SCS ENGINEERS

Unstable Areas Compliance Demonstration Lansing Landfill

Lansing Power Station

Prepared for:

Interstate Power and Light Company
Lansing Generating Station
2320 Power Plant Drive
Lansing, Iowa 52151

Prepared by:

SCS ENGINEERS
2830 Dairy Drive
Madison, Wisconsin 53718-6751
(608) 224-2830

October 2018
File No. 25218081.00

Offices Nationwide
www.scsengineers.com

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Figures

Appendices

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P.E. Certification

ERIC J. NELSON
23136

I, Eric J. Nelson, hereby certify that the unstable areas demonstration prepared for the Lansing Landfill at the Lansing Generating Station meets the requirements in 40 CFR 257.64(a). This certification is based on the enclosed October 2018 Unstable Areas Compliance Demonstration for the Lansing Landfill prepared by SCS Engineers. I am a duly licensed Professional Engineer under the laws of the State of Iowa.

10/12/2018

(signature) (date)

Eric J. Nelson

(printed or typed name)

License number 23136

My license renewal date is December 31, 2018.

Pages or sheets covered by this seal:

Unstable Areas Compliance Demonstration, Lansing

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1.0 INTRODUCTION AND PROJECT SUMMARY

On behalf of Interstate Power and Light Company (IPL), SCS Engineers (SCS) has prepared the enclosed Unstable Areas Compliance Demonstration for the Lansing Landfill (existing coal combustion residual [CCR] landfill) as required by 40 CFR 257.64.

Figure 1 shows the site location. **Figure 2** shows the Lansing Landfill location.

2.0 UNSTABLE AREAS RESTRICTION

257.64 *“Unstable areas.”*

“(a) An existing or new CCR landfill, existing or new CCR surface impoundment, or any lateral expansion of a CCR unit must not be located in an unstable area unless the owner or operator demonstrates by the dates specified in paragraph (d) of this section that recognized and generally accepted good engineering practices have been incorporated into the design of the CCR unit to ensure that the integrity of the structural components of the CCR unit will not be disrupted.”

“(b) The owner or operator must consider all of the following factors, at a minimum, when determining whether an area is unstable:

“(1) On-site or local soil conditions that may result in significant differential settling;

As discussed in **Appendices A** and **B**, and as shown by the boring location plans and boring logs from the 2001 Ash Disposal Area Stability Evaluation prepared by BT2, Inc., and the 2017 Monitoring Well Construction Documentation prepared by SCS Engineers (see **Appendix C**), the Lansing Landfill CCR unit is not located in on-site or local soil conditions that may result in significant differential settling. The site soils below the landfill consist primarily of sand and gravel weathered from bedrock overlying relatively competent bedrock. Based on the Standard Penetration Test (SPT) blow counts on the boring logs in **Appendix C**, the soils are typically medium dense to very dense and therefore not susceptible to appreciable differential settlement that would affect the performance of the landfill.

(2) On-site or local geologic or geomorphologic features; and

As discussed in **Appendices A**, **B**, and **E**, and shown by the boring logs in **Appendix C**, the Lansing Landfill CCR unit is not located in on-site or local geologic or geomorphologic features that are unstable. The boring logs show primarily medium to very dense sand and gravel overlying bedrock below the landfill. Borings in the landfill perimeter berm encountered primarily medium dense sand and stiff clay fill soils. These geologic features provide a stable foundation for the CCR landfill. This assessment is confirmed by the slope stability evaluation in **Appendix D** that indicates the slope stability safety factor is acceptable.

(3) On-site or local human-made features or events (both surface and subsurface).”

As shown by the boring location plans and boring logs in **Appendix C**, the Lansing Landfill CCR unit is not located in on-site or local human-made features or events (both surface and subsurface) that are unstable.

As discussed in **Appendix E**, groundwater or surface water is unlikely to cause instability. The facility is designed with adequate run-on and run-off control systems. Groundwater monitoring wells near the landfill perimeter berm show that groundwater hydraulic gradients are downward and therefore groundwater is unlikely to negatively impact the performance of the facility.

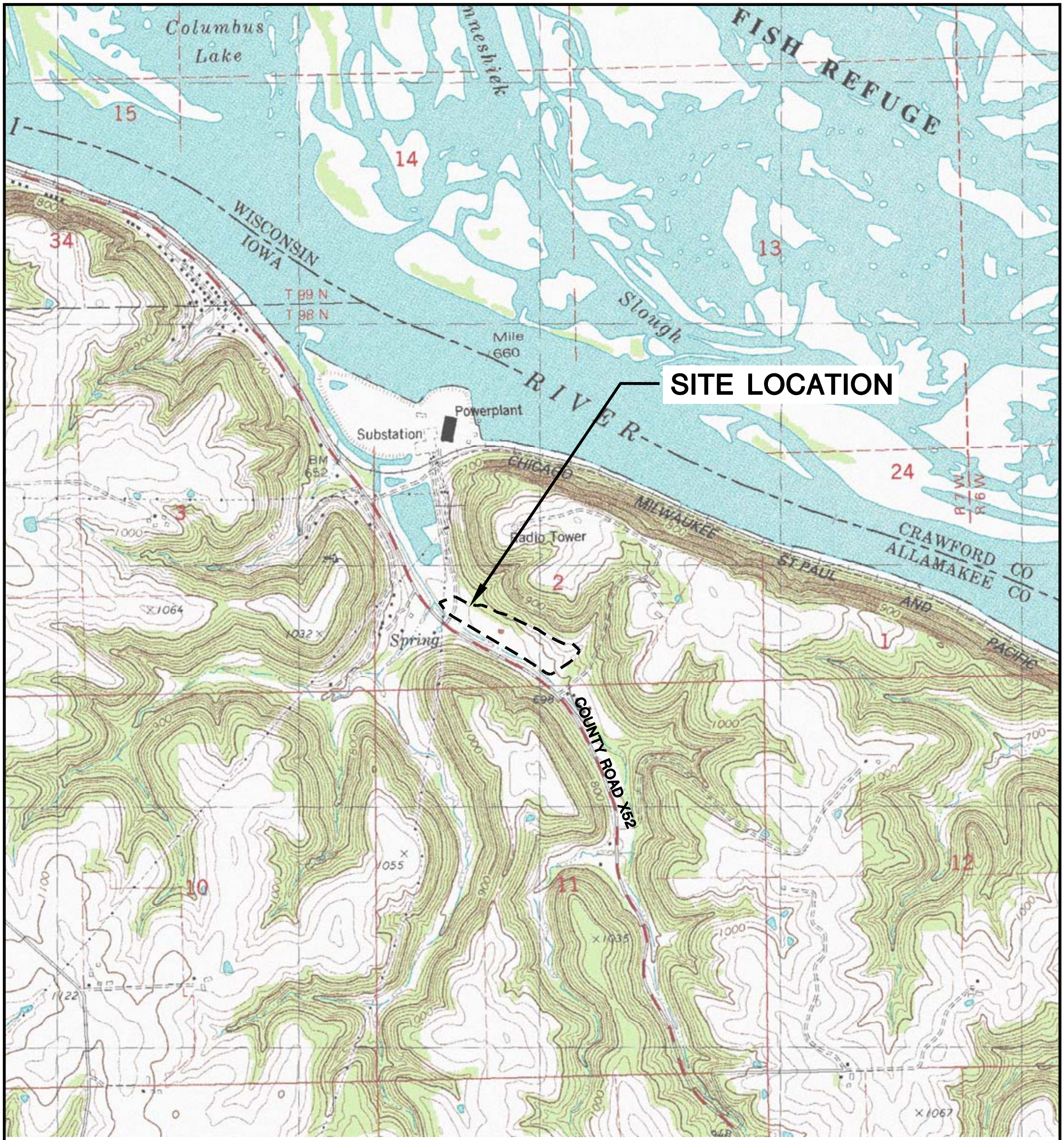
3.0 REFERENCES

A. BT2, Inc., 2001, Ash Disposal Area Stability Evaluation, Alliant Energy – Lansing Power Station.

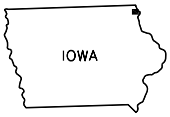
B. SCS Engineers, 2017, Monitoring Well Construction Documentation, Soil and Hydrogeologic Investigation, IPL Lansing Generating Station.

C. Terracon, 1996, Preliminary Subsurface Investigation, Proposed Fly Ash Embankment, Interstate Power Company, Lansing, Iowa.

FIGURES



LANSING QUADRANGLE
IOWA–ALLAMAKEE CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)
NW/4 LANSING 15' QUADRANGLE
1997
SCALE: 1" = 2,000'



CLIENT
ALLIANT ENERGY.
INTERSTATE POWER AND LIGHT
2320 POWER PLANT DRIVE
LANSING, IA 52151-9733

SITE
INTERSTATE POWER AND LIGHT
LANSING POWER STATION
COAL COMBUSTION RESIDUE LANDFILL
LANSING, IOWA

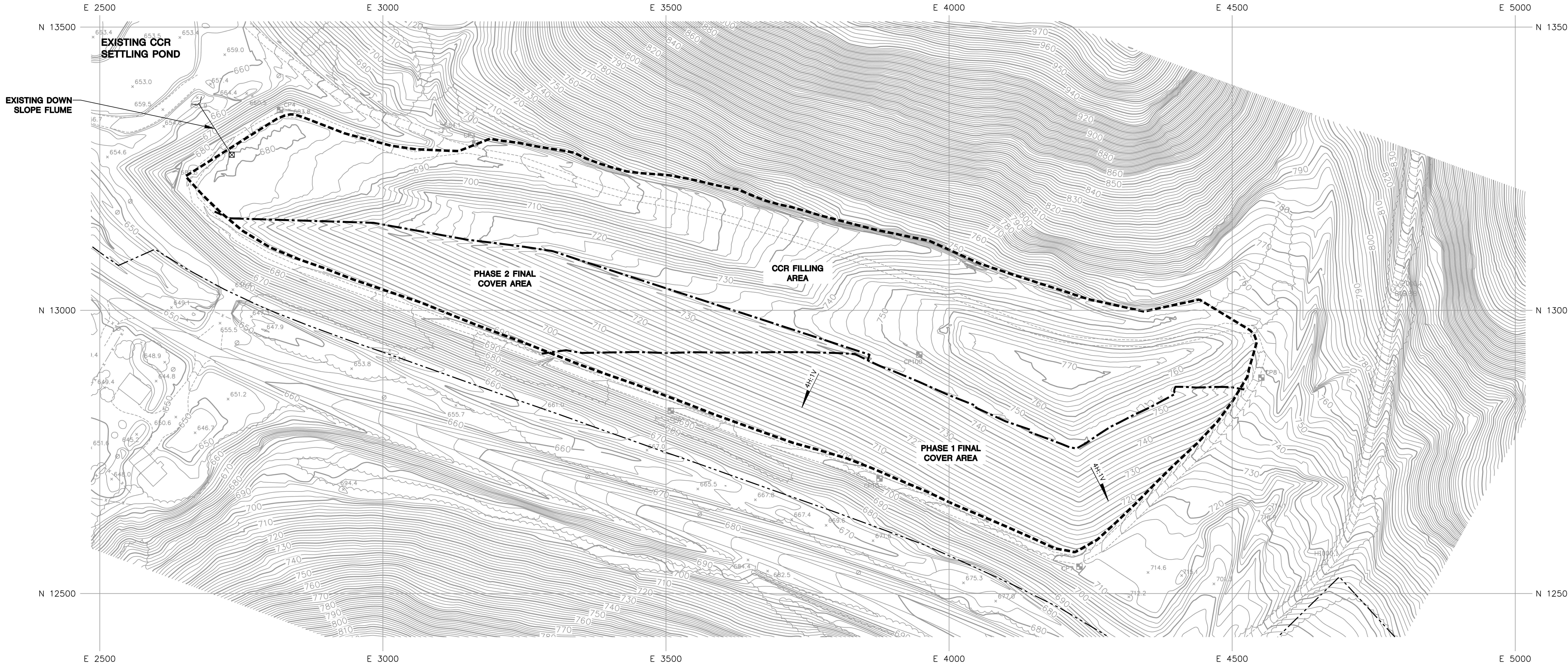
SITE LOCATION MAP

PROJECT NO.	25218081.00	DRAWN BY:	BSS
DRAWN:	08/09/12	CHECKED BY:	DN
REVISED:	09/14/18	APPROVED BY:	

ENGINEER
SCS ENGINEERS
2830 DAIRY DRIVE MADISON, WI 53718-6751
PHONE: (608) 224-2830

FIGURE
1

I:\25218081.00\Drawings\Site Location Map.dwg, 9/14/2018 11:11:54 AM



LEGEND	
-··-··-	APPROXIMATE PROPERTY LINE
- - - -	APPROVED LIMITS OF WASTE
-·-·-	LIMITS OF CURRENT FINAL COVER
—760—	EXISTING 10' CONTOUR
——	EXISTING 2' CONTOUR
- - -	UNPAVED ROAD
4H:1V	SLOPE AND DIRECTION

NOTES:

1. TOPOGRAPHIC SURVEY OF EXISTING LANDFILL GRADES WITHIN LIMITS OF WASTE WAS COMPLETED BY MOHN SURVEYING IN APRIL 2015, SEPTEMBER 2015, OCTOBER 2015, AND IN MARCH 2018.
2. EXISTING GRADES OUTSIDE THE LIMIT OF WASTE ARE BASED ON KBM, INC. AERIAL SURVEY COMPLETED ON APRIL 18, 2001.

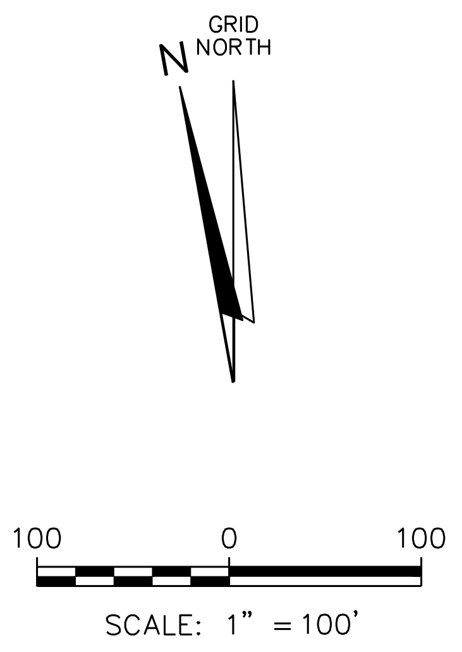


FIGURE
2

LANSING POWER STATION CCR LANDFILL
EXISTING CONDITIONS

GENERATING

SITE
UNSTABLE AREAS ~~RESTRICTION~~
COMPLIANCE DEMONSTRATION
LANSING ~~POWER~~ STATION
LANSING, IOWA

CLIENT
INTERSTATE POWER AND LIGHT CO.
2320 POWER PLANT DRIVE
LANSING, IA 52151-9733

ENGINEER
SCS ENGINEERS
2830 DAIRY DRIVE MADISON, WI 53718-6751
PHONE: (608) 224-2830

PROJECT NO.	25218081.00	DRAWN BY:	KP
DRAWN:	09/17/18	CHECKED BY:	PG
REVISED:	09/18/18	APPROVED BY:	

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APPENDIX A

Site Description and Geologic Summary

Site Description and Geologic Summary

Site Information

The Lansing Ash Disposal Area encompasses approximately 13 acres, and is located in an agricultural area near the Mississippi River. The site location is the Southwest ¼ of Section 2, T98N, R3W located in Allamakee County, Iowa. The landfill is bounded by a bluff to the northeast and by County Highway X52 to the southwest. CCR ash ponds are located directly west of the landfill and a perimeter berm surrounds the landfill on the south and east sides.

Regional Geology

A summary of the regional hydrogeologic stratigraphy is presented in **Attachment A1**. A regional bedrock surface hydrogeologic map is shown in **Attachment A2**. Regional hydrogeologic cross-sections are shown in **Attachment A2**. The bedrock surface elevation is highly variable due to erosion; the landscape is made up of steep hills and valleys, and the landfill site is located in a valley. The uppermost bedrock unit in the site area is the Jordan Sandstone, which is the lower Cambrian-Ordovician sandstone interbedded with dolostone. Borings MW-5, MW-6, MW-18, MW-19, and MW-22P encountered sandstone bedrock in the area of the landfill. Boring logs for these wells are included in **Appendix C**. The well locations are shown on a figure in **Appendix C**.

Attachment A3 shows locations of known sinkholes and potential karst areas in the vicinity of the Lansing site. The site is within an area identified as "karst or potential karst," however this is due to the presence of a sinkhole on the bluff along the Mississippi River rather than to identified karst features on the landfill site. The elevation of the mapped sinkhole location is approximately 300 feet above the landfill site elevation. The Galena Group, composed primarily of limestone and dolostone, is known to contain karst features within Allamakee County and is stratigraphically above the sandstone unit observed in borings at the landfill site. Bedrock of the Galena Group has not been observed in borings at the Lansing landfill; the uppermost bedrock unit observed in borings MW-5, MW-6, MW-18, MW-19, and MW-22P is the Jordan Sandstone. Because the borings (**Appendix C**) near the landfill did not encounter karst features or limestone bedrock that is likely to contain karst features, it is unlikely that karst conditions are present below the landfill.

The thickness of the Jordan Sandstone aquifer varies from 50 to more than 120 feet thick in most areas of Allamakee County. Underlying the Cambrian-Ordovician sandstone are the Cambrian confining beds comprised of dolostone, siltstone, and shale. The Cambrian confining beds overly the Dresbach aquifer, composed of shaly sandstone. **Attachment A4** shows the elevation of the top of the Cambrian-Ordovician sandstone in northeastern Iowa.

Unconsolidated alluvial material, which is up to 60 feet thick within the deeply incised valley where the Lansing Generating Station, landfill, and CCR ponds are located, is thin to absent on the surrounding bluffs and hilltops. Unconsolidated deposits at the site consist of sand, silt, silty clay, organic silt, and gravel.

