Structural Geotechnical Report

Ramp A over Northbound LaGrange Road
FAP 330 (IL 171)
Section (10-30)BR
Cook County, Illinois
PTB195-015
Contract No.
IDOT Job No. D-91-357-20
Proposed SN 016-2757
Existing SN 016-0518

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1.0 Project Description and Proposed Structure Information

1.1 Introduction

This report summarizes the results of a geotechnical investigation performed for the design of the proposed new single span bridge, SN 016-2757, for Ramp A over northbound LaGrange Road in Cook County, Illinois. This report describes the exploration procedures used, presents the field and laboratory data, includes an assessment of the subsurface conditions in the area, and provides geotechnical recommendations for the construction. Based on subsurface conditions encountered at the borings performed by Millennia.

1.2 Project Description

The project consists of a complete bridge replacement of the existing Ramp A over northbound LaGrange Road structure (SN 016-0518) located in Lemont, Illinois. Also included in the project are two MSE walls located near the west and east abutments. The general site area is shown on the attached Vicinity Map, Figure 1 in Appendix A. Plans that show the approximate locations of the borings performed for this study are presented as Boring Location Plans, Figures 2.1 and 2.2, in Appendix A.

1.3 Existing Bridge Information

The original structure (SN 016-0518) was built in 1958. The superstructure consists of a reinforced concrete deck on three simply supported spans on steel beams. The structure is 179'-8.5" long and 36'-4" wide out-to-out on curved alignment having a radius of 700 feet.

1.4 Proposed Bridge Information

The proposed structure will consist of a single span bridge built on a varying skew from northbound LaGrange Road. The proposed structure will have an overall length of 126 feet-9 1/2-inches from back-to-back abutments. The out-to-out deck width is 42-feet-10-inches. The proposed structure will include two 12-foot-wide driving lanes with an eastbound shoulder width of 10-feet and a westbound shoulder width of 6-feet (As indicated on the TSL in Appendix B).

In addition, two MSE walls are anticipated as part of the project and are located near the proposed structure abutments. The first MSE wall is located near the west abutment with a proposed length of 189-feet-11 ½-inches with an approximate maximum height of 22-feet. The second wall is located at the east abutment with a proposed length of 271-feet-9 ¼-inches with an approximate maximum height of 27-feet.

2.0 Subsurface Exploration and Laboratory Testing

2.1 Subsurface Exploration

From January 25 through February 8, 2022, Millennia conducted a subsurface exploration at the site, consisting of ten (10) soil test borings, designated as Borings B-1 through B-4 for the proposed structure and P-1 through P-6 for the roadway borings. The roadway borings are listed for reference, and will be discussed in further detail in a separate roadway geotechnical report. The approximate ground surface elevations at the boring locations were provided by Millennia's survey crew. The approximate locations of borings are indicated on the Boring Location Plans, Figures 2.1 and 2.2, Appendix A.

After the initial subsurface exploration was completed, it was determined that three (3) additional borings would be required for the addition of the MSE walls near the abutment locations. From January 12 through January 13, 2023, the additional borings were performed at the site, consisting of three (3) soil test borings, designated as Borings MSE-1, MSE-2, and MSE-3. The approximate ground surface elevations at the boring locations were estimated from the topographic survey of the site, performed by Millennia. The Borings were advanced to depths from 36.25 to 39.25-feet below ground surface (bgs). The approximate locations of borings are indicated on the Boring Location Plans, Figures 2.1 and 2.2, Appendix A.

The borings were advanced using hollow stem, mud-rotary, and continuous flight auger drilling methods. Split-spoon samples were recovered from the borings using a 2-inch outside-diameter, split-barrel sampler, driven by an automatic hammer, in accordance with ASTM D 1586. Samples were obtained at 2.5-foot intervals to a depth of 30 feet and 5-foot intervals thereafter. The split-spoon samples were placed in glass jars for later testing in the laboratory. The split-spoon samples were placed in containers for later testing in the laboratory. The sampling sequence for each boring is summarized on the boring logs in Appendix C.

Unconfined compression tests were performed on selected split-spoon samples using a Rimac field testing machine. The resulting unconfined compressive strengths are reported on the boring logs. Borings B-2 and B-3 were advanced below auger refusal into the underlying bedrock using rock coring methods. At B-2 bedrock was encountered at 56 feet bgs and 60 feet bgs at B-3. The material recovered was a light gray to gray dolomite, moderately hard to hard, and slightly to highly weathered. Boring MSE-2 encountered auger refusal at 36-feet below ground surface, and was terminated after a split-spoon was driven 3-inches with 50 blows from the automatic hammer.

2.2 Laboratory Testing

A laboratory testing program consisting of natural moisture contents, visual classifications, and unconfined compressive strength testing using a RIMAC, was conducted by Millennia to determine selected engineering properties of the obtained soil samples. The results of the individual tests are presented on the boring logs in Appendix C.

3.0 Subsurface Conditions

Details of the subsurface conditions encountered at the boring locations are shown on the boring logs. The general subsurface conditions encountered and their pertinent engineering characteristics are described in the following paragraphs. Conditions represented by the borings should be considered applicable only at the boring locations on the dates shown; the reported conditions may be different at other locations and at other times.

3.1 Generalized Subsurface Profile

The surficial material at the borings typically consists of either a pavement section or topsoil. Refer to the individual boring logs for the relevant pavement section and topsoil thicknesses.

Existing fill or possible fill materials related to the construction of the original interchange and embankments were encountered in three out of the four proposed structure borings, to depths ranging from approximately 3 to 10.5 feet. The fill soils typically consist of silty clay, silty clay loam, and sand. Trace amounts of sand, gravel sized rock, and brick fragments were observed in the fill. Moisture contents range from 9 to 22%. The standard penetration test (N) values range from 3 to 15 blows per foot (bpf). Rimac unconfined compression test values on samples range from 1.2 to 4.0 tons per square foot (tsf).

Natural cohesive soils were encountered either below the fill, the pavement surface, or at the existing ground surface at the site and are predominantly made up of silty clay, silty clay loam, silt, silt loam, clay loam, and sandy clay loam. The natural soils contain variable amounts of sand, sand seams, and gravel. Moisture contents vary from 7 to 24%. The standard penetration test (N) values range 7 bpf to 100 blows for 0.5-inches of penetration. Rimac unconfined compression test values on samples range from 1.7 to 3.8 tsf. The cohesive materials were generally stiff to hard. It should be noted that many of the cohesive soils were too disturbed to perform RIMAC testing.

Natural granular soils were encountered interbedded in the layers of cohesive materials. The granular soils generally consist of sand and sandy loam. N-values in the granular soils vary from 17 bpf to 100 blows per 1-inch of penetration. The thickness of the granular soil varies from about 5 to 7.5 feet, where encountered. Generally, the granular material was medium-dense to very dense. Cobbles were noted in Boring B-3.

The MSE wall borings encountered natural cohesive soils predominately composed of clay loam and sandy clay loam. These soils contained varying amounts of sand and gravel. N-values range from 7 bpf to 50 blows per 3-inches of penetration. Rimac or hand penetrometer unconfined compression test values on intact samples range from 1.3 to 6.2 tsf. Moisture contents vary from 7 to 30 percent.

The natural granular soil, encountered in the MSE wall borings, consisted of a Sandy Loam material interbedded in the layers of cohesive materials. The N-values range from 7 bpf to 50 blows per 3-inches of penetration, and moisture contents between 7 and 26 percent.

Split-spoon refusal was encountered in all four of the structure borings, with a 5 or more consecutive blow counts of exceeding 100 blows for six inches of penetration. Boring MSE-2 encountered auger refusal at approximately 36-feet bgs. The split-spoon sample obtained after auger refusal contained trace amounts of fragmented rock. B-1 and B-4 were advanced to depths deep enough to show adequate pile capacity can be achieved, per the IDOT Geotechnical Manual, updated 2020. This typically occurred at depths from 28 to 30 feet below the ground surface. Two borings, B-2 and B-3, were advanced below auger refusal on bedrock at elevations 538.2 and 536.1, respectively. A moderately hard to hard, grey dolomite was encountered with 100 percent recovery on all runs and RQD values between 91 and 100 percent.

3.2 Groundwater

Groundwater was observed during drilling or at completion, at Borings B-1, B-3, B-4, MSE-1, MSE-2, and MSE-3. Groundwater was not encountered in boring B-2 prior to changing to mud rotary drilling techniques. The presence or absence of groundwater at a particular location does not necessarily indicate that groundwater will be present or absent at that location at other times. Groundwater levels may vary significantly over time due to the effect of seasonal variations in precipitation, or other factors not evident at the time of exploration. Table below ists the groundwater depths and elevations at the boring locations where groundwater was encountered.

Groundwater Depths and Elevations:

Boring	Groundwater Depths (ft.)		Groundwater Elevations (ft.)	
	During Drilling	Upon Completion		
B-1	18.0	18.0	592.3	592.3
B-3	8.0	--	588.1	--
B-4	23.0	23.0	596.2	596.2
MSE-1	11.0	--	573.0	--
MSE-2	16.5	--	567.5	--
MSE-3	11.0	--	576.0	--

4.0 Foundation Evaluations and Design Recommendations

4.1 Settlement Considerations

A substantial amount of new fill is anticipated to be needed for the construction of the proposed MSE wall structure for the east abutment. Fills from earthwork operations are anticipated to be approximately 23 to 25-feet thick. Due to the anticipated maximum fill height, a settlement analysis was performed using IDOT's spreadsheet, "Cohesive Soil Settlement Estimate", and soil characteristics from Boring MSE-3.

The load imposed by the new fill at the eastern MSE wall is anticipated to generate some compression of the supporting materials. Based on the conditions encountered at the east MSE wall boring locations, the anticipated condition of any new fill, and the structural loads, total settlement at the east abutment was calculated to be up to 1 inch, with differential settlements up to approximately half the total. As indicated from the borings, the anticipated foundation bearing soils are anticipated to be composed of stiff to hard cohesive soils. The majority of the settlement within the new fill should take place during construction, as the load is applied.

Based on this information, Millennia does not anticipate downdrag to be an issue for the abutment pile foundations.

4.2 Seismic Considerations

The determination of Seismic Site Class was based on the method described by IDOT AGMU Memo 09.1 - Seismic Site Class Definition and the IDOT provided spreadsheet titled: '*Seismic Site Class Determination*.' Using these resources, the controlling global site class for this project is Soil Site Class C.

Additional seismic parameters were calculated for use in design of the structure and evaluation of liquefaction potential. Published information and mapping, including software directly applicable to the AASHTO Guide Specifications for LRFD Seismic Bridge Design, was used to develop the parameters for the project site location. The values, based on Soil Site Class C, are summarized below.

Parameter	Value
Soil Site Class	C
Spectral Response Acceleration, 0.2 Sec, S_{DS}	0.1187g (Site Class C)
Spectral Response Acceleration, 1.0 Sec, S_{D1}	0.0563g (Site Class C)
Seismic Performance Zone	1

As indicated in the table above, based on S_{D1} and Table 3.15.2 in the IDOT Bridge Manual, the Soil Site Class D, and Figure 2.3.10-2 in the IDOT Bridge Manual, the Seismic Performance Zone is 1. Since the proposed structure is located in Seismic Performance Zone 1, as per the IDOT Bridge Manual, 2012, liquefaction analysis is not required.

4.3 Global Stability of MSE Walls

A stability analysis using SLOPE/W was performed using the MSE wall geometry as per the TS&L details, provided by GKE, and soil characteristics from the borings performed for the initial subsurface exploration and the additional MSE wall borings. Three conditions were modeled: end of construction, long-term, and seismic stability. A critical factor of safety (FOS) was calculated for each condition. According to current standard of practice, the target FOS is 1.5 for static conditions and 1.0 for seismic. The slope stability analyses for the abutment walls and side slopes indicate that the required minimum FOS for all conditions were met.

The parameters used in the analysis were based on the results of the field and laboratory investigations, along with Millennia's experience in the area. In order to model the end of construction condition, full cohesion and a friction angle of 0 degrees were assumed. Nominal values for cohesion were used with full friction angle to model the long-term condition to analyze the theoretical condition where pore water pressure has dissipated. Nominal values were 100 psf for the cohesive soils, and friction angles ranged from 26 to 34 degrees.

The Bishop Circular Method, which generates circular-shaped failure surfaces was used to calculate the critical failure surfaces and FOS for the proposed conditions. The FOS obtained in the analysis are tabulated below. Slope/W program output from this analysis can be found in Summary Stability Profiles provided in Appendix D.

Analysis Location Section	Borings	Assumed Conditions	Minimum Computed Factor of Safety		
			Short Term	Long-Term	Seismic
West Abutment MSE Retaining Wall	MSE-1, B-1, & B-2	Maximum Wall Height = 22 ft.	3.3	1.6	1.4
East Abutment MSE Retaining Wall Global	MSE-3, B-3, & B-4	Maximum Wall Height = 27 ft.	3.0	1.6	1.4

The onsite soils can potentially be highly erosive, a mechanism of soil movement unrelated to global stability. Future erosion and shallow, superficial slumps are always a possibility, despite the results of advanced computer modeling for slope stability. Maintaining healthy vegetation, along with appropriate erosion control practices, will reduce the potential for these issues to become problematic. In addition, the abutment slopes will be almost entirely constructed from engineered fill. In order for the slopes to perform as modeled, proper compaction and construction specifications must be followed during construction.

Geotechnical conditions between the boring locations are essentially unknown, and there is potential for variation in elevations and soil composition across the proposed structure footprint. If the contractor exposes conditions during excavation and other earthwork activities that differ from those indicated at the boring locations, Millennia should be notified to assess the effect (if any) of the unanticipated conditions upon the findings of the global slope stability assessment. At the time of this report, there does not appear to be any new sideslopes associated with the proposed structure. If any new side slopes located behind the proposed structure support slabs are utilized, they will be analyzed as part of the Roadway Geotechnical Report.

4.4 Pile Supported Foundations

The foundations supporting the proposed structure must provide sufficient support to resist dead and live loads, including seismic loading. Based on the encountered subsurface conditions, and information available to date, steel H-pile and metal shell piles are feasible options for support of the proposed structure. If metal shell piles are chosen, protective conical tips and care should be taken to prevent damage from driving through the very-stiff to hard till that is indicated on the boring logs. Based on the encountered subsurface conditions, Millennia utilized the Modified IDOT Static Method of Estimating Pile Length (Appendix E) provided by IDOT BBS Foundations and Geotechnical Unit, and the information available to date, to estimate the pile lengths.

The Maximum Nominal required Bearing (R_N) represents the resistance the pile will experience during driving, and will assist the contractor in selecting a proper hammer size. The Maximum Factored Resistance Available (R_F) documents the net long-term axial factored pile capacity available at the tip of the pile to support factored substructure loading. The maximum factored resistance available uses a LRFD Resistance Factor of 0.55. Millennia assumes that the piles will be driven to the maximum nominal bearing of the pile in cohesive or granular material and will not be driven to bedrock. Based on the geotechnical analysis performed for the proposed structure, the impacts of downdrag and liquefaction do not result in a need to reduce the axial factored pile capacity.

MS 12” Φ w/.25” walls

Location	R_N Maximum Nominal Required Bearing (kips)	R_F Maximum Factored Resistance Available (kips)	Estimated Pile Length (ft.)	Assumed Pile Cut-off Elevation (ft.)
West Abutment B-1 & B-2	392	215	26	606.4
East Abutment North Side B-3 & B-4	392	215	16	605.8

MS 14” Φ w/.312” walls

Location	R_N Maximum Nominal Required Bearing (kips)	R_F Maximum Factored Resistance Available (kips)	Estimated Pile Length (ft.)	Assumed Pile Cut-off Elevation (ft.)
West Abutment B-1 & B-2	570	313	34	606.4
East Abutment North Side B-3 & B-4	570	313	16	605.8

HP 12X53

Location	R_N Maximum Nominal Required Bearing (kips)	R_F Maximum Factored Resistance Available (kips)	Estimated Pile Length (ft.)	Assumed Pile Cut-off Elevation (ft.)
West Abutment B-1 & B-2	418	230	62	606.4
East Abutment North Side B-3 & B-4	418	230	51	605.8

HP 14X73

Location	R_N Maximum Nominal Required Bearing (kips)	R_F Maximum Factored Resistance Available (kips)	Estimated Pile Length (ft.)	Assumed Pile Cut-off Elevation (ft.)
West Abutment B-1 & B-2	578	318	68	606.4
East Abutment North Side B-3 & B-4	578	318	57	605.8

Other pile configurations are available and could be considered as substitutes for the sections summarized above. The pile group capacity may be designed as the sum of the individual piles with the understanding that a spacing of at least three pile widths is maintained between piles, center to center.

ASTM A 572 Grade 50 high-strength steel is recommended in order to be driven through the stiff soils, while minimizing potential bending, buckling, distortion, or curling of pile tips. The piles should be equipped with tip reinforcement/shoes to promote penetration through the stiff to hard layers. After the pile section and driving equipment have been selected, a termination driving criteria should be established using a wave equation analysis to help assure adequate capacity and reduce the potential for over stressing the piles during installation. Millennia recommends a test pile be performed at one of the abutments. Test piles are performed prior to production driving so that actual, on-site field data can be gathered to further evaluate pile driving requirements for the project. The test pile results will also provide data for use in assessing the contractor's proposed equipment and methodologies, previously identified in their Pile Installation Plan

Assuming that the piles are properly installed, as discussed herein, total settlement should be less than approximately one inch, with differential settlements up to approximately half the total.

4.5 Lateral Load Resistance

Lateral load resistance and induced lateral deflection for pile foundations are typically assessed using finite difference computer models based on the lateral modulus-of-subgrade reaction, such as LPILE. Based on the conditions encountered at the borings, the following parameters are recommended for use in the design of the abutment foundations:

Boring	Elev. at Bottom of Layer	Total Unit Weight (pcf)	Short Term		Long Term		N Value (bpf)	K (pci)	ε50
			Φ (deg.)	c (psf)	Φ (deg.)	c (psf)			
B-1	607.3	120	0	2,500	26	100	5	850	0.006
	604.8	120	0	2,200	26	100	7	650	0.006
	599.8	120	0	1,750	26	100	8	500	0.007
	594.8	110	32	0	32	0	24	78	--
	580.3	130	0	4,000	26	100	100	1,200	0.004
B-2	591.2	110	32	0	32	0	15	78	--
	578.7	120	0	2,000	28	100	36	650	0.006
	571.2	120	0	2,500	28	100	61	850	0.006
	538.2	125	0	4,000	28	100	85	1,200	0.004
	522.8	145	45	7,000	45	7,000	RC	--	0.001
B-3	593.1	120	0	1,800	26	100	35	550	0.007
	580.6	125	0	2,750	28	100	73	850	0.006
	573.1	125	0	3,250	28	100	89	1,000	0.005
	566.1	125	0	2,750	28	100	76	850	0.006
	554.4	130	0	3,250	26	100	91	1,000	0.005
	549.4	130	0	3,500	29	100	100	1,100	0.005
	544.4	130	0	3,500	28	100	100	1,100	0.005

Boring	Elev. at Bottom of Layer	Total Unit Weight (pcf)	Short Term		Long Term		N Value (bpf)	K (pci)	ε50
			Φ (deg.)	c (psf)	Φ (deg.)	c (psf)			
B-3	539.4	120	36	0	36	0	100	157	--
	536.1	125	0	3,250	28	100	90	1,000	0.005
	521.1	145	45	7,000	45	7,000	RC	--	0.001
B-4	611.2	120	0	2,500	26	100	9	850	0.006
	608.7	120	0	1,200	26	100	3	425	0.008
	601.2	120	0	3,100	26	100	19	1,000	0.005
	593.7	125	36	0	36	0	100	157	--
	591.2	125	0	3,500	28	100	100	1,100	0.005

pcf = pounds per cubic foot psf = pounds per square foot pci = pounds per cubic inch
RC=rock core -unit weight not adjusted for groundwater

4.6 Lateral Earth Pressures

Lateral earth pressure parameters are provided for the design of the retaining wall structures. Structures that are restricted from movement at the top should be designed to resist at-rest earth pressures. Structures that are free to move and deflect at the top may be designed to resist active earth pressures. A horizontal deflection at the top of the structure of approximately 1% of the supported height is typically required to permit active pressure to develop. Earth pressures are a function of the excavation configuration and the backfill materials. The following design parameters are recommended for the indicated backfill materials:

Lateral Earth Pressure Parameters

Parameter		Crushed Limestone	Cohesive Soil
At-Rest Equivalent Fluid Pressure	Drained	55 pcf	65 pcf
	Submerged	90 pcf	95 pcf
Active Equivalent Fluid Pressure	Drained	35 pcf	45 pcf
	Submerged	80 pcf	85 pcf
Passive Equivalent Fluid Pressure	Drained	480 pcf	320 pcf
	Submerged	310 pcf	215 pcf
Soil Wet Unit Weight		130 pcf	120 pcf
Angle of Internal Friction		35°	27°
Assumed Surcharge Condition		None	None
Ground Surface Profile		Horizontal	Horizontal

No factor of safety has been applied to the values above.
pcf = pounds per cubic foot

Submerged values should be used for the calculation of lateral pressures for those portions of the structure that extend below the highest level of anticipated groundwater. The values for undrained fluid pressure for active and at-rest conditions include hydrostatic pressures.

