US Army Corps of Engineers®
CHICAGO DISTRICT

DUPAGE RIVER, ILLINOIS
FEASIBILITY REPORT AND
INTEGRATED ENVIRONMENTAL ASSESSMENT

Appendix E - Geotechnical Engineering

Final Report

July, 2019

GEOTECHNICAL ENGINEERING APPENDIX

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ATTACHMENTS

Attachment 1: - USDA Soil Survey Map for River Dumoulin Levee Project
Attachment 2: - Engineering Resource Associates, Inc. "River Dumoulin Levee Study – Geotechnical Engineering Analysis" Report, May 2012.
Attachment 3: - 30 January 2012 Site Visit Photos and Descriptions
- 1 May 2013 Site Visit Photos post April 2013 Flood
Attachment 4: - Sites Removed from Consideration, Including USDA Soil Maps & Available Borings
Attachment 5: - GEI Consultants. "Subsurface Investigation Report - DuPage River Flood Risk Management, Lisle, IL", 1 November 2018.

DUPAGE RIVER FEASIBILITY REPORT
GEOTECHNICAL ENGINEERING APPENDIX

INTRODUCTION

1. The study area encompasses the DuPage River Basin which includes the East and West Branch, as well as, larger tributaries such as the Lily Cache Creek and St. Joseph Creek all within the state of Illinois. The branches are primarily in DuPage County while the main stem is in Will County. The DuPage River Basin flows generally north to south into the Des Plaines River near Channahon. The purpose of this appendix is to evaluate subsurface soil information and provide generalized geotechnical design and related construction considerations for each project feature of the proposed flood risk management.

2. The DuPage River, Illinois Feasibility Study investigates overbank and backwater flooding across the DuPage River Basin, all within DuPage and Will Counties. A previous study was completed in 1982 addressing this area and is summarized within the main report. However, the area has experienced rapid development over the past several decades and has experienced several events which resulted in overbank flooding of roads, homes, and businesses.

3. During the feasibility study formulation, the team has identified one levee rehabilitation and one creek restriction to be part of the recommended plan. It has also identified several non-structural plans, although those are not addressed in this appendix. Other sites that were eliminated from consideration which had some level of geotechnical investigation completed are included in Attachment 4 of this appendix.

REGIONAL GEOLOGY

Bedrock Geology

4. The surface bedrock of the region consists predominantly of rock of the Silurian System (Figure 1), which is newer than the underlying and adjacent Ordovician System. Both systems consist of almost exclusively dolomitic limestone. The Ordovician Series, which is present at the top of bedrock in the southwestern-most reaches of the project area is very thick, at several hundred feet. South of the project area, Pennsylvanian System is present, which contains a more varied bedrock composition such as limestone, shale, and coal.

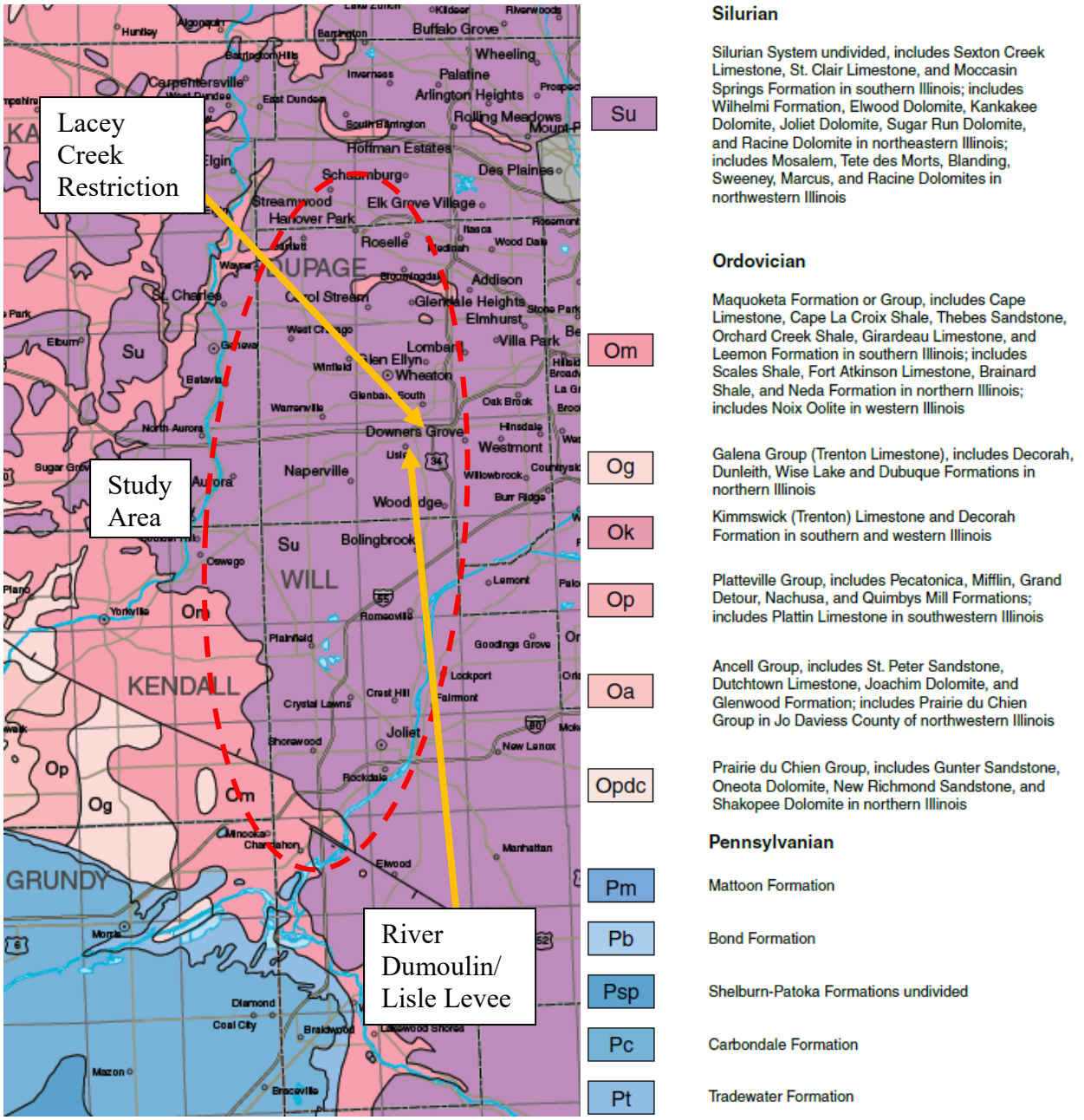


Figure 1. General Bedrock Geology of Project Area

Surficial Geology

5. Thicknesses of the overburden are estimated in Figure 2 below. Shallow bedrock less than 25 feet below grade is present throughout most of the main stem of the DuPage River, as well as, the southern-most portion of the west branch. The rest of the project area is expected to have bedrock between 25 and 100 feet below grade, except for stretches on the northern portion where bedrock is likely to be 100-300 feet below grade.

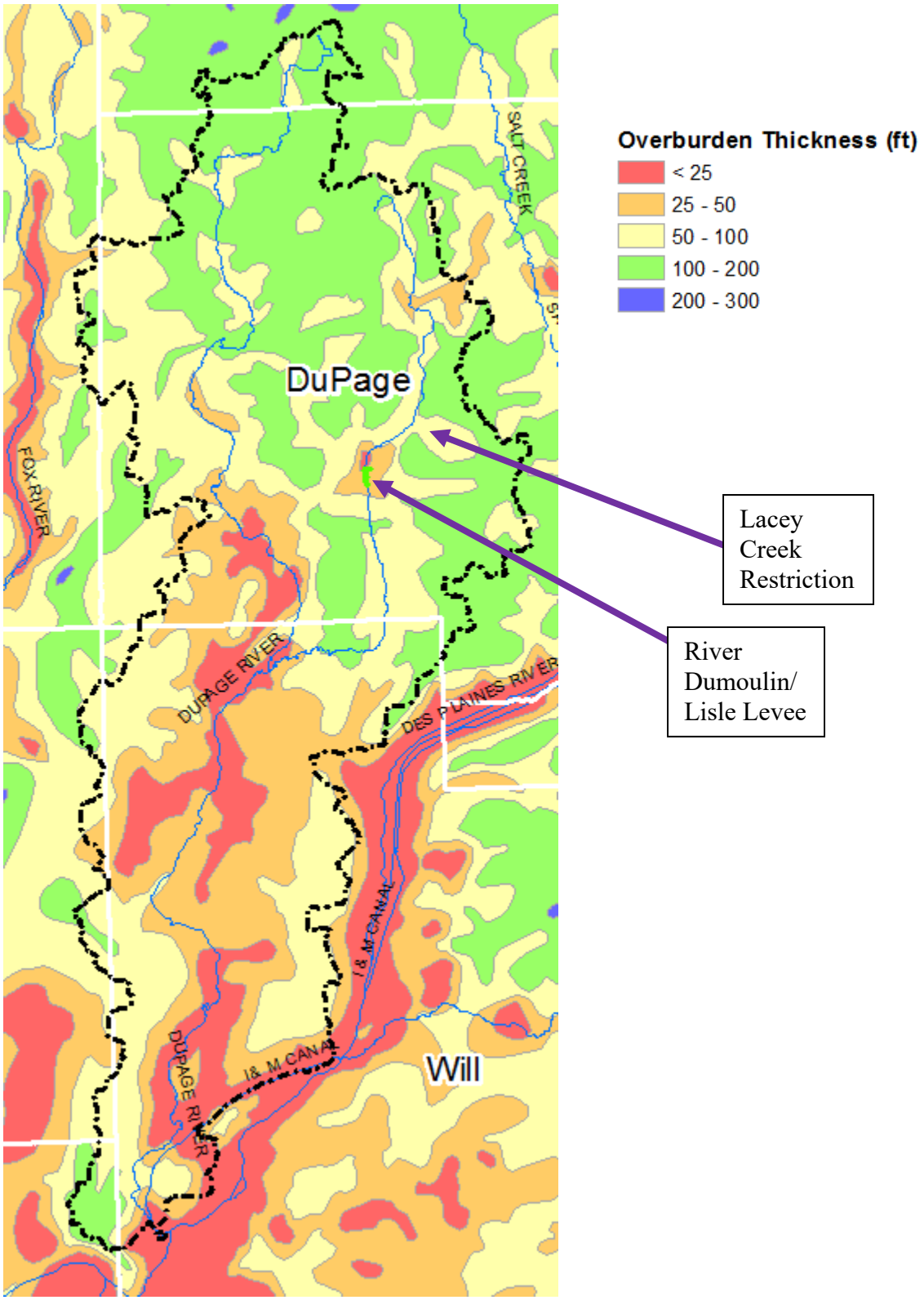


Figure 2. General Thickness of Overburden in Project Area

Physiography

6. Deposits on the Silurian and Ordovician Series bedrocks consist of glacial till. The major topographic features in these counties reflecting the influence of glacial deposition (moraines); till plains and sand and gravel outwash plains; a few knob-like hills of sand and gravel (kames); and the Sag, Fox, and Des Plaines River valleys which were drainage-ways for glacial melt-waters. Sand and gravel accumulated as valley trains along these rivers. The DuPage River is relatively young and would not have the same amount of sand and gravel as those of the Des Plaines, Fox, or Illinois Rivers. However, the historic meandering of these rivers may have influenced the subsurface.

7. The DuPage River Basin is located within the Wedron Formation, split into the Wadsworth Till to the northeast and Yorkville Till to the southwest. The Wedron Formation was covered by the most recent glaciation; the Wisconsinan from about 85,000 to 11,000 years ago meaning the native clay within the area is almost always overconsolidated due to the historic ice loads it has experienced. However, there may be some pockets of water deposited alluvium or wind deposited loess on the surface which would not be overconsolidated. The difference between the two tills is the Wadsworth till was more recently affected by the ebb and flow of the glacial advances and retreats, which each resulted in a moraine. The Wadsworth till generally consists of less sands than the Yorkville till, implying there was a glacial lake covering the Wadsworth area but not the Yorkville area.

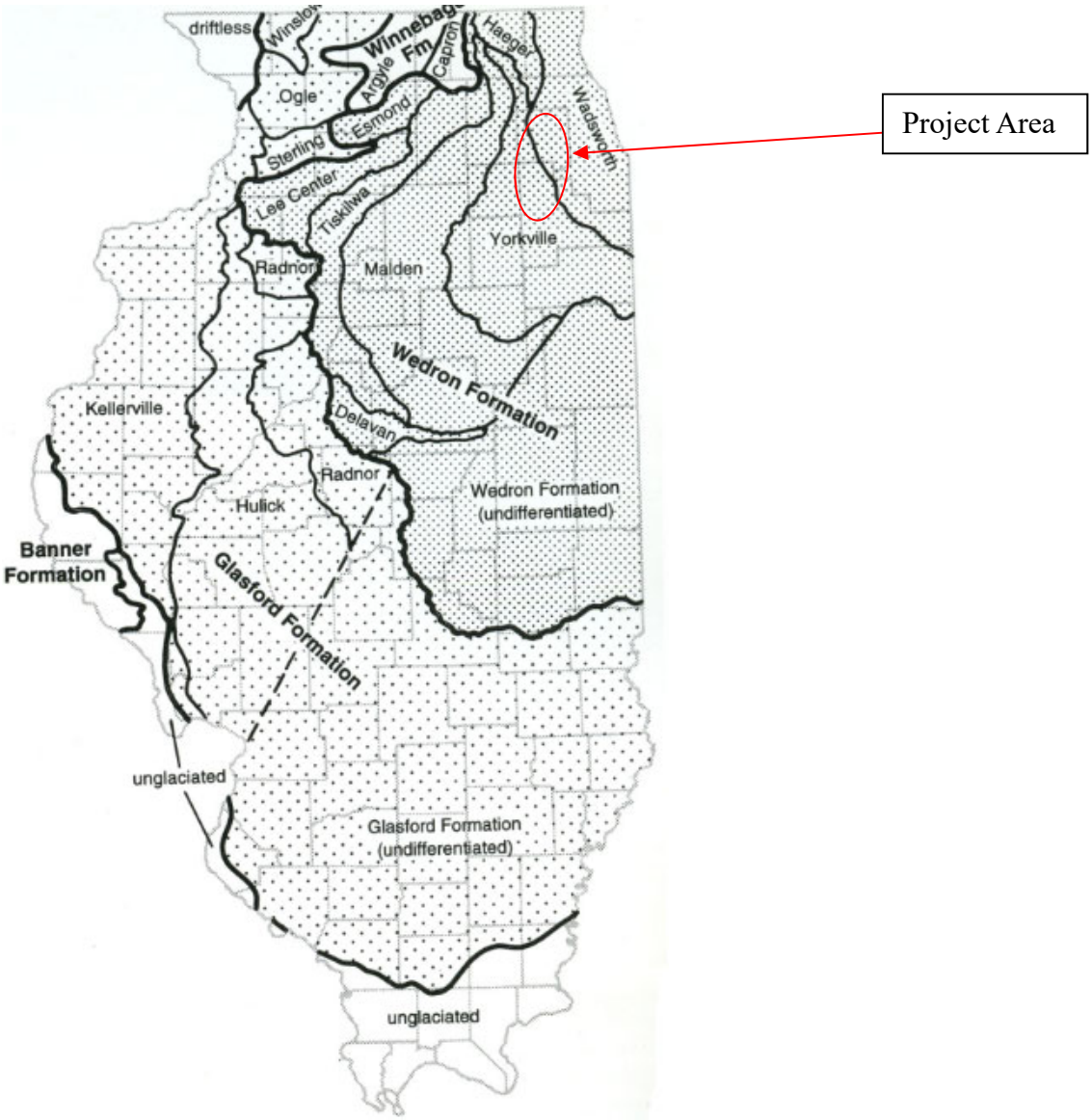


Figure 3. Areal distribution of predominant Quaternary formations in Illinois (Willman & Frye 1970)

8. Figure 3 is a regional description of the expected conditions. A second soils quaternary map was investigated and included in Figure 4. It is provided by IDNR as a shapefile and includes the Yorkville and Wadsworth members as mentioned in Figure 3 above. However, it also includes more detail as the below map shows areas which have been affected by alluvial movement (Cahokia Member) as fine-grained materials from the till has moved due to water erosion/deposition.

9. The Mackinaw Member, Batavia Member, and Surface-Mined Areas identify areas where shallow/exposed bedrock may be present. The Carmi Member is differentiated as it was likely a location of a glacial drainage areas of sediment. These soils are still likely to be fine-grained, though.

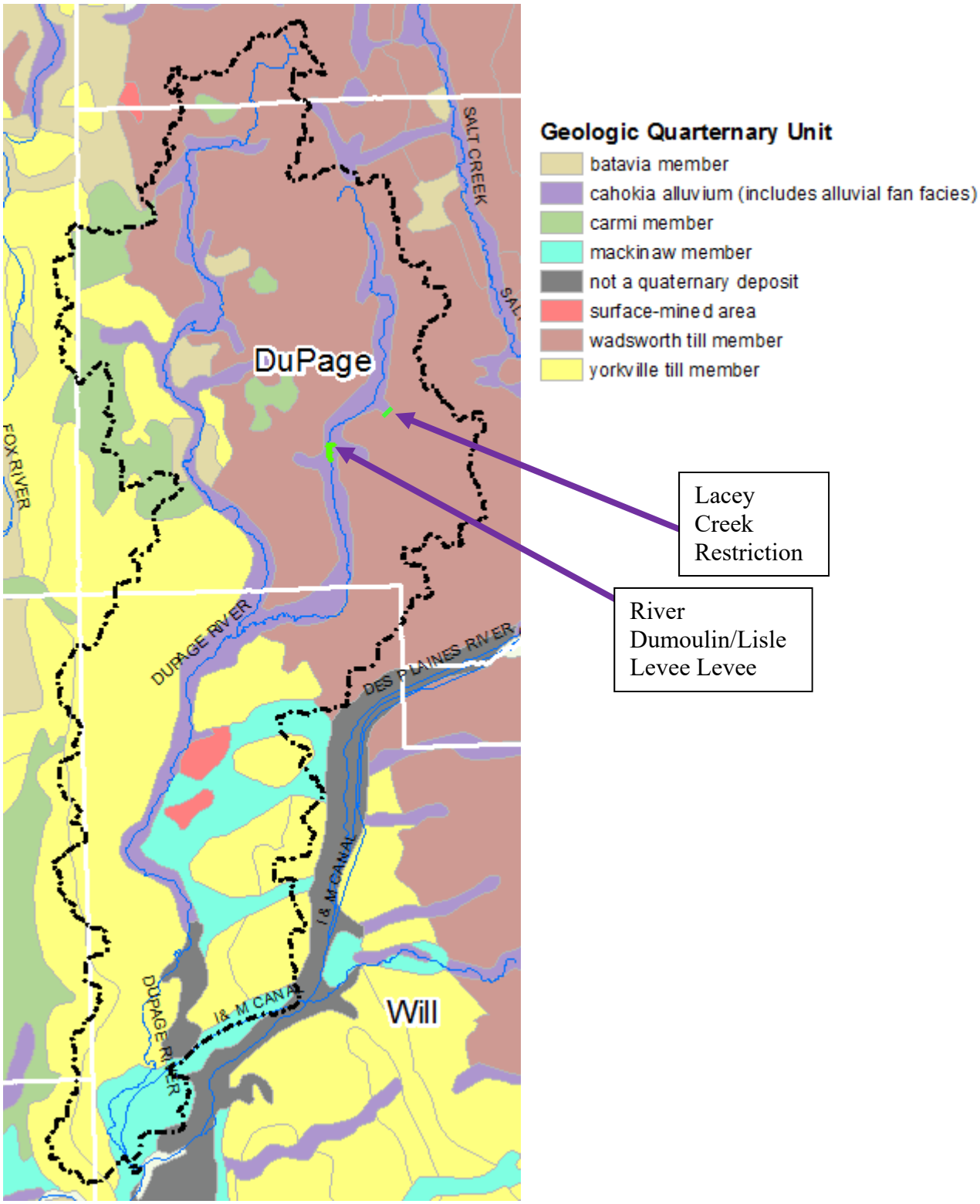


Figure 4. Geologic Quaternary Map (IDNR)

10. Over the last 200 years, the river has become increasingly channelized due to urbanization, reducing the DuPage River's opportunity for meandering. Because of extensive urbanization, there are many areas of DuPage and Will Counties where geologic materials have been affected by human activities. It is recognized that a few feet of miscellaneous fills and/or regraded topsoil and other surficial material underline parts of the study area.

RIVER DUMOULIN LEVEE REHABILITATION

11. The River Dumoulin Levee Rehabilitation project includes multiple levee systems between I-88 and Maple Ave in Lisle along the East Branch and St. Joseph Creek. It is sometimes referred to as the Lisle Levee project. These levees are included in the National Levee Database as shown in Figure 5 with the system names shown. However, it should be noted that some of these systems are likely to be combined as the NLD leveed areas are not as detailed compared to what is included in this study. The NLD relies on rough LiDAR survey of the existing levee heights and does not account for pipe connections.

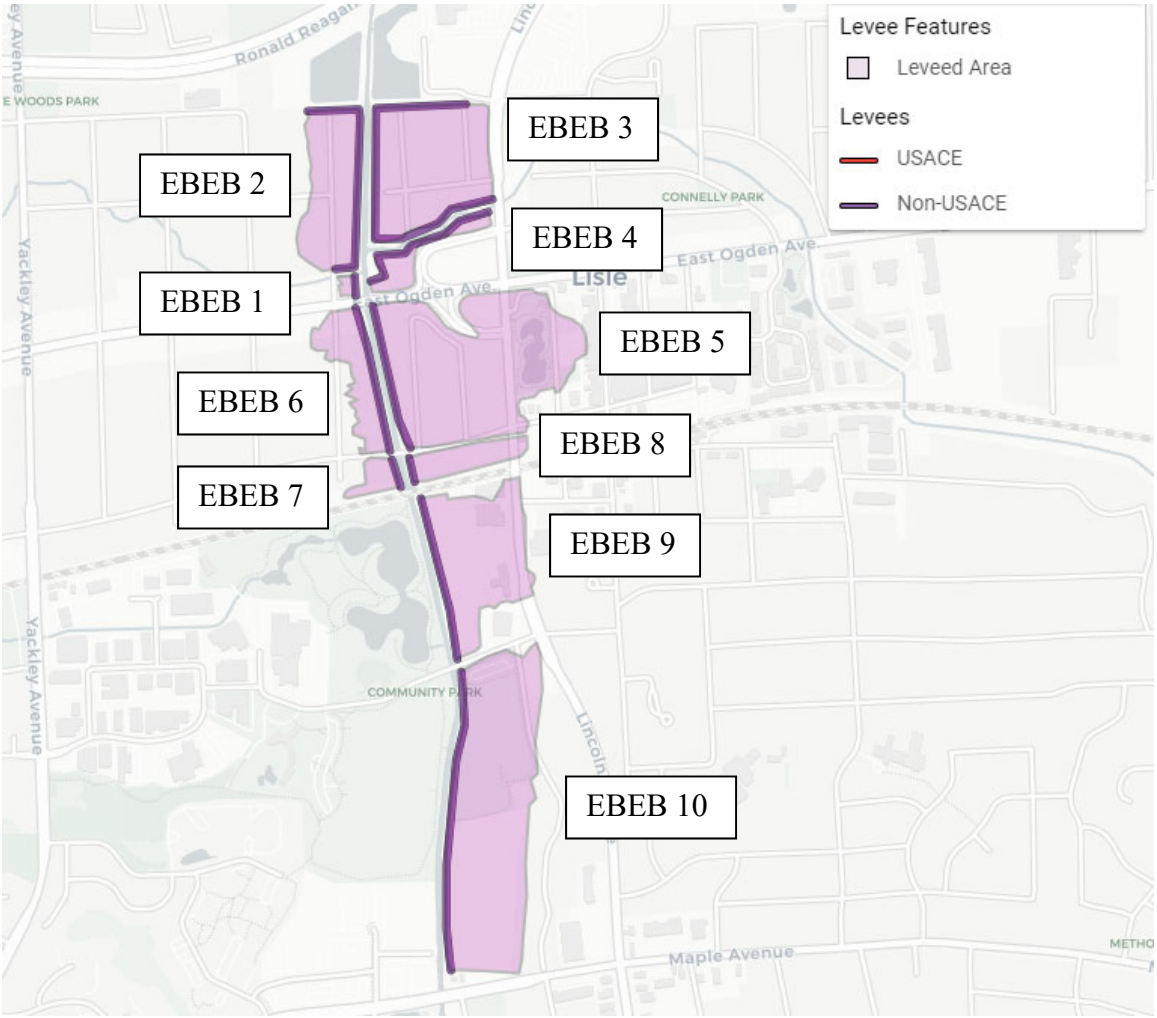


Figure 5. Lisle Levee Systems as shown in the National Levee Database may be more segmented than reality

Table 1. Summary of levee data provided by the National Levee Database

Feature Name	NLD Levee System ID	Segment Length (miles)	People at Risk*	Structures at Risk*	Property Value*	Study System Designation
East Branch DuPage River (EBEB) 1	1505901401	0.03	3	1	$417k	West System
EBEB 2	1505901402	0.34	27	14	$10,400k	West System
EBEB 3	1505901403	0.52	66	30	$12,500k	Northeast System
EBEB 4	1505901404	0.24	1	1	$2,690k	Southeast System
EBEB 5	1505901405	0.22	121	45	$18,700k	Southeast System
EBEB 6	1505901406	0.22	51	16	$14,600k	West System
EBEB 7	1505901407	0.04	3	2	$1,900k	West System
EBEB 8	1501000250	0.04	21	8	$3,340k	Southeast System
EBEB 9	1505901409	0.24	78	9	$23,900k	Not included in recommended plan
EBEB 10	1505901410	0.44	38	12	$5,010k	Not included in recommended plan

**Provided by NLD, but has been refined per the Economic Appendix*

12. The 10 systems identified in the NLD are shown on Table 1 and are color coded per what is considered the three systems included in this study. The two systems in the NLD that are south of the railroad are not included in the study.

13. Figure 6 combines the existing levees north of the railroad into the three segments. The levee on the west bank is about 3,500 feet long, east bank north is about 2,000 feet long, and east bank south is about 2,000 feet long. Each consists of earthen embankment, only.

Figure 6. Approximate extents of existing levee in Lisle (3 systems)

14. These existing levees have various deficiencies such as encroachments, corroded pipes, erosion of the crest and riverside slopes, and vegetation as described in the Existing Levee Condition section below.

15. The current levee is constructed to a level that would reduce flood impacts for a 50-year or less event. The proposed plan would consist of rehabilitating and raising the levee to approximately the 100-year event. Therefore, FEMA accreditation is unlikely as it requires 100-year plus 2 feet.

16. The rehabilitation for the levee would include several measures. Vegetation on the slopes and within 15 feet of the new toes would be removed. Also, miscellaneous structures within the footprint such as power poles, fences, and staircases would be removed/relocated/approved on a case-by-case analysis. The riverside toe would also require additional bank protection such as riprap. A closure structure is required across IL-53 underneath/adjacent to the railroad underpass. Finally, existing features such as gravity drains and pump stations may require upgrades.

River Dumoulin Levee Rehabilitation Subsurface Information

17. The area along the River Dumoulin levee alignment consists of alluvium (Sawmill). Refer to Attachment 1 for a more detailed soil map provided by NRCS. The depth to bedrock varies from under 25 feet below grade at the north to 50-100 feet below grade at the south, according to Figure 2.

18. There have been two subsurface investigations completed along the existing levee. The first was completed by ERA in 2012 under a report called "River Dumoulin Levee Study between Maple Avenue and Middleton Avenue". This report is included in Attachment 2. The other investigation was completed by Strata in 2018 under a report called "DuPage River Flood Risk Management Subsurface Investigation Report" and included in Attachment 5. A combined soil boring map is shown in Figure 7 below.

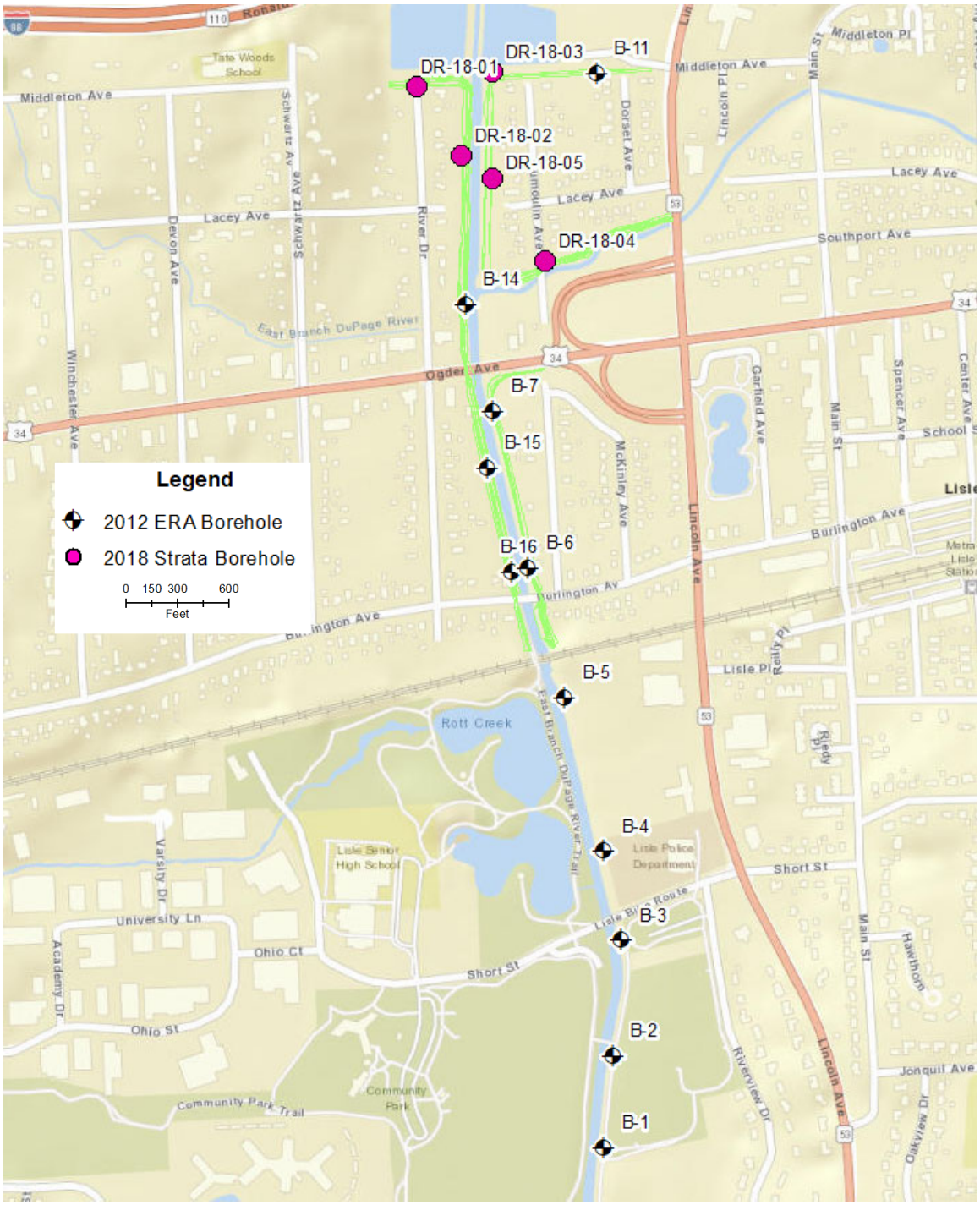


Figure 7. Soil boring map from 2012 ERA & 2018 Strata investigations with proposed levee

19. As shown above, eleven were completed by ERA in 2012. Of the eleven soil borings completed, nine were done on the centerline while two (B-2 and B-15) were done on the landside toe of the existing levee. Five of these borings (B-1 thru B-5) are south of the BNSF railroad and therefore not along the project proposed in this report.

20. Levee material and the top strata of the foundation consisted of similar materials of silty or sandy clay with pebbles. This layer was about 8 to 12 feet thick, although the boring logs do not differentiate between native and fill. Below this material, the second native layer generally consisted of sand and/or broken rock, which continued to the bottom depth of boring (between 20 and 30 feet below grade). Bedrock was not encountered in any of the logs. Additional information can be found in Attachment 2.

21. Five additional were completed by Strata in October 2018 as part of this feasibility study to decrease the data gaps. DR-18-01, DR-18-02, and DR-18-05 were completed on the landside toe while DR-18-03 was completed on the riverside toe. DR-18-04 was completed along the proposed centerline of the levee.

22. These borings encountered about 6 ½ to 8 feet of clayey soils beneath the surface. These clays varied from clayey topsoil to organic clay to sandy/silty clay. DR-18-03 encountered about 1 ½ feet of clay fill. Beneath the clay materials, the borings encountered silty to gravelly sand. Each boring extended to apparent bedrock, which was encountered between 17 ½ to 21 feet below grade. Two of the borings included 10 feet of rock coring which included medium hard dolomite limestone. Additional information can be found in Attachment 5, including a cross section.

River Dumoulin Historic Topographic Maps

23. There are several topographic maps available for the area around the River-Dumoulin Levee. The first available is from 1908. The proposed levee alignment, current creek alignment, and existing soil borings are shown on the maps to identify changes in the topography.

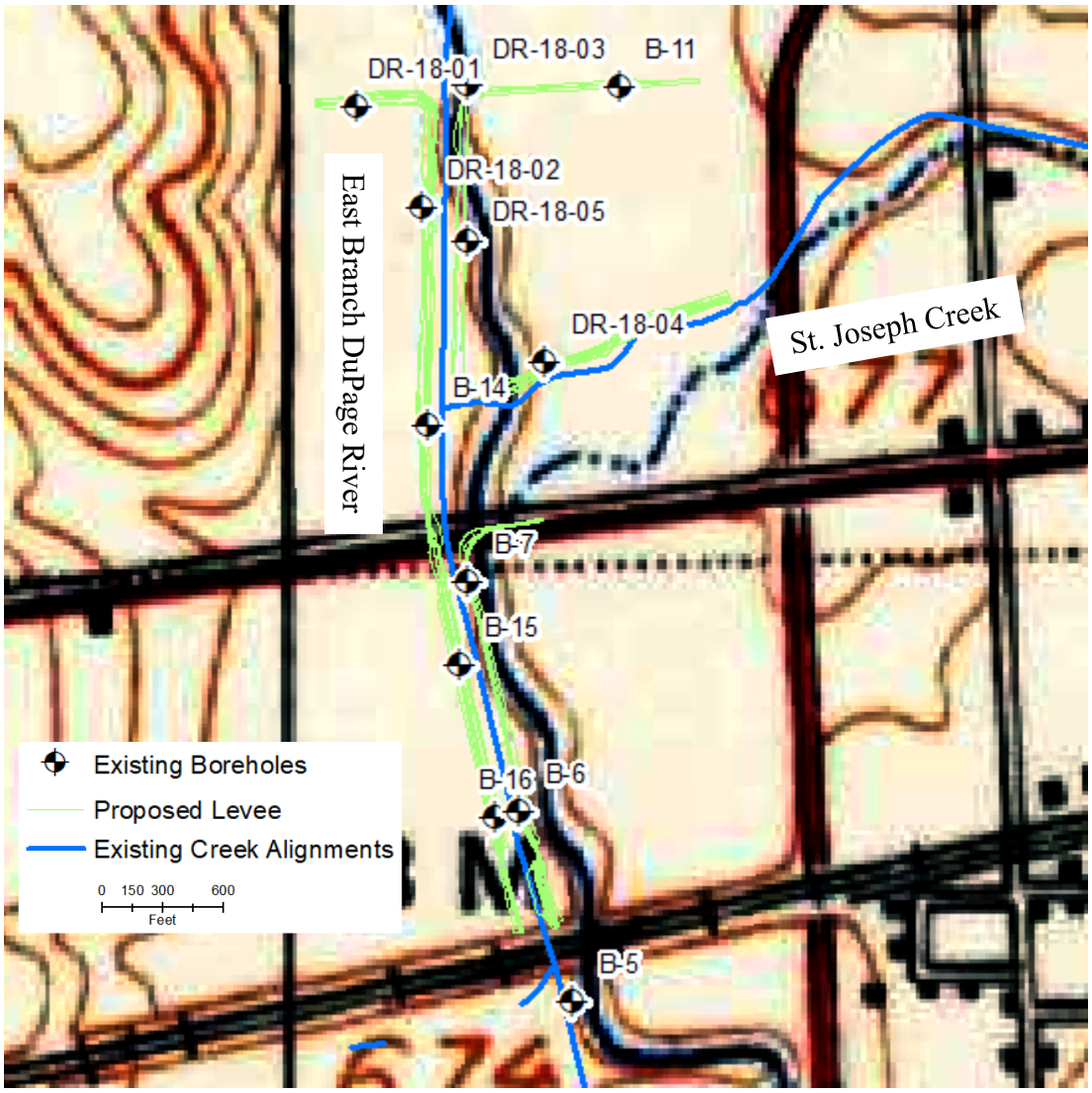


Figure 8. Lisle Levees with 1908 Topographic Map showing old versus new river alignment

24. The 1908 topographic map indicates both the East Branch and St. Joseph Creek have changed alignments. Within the area of the levee, the East Branch has shifted west and straightened. St. Joseph Creek has generally shifted north, particularly at the confluence.

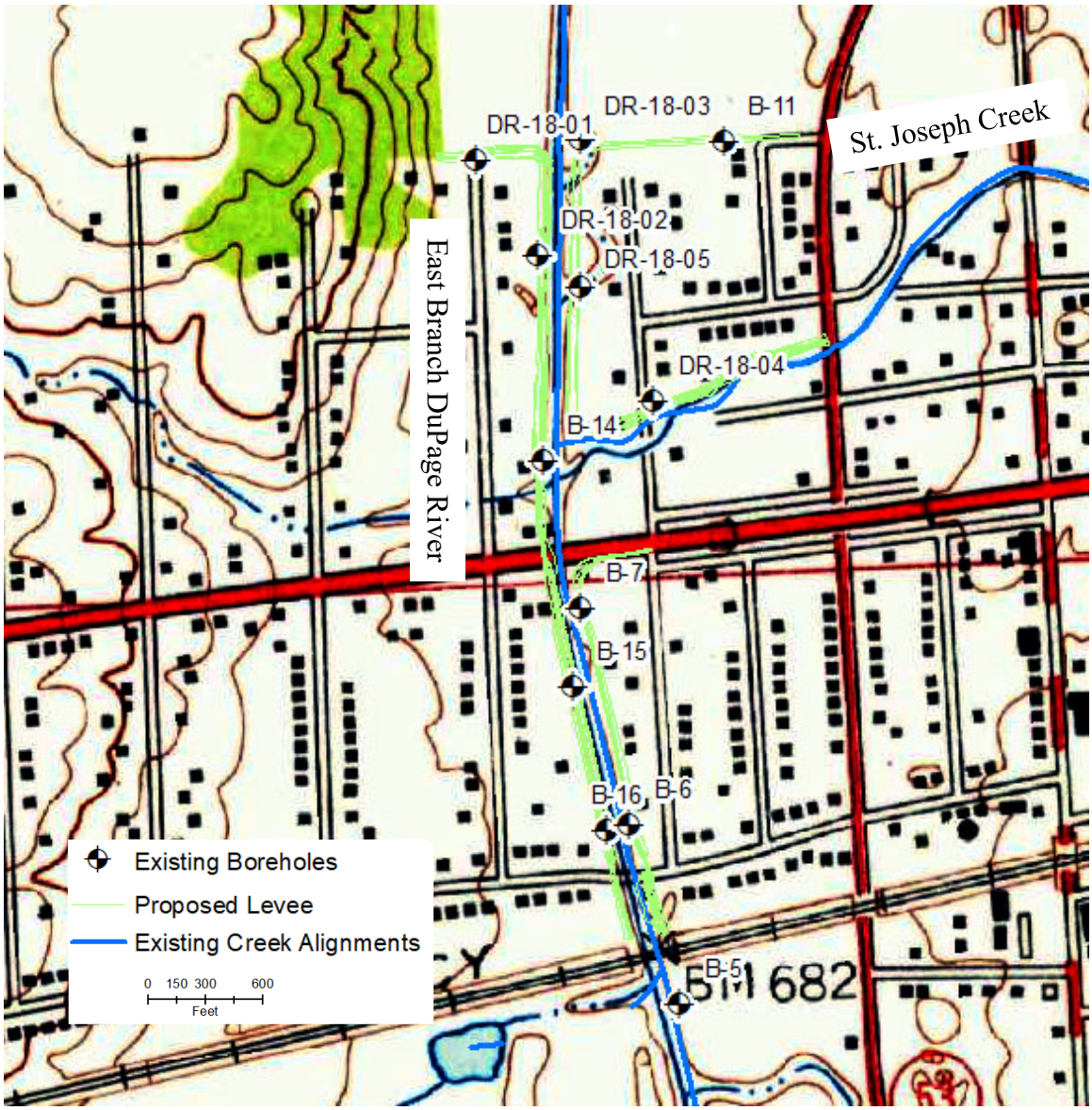


Figure 9. Lisle Levees with 1954 Topographic Map showing old versus new river alignment

25. From 1908 to 1954, a significant amount of development has occurred in the area in the form of roads and homes. As for the East Branch, it has been straightened to roughly the existing channel and the confluence from St. Joseph Creek has been adjusted north to roughly the existing location.

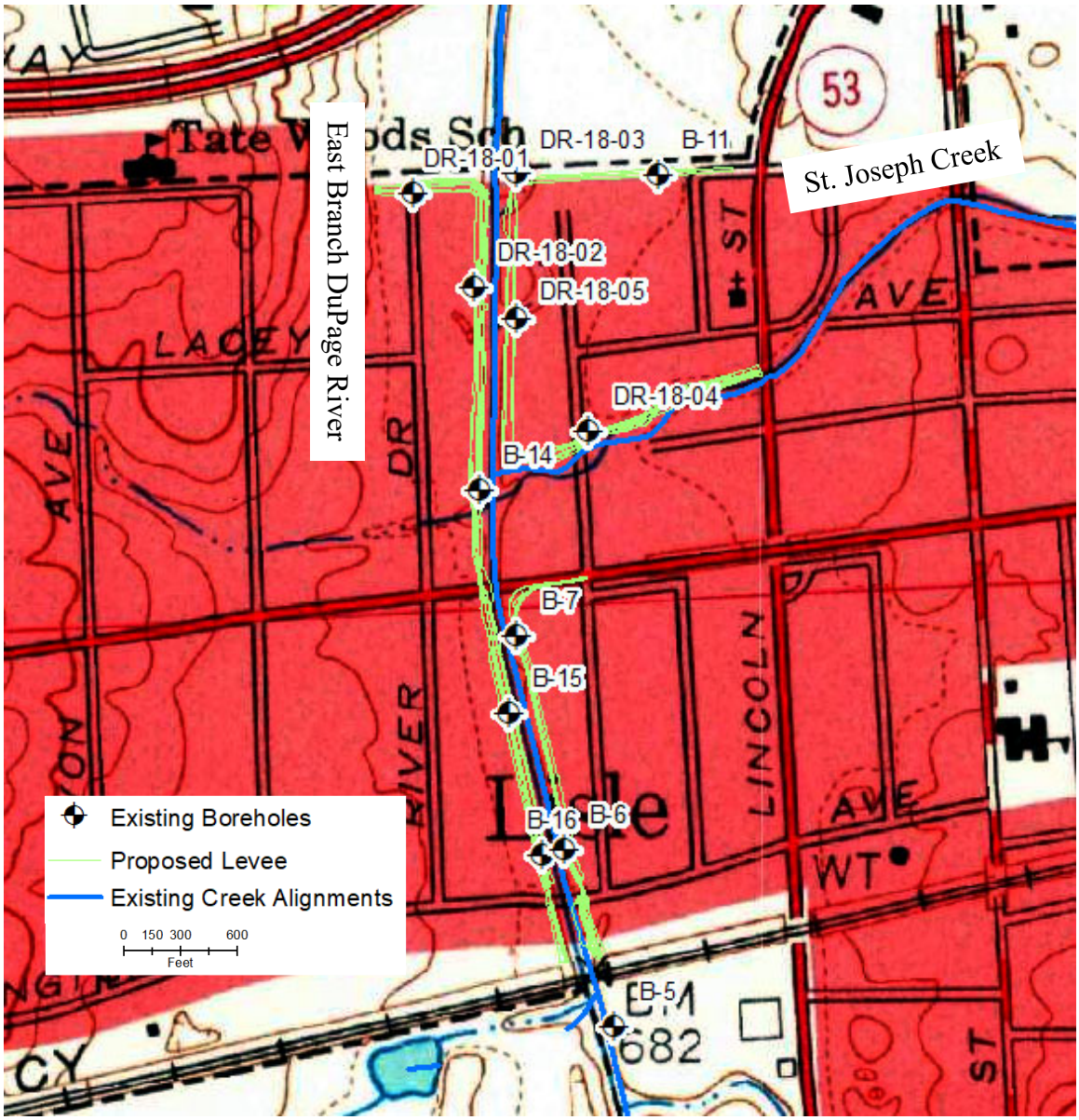


Figure 10. Lisle Levees with 1962 Topographic Map showing old versus new river alignment

26. From 1954 to 1962, the biggest change is the addition of the East-West Tollway (I-88) north of the levees. Another topo map was available from 1985 but no major changes were noticed.

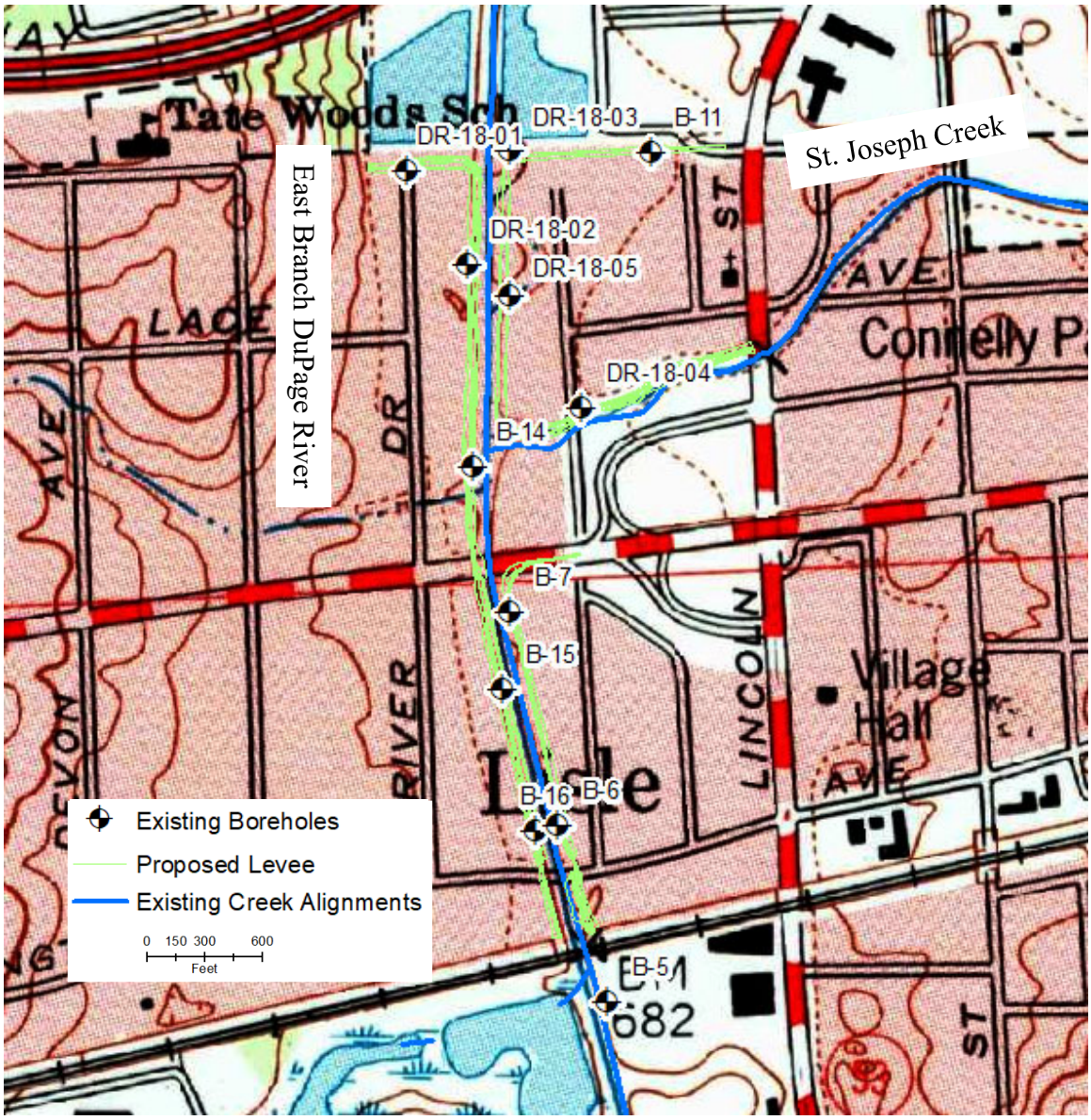


Figure 11. Lisle Levees and Storage Areas with 1993 Topographic Map showing old versus new river alignment

27. From 1985 to 1993, ponds are added between I-88 and the levees. There is also a 1998 map available, but no noticeable changes are present near the proposed project features versus the 1993 map. These topographic maps indicate there are several locations where previous meanderings of the rivers intersect with the levee. These locations should be focuses of future subsurface investigations when accessible.

River Dumoulin Existing Levee Conditions

28. As part of ERA's investigation and report, a site visit was conducted in 2012 to determine the existing condition of the levee. These photos are shown in Attachment 3 and show various encroachments and vegetation. These inhibit inspection of the levee, promote animal burrows into the levee, create seepage paths via root systems, and decrease slope stability should these trees die/fall over. Additionally, there are encroachments which include homes, fishing piers, fences, power poles, etc. that further reduce the ability to inspect the levee and could increase the risk of instability/seepage. Levee guidelines require the levee crest, slopes, and within 15 feet of both toes to be free of vegetation. Any encroachment near the levee should be analyzed to determine if it has an adverse effect of levee/floodfighting performance. A sampling of the 2012 Attachment 3 photos are shown in Figure 12 below.

Figure 12. Vegetation and Encroachment examples along River-Dumoulin Levee (30 January 2012)

29. In April 2013, a flood event occurred on the river and eroded significant areas of the riverside slopes. A post-flood site visit was conducted 1 May 2013 (included in Attachment 3) which included photos of the damage from the flood, including severe erosion of the riverside slope. It is unknown if riverbed degradation also occurred.

Figure 13. Erosion on riverside slope of Lisle Levee from April 2013 flood (1 May 2013)

30. The 2013 event overtopped the levee in some locations and eroded the crown and landside of the levee, particularly in areas without sod cover where woody vegetation was prevalent. The 2013 Post Flood Memo in Attachment 3 identified several locations where overtopping occurred. Based on the height of debris on the fence along the crest, these overtopping locations were as much as 400 feet long and as much as 1 foot deep. The top foot of the hydraulic curve at the closest gage (USGS 05540160) lasted about 12 hours, so it is likely that the overtopping event lasted about that long. This overtopping event eroded the crest and has reduced the effective top of levee elevation. It also increases the likelihood of total levee failure during the next overtopping event. One of these locations included in Attachment 3 is shown on Figure 14.

Figure 14. Erosion on landside slope of levee due to overtopping in April 2013 event (1 May 2013)

31. There are several CMP culverts which have excessive erosion around the riverside outlets. The CMP have never been camera inspected and it is assumed they are the original pipes from construction in the early 1960's, making them over 50 years old. With the CMP portion exposed to the river, they are increasingly susceptible to corrosion and puncture damage, which would circumvent the flap gate at the end of each pipe. There are approximately 9 gravity drainage culverts through the existing levee north of the BNSF railroad. These pipes range in size from 12 to 24 inches in diameter.

Figure 15. Culverts with CMP exposed on riverside (1 May 2013)

32. According to the local sponsor, the Village of Lisle occasionally checks to make sure the flap gates are operational and mows the turf portions, but there have been no repairs to the erosion caused by the April 2013 event. There is no formal written plan of operation and maintenance, Emergency Action Plan, stockpiled emergency supplies (sand bags, portable pumps, etc.), training, or public outreach. Without these plans in place, the risk of levee overtopping/breach is increased due to lack of knowledge, responsibility, and information on what areas are more susceptible to issues.

33. Due to the lack of real estate easements, USACE was not able to inspect the levee prior to compiling this report. Therefore, all of the site information available is from inspections that occurred about 5 years prior.

River Dumoulin / Lisle Levee Fragility Curve

34. The existing levee provides some amount of flood damage reduction, but since there are deficiencies present, the levee is not expected to perform well against every future flood. Per EM 1110-2-1619, the method to determine a failure rate of an existing levee is to create a fragility curve of an existing levee allows elevations to be applied to the expected failure rate of the levee. The fragility curve is defined by determining two points on a graph; the probable failure point (PFP) and probable non-failure point (PNP). The PFP is defined as the water elevation above which the levee is highly likely to fail, set at 85% failure rate in the EM. The PNP is defined as the water elevation below which the levee has a low likelihood of failure, set at 15% failure rate in the EM. Figure 16 is shown below, which is extracted from EM 1110-2-1619.

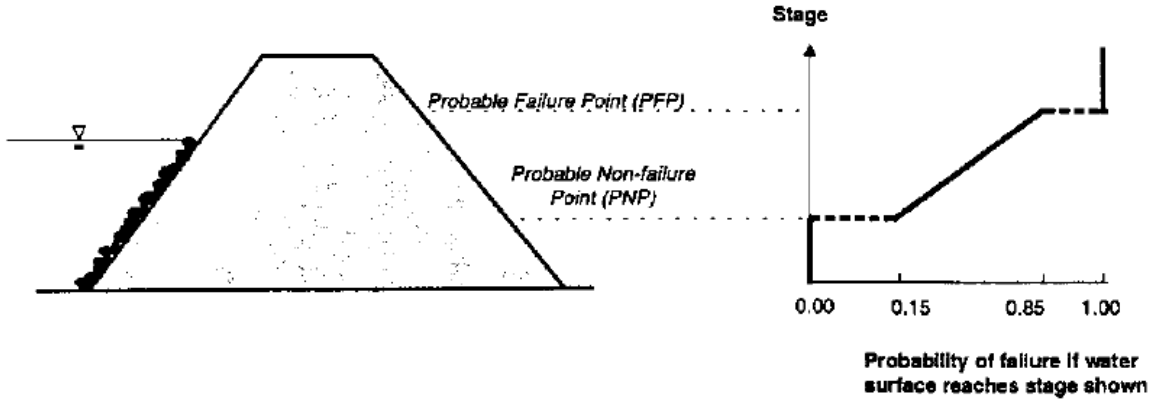


Figure 16. Figure from EM 1110-2-1619 showing PFP and PNP

35. To establish the PNP, the levee was examined at the lowest elevation which may induce a breach scenario. This scenario was determined to be a breach at the CMP gravity drainage pipes, which extend underneath the levee. Figure 15 shows photographs of the

50+ year old pipes exposed to on the riverside. A breach may occur in any of the following scenarios:

1. Debris floating down the river damages/shears the pipe from the backflow prevention (flap gate), allowing free flow up the pipe to the landside.

2. Erosion extends underneath the concrete headwall to create a cantilever. The headwall settles and the pipe cracks.

3. Erosion around the pipe exposes piping pathways, allowing seepage along the outside wall of the pipe to the landside.

4. Corrosion of the CMP exposed directly to the river allows free flow up the pipe to the landside.

5. Corrosion of the CMP within the levee allows levee material to enter the pipe, which results in a void above the pipe. This void may settle, create a piping pathway, and/or clog the CMP.

36. Each of these scenarios are possible based on the known erosion around the outlets, as well as, the lack of information on the interior condition of the aging pipes. Therefore, there is a small chance that levee failure could occur at a storm event which inundates the culverts, which will be the PNP. For the levee to fail, the river would have to exceed the height of the landside invert elevation, which is assumed to be 662.25 ft NAVD88 based on the lower elevation of the landside toe. (This cross section was taken about 200 ft north of Burlington Ave.)

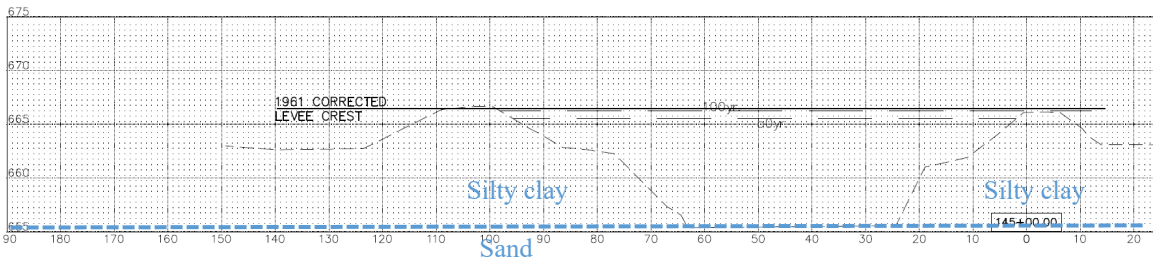


Figure 17. Cross section of levees about 200 ft north of Burlington Ave (Geology from B-16)

37. With the numerous deficiencies the River-Dumoulin Levee has documented across the project site, there are many possible failure modes that could occur during a high water event. Determining the PFP is based on the following issues:

1. Issues associated with culverts described in PNP determination.
2. Erosion noted on the crest lowers the effective top of levee.
3. Erosion of landside and riverside slopes shortens the seepage path, decreases stability, and is more likely to erode during future events.

4. Trees and encroachments reduce effectiveness of flood fighting measures.
5. Trees increase the risk of seepage through their root systems. The risk increases as trees die and roots rot to leave voids.
6. Trees increase the risk of instability, as they can tip over during storms. This pulls out their root balls along with portions of the levee.
7. Lack of formalized plan reduces effectiveness of flood fighting measures.
8. Lack of right of access agreements with the private residents to allow local workers to inspect and floodfight reduces the resiliency of the levee.

38. Due to the above factors, the PFP is determined to be at the lowest surveyed elevation of the levee crest, or 665 ft NAVD88. At this elevation, the water can overtop low spots and begin eroding the levee further. These low spots were overtopped in the 2013 event, so any future floods will only continue to erode and reduce the levee's resiliency. The other failure modes listed above could also initiate/contribute to an overall failure at this elevation.

Table 2. Fragility Curve PFP and PNP determinations

	Probability of Levee failure per EM 1110-2-1619	Ft NAVD88 at cross section 200 ft north of Burlington Ave	Elevation description	Potential Failure Mode
PNP	15%	662.25	Levee toe	Continued erosion/ corrosion on the gravity drains leads to breach around the flap gate(s)
PFP	85%	665	Lowest surveyed height of existing levee	Erosion and vegetation on the embankment leads to overtopping during events lower than the design height. Water overtopping the levee continues to erode levee and causes failure.

River Dumoulin Design Analysis

39. The subsurface report completed for the River Dumoulin Levee by Engineering Resource Associates in May 2012 (Attachment 2) included seepage, stability, and settlement analyses. This analysis used the following soil parameters developed from the ERA soil borings in Table 3.

Table 3. Soil Parameters used in 2012 analyses

Soil Type	Permeability (ft/sec)	Unit Weight (pcf)	Friction Angle
Clay Embankment	3.3E-9	115	29
Sandy Subsurface	6.6E-6	-	-

40. The 2018 subsurface investigation completed 5 unconfined compression and density tests on undisturbed clay samples. The results are in Table 4, with calculated averages.

Table 4. Soil Tests on undisturbed samples completed in 2018 investigation

	Depth (ft)	Unconfined Compressive Strength (tsf)	Moisture Content (%)	Dry Density (pcf)	Unit Weight (pcf)
DR-18-01	3.5-5.5	1.39	31.3	89.8	117.9
DR-18-02	4-6	2.19	24.9	97.9	122.3
DR-18-03	4-6	1.26	34.7	92.5	124.6
DR-18-04	4-6	2.15	22.3	96.4	119.9
DR-18-05	4-6	1.04	31.7	85.9	113.1
Average		**1.61**	**30.0**	**92.5**	**119.6**

41. Based on the additional information provided from the 2018 soil borings, the unit weight for the clay embankment can be carried over to the top 6-8 feet of overburden, as the clay in this layer has generally similar properties. Additionally, a cohesion of 1,000 psf can be applied to the end of construction condition of the clay, which is the low end of the values above.

42. As for the long term friction angle, since no additional borings were completed in the embankment, the 29 degrees is carried over. However, this is likely too high for the native clay. Therefore, with the Atterberg Limit data provided by the 2018 investigation, the below relation in Figure 18 was completed.

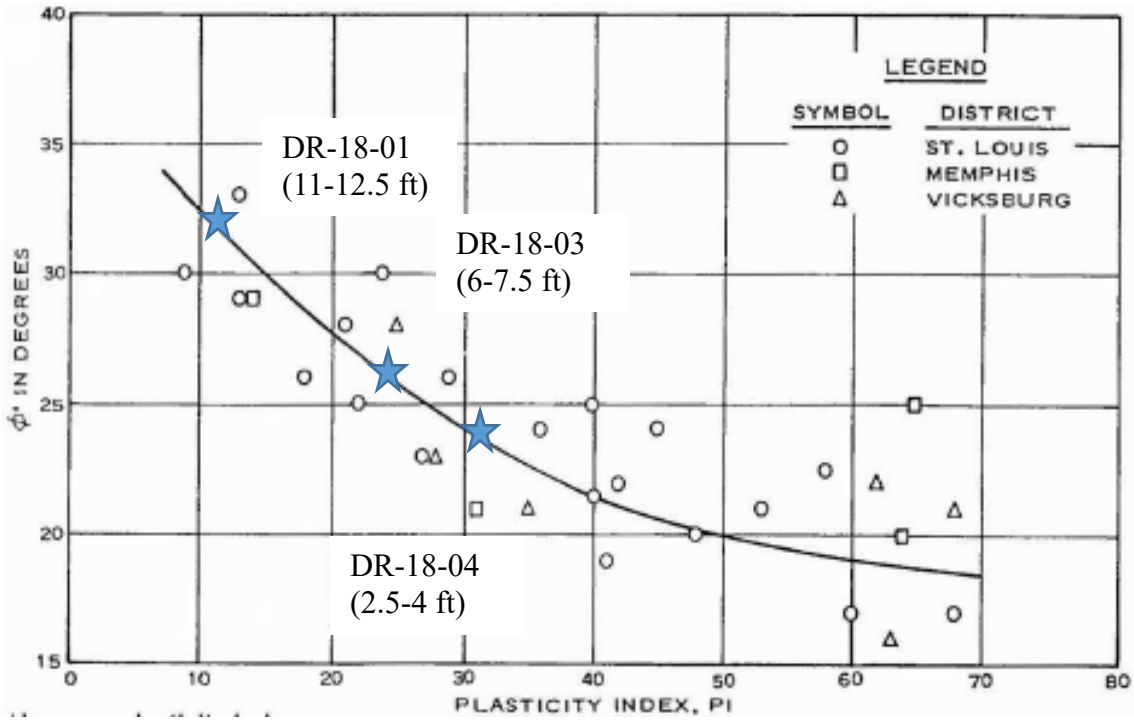


Figure 18. Plasticity Index related to friction angle of Lisle Levee samples (EM 1110-2-1913, Figure 3-2)

43. As shown above, the plasticity indexes relate to the friction angle at around 24, 26 and 32 degrees. Taking the low from these tests, this analysis will use 24 degrees for the native clays. The remaining properties for the silty sand and gravelly sand are from the below chart.

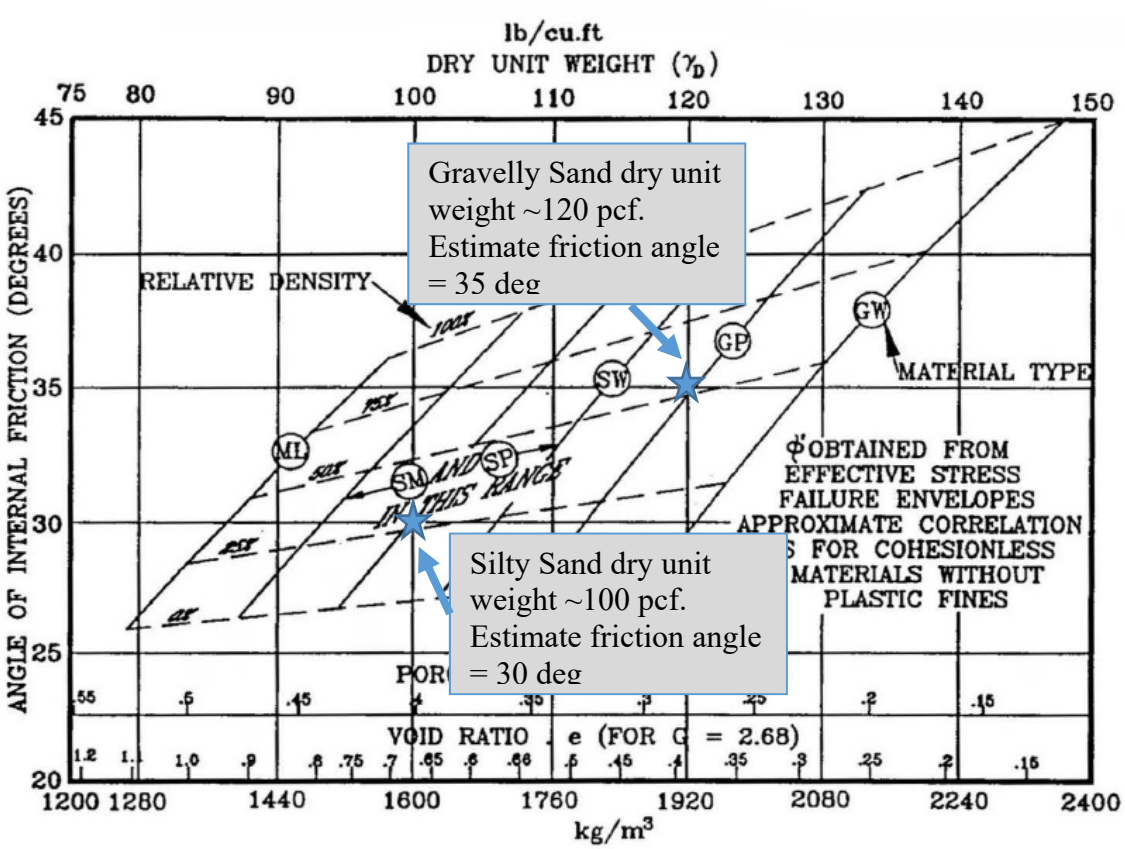


Figure 19. Friction Angle versus Unit Weight Chart (NAVFAC DM-7)

44. Finally, for permeability, the 2018 investigation included falling head tests completed during drilling. These were completed as shown in Table 5 below. Using the values in this table, permeability of the sandy subsurface layers were applied. It is assumed that the clay layers are several orders of magnitude less permeable, so they did not significantly affect the falling head tests.

