NP	19
	579.1				4	3 7 18 29	NP	8
		Very dense, gray GRAVELLY SAND; saturated						
		--RDR 2--	10		5	15 39 36 32	NP	6
	576.3							
		Boring terminated at 11.00 ft						
			15					
			20					
			25					

GENERAL NOTES

Begin Drilling: **06-15-2018** Complete Drilling: **06-15-2018**
Drilling Contractor: **Wang Testing Services** Drill Rig:
Driller: **K&R** Logger: **J. Rowells** Checked by: **E. Datz**
Drilling Method: **2.25" HSA; boring backfilled upon completion**

WATER LEVEL DATA

While Drilling: **2.75 ft**
At Completion of Drilling: **3.50 ft**
Time After Drilling: **NA**
Depth to Water: **NA**

The stratification lines represent the approximate boundary between soil types; the actual transition may be gradual.

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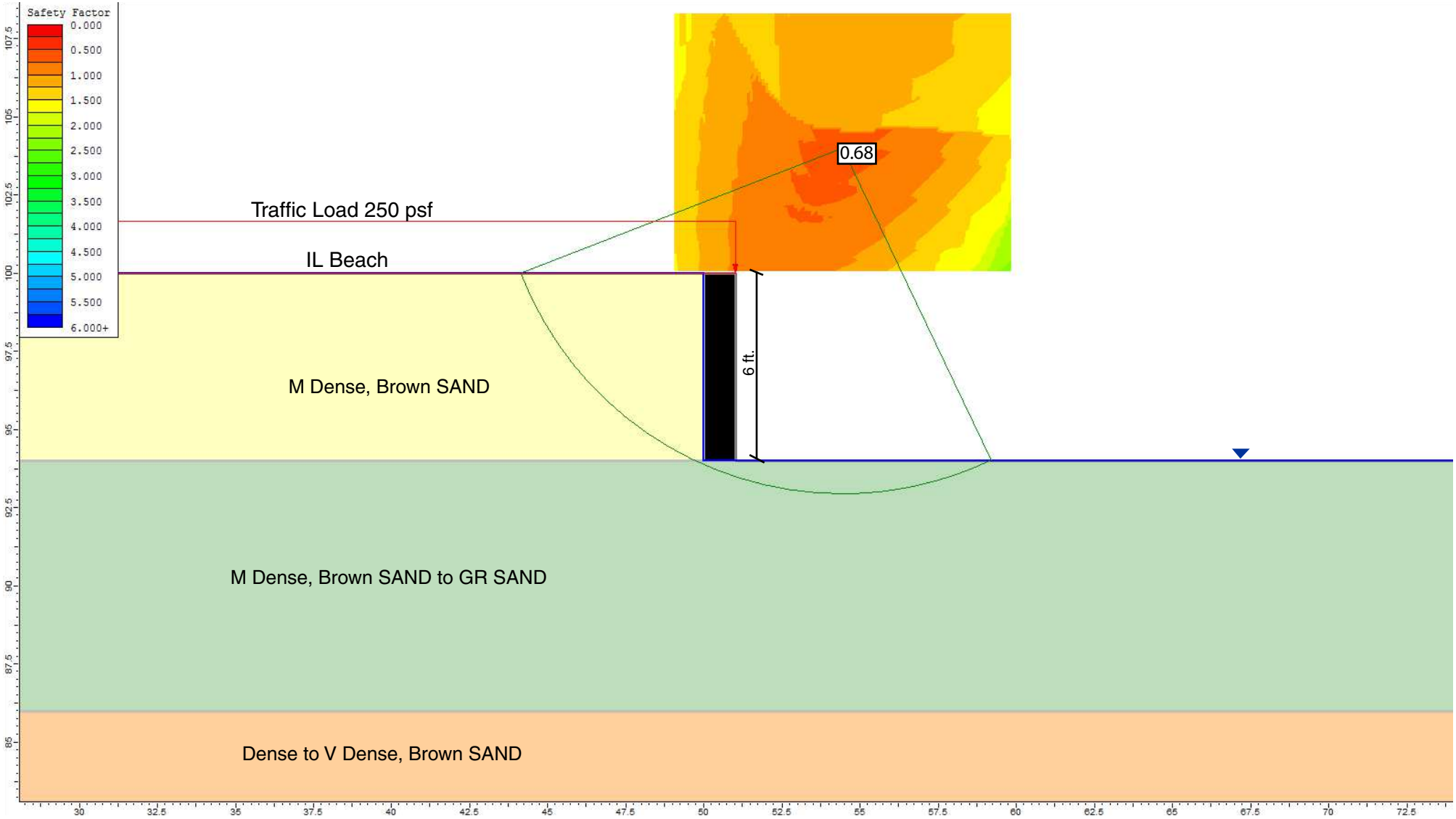

Undrained/ Drained Analysis at IL Beach State Park, Ref. Borings: RWB-01 to RWB-03