Previous Geologic Investigations

The vicinity of the landfill site was investigated by Terracon in 1996, by BT2, Inc. in 2000, and by SCS Engineers in 2017 by performing approximately 20 borings within and adjacent to the landfill footprint. Four of the borings were instrumented with groundwater monitoring wells. The majority of the borings extend to bedrock. Split spoon and Shelby tube samples were collected. Laboratory testing included grain size analysis, Atterberg limits, unconsolidated undrained triaxial compression, and consolidated undrained triaxial compression tests with pore water pressure measurement. The boring locations and boring logs are shown in **Appendix C**.

Based on the results of the subsurface investigations, the soils below the landfill consist primarily of sand and gravel weathered from bedrock overlying sandstone bedrock. Based on the Standard Penetration Test (SPT) blow counts on the boring logs in **Appendix C**, the soils are typically medium dense to very dense.

References

BT2, Inc., 2001, Ash Disposal Area Stability Evaluation, Alliant Energy – Lansing Power Station.

SCS Engineers, 2017, Monitoring Well Construction Documentation, Soil and Hydrogeologic Investigation, IPL Lansing Generating Station.

Terracon, 1996, Preliminary Subsurface Investigation, Proposed Fly Ash Embankment, Interstate Power Company, Lansing, Iowa.

DLN/AJR/MDB/DH/EJN

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Table LAN-3 Regional Hydrogeologic Stratigraphy
Lansing Generating Station / SCS Engineers Project #25215053

Strategic Unit			Hydrogeologic Units	Type of Rock	Hydrologic Conditions	Thickness Range (ft)	Age of Rocks*
Quaternary		Recent and Pleistocene deposits	Surficial aquifers-Alluvium, Drift, Buried-channel	Sand and gravel interbedded with silt and clay	Mostly unconfined local aquifers, some artesian, small-to-large yields	0 – 305	0 – 2.8 million years (m.y.)
Devonian	Yellow Spring Group (Gp)	Lime Creek Formation (Fm)	Confining layers	Shale, some dolostone	Non-aquifer	0 – 50	365 – 405 m.y.
	Cedar Valley Gp	Lithograph City Fm Coralville Fm Little Cedar Fm	Silurian-Devonian aquifer	Limestone and dolostone, thin shales	Major aquifer, mostly artesian, moderate-to-large yields	0 – 400	
	Wapsipinicon Gp	Pinicon Ridge Fm Spillville Fm		Dolostone and limestone			
Silurian		Scotch Grove Fm Hopkinton Fm Blanding Fm Tete des Morts Fm		Dolostone, locally with much chert, local shale as cavern fillings			405 – 425 m.y.
Ordovician	Maquoketa Fm	Brainard Member Fort Atkinson Member Clermont Member Elgin Member	Maquoketa Fm, confining beds Fort Atkinson – Elgin aquifer	Shale and dolostone, some chert	Non-aquifer to local aquifer, small-to-moderate yields	0 – 300	425 – 455 m.y.
	Galena Gp	Dubuque Fm Wise Lake Fm Dunleith Fm Decorah Fm	Galena aquifer	Limestone and dolostone, minor chert, shale at base and locally in upper part	Local aquifer, confined and unconfined, small-to-moderate yields	0 – 240	455 – 460 m.y.
		Platteville Fm Glenwood Fm	Decorah-Platteville-Glenwood confining beds	Limestone and shale	Non-aquifer	0 – 50	
		St. Peter Sandstone	Cambrian-Ordovician aquifer	Sandstone	Major aquifer, mostly artesian, large yields	0 – 580	460 – 500 m.y.
		Prairie du Chien Gr		Dolostone, minor sandstone and chert			500 – 503 m.y.
Cambrian		Jordan Sandstone		Sandstone, dolomitic			
		St. Lawrence Fm	Cambrian confining beds	Dolostone, silty	Non-aquifer	0 – 400	503 – 508 m.y.
		Lone Rock (Franconia) Fm		Fine, sandstone, siltstone, shale, and minor dolostone			
		Wenowoc (incl Ironton-Galesville sandstone) Fm	Dresbach aquifer	Sandstone	Artesian aquifer, large yields	0 – 1,950	508 – 515 m.y.
		Eau Claire Fm		Fine sandstone, siltstone, and shale			
		Mt. Simon Sandstone		Sandstone			
Pre-C		Undifferentiated crystalline rocks	Unknown	Igneous and metamorphic rocks	Unknown	Unknown	570 m.y. – > 2 billion years

*Age determinations as used on COSUNA charts published by AAPG-USGS
Source: “Water Resources of Southeast Iowa,” Iowa Geologic Survey Water Atlas No. 4.

I:\25215053\Data\Tables\Table 2_Regional Hydrogeologic Stratigraphy.doc

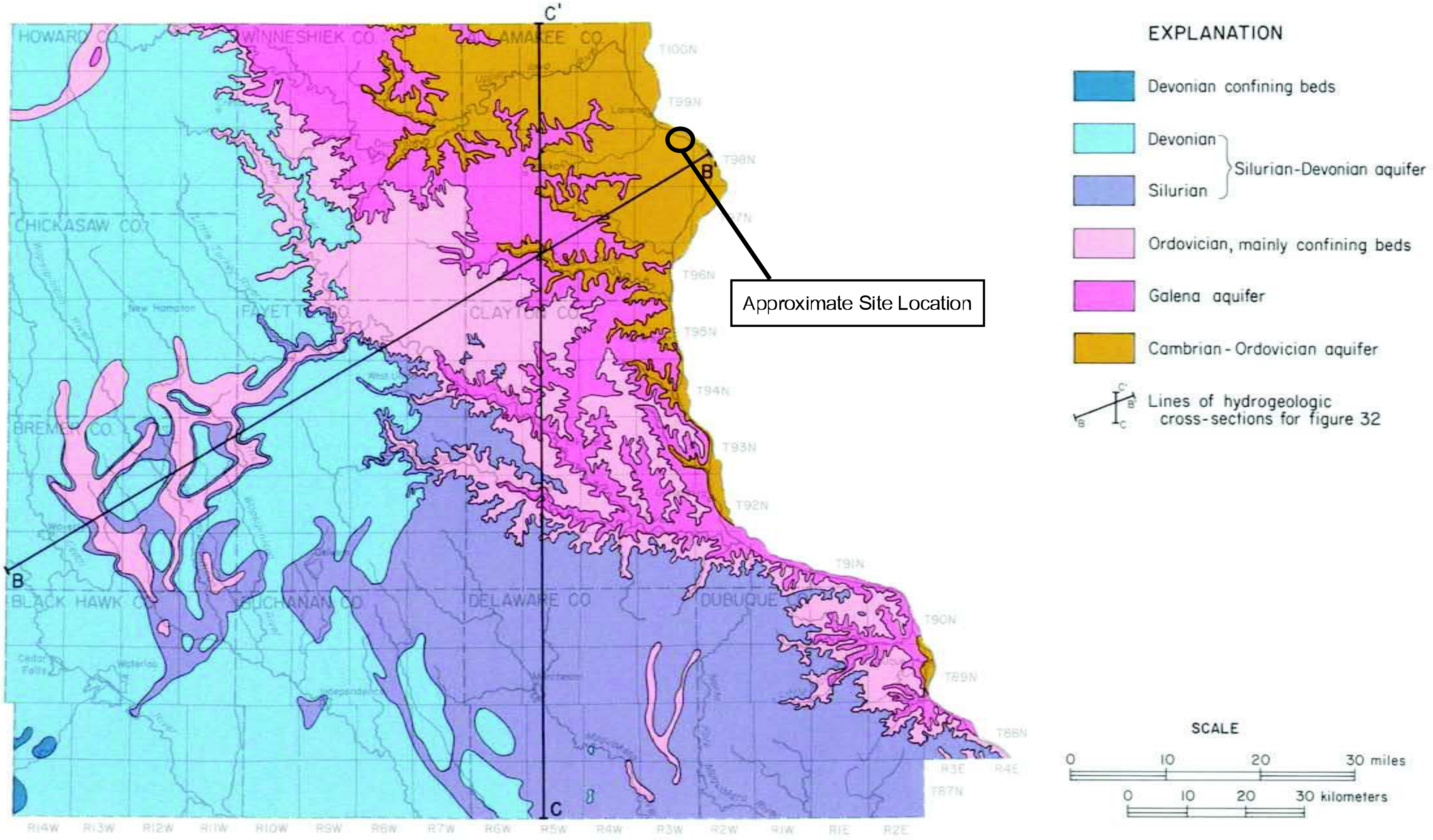
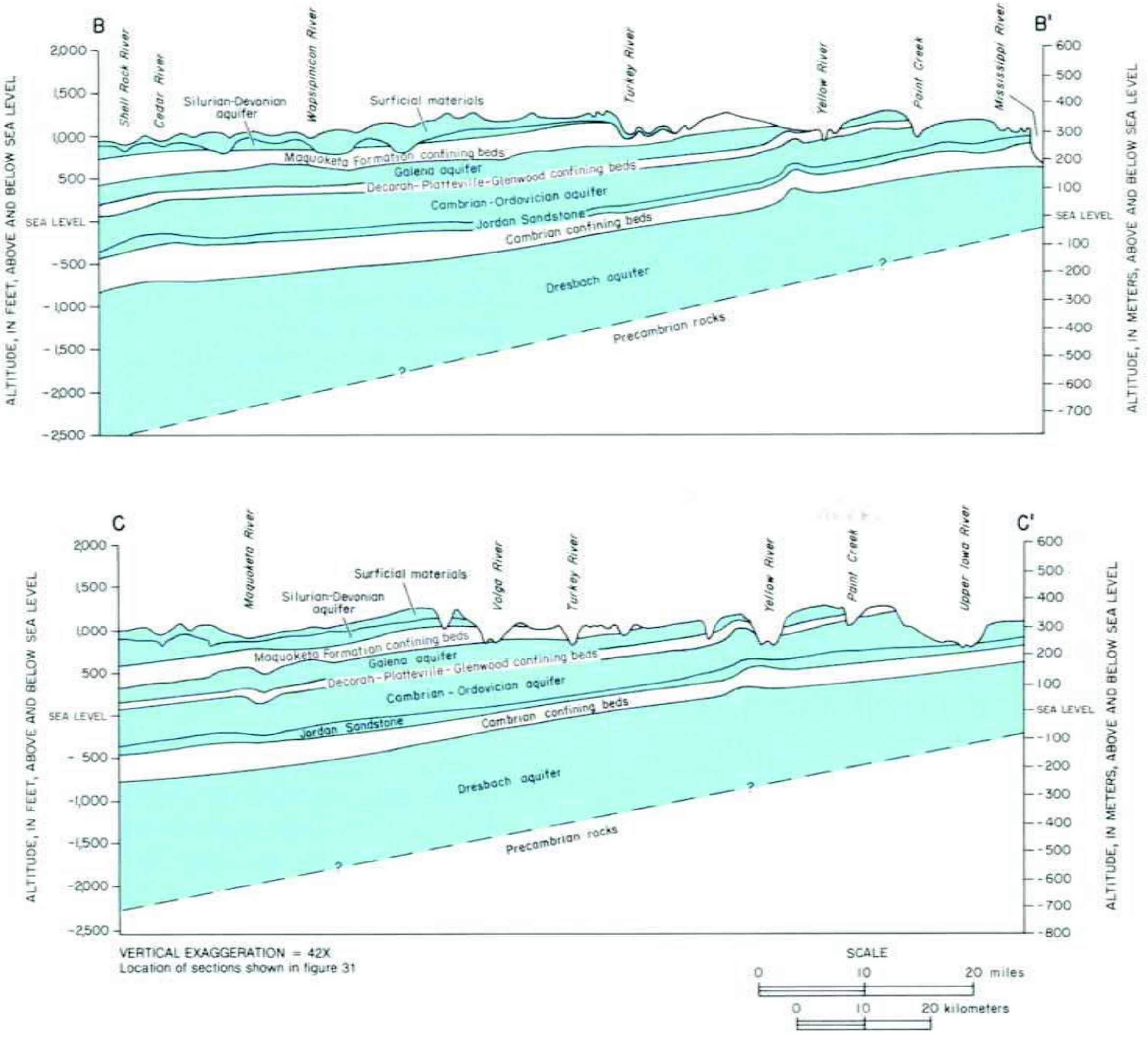


Figure 31. Bedrock hydrogeologic map

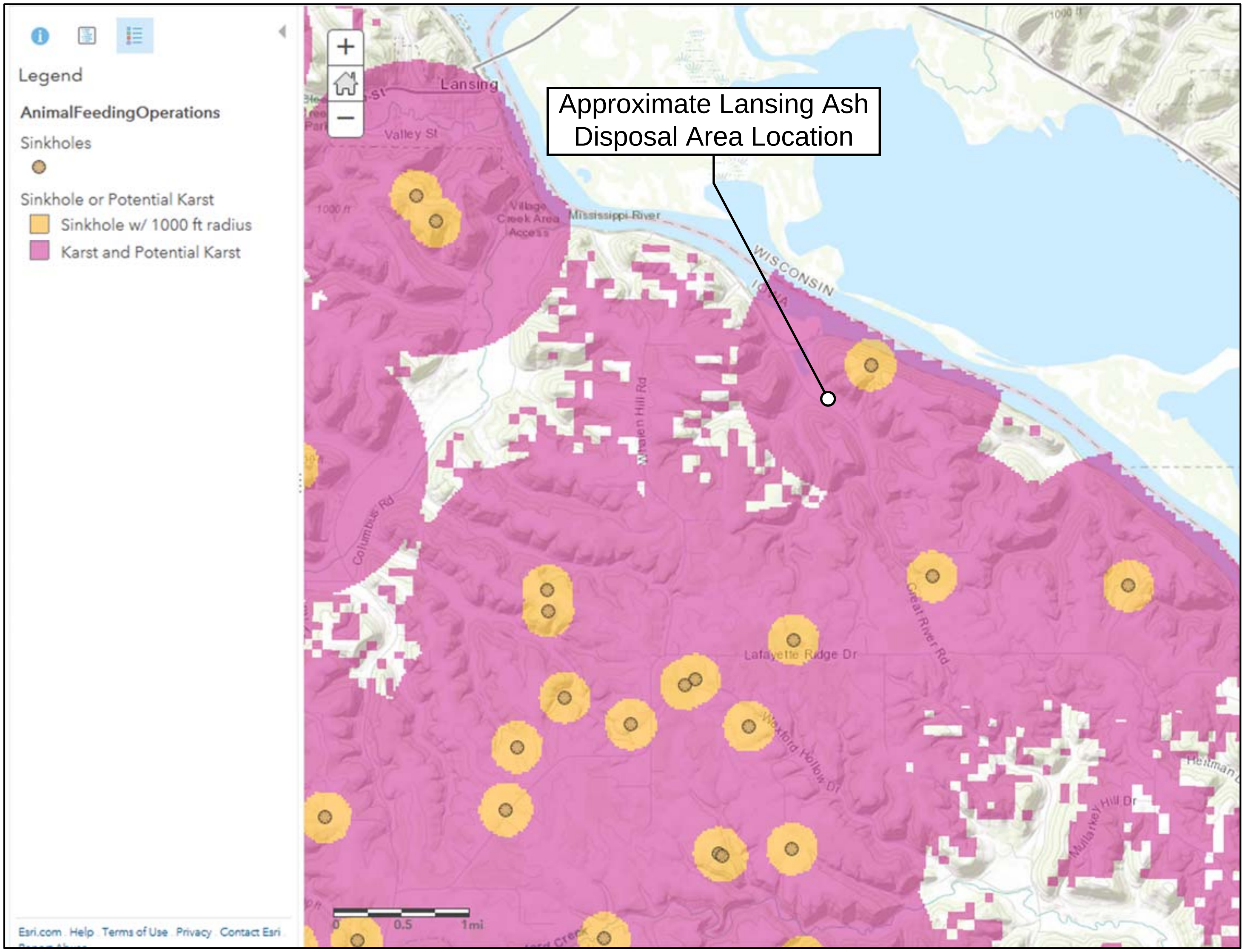
Source: Horick, Paul J., Water Resources of Northeast Iowa, Iowa Department of Natural Resources Water Atlas Number 8, October



VERTICAL EXAGGERATION = 42X
Location of sections shown in figure 31

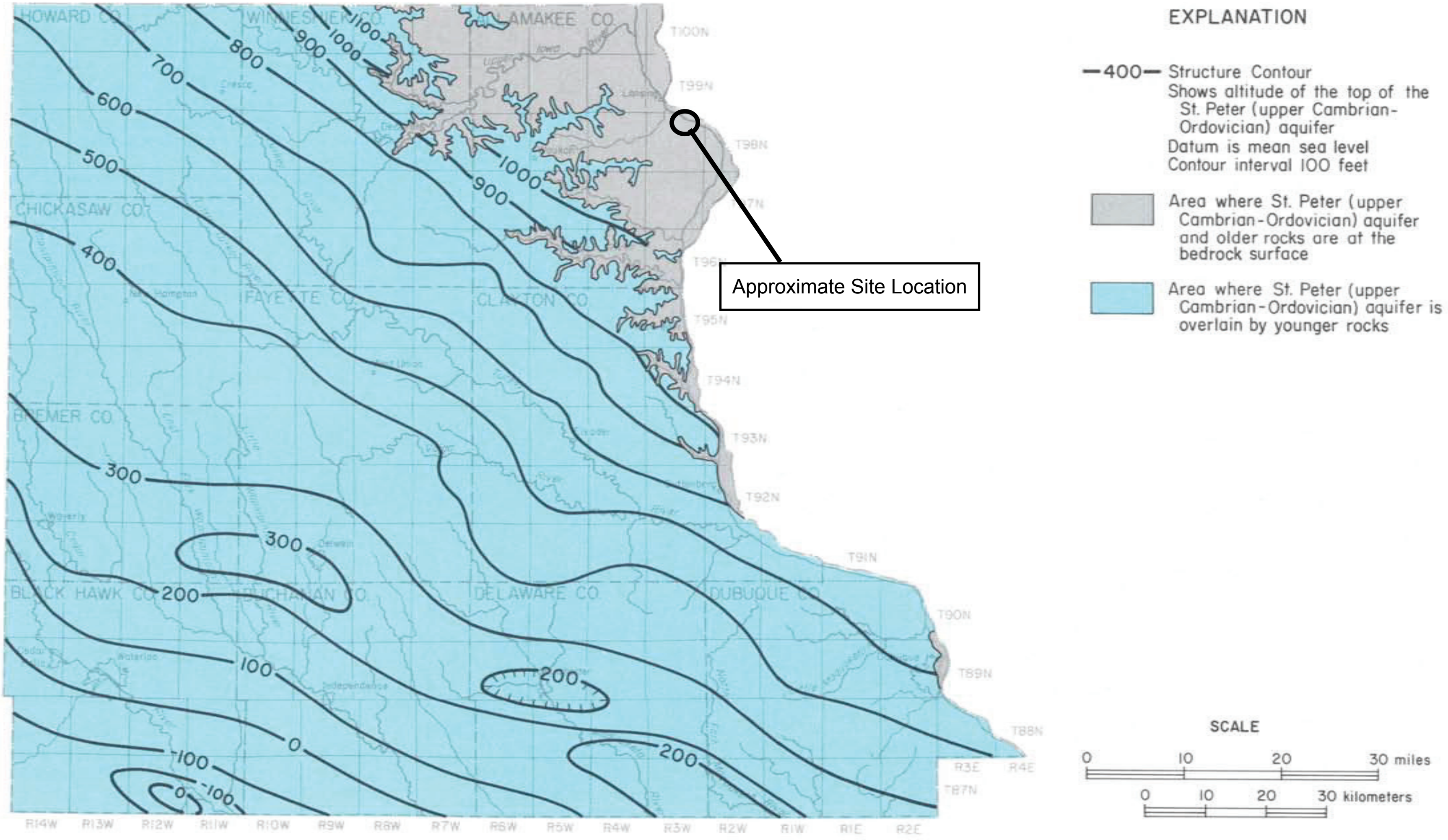
Figure 32. Hydrogeologic cross-sections

Sinkholes and Potential Karst Areas in



Approximate Lansing Ash Disposal Area Location

Source: Iowa Department of Natural Resources, Geodata, "Karst and Sinkholes in Iowa", December 14, 2017.