Significant movement would generally be necessary to develop the full values of passive pressures given; typically, the passive values stated are reduced by up to one-half for design. The effects of vertical surcharge loads or sloping ground behind the structures are not included for the stated fluid pressures. To use the lateral earth pressures recommended in Table for design, the backfill material should be placed within a zone defined by a line beginning at the bottom edge of the structure pad or foundation and extending up at a 45° inclination. Resistance to sliding of the structure base may be analyzed using the resistance factors displayed in Section 4.7.

4.7 MSE Wall Foundations

As previously mentioned, two MSE retaining walls, one at each abutment location, are planned as part of the overall project. Based on plans provided by GKE, Millennia understands the MSE walls will be designed with maximum exposed heights of approximately 22 to 27 feet. Along some portions of the east abutment wall footprint there are areas that will require placement of new fill.

While encountered in limited areas at the boring locations for this study, existing fill may be present elsewhere throughout the project area. In order to eliminate risks to the new structures, any existing fill should be removed and replaced with new structural fill within the planned foundation area. At this time, the depth and extent of any fill that might remain below the bearing level will not be known until the foundation excavations have been performed. Millennia suggests that unit rates for removal and replacement be included in the bid documents.

The MSE wall at the west abutment location was designed with a maximum fill height of approximately 22 feet and will have an overall length of 189-feet 11 ½-inches. The proposed bearing elevation is approximately 589.0. Borings B-1 and B-2 indicate that there is potential for encountering similar materials along the length of the wall. B-1 performed on the north side of the existing abutment encountered a stiff to very stiff silt at the proposed bearing elevation, while boring B-2 on the south side of the existing abutment encountered a hard to very hard silt. In order to obtain additional information about the subsurface conditions, additional borings, designated MSE-1 and MSE-2 were drilled at the north and south ends of the west MSE wall, respectively. The ground surface of the borings was estimated to be approximate El. 594.5 and 594.0, and indicate that cohesive materials, primarily stiff to very-stiff clay loam, at and below the anticipated bearing elevation of the west MSE wall. The MSE wall located at the west abutment bearing on natural soil may be designed for a factored bearing resistance of 5.0 kips per square foot (ksf). For the soil conditions encountered at the site of the west MSE wall, a bearing resistance factor of 0.5 was used, and a sliding resistance factor for foundations bearing on clay of 0.85 may be used.

The MSE wall located at the east abutment with a proposed length of 271-feet 9 ¼-inches with an approximate maximum height of 27-feet. The proposed bearing elevation varies from approximately 612.4 to 591.4. Borings B-3, B-4, and MSE-3 indicate that the foundation bearing material are similar along of the wall. B-3 indicated a stiff to very stiff clay loam, B-4 indicates stiff to very-stiff materials composed of silt clay, silty clay loam, and silt loam, and MSE-3 indicates a medium-stiff to very-stiff clay loam. The MSE wall located at the east abutment bearing on natural soil may be designed for a factored bearing resistance of 5.0 ksf. For the soil conditions encountered at the site of the east MSE wall, a bearing resistance factor of 0.5 was used, and a sliding resistance factor for foundations bearing on clay of 0.85 may be used.

Shallow foundations in soil should be excavated with a smooth-edged, clawless excavating bucket to reduce disturbance of the bearing surface. The excavations should be kept dry, and foot traffic should be kept to a minimum to limit disturbance. Any loose or soft material that accumulates or develops at the footing subgrade should be removed prior to the placement of concrete. If zones of soft soils are encountered at the foundation support level, they should be removed and replaced with properly compacted fill, or the footings should be deepened to bear on stiffer soil. Footings should be constructed at least 40 inches below the finish grade to provide protection against the detrimental effects of seasonal moisture variations and frost penetration.

Concrete should be placed as soon as practical after the excavation has been completed to avoid deterioration of the bearing surface due to excessive drying, or excessive wetting caused by precipitation. Alternately, a thin layer of lean concrete could be placed over the excavation floor to protect the bearing surface.

5.0 Construction Considerations

5.1 Subgrade, Fill, and Backfill

Earthwork activities including backfill and fill should be performed in accordance with Section 205 of the Standard Specifications.

5.2 Subgrade Protection

Construction areas should be properly drained in order to reduce or prevent surface runoff from collecting on the subgrade. Any ponded water on the exposed subgrade should be removed immediately. To prevent unnecessary disturbance of the subgrade soils, trucks and other heavy construction vehicles should be restricted from traveling through the finished subgrade area. If disturbed areas develop, they should be reworked and compacted as previously described.

If this project is constructed during the winter season, fill materials should be carefully observed to see that no ice or frozen soils are placed as fill or remain in the base materials upon which fill is placed.

5.3 Site Excavations

Millennia recommends that excavations be performed in accordance with Occupational Safety and Health Administration (OSHA) regulations, and any other applicable regulatory agencies. In accordance with the OSHA excavation regulations, the soil encountered in most of the boring locations would be classified as Type C materials. Excavations in sands, gravels, or silts will likely need to be at gentler inclinations, particularly if the soils are saturated. According to OSHA requirements, any excavation extending to a depth of more than 20 feet must be designed by a registered professional engineer. All excavations for this project are anticipated to be less than 20 feet.

In some areas of the project, the retaining walls could be constructed in line with, near, or intersect with other existing utilities. Existing utility trenches could contain crushed limestone or other types of granular bedding and backfill. It is possible that such granular materials are saturated and will be unstable when excavating through or adjacent to them. Undermining of adjacent utilities and structures could occur due to flowing and caving of the granular bedding and backfill, along with any overlying soil. A properly designed retention system, underpinning, or other suitable means of support should be used to maintain the integrity of nearby utilities and other structures.

It is anticipated that groundwater encountered in the site excavations can be controlled by a sump and pump arrangement in most situations. The sump and pump should be of large enough size to handle a high volume of flow that could be encountered if water-bearing zones of soil with significant granular content are intersected. Surface water should be routed away from the top of the excavations and prevented from flowing into the excavations.

Worker safety and classification of the excavation classifications are ultimately the responsibility of the contractor. Where the excavation lies within the zone of influence of existing pavements, buildings, slabs, utilities, or other structures, the integrity of those elements must be maintained by a properly designed earth retention system, underpinning, or other suitable means.

6.0 Closing

This report has been prepared for the exclusive use of Garza Karhoff Engineering, LLC and the Illinois Department of Transportation for use in the design and construction of the proposed Ramp A over Northbound LaGrange Road structure project in Cook County, Illinois. This report has been prepared in accordance with generally accepted soil and foundation engineering practices. No other warranty, expressed or implied, is made to the professional advice and recommendations included herein. This report is not for use by parties other than those named or for purposes other than those stated herein. It may not contain sufficient information for the use of other parties or for other purposes.

If there is a substantial lapse of time between the submission of this report and the start of work at the site, or if conditions have changed due to natural causes or construction operations at or adjacent to the site, this report should be reviewed by Millennia to determine the applicability of the analyses and recommendations considering the changed conditions and time lapse. The report should also be reviewed by Millennia if changes occur in structure locations, sizes, and types, or in the planned loads, elevations, grading plans, and project concepts.

These analyses and recommendations are based on data obtained from site reconnaissance, the borings performed for this study and other pertinent information presented herein. This report does not reflect any variations between, beyond, or below the borings. Should such variations become evident, it may be necessary to re-evaluate the recommendations of this report after performing on-site observation during the construction period and noting the characteristics of any such variation.

We appreciate this opportunity to be of service to you and would be pleased to discuss any aspect of this report with you at your convenience.

Sincerely,

Millennia Professional Services, Ltd.

Charles R. Graham
Geotechnical Engineer/Project Manager

LICENSED PROFESSIONAL ENGINEER
JACOB ALLEN SCHAEFFER
062.068397
Exp. 11-30-23
STATE OF ILLINOIS

Jacob A. Schaeffer, P.E.
Geotechnical Manager

Appendix A: Vicinity Map: Figure 1
Boring Location Plans: Figure 2.1 & 2.2

Millennia Professional Services
11 Executive Drive, Suite 12, Fairview Heights, IL 62208
Phone: (618) 624-8610
Fax: (618) 624-8611
Project No.: ME21043

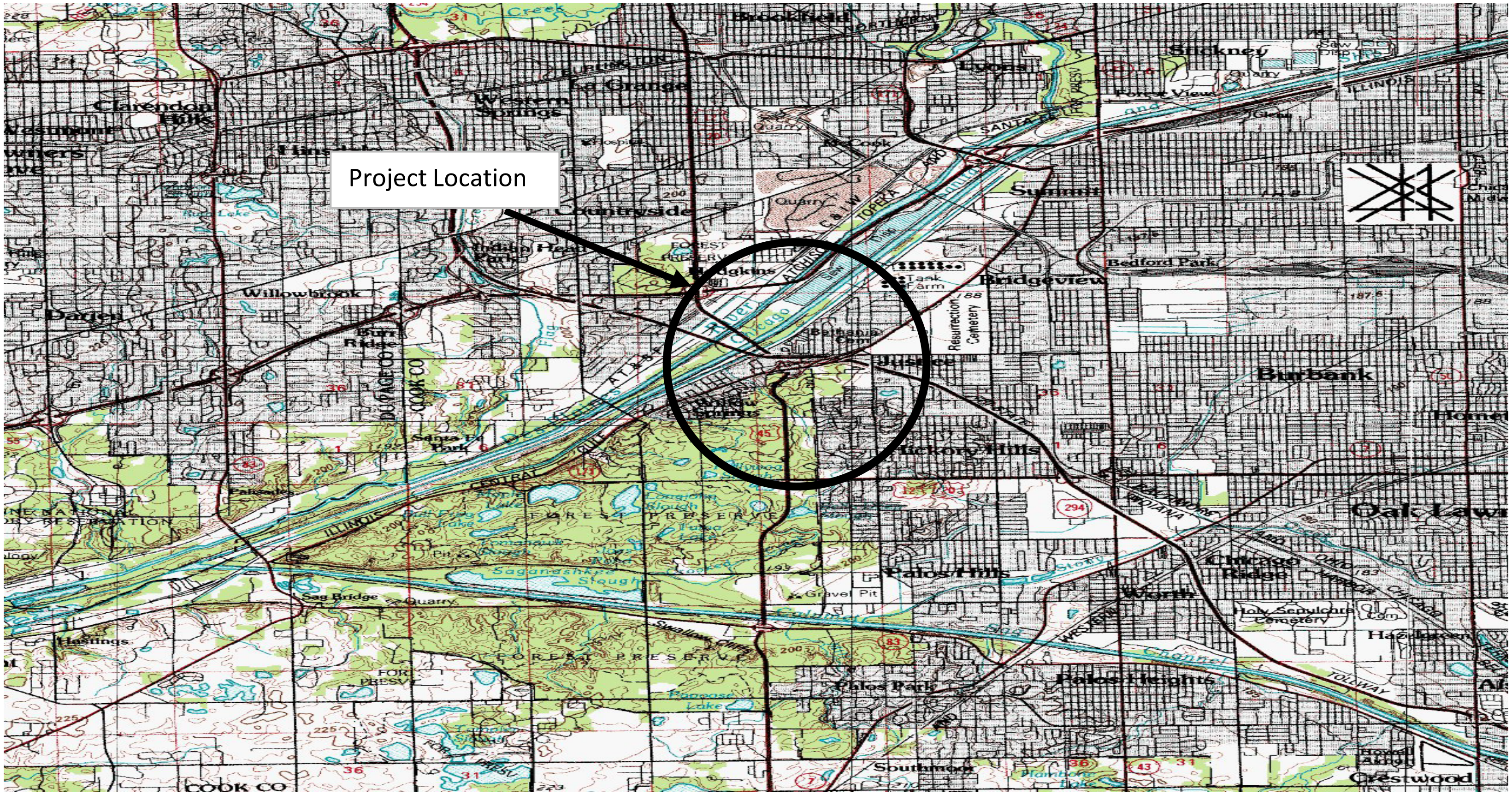


FIGURE 1: VICINITY MAP

FAP 330 Illinois Route 171 at US 12/20/45 (LaGrange Road) Interchange Cook County, Illinois

N

Project location designated by the black box at the center of the map	Drawn by:	R. Onesky	Checked by:	CRG
Image obtained from TopoQuest *Not to scale	Project No.:	ME21043	Date:	1/10/2022

Millennia Professional Services
6439 Plymouth Avenue W-129, St. Louis, MO
Phone: (618) 624-8610
Fax: (618) 624-8611
Project No.: ME21043

N

Approximate Boring Location:

Image obtained from Google Earth

*Not to scale

BORING LOCATION PLAN: Figure 2.1			
FAP 330 Illinois Route 171 at US 12/20/45 (LaGrange Road) Interchange Cook County, Illinois			
Drawn by:	R. Onesky	Checked by:	CRG
Project No.:	ME21043	Date:	1/22/2022

Millennia Professional Services
6439 Plymouth Avenue W-129, St. Louis, MO
Phone: (618) 624-8610
Fax: (618) 624-8611
Project No.: ME21043

N

Approximate Boring Location:

Image obtained from Google Earth

*Not to scale

BORING LOCATION PLAN: Figure 2.2			
FAP 330 Illinois Route 171 at US 12/20/45 (LaGrange Road) Interchange Cook County, Illinois			
Drawn by:	C. Graham	Checked by:	JAS
Project No.:	ME21043	Date:	1/20/2023

Appendix B: Type, Size, & Location Plan

Benchmark: Chiseled □ on the east corner of the headwall on the south side of I-294 and east side of NB US 45 on the ramp.

Existing Structure: S.N. 016-0518 was built in 1959 as F.A.R.T. 5, Section BR-H-6. The superstructure consists of a reinforced concrete deck on three simply supported spans on steel beams. The structure is 179'-8½" long and 36'-4" wide out-to-out on curved alignment having a radius of 700 feet at a 46° 16'-38" skew. In 1996, a new bridge rail was added, the exisitng bearings were replaced with elastomeric bearings, the deck was repaired and overlayed. In 2009, the fascia beam was replaced. Existing structure will be removed and replaced.

Ramp A Traffic will be detoured during construction. NB La Grange Rd will be maintained using stage construction.

No salvage.

HIGHWAY CLASSIFICATION

F.A.P. 330 - Ramp A
Functional Class: Other Principal Arterial
ADT: 22,900 (2018): 23,129 (2046)
ADTT: 4122 (2018): 4163 (2046)
DHV = 2519
One-way Traffic
Directional Distribution: 100% SB
Design Speed: 35 mph
Posted Speed: 35 mph

F.A.P. 330 -Northbound
Functional Class: Other Principal Arterial
ADT: 43,000 (2019): 43,430 (2046)
ADTT: 2580 (2019): 2606 (2046)
DHV = 4636
One-way Traffic
Directional Distribution: 100% NB
Design Speed: 45 mph
Posted Speed: 45 mph

DESIGN STRESSES

FIELD UNITS

f'c = 3,500 psi (Substructure)
f'c = 4,000 psi (Superstructure, Anchorage Slab)
fy = 60,000 psi (Reinforcement)
fy = 50,000 psi (AASHTO M270, Grade 50)

PRECAST UNITS

f'c = 4,500 psi (MSE Wall Panels)

SEISMIC DATA

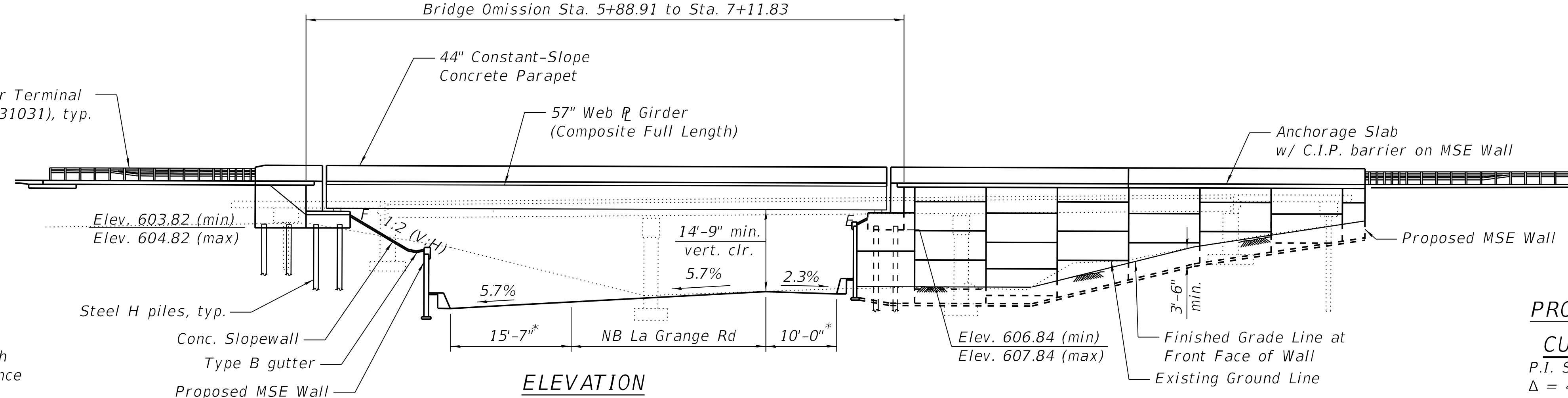
Seismic Performance Zone (SPZ) = 1
Design Spectral Acceleration at 1.0 sec (SD1) = 0.056g
Design Spectral Acceleration at 0.2 sec (SDS) = 0.119g
Soil Site Class = C

LOADING HL-93

Allow 50#/sq. ft. for Future Wearing Surface

DESIGN SPECIFICATIONS

2020 AASHTO LRFD Bridge Design Specifications, 9th Edition



** Additional shoulder width for stopping sight distance

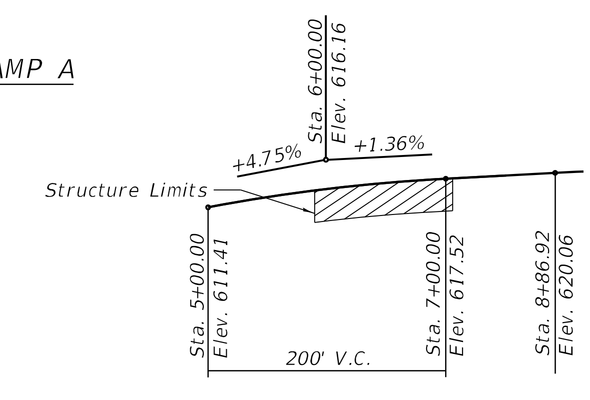
ELEVATION

* Min horiz. clr.