Table 5. Falling Head tests completed in 2018 near landside toe indicate permeability

Hydraulic conductivity - ASTM D 6391			
Boring	Test Depth (feet)	USCS	K (m/s)
DR-18-01	4-9	OL, CL, SM, SP-GM	4.81E-4
DR-18-03	4-9	OL, CL, SP	2.28E-5
DR-18-05	4-9	OL, CL, SP-GM	4.08E-4

45. A summary of the material properties are included in Table 6 below.

Table 6. Soil Parameter Summary Table

Zone	Wet Unit Weight (pcf)	End of Construction		Long Term		Permeability (ft/s)
		Cohesion (psf)	Phi Angle	Cohesion (psf)	Phi Angle	
Embankment	115	1,000	0	0	29	3.3E-9
Native Clay	115	1,000	0	0	24	3.3E-9
Silty Sand	110	0	30	0	30	7.5E-5
Gravelly Sand	130	0	35	0	35	1.6E-3

46. Using the above parameters, a new stability and seepage analysis were completed as part of this feasibility report.

<u>River Dumoulin / Lisle Levee Slope Stability</u>

47. A typical cross section is shown in Figure 20 below, provided by the Civil Appendix. The top of levee is shown at 667.25 ft NAVD88 with a 10-foot wide crest. The below analysis rounds up to 668 ft NAVD88 to be conservative. The new slopes would be at a 2.5H:1V incline to meet up with the existing ground. The location below is representative of the tallest section, with the toe at elevation 662 ft NAVD88, for a total height of 5.25 feet (modeled below at 6 feet). Using these elevations, as well as, a representative subsurface based off of DR-18-05 with 6 feet of clay, 2 feet of silty sand, and gravelly sand to bedrock around 19 feet below grade, the stability and seepage potential were modelled using GeoStudio.

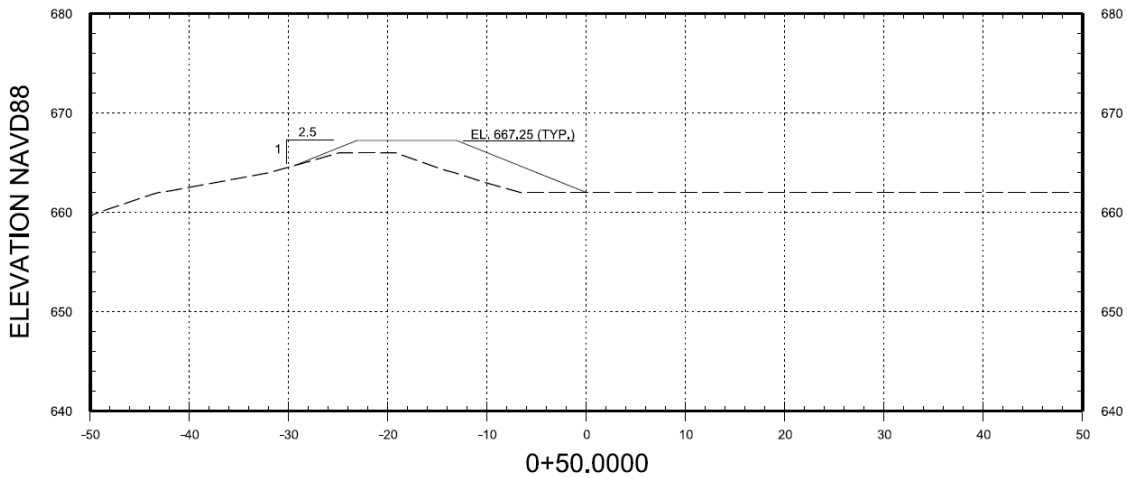


Figure 20. Typical Cross Section of Lisle Levee (Sta. 0+50 on NE levee)

48. Per the descriptions above, the below cross sections were developed to conduct a stability and seepage analysis of the levee. The stability was modeled using an entry and exit slip surface and Morgenstern-Price analysis type. The program ignores slip surfaces within 5 feet of the surface to eliminate surface sliding. The water level was assumed to be at 659 ft NAVD88 for the end of construction and long term analyses, which is the approximate normal flow stream level. The rapid drawdown assumes the two stage Duncan et al., 1990 method with the first stage at the top of the levee, saturating from the top riverside crest to the landside toe. Then the second stage is at the ordinary water level.

49. Additionally, a surcharge load of 300 psf was added to the each analyses to account for any vehicles driving along the crest. A tension crack line was added to the end of construction cases, as well. Properties used for each analysis are shown in the respective figures below, along with the results from SLOPE/W.

Color	Name	Model	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Phi-B (°)
	Existing Levee (EoC)	Mohr-Coulomb	115	0	0	0
	Gravelly Sand	Mohr-Coulomb	130	0	35	0
	Native Clay (EoC)	Mohr-Coulomb	115	1,000	0	0
	New Levee (EoC)	Mohr-Coulomb	115	1,000	0	0
	Silty Sand	Mohr-Coulomb	110	0	30	0

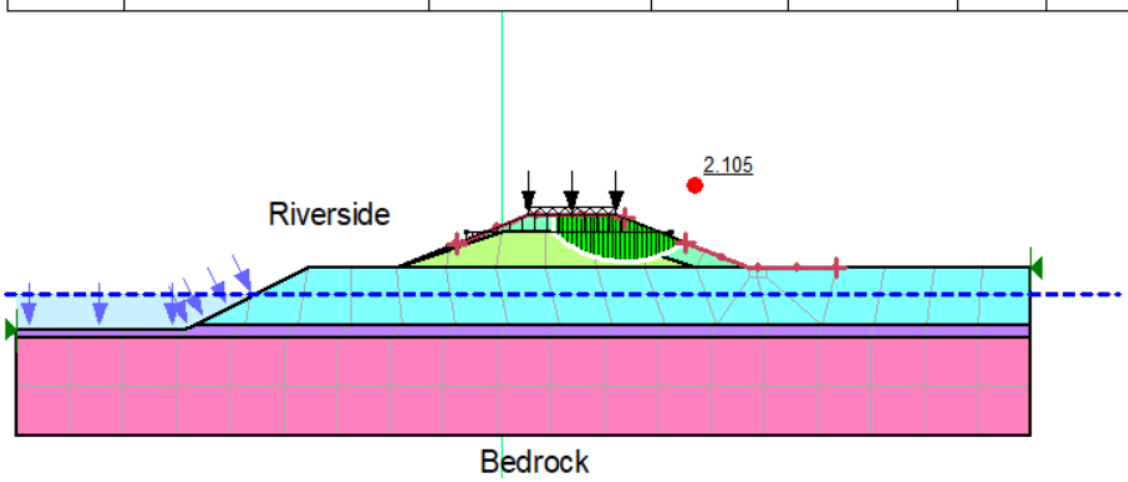


Figure 21**. End of Construction Slope Stability Landside**

50. The tension crack line in Figure **21** was moved up and down to find the critical elevation. The elevation shown above is at 666 ft. At 665 ft, the factor of safety is 2.948. At 667 ft, the factor of safety is 2.468.

Color	Name	Model	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Phi-B (°)
	Existing Levee (EoC)	Mohr-Coulomb	115	0	0	0
	Gravelly Sand	Mohr-Coulomb	130	0	35	0
	Native Clay (EoC)	Mohr-Coulomb	115	1,000	0	0
	New Levee (EoC)	Mohr-Coulomb	115	1,000	0	0
	Silty Sand	Mohr-Coulomb	110	0	30	0

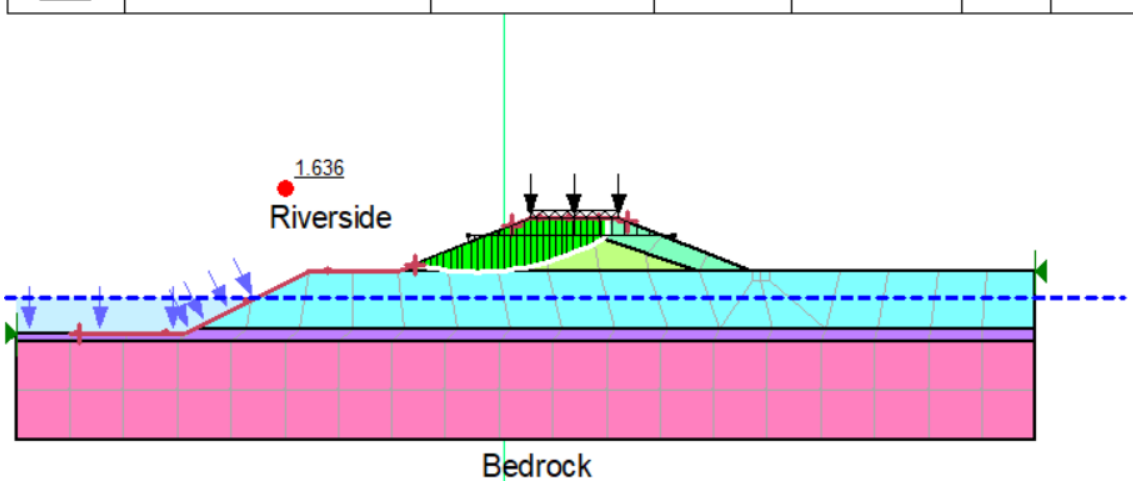


Figure 22. End of Construction Slope Stability Riverside

51. The tension crack line in Figure 22 was moved up and down to find the critical elevation. The elevation shown above is at 666 ft. At 665 ft, the factor of safety is 1.718. At 667 ft, the factor of safety is 2.069.

Color	Name	Model	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Phi-B (°)
	Existing Levee (LT)	Mohr-Coulomb	115	0	29	0
	Gravelly Sand	Mohr-Coulomb	130	0	35	0
	Native Clay (LT)	Mohr-Coulomb	115	0	24	0
	New Levee (LT)	Mohr-Coulomb	115	0	29	0
	Silty Sand	Mohr-Coulomb	110	0	30	0

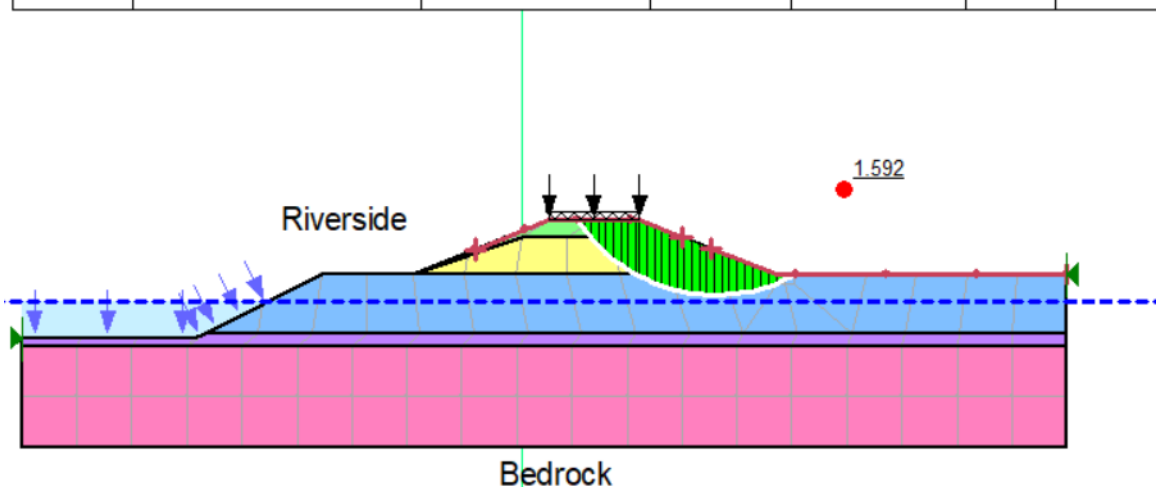


Figure 23. Long Term Slope Stability Landside

Color	Name	Model	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Phi-B (°)
	Existing Levee (LT)	Mohr-Coulomb	115	0	29	0
	Gravelly Sand	Mohr-Coulomb	130	0	35	0
	Native Clay (LT)	Mohr-Coulomb	115	0	24	0
	New Levee (LT)	Mohr-Coulomb	115	0	29	0
	Silty Sand	Mohr-Coulomb	110	0	30	0

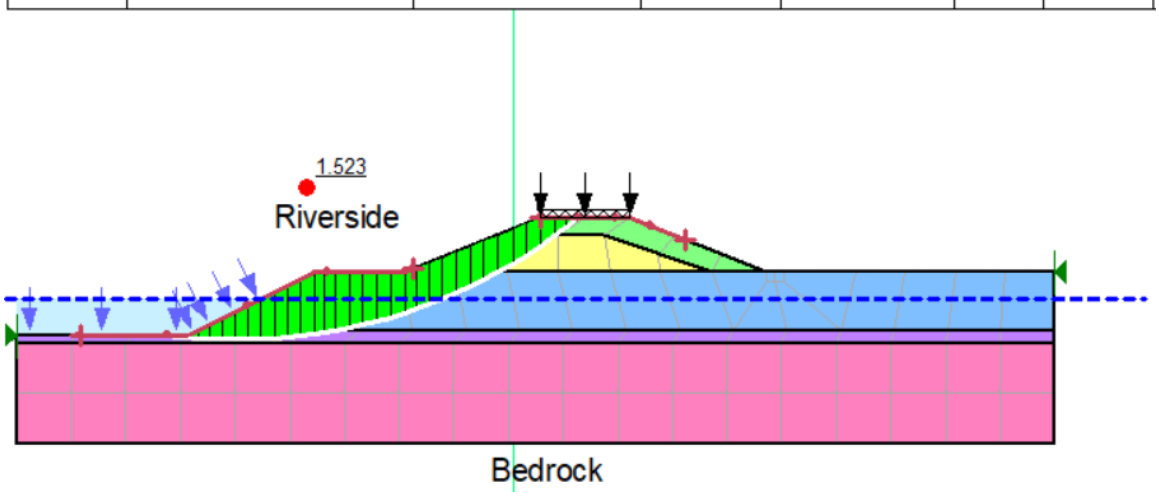


Figure 24. Long Term Slope Stability Riverside

Color	Name	Model	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Phi-B (°)	Cohesion R (psf)	Phi R (°)
	Existing Levee (RDD)	Mohr-Coulomb	115	0	32	0	1,000	0
	Gravelly Sand	Mohr-Coulomb	130	0	35	0	0	0
	Native Clay (RDD)	Mohr-Coulomb	115	0	29	0	1,000	0
	New Levee (RDD)	Mohr-Coulomb	115	0	32	0	1,000	0
	Silty Sand	Mohr-Coulomb	110	0	30	0	0	0

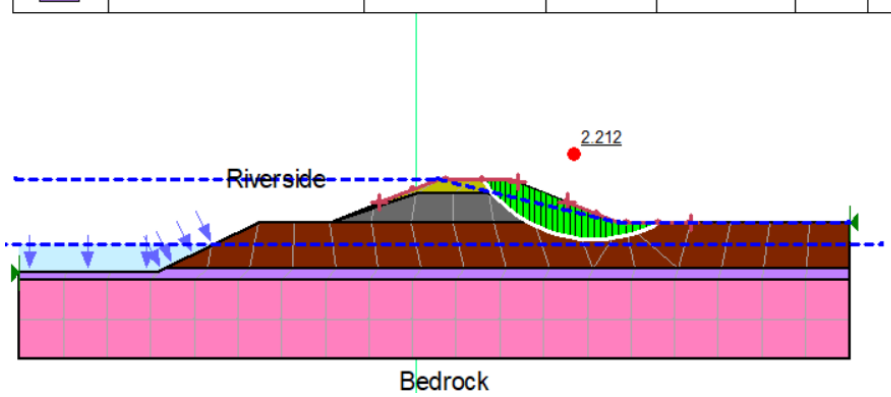


Figure 25. Rapid Drawdown Slope Stability Landside

Color	Name	Model	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Phi-B (°)	Cohesion R (psf)	Phi R (°)
	Existing Levee (RDD)	Mohr-Coulomb	115	0	32	0	1,000	0
	Gravelly Sand	Mohr-Coulomb	130	0	35	0	0	0
	Native Clay (RDD)	Mohr-Coulomb	115	0	29	0	1,000	0
	New Levee (RDD)	Mohr-Coulomb	115	0	32	0	1,000	0
	Silty Sand	Mohr-Coulomb	110	0	30	0	0	0

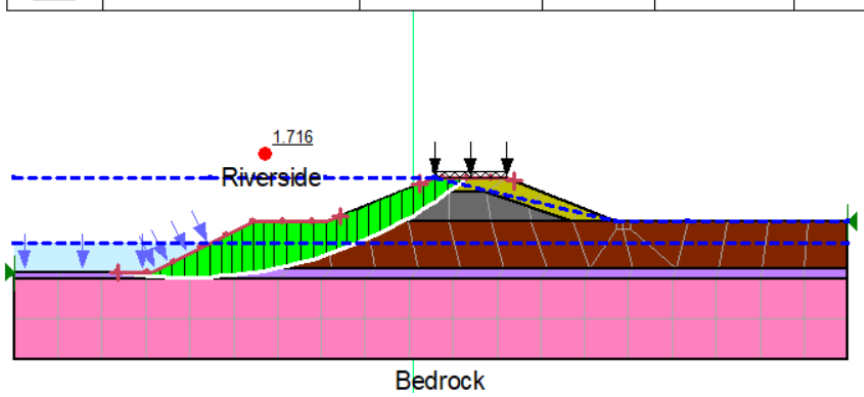


Figure 26. Rapid Drawdown Slope Stability Riverside

52. The six cases are modelled above and summarized in Table 7 below and compared to the recommended safety factors in EM 1110-2-1913, Table 6-1b. All cases are determined to be acceptable.

Table 7. Soil Summary of Slope Stability Analyses of Levee

Slope Stability Case	Calculated Factor of Safety (Landside)	Calculated Factor of Safety (Riverside)	Recommended Factor of Safety
End of Construction	2.105	1.636	1.3
Long Term	1.592	1.523	1.4
Rapid Drawdown	2.212	1.716	1.1

53. The 2012 soils report also included a stability analysis, which was completed on a cross section near Boring B-7 on the east bank, just south of Ogden Ave. Three cases were run for the levee stability; normal conditions, steady seepage from long term flood, and sudden drawdown. No cohesion was assumed and the analysis was completed via the Modified Bishop's Method by hand. A summary of the results are in Table 8 below, which also indicate stable slopes.

Table 8. Slope stability calculated safety factors for River Dumoulin Levee near Boring B-7 on landside indicates no issue

Case	Calculated Safety Factor	Minimum Safety Factor
Normal Flow (normal water level)	2.416	1.5
Steady Seepage (fully saturated, water at top of levee)	2.296	1.4
Sudden Drawdown (fully saturated, normal water level)	1.941	1.0-1.2

River Dumoulin Levee Seepage

54. In order to ensure the levee design adequately addresses any seepage or uplift concerns, the program SEEP/W was used. The parameters developed in Table 6 were input and uses the same cross section as the above stability analysis. Also, the case is assumed to be steady-state seepage where the water is at the top of the levee (elevation 668 ft NAVD88) for a sufficiently long time to completely saturate the subsurface. This is overly conservative, as the actual flood duration for this river is less than a week per the HH Appendix. On the landside, the levee slope and ground surface are considered potential seepage faces, while the vertical boundary condition has a constant head equal to the ground surface at 662 ft NAVD88.

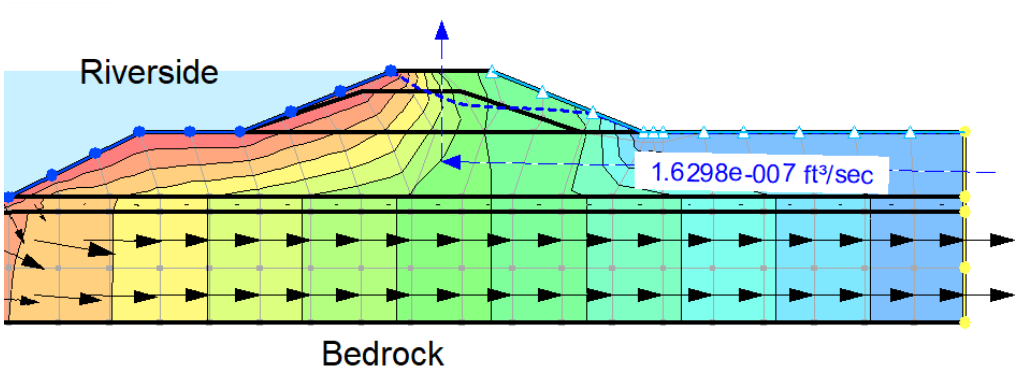


Figure 27. Levee Seepage Analysis

55. As shown in Figure 27 above, the amount of seepage is 1.6e-7 cf/sec. This equates to about 0.007 gallons/min for 100 feet. According to the USACE Waterways Experiment Station Publication, "Investigation of Underseepage and Its Control – Lower Mississippi River Levees", Technical Memorandum No. 3-424, Vol. 1, October 1956, an underseepage flow of less than 5 gpm per 100 ft is considered light seepage.

56. The 2012 report also calculated seepage and with a rate of 1.26 ft^3/day/foot. This translates to about 0.65 gal/min per 100 feet. The ERA report in Attachment 2 classifies this amount of seepage as unacceptable and suggests methods to cut off paths with sheetpile, grouting, or clay cap. However, as stated in the previous paragraph, seepage under 5 gpm per 100 feet is considered light. Therefore, even though the 2012 analysis resulted in significantly higher seepage than the USACE analysis, neither indicate that there needs to be any mitigation.

57. The exit gradient (i_e) is calculated by the program as 0.25 in the Y direction, one foot from the levee toe (ignoring the first foot is normal practice as the model overstates the gradients at significant surface changes). This exit gradient is compared to the Critical Gradient (i_c), defined as $(\gamma_{sat} - \gamma_w)/\gamma_w$ which is the weight ratio of the soil. Using the unit weight of clay (115 pcf) and water (62.4 pcf), $i_c = 0.84$. The Factor of Safety is defined as i_c/i_e, which is 0.84/0.25 = 3.36. This is greater than the 1.5 factor of safety recommended ETL 1110-2-569, dated May 2005.

<u>River Dumoulin Settlement</u>

58. The settlement analysis in the 2012 report determined that the existing levee would've created about 1 inch of settlement based on the subsurface soils. However, per the 2013 Post Flood Memo, there are several locations which are lower than the design elevation by as much as 2 feet. This was likely not caused by settlement, but by erosion, or some man-made method such as a path or encroachment. The 2018 Strata investigation encountered some organic clays which may have a higher risk of settlement. However, strength tests on this material indicated it was stiff, greater than 1 tsf in unconsolidated compression. If this material were to settle, most settlement has likely been realized since the existing levee is 50+ years old. Additionally, adding another 1-3 feet of fill per the recommended plan is relatively insignificant.

<u>River Dumoulin High Ground</u>

59. The levee alignment was checked to ensure that high ground tiebacks exist for the Lisle Levee. Figure 28 below shows the north portion of the proposed levee and the existing contours. The northwest end ties back to high ground, while the northeast end ties back to IL-53, which is also high ground. The northeast system south end ties into IL-53, as well which is high ground. Finally, Ogden Ave bridge is higher than the top of levee, so it does not require a closure.

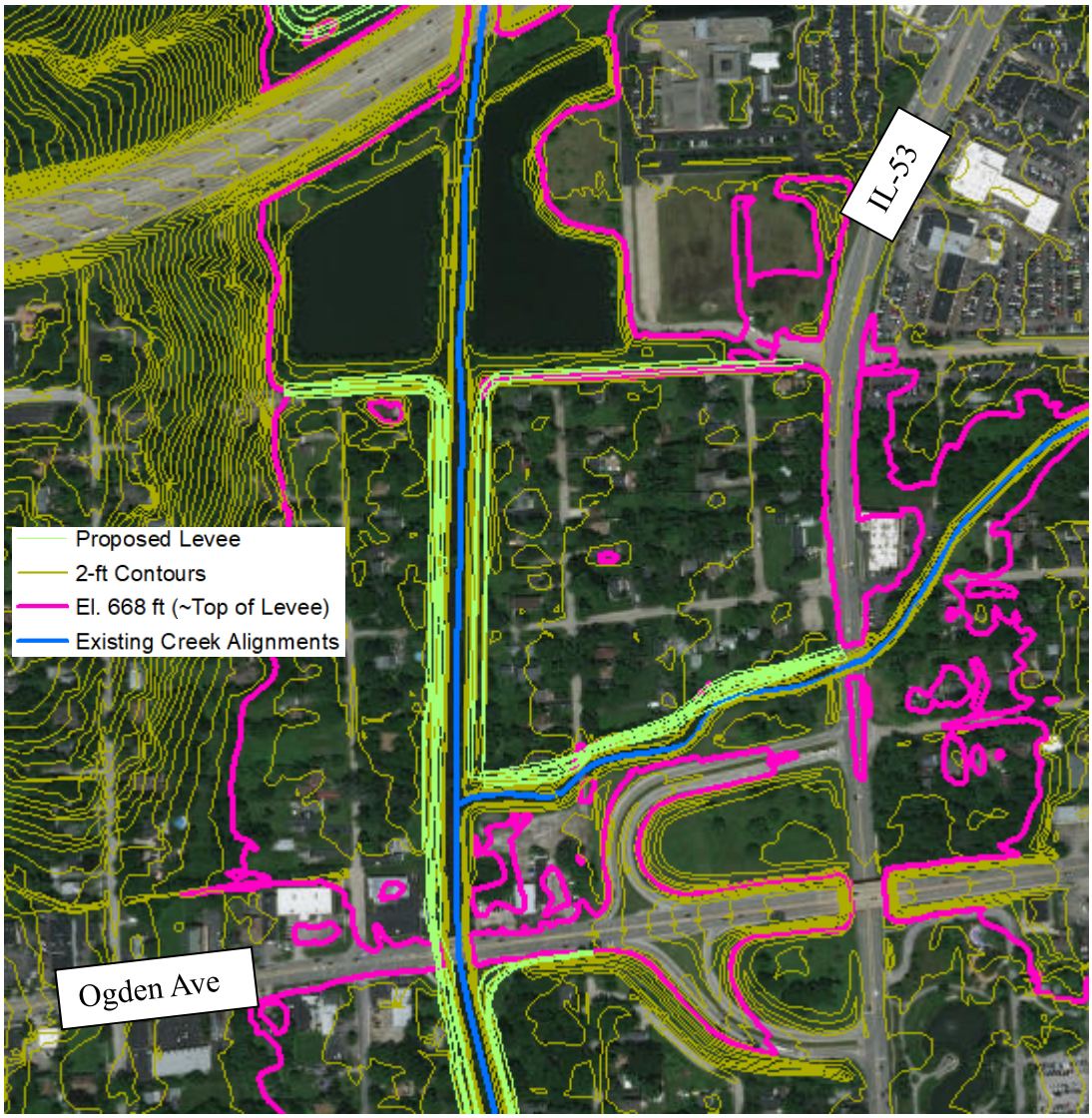


Figure 28. Contour Map of North section showing adequate tiebacks

60. In the southern section, both the left and right bank south ends tie into the existing BNSF railroad embankment. The alignment crosses one road, Burlington Ave, which is above the design height of the levee. However, the IL-53 underpass under the BNSF railroad would require a closure structure to prevent end-around inundation. The cost analysis assumes a swing gate-type closure about 2-3 feet tall would be implemented at this location. This type of closure was selected as it can be installed quickly, as IL-53 is a major road and closing it early for a sandbag closure would be detrimental to traffic.

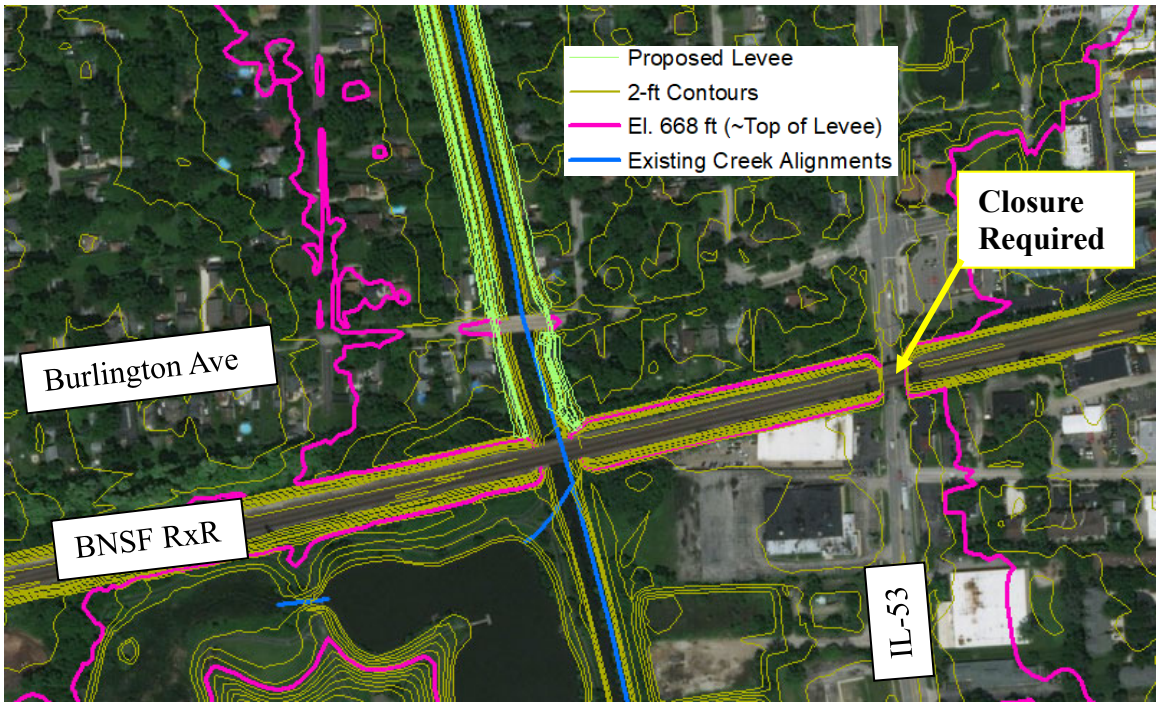


Figure 29. Contour Map of South section showing tiebacks and closure location

61. The BNSF railroad embankment would act as a non-project feature that will require additional investigation to ensure it can be relied upon as it acts as a levee during high water. Based on a preliminary evaluation, the railroad embankment is expected to function during a high water event. A cross section was developed as shown in Figure **30** showing the existing dimensions of the railroad embankment compared to the proposed Lisle Levee cross section. The railroad embankment is significantly larger than the proposed levee, so instability and seepage present low risk.

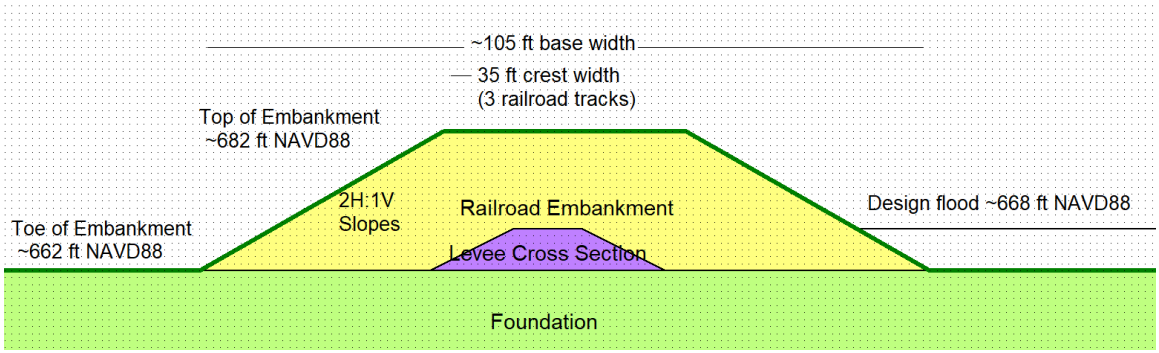


Figure 30**. BNSF Railroad cross section compared to Lisle Levee**

River Dumoulin Overtopping Protection

62. There are four methods where the landside of a levee would be inundated, as shown in the Figure 31 below. The risk of breach prior to overtopping and malfunction of levee system components are mitigated with recommendations made in the rest of this appendix. Overtopping without breach is an accepted risk, as no levee is constructed to handle all floods. Overtopping with breach, however, should be addressed.

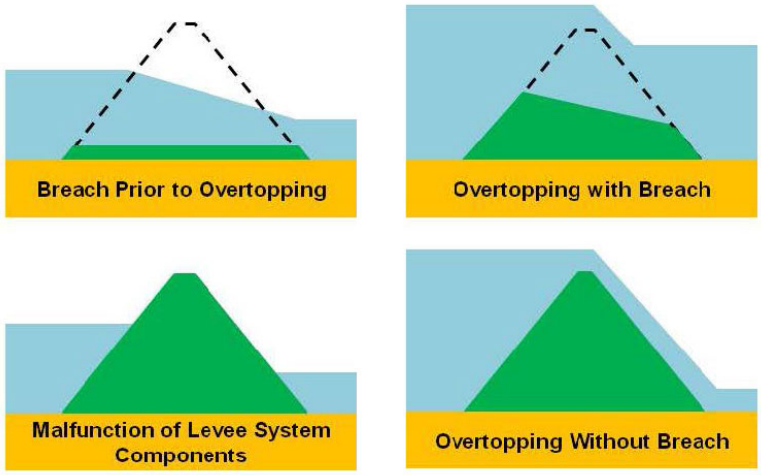


Figure 31. Landside inundation methods for a levee

63. It can be beneficial in some cases to consider lining of the levee crest at the lowest portion of the levee that is subjected to the greatest risk of overtopping. However, in this case, the levee crest is uniformly low for a significant distance; therefore, there is no one relatively short levee portion where overtopping flows are concentrated and can be controlled without significantly increasing the construction cost for a liner system. Furthermore, the proper design of such a liner system would have to consider the fact that such a system can introduce additional risk with respect to seepage pathways under the liner system, as well as overtopping flow accelerations on liner surfaces that can promote added stresses to the levee on the downstream slope and toe. These design considerations would require design countermeasures that would add significantly to the cost of the levee restoration. In addition, the levee armor feature would be intended to reduce the time of breach formation and the associated risks of the development of a flood wave through a breach. The life safety risk associated with a faster developing breach is low at this site due to the limited number of residents that would be affected, along with the fact that those affected would be inundated by only about 2 feet of water. A levee crest lining was therefore not considered for the levee improvements design.

River Dumoulin Summary

64. Based on the above analysis, the Lisle (River Dumoulin) Levee can be suitable to reduce flood risk to the crest elevation of the levee with 10-foot wide crest, 2.5:1 side slopes, and no seepage mitigation. Additional analysis is necessary for specific cross sections of the levee to ensure that the levee can perform across the entire stretch. These may include additional subsurface investigations in areas that were inaccessible to the previous investigations due to vegetation, utilities, etc. Also, a real estate agreement should be completed to allow USACE access to the site to conduct an updated inspection. For the final project, permanent easements should be established on the levee and toes to facilitate inspection/flood fighting, as well as, prevent damages to the project. The gravity drains, pipes, and flap gates should be inspected to determine their adequacy. Additional inspection of the BNSF railroad embankment is necessary to ensure it does not increase the risk of the project. The proposed plan of constructing the levee to the 100-year flood likely would not meet FEMA accreditation.

LACEY CREEK RESTRICTION

65. This project is located southeast of the intersection of Butterfield Road and State Route 53 in Lisle, Illinois, just upstream of the confluence with the East Branch of the DuPage River as shown on Figure 32. The project consists of a berm and culvert to reduce the flow of Lacey Creek into the East Branch of the DuPage River. The berm would have a maximum height of about 8 ½ feet. There are existing culverts and a berm across the creek, but it is only about 4 feet high and thick with grassy vegetation. The existing berm can be seen just northwest of the proposed berm below.

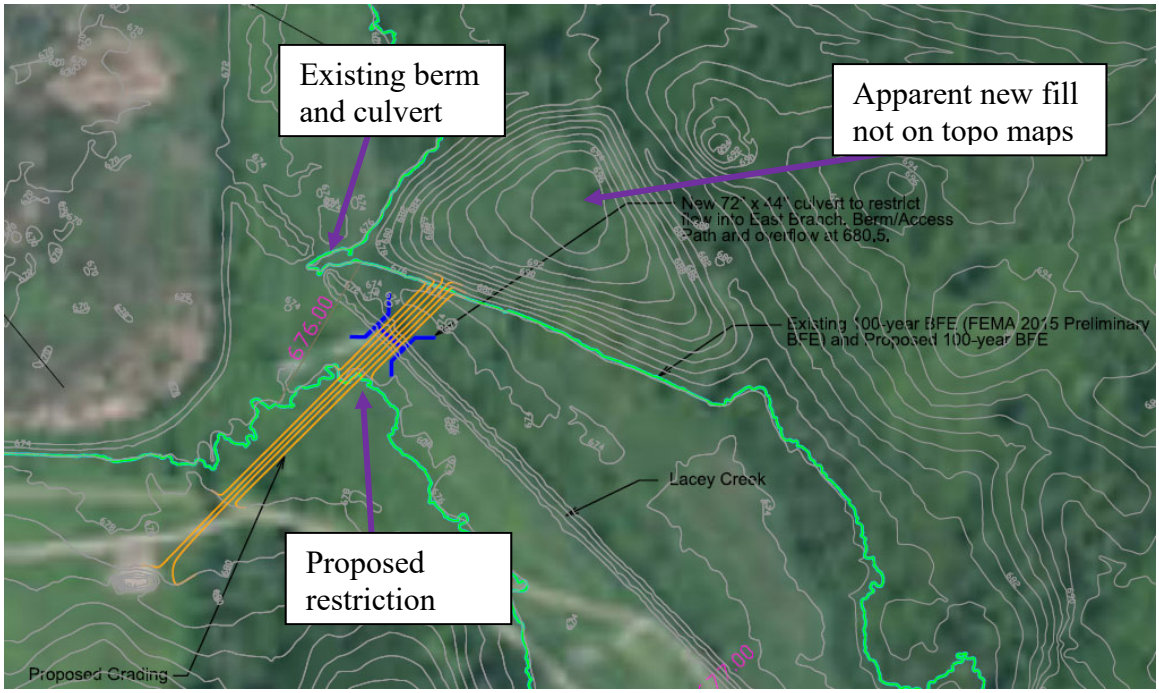


Figure 32. Lacey Creek Restriction proposed alignment and existing features

66. ISGS logs were investigated around the Lacey Creek Restriction site, but there are only two logs within ½-mile of the site and neither log has any subsurface data included. The NRCS soil map (Attachment 1) indicates the majority of the area is Sawmill silty clay loam. The depth to bedrock is about 50-100 feet below grade, according to Figure 2.

67. Additionally, historic topographic logs were investigated for this project. The first available is from 1908.

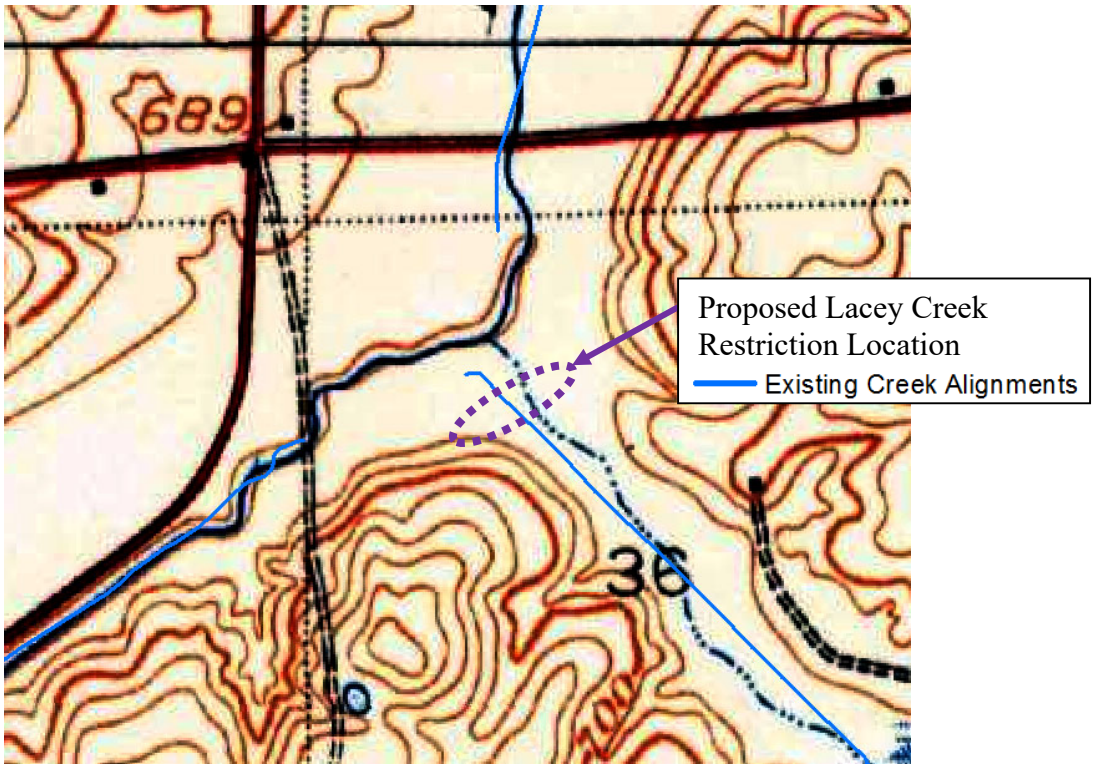


Figure 33. Lacey Creek Restriction area with 1908 Topographic Map showing old versus new river alignment

68. The 1908 topographic map indicates the rivers and streams in this area meandered more than they do now. There is also a south-southeast road that does not exist anymore branching from the intersection of State Route 53 and Butterfield Road.

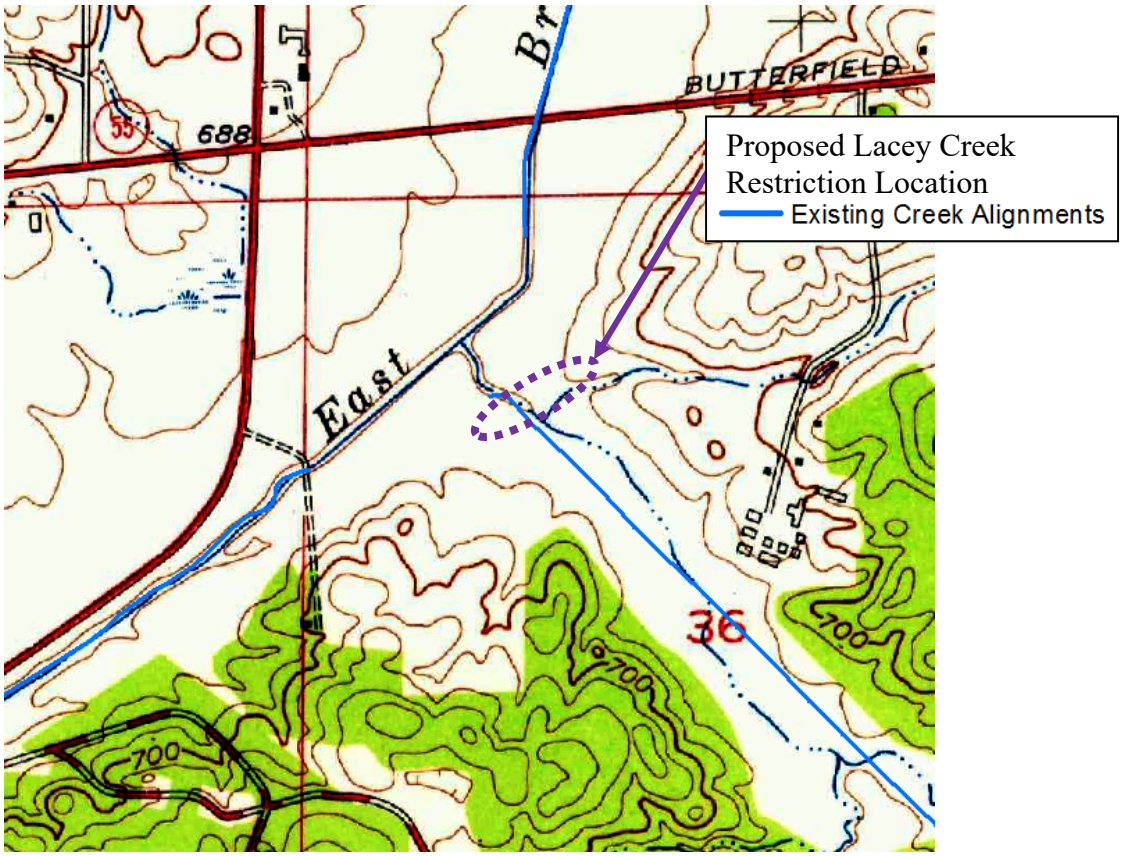


Figure 34. Lacey Creek Restriction Area with 1954 Topographic Map showing old versus new river alignment

69. From 1908 to 1954, the East Branch has been straightened to roughly the existing conditions, minus the ponds. A smaller tributary is added to the map, although the topography on the 1908 map indicate that this small tributary may have been there, just not drawn. This tributary is near the proposed alignment of the Lacey Creek Restriction.

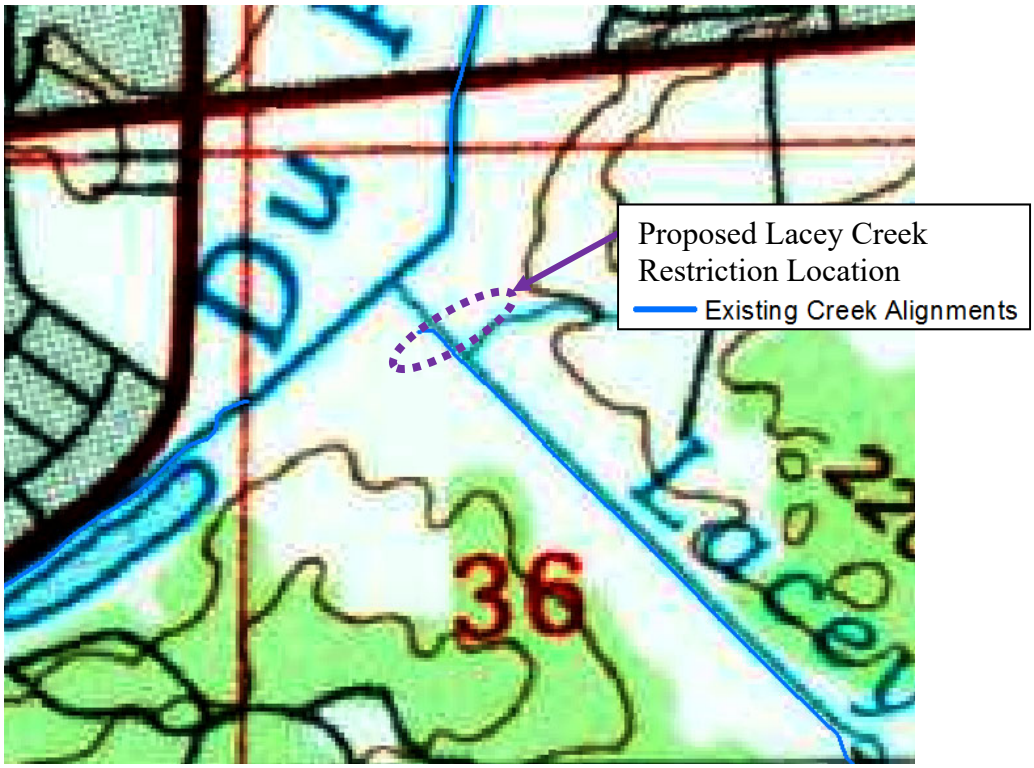


Figure 35. Lacey Creek Restriction Area with 1985 Topographic Map showing old versus new river alignment

70. From 1954 to 1985, the Lacey Creek has been channelized. Also, a pond has been created downstream of the confluence.

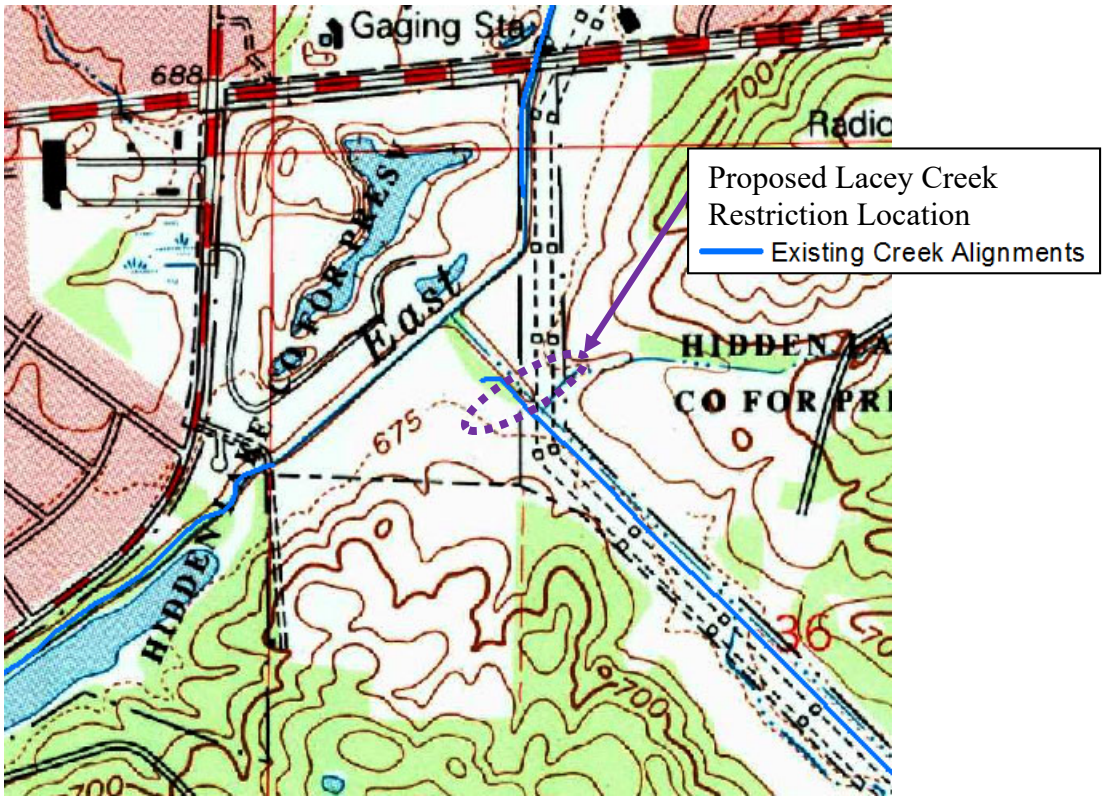


Figure 36. Lacey Creek Restriction Area with 1993 Topographic Map showing old versus new river alignment

71. From 1985 to 1993, the pond at the confluence was added.

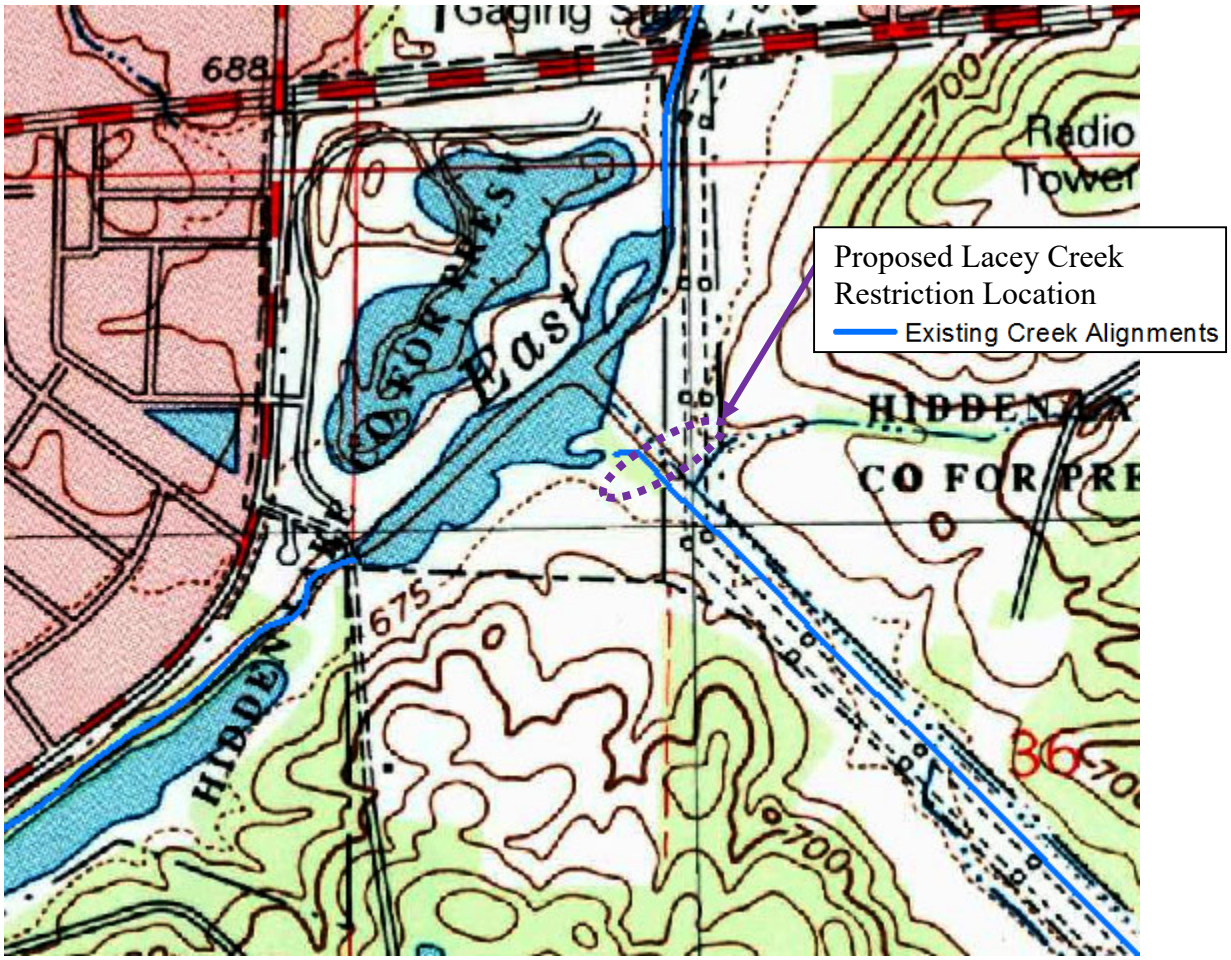


Figure 37. Lacey Creek Restriction Area with 1998 Topographic Map showing old versus new river alignment

72. From 1993 to 1998, the pond along the alignment of the East Branch has been expanded. Also, a pond has been added at the downstream end of Lacey Creek as it connects to the East Branch.

73. These topographic maps indicate the original Lacey Creek meandered away from the current channel underneath the proposed berm. This may have left softer or coarser grained soils in those locations. Also, the tributary shown on the maps from 1954 on may also have deposited some softer/coarser materials, as well. Finally, the fill pile shown on the recent topography in Figure 32 should be investigated to determine the contents.

Lacey Creek Design

74. Without any subsurface information, no design analysis was completed for the Lacey Creek Restriction. It is assumed the berm would be constructed out of compacted clay with a 10-ft wide crest and 2.5H:1V slopes (same as Lisle Levee). The Lacey Creek Restriction would also include a concrete spillway 50 feet wide to reduce the risk of erosion during an overtopping event.

75. Since the restriction would hold back water, there is potential for the Lacey Creek Restriction to be classified as a dam. Per USACE ER 1110-2-1156, "Safety of Dams – Policy and Procedures" dated 31 March 2014, a dam is defined as an artificial barrier used to store, control, or divert water. It must be either 25 feet tall or store more than 50 acre-feet. This project is less than 25 feet tall, but it would store greater than 50 acre-feet. Therefore, it is likely that this project would qualify as a dam and require additional analysis and permitting.

76. Locally, the Illinois Department of Natural Resources – Office of Water Resources (IDNR-OWR) oversees and permits dam construction/rehab/removal. Per 17 Illinois Adm. Code, Chapter I, Section 3702, "Construction and Maintenance of Dams" dated December 31, 2014, their definition of a dam is similar to USACE. There are three criteria and if the structure meets any of them, it is considered a dam. The criteria are:

(i) The drainage area of the proposed dam is 6,400 acres or more in rural area or 640 acres or more in an urban area; or

(ii) The dam is 25 feet of more in height, provided that the impounding capacity is greater than 15 acre-feet; or

(iii) The dam has an impounding capacity of 50 acre-feet or more, provided that the dam height is greater than 6 feet.

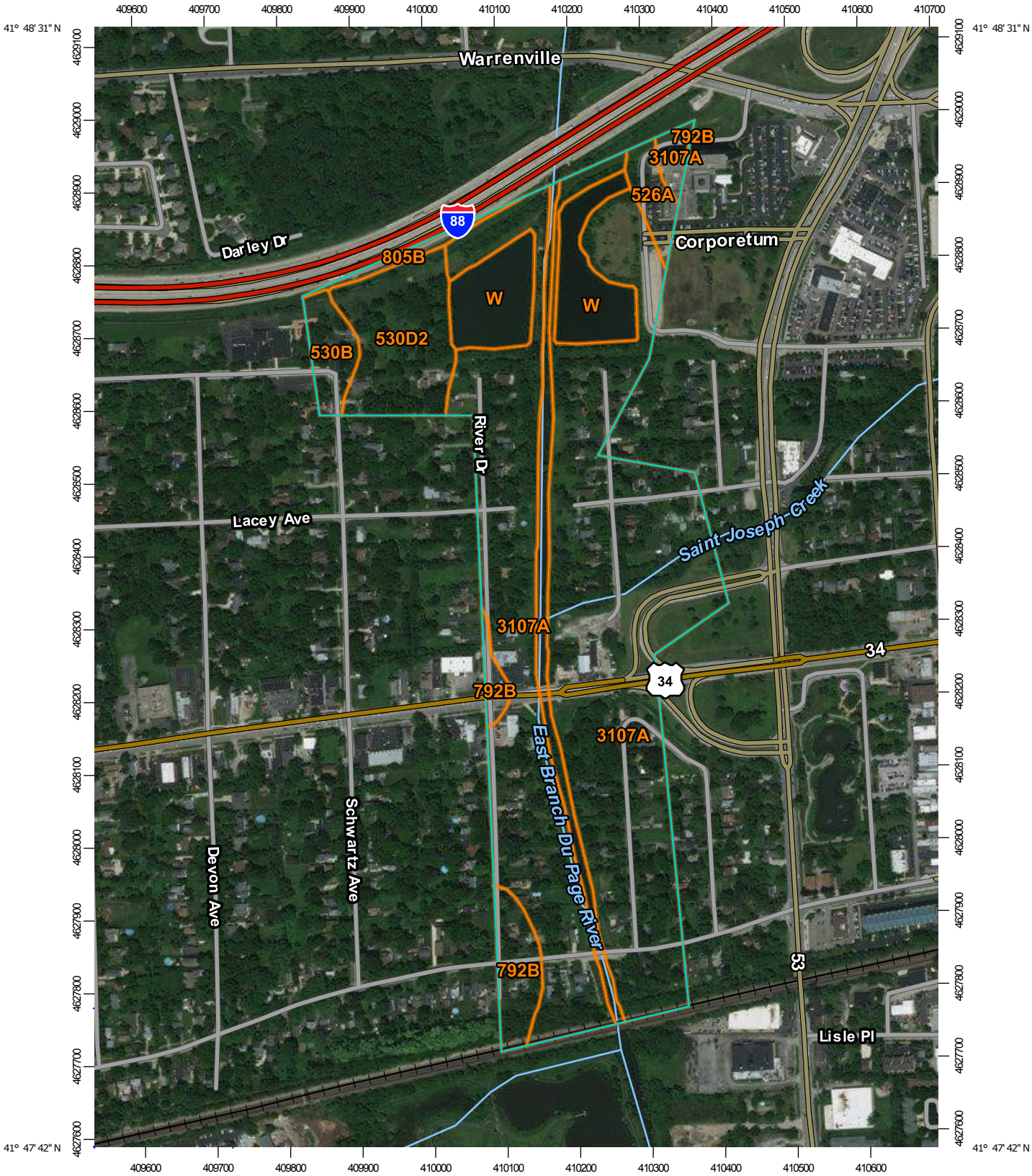
77. The Lacey Creek project likely meets (iii), so it would classify as a dam per local definition, as well. The IDNR-OWR divides dams into three Classes (I, II, and III) which depends on the life safety and economic consequences downstream should the dam fail. The highest risk is Class I. There are some structures downstream, but it is not clear if they would be affected by a breach as they are about ½ to 1 mile downstream, on the opposite side of IL-53. A breach analysis should be completed to determine the risk associated with this structure. A Class can be assigned based on that analysis, which will affect the robustness of design, permit application, operation, maintenance, and emergency actions related to the project.

Lacey Creek Summary

78. Since there is no subsurface data and therefore no stability/seepage/stability analysis for the Lacey Creek Restriction, there is additional risk that this structure may require additional features not included in the estimate. These may include seepage mitigation such as a toe drain, settlement considerations if the subsurface is soft, and/or shallower slopes if the subsurface is unsuitable. Soil borings along the alignment early in the design phase will better determine the features required for a fully functional project. Additional borings should be completed in the tiebacks, particularly the apparent spoil pile on the right abutment to determine the contents. Additional analysis should be completed to determine the risk associated with constructing a new dam.