Approximate Site Location

Figure 38. Altitude of the top of the St. Peter (upper Cambrian-Ordovician) aquifer

Source: Horick, Paul J., Water Resources of Northeast Iowa, Iowa Department of Natural Resources Water Atlas Number 8, October

APPENDIX B

Liquefaction and Settlement Potential Evaluation

Liquefaction and Settlement Potential Evaluation

Based on the results of the site investigation borings and laboratory testing performed by BT2, Inc., the landfill site soils are not subject to liquefaction or settlement concerns for the performance of the landfill.

Liquefaction is the process by which a saturated, loose, cohesionless soil influenced by external forces suddenly loses its shear strength and behave as a fluid. The external forces result from ground motion from an earthquake. The landfill site soils in borings consist primarily of medium dense to very dense sands and gravels that are not subject to liquefaction. In addition, liquefaction is not a concern given the low magnitude (less than 0.04g, 2 percent in 50 years) of maximum ground accelerations expected in the area; see **Attachment B1**.

Settlement below a landfill can be a concern if the facility is underlain by extensive soft, fine-grained soils. Soft soils are subject to consolidation settlement depending on the load over the soft soils. The landfill site soils consist of medium dense to very dense sands and gravels that are not subject to consolidation settlement, so settlement is not a concern for the performance of the landfill.

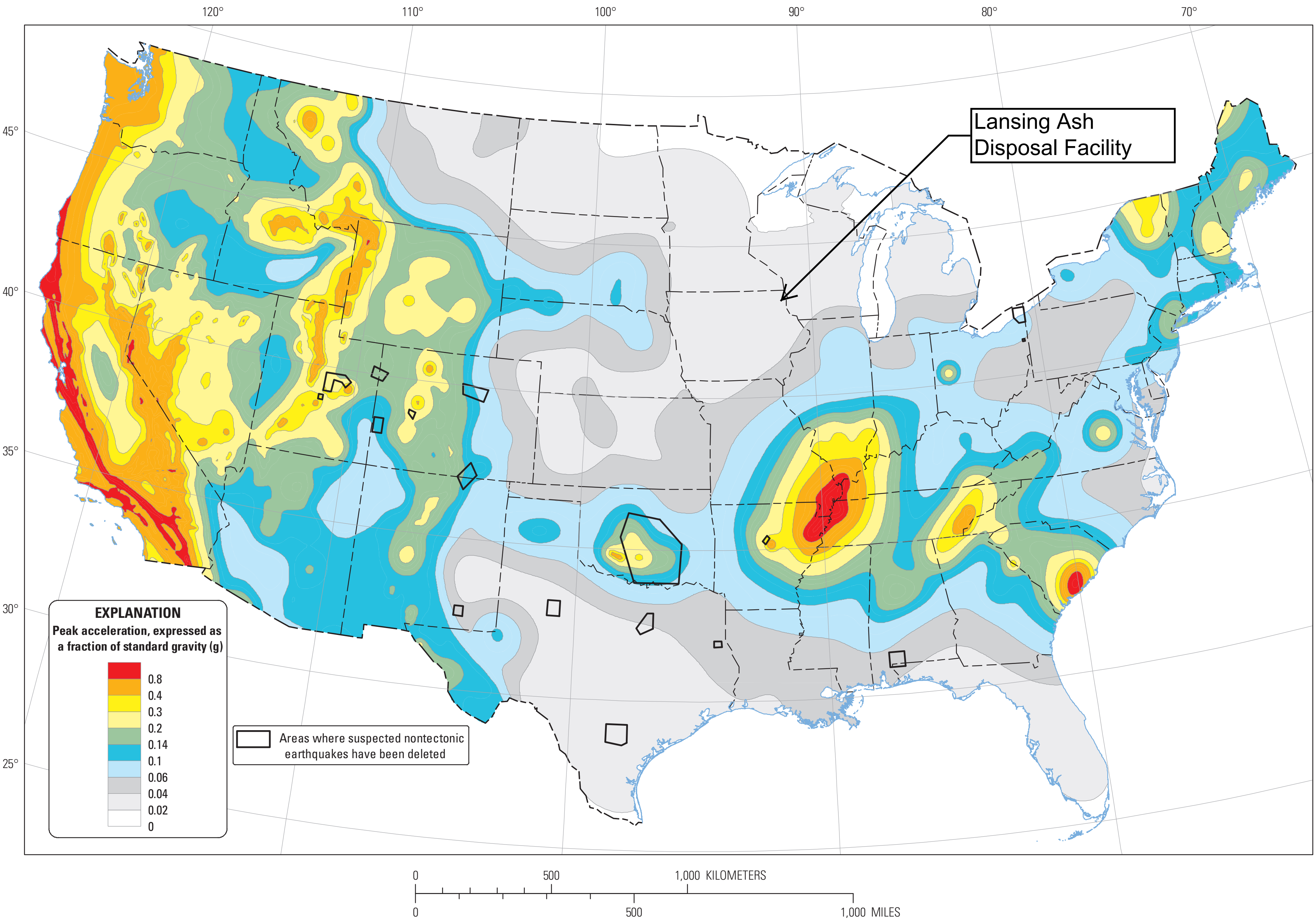
References

BT2, Inc., 2001, Ash Disposal Area Stability Evaluation, Alliant Energy – Lansing Power Station.

USGS seismic impact zones map website:
https://earthquake.usgs.gov/static/lfs/nshm/conterminous/2014/2014pga2pct.pdf

DLN/AJR/EJN

I:\25218081.00\Deliverables\Unstable Areas Demonstration\Appendices\Appendix B\B_Liquefaction and Settlement Potential Evaluation_0926.docx



Lansing Ash Disposal Facility

Two-percent probability of exceedance in 50 years map of peak ground acceleration

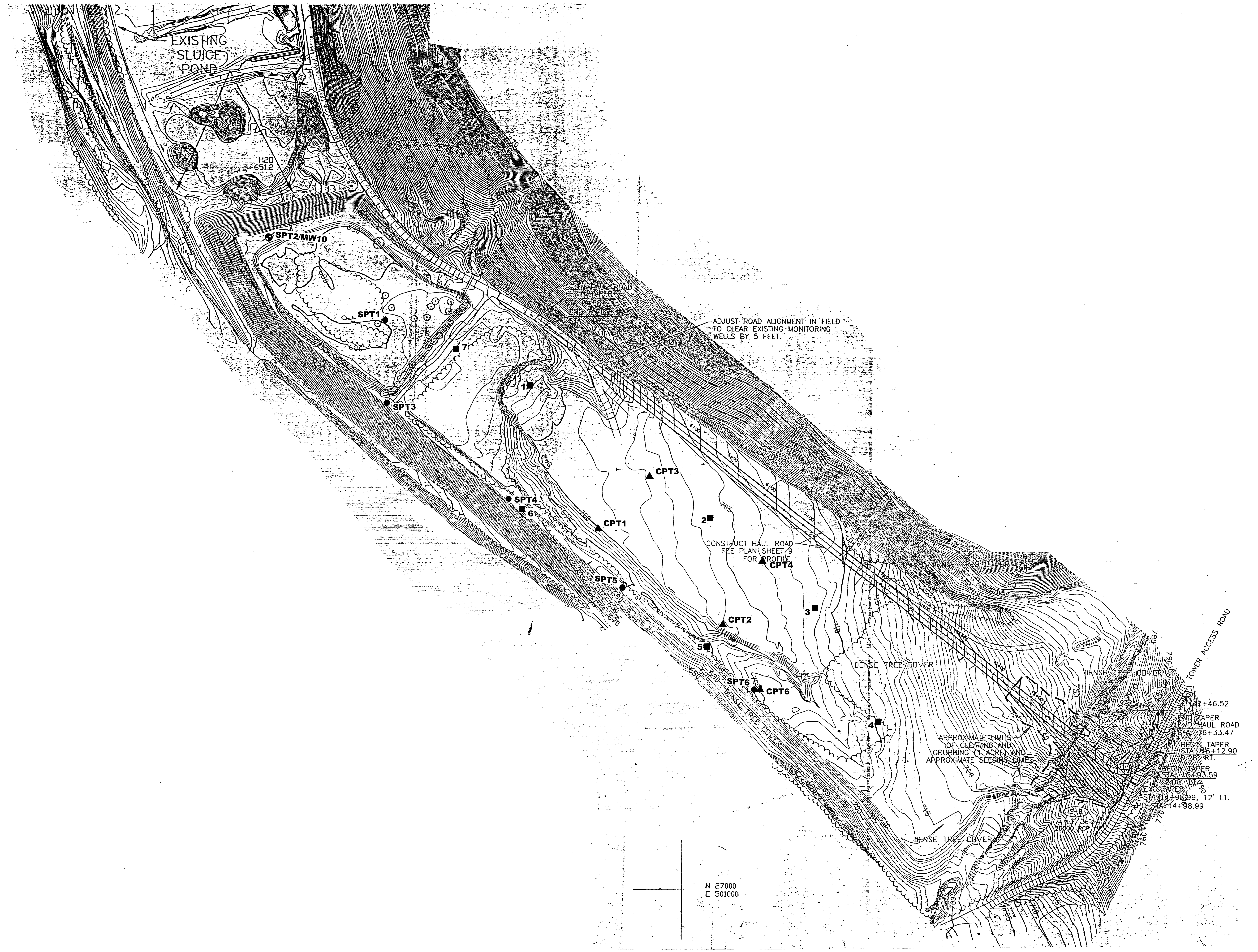
Source: USGS seismic impact zones map - https://earthquake.usgs.gov/static/lfs/nshm/conterminous/2014/2014pga2pct.pdf

APPENDIX C

Boring Locations and Boring Logs

ATTACHMENT B

SOIL BORING LOCATION MAP



N

LEGEND

1 ■	1996 BORING LOCATION
SPT1 ●	2000 BORING LOCATION
CPT1 ▲	CONE PENETRATION TEST LOCATION
SPT2/MW10 ⊕	WATER TABLE MONITORING WELL

NOTES:

1. BASE MAP OBTAINED FROM HOWARD R. GREEN COMPANY SHEET NO. 8 DATED MAY 1997, JOB NO. 717680J03.
2. LOCATIONS OF BORINGS 1–7 WERE OBTAINED FROM TERRACON BORING LOCATION DIAGRAM DATED SEPTEMBER 13, 1996, JOB NO. 06967025.
3. 2000 BORING AND CONE PENETRATION TEST LOCATIONS WERE SURVEYED BY KEITH NOTBOHM SURVEYING, MADISON, WISCONSIN, ON DECEMBER 6, 2000.

100 0 100

SCALE: 1" = 100'

BORING AND CONE TEST LOCATIONS

ASH DISPOSAL AREA
ALLIANT ENERGY
LANSING, IOWA

PROJECT NO. 1792
DRAWN BY: KP
CHECKED BY: DN
DRAWN: 12/20/00 REVISED: 12/20/00
J:\1792\TBLOCK1.DWG

BT² inc.

SHEET 1 OF 1

ATTACHMENT D

LOG OF TEST BORINGS (BOART LONGYEAR)
WELL DETAIL
LOG OF TEST BORING-GENERAL NOTES
UNIFIED SOIL CLASSIFICATION SYSTEM
ABANDONMENT FORMS

CGC Inc.

LOG OF TEST BORING

Project **Alliant Ash Landfill Expansion**

Location **Lansing, Iowa**

Boring No. **SPT-1**
Surface Elevation (ft) **680.1**
Job No. **C20207**
Sheet **1** of **1**

3011 PERRY STREET, MADISON, WIS. 53713 (608) 288-4100, FAX (608) 288-7887

SAMPLE

No.	TYPE	Rec (in.)	Moist	N
1	▮	16	M	4
2	▮	20	M	7
3	▮	24	M	2
4	▮	24	M	2
5	▮	24	M	2
6	▮	34	M	1
7	▮	24	M	1
8	▮	24	M	1
9	▮	34	M	1
10	▮	24	M	2
11	▮	24	M	1
12	▮	24	M	6

Depth (ft): 5, 10, 15, 20, 25, 30, 35

VISUAL CLASSIFICATION and Remarks

FILL: Very Loose to Loose, Black to Gray Fly Ash

End of Boring at 29.5 ft

Borehole backfilled with bentonite grout

SOIL PROPERTIES

qu (qa) (tsf)	W	LL	PL	P200

WATER LEVEL OBSERVATIONS

While Drilling ⊻ NW   Upon Completion of Drilling
Time After Drilling 3/4 hr
Depth to Water 22.5' ▼
Depth to Cave in

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

GENERAL NOTES

Start **11/27/00** End **11/27/00**
Driller **Boart** Chief **MM** Rig **811**
Logger **MM** Editor **WWW**
Drill Method **4 1/4" HSA**

CGC Inc.

LOG OF TEST BORING

Project Alliant Ash Landfill Expansion

Location Lansing, Iowa

Boring No. **SPT-2/MW-10**
Surface Elevation (ft) 684.6
Job No. C20207
Sheet 1 of 1

3011 PERRY STREET, MADISON, WIS. 53713 (608) 288-4100, FAX (608) 288-7887

SAMPLE

No.	TYPE	Rec (in.)	Moist	N	Depth (ft)
1	■	18	M	15	
2	■	22	M	15	
3	■	15	M	16	5
4	■	15	M	20	
5	■	20	M	21	10
6	■	15	M	38	
7	■	0	M	30	15
8	■	7	M	18	
9	■	13	M	63	20
10	■	7	M	50	
11	■	15	M	25	25
12	■	15	M	27	
					30
					35

VISUAL CLASSIFICATION and Remarks

FILL: Medium Dense to Dense, Brown to Gray Fine to Medium SAND, Some Silt and Gravel, Scattered Silt and/or Clay Layers (Dike Material)

Medium Dense to Very Dense, Light Brown to Gray-Brown SAND and GRAVEL, Some Silt, Scattered Cobbles (SM/GM) (Weathered Dolomite)

End of Boring at 30 ft
Set Well at 29 ft

SOIL PROPERTIES

qu (qa) (tsf)	W	LL	PL	P200

WATER LEVEL OBSERVATIONS

While Drilling ⊻ NW Upon Completion of Drilling ______
Time After Drilling ______ ______ ______ ______
Depth to Water ______ ______ ______ ______ ▼
Depth to Cave in ______ ______ ______ ______

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

GENERAL NOTES

Start 11/28/00 End 11/28/00
Driller Boart Chief MM Rig 811
Logger MM Editor WWW
Drill Method 4 1/4" HSA

CGC Inc.

LOG OF TEST BORING

Project Alliant Ash Landfill Expansion
Location Lansing, Iowa

Boring No. SPT-3
Surface Elevation (ft) 689.1
Job No. C20207
Sheet 1 of 1

3011 PERRY STREET, MADISON, WIS. 53713 (608) 288-4100, FAX (608) 288-7887

SAMPLE

No.	TYPE	Rec (in.)	Moist	N	Depth (ft)
1		18	M	17	
2		22	M	30	
3			M	19	5
4		18	M	32	
5		18	M	36	10
6		8	M	37	
7		7	M	68	15
8		10	M	44	
9		8	M	54	20
10		11	M	55	
11		12	M	70	25
12		12	M	62	
					30
					35

VISUAL CLASSIFICATION and Remarks

FILL: Medium Dense to Dense, Brown to Gray Fine to Medium SAND, Some Silt and Gravel, Scattered Silt and/or Clay Layers (Dike Material)

Dense to Very Dense, Light Brown to Gray-Brown SAND and GRAVEL, Some Silt, Scattered Cobbles (SM/GM) (Weathered Dolomite)

End of Boring at 29.5 ft

Borehole backfilled with bentonite chips

SOIL PROPERTIES

qu (qa) (tsf)	W	LL	PL	P200

WATER LEVEL OBSERVATIONS

While Drilling ∇ NW Upon Completion of Drilling ________
Time After Drilling
Depth to Water
Depth to Cave in

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

GENERAL NOTES

Start 11/28/00 End 11/28/00
Driller Boart Chief MM Rig 811
Logger MM Editor WWW
Drill Method 4 1/4" HSA

CGC Inc.