PROPOSED RAMP A

CURVE DATA

P.I. Sta. = 6+49.03
Δ = 43° 06' 50" (LT)
D = 8° 11' 06"
R = 700.00'
T = 276.54'
L = 526.74'
E = 52.65'
e = 5.0%
T.R. = N/A
S.E. Run = 97.00'
P.C. Sta. = 3+72.49
P.T. Sta. = 8+99.23

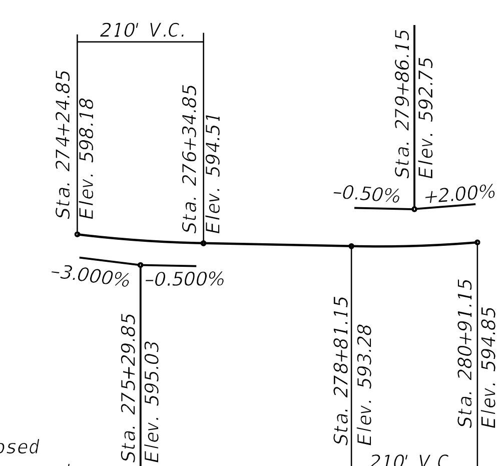


RAMP A PROFILE GRADE

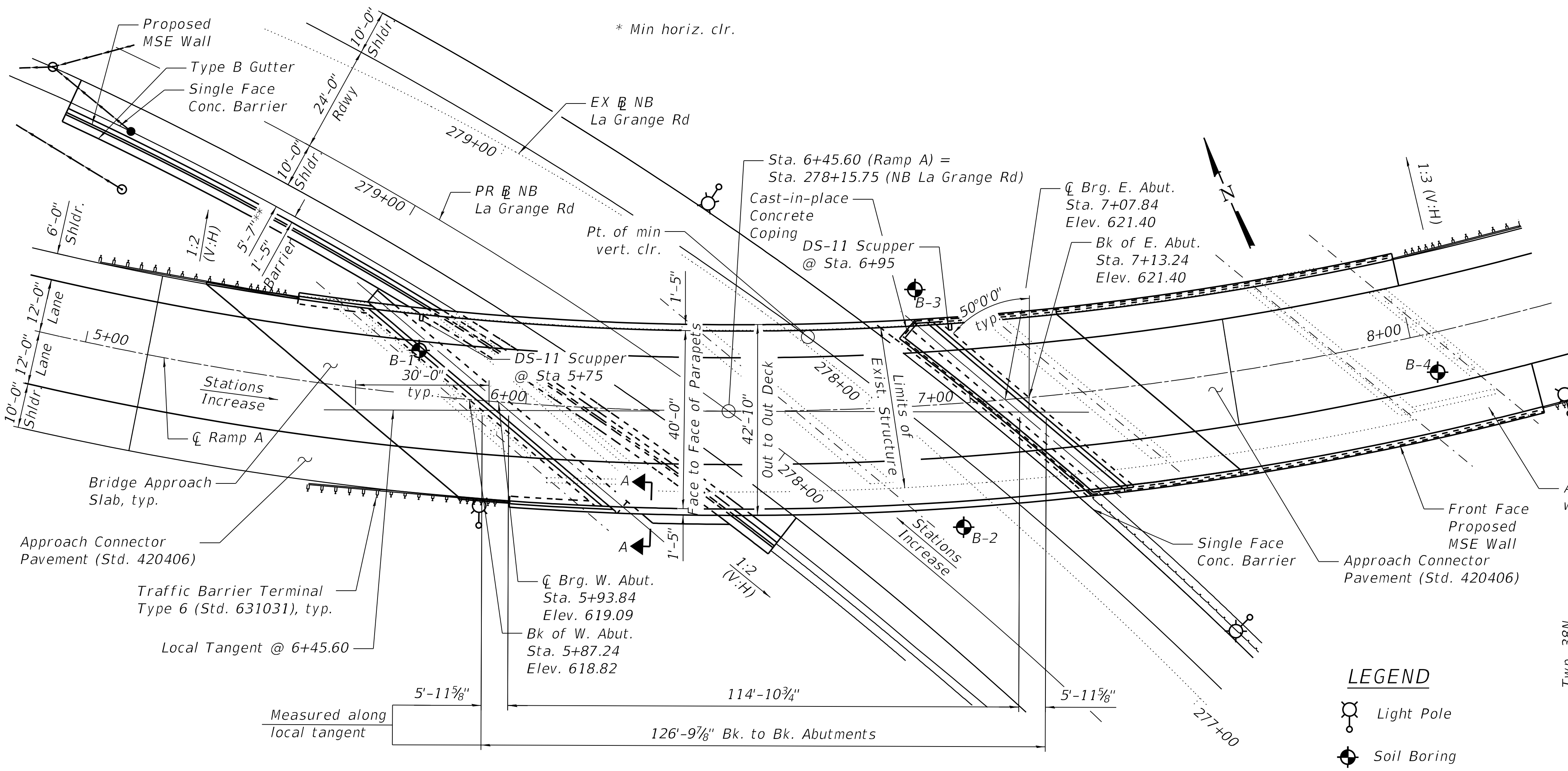
PROPOSED NB LA GRANGE RD

CURVE DATA

P.I. Sta. = 276+99.51
Δ = 56° 37' 49" (LT)
D = 6° 43' 38"
R = 851.71'
T = 458.89'
L = 841.82'
E = 115.76'
e = 5.7%
T.R. = N/A
S.E. Run = 150.00'
P.C. Sta. = 272+40.62
P.T. Sta. = 280+82.44



NB LA GRANGE RD PROFILE GRADE

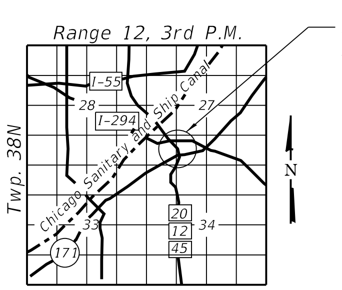


PLAN

LEGEND

Light Pole

Soil Boring



LOCATION SKETCH

GENERAL PLAN
RAMP A OVER NB LA GRANGE RD
F.A.P. 330 (US ROUTE 12/20/45)
SEC 2019-187-B
COOK COUNTY
STATION 6+45.60
STRUCTURE NO. 016-2757

GARZA KARHOFF ENGINEERING, LLC	USER NAME =	DESIGNED - JSR	REVISED -	STATE OF ILLINOIS DEPARTMENT OF TRANSPORTATION	GENERAL PLAN STRUCTURE NO. 016-2757
		CHECKED - LM	REVISED -		
	PLOT SCALE =	DRAWN - JSR	REVISED -		
	PLOT DATE =	CHECKED - LM	REVISED -		SHEET 1 OF 5 SHEETS

F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
330	2019-187-B	COOK	119	68
		CONTRACT NO. 62K60		
		ILLINOIS FED. AID PROJECT		

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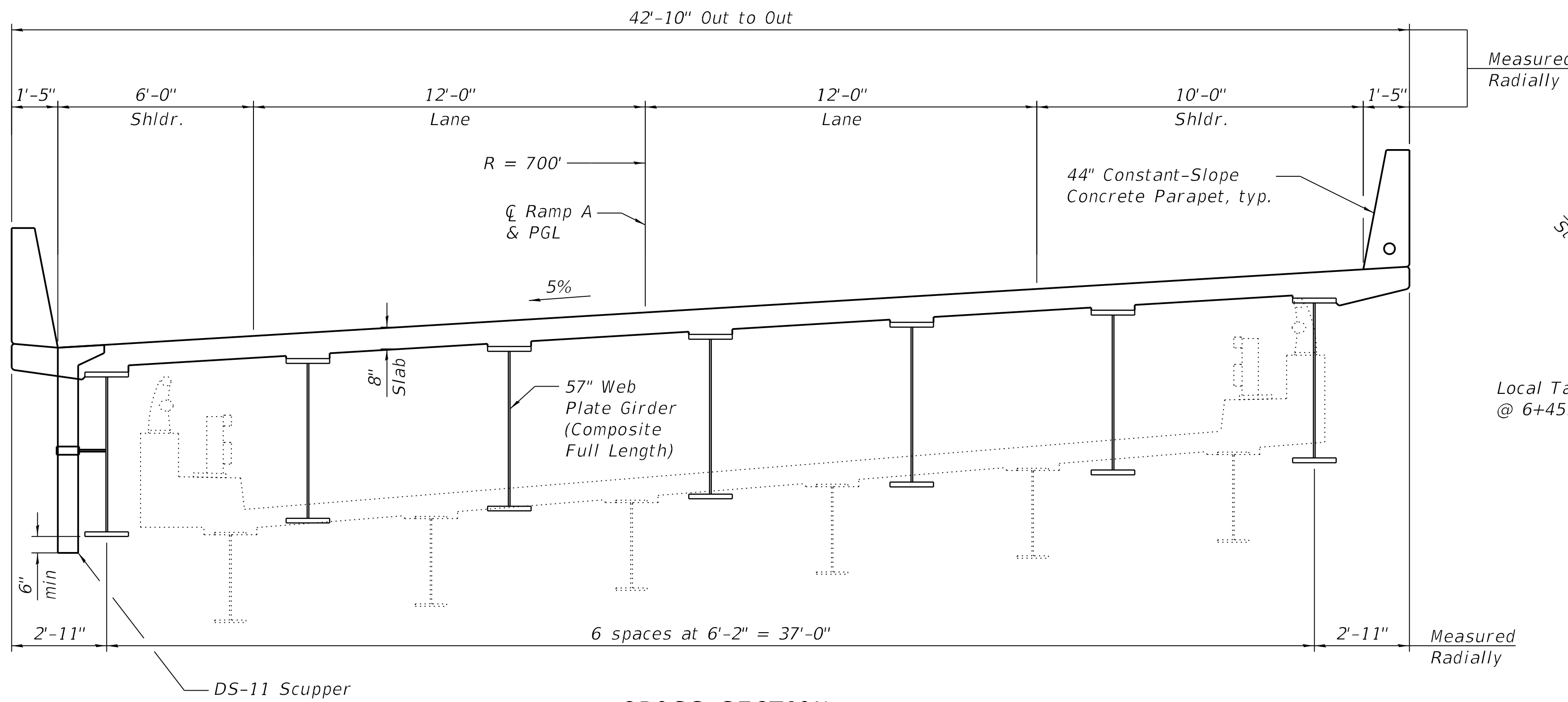
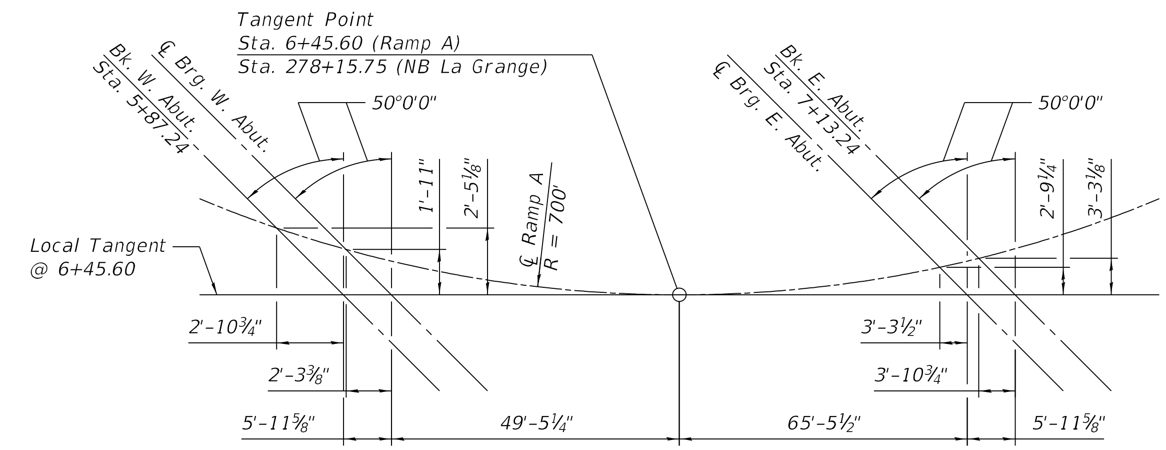
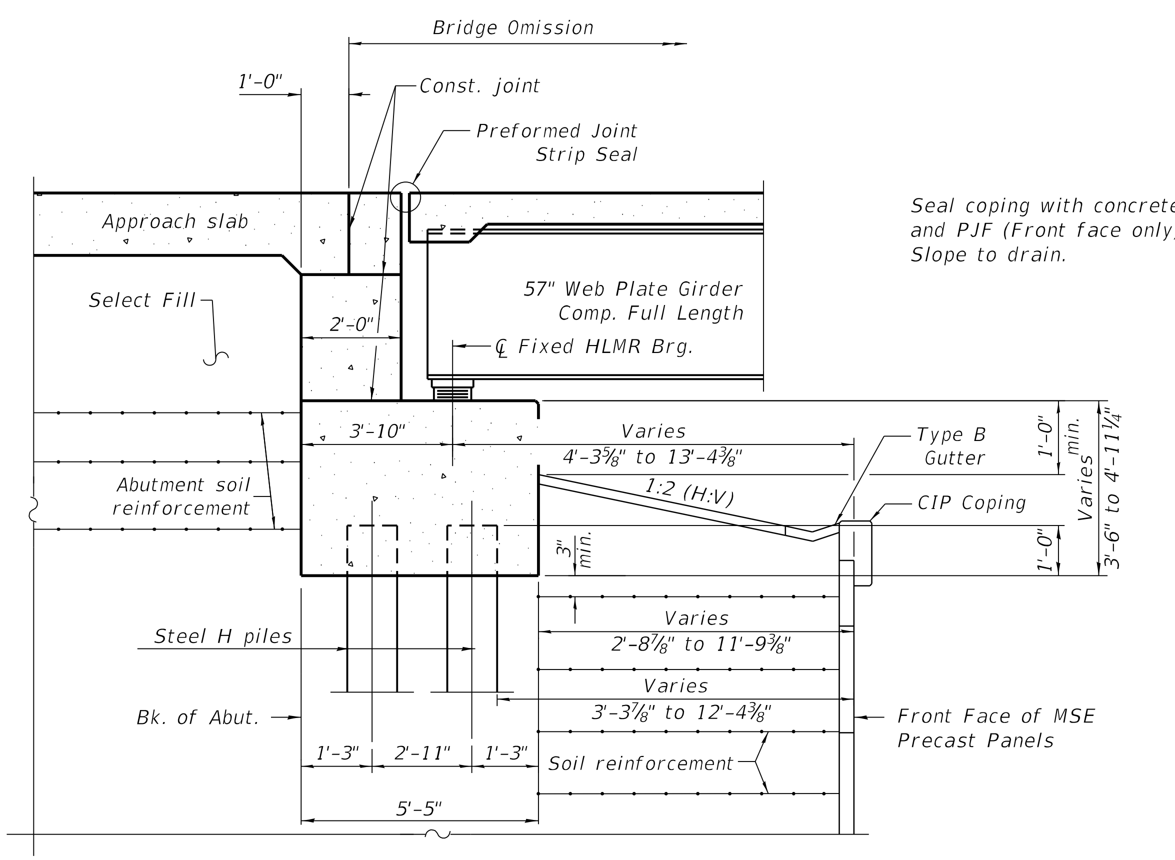


CROSS-SECTION

(Horiz. dim. @ Rt. ∠'s)



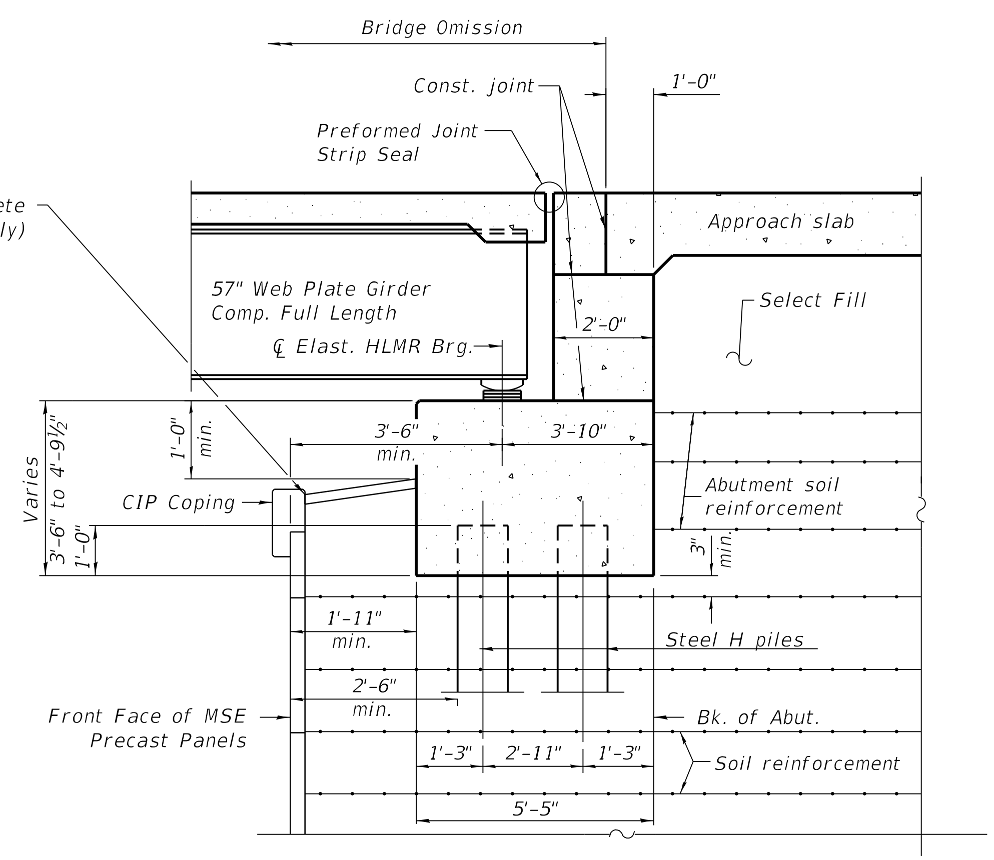
OFFSET SKETCH



SECTION THRU WEST ABUTMENT

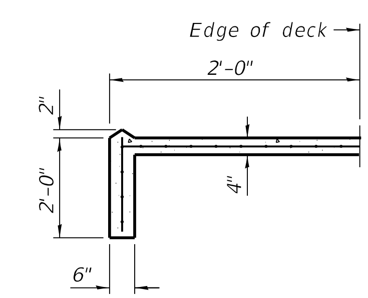
(Horiz. dim. @ Rt. ∠'s)

Seal coping with concrete and PJF (Front face only) Slope to drain.



SECTION THRU EAST ABUTMENT

(Horiz. dim. @ Rt. ∠'s)



SECTION A-A

GENERAL DETAILS
RAMP A OVER NB LA GRANGE RD
F.A.P. 330 (US ROUTE 12/20/45)
SEC 2019-187-B
COOK COUNTY
STATION 6+45.60
STRUCTURE NO. 016-2757

GARZA KARHOFF ENGINEERING, LLC

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	CHECKED - LM	REVISED -
PLOT SCALE =	DRAWN - JSR	REVISED -
PLOT DATE =	CHECKED - LM	REVISED -

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

GENERAL DETAILS
STRUCTURE NO. 016-2757

SHEET 2 OF 5 SHEETS

F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
330	2019-187-B	COOK	119	69

CONTRACT NO. 62K60

ILLINOIS FED. AID PROJECT

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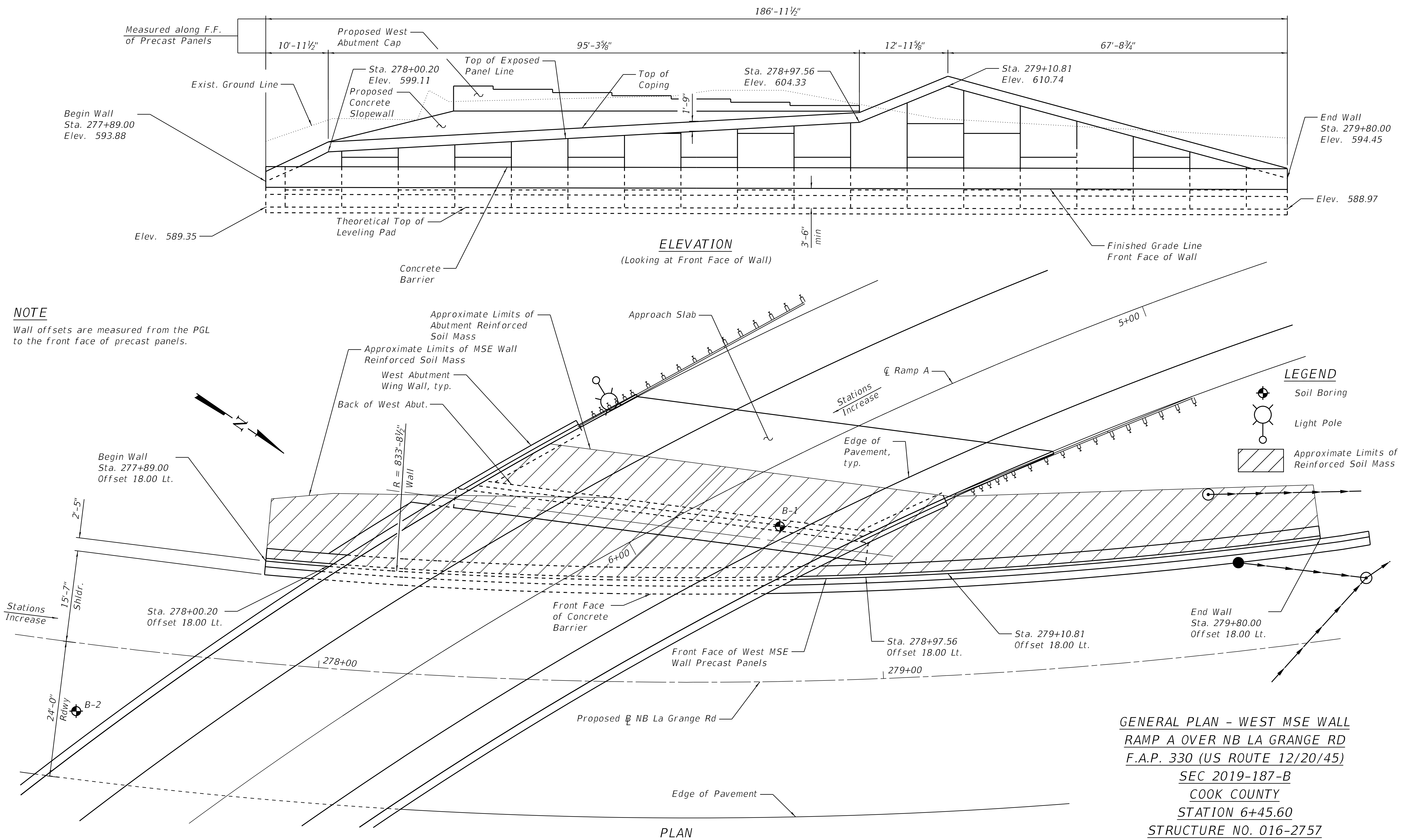
Benchmark: Chiseled □ on the east corner of the headwall on the south side of I-294 and east side of NB US 45 on the ramp.