Soil Map—DuPage County, Illinois

Lisle Levee



Map Scale: 1:7,500 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 100 200 400 600

Feet: 0 350 700 1400 2100

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 16N WGS84

Lisle Levee

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Map Unit Polygons

Soil Map Unit Lines

Soil Map Unit Points

Special Point Features

Blowout

Borrow Pit

Clay Spot

Closed Depression

Gravel Pit

Gravelly Spot

Landfill

Lava Flow

Marsh or swamp

Mine or Quarry

Miscellaneous Water

Perennial Water

Rock Outcrop

Saline Spot

Sandy Spot

Severely Eroded Spot

Sinkhole

Slide or Slip

Sodic Spot

Spoil Area

Stony Spot

Very Stony Spot

Wet Spot

Other

Special Line Features

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:12,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: DuPage County, Illinois
Survey Area Data: Version 13, Sep 20, 2017

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Feb 10, 2016—Oct 8, 2016

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

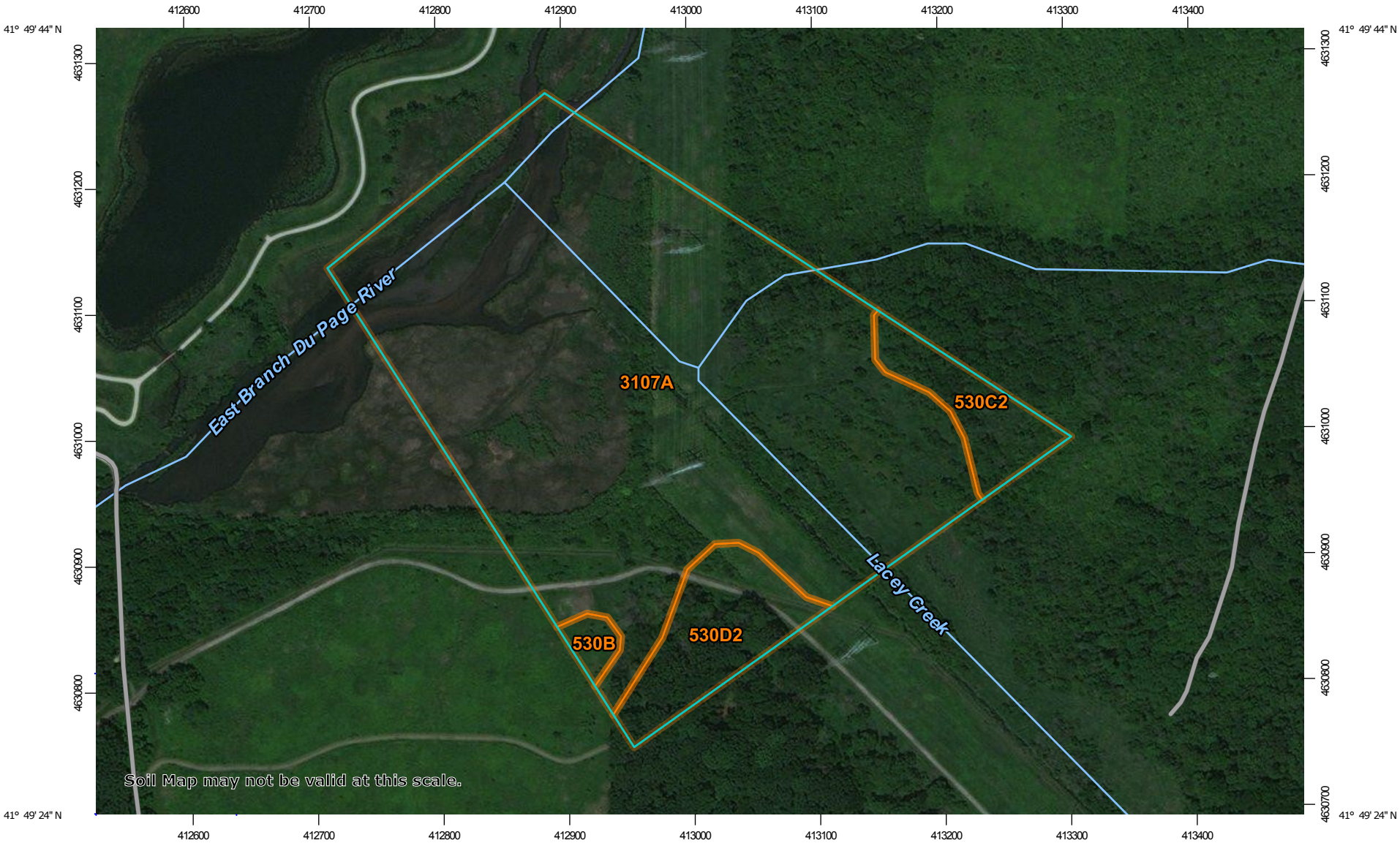
Lisle Levee

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
526A	Grundelein silt loam, 0 to 2 percent slopes	1.6	1.8%
530B	Ozaukee silt loam, 2 to 4 percent slopes	2.2	2.4%
530D2	Ozaukee silt loam, 6 to 12 percent slopes, eroded	7.3	8.2%
792B	Bowes silt loam, 2 to 4 percent slopes	3.4	3.9%
805B	Orthents, clayey, undulating	0.8	0.9%
3107A	Sawmill silty clay loam, heavy till plain, 0 to 2 percent slopes, frequently flooded	62.1	70.1%
W	Water	11.3	12.7%
Totals for Area of Interest		**88.7**	**100.0%**

Soil Map—DuPage County, Illinois

Lacey Creek Restriction



Map Scale: 1:4,400 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 50 100 200 300

Feet: 0 200 400 800 1200

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 16N WGS84

Lacey Creek Restriction

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features

- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:12,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: DuPage County, Illinois
Survey Area Data: Version 13, Sep 20, 2017

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Feb 10, 2016—Oct 8, 2016

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Lacey Creek Restriction

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
530B	Ozaukee silt loam, 2 to 4 percent slopes	0.4	1.1%
530C2	Ozaukee silt loam, 4 to 6 percent slopes, eroded	1.9	5.1%
530D2	Ozaukee silt loam, 6 to 12 percent slopes, eroded	3.0	8.0%
3107A	Sawmill silty clay loam, heavy till plain, 0 to 2 percent slopes, frequently flooded	31.7	85.8%
Totals for Area of Interest		**37.0**	**100.0%**

ENGINEERING RESOURCE ASSOCIATES, INC.
Consulting Engineers, Scientists & Surveyors

Jason Elias
Village of Lisle
925 Burlington Avenue
Lisle, IL 60532

SUBJECT: RIVER DUMOULIN LEVEE STUDY - GEOTECHNICAL ENGINEERING ANALYSIS

Dear Mr. Elias:

Engineering Resource Associates, Inc. has completed the geotechnical engineering analysis for the River Dumoulin Levee Study, between Maple Avenue and Middleton Avenue along the East Branch DuPage River, in Lisle, Illinois. This report describes the subsurface exploration procedures, laboratory testing, and geotechnical recommendations for project construction. A Location Map (Appendix 1), Approximate Boring Location Map (Appendix 2), Boring Logs (Appendix 3), Slope Stability Analysis (Appendix 4), Settlement Analysis (Appendix 5), and the Seepage Analysis (Appendix 6) are included as Appendices in this report.

We appreciate this opportunity to be of service to the Village of Lisle during the planning phase of this project. If you have any questions with regard to the information and recommendations presented in this report, or if we can be of further assistance to you in any way during the design or construction of this project, please do not hesitate to contact us.

Respectfully,

Frauenhoffer and Associates
A Division of Engineering Resource Associates, Inc.

Jake Wolf, P.E.
Project Manager / Design Engineer

Warrenville
3s701 West Avenue, Suite 150
Warrenville, IL 60555
T 630.393.3060
F 630.393.2152

Geneva
501 West State Street, Suite 203
Geneva, IL 60134
T 630.262.8689
F 630.262.8698

Chicago
10 South Riverside Plaza, Suite 1800
Chicago, IL 60606
T 312.683.0110
F 312.474.6099

Champaign
3002 Crossing Court
Champaign, IL 61822
T 217.351.6268
F 217.355.1902

GEOTECHNICAL ENGINEERING ANALYSIS REPORT

RIVER DUMOULIN LEVEE STUDY

BETWEEN MAPLE AVENUE AND MIDDLETON AVENUE

LISLE, ILLINOIS

FOR

VILLAGE OF LISLE

May 18, 2012

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EXECUTIVE SUMMARY

The subsurface conditions encountered during our exploration and ERA's conclusions and recommendations are summarized below. Details of our conclusions and recommendations are discussed in the following sections and in the Appendix of this report.

Subsurface Exploration

A total of eleven (11) soil borings (B-1 through B-7, B-11, B-14 through B-16), extending to depths of approximately 20 to 30 feet below existing grade, were located along the River Dumoulin Levee. All but two of the borings (B-2 and B-15) were performed along the centerline of the levee crest, with the aforementioned two borings being performed near the toe of the levee due to inaccessibility of truck mounted rig along the crest.

All borings were found to have a similar soil stratigraphy and generally exhibited two distinct soil types. The top 8' to 12' of each boring generally consisted of Silty or Sandy Clay material with Pebbles. Below this material, the second layer generally consisted of Sand and/or Broken Rock, which continued to the bottom depth of boring (between 20' and 30'). Water levels were generally encountered within the transition area between the two layers at 8' to 12', corresponding to the adjacent river water elevation. Two borings (B-4, B-6) had a buried Clay layer several feet thick at 20' to 25' depth.

Groundwater levels were generally encountered at depths between 8' and 12', corresponding to the adjacent river water surface elevation. Three borings (B-3, B-6, and B-16) encountered no groundwater during or after completion of drilling.

Unconfined compressive strength tests were performed in the field on cohesive soil samples with the use of a calibrated hand penetrometer. Of the 99 samples collected, only 42 were cohesive enough to perform the field compression test using the penetrometer. For the samples that were tested, the values ranged from 0.25 tsf to 4.0 tsf.

Laboratory Testing

Unconfined compression tests and moisture content tests were performed on the soil samples in the laboratory. Of the 99 samples collected, only 16 were cohesive enough to perform the lab compression test. For the samples that were tested, the values ranged from 0.6 tsf to 4.9 tsf. Two samples exhibited a bulge failure; six samples exhibited a split failure; two samples exhibited a shear failure; and six samples exhibited a combination bulge/split failure. Moisture content ranged from 4.4% to 56.3%.

Performance Analyses

Analyses relating to material performance during flood conditions were performed using selected representative samples. These analyses included a slope stability analysis, settlement analysis, and seepage analysis.

Slope Stability Analysis: A factor of safety greater than 1.0 indicates slope stability, while a factor of safety less than 1.0 indicates instability. Three trial failure surfaces were calculated at the approximate location of Boring B-7 near Station 153+00. For comparison, the minimum factors of safety as recommended by the US Army Corps of Engineers for existing levees are also included.

	Calculated FS	Minimum FS
CASE 1: Normal Low Flow Conditions	2.416	1.0 (for stability)
CASE 2: Steady Seepage	2.296	1.4
CASE 3: Sudden Drawdown	1.941	1.0 - 1.2

Settlement Analysis: A settlement analysis for the foundations soils of the existing levee was performed near the location of Boring B-7 approximately at Station 153+00. The results of our analysis indicate that the consolidation settlement of the silty clay material beneath the embankment can be expected to settle approximately 1" due to the load from additional embankment fill in the area of Station 153+00.

Seepage Analysis: A seepage analysis was performed on the levee using the calculations and equations found in the US Army Corps of Engineers Manual on Design and Construction of Levees. Typical soil permeability parameters were assigned to the generalized soil layers of the levee cross section at the approximate location of Boring B-7 near Station 153+00. Seepage through the levee was calculated to be approximately 1.46×10^{-5} cubic feet per second per foot of levee, or 1.26 cubic feet per day, during high water conditions.

Summary

Based on the results of this Geotechnical Engineering Analysis, the River Dumoulin Levee is largely composed of unconsolidated materials that are conducive to seepage during high water and flood conditions, and therefore may promote destabilization of the levee embankment during flood events.

The results of the soil boring investigation indicate that no highly compressible soils were encountered. Because the levee was built so many years ago, the majority of the consolidation settlements of embankment fill and foundation soils have already taken place. However, the addition of newly compacted embankment fill during a levee rehabilitation project, especially anything greater than 12" in depth, will likely cause additional settlements due to the added load from the fill and required compaction efforts.

Any soil placed as engineered fill should be an approved material, free of organic matter or debris, be a non-frost susceptible soil, and have a liquid limit and plasticity index less than 40 and 15, respectively. The project geotechnical engineer should be consulted to determine the suitability of off-site/on-site materials for use as engineered fill, prior to use or placement.

The results of the seepage analysis indicated problematic seepage through the levee foundation materials. The best recommendation for eliminating seepage problems and subsequent piping is a cutoff beneath the levee to block seepage through the pervious foundation strata. This cutoff can consist of either steel sheetpiling driven down to bedrock, construction of a bentonite slurry wall down to bedrock or pressure injection grouting.

PROJECT OVERVIEW

Introduction

The project consists of an evaluation of existing levee embankment conditions for the River Dumoulin Levee Study. This report presents the results of our subsurface exploration and engineering services. We understand that the levee was originally built in the 1960's; however, Record Drawings of the constructed improvements are not available.

The existing levee is located along the East Branch DuPage River between Maple Avenue and Middleton Avenue, in Lisle, Illinois (**Appendix 1-Location Map**). The levee extends approximately 7,700 feet along the east bank from Maple Avenue to Middleton Avenue, and approximately 3,700 feet along the west bank from the railroad tracks to Middleton Avenue.

Scope of Work

A total of eleven (11) soil borings (B-1 through B-7, B-11, B-14 through B-16), extending to depths of approximately 20 to 30 feet below existing grade, were located in accessible locations for the drilling rig along the River Dumoulin Levee (**Appendix 2 - Approximate Boring Locations**). The number of borings, depths of borings and boring locations were selected by ERA. Field and laboratory testing were performed on all soil borings. Additionally, analyses relating to material performance during flood conditions were performed using selected representative samples.

Purpose of Exploration

The purpose of this exploration was to explore the soil and groundwater conditions at the site and to develop engineering recommendations to guide design and construction of the project. We accomplished this by:

1. Drilling eleven (11) soil borings to depths of approximately 20 to 30 feet below the existing ground surface along the existing levee to explore the subsurface soil and groundwater conditions;

2. Performing laboratory tests on selected representative soil samples from the borings to evaluate pertinent engineering properties; and

3. Analyzing the field and laboratory data to evaluate appropriate engineering and stability properties of the levee.

FIELD AND LABORATORY PROCEDURES & RESULTS

Site Conditions

The soil borings were located in the field by an ERA Field Engineer based on the proposed boring site plan. As required by the State of Illinois, the driller notified Illinois One-Call System, JULIE, to verify underground utilities in the vicinity of the project site prior to drilling operations. Sixteen soil boring locations were planned (B-1 thru B-16) at approximately five hundred foot intervals along the crest of the levee between Maple Avenue and Middleton Avenue on the east side of the river and between the railroad tracks and Middleton Avenue on the west side of the river (**Appendix 2 - Approximate Boring Locations**).

Five borings were abandoned (B-8 thru B-10, B-12, B-13) due to site and access constraints. The levee segment from Ogden Avenue to Middleton Avenue on the east side of the river has power poles located along the levee crest. Due to the low hanging lines on these poles, B-8 thru B-10 as well as B-13 (power lines cross river at this location) would require ComEd to shutdown power during drilling operations. ComEd was consulted to determine how many homes would be affected during the shutdown. This consultation revealed a mapping error in ComEd's database at this location, which prevented them from accurately determining the number of affected homes with any degree of certainty. Therefore, these borings were abandoned. Additionally, B-12 was abandoned due to access constraints. This boring is only accessible from Schwartz Avenue along the utility easement, which has been recently restored (Water Main). It was concluded that the quality of data from this boring would not likely be worth the damages caused in obtaining it, particularly because the boring represents the terminal end of the levee where it ties into natural ground.

Subsurface Exploration Procedures

All borings were performed with a rubber tired All Terrain drill rig, which utilized continuous hollow stem augers to advance the boreholes. Representative soil samples were obtained at 2.5' intervals for the first 20', and at 5' intervals thereafter by means of conventional split-barrel sampling procedures. In this procedure, a 2-inch O.D., split-barrel sampler is driven into the soil a distance of 18 inches by a 140-pound hammer falling 30 inches. The number of blows required to drive the sampler through a 12-inch interval, after initial setting of 6 inches, is termed the Standard Penetration Test (SPT) or N-value and is indicated for each sample on the boring logs. The SPT value can be used as a qualitative indication of the in-place relative density of cohesionless soils. In a less reliable way, it also indicates the consistency of cohesive soils. This indication is qualitative, since many factors can significantly affect the standard penetration resistance value and prevent a direct correlation between drill crews, drill rigs, drilling procedures, and hammer-rod-sampler assemblies. The drill rig utilized an automatic trip hammer to drive the sampler. Consideration of the effect of the automatic hammer's efficiency was included in the interpretation of subsurface information for the analyses prepared for this report.

The drill crew maintained a field log of the soils encountered in the borings. After recovery, each geotechnical soil sample was removed from the sampler and visually classified. Representative portions of each soil sample were then sealed in jars and brought to our laboratory in Champaign, Illinois for further visual examination and laboratory testing. After completion of the drilling operations, the boreholes were backfilled with auger cuttings to the existing ground surface.

Observations for groundwater were made during sampling and upon completion of the drilling operations at the boring locations. In auger drilling operations, water is not introduced into the

boreholes, and the groundwater position can often be obtained by observing water flowing into or out of the boreholes. Furthermore, visual observation of the soil samples retrieved during the auger drilling exploration can often be used in evaluating the groundwater conditions.

Unconfined compressive strength tests were performed on cohesive soil samples with the use of a calibrated hand penetrometer. In the hand penetrometer test, the unconfined compressive strength of a soil sample is estimated to a maximum of 4.5 tons per square foot (tsf) by measuring the resistance of a soil sample to penetration of a small, calibrated spring-loaded cylinder.

Subsurface Exploration Results

A total of eleven (11) soil borings (B-1 through B-7, B-11, B-14 through B-16), extending to depths of approximately 20 to 30 feet below existing grade, were located along the River Dumoulin Levee. All but two of the borings (B-2 and B-15) were performed along the centerline of the levee crest, with the aforementioned two borings being performed near the toe of the levee due to inaccessibility of truck mounted rig along the crest. The subsurface conditions encountered at the borings can be summarized as follows (**Appendix 3 - Boring Log**).

Borings along Centerline of Levee Crest (B-1, B-3, B-4, B-5, B-6, B-7, B-11, B-14, and B-16): All borings performed along the centerline of the levee crest were found to have a similar soil stratigraphy and generally exhibited two distinct soil types. The top 9’ to 12’ of each boring generally consisted of Silty or Sandy Clay material with Pebbles. Below this material, the second layer generally consisted of Sand and/or Broken Rock, which continued to the bottom depth of boring (between 20’ and 30’). Two borings (B-4, B-6) had a buried Clay layer several feet thick at 20’ to 25’ depth.

Borings near Toe of Levee (B-2 and B-15): These two borings performed near the toe of the levee were found to have a similar soil stratigraphy and generally exhibited two distinct soil types. The top 11.5’ of each boring generally consisted of Silty or Sandy Clay material with Pebbles or Broken Rock. Below this material, the second layer generally consisted of Sand and/or Broken Rock, which continued to the bottom depth of boring (between 20’ and 30’).

Groundwater levels were generally encountered at depths between 8’ and 12’, corresponding to the adjacent river water surface elevation. Three borings (B-3, B-6, and B-16) encountered no groundwater during or after completion of drilling. Glacial till soils in the Midwest frequently oxidize from gray to brown above the level at which the soil remains saturated. The long-term groundwater level is often interpreted to be near this zone of color change. Based on the results of this exploration, the long-term groundwater level may be located at a depth of approximately 10’ to 12’ below grade.

Unconfined compressive strength tests were performed in the field on cohesive soil samples with the use of a calibrated hand penetrometer. Of the 99 samples collected, only 42 were cohesive enough to perform the field compression test using the penetrometer. For the samples that were tested, the values ranged from 0.25 tsf to 4.0 tsf.

Laboratory Testing Procedures

An experienced geotechnical engineer classified each soil sample in our laboratory to check field classifications and to determine pertinent engineering properties. The geotechnical engineer grouped the various soil types into the major zones noted on the boring logs. The stratification lines designating the interfaces between earth materials on the boring logs and profiles are approximate; in situ, the transitions may be gradual. Unconfined compression tests and moisture content tests were performed

on the soil samples in the laboratory. The unconfined compressive strength tests were performed in accordance with ASTM D2166.

Laboratory Testing Results

Of the 99 samples collected, only 16 were cohesive enough to perform the lab compression test (**Appendix 3 - Boring Log**). For the samples that were tested, the values ranged from 0.6 tsf to 4.9 tsf. Two samples exhibited a bulge failure; six samples exhibited a split failure; two samples exhibited a shear failure; and six samples exhibited a combination bulge/split failure. Moisture content ranged from 4.4% to 56.3%.

ANALYSES AND SUMMARY

Analyses relating to material performance during flood conditions were performed using selected representative samples.

Slope Stability Analysis

The principal method used to analyze levee embankments for stability against shear failure assumes a sliding surface having the shape of a circular arc within the foundation and/or the embankment. Our analysis was completed using the Modified Bishop's Method of slices and circular failure surfaces, and the results are presented in terms of factor of safety against slope instability (**Appendix 4 – Slope Stability Calculations**). Factor of safety is defined as the ratio of the sum of the forces causing failure along a specified failure surface. A factor of safety greater than 1.0 indicates slope stability, while a factor of safety less than 1.0 indicates instability. As recommended by the US Army Corps of Engineers, the effective stress conditions were used in the calculations.

The various loading conditions to which the levee and its foundation may be subjected, and which were considered in our analysis, include the following:

- *Case 1 - Normal Low Flow Conditions:* This case represents normal, non-flooding conditions.
- *Case 2 - Steady Seepage from 50 Year Flood Stage:* This case represents the condition that occurs when the water remains at or near the 50 year flood stage long enough so that the embankment becomes fully saturated with a fully developed phreatic surface and a condition of steady seepage occurs.
- *Case 3 - Sudden Drawdown from 50 Year Flood Stage:* This case represents the condition whereby a prolonged flood stage, in this case 50 year flood, saturates at least the major part of the upstream embankment portion and then falls faster than the soil can drain.

Three trial failure surfaces were calculated at the approximate location of Boring B-7 near Station 153+00. The average results are included in the table below. For comparison, the minimum factors of safety as recommended by the US Army Corps of Engineers for existing levees are also included.

	Calculated FS	Minimum FS
CASE 1: Normal Low Flow Conditions	2.416	1.0 (for stability)
CASE 2: Steady Seepage	2.296	1.4
CASE 3: Sudden Drawdown	1.941	1.0 - 1.2

Settlement Analysis

A settlement analysis for the foundations soils of the existing levee was performed near the location of Boring B-7 approximately at Station 153+00. The height of the embankment fill in this area is approximately 4'. The results of our analysis indicate that the consolidation settlement of the silty clay material beneath the embankment can be expected to settle approximately 1" due to the load from additional embankment fill in the area of Station 153+00 (**Appendix 5 – Settlement Calculations**).

Generally, compacted embankment fill will settle about ½ to 1 percent of its height if compacted to at least 95% of the Modified Procter value. There has been evidence of previous settlement areas at locations along the length of the levee, indicating that the levels of compaction during levee construction did not meet the 95% value. Levee embankment fill will settle up to 5 percent of its height in areas of minimal compaction, which is likely where previous settlement has occurred. Given a levee height of 4', this amounts to nearly 2 ½" of settlement.

Seepage Analysis

A seepage analysis was performed on the levee using the calculations and equations found in the US Army Corps of Engineers Manual on Design and Construction of Levees. Typical soil permeability parameters were assigned to the generalized soil layers of the levee cross section at the approximate location of Boring B-7 near Station 153+00. A pressure head on the river side of the levee was used to address ponded water behind the levee during high water conditions.

For a levee underlain by a pervious foundation consisting of coarse sand and broken rock, the natural seepage per unit length of levee, Qs, can be expressed by the general equation,

$$Qs = \$ (k_f) (H),$$

where $ = shape factor and is dependent on the dimensions of the generalized cross section of the levee and foundation, the characteristics of the top stratum both the river side and land side of the levee, and the pervious substratum.

Seepage through the levee was calculated to be approximately 1.46×10^{-5} cubic feet per second per foot of levee, or 1.26 cubic feet per day, during high water conditions (**Appendix 6 – Seepage Calculations**). There is no recommended minimum value for levee seepage. However, by comparison, if this levee were underlain by a practically impervious foundation consisting of well compacted silty clay, the calculated seepage through the levee would be approximately 7×10^{-9} cubic feet per second per foot of levee, or .0006 cubic feet per day.

Summary

Based on the results of this Geotechnical Engineering Analysis, the River Dumoulin Levee is largely composed of unconsolidated materials that are conducive to seepage during high water and flood conditions, and therefore may promote destabilization of the levee embankment during flood events.

The results of the soil boring investigation indicate that no highly compressible soils were encountered. Because the levee was built so many years ago, the majority of the consolidation settlements of embankment fill and foundation soils have already taken place. However, the addition of newly compacted embankment fill during a levee rehabilitation project, especially anything greater than 12" in depth, will likely cause additional settlements due to the added load from the fill and required compaction efforts.

Any soil placed as engineered fill should be an approved material, free of organic matter or debris, be a non-frost susceptible soil, and have a liquid limit and plasticity index less than 40 and 15, respectively. The project geotechnical engineer should be consulted to determine the suitability of off-site/on-site materials for use as engineered fill, prior to use or placement. We do not recommend the use of granular material as engineered fill in levee embankment, due to high permeability properties of the granular material.

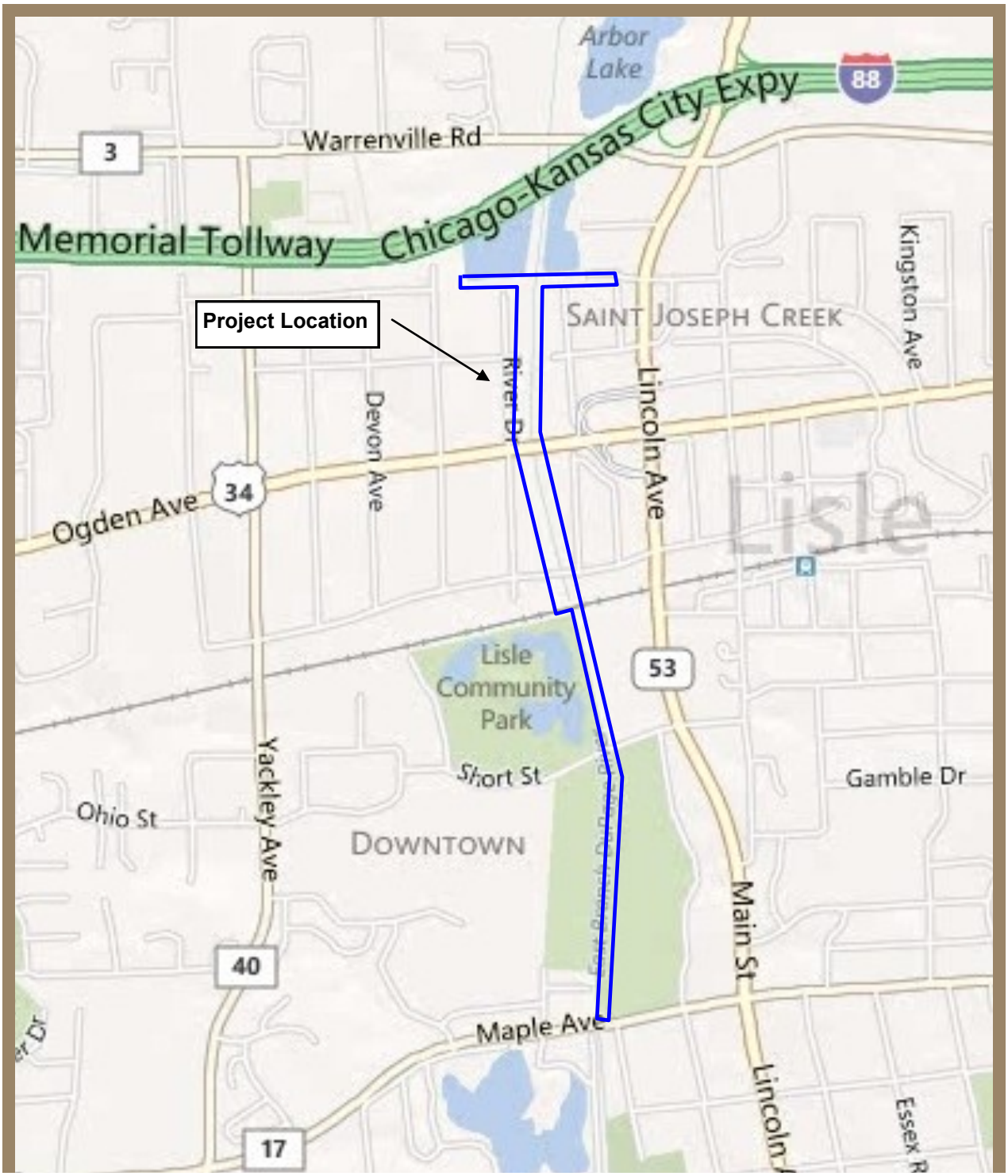
Fill should be placed in lifts not exceeding 8 inches in loose thickness, moisture conditioned to within 2% of the optimum moisture content and compacted to at least 90% of the maximum dry density obtained in accordance with ASTM Specification D 1557, Modified Proctor Method. Moisture control during earthwork operations, including the use of disking or appropriate drying equipment and techniques, should be expected. In-place density tests should be performed with a minimum of 1 test per 2,000 square feet of fill area for each lift of fill placed. Moisture contents shall be controlled by disking or other approved chemical or mechanical means to achieve the desired moisture content and density specifications. Laboratory Proctor tests should be performed on fill materials to determine the maximum dry density and optimum moisture content.

We recommend suitable silty clays used to raise the grade or backfill undercuts should be compacted with sheepsfoot roller. Moisture control during earthwork operations, including the use of disking or appropriate drying equipment and techniques, should be expected. We recommend that the placement of engineered fill be monitored full-time by geotechnical engineer and in-place density tests should be performed to verify the adequacy of the compaction for each lift of fill placed. We also recommend that prior to placing new fill in the vicinity of existing embankment the area should be scarified and benched into levee to provide a proper bond between new fill and existing embankment.

The results of the seepage analysis indicated problematic seepage through the levee foundation materials. Seepage through pervious levee foundations is relatively common and requires control. Without control, this underseepage may result in excessive hydrostatic pressures beneath a less pervious top stratum, sand boils, and piping beneath the levee itself. Underseepage problems are most acute where a pervious foundation underlies a levee and extends both landward and riverward of the levee, as is the case with the River Dumoulin Levee.

There are several options for eliminating seepage problems and subsequent piping beneath through the pervious foundation strata. These options can consist of either steel sheetpiling driven down to bedrock; construction of a bentonite/cement slurry seam down to bedrock; or pressure injection grouting.

This report has been prepared in order to aid in the evaluation of this levee. This report does not reflect any variations, which may occur between the borings. In the performance of the subsurface exploration, specific information is obtained at specific locations at specific times. However, it is a well known fact that variations in soil conditions exist on most sites between boring locations and also such situations as groundwater levels vary from time to time. The nature and extent of variations may not become evident until the course of construction. If variations then appear evident, after performing on-site observations during the construction period and noting characteristics and variations, a reevaluation of the recommendations for this report will be necessary.


Arbor Lake
Chicago-Kansas City Expy
88
Warrenville Rd
3
Memorial Tollway
Project Location
Saint Joseph Creek
Kingston Ave
Lincoln Ave
Devon Ave
Ogden Ave
34
Lisle
Lisle Community Park
53
Short St
Gamble Dr
Ohio St
Yackley Ave
Downtown
Main St
40
Maple Ave
17
Lincoln
Essex

Legend
Boring Locations
Abandoned Borings
B-12
B-11
B-10
B-9
B-13
B-14
B-8
B-7
B-15
B-16
B-6
B-5
B-4
B-3
B-2
B-1
Southport Ave
Lisle, IL
Lisle
Schwartz Ave
River Dr
Dumoulin Ave
McKinley Ave
Garfield Ave
School St
Devon Ave
Lisle Pl
Division St
Columbia Ave
Center Ave
Varsity Dr
Ohio Ct
Main St
53
Oakview Dr
Robin Ln
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ENGINEERING RESOURCE ASSOCIATES, INC.
CONSULTING ENGINEERS, SCIENTISTS & SURVEYORS

3S701 WEST AVENUE, SUITE 150
WARRENVILLE, ILLINOIS 60555
PHONE (630) 393-3060
FAX (630) 393-2152

501 W. STATE STREET, SUITE 203
GENEVA, ILLINOIS 60134
PHONE (630) 262-8689
FAX (630) 262-8698

3002 CROSSING CT.
CHAMPAIGN, ILLINOIS 61822
PHONE (217) 351-6268
FAX (217) 355-1902

RECORD OF SUBSURFACE EXPLORATION

Project: RIVER DUMOULIN LEVEE STUDY

Client: VILLAGE OF LISLE

Boring No.: B-1 Date: 2/20/12 Project No.: 120102

Location: ℄ Top/Levee, East side of river, 538' south of ℄ of footbridge

Elevations

Ground Surface Elev. 663.91

End of Boring Elev. 643.91

Water Levels

While Drilling 653.91

At Completion 653.41

LEGEND

SS = Split Spoon Sample
N = Blow Counts
Qu = Unconfined Compressive Strength (Lab Test)
Qp = Unconfined Compressive Strength (Field Test)
S = Split Failure
B = Bulge Failure
V = Shear Failure
Mc = Moisture Content

Soil Description	Elev.	Sample No.	Sample Type	N	Qu (tsf)	Qp (tsf)	Mc (%)
Topsoil							
Dark brown, silty CLAY w/ small pebbles, broken rock, loose, dry		1	SS	6,7,8	- -	- -	8.5
	658.91	2	SS	6,4,3	- -	- -	21.1
		3	SS	3,2,2	- -	1.0	33.3
Coarse gray SAND w/ some clay, damp	653.91	4	SS	4,5,6	- -	- -	9.9
Broken rock, SAND, wet		5	SS	9,10,10	- -	- -	7.9
Blown in @ 15'	648.91	6	SS	2,3,4	- -	- -	11.1
Coarse gray SAND, small to medium pebbles, wet, some broken rock		7	SS	7,7,7	- -	- -	12.5
	643.91	8	SS	2,2,3	- -	- -	17.0
End of Boring @ 20'							

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CONSULTING ENGINEERS, SCIENTISTS & SURVEYORS

3S701 WEST AVENUE, SUITE 150
WARRENVILLE, ILLINOIS 60555
PHONE (630) 393-3060
FAX (630) 393-2152

501 W. STATE STREET, SUITE 203
GENEVA, ILLINOIS 60134
PHONE (630) 262-8689
FAX (630) 262-8698

3002 CROSSING CT.
CHAMPAIGN, ILLINOIS 61822
PHONE (217) 351-6268
FAX (217) 355-1902

RECORD OF SUBSURFACE EXPLORATION

Project: RIVER DUMOULIN LEVEE STUDY

Client: VILLAGE OF LISLE

Boring No.: B-2 Date: 2/20/12 Project No.: 120102

Location: 7' west of ℄ Top/Levee, East side of river, 81' south of ℄ of footbridge

Elevations

Ground Surface Elev. 664.05

End of Boring Elev. 634.04

Water Levels

While Drilling N/A

At Completion 653.55

LEGEND

SS = Split Spoon Sample
N = Blow Counts
Qu = Unconfined Compressive Strength (Lab Test)
Qp = Unconfined Compressive Strength (Field Test)
S = Split Failure
B = Bulge Failure
V = Shear Failure
Mc = Moisture Content

Soil Description	Elev.	Sample No.	Sample Type	N	Qu (tsf)	Qp (tsf)	Mc (%)
Topsoil							
Dark brown, silty CLAY w/ small pebbles, some vegetation		1	SS	6,5,6	- -	2.5	15.5
		2	SS	3,5,6	- -	1.5	34.8
	659.05	3	SS	4,4,3	- -	1.0	28.5
		4	SS	3,3,4	- -	1.75	19.4
Brown, sandy CLAY, damp	654.05						
		5	SS	14,16,19	- -	- -	- -
Broken ROCK w/ sand, wet		6	SS	10,14,13	- -	- -	6.8
	649.05						
6" SAND seam		7	SS	14,16,10	- -	- -	3.7
		8	SS	7,8,10	- -	- -	22.9
	644.05						
Gray fine SAND		9	SS	8,9,9	- -	- -	5.8
	639.05						
		10	SS	22,24,23	- -	- -	4.4
End of Boring @ 30'	634.05						

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CONSULTING ENGINEERS, SCIENTISTS & SURVEYORS

3S701 WEST AVENUE, SUITE 150
WARRENVILLE, ILLINOIS 60555
PHONE (630) 393-3060
FAX (630) 393-2152

501 W. STATE STREET, SUITE 203
GENEVA, ILLINOIS 60134
PHONE (630) 262-8689
FAX (630) 262-8698

3002 CROSSING CT.
CHAMPAIGN, ILLINOIS 61822
PHONE (217) 351-6268
FAX (217) 355-1902

RECORD OF SUBSURFACE EXPLORATION

Project: RIVER DUMOULIN LEVEE STUDY

Client: VILLAGE OF LISLE

Boring No.: B-3 Date: 2/20/12 Project No.: 120102

Location: ℄ Top/Levee, East side of river, 112' south of the ℄ of Short St.

Elevations

Ground Surface Elev. 663.96

End of Boring Elev. 639.96

Water Levels

While Drilling N/A

At Completion N/A

LEGEND

SS = Split Spoon Sample
N = Blow Counts
Qu = Unconfined Compressive Strength (Lab Test)
Qp = Unconfined Compressive Strength (Field Test)
S = Split Failure
B = Bulge Failure
V = Shear Failure
Mc = Moisture Content

Soil Description	Elev.	Sample No.	Sample Type	N	Qu (tsf)	Qp (tsf)	Mc (%)
Dark brown, silty CLAY w/ small pebbles		1	SS	3,5,4	2.7 BS	2.5	17.5
	658.96	2	SS	3,3,5	- -	1.75	29.3
Dark brown CLAY, consistant		3	SS	3,3,3	1.6 BS	1.5	35.1
Coarse, sandy CLAY w/ small pebbles, damp	653.96	4	SS	3,2,7	- -	0.25	16.5
Gray coarse SAND w/ wet, crushed rock		5	SS	12,12,13	- -	- -	5.2
	648.96	6	SS	10,12,13	- -	- -	8.3
Gray CLAY, wet		7	SS	24,17,11	2.9 S	2.75	13.4
Loose GRAVEL, coarse SAND	643.96	8	SS	10,16,11	- -	- -	11.3
Broken ROCK, wet		9	SS	33,21,34	- -	- -	11.3
End of Boring @ 24'	638.96						

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CONSULTING ENGINEERS, SCIENTISTS & SURVEYORS

3S701 WEST AVENUE, SUITE 150
WARRENVILLE, ILLINOIS 60555
PHONE (630) 393-3060
FAX (630) 393-2152

501 W. STATE STREET, SUITE 203
GENEVA, ILLINOIS 60134
PHONE (630) 262-8689
FAX (630) 262-8698

3002 CROSSING CT.
CHAMPAIGN, ILLINOIS 61822
PHONE (217) 351-6268
FAX (217) 355-1902

RECORD OF SUBSURFACE EXPLORATION

Project: RIVER DUMOULIN LEVEE STUDY

Client: VILLAGE OF LISLE

Boring No.: B-4 Date: 2/22/12 Project No.: 120102

Location: ℄ Top/Levee, East side of river, 408' north of ℄ of Short St., Adjacent to Lisle Police Station

Elevations

Ground Surface Elev. 665.21

End of Boring Elev. 635.21

Water Levels

While Drilling N/A

At Completion 653.21

LEGEND

SS = Split Spoon Sample
N = Blow Counts
Qu = Unconfined Compressive Strength (Lab Test)
Qp = Unconfined Compressive Strength (Field Test)
S = Split Failure
B = Bulge Failure
V = Shear Failure
Mc = Moisture Content

Soil Description	Elev.	Sample No.	Sample Type	N	Qu (tsf)	Qp (tsf)	Mc (%)
Brown, silty CLAY w/ small pebbles		1	SS	3,4,2	- -	2.0	11.5
Light brown, silty CLAY w/ small pebbles, some sand	660.21	2	SS	20,6,20	- -	1.75	26.3
		3	SS	3,3,2	- -	- -	23.7
Dark brown, silty CLAY, firm, light moisture	655.21	4	SS	2,4,12	1.0 BS	1.25	56.3
Gray, rocky SAND w/ small pebbles, coarse, damp		5	SS	11,11,7	- -	- -	6.3
Dark gray, broken ROCK w/ small pebbles and fine sand, wet	650.21	6	SS	6,10,11	- -	- -	8.8
Light gray, broken ROCK, coarse sand, wet		7	SS	24,5,6	- -	- -	10.5
Light gray CLAY w/ very fine sand, damp	645.21	8	SS	5,7,8	- -	0.5	18.1
	640.21	9	SS	4,5,5	- -	0.25	20.2
Broken ROCK, coarse sand, damp	635.21	10	SS	7,7,11	- -	- -	10.5
End of Boring @ 30'							

ENGINEERING RESOURCE ASSOCIATES, INC.
CONSULTING ENGINEERS, SCIENTISTS & SURVEYORS

3S701 WEST AVENUE, SUITE 150
WARRENVILLE, ILLINOIS 60555
PHONE (630) 393-3060
FAX (630) 393-2152

501 W. STATE STREET, SUITE 203
GENEVA, ILLINOIS 60134
PHONE (630) 262-8689
FAX (630) 262-8698

3002 CROSSING CT.
CHAMPAIGN, ILLINOIS 61822
PHONE (217) 351-6268
FAX (217) 355-1902

RECORD OF SUBSURFACE EXPLORATION

Project: RIVER DUMOULIN LEVEE STUDY

Client: VILLAGE OF LISLE

Boring No.: B-5 Date: 2/22/12 Project No.: 120102

Location: ℄ Top/Levee, East side of river, 233' south of the south face of railroad bridge, Behind Lisle Lanes

Elevations

Ground Surface Elev. 665.64

End of Boring Elev. 640.64

Water Levels

While Drilling N/A

At Completion 653.64

LEGEND

SS = Split Spoon Sample
N = Blow Counts
Qu = Unconfined Compressive Strength (Lab Test)
Qp = Unconfined Compressive Strength (Field Test)
S = Split Failure
B = Bulge Failure
V = Shear Failure
Mc = Moisture Content

Soil Description	Elev.	Sample No.	Sample Type	N	Qu (tsf)	Qp (tsf)	Mc (%)
Light brown, silty CLAY w/ small pebbles		1	SS	3,2,2	- -	1.75	12.4
	660.64	2	SS	5,4,4	- -	1.0	15.2
Dark brown CLAY		3	SS	3,3,3	1.5 S	2.0	38.3
Light brown, silty CLAY	655.64	4	SS	4,5,7	0.6 V	3.5	9.5
Gray, silty CLAY w/ broken rock, coarse sand, and medium pebbles		5	SS	10,13,13	- -	- -	5.8
	650.64	6	SS	20,6,28	- -	- -	9.0
Gray coarse SAND and broken rock, wet		7	SS	18,19,19	- -	- -	7.9
Coarse SAND seam							
Gray broken ROCK w/ a mixture of coarse and fine sand, wet	645.64	8	SS	20,20,14	- -	- -	5.9
	640.64	9	SS	4,4,4	- -	- -	14.4
End of Boring @ 25'							

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CONSULTING ENGINEERS, SCIENTISTS & SURVEYORS

3S701 WEST AVENUE, SUITE 150
WARRENVILLE, ILLINOIS 60555
PHONE (630) 393-3060
FAX (630) 393-2152

501 W. STATE STREET, SUITE 203
GENEVA, ILLINOIS 60134
PHONE (630) 262-8689
FAX (630) 262-8698

3002 CROSSING CT.
CHAMPAIGN, ILLINOIS 61822
PHONE (217) 351-6268
FAX (217) 355-1902

RECORD OF SUBSURFACE EXPLORATION

Project: RIVER DUMOULIN LEVEE STUDY

Client: VILLAGE OF LISLE

Boring No.: B-6 Date: 2/22/12 Project No.: 120102

Location: ℄ Top/Levee, East side of river, 126′ north of ℄ of Brrlington Ave., Behind 4734 Dumoulin Ave.

Elevations

Ground Surface Elev. 665.30

End of Boring Elev. 640.30

Water Levels

While Drilling N/A

At Completion N/A

LEGEND

SS = Split Spoon Sample
N = Blow Counts
Qu = Unconfined Compressive Strength (Lab Test)
Qp = Unconfined Compressive Strength (Field Test)
S = Split Failure
B = Bulge Failure
V = Shear Failure
Mc = Moisture Content

Soil Description	Elev.	Sample No.	Sample Type	N	Qu (tsf)	Qp (tsf)	Mc (%)
Light brown, silty CLAY w/ small-medium sized pebbles		1	SS	4,15,6	1.0 S	2.0	13.5
	660.30	2	SS	3,3,3	- -	1.75	17.4
Dark brown silty CLAY, damp		3	SS	2,3,3	1.3 BS	1.5	42.2
	655.30	4	SS	2,3,3	1.2 B	1.25	19.8
Gray silty CLAY and coarse SAND		5	SS	6,12,9	- -	- -	5.7
Broken ROCK, wet	650.30	6	SS	7,9,10	- -	- -	9.4
Gray CLAY and coarse SAND, rocky		7	SS	7,7,9	4.9 V	4.0	23.6
Gray CLAY, firm, damp	645.30	8	SS	4,5,7	3.2 B	3.0	25.6
Coarse SAND and broken rock, wet	640.30	9	SS	13,9,10	- -	- -	5.8
End of Boring @ 25′							

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CONSULTING ENGINEERS, SCIENTISTS & SURVEYORS

3S701 WEST AVENUE, SUITE 150
WARRENVILLE, ILLINOIS 60555
PHONE (630) 393-3060
FAX (630) 393-2152

501 W. STATE STREET, SUITE 203
GENEVA, ILLINOIS 60134
PHONE (630) 262-8689
FAX (630) 262-8698

3002 CROSSING CT.
CHAMPAIGN, ILLINOIS 61822
PHONE (217) 351-6268
FAX (217) 355-1902

RECORD OF SUBSURFACE EXPLORATION

Project: RIVER DUMOULIN LEVEE STUDY

Client: VILLAGE OF LISLE

Boring No.: B-7 Date: 2/22/12 Project No.: 120102

Location: ℄ Top/Levee, East side of river, 164' south of the ℄ of Ogden Ave., East of 1519 Ogden Ave.

Elevations

Ground Surface Elev. 667.31

End of Boring Elev. 643.81

Water Levels

While Drilling N/A

At Completion 657.31

LEGEND

SS = Split Spoon Sample
N = Blow Counts
Qu = Unconfined Compressive Strength (Lab Test)
Qp = Unconfined Compressive Strength (Field Test)
S = Split Failure
B = Bulge Failure
V = Shear Failure
Mc = Moisture Content

Soil Description	Elev.	Sample No.	Sample Type	N	Qu (tsf)	Qp (tsf)	Mc (%)
Dark brown, silty CLAY		1	SS	2,3,6	- -	1.75	37.4
	662.31	2	SS	3,4,4	1.0 S	1.75	31.4
		3	SS	3,4,5	- -	1.75	29.2
	657.31	4	SS	3,3,4	- -	1.5	8.8
Light brown, silty CLAY and fine SAND w/ small pebbles		5	SS	4,7,13	- -	- -	5.0
Gray, coarse SAND and broken ROCK, damp	652.31	6	SS	8,10,15	- -	- -	7.8
		7	SS	10,16,10	- -	- -	6.5
Coarse SAND w/ small pebbles, wet	647.31	8	SS	1,1,6	- -	- -	22.2
		9	SS	45,-,-	- -	- -	14.0
End of Boring @ 23.5'	642.31						

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CONSULTING ENGINEERS, SCIENTISTS & SURVEYORS

3S701 WEST AVENUE, SUITE 150
WARRENVILLE, ILLINOIS 60555
PHONE (630) 393-3060
FAX (630) 393-2152

501 W. STATE STREET, SUITE 203
GENEVA, ILLINOIS 60134
PHONE (630) 262-8689
FAX (630) 262-8698

3002 CROSSING CT.
CHAMPAIGN, ILLINOIS 61822
PHONE (217) 351-6268
FAX (217) 355-1902

RECORD OF SUBSURFACE EXPLORATION

Project: RIVER DUMOULIN LEVEE STUDY

Client: VILLAGE OF LISLE

Boring No.: B-11 Date: 2/23/12 Project No.: 120102

Location: ℄ Top/Levee, 173' west of the ℄ of Dorset Ave.,
Near NW corner of 4500 Dorset Ave.

Elevations

Ground Surface Elev. 669.27

End of Boring Elev. 644.77

Water Levels

While Drilling N/A

At Completion 658.77

LEGEND

SS = Split Spoon Sample
N = Blow Counts
Qu = Unconfined Compressive Strength (Lab Test)
Qp = Unconfined Compressive Strength (Field Test)
S = Split Failure
B = Bulge Failure
V = Shear Failure
Mc = Moisture Content

Soil Description	Elev.	Sample No.	Sample Type	N	Qu (tsf)	Qp (tsf)	Mc (%)
Light brown, silty CLAY w/ small-medium pebbles		1	SS	5,3,3	- -	3.5	14.6
		2	SS	2,3,6	- -	1.25	21.2
Dark brown, silty CLAY w/ small pebbles	664.27						
		3	SS	3,4,5	0.9 BS	1.25	20.2
Light brown, silty CLAY and coarse SAND w/ small pebbles		4	SS	3,5,5	- -	- -	15.6
	659.27						
Light brown, coarse SAND w/ rocks and small pebbles		5	SS	6,5,4	- -	- -	7.9
Fine and coarse SAND							
		6	SS	5,5,5	- -	- -	12.3
	654.27						
Fine and coarse SAND w/ rocks and broken rock		7	SS	8,8,6	- -	- -	- -
		8	SS	5,5,6	- -	- -	7.3
	649.27						
Fine and coarse SAND w/ broken rock		9	SS	7,40,-	- -	- -	12.1
End of Boring @ 24.5'	644.27						

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CONSULTING ENGINEERS, SCIENTISTS & SURVEYORS

3S701 WEST AVENUE, SUITE 150
WARRENVILLE, ILLINOIS 60555
PHONE (630) 393-3060
FAX (630) 393-2152

501 W. STATE STREET, SUITE 203
GENEVA, ILLINOIS 60134
PHONE (630) 262-8689
FAX (630) 262-8698

3002 CROSSING CT.
CHAMPAIGN, ILLINOIS 61822
PHONE (217) 351-6268
FAX (217) 355-1902

RECORD OF SUBSURFACE EXPLORATION

Project: RIVER DUMOULIN LEVEE STUDY

Client: VILLAGE OF LISLE

Boring No.: B-14 Date: 2/23/12 Project No.: 120102

Location: ℄ Top/Levee, West side of river, 315' north of the ℄ of Ogden Ave., Behind 4621 River Dr.

Elevations

Ground Surface Elev. 667.53

End of Boring Elev. 643.53

Water Levels

While Drilling N/A

At Completion 659.53

LEGEND

SS = Split Spoon Sample
N = Blow Counts
Qu = Unconfined Compressive Strength (Lab Test)
Qp = Unconfined Compressive Strength (Field Test)
S = Split Failure
B = Bulge Failure
V = Shear Failure
Mc = Moisture Content

Soil Description	Elev.	Sample No.	Sample Type	N	Qu (tsf)	Qp (tsf)	Mc (%)
Med. brown, silty CLAY w/ small pebbles, rocks, and red clunks		1	SS	6,4,4	- -	3.5	17.5
	662.53	2	SS	7,5,5	- -	3.0	9.4
Dark brown, silty clay w/ small rocks		3	SS	5,4,5	2.2 S	2.5	35.8
Med. brown, silty CLAY w/ small pebbles and rock	657.53	4	SS	3,4,5	1.4BS	3.5	12.7
Gray, coarse SAND and broken rock		5	SS	25,25,19	- -	- -	6.7
Gray, coarse SAND and broken rock w/ small pebbles, wet	652.53	6	SS	11,14,13	- -	- -	7.3
		7	SS	22,19,17	- -	- -	8.0
6" coarse SAND seam	647.53	8	SS	8,9,13	- -	- -	7.1
Gray ROCK, small and broken		9	SS	50,-,-	- -	- -	5.6
End of Boring @ 24.0'	642.53						

ENGINEERING RESOURCE ASSOCIATES, INC.
CONSULTING ENGINEERS, SCIENTISTS & SURVEYORS

3S701 WEST AVENUE, SUITE 150
WARRENVILLE, ILLINOIS 60555
PHONE (630) 393-3060
FAX (630) 393-2152

501 W. STATE STREET, SUITE 203
GENEVA, ILLINOIS 60134
PHONE (630) 262-8689
FAX (630) 262-8698

3002 CROSSING CT.
CHAMPAIGN, ILLINOIS 61822
PHONE (217) 351-6268
FAX (217) 355-1902

RECORD OF SUBSURFACE EXPLORATION

Project: RIVER DUMOULIN LEVEE STUDY

Client: VILLAGE OF LISLE

Boring No.: B-15 Date: 2/22/12 Project No.: 120102

Location: 17' east of ℄ of the Top/Levee, West side of river, 657' north of the ℄ of Burlington Ave., behind 4715 & 4717 River Dr.

Elevations

Ground Surface Elev. 664.01

End of Boring Elev. 644.01

Water Levels

While Drilling N/A

At Completion 657.01

LEGEND

SS = Split Spoon Sample
N = Blow Counts
Qu = Unconfined Compressive Strength (Lab Test)
Qp = Unconfined Compressive Strength (Field Test)
S = Split Failure
B = Bulge Failure
V = Shear Failure
Mc = Moisture Content

Soil Description	Elev.	Sample No.	Sample Type	N	Qu (tsf)	Qp (tsf)	Mc (%)
Dark brown, silty CLAY w/ small pebbles		1	SS	3,4,4	- -	1.5	23.7
		2	SS	3,3,3	- -	1.75	33.0
Light brown, silty CLAY w/ small pebbles	659.01						
		3	SS	5,10,12	- -	- -	11.8
Light brown, silty CLAY and fine SAND w/ broken rock		4	SS	5,16,20	- -	- -	8.9
	654.01						
Coarse SAND w/ gray broken rock, wet		5	SS	15,15,13	- -	- -	6.4
Fine and coarse SAND, wet		6	SS	7,18,21	- -	- -	5.7
Gray broken ROCK, wet	649.01						
Fine and coarse SAND, wet		7	SS	7,15,23	- -	- -	10.4
Gray broken ROCK, wet		8	SS	29,30,9	- -	- -	9.9
	644.01						
End of Boring @ 20.0'							

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RECORD OF SUBSURFACE EXPLORATION

Project: RIVER DUMOULIN LEVEE STUDY

Client: VILLAGE OF LISLE

Boring No.: B-16 Date: 2/22/12 Project No.: 120102

Location: ℄ Top/Levee, West side of river, 127' north of the ℄ of Burlington Ave., Adjacent to 1504 Burlington Ave.

Elevations

Ground Surface Elev. 666.84

End of Boring Elev. 641.84

Water Levels

While Drilling N/A

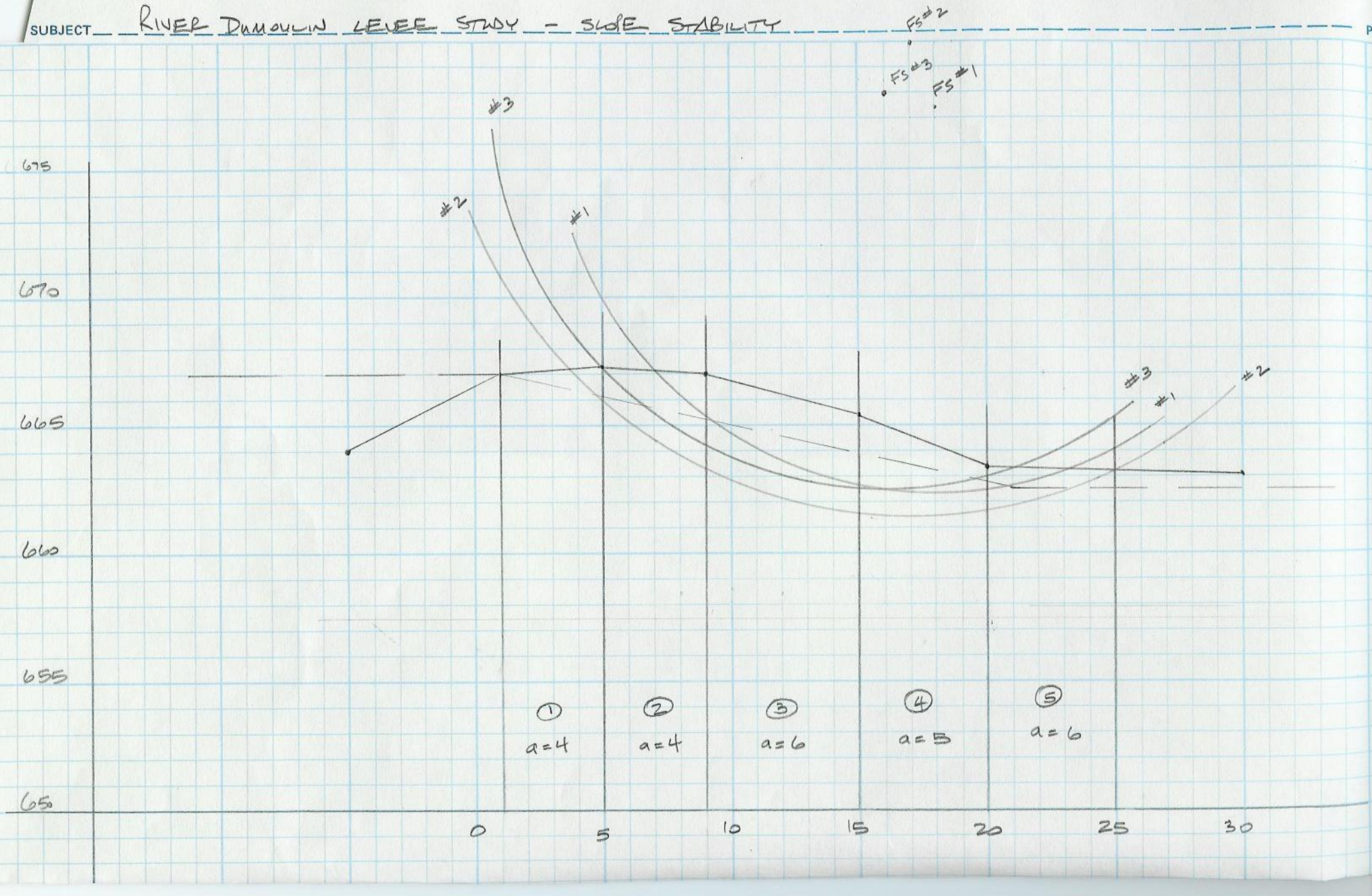
At Completion dry

LEGEND

SS = Split Spoon Sample
N = Blow Counts
Qu = Unconfined Compressive Strength (Lab Test)
Qp = Unconfined Compressive Strength (Field Test)
S = Split Failure
B = Bulge Failure
V = Shear Failure
Mc = Moisture Content

Soil Description	Elev.	Sample No.	Sample Type	N	Qu (tsf)	Qp (tsf)	Mc (%)
Dark brown, silty CLAY w/ small pebbles and rocks		1	SS	4,4,6	- -	1.75	23.3
	662.31	2	SS	4,4,3	- -	2.0	18.9
		3	SS	3,3,3	1.25 S	2.25	27.9
Dark brown, silty CLAY		4	SS	2,2,10	- -	0.5	20.0
Light brown silty CLAY w/ small rocks and pebbles	657.31	5	SS	21,25,25	- -	- -	7.2
Coarse SAND w/ broken rock, damp	652.31	6	SS	13,15,21	- -	- -	6.1
Coarse SAND w/ broken rock, wet		7	SS	20,8,8	- -	- -	8.5
Gray, soupy CLAY, coarse SAND	647.31	8	SS	6,9,8	- -	- -	9.3
Gray, fine SAND w/ broken rock, wet							
Wet, broken ROCK	642.31	9	SS	10,18,27	- -	- -	9.5
End of Boring @ 25.0'							

SUBJECT RIVER DUMOULIN LEVEE STUDY - SLOPE STABILITY



River Dumoulin Levee Study Modified Bishop's Method **Failure Surface #1-Case 1**

				$\gamma 1 =$	0.115	kcf	$\gamma 2 =$	0	kcf		
Coordinates of	x =	18.07	ft	c'1 =	0	ksf	c'2 =	0	ksf	Δx circle=	16.2
Center of Circle	y =	677.27	ft	ø'1 =	29	°	ø'2 =	0	°	Δy circle=	3.97

Radius of failure surface (r) 15 ft F.S. = 2.172 assumed

Slice	Lt Side x coord	Rt side x coord	Lt Side y coord bottom	Rt Side y coord bottom	Lt Side y coord top	Rt Side y coord top	Vol. Slice ($\gamma 1$) cf/ft	Vol. Slice ($\gamma 2$) cf/ft	Yb ft	Zb ft	Yc ft	Zc ft
2	7	9	667.15	665.40	667.15	667.00	1.600	0.00	0.000	0.000	0.000	0.000
3	9	15	665.40	662.60	667.00	665.50	13.500	0.00	0.000	0.000	0.000	0.000
4	15	20	662.60	662.50	665.50	663.40	9.500	0.00	0.000	0.000	0.000	0.000
5	20	23.2	662.50	663.18	663.40	663.18	1.440	0.00	0.000	0.000	0.000	0.000

Slice	a ft	α degrees	Ws kips	Ww kips	(1) W total	$W \times \sin(\alpha)$	U_{base}	(2) $U_{base} \times \cos(\alpha)$	(3) C'a kips	(4) m_α	[(1)-(2)]tanø'+(3) (4) kips
2	2	41.186	0.184	0.000	0.184	0.121	0.000	0.000	0.000	0.921	0.111
3	6	25.017	1.553	0.000	1.553	0.657	0.000	0.000	0.000	1.014	0.849
4	5	1.146	1.092	0.000	1.092	0.022	0.000	0.000	0.000	1.005	0.603
5	3.2	-11.997	0.166	0.000	0.166	-0.034	0.000	0.000	0.000	0.925	0.099
					∑	0.765				∑	1.661

FS = 1.661 / 0.765 = 2.17122

FS = **2.171**

River Dumoulin Levee Study Modified Bishop's Method **Failure Surface #1-Case 2**

				$\gamma 1 =$	0.115	kcf	$\gamma 2 =$	0	kcf		
Coordinates of	x =	18.07	ft	c'1 =	0	ksf	c'2 =	0	ksf	Δx circle=	16.2
Center of Circle	y =	677.27	ft	ø'1 =	29	°	ø'2 =	0	°	Δy circle=	3.97

Radius of failure surface (r) 15 ft F.S. = 2.244 assumed

Slice	Lt Side x coord	Rt side x coord	Lt Side y coord bottom	Rt Side y coord bottom	Lt Side y coord top	Rt Side y coord top	Vol. Slice ($\gamma 1$) cf/ft	Vol. Slice ($\gamma 2$) cf/ft	Yb ft	Zb ft	Yc ft	Zc ft
2	7	9	667.15	665.40	667.15	667.00	1.600	0.00	0.000	0.000	0.000	0.000
3	9	15	665.40	662.60	667.00	665.50	13.500	0.00	0.000	0.000	1.300	0.000
4	15	20	662.60	662.50	665.50	663.40	9.500	0.00	1.300	1.261	0.300	0.000
5	20	23.2	662.50	663.18	663.40	663.18	1.440	0.00	0.300	0.291	0.000	1.261

Slice	a ft	α degrees	Ws kips	Ww kips	(1) W total	$W \times \sin(\alpha)$	U_{base}	(2) $U_{base} \times \cos(\alpha)$	(3) C'a kips	(4) m_α	[(1)-(2)]tanø'+(3) (4) kips
2	2	41.186	0.184	-0.150	0.034	0.023	0.000	0.000	0.000	0.915	0.021
3	6	25.017	1.553	0.206	1.758	0.744	0.000	0.000	0.000	1.011	0.964
4	5	1.146	1.092	0.250	1.342	0.027	0.197	0.197	0.000	1.005	0.632
5	3.2	-11.997	0.166	0.007	0.173	-0.036	0.037	0.036	0.000	0.927	0.082
					∑	0.757				∑	1.699

FS = 1.699 / 0.757 = 2.2436

FS = **2.244**

River Dumoulin Levee Study Modified Bishop's Method **Failure Surface #1-Case 3**

				$\gamma 1 =$	0.115	kcf	$\gamma 2 =$	0	kcf		
Coordinates of	x =	18.07	ft	c'1 =	0	ksf	c'2 =	0	ksf	Δx circle=	16.2
Center of Circle	y =	677.27	ft	ø'1 =	29	°	ø'2 =	0	°	Δy circle=	3.97

Radius of failure surface (r) 15 ft F.S. = 1.692 assumed

Slice	Lt Side x coord	Rt side x coord	Lt Side y coord bottom	Rt Side y coord bottom	Lt Side y coord top	Rt Side y coord top	Vol. Slice ($\gamma 1$) cf/ft	Vol. Slice ($\gamma 2$) cf/ft	Yb ft	Zb ft	Yc ft	Zc ft
2	7	9	667.15	665.40	667.15	667.00	1.600	0.00	0.000	0.000	0.000	0.000
3	9	15	665.40	662.60	667.00	665.50	13.500	0.00	0.000	0.000	2.900	0.000
4	15	20	662.60	662.50	665.50	663.40	9.500	0.00	2.900	2.813	0.900	0.000
5	20	23.2	662.50	663.18	663.40	663.18	1.440	0.00	0.900	0.873	0.000	2.813

Slice	a ft	α degrees	Ws kips	Ww kips	(1) W total	$W \times \sin(\alpha)$	U_{base}	(2) $U_{base} \times \cos(\alpha)$	(3) C'a kips	(4) m_α	[(1)-(2)]tanø'+(3) (4) kips
2	2	41.186	0.184	0.200	0.384	0.253	0.000	0.000	0.000	0.968	0.220
3	6	25.017	1.553	0.842	2.395	1.013	0.000	0.000	0.000	1.045	1.271
4	5	1.146	1.092	0.593	1.685	0.034	0.439	0.439	0.000	1.006	0.687
5	3.2	-11.997	0.166	0.090	0.255	-0.053	0.376	0.368	0.000	0.910	-0.069
					∑	1.246				∑	2.108

FS = $\frac{2.108}{1.246}$ = 1.69213

FS = **1.692**

River Dumoulin Levee Study Modified Bishop's Method **Failure Surface #2-Case 1**

				$\gamma 1 =$	0.115	kcf	$\gamma 2 =$	0	kcf		
Coordinates of	x =	17.08	ft	c'1 =	0	ksf	c'2 =	0	ksf	Δx circle=	21.4
Center of Circle	y =	679.87	ft	ø'1 =	29	°	ø'2 =	0	°	Δy circle=	4.05

Radius of failure surface (r) 18.5 ft F.S. = 2.674 assumed

Slice	Lt Side x coord	Rt side x coord	Lt Side y coord bottom	Rt Side y coord bottom	Lt Side y coord top	Rt Side y coord top	Vol. Slice ($\gamma 1$) cf/ft	Vol. Slice ($\gamma 2$) cf/ft	Yb ft	Zb ft	Yc ft	Zc ft
1	3.6	5	667.20	665.90	667.20	667.31	0.987	0.00	0.000	0.000	0.000	0.000
2	5	9	665.90	663.30	667.31	667.00	10.220	0.00	0.000	0.000	0.000	0.000
3	9	15	663.30	661.60	667.00	665.50	22.800	0.00	0.000	0.000	0.000	0.000
4	15	20	661.60	661.70	665.50	663.40	14.000	0.00	0.000	0.000	0.000	0.000
5	20	25	661.70	663.15	663.40	663.15	4.250	0.00	0.000	0.000	0.000	0.000

Slice	a ft	α degrees	Ws kips	Ww kips	(1) W total	$W \times \sin(\alpha)$	U_{base}	(2) $U_{base} \times \cos(\alpha)$	(3) C'a kips	(4) m_α	[(1)-(2)]tanø'+(3) (4) kips
1	1.4	42.879	0.114	0.000	0.114	0.077	0.000	0.000	0.000	0.874	0.072
2	4	33.024	1.175	0.000	1.175	0.641	0.000	0.000	0.000	0.951	0.685
3	6	15.819	2.622	0.000	2.622	0.715	0.000	0.000	0.000	1.019	1.427
4	5	-1.146	1.610	0.000	1.610	-0.032	0.000	0.000	0.000	0.996	0.896
5	5	-16.172	0.489	0.000	0.489	-0.136	0.000	0.000	0.000	0.903	0.300
					$\sum$	1.264				$\sum$	3.380

$$FS = \frac{3.380}{1.264} = 2.67362$$

FS = **2.674**

River Dumoulin Levee Study Modified Bishop's Method **Failure Surface #2-Case 2**