LOG OF TEST BORING

Project **Alliant Ash Landfill Expansion**

Location **Lansing, Iowa**

Boring No. **SPT-4**
Surface Elevation (ft) **693.3**
Job No. **C20207**
Sheet **1** of **1**

3011 PERRY STREET, MADISON, WIS. 53713 (608) 288-4100, FAX (608) 288-7887

SAMPLE						VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES				
No.	TYPE	Rec (in.)	Moist	N	Depth (ft)		qu (qa) (tsf)	W	LL	PL	P200
1		18	M	16		FILL: Medium Dense to Dense, Brown to Gray Fine to Medium SAND, Some Silt and Gravel, Scattered Silt and/or Clay Layers (Dike Material)					
2		16	M	20							
3		17	M	18	5						
4		15	M	23							
5		18	M	33	10						
6		15	M	29							
7		21	M	21	15						
8		187	M	24							
9		20	M	18	20						
10		12	M	18		Medium Dense to Very Dense, Light Brown to Gray-Brown SAND and GRAVEL, Some Silt, Scattered Cobbles (SM/GM) (Weathered Dolomite)					
11		5	M	50/5"	25						
12		12	M	78		Stiff Clay Seam near 29 ft	(1.5)				
					30	End of Boring at 29.5 ft Borehole backfilled with bentonite chips					
					35						

WATER LEVEL OBSERVATIONS

While Drilling ⊻ NW Upon Completion of Drilling
Time After Drilling
Depth to Water
Depth to Cave in

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

GENERAL NOTES

Start **11/28/00** End **11/28/00**
Driller **Boart** Chief **MM** Rig **811**
Logger **MM** Editor **WWW**
Drill Method **4 1/4" HSA**

CGC Inc.

LOG OF TEST BORING

Project **Alliant Ash Landfill Expansion**

Location **Lansing, Iowa**

Boring No. **SPT-5**
Surface Elevation (ft) **697.3**
Job No. **C20207**
Sheet **1** of **1**

3011 PERRY STREET, MADISON, WIS. 53713 (608) 288-4100, FAX (608) 288-7887

SAMPLE						VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES				
No.	TYPE	Rec (in.)	Moist	N	Depth (ft)		qu (qa) (tsf)	W	LL	PL	P200
1		18	M	11		FILL: Medium Dense to Dense, Brown to Gray Fine to Medium SAND, Some Silt and Gravel, Scattered Silt and/or Clay Layers (Dike Material)					
2		18	M	30							
3		18	M	44	5						
4		18	M	36							
5		12	M	12	10						
6		18	M	12							
7		15	M	23	15						
8		18	M	17							
9		18	M	15	20						
10		20	M	15		Medium Dense, Greenish Gray Sandy SILT, Trace Gravel (ML)					
11		16	M	26	25	Medium Dense, Light Brown to Gray-Brown SAND and GRAVEL, Some Silt, Scattered Cobbles (SM/GM) (Weathered Dolomite)					
12		21	M	23							
					30	End of Boring at 29.5 ft Borehole backfilled with bentonite chips					
					35						

WATER LEVEL OBSERVATIONS

While Drilling ⊻ NW Upon Completion of Drilling ________
Time After Drilling ________ ________ ________ ________
Depth to Water ________ ________ ________ ________
Depth to Cave in ________ ________ ________ ________

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

GENERAL NOTES

Start **11/28/00** End **11/28/00**
Driller **Boart** Chief **MM** Rig **811**
Logger **MM** Editor **WWW**
Drill Method **4 1/4" HSA**

CGC Inc.

LOG OF TEST BORING

Project **Alliant Ash Landfill Expansion**
Location **Lansing, Iowa**

Boring No. **SPT-6**
Surface Elevation (ft) **703.5**
Job No. **C20207**
Sheet **1** of **1**

3011 PERRY STREET, MADISON, WIS. 53713 (608) 288-4100, FAX (608) 288-7887

SAMPLE						VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES				
No.	TYPE	Rec (in.)	Moist	N	Depth (ft)		qu (qa) (tsf)	W	LL	PL	P200
1		21	M	3		FILL: Medium Stiff, Sandy Lean CLAY, Frequent Loose Sand & Silt Layers (CL) (Dike Material)					
2		24	M	14							
3		18	M	3	5		(1.0)				
4		17	M	11							
5		15	M	3	10						
6		13	M	1			(0.5)				
7		12	M	4	15		(0.75)				
8		0	M	2							
9		16	M	8	20		(1.0)				
10		18	M	8							
11		12	M	10	25						
12		12	M	16		Medium Dense, Black Sandy SILT, Trace Gravel (ML) (Possible Buried Topsoil)					
					30	End of Boring at 29.5 ft Borehole backfilled with bentonite chips					
					35						

WATER LEVEL OBSERVATIONS

While Drilling ⊻ NW   Upon Completion of Drilling ____
Time After Drilling
Depth to Water
Depth to Cave in

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

GENERAL NOTES

Start **11/28/00** End **11/28/00**
Driller **Boart** Chief **MM** Rig **811**
Logger **MM** Editor **WWW**
Drill Method **4 1/4" HSA**

CGC, Inc.

LOG OF TEST BORING
General Notes

Descriptive Soil Classification

GRAIN SIZE TERMINOLOGY

Soil Fraction	Particle Size	U.S. Standard Sieve Size
Boulders	Larger than 12"	Larger than 12"
Cobbles	3" to 12"	3" to 12"
Gravel: Coarse	3/4" to 3"	3/4" to 3"
Fine	4.76 mm to 3/4"	#4 to 3/4"
Sand: Coarse	2.00 mm to 4.76 mm	#10 to #4
Medium	0.42 to mm to 2.00 mm	#40 to #10
Fine	0.074 mm to 0.42 mm	#200 to #40
Silt	0.005 mm to 0.074 mm	Smaller than #200
Clay	Smaller than 0.005 mm	Smaller than #200

Plasticity characteristics differentiate between silt and clay.

GENERAL TERMINOLOGY

Physical Characteristics
Color, moisture, grain shape, fineness, etc.
Major Constituents
Clay, silt, sand, gravel
Structure
Laminated, varved, fibrous, stratified, cemented, fissured, etc.
Geologic Origin
Glacial, alluvial, eolian, residual, etc.

RELATIVE DENSITY

Term	"N" Value
Very Loose	0-4
Loose	4-10
Medium Dense	10-30
Dense	30-50
Very Dense	Over 50

RELATIVE PROPORTIONS OF OF COHESIONLESS SOILS

Proportional Term	Defining Range by Percentage of Weight
Trace	0%-5%
Little	5%-12%
Some	12%-35%
And	35%-50%

CONSISTENCY

Term	q_u-tons/sq. ft.
Very Soft	0.0 to 0.25
Soft	0.25 to 0.50
Medium	0.50 to 1.0
Stiff	1.0 to 2.0
Very Stiff	2.0 to 4.0
Hard	Over 4.0

ORGANIC CONTENT BY COMBUSTION METHOD

Soil Description	Loss on Ignition
Non Organic	Less than 4%
Organic Silt/Clay	4-12%
Sedimentary Peat	12-50%
Fibrous and Woody Peat	More than 50%

PLASTICITY

Term	Plastic Index
None to Slight	0-4
Slight	5-7
Medium	8-22
High to Very High	Over 22

The penetration resistance, N, is the summation of the number of blows required to effect two successive 6" penetrations of the 2" split-barrel sampler. The sampler is driven with a 140 lb. weight falling 30" and is seated to a depth of 6" before commencing the standard penetration test.

SYMBOLS

DRILLING AND SAMPLING

CS--Continuous Sampling
RC--Rock Coring: Size AW, BW, NW, 2"W
RQD--Rock Quality Designator
RB--Rock Bit
FT--Fish Tail
DC--Drove Casing
C--Casing: Size 2 1/2", NW, 4", HW
CW--Clear Water
DM--Drilling Mud
HSA--Hollow Stem Auger
FA--Flight Auger
HA--Hand Auger
COA--Clean-Out Auger
SS--2" Diameter Split-Barrel Sample
2ST--2" Diameter Thin-Walled Tube Sample
3ST--3" Diameter Thin-Walled Tube Sample
PT--3" Diameter Piston Tube Sample
AS--Auger Sample
WS--Wash Sample
PTS--Peat Sample
PS--Pitcher Sample
NR--No Recovery
S--Sounding
PMT--Borehole Pressuremeter Test
VS--Vane Shear Test
WPT--Water Pressure Test

LABORATORY TESTS

q_a--Penetrometer Reading, tons/sq. ft.
q_u--Unconfined Strength, tons/sq. ft.
W--Moisture Content, %
LL--Liquid Limit, %
PL--Plastic Limit, %
SL--Shrinkage Limit, %
LI--Loss on Ignition, %
D--Dry Unit Weight, lbs/cu. ft.
pH--Measure of Soil Alkalinity or Acidity
FS--Free Swell, %

WATER LEVEL MEASUREMENT

∇ --Water Level at time shown
NW--No Water Encountered
WD--While Drilling
BCR--Before Casing Removal
ACR--After Casing Removal
CW--Caved and Wet
CM--Caved and Moist

Note: Water level measurements shown on the boring logs represent conditions at the time indicated and may not reflect static levels, especially in cohesive soils.

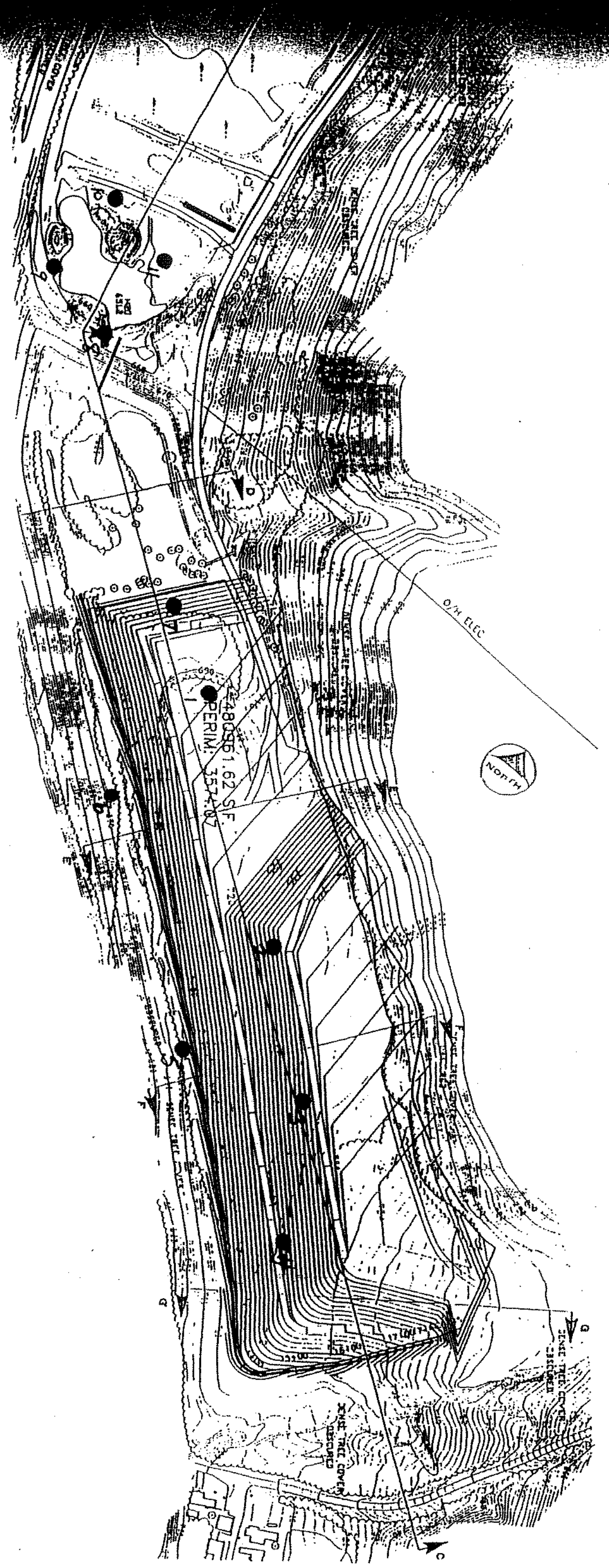
ATTACHMENT E

PREVIOUS TERRACON REPORT

APPENDIX

Terracon

[redacted]



Note: This diagram is not to scale and is intended for general location purposes only.

BORING LOCATION DIAGRAM
PROPOSED FLY ASH EMBANKMENT
INTERSTATE POWER COMPANY
LANSING, IOWA

Job #	Date	Drawn	Scale
06967025	9/13/96	by others	NTS

Terracon

Form 149—10-85

GENERAL NOTES

DRILLING & SAMPLING SYMBOLS:

SS : Split Spoon - 1⅜" I.D., 2" O.D., unless otherwise noted
ST : Thin-Walled Tube - 2" O.D., Unless otherwise noted
PA : Power Auger
HA : Hand Auger
DB : Diamond Bit - 4", N, B
AS : Auger Sample
HS : Hollow Stem Auger

PS : Piston Sample
WS : Wash Sample
FT : Fish Tail Bit
RB : Rock Bit
BS : Bulk Sample
PM : Pressuremeter
DC : Dutch Cone
WB : Wash Bore

Standard "N" Penetration: Blows per foot of a 140 pound hammer falling 30 inches on a 2 inch OD split spoon, except where noted.

WATER LEVEL MEASUREMENT SYMBOLS:

WL : Water Level
WCI : Wet Cave In
DCI : Dry Cave In
AB : After Boring

WS : While Sampling
WD : While Drilling
BCR : Before Casing Removal
ACR : After Casing Removal

Water levels indicated on the boring logs are the levels measured in the borings at the times indicated. In pervious soils, the indicated levels may reflect the location of groundwater. In low permeability soils, the accurate determination of ground water levels is not possible with only short term observations.

DESCRIPTIVE SOIL CLASSIFICATION:

Soil Classification is based on the Unified Soil Classification System and ASTM Designations D-2487 and D-2488. Coarse Grained Soils have more than 50% of their dry weight retained on a #200 sieve; they are described as: boulders, cobbles, gravel or sand. Fine Grained Soils have less than 50% of their dry weight retained on a #200 sieve; they are described as: clays, if they are plastic, and silts if they are slightly plastic or non-plastic. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse grained soils are defined on the basis of their relative in-place density and fine grained soils on the basis of their consistency. Example: Lean clay with sand, trace gravel, stiff (CL); silty sand, trace gravel, medium dense (SM).

CONSISTENCY OF FINE-GRAINED SOILS:

Unconfined Compressive Strength, Qu, psf	**Consistency**
< 500	Very Soft
500 - 1.000	Soft
1,001 - 2,000	Medium
2,001 - 4.000	Stiff
4,001 - 8,000	Very Stiff
8,001 -16.000	Hard
> -16,000	Very Hard

RELATIVE DENSITY OF COARSE-GRAINED SOILS:

N-Blows/ft.	**Relative Density**
0-3	Very Loose
4-9	Loose
10-29	Medium Dense
30-49	Dense
50-80	Very Dense
80+	Extremely Dense

RELATIVE PROPORTIONS OF SAND AND GRAVEL

Descriptive Term(s) (of Components Also Present in Sample)	**Percent of Dry Weight**
Trace	< 15
With	15 - 29
Modifier	> 30

RELATIVE PROPORTIONS OF FINES

Descriptive Term(s) (of Components Also Present in Sample)	**Percent of Dry Weight**
Trace	< 5
With	5 - 12
Modifier	> 12

GRAIN SIZE TERMINOLOGY

Major Component Of Sample	**Size Range**
Boulders	Over 12 in. (300mm)
Cobbles	12 in. to 3 in. (300mm to 75mm)
Gravel	3 in. to #4 sieve (75mm to 4.75mm)
Sand	#4 to #200 sieve (4.75mm to 0.075mm)
Silt or Clay	Passing #200 sieve (0.075mm)

Terracon

GENERAL NOTES

Sedimentary Rock Classification

DESCRIPTIVE ROCK CLASSIFICATION:

Sedimentary rocks are composed of cemented clay, silt and sand sized particles. The most common minerals are clay, quartz and calcite. Rock composed primarily of calcite is called limestone; rock of sand size grains is called sandstone, and rock of clay and silt size grains is called mudstone or claystone, siltstone, or shale. Modifiers such as shaly, sandy, dolomitic, calcareous, carbonaceous, etc. are used to describe various constituents. Examples: sandy shale; calcareous sandstone.

LIMESTONE	Light to dark colored, crystalline to fine-grained texture, composed of $CaCo_3$, reacts readily with HCl.
DOLOMITE	Light to dark colored, crystalline to fine-grained texture, composed of $CaMg(CO_3)_2$, harder than limestone, reacts with HCl when powdered.
CHERT	Light to dark colored, very fine-grained texture, composed of micro-crystalline quartz (SiO_2), brittle, breaks into angular fragments, will scratch glass.
SHALE	Very fine-grained texture, composed of consolidated silt or clay, bedded in thin layers. The unlaminated equivalent is frequently referred to as siltstone, claystone or mudstone.
SANDSTONE	Usually light colored, coarse to fine texture, composed of cemented sand size grains of quartz, feldspar, etc. Cement usually is silica but may be such minerals as calcite, iron-oxide, or some other carbonate.
CONGLOMERATE	Rounded rock fragments of variable mineralogy varying in size from near sand to boulder size but usually pebble to cobble size (½ inch to 6 inches). Cemented together with various cementing agents. Breccia is similar but composed of angular, fractured rock particles cemented together.

DEGREE OF WEATHERING:

SLIGHT	Slight decomposition of parent material on joints. May be color change.
MODERATE	Some decomposition and color change throughout.
HIGH	Rock highly decomposed, may be extremely broken.

Classification of rock materials has been estimated from disturbed samples.
Core samples and petrographic analysis may reveal other rock types.