Existing Structure: None



NOTE

Wall offsets are measured from the PGL to the front face of precast panels.

LEGEND

- Soil Boring
- Light Pole
- Approximate Limits of Reinforced Soil Mass

GENERAL PLAN - WEST MSE WALL
RAMP A OVER NB LA GRANGE RD
F.A.P. 330 (US ROUTE 12/20/45)
SEC 2019-187-B
COOK COUNTY
STATION 6+45.60
STRUCTURE NO. 016-2757

GARZA KARHOFF ENGINEERING, LLC

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	CHECKED - LM	REVISED -	
PLOT SCALE =	DRAWN - JSR	REVISED -	
PLOT DATE =	CHECKED - LM	REVISED -	

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

GENERAL PLAN – WEST MSE WALL
STRUCTURE NO. 016–2757
SHEET 3 OF 5 SHEETS

F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
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		CONTRACT NO. 62K60		
		ILLINOIS FED. AID PROJECT		

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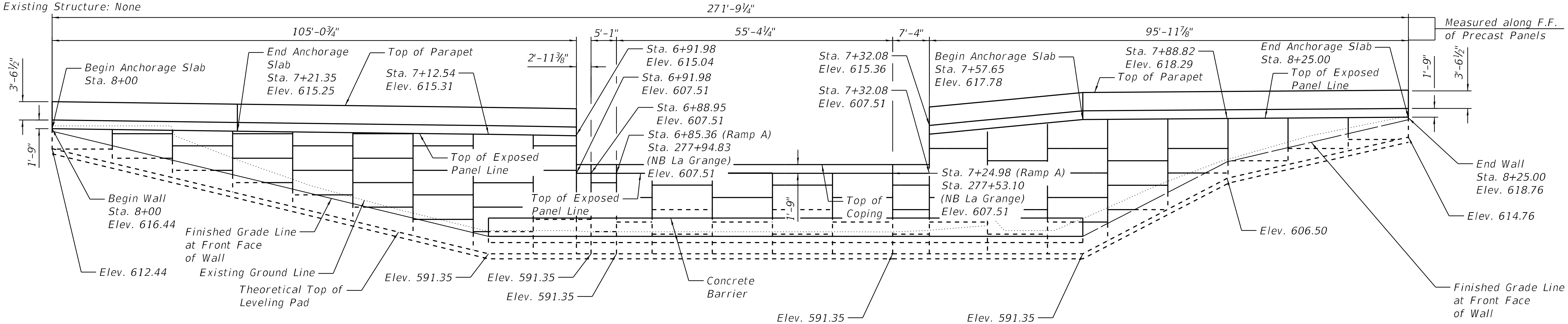
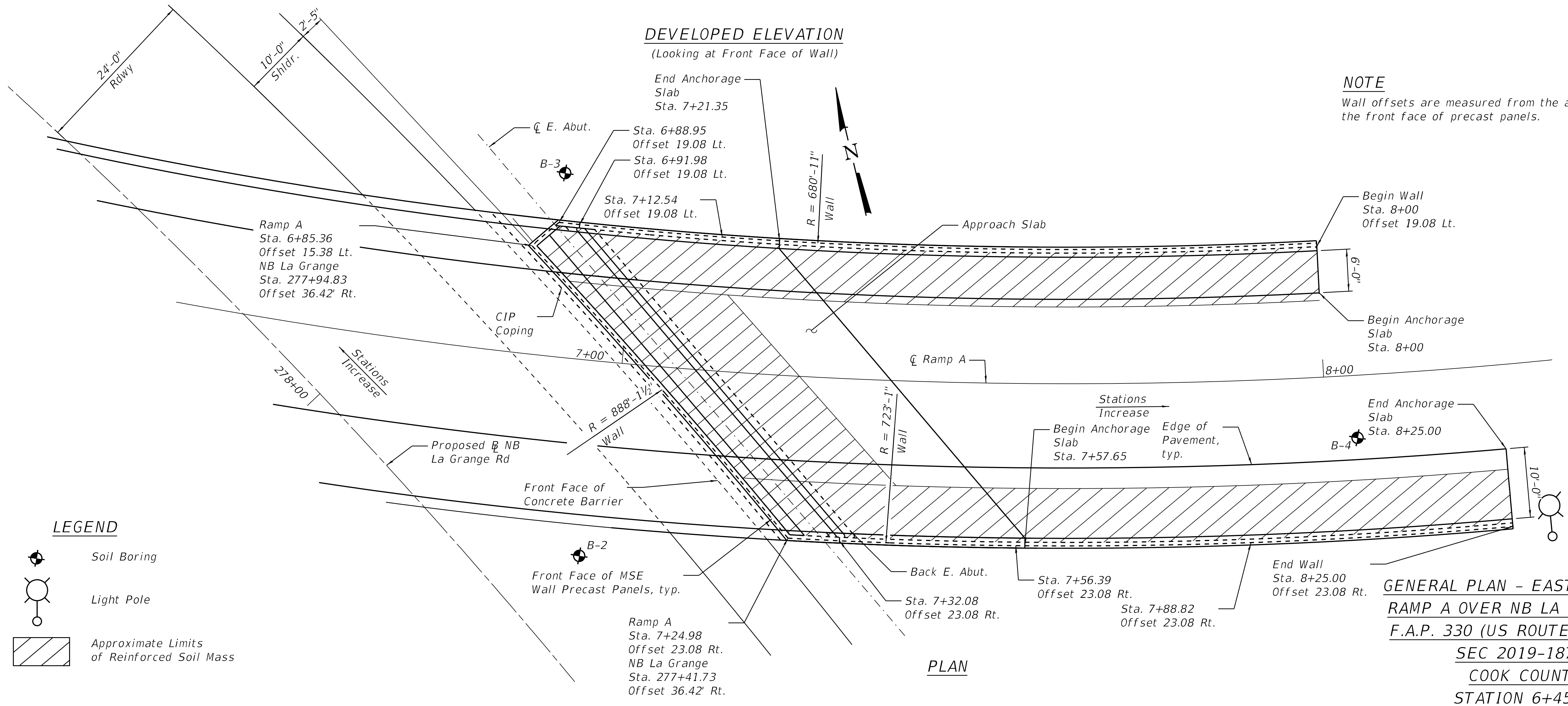
Benchmark: Chiseled □ on the east corner of the headwall on the south side of I-294 and east side of NB US 45 on the ramp.

Existing Structure: None



DEVELOPED ELEVATION
(Looking at Front Face of Wall)

NOTE
Wall offsets are measured from the alignment to the front face of precast panels.



PLAN

LEGEND
- Soil Boring
- Light Pole
- Approximate Limits of Reinforced Soil Mass

GENERAL PLAN - EAST MSE WALL
RAMP A OVER NB LA GRANGE RD
F.A.P. 330 (US ROUTE 12/20/45)
SEC 2019-187-B
COOK COUNTY
STATION 6+45.60
STRUCTURE NO. 016-2757

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GARZA KARHOFF ENGINEERING, LLC

USER NAME =	DESIGNED - JSR	REVISED -
	CHECKED - LM	REVISED -
PLOT SCALE =	DRAWN - JSR	REVISED -
PLOT DATE =	CHECKED - LM	REVISED -

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

GENERAL PLAN - EAST MSE WALL
STRUCTURE NO. 016-2757
SHEET 4 OF 5 SHEETS

F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
330	2019-187-B	COOK	119	71

CONTRACT NO. 62K60
ILLINOIS FED. AID PROJECT

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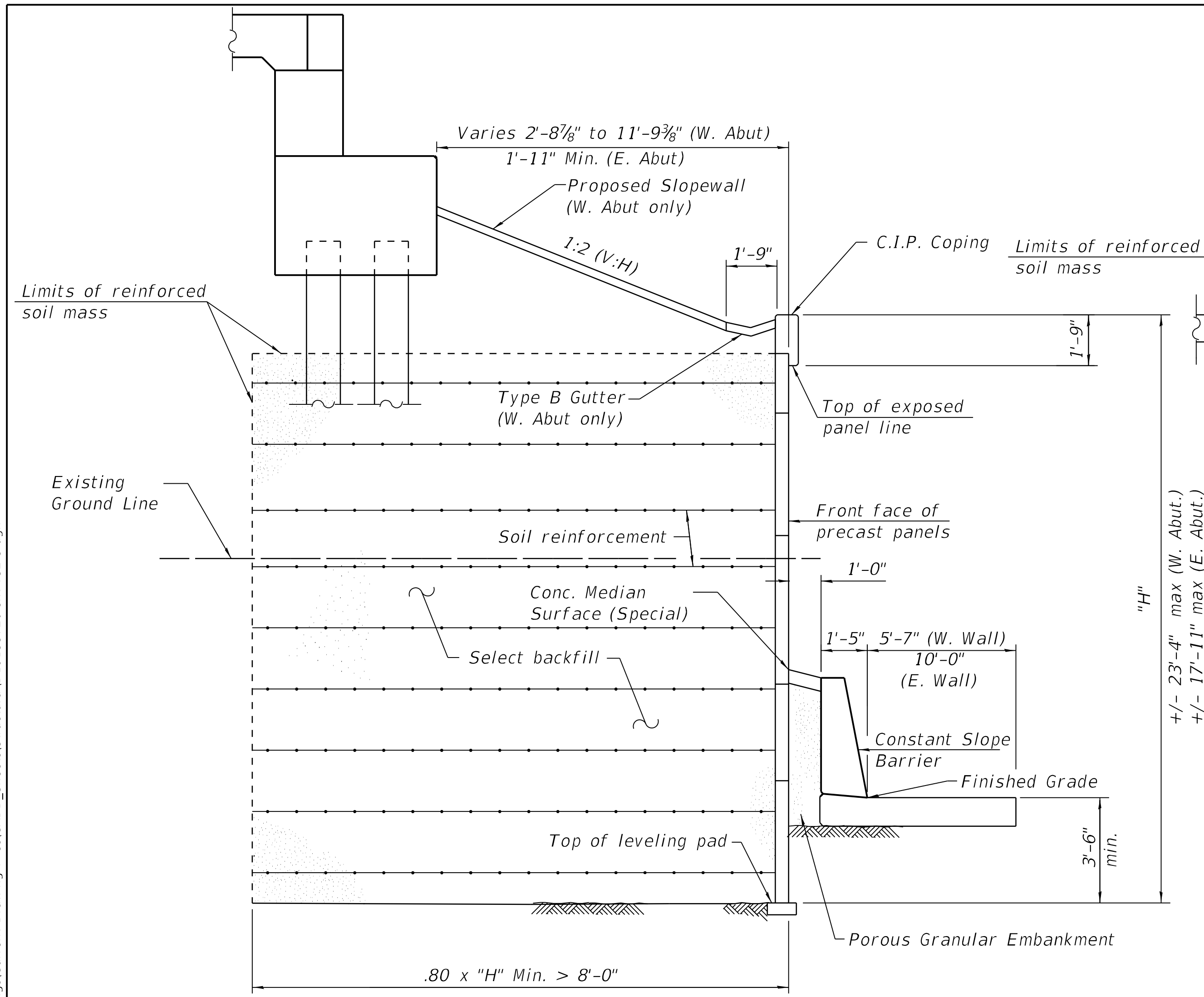
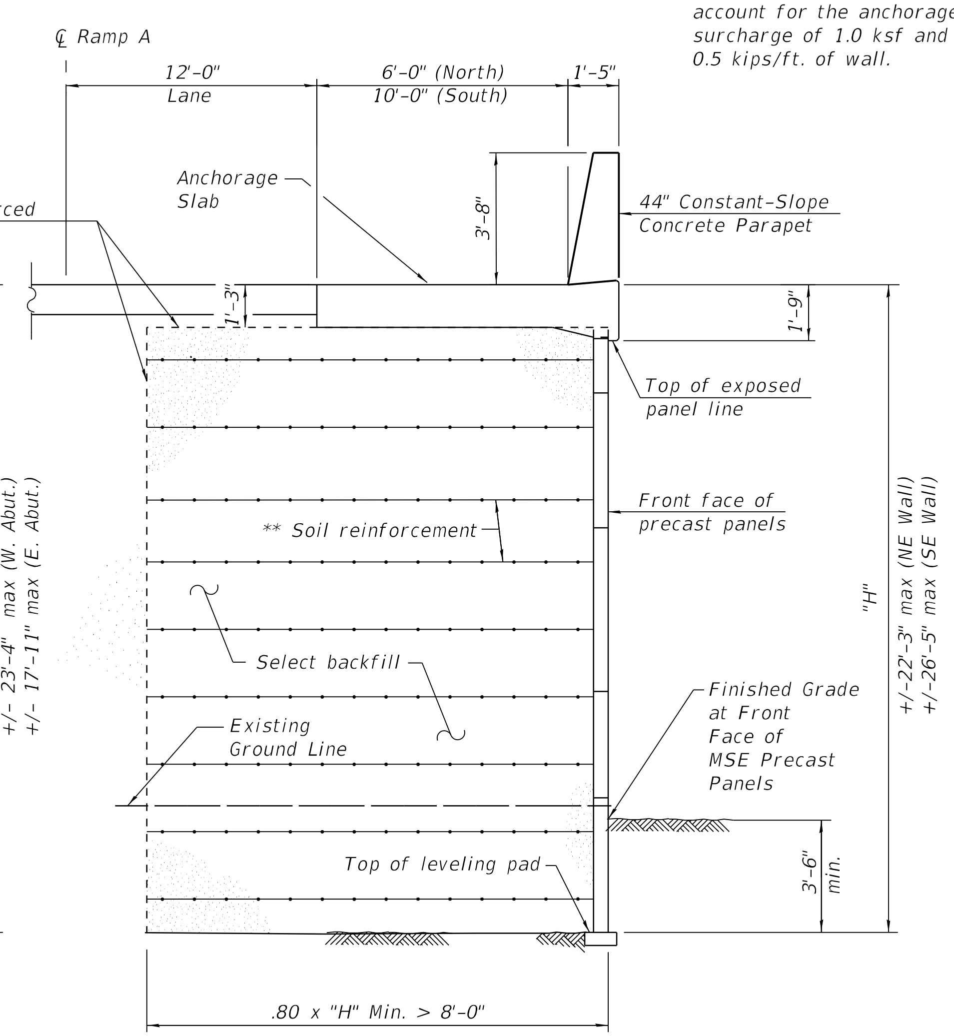
** The MSE wall supplier's internal stability design shall account for the anchorage slab's bearing pressure surcharge of 1.0 ksf and horizontal sliding force of 0.5 kips/ft. of wall.

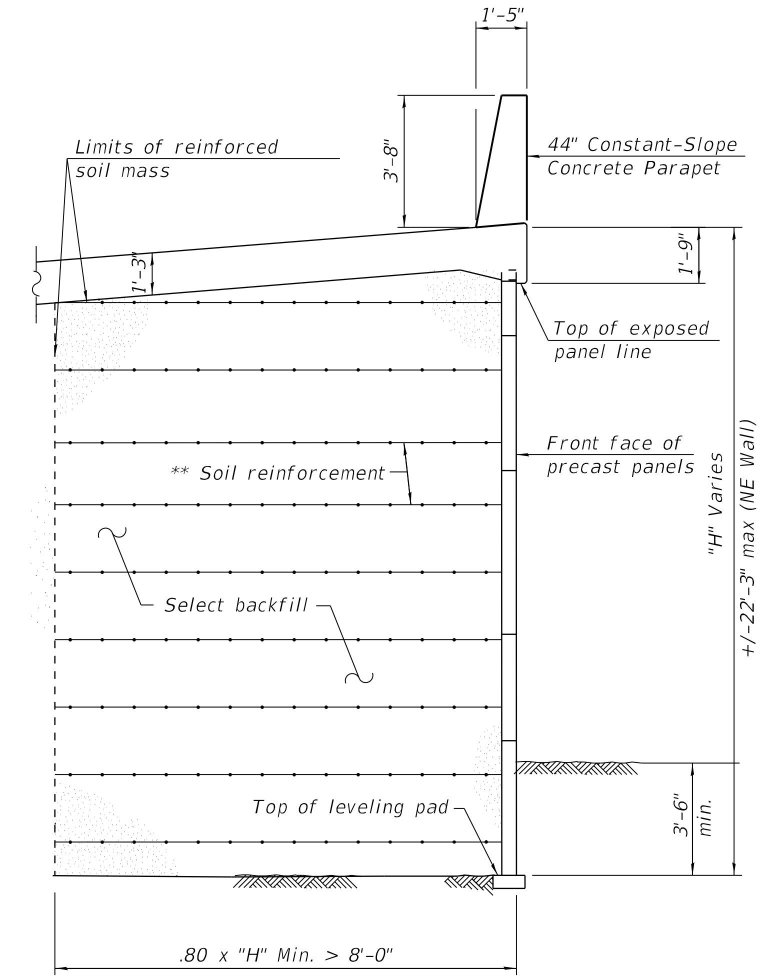


SECTION THRU
MSE WALL AT ABUTMENT

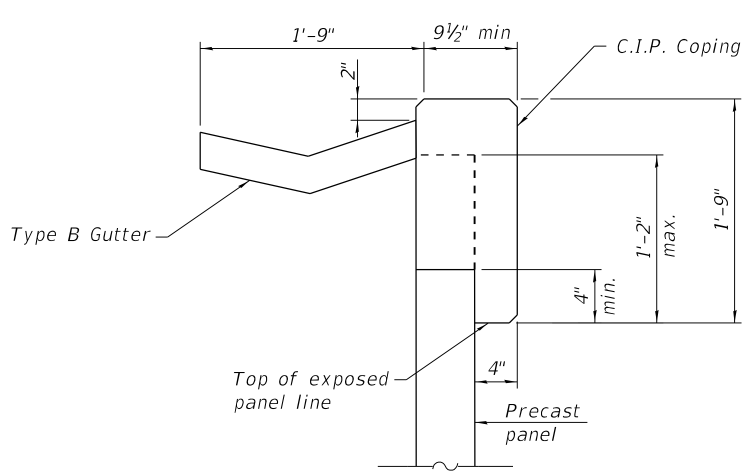
(W. Abut. shown. E. Abut. includes concrete coping seal, sloped to drain in place of Conc. Slopewall and Type B Gutter)



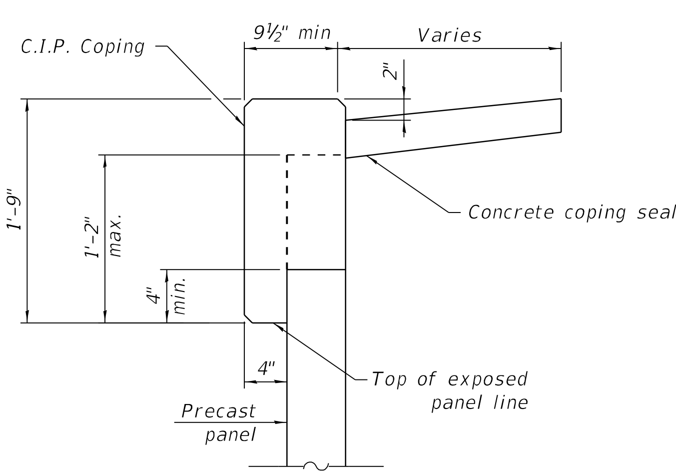
SECTION THRU ANCHORAGE
SLAB AND MSE WALL



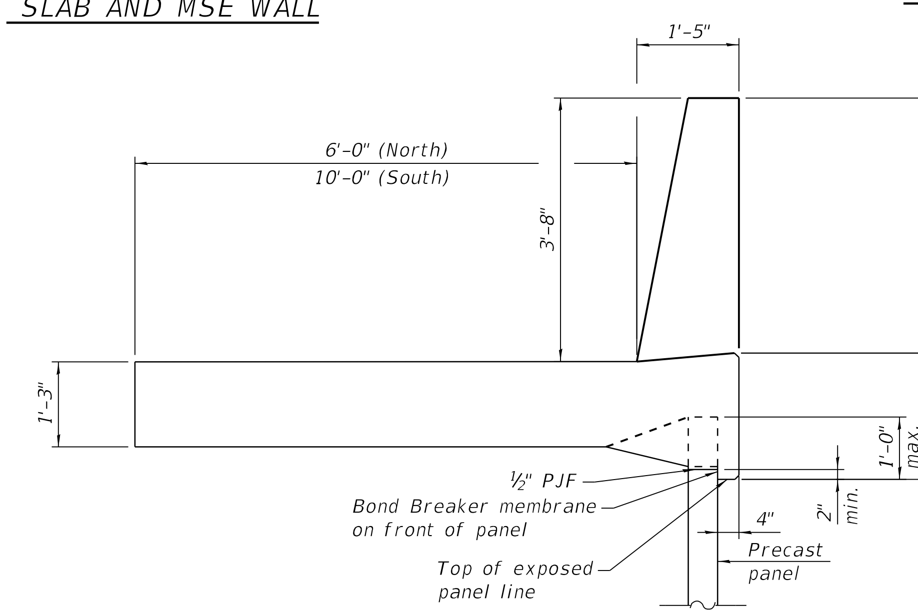
SECTION THRU APPROACH SLAB
AND MSE WALL



SECTION THRU
COPING
(W. Abut.)