Layer ID	Description	Total Unit Weight (pcf)	Undrained/ Drained Cohesion (psf)	Undrained/ Drained Friction Angle (degrees)
1	M Dense, Brown SAND	115	0	31
2	M Dense, Brown SAND to GR SAND	115	0	33
3	Dense to V Dense, Brown SAND	120	0	35

GLOBAL STABILITY: ILLINOIS BEACH STATE PARK ROAD, ZION , LAKE COUNTY, ILLINOIS

SCALE: GRAPHICAL | APPENDIX 4-1 | DRAWN BY: RKC | CHECKED BY: M. Kothawala

Wang Engineering
1145 N. Main Street
Lombard, IL 60148
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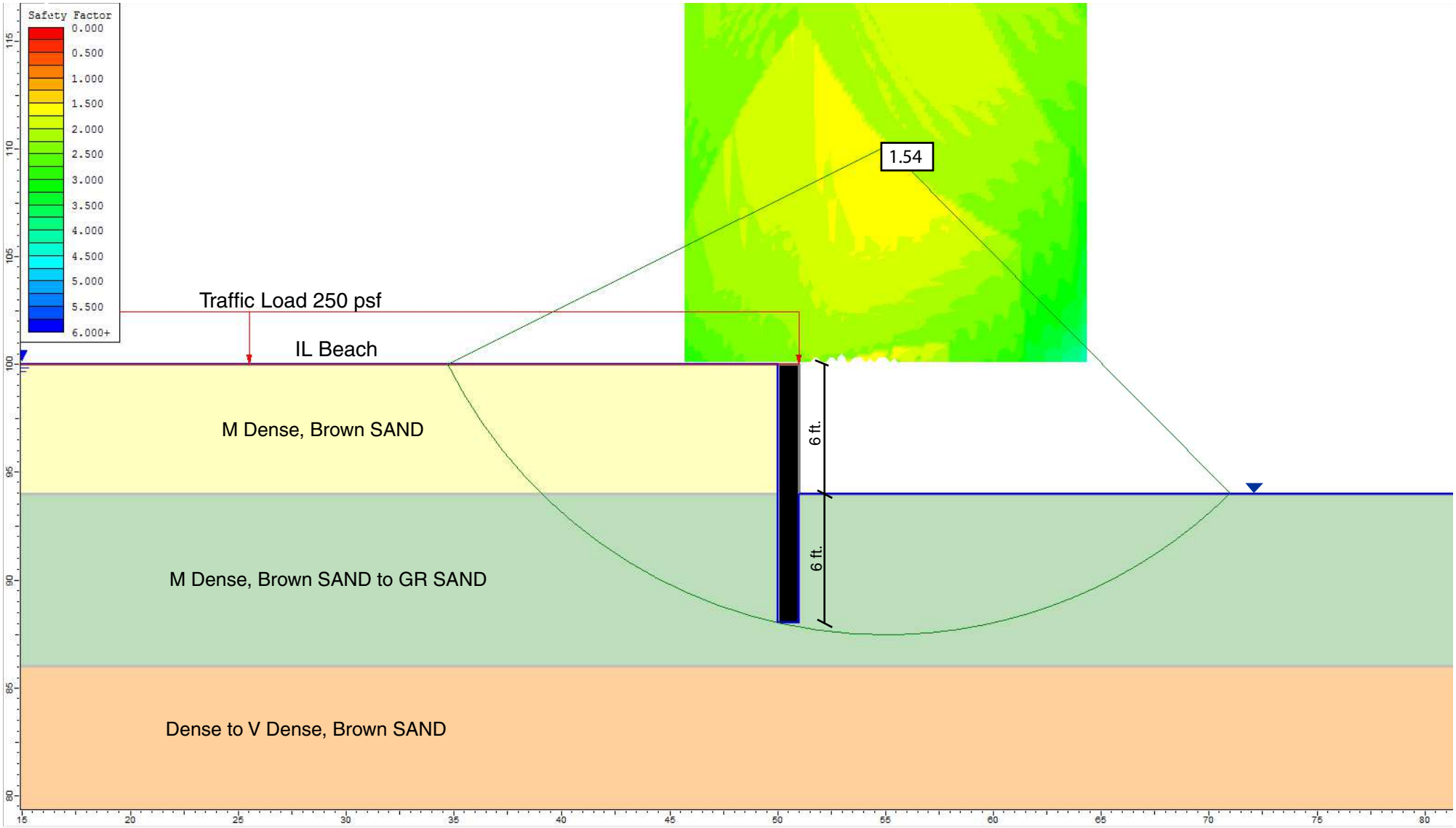

Undrained/ Drained Analysis at IL Beach State Park, Ref. Borings: RWB-01 to RWB-03

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GLOBAL STABILITY: ILLINOIS BEACH STATE PARK ROAD, ZION , LAKE COUNTY, ILLINOIS

SCALE: GRAPHICAL | APPENDIX 4-2 | DRAWN BY: RKC | CHECKED BY: M. Kothawala

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Lombard, IL 60148
www.wangeng.com

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