UNIFIED SOIL CLASSIFICATION SYSTEM

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests[A]				Soil Classification	
				Group Symbol	Group Name[B]
Coarse-Grained Soils More than 50% retained on No. 200 sieve	Gravels More than 50% of coarse fraction retained on No. 4 sieve	Clean Gravels Less than 5% fines[C]	$Cu \geq 4$ and $1 \leq Cc \leq 3$[E]	GW	Well-graded gravel[F]
			$Cu < 4$ and/or $1 > Cc > 3$[E]	GP	Poorly graded gravel[F]
		Gravels with Fines More than 12% fines[C]	Fines classify as ML or MH	GM	Silty gravel[F, G, H]
			Fines classify as CL or CH	GC	Clayey gravel[F, G, H]
	Sands 50% or more of coarse fraction passes No. 4 sieve	Clean Sands Less than 5% fines[E]	$Cu \geq 6$ and $1 \leq Cc \leq 3$[E]	SW	Well-graded sand[I]
			$Cu < 6$ and/or $1 > Cc > 3$[E]	SP	Poorly graded sand[I]
		Sands with Fines More than 12% fines[D]	Fines classify as ML or MH	SM	Silty sand[G, H, I]
			Fines classify as CL or CH	SC	Clayey sand[G, H, I]
Fine-Grained Soils 50% or more passes the No. 200 sieve	Silts and Clays Liquid limit less than 50	inorganic	$PI > 7$ and plots on or above "A" line[J]	CL	Lean clay[K, L, M]
			$PI < 4$ or plots below "A" line[J]	ML	Silt[K, L, M]
		organic	$\frac{\text{Liquid limit — oven dried}}{\text{Liquid limit — not dried}} < 0.75$	OL	Organic clay[K, L, M, N]
					Organic silt[K, L, M, O]
	Silts and Clays Liquid limit 50 or more	inorganic	PI plots on or above "A" line	CH	Fat clay[K, L, M]
			PI plots below "A" line	MH	Elastic silt[K, L, M]
		organic	$\frac{\text{Liquid limit — oven dried}}{\text{Liquid limit — not dried}} < 0.75$	OH	Organic clay[K, L, M, P]
					Organic silt[K, L, M, Q]
Highly organic soils			Primarily organic matter, dark in color, and organic odor	PT	Peat

[A] Based on the material passing the 3-in. (75-mm) sieve.

[B] If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

[C] Gravels with 5 to 12% fines require dual symbols:
- GW-GM well-graded gravel with silt
- GW-GC well-graded gravel with clay
- GP-GM poorly graded gravel with silt
- GP-GC poorly graded gravel with clay

[D] Sands with 5 to 12% fines require dual symbols:
- SW-SM well-graded sand with silt
- SW-SC well-graded sand with clay
- SP-SM poorly graded sand with silt
- SP-SC poorly graded sand with clay

[E] $Cu = D_{60}/D_{10} \qquad Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}}$

[F] If soil contains ≥ 15% sand, add "with sand" to group name.

[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

[H] If fines are organic, add "with organic fines" to group name.

[I] If soil contains ≥ 15% gravel, add "with gravel" to group name.

[J] If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

[K] If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel", whichever is predominant.

[L] If soil contains ≥ 30% plus. No. 200 predominantly sand, add "sandy" to group name.

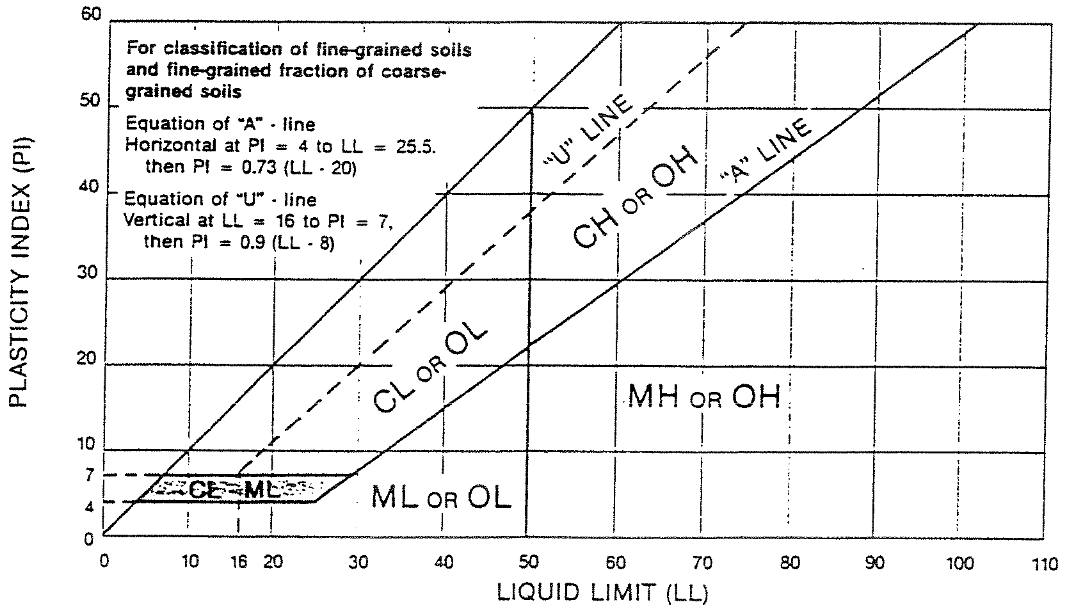
[M] If soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.

[N] $PI \geq 4$ and plots on or above "A" line.

[O] $PI < 4$ or plots below "A" line.

[P] PI plots on or above "A" line.

[Q] PI plots below "A" line.



Terracon

LOG OF BORING NO. 1

Page 1 of 2

OWNER INTERSTATE POWER COMPANY	ENGINEER HOWARD R. GREEN COMPANY
SITE LANSING, IOWA	PROJECT PROPOSED FLY ASH EMBANKMENT

GRAPHIC LOG	DESCRIPTION	DEPTH (FT.)	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, IN.	SAMPLES **SPT - N BLOWS / FT.	TESTS MOISTURE, %	TESTS DRY DENSITY PCF	TESTS UNCONFINED STRENGTH, PSF
0.5	4" Root Zone				HS					
	<u>FILL, LEAN CLAY, TRACE SAND & ORGANICS</u>, Dark Brown									
	- Trace brick @ 4 feet.	5		1	SS	10	4			
	∇				HS					
	<u>FILL, FLY ASH WITH FINE SAND</u>, Gray and Dark Gray									
		10		2	SS	18	2			
					HS					
13										
	<u>FILL, FINE SAND, TRACE FLY ASH & BRICK</u>, Brown	15		3	SS	18	3			
					HS					
17										
	<u>FILL, FINE SAND WITH SILT & LIMESTONE SEAMS, TRACE FLY ASH</u>, Gray	20		4	SS	18	1			
21					HS					
	<u>FILL, FLY ASH, TRACE SAND</u>, Gray	25		5	SS	18	2			
					HS					
		30		6	SS	18	0 WOH			
					HS					

Continued Next Page

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

Calibrated Hand Penetrometer*
CME 140 Lb. Auto. SPT Hammer **

WATER LEVEL OBSERVATIONS (FT.)		
WL	∇ 5.5	ws ▼ 34 (8/29/96)
WL	∇	▼
WL	WCI @ 36' (8/29/96)	

Terracon

BORING STARTED	8-28-96		
BORING COMPLETED	8-28-96		
RIG	#37	FOREMAN	REF
APPROVED	AMG	JOB #	06967025

LOG OF BORING NO. 1

Page 2 of 2

OWNER INTERSTATE POWER COMPANY	ENGINEER HOWARD R. GREEN COMPANY
SITE LANSING, IOWA	PROJECT PROPOSED FLY ASH EMBANKMENT

DESCRIPTION	DEPTH (FT.)	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, IN.	SAMPLES **SPT - N BLOWS / FT.	TESTS MOISTURE, %	TESTS DRY DENSITY PCF	TESTS UNCONFINED STRENGTH, PSF
⊻	35		7	SS	18	0 WOH			
FILL, FLY ASH, TRACE SAND, Gray				HS					
	40		8	SS	18	0 WOH			
44				HS					
44.5 LEAN CLAY, TRACE SAND, Brown and Dark Brown	45		9	SS	18	21			*2000
45.5 ***HIGHLY WEATHERED SANDSTONE, Light Brown									

BOTTOM OF BORING

***Classification estimated from disturbed samples. Core samples and petrographic analysis may reveal other rock types.

NOTE: Material descriptions are based on driller's visual classification only.

- WOH refers to Weight of Hammer.

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

Calibrated Hand Penetrometer*
CME 140 Lb. Auto. SPT Hammer **

WATER LEVEL OBSERVATIONS (FT.)		
WL ⊻ 5.5	WS ⊻ 34	(8/29/96)
WL ⊻	⊻	
WL	WCI @ 36' (8/29/96)	

Terracon

BORING STARTED			8-28-96
BORING COMPLETED			8-28-96
RIG	#37	FOREMAN	REF
APPROVED	AMG	JOB #	06967025

N3BLGE 67026 9/10/96

LOG OF BORING NO. 2

OWNER INTERSTATE POWER COMPANY	ENGINEER HOWARD R. GREEN COMPANY
SITE LANSING, IOWA	PROJECT PROPOSED FLY ASH EMBANKMENT

GRAPHIC LOG	DESCRIPTION	DEPTH (FT.)	USCS SYMBOL	SAMPLES				TESTS		
				NUMBER	TYPE	RECOVERY, IN.	**SPT - N BLOWS / FT.	MOISTURE, %	DRY DENSITY PCF	UNCONFINED STRENGTH, PSF
▨ 0.5	4" Root Zone FILL, LEAN CLAY, TRACE SAND & ORGANICS, Dark Brown				HS					
▨	FILL, FLY ASH, TRACE SAND, Dark Gray ∇	5		1	SS	10	4			
▨					HS					
▨ 10.5		10		2	SS	18	2			
▨					HS					
▨	FILL, FINE TO COARSE SAND WITH LIMESTONE PIECES & FLY ASH, Brown	15		3	SS	16	11			
▨					HS					
▨		20		4	SS	2	8			
▨					HS					
▨		25		5	SS	16	13			
▨ 28					HS					
▨	***FILL, EXTREMELY WEATHERED LIMESTONE, Light Gray	30		6	SS	10	13			
▨					HS					

Continued Next Page

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

Calibrated Hand Penetrometer*
CME 140 Lb. Auto. SPT Hammer **

WATER LEVEL OBSERVATIONS (FT.)			
WL	∇ 6	WS ▼	NONE (8/29/96)
WL	▼	▼	
WL	DCI @ 42' (8/29/96)		

Terracon

BORING STARTED			8-28-96
BORING COMPLETED			8-28-96
RIG	#37	FOREMAN	REF
APPROVED	AMG	JOB #	06967025

LOG OF BORING NO. 2

Page 2 of 2

OWNER INTERSTATE POWER COMPANY	ENGINEER HOWARD R. GREEN COMPANY
SITE LANSING, IOWA	PROJECT PROPOSED FLY ASH EMBANKMENT

				SAMPLES				TESTS		
GRAPHIC LOG	DESCRIPTION	DEPTH (FT.)	USCS SYMBOL	NUMBER	TYPE	RECOVERY, IN.	**SPT - N BLOWS / FT.	MOISTURE, %	DRY DENSITY PCF	UNCONFINED STRENGTH, PSF
	***<u>FILL, EXTREMELY WEATHERED LIMESTONE</u>, Light Gray	35		7	SS	16	0 WOH			
37.5					HS					
	<u>FILL, SILTY FINE SAND, TRACE LIMESTONE GRAVEL</u>, Dark Gray	40		8	SS	16	10			
					HS					
45		45		9	SS	18	3			
46	<u>FILL, FINE TO COARSE SAND</u>, Brown				HS					
	***<u>FILL, HIGHLY WEATHERED LIMESTONE & SANDSTONE</u>, Light Brown									
50		50		10	SS	12	10			*3000
	<u>CLAYEY SILT, TRACE SAND & LIMESTONE PIECES</u>, Brown Gray				HS					
55.5		55		11	SS	14	6			*1000

BOTTOM OF BORING

***Classification estimated from disturbed samples. Core samples and petrographic analysis may reveal other rock types.

NOTE: Material descriptions are based on driller's visual classification only.

- WOH refers to Weight of Hammer.

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

Calibrated Hand Penetrometer*
CME 140 Lb. Auto. SPT Hammer **

WATER LEVEL OBSERVATIONS (FT.)		
WL	▽ 6	WS ▼ NONE (8/29/96)
WL	▽	▼
WL	DCI @ 42' (8/29/96)	

Terracon

BORING STARTED			8-28-96
BORING COMPLETED			8-28-96
RIG	#37	FOREMAN	REF
APPROVED	AMG	JOB #	06967025

LOG OF BORING NO. 3

Page 1 of 2

OWNER INTERSTATE POWER COMPANY	ENGINEER HOWARD R. GREEN COMPANY
SITE LANSING, IOWA	PROJECT PROPOSED FLY ASH EMBANKMENT

GRAPHIC LOG	DESCRIPTION
0.5	3" Root Zone
	<u>FILL, LEAN CLAY, TRACE SAND & ORGANICS</u>, Dark Brown
6	<u>FILL, FLY ASH, TRACE SAND</u>, Dark Gray ∇
17	<u>FILL, LEAN CLAY, TRACE GRAVEL WITH SAND SEAMS</u>, Brown and Dark Brown
22	<u>CLAYEY SILT, TRACE SAND & WOOD</u>, Brown Gray
30.5	<u>LEAN CLAY, TRACE SAND, GRAVEL & ORGANICS</u>, Brown and Dark Brown
	<u>CLAYEY SILT, TRACE SAND WITH LIMESTONE GRAVEL PIECES & SAND SEAMS</u>, Brown

Continued Next Page

DEPTH (FT.)	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, IN.	SAMPLES **SPT - N BLOWS / FT.	TESTS MOISTURE, %	TESTS DRY DENSITY PCF	TESTS UNCONFINED STRENGTH, PSF
			HS					
5		1	SS	18	2			
			HS					
10		2	SS	14	6			
			HS					
15		3	SS	4	4			
			HS					
20		4	SS	16	5			*1500
			HS					
25		5	SS	18	7			*5000
			HS					
30		6	3" ST					
			HS					

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

Calibrated Hand Penetrometer*
CME 140 Lb. Auto. SPT Hammer **

WATER LEVEL OBSERVATIONS (FT.)		
WL	∇ 5	WS ▼ NONE (8/29/96)
WL	∇	▼
WL	DCI @ 31' (8/29/96)	

Terracon

BORING STARTED			8-28-96
BORING COMPLETED			8-28-96
RIG	#37	FOREMAN	REF
APPROVED	AMG	JOB #	06967025

LOG OF BORING NO. 3

Page 2 of 2

OWNER	ENGINEER
INTERSTATE POWER COMPANY	HOWARD R. GREEN COMPANY
SITE	PROJECT
LANSING, IOWA	PROPOSED FLY ASH EMBANKMENT

GRAPHIC LOG	DESCRIPTION	DEPTH (FT.)	USCS SYMBOL	SAMPLES				TESTS		
				NUMBER	TYPE	RECOVERY, IN.	**SPT - N BLOWS / FT.	MOISTURE, %	DRY DENSITY PCF	UNCONFINED STRENGTH, PSF
▨	CLAYEY SILT, TRACE SAND WITH LIMESTONE GRAVEL PIECES & SAND SEAMS, Brown			7	SS	16	9			*1500
36		35			HS					
⁘	FINE TO MEDIUM SAND, Brown			8	SS	18	25			
40.5		40								
	BOTTOM OF BORING									
	NOTE: Material descriptions are based on driller's visual classification only.									

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

Calibrated Hand Penetrometer*
CME 140 Lb. Auto. SPT Hammer **

WATER LEVEL OBSERVATIONS (FT.)			
WL	▽ 5	WS ▼	NONE (8/29/96)
WL	▽	▽	
WL	DCI @ 31' (8/29/96)		

Terracon

BORING STARTED	8-28-96		
BORING COMPLETED	8-28-96		
RIG	#37	FOREMAN	REF
APPROVED	AMG	JOB #	06967025

LOG OF BORING NO. 4

Page 1 of 1

OWNER INTERSTATE POWER COMPANY	ENGINEER HOWARD R. GREEN COMPANY
SITE LANSING, IOWA	PROJECT PROPOSED FLY ASH EMBANKMENT

GRAPHIC LOG	DESCRIPTION	DEPTH (FT.)	USCS SYMBOL	SAMPLES				TESTS		
				NUMBER	TYPE	RECOVERY, IN.	**SPT - N BLOWS / FT.	MOISTURE, %	DRY DENSITY PCF	UNCONFINED STRENGTH, PSF
4	6" Root Zone FILL, FINE TO COARSE SAND WITH GRAVEL, TRACE SILT, Brown and Dark Brown				HS					
	SANDY LEAN CLAY, TRACE ORGANICS, Dark Gray	5		1	SS	16	7			*2000
7					HS					
	CLAYEY SILT WITH SAND SEAMS, Medium Light Gray	10		2	3" ST					
					HS					
		15		3	3" ST					
17.5					HS					
	SILTY FINE TO MEDIUM SAND, TRACE GRAVEL WITH CLAY SEAMS, Brown	20		4	SS	18	6			
22					HS					
25.5	***WEATHERED LIMESTONE WITH SANDSTONE PIECES, Light Brown Gray	25		5	SS	12	35			

BOTTOM OF BORING

***Classification estimated from disturbed samples. Core samples and petrographic analysis may reveal other rock types.

NOTE: Material descriptions are based on driller's visual classification only.