SECTION THRU
COPING
(E. Abut.)



SECTION THRU
ANCHORAGE SLAB

GENERAL DETAILS - MSE WALLS
RAMP A OVER NB LA GRANGE RD
F.A.P. 330 (US ROUTE 12/20/45)
SEC 2019-187-B
COOK COUNTY
STATION 6+45.60
STRUCTURE NO. 016-2757

GARZA KARHOFF ENGINEERING, LLC	USER NAME =	DESIGNED - JSR	REVISED -
		CHECKED - LM	REVISED -
	PLOT SCALE =	DRAWN - JSR	REVISED -
	PLOT DATE =	CHECKED - LM	REVISED -

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

GENERAL DETAILS – MSE WALLS
STRUCTURE NO. 016–2757
SHEET 5 OF 5 SHEETS

F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
330	2019-187-B	COOK	119	72
		CONTRACT NO. 62K60		
		ILLINOIS	FED. AID PROJECT	

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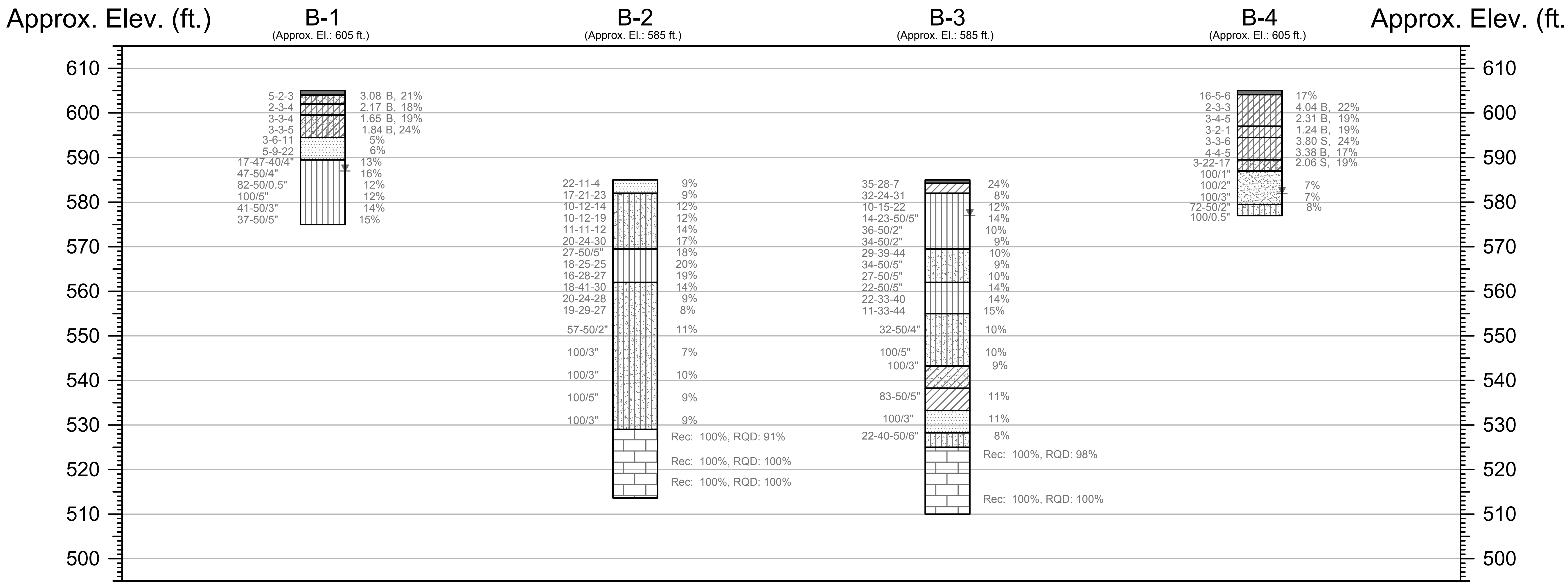
Appendix C: Soil Profile, Boring Logs, and Rock Core Photographs

IL ROUTE 171 - LA GRANGE ROAD



STRATIGRAPHY KEY:

CONCRETE
CLAY LOAM
SAND
SANDY CLAY LOAM
SANDY LOAM
SILT
SILT LOAM
SILTY CLAY
SILTY CLAY LOAM
DOLOMITE

Note: Vertical elevations shown are approximated from Google Earth.
Conditions between borings are unknown, and subject to change.
Horizontal scale shown is only for reference.

0
5
10
20

VERTICAL SCALE: 1:25

BORING DATA KEY:

Boring ID
Groundwater level encountered while drilling
N-Value (bpf)
Stratigraphy
Pocket Penetrometer (tsf) , Moisture Content (%)

FIGURE 3.1:

SUBSURFACE PROFILE

PROJECT NAME:	PROJECT No.:	DRAWN BY:	CHECKED BY:
IL Route 171 La Grange Road	ME21043	B. FISHER	C. GRAHAM
		2/28/2022	2/28/2022

MILLENNIA
PROFESSIONAL
SERVICES

Millennia Professional Services

SUBSURFACE DIAGRAM
Illinois Rte 171/LaGrange Road MSE Wall
Borings: Figure 3.2

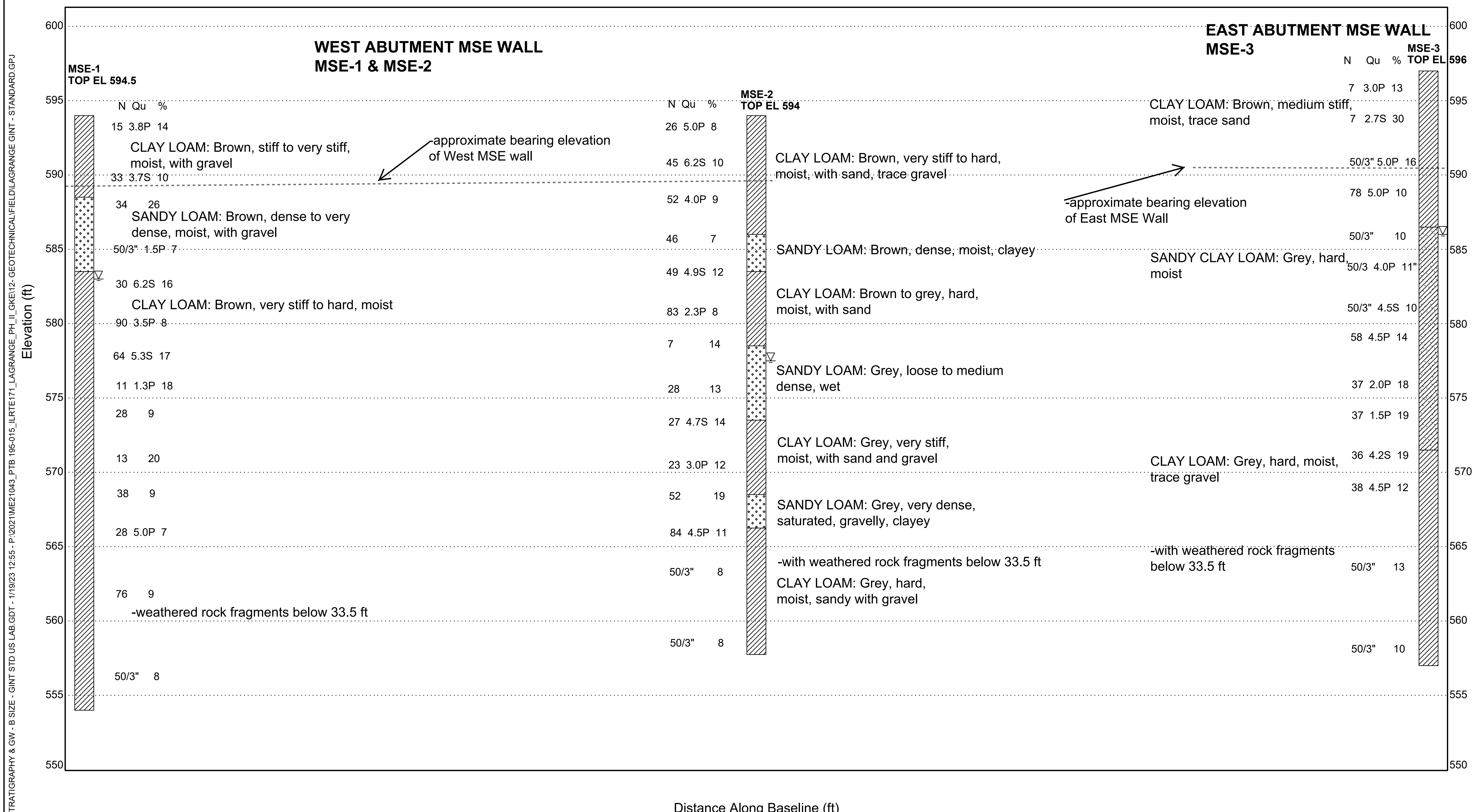
USCS Low Plasticity Clay | USCS Well-graded Sand | USCS Low Plasticity Sandy Clay

CLIENT IDOT

PROJECT NUMBER ME21043

PROJECT NAME Illinois Rte 171/LaGrange Road

PROJECT LOCATION Chicago, Illinois



MILLENNIA PROFESSIONAL SERVICES
www.millennia.pro

B-1 SOIL BORING LOG

Sheet 1 of 1

COUNTY	Cook
SECTION	N/A
ROUTE	IL-171
MPS PROJECT NO.	ME21043
DATE	1/25/2022

DESCRIPTION	La Grange Road, Phase II	DISTRICT	1		
LOCATION	Chicago, Illinois	CONSULTANT	Millennia Professional Services		
DRILLED BY	TSC	LOGGED BY	L. Williams	RIG TYPE	CME 75
DRILLING METHOD	Hollow Stem Auger, CFA	HAMMER TYPE	Auto	EFFICIENCY	N/A

BORING NO.	B-1
Notes	No Offset
Offset	ft
Northing	1850215.17
Easting	1115409.98
Ground Surface Elev.	610.3 ft
Surface Water Elev.	ft
Stream Bed Elev.	ft
Groundwater Elev.:	
First Encounter	592.3 ft
Upon Completion	592.3 ft
After ___ Hrs.	ft

LITHOLOGY	ELEV (ft)	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
CONCRETE (12.0")	609.30	1			
SILTY CLAY LOAM: Brown, soft, dry (Possible Fill)			5 2 3	3.1 B	21
	607.30	3			
SILTY CLAY: Brown to black, stiff, dry, with organics, trace gravel (Possible Fill)			2 3 4	2.2 B	18
	604.80	5.5			
SILTY CLAY LOAM: Brown, medium stiff to stiff, dry			3 3 4	1.7 B	19
			3 3 5	1.8 B	24
	599.80	10.5			
SAND: Brown and grey, medium dense to dense, dry with gravel			3 6 11		5
			5 9 22		6
	594.80	15.5			
SILT: Grey, hard to very hard, dry (Possible Till)			17 47 50/4"		13
- drilling method switched to Continuous Flight Auger at 18.0 ft.			47 50/4"		16
SILT: Grey, hard to very hard, dry (Possible Till) *(continued)*			82 50/0.5"		12
			100/5"		12
			41 50/3"		14
			37 50/5"		15
	580.30	30			
End of Boring					

The Unconfined Compressive Strength (UCS) Qu column represents either the IDOT Rimac or AASHTO T 208 Test Procedure. The Qu failure mode is indicated by B for Bulge or S for Shear. P is a Pocket Penetrometer test. The Standard Penetration Test (SPT) N value is the sum of the second and third Blows /6 in. values in each sample using AASHTO T 206.

Printed 8/26/2022

MILLENNIA PROFESSIONAL SERVICES
www.millennia.pro

B-2 SOIL BORING LOG

Sheet 1 of 3

COUNTY	Cook
SECTION	N/A
ROUTE	IL-171
MPS PROJECT NO.	ME21043
DATE	2/8/2022

DESCRIPTION	La Grange Road, Phase II	**DISTRICT**	1		
LOCATION	Chicago, Illinois	**CONSULTANT**	Millennia Professional Services		
DRILLED BY	TSC	**LOGGED BY**	L. Williams	**RIG TYPE**	CME 75
DRILLING METHOD	CFA, Mud Rotary, Rock Core	**HAMMER TYPE**	Auto	**EFFICIENCY**	N/A

BORING NO.	B-2
Notes	No Offset
Offset	ft
Northing	1850130.95
Easting	1115507.26
Ground Surface Elev.	594.2 ft

Surface Water Elev.	ft
Stream Bed Elev.	ft
Groundwater Elev.:	
First Encounter	N/E ft
Upon Completion	N/A ft
After ______ Hrs.	ft

LITHOLOGY	ELEV (ft)	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
SAND: Grey, medium dense, unsatruated (Possible Fill)			22 11 4		9
	591.20	3			
SILT LOAM: Grey, very stiff to hard, dry			17 21 23		9
			10 12 14		12
			10 12 19		12
- drilling method switched to Mud-Rotary at 10.0 ft.			11 11 12		14
			20 24 30		17
	578.70	15.5			
SILT: Grey, hard, dry			27 50/5"		18
- with gravel above 17.5 ft.			18 25 25		20

LITHOLOGY	ELEV (ft)	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
SILT: Grey, hard, dry *(continued)*			16 28 27		19
	571.20	23			
SILT LOAM: Grey, hard, dry			18 41 30		14
			20 24 28		9
			19 29 27		8
			57 50/2"		11
- drilling method switched back to Continuous Flight Auger below 38.0 ft. due to drilling issues			100/3"		7

The Unconfined Compressive Strength (UCS) Qu column represents either the IDOT Rimac or AASHTO T 208 Test Procedure. The Qu failure mode is indicated by B for Bulge or S for Shear. P is a Pocket Penetrometer test. The Standard Penetration Test (SPT) N value is the sum of the second and third Blows /6 in. values in each sample using AASHTO T 206.

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B-2
SOIL BORING LOG

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COUNTY	Cook
SECTION	N/A
ROUTE	IL-171
MPS PROJECT NO.	ME21043
DATE	2/8/2022

DESCRIPTION	La Grange Road, Phase II	DISTRICT	1		
LOCATION	Chicago, Illinois	CONSULTANT	Millennia Professional Services		
DRILLED BY	TSC	LOGGED BY	L. Williams	RIG TYPE	CME 75
DRILLING METHOD	CFA, Mud Rotary, Rock Core	HAMMER TYPE	Auto	EFFICIENCY	N/A

BORING NO.	B-2
Notes	No Offset
Offset	ft
Northing	1850130.95
Easting	1115507.26
Ground Surface Elev.	594.2 ft

Surface Water Elev.	ft
Stream Bed Elev.	ft
Groundwater Elev.:	
First Encounter	N/E ft
Upon Completion	N/A ft
After ___ Hrs.	ft

LITHOLOGY	ELEV (ft)	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
SILT LOAM: Grey, hard, dry *(continued)*					
			100/3"		10
			100/5"		9
			100/3"		9
	538.20	56			
Borehole continued with rock coring					

LITHOLOGY

The Unconfined Compressive Strength (UCS) Qu column represents either the IDOT Rimac or AASHTO T 208 Test Procedure. The Qu failure mode is indicated by B for Bulge or S for Shear. P is a Pocket Penetrometer test. The Standard Penetration Test (SPT) N value is the sum of the second and third Blows /6 in. values in each sample using AASHTO T 206.

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B-2
ROCK CORE LOG

COUNTY: Cook
SECTION: N/A
ROUTE: IL-171
MPS PROJECT NO. ME21043
DATE: 2/8/22

DESCRIPTION La Grange Road, Phase II
DISTRICT 1
LOCATION Chicago, Illinois
CONSULTANT Millennia Professional Services
DRILLED BY TSC
LOGGED BY L. Williams
RIG TYPE CME 75
CORING METHOD Diamond tipped core barrel

BORING NO. B-2
Notes No Offset
Offset
Northing 1850130.95
Easting 1115507.26
Ground Surface Elev. 594.20 ft

CORING BARREL TYPE & SIZE NQ

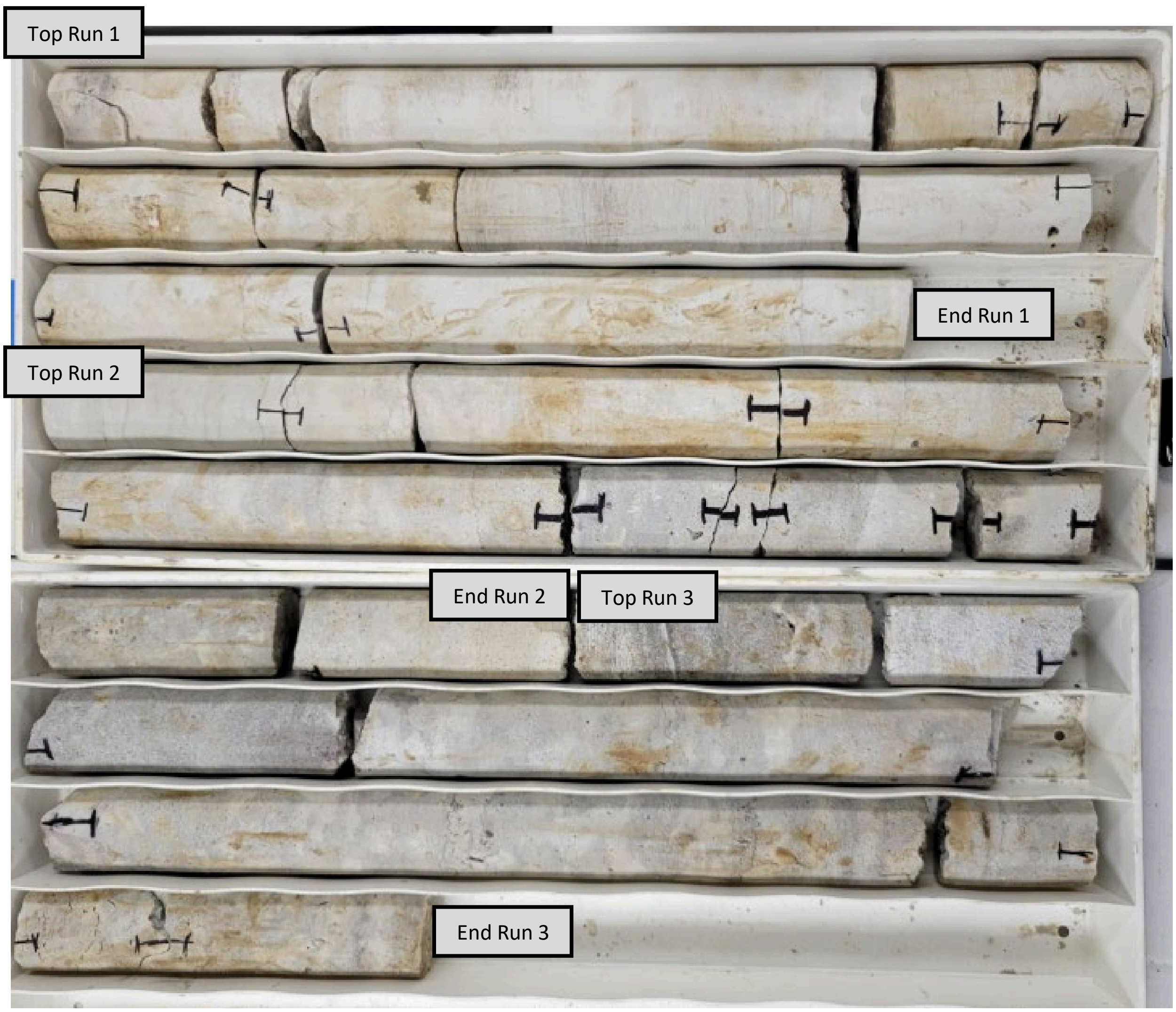
Core Diameter 1.9 in
Top of Rock Elev. 538.20 ft
Begin Core Elev. 538.20 ft

Description	Elev.	DEPTH (ft)	CORE (#)	RECOVERY (%)	R.Q.D. (%)	CORE TIME (min/ft)	STRENGTH (tsf)
DOLOMITE: Grey, moderately hard to hard, moderately fractured	538.20	56	1	100	91		
		61.5	2	100	100		
		66.2	3	100	100		
	522.80						
End of Boring							

Color pictures of the cores ____________
Cores will be stored for examination until ____________
The "Strength" column represents the uniaxial compressive strength of the core sample (ASTM D-2938)

Rock Core Photograph
IL Route 171 at La Grange Rd.
Project No.: ME21043

Boring: B-2



Run	Depth (ft.)	Recovery (%)	RQD (%)
1	56.0-61.5	100	91
2	61.5-66.2	100	100
3	66.2-71.4	100	100

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B-3
SOIL BORING LOG

Sheet 1 of 3

COUNTY	Cook
SECTION	N/A
ROUTE	IL-171
MPS PROJECT NO.	ME21043
DATE	1/27/2022

DESCRIPTION	La Grange Road, Phase II	DISTRICT	1		
LOCATION	Chicago, Illinois	CONSULTANT	Millennia Professional Services		
DRILLED BY	TSC	LOGGED BY	L. Williams	RIG TYPE	CME 75
DRILLING METHOD	CFA, Mud Rotary, Rock Core	HAMMER TYPE	Auto	EFFICIENCY	N/A

BORING NO.	B-3
Notes	No Offset
Offset	ft
Northing	1850184.39
Easting	1115517.95
Ground Surface Elev.	596.1 ft

Surface Water Elev.	ft
Stream Bed Elev.	ft
Groundwater Elev.:	
First Encounter	588.1 ft
Upon Completion	N/A ft
After ___ Hrs.	ft

LITHOLOGY	ELEV (ft)	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
CONCRETE (9.0")	595.35	0.75			
CLAY LOAM: Brown, soft, dry			35		
			28		24
			7		
	593.10	3			
SILT: Grey, hard, dry (Possible Till)			32		
			24		8
			31		
			10		
			15		12
			22		
			14		
			23		14
			50/5"		
			36		
			50/2"		10
			34		
			50/2"		9
	580.60	15.5			
SILT LOAM: Grey, hard, dry (Possible Till)			29		
			39		10
			44		
			34		
			50/5"		9

LITHOLOGY	ELEV (ft)	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
SILT LOAM: Grey, hard, dry (Possible Till) *(continued)*			27		
			50/5"		10
	573.10	23			
SILT: Grey, very stiff, dry (Possible Till)			22		
			50/5"		14
			22		
			33		14
			40		
			11		
- drilling method switched to Mud Rotary at 30.0 ft.			33		15
	566.10	30	44		
COBBLE: Attempted to core, no recovery, resumed split-spoon sampling					
	563.10	33			
SILT LOAM: Grey, hard, dry (Possible Till)			32		
			50/4"		10
- sandy below 38.5 ft.			100/5"		10

The Unconfined Compressive Strength (UCS) Qu column represents either the IDOT Rimac or AASHTO T 208 Test Procedure. The Qu failure mode is indicated by B for Bulge or S for Shear. P is a Pocket Penetrometer test. The Standard Penetration Test (SPT) N value is the sum of the second and third Blows /6 in. values in each sample using AASHTO T 206.