				$\gamma 1 =$	0.115	kcf	$\gamma 2 =$	0	kcf		
Coordinates of	x =	17.08	ft	c'1 =	0	ksf	c'2 =	0	ksf	Δx circle=	21.4
Center of Circle	y =	679.87	ft	ø'1 =	29	°	ø'2 =	0	°	Δy circle=	4.05

Radius of failure surface (r) 18.5 ft F.S. = 2.081 assumed

Slice	Lt Side x coord	Rt side x coord	Lt Side y coord bottom	Rt Side y coord bottom	Lt Side y coord top	Rt Side y coord top	Vol. Slice ($\gamma 1$) cf/ft	Vol. Slice ($\gamma 2$) cf/ft	Yb ft	Zb ft	Yc ft	Zc ft
1	3.6	5	667.20	665.90	667.20	667.31	0.987	0.00	0.000	0.000	0.250	0.000
2	5	9	665.90	663.30	667.31	667.00	10.220	0.00	0.250	0.242	1.900	0.000
3	9	15	663.30	661.60	667.00	665.50	22.800	0.00	1.900	1.843	2.300	0.242
4	15	20	661.60	661.70	665.50	663.40	14.000	0.00	2.300	2.231	1.100	1.843
5	20	25	661.70	663.15	663.40	663.15	4.250	0.00	1.100	1.067	0.000	2.231

Slice	a ft	α degrees	Ws kips	Ww kips	(1) W total	$W \times \sin(\alpha)$	U_{base}	(2) $U_{base} \times \cos(\alpha)$	(3) C'a kips	(4) m_α	[(1)-(2)]tanø'+(3) (4) kips
1	1.4	42.879	0.114	-0.008	0.105	0.072	0.000	0.000	0.000	0.914	0.064
2	4	33.024	1.175	0.268	1.444	0.787	0.036	0.030	0.000	0.984	0.796
3	6	15.819	2.622	0.885	3.507	0.956	0.456	0.439	0.000	1.035	1.643
4	5	-1.146	1.610	0.359	1.969	-0.039	0.636	0.635	0.000	0.994	0.743
5	5	-16.172	0.489	0.042	0.531	-0.148	0.321	0.309	0.000	0.886	0.139
					$\sum$	1.627				$\sum$	3.386

FS = $\frac{3.386}{1.627}$ = 2.08083

FS = **2.081**

River Dumoulin Levee Study Modified Bishop's Method **Failure Surface #2-Case 3**

				$\gamma 1 =$	0.115	kcf	$\gamma 2 =$	0	kcf		
Coordinates of	x =	17.08	ft	c'1 =	0	ksf	c'2 =	0	ksf	Δx circle=	21.4
Center of Circle	y =	679.87	ft	ø'1 =	29	°	ø'2 =	0	°	Δy circle=	4.05

Radius of failure surface (r) 18.5 ft F.S. = 1.587 assumed

Slice	Lt Side x coord	Rt side x coord	Lt Side y coord bottom	Rt Side y coord bottom	Lt Side y coord top	Rt Side y coord top	Vol. Slice ($\gamma 1$) cf/ft	Vol. Slice ($\gamma 2$) cf/ft	Yb ft	Zb ft	Yc ft	Zc ft
1	3.6	5	667.20	665.90	667.20	667.31	0.987	0.00	0.000	0.000	1.410	0.000
2	5	9	665.90	663.30	667.31	667.00	10.220	0.00	1.410	1.367	3.700	0.000
3	9	15	663.30	661.60	667.00	665.50	22.800	0.00	3.700	3.588	3.900	1.367
4	15	20	661.60	661.70	665.50	663.40	14.000	0.00	3.900	3.782	1.700	3.588
5	20	25	661.70	663.15	663.40	663.15	4.250	0.00	1.700	1.649	0.000	3.782

Slice	a ft	α degrees	Ws kips	Ww kips	(1) W total	$W \times \sin(\alpha)$	U_{base}	(2) $U_{base} \times \cos(\alpha)$	(3) C'a kips	(4) m_α	[(1)-(2)]tanø'+(3) (4) kips
1	1.4	42.879	0.114	0.062	0.175	0.119	0.000	0.000	0.000	0.971	0.100
2	4	33.024	1.175	0.638	1.813	0.988	0.204	0.171	0.000	1.029	0.885
3	6	15.819	2.622	1.601	4.223	1.151	1.085	1.044	0.000	1.057	1.666
4	5	-1.146	1.610	0.608	2.218	-0.044	1.150	1.150	0.000	0.993	0.597
5	5	-16.172	0.489	0.257	0.746	-0.208	0.882	0.847	0.000	0.863	-0.065
					$\sum$	2.006				$\sum$	3.183

FS = $\frac{3.183}{2.006}$ = 1.58665

FS = **1.587**

River Dumoulin Levee Study Modified Bishop's Method **Failure Surface #3-Case 1**

				$\gamma 1 =$	0.12	kcf	$\gamma 2 =$	0	kcf		
Coordinates of	x =	16.13	ft	c'1 =	0	ksf	c'2 =	0	ksf	Δx circle=	16
Center of Circle	y =	677.95	ft	ø'1 =	29	°	ø'2 =	0	°	Δy circle=	3.97

Radius of failure surface (r) 15.4 ft F.S. = 2.403 assumed

Slice	Lt Side x coord	Rt side x coord	Lt Side y coord bottom	Rt Side y coord bottom	Lt Side y coord top	Rt Side y coord top	Vol. Slice ($\gamma 1$) cf/ft	Vol. Slice ($\gamma 2$) cf/ft	Yb ft	Zb ft	Yc ft	Zc ft
2	5	9	667.31	664.30	667.31	667.00	5.400	0.00	0.000	0.000	0.000	0.000
3	9	15	664.30	662.50	667.00	665.50	17.100	0.00	0.000	0.000	0.000	0.000
4	15	20	662.50	663.00	665.50	663.40	8.500	0.00	0.000	0.000	0.000	0.000
5	20	21	663.00	663.34	663.40	663.34	0.200	0.00	0.000	0.000	0.000	0.000

Slice	a ft	α degrees	Ws kips	Ww kips	(1) W total	$W \times \sin(\alpha)$	U_{base}	(2) $U_{base} \times \cos(\alpha)$	(3) C'a kips	(4) m_α	[(1)-(2)]tanø'+(3) (4) kips
2	4	36.961	0.648	0.000	0.648	0.390	0.000	0.000	0.000	0.938	0.383
3	6	16.699	2.052	0.000	2.052	0.590	0.000	0.000	0.000	1.024	1.111
4	5	-5.711	1.020	0.000	1.020	-0.101	0.000	0.000	0.000	0.972	0.582
5	1	-18.778	0.024	0.000	0.024	-0.008	0.000	0.000	0.000	0.873	0.015
					∑	0.870				∑	2.091

FS = $\frac{2.091}{0.870}$ = 2.40284

FS = **2.403**

River Dumoulin Levee Study Modified Bishop's Method **Failure Surface #3-Case 2**

				γ1 =	0.115	kcf	γ2 =	0	kcf		
Coordinates of	x =	16.13	ft	c'1 =	0	ksf	c'2 =	0	ksf	Δx circle=	16
Center of Circle	y =	677.95	ft	ø'1 =	29	°	ø'2 =	0	°	Δy circle=	3.97

Radius of failure surface (r) 15.4 ft F.S. = 2.562 assumed

Slice	Lt Side x coord	Rt side x coord	Lt Side y coord bottom	Rt Side y coord bottom	Lt Side y coord top	Rt Side y coord top	Vol. Slice (γ1) cf/ft	Vol. Slice (γ2) cf/ft	Yb ft	Zb ft	Yc ft	Zc ft
2	5	9	667.31	664.30	667.31	667.00	5.400	0.00	0.000	0.000	0.000	0.000
3	9	15	664.30	662.50	667.00	665.50	17.100	0.00	0.000	0.000	0.000	0.000
4	15	20	662.50	663.00	665.50	663.40	8.500	0.00	0.000	0.000	0.000	0.000
5	20	21	663.00	663.34	663.40	663.34	0.200	0.00	0.000	0.000	0.000	0.000

Slice	a ft	α degrees	Ws kips	Ww kips	(1) W total	$W \times \sin(\alpha)$	U_{base}	(2) $U_{base} \times \cos(\alpha)$	(3) C'a kips	(4) m_α	[(1)-(2)]tanø'+(3) (4) kips
2	4	36.961	0.621	-0.053	0.568	0.341	0.000	0.000	0.000	0.929	0.339
3	6	16.699	1.967	0.431	2.397	0.689	0.000	0.000	0.000	1.020	1.303
4	5	-5.711	0.977	0.192	1.170	-0.116	0.000	0.000	0.000	0.974	0.666
5	1	-18.778	0.023	0.000	0.023	-0.007	0.000	0.000	0.000	0.877	0.015
					∑	0.906				∑	2.322

FS = 2.322 / 0.906 = 2.56167

FS = **2.562**

River Dumoulin Levee Study Modified Bishop's Method **Failure Surface #3-Case 3**

				$\gamma 1 =$	0.115	kcf	$\gamma 2 =$	0	kcf		
Coordinates of	x =	16.13	ft	c'1 =	0	ksf	c'2 =	0	ksf	Δx circle=	16
Center of Circle	y =	677.95	ft	ø'1 =	29	°	ø'2 =	0	°	Δy circle=	3.97

Radius of failure surface (r) 15.4 ft F.S. = 2.362 assumed

Slice	Lt Side x coord	Rt side x coord	Lt Side y coord bottom	Rt Side y coord bottom	Lt Side y coord top	Rt Side y coord top	Vol. Slice ($\gamma 1$) cf/ft	Vol. Slice ($\gamma 2$) cf/ft	Yb ft	Zb ft	Yc ft	Zc ft
2	5	9	667.31	664.30	667.31	667.00	5.400	0.00	0.000	0.000	0.000	0.000
3	9	15	664.30	662.50	667.00	665.50	17.100	0.00	0.000	0.000	0.000	0.000
4	15	20	662.50	663.00	665.50	663.40	8.500	0.00	0.000	0.000	0.000	0.000
5	20	21	663.00	663.34	663.40	663.34	0.200	0.00	0.000	0.000	0.000	0.000

Slice	a ft	α degrees	Ws kips	Ww kips	(1) W total	$W \times \sin(\alpha)$	U_{base}	(2) $U_{base} \times \cos(\alpha)$	(3) C'a kips	(4) m_α	[(1)-(2)]tanø'+(3) (4) kips
2	4	36.961	0.621	0.337	0.958	0.576	0.000	0.000	0.000	0.940	0.565
3	6	16.699	1.967	1.067	3.034	0.872	0.000	0.000	0.000	1.025	1.640
4	5	-5.711	0.977	0.468	1.445	-0.144	0.000	0.000	0.000	0.972	0.825
5	1	-18.778	0.023	0.012	0.035	-0.011	0.000	0.000	0.000	0.871	0.023
					∑	1.292				∑	3.052

FS = $\frac{3.052}{1.292}$ = 2.36151

FS = **2.362**

[redacted]

CONTRACT NO. 120102
SHEET NO. 1 DATE 5/16/12

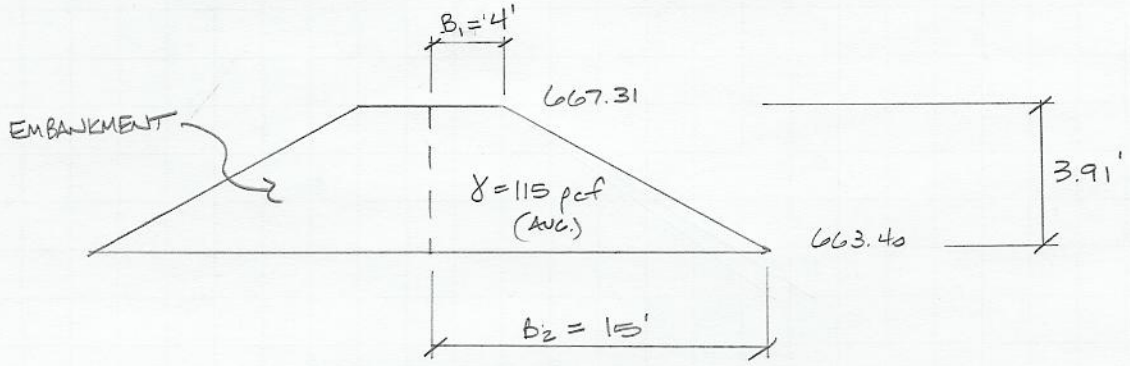
CONSULTING ENGINEERS
3002 CROSSING COURT
CHAMPAIGN, ILLINOIS 61822
PHONE 217/351-6268

RIVER DUMOULIN LEVEE STUDY

SETTLEMENT CALCULATIONS

USE BORING B-7 (NEAR STA. 153+00)

1. ELEV. 667.31 → 657.81 BROWN SILTY CLAY
2. ELEV. 657.81 → 655.31 SILTY, SANDY CLAY
3. ELEV. 655.31 → END COARSE SAND / BROKEN ROCK



DETERMINE STRESS INCREASE UNDER EMBANKMENT AT MIDDLE OF TOP 2 LAYERS

$$q_o = \gamma H = (115\,pcf)(3.91') = 450\,psf \quad (@\ \text{ELEV. } 663.40)$$

AT MIDDLE OF TOP 2 LAYERS

$$z = \frac{663.40 - 655.31}{2} = 4.05'$$

$$B_1/z = 4'/4.05' = 0.99 \qquad B_2/z = 15'/4.05' = 3.70$$

USE INFLUENCE FACTOR $I' = 0.40$ FOR BOTH SIDES OF EMBANKMENT

$$\Delta\rho_{@\ \text{MIDDLE DEPTH}} = \Delta\rho_1 + \Delta\rho_2$$
$$= q_o\left(I'_{LEFT} + I'_{RIGHT}\right)$$
$$= 450\,(0.40 + 0.40)$$
$$= 360\,psf$$

[redacted]

CONTRACT NO. 120102
SHEET NO. 2 DATE 5/16/12

CONSULTING ENGINEERS
3002 CROSSING COURT
CHAMPAIGN, ILLINOIS 61822
PHONE 217/351-6268

RIVER DUMOULIN LEVEE STUDY

SETTLEMENT CALCULATIONS

CALCULATE CONSOLIDATION SETTLEMENTS OF SILTY CLAY MATERIAL

$$S = \frac{C_s}{1+e_o} H \log \frac{p_o + \Delta p_{AVG.}}{p_o}$$

p_o = AVG. EFFECTIVE PRESSURE ON CLAY MATERIALS BEFORE EMBANKMENT CONSTRUCTION

$\Delta p_{AVG.}$ = AVG. INCREASE OF PRESSURE ON CLAY MATERIALS CAUSED BY EMBANKMENT CONSTRUCTION

e_o = VOID RATIO OF CLAY LAYERS (0.65, BASED ON SIMILAR SOILS AND CONSERVATIVE)

C_s = SWELLING INDEX

H = THICKNESS OF CLAY MATERIALS (663.40 - 655.31 = 8.09')

$p_o = 4.05' (115 \text{ pcf}) = 466 \text{ psf}$

$G_s = 2.7$ (TYPICAL)

$LL = 42$ (SILTY CLAY, SOME SAND CONS.)

$C_s = (0.0463)(LL/100)(G_s)$

$= 0.0463 (49/100)(2.7) = 0.061$

$$S = \frac{0.061 (8.09')}{1 + 0.65} \log \frac{(466 \text{ psf} + 360 \text{ psf})}{466 \text{ psf}}$$

$= 0.299 (0.249)$

$= 0.074 \text{ ft.} (12''/1) = 0.9''$ $\boxed{\text{USE } 1''}$

[redacted]

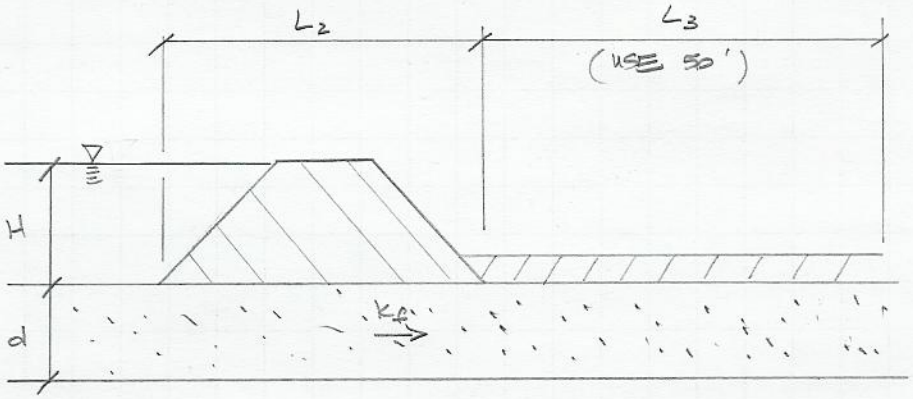
CONTRACT NO. 120102
SHEET NO. 1 DATE 5/15/12

CONSULTING ENGINEERS
3002 CROSSING COURT
CHAMPAIGN, ILLINOIS 61822
PHONE 217/351-6268

RIVER DUMMOULIN LEVEE STUDY

SEEPAGE CALCULATIONS

USE X-SEC. @ STA. 153+00 (B-7)



$$Q_s = \phi (K_f)(H)$$

K_f = PERMEABILITY OF FOUNDATION SOILS
$= 6.6 \times 10^{-6}$ ft.³/sec. (SAND)
$= 3.3 \times 10^{-9}$ ft³/sec (CLAY)

ϕ = SHAPE FACTOR

$$= \frac{d}{0.43d + L_2 + L_3}$$

$$= \frac{15'}{0.43(15') + 25' + 50'} = \frac{15'}{81.45'} = 0.184$$

$$Q_s = 0.184\left(6.6 \times 10^{-6}\ \text{ft.}^3/\text{sec}\right)(12') = 1.46 \times 10^{-5}\ \text{ft.}^3/\text{sec}$$
$$= 1.26\ \text{ft.}^3/\text{day}$$

IF CLAY FOUNDATION SOILS;

$$Q_s = 0.184\left(3.3 \times 10^{-9}\ \text{ft.}^3/\text{sec}\right)(12') = 7 \times 10^{-9}\ \text{ft.}^3/\text{sec}$$
$$= 0.0006\ \text{ft.}^3/\text{day}$$

Photos

Photo 1

Site: River Dumoulin Levee Study, Incorporated Lisle, DuPage County, IL

Date: January 30, 2012

Description: Land side of east levee, facing south, between Maple Ave and Short St.

Investigator: Engineering Resource Associates, Inc. (D.Matter)

Photo 2

Site: River Dumoulin Levee Study, Incorporated Lisle, DuPage County, IL

Date: January 30, 2012

Description: Crest of east levee, facing south, between Maple Ave and Short St.

Investigator: Engineering Resource Associates, Inc. (D.Matter)

Photo 3

Site: River Dumoulin Levee Study, Incorporated Lisle, DuPage County, IL

Date: January 30, 2012

Description: Crest of east levee, facing north, between Maple Ave and Short St at pedestrian bridge, near soil boring B-2.

Investigator: Engineering Resource Associates, Inc. (D.Matter)

Photo 4

Site: River Dumoulin Levee Study, Incorporated Lisle, DuPage County, IL

Date: January 30, 2012

Description: River side of east levee, facing northwest, between Maple Ave and Short St at pedestrian bridge, near soil boring B-2.

Investigator: Engineering Resource Associates, Inc. (D.Matter)

Photo 5

Site: River Dumoulin Levee Study, Incorporated Lisle, DuPage County, IL

Date: January 30, 2012

Description: Crest of east levee, facing south, between Maple Ave and Short St, near soil boring B-1.

Investigator: Engineering Resource Associates, Inc. (D.Matter)

Photo 6

Site: River Dumoulin Levee Study, Incorporated Lisle, DuPage County, IL

Date: January 30, 2012

Description: River side of east levee, facing north, between Maple Ave and Short St, near soil boring B-1.

Investigator: Engineering Resource Associates, Inc. (D.Matter)

Photo 7

Site: River Dumoulin Levee Study, Incorporated Lisle, DuPage County, IL

Date: January 30, 2012

Description: Crest of east levee, facing north, between Maple Ave and Short St, at soil boring B-1.

Investigator: Engineering Resource Associates, Inc. (D.Matter)

Photo 8

Site: River Dumoulin Levee Study, Incorporated Lisle, DuPage County, IL

Date: January 30, 2012

Description: Land side of east levee, facing northeast, between Maple Ave and Short St across from pedestrian bridge, near soil boring B-2.

Investigator: Engineering Resource Associates, Inc. (D.Matter)

Photo 9

Site: River Dumoulin Levee Study, Incorporated Lisle, DuPage County, IL

Date: January 30, 2012

Description: Land side of east levee, facing northeast, between Maple Ave and Short St across from pedestrian bridge, near soil boring B-2.

Investigator: Engineering Resource Associates, Inc. (D.Matter)

Photo 10

Site: River Dumoulin Levee Study, Incorporated Lisle, DuPage County, IL

Date: January 30, 2012

Description: River side of east levee, facing east, between Maple Ave and Short St, north of pedestrian bridge, showing Village sewer location.

Investigator: Engineering Resource Associates, Inc. (D.Matter)

Photo 11

Site: River Dumoulin Levee Study, Incorporated Lisle, DuPage County, IL

Date: January 30, 2012

Description: Crest of east levee, facing north, just south of Short St, near boring B-3.

Investigator: Engineering Resource Associates, Inc. (D.Matter)

Photo 12

Site: River Dumoulin Levee Study, Incorporated Lisle, DuPage County, IL

Date: January 30, 2012

Description: Crest of east levee, facing north, just south of Short St, near boring B-3, showing multiple utilities.

Investigator: Engineering Resource Associates, Inc. (D.Matter)

Photo 13

Site: River Dumoulin Levee Study, Incorporated Lisle, DuPage County, IL

Date: January 30, 2012

Description: Crest of east levee, facing north, just south of Short St, near boring B-3, showing multiple utilities.

Investigator: Engineering Resource Associates, Inc. (D.Matter)

Photo 14

Site: River Dumoulin Levee Study, Incorporated Lisle, DuPage County, IL

Date: January 30, 2012

Description: River side of east levee, facing west, just north of Short St, showing Village sewer location.

Investigator: Engineering Resource Associates, Inc. (D.Matter)

Photo 15

Site: River Dumoulin Levee Study, Incorporated Lisle, DuPage County, IL

Date: January 30, 2012

Description: Crest of east levee, facing north, just north of Short St.

Investigator: Engineering Resource Associates, Inc. (D.Matter)

Photo 16

Site: River Dumoulin Levee Study, Incorporated Lisle, DuPage County, IL

Date: January 30, 2012

Description: Crest of east levee, facing north, between Short St and the railroad tracks, showing Village sewer location.

Investigator: Engineering Resource Associates, Inc. (D.Matter)

Photo 17

Site: River Dumoulin Levee Study, Incorporated Lisle, DuPage County, IL

Date: January 30, 2012

Description: Crest of east levee, facing north, between Short St and the railroad tracks, near boring B-4.

Investigator: Engineering Resource Associates, Inc. (D.Matter)

Photo 18

Site: River Dumoulin Levee Study, Incorporated Lisle, DuPage County, IL

Date: January 30, 2012

Description: Crest of east levee, facing north, between Short St and the railroad tracks, showing woody vegetation established on levee.

Investigator: Engineering Resource Associates, Inc. (D.Matter)

Photo 19

Site: River Dumoulin Levee Study, Incorporated Lisle, DuPage County, IL

Date: January 30, 2012

Description: Crest of east levee, facing north, between Short St and the railroad tracks, near boring B-5.

Investigator: Engineering Resource Associates, Inc. (D.Matter)

Photo 20

Site: River Dumoulin Levee Study, Incorporated Lisle, DuPage County, IL

Date: January 30, 2012

Description: Crest of east levee, facing north, between Short St and the railroad tracks, at boring B-5. Note woody vegetation established on levee.

Investigator: Engineering Resource Associates, Inc. (D.Matter)

Photo 21

Site: River Dumoulin Levee Study, Incorporated Lisle, DuPage County, IL

Date: January 30, 2012

Description: River side of east levee, facing north, just north of the railroad tracks, showing woody vegetation established on levee.

Investigator: Engineering Resource Associates, Inc. (D.Matter)

Photo 22

Site: River Dumoulin Levee Study, Incorporated Lisle, DuPage County, IL

Date: January 30, 2012

Description: Crest of east levee, facing north, between railroad tracks and Burlington Ave, showing woody vegetation, power poles, and fence on levee.

Investigator: Engineering Resource Associates, Inc. (D.Matter)

Photo 23

Site: River Dumoulin Levee Study, Incorporated Lisle, DuPage County, IL

Date: January 30, 2012

Description: Crest of east levee, facing south, just north of the railroad tracks, showing woody vegetation and bridge abutments.

Investigator: Engineering Resource Associates, Inc. (D.Matter)

Photo 24

Site: River Dumoulin Levee Study, Incorporated Lisle, DuPage County, IL

Date: January 30, 2012

Description: Corner of River Dumoulin Levee (east side) and St Joseph Creek Levee, between Ogden Ave and Lacey Ave, facing east, showing woody vegetation and fence on levee.

Investigator: Engineering Resource Associates, Inc. (D.Matter)

Photo 25

Site: River Dumoulin Levee Study, Incorporated Lisle, DuPage County, IL

Date: January 30, 2012

Description: Corner of River Dumoulin Levee (east side) and St Joseph Creek Levee, between Ogden Ave and Lacey Ave, facing southeast, showing woody vegetation, power poles and fence on levee.

Investigator: Engineering Resource Associates, Inc. (D.Matter)

Photo 26

Site: River Dumoulin Levee Study, Incorporated Lisle, DuPage County, IL

Date: January 30, 2012

Description: River side of east levee, between Ogden Ave and Lacey Ave, facing south, showing woody vegetation, power poles and fence on levee.

Investigator: Engineering Resource Associates, Inc. (D.Matter)

Photo 27

Site: River Dumoulin Levee Study, Incorporated Lisle, DuPage County, IL

Date: January 30, 2012

Description: Crest of east levee, facing south, at terminal end of Lacey Ave, showing woody vegetation, power poles, and utilities on levee.

Investigator: Engineering Resource Associates, Inc. (D.Matter)

Photo 28

Site: River Dumoulin Levee Study, Incorporated Lisle, DuPage County, IL

Date: January 30, 2012

Description: View of west levee (from east bank), facing west, at terminal end of Lacey Ave, showing pump station and power poles on levee.

Investigator: Engineering Resource Associates, Inc. (D.Matter)

Photo 29

Site: River Dumoulin Levee Study, Incorporated Lisle, DuPage County, IL

Date: January 30, 2012

Description: Crest of east levee, facing north, at terminal end of Lacey Ave, showing pump station and power poles on levee.

Investigator: Engineering Resource Associates, Inc. (D.Matter)

Photo 30

Site: River Dumoulin Levee Study, Incorporated Lisle, DuPage County, IL

Date: January 30, 2012

Description: Crest of east levee, facing south, just south of Lacey Ave, showing power poles, woody vegetation, and garden on levee.

Investigator: Engineering Resource Associates, Inc. (D.Matter)

Photo 31

Site: River Dumoulin Levee Study, Incorporated Lisle, DuPage County, IL

Date: January 30, 2012

Description: Crest of east levee, facing east, between Lacey Ave and St Joseph Creek, showing power poles, woody vegetation, and fence on levee.

Investigator: Engineering Resource Associates, Inc. (D.Matter)

Photo 32

Site: River Dumoulin Levee Study, Incorporated Lisle, DuPage County, IL

Date: January 30, 2012

Description: River side of east levee, facing south, between Lacey Ave and St Joseph Creek, showing woody vegetation on levee.

Investigator: Engineering Resource Associates, Inc. (D.Matter)

Photo 33

Site: River Dumoulin Levee Study, Incorporated Lisle, DuPage County, IL

Date: January 30, 2012

Description: River side of east levee, facing north, just north of Lacey Ave, showing power poles, woody vegetation, and fence on levee.

Investigator: Engineering Resource Associates, Inc. (D.Matter)

Photo 34

Site: River Dumoulin Levee Study, Incorporated Lisle, DuPage County, IL

Date: January 30, 2012

Description: Crest of east levee, facing north, between Lacey Ave and Middleton Ave, showing power poles and woody vegetation on levee.

Investigator: Engineering Resource Associates, Inc. (D.Matter)

Photo 35

Site: River Dumoulin Levee Study, Incorporated Lisle, DuPage County, IL

Date: January 30, 2012

Description: Crest of east levee, facing north, just south of Middleton Ave, showing power poles and woody vegetation on levee.

Investigator: Engineering Resource Associates, Inc. (D.Matter)

Photo 36

Site: River Dumoulin Levee Study, Incorporated Lisle, DuPage County, IL

Date: January 30, 2012

Description: Corner where east levee bends east along Middleton Ave, at Middleton Ave (where water main was installed), facing east, showing woody vegetation on levee.

Investigator: Engineering Resource Associates, Inc. (D.Matter)

Photo 37

Site: River Dumoulin Levee Study, Incorporated Lisle, DuPage County, IL

Date: January 30, 2012

Description: Land side of east levee, at terminal end of Lacey Ave, facing east, showing pump station at toe of levee.

Investigator: Engineering Resource Associates, Inc. (D.Matter)

Photo 38

Site: River Dumoulin Levee Study, Incorporated Lisle, DuPage County, IL

Date: January 30, 2012

Description: River side of west levee, between Lacey Ave and Middleton Ave, facing north, showing woody vegetation and fence on levee.

Investigator: Engineering Resource Associates, Inc. (D.Matter)

Photo 39

Site: River Dumoulin Levee Study, Incorporated Lisle, DuPage County, IL

Date: January 30, 2012

Description: River side of west levee, between Lacey Ave and Middleton Ave, facing north, showing woody vegetation and power poles on levee. Note pier on shoreline.

Investigator: Engineering Resource Associates, Inc. (D.Matter)

Photo 40

Site: River Dumoulin Levee Study, Incorporated Lisle, DuPage County, IL

Date: January 30, 2012

Description: River side of west levee, just south of Lacey Ave, facing south, showing woody vegetation and a fence on levee.

Investigator: Engineering Resource Associates, Inc. (D.Matter)

Photo 41

Site: River Dumoulin Levee Study, Incorporated Lisle, DuPage County, IL

Date: January 30, 2012

Description: Crest of west levee, just north of Ogden Ave, facing south, showing woody vegetation along streambank and house on levee.

Investigator: Engineering Resource Associates, Inc. (D.Matter)

Site: River Dumoulin Levee Study, Incorporated Lisle, DuPage County, IL

Date: January 30, 2012

Description: Crest of west levee, between Ogden Ave and Lacey Ave, facing north, near boring B-14.

Investigator: Engineering Resource Associates, Inc. (D.Matter)

Photo 43

Site: River Dumoulin Levee Study, Incorporated Lisle, DuPage County, IL

Date: January 30, 2012

Description: View of corner of east levee and St Joseph Creek Levee, at mouth of St Joseph Creek, facing northeast, showing woody vegetation on levee.

Investigator: Engineering Resource Associates, Inc. (D.Matter)

Photo 44

Site: River Dumoulin Levee Study, Incorporated Lisle, DuPage County, IL

Date: January 30, 2012

Description: View of east levee (south of St Joseph Creek) and river side of west levee, facing southeast (from west side), showing woody vegetation and power poles on levee.

Investigator: Engineering Resource Associates, Inc. (D.Matter)

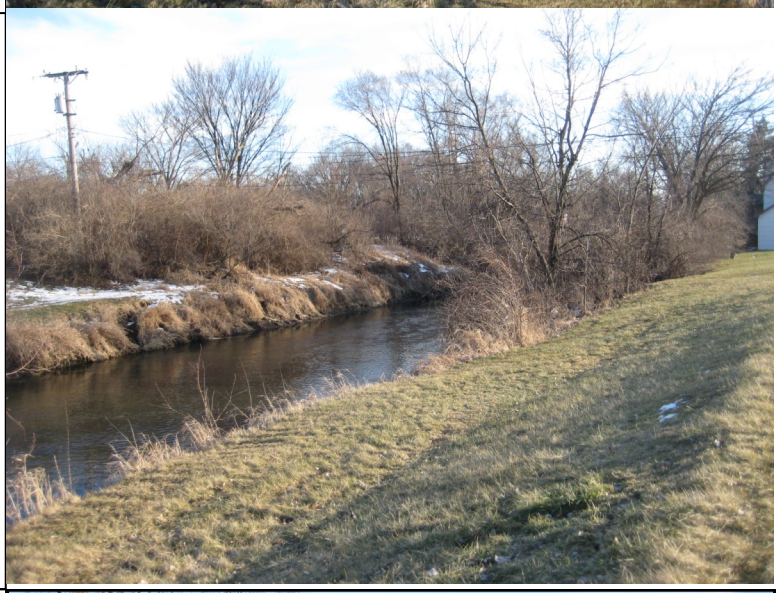


Photo 45

Site: River Dumoulin Levee Study, Incorporated Lisle, DuPage County, IL

Date: January 30, 2012

Description: View of corner of east levee and St Joseph Creek Levee, at mouth of St Joseph Creek, facing northeast, showing woody vegetation and power poles on levee.

Investigator: Engineering Resource Associates, Inc. (D.Matter)

Photo 46

Site: River Dumoulin Levee Study, Incorporated Lisle, DuPage County, IL

Date: January 30, 2012

Description: Crest of east levee, facing south, just south of Ogden Ave, near boring B-7, showing woody vegetation on levee and billboard at toe of levee.

Investigator: Engineering Resource Associates, Inc. (D.Matter)

Photo 47

Site: River Dumoulin Levee Study, Incorporated Lisle, DuPage County, IL

Date: January 30, 2012

Description: View of west levee, facing west, just south of Ogden Ave, showing woody vegetation on levee.

Investigator: Engineering Resource Associates, Inc. (D.Matter)

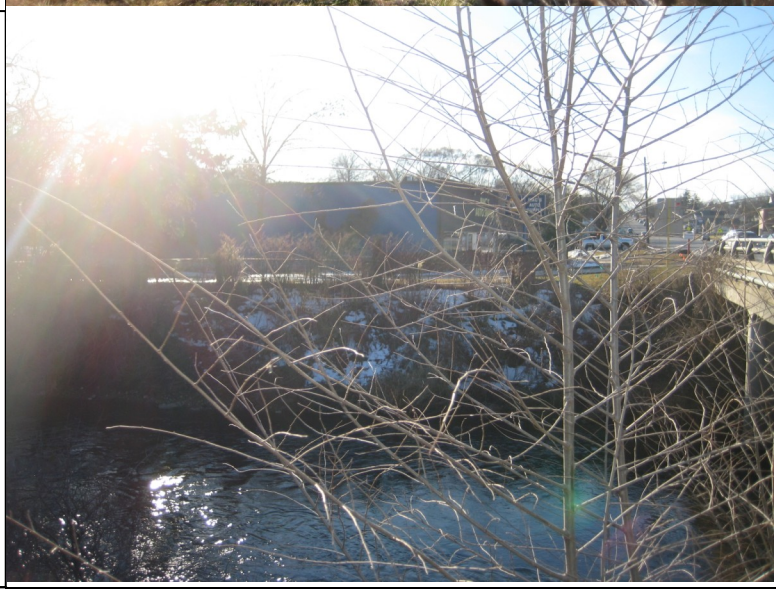


Photo 48

Site: River Dumoulin Levee Study, Incorporated Lisle, DuPage County, IL

Date: January 30, 2012

Description: View of west levee, facing southwest, just south of Ogden Ave, showing woody vegetation on levee.

Investigator: Engineering Resource Associates, Inc. (D.Matter)

Photo 49

Site: River Dumoulin Levee Study, Incorporated Lisle, DuPage County, IL

Date: January 30, 2012

Description: River side of east levee, facing north, between Ogden Ave and Burlington Ave, showing woody vegetation and staircase on levee.

Investigator: Engineering Resource Associates, Inc. (D.Matter)

Photo 50

Site: River Dumoulin Levee Study, Incorporated Lisle, DuPage County, IL

Date: January 30, 2012

Description: River side of east levee, facing south, between Ogden Ave and Burlington Ave, showing woody vegetation and pump station on levee.

Investigator: Engineering Resource Associates, Inc. (D.Matter)

Photo 51

Site: River Dumoulin Levee Study, Incorporated Lisle, DuPage County, IL

Date: January 30, 2012

Description: River side of east levee, facing north, between Ogden Ave and Burlington Ave, showing woody vegetation on levee.

Investigator: Engineering Resource Associates, Inc. (D.Matter)

Photo 52

Site: River Dumoulin Levee Study, Incorporated Lisle, DuPage County, IL

Date: January 30, 2012

Description: View of west levee, facing northwest, between Ogden Ave and Burlington Ave, showing woody vegetation and power poles on levee.

Investigator: Engineering Resource Associates, Inc. (D.Matter)

Photo 53

Site: River Dumoulin Levee Study, Incorporated Lisle, DuPage County, IL

Date: January 30, 2012

Description: View of west levee, facing southwest, between Ogden Ave and Burlington Ave, showing woody vegetation, pump station, and power poles on levee.

Investigator: Engineering Resource Associates, Inc. (D.Matter)

Photo 54

Site: River Dumoulin Levee Study, Incorporated Lisle, DuPage County, IL

Date: January 30, 2012

Description: Crest of east levee, facing north, just north of Burlington Ave, near boring B-16, showing gas utility location.

Investigator: Engineering Resource Associates, Inc. (D.Matter)

Photo 55

Site: River Dumoulin Levee Study, Incorporated Lisle, DuPage County, IL

Date: January 30, 2012

Description: River side of east levee, facing south, just south of Burlington Ave, showing woody vegetation on levee.

Investigator: Engineering Resource Associates, Inc. (D.Matter)

Photo 56

Site: River Dumoulin Levee Study, Incorporated Lisle, DuPage County, IL

Date: January 30, 2012

Description: Crest of west levee, facing south, just south of Burlington Ave, showing woody vegetation and guard rail on levee.

Investigator: Engineering Resource Associates, Inc. (D.Matter)

Photo 57

Site: River Dumoulin Levee Study, Incorporated Lisle, DuPage County, IL

Date: January 30, 2012

Description: Crest of west levee, facing north, just north of Burlington Ave, near boring B-16, showing gas utility location.

Investigator: Engineering Resource Associates, Inc. (D.Matter)

ENGINEERING RESOURCE ASSOCIATES, INC.
Consulting Engineers, Scientists & Surveyors

Levee Inspection

SUBJECT: Levee Inspection Following April 18, 2013 Flood Event

DATE: May 1, 2013 (Jake Wolf on May 8, 2013)

LOCATION: River Dumoulin Levee System

FROM: Erin Pande, Marty Michalisko & Jake Wolf

ATTENDEES:

Name	Entity	Phone	Email
Jason Elias	Village of Lisle	630-271-4171	jelias@villageoflisle.org
Marty Michalisko	Engineering Resource Assoc.	630-393-3060	mmichalisko@eraconsultants.com
Erin Pande	Engineering Resource Assoc	630-393-3060	Epande@eraconsultants.com

Contents

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East side of the East Branch DuPage River Short Street to Burlington Ave. 11

East side of the East Branch DuPage River Short Street to Driving Range 12

Summary: 14

Field Observations

Jason, Marty and Erin met at the parking area west of the Short Street bridge at approximately 8:15 am. Weather was sunny and about 70 degrees. We proceeded to inspect the levee starting along the west side of the East Branch DuPage River north of Ogden. Marty left for a meeting following inspection of this segment. Erin and Jason proceeded to inspect the levee east of the river north of Ogden, proceeded by the east side of the river between Ogden and Burlington, then the west side of the river between Ogden and Burlington, then east side of the river Short Street to Burlington and finally east side of levee Short street to Driving Range. The following is a description of the segment and notes from the inspection as they correspond to that segment:

West of the East Branch DuPage River North of Ogden

The levee crested north of the pump station between stations 264+00 and 266+00. Evidence of overtopping is debris line along chain link fence on the levee. This area was identified as an area that would exceed the 50-year design elevation in the levee study.

Figure 1 Debris line along chain link fence.

An existing fishing pier was damaged and is no longer present on the bank/piers.

Figure 2 Piers from fishing dock

The levee crested along the Middleton Ave levee segment west of the River. This area was identified as an area that would exceed the 50-year design elevation in the levee study. Erosion was observed along levee in this area.

Figure 3 Erosion along top of levee

Figure 4 Erosion along top of levee

Figure 5 Erosion along top of levee

A manhole cover was found near the outlet near 269+00. The cover was not on a storm sewer. Erosion was observed around the storm sewer outlet. Debris was noted in the storm sewer.

Figure 6 Erosion around outlet structure

Figure 7 Debris in pipe

The levee crested between stations 255+50 and 261+50. This area was identified as an area that would exceed the 50-year design elevation in the levee study.

Figure 8 debris line in trees

Bank erosion is consistent with previous observations.

Figure 9 Erosion around outlet structures

East of the East Branch DuPage River north of Ogden

The levee crested north of the pump station between stations 165+00 and 167+00. Evidence of overtopping was sediment on leaves along the top of the levee and debris line in trees and shrubs along the levee. This area was not identified as an area that would exceed the 50-year design elevation in the levee study.

Figure 10 Debris line in trees/shrubs

A potential area of piping was noted south of the pump station at 162+00. Soils on both the east and west side of the levee were soft at the toe of the slopes.

Figure 11 Potential piping location

The levee crested north of St. Joseph creek between 158+50 and 162+00. This area was identified as an area that would exceed the 50-year design elevation in the levee study. Evidence of overtopping was debris line in trees along the top of the levee. A dead fish was observed on the opposite side of the fence on the top of the levee.

Figure 12 Debris line in trees and shrubs

Figure 13 Dead fish on opposite side of fence

Erosion was noted along the south side of St. Joseph creek. The erosion appears to be worse than that observed during the levee study observations.

Figure 14 Erosion along St. Joseph Creek

East side of the East Branch DuPage River between Ogden and Burlington Ave.

An animal burrow was noted north of the pump station near 148+50.

Figure 15 Animal burrow

The levee crested north of the pump station between stations 150+50 and 153+00. Evidence of overtopping was debris line in trees/shrubs/fence along the levee. This area was not identified as an area that would exceed the 50-year design elevation in the levee study.

Figure 16 Debris line along fence

The levee crested north of the pump station between stations 143+50 and 146+50. Evidence of overtopping was debris line in trees/shrubs along the levee. This area was not identified as an area that would exceed the 50-year design elevation in the levee study.

Figure 17 Debris line in tees/shrubs

Bank erosion is consistent with previous observations.

West side of the East Branch DuPage River between Ogden and Railroad

It does not appear that the levee was crested in this area. This segment was not identified as an area that would exceed the 50-year design elevation in the levee study.

New landscape trees were planted near the levee between 246+00 and 247+00.

Figure 18 New plantings along levee

Bank erosion is consistent with previous observations.

East side of the East Branch DuPage River Short Street to Burlington Ave.

The levee may have crested south of the railroad between stations 137+50 and 138+50. Evidence of overtopping was debris line in trees/shrubs along the levee. This area was not identified as an area that would exceed the 50-year design elevation in the levee study.

A large diameter pipe without a flap gate was observed north of the railroad. Further investigation is needed to determine what it drains.

Figure 19 Inside of storm sewer

Bank erosion is consistent with previous observations.

East side of the East Branch DuPage River Short Street to Driving Range

The levee crested between stations 105+00 and 117+50. Evidence of overtopping was debris line on the chain link fence along the top of the levee. This area was identified as an area that would exceed the 50-year design elevation in the levee study.

Figure 20 Debris lines along chain link fence

Figure 21 Debris line along base of gate to driving range

Figure 22 debris line along chain link fence

Bank erosion is consistent with previous observations.

Figure 23 Evidence of bank erosion

Summary:

The April 18, 2013 flood event exceeded the 50-year storm the levee was designed to protect. This is evident as the levee crested in locations where design exceedence was not identified (in some location greater than 1ft). Based upon the gauge data on the East Branch DuPage River at Butterfield Road the elevation was between a 100 and 500 year event. Gauge data for St Joseph Creek at Ogden when compared to the Flood Insurance Study indicated that the storm exceeded a 500 year event. See attached FIS with gauge locations and elevations identified.

INTRODUCTION

1. Dozens of sites were initially considered during this study, but most were not justified for various reasons described in the main report. Of the sites eliminated, some sites required a limited geotechnical analysis using existing data. These analyses are included in this attachment in case a future study investigates these same sites. Soil maps and existing soil borings are at the end of this attachment.

2. As an overall note, ISGS soil logs may not be accurate as they were logged during the drilling of water wells and not for the purpose of studying soil strata. The logs available from ISGS were taken verbatim from the drillers' logs which were not verified. Typically, these logs would be recorded by identification of the borehole cuttings and when they change composition.

Lacey Creek Restriction

3. This project was going to be located southeast of the intersection of Butterfield Road and State Route 53 in Lisle, Illinois, just upstream of the confluence with the East Branch of the DuPage River as shown on **Figure 1**. The project consisted of a berm and culvert to reduce the flow of Lacey Creek into the East Branch of the DuPage River. The actual dimensions of the berm were not fully developed, but it was expected to have an approximate maximum height of 8.5 feet. There are existing culverts and a berm across the creek, but it is only about 4 feet high and thick with grassy vegetation. The existing berm can be seen just northwest of the proposed berm below.

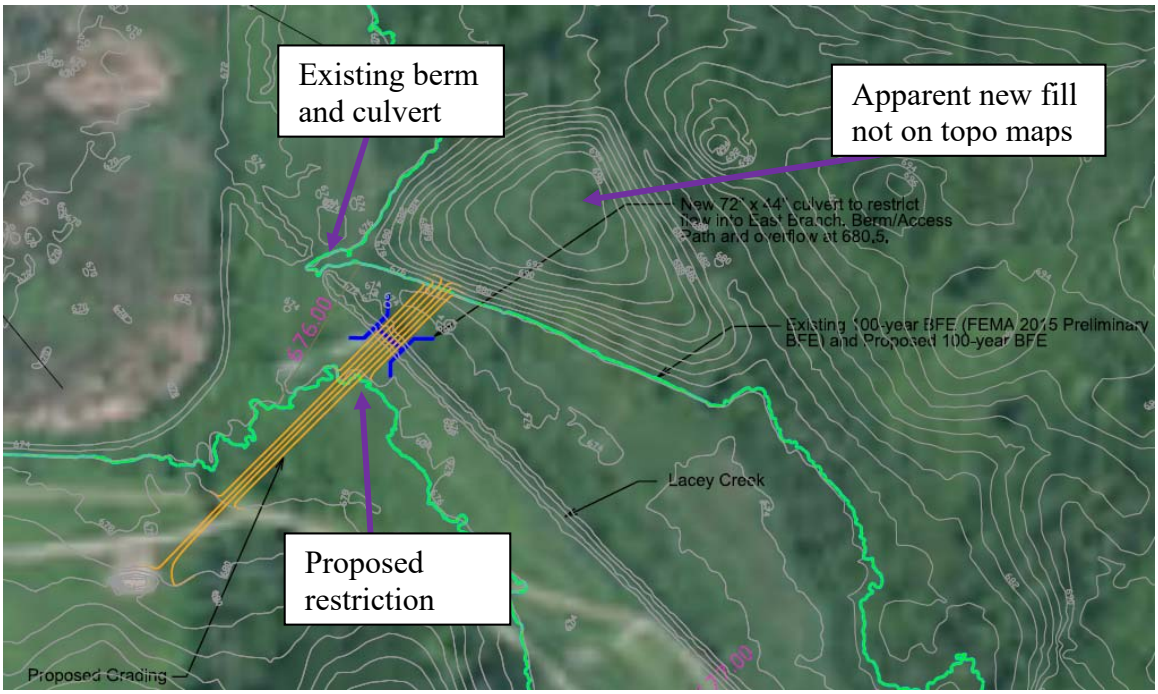


Figure 1. Lacey Creek Restriction proposed alignment and existing features

4. ISGS logs were investigated around the Lacey Creek Restriction site, but there are only two logs within ½-mile of the site and neither log has any subsurface data included. The NRCS soil map indicates the majority of the area is Sawmill silty clay loam. The depth to bedrock is about 50-100 feet below grade, according to Figure 2 in Appendix E.

5. Additionally, historic topographic logs were investigated for this project. The first available is from 1908.

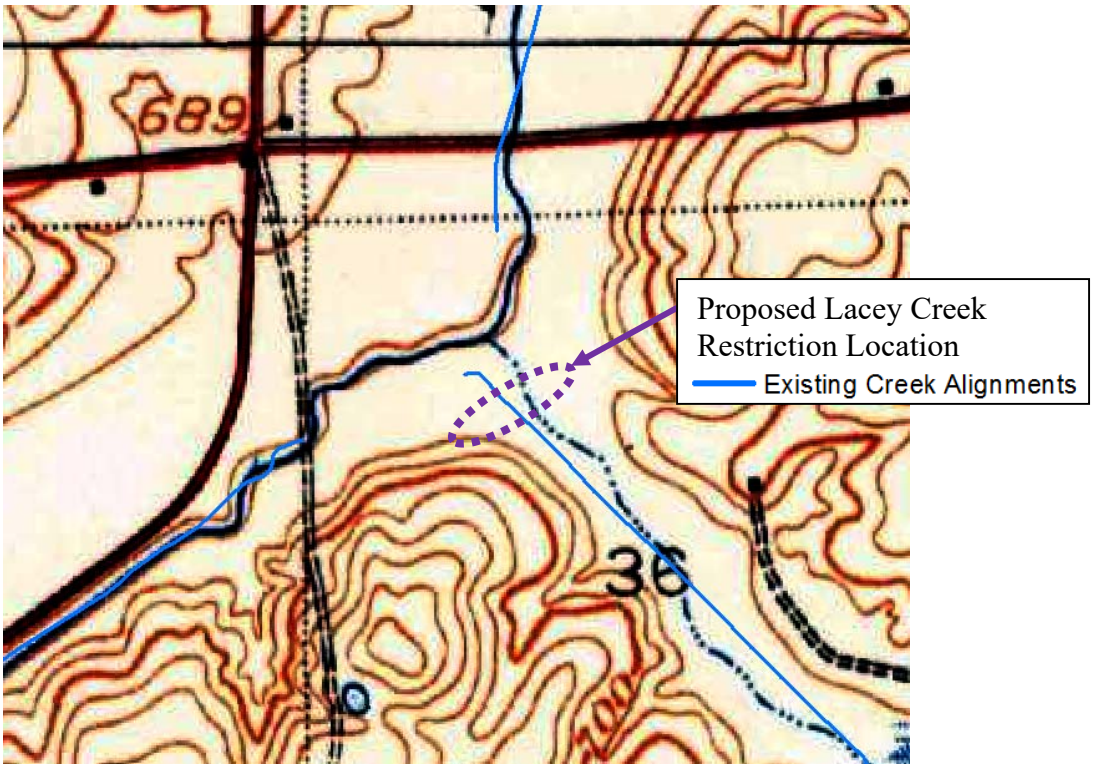


Figure 2. Lacey Creek Restriction area with 1908 Topographic Map showing old versus new river alignment

6. The 1908 topographic map indicates the rivers and streams in this area meandered more than they do now. There is also a south-southeast road that does not exist anymore branching from the intersection of State Route 53 and Butterfield Road.

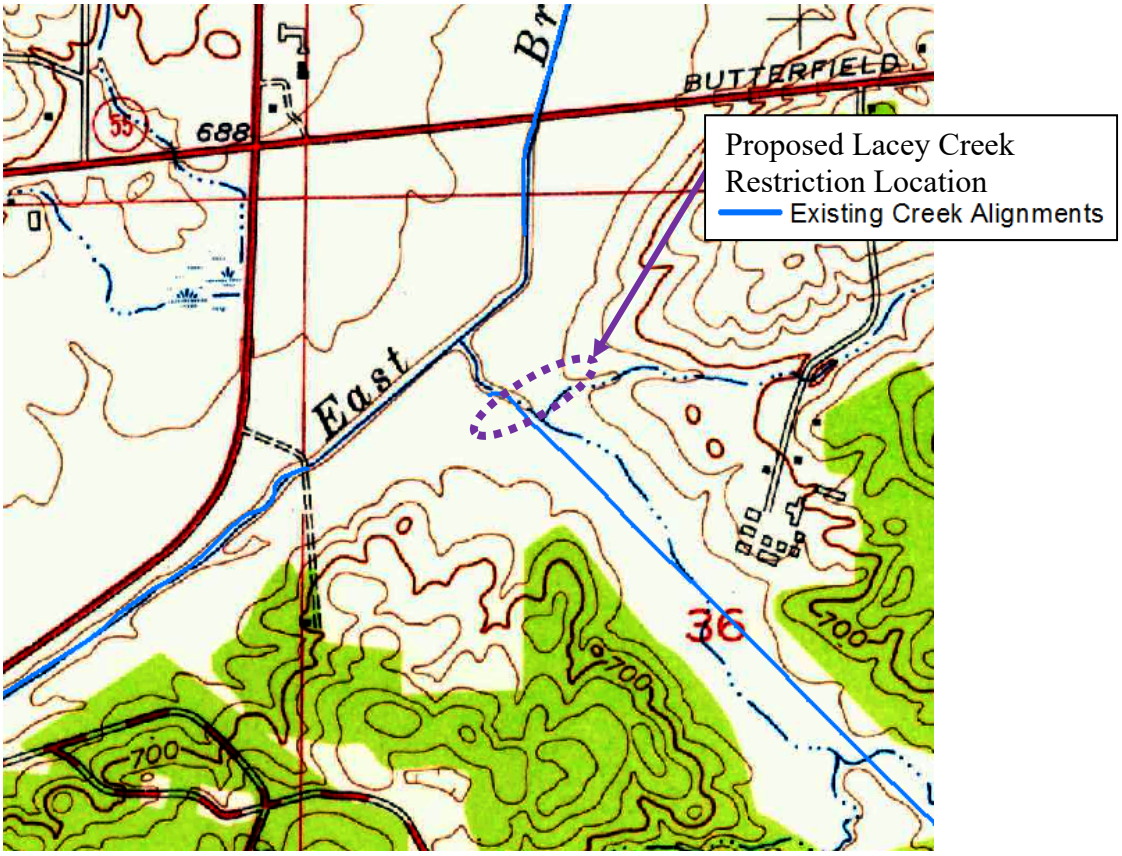


Figure 3. Lacey Creek Restriction Area with 1954 Topographic Map showing old versus new river alignment

7. From 1908 to 1954, the East Branch has been straightened to roughly the existing conditions, minus the ponds. A smaller tributary is added to the map, although the topography on the 1908 map indicate that this small tributary may have been there, just not drawn. This tributary is near the proposed alignment of the Lacey Creek Restriction.

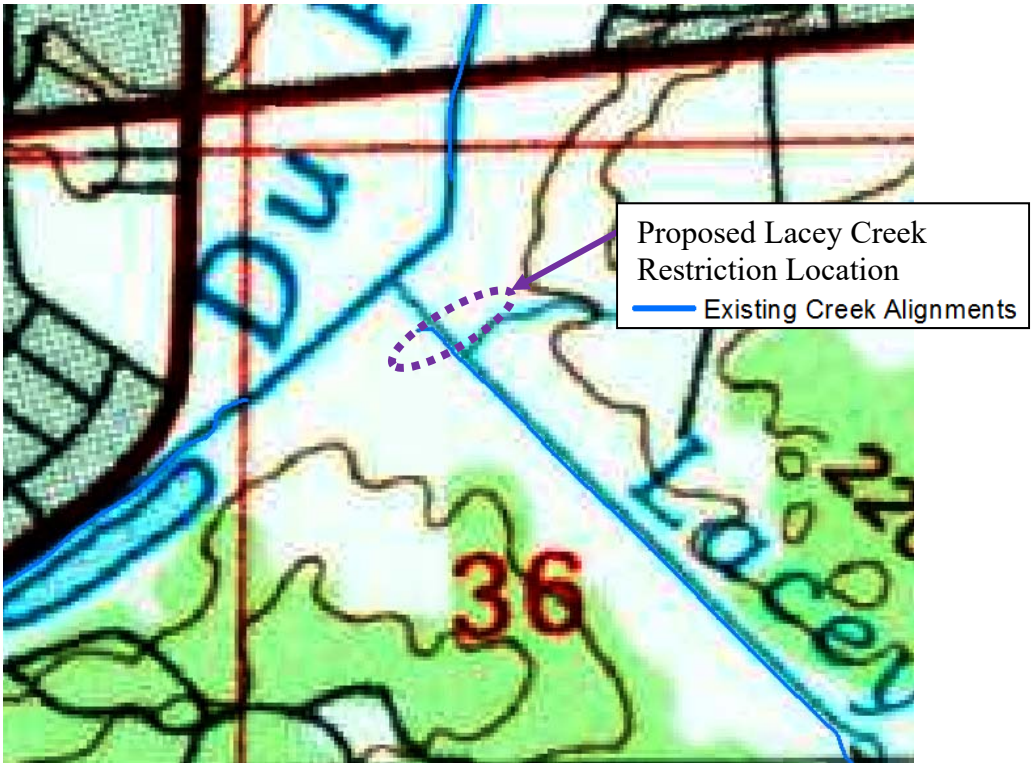


Figure 4. Lacey Creek Restriction Area with 1985 Topographic Map showing old versus new river alignment

8. From 1954 to 1985, the Lacey Creek has been channelized. Also, a pond has been created downstream of the confluence.

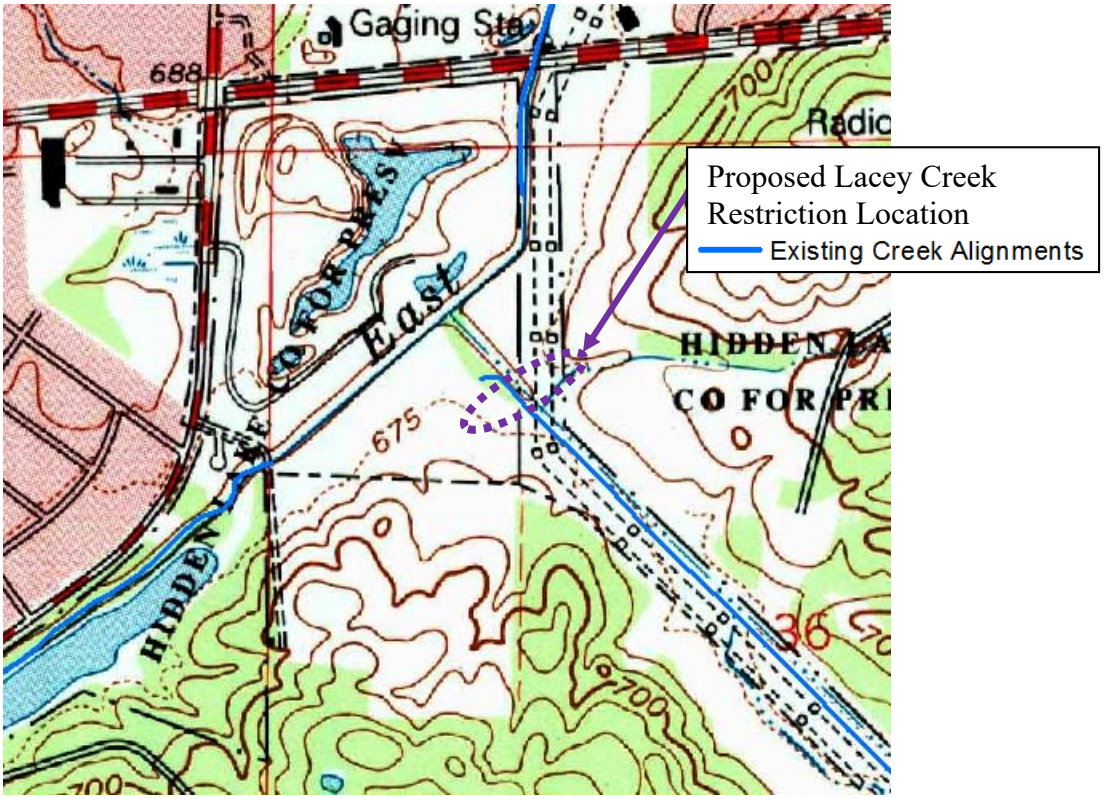


Figure 5. Lacey Creek Restriction Area with 1993 Topographic Map showing old versus new river alignment

9. From 1985 to 1993, the pond at the confluence was added.

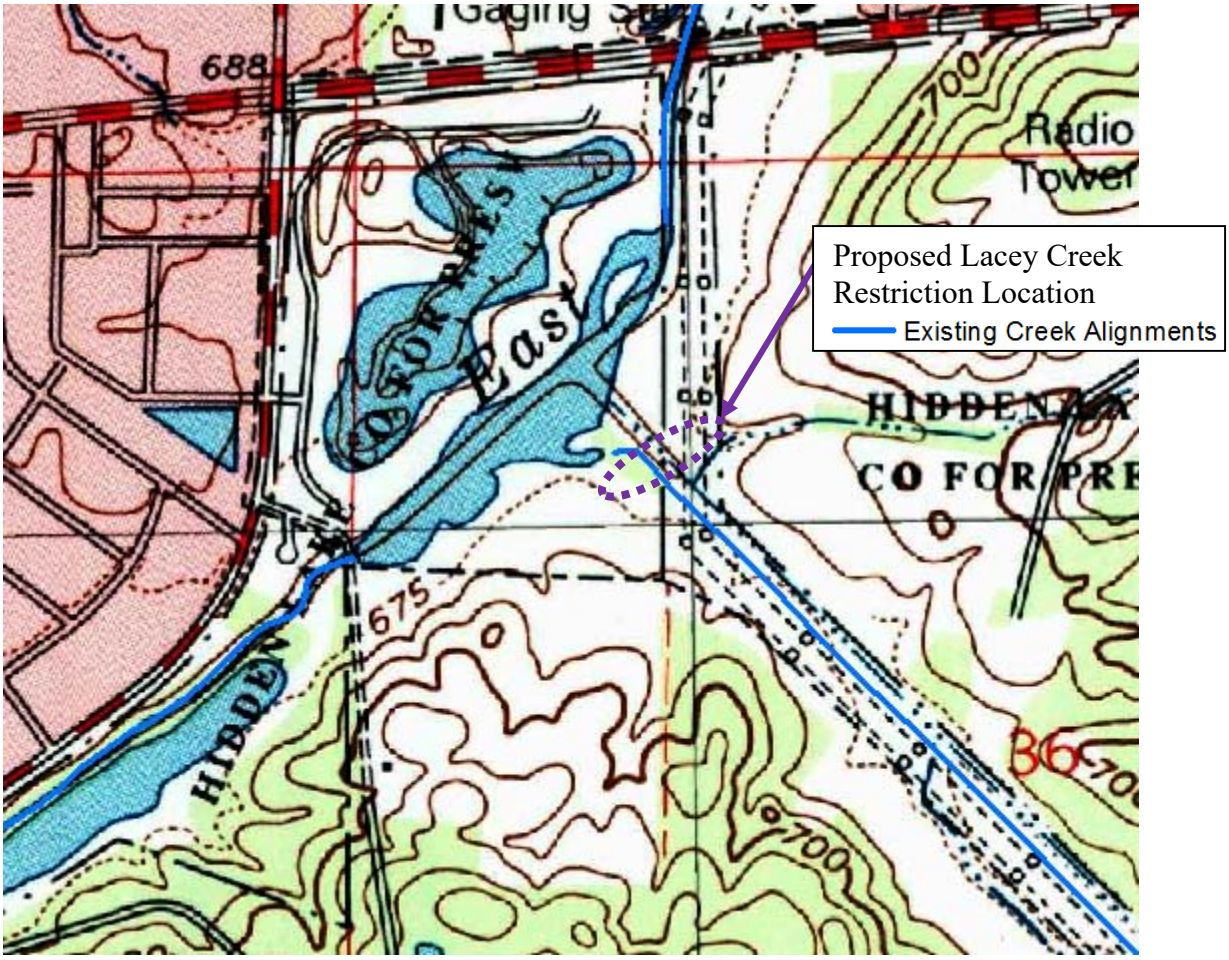


Figure 6. Lacey Creek Restriction Area with 1998 Topographic Map showing old versus new river alignment

10. From 1993 to 1998, the pond along the alignment of the East Branch has been expanded. Also, a pond has been added at the downstream end of Lacey Creek as it connects to the East Branch.

11. If this project is considered in the future, these topographic maps provide some insight which may lead to design considerations. These include if the original Lacey Creek meandered away from the current channel underneath the proposed berm. This may have left softer or coarser grained soils in those locations. Also, the tributary shown on the maps from 1954 on may also have deposited some softer/coarser materials, as well. Finally, the fill pile shown on the recent topography in **Figure 1** should be investigated to determine the contents.

12. No design analysis was completed for the Lacey Creek Restriction at this time. It is assumed the berm would be constructed out of compacted clay and that there should be a feature designed to account for an overtopping event, like a spillway.

13. Since the restriction would have held back water, there is potential for the Lacey Creek Restriction to be classified as a dam. Per USACE ER 1110-2-1156, "Safety of Dams – Policy and Procedures" dated 31 March 2014, a dam is defined as an artificial barrier used to store, control, or divert water. It must be either 25 feet tall or store more than 50 acre-feet. This project is less than 25 feet tall, but it would store greater than 50 acre-feet. Therefore, it is likely that this project would qualify as a dam and require additional analysis and permitting.

14. Locally, the Illinois Department of Natural Resources – Office of Water Resources (IDNR-OWR) oversees and permits dam construction/rehab/removal. Per 17 Illinois Adm. Code, Chapter I, Section 3702, "Construction and Maintenance of Dams" dated December 31, 2014, their definition of a dam is similar to USACE. There are three criteria and if the structure meets any of them, it is considered a dam. The criteria are:

(i) The drainage area of the proposed dam is 6,400 acres or more in rural area or 640 acres or more in an urban area; or

(ii) The dam is 25 feet of more in height, provided that the impounding capacity is greater than 15 acre-feet; or

(iii) The dam has an impounding capacity of 50 acre-feet or more, provided that the dam height is greater than 6 feet.