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

Calibrated Hand Penetrometer*
CME 140 Lb. Auto. SPT Hammer **

WATER LEVEL OBSERVATIONS (FT.)	
WL ∇ NONE	WS ▼ NONE (8/29/96)
WL ∇	▼
WL DCI @ 17' (8/29/96)	

Terracon

BORING STARTED			8-28-96
BORING COMPLETED			8-28-96
RIG	#37	FOREMAN	REF
APPROVED	AMG	JOB #	06967025

LOG OF BORING NO. 5

Page 1 of 2

OWNER INTERSTATE POWER COMPANY	ENGINEER HOWARD R. GREEN COMPANY
SITE LANSING, IOWA	PROJECT PROPOSED FLY ASH EMBANKMENT

GRAPHIC LOG	DESCRIPTION	DEPTH (FT.)	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, IN.	SAMPLES **SPT - N BLOWS / FT.	TESTS MOISTURE, %	TESTS DRY DENSITY PCF	TESTS UNCONFINED STRENGTH, PSF*
	3" Root Zone				HS					
		5		1	SS	16	7			
	FILL, CLAYEY SILT, TRACE SAND & LIMESTONE GRAVEL, Brown and Gray				HS					
		10		2	3" ST					
					HS					
16		15		3	3" ST					
	FILL, SANDY LEAN CLAY & CLAYEY SILT, TRACE GRAVEL, Brown and Dark Brown				HS					
21		20		4	SS	18	7			
	SANDY LEAN CLAY, Medium Dark Brown				HS					
		25		5	3" ST					
28					HS					
	FINE TO COARSE SAND & LIMESTONE GRAVEL, Brown	30		6	SS	8	21			
32.5					HS					

Continued Next Page

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

Calibrated Hand Penetrometer*
CME 140 Lb. Auto. SPT Hammer **

WATER LEVEL OBSERVATIONS (FT.)			
WL	∇ NONE	WS ▼	NONE (8/29/96)
WL	∇	▼	
WL	DCI @ 29' (8/29/96)		

Terracon

BORING STARTED	8-28-96		
BORING COMPLETED	8-28-96		
RIG	#37	FOREMAN	REF
APPROVED	AMG	JOB #	06967025

LOG OF BORING NO. 5

Page 2 of 2

OWNER **INTERSTATE POWER COMPANY**	ENGINEER **HOWARD R. GREEN COMPANY**
SITE **LANSING, IOWA**	PROJECT **PROPOSED FLY ASH EMBANKMENT**

				SAMPLES				TESTS		
GRAPHIC LOG	DESCRIPTION	DEPTH (FT.)	USCS SYMBOL	NUMBER	TYPE	RECOVERY, IN.	**SPT - N BLOWS / FT.	MOISTURE, %	DRY DENSITY PCF	UNCONFINED STRENGTH, PSF
	***WEATHERED TO HARD 34.5 LIMESTONE, Light Brown Gray			7	SS	0	50/4"			
	BOTTOM OF BORING									

***Classification estimated from disturbed samples. Core samples and petrographic analysis may reveal other rock types.

NOTE: Material descriptions are based on driller's visual classification only.

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

Calibrated Hand Penetrometer*
CME 140 Lb. Auto. SPT Hammer **

WATER LEVEL OBSERVATIONS (FT.)			BORING STARTED	8-28-96		
WL	∇ NONE	WS ▼ NONE (8/29/96)	BORING COMPLETED	8-28-96		
WL	∇	▼	RIG	#37	FOREMAN	REF
WL	DCI @ 29' (8/29/96)		APPROVED	AMG	JOB #	06967025

Terracon

N3BLGE 67025 9/16/96

LOG OF BORING NO. 6

Page 1 of 2

OWNER INTERSTATE POWER COMPANY	ENGINEER HOWARD R. GREEN COMPANY
SITE LANSING, IOWA	PROJECT PROPOSED FLY ASH EMBANKMENT

DESCRIPTION	DEPTH (FT.)	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, IN.	SAMPLES **SPT - N BLOWS / FT.	TESTS MOISTURE, %	TESTS DRY DENSITY PCF	TESTS UNCONFINED STRENGTH, PSF°
4" Root Zone				HS					
	5		1	SS	16	27			
<u>FILL, FINE TO COARSE SAND WITH LIMESTONE PIECES, TRACE GRAVEL & SILT</u>, Brown and Gray				HS					
	10		2	SS	16	11			
				HS					
	15		3	SS	0	8			
17				HS					
	20		4	SS	10	4			
<u>FILL, SANDY LEAN CLAY, TRACE GRAVEL WITH LIMESTONE COBBLES</u>, Brown and Dark Brown				HS					
	25		5	SS	12	51			
				HS					
	30		6	SS	14	9			
32.5				HS					

Continued Next Page

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

Calibrated Hand Penetrometer°
CME 140 Lb. Auto. SPT Hammer **

WATER LEVEL OBSERVATIONS (FT.)	
WL ∇ 43	WS ▼ 42 (8/29/96)
WL ∇	▼
WL WCI @ 43' (8/29/96)	

Terracon

BORING STARTED	8-28-96
BORING COMPLETED	8-28-96
RIG #37	FOREMAN REF
APPROVED AMG	JOB # 06967025

LOG OF BORING NO. 6

Page 2 of 2

OWNER INTERSTATE POWER COMPANY	ENGINEER HOWARD R. GREEN COMPANY
SITE LANSING, IOWA	PROJECT PROPOSED FLY ASH EMBANKMENT

GRAPHIC LOG	DESCRIPTION	DEPTH (FT.)	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, IN.	SAMPLES **SPT - N BLOWS / FT.	TESTS MOISTURE, %	TESTS DRY DENSITY PCF	TESTS UNCONFINED STRENGTH, PSF
	***HIGHLY WEATHERED LIMESTONE WITH CLAY SEAMS, Light Brown	35		7	SS	10	23			
					HS					
		40		8	SS	8	14			
43	▼ ▽				HS					
	FINE TO MEDIUM SAND, Brown	45		9	SS	17	11			
50					HS					
	***WEATHERED LIMESTONE WITH SAND POCKETS, Light Gray Brown	50		10	SS	12	35			
					HS					
55.5		55		11	SS	16	42			

BOTTOM OF BORING

***Classification estimated from disturbed samples. Core samples and petrographic analysis may reveal other rock types.

NOTE: Material descriptions are based on driller's visual classification only.

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

Calibrated Hand Penetrometer*
CME 140 Lb. Auto. SPT Hammer **

WATER LEVEL OBSERVATIONS (FT.)				
WL	▽ 43	WS ▼ 42	(8/29/96)	
WL	▽	▼		
WL	WCI @ 43' (8/29/96)			

Terracon

BORING STARTED	8-28-96		
BORING COMPLETED	8-28-96		
RIG	#37	FOREMAN	REF
APPROVED	AMG	JOB #	06967025

N3BLGE 67025 9/16/96

LOG OF BORING NO. 7

Page 1 of 2

OWNER INTERSTATE POWER COMPANY	ENGINEER HOWARD R. GREEN COMPANY
SITE LANSING, IOWA	PROJECT PROPOSED FLY ASH EMBANKMENT

GRAPHIC LOG	DESCRIPTION	DEPTH (FT.)	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, IN.	SAMPLES **SPT - N BLOWS / FT.	TESTS MOISTURE, %	TESTS DRY DENSITY PCF	TESTS UNCONFINED STRENGTH, PSF
	3" Root Zone				HS					
	FILL, FINE TO COARSE SAND WITH GRAVEL, TRACE SILT & SHELLS, Brown	5		1	SS	14	15			
					HS					
	8									
	FILL, LEAN CLAY, TRACE ORGANICS WITH SAND SEAMS, Dark Gray	10		2	SS	18	3			
	12 ∇				HS					
		15		3	SS	18	1			
					HS					
	FILL, FLY ASH WITH SAND SEAMS, Gray	20		4	SS	18	0 WOH			
					HS					
	▼									
		25		5	SS	18	0 WOH			
					HS					
		30		6	SS	18	0 WOH			
					HS					

Continued Next Page

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

Calibrated Hand Penetrometer*
CME 140 Lb. Auto. SPT Hammer **

WATER LEVEL OBSERVATIONS (FT.)			
WL	∇ 12	WS	▼
WL	∇ 24	(2 HRS AB)	▼
WL			

Terracon

BORING STARTED			8-29-96
BORING COMPLETED			8-29-96
RIG	#37	FOREMAN	REF
APPROVED	AMG	JOB #	06967025

LOG OF BORING NO. 7

Page 2 of 2

OWNER	ENGINEER
INTERSTATE POWER COMPANY	HOWARD R. GREEN COMPANY
SITE	PROJECT
LANSING, IOWA	PROPOSED FLY ASH EMBANKMENT

GRAPHIC LOG	DESCRIPTION	DEPTH (FT.)	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, IN.	SAMPLES **SPT - N BLOWS / FT.	TESTS MOISTURE, %	TESTS DRY DENSITY PCF	TESTS UNCONFINED STRENGTH, PSF
▨	FILL, FLY ASH WITH SAND SEAMS, Gray									
35		35		7	SS	16	8			
▨	FILL, LEAN CLAY, TRACE SAND & ORGANICS, Dark Brown and Dark Gray				HS					
38.5										
▒	FINE TO COARSE SAND WITH GRAVEL, TRACE LIMESTONE PIECES, Brown	40		8	SS	12	7			
41	BOTTOM OF BORING									

NOTE: Material descriptions are based on driller's visual classification only.

- WOH refers to Weight of Hammer.

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

Calibrated Hand Penetrometer*
CME 140 Lb. Auto. SPT Hammer **

WATER LEVEL OBSERVATIONS (FT.)		
WL	⊻ 12	WS ⊻
WL	⊻ 24	(2 HRS AB) ⊻
WL		

Terracon

BORING STARTED			8-29-96
BORING COMPLETED			8-29-96
RIG	#37	FOREMAN	REF
APPROVED	AMG	JOB #	06967025

LOG OF BORING NO. 8

Page 1 of 1

OWNER INTERSTATE POWER COMPANY	ENGINEER HOWARD R. GREEN COMPANY
SITE LANSING, IOWA	PROJECT PROPOSED FLY ASH EMBANKMENT

GRAPHIC LOG	DESCRIPTION	DEPTH (FT.)	USCS SYMBOL	SAMPLES				TESTS		
				NUMBER	TYPE	RECOVERY, IN.	**SPT - N BLOWS / FT.	MOISTURE, %	DRY DENSITY PCF	UNCONFINED STRENGTH, PSF
▩	∇ FILL, SLUICE POND SETTLINGS (FINE FLY ASH), Black 9	5			PA					
▩	FILL, BOTTOM ASH MIXED WITH FINE SAND, Gray 17	10 15								
▨	SANDY LEAN CLAY, Brown 20	20								
	BOTTOM OF BORING NOTE: Material descriptions are based on driller's visual classification only.									

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

Calibrated Hand Penetrometer*
CME 140 Lb. Auto. SPT Hammer **

WATER LEVEL OBSERVATIONS (FT.)			
WL	∇ 1	WD	▼
WL	∇		▼
WL			

Terracon

BORING STARTED			8-29-96
BORING COMPLETED			8-29-96
RIG	#37	FOREMAN	REF
APPROVED	AMG	JOB #	06967025

LOG OF BORING NO. 9

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OWNER INTERSTATE POWER COMPANY	ENGINEER HOWARD R. GREEN COMPANY
SITE LANSING, IOWA	PROJECT PROPOSED FLY ASH EMBANKMENT

GRAPHIC LOG	DESCRIPTION	DEPTH (FT.)	USCS SYMBOL	SAMPLES				TESTS		
				NUMBER	TYPE	RECOVERY, IN.	**SPT - N BLOWS / FT.	MOISTURE, %	DRY DENSITY PCF	UNCONFINED STRENGTH, PSF
▨ 11	▽ FILL, SLUICE POND SETTLINGS BOTTOM ASH, SAND & HYDRATED FLY ASH, Black, Brown and Gray	5 10			PA					
▨ 20	FILL, SILTY BOTTOM ASH (LESS COARSE), Black	15 20								

NOTE: Material descriptions are based on driller's visual classification only.

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

Calibrated Hand Penetrometer*
CME 140 Lb. Auto. SPT Hammer **

WATER LEVEL OBSERVATIONS (FT.)		
WL	▽ 1	WD ▼
WL	▼	▼
WL		

Terracon

BORING STARTED			8-29-96
BORING COMPLETED			8-29-96
RIG	#37	FOREMAN	REF
APPROVED	AMG	JOB #	06967025

N3BLGE 67025 9/16/96

LOG OF BORING NO. 10

Page 1 of 1

OWNER INTERSTATE POWER COMPANY	ENGINEER HOWARD R. GREEN COMPANY
SITE LANSING, IOWA	PROJECT PROPOSED FLY ASH EMBANKMENT

GRAPHIC LOG	DESCRIPTION	DEPTH (FT.)	USCS SYMBOL	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: RECOVERY, IN.	SAMPLES: **SPT - N BLOWS / FT.	TESTS: MOISTURE, %	TESTS: DRY DENSITY PCF	TESTS: UNCONFINED STRENGTH, PSF
▨ 7	∇ FILL, ASH, BTM, TRACE HYDRATED FLY ASH, COARSE (GRAVELLY), Black	5			PA					
▨ 8	FILL, SILTY FINE FLY ASH									
▨ 20	FILL, GOOPY FINE FLY ASH, Black	10 15 20								
	BOTTOM OF BORING NOTE: Material descriptions are based on driller's visual classification only.									

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

Calibrated Hand Penetrometer*
CME 140 Lb. Auto. SPT Hammer **

WATER LEVEL OBSERVATIONS (FT.)		
WL	∇ 2	WD ▼
WL	∇	▼
WL		

Terracon

BORING STARTED	8-29-96		
BORING COMPLETED	8-29-96		
RIG	#37	FOREMAN	REF
APPROVED	AMG	JOB #	06967025

LOG OF BORING NO. 11

Page 1 of 1

OWNER INTERSTATE POWER COMPANY	ENGINEER HOWARD R. GREEN COMPANY
SITE LANSING, IOWA	PROJECT PROPOSED FLY ASH EMBANKMENT

GRAPHIC LOG	DESCRIPTION	DEPTH (FT.)	USCS SYMBOL	SAMPLES				TESTS			
				NUMBER	TYPE	RECOVERY, IN.	**SPT - N BLOWS / FT.	MOISTURE, %	DRY DENSITY PCF	UNCONFINED STRENGTH, PSF	
▨ 17	⊻ FILL, HYDRATED FLY ASH (GRAVELLY TEXTURE), Black and Brown - Finer goopy fly ash @ about 7 to 13 feet.	5 10 15			PA						
▨ 20	SANDY LEAN CLAY, Brown	20									
	BOTTOM OF BORING NOTE: Material descriptions are based on driller's visual classification only.										

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

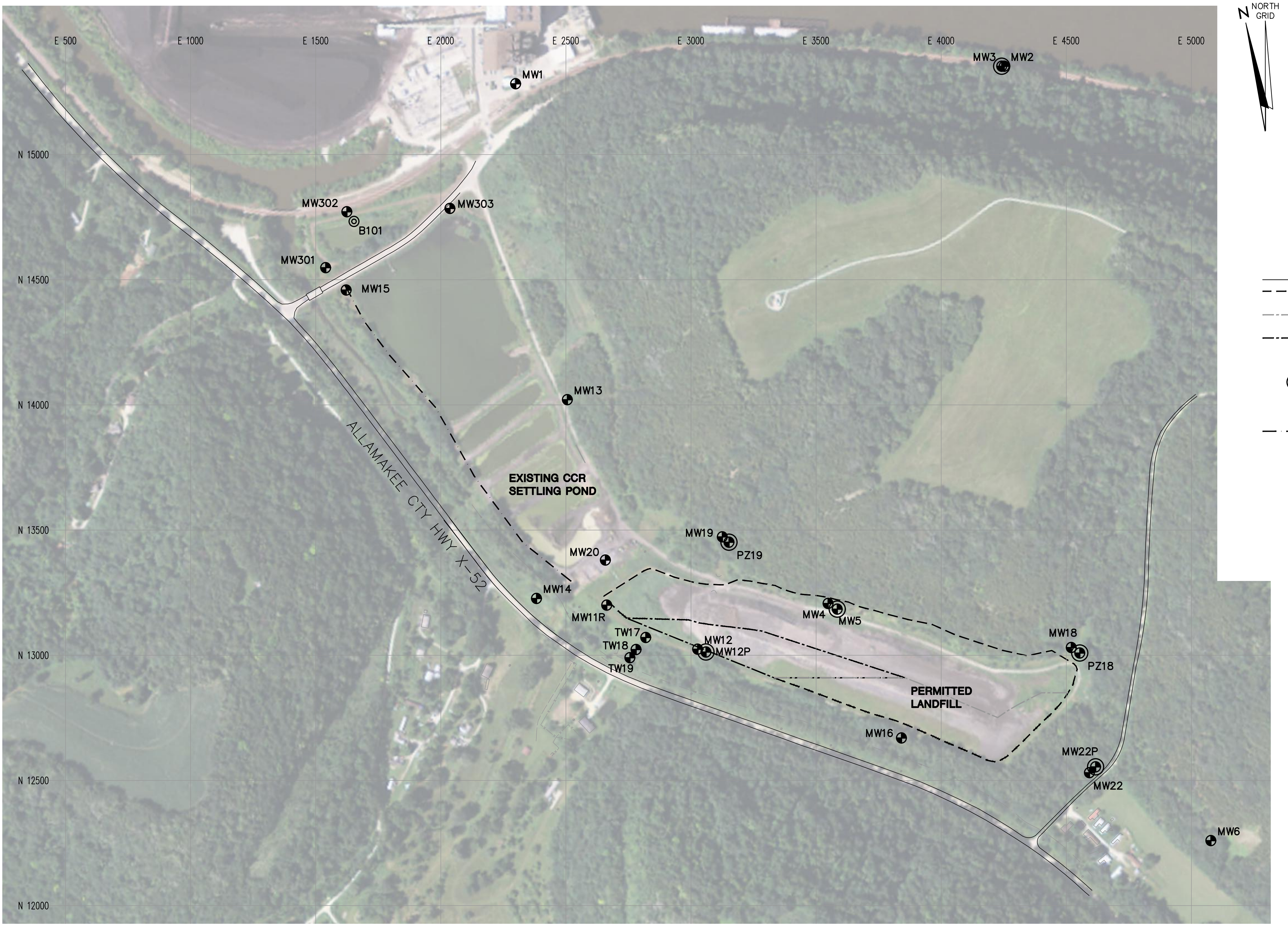
Calibrated Hand Penetrometer*
CME 140 Lb. Auto. SPT Hammer **

WATER LEVEL OBSERVATIONS (FT.)		
WL	⊻ 0.5	WD ⊻
WL	⊻	⊻
WL		

Terracon

BORING STARTED	8-29-96
BORING COMPLETED	8-29-96
RIG #37	FOREMAN REF
APPROVED AMG	JOB # 06967025

N3BLGE 67025 9/16/96



400 0 400

SCALE: 1" = 400'

LEGEND

— — — — —	APPROVED LIMITS OF WASTE
—·—·—·—	LIMITS OF PHASE 1 FINAL COVER
—·—·—·—	LIMITS OF PHASE 2 FINAL COVER
◉ MW17	EXISTING MONITORING WELL
◎ MW12P	EXISTING PIEZOMETER
◎ B101	SOIL & BEDROCK BORING
— · — · —	SLURRY WALL

NOTES:

1. MONITORING WELL LOCATIONS ARE APPROXIMATE.

PROJECT NO.	25216070.00	DRAWN BY:	AHB
DRAWN:	10/24/16	CHECKED BY:	MDB
REVISED:	11/28/16	APPROVED BY:	

ENGINEER

SCS ENGINEERS
2830 DAIRY DRIVE MADISON, WI 53718-6751
PHONE: (608) 224-2830

CLIENT

ALLIANT ENERGY.