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B-3
SOIL BORING LOG

COUNTY	Cook
SECTION	N/A
ROUTE	IL-171
MPS PROJECT NO.	ME21043
DATE	1/27/2022

DESCRIPTION	La Grange Road, Phase II	DISTRICT	1		
LOCATION	Chicago, Illinois	CONSULTANT	Millennia Professional Services		
DRILLED BY	TSC	LOGGED BY	L. Williams	RIG TYPE	CME 75
DRILLING METHOD	CFA, Mud Rotary, Rock Core	HAMMER TYPE	Auto	EFFICIENCY	N/A

BORING NO.	B-3
Notes	No Offset
Offset	ft
Northing	1850184.39
Easting	1115517.95
Ground Surface Elev.	596.1 ft

Surface Water Elev.	ft
Stream Bed Elev.	ft
Groundwater Elev.:	
First Encounter	588.1 ft ▼
Upon Completion	N/A ft
After ____ Hrs.	ft

LITHOLOGY	ELEV (ft)	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
SILT LOAM: Grey, hard, dry (Possible Till) *(continued)*					
	554.35	41.75			
SANDY CLAY LOAM: Grey, hard, dry, with gravel (Possible Till)					
			100/3"		9
	549.35	46.75			
CLAY LOAM: Grey, hard, dry, with gravel (Possible Till)					
			83 50/5"		11
	544.35	51.75			
SAND: Grey, very dense, unsaturated, with gravel					
			100/3"		11
	539.35	56.75			
SILT LOAM: Grey, hard, dry, with gravel (Possible Till)					
			22 40 50/6"		8
	536.10	60			

LITHOLOGY

Borehole continued with rock coring

The Unconfined Compressive Strength (UCS) Qu column represents either the IDOT Rimac or AASHTO T 208 Test Procedure. The Qu failure mode is indicated by B for Bulge or S for Shear. P is a Pocket Penetrometer test. The Standard Penetration Test (SPT) N value is the sum of the second and third Blows /6 in. values in each sample using AASHTO T 206.

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B-3
ROCK CORE LOG

COUNTY Cook
SECTION N/A
ROUTE IL-171
MPS PROJECT NO. ME21043
DATE 1/27/22

DESCRIPTION La Grange Road, Phase II
DISTRICT 1
LOCATION Chicago, Illinois
CONSULTANT Millennia Professional Services
DRILLED BY TSC
LOGGED BY L. Williams
RIG TYPE CME 75
CORING METHOD Diamond tipped core barrel

BORING NO. B-3
Notes No Offset
Offset
Northing 1850184.39
Easting 1115517.95
Ground Surface Elev. 596.10 ft

CORING BARREL TYPE & SIZE NQ

Core Diameter 1.9 in
Top of Rock Elev. 536.10 ft
Begin Core Elev. 536.10 ft

Description	Elev.	DEPTH (ft)	CORE (#)	RECOVERY (%)	R.Q.D. (%)	CORE TIME (min/ft)	STRENGTH (tsf)
DOLOMITE: Grey, moderately hard to hard, moderately fractured, trace stylolites - Mohs' hardness = 3.5 - mottled grey and light grey, hard, highly weathered, slightly pitted, slightly vuggy, trace clay-filled fractures below 63.0 ft. - Mohs' hardness = 4.5	536.10	60	1	100	98		
		70	2	100	100		
	521.10						
End of Boring							

Color pictures of the cores ____________
Cores will be stored for examination until ____________
The "Strength" column represents the uniaxial compressive strength of the core sample (ASTM D-2938)

Rock Core Photograph
IL Route 171 at La Grange Rd.
Project No.: ME21043

Boring: B-3

Run	Depth (ft.)	Recovery (%)	RQD (%)
1	60.0-70.0	100	98
2	70.0-75.0	100	100

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B-4
SOIL BORING LOG

Sheet 1 of 1

COUNTY	Cook
SECTION	N/A
ROUTE	IL-171
MPS PROJECT NO.	ME21043
DATE	1/26/2022

DESCRIPTION	La Grange Road, Phase II	DISTRICT	1		
LOCATION	Chicago, Illinois	CONSULTANT	Millennia Professional Services		
DRILLED BY	TSC	LOGGED BY	L. Williams	RIG TYPE	CME 75
DRILLING METHOD	CFA	HAMMER TYPE	Auto	EFFICIENCY	N/A

BORING NO.	B-4
Notes	No Offset
Offset	ft
Northing	1850121.58
Easting	1115618.96
Ground Surface Elev.	619.2 ft

Surface Water Elev.	ft
Stream Bed Elev.	ft
Groundwater Elev.:	
First Encounter	596.2 ft
Upon Completion	596.2 ft
After ___ Hrs.	ft

LITHOLOGY	ELEV (ft)	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
CONCRETE (11.0")	618.30	0.9			
SILTY CLAY: Brown, very stiff to hard, dry (Possible Fill)			16 5 6		17
			2 3 3	4.0 B	22
			3 4 5	2.3 B	19
	611.20	8			
SILTY CLAY: Black, stiff, dry, with organics, trace brick fragments (Possible Fill)			3 2 1	1.2 B	19
	608.70	10.5			
SILTY CLAY: Brown to dark brown, stiff, dry			3 3 6	3.8 S	24
			4 4 5	3.4 B	17
	603.70	15.5			
SILTY CLAY LOAM: Brown, soft, dry, with gravel			3 22 17	2.1 S	19
	601.20	18			
SANDY LOAM: Brown, very dense, unsaturated - with gravel and possible cobbles above 20.0 ft.			100/1"		
SANDY LOAM: Brown, very dense, unsaturated *(continued)* - brown and grey below 21.0 ft.			100/2"		7
			100/3"		7
	593.70	25.5			
SILT LOAM: Grey, hard, dry, with gravel (Possible Till)			72 50/2"		8
	591.20	28	100/0.5"		
End of Boring					

The Unconfined Compressive Strength (UCS) Qu column represents either the IDOT Rimac or AASHTO T 208 Test Procedure. The Qu failure mode is indicated by B for Bulge or S for Shear. P is a Pocket Penetrometer test. The Standard Penetration Test (SPT) N value is the sum of the second and third Blows /6 in. values in each sample using AASHTO T 206.

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MSE-1
SOIL BORING LOG

Sheet 1 of 1

COUNTY	Cook
SECTION	N/A
ROUTE	IL-171
MPS PROJECT NO.	ME21043
DATE	1/12/2023

DESCRIPTION	La Grange Road, Phase II	**DISTRICT**	1		
LOCATION	Chicago, Illinois	**CONSULTANT**	Millennia Professional Services		
DRILLED BY	TSC	**LOGGED BY**	E. Dela Cruz	**RIG TYPE**	CME 75
DRILLING METHOD	CFA	**HAMMER TYPE**	Auto	**EFFICIENCY**	N/A

BORING NO.	MSE-1
Notes	No Offset
Offset	ft
Latitude	
Longitude	
Ground Surface Elev.	594.5 ft
Surface Water Elev.	ft
Stream Bed Elev.	ft
Groundwater Elev.:	
First Encounter	583.5 ft ▼
Upon Completion	N/A ft
After ___ Hrs.	ft

LITHOLOGY	ELEV (ft)	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
CLAY LOAM: Brown, stiff to very stiff, moist, with gravel			4 6 9	3.8 P	14
			8 14 19	3.7 S	10
SANDY LOAM: Brown, dense to very dense, moist, with gravel	589.00	5.5	13 15 19		26
			24 33 50/3"	1.5 P	7
CLAY LOAM: Brown, very stiff to hard, moist ▼	584.00	10.5	4 9 21	6.2 S	16
- with gravel below 13.5 ft.			13 39 51	3.5 P	8
- trace gravel below 16.0 ft.			23 24 40	5.3 S	17
- stiff to very stiff, sandy below 18.5 ft.			2 3 8	1.3 P	18

LITHOLOGY	ELEV (ft)	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
CLAY LOAM: Brown, very stiff to hard, moist *(continued)* - grey and brown below 21.0 ft.			13 13 15		9
			4 6 7		20
- very stiff to hard, gravelly, with sand below 26.0 ft.			19 18 20		9
			28 18 10	5.0 P	7
- with weathered rock fragments below 33.5 ft.			18 43 33		9
	555.25	39.25	18 50/3"		8
End of Boring					

The Unconfined Compressive Strength (UCS) Qu column represents either the IDOT Rimac or AASHTO T 208 Test Procedure. The Qu failure mode is indicated by B for Bulge or S for Shear. P is a Pocket Penetrometer test. The Standard Penetration Test (SPT) N value is the sum of the second and third Blows /6 in. values in each sample using AASHTO T 206.

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MSE-2 SOIL BORING LOG

Sheet 1 of 1

COUNTY	Cook
SECTION	N/A
ROUTE	IL-171
MPS PROJECT NO.	ME21043
DATE	1/12/2023

DESCRIPTION	La Grange Road, Phase II	DISTRICT	1		
LOCATION	Chicago, Illinois	CONSULTANT	Millennia Professional Services		
DRILLED BY	TSC	LOGGED BY	E. Dela Cruz	RIG TYPE	CME 75
DRILLING METHOD	CFA	HAMMER TYPE	Auto	EFFICIENCY	N/A

BORING NO.	MSE-2
Notes	No Offset
Offset	ft
Latitude	
Longitude	
Ground Surface Elev.	594 ft
Surface Water Elev.	ft
Stream Bed Elev.	ft
Groundwater Elev.:	
First Encounter	577.5 ft ▼
Upon Completion	N/A ft
After ___ Hrs.	ft

LITHOLOGY	ELEV (ft)	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
CLAY LOAM: Brown, very stiff to hard, moist, with sand, trace gravel			7 12 14	5.0 P	8
- grey and brown below 3.5 ft.			8 20 25	6.2 S	10
- gravelly below 6.0 ft.			9 29 23	4.0 P	9
	586.00	8			
SANDY LOAM: Brown, dense, moist, clayey			11 16 30		7
	583.50	10.5			
CLAY LOAM: Brown to grey, hard, moist, with sand			21 22 27	4.9 S	12
			28 40 43	2.3 P	8
	578.50	15.5			
SANDY LOAM: Grey, loose to medium dense, wet	▼		6 4 3		14
			4 13 15		13
	573.50	20.5			
CLAY LOAM: Grey, very stiff, moist, sandy, with gravel			5 13 14	4.7 S	14
- grey and brown, trace gravel below 23.5 ft.			7 6 17	3.0 P	12
	568.50	25.5			
SANDY LOAM: Grey, very dense, saturated, gravelly, clayey			8 29 23		19
	566.25	27.75			
CLAY LOAM: Grey, hard, moist, sandy, with gravel			14 33 51	4.5 P	11
- with weathered rock fragments below 33.5 ft.			47 50/3"		8
Auger Refusal at 36.0 ft.	557.75	36.25	50/3"		8
End of Boring					

The Unconfined Compressive Strength (UCS) Qu column represents either the IDOT Rimac or AASHTO T 208 Test Procedure. The Qu failure mode is indicated by B for Bulge or S for Shear. P is a Pocket Penetrometer test. The Standard Penetration Test (SPT) N value is the sum of the second and third Blows /6 in. values in each sample using AASHTO T 206.

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MSE-3
SOIL BORING LOG

Sheet 1 of 1

COUNTY	Cook
SECTION	N/A
ROUTE	IL-171
MPS PROJECT NO.	ME21043
DATE	1/13/2023

DESCRIPTION	La Grange Road, Phase II	DISTRICT	1		
LOCATION	Chicago, Illinois	CONSULTANT	Millennia Professional Services		
DRILLED BY	TSC	LOGGED BY	E. Dela Cruz	RIG TYPE	CME 75
DRILLING METHOD	CFA	HAMMER TYPE	Auto	EFFICIENCY	N/A

BORING NO.	MSE-3
Notes	No Offset
Offset	ft
Latitude	
Longitude	
Ground Surface Elev.	596 ft
Surface Water Elev.	ft
Stream Bed Elev.	ft
Groundwater Elev.:	
First Encounter	585.0 ft ▼
Upon Completion	N/A ft
After ___ Hrs.	ft

LITHOLOGY	ELEV (ft)	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
CLAY LOAM: Brown, medium stiff, moist, trace sand			3 4 3	3.0 P	13
- dark brown, with sand below 3.5 ft.			3 3 4	2.7 S	30
- hard, with gravel below 6.0 ft.			9 37 50/3"	5.0 P	16
			27 50 28	5.0 P	10
	585.50	10.5			
SANDY CLAY LOAM: Grey, hard, moist ▼			23 35 50/3"		10
- gravelly above 12.5 ft.			10 35 50/3"	4.0 P	11
			20 45 50/3"	4.5 S	10
			5 20 38	4.5 P	14
SANDY CLAY LOAM: Grey, hard, moist *(continued)*			10 17 20	2.0 P	18
			9 16 21	1.5 P	19
	570.50	25.5			
CLAY LOAM: Grey, hard, moist, trace gravel			7 13 23	4.2 S	19
- grey and brown, trace rock fragments below 28.5 ft.			10 17 21	4.5 P	12
- with weathered rock fragments below 33.5 ft.			20 40 50/3"		13
	557.25	38.75	50/3"		10
End of Boring					

The Unconfined Compressive Strength (UCS) Qu column represents either the IDOT Rimac or AASHTO T 208 Test Procedure. The Qu failure mode is indicated by B for Bulge or S for Shear. P is a Pocket Penetrometer test. The Standard Penetration Test (SPT) N value is the sum of the second and third Blows /6 in. values in each sample using AASHTO T 206.