15. The Lacey Creek project likely met (iii), so it would have classified as a dam per local definition, as well. The IDNR-OWR divides dams into three Classes (I, II, and III) which depends on the life safety and economic consequences downstream should the dam fail. The highest risk is Class I. There are some structures downstream, but it is not clear if they would be affected by a breach as they are about ½ to 1 mile downstream, on the opposite side of IL-53. If this project is considered in the future, a breach analysis should be completed to determine the risk associated with this structure. A Class can be assigned based on that analysis, which will affect the robustness of design, permit application, operation, maintenance, and emergency actions related to the project.

Fawell Dam Site

16. This site would excavate an area behind the Fawell Dam to increase storage. A pump station may be required and additional berms may also be included in low areas of the storage area. The site is currently park district land with natural wooded and field regions, as well as, a gravel path, as shown in **Figure 7**.

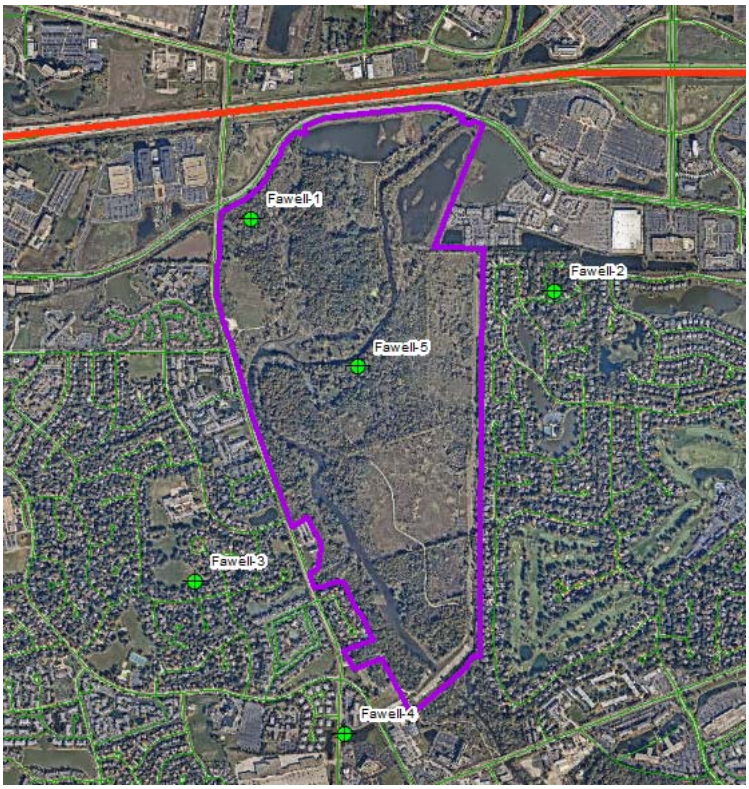


Figure 7. Fawell Dam Site with ISGS Borehole Locations

17. The area upstream of Fawell Dam consists of alluvium (Sawmill), silty material and the underlying loamy and gravelly outwash (Waupecan, Bowes), loamy drift over sandy and gravelly deposits (Fox), silty material and the underlying loamy outwash over sandy and gravely deposits (Grundelein, Dunham, Millstream), thin mantle of silty material and the underlying silty clay loam till (Markham, Ozaukee), silty colluvium and the underlying drift (Peotone), and disturbed surface (Orthents).

18. According to the National Inventory of Dams, Fawell Dam (ID Number: IL01236) was constructed in 1972 to restrict the river to flow through three culverts via three 10 ft by 10 ft sluice gates. The downstream side of the dam is concrete to act as the spillway. The dam is 26 feet high and 1,480 feet wide.

19. There are also five nearby ISGS water well logs available on or near the site. These generally describe the subsurface as mostly clay and silt present, with some thick pockets of coarser material such as gravel and cobbles. Limestone bedrock is encountered in the four deeper holes at depths ranging from 40 to 154 feet below grade. Only Fawell-5 did not encounter rock, as it terminated 49 feet below grade.

20. The above investigations indicate that the Fawell site consists of mostly clay, but there is likely some subsurface sands and/or gravel present that may require clay liner to reduce seepage. No strength data is known about the soils onsite.

Valley View Site

21. This site is a subdivision of single family residential homes in Lisle, Illinois. They are located south of Butterfield Road between Park Avenue and State Route 53 in a low-lying area susceptible mostly to underground flooding due to a highly permeable subsurface. The potential project would've attempted to reduce/cut off the subsurface seepage. The site and existing borehole locations are shown in **Figure 8** below.

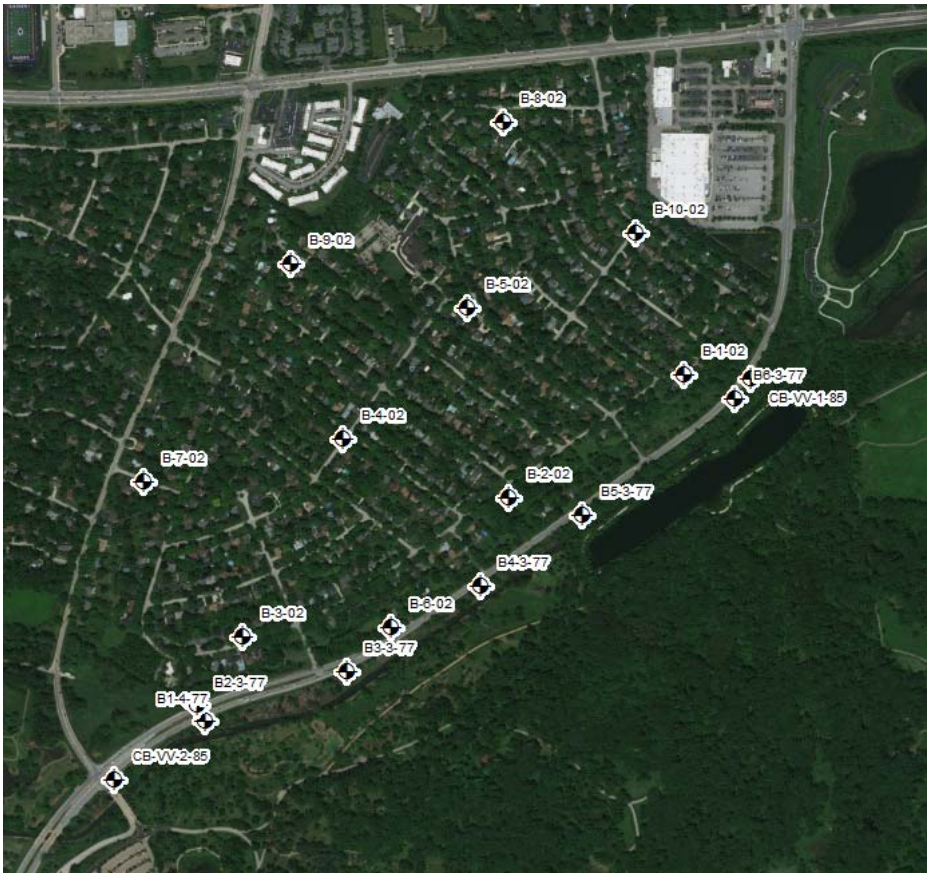


Figure 8. Valley View Site with existing borehole locations

22. The area around the Valley View area consists of alluvium (Sawmill), silty material and the underlying loamy and gravelly outwash (Waupecan), loamy drift over sandy and gravelly deposits (Fox), silty material and the underlying loamy outwash over sandy and gravely deposits (Dunham), and disturbed surface (Orthents).

23. While there are 2 nearby ISGS logs, there has also been several subsurface investigations completed near the project area which include more accurate and complete data. The first report is the "Valley View – Illinois Route 53 Relocation Subsurface Investigation" completed by Patrick Engineering in November 1985. This includes eight soil borings along IL-53 between Park Ave and Arboretum Road. These borings indicated thick layers of sand and gravel overlain by a 0-3 ft thick layer of organic clay. In some areas, the organic clay was overlain by clay fill, likely placed to construct the road. Most of the borings terminated prior to encountering bedrock except for two, which encountered bedrock between 30 and 40 feet below grade around elevation 635 ft NAVD88. This is shallower than what was identified via the drift thickness, as the site is within the 50-100 ft deep area.

24. A second subsurface report was completed in September 2003 called 'Report of Groundwater Impact Assessment for Valley View Subdivision." This report focused on the subdivision between Park Ave, IL-53, and Butterfield Road and the effects groundwater has on the flooding of this area. The report concludes that water can easily permeate through the sand and gravel subsurface and that the groundwater elevations indicate groundwater flows to the DuPage River during normal conditions. During flooding of the DuPage River, groundwater cannot drain properly and is trapped in the subdivision. Groundwater also rises quickly during rain events. This report also provides two recommendations to reduce the likelihood of subsurface flooding in Valley View; installing groundwater extraction wells with and without a cutoff wall.

Bolingbrook Quarry Site

25. The Bolingbrook Quarry is located in Bolingbrook, Illinois, southwest of the corner of State Route 53 and Royce Road. The potential project would have used the excavation as a reservoir. An aerial is shown in **Figure 9** below.

Figure 9. Bolingbrook Quarry Aerial

26. According to the NRCS soils map, the quarry site is coded as a gravel/quarry pit with some areas of standing water. However, closer to the East Branch of the DuPage River, there are some locations of Houghton Muck. These areas should be further investigated to determine if this soft, wet soil type would affect the design, such as the inlet/outlet connected to the proposed reservoir.

27. ISGS was checked to see if there are any nearby logs within that database. However, there are none within ½ mile of the site. There are some logs at greater distances, which indicate the overburden consists of a mix of sand, gravel, and clay. Bedrock is encountered between 18 and 133 feet below grade. This wide variety is partially due to the variation of the ground surface between locations. It is also across an area about 2 miles wide, so variation would be expected.

28. The site is located between the 600 and 650 ft bedrock contour while the typical elevation of the quarry rim is around 650 ft, so bedrock is likely less than 50 feet below grade. Additional information from the quarry would be able to establish the actual depth to bedrock.

29. The depth to bedrock is important to determine, as bedrock is much less permeable than the sand/gravel present in some of the ISGS logs. If the reservoir became filled, then the permeable layers could channel some of the reservoir water offsite to unknown consequences.

Channahon Slurry Wall

30. A possible project was investigated to reduce the risk of subsurface seepage into a neighborhood in Channahon, Illinois, southeast of McEvilly Road and Bell Road. Several ISGS soil borings were around the proposed project site that indicated the subsurface is permeable gravel and sand. Bedrock was encountered at least 40 feet below grade in these records, per Figure 10 below. Therefore, to construct an effective slurry wall, it would have to extend around 45 feet below grade. Additionally, it is assumed the wall would have to encircle the entire site, rather than just the riverside. This is what was required for the Valley View site in Lisle. It is possible that the groundwater source is at least partially from the west so a partial wall would prevent water from going west to east and exacerbate the issue. No groundwater flow data is available, however, so a final determination cannot be made at this time.

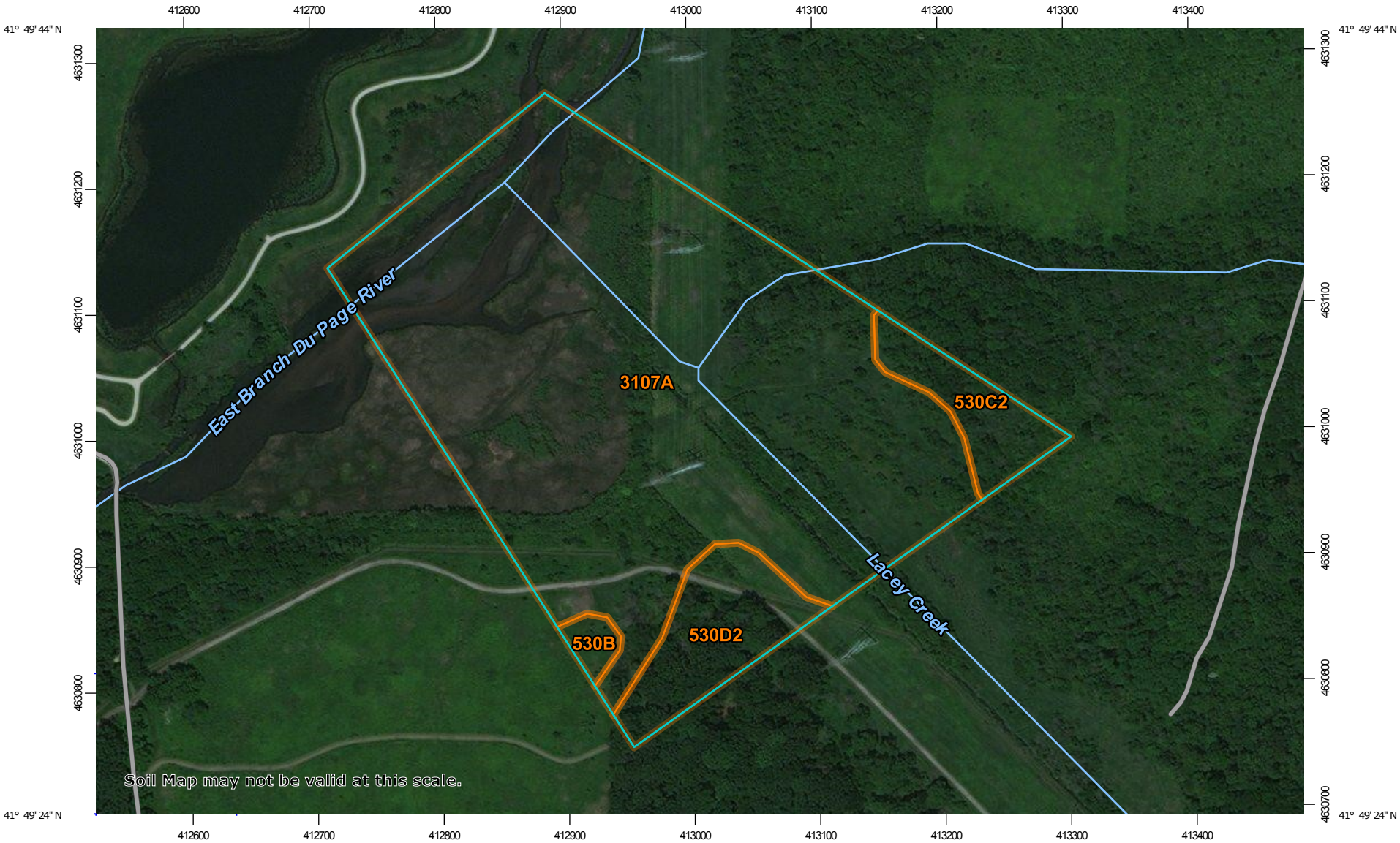
Figure 10. Channahon Slurry Wall with ISGS logs indicating bedrock depth

31. The civil appendix used these assumptions to estimate the cost of a slurry wall around the entire subdivision and concluded that the cost would be greater than the benefits. Therefore, this project is no longer under consideration.

32. There are other sites which were considered but not included in this attachment. Those sites were eliminated prior to any geotechnical analysis.

Soil Map—DuPage County, Illinois

Lacey Creek Restriction



Map Scale: 1:4,400 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 50 100 200 300

Feet: 0 200 400 800 1200

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 16N WGS84

Lacey Creek Restriction

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features

- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:12,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: DuPage County, Illinois
Survey Area Data: Version 13, Sep 20, 2017

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Feb 10, 2016—Oct 8, 2016

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Lacey Creek Restriction

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
530B	Ozaukee silt loam, 2 to 4 percent slopes	0.4	1.1%
530C2	Ozaukee silt loam, 4 to 6 percent slopes, eroded	1.9	5.1%
530D2	Ozaukee silt loam, 6 to 12 percent slopes, eroded	3.0	8.0%
3107A	Sawmill silty clay loam, heavy till plain, 0 to 2 percent slopes, frequently flooded	31.7	85.8%
Totals for Area of Interest		**37.0**	**100.0%**

ILLINOIS STATE GEOLOGICAL SURVEY

Fawell-1

Water Well	Top	Bottom
yellow clay	0	5
gravel	5	15
gravel & clay	15	22
blue clay	22	62
soft yellow rock	62	66
limestone	66	98
Total Depth		**98**

Casing: 4" GALV from 0' to 66'

Size hole below casing: 4"

Water from limestone at ' to 98'.
Static level 22' below casing top which is ' above GL
Pumping level 22' when pumping at 8 gpm for 2 hours

Driller's Log filed

Owner Address: ,
Location source: Location from a log

Permit Date: April 11, 1949 **Permit #:**

COMPANY Diebold, Chester C.
FARM Ulrick, D. J.
DATE DRILLED January 1, 1949 **NO.**
ELEVATION 0 **COUNTY NO.** 00039
LOCATION NE SE SE
LATITUDE 41.801103 **LONGITUDE** -88.18734
COUNTY DuPage **API** 120430003900 **3 - 38N - 9E**

ILLINOIS STATE GEOLOGICAL SURVEY

Fawell-2

Water Well	Top	Bottom
clay	0	55
sand	55	60
clay	60	65
limestone	65	150
Total Depth		**150**

Casing: 6" 67' from ' to '

Static level 67' below casing top which is ' above GL
Pumping level 67' when pumping at 100 gpm for hours

Driller's Log filed

Owner Address: ,
Location source: Location from a log

Permit Date: **Permit #:**

COMPANY Geiger, S. B.
FARM Glassner, R. W.
DATE DRILLED January 1, 1940 **NO.** 2
ELEVATION 0 **COUNTY NO.** 01573
LOCATION 50'S line, 1700'E line of section
LATITUDE 41.798512 **LONGITUDE** -88.172862
COUNTY **DuPage** **API** **120430157300** **2 - 38N - 9E**

ILLINOIS STATE GEOLOGICAL SURVEY

Fawell-3

Private Water Well	Top	Bottom
clay	0	10
gravel	10	65
stoney clay	65	145
gravel	145	154
rock	154	200
Total Depth		**200**

Casing: 5" BLACK 15#/FT from 0' to 154'

Size hole below casing: 5"

Water from limestone at 154' to 200'.
Static level 70' below casing top which is 1' above GL
Pumping level 70' when pumping at 0 gpm for 2 hours

Permanent pump installed at 120'
on September 8, 1989, with a capacity of 20 gpm

Owner Address: P.O. Box #607 West Chicago, IL
Address of well: 29W205 Donald
Add'l loc. info: Lot: #7 & 8

Location source: Location from permit

Permit Date: May 8, 1989 **Permit #:** 011170

COMPANY Liberg, Thomas P.
FARM Strictland, Dakota
DATE DRILLED August 22, 1989 **NO.**
ELEVATION 0 **COUNTY NO.** 28634
LOCATION SW NE SE
LATITUDE 41.788227 **LONGITUDE** -88.190082
COUNTY **DuPage** **API** **120432863400** **10 - 38N - 9E**

ILLINOIS STATE GEOLOGICAL SURVEY

Fawell-4

Irrigation Well	Top	Bottom
topsoil	0	3
clay w/some gravel	3	35
gravel & broken lime	35	40
limestone green	40	60
brown limestone	60	260
limestone & shale mix gray	260	270
gray shale	270	275
Total Depth		**275**

Casing: 5" BLACK STEEL A53B from -1' to 275'

Grout: BENTONITE from 0 to 40.

Water from limestone at 40' to 270'.
Static level 20' below casing top which is 1' above GL
Pumping level 100' when pumping at 20 gpm for 4 hours

Owner Address: 10 S. 059 Schoger Drive Unit 8 Naperville, IL
Address of well: River North, Ogden Ave.
Naperville, IL
Add'l loc. info: Lot: 3 Subdivision: River North

Location source: Location from permit

Permit Date: November 19, 1996 **Permit #:**

COMPANY Snelten, Stephen A.
FARM Irrigation Services/D. Fiddick
DATE DRILLED November 25, 1996 **NO.**
ELEVATION 0 **COUNTY NO.** 30819
LOCATION NE NW NW
LATITUDE 41.782769 **LONGITUDE** -88.18295
COUNTY **DuPage** **API** **120433081900** **14 - 38N - 9E**

ILLINOIS STATE GEOLOGICAL SURVEY

Fawell-5

Stratigraphic Test	Top	Bottom
Interpretation by: Brandon Curry on 01-SEP-11		
topsil, dark brown, silty organics	0	.7
silt, dark brown, dry hard to firm, red-stained organics, weathered (Peoria Silt)	.7	2.9
diamicton, heavy loam, dark yellowish brown (10YR 4/4), sticky, beta B horizon developed in sand and gravel (Henry formation)	2.9	4
core loss	4	5
SAA	5	5.9
diamiction, silt loam, light reddish brown, firm, 10% gravel (Wedron Group, undiff).	5.9	6.3
diamicton, silty clay loam, gray (2.5Y 5/1), 20% gravel, unweathered	6.3	10
silt, some clay, very fine sand, some coarser sand, light olive brown (2.5Y 5/3), finer intervals grayer, 11.5 - 11.9 ft. very fine sand	10	25
diamicton, silty clay loam, gray (2.5Y 4.5/1 to 5/1), 20% gravel, up to 30% gravel in upper part	25	35
cobble, dolomite	35	35.5
silt and clay, laminated	35.5	41.7
sand, medium reddish brown, wet, loose	41.7	43.9
diamicton, silty clay loam, grayish brown (10YR 5/2), 10% gravel	43.9	45
gravelly sand, light brown, loose, 40% gravel, light yellowish brown (10YR 6/3), looks like Batestown Mbr.	45	49
Total Depth		**49**

Owner Address: ,

Address of well:

Naperville, IL

Verified by: BBC on September 1, 2011.

Permit Date: **Permit #:**

COMPANY CH2M Hill Consult.

FARM McDowell Grove Forest Preserve

DATE DRILLED **NO.** MW-17

ELEVATION **COUNTY NO.** 31995

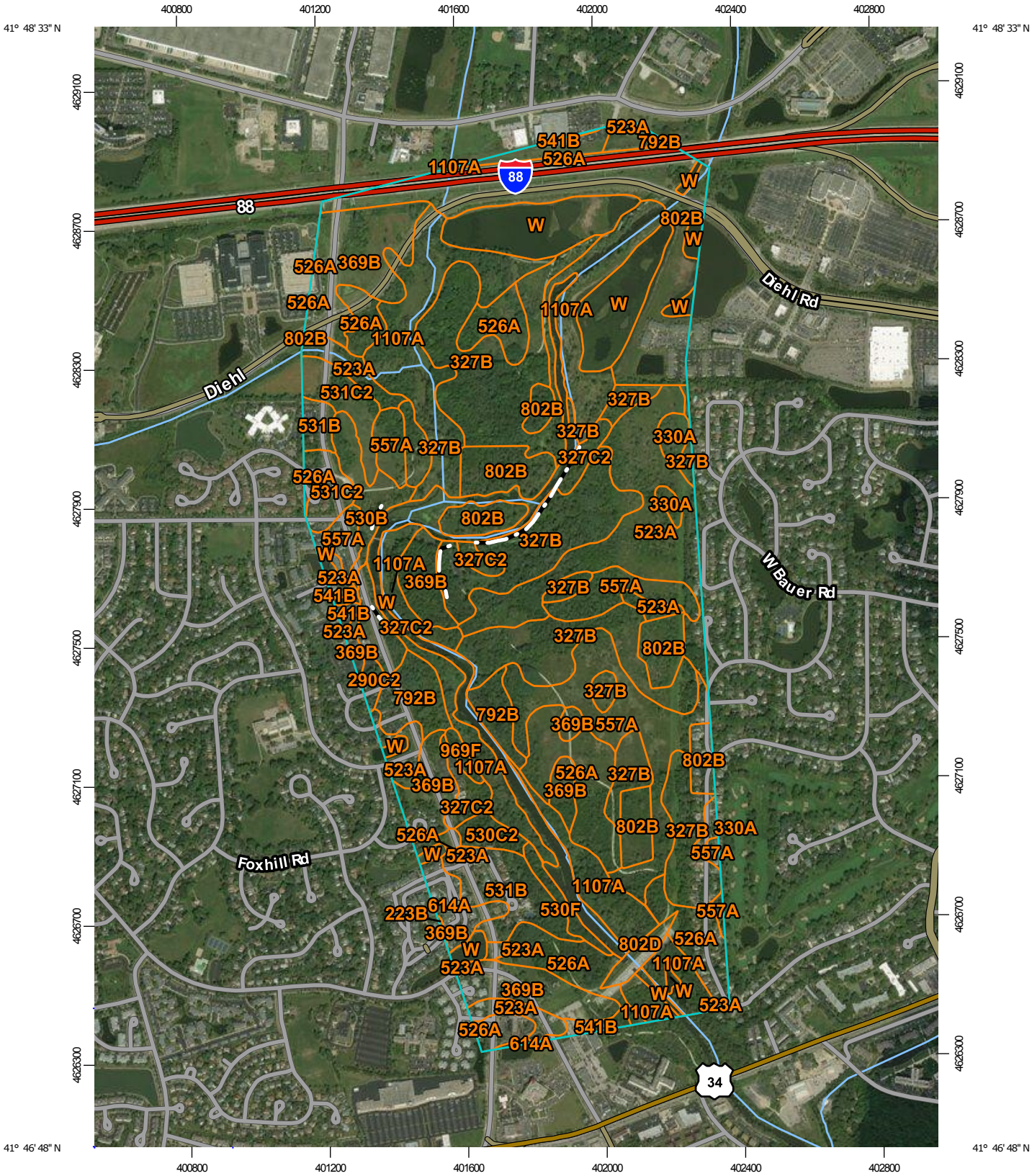
LOCATION SW NW NW

LATITUDE 41.795844 **LONGITUDE** -88.182267

COUNTY **DuPage** **API** **120433199500** **11 - 38N - 9E**

Soil Map—DuPage County, Illinois

Fawell Dam



Map Scale: 1:15,700 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 200 400 800 1200

Feet: 0 500 1000 2000 3000

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 16N WGS84

Fawell Dam

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Map Unit Polygons

Soil Map Unit Lines

Soil Map Unit Points

Special Point Features

Blowout

Borrow Pit

Clay Spot

Closed Depression

Gravel Pit

Gravelly Spot

Landfill

Lava Flow

Marsh or swamp

Mine or Quarry

Miscellaneous Water

Perennial Water

Rock Outcrop

Saline Spot

Sandy Spot

Severely Eroded Spot

Sinkhole

Slide or Slip

Sodic Spot

Spoil Area

Stony Spot

Very Stony Spot

Wet Spot

Other

Special Line Features

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:12,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: DuPage County, Illinois
Survey Area Data: Version 13, Sep 20, 2017

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Feb 10, 2016—Oct 8, 2016

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Fawell Dam

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
152A	Drummer silty clay loam, 0 to 2 percent slopes	0.3	0.0%
223B	Varna silt loam, 2 to 4 percent slopes	0.1	0.0%
290C2	Warsaw silt loam, 4 to 6 percent slopes, eroded	1.9	0.3%
327B	Fox silt loam, 2 to 4 percent slopes	105.4	16.8%
327C2	Fox silt loam, 4 to 6 percent slopes, eroded	14.0	2.2%
330A	Peotone silty clay loam, 0 to 2 percent slopes	5.2	0.8%
369B	Waupecan silt loam, 2 to 4 percent slopes	51.9	8.3%
523A	Dunham silty clay loam, 0 to 2 percent slopes	56.7	9.0%
526A	Grundelein silt loam, 0 to 2 percent slopes	54.4	8.6%
530B	Ozaukee silt loam, 2 to 4 percent slopes	8.4	1.3%
530C2	Ozaukee silt loam, 4 to 6 percent slopes, eroded	3.7	0.6%
530F	Ozaukee silt loam, 20 to 30 percent slopes	3.1	0.5%
531B	Markham silt loam, 2 to 4 percent slopes	17.3	2.7%
531C2	Markham silt loam, 4 to 6 percent slopes, eroded	13.4	2.1%
541B	Graymont silt loam, 2 to 5 percent slopes	3.0	0.5%
557A	Millstream silt loam, 0 to 2 percent slopes	45.9	7.3%
614A	Chenoa silty clay loam, 0 to 2 percent slopes	6.4	1.0%
792B	Bowes silt loam, 2 to 4 percent slopes	14.0	2.2%
802B	Orthents, loamy, undulating	75.2	11.9%
802D	Orthents, loamy, rolling	3.1	0.5%
969F	Casco-Rodman complex, 20 to 30 percent slopes	1.5	0.2%
1107A	Sawmill silty clay loam, undrained, 0 to 2 percent slopes, frequently flooded	82.4	13.1%
W	Water	61.7	9.8%

Fawell Dam

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
Totals for Area of Interest		**629.0**	**100.0%**

Valleyview Existing Borehole Log

PATRICK ENGINEERING INC.

BORING NUMBER **B-1-02** SHEET **1** OF **2**
CLIENT **DuPage County Dept. of Environmental Concerns**
PROJECT & NO. **Groundwater Impact Assessment 7003.K0**
LOCATION **Northing: 1878941.90 feet, Easting: 1059578.28 feet (22W151 Arbor Lane)**

LOGGED BY **JPR**
GROUND ELEVATION **674.0**

ELEVATION	DEPTH (FT)	STRATA	SOIL/ROCK DESCRIPTION	SAMPLE TYPE & NO. DEPTH (FT) RECOVERY(IN)	BLOW COUNTS	Water Content PL □ ○ △ LL (10 20 30 40 50) / Unconfined Compressive Strength (TSF) ✳ (1 2 3 4 5)	NOTES & TEST RESULTS
674.0	0.0		Brown to black silty clay topsoil and fill, trace coarse to fine sand, trace organics, very stiff, medium plasticity, moist -FILL-	AU-1 0.0-1.0			
				SS-2 1.0-2.5 2"R	2 6 4	✳	
670.2	3.8		▽	SS-3 3.5-5.0 3"R	3 2 4	✳	
669.1	4.9		Tan coarse to fine gravel, trace coarse to fine sand, well graded, dense, wet to saturated GW				
667.2	6.8		▽	SS-4 6.0-7.5 3"R	2 12 20		N=32
666.6	7.4		Tan coarse to fine sand, little to trace coarse to fine gravel, trace silt, well graded, dense, saturated SW				
				SS-5 8.5-10.0 6"R	16 27 13		N=40
664.0	10.0		Gray coarse to fine sand, trace fine gravel, trace silt, well graded, medium dense, saturated SW				
				SS-6 11.0-12.5 14"R	4 6 8		N=14
				SS-7 13.5-15.0 12"R	2 5 7		N=12
655.0	19.0		Gray coarse to fine gravel, little coarse to fine sand, well graded, trace silt, medium dense,	SS-8 18.5-20.0 16"R	2 5 10		SS-8: Gravel=59.6% Sand=37.6% Silt/clay=2.8% N=15
654.0	20.0						

DRILLING CONTRACTOR **Patrick Drilling Inc.**
DRILLING METHOD **3.25" I.D. HSA**
DRILLING EQUIPMENT **CME 75 ATV Rig**
DRILLING STARTED **04/01/02** ENDED **04/01/02**

REMARKS

WATER LEVEL (ft.)
▽ **6.8** during drilling
▼
▼ **3.8** 4/10/02

Valleyview Existing Borehole Log

PATRICK ENGINEERING INC.

BORING NUMBER **B-1-02** SHEET **2** OF **2**
CLIENT **DuPage County Dept. of Environmental Concerns**
PROJECT & NO. **Groundwater Impact Assessment 7003.K0**
LOCATION **Northing: 1878941.90 feet, Easting: 1059578.28 feet (22W151 Arbor Lane)**

LOGGED BY **JPR**
GROUND ELEVATION **674.0**

ELEVATION	DEPTH (FT)	STRATA	SOIL/ROCK DESCRIPTION	SAMPLE TYPE & NO. DEPTH (FT) RECOVERY(IN)	BLOW COUNTS	Water Content PL □ - - - ○ - - - △ LL (10 20 30 40 50) / Unconfined Compressive Strength (TSF) ✳ (1 2 3 4 5)	NOTES & TEST RESULTS
654.0	20.0		saturated GW				
652.3	21.7		Gray coarse to fine sand, some to little coarse to fine gravel, well graded, medium dense, saturated SW				
			Gray coarse to fine gravel and or cobbles, well graded, dense, saturated GW				
				SS-9 23.5-25.0 8"R	12 25 24		14" blow-in N=49
				SS-10 26.5-28.0 0"R	50/0"		Auger refused at 26.5'. Attempted spoon sample but no recovery. Offset hole to current location and augered to 28.5' to set observation well. Boring converted to observation well OW-1-02 immediately after drilling. Screen interval 16.5' to 26.5'. Sand pack (native soil caved in) 11.8' top 28.5'. Bentonite seal 2' to 11.8'. Flush mount protector installed in concrete at surface.
645.5	28.5		End of Boring at 28.5'				

DRILLING CONTRACTOR **Patrick Drilling Inc.**
DRILLING METHOD **3.25" I.D. HSA**
DRILLING EQUIPMENT **CME 75 ATV Rig**
DRILLING STARTED **04/01/02** ENDED **04/01/02**

REMARKS

WATER LEVEL (ft.)
▽ **6.8** during drilling
▼
▼ **3.8** 4/10/02

Valleyview Existing Borehole Log

PATRICK ENGINEERING INC.

BORING NUMBER **B-2-02** SHEET **1** OF **2**
CLIENT **DuPage County Dept. of Environmental Concerns**
PROJECT & NO. **Groundwater Impact Assessment 7003.K0**
LOCATION **Northing: 1878142.78 feet, Easting: 1058439.45 feet (22W321 Arbor Lane)**

LOGGED BY **JPR**
GROUND ELEVATION **673.2**

ELEVATION	DEPTH (FT)	STRATA	SOIL/ROCK DESCRIPTION	SAMPLE TYPE & NO. DEPTH (FT) RECOVERY(IN)	BLOW COUNTS	Water Content PL 10 20 30 40 LL 50 / Unconfined Compressive Strength (TSF) 1 2 3 4 5	NOTES & TEST RESULTS
673.2	0.0		Brown and black topsoil and silty clay, trace organics, trace coarse to fine sand, very stiff, medium plasticity, moist CL	AU-1 0.0-1.0			Topsoil 3" thick
				SS-2 1.0-2.5 6"R	3 3 3	✳	
669.6	3.6		Brown silty clay, some to little coarse to fine sand, stiff, low plasticity, moist CL	SS-3 3.5-5.0 4"R	2 4 5	✳	N=9
668.8	4.4		▽				
668.2	5.0		Brown and tan coarse to fine sand, trace coarse to fine gravel, trace silt, trace clay, well graded, medium dense, wet SW	SS-4 6.0-7.5 5"R	3 8 10		N=18
665.7	7.5						
665.6	7.6		▼ Tan coarse to fine gravel, little coarse to fine sand, well graded, medium dense, saturated GW	SS-5 8.5-10.0 4"R	3 11 7		Rock/cobble 9.0-9.5' N=18
663.7	9.5		▽ Gray coarse to fine sand, well graded, trace fine gravel, medium dense, saturated SW				
662.1	11.1		White to gray coarse to fine gravel, some to little coarse to fine sand, well graded, trace silt, medium dense, saturated GW	SS-6 11.0-12.5 8"R	5 11 10		N=21
				SS-7 13.5-15.0 12"R	12 18 24		N=42
			Dense				SS-7: Gravel=64.9% Sand=26.4% Silt/clay=8.8%
			Dense	SS-8 18.5-20.0 0"R	50/3"		6" blow-in Spoon pounded on cobble at 18.5'. No
653.2	20.0						

DRILLING CONTRACTOR **Patrick Drilling Inc.**
DRILLING METHOD **3.25" I.D. HSA**
DRILLING EQUIPMENT **CME 75 ATV Rig**
DRILLING STARTED **04/02/02** ENDED **04/02/02**

REMARKS

WATER LEVEL (ft.)
▽ **9.5** during drilling
▼ **7.6** after drilling
▽ **4.4** 4/10/02

Valleyview Existing Borehole Log

PATRICK ENGINEERING INC.

BORING NUMBER B-2-02 SHEET 2 OF 2
CLIENT DuPage County Dept. of Environmental Concerns
PROJECT & NO. Groundwater Impact Assessment 7003.K0
LOCATION Northing: 1878142.78 feet, Easting: 1058439.45 feet (22W321 Arbor Lane)

LOGGED BY JPR
GROUND ELEVATION 673.2

ELEVATION	DEPTH (FT)	STRATA	SOIL/ROCK DESCRIPTION	SAMPLE TYPE & NO. DEPTH (FT) RECOVERY(IN)	BLOW COUNTS	Water Content PL 10 20 30 40 LL / Unconfined Compressive Strength (TSF) ✳ 1 2 3 4 5	NOTES & TEST RESULTS
653.2	20.0		White to gray coarse to fine gravel, some to little coarse to fine sand, trace silt, well graded, medium dense, saturated GW				recovery. Augers grinding on cobbles/blow-in. Difficult drilling.
				SS-9 23.5-25.0 1"R	- - 15		1.0' blow-in
644.7	28.5		End of Boring at 28.5'				Auger refusal at 28.5'. Possible top of bedrock. Boring converted to observation well OW-2-02 immediately after drilling. Screen interval 18.3' to 28.3'. Sand pack (native soil caved in) 16.0' to 28.5'. Bentonite seal 2.0' to 16.0' flush mount protector installed in concrete at surface.

DRILLING CONTRACTOR Patrick Drilling Inc.
DRILLING METHOD 3.25" I.D. HSA
DRILLING EQUIPMENT CME 75 ATV Rig
DRILLING STARTED 04/02/02 ENDED 04/02/02

REMARKS

WATER LEVEL (ft.)
▽ 9.5 during drilling
▼ 7.6 after drilling
▽ 4.4 4/10/02

Valleyview Existing Borehole Log

PATRICK ENGINEERING INC.

BORING NUMBER **B-3-02** SHEET **1** OF **2**
CLIENT **DuPage County Dept. of Environmental Concerns**
PROJECT & NO. **Groundwater Impact Assessment 7003.K0**
LOCATION **Northing: 1877240.74 feet, Easting: 1056711.22 feet (22W580 Arbor Lane)**

LOGGED BY **JPR**
GROUND ELEVATION **672.5**

ELEVATION	DEPTH (FT)	STRATA	SOIL/ROCK DESCRIPTION	SAMPLE TYPE & NO. DEPTH (FT) RECOVERY(IN)	BLOW COUNTS	Water Content PL 10 20 30 40 LL 50 / Unconfined Compressive Strength (TSF) 1 2 3 4 5	NOTES & TEST RESULTS
672.5	0.0		Black silty clay fill, some to trace medium to fine gravel, trace coarse to fine sand, very stiff, medium plasticity, moist -FILL-	AU-1 0.0-1.0			
				SS-2A 1.0-2.5 8"R	3 4 5		
669.9	2.6		Olive to brown silty clay fill, trace medium to fine gravel, trace coarse to fine sand, medium stiff, medium plasticity, moist -FILL-				
668.4	4.1		▼	SS-3 3.5-5.0 6"R	2 2 2		
				SS-4 6.0-7.5 4"R	1 4 6		
665.1	7.4		Gray to tan coarse to fine sand, and coarse to fine gravel, well graded, medium dense, saturated SW				
664.0	8.5		▽	SS-5 8.5-10.0 8"R	2 12 11		N=23
661.0	11.5		Gray coarse to fine sand, some coarse to fine gravel, trace silt, occassional cobbles, well graded, medium dense to dense, saturated SW-SM	SS-6 11.0-12.5 8"R	7 12 10		N=22
				SS-7 13.5-15.0 7"R	5 14 13		N=27 SS-7: Gravel=29.6% Sand=64.4% Silt/clay=6.0% Cobbles encountered
				SS-8 18.5-20.0 2"R	14 18 14		N=32 6" blow-in

DRILLING CONTRACTOR **Patrick Drilling Inc.**
DRILLING METHOD **3.25" I.D. HSA**
DRILLING EQUIPMENT **CME 75 ATV Rig**
DRILLING STARTED **04/03/02** ENDED **04/03/02**

REMARKS

WATER LEVEL (ft.)
▽ **8.5** during drilling
▼
▼ **4.1** 4/10/02

Valleyview Existing Borehole Log

PATRICK ENGINEERING INC.

BORING NUMBER **B-3-02** SHEET **2** OF **2**
CLIENT **DuPage County Dept. of Environmental Concerns**
PROJECT & NO. **Groundwater Impact Assessment 7003.K0**
LOCATION **Northing: 1877240.74 feet, Easting: 1056711.22 feet (22W580 Arbor Lane)**

LOGGED BY **JPR**
GROUND ELEVATION **672.5**

ELEVATION	DEPTH (FT)	STRATA	SOIL/ROCK DESCRIPTION	SAMPLE TYPE & NO. DEPTH (FT) RECOVERY(IN)	BLOW COUNTS	Water Content PL □---○---△ LL (10 20 30 40 50) / Unconfined Compressive Strength (TSF) ✳ (1 2 3 4 5)	NOTES & TEST RESULTS
652.5	20.0		Gray coarse to fine sand, some coarse to fine gravel, trace silt, occassional cobbles, well graded, medium dense to dense, saturated SW-SM				
				SS-9 23.5-25.0 2"R	7 6 7		Medium gravel in tip of spoon N=13
646.4	26.1		White to gray coarse to fine gravel, and coarse to fine sand, well graded, medium dense, saturated GW				
				SS-10 28.5-30.0 8"R	11 12 12		N=24
642.5	30.0		End of Boring at 30.0'				Boring converted to observation well OW-3-02 immediately after drilling. Screen interval 16.5' to 26.5'. Sand pack (native soil caved in) 13.9' to 30.0'. Bentonite seal 2.0' to 13.9'. Flush mount protector installed in concrete at surface.

DRILLING CONTRACTOR **Patrick Drilling Inc.**
DRILLING METHOD **3.25" I.D. HSA**
DRILLING EQUIPMENT **CME 75 ATV Rig**
DRILLING STARTED **04/03/02** ENDED **04/03/02**

REMARKS

WATER LEVEL (ft.)
▽ **8.5** during drilling
▼
▼ **4.1** 4/10/02

Valleyview Existing Borehole Log

PATRICK ENGINEERING INC.

BORING NUMBER **B-4-02** SHEET 1 OF 2

CLIENT **DuPage County Dept. of Environmental Concerns**

PROJECT & NO. **Groundwater Impact Assessment 7003.K0**

LOCATION **Northing: 1878519.91 feet, Easting: 1057363.96 feet (3S328 Juniper Lane)**

LOGGED BY **JPR**

GROUND ELEVATION **682.5**

ELEVATION	DEPTH (FT)	STRATA	SOIL/ROCK DESCRIPTION	SAMPLE TYPE & NO. DEPTH (FT) RECOVERY(IN)	BLOW COUNTS	Water Content PL LL (10 20 30 40 50) / Unconfined Compressive Strength (TSF) (1 2 3 4 5)	NOTES & TEST RESULTS
682.5	0.0		Crushed limestone CA-6 fill				
682.1	0.4		Tan and brown sandy clay fill, some to little coarse to fine gravel, trace silt, low plasticity, moist -FILL-	AU-1 0.0-1.0			CA-6 gravel at surface to 2.0"
				SS-2 1.0-2.5 6"R	3 10 7		N=17
			Tan coarse to fine clayey gravel, some coarse to fine sand, trace silt, well graded, medium dense, moist GC				
				SS-3 3.5-5.0 6"R	5 7 10		N=17
677.5	5.0		Tan coarse to fine clayey sand, some coarse to fine gravel, little silt, well graded, loose, moist SC				Coarse gravel coming up from auger flights
				SS-4 6.0-7.5 7"R	4 5 4		N=9
			Dense at 9.0'	SS-5 8.5-10.0 10"R	6 15 20		N=35
672.0	10.5		Tan to white coarse to fine clayey gravel, some coarse to fine sand, trace silt, well graded, medium dense, dry to moist GC				Coarse to fine gravel coming up in auger flights
				SS-6 11.0-12.5 8"R	14 14 10		N=24
669.9	12.6		Tan to white coarse to fine clayey sand, little medium to fine gravel, trace silt, well graded, loose to medium dense, saturated SC				Coarse to fine gravel coming up in augers
668.8	13.7			SS-7 13.5-15.0 9"R	3 6 4		N=10
666.1	16.4		Tan coarse to fine sand, and medium to fine gravel, trace silt, well graded, loose, saturated SW				
				SS-8 18.5-20.0 3"R	2 2 3		Screen interval 18-27.9' 4-6" blow-in
662.5	20.0						

DRILLING CONTRACTOR **Patrick Drilling Inc.**

DRILLING METHOD **3.25" I.D. HSA**

DRILLING EQUIPMENT **CME 75 ATV Rig**

DRILLING STARTED **04/04/02** ENDED **04/04/02**

REMARKS

WATER LEVEL (ft.)

▽ **13.6** during drilling

▼

▼ **13.7** 4/11/02

Valleyview Existing Borehole Log

PATRICK ENGINEERING INC.

BORING NUMBER **B-4-02** SHEET **2** OF **2**
CLIENT **DuPage County Dept. of Environmental Concerns**
PROJECT & NO. **Groundwater Impact Assessment 7003.K0**
LOCATION **Northing: 1878519.91 feet, Easting: 1057363.96 feet (3S328 Juniper Lane)**

LOGGED BY **JPR**
GROUND ELEVATION **682.5**

ELEVATION	DEPTH (FT)	STRATA	SOIL/ROCK DESCRIPTION	SAMPLE TYPE & NO. DEPTH (FT) RECOVERY(IN)	BLOW COUNTS	Water Content PL 10 20 30 40 LL 50 / Unconfined Compressive Strength (TSF) ✳ 1 2 3 4 5	NOTES & TEST RESULTS
662.5	20.0		Tan coarse to fine sand, and medium to fine sand, well graded, trace silt, loose, saturated SP				
661.4	21.1		Reddish-brown fine gravel and coarse to fine sand, well graded, some silty clay, medium dense, saturated GM				
				SS-9 23.5-25.0 15"R	7 15 14		N=29 SS-9: Gravel=39% Sand=31% Silt/clay=30%
656.0	26.5		Light yellowish brown coarse to fine sand and gravel, little silty clay, well graded, medium dense to dense, saturated SM				
				SS-10 28.5-30.0 10"R	12 19 11		N=30 SS-10: Gravel=41.8% Sand=44.2% Silt/clay=13.9%
652.5	30.0		End of Boring at 30.0'				

Boring converted to observation well OW-4-02 immediately after drilling. Screen interval 17.9' to 27.9 sand pack (#5 silica sand) 14.0' to 30.0'. Bentonite seal 2.0' t 14.0'. Flush mount protector installed in concrete at surface.

DRILLING CONTRACTOR **Patrick Drilling Inc.**
DRILLING METHOD **3.25" I.D. HSA**
DRILLING EQUIPMENT **CME 75 ATV Rig**
DRILLING STARTED **04/04/02** ENDED **04/04/02**

REMARKS

WATER LEVEL (ft.)
▽ **13.6** during drilling
▼
▽ **13.7** 4/11/02

Valleyview Existing Borehole Log

PATRICK ENGINEERING INC.

BORING NUMBER **B-5-02** SHEET **1** OF **2**
CLIENT **DuPage County Dept. of Environmental Concerns**
PROJECT & NO. **Groundwater Impact Assessment 7003.K0**
LOCATION **Northing: 1879373.81 feet, Easting: 1058167.45 feet (3S160 Cherrywood Lane)**

LOGGED BY **JPR**
GROUND ELEVATION **684.6**

ELEVATION	DEPTH (FT)	STRATA	SOIL/ROCK DESCRIPTION	SAMPLE TYPE & NO. DEPTH (FT) RECOVERY(IN)	BLOW COUNTS	NOTES & TEST RESULTS
684.6 / 684.4	0.0 / 0.2		Black topsoil	AU-1 0.0-1.0		0.2" thick topsoil
683.1	1.5		Brown silty clay fill, some to little coarse to fine sand, medium to low plasticity, moist -FILL-	SS-2AB 1.0-2.5 6"R	2 3 4	
			Brown coarse to fine clayey sand, trace silt, loose, dry to moist SC			
				SS-3 3.5-5.0 8"R	3 3 3	N=6
			Trace medium to fine gravel	SS-4 6.0-7.5 10"R	4 5 4	N=9
				SS-5 8.5-10.0 12"R	3 3 2	N=5
672.9	11.7		Brown, medium to fine sand, and silt, poorly graded, loose, dry to moist SP	SS-6 11.0-12.5 10"R	4 4 3	N=7
672.0	12.6		Brown coarse to fine clayey sand, trace silt, medium dense, dry to moist SC	SS-7 13.5-15.0 10"R	3 7 6	N=13
669.6	15.0					
668.3	16.3		Brown coarse to fine sand, some silt, little fine gravel, well graded, loose, saturated SM			
666.0	18.6			SS-8 18.5-20.0 16"R	2 3 3	N=6
664.6	20.0					

Water Content: PL □ — ○ — △ LL (10, 20, 30, 40, 50)
Unconfined Compressive Strength (TSF) ✳ (1, 2, 3, 4, 5)

DRILLING CONTRACTOR **Patrick Drilling Inc.**
DRILLING METHOD **3.25" I.D. HSA**
DRILLING EQUIPMENT **CME 75 ATV Rig**
DRILLING STARTED **04/04/02** ENDED **04/04/02**

REMARKS

WATER LEVEL (ft.)
▽ **18.6** during drilling
▼
▼ **15.0** 4/10/02

Valleyview Existing Borehole Log

PATRICK ENGINEERING INC.

BORING NUMBER **B-5-02** SHEET **2** OF **2**
CLIENT **DuPage County Dept. of Environmental Concerns**
PROJECT & NO. **Groundwater Impact Assessment 7003.K0**
LOCATION **Northing: 1879373.81 feet, Easting: 1058167.45 feet (3S160 Cherrywood Lane)**

LOGGED BY **JPR**
GROUND ELEVATION **684.6**

ELEVATION	DEPTH (FT)	STRATA	SOIL/ROCK DESCRIPTION	SAMPLE TYPE & NO. DEPTH (FT) RECOVERY(IN)	BLOW COUNTS	Water Content PL 10 20 30 40 LL / Unconfined Compressive Strength (TSF) ✳ 1 2 3 4 5	NOTES & TEST RESULTS
664.6	20.0		Brown coarse to fine sand, some silt, little fine gravel, well graded, loose, saturated SM				SS-8: Gravel=13.6% Sand=60.7% Silt/clay=25.7%
			(Little to trace fine gravel, saturated)	SS-9 23.5-25.0 12"R	WOH 3 7		N=10
							WOH = Weight of Hammer
658.1	26.5		White to gray coarse to fine sand, trace fine gravel, trace silt, well graded, medium dense, saturated SW				
				SS-10 28.5-30.0 18"R	10 13 17		N=30
655.3	29.3		White to gray medium to fine gravel, and coarse to fine sand, trace silt, well graded, medium dense to dense, saturated GW				
654.6	30.0		End of Boring at 30.0'				

Boring converted to observation well OW-5-02 immediately after drilling screen interval 17.3' to 27.3' sand pack (#5 silica sand) 12.5' to 30.0'. Bentonite seal 2.0' to 12.5'. Flush mount protector installed in concrete at surface.

DRILLING CONTRACTOR **Patrick Drilling Inc.**
DRILLING METHOD **3.25" I.D. HSA**
DRILLING EQUIPMENT **CME 75 ATV Rig**
DRILLING STARTED **04/04/02** ENDED **04/04/02**

REMARKS

WATER LEVEL (ft.)
▽ **18.6** during drilling
▼
▼ **15.0** 4/10/02

Valleyview Existing Borehole Log

PATRICK ENGINEERING INC.

BORING NUMBER **B-6-02** SHEET **1** OF **2**
CLIENT **DuPage County Dept. of Environmental Concerns**
PROJECT & NO. **Groundwater Impact Assessment 7003.K0**
LOCATION **Northing: 1877300.51, Easting: 1057675.73 (22W440 Route 53)**

LOGGED BY **JPR**
GROUND ELEVATION **670.9**

ELEVATION	DEPTH (FT)	STRATA	SOIL/ROCK DESCRIPTION	SAMPLE TYPE & NO. DEPTH (FT) RECOVERY(IN)	BLOW COUNTS	Water Content PL 10 20 30 40 50 LL / Unconfined Compressive Strength (TSF) ✳ 1 2 3 4 5	NOTES & TEST RESULTS
670.9	0.0		Dark brown to black silty clay topsoil, trace coarse to fine sand, trace organics, stiff, medium plasticity, moist CL	AU-1 0.0-1.0			Crumbled up asphalt in spoon SS-2
				SS-2 1.0-2.5 1"R	4 3 2		
668.7	2.2		Brown silty clay, trace coarse to fine sand, stiff, medium plasticity, moist CL				
667.5	3.4		▽				
667.0	3.9		Black clayey silt, trace medium to fine sand, stiff, low plasticity, moist CL-ML	SS-3AB 3.5-5.0 6"R	2 3 3	✳	
664.6	6.3		White to gray coarse to fine sand, and coarse to fine gravel, trace silt, well graded, medium dense, moist to wet SW	SS-4 6.0-7.5 4"R	1 3 9	✳	
662.4	8.5		▽ Saturated at 8.5' while drilling	SS-5 8.5-10.0 2"R	3 7 4		N=15
661.0	9.9		White to gray coarse to fine sand, well graded, medium dense, saturated SW	SS-6 11.0-12.5 8"R	5 6 9		N=15
658.2	12.7		White to gray coarse to fine silty sand, little coarse to fine gravel, well graded, medium dense, saturated SM	SS-7 13.5-15.0 8"R	4 6 6		N=12
654.4	16.5		Gray coarse to fine sand, little fine gravel, trace silt, well graded, medium dense, saturated SW-SM	SS-8 18.5-20.0 10"R	2 5 8		N=13
650.9	20.0						

DRILLING CONTRACTOR **Patrick Drilling Inc.**
DRILLING METHOD **3-1/4" HSA**
DRILLING EQUIPMENT **CME D75 ATV**
DRILLING STARTED **05/15/02** ENDED **05/15/02**

REMARKS
Boring converted to Observation Well OW-6-02 upon completion.

WATER LEVEL (ft.)
▽ **8.5** during drilling
▼ **None taken after drilling due to rain**
▼ **3.41** 5/21/02

Valleyview Existing Borehole Log

PATRICK ENGINEERING INC.

BORING NUMBER **B-6-02** SHEET **2** OF **2**
CLIENT **DuPage County Dept. of Environmental Concern**
PROJECT & NO. **Groundwater Impact Assessment 7003.K0**
LOCATION **Northing: 1877300.51, Easting: 1057675.73 (22W440 Route 53)**

LOGGED BY **JPR**
GROUND ELEVATION **670.9**

ELEVATION	DEPTH (FT)	STRATA	SOIL/ROCK DESCRIPTION	SAMPLE TYPE & NO. DEPTH (FT) RECOVERY(IN)	BLOW COUNTS	Water Content PL 10 20 30 40 LL 50 / Unconfined Compressive Strength (TSF) ✳ 1 2 3 4 5	NOTES & TEST RESULTS
650.9	20.0		Gray coarse to fine sand, little fine gravel, trace silt, well graded, loose, saturated SW-SM				SS-8: Gravel=13.6% Sand=80.8% Silt/clay=5.6%
				SS-9 23.5-25.0 16"R	3 3 6		6" blow-in N=9
644.2	26.7		Light gray coarse to fine sand, and fine gravel, trace silt, well graded, loose, saturated SW				SS-10: Gravel=33.6% Sand=64.5% Silt/clay=1.9%
				SS-10 28.5-30.0 6"R	4 3 5		N=8
640.9	30.0		End of Boring at 30.0'				Boring converted to observation well OW-6-02 immediately after drilling. Screen interval 18.4' to 28.4 sand pack (#5 silica sand and native soil cave-in) 16.0' to 30.0'. Bentonite sea 2.0' to 16.0' flush mount protector installed in concrete at surface.

DRILLING CONTRACTOR **Patrick Drilling Inc.**
DRILLING METHOD **3-1/4" HSA**
DRILLING EQUIPMENT **CME D75 ATV**
DRILLING STARTED **05/15/02** ENDED **05/15/02**

REMARKS
Boring converted to Observation Well OW-6-02 upon completion.

WATER LEVEL (ft.)
▽ **8.5** during drilling
▼ **None taken after drilling due to ra**
▼ **3.41** 5/21/02

Valleyview Existing Borehole Log

PATRICK ENGINEERING INC.

BORING NUMBER **B-7-02** SHEET **1** OF **2**
CLIENT **DuPage County Dept. of Environmental Concerns**
PROJECT & NO. **Groundwater Impact Assessment 7003.K0**
LOCATION **Northing: 1878240.58, Easting 1056068.16 (22W701 Sycamore Street)**

LOGGED BY **JPR**
GROUND ELEVATION **688.0**

ELEVATION	DEPTH (FT)	STRATA	SOIL/ROCK DESCRIPTION	SAMPLE TYPE & NO. DEPTH (FT) RECOVERY(IN)	BLOW COUNTS	Water Content PL 10 20 30 40 LL 50 / Unconfined Compressive Strength (TSF) 1 2 3 4 5	NOTES & TEST RESULTS
688.0	0.0		CA-6 crushed limestone fill -FILL-	AU-1 0.0-1.0			Crushed limestone (CA-6) at surface
687.7	0.3		Asphalt				
687.4	0.6		Brown silty clay, trace coarse to fine sand, trace organics, stiff to very stiff, medium plasticity, moist CL	SS-2 1.0-2.5 7"R	2 2 4		
				SS-3/GS-3 3.5-5.0 0"R	3 5 5		No recovery in spoon GS-3 sample obtained from augers
			(Some to little medium to fine sand, low plasticity)	SS-4 6.0-7.5 6"R	6 5 3		
680.5	7.5		Brown silty clay, trace coarse to fine sand, stiff to very stiff, medium plasticity, moist CL	SS-5 8.5-10.0 11"R	2 4 6		Perched water at approximately 9.0'
677.8	10.2		Gray silty clay, trace coarse to fine sand, very stiff to hard, medium plasticity, moist CL	SS-6 11.0-12.5 18"R	3 6 10		
				SS-7 13.5-15.0 13"R	2 4 7		
671.6	16.4		Tan coarse to fine gravel, and coarse to fine sand, little silt, well graded, medium dense, saturated GM				SS-8: Gravel=46.1% Sand=41.4% Silt/clay=12.6%
670.5	17.5						
669.3	18.7			SS-8 18.5-20.0 12"R	5 8 8		N=16
668.0	20.0						

DRILLING CONTRACTOR **Patrick Drilling Inc.**
DRILLING METHOD **3-1/4" HSA**
DRILLING EQUIPMENT **CME D75 ATV**
DRILLING STARTED **05/16/02** ENDED **05/16/02**

REMARKS
Boring converted to Observation Well OW-7-02 upon completion.

WATER LEVEL (ft.)
▽ **17.5** during drilling
▼ **18.7** after drilling
▼ **16.38** 5/21/02

Valleyview Existing Borehole Log

PATRICK ENGINEERING INC.

BORING NUMBER **B-7-02** SHEET **2** OF **2**
CLIENT **DuPage County Dept. of Environmental Concern**
PROJECT & NO. **Groundwater Impact Assessment 7003.K0**
LOCATION **Northing: 1878240.58, Easting 1056068.16 (22W701 Sycamore Street)**

LOGGED BY **JPR**
GROUND ELEVATION **688.0**

ELEVATION	DEPTH (FT)	STRATA	SOIL/ROCK DESCRIPTION	SAMPLE TYPE & NO. DEPTH (FT) RECOVERY(IN)	BLOW COUNTS	Water Content PL 10 20 30 40 LL / Unconfined Compressive Strength (TSF) ✳ 1 2 3 4 5	NOTES & TEST RESULT
668.0	20.0		Light brown coarse to fine gravel, and coarse to fine sand, little silt, well graded, occasional cobbles, dense, saturated GM				
666.5	21.5		Light brown coarse to fine gravel, and coarse to fine sand, trace silt, well graded, occasional cobbles, dense, saturated GW-GM				Cobbles encountered while augering to SS-9
				SS-9 23.5-25.0 10"R	12 17 22		N=39 SS-9 Gravel=59.2% Sand=30.9% Silt/clay=9.9%
							Cobbles encountered while augering to SS-10
				SS-10 28.5-30.0 6"R	10 14 21		12" blow-in
658.0	30.0		End of Boring at 30.0'				N=35

Boring converted to observation well OW-7-02 immediately after drilling. Screen interval 16.7' to 26.7'. Sand pack (#5 silica sand) 15.0' to 30.0' bentonite seal 2.0' to 15.0'. Flush mount protector installed in concrete at surface.

DRILLING CONTRACTOR **Patrick Drilling Inc.**
DRILLING METHOD **3-1/4" HSA**
DRILLING EQUIPMENT **CME D75 ATV**
DRILLING STARTED **05/16/02** ENDED **05/16/02**

REMARKS
Boring converted to Observation Well OW-7-02 upon completion.

WATER LEVEL (ft.)
▽ **17.5** during drilling
▼ **18.7** after drilling
▼ **16.38** 5/21/02

Valleyview Existing Borehole Log

PATRICK ENGINEERING INC.

BORING NUMBER **B-8-02** SHEET **1** OF **2**
CLIENT **DuPage County Dept. of Environmental Concerns**
PROJECT & NO. **Groundwater Impact Assessment 7003.K0**
LOCATION **Northing: 1880584.77, Easting 1058394.90 (3S031 Sequoia Drive)**

LOGGED BY **JPR**
GROUND ELEVATION **699.2**

ELEVATION	DEPTH (FT)	STRATA	SOIL/ROCK DESCRIPTION	SAMPLE TYPE & NO. DEPTH (FT) RECOVERY(IN)	BLOW COUNTS	Water Content PL 10 20 30 40 LL 50 / Unconfined Compressive Strength (TSF) 1 2 3 4 5	NOTES & TEST RESULTS
699.3	0.9		CA-6 crushed limestone fill -FILL-	AU-1 0.0-1.0			Gravel at surface - 4" thick
698.4	0.8		Brown silty clay fill, little to trace coarse to fine sand, medium plasticity, moist FILL	SS-2 1.0-2.5 6"R	2 3 4	✳	
696.7	2.5		Black silty clay, trace coarse to fine sand, very stiff, medium plasticity, moist CL				
			Brown silty clay, trace coarse to fine sand, trace fine gravel, stiff to very stiff, medium plasticity, moist CL	SS-3 3.5-5.0 8"R	2 2 2	✳	Brown to tan medium to fine sand seam 0.01" thick at 3.9' bgs.
				SS-4 6.0-7.5 14"R	3 4 5	✳	Brown to tan fine sand and silt seam 0.1" thick at 4.1' bgs.
			Very stiff to hard	SS-5 8.5-10.0 12"R	4 6 7	✳	Brown to tan medium to fine sand at tip of spoon.
				SS-6 11.0-12.5 18"R	3 8 10	✳	Brown to tan medium to fine sand seam at 9.5'.
686.2	13.0		Olive gray silty clay, trace coarse to fine sand, trace fine gravel, very stiff, medium plasticity, moist CL	SS-7 13.5-15.0 12"R	3 5 8	✳	Tan medium to fine sand seam 0.01" thick at 14.4' bgs.
				SS-8 18.5-20.0 12"R	3 4 8	✳	

DRILLING CONTRACTOR **Patrick Drilling Inc.**
DRILLING METHOD **3-1/4" HSA**
DRILLING EQUIPMENT **CME D75 ATV**
DRILLING STARTED **05/17/02** ENDED **05/17/02**

REMARKS
Boring converted to Observation Well OW-8-02 upon completion.

WATER LEVEL (ft.)
▽ **29.4** during drilling
▼ **29.4** after drilling
▽ **25.96** 5/21/02

Valleyview Existing Borehole Log

PATRICK ENGINEERING INC.

BORING NUMBER **B-8-02** SHEET **2** OF **2**
CLIENT **DuPage County Dept. of Environmental Concern**
PROJECT & NO. **Groundwater Impact Assessment 7003.K0**
LOCATION **Northing: 1880584.77, Easting 1058394.90 (3S031 Sequoia Drive)**

LOGGED BY **JPR**
GROUND ELEVATION **699.2**

ELEVATION	DEPTH (FT)	STRATA	SOIL/ROCK DESCRIPTION	SAMPLE TYPE & NO. DEPTH (FT) RECOVERY(IN)	BLOW COUNTS	Water Content PL 10 20 30 40 LL 50 / Unconfined Compressive Strength (TSF) 1 2 3 4 5	NOTES & TEST RESULTS
679.2	20.0		Olive gray silty clay, trace coarse to fine sand, trace fine gravel, very stiff, medium plasticity, moist CL				
				SS-9 23.5-25.0 18"R	3 9 14	✳	SS-9: Gravel=0.0% Sand=2.3% Silt/clay=97.7% Cobble at 25.0'
673.2	26.0		▽				
670.1	29.1			SS-10AB 28.5-30.0 17"R	3 13 13	✳	N=26 SS-10B: Gravel=11.1% Sand=75.4% Silt/clay=13.4%
669.8	29.4		▼ Brown silty clay, trace coarse to fine sand, hard, medium plasticity, moist CL			✳	
669.2	30.0		Light brown coarse to fine sand, little fine gravel, little silt, poorly graded, medium dense, saturated SM				
			End of Boring at 30.0'				Boring converted to observation well OW-8-02 immediately after drilling. Screen interval 20.2' to 30.2' sand pack (#5 silica sand) 18.0' to 30.5'. Bentonite seal 2.0' to 18.0'. Flush mount protector installed in concrete at surface.

DRILLING CONTRACTOR **Patrick Drilling Inc.**
DRILLING METHOD **3-1/4" HSA**
DRILLING EQUIPMENT **CME D75 ATV**
DRILLING STARTED **05/17/02** ENDED **05/17/02**

REMARKS
Boring converted to Observation Well OW-8-02 upon completion.