INTERSTATE POWER AND LIGHT
2320 POWER PLANT DRIVE
LANSING, IA 52151-9733

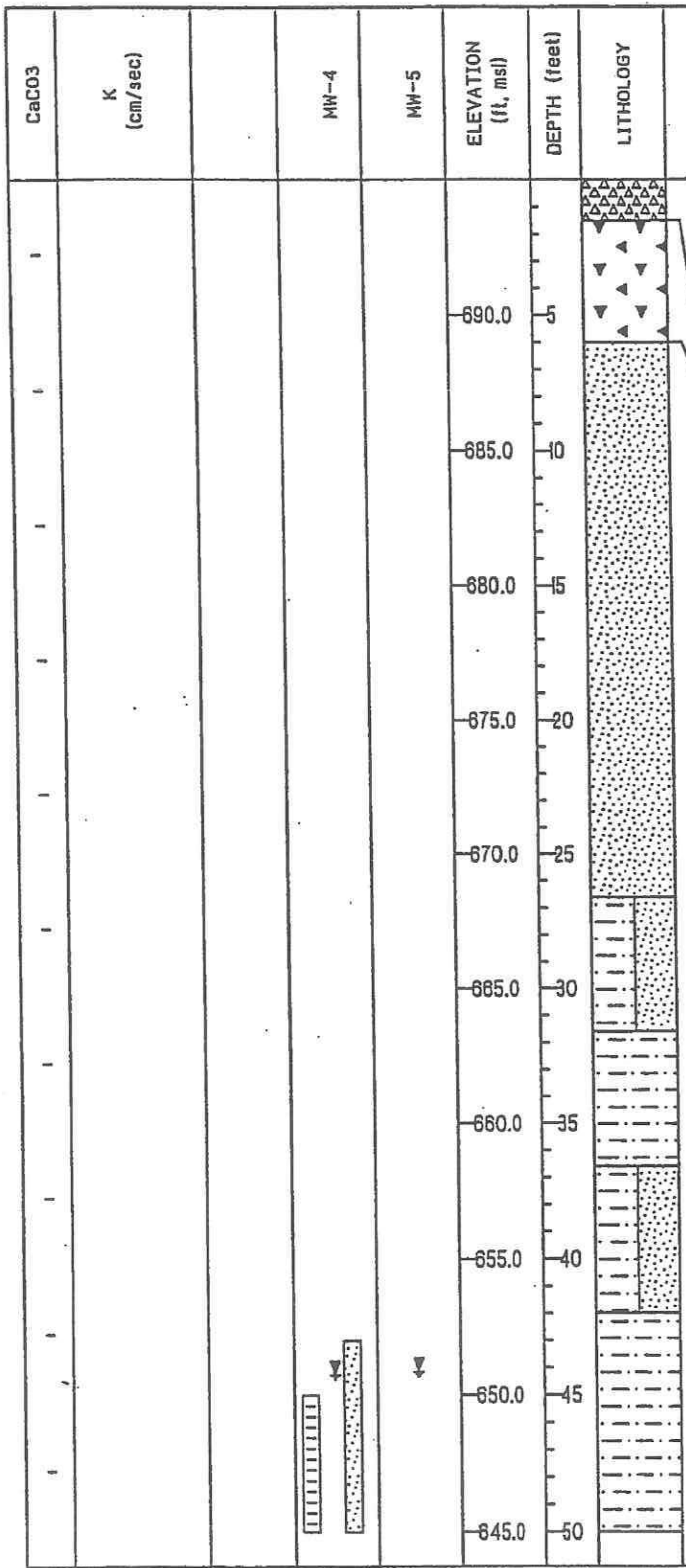
SITE

INTERSTATE POWER AND LIGHT
LANSING POWER STATION
COAL COMBUSTION RESIDUE LANDFILL
LANSING, IOWA

SITE PLAN

FIGURE
2

I:\2521□0□0.00\Drawings\□it□□an.dwg, 11/28/201□3:20:2□□M



MATERIALS DESCRIPTION

0.0 to 1.5 DISTURBED MATERIAL
Brown sandy silt. Fly ash mixed in lower 1.0 foot. Likely from cover placement operations for nearby ash area.

1.5 to 6.0 TALUS
Brown silty sand with quartz sandstone chunks.

6.0 to 78.5 INTERBEDDED SANDSTONE AND SILTSTONE
Sandstone is fine-grained, with quartz silt matrix, glauconitic. Siltstone contains minor amount of very fine quartz sand and glauconite. Sandstone is laminated light greenish gray with creamy color. Siltstone is light greenish gray.

Sandstone from 6.0 to 26.6.

Interbedded sandstone and siltstone from 26.6 to 31.6.

Siltstone from 31.6 to 36.6

Interbedded sandstone and siltstone from 36.6 to 42.0.

Siltstone from 42.0 to 58.5.

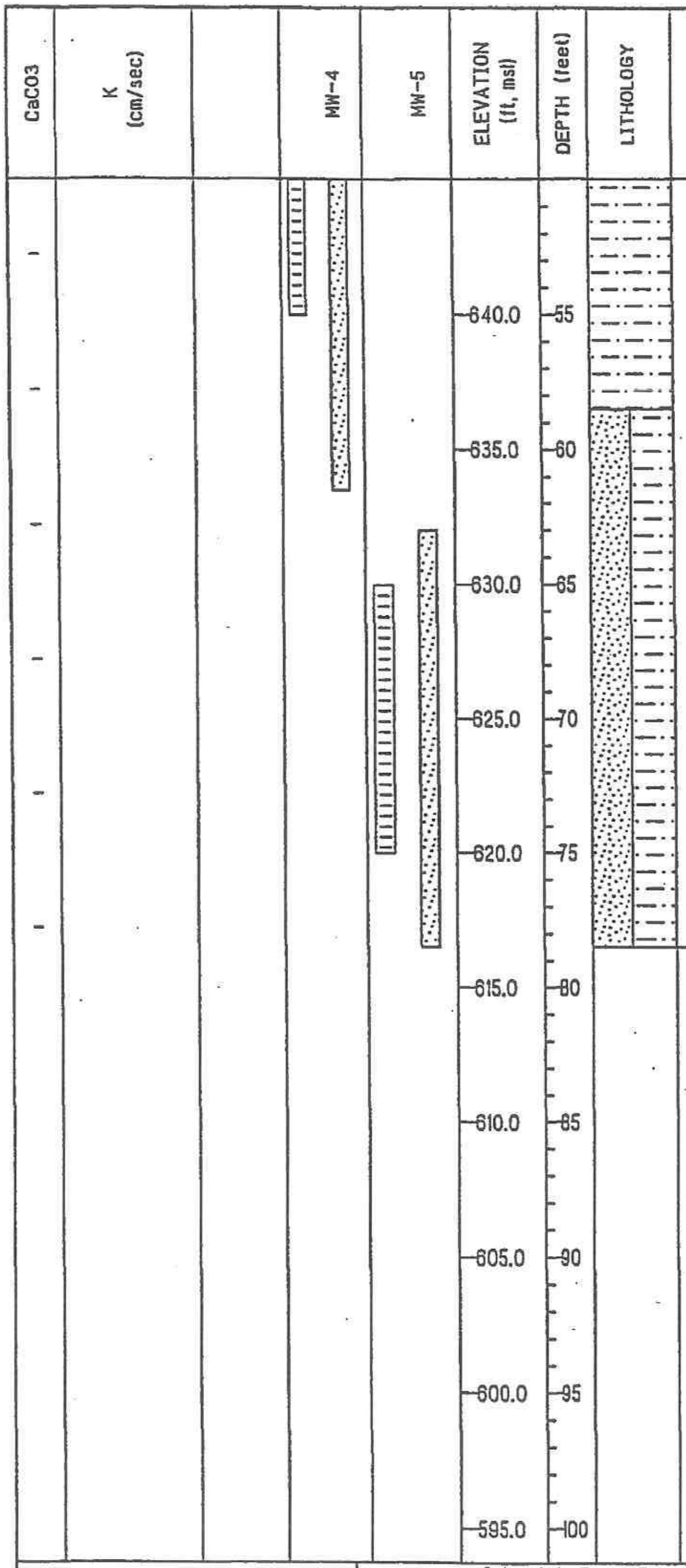
Howard R. Green Company
CONSULTING ENGINEERS

PROJECT Interstate Power Company
PROJECT NUMBER 717680-J
SURFACE ELEVATION 695.3 Feet MSL
TOTAL DEPTH OF HOLE 78.5 Feet

LOG OF MW-4, MW-5

LOCATION Lansing, Iowa
GEOLOGIST Barbara Torney

Page 2 of 2



MATERIALS DESCRIPTION

Interbedded sandstone and siltstone from 58.5 to 78.5.

Loss of air pressure for rotary drilling below 68.5, likely due to fractures.

Howard R. Green Company
CONSULTING ENGINEERS

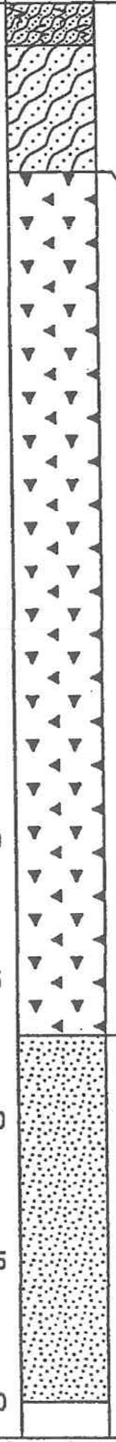
PROJECT Interstate Power Company
PROJECT NUMBER 717680-J
SURFACE ELEVATION 695.3 Feet MSL
TOTAL DEPTH OF HOLE 78.5 Feet

LOG OF MW-4, MW-5

LOCATION Lansing, Iowa
GEOLOGIST Barbara Torney

CaCO3	K (cm/sec)			MW-6	ELEVATION (ft, msl)	DEPTH (feet)
					734.0	5
					729.0	10
					724.0	15
					719.0	20
					714.0	25
					709.0	30
					704.0	35
					699.0	40
					694.0	45
					689.0	50

LITHOLOGY



MATERIALS DESCRIPTION

0.0 to 6.0 SILT
Topsoil developed in silt from 0.0 to 1.5. Topsoil is dark brown. Clayey silt, trace sand is loess or colluvium (slopewash) derived from loess. Medium brown, changing gradually to yellow brown below 5.0.

6.0 to 37.0 TALUS
Light brown sandy silt with dolomite chunks.

37.0 to 93.5 INTERBEDDED SANDSTONE AND SILTSTONE
Sandstone is fine-grained, with quartz silt matrix, glauconitic. Siltsone contains minor amount of very fine quartz sand and glauconite. Sandstone is laminated light greenish gray with creamy color. Siltstone is light greenish gray.

Sandstone from 37.0 to 58.0.

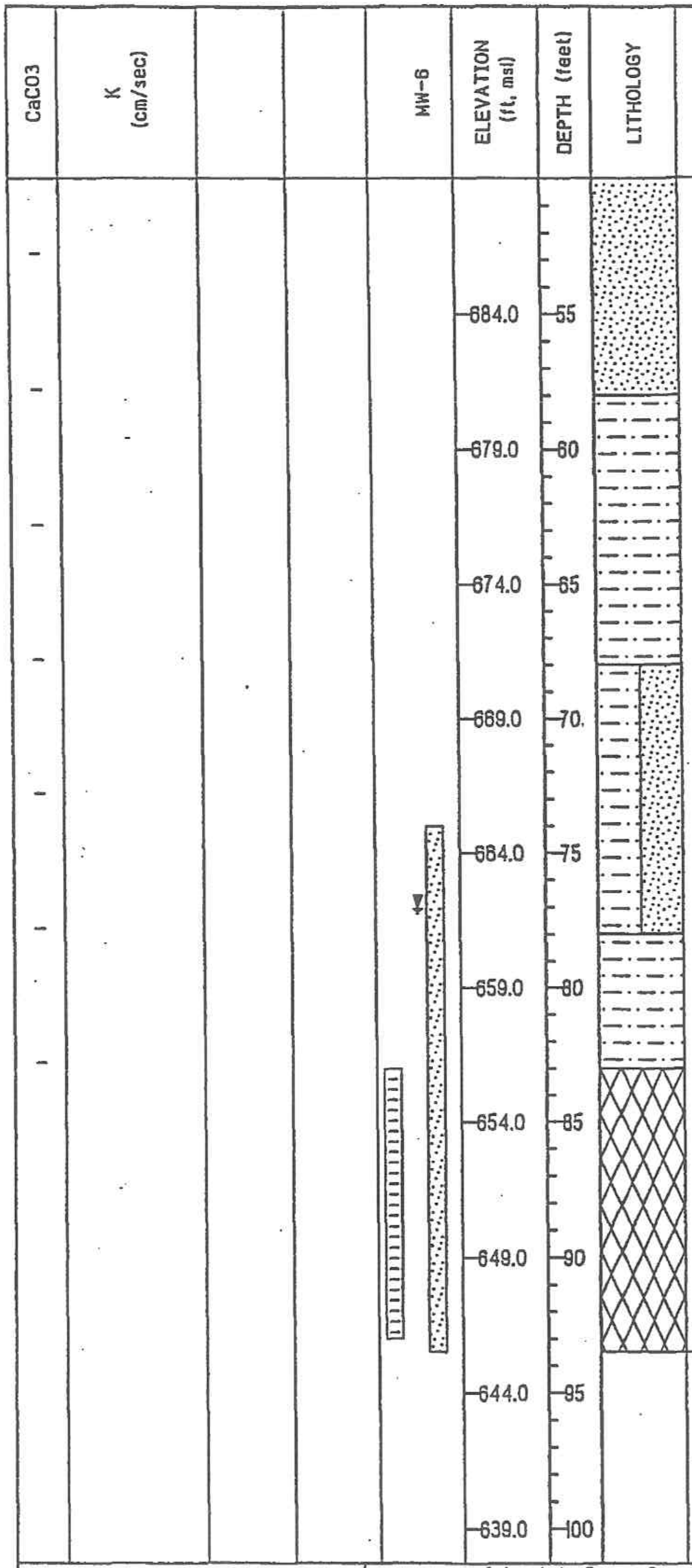
Howard R Green Company
CONSULTING ENGINEERS

PROJECT Interstate Power Company
PROJECT NUMBER 717680-J
SURFACE ELEVATION 739.3 Feet MSL
TOTAL DEPTH OF HOLE 93.5 Feet

LOG OF MW-6

LOCATION Lansing, Iowa
GEOLOGIST Barbara Torney

Page 2 of 2



MATERIALS DESCRIPTION

Siltstone from 58.0 to 68.0.

Interbedded sandstone and siltstone from 68.0 to 78.0.

Siltstone from 78.0 to 83.0

No sample from 83.0 to 93.5.
Likely interbedded sandstone and siltstone by comparison to same interval on log of MW-4 and MW-5. Lower few feet may be primarily siltstone.

Howard R. Green Company
CONSULTING ENGINEERS

PROJECT Interstate Power Company
PROJECT NUMBER 717680-J
SURFACE ELEVATION 739.3 Feet MSL
TOTAL DEPTH OF HOLE 93.5 Feet

LOG OF MW-6

LOCATION Lansing, Iowa
GEOLOGIST Barbara Torney

SCS ENGINEERS
Environmental Consultants and Contractors

SOIL BORING LOG INFORMATION

Route To: Watershed/Wastewater ☐ Waste Management ☐
Remediation/Redevelopment ☐ Other ☐

Page 1 of 5

Facility/Project Name Alliant Lansing SCS#: 25214156	License/Permit/Monitoring Number 03-SDP-05-01P	Boring Number MW-18

Boring Drilled By: Name of crew chief (first, last) and Firm Mike Mueller Cascade Drilling	Date Drilling Started 7/13/2016	Date Drilling Completed 7/15/2016	Drilling Method sonic

Unique Well No.	DNR Well ID No.	Common Well Name MW-18	Final Static Water Level Feet	Surface Elevation 768.7 Feet	Borehole Diameter 6.0 in

Local Grid Origin ☐ (estimated: ☐) or Boring Location ☒
State Plane 13,105 N, 4,553 E S/C/N
SW 1/4 of SE 1/4 of Section 2, T 98 N, R 3 W
Lat ___° ___' ___"
Long ___° ___' ___"
Local Grid Location ☐ N Feet ☐ S ☐ E Feet ☐ W

Facility ID	County Allamakee	Civil Town/City/ or Village Lansing, Iowa

Sample									Soil Properties					
Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
				SILT WITH SAND, dark brown (10YR 3/3), fine grained sand.										
			1											
			2											
S1	32									M				
			3											
			4											
					ML									
			5											
			6	Same as above except, very dark grayish brown (10YR 3/2).										
S2			7							M				
	40													
			8											
			9	POORLY GRADED SAND, dark yellowish brown (10YR 4/4), fine to medium grained.										
S3										M				
			10											
			11											
			12											
S4	24				SP					W				
			13											
			14											
			15											
S5			16							M				

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature for Kyle Kramer	Firm SCS Engineers 2830 Dairy Drive Madison, WI 53711	Tel: (608) 224-2830 Fax:

SCS ENGINEERS
Environmental Consultants and Contractors

SOIL BORING LOG INFORMATION SUPPLEMENT
Form 4400-122A

Boring Number MW-18

Page 2 of 5

Sample		Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Soil Properties					RQD/ Comments
Number and Type	Length Att. & Recovered (in)								Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200	
					SP									
			17	SILTY GRAVEL WITH SAND, light yellowish brown (10YR 6/4), medium to coarse grained gravel, weathered sandstone bedrock.										
			18											
S6					GM					M				
			19											
			20	SANDSTONE, brownish yellow (10YR 6/6), very weak, fine grained, massive, poorly cemented, loose sand.										
			21											
			22											
S7	60									M				<4" intactcore.
			23											
			24											
			25											
			26											
			27											
S8	60									M				
			28											
			29											
			30	Same as above except, very pale brown (10YR 7/4).										
			31											
			32											
S9	60									M				
			33											
			34											
			35											
			36											
			37											
S10	-									M				Samples (S14-S30) could not be bagged and recovery was not measured.
			38											
			39											
			40											
			41											
			42											

Boring Number MW-18

Sample									Soil Properties					
Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
S11	60		43	SANDSTONE, brownish yellow (10YR 6/6), very weak, fine grained, massive, poorly cemented, loose sand. *(continued)*						M				
			44											
			45											
			46											
			47	Same as above except, very pale brown (10YR 7/4).										
S12	60		48							M				
			49											
			50											
			51											
			52											
S13	60		53							M				
			54											
			55											
			56											
			57											
S14	-		58							M				
			59											
			60											
			61											
S15	-		62							M				
	-		63											
S16	-		64							D				
			65											
			66											
S17	-		67							D				
			68											
			69	Same as above except, light greenish gray (5G 7/1).										