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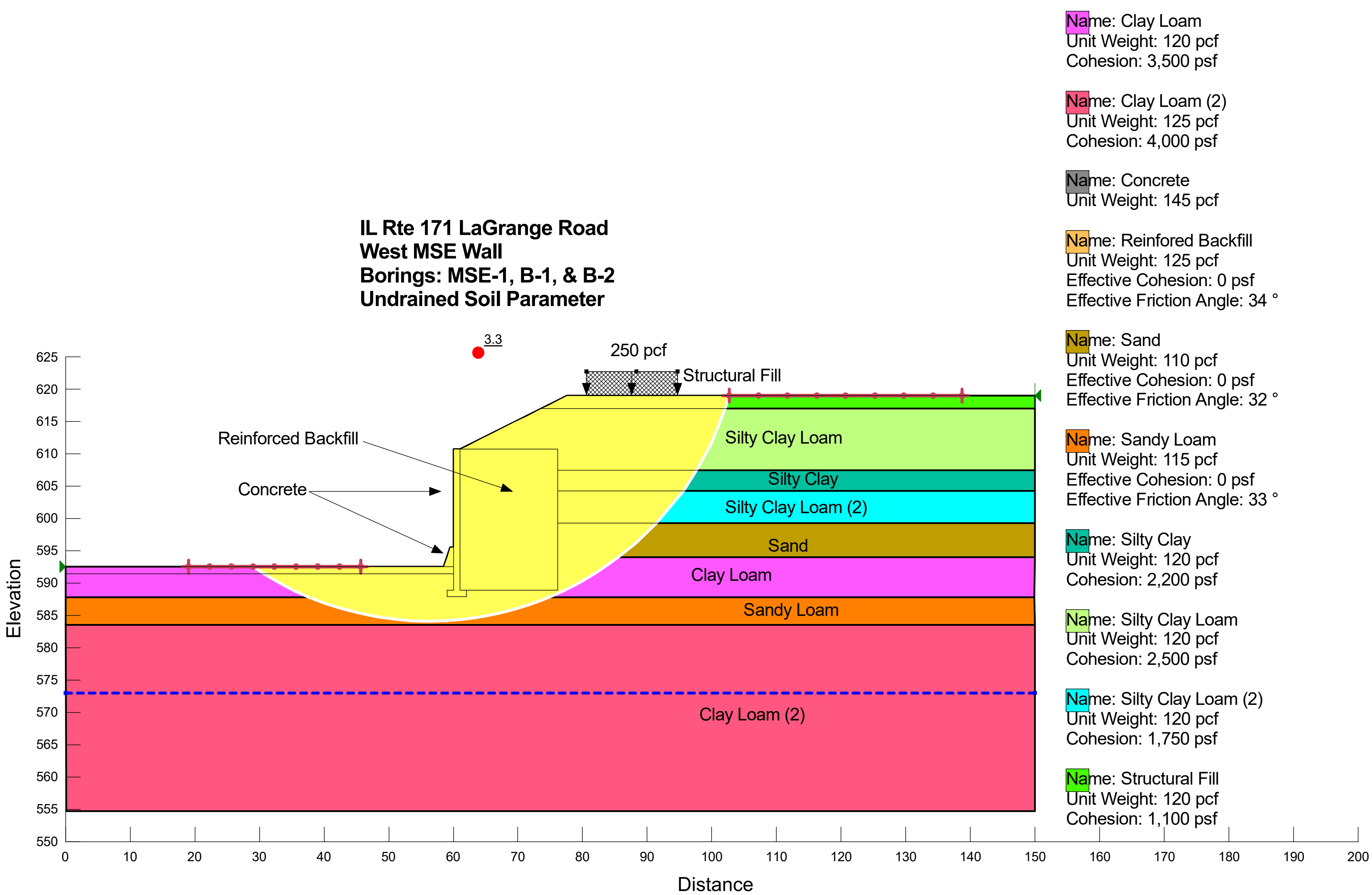
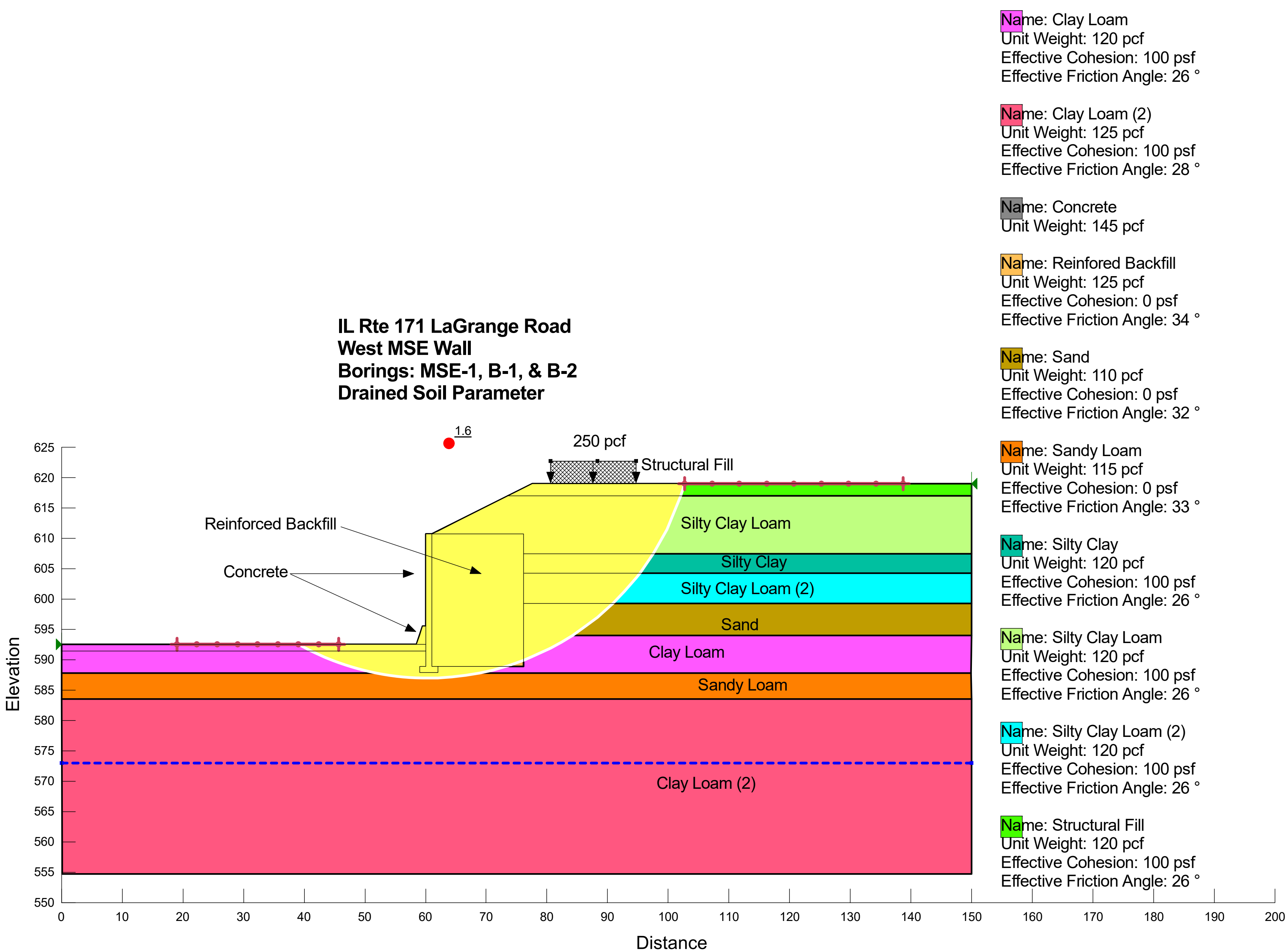
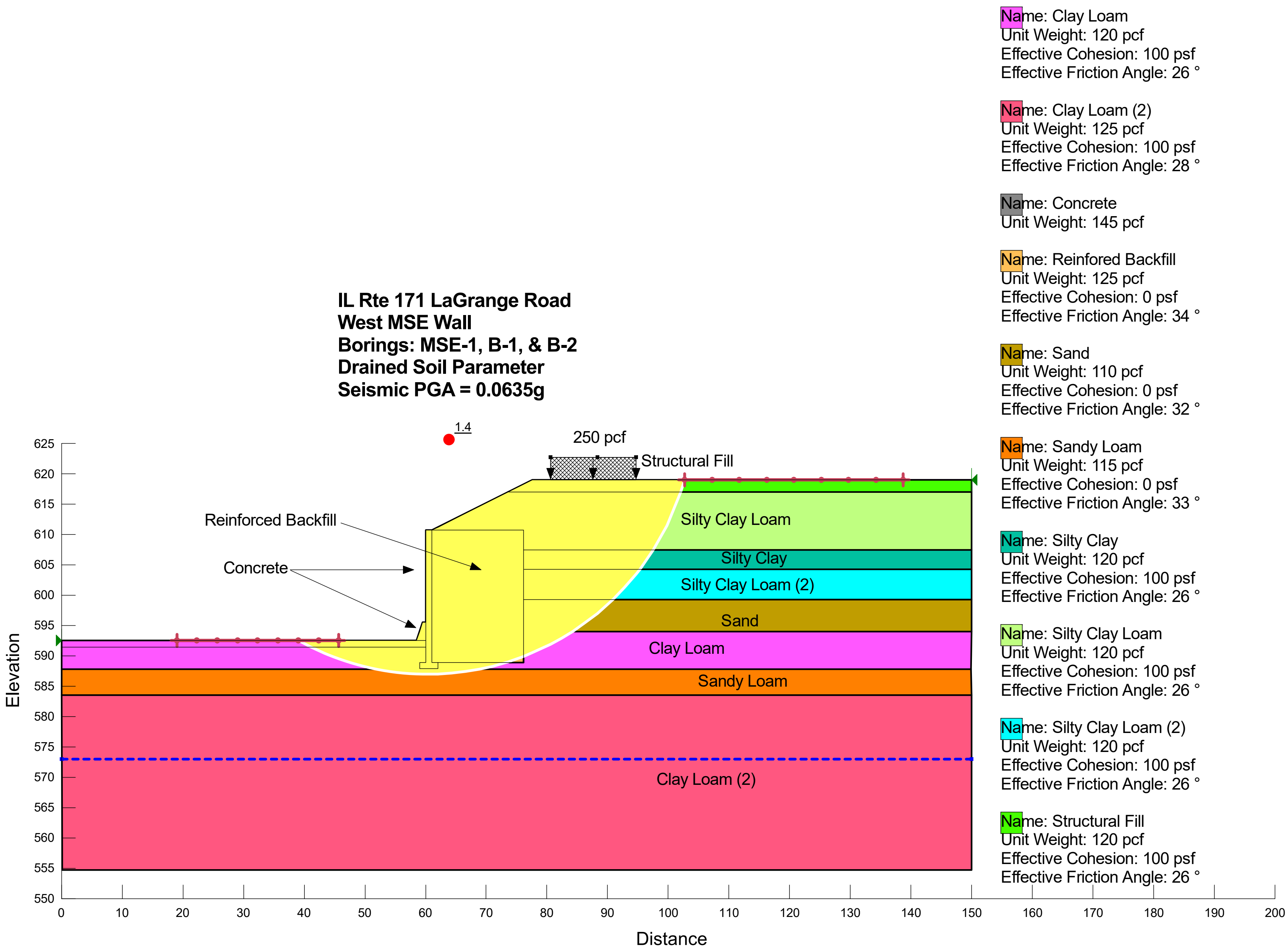
Appendix D: Summary Stability Profiles

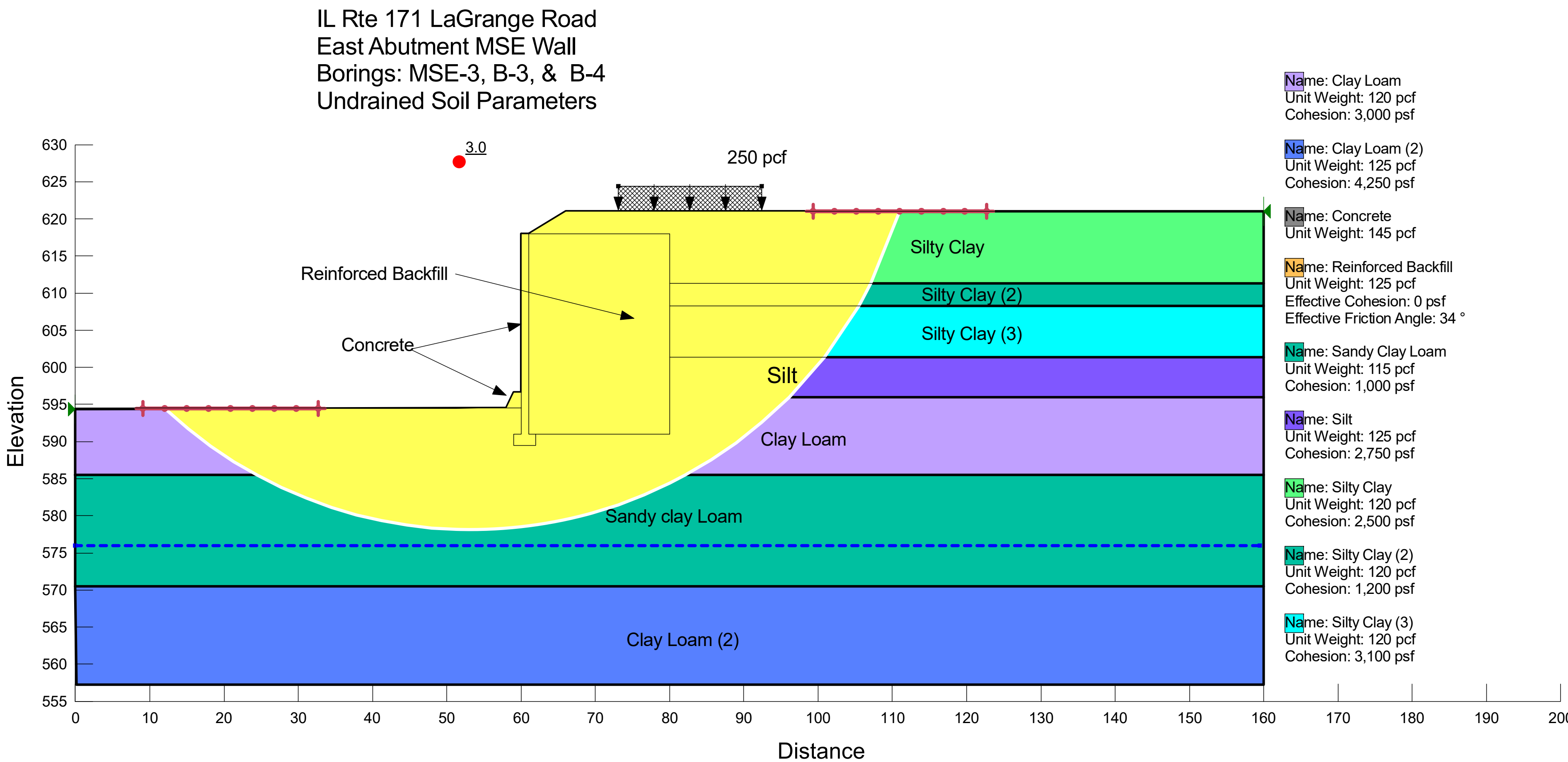


IL Rte 171 LaGrange Road
West MSE Wall
Borings: MSE-1, B-1, & B-2
Undrained Soil Parameter
3.3
250 pcf
Structural Fill
Reinforced Backfill
Concrete
Silty Clay Loam
Silty Clay
Silty Clay Loam (2)
Sand
Clay Loam
Sandy Loam
Clay Loam (2)
Elevation
Distance
625
620
615
610
605
600
595
590
585
580
575
570
565
560
555
550
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
190
200
Name: Clay Loam
Unit Weight: 120 pcf
Cohesion: 3,500 psf
Name: Clay Loam (2)
Unit Weight: 125 pcf
Cohesion: 4,000 psf
Name: Concrete
Unit Weight: 145 pcf
Name: Reinforced Backfill
Unit Weight: 125 pcf
Effective Cohesion: 0 psf
Effective Friction Angle: 34 °
Name: Sand
Unit Weight: 110 pcf
Effective Cohesion: 0 psf
Effective Friction Angle: 32 °
Name: Sandy Loam
Unit Weight: 115 pcf
Effective Cohesion: 0 psf
Effective Friction Angle: 33 °
Name: Silty Clay
Unit Weight: 120 pcf
Cohesion: 2,200 psf
Name: Silty Clay Loam
Unit Weight: 120 pcf
Cohesion: 2,500 psf
Name: Silty Clay Loam (2)
Unit Weight: 120 pcf
Cohesion: 1,750 psf
Name: Structural Fill
Unit Weight: 120 pcf
Cohesion: 1,100 psf

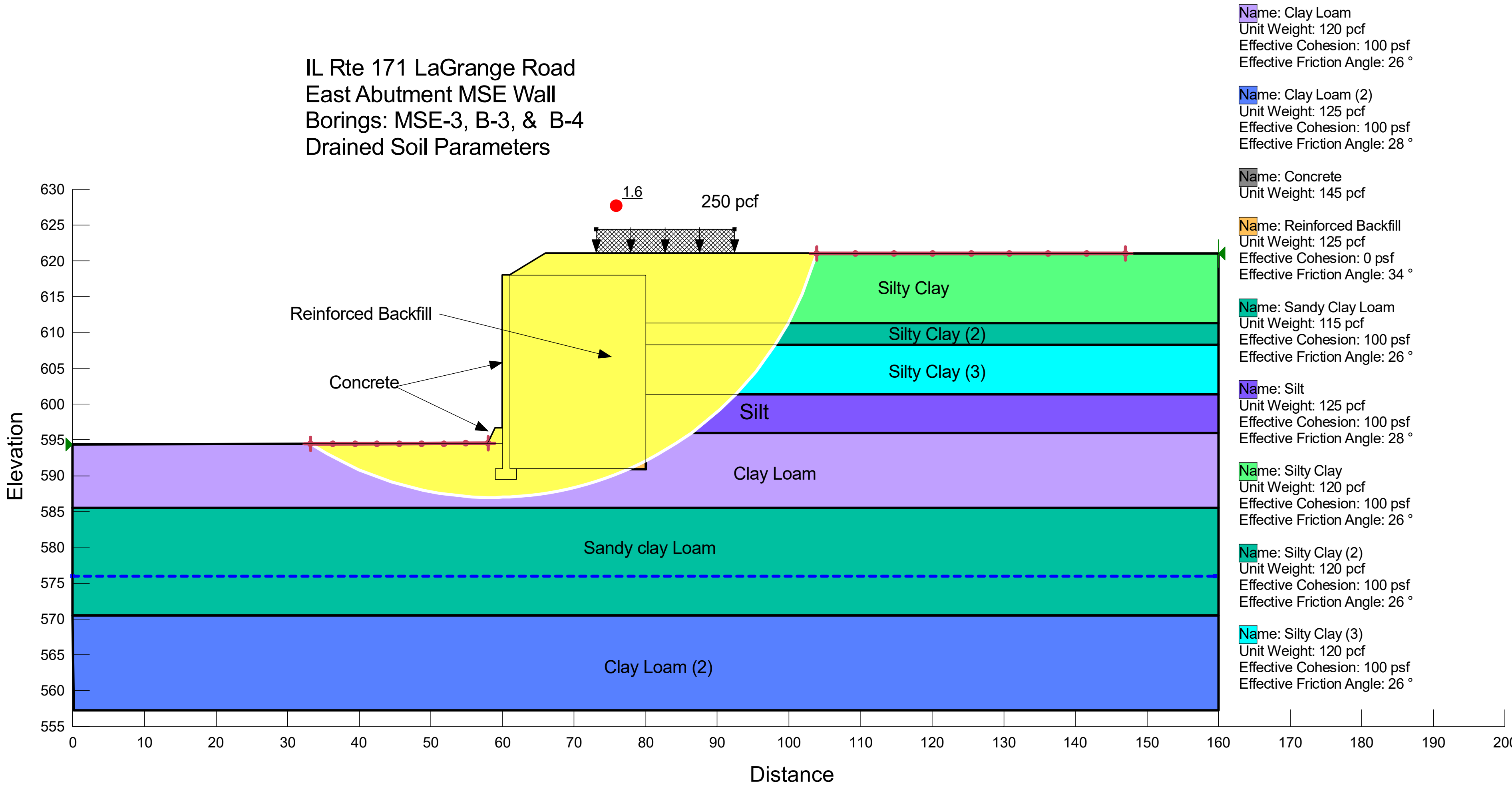


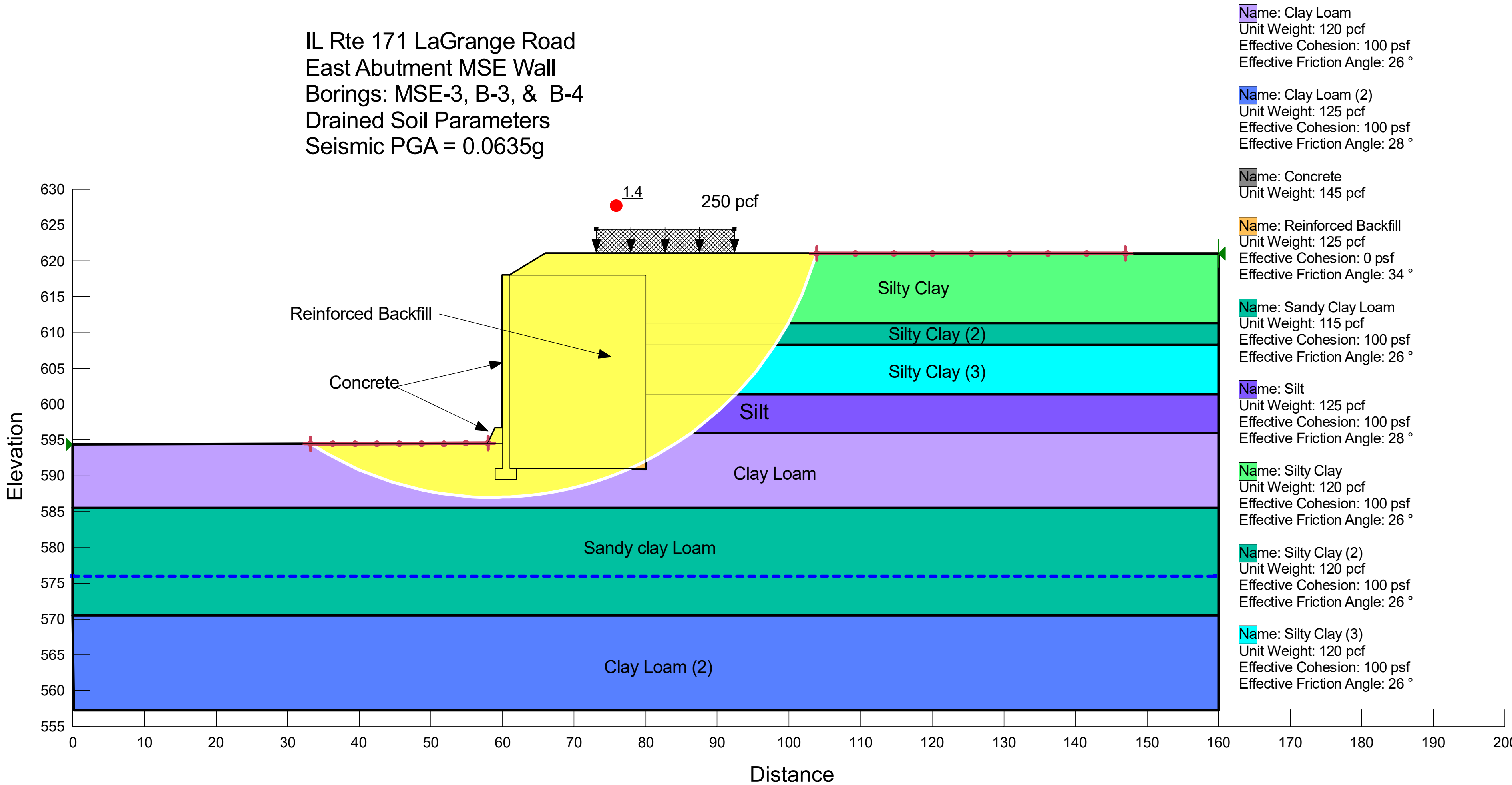
IL Rte 171 LaGrange Road
West MSE Wall
Borings: MSE-1, B-1, & B-2
Drained Soil Parameter
1.6
250 pcf
Structural Fill
Reinforced Backfill
Concrete
Silty Clay Loam
Silty Clay
Silty Clay Loam (2)
Sand
Clay Loam
Sandy Loam
Clay Loam (2)
Elevation
625
620
615
610
605
600
595
590
585
580
575
570
565
560
555
550
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
190
200
Distance
Name: Clay Loam
Unit Weight: 120 pcf
Effective Cohesion: 100 psf
Effective Friction Angle: 26 °
Name: Clay Loam (2)
Unit Weight: 125 pcf
Effective Cohesion: 100 psf
Effective Friction Angle: 28 °
Name: Concrete
Unit Weight: 145 pcf
Name: Reinfored Backfill
Unit Weight: 125 pcf
Effective Cohesion: 0 psf
Effective Friction Angle: 34 °
Name: Sand
Unit Weight: 110 pcf
Effective Cohesion: 0 psf
Effective Friction Angle: 32 °
Name: Sandy Loam
Unit Weight: 115 pcf
Effective Cohesion: 0 psf
Effective Friction Angle: 33 °
Name: Silty Clay
Unit Weight: 120 pcf
Effective Cohesion: 100 psf
Effective Friction Angle: 26 °
Name: Silty Clay Loam
Unit Weight: 120 pcf
Effective Cohesion: 100 psf
Effective Friction Angle: 26 °
Name: Silty Clay Loam (2)
Unit Weight: 120 pcf
Effective Cohesion: 100 psf
Effective Friction Angle: 26 °
Name: Structural Fill
Unit Weight: 120 pcf
Effective Cohesion: 100 psf
Effective Friction Angle: 26 °