WATER LEVEL (ft.)
▽ **29.4** during drilling
▼ **29.4** after drilling
▽ **25.96** 5/21/02

Valleyview Existing Borehole Log

PATRICK ENGINEERING INC.

BORING NUMBER **B-9-02** SHEET **1** OF **2**
CLIENT **DuPage County Dept. of Environmental Concerns**
PROJECT & NO. **Groundwater Impact Assessment 7003.K0**
LOCATION **Northing: 1879659.23, Easting: 1057020.33 (3S155 Shagbark Lane)**

LOGGED BY **JPR**
GROUND ELEVATION **716.6**

ELEVATION	DEPTH (FT)	STRATA	SOIL/ROCK DESCRIPTION	SAMPLE TYPE & NO. DEPTH (FT) RECOVERY(IN)	BLOW COUNTS	Water Content PL 10 20 30 40 LL 50 / Unconfined Compressive Strength (TSF) 1 2 3 4 5	NOTES & TEST RESULTS
716.6	0.0		CA-6 crushed limestone -Fill-	AU-1 0.0-1.0			
716.3	0.3		Black to brown and olive silty clay fill, little coarse to fine gravel, little coarse to fine sand, stiff, medium plasticity, moist -FILL-	SS-2 1.0-2.5 8"R	1 2 3		
				SS-3 3.5-5.0 6"R	3 7 7		
711.6	5.0		Brown silty clay to clayey silt, trace coarse to fine sand, very stiff, medium to low plasticity, moist CL-ML	SS-4 6.0-7.5 10"R	7 3 4		
				SS-5 8.5-10.0 15"R	2 4 7		
706.4	10.2		Gray silty clay to clayey silt, trace coarse to fine sand, hard, low plasticity, moist CL-ML	SS-6 11.0-12.5 10"R	3 6 7		
702.6	14.0			SS-7 13.5-15.0 10"R	4 6 11		
697.6	19.0		Gray silty clay, trace coarse to fine sand, medium stiff, low plasticity, moist	SS-8AB 18.5-20.0 10"R	3 9 20		
696.6	20.0						

DRILLING CONTRACTOR **Patrick Drilling Inc.**
DRILLING METHOD **3-1/4" HSA**
DRILLING EQUIPMENT **CME D75 ATV**
DRILLING STARTED **05/16/02** ENDED **05/16/02**

REMARKS
Boring converted to Observation Well OW-9-02 upon completion.

WATER LEVEL (ft.)
▽ **19.0** during drilling
▼
▼ **13.96** 5/21/02

Valleyview Existing Borehole Log

PATRICK ENGINEERING INC.

BORING NUMBER **B-9-02** SHEET **2** OF **2**
CLIENT **DuPage County Dept. of Environmental Concern**
PROJECT & NO. **Groundwater Impact Assessment 7003.K0**
LOCATION **Northing: 1879659.23, Easting: 1057020.33 (3S155 Shagbark Lane)**

LOGGED BY **JPR**
GROUND ELEVATION **716.6**

ELEVATION	DEPTH (FT)	STRATA	SOIL/ROCK DESCRIPTION	SAMPLE TYPE & NO. DEPTH (FT) RECOVERY(IN)	BLOW COUNTS	Water Content PL 10 20 30 40 LL 50 / Unconfined Compressive Strength (TSF) 1 2 3 4 5	NOTES & TEST RESULT
696.6	20.0		CL Gray silt, trace coarse to fine sand, dense, non-plastic, moist ML (Occasional cobbles)				
				SS-9 23.5-25.0 1"R	66 25 15		N=40
				SS-10 28.5-30.0 5"R	34 57 57/3"		
686.6	30.0		(Some to little coarse to fine gravel, little to trace cobbles, extremely dense) End of Boring at 30.0'				Boring converted to observation well OW-9-02 immediately after drilling. Screen interval 18.5' to 28.5'. Sand pack (#5 silica sand) 16.5 to 30.0'. Bentonite seal 2.0' to 16.5' flush mount protector installed in concrete at surface.

DRILLING CONTRACTOR **Patrick Drilling Inc.**
DRILLING METHOD **3-1/4" HSA**
DRILLING EQUIPMENT **CME D75 ATV**
DRILLING STARTED **05/16/02** ENDED **05/16/02**

REMARKS
Boring converted to Observation Well OW-9-02 upon completion.

WATER LEVEL (ft.)
▽ **19.0** during drilling
▼
▼ **13.96** 5/21/02

Valleyview Existing Borehole Log

PATRICK ENGINEERING INC.

BORING NUMBER **B-10-02** SHEET **1** OF **2**

CLIENT **DuPage County Dept. of Environmental Concerns**

PROJECT & NO. **Groundwater Impact Assessment 7003.K0**

LOCATION **Northing: 1879853.11, Easting: 1059260.81 (3S201 Burr Oak Drive)**

LOGGED BY **JPR**

GROUND ELEVATION **680.2**

ELEVATION	DEPTH (FT)	STRATA	SOIL/ROCK DESCRIPTION	SAMPLE TYPE & NO. DEPTH (FT) RECOVERY(IN)	BLOW COUNTS	Water Content PL LL / Unconfined Compressive Strength (TSF)	NOTES & TEST RESULTS
680.2 / 679.9	0.0 / 0.3		CA-6 crushed limestone fill -FILL-	AU-1 0.0-1.0			Gravel at surface
			Dark brown silty clay fill, little coarse to fine gravel, trace coarse to fine sand, very stiff, medium plasticity, moist -FILL-	SS-2 1.0-2.5 5"R	2 2 4	*	
677.7	2.5		Brown and gray mottled silty clay, trace coarse to fine sand, very stiff, medium plasticity, moist CL	SS-3 3.5-5.0 9"R	2 3 4	*	
675.1	5.1		Brown and gray silt, some coarse to fine sand, loose, non-plastic, moist ML	SS-4 6.0-7.5 6"R	1 2 2		
671.2	9.0		(Occasional trace fine gravel, occasional cobbles)	SS-5 8.5-10.0 4"R	4 4 6		
670.3	9.9		Tan to gray coarse to fine sand, some coarse to fine gravel, well graded, loose, wet to saturated SW	SS-6 11.0-12.5 3"R	2 3 4		N=7
668.2 / 668.0	12.0 / 12.2		(Medium dense)	SS-7 13.5-15.0 5"R	13 12 5		N=17
664.0	16.2		Brownish gray coarse to fine gravel, some coarse to fine sand, trace silt, occasional cobbles, well graded, very dense, saturated GW-GM	SS-8 18.5-20.0 10"R	22 47 23		1.0' blow-in
660.2	20.0						N=70

DRILLING CONTRACTOR **Patrick Drilling Inc.**

DRILLING METHOD **3-1/4" HSA**

DRILLING EQUIPMENT **CME D75 ATV**

DRILLING STARTED **05/17/02** ENDED **05/17/02**

REMARKS

Boring converted to Observation Well OW-10-02 upon completion.

WATER LEVEL (ft.)

▽ **12.0** during drilling

▼ **12.2** after drilling

▽ **8.97** 5/21/02

Valleyview Existing Borehole Log

PATRICK ENGINEERING INC.

BORING NUMBER **B-10-02** SHEET **2** OF **2**
CLIENT **DuPage County Dept. of Environmental Concerns**
PROJECT & NO. **Groundwater Impact Assessment 7003.K0**
LOCATION **Northing: 1879853.11, Easting: 1059260.81**
(3S201 Burr Oak Drive)

LOGGED BY **JPR**
GROUND ELEVATION **680.2**

ELEVATION	DEPTH (FT)	STRATA	SOIL/ROCK DESCRIPTION	SAMPLE TYPE & NO. DEPTH (FT) RECOVERY(IN)	BLOW COUNTS	Water Content PL 10 20 30 40 LL / Unconfined Compressive Strength (TSF) 1 2 3 4 5	NOTES & TEST RESULTS
660.2	20.0		Brownish gray coarse to fine gravel, some coarse to fine sand, trace silt, occasional cobbles, well graded, very dense, saturated GW-GM				SS-8: Gravel=65.5% Sand=25.2% Silt/clay=9.3%
658.8	21.4		Dark gray coarse to fine gravel, and coarse to fine sand, little silt, well graded, dense, saturated GM				
				SS-9 23.5-25.0 10"R	23 22 23		N=55 SS-9: Gravel=49.3% Sand=32.9% Silt/clay=17.8%
653.8	26.4		Gray coarse to fine gravel, little coarse to fine sand, trace silt, well graded, dense, saturated GW-GM				
				SS-10 28.5-30.0 12"R	17 12 20		N=32
650.2	30.0		End of Boring at 30.0'				

Boring converted to observation well OW-10-02 immediately after drilling. Screen interval 18.8' to 28.8'. Sand pack (#5 silica sand) 17.0' to 30.0'. Bentonite seal 2.0' to 17.0'. Flush mount protector installed in concrete at surface.

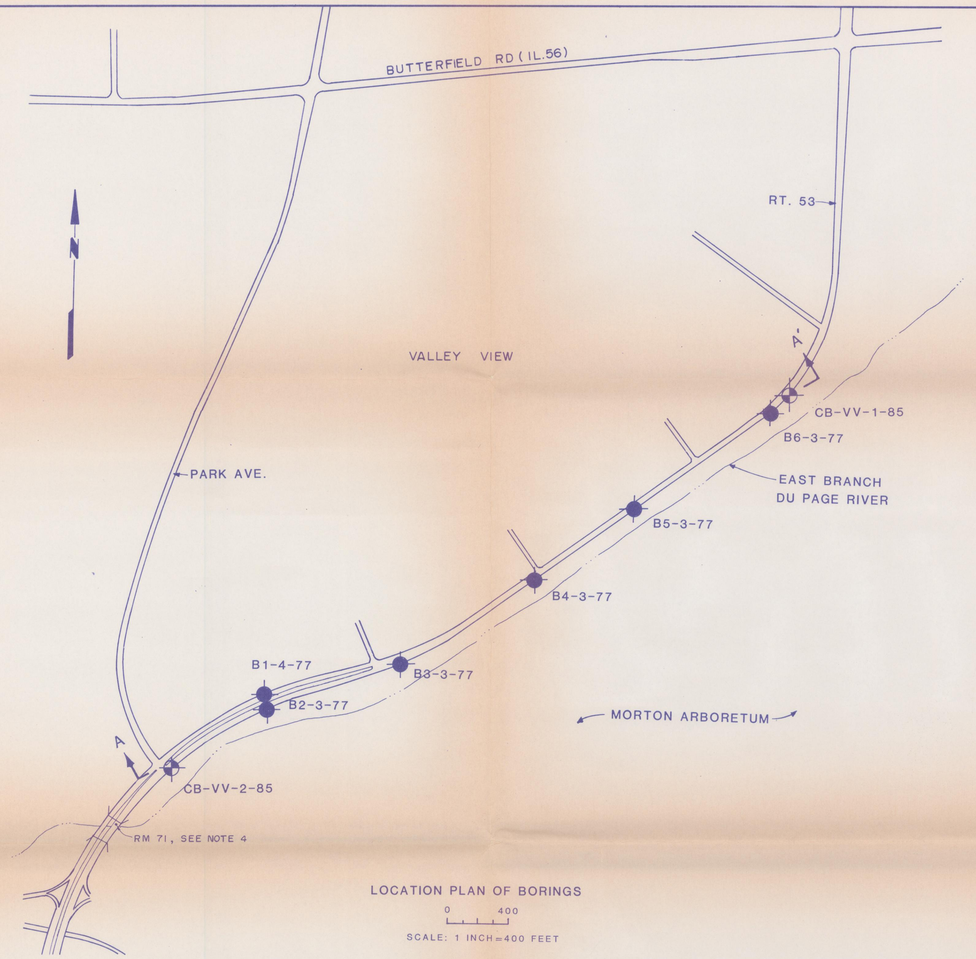
DRILLING CONTRACTOR **Patrick Drilling Inc.**
DRILLING METHOD **3-1/4" HSA**
DRILLING EQUIPMENT **CME D75 ATV**
DRILLING STARTED **05/17/02** ENDED **05/17/02**

REMARKS
Boring converted to Observation Well OW-10-02 upon completion.

WATER LEVEL (ft.)
▽ **12.0** during drilling
▼ **12.2** after drilling
▼ **8.97** 5/21/02

CORPS OF ENGINEERS

U. S. ARMY



LOCATION PLAN OF BORINGS

0 400

SCALE: 1 INCH=400 FEET

PROJECT LOCATION MAP

0 2 4 MILES

SCALE: 1.1 INCH=2 MILES

LEGEND

A — A' CROSS SECTION

CB-VV-2-85 BORING BY PATRICK ENGINEERING INC. COMPLETED IN SEPT. 1985.

B4-3-77 BORING BY APPLIED SOIL MECHANICS INC. COMPLETED IN MARCH & APRIL, 1977 AND JUNE, 1978

IMPROVED ROADWAY

BRIDGE, CULVERT

WATER LINE

9-11-85 WATER LEVEL DURING DRILLING, DATE

9-11-85 WATER LEVEL AFTER DRILLING, DATE

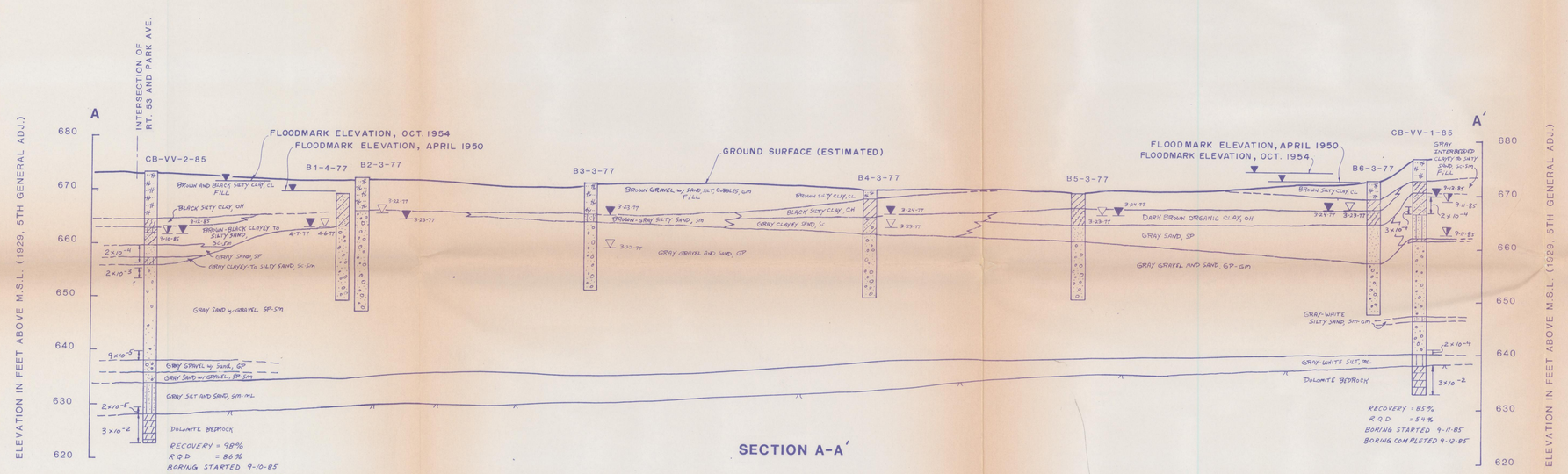
9-12-85 WATER LEVEL AFTER 24 HOURS, DATE

DENOTES SILTY CLAY; SEE EXHIBIT 3 FOR ADDITIONAL GRAPHIC LOG SYMBOLS

2×10^{-4} BOREHOLE RECHARGE TEST, HYDRAULIC CONDUCTIVITY, CM/SEC.

NOTES

1. DUPAGE RIVER FLOOD MARK ELEVATIONS WERE OBTAINED FROM MAY, J.V. AND ALLEN, H.E., DEPARTMENT OF THE INTERIOR, UNITED STATES GEOLOGICAL SURVEY, FLOODS IN WHEATON QUADRANGLE, NORTHEASTERN ILLINOIS, HYDROLOGIC INVESTIGATIONS, ATLAS HA-148, 1977. SEE EXHIBIT 1.
2. INTERPRETED PROFILE OF SUBSURFACE CONDITIONS IS SCHEMATIC: CONSULT BORING LOGS, APPENDIX A, FOR SOIL DESCRIPTIONS.
3. REFERENCE EXHIBIT 3 FOR SOIL DESCRIPTION TERMINOLOGY AND INTERPRETATION OF GRAPHIC SYMBOLS.
4. REFERENCE MARK, ASSUMED EL. 676.74, TAKEN FROM FLOOD INSURANCE RATE MAP, COUNTY OF DUPAGE, PANEL 40 OF 65, COMMUNITY-PANEL NUMBER 170197 0040 B, APRIL 15, 1982.



SECTION A-A'

0 200 400

HORIZONTAL SCALE: 1 INCH=200 FEET

0 10 20

VERTICAL SCALE: 1 INCH=10 FEET

Valleyview Existing Borehole Map and Profile

REVISION	DATE	DESCRIPTION	BY

PATRICK ENGINEERING INC.
Engineers • Geologists • Hydrologists
Glen Ellyn, Illinois

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
CHICAGO, ILLINOIS

US Army Corps of Engineers

PREPARED BY: JCS
DRAWN BY: KVAE WRM
CHECKED BY: JCS
SUBMITTED BY:
APPROVAL RECOMMENDED: PROJECT MANAGER
APPROVED: CHIEF, PLANNING/ENGINEERING DIVISION

APPROVAL RECOMMENDED DATE
CHIEF, TECHNICAL ENGINEERING BRANCH

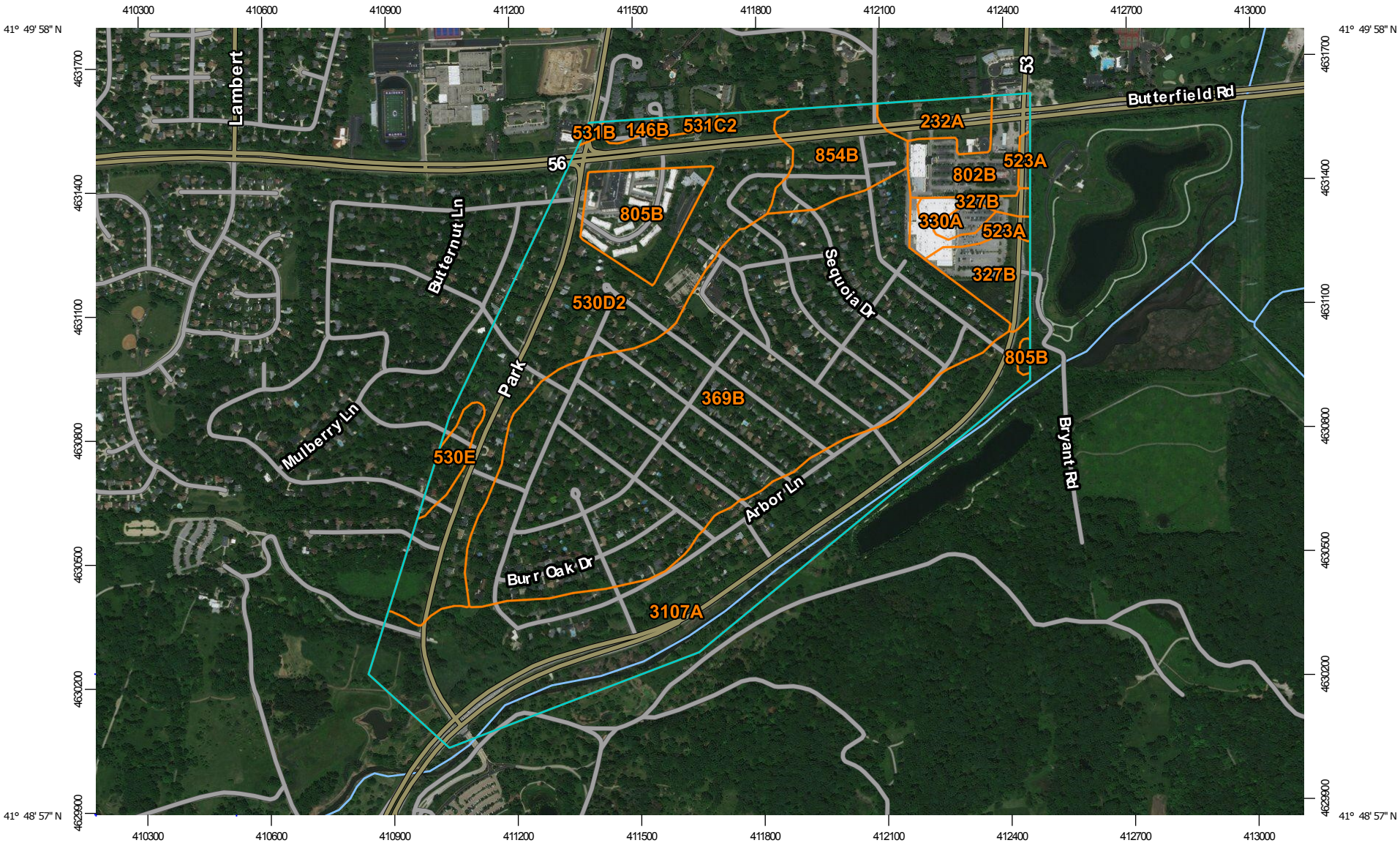
VALLEY VIEW
ILLINOIS ROUTE 53 RELOCATION

LOCATION PLAN OF BORINGS & SOIL PROFILE

SCALE: AS SHOWN DACW 23
FILE NO.
EXHIBIT 2
SHEET OF

Soil Map—DuPage County, Illinois

Valleyview



Map Scale: 1:13,400 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 150 300 600 900

Feet: 0 500 1000 2000 3000

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 16N WGS84

Valleyview

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Map Unit Polygons

Soil Map Unit Lines

Soil Map Unit Points

Special Point Features

Blowout

Borrow Pit

Clay Spot

Closed Depression

Gravel Pit

Gravelly Spot

Landfill

Lava Flow

Marsh or swamp

Mine or Quarry

Miscellaneous Water

Perennial Water

Rock Outcrop

Saline Spot

Sandy Spot

Severely Eroded Spot

Sinkhole

Slide or Slip

Sodic Spot

Spoil Area

Stony Spot

Very Stony Spot

Wet Spot

Other

Special Line Features

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:12,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: DuPage County, Illinois
Survey Area Data: Version 13, Sep 20, 2017

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Feb 10, 2016—Oct 8, 2016

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Valleyview

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
146B	Elliott silt loam, 2 to 4 percent slopes	1.3	0.3%
232A	Ashkum silty clay loam, 0 to 2 percent slopes	6.9	1.7%
327B	Fox silt loam, 2 to 4 percent slopes	11.3	2.8%
330A	Peotone silty clay loam, 0 to 2 percent slopes	1.8	0.5%
369B	Waupecan silt loam, 2 to 4 percent slopes	160.0	40.1%
523A	Dunham silty clay loam, 0 to 2 percent slopes	4.6	1.2%
530D2	Ozaukee silt loam, 6 to 12 percent slopes, eroded	72.4	18.1%
530E	Ozaukee silt loam, 12 to 20 percent slopes	3.9	1.0%
531B	Markham silt loam, 2 to 4 percent slopes	0.5	0.1%
531C2	Markham silt loam, 4 to 6 percent slopes, eroded	1.6	0.4%
802B	Orthents, loamy, undulating	11.1	2.8%
805B	Orthents, clayey, undulating	15.1	3.8%
854B	Markham-Ashkum-Beecher complex, 1 to 6 percent slopes	15.2	3.8%
3107A	Sawmill silty clay loam, heavy till plain, 0 to 2 percent slopes, frequently flooded	93.6	23.5%
Totals for Area of Interest		**399.3**	**100.0%**

Soil Map—Will County, Illinois

Bolingbrook Quarry

Map Scale: 1:14,600 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 200 400 800 1200

Feet: 0 500 1000 2000 3000

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 16N WGS84

Bolingbrook Quarry

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Map Unit Polygons

Soil Map Unit Lines

Soil Map Unit Points

Special Point Features

Blowout

Borrow Pit

Clay Spot

Closed Depression

Gravel Pit

Gravelly Spot

Landfill

Lava Flow

Marsh or swamp

Mine or Quarry

Miscellaneous Water

Perennial Water

Rock Outcrop

Saline Spot

Sandy Spot

Severely Eroded Spot

Sinkhole

Slide or Slip

Sodic Spot

Spoil Area

Stony Spot

Very Stony Spot

Wet Spot

Other

Special Line Features

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:12,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Will County, Illinois
Survey Area Data: Version 12, Sep 21, 2017

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Feb 10, 2016—Oct 8, 2016

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Bolingbrook Quarry

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
103A	Houghton muck, 0 to 2 percent slopes	35.7	6.4%
152A	Drummer silty clay loam, 0 to 2 percent slopes	5.6	1.0%
290B	Warsaw silt loam, 2 to 4 percent slopes	15.7	2.8%
369B	Waupecan silt loam, 2 to 4 percent slopes	6.1	1.1%
523A	Dunham silty clay loam, 0 to 2 percent slopes	7.6	1.4%
526A	Grundelein silt loam, 0 to 2 percent slopes	13.5	2.4%
530D2	Ozaukee silt loam, 6 to 12 percent slopes, eroded	0.4	0.1%
802D	Orthents, loamy, rolling	6.2	1.1%
864	Pits, quarry	195.5	35.3%
865	Pits, gravel	130.9	23.6%
3107A	Sawmill silty clay loam, heavy till plain, 0 to 2 percent slopes, frequently flooded	25.8	4.7%
W	Water	111.1	20.1%
Totals for Area of Interest		**554.1**	**100.0%**

ILLINOIS STATE GEOLOGICAL SURVEY

Channahon ISGS Log

Private Water Well	Top	Bottom
topsoil	0	1
gravel	1	30
sand	30	40
gravel	40	54
Total Depth		**54**

Casing: 5" A-53 15 LBS from 0' to 54'

Size hole below casing: 5"

Water from gravel at 40' to 54'.
Static level 29' below casing top which is 1' above GL
Pumping level 29' when pumping at 10 gpm for 1 hour

Driller's Log filed

Owner Address: Route 2 Morris, IL

Location source: Location from permit Verified by: VJA on December 4, 2013.

Permit Date: September 10, 1971 **Permit #:** 14432

COMPANY Fykes, Charles N.
FARM Holmes, Bill
DATE DRILLED October 8, 1971 **NO.** 1
ELEVATION **COUNTY NO.** 02203
LOCATION SE SW NE
LATITUDE 41.44202 **LONGITUDE** -88.239829
COUNTY Will **API** 121970220300 **7 - 34N - 9E**

ILLINOIS STATE GEOLOGICAL SURVEY

Channahon ISGS Log

Private Water Well	Top	Bottom
overburden	0	47
rock formation	47	50
Total Depth		**50**

Casing: 5" BLK 15 LBS from 0' to 47'

Size hole below casing: 5"

Water from rock at 20' to 50'.
Static level 20' below casing top which is 1' above GL
Pumping level 42' when pumping at 20 gpm for 4 hours

Permanent pump installed at 42'
on , with a capacity of gpm

Driller's Log filed

Owner Address: Channahon, IL
Location source: Location from permit Verified by: VJA on December 4, 2013.

Permit Date: July 1, 1975 **Permit #:** 39011

COMPANY Knierim, Paul L.
FARM McDonald Construction
DATE DRILLED July 16, 1975 **NO.**
ELEVATION **COUNTY NO.** 25144
LOCATION NE SW NE
LATITUDE 41.443841 **LONGITUDE** -88.239898
COUNTY **Will** **API** **121972514400** **7 - 34N - 9E**

ILLINOIS STATE GEOLOGICAL SURVEY

Channahon ISGS Log

Test Hole	Top	Bottom
sand & gravel	0	30
clay	30	32
gravel	32	42
Total Depth		**42**

Casing: 1.25" GALV. PIPE from -1' to 40'

Driller's Log filed

Owner Address: Box 457 Monooka, IL

Location source: Platbook verified Verified by: VJA on December 4, 2013.

Permit Date: December 1, 1978 **Permit #:** 82657

COMPANY Wehling, Richard H.

FARM Minooka, Village of

DATE DRILLED December 15, 1978 **NO.**

ELEVATION **COUNTY NO.** 26846

LOCATION 3550'N line, 2900'E line of NE

LATITUDE 41.438493 **LONGITUDE** -88.244273

COUNTY **Will** **API** **121972684600** **7 - 34N - 9E**

ILLINOIS STATE GEOLOGICAL SURVEY

Channahon ISGS Log

Private Water Well	Top	Bottom
clay & gravel	0	40
limestone	40	100
Total Depth		**100**

Casing: 5" BLACK STEEL 14.98 from 0' to 40'

Size hole below casing: 5"

Water from limestone at ' to '.
Static level 35' below casing top which is 1' above GL
Pumping level 35' when pumping at 10 gpm for 4 hours

Permanent pump installed at 45'
on , with a capacity of gpm

Driller's Log filed

Owner Address: Rt. 2, Box 27 Minooka, IL
Location source: Location from permit Verified by: VJA on December 4, 2013.

Permit Date: January 13, 1981 **Permit #:** 98118

COMPANY Rob, Ronald Gene
FARM Cullinane, Pat
DATE DRILLED January 15, 1981 **NO.**
ELEVATION **COUNTY NO.** 28251
LOCATION SE SW NE
LATITUDE 41.44202 **LONGITUDE** -88.239829
COUNTY **Will** **API** **121972825100** **7 - 34N - 9E**

ILLINOIS STATE GEOLOGICAL SURVEY

Channahon ISGS Log

Municipal Water Supply	Top	Bottom
sand & rocks	0	7
clay	7	8
overburden	8	41
Total Depth		**41**

Casing: 30" BLACK STEEL from 0' to 40'

Static level 15' below casing top which is ' above GL
Pumping level 26' when pumping at 330 gpm for 6 hours

Driller's Log filed

Owner Address: Village Hall Minooka, IL
Location source: Platbook verified Verified by: VJA on December 4, 2013.

Permit Date: March 24, 1980 **Permit #:** 93106

COMPANY Wehling, Richard H.
FARM Minooka, Village Of
DATE DRILLED March 28, 1980 **NO.** 5
ELEVATION 530GL **COUNTY NO.** 28252
LOCATION 3550'N line, 1900'E line of section
LATITUDE 41.438584 **LONGITUDE** -88.240614
COUNTY Will **API** 121972825200 **7 - 34N - 9E**

ILLINOIS STATE GEOLOGICAL SURVEY

Channahon ISGS Log

Municipal Water Supply	Top	Bottom
sandy dirt/boulders	0	10
boulders sand/gravel	10	31
gray clay	31	39
gravel & broken rock	39	43
broken rock & gravel	43	45
hard lime	45	50
Total Depth		**50**

Casing: 16" from -2' to 26'
16" from 31' to 40'
16" from 45' to 48'

Screen: 5' of 16" diameter 100 slot

Water from at 0' to 16'.

Owner Address: Village Hall Minooka, IL

Address of well: 529 San Carlos Rd.

Add'l loc. info: Lot: 173 Subdivision: Bonita Vista Unit 11

Location source: Aerial Photograph verified Verified by: VJA on December 4, 2013.

Permit Date: June 15, 1987 **Permit #:** 132633

COMPANY Wehling, Richard H.

FARM Minooka, Village of

DATE DRILLED July 20, 1987 **NO.** 6

ELEVATION **COUNTY NO.** 29667

LOCATION NE NE NW

LATITUDE 41.447883 **LONGITUDE** -88.242882

COUNTY **Will** **API** **121972966700** **7 - 34N - 9E**

ILLINOIS STATE GEOLOGICAL SURVEY

Channahon ISGS Log

Stratigraphic Test	Top	Bottom
soil	0	4
gravel	4	40
limestone	40	60
shale	60	100
limestone	100	180
sandy limestone	180	220
sandy limestone	220	690
St Peter sandstone	690	720
Total Depth		**720**

Permit Date: **Permit #:**

COMPANY

FARM Fisher

DATE DRILLED **NO.** 75

ELEVATION 538 **COUNTY NO.** 33588

LOCATION NW NE SW

LATITUDE 41.440127 **LONGITUDE** -88.246952

COUNTY **Will** **API** **121973358800** **7 - 34N - 9E**

ILLINOIS STATE GEOLOGICAL SURVEY

Channahon ISGS Log

Municipal Water Supply	Top	Bottom
boulders & sand	0	10
sandy dirt & boulders	10	18
boulders, sand & gravel	18	27
gravel sand & boulders	27	31
gray clay	31	39
clay gravel & broken rock	39	43
broken rock & gravel	43	45
white hard lime	45	50
Total Depth		**50**

Casing: 16" BLACK STEEL from -1' to 42'

Screen: 10' of 16" diameter .1 slot

Owner Address: Minooka, IL

Address of well: San Carlos Rd.

Location source: Location from the driller Verified by: VJA on December 4, 2013.

Permit Date: **Permit #:** EPA 87-

COMPANY Wehling, Richard H.

FARM Village of Minooka

DATE DRILLED January 29, 1988 **NO.** 7

ELEVATION 0 **COUNTY NO.** 36338

LOCATION NW NW NE

LATITUDE 41.447413 **LONGITUDE** -88.242449

COUNTY **Will** **API** **121973633800** **7 - 34N - 9E**

ILLINOIS STATE GEOLOGICAL SURVEY

Channahon ISGS Log

Irrigation Well	Top	Bottom
gravel	0	15
clay	15	25
sand gravel	25	41
Total Depth		**41**

Casing: 6" PVC SDR 21 from -1' to 36'
Screen: 5' of 5" diameter .02 slot
Grout: BENTONITE from 0 to 30.

Water from gravel at 36' to 41'.
Static level 11' below casing top which is 3' above GL
Pumping level 25' when pumping at 0 gpm for 2 hours

Permanent pump installed at 25'
on May 17, 2000, with a capacity of 70 gpm

Owner Address: 100 Jardin Minooka, IL
Address of well: same as above
Add'l loc. info: Subdivision: Bonita Vista

Location source: Aerial Photograph verified Verified by: VJA on December 4, 2013.

Image viewing help: New users please read this.
GET FILE Related File -

Permit Date: September 18, 2000 **Permit #:** 197-00-

COMPANY Craven, Martin
FARM Minooka, Village of
DATE DRILLED May 16, 2000 **NO.** 1
ELEVATION 0 **COUNTY NO.** 38800
LOCATION SE NW SE
LATITUDE 41.438912 **LONGITUDE** -88.23833
COUNTY Will **API** 121973880000 **7 - 34N - 9E**

GEI Consultants

Geotechnical
Environmental and
Water Resources
Engineering

Subsurface Investigation Report

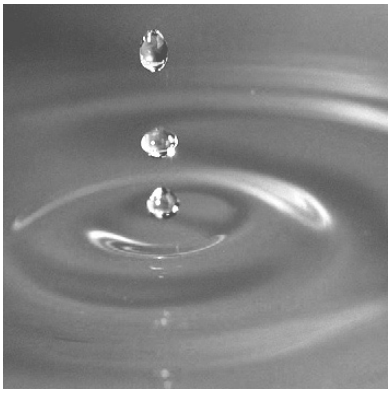
DuPage River Flood Risk Management
Lisle, Illinois

W912P6-14-D-0002, Delivery Order W912P618F0008

Submitted to:
Mr. Dan Ferris
U.S. Army Corps of Engineers
Geotechnical Branch (Attn: CELRC-TS-D-G)
231 S. LaSalle Street, Suite 1500
Chicago, Illinois 60604

Submitted by:
GEI Consultants of Michigan, P.C.
230 N. Washington Square
Lansing, Michigan 48933
(517) 803-2836

November 1, 2018



GEI Project No. 1803673

Jamie S. Matus, CPG
Senior Consultant

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- Figure 2 – As Drilled Boring Locations
- Figure 3 – Soil Profile

B. Tables
- Table 1 – Boring Location, Elevation, and Depth Summary
- Table 2 – Summary of the Laboratory Testing Program

C. Boring Logs
D. GEI Standard Attachments
E. Laboratory Test Results
F. In-Situ Permeability Test Results
G. Photo Log

1. Authorization and Project Background

This report summarizes the results of the Geotechnical Investigation for the DuPage River Flood Risk Management Project Subsurface Investigation Scope of Work (USACE Delivery Order W912P618F0008, dated July 10, 2018, and prepared by the US Army Corps of Engineers (USACE), Chicago District. GEI Consultants, Inc. (GEI) was contracted by Strata Earth Services (Strata) to provide field oversight, logging of the soil borings and to prepare this summary report. Strata holds IDIQ contract No. W912P6-14-D-0002 with the USACE Chicago and Detroit Districts to provide geotechnical services. An Accident Prevention Plan and Quality Control Plan was prepared by Strata for dated September 4, 2018.

2. Project Location and Site Conditions

The project site is located south of IL-88 and west of Route 53, by DuPage River in Lisle, Illinois. Sampling was conducted along the DuPage River. The project area consists of a residential subdivision. Figure 1 in Appendix A illustrates the location of the project site.

The borings were completed along DuPage River, which consists of residential homes with manicured lawns. According to the USACE, the area has experienced flooding. Five (5) borings were advanced at the locations shown on Figure 2 in Appendix A.

3. Scope of Work

Strata/GEI's services were completed in general accordance with the DuPage River Flood Risk Management Project Subsurface Investigation Scope of Work (USACE Contract No. W912P6-14-D-0002, July 10, 2018). The Scope of Work (SOW) included, but was not limited to, the following tasks:

- Preparation of a Quality Control Plan (QCP) and Accident Prevention Plan (APP) and submitted for review and approval by USACE.
- Coordinate site access and utility clearance with USACE representatives.
- Established soil boring location as specified by USACE.
- Mobilize drilling equipment and personnel to complete 5 soil borings to top of rock, expected at about 18 feet below surface grade, plus two rock cores at two boring locations.
- Drill borings at the proposed location to recover soil samples for analysis and testing. Prepare a field boring log for the borehole on ENG FORM 1836 at the time of drilling with all pertinent data included.
- Perform three (3) falling head in-situ falling head hydraulic conductivity tests.
- Visually inspect and classify the soil recovered from the borehole for USCS soil classification, color, water saturation, bearing strength (using a calibrated penetrometer), and other pertinent information.
- Restore the drill site to "original condition" after drilling.
- Collect soil samples from the boring into sample jars for laboratory classification and testing.
- Prepare a final stratigraphic log of subsurface conditions encountered at the boring location.
- Perform laboratory testing on soil samples.
- Prepare a subsurface investigation report summarizing the field investigation, soil and rock conditions, the boring location, a final boring log, and laboratory test results.

4. Subsurface Exploration Procedures

4.1 Drilling Procedures

Drilling was conducted at the site on September 27th and 28th, and October 1st, 2018. Borings were completed using a truck-mounted drill rig. Drilling and sampling of the overburden soil was conducted in accordance with appropriate ASTM methods, including:

- ASTM D 1586, "Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils"
- ASTM D 2113, "Standard Practice for Rock Core Drilling and Sampling of Rock for Site Exploration"

Five (5) borings were advanced through the soil using temporary casing and a wash boring technique employing a tricone drilling bit and drilling fluids. Samples were obtained at 2.5-foot intervals. Upon completion of the borings and removal of the augers and casing, the boreholes were backfilled with soil cuttings and bentonite chips and the ground surface leveled to original grade.

4.2 Field Permeability Test

Three (3) falling head permeability tests were performed in field. Based on the results of the borings and depth of the granular layer, a new borehole was drilled adjacent to the existing boring to a depth of 10 feet, then a temporary 5-foot long, 2-inch schedule 40, 0.01 slot PVC pipe and a 5-foot PVC pipe was inserted in the borehole. The pipe then was filled with water and level of water versus time was measured. The results of the test are presented in the Appendix F of this report.

4.3 Boring Locations and Elevations

Surveyed coordinates for the final boring location were provided to Strata/GEI by the USACE. Survey coordinates were Illinois State Plane East NAD83, based on North American Datum 1983 (NAD83) for the horizontal location of the borings. Boring elevation data was also obtained and supplied by USACE using 1988 North American Vertical Datum (NAVD). Figure 2 in Appendix A illustrates the actual drilled ("as drilled") location of the boring, and Table 1 in Appendix B provides a summary of the surveyed locations.

4.4 Boring Log Procedures

An experienced engineer or geologist was present during drilling to inspect the recovered soil, and interpret the information obtained from the samples. Soil samples were examined

and logged following ASTM D 2488, "Standard Practice for Description and Identification of Soils", and ASTM D 5434-93, "Standard Guide for Field Logging of Subsurface Explorations of Soil and Rock." Soil was examined and classified for USCS soil classification, color, water saturation, bearing strength (using a calibrated penetrometer), and other pertinent information. Representative samples from each sampled interval were placed into glass jars for laboratory analysis. The rock core was observed and photographed and included on to photographic log in Appendix C.

A boring log was prepared on USACE ENG FORM 1836 at the time of drilling. Field data and laboratory classification of soil was placed into a formal boring log using the gINT program. The completed boring logs are contained in Appendix C. Field logs are also included.

Photographs documenting various aspects of the field work were also obtained by the GEI Field Engineer and are included in Appendix G.

4.5 Laboratory Testing Procedures

Soil samples recovered from the boring were submitted to the Terracon laboratory in Glendale Heights, Illinois for testing. Table 2 in Appendix B contains a summary of the laboratory testing program for the samples collected from this site.

GEI's standard drilling and laboratory procedures are contained in Appendix D.

5. Subsurface Conditions

The borings were generally completed at the base of the existing levee. The surface elevations at each boring ranged from elevation 662.3 ft to 666.8 ft. the near surface soils consisted of clayey topsoil extending to depths ranging from 3 to 4 feet below exiting grade and were underline by a dark gray to black organic clay with organic contents ranging from approximately 2 to 5.5 percent and extended to a maximum depth of 6.5 ft in Boring DR-18-04. Interbedded silty and sandy clay soils were encountered below the organic clays with occasional layers and lenses of sand. At depths ranging from 8.5 to 12.5 feet below exiting grade, a saturated granular layer consisting of sand and gravels with rock fragments was encountered to the assumed top of rock which was cored or noted by the drillers at depths ranging from 17.5 ft in Boring DR-18-03 to 21.5ft in Boring DR-18-04. It is important to note that the top of rock elevation in borings where rock coring was not completed are based on the drillers observations and drilling resistance. As a result, the actual top of rock elevation may vary from those noted on the boring logs.

We also prepared a soil profile using the results of the of borings which is included in Appendix A, Figure 3. The profile includes generalized soil descriptions between boring locations including the estimate top of rock and water levels encountered during drilling where recorded. The soil boring logs are included in Appendix C.

6. Soil Engineering Properties

Soil samples were delivered to the Terracon geotechnical laboratory in Glendale Heights, Illinois for testing of a variety of engineering properties. The testing results are summarized below, and copies of the laboratory reports are included in Appendix E. Table 2 in Appendix B contains a summary of the proposed laboratory testing program for the samples collected from this site. In addition, Page 2 and 3 of the Terracon Lab report in Appendix E includes a summary of all laboratory test completed for the project.

6.1 Soil Testing Results

6.1.1 Visual Classification

All samples collected from the soil borings were visual classified following ASTM D 2488, "Standard Practice for Description and Identification of Soils." These laboratory classifications have been included on the boring logs (Appendix C), and where appropriate have superseded the field classification of the soils.

6.1.2 Moisture Content

The moisture content of all soil samples collected from the soil borings determined following ASTM D 2216, "Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass." Moisture content as determined by laboratory analysis, and are contained on the lab data sheets contained in Appendix E. Moisture content ranged from a low of 6.4% for a sand to as high as 48.7% for cohesive soils. .

6.1.3 Atterberg Limits

Liquid and plastic limits were determined on 3 samples following ASTM D 4318, "Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils." A copy of the laboratory report for the limit testing is contained in Appendix E. Boring log descriptions were updated to recognize the laboratory test classifications, and the laboratory test results superseded the visual classifications, where appropriate. The table below summarizes the test results.

Atterberg Limits - ASTM D 4318						
Boring	**Sample No.**	**Depth (feet)**	**USCS**	**LL**	**PL**	**PI**
DR-18-01	S-5	11-12.5	CL	27	16	11
DR-18-03	S-4A	6.0-7.5	CL	41	16	25
DR-18-04	S-2	2.5-4.0	CL	54	23	31

6.1.4 Organic Content

Organic content was determined on 2 samples following ASTM D 2974, "Standard Test Methods for Moisture, Ash, and Organic Matter of Peat and Other Organic Soils." A copy of the laboratory report for the organic content is contained in Appendix E.

Organic Content - ASTM D 2974				
Boring	**Sample No.**	**Depth (feet)**	**USCS**	**Organic Content (%)**
DR-18-02	S-2	2.5-4.0	CL	5.36
DR-18-04	S-4	6.0-7.5	CL	1.73

6.1.5 Sieve and Hydrometer (Combined) Analysis

The particle size distribution was determined on 4 samples, following ASTM D 422, "Standard Test Method for Particle-Size Analysis of Soils." A copy of the laboratory report for the particle size testing is contained in Appendix E. A summary of the laboratory test results is contained in the table below.

Particle Size Analysis - ASTM D 422									
Boring	**Sample No.**	**Depth (feet)**	**%Gravel**		**%Sand**			**%Fines**	
			Coarse	**Fine**	**Coarse**	**Medium**	**Fine**	**Silt**	**Clay**
DR-18-01	S-3B	5.5-7.5	0	8.8	13.7	44	16.2	15.6	1.7
DR-18-02	S-8	16.0-17.5	39	19.3	11	10.6	4.3	12	3.8
DR-18-04	S-5	8.5-10.0	0	0	0.1	3.2	23.6	44.5	28.6
DR-18-05	S-7	13.5-15.0	35.5	17.8	10.7	14.8	7.3	11.6	2.3

6.1.6 Unconfined Compressive Strength

Unconfined compressive strength was determined on 5 samples, following ASTM D 2166, "Standard Test Method for Unconfined Compressive Strength of Cohesive Soil." A copy of the laboratory report for the Unconfined Compression testing is contained in Appendix E. A summary of the laboratory test results is contained in the table below.

Summary of Unconfined Compression Testing - ASTM D 2166					
Boring	**Sample No.**	**Depth (feet)**	**USCS**	**Unconfined Compressive Strength (tsf)**	**Undrained Shear Strength (tsf)**
DR-18-01	S-2 ST	3.5-5.5	OL	1.39	0.69
DR-18-02	S-3 ST	4.0-6.0	CL	2.19	1.09
DR-18-03	S-3 ST	4.0-6.0	OL	1.26	0.63
DR-18-04	S-3 ST	4.0-6.0	OL	2.15	1.08
DR-18-05	S-3 ST	4.0-6.0	OL	1.04	0.52

6.1.7 Dry Density

The dry density (unit weight) of the soil was determined using method ASTM D2937, "Standard Test Methods for Laboratory Determination of Density (Unit Weight) of Soil Specimens." A copy of the laboratory report for the Dry Density testing is contained in Appendix E. A summary of the laboratory test results is contained in the table below.

Summary of Dry Density Testing - ASTM D2937				
Boring	**Sample No.**	**Depth (feet)**	**USCS**	**Dry Density (pcf)**
DR-18-01	S-2 ST	3.5-5.5	OL	89.8
DR-18-02	S-3 ST	4.0-6.0	CL	97.9
DR-18-03	S-3 ST	4.0-6.0	OL	92.5
DR-18-04	S-3 ST	4.0-6.0	OL	96.4
DR-18-05	S-3 ST	4.0-6.0	OL	85.9

6.1.8 In-Situ Permeability

The calculations were performed based on ASTM D6391 "Standard Test Method for Field Measurement of Hydraulic Conductivity Using Borehole Infiltration", Method B.

Hydraulic conductivity - ASTM D 6391			
Boring	**Test Depth (feet)**	**USCS**	**K (m/s)**
DR-18-01	4-9	OL, CL, SM, SP-GM	4.81E-4
DR-18-03	4-9	OL, CL, SP	2.28E-5
DR-18-05	4-9	OL, CL, SP-GM	4.08E-4

7. Limitations

This report has been prepared in general accordance with generally accepted geotechnical engineering practices to aid in the evaluation of this site and to assist the owner or engineer in the design of this project. No other warranty, either expressed or implied, is made. The scope is limited to the specific project and location described herein, and our description of the project represents our understanding of the significant aspects relevant to the geotechnical characteristics.

The analysis and recommendations submitted in this report are based on data obtained from soil borings performed at locations indicated on the location diagram and from information discussed in this report. This report does not reflect any variations which may occur between borings. In the performance of subsurface explorations, specific information is obtained at specific locations at specific times. However, it is a well-known fact that variations in soil and rock conditions exist on most sites between boring locations, and that seasonal and annual fluctuations in groundwater levels will likely occur. The nature and extent of variations may not become evident until the course of construction. If variations then appear evident, it will be necessary for a re-evaluation of recommendations contained in this report after performing on-site observations during the construction period and noting characteristics of the variations.

Appendix A

Figures

- Figure 1 – Site Location
- Figure 2 – As Drilled Boring Location
- Figure 3 – Soil Profile

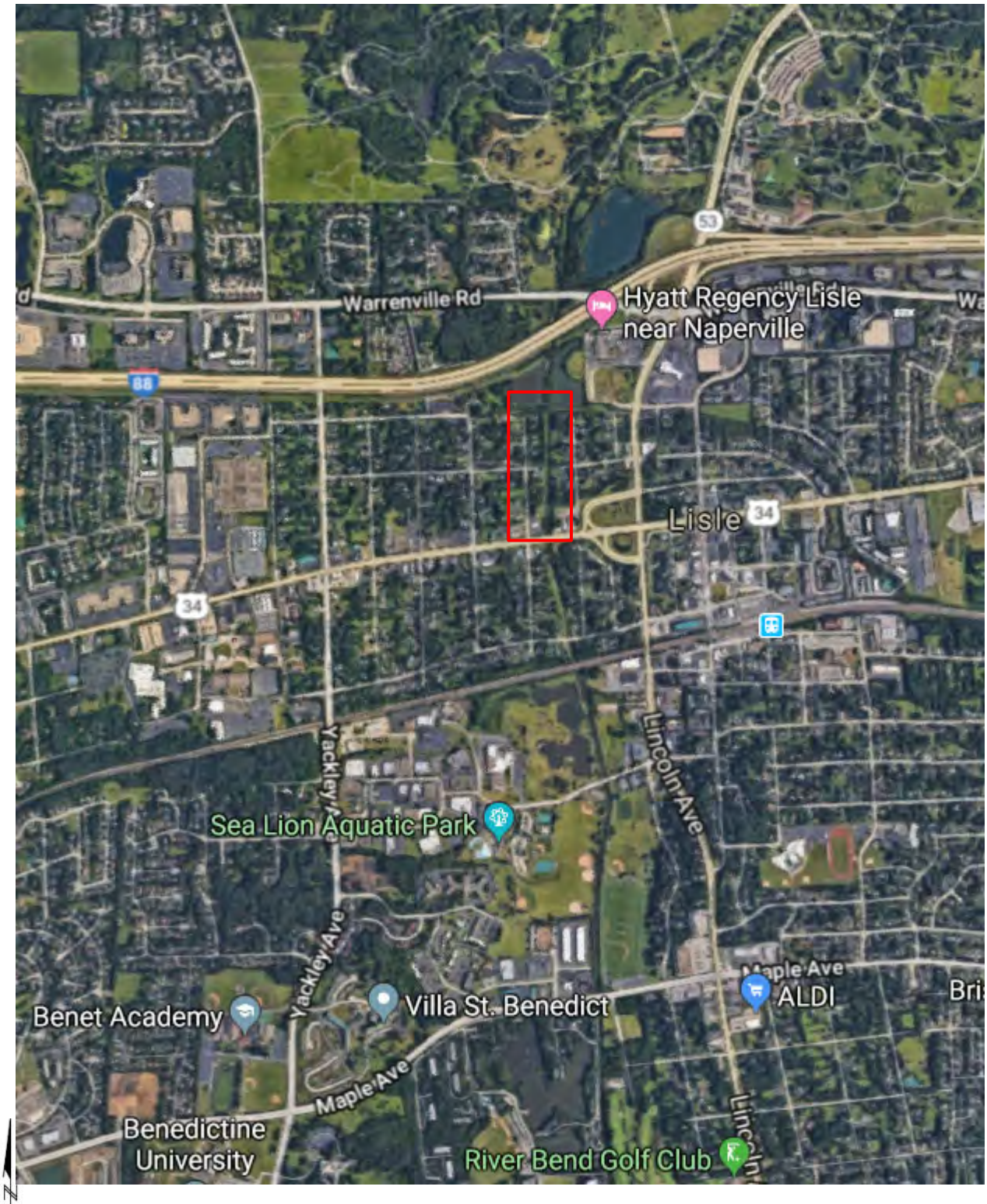


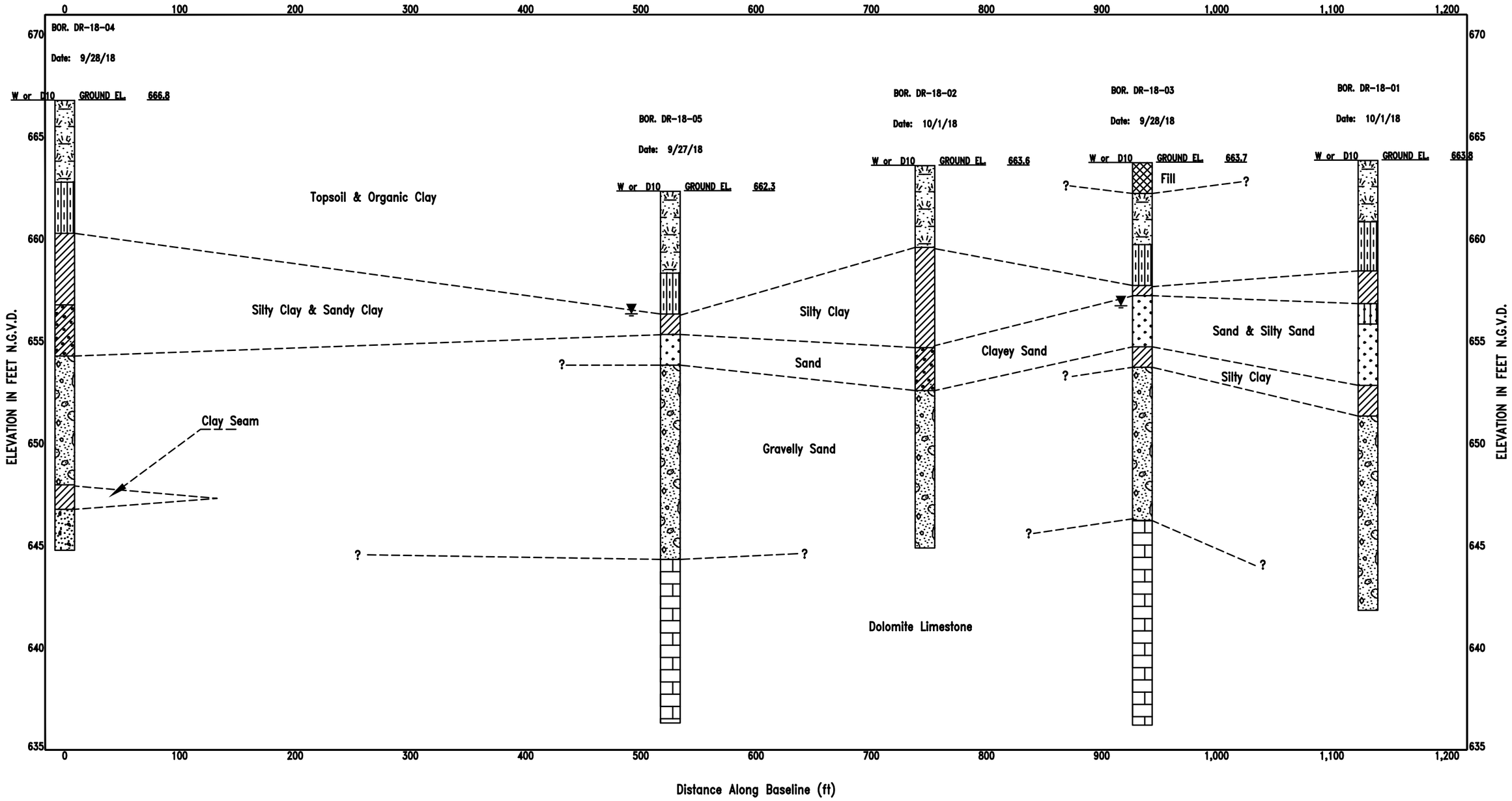
DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

DuPage River Flood Risk Management **Lisle, Illinois**	GEI Consultants	**SITE LOCATION DIAGRAM**	Fig.
Strata Earth Services / Army Corps of Engineers	Project No. 1803673	October 2018	1

N

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

DuPage River Flood Risk Management **Lisle, Illinois**	GEI Consultants	**BORING LOCATION DIAGRAM**	Fig.
Strata Earth Services / Army Corps of Engineers	Project No. 1803673	October 2018	2



Topsoil – Topsoil
OL – Organic Silt
CL – Lean Clay
SM – Silty Sand
SP – Sand, Poorly Graded
SPG – Poorly-graded Gravelly Sand
SC – Clayey Sand
FILL – Fill (made ground)
Limestone – Limestone
GP – Gravel, Poorly Graded

DuPage River Flood Risk Management Lisle, Illinois	GEI Consultants	Soil Profile
U.S. Army Corps of Engineer Chicago, Illinois	Project 1803673	October 2018 Fig. 3

---- C:\Ati Files\Ati Projects\Des Plaines River\gINT File\profile.dwg - 10/22/2018

Appendix B

Tables

- Table 1 – Boring Location, Elevation, and Depth Summary
- Table 2 – Summary of Laboratory Testing Results

TABLE 1

DuPage River Flood Risk Management Project

Boring Location, Elevation and Depth Summary

Boring Number	Drilled Coordinates[1]		Date Drilled	Total Depth Drilled (feet)	Depth to Groundwater (feet)[2]	Ground Surface Elevation[3]
	Northing	Easting				
DR-18-01	1871486	1052636	10/1/2018	22	Not encountered	663.827
DR-18-02	1871168	1052854	10/1/2018	18.66	Not encountered	663.575
DR-18-03	1871556	1053029	9/28/2018	27.5	7	663.714
DR-18-04	1870562	1053293	9/28/2018	21.16	Not encountered	666.765
DR-18-05	1871016	1053017	9/27/2018	26	6	662.318

1 = Projected Coordinate System NAD 1983 Illinois Plane Wisconsin East NAD83, US Survey Feet.

2 = N/E: not encountered before drilling fluid was introduced.

3 = Elevation of ground surface in 1988 North American Vertical Datum.

TABLE 2
Proposed and Actual Laboratory Testing Program
DuPage River Flood Risk Management Project

Test Description	Test Method	Number of Proposed Tests	Actual Number of Tests Performed	Remarks
Visual Classification	ASTM D2488	65	47	All samples
Moisture Content	ASTM D2216	65	47	All samples
Laboratory Hand Penetrometer		40	21	Cohesive samples
Organic Content	ASTM D2974	2	2	Selected samples
Atterberg Limits	ASTM D4318	3	3	Selected samples of cohesive material
Hydrometer (Combined) Analysis	ASTM D422	4	4	Selected samples of coarser material
Unconfined Compressive Strength	ASTM D2166	5	5	Selected undisturbed cohesive samples (3 point, 0.5x, 1x and 2x effective overburden weight)
Dry Density	ASTM 2937	5	5	Shelby Tube Samples

Appendix C

Boring Logs

DRILLING LOG

DIVISION	USACE
INSTALLATION	
SHEET	1 OF 2 SHEETS
1. PROJECT	DuPage River Flood Risk Management Study
2. LOCATION (Coordinates or Station)	State Plane N 1,871,486 E 1,052,636
3. DRILLING AGENCY	Strata Earth Services, LLC
4. HOLE NO. *(As shown on drawing title and file number)*	DR-18-01
5. NAME OF DRILLER	B. McCarthy
6. DIRECTION OF HOLE	☒ VERTICAL ☐ INCLINED --- DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN (FT.)	
8. DEPTH DRILLED INTO ROCK (FT.)	
9. TOTAL DEPTH OF HOLE (FT.)	22.0
10. SIZE AND TYPE OF BIT	4"
11. DATUM FOR ELEVATION SHOWN *(TBM or MSL)*	NAVD88
12. MANUFACTURER'S DESIGNATION OF DRILL	CME-75
13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN	DISTURBED: UNDISTURBED:
14. TOTAL NUMBER CORE BOXES	
15. ELEVATION GROUND WATER	
16. DATE HOLE	STARTED 10/1/2018 COMPLETED 10/1/2018
17. ELEVATION TOP OF HOLE	+663.8
18. TOTAL CORE RECOVERY FOR BORING	%
19. SIGNATURE OF INSPECTOR	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth weathering, etc., if significant) g
+663.8	0.0		Clayey Topsoil, dark brown and black, trace sand and gravel, very stiff (CL)			
	1			58.0	1 1.0 2.5	N: 2-4-4 WC=29.8% Qp=2 tsf
	2					
+660.8	3.0					
	3		Organic Clay, trace sand and gravel, black, stiff (OL)			
	4			54.0	2 3.5 5.5	Tube Sample WC=31.3% Qu=1.39 tsf Dry Density=89.8 pcf
	5					
+658.4	5.4					
	6		Sandy Clay, trace to with sand and gravel, brown, stiff (CL)	54.0	3 5.5 7.5	N: 2-2-4-4 WC=20.1% Qp=1 tsf Gravel=8.8% Sand=73.9% Silt=15.6% Clay=1.7%
+656.8	7.0					
	7		Silty Sand, gray (SM) WC=18.4%			
+655.8	8.0					
	8		Gravelly Sand, gray, moist to wet, loose (SP-GM)			
	9			28.0	4 8.5 10.0	N: 7-4-2 WC=16.3%
	10					
+652.8	11.0					
	11		Silty Clay, gray, stiff (CL)	83.3	5 11.0 12.5	N: 2-3-5 WC=23.9% Qp=1 tsf LL = 27 PL = 16 PI = 11
	12					
+651.3	12.5					
	13		Fine to Coarse Sand with gravel, limestone rock fragments noted, wet, very dense to dense (SP)			
	14			66.7	6 13.5 14.4	N: 35-50/4" WC=12.1%
	15					
	16			50.0	7 16.0 17.5	N: 14-13-30 WC=9.9%
	17					
	18					
	19			50.0	8 18.5 20.0	N: 8-11-9 WC=14.3%
			Driller's note: 100% water loss at about 19.5 ft			

DRILLING LOG (Cont Sheet)	ELEVATION TOP OF HOLE 663.8	Hole No. DR-18-01
PROJECT DuPage River Flood Risk Management Study	INSTALLATION	SHEET 2 OF 2 SHEETS

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% RECOV-ERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth weathering, etc., if significant) g
+643.1	20.8					
+641.8	21 22.0		Driller's Note: Top of Rock at about 20.75 feet			
	22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43		End of Boring Boring advanced to 8 feet with rock bit and drilling fluid HW casing driven to 10.0 feet Boring backfilled with cement bentonite grout **Water was not encountered before drilling fluid was introduced WC = Water Content Qp = Hand Penetrometer Qu = Unconfined Compressive Strength OC = Organic Content LL = Liquid Limit PL = Plastic Limit PI = Plastic Index			

DRILLING LOG

DIVISION	USACE
INSTALLATION	
SHEET	1 OF 2 SHEETS
1. PROJECT	DuPage River Flood Risk Management Study
2. LOCATION (Coordinates or Station)	State Plane N 1,871,168 E 1,052,854
3. DRILLING AGENCY	Strata Earth Services, LLC
4. HOLE NO. *(As shown on drawing title and file number)*	DR-18-02
5. NAME OF DRILLER	B. McCarthy
6. DIRECTION OF HOLE	☒ VERTICAL ☐ INCLINED --- DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN (FT.)	
8. DEPTH DRILLED INTO ROCK (FT.)	
9. TOTAL DEPTH OF HOLE (FT.)	18.7
10. SIZE AND TYPE OF BIT	4"
11. DATUM FOR ELEVATION SHOWN *(TBM or MSL)*	NAVD88
12. MANUFACTURER'S DESIGNATION OF DRILL	CME-75
13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN	DISTURBED: UNDISTURBED:
14. TOTAL NUMBER CORE BOXES	
15. ELEVATION GROUND WATER	
16. DATE HOLE	STARTED 10/1/2018 COMPLETED 10/1/2018
17. ELEVATION TOP OF HOLE	+663.6
18. TOTAL CORE RECOVERY FOR BORING	%
19. SIGNATURE OF INSPECTOR	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% RECOVERY e	BOX OR SAMPLE NO. f	REMARKS *(Drilling time, water loss, depth weathering, etc., if significant)* g
+663.6	0.0		Clayey Topsoil, dark brown and black, with sand and gravel, roots noted, very stiff (CL)	38.7	1 0.0 1.5	N:3-3-3 WC=30.3% Qp=3 tsf
	1					
	2					
	3			45.3	2 2.5 4.0	N: 3-3-5 WC=24% Qp=3.5 tsf OC=5.36%
+659.6	4.0		Silty Clay, trace sand, brown to gray, very stiff (CL)	50.0	3 4.0 6.0	Tube Sample WC=24.9% Qu=2.19 tsf Dry Density=97.7 pcf
	4					
	5					
+657.6	6.0		Sandy Clay, trace gravel, gray, very stiff (CL)	83.3	4 6.0 7.5	N: 2-1-1 WC=33.7% Qp=3.5 tsf
	6					
	7					
	8					
+654.7	8.9		Clayey Sand, with gravel, gray, moist to wet, loose (SC)	72.0	5 8.5 10.0	N: 4-4-7 WC=15.1%
	9					
	10					
+652.6	11.0		Gravelly Sand, gray, wet, very dense to extremely dense, rock fragments noted (SP-GM)	66.7	6 11.0 12.5	N: 20-25-20 WC=7.2%
	11					
	12					
	13			72.0	7 13.5 15.0	N: 30-30-18 WC=6.4%
	14					
	15					
	16			100.0	8 16.0 16.8	N: 28-50/3" WC=9.6% Gravel=58.3% Sand=25.9% Silt=12% Clay=3.8%
	17					
	18					
+644.9	18.7		Driller's Note: Top of Rock at about 18.6 feet	62.5	9 18.5 18.7	N: 50/2" WC=10.9%
	19		End of Boring Boring advanced to 8.5 feet with rock bit and drilling fluid HW casing driven to 10.0 feet			

DRILLING LOG (Cont Sheet)	ELEVATION TOP OF HOLE 663.6	Hole No. DR-18-02
PROJECT DuPage River Flood Risk Management Study	INSTALLATION	SHEET 2 OF 2 SHEETS

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% RECOV-ERY e	BOX OR SAMPLE NO. f	REMARKS *(Drilling time, water loss, depth weathering, etc., if significant)* g
			Boring backfilled with cement bentonite grout **Water was not encountered before drilling fluid was introduced WC = Water Content Qp = Hand Penetrometer Qu = Unconfined Compressive Strength OC = Organic Content LL = Liquid Limit PL = Plastic Limit PI = Plastic Index			
	21					
	22					
	23					
	24					
	25					
	26					
	27					
	28					
	29					
	30					
	31					
	32					
	33					
	34					
	35					
	36					
	37					
	38					
	39					
	40					
	41					
	42					
	43					

DRILLING LOG

DIVISION	USACE
INSTALLATION	
SHEET	1 OF 2 SHEETS
1. PROJECT	DuPage River Flood Risk Management Study
2. LOCATION (Coordinates or Station)	State Plane N 1,871,556 E 1,053,029
3. DRILLING AGENCY	Strata Earth Services, LLC
4. HOLE NO. *(As shown on drawing title and file number)*	DR-18-03
5. NAME OF DRILLER	B. McCarthy
6. DIRECTION OF HOLE	☒ VERTICAL ☐ INCLINED --- DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN (FT.)	
8. DEPTH DRILLED INTO ROCK (FT.)	
9. TOTAL DEPTH OF HOLE (FT.)	27.5
10. SIZE AND TYPE OF BIT	4"
11. DATUM FOR ELEVATION SHOWN *(TBM or MSL)*	NAVD88
12. MANUFACTURER'S DESIGNATION OF DRILL	CME-75
13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN	DISTURBED: UNDISTURBED:
14. TOTAL NUMBER CORE BOXES	
15. ELEVATION GROUND WATER	656.7
16. DATE HOLE	STARTED 9/28/2018 COMPLETED 9/28/2018
17. ELEVATION TOP OF HOLE	+663.7
18. TOTAL CORE RECOVERY FOR BORING	%
19. SIGNATURE OF INSPECTOR	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% RECOVERY e	BOX OR SAMPLE NO. f	REMARKS *(Drilling time, water loss, depth weathering, etc., if significant)* g
+663.7	0.0		Fill: Sandy Clay, trace gravel, brown and dark brown, hard	50.0	1 0.0 1.5	N:7-6-7 WC=11.2% Qp=4.5+ tsf
+662.2	1.5		Clayey Topsoil, trace sand and gravel, dark brown and black, very stiff (CL)			
				58.0	2 2.5 4.0	N: 4-6-6 WC=20.2% Qp=3.5 tsf
+659.7	4.0		Organic Clay, trace sand and gravel, brown sand seam noted, stiff (OL)	34.0	3 4.0 6.0	Tube Sample WC=34.7% Qu=1.26 tsf Dry Density=92.5 pcf
+657.7	6.0		Sandy Clay & Topsoil, brown and dark brown, soft (CL)	72.0	4 6.0 7.5	N: 3-4-7 WC=37.5% Qp=0.5 tsf LL = 41 PL = 16 PI = 25 WC=14%
+657.2	6.5		Sand, with gravel, gray and brown, wet, loose to medium dense (SP)			
+654.7	9.0			58.0	5 8.5 10.0	N: 7-4-2 WC=10.9% WC=21.5% QP=1 tsf
+653.7	10.0		Clay, trace sand and gravel, gray, stiff (CL)			
			Sand, Gravel and Rock fragments, gray, moist to wet, medium dense to extremely dense (SP-GM)	45.3	6 11.0 12.5	N: 11-11-12 WC=10.4%
				77.3	7 13.5 15.0	N: 26-26-49 WC=8%
				78.2	8 16.0 16.9	N: 23-50/2" WC=6.5%
+646.2	17.5		Gray Dolomite Limestone, fresh, medium hard REC: 98% RQD=83%	98.0	9 17.5 27.5	
			Driller's Note: 100% water loss at about 19.5 ft			

DRILLING LOG (Cont Sheet)	ELEVATION TOP OF HOLE 663.7	Hole No. DR-18-03
PROJECT DuPage River Flood Risk Management Study	INSTALLATION	SHEET 2 OF 2 SHEETS

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% RECOV-ERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth weathering, etc., if significant) g
			Gray Dolomite Limestone, fresh, medium hard REC: 98% RQD=83% *(continued)*			
	21					
	22					
	23					
	24					
	25					
	26					
	27					
+636.2	27.5					
	28		End of Boring Boring advanced to 8.5 feet with rock bit and drilling fluid HW casing driven to 15.0 feet Boring backfilled with cement bentonite grout WC = Water Content Qp = Hand Penetrometer Qu = Unconfined Compressive Strength OC = Organic Content LL = Liquid Limit PL = Plastic Limit PI = Plastic Index			
	29					
	30					
	31					
	32					
	33					
	34					
	35					
	36					
	37					
	38					
	39					
	40					
	41					
	42					
	43					

DR-18-03
17.5-27.5
DuPage River

DRILLING LOG

DIVISION	USACE
INSTALLATION	
SHEET	1 OF 2 SHEETS
1. PROJECT	DuPage River Flood Risk Management Study
2. LOCATION (Coordinates or Station)	State Plane N 1,870,562 E 1,053,293
3. DRILLING AGENCY	Strata Earth Services, LLC
4. HOLE NO. *(As shown on drawing title and file number)*	DR-18-04
5. NAME OF DRILLER	B. McCarthy
6. DIRECTION OF HOLE	☒ VERTICAL ☐ INCLINED --- DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN (FT.)	
8. DEPTH DRILLED INTO ROCK (FT.)	
9. TOTAL DEPTH OF HOLE (FT.)	21.2
10. SIZE AND TYPE OF BIT	4"
11. DATUM FOR ELEVATION SHOWN *(TBM or MSL)*	NAVD88
12. MANUFACTURER'S DESIGNATION OF DRILL	CME-75
13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN	DISTURBED: UNDISTURBED:
14. TOTAL NUMBER CORE BOXES	
15. ELEVATION GROUND WATER	
16. DATE HOLE	STARTED 9/28/2018 COMPLETED 9/28/2018
17. ELEVATION TOP OF HOLE	+666.8
18. TOTAL CORE RECOVERY FOR BORING	%
19. SIGNATURE OF INSPECTOR	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth weathering, etc., if significant) g
+666.8	0.0		Clayey Topsoil, trace sand and gravel, black and dark brown (CL)	16.7	1 0.0 1.5	N: 4-3-5 WC=25.8%
+664.3	2.5		Clayey Topsoil, teace sand and gravel, dark brown (CH)	10.7	2 2.5 4.0	N: 5-4-6 WC=19.5% LL = 54 PL = 23 PI = 31
+662.8	4.0		Organic Clay, trace sand and gravel, black, very stiff (OL)	50.0	3 4.0 6.0	Tube Sample WC=22.27% Qu=2.16 tsf Dry Density=96.4 pcf
+660.3	6.5		Silty Clay, trace sand and gravel, brown and dark brown, very stiff to stiff (CL)	38.7	4 6.0 7.5	N: 2-2-3 WC=25% Qp=2 tsf OC=1.73%
+657.8	9.0		Lean Clay, with sand, trace to with gravel, brown, stiff (CL)	77.3	5 8.5 10.0	N: 5-6-8 WC=25.7% Qp=1.75 tsf Gravel=0% Sand=26.9% Silt=44.5% Clay=28.6%
+656.8	10.0		Clayey Sand, with gravel, brown and gray, moist to wet, medium dense (SC)			
+654.3	12.5		Gravelly Sand, brown and gray, moist to wet, medium dense (SP-GM)	72.0	6 11.0 12.5	N: 6-12-6 WC=16.8%
			with rock fragments below about 15 ft.	45.3	7 13.5 15.0	N: 11-11-10 WC=9.6%
+648.3	18.5			52.0	8 16.0 17.5	N: 18-17-11 WC=11.7%
+648.0	18.8		3" sand and gravel at top of sample	72.0	9 18.5 20.0	N: 12-5-6 WC=24.53% Qp=2 tsf
+646.8	20.0		Silty Clay, trace sand and gravel, gray, very stiff (CL)			

DRILLING LOG (Cont Sheet)

ELEVATION TOP OF HOLE: 666.8

Hole No. DR-18-04

PROJECT: DuPage River Flood Risk Management Study

INSTALLATION:

SHEET 2 OF 2 SHEETS

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% RECOV-ERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth weathering, etc., if significant) g
			Driller's Note: Top of rock at 20 feet			
+645.7	21.1					
			End of Boring Boring advanced to 8.5 feet with rock bit and drilling fluid HW casing driven to 15.0 feet Boring backfilled with cement bentonite grout **Water was not encountered before drilling fluid was introduced WC = Water Content Qp = Hand Penetrometer Qu = Unconfined Compressive Strength OC = Organic Content LL = Liquid Limit PL = Plastic Limit PI = Plastic Index	100.0	10 21.0 21.2	N: 50/2" WC=11.8%

22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43

DRILLING LOG

DIVISION	USACE
INSTALLATION	
SHEET	1 OF 2 SHEETS
1. PROJECT	DuPage River Flood Risk Management Study
2. LOCATION (Coordinates or Station)	State Plane N 1,871,016 E 1,053,017
3. DRILLING AGENCY	Strata Earth Services, LLC
4. HOLE NO. *(As shown on drawing title and file number)*	DR-18-05
5. NAME OF DRILLER	B. McCarthy
6. DIRECTION OF HOLE	☒ VERTICAL ☐ INCLINED --- DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN (FT.)	
8. DEPTH DRILLED INTO ROCK (FT.)	
9. TOTAL DEPTH OF HOLE (FT.)	26.0
10. SIZE AND TYPE OF BIT	
11. DATUM FOR ELEVATION SHOWN *(TBM or MSL)*	NAVD88
12. MANUFACTURER'S DESIGNATION OF DRILL	
13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN	DISTURBED: UNDISTURBED:
14. TOTAL NUMBER CORE BOXES	
15. ELEVATION GROUND WATER	656.3
16. DATE HOLE	STARTED 9/27/2018 COMPLETED 9/27/2018
17. ELEVATION TOP OF HOLE	+662.3
18. TOTAL CORE RECOVERY FOR BORING	%
19. SIGNATURE OF INSPECTOR	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth weathering, etc., if significant) g
+662.3	0.0		Clayey Topsoil, trace sand, gravel and organics, black and dark brown, very stiff to stiff (CL)	50.0	1 0.0 1.5	N: 1-2-3 WC=27.9% Qp=3 tsf
	1					
	2					
	3			72.0	2 2.5 4.0	N: 2-3-3 WC=32.7% Qp=1.75 tsf
+658.3	4.0		Organic Clay, trace sand and gravel, black, stiff (OL) sand seams noted	50.0	3 4.0 6.0	Tube Sample WC=31.7% Qu=1.04 tsf Dry Density=85.9 pcf
	5					
+656.3	6.0		Sandy Clay, brown and gray, stiff (CL)	66.7	4 6.0 7.5	N: 3-5-6 WC=48.7% Qp=1 tsf
+655.3	7.0		Gravelly Sand, brown, wet, medium dense (SP-GM)			WC=17.6%
	8					
+653.8	8.5		Gravel and Gravelly Sand, trace to with silt, wet, very dense to extremely dense (SP-GM)	58.0	5 8.5 10.0	N: 28-31-32 WC=7.2%
	9					
	10					
	11			58.0	6 11.0 12.5	N:24-26-24 WC=8.4%
	12					
	13					
	14			66.7	7 13.5 15.0	N: 23-28-32 WC=8.7% Gravel=53.3% Sand=32.8% Silt=11.6% Clay=2.3%
	15					
	16			56.0	8 16.0 16.8	N: 35-50/3" WC=13.3%
	17		Driller's Observation: sand layer from 17 to 17.5 ft			
+644.3	18.0		Gray Dolomite Limestone, fresh, medium hard REC: 92% RQD=59%	92.0	9 18.0 26.0	
	19					

DRILLING LOG (Cont Sheet)	ELEVATION TOP OF HOLE 662.3	Hole No. DR-18-05
PROJECT DuPage River Flood Risk Management Study	INSTALLATION	SHEET 2 OF 2 SHEETS

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% RECOV-ERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth weathering, etc., if significant) g
			Gray Dolomite Limestone, fresh, medium hard REC: 92% RQD=59% *(continued)* Driller's Note: 100% water loss at about 20.5 ft			
+636.3	26.0		End of Boring Boring advanced to 8 feet with rock bit and drilling fluid HW casing driven to 15.0 feet Boring backfilled with cement bentonite grout WC = Water Content Qp = Hand Penetrometer Qu = Unconfined Compressive Strength OC = Organic Content LL = Liquid Limit PL = Plastic Limit PI = Plastic Index			

DR_18_05
18-26'

Appendix D

GEI Standard Attachments

SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS GRAPH	SYMBOLS LETTER	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	GRAVEL AND GRAVELLY SOILS MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
				GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
	SAND AND SANDY SOILS MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
				SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND - SILT MIXTURES
				SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

GEI Consultants

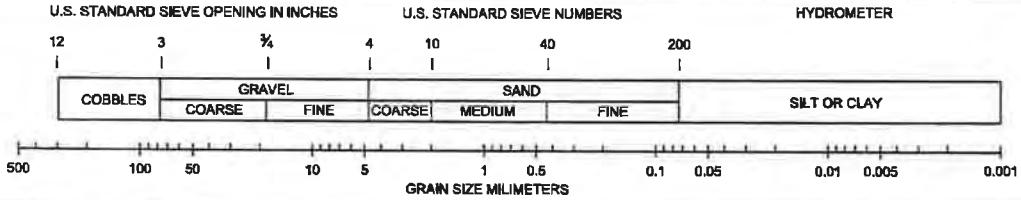
COARSE-GRAINED SOILS

VISUAL-MANUAL DESCRIPTIONS

TYPICAL SOIL COLORS

- YELLOW
- OLIVE
- LIGHT BROWN
- BROWN
- REDDISH BROWN
- RED
- GRAY
- BLACK

				GROUP SYMBOL		GROUP NAME
GRAVEL, % Gravel > % Sand	≤5% Fines	WIDELY GRADED		GW	<15% Sand	WIDELY GRADED GRAVEL
					≥15% Sand	WIDELY GRADED GRAVEL WITH SAND
		NARROWLY GRADED		GP	<15% Sand	NARROWLY GRADED GRAVEL
					≥15% Sand	NARROWLY GRADED GRAVEL WITH SAND
	~10% Fines	WIDELY GRADED	Fines = ML or MH	GW-GM	<15% Sand	WIDELY GRADED GRAVEL WITH SILT
					≥15% Sand	WIDELY GRADED GRAVEL WITH SILT AND SAND
			Fines = CL or CH	GW-GC	<15% Sand	WIDELY GRADED GRAVEL WITH CLAY
					≥15% Sand	WIDELY GRADED GRAVEL WITH CLAY AND SAND
		NARROWLY GRADED	Fines = ML or MH	GP-GM	<15% Sand	NARROWLY GRADED GRAVEL WITH SILT
					≥15% Sand	NARROWLY GRADED GRAVEL WITH SILT AND SAND
			Fines = CL or CH	GP-GC	<15% Sand	NARROWLY GRADED GRAVEL WITH CLAY
					≥15% Sand	NARROWLY GRADED GRAVEL WITH CLAY AND SAND
	≥15% Fines		Fines = ML or MH	GM	<15% Sand	SILTY GRAVEL
					≥15% Sand	SILTY GRAVEL WITH SAND
			Fines = CL or CH	GC	<15% Sand	CLAYEY GRAVEL
					≥15% Sand	CLAYEY GRAVEL WITH SAND
SOILS WITH <50% FINES						
SAND, % Sand ≥ % Gravel	≤5% Fines	WIDELY GRADED		SW	<15% Gravel	WIDELY GRADED SAND
					≥15% Gravel	WIDELY GRADED SAND WITH GRAVEL
		NARROWLY GRADED		SP	<15% Gravel	NARROWLY GRADED SAND
					≥15% Gravel	NARROWLY GRADED SAND WITH GRAVEL
	~10% Fines	WIDELY GRADED	Fines = ML or MH	SW-SM	<15% Gravel	WIDELY GRADED SAND WITH SILT
					≥15% Gravel	WIDELY GRADED SAND WITH SILT AND GRAVEL
			Fines = CL or CH	SW-SC	<15% Gravel	WIDELY GRADED SAND WITH CLAY
					≥15% Gravel	WIDELY GRADED SAND WITH CLAY AND GRAVEL
		NARROWLY GRADED	Fines = ML or MH	SP-SM	<15% Gravel	NARROWLY GRADED SAND WITH SILT
					≥15% Gravel	NARROWLY GRADED SAND WITH SILT AND GRAVEL
			Fines = CL or CH	SP-SC	<15% Gravel	NARROWLY GRADED SAND WITH CLAY
					≥15% Gravel	NARROWLY GRADED SAND WITH CLAY AND GRAVEL
	≥15% Fines		Fines = ML or MH	SM	<15% Gravel	SILTY SAND
					≥15% Gravel	SILTY SAND WITH GRAVEL
			Fines = CL or CH	SC	<15% Gravel	CLAYEY SAND
					≥15% Gravel	CLAYEY SAND WITH GRAVEL

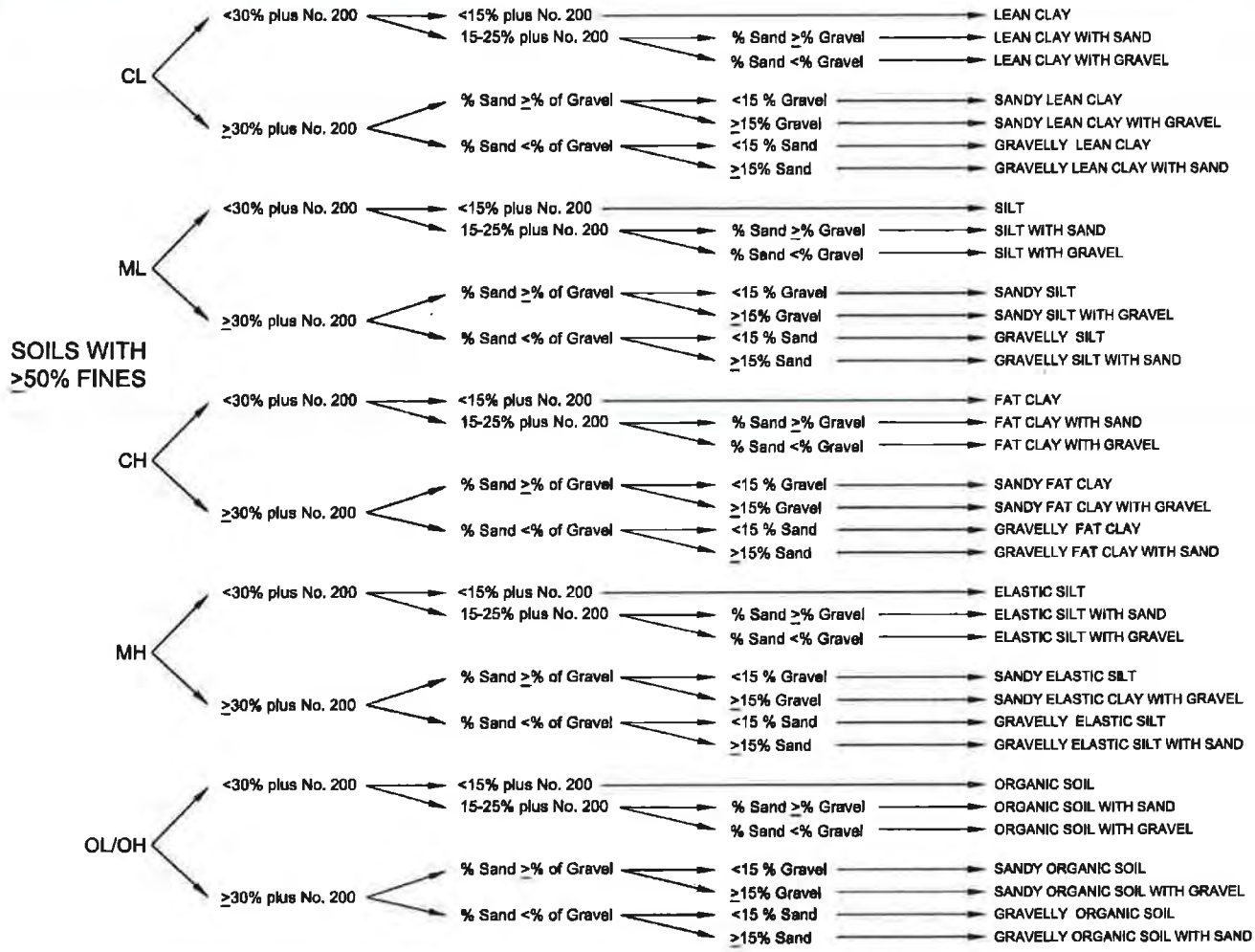


ROUNDED SUBROUNDED SUBANGULAR ANGULAR

1. GROUP NAME and (SYMBOL)
2. Structure , if any. (stratified layer thicknesses, lenses, varves, gradational changes)
3. Describe sand, gravel and fines components, with percentages, in order of predominance. Include max gravel size. For test pits give percent cobbles and boulders, by volume, and include max size.
4. Color
5. Sheen, odor, roots, ash, brick, cementation, reaction with HCL, etc.
6. "Fill," local name or geologic name, if known

GEI Consultants

FINE-GRAINED SOILS
VISUAL-MANUAL DESCRIPTIONS



ID OF INORGANIC FINE SOILS FROM MANUAL TESTS

Symbol	Name	Dry Strength	Dilatancy	Toughness*
ML	Silt	None to low	Slow to rapid	Low or thread cannot be formed
CL	Lean Clay	Medium to high	None to slow	Medium
MH	Elastic Silt	Low to medium	None to slow	Low to medium
CH	Fat Clay	High to very high	None	High

1. GROUP NAME and (SYMBOL)
2. Describe fines, sand, and gravel components, in order of predominance. Include plasticity of fines. Include percentages of sand and gravel.
3. Color
4. Sheen, odor, roots, ash, brick, cementation, torvane and penetrometer results, etc.
5. "Fill," local name or geologic name, if known

PEAT

Peat refers to a sample composed primarily of vegetable matter in varying stages of decomposition. The description should begin: PEAT (PT) and need not include percentages of sand, gravel or fines.

CRITERIA FOR DESCRIBING PLASTICITY

Description	Criteria
Nonplastic ML	A 1/8-in. (3 -mm) thread cannot be rolled at any water content
Low Plasticity ML, MH	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit *
Medium Plasticity MH, CL	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit
High Plasticity CH	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit

* Toughness refers to the strength of the thread near plastic limit. The lump refers to a lump of soil drier than the plastic, similar to dry strength.

GENERAL NOTES

Drilling and Sampling Symbols:

SS: Split-Spoon, 1 3/8-inch ID, 2-inch OD Unless otherwise noted
ST: Shelby Tube
PA: Power Auger
DB: Diamond Bit
AS: Auger Sample
JS: Jar Sample
VS: Vane Shear
WOH: Weight of Hammer
OS: Osterburg Sampler
HSA: Hollow Stem Auger
WS: Wash Sample
FT: Fish Tail
RB: Rock Bit
BS: Bulk Sample
PMT: Pressuremeter Test
GS: Giddings Sampler

Standard Penetration Test (STP) Value: Blows per foot of a 140-pound hammer falling 30 inches on a 2-inch OD split-spoon sampler, except where otherwise noted.

Water Level Measurement Symbols:

WL: Water Level
WS: While Sampling
WD: While Drilling
AB: After Boring
WCI: Wet Cave-in
DCI: Dry Cave-in
BCI: Before Casing Installation
BCR: Before Casing Removal
ACR: After Casing Removal

Water levels indicated on the boring logs are the levels measured in the boring at the time indicated. In permeable soils, the indicated elevations can be considered a reliable groundwater level. In impervious soils, the accurate determination of groundwater elevations may not be possible, even after several days of observations. In these cases, groundwater monitoring wells may need to be constructed and monitored for an extended period of time to determine the actual groundwater level.

Gradation Description and Terminology:

Coarse-grained or granular soils are defined as having more than 50% of their dry weight retained on the No. 200 sieve. Coarse grained soils include boulders, cobbles, gravel, and/or sand. Fine-grained soils are defined as having less than 50% of their dry weight retained on the No. 200 sieve. Fine grained soils include clay or clayey silt (cohesive), and silt (non-cohesive). In addition to gradation, granular soils are further defined based on their relative in-place density. Fine-grained soils are further defined based of their strength or consistency and plasticity. Additional information is provided below.

Major Component of Sample	Size Range	Other Components Present in Sample	Dry Weight, %
Boulders	Over 8 inches (200 mm)	Trace	1 to 5
Cobbles	8 inches to 3 inches (200 mm to 75 mm)	Trace to Some	5 to 12
Gravel	3 inches to No. 4 sieve	Some	12 to 34
Sand	Nos. 4 to 200 sieves (4.76 mm to 0.074 mm)	And	34 to 50
Silt	Passing No. 200 sieve (0.074 mm to 0.005 mm)		
Clay	Smaller than 0.005 mm		

Consistency of Cohesive Soils		Relative Density of Granular Soils	
Unconfined Compressive Strength, Qu, tsf	Consistency	N, blows per foot	Relative Density
<0.25	Very Soft	0 to 3	Very Loose
0.25 to 0.49	Soft	4 to 9	Loose
0.50 to 0.99	Medium (firm)	10 to 29	Medium Dense
1.0 to 1.99	Stiff	30 to 49	Dense
2.00 to 3.99	Very Stiff	50 – 80	Very Dense
4.00 to 8.00	Hard	>80	Extremely Dense
>8.00	Very Hard		

FIELD AND LABORATORY PROCEDURES

Field Sampling Procedures

Auger Sampling (AS)

In this procedure, soil samples are collected from cuttings off the auger flights as they are removed from the ground. Such samples provide a general indication of subsurface conditions; however, they do not provide undisturbed samples, nor do they provide samples from discrete depths.

Split-Barrel Sampling (SS) – (ASTM Standard D-1586-99)

In the split-barrel sampling procedures, a 2-inch O.D. split-barrel sampler is driven into the soil a distance of 18 inches by means of a 140-pound hammer falling 30 inches. The value of the Standard Penetration Resistance is obtained by counting the number of blows of the hammer over the final 12 inches of driving. The value provides a qualitative indication of the in-place relative density of cohesionless soils. The indication is only qualitative, however, since many factors can significantly affect the Standard Penetration Resistance Value, and direct correlation of results obtained by drill crews using different rigs, frilling procedures, and hammer-rod-spoon assemblies should not be made. A portion of the recovered sample is place in a sample jar and returned to the laboratory for further analysis and testing.

Shelby Tube Sampling Procedure (ST) - (ASTM D-1587-94)

In the Shelby tube sampling procedure, a thin-walled steel seamless tube with a sharp cutting edge is pushed hydraulically into the soil and a relatively undisturbed sample is obtained. This procedure is generally employed in cohesive soils. The tubes are identified, sealed, and carefully handled in the field to avoid excessive disturbance and are returned to the laboratory for extrusion and further analysis and testing.

Giddings Sampler (GS)

This type of sampling device consists of 5-foot sections of thin-wall tubing, which are capable of retrieving continuous columns of soil in 5-foot maximum increments. Because of a continuous slot in the sampling tubes, the sampler allows field determination of stratification boundaries and containerization of soil samples from any sampling depth within the 5-foot interval.

FIELD AND LABORATORY PROCEDURES

Subsurface Exploration Field Procedures

Hand-Auger Drilling (HA)

In this procedure, a sampling device is driven into the soil by repeated blows of a sledge hammer or a drop hammer. When the sampler is driven to the desired depth, the soil sample is retrieved. The hole is then advanced by manually turning the hand auger until the next sampling depth increment is reached. The hand auger drilling between sampling intervals also helps to clean and enlarge the borehole in preparation for obtaining the next sample.

Power Auger Drilling (PA)

In this type of drilling procedures, continuous flight augers are used to advance the boreholes. They are turned and hydraulically advanced by a truck, trainer, or track-mounted unit as site accessibility dictates. In auger drilling, casing and drilling mud are not required to maintain open boreholes.

Hollow-Stem Auger Drilling (HS)

In this drilling procedure, continuous flight augers (with open stems) are used to advance the boreholes. The open stem allows the sampling tool to be used without removing the augers from the borehole. Hollow-stem augers thus provide support to the sides of the borehole during the sampling operations.

Rotary Drilling (RD)

In employing rotary drilling methods, various cutting bits are used to advance the boreholes. In this process, surface casing and/or drilling fluids are used to maintain open boreholes.

Diamond Core Drilling (DB)

Diamond core drilling is used to sample cemented formations. In this procedure, a double tube (or triple tube) core barrel with a diamond bit cuts an annular space around a cylindrical prism of the material sampled. The sample is retrieved by a catcher just above the bit. Samples recovered by this procedure are placed in study containers in sequential order.

FIELD AND LABORATORY PROCEDURES

Laboratory Procedures

Water Content (Wc)

The water content of a soil is the ratio of the weight of water in a given soil mass to the weight of the dry soil. Water content is generally expressed as a percentage.

Hand Penetrometer (Qp)

In the hand penetrometer gtest, the unconfined compressive strength of a soil is determined to a maximum value of 4.5 tons per square foot (tsf) or 7.0 tsf, depending on the testing device utilized, by measuring the resistance of the soil sample to penetration by a small spring-calibrated cylinder. The hand penetrometer test has been carefully correlated with unconfined compressive strength tests and thereby provides a useful and a relative simple testing procedure in which soil strength can be quickly and easily estimated.

Unconfined Compression Tests (Qu)

In the unconfined compression strength test, an undisturbed prism of soil is loaded axially until failure or until 20% strain has been reached, whichever comes first.

Dry Density (γd)

The dry density is a measure of the amount of solids in a unit volume of soil. Use of this value is often made when measuring the degree of compaction of a soil.

Classification of Samples

In conjunction with the sample testing program, all soil samples are examined in our laboratory and visually classified on the basis of their texture and plasticity in general accordance with the Unified Soil Classification System. The soil descriptions on the boring logs are derived from this system, as well as the component gradation terminology, consistency of cohesive soils, and relative density of granular soils, as described on a separate sheet entitled General Notes. The estimated groups symbols, included in parentheses following the soil descriptions on the boring logs, are in general conformance with the Unified Soil Classification System (USCS).

FIELD AND LABORATORY PROCEDURES

Standard Boring Log Procedures

In the process of obtaining and testing samples and preparing this report, standard procedures are followed regarding field logs, laboratory data sheets, and samples.

Field logs are prepared during performance of the drilling and sampling operations and are intended to essentially portray field occurrences, sampling locations, and procedures.

Samples obtained in the field are frequently subjected to additional testing an re-classification in the laboratory by experienced Geotechnical Engineers; and therefore, differences between the field logs and the final logs may exist. The engineer preparing the report reviews the field logs, laboratory test data, and classifications and then, using judgement and experience in interpreting this data, may make further changes. It is common practice in the geotechnical engineering profession not to include field logs and laboratory data sheets in engineering reports, because they do not represent the engineer's final opinions as to appropriate descriptions for conditions encountered in the exploration and testing work. Results of laboratory tests are generally shown on the boring logs or are described in the text of the report, as appropriate.

Samples taken in the field, some of which are later subjected to laboratory tests, are retained in our laboratory for 60 days and then discarded, unless special disposition is requested by our client. Samples retained over a long period of time, even though in sealed jars, are subject to moisture loss, which changes the apparent strength of cohesive soil, generally increasing the strength from what was originally encountered in the field. Since they are then no longer representative of the moisture conditions initially encountered, observers of these samples need to recognize this factor.

Appendix E

Laboratory Test Results

October 16, 2018

Ms. Sara Knight
Strata Earth Services
530 W. Colfax Street
Palatine, IL 60067

RE: Laboratory Testing Program for the DuPage River Flood Risk Management Project – Terracon Project No. 11185025

Dear Ms. Knight,

We are pleased to submit our laboratory report pertaining to geotechnical laboratory testing of soil samples received in our testing facility and in reference to the DuPage River Flood Risk Management Project. As instructed, Terracon performed the following tests on selected samples:

- Particle Size Analysis of Soils – ASTM D 422
- Unconfined Strength of Cohesive Soils – ASTM D 2166
- Water Content of Soil and Rock – ASTM D 2216
- Visual Engineering Classification – ASTM D 2488
- Organic Content by Loss on Ignition – ASTM D 2974
- Liquid Limit, Plastic Limit and Plasticity Index of Soils – ASTM D 4318
- Estimate of Unconfined Strength by Penetrometer

Specific test assignments were provided to Terracon by GEI Consultants, Inc.

The test data included in this report, only represent the samples tested and may not reflect actual site materials and/or conditions. The scope of services provided by Terracon did not include interpretation of the laboratory test data, and therefore, we are not liable for any interpretation performed by others. If you wish us to provide you with this service, we would be happy to discuss this matter with you at your convenience. Any reproduction of this report must be done in its entirety.

We are pleased to have the opportunity to provide you with our testing services. Should you have any questions, or require additional assistance, please feel free to contact us at any time.

Sincerely,
Terracon Consultants. Inc.

William P. Quinn
Department Manager – Laboratory Services

Attachments:

LABORATORY TESTING SUMMARY

PROJECT NAME: DuPage River Risk Management Project PROJECT NUMBER: 11185025 CLIENT: STRATA Earth

Boring Number	Sample Number	Depth	Description	USCS	WC %	Qp (tsf)	Density (pcf)	Gravel %	Sand %	Silt %	Clay %	LL	PL	PI	Organic Content %	Unconfined (tsf)
DR-18-01	S-1	1.0'-2.5'	TOPSOIL: DARK GRAY LEAN CLAY TRACE SAND OCCASIONAL GRAVEL	CL	29.8	2.00										
DR-18-01	ST-2	3.5'-5.0'	BLACK ORGANIC CLAY TRACE SAND AND GRAVEL	OL	31.3	1.75	89.8									1.39
DR-18-01	S-3A	5.5'-7.5'	BROWN AND GRAY SANDY LEAN CLAY TRACE GRAVEL	CL	20.1	1.00										
DR-18-01	S-3B	5.5'-7.5'	GRAY SILTY SAND	SM	18.4			8.8	73.9	15.6	1.7					
DR-18-01	S-4	8.5'-10.0'	GRAY GRAVELLY POORLY GRADED SAND	SP	16.3											
DR-18-01	S-5	11.0'-12.5'	GRAY LEAN CLAY	CL	23.9	1.00						27	16	11		
DR-18-01	S-6	13.5'-15.0'	GRAY POORLY GRADED SAND WITH GRAVEL - ROCK FRAGMENTS NOTED	SP	12.1											
DR-18-01	S-7	16.0'-17.5'	GRAY AND LIGHT BROWN POORLY GRADED SAND WITH GRAVEL - ROCK FRAGMENTS NOTED	SP	9.9											
DR-18-01	S-8	18.5'-20.0'	GRAY POORLY GRADED SAND WITH GRAVEL - ROCK FRAGMENTS NOTED	SP	14.3											
DR-18-02	S-1	0.0'-1.5'	TOPSOIL/FILL: DARK BROWN LEAN CLAY TRACE SAND OCCASIONAL GRAVEL - ROOTS NOTED	CL	30.3	3.00										
DR-18-02	S-2	2.5'-4.0'	TOPSOIL/FILL: DARK BROWN LEAN CLAY TRACE SAND OCCASIONAL GRAVEL	CL	24.0	3.50									5.36	
DR-18-02	ST-3	4.0'-6.0'	BROWN MOTTLED GRAY CHANGING TO GRAY LEAN CLAY TRACE SAND	CL	24.9	3.75	97.7									2.19
DR-18-02	S-4	6.0'-7.5'	GRAY SANDY LEAN CLAY OCCASIONAL GRAVEL	CL	33.7	3.50										
DR-18-02	S-5	8.5'-10.0'	GRAY CLAYEY SAND WITH GRAVEL	SC	15.1											
DR-18-02	S-6	11.0'-12.5'	GRAY POORLY GRADED SAND WITH GRAVEL - ROCK FRAGMENTS NOTED	SP	7.2											
DR-18-02	S-7	13.5'-15.0'	GRAY POORLY GRADED SAND WITH GRAVEL - LIMESTONE FRAGMENTS NOTED	SP	6.4											
DR-18-02	S-8	16.0'-17.5'	GRAY SILTY GRAVEL WITH SAND	GM	9.6			58.3	25.9	12.0	3.8					
DR-18-02	S-9	18.5'-20.0'	GRAY GRAVELLY POORLY GRADED SAND - ROCK FRAGMENTS NOTED	SP	10.9											
DR-18-03	S-1	0.0'-1.5'	FILL: DARK BROWN SANDY LEAN CLAY OCCASIONAL GRAVEL - BRICK FRAGMENTS NOTED	CL	11.2	7.50										
DR-18-03	S-2	2.5'-4.0'	TOPSOIL: DARK GRAY LEAN CLAY TRACE SAND OCCASIONAL GRAVEL	CL	20.2	3.50										
DR-18-03	ST-3	4.0'-6.0'	BLACK ORGANIC CLAY TRACE SAND AND GRAVEL - BROWN SAND SEAMS NOTED	OL	34.7	1.25	92.5									1.26
DR-18-03	S-4A	6.0'-7.5'	DARK BROWN LEAN CLAY TRACE SAND OCCASIONAL GRAVEL	CL	37.5	0.50						41	16	25		
DR-18-03	S-4B	6.0'-7.5'	GRAYISH BROWN TO GRAY CLAYEY SAND TRACE GRAVEL OCCASIONAL SILT	SC	14.0											
DR-18-03	S-5A	8.5'-10.0'	GRAY POORLY GRADED SAND WITH GRAVEL	SP	10.9											
DR-18-03	S-5B	8.5'-10.0'	GRAY LEAN CLAY TRACE SAND	CL	21.5	1.00										
DR-18-03	S-6	11.0'-12.5'	GRAY POORLY GRADED SAND WITH GRAVEL	SP	10.4											
DR-18-03	S-7	13.5'-15.0'	GRAY GRAVELLY POORLY GRADED SAND	SP	8.0											
DR-18-03	S-8	16.0'-17.5'	GRAY GRAVELLY POORLY GRADED SAND	SP	6.5											

LABORATORY TESTING SUMMARY

PROJECT NAME: DuPage River Risk Management Project PROJECT NUMBER: 11185025 CLIENT: STRATA Earth

Boring Number	Sample Number	Depth	Description	USCS	WC %	Qp (tsf)	Density (pcf)	Gravel %	Sand %	Silt %	Clay %	LL	PL	PI	Organic Content %	Unconfined (tsf)
DR-18-04	S-1	0.0'-1.5'	TOPSOIL/FILL: DARK BROWN LEAN CLAY TRACE SAND - ROOTS NOTED	CL	25.8											
DR-18-04	S-2	2.5'-4.0'	TOPSOIL/FILL: DARK BROWN FAT CLAY TRACE SAND OCCASIONAL GRAVEL	CH	19.5							54	23	31		
DR-18-04	ST-3	4.0'-6.0'	BLACK ORGANIC CLAY TRACE SAND AND GRAVEL	OL	22.2	4.25	96.4									2.16
DR-18-04	S-4	6.0'-7.5'	DARK BROWN TO BROWN LEAN CLAY WITH SAND OCCASIONAL GRAVEL - SILT POCKETS NOTED	CL	25.0	2.00									1.73	
DR-18-04	S-5	8.5'-10.0'	BROWN TO GRAYISH BROWN LEAN CLAY WITH SAND - SILT POCKETS NOTED	CL	25.7	1.75		0.0	26.9	44.5	28.6					
DR-18-04	S-6	11.0'-12.5'	BROWN AND GRAY CLAYEY SAND WITH GRAVEL	SC	16.8											
DR-18-04	S-7	13.5'-15.0'	GRAY GRAVELLY POORLY GRADED SAND	SP	9.6											
DR-18-04	S-8	16.0'-17.5'	GRAY GRAVELLY POORLY GRADED SAND	SP	11.7											
DR-18-04	S-9	18.5'-20.0'	GRAY LEAN CLAY TRACE SAND	CL	24.5	2.00										
DR-18-04	S-10	21.0'-21.1'	GRAY POORLY GRADED SAND WITH GRAVEL	SP	11.8											
B-18-05	S-1	0.0'-1.5'	TOPSOIL: DARK GRAY AND BLACK LEAN CLAY TRACE SAND	CL	27.9	3.00										
B-18-05	S-2	2.5'-4.0'	TOPSOIL: DARK GRAY LEAN CLAY TRACE SAND	CL	32.7	1.75										
B-18-05	ST-3	4.0'-6.0'	BLACK ORGANIC CLAY TRACE SAND AND GRAVEL - SAND SEAMS NOTED	OL	31.7	1.25	85.9									1.04
B-18-05	S-4A	6.0'-7.5'	BROWN TO DARK BROWN SANDY LEAN CLAY OCCASIONAL GRAVEL	CL	48.7	1.00										
B-18-05	S-4B	6.0'-7.5'	BROWN TO GRAYISH BROWN GRAVELLY POORLY GRADED SAND	SP	17.6											
B-18-05	S-5	8.5'-10.0'	GRAY SILTY GRAVEL WITH SAND	GM	7.2											
B-18-05	S-6	11.0'-12.5'	GRAY GRAVELLY POORLY GRADED SAND - ROCK FRAGMENTS NOTED	SP	8.4											
B-18-05	S-7	13.5'-15.0'	GRAY GRAVELLY POORLY GRADED SAND - ROCK FRAGMENTS NOTED	SP	8.7			53.3	32.8	11.6	2.3					
B-18-05	S-8	16.0'-17.5'	GRAY GRAVELLY POORLY GRADED SAND - ROCK FRAGMENTS NOTED	SP	13.3											

Unconfined Strength of Cohesive Soils
– ASTM D 2166

UNCONFINED COMPRESSION TEST REPORT

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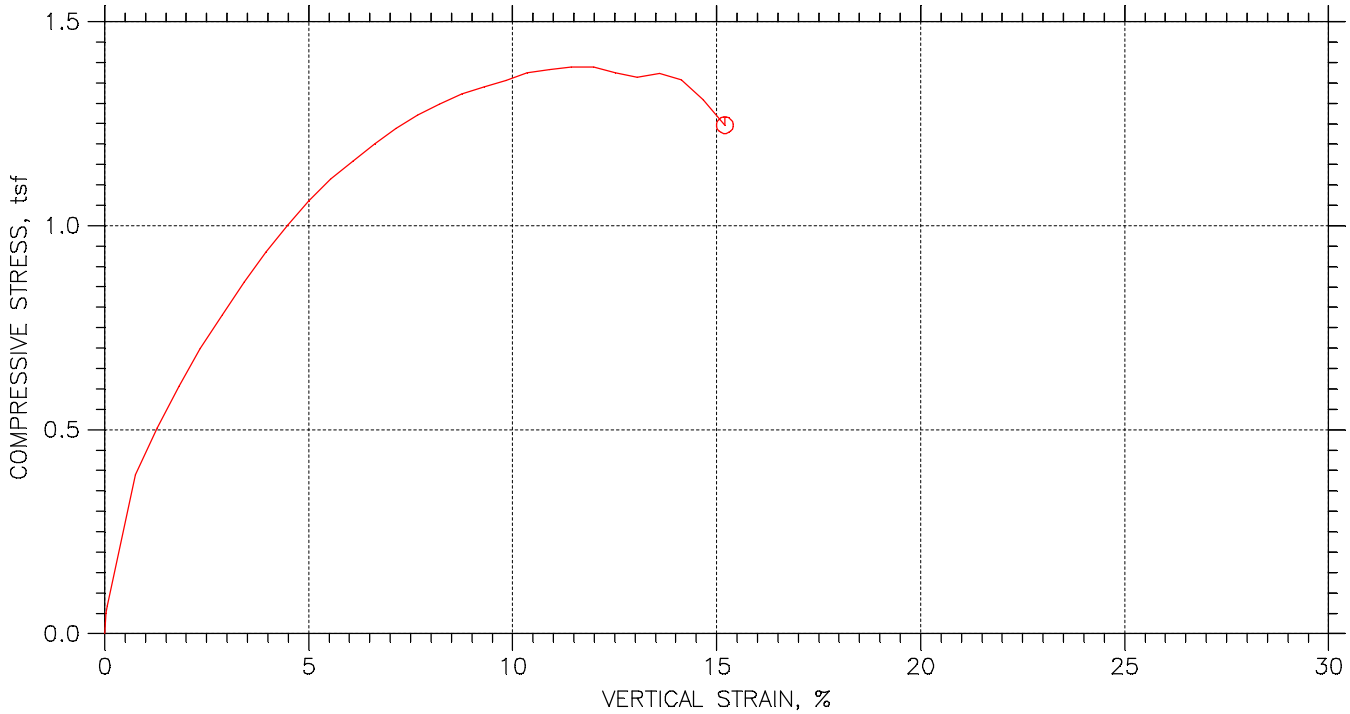
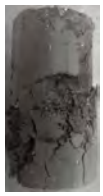


Symbol		⏲			
Test No.		DR18013-5			
Initial	Diameter, in	2.8698			
	Height, in	5.7602			
	Water Content, %	31.29			
	Dry Density, pcf	89.76			
	Saturation, %	97.06			
	Void Ratio	0.86403			
Unconfined Compressive Strength, tsf		1.3893			
Undrained Shear Strength, tsf		0.69465			
Time to Failure, min		13.501			
Strain Rate, %/min		1.52			
Estimated Specific Gravity		2.68			
Liquid Limit		---			
Plastic Limit		---			
Plasticity Index		---			
Failure Sketch					

Project: DUPAGE RIVER FLOOD RISK
Location: LISLE, IL
Project No.: 11185025
Boring No.: DR-18-01 ST-2 Depth 3.5'-5.0'
Sample Type: 3.0'' ST
Description: BLACK ORGANIC CLAY TRACE SAND TRACE GRAVEL OL Qp= 1.75 tsf
Remarks: TEST PERFORMED AS PER ASTM D 2166

Tue, 16-OCT-2018 13:54:24

UNCONFINED COMPRESSION TEST

Project: DUPAGE RIVER FLOOD RISK
Boring No.: DR-18-01
Sample No.: ST-2
Test No.: DR18013-5

Location: LISLE, IL
Tested By: WPQ
Test Date: 10/11/2018
Sample Type: 3.0" ST

Project No.: 11185025
Checked By: BCM
Depth: 3.5'-5.0'
Elevation: ----

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Soil Description: BLACK ORGANIC CLAY TRACE SAND TRACE GRAVEL OL Qp= 1.75 tsf
Remarks: TEST PERFORMED AS PER ASTM D 2166

Specimen Height: 5.76 in
Specimen Area: 6.47 in^2
Specimen Volume: 37.26 in^3

Liquid Limit: ---
Plastic Limit: ---
Estimated Specific Gravity: 2.68

Cap Mass: 0 gm

	Time min	Axial Displacement in	Axial Strain %	Load lb	Corrected Area in^2	Vertical Stress tsf	Shear Stress tsf
1	0	0	0	0	6.4684	0	0
2	0.25222	0.0019137	0.033222	4.6136	6.4705	0.051337	0.025669
3	0.50013	0.003923	0.068105	6.1062	6.4728	0.067923	0.033961
4	3.0009	0.043536	0.7558	35.281	6.5176	0.38974	0.19487
5	3.5009	0.07425	1.289	45.865	6.5528	0.50394	0.25197
6	4.0012	0.10487	1.8206	55.499	6.5883	0.60652	0.30326
7	4.5015	0.1351	2.3455	64.319	6.6237	0.69915	0.34958
8	5.0017	0.16591	2.8803	72.325	6.6602	0.78187	0.39093
9	5.502	0.19663	3.4136	80.195	6.697	0.86219	0.4311
10	6.0022	0.22744	3.9484	87.523	6.7343	0.93576	0.46788
11	6.5023	0.25815	4.4816	94.172	6.7718	1.0013	0.50063
12	7.0025	0.28868	5.0115	100.28	6.8096	1.0603	0.53013
13	7.5025	0.31929	5.5431	105.98	6.8479	1.1143	0.55713
14	8.0028	0.35049	6.0846	110.86	6.8874	1.1589	0.57947
15	8.5031	0.38111	6.6161	115.48	6.9266	1.2003	0.60017
16	9.0033	0.41163	7.146	119.82	6.9662	1.2384	0.6192
17	9.5036	0.44215	7.6759	123.75	7.0061	1.2718	0.63589
18	10.004	0.47287	8.2091	127.01	7.0468	1.2977	0.64885
19	10.504	0.50425	8.754	130.27	7.0889	1.3231	0.66154
20	11.004	0.53554	9.2972	132.71	7.1314	1.3399	0.66993
21	11.504	0.56625	9.8304	135.15	7.1735	1.3565	0.67825
22	12	0.59678	10.36	137.73	7.2159	1.3743	0.68713
23	12.5	0.62797	10.902	139.36	7.2598	1.3821	0.69105
24	13	0.65916	11.443	140.85	7.3042	1.3884	0.69421
25	13.501	0.69007	11.98	141.8	7.3487	1.3893	0.69465
26	14.001	0.72078	12.513	141.12	7.3935	1.3743	0.68714
27	14.501	0.75169	13.05	140.85	7.4391	1.3632	0.68161
28	15.001	0.78307	13.594	142.75	7.486	1.373	0.68648
29	15.501	0.81426	14.136	142.07	7.5333	1.3579	0.67893
30	16.002	0.84507	14.671	137.87	7.5805	1.3095	0.65473
31	16.502	0.8756	15.201	132.03	7.6278	1.2462	0.62312

UNCONFINED COMPRESSION TEST REPORT

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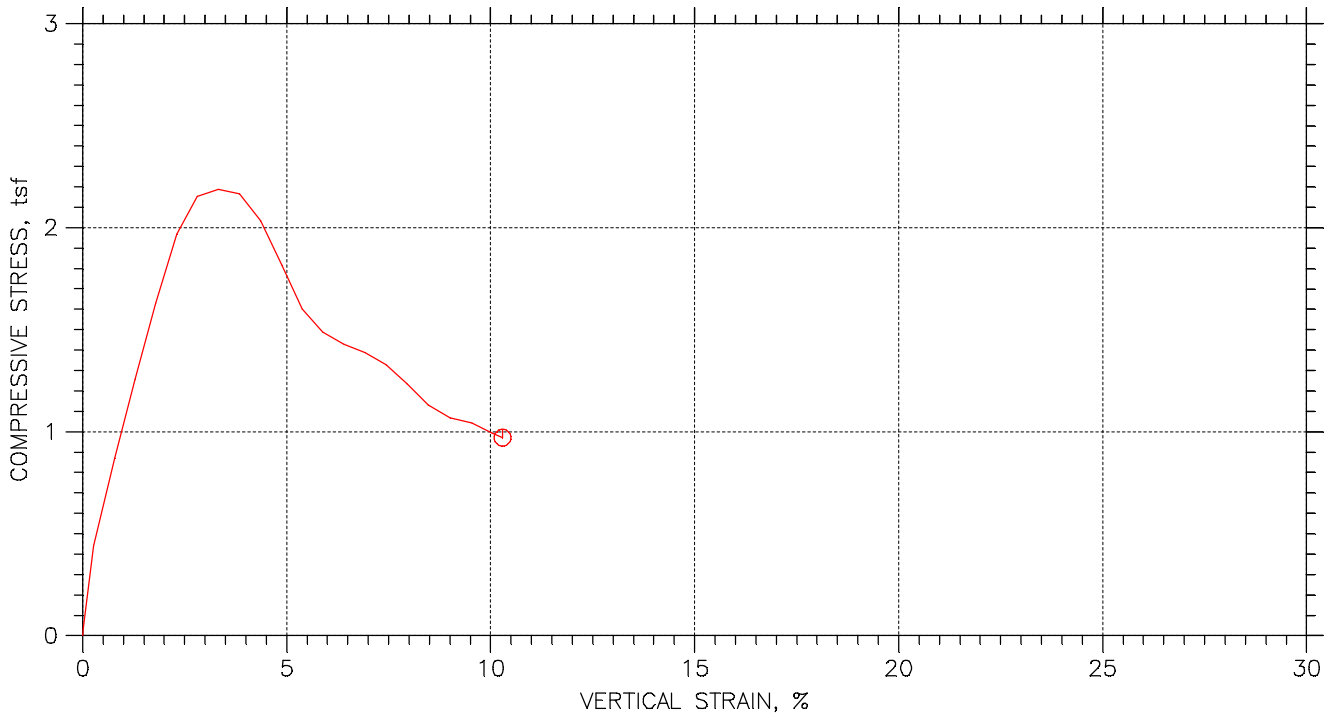

Symbol		⏲			
Test No.		DR18024-6			
Initial	Diameter, in	2.8609			
	Height, in	5.9598			
	Water Content, %	24.92			
	Dry Density, pcf	97.68			
	Saturation, %	92.74			
	Void Ratio	0.7255			
Unconfined Compressive Strength, tsf		2.1863			
Undrained Shear Strength, tsf		1.0931			
Time to Failure, min		5.5016			
Strain Rate, %/min		1.52			
Estimated Specific Gravity		2.70			
Liquid Limit		---			
Plastic Limit		---			
Plasticity Index		---			
Failure Sketch					

Project: DUPAGE RIVER FLOOD RISK
Location: LISLE, IL
Project No.: 11185025
Boring No.: DR-18-02 ST-3 Depth 4.0'-6.0'
Sample Type: 3.0" ST
Description: BROWN MOTTLED GRAY CHANGING TO GRAY CLAY TRACE SAND CL Qp= 3.75 tsf
Remarks: TEST PERFORMED AS PER ASTM D 2166

Tue, 16-OCT-2018 14:05:09

UNCONFINED COMPRESSION TEST

Project: DUPAGE RIVER FLOOD RISK
Boring No.: DR-18-02
Sample No.: ST-3
Test No.: DR18024-6

Location: LISLE, IL
Tested By: WPQ
Test Date: 10/11/2018
Sample Type: 3.0" ST

Project No.: 11185025
Checked By: BCM
Depth: 4.0'-6.0'
Elevation: ----

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Soil Description: BROWN MOTTLED GRAY CHANGING TO GRAY CLAY TRACE SAND CL Qp= 3.75 tsf
Remarks: TEST PERFORMED AS PER ASTM D 2166

Specimen Height: 5.96 in
Specimen Area: 6.43 in^2
Specimen Volume: 38.31 in^3

Liquid Limit: ---
Plastic Limit: ---
Estimated Specific Gravity: 2.70

Cap Mass: 0 gm

	Time min	Axial Displacement in	Axial Strain %	Load lb	Corrected Area in^2	Vertical Stress tsf	Shear Stress tsf
1	0	0	0	0	6.4283	0	0
2	0.50028	0.0014352	0.024082	3.3924	6.4299	0.037987	0.018993
3	2.5008	0.016266	0.27293	39.351	6.4459	0.43955	0.21977
4	3.0011	0.046406	0.77865	78.296	6.4788	0.87012	0.43506
5	3.5013	0.076546	1.2844	113.98	6.5119	1.2603	0.63013
6	4.0016	0.10678	1.7917	148.18	6.5456	1.6299	0.81496
7	4.5016	0.13711	2.3006	179.93	6.5797	1.9689	0.98447
8	5.0016	0.16783	2.816	197.71	6.6146	2.152	1.076
9	5.5016	0.19826	3.3265	201.91	6.6495	2.1863	1.0931
10	6.0019	0.22926	3.8467	201.23	6.6855	2.1672	1.0836
11	6.5021	0.26007	4.3636	189.97	6.7216	2.0349	1.0175
12	7.0024	0.29097	4.8822	170.7	6.7583	1.8186	0.9093
13	7.5027	0.32044	5.3767	151.16	6.7936	1.6021	0.80103
14	8.0029	0.35068	5.884	141.12	6.8302	1.4876	0.74381
15	8.5029	0.38139	6.3994	136.24	6.8678	1.4283	0.71413
16	9.0032	0.41239	6.9195	133.25	6.9062	1.3892	0.6946
17	9.5032	0.44311	7.4349	128.1	6.9446	1.3281	0.66403
18	10.003	0.47392	7.9519	119.82	6.9836	1.2353	0.61765
19	10.504	0.50511	8.4752	110.32	7.0236	1.1309	0.56545
20	11.004	0.53659	9.0034	104.76	7.0643	1.0677	0.53384
21	11.504	0.56807	9.5316	102.86	7.1056	1.0422	0.52111
22	12	0.59878	10.047	98.378	7.1463	0.99118	0.49559
23	12.235	0.61333	10.291	96.614	7.1657	0.97076	0.48538

UNCONFINED COMPRESSION TEST REPORT

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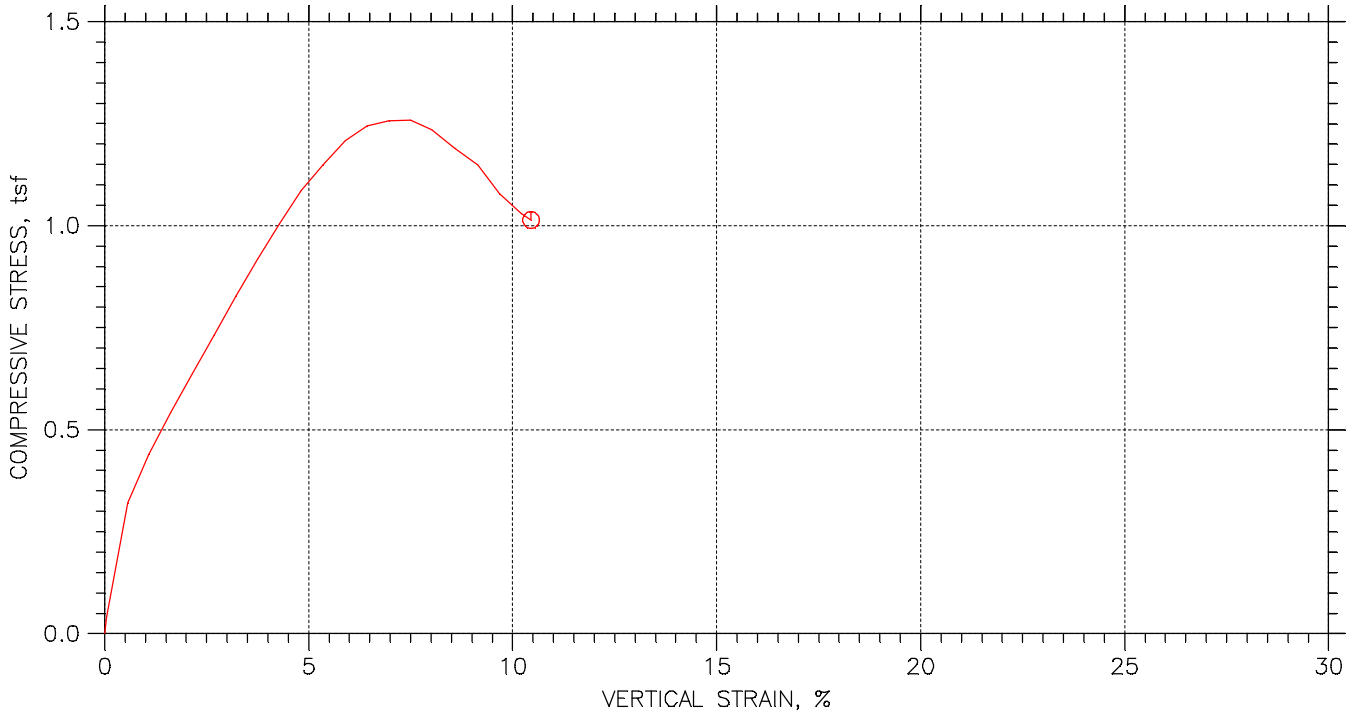

Symbol		⏲			
Test No.		DR18036-7.5			
Initial	Diameter, in	2.8609			
	Height, in	5.7736			
	Water Content, %	34.74			
	Dry Density, pcf	92.54			
	Saturation, %	115.22			
	Void Ratio	0.80802			
Unconfined Compressive Strength, tsf		1.2583			
Undrained Shear Strength, tsf		0.62916			
Time to Failure, min		9.5033			
Strain Rate, %/min		1.52			
Estimated Specific Gravity		2.68			
Liquid Limit		---			
Plastic Limit		---			
Plasticity Index		---			
Failure Sketch					

Project: DUPAGE RIVER FLOOD RISK
Location: LISLE, IL
Project No.: 11185025
Boring No.: DR-18-03 ST-3 Depth 6.0'-7.5'
Sample Type: 3.0" ST
Description: BLACK ORGANIC CLAY TRACE SAND TRACE GRAVEL OL BROWN SAND SEAMS NOTED Qp= 1.25 tsf
Remarks: TEST PERFORMED AS PER ASTM D 2166

Tue, 16-OCT-2018 14:06:46

UNCONFINED COMPRESSION TEST

Project: DUPAGE RIVER FLOOD RISK
Boring No.: DR-18-03
Sample No.: ST-3
Test No.: DR18036-7.5

Location: LISLE, IL
Tested By: WPQ
Test Date: 10/11/2018
Sample Type: 3.0" ST

Project No.: 11185025
Checked By: BCM
Depth: 6.0'-7.5'
Elevation: ----

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Soil Description: BLACK ORGANIC CLAY TRACE SAND TRACE GRAVEL OL BROWN SAND SEAMS NOTED Qp= 1.25 tsf
Remarks: TEST PERFORMED AS PER ASTM D 2166

Specimen Height: 5.77 in
Specimen Area: 6.43 in^2
Specimen Volume: 37.11 in^3

Liquid Limit: ---
Plastic Limit: ---
Estimated Specific Gravity: 2.68

Cap Mass: 0 gm

	Time min	Axial Displacement in	Axial Strain %	Load lb	Corrected Area in^2	Vertical Stress tsf	Shear Stress tsf
1	0	0	0	0	6.4283	0	0
2	0.25218	0.0024878	0.043088	3.6637	6.4311	0.041018	0.020509
3	3.0006	0.032341	0.56015	28.767	6.4645	0.3204	0.1602
4	3.5009	0.062768	1.0872	39.758	6.499	0.44047	0.22024
5	4.0011	0.093769	1.6241	49.121	6.5344	0.54125	0.27062
6	4.5012	0.12458	2.1577	58.213	6.5701	0.63794	0.31897
7	5.0014	0.15501	2.6847	67.169	6.6057	0.73212	0.36606
8	5.5014	0.18572	3.2167	76.26	6.642	0.82667	0.41334
9	6.0017	0.21672	3.7537	85.216	6.679	0.91863	0.45932
10	6.502	0.24753	4.2873	93.765	6.7163	1.0052	0.50259
11	7.0022	0.27834	4.8209	101.91	6.7539	1.0864	0.54319
12	7.5025	0.30915	5.3546	108.42	6.792	1.1493	0.57466
13	8.0027	0.34015	5.8915	114.66	6.8307	1.2086	0.6043
14	8.503	0.37125	6.4301	118.73	6.8701	1.2443	0.62217
15	9.003	0.40206	6.9637	120.63	6.9095	1.257	0.62852
16	9.5033	0.43268	7.4941	121.45	6.9491	1.2583	0.62916
17	10.004	0.4633	8.0244	119.95	6.9891	1.2357	0.61786
18	10.504	0.49526	8.5779	116.15	7.0315	1.1894	0.59469
19	11.004	0.52769	9.1397	112.9	7.0749	1.1489	0.57447
20	11.504	0.55869	9.6767	106.52	7.117	1.0776	0.53881
21	12	0.58922	10.205	102.45	7.1589	1.0304	0.51519
22	12.23	0.60338	10.451	101.09	7.1785	1.0139	0.50697