IL Rte 171 LaGrange Road
West MSE Wall
Borings: MSE-1, B-1, & B-2
Drained Soil Parameter
Seismic PGA = 0.0635g
1.4
250 pcf
Structural Fill
Reinforced Backfill
Concrete
Silty Clay Loam
Silty Clay
Silty Clay Loam (2)
Sand
Clay Loam
Sandy Loam
Clay Loam (2)
Elevation
Distance
Name: Clay Loam
Unit Weight: 120 pcf
Effective Cohesion: 100 psf
Effective Friction Angle: 26 °
Name: Clay Loam (2)
Unit Weight: 125 pcf
Effective Cohesion: 100 psf
Effective Friction Angle: 28 °
Name: Concrete
Unit Weight: 145 pcf
Name: Reinfored Backfill
Unit Weight: 125 pcf
Effective Cohesion: 0 psf
Effective Friction Angle: 34 °
Name: Sand
Unit Weight: 110 pcf
Effective Cohesion: 0 psf
Effective Friction Angle: 32 °
Name: Sandy Loam
Unit Weight: 115 pcf
Effective Cohesion: 0 psf
Effective Friction Angle: 33 °
Name: Silty Clay
Unit Weight: 120 pcf
Effective Cohesion: 100 psf
Effective Friction Angle: 26 °
Name: Silty Clay Loam
Unit Weight: 120 pcf
Effective Cohesion: 100 psf
Effective Friction Angle: 26 °
Name: Silty Clay Loam (2)
Unit Weight: 120 pcf
Effective Cohesion: 100 psf
Effective Friction Angle: 26 °
Name: Structural Fill
Unit Weight: 120 pcf
Effective Cohesion: 100 psf
Effective Friction Angle: 26 °



IL Rte 171 LaGrange Road
East Abutment MSE Wall
Borings: MSE-3, B-3, & B-4
Undrained Soil Parameters
3.0
250 pcf
Reinforced Backfill
Concrete
Silty Clay
Silty Clay (2)
Silty Clay (3)
Silt
Clay Loam
Sandy clay Loam
Clay Loam (2)
Elevation
Distance
Name: Clay Loam
Unit Weight: 120 pcf
Cohesion: 3,000 psf
Name: Clay Loam (2)
Unit Weight: 125 pcf
Cohesion: 4,250 psf
Name: Concrete
Unit Weight: 145 pcf
Name: Reinforced Backfill
Unit Weight: 125 pcf
Effective Cohesion: 0 psf
Effective Friction Angle: 34 °
Name: Sandy Clay Loam
Unit Weight: 115 pcf
Cohesion: 1,000 psf
Name: Silt
Unit Weight: 125 pcf
Cohesion: 2,750 psf
Name: Silty Clay
Unit Weight: 120 pcf
Cohesion: 2,500 psf
Name: Silty Clay (2)
Unit Weight: 120 pcf
Cohesion: 1,200 psf
Name: Silty Clay (3)
Unit Weight: 120 pcf
Cohesion: 3,100 psf


IL Rte 171 LaGrange Road
East Abutment MSE Wall
Borings: MSE-3, B-3, & B-4
Drained Soil Parameters
1.6
250 pcf
Reinforced Backfill
Concrete
Silty Clay
Silty Clay (2)
Silty Clay (3)
Silt
Clay Loam
Sandy clay Loam
Clay Loam (2)
Elevation
Distance
Name: Clay Loam
Unit Weight: 120 pcf
Effective Cohesion: 100 psf
Effective Friction Angle: 26 °
Name: Clay Loam (2)
Unit Weight: 125 pcf
Effective Cohesion: 100 psf
Effective Friction Angle: 28 °
Name: Concrete
Unit Weight: 145 pcf
Name: Reinforced Backfill
Unit Weight: 125 pcf
Effective Cohesion: 0 psf
Effective Friction Angle: 34 °
Name: Sandy Clay Loam
Unit Weight: 115 pcf
Effective Cohesion: 100 psf
Effective Friction Angle: 26 °
Name: Silt
Unit Weight: 125 pcf
Effective Cohesion: 100 psf
Effective Friction Angle: 28 °
Name: Silty Clay
Unit Weight: 120 pcf
Effective Cohesion: 100 psf
Effective Friction Angle: 26 °
Name: Silty Clay (2)
Unit Weight: 120 pcf
Effective Cohesion: 100 psf
Effective Friction Angle: 26 °
Name: Silty Clay (3)
Unit Weight: 120 pcf
Effective Cohesion: 100 psf
Effective Friction Angle: 26 °


IL Rte 171 LaGrange Road
East Abutment MSE Wall
Borings: MSE-3, B-3, & B-4
Drained Soil Parameters
Seismic PGA = 0.0635g
1.4
250 pcf
Reinforced Backfill
Concrete
Silty Clay
Silty Clay (2)
Silty Clay (3)
Silt
Clay Loam
Sandy clay Loam
Clay Loam (2)
Elevation
Distance
Name: Clay Loam
Unit Weight: 120 pcf
Effective Cohesion: 100 psf
Effective Friction Angle: 26 °
Name: Clay Loam (2)
Unit Weight: 125 pcf
Effective Cohesion: 100 psf
Effective Friction Angle: 28 °
Name: Concrete
Unit Weight: 145 pcf
Name: Reinforced Backfill
Unit Weight: 125 pcf
Effective Cohesion: 0 psf
Effective Friction Angle: 34 °
Name: Sandy Clay Loam
Unit Weight: 115 pcf
Effective Cohesion: 100 psf
Effective Friction Angle: 26 °
Name: Silt
Unit Weight: 125 pcf
Effective Cohesion: 100 psf
Effective Friction Angle: 28 °
Name: Silty Clay
Unit Weight: 120 pcf
Effective Cohesion: 100 psf
Effective Friction Angle: 26 °
Name: Silty Clay (2)
Unit Weight: 120 pcf
Effective Cohesion: 100 psf
Effective Friction Angle: 26 °
Name: Silty Clay (3)
Unit Weight: 120 pcf
Effective Cohesion: 100 psf
Effective Friction Angle: 26 °

Appendix E: Pile Length Estimate Spreadsheet

Illinois Department of Transportation

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

SUBSTRUCTURE===================================== West Abutment
REFERENCE BORING ================================ B-1 & B-2
LRFD or ASD or SEISMIC ============================== LRFD
PILE CUTOFF ELEV. ================================== 606.40 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 603.40 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) ===== None
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ================= ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) =============== ft

TOTAL FACTORED SUBSTRUCTURE LOAD ============= kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)========= ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ====== 4

MAX. REQUIRED BEARING & RESISTANCE for Selected Pile, Soil Profile, & Losses

Maximum Nominal Req'd Bearing of Pile	Maximum Nominal Req.d Bearing of Boring	Maximum Factored Resistance Available in Boring	Maximum Pile Driveable Length in Boring
418 KIPS	**407** KIPS	**224** KIPS	**62** FT.

PILE TYPE AND SIZE ============= Steel HP 12 X 53
Plugged Pile Perimeter========================= 3.967 FT. Unplugged Pile Perimeter============= 5.800 FT.
Plugged Pile End Bearing Area=================== 0.983 SQFT. Unplugged Pile End Bearing Area======= 0.108 SQFT.

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF.)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	NOMINAL PLUGGED SIDE RESIST. (KIPS)	NOMINAL PLUGGED END BRG. RESIST. (KIPS)	NOMINAL PLUGGED TOTAL RESIST. (KIPS)	NOMINAL UNPLUG'D SIDE RESIST. (KIPS)	NOMINAL UNPLUG'D END BRG. RESIST. (KIPS)	NOMINAL UNPLUG'D TOTAL RESIST. (KIPS)	NOMINAL REQ'D BEARING (KIPS)	FACTORED GEOTECH. LOSS FROM SCOUR or DD (KIPS)	FACTORED GEOTECH. LOSS LOAD FROM DD (KIPS)	FACTORED RESISTANCE AVAILABLE (KIPS)	ESTIMATED PILE LENGTH (FT.)
602.97	0.43	1.70			1.8		26.6	2.6		***5.3***	5	0	0	3	3
599.80	3.17	1.80			13.7	24.8	40.9	20.0	2.7	***25.4***	25	0	0	14	7
597.30	2.50		17	Medium Sand	3.1	25.4	83.8	4.5	2.8	***34.2***	34	0	0	19	9
594.80	2.50		31	Medium Sand	5.9	65.3	61.2	8.7	7.1	***39.8***	40	0	0	22	12
591.20	3.60		15	Medium Sand	3.9	36.7	109.2	5.7	4.0	***50.3***	50	0	0	28	15
588.70	2.50		44	Hard Till	5.2	80.8	81.4	7.6	8.8	***54.3***	54	0	0	30	18
586.20	2.50		26	Hard Till	2.8	47.8	93.4	4.1	5.2	***59.5***	59	0	0	33	20
583.70	2.50		31	Hard Till	3.3	57.0	82.0	4.9	6.2	***62.7***	63	0	0	35	23
581.20	2.50		23	Hard Till	2.5	42.3	141.4	3.6	4.6	***72.6***	73	0	0	40	25
578.70	2.50		54	Hard Till	7.1	99.2	190.8	10.4	10.9	***87.6***	88	0	0	48	28
576.20	2.50		77	Hard Till	13.1	141.5	154.4	19.2	15.5	***101.4***	101	0	0	56	30
573.70	2.50		50	Hard Till	6.3	91.9	171.7	9.2	10.1	***111.9***	112	0	0	62	33
571.20	2.50		56	Hard Till	7.6	102.9	206.8	11.1	11.3	***125.9***	126	0	0	69	35
568.70	2.50		71	Hard Till	11.4	130.5	183.3	16.6	14.3	***138.7***	139	0	0	76	38
566.20	2.50		52	Hard Till	6.7	95.5	197.3	9.8	10.5	***149.3***	149	0	0	82	40
563.70	2.50		56	Hard Till	7.6	102.9	285.7	11.1	11.3	***169.2***	169	0	0	93	43
553.70	10.00		100	Hard Till	85.5	183.7	371.2	125.0	20.1	***294.3***	294	0	0	162	53
552.70	1.00		100	Hard Till	8.5	183.7	379.8	12.5	20.1	***306.8***	307	0	0	169	54
551.70	1.00		100	Hard Till	8.5	183.7	388.3	12.5	20.1	***319.3***	319	0	0	176	55
550.70	1.00		100	Hard Till	8.5	183.7	396.9	12.5	20.1	***331.8***	332	0	0	182	56
549.70	1.00		100	Hard Till	8.5	183.7	405.4	12.5	20.1	***344.3***	344	0	0	189	57
548.70	1.00		100	Hard Till	8.5	183.7	414.0	12.5	20.1	***356.8***	357	0	0	196	58
547.70	1.00		100	Hard Till	8.5	183.7	422.5	12.5	20.1	***369.3***	369	0	0	203	59
545.70	2.00		100	Hard Till	17.1	183.7	439.6	25.0	20.1	***394.3***	394	0	0	217	61
544.70	1.00		100	Hard Till	8.5	183.7	448.2	12.5	20.1	***406.8***	407	0	0	224	62
543.70	1.00		100	Hard Till	8.5	183.7	456.7	12.5	20.1	***419.3***	~~419~~	~~0~~	~~0~~	~~231~~	~~63~~
538.70	5.00		100	Hard Till	42.7	183.7	560.7	62.5	20.1	***488.5***	~~488~~	~~0~~	~~0~~	~~269~~	~~68~~
537.70	1.00			Limestone	98.8	245.0	659.6	144.5	26.8	***633.0***	~~633~~	~~0~~	~~0~~	~~348~~	~~68.7~~
536.70	1.00			Limestone	98.8	245.0	***758.4***	144.5	26.8	777.5	~~758~~	~~0~~	~~0~~	~~417~~	~~69.7~~
535.70	1.00			Limestone	98.8	245.0	***857.2***	144.5	26.8	922.0	~~857~~	~~0~~	~~0~~	~~471~~	~~70.7~~
534.70	1.00			Limestone	98.8	245.0	***956.0***	144.5	26.8	1066.5	~~956~~	~~0~~	~~0~~	~~526~~	~~71.7~~
533.70	1.00			Limestone	98.8	245.0	***1054.9***	144.5	26.8	1211.0	~~1055~~	~~0~~	~~0~~	~~580~~	~~72.7~~
532.70	1.00			Limestone	98.8	245.0	***1153.7***	144.5	26.8	1355.5	~~1154~~	~~0~~	~~0~~	~~635~~	~~73.7~~
531.70	1.00			Limestone	98.8	245.0	***1252.5***	144.5	26.8	1500.0	~~1253~~	~~0~~	~~0~~	~~689~~	~~74.7~~
530.70	1.00			Limestone	98.8	245.0	***1351.3***	144.5	26.8	1644.5	~~1351~~	~~0~~	~~0~~	~~743~~	~~75.7~~
529.70	1.00			Limestone	98.8	245.0	***1450.2***	144.5	26.8	1789.0	~~1450~~	~~0~~	~~0~~	~~798~~	~~76.7~~
529.30	0.40			Limestone		245.0			26.8						

Illinois Department of Transportation

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

SUBSTRUCTURE===================================== East Abutment
REFERENCE BORING ================================ B-3 & B-4
LRFD or ASD or SEISMIC ============================== LRFD
PILE CUTOFF ELEV. ================================== 605.80 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 602.80 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) ===== None
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ================= ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) =============== ft

TOTAL FACTORED SUBSTRUCTURE LOAD ============== kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)========= ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ======= 4

MAX. REQUIRED BEARING & RESISTANCE for Selected Pile, Soil Profile, & Losses

Maximum Nominal Req'd Bearing of Pile	Maximum Nominal Req.d Bearing of Boring	Maximum Factored Resistance Available in Boring	Maximum Pile Driveable Length in Boring
418 KIPS	**411** KIPS	**226** KIPS	**51** FT.

PILE TYPE AND SIZE ============= Steel HP 12 X 53
Plugged Pile Perimeter========================= 3.967 FT. Unplugged Pile Perimeter============= 5.800 FT.
Plugged Pile End Bearing Area=================== 0.983 SQFT. Unplugged Pile End Bearing Area======== 0.108 SQFT.

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF.)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	NOMINAL PLUGGED SIDE RESIST. (KIPS)	END BRG. RESIST. (KIPS)	TOTAL RESIST. (KIPS)	NOMINAL UNPLUG'D SIDE RESIST. (KIPS)	END BRG. RESIST. (KIPS)	TOTAL RESIST. (KIPS)	NOMINAL REQ'D BEARING (KIPS)	FACTORED GEOTECH. LOSS FROM SCOUR or DD (KIPS)	FACTORED GEOTECH. LOSS LOAD FROM DD (KIPS)	FACTORED RESISTANCE AVAILABLE (KIPS)	ESTIMATED PILE LENGTH (FT.)
601.20	1.60	2.10			7.6		108.1	11.1		22.1	22	0	0	12	5
598.70	2.50		100	Very Fine Silty Sand	30.1	100.4	102.0	44.0	11.0	62.2	62	0	0	34	7
593.20	5.50		35	Hard Till	8.4	64.3	147.2	12.3	7.0	78.6	79	0	0	43	13
590.70	2.50		55	Hard Till	7.3	101.1	121.5	10.7	11.1	85.7	86	0	0	47	15
588.20	2.50		37	Hard Till	4.1	68.0	191.8	6.0	7.4	98.9	99	0	0	54	18
585.70	2.50		73	Hard Till	11.9	134.1	253.3	17.5	14.7	121.8	122	0	0	67	20
583.20	2.50		100	Hard Till	21.4	183.7	274.7	31.3	20.1	153.1	153	0	0	84	23
580.60	2.60		100	Hard Till	22.2	183.7	265.7	32.5	20.1	182.2	182	0	0	100	25
578.10	2.50		83	Hard Till	15.1	152.5	282.6	22.0	16.7	204.4	204	0	0	112	28
575.60	2.50		84	Hard Till	15.4	154.3	285.1	22.5	16.9	225.5	226	0	0	124	30
573.10	2.50		77	Hard Till	13.1	141.5	289.1	19.2	15.5	243.7	244	0	0	134	33
570.60	2.50		72	Hard Till	11.6	132.3	302.6	17.0	14.5	261.0	261	0	0	144	35
568.10	2.50		73	Hard Till	11.9	134.1	321.9	17.5	14.7	279.2	279	0	0	154	38
565.10	3.00		77	Hard Till	15.8	141.5	346.8	23.1	15.5	303.3	303	0	0	167	41
560.10	5.00		82	Hard Till	29.5	150.7	409.4	43.1	16.5	350.0	350	0	0	193	46
559.10	1.00		100	Hard Till	8.5	183.7	417.9	12.5	20.1	362.5	363	0	0	199	47
558.10	1.00		100	Hard Till	8.5	183.7	426.5	12.5	20.1	375.0	375	0	0	206	48
557.10	1.00		100	Hard Till	8.5	183.7	435.0	12.5	20.1	387.5	388	0	0	213	49
556.10	1.00		100	Hard Till	8.5	183.7	443.6	12.5	20.1	400.0	400	0	0	220	50
555.10	1.00		100	Hard Till	8.5	183.7	433.7	12.5	20.1	410.5	411	0	0	226	51
554.10	1.00		90	Hard Till	7.0	165.4	440.8	10.2	18.1	420.8	~~421~~	~~0~~	~~0~~	~~231~~	~~52~~
536.10	18.00		90	Hard Till	126.2	165.4	646.5	184.5	18.1	613.9	~~614~~	~~0~~	~~0~~	~~338~~	~~70~~
535.10	1.00			Limestone	98.8	245.0	745.4	144.5	26.8	758.4	~~745~~	~~0~~	~~0~~	~~410~~	~~70.7~~
534.10	1.00			Limestone	98.8	245.0	844.2	144.5	26.8	902.9	~~844~~	~~0~~	~~0~~	~~464~~	~~71.7~~
533.10	1.00			Limestone	98.8	245.0	943.0	144.5	26.8	1047.4	~~943~~	~~0~~	~~0~~	~~519~~	~~72.7~~
532.10	1.00			Limestone	98.8	245.0	1041.8	144.5	26.8	1191.9	~~1042~~	~~0~~	~~0~~	~~573~~	~~73.7~~
531.10	1.00			Limestone	98.8	245.0	1140.7	144.5	26.8	1336.4	~~1141~~	~~0~~	~~0~~	~~627~~	~~74.7~~
530.10	1.00			Limestone	98.8	245.0	1239.5	144.5	26.8	1480.9	~~1239~~	~~0~~	~~0~~	~~682~~	~~75.7~~
529.10	1.00			Limestone	98.8	245.0	1338.3	144.5	26.8	1625.4	~~1338~~	~~0~~	~~0~~	~~736~~	~~76.7~~
528.10	1.00			Limestone	98.8	245.0	1437.1	144.5	26.8	1769.9	~~1437~~	~~0~~	~~0~~	~~790~~	~~77.7~~
527.10	1.00			Limestone	98.8	245.0	1536.0	144.5	26.8	1914.5	~~1536~~	~~0~~	~~0~~	~~845~~	~~78.7~~
526.10	1.00			Limestone	98.8	245.0	1634.8	144.5	26.8	2059.0	~~1635~~	~~0~~	~~0~~	~~899~~	~~79.7~~
525.10	1.00			Limestone	98.8	245.0	1733.6	144.5	26.8	2203.5	~~1734~~	~~0~~	~~0~~	~~953~~	~~80.7~~
524.10	1.00			Limestone	98.8	245.0	1832.4	144.5	26.8	2348.0	~~1832~~	~~0~~	~~0~~	~~1008~~	~~81.7~~
523.10	1.00			Limestone	98.8	245.0	1931.3	144.5	26.8	2492.5	~~1931~~	~~0~~	~~0~~	~~1062~~	~~82.7~~
522.10	1.00			Limestone		245.0			26.8						