UNCONFINED COMPRESSION TEST REPORT

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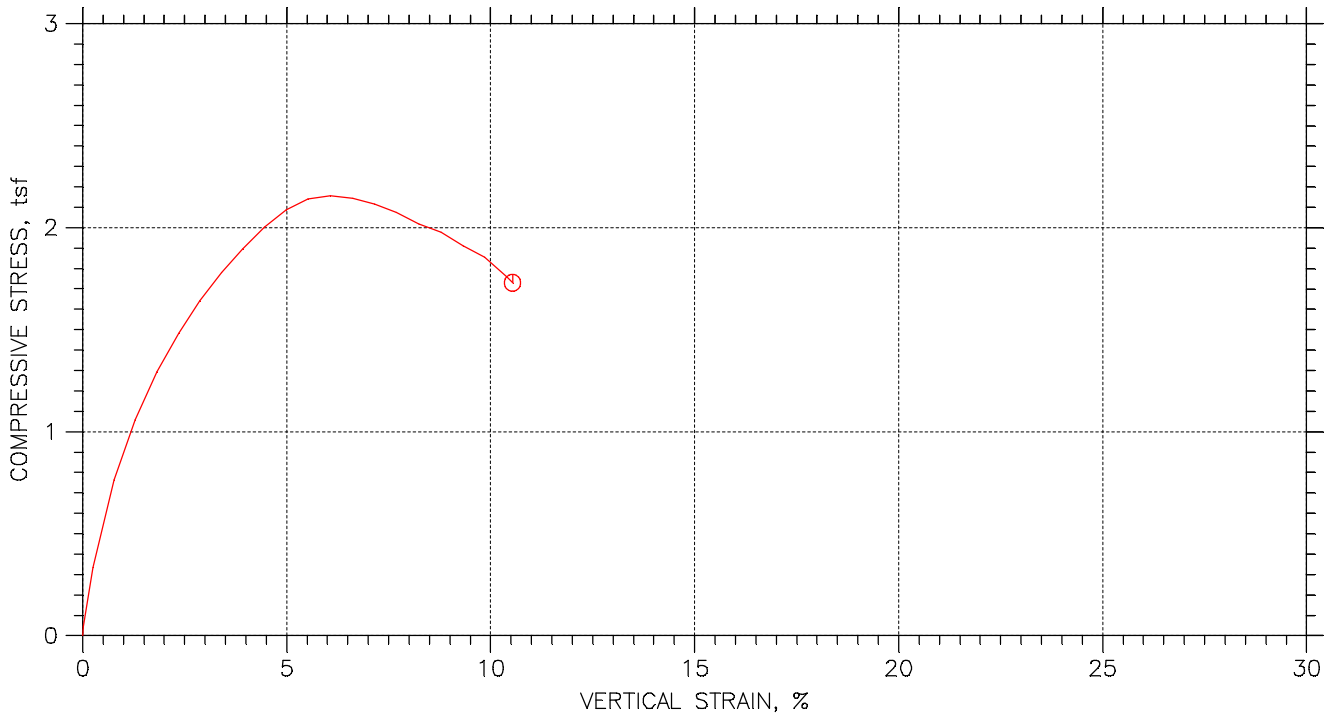

Symbol		⏲			
Test No.		DR18044-6			
Initial	Diameter, in	2.8617			
	Height, in	5.7406			
	Water Content, %	22.22			
	Dry Density, pcf	96.38			
	Saturation, %	80.52			
	Void Ratio	0.74233			
Unconfined Compressive Strength, tsf		2.1558			
Undrained Shear Strength, tsf		1.0779			
Time to Failure, min		8.0032			
Strain Rate, %/min		1.52			
Estimated Specific Gravity		2.69			
Liquid Limit		---			
Plastic Limit		---			
Plasticity Index		---			
Failure Sketch					

Project: DUPAGE RIVER FLOOD RISK
Location: LISLE, IL
Project No.: 11185025
Boring No.: DR-18-04 ST-3 Depth 4.0'-6.0'
Sample Type: 3.0'' ST
Description: BLACK ORGANIC CLAY TRACE SAND TRACE GRAVEL OL ROOTS NOTED Qp= 4.25 tsf
Remarks: TEST PERFORMED AS PER ASTM D 2166

Tue, 16-OCT-2018 14:13:23

UNCONFINED COMPRESSION TEST

Project: DUPAGE RIVER FLOOD RISK
Boring No.: DR-18-04
Sample No.: ST-3
Test No.: DR18044-6

Location: LISLE, IL
Tested By: WPQ
Test Date: 10/11/2018
Sample Type: 3.0" ST

Project No.: 11185025
Checked By: BCM
Depth: 4.0'-6.0'
Elevation: ----

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Soil Description: BLACK ORGANIC CLAY TRACE SAND TRACE GRAVEL OL ROOTS NOTED Qp= 4.25 tsf
Remarks: TEST PERFORMED AS PER ASTM D 2166

Specimen Height: 5.74 in
Specimen Area: 6.43 in^2
Specimen Volume: 36.92 in^3

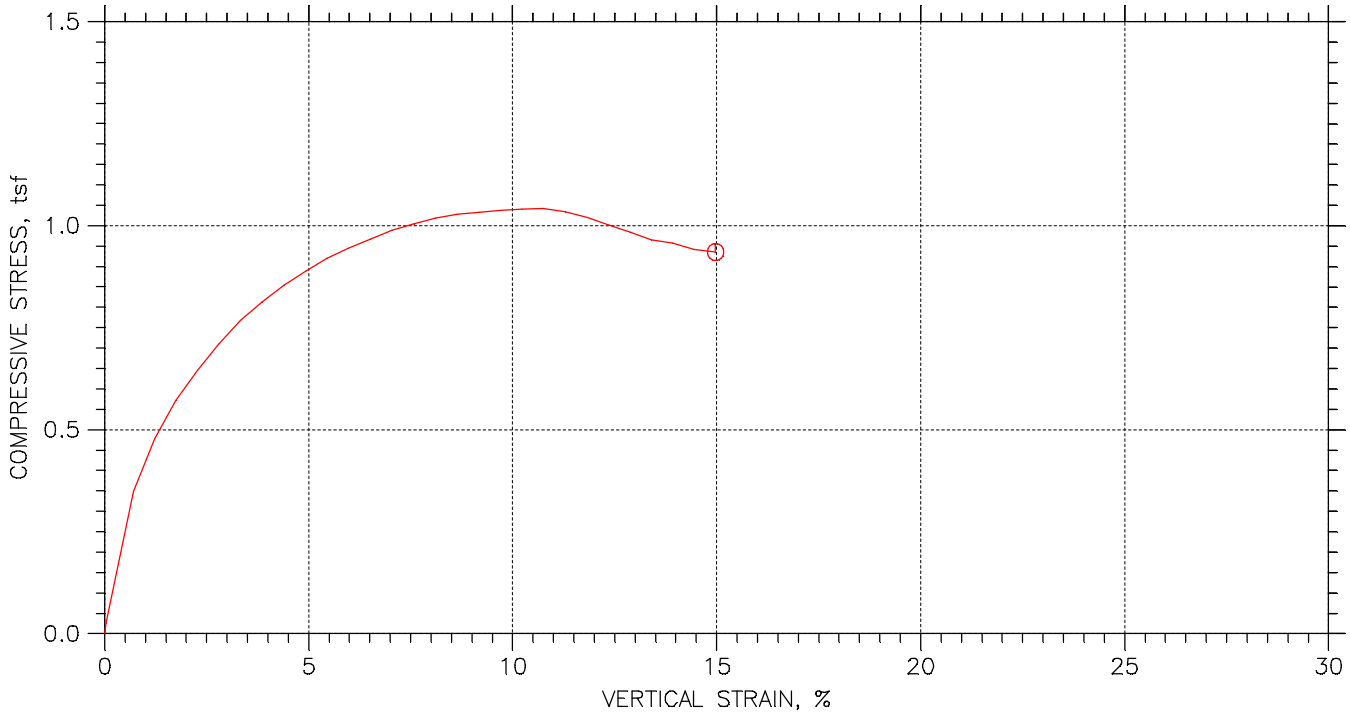
Liquid Limit: ---
Plastic Limit: ---
Estimated Specific Gravity: 2.69

Cap Mass: 0 gm

	Time min	Axial Displacement in	Axial Strain %	Load lb	Corrected Area in^2	Vertical Stress tsf	Shear Stress tsf
1	0	0	0	0	6.4319	0	0
2	1.0003	0.0005741	0.010001	4.0708	6.4325	0.045565	0.022783
3	2.501	0.014735	0.25669	29.988	6.4484	0.33484	0.16742
4	3.0013	0.04411	0.76839	68.797	6.4817	0.76422	0.38211
5	3.5016	0.07425	1.2934	95.8	6.5161	1.0585	0.52927
6	4.0016	0.10429	1.8168	117.78	6.5509	1.2945	0.64727
7	4.5018	0.13472	2.3468	135.56	6.5864	1.4819	0.74093
8	5.0021	0.16524	2.8786	151.16	6.6225	1.6435	0.82173
9	5.5021	0.19538	3.4036	164.6	6.6585	1.7798	0.88992
10	6.0024	0.22514	3.922	176.4	6.6944	1.8973	0.94863
11	6.5026	0.25557	4.452	187.26	6.7315	2.0029	1.0014
12	7.0029	0.28619	4.9854	196.35	6.7693	2.0884	1.0442
13	7.5032	0.31738	5.5287	202.46	6.8083	2.141	1.0705
14	8.0032	0.34876	6.0755	205.03	6.8479	2.1558	1.0779
15	8.5034	0.37977	6.6155	205.03	6.8875	2.1434	1.0717
16	9.0037	0.41038	7.1489	203.68	6.9271	2.117	1.0585
17	9.504	0.44167	7.6939	200.69	6.968	2.0738	1.0369
18	10.004	0.47296	8.239	196.49	7.0093	2.0183	1.0091
19	10.504	0.50406	8.7807	193.64	7.051	1.9773	0.98864
20	11.004	0.53477	9.3157	188.34	7.0926	1.912	0.95598
21	11.504	0.5653	9.8474	183.73	7.1344	1.8542	0.9271
22	12.004	0.59668	10.394	175.18	7.1779	1.7572	0.8786
23	12.137	0.60491	10.537	172.74	7.1894	1.7299	0.86496

UNCONFINED COMPRESSION TEST REPORT

Terracon
Consulting Engineers & Scientists



Symbol		⏲			
Test No.		DR18054-6			
Initial	Diameter, in	2.8514			
	Height, in	5.8232			
	Water Content, %	31.69			
	Dry Density, pcf	85.86			
	Saturation, %	89.17			
	Void Ratio	0.95595			
Unconfined Compressive Strength, tsf		1.0419			
Undrained Shear Strength, tsf		0.52095			
Time to Failure, min		12.5			
Strain Rate, %/min		1.52			
Estimated Specific Gravity		2.69			
Liquid Limit		---			
Plastic Limit		---			
Plasticity Index		---			
Failure Sketch					

Project: DUPAGE RIVER FLOOD RISK
Location: LISLE, IL
Project No.: 11185025
Boring No.: DR-18-05 ST-3 Depth 4.0'-6.0'
Sample Type: 3.0" ST
Description: BLACK ORGANIC CLAY TRACE SAND TRACE GRAVEL OL SAND SEAMS NOTED Qp= 1.25 tsf
Remarks: TEST PERFORMED AS PER ASTM D 2166

Tue, 16-OCT-2018 14:17:06

UNCONFINED COMPRESSION TEST

Project: DUPAGE RIVER FLOOD RISK
Boring No.: DR-18-05
Sample No.: ST-3
Test No.: DR18054-6

Location: LISLE, IL
Tested By: WPQ
Test Date: 10/11/2018
Sample Type: 3.0" ST

Project No.: 11185025
Checked By: BCM
Depth: 4.0'-6.0'
Elevation: ----

Terracon
Consulting Engineers & Scientists

Soil Description: BLACK ORGANIC CLAY TRACE SAND TRACE GRAVEL OL SAND SEAMS NOTED Qp= 1.25 tsf
Remarks: TEST PERFORMED AS PER ASTM D 2166

Specimen Height: 5.82 in
Specimen Area: 6.39 in^2
Specimen Volume: 37.19 in^3

Liquid Limit: ---
Plastic Limit: ---
Estimated Specific Gravity: 2.69

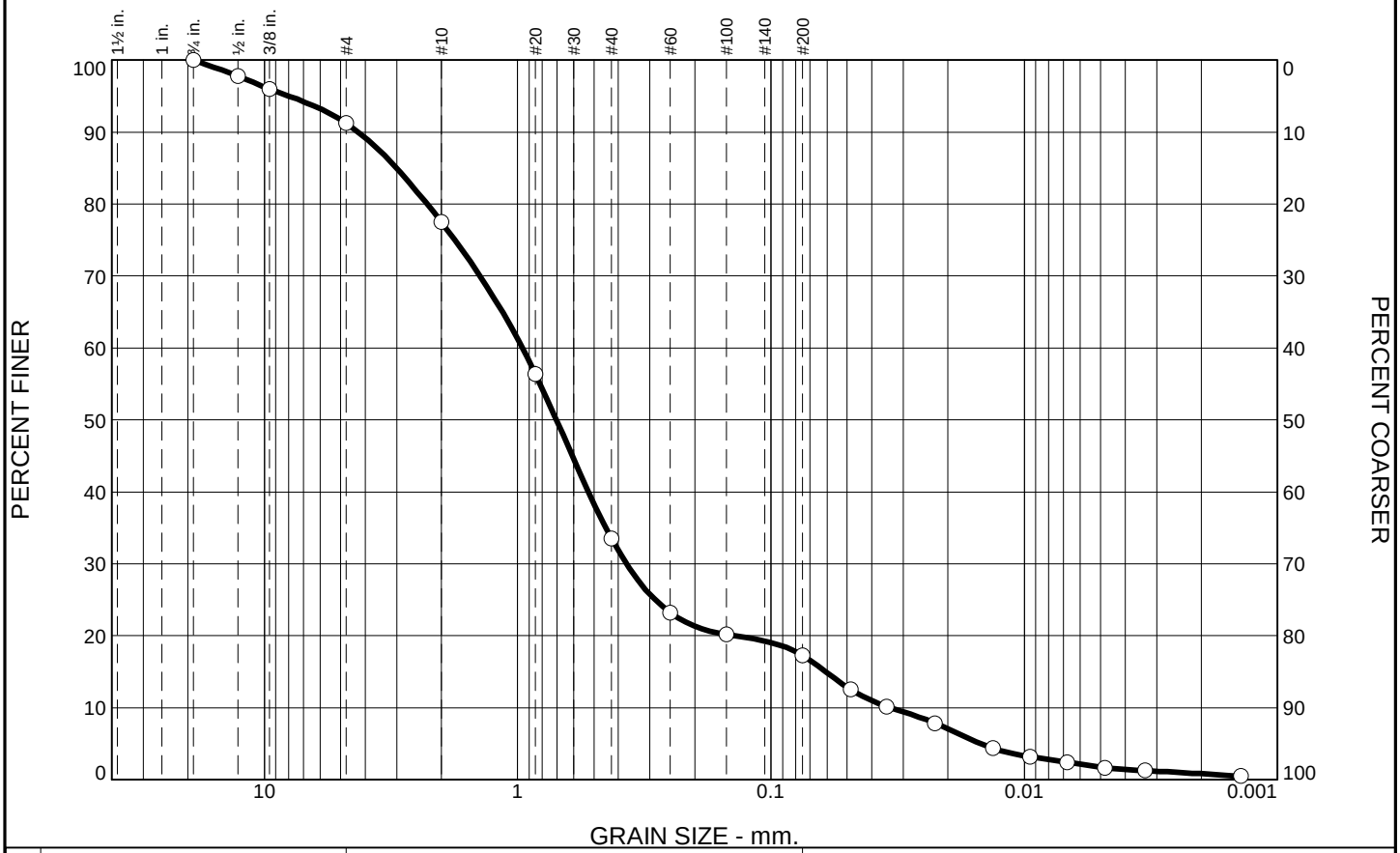
Cap Mass: 0 gm

	Time min	Axial Displacement in	Axial Strain %	Load lb	Corrected Area in^2	Vertical Stress tsf	Shear Stress tsf
1	0	0	0	0	6.3857	0	0
2	0.25235	0.0022007	0.037792	2.3068	6.3881	0.026	0.013
3	3.0005	0.040857	0.70162	31.21	6.4308	0.34943	0.17471
4	3.5008	0.071188	1.2225	42.879	6.4647	0.47756	0.23878
5	4.0011	0.1019	1.7499	51.564	6.4994	0.57122	0.28561
6	4.5013	0.13252	2.2757	58.62	6.5344	0.64591	0.32296
7	5.0013	0.16295	2.7982	64.726	6.5695	0.70938	0.35469
8	5.5016	0.19385	3.329	70.425	6.6056	0.76763	0.38381
9	6.0019	0.22495	3.863	75.039	6.6423	0.8134	0.4067
10	6.5021	0.25595	4.3954	79.245	6.6793	0.85424	0.42712
11	7.0021	0.28657	4.9212	82.909	6.7162	0.88881	0.44441
12	7.5024	0.31729	5.4486	86.302	6.7537	0.92005	0.46002
13	8.0027	0.34829	5.981	89.151	6.7919	0.94508	0.47254
14	8.5029	0.37938	6.515	91.729	6.8307	0.96688	0.48344
15	9.0032	0.41038	7.0474	94.308	6.8698	0.9884	0.4942
16	9.5035	0.44119	7.5765	96.343	6.9092	1.004	0.50199
17	10.004	0.472	8.1055	98.243	6.9489	1.0179	0.50896
18	10.504	0.5032	8.6412	99.735	6.9897	1.0274	0.51368
19	11.004	0.53429	9.1752	100.82	7.0308	1.0325	0.51624
20	11.5	0.56482	9.6994	101.91	7.0716	1.0376	0.51878
21	12	0.59534	10.224	102.86	7.1129	1.0412	0.52058
22	12.5	0.62596	10.749	103.53	7.1548	1.0419	0.52095
23	13	0.65725	11.287	103.4	7.1981	1.0343	0.51713
24	13.5	0.68882	11.829	102.58	7.2424	1.0198	0.50992
25	14	0.71982	12.361	101.36	7.2864	1.0016	0.50081
26	14.501	0.74977	12.876	100.14	7.3294	0.98374	0.49187
27	15.001	0.77991	13.393	98.921	7.3732	0.96598	0.48299
28	15.501	0.81053	13.919	98.65	7.4182	0.95748	0.47874
29	16.001	0.84153	14.451	97.564	7.4644	0.94108	0.47054
30	16.502	0.87186	14.972	97.564	7.5101	0.93535	0.46768

Terracon

Particle Size Analysis of Soils
– ASTM D 422

PARTICLE SIZE ANALYSIS OF SOILS ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	8.8	13.7	44.0	16.2	15.6	1.7

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.75	100.0		
.5	97.8		
.375	96.0		
#4	91.2		
#10	77.5		
#20	56.4		
#40	33.5		
#60	23.2		
#100	20.2		
#200	17.3		
0.0484 mm.	12.5		
0.0349 mm.	10.2		
0.0225 mm.	7.9		
0.0133 mm.	4.4		
0.0095 mm.	3.2		
0.0068 mm.	2.4		
0.0048 mm.	1.7		
0.0033 mm.	1.3		
0.0014 mm.	0.5		

* (no specification provided)

Soil Description

GRAY SILTY SAND

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 4.2522 D_{85}= 3.0056 D_{60}= 0.9577
D_{50}= 0.7026 D_{30}= 0.3711 D_{15}= 0.0607
D_{10}= 0.0337 C_u= 28.42 C_c= 4.27

Classification

USCS= SM AASHTO=

Remarks

F.M.=2.76

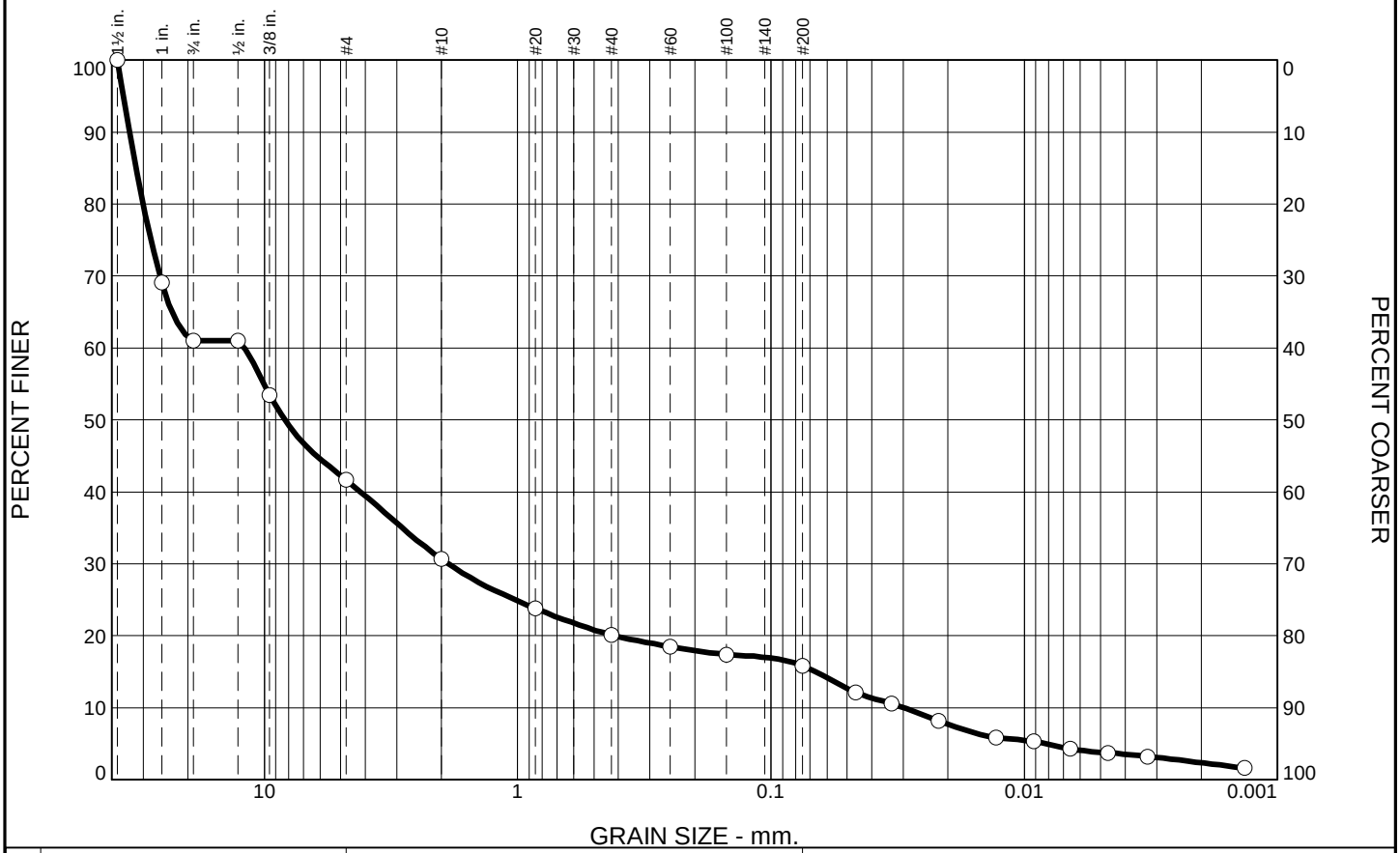
Source of Sample: B-18-01 **Depth:** 5.5'-7.5'
Sample Number: S-3B **Date:** 10-12-18

Terracon

Client: STRATA EARTH
Project: DUPAGE RIVER RISK MANAGMENT PROJECT
Project No: 11185025 **Figure**

Tested By: SJH **Checked By:** WPQ

PARTICLE SIZE ANALYSIS OF SOILS ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	39.0	19.3	11.0	10.6	4.3	12.0	3.8

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5	100.0		
1	69.1		
.75	61.0		
.5	61.0		
.375	53.5		
#4	41.7		
#10	30.7		
#20	23.8		
#40	20.1		
#60	18.5		
#100	17.4		
#200	15.8		
0.0462 mm.	12.1		
0.0334 mm.	10.6		
0.0217 mm.	8.2		
0.0129 mm.	5.8		
0.0092 mm.	5.3		
0.0066 mm.	4.3		
0.0047 mm.	3.7		
0.0033 mm.	3.2		
0.0014 mm.	1.6		

* (no specification provided)

Soil Description

GRAY SILTY GRAVEL WITH SAND

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 33.9819 D_{85}= 32.0114 D_{60}= 12.0015
D_{50}= 8.3061 D_{30}= 1.8793 D_{15}= 0.0665
D_{10}= 0.0298 C_u= 402.39 C_c= 9.87

Classification

USCS= GM AASHTO=

Remarks

F.M.=5.27

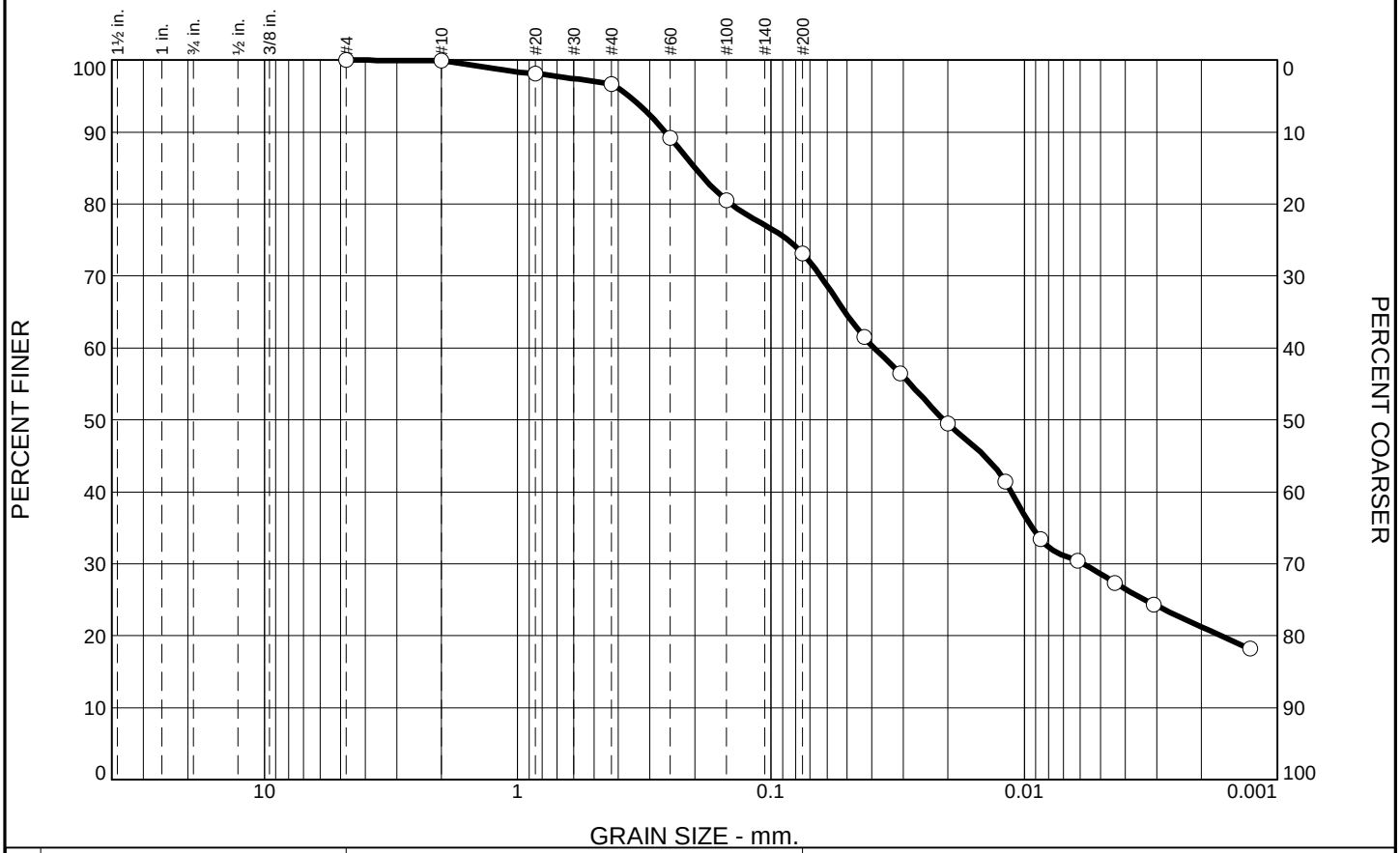
Source of Sample: B-18-02 **Depth:** 16.0'-17.5'
Sample Number: S-8 **Date:** 10-12-18

Terracon

Client: STRATA EARTH
Project: DUPAGE RIVER RISK MANAGMENT PROJECT
Project No: 11185025 **Figure**

Tested By: SJH **Checked By:** WPQ

PARTICLE SIZE ANALYSIS OF SOILS ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.1	3.2	23.6	44.5	28.6

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	99.9		
#20	98.2		
#40	96.7		
#60	89.2		
#100	80.5		
#200	73.1		
0.0428 mm.	61.5		
0.0309 mm.	56.5		
0.0200 mm.	49.5		
0.0119 mm.	41.4		
0.0086 mm.	33.4		
0.0062 mm.	30.4		
0.0044 mm.	27.4		
0.0031 mm.	24.4		
0.0013 mm.	18.2		

* (no specification provided)

Soil Description

BROWN TO GRAYSIH BROWN LEAN CLAY WITH SAND - SILT POCKETS NOTED

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.2616 D_{85}= 0.1990 D_{60}= 0.0392
D_{50}= 0.0208 D_{30}= 0.0058 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= CL AASHTO=

Remarks

F.M.=0.31

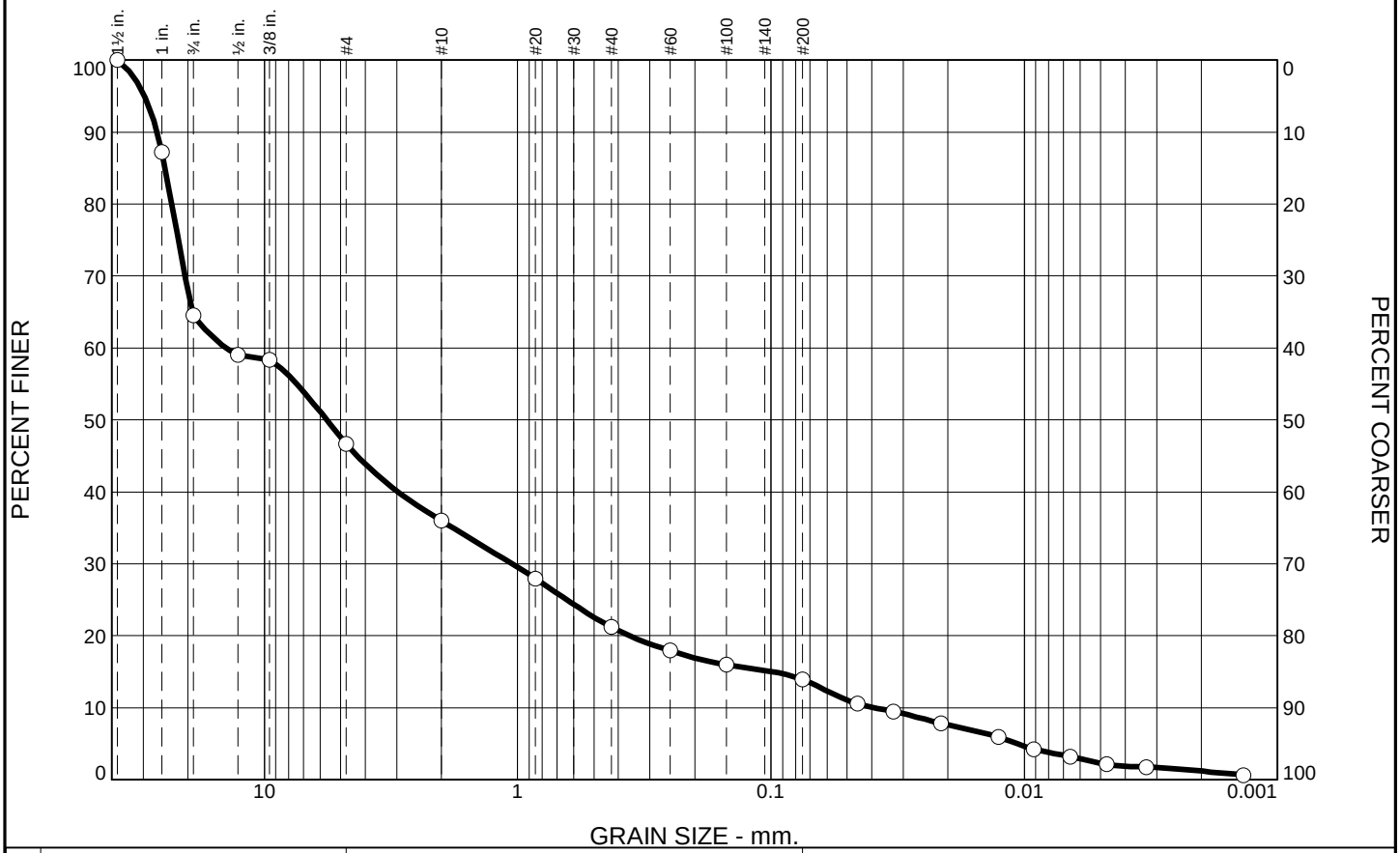
Source of Sample: B-18-04 **Depth:** 8.5'-10.0'
Sample Number: S-5 **Date:** 10-12-18

Terracon

Client: STRATA EARTH
Project: DUPAGE RIVER RISK MANAGMENT PROJECT
Project No: 11185025 **Figure**

Tested By: SJH **Checked By:** WPQ

PARTICLE SIZE ANALYSIS OF SOILS ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	35.5	17.8	10.7	14.8	7.3	11.6	2.3

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5	100.0		
1	87.2		
.75	64.5		
.5	59.0		
.375	58.3		
#4	46.7		
#10	36.0		
#20	27.9		
#40	21.2		
#60	17.9		
#100	16.0		
#200	13.9		
0.0456 mm.	10.5		
0.0328 mm.	9.5		
0.0213 mm.	7.8		
0.0127 mm.	5.9		
0.0092 mm.	4.3		
0.0066 mm.	3.2		
0.0047 mm.	2.2		
0.0033 mm.	1.7		
0.0014 mm.	0.6		

* (no specification provided)

Soil Description

GRAY SILTY GRAVEL WITH SAND

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 26.5497 D_{85}= 24.6439 D_{60}= 14.1472
D_{50}= 5.6789 D_{30}= 1.0497 D_{15}= 0.0984
D_{10}= 0.0393 C_u= 359.75 C_c= 1.98

Classification

USCS= GM AASHTO=

Remarks

F.M.=5.03

Source of Sample: B-18-05 **Depth:** 13.5'-15.0'
Sample Number: S-5 **Date:** 10-12-18

Terracon

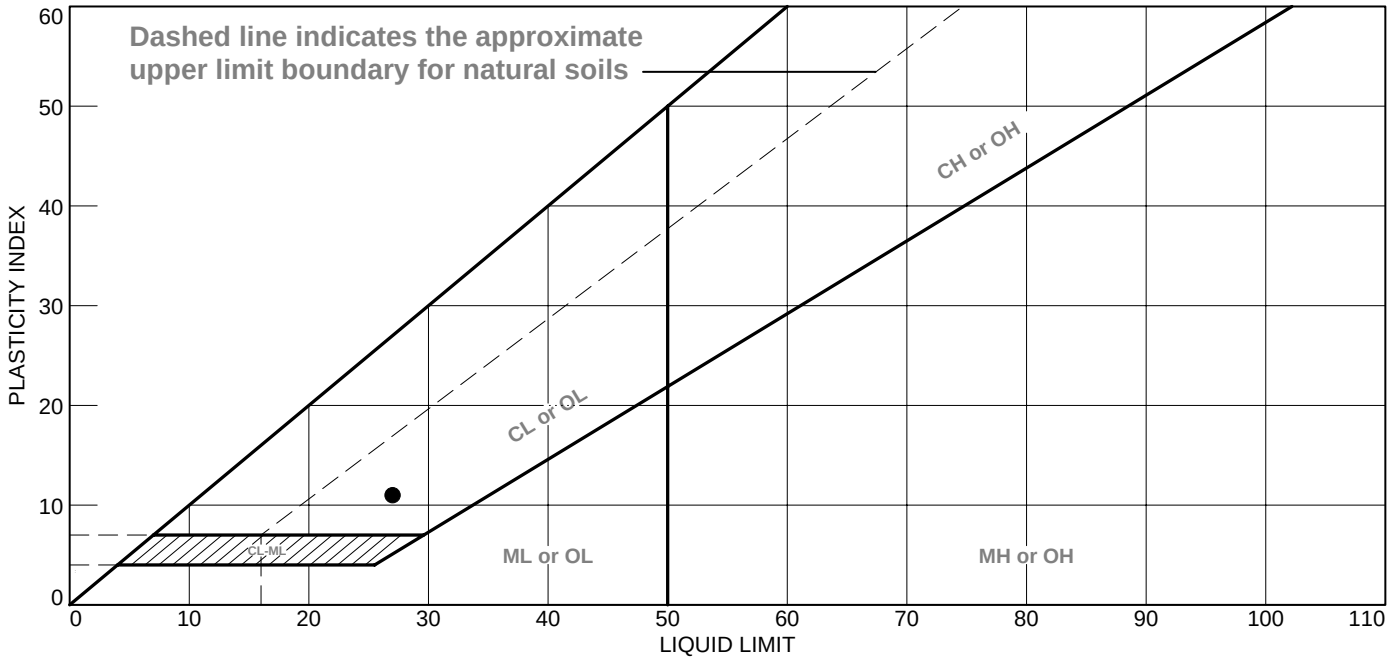
Client: STRATA EARTH
Project: DUPAGE RIVER RISK MANAGMENT PROJECT
Project No: 11185025 **Figure**

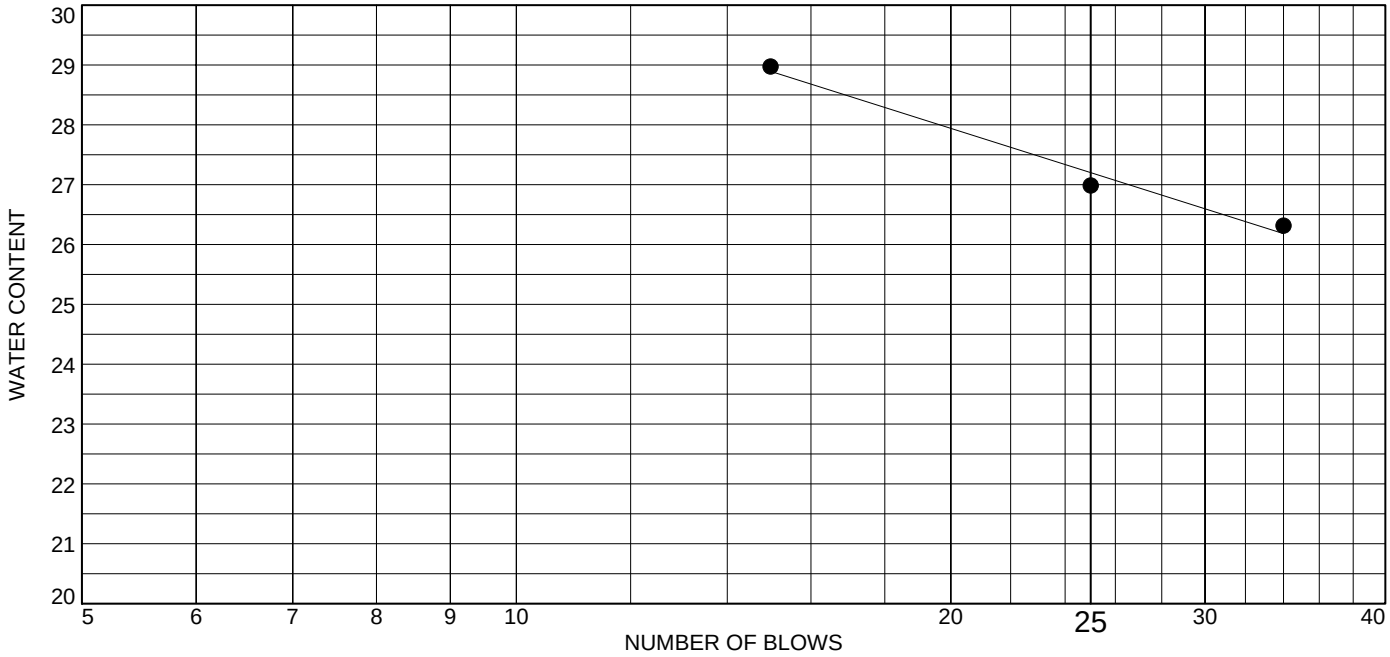
Tested By: SJH **Checked By:** WPQ

Terracon

Liquid Limit, Plastic Limit and Plasticity Index of Soils – ASTM D 4318

LIQUID AND PLASTIC LIMITS ASTM D4318





	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	GRAY LEAN CLAY	27	16	11			CL

Project No. 11185025 **Client:** STRATA EARTH

Project: DUPAGE RIVER RISK MANAGMENT PROJECT

Source of Sample: B-18-01 **Depth:** 11.0'-12.5'
Sample Number: S-5

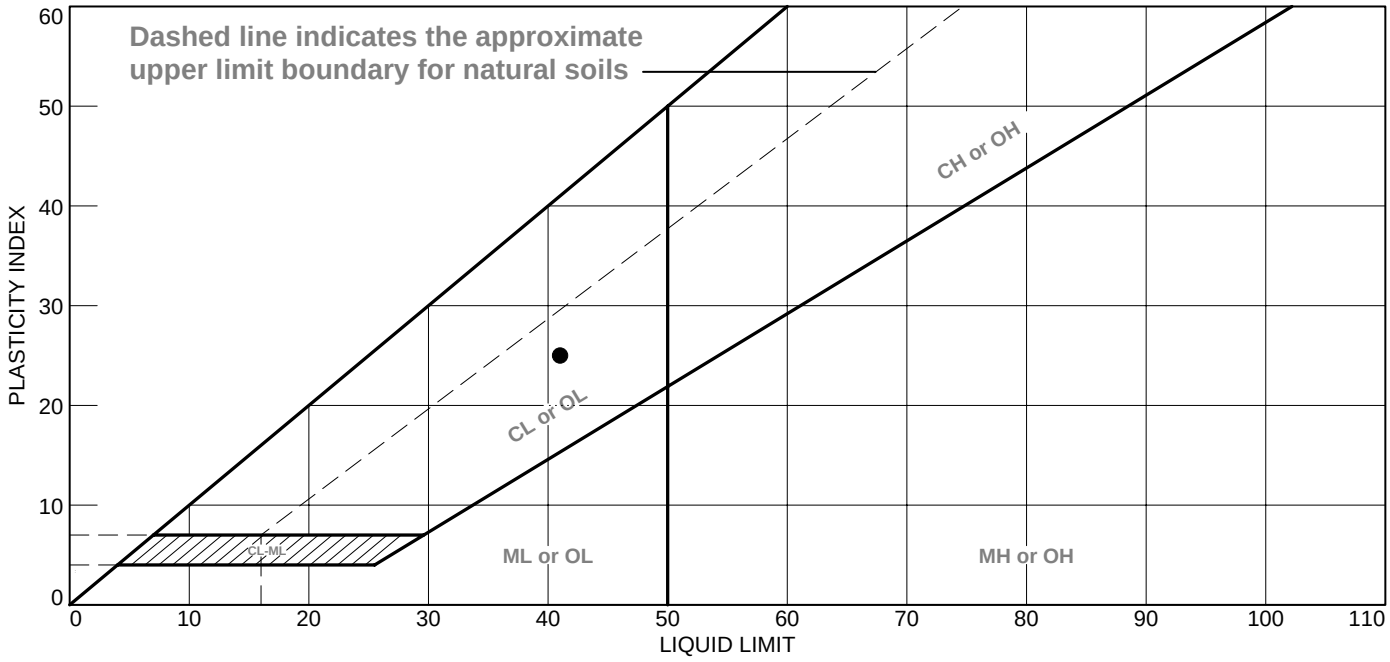
Remarks:

Terracon

Figure

Tested By: DT **Checked By:** WPQ

LIQUID AND PLASTIC LIMITS ASTM D4318



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	DARK BROWN LEAN CLAY TRACE SAND OCCASIONAL GRAVEL	41	16	25			CL

Project No. 11185025 **Client:** STRATA EARTH

Project: DUPAGE RIVER RISK MANAGMENT PROJECT

Source of Sample: B-18-03 **Depth:** 6.0'-7.5'
Sample Number: S-4A

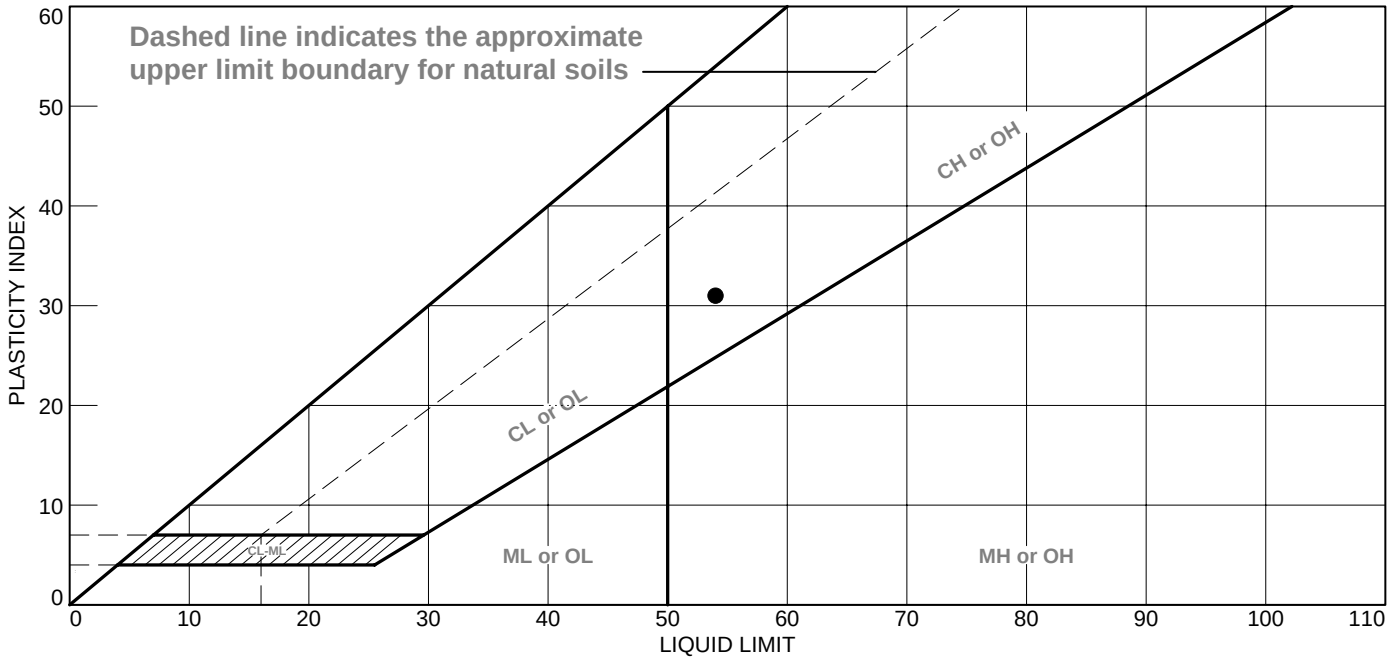
Remarks:

Terracon

Figure

Tested By: DT **Checked By:** WPQ

LIQUID AND PLASTIC LIMITS ASTM D4318



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	DARK BROWN FAT CLAY TRACE SAND OCCASIONAL GRAVEL	54	23	31			CH

Project No. 11185025 **Client:** STRATA EARTH

Project: DUPAGE RIVER RISK MANAGMENT PROJECT

Source of Sample: B-18-04 **Depth:** 2.5'-4.0'
Sample Number: S-2

Remarks:

Terracon

Figure

Tested By: DT **Checked By:** WPQ

Terracon

Organic Content by Loss on Ignition – ASTM D 2974

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ORGANIC CONTENT TEST
ASTM D2974
Method C

Laboratory Services Group *192 Exchange Blvd., Glendale Heights, Illinois 60139* *Phone: (630) 717-4263*

Project No.: 11185025
Project Name: DuPage River Flood Risk Management
Client: STRATA Earth
Date Tested: 10/11/2018

Sample Information

Boring / Source:	DR-18-02	DR-18-04
Sample No.:	S-2	S-4
Depth (ft.):	2.5'-4.0'	6.0'-7.5'
Description:	Topsoil	Sandy Clay

Organic Content Test Data

Tare No.:	32	G
Tare Wt. (gm):	18.56	20.64
Wet Wt. + Tare (gm):	59.81	69.32
Dry Wt. + Tare (gm):	50.28	60.99
Moisture Content (%):	**30.04**	**20.64**
Wt. of Ash + Tare (gm):	48.58	60.29
Percent Ash:	94.64	98.27
Organic Content (%):	**5.36**	**1.73**

** Note: Test performed by heating the sample to 440 degrees Centigrade until constant weight of ash is attained.

Appendix F

In-Situ Permeability Test Results

Borehole Hydraulic Conductivity Test - ASTM D 6391 Method B

Boring ID: DR-18-01
Test Date: 1-Oct

Fixed Variables

d(cm) =	50.8
D (cm) =	50.8
R_0 (cm) =	0
Duration (m) =	11
Temp (C) =	25

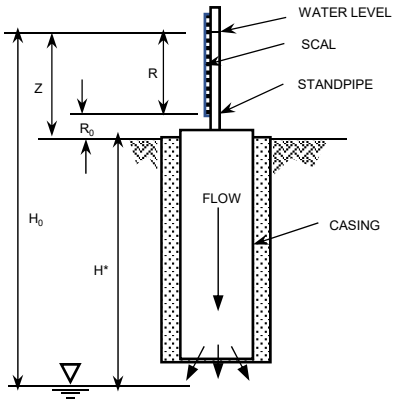
Fitted Variables

Initial Total Head, H_0 (m) =	3.05
Depth to DATUM, H* (m) =	0.9672
Iterate: a (s^{-1}) =	0.003732

Adjust *a* until the differences between the measured data (Z_i, t_i) and the fitted solution are minimized

Checks and Constraints

Minimize: 1/n $\Sigma(Z_i-Z_{ti})$ (m) =	1.82E-01
Constraint = 0: $\Sigma(Z_i-Z_{ti})$ (m) =	4.07E-08



Temporal Field Data

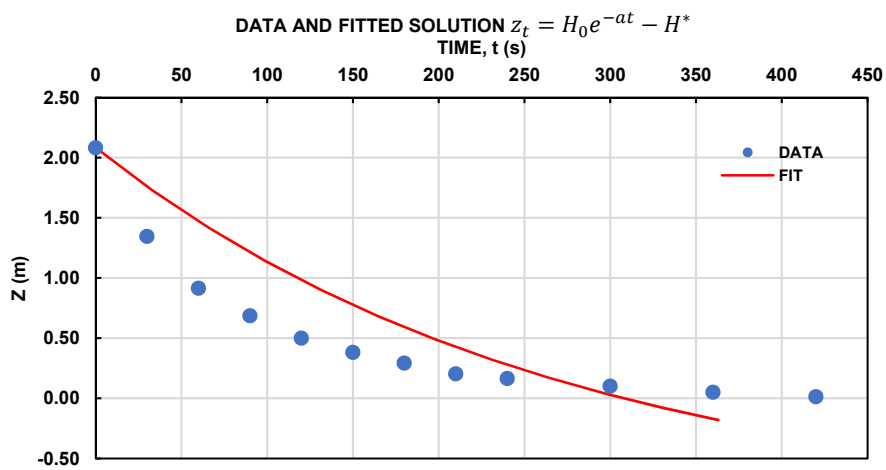
Rdg	Time (m)	R (cm)
-	0	208.28
1	0.50	134.62
2	1	91.44
3	1.5	68.58
4	2	50
5	2.5	38.1
6	3	29.21
7	3.5	20.32
8	4	16.51
9	5	10.16
10	6	5.08
11	7	1.27
12	8	0
13	9	0
14	10	0
15	11	0

Z-t Computations

Z_i (m)	t (s)	Fit Z_t (m)	Z_i-Z_{ti} (m)	$(Z_i-Z_{ti})^2$ (m^2)
2.08	0	2.083	0.00E+00	0.00E+00
1.35	30	1.760	-4.14E-01	1.71E-01
0.91	60	1.471	-5.57E-01	3.10E-01
0.69	90	1.213	-5.27E-01	2.78E-01
0.50	120	0.982	-4.82E-01	2.32E-01
0.38	150	0.775	-3.94E-01	1.56E-01
0.29	180	0.591	-2.99E-01	8.92E-02
0.20	210	0.426	-2.23E-01	4.96E-02
0.17	240	0.278	-1.13E-01	1.28E-02
0.10	300	0.028	7.32E-02	5.35E-03
0.05	360	-0.171	2.22E-01	4.93E-02
0.01	420	-0.331	3.44E-01	1.18E-01
0.00	480	-0.459	4.59E-01	2.10E-01
0.00	540	-0.561	5.61E-01	3.14E-01
0.00	600	-0.642	6.42E-01	4.12E-01
0.00	660	-0.707	7.07E-01	5.00E-01

Fitted Z-t Function

Int	t_i (s)	Z_{ti} (m)
-	0	2.083
1	33	1.729
2	66	1.417
3	99	1.141
4	132	0.896
5	165	0.681
6	198	0.490
7	231	0.321
8	264	0.172
9	297	0.040
10	330	-0.077
11	363	-0.180
12	396	-0.271
13	429	-0.352
14	462	-0.423
15	495	-0.486
16	528	-0.542
17	561	-0.591
18	594	-0.635
19	627	-0.673
20	660	-0.707



SOLUTION

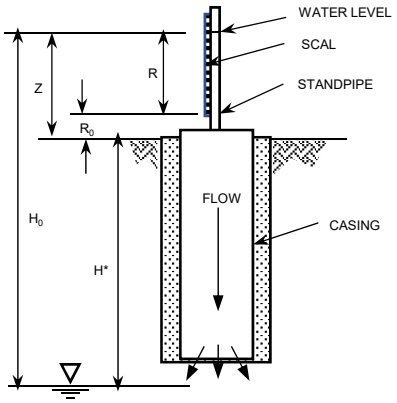
Temperature Correction, R_T = 0.8893

$$K = R_T a \frac{\pi d^2}{11D}$$

Hydraulic Conductivity, K (m/s) = 4.81E-04

Borehole Hydraulic Conductivity Test - ASTM D 6391 Method B

Boring ID: DR-18-03
Test Date: 28-Sep



Fixed Variables

d(cm) =	50.8
D (cm) =	50.8
R_0 (cm) =	0
Duration (m) =	67
Temp (C) =	25

Fitted Variables

Initial Total Head, H_0 (m) =	3.05
Depth to DATUM, H* (m) =	1.145
Iterate: a (s^{-1}) =	0.000177

Adjust *a* until the differences between the measured data (Z_i, t_i) and the fitted solution are minimized

Checks and Constraints

Minimize: 1/n $\Sigma(Z_i-Z_{ti})$ (m) =	4.59E-03
Constraint = 0: $\Sigma(Z_i-Z_{ti})$ (m) =	-9.11E-07

Temporal Field Data

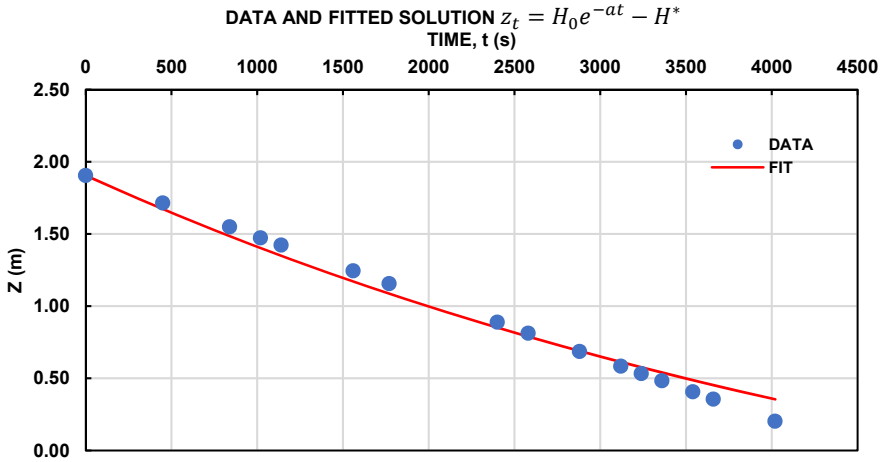
Rdg	Time (m)	R (cm)
-	0	190.5
1	7.50	171.45
2	14	154.94
3	17	147.32
4	19	142.24
5	26	124.46
6	29.5	115.57
7	40	88.9
8	43	81.28
9	48	68.58
10	52	58.42
11	54	53.34
12	56	48.26
13	59	40.64
14	61	35.56
15	67	20.32

Z-t Computations

Z_i (m)	t (s)	Fit Z_t (m)	Z_i-Z_{ti} (m)	$(Z_i-Z_{ti})^2$ (m^2)
1.91	0	1.905	0.00E+00	0.00E+00
1.71	450	1.672	4.26E-02	1.81E-03
1.55	840	1.484	6.50E-02	4.23E-03
1.47	1020	1.402	7.12E-02	5.06E-03
1.42	1140	1.349	7.38E-02	5.44E-03
1.24	1560	1.170	7.43E-02	5.52E-03
1.16	1770	1.086	6.97E-02	4.86E-03
0.89	2400	0.851	3.80E-02	1.45E-03
0.81	2580	0.788	2.43E-02	5.91E-04
0.69	2880	0.689	-2.88E-03	8.29E-06
0.58	3120	0.613	-2.84E-02	8.04E-04
0.53	3240	0.576	-4.23E-02	1.79E-03
0.48	3360	0.540	-5.70E-02	3.25E-03
0.41	3540	0.487	-8.05E-02	6.47E-03
0.36	3660	0.453	-9.70E-02	9.41E-03
0.20	4020	0.354	-1.51E-01	2.28E-02

Fitted Z-t Function

Int	t_i (s)	Z_{ti} (m)
-	0	1.905
1	201	1.799
2	402	1.696
3	603	1.597
4	804	1.501
5	1005	1.409
6	1206	1.320
7	1407	1.234
8	1608	1.151
9	1809	1.071
10	2010	0.993
11	2211	0.919
12	2412	0.847
13	2613	0.777
14	2814	0.710
15	3015	0.645
16	3216	0.583
17	3417	0.523
18	3618	0.465
19	3819	0.408
20	4020	0.354



SOLUTION

Temperature Correction, R_T = 0.8893

$$K = R_T a \frac{\pi d^2}{11D}$$

Hydraulic Conductivity, K (m/s) = 2.28E-05

Borehole Hydraulic Conductivity Test - ASTM D 6391 Method B

Boring ID: DR-18-05
Test Date: 27-Sep

Fixed Variables

d(cm) =	50.8
D (cm) =	50.8
R_0 (cm) =	0
Duration (m) =	9
Temp (C) =	25

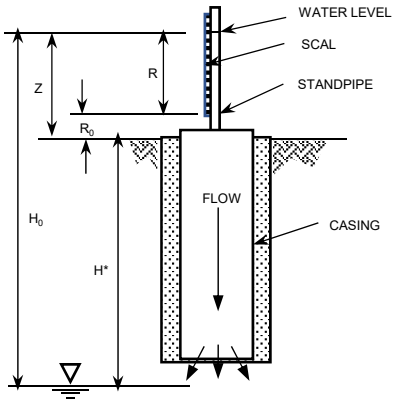
Fitted Variables

Initial Total Head, H_0 (m) =	3.05
Depth to DATUM, H* (m) =	1.018
Iterate: a (s^{-1}) =	0.003161

Adjust *a* until the differences between the measured data (Z_i, t_i) and the fitted solution are minimized

Checks and Constraints

Minimize: 1/n $\Sigma(Z_i-Z_{ti})$ (m) =	4.64E-02
Constraint = 0: $\Sigma(Z_i-Z_{ti})$ (m) =	-2.71E-06



Temporal Field Data

Rdg	Time (m)	R (cm)
-	0	203.2
1	0.92	157.48
2	1.5	104.14
3	2	86.36
4	2.5	58.42
5	3	45.72
6	3.5	39.37
7	4	22.86
8	4.5	22.86
9	5	15.24
10	5.5	10.16
11	6	7.62
12	6.5	2.54
13	7	2.54
14	8	0
15	9	0

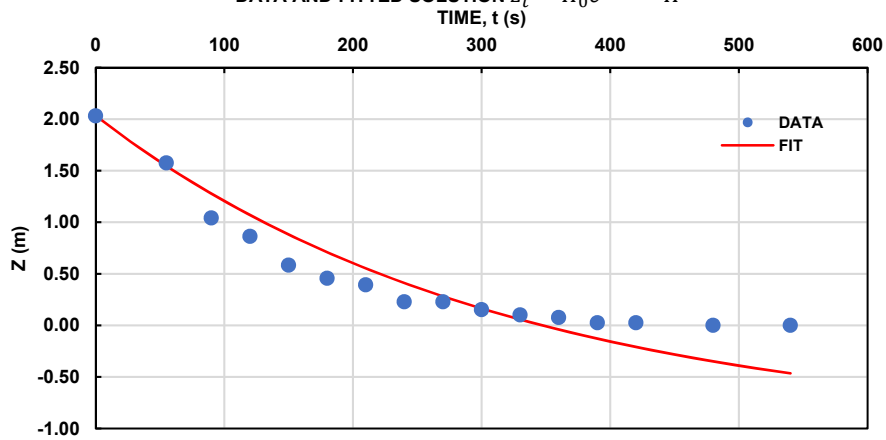
Z-t Computations

Z_i (m)	t (s)	Fit Z_t (m)	Z_i-Z_{ti} (m)	$(Z_i-Z_{ti})^2$ (m^2)
2.03	0	2.032	0.00E+00	0.00E+00
1.57	55	1.545	2.95E-02	8.69E-04
1.04	90	1.277	-2.35E-01	5.55E-02
0.86	120	1.069	-2.06E-01	4.23E-02
0.58	150	0.880	-2.96E-01	8.78E-02
0.46	180	0.709	-2.52E-01	6.33E-02
0.39	210	0.553	-1.59E-01	2.52E-02
0.23	240	0.410	-1.82E-01	3.31E-02
0.23	270	0.281	-5.26E-02	2.77E-03
0.15	300	0.164	-1.13E-02	1.27E-04
0.10	330	0.057	4.48E-02	2.01E-03
0.08	360	-0.040	1.17E-01	1.36E-02
0.03	390	-0.129	1.54E-01	2.38E-02
0.03	420	-0.209	2.35E-01	5.51E-02
0.00	480	-0.349	3.49E-01	1.22E-01
0.00	540	-0.465	4.65E-01	2.16E-01

Fitted Z-t Function

Int	t_i (s)	Z_{ti} (m)
-	0	2.032
1	27	1.783
2	54	1.553
3	81	1.343
4	108	1.150
5	135	0.973
6	162	0.810
7	189	0.660
8	216	0.523
9	243	0.397
10	270	0.281
11	297	0.175
12	324	0.077
13	351	-0.012
14	378	-0.095
15	405	-0.170
16	432	-0.239
17	459	-0.303
18	486	-0.362
19	513	-0.415
20	540	-0.465

DATA AND FITTED SOLUTION $z_t = H_0 e^{-at} - H^*$



SOLUTION

Temperature Correction, R_T = 0.8893

$$K = R_T a \frac{\pi d^2}{11D}$$

Hydraulic Conductivity, K (m/s) = 4.08E-04

Appendix G

Photo Log

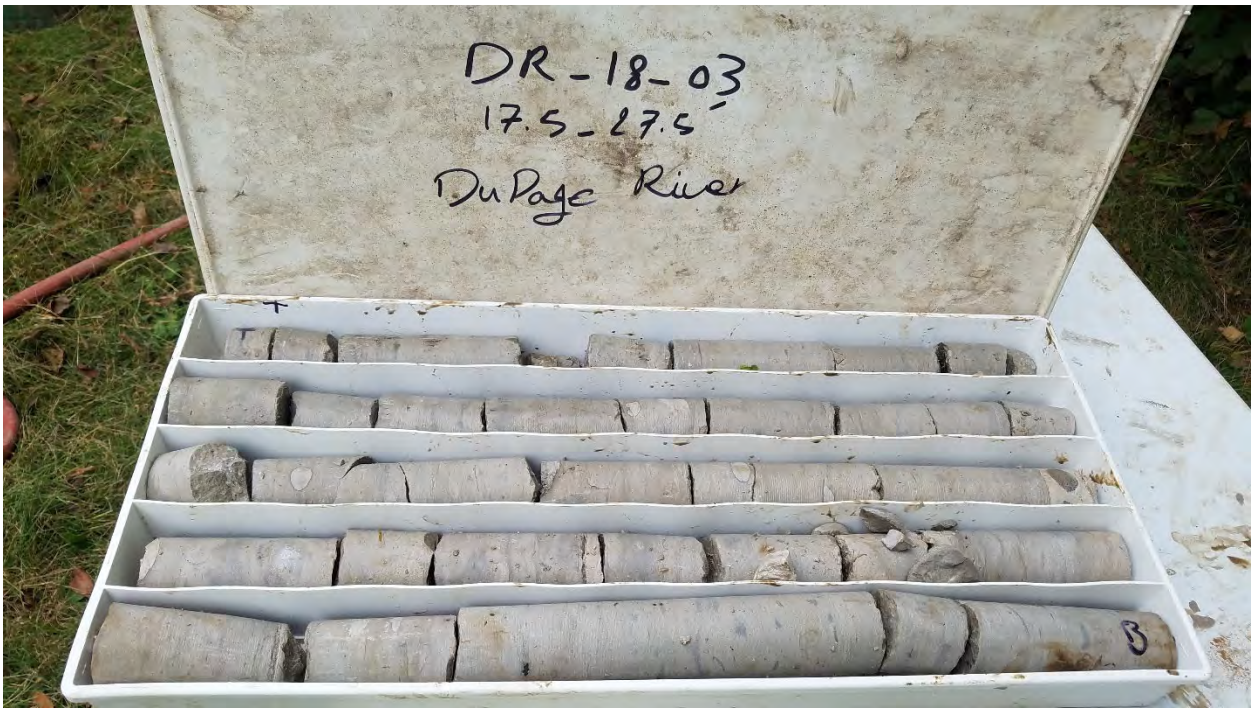
Picture 1: Boring 18-DR-01, drilling set-up

Picture 2: Boring 18-DR-01, Sample #8

Picture 3: Boring 18-DR-02, drilling set-up

Picture 4: Boring 18-DR-02, Sample #6 & #7

Picture 5: Boring 18-DR-03, drilling set-up



Picture 6: Boring 18-DR-03, Rock Core

Picture 7: Boring 18-DR-03, Sample #4 & #7

Picture 8: Boring 18-DR-04, drilling set-up

Picture 9: Boring 18-DR-04, Sample #4 & #6

Picture 10: Boring 18-DR-04, Sample #7

Picture 11: Boring 18-DR-05, drilling set-up

Picture 12: Boring 18-DR-05, Sample #7 & #8

Picture 13: Boring 18-DR-05, Rock Core