SOIL BORING LOG INFORMATION SUPPLEMENT
Form 4400-122A

Boring Number MW-18

Sample									Soil Properties					
Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
S18	-		70	SANDSTONE, brownish yellow (10YR 6/6), very weak, fine grained, massive, poorly cemented, loose sand. *(continued)*						D				
			71	Same as above except, greenish gray (5GY 6/1).										
			72											
S19	-		73							M				
			74											
S20	-		75	Same as above except, yellowish brown (2.5Y 6/4).						M				
S21	-		76							M				
			77	Same as above except, olive (5Y 5/4).										
			78											
S22	-		79							M				
			80	Same as above except, greenish gray (5GY 6/1) secondary color-light yellowish brown (2.5Y 6/4).										
			81											
			82											
S23	-		83							M				
			84											
			85											
			86											
			87											
S24	-		88							M				
			89											
			90											
			91											
			92											
S25	-		93							M				
			94											
			95											
			96											

Boring Number MW-18

Sample									Soil Properties					
Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
				SANDSTONE, brownish yellow (10YR 6/6), very weak, fine grained, massive, poorly cemented, loose sand. *(continued)*										
S26	-		97	Same as abov except, pale green (5G 6/2) secondary color-yellowish brown (10YR 5/8).						M				
			98											
			99											
			100	Same as above except, grayish green (5G 5/2) secondary color-brownish yellow (10YR 6/6).										
			101											
S27	-		102							M				
			103											
			104	Same as above except, pale green (5G 6/2) secondary color-yellowish brown (10YR 5/8).										
S28	-		105							M				
			106	Same as above except, olive (5Y 4/4).										
			107											
S29	-		108							M				
			109											
			110	Same as above except, grayish green (5G 4/2).										
			111											
			112											
S30	-		113							M				
			114											
			115											
				End of boring at 115.5 ft bgs.										

SCS ENGINEERS

Environmental Consultants and Contractors

SOIL BORING LOG INFORMATION

Route To: Watershed/Wastewater ☐ Waste Management ☐
Remediation/Redevelopment ☐ Other ☐

Page 1 of 4

Facility/Project Name Alliant Lansing SCS#: 25214156	License/Permit/Monitoring Number	Boring Number MW-19

Boring Drilled By: Name of crew chief (first, last) and Firm Paul Dickinson Cascade Drilling	Date Drilling Started 9/4/2014	Date Drilling Completed 9/8/2014	Drilling Method rotary/core

Unique Well No.	DNR Well ID No.	Common Well Name MW-19	Final Static Water Level Feet	Surface Elevation 713.7 Feet	Borehole Diameter 42158.0 in

Local Grid Origin ☒ (estimated: ☐) or Boring Location ☐
State Plane N, E S/C/N
NE 1/4 of SW 1/4 of Section 2, T 98 N, R 3 W
Lat ° ' "
Long ° ' "
Local Grid Location
13474 Feet ☒ N ☐ S
3073.28 Feet ☒ E ☐ W

Facility ID	County Allamakee	Civil Town/City/ or Village Lansing, Iowa

Sample: Number and Type	Sample: Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Soil Properties: Standard Penetration	Soil Properties: Moisture Content	Soil Properties: Liquid Limit	Soil Properties: Plasticity Index	Soil Properties: P 200	RQD/ Comments
			1 2		ML									Area disturbed by leveling, nearby topsoil is grayish brown silty sand
S1	24	6 6 8 33	3 4	SILT with SAND, medium brown, massive, sand is very fine to fine, trace gravel at 4.5'						M				
S2	5	100/0.7	5	SANDSTONE, tan, 2mm to 5mm horizontal laminations						M				
			6 7 8 9 10 11	LIMESTONE and SANDSTONE, tan to light gray, interbedded, fine to medium grained, fresh to slightly decomposed, competent, intensely fractured, limestone has trace vugs										
Run 1	16/96		12 13 14 15 16											Run 1 all gravel TCR=17% SCR=0% MCR=0% RQD=very poor

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature	Firm SCS Engineers 2830 Dairy Drive Madison, WI 53718	Tel: (608)224-2830 Fax:

Boring Number MW-19

Sample		Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Soil Properties					RQD/ Comments
Number and Type	Length Att. & Recovered (in)								Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200	
				SANDSTONE, tan, 2mm to 5mm horizontal laminations *(continued)*										
			17											
			18											
			19	SANDSTONE and SILTSTONE, yellowish brown to gray, interbedded, sandstone is fine to medium grained, 1mm to 3cm laminations, fresh to moderately decomposed, competent, intensely fractured										
			20											
			21											
			22											
Run 2	24/84		23											Run 2 TRC=29% SCR=21% MCR=0% RQD=very poor
			24											
			25											
			26											
			27											
			28											
			29											
			30											
Run 3	24/120		31											Run 2 TCR=20% SCR=14% MCR=0% RQD=very poor
			32											
			33											
			34											
			35											
			36	SANDSTONE, yellowish tan, with gray, black, pinkish brown mottles, weak, fine to medium grained, laminated, slightly decomposed, slightly desintegrated, very intensely fractured										
			37											
			38											
Run 4	27/60		39											Run 4 TCR=45% SCR=32% MCR=0% RQD=very poor
			40											
			41	SANDSTONE, light gray and yellowish tan, trace black, weak, fine to medium grained, laminated, laminations mostly horizontal but are ~ 15° off horizontal at ~ 42', slightly disintegrated, intensely fractured										
			42											

Boring Number MW-19

Sample									Soil Properties					
Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
			43	SANDSTONE, tan, 2mm to 5mm horizontal laminations *(continued)*										
Run 5	24/60		44											Run 5 TCR=40% SCR=28% MCR=0% RQD=poor
			45											
			46	SANDSTONE, tan to yellowish tan and black, weak to very weak, fine to medium grained, laminated, very decomposed, with SILTSTONE layers less than or equal to 1mm thick										
			47											
			48											
Run 6	8/60		49											Run 6 TCR= 13% SCR=3% MCR=0% RQD=very poor
			50											
			51	SANDSTONE, gray and tan, trace black, very weak, fine to medium grained, fresh to slightly decomposed, slightly disintegrated, very intensely fractured										
			52											
			53											
Run 7	20/60		54											Run 7 TCR=33% SCR=15% MCR=8% RQD=very poor
			55											
			56	SANDSTONE, light to dark gray with some orangey brown and tan, very weak to weak, medium grained, siltstone laminations, stringers and mottles <5mm thick, fresh to slightly decomposed, competent, intensely fractured										
			57											
			58											
Run 8	30/60		59											Run 8 TCR=50% SCR=37% MCR=0% RQD=very poor
			60											
			61											
			62											
			63											
Run 9	0		64											
			65											
			66	SANDSTONE, dark gray, very weak, greenish gray shale/siltstone mottles up to 0.5cm in diameter, moderately decomposed										
			67											
			68											
Run 10	4/60		69											Standing Water @ 67'

Boring Number MW-19

Sample									Soil Properties					
Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
			70	SANDSTONE, tan, 2mm to 5mm horizontal laminations *(continued)*										Run 10 TCR=7% SCR=3% MCR=0% RQD=very poor
			71	SHALEY SANDSTONE, brownish yellow (10YR 6/0), very weak to weak, competent sandstone layers are brownish yellow, shaley layers are olive (5Y 5/3), brownish yellow and black mottled sandstone is fine to medium grained, sandstone intervals are laminated (1mm to 5mm), shaley intervals (>1cm), fresh to lightly decomposed, very intensely fractured										
			72											
			73											
			74											
Run 11	6/96		75											Run 11 TCR=6% SCR=22% MCR=0% RQD=very poor
			76											
			77											
			78											
			79	End of boring @ 79' Ream with 6" rotary, install MW19 to 77'										

SCS ENGINEERS
Environmental Consultants and Contractors

SOIL BORING LOG INFORMATION

Route To: Watershed/Wastewater ☐ Waste Management ☐
Remediation/Redevelopment ☐ Other ☐

Page 1 of 4

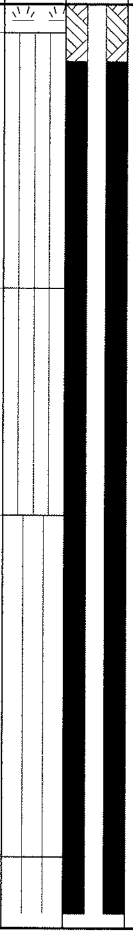
Facility/Project Name Alliant Lansing SCS#: 25214156	License/Permit/Monitoring Number 03-SDP-05-01P	Boring Number MW-22P

Boring Drilled By: Name of crew chief (first, last) and Firm Mike Mueller Cascade Drilling	Date Drilling Started 7/16/2016	Date Drilling Completed 7/16/2016	Drilling Method sonic

Unique Well No.	DNR Well ID No.	Common Well Name MW-22P	Final Static Water Level Feet	Surface Elevation 700.3 Feet	Borehole Diameter 6.0 in

Local Grid Origin ☐ (estimated: ☐) or Boring Location ☒
State Plane 12,386 N, 4,453 E S/C/N
SW 1/4 of SE 1/4 of Section 2, T 98 N, R 3 W
Lat ° ' "
Long ° ' "
Local Grid Location
Feet ☐ N ☐ S Feet ☐ E ☐ W

Facility ID	County Allamakee	Civil Town/City/ or Village Lansing, Iowa



Sample									Soil Properties					
Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
				TOPSOIL.										
S1	60		1 2 3 4	SILT WITH SAND, very dark grayish brown (10YR 3/2), trace coarse gravel.	ML					M				
S2	60		5 6 7 8	SILT, very dark grayish brown (10YR 3/2).	ML					M				
S3			9 10 11	SILTY SAND, dark yellowish brown (10YR 3/4), weathered sandstone bedrock.						M				
S4	35		12 13 14	Trace coarse gravel.	SM					M				
			15 16	SILTY SAND WITH GRAVEL, yellowish brown (10YR 5/4), coarse 2" gravel, weathered sandstone bedrock.	SM									

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature for Kyle Kramer	Firm SCS Engineers 2830 Dairy Drive Madison, WI 53711 Tel: (608) 224-2830 Fax:

SCS ENGINEERS
Environmental Consultants and Contractors

SOIL BORING LOG INFORMATION SUPPLEMENT
Form 4400-122A

Boring Number MW-22P

Page 2 of 4

Sample									Soil Properties					
Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
				SILTY SAND WITH GRAVEL, yellowish brown (10YR 5/4), coarse 2" gravel, weathered sandstone bedrock. *(continued)*										
			17											
S5	60									D				
			18											
			19											
			20											
			21											
			22											
S6	60									D				
			23											
			24											
			25											
			26											
			27											
S7	60									D				
			28											
			29											
					SM									
			30											
			31											
			32											
S8	60									D				
			33											
			34											
			35											
			36											
			37											
S9	60									M				
			38											
			39											
			40											
			41											
			42											

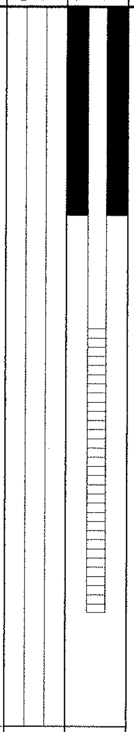
SOIL BORING LOG INFORMATION SUPPLEMENT
Form 4400-122A

Boring Number MW-22P

Sample										Soil Properties				
Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
S10	60		43	SILTY SAND WITH GRAVEL, yellowish brown (10YR 5/4), coarse 2" gravel, weathered sandstone bedrock. *(continued)*						S				wl @ 39.5 ft bgs.
			44											
			45		SM									
S11			46							S				
			47											
	60		48	SILTY SAND, olive (5Y 4/3), fine grained sand, poorly cemented weathered sandstone bedrock.										
S12			49							D				
			50	Same as above except, dark greensih gray (5GY 4/1).										
			51											
S13	36		52							D				
			53											
S14	24		54							D				
			55											
			56											
			57											
S15	60		58		SM					D				
			59											
			60											
			61											
			62											
			63											
S16	84		64							D				
			65											
			66											
			67	Same as above except, light olive brown (2.5Y 5/6).										
			68											
S17			69							D				

Boring Number MW-22P

Sample									Soil Properties					
Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth In Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	U S C S	Graphic Log	Well Diagram	PID/FID	Standard Penetration	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
	72		70	SILTY SAND, olive (5Y 4/3), fine grained sand, poorly cemented weathered sandstone bedrock. *(continued)*										
			71	Same as above except, greenish gray (5GY 5/1).										
S18			72							D				
			73											
			74	Same as above except, grayish green (5G 4/2).										
S19	48		75							D				
			76		SM									
			77											
			78											
			79											
S20	60		80							D				
			81											
			82	End of boring 82 ft bgs.										



APPENDIX D

Slope Stability Evaluation

BT² inc.
Environmental Engineering and Science

January 2, 2001

Ms. Linda Lynch
Alliant Energy
222 W. Washington Ave.
P.O. Box 192
Madison, WI 53701-0192

Mr. Ted Shonts
Alliant Energy
2320 Power Plant Drive
Lansing, IA 52151-7539

SUBJECT: Ash Disposal Area Stability Evaluation
Alliant Energy - Lansing Power Station
BT² Project #1792

Dear Ms. Lynch and Mr. Shonts:

This report provides the results of a slope stability evaluation for the proposed expansion of the ash disposal area at the Lansing Power Station. Slope stability had been identified as a potential barrier to vertical expansion of the ash disposal area in previous analysis performed by Terracon Consultants, Inc. Terracon noted the apparent very loose/soft condition of the existing ash fill based on conventional borings using the standard penetration test. In BT²'s Ash Fill Options Evaluation report, dated August 22, 2000, we indicated that vertical expansion of the ash disposal area was potentially feasible and could provide cost-effective ash disposal by filling over the existing plateau area without raising the height of the existing perimeter soil berm. To evaluate this option further, we recommended additional borings, field cone penetration testing of the ash fill to assess its strength and settlement characteristics, geotechnical laboratory testing, and analysis of the slope stability of the proposed expansion.

The stability analysis was performed by CGC, Inc., of Madison, Wisconsin, under subcontract to BT². CGC's report is attached to this letter.

Description of the Proposed Expansion

The stability analysis was performed based on the preliminary design for the disposal area expansion that was outlined in the previous Ash Fill Options Evaluation report. A map and two cross sections showing the proposed design are attached as **Figures 1** through **3**. The key design and operations assumptions that were incorporated into the analysis are based on the following project description.

For the proposed vertical expansion of the existing ash disposal area, ash fill will be placed over the existing ash in the plateau area. Construction of the expansion will involve preparing the site for ash filling, constructing surface water drainage controls, dredging and dewatering the ash, hauling and placing the ash, and constructing a final cover. Unlike the existing ash disposal area, construction of the vertical expansion will not involve construction of perimeter berms with relatively steep exterior side slopes, to be filled with ash. Instead, ash will be placed within the limits of the existing berms, at a maximum slope of 4 horizontal to 1 vertical (4H:1V).

The two attached cross sections (**Figures 2** and **3**) show the proposed expansion with 4H:1V slopes on both the berm side and the bluff side of the disposal area. A possible additional expansion area is also shown, based on filling against the existing bluff. With the additional expansion option, ash would be placed at a 4H:1V slope up to approximately the center of the existing disposal area, then at a 20H:1V slope up to the bluff. For the stability analysis, CGC made the conservative assumption that the additional expansion area would be filled.

Prior to placing ash in the plateau area, vegetated areas will be cleared and grubbed and any existing cover soils will be removed and stockpiled for reuse in the new final cover. The existing ash stock piles will be leveled and compacted prior to placement of new ash. In addition, berms and other stormwater diversion structures will be constructed to divert water away from active fill areas. We assume that ash will be placed to a maximum height of approximately 40 feet above the existing elevation of the plateau area. Following the placement of the ash, a final cover consisting of 2 feet of compacted soil, 6 inches of rooting zone soil, and 6 inches of top soil will be placed, along with seed, fertilizer, and mulch. The cover could be constructed over several years as phases of the landfill expansion are filled to final grades.

We assume that the ash will be dredged and dewatered on-site near the ash sluice pond. We also assume that ash dredging, dewatering, hauling, and placement will occur over a 10-year period.

Stability Analysis

The stability analysis for the proposed vertical expansion of the ash disposal area included the following tasks:

- Additional borings in the perimeter soil berm (5) and one boring in the ash fill;
- Installation of a water table monitoring well in the berm;
- Cone penetration tests in the ash (4) and one test in the soil berm;
- Geotechnical laboratory testing; and
- Slope stability analysis (3 sections).

The results of the stability analysis indicate that vertical expansion of the ash disposal area is geotechnically feasible. For the proposed design, the analysis indicated safety factors ranging from 1.55 to 2.32, based on varying sets of assumed soil parameters. Minimum acceptable safety factors for a project of this type are in the range of 1.3 to 1.5. The only scenario that yielded a safety factor of less than 2 was based on the results from a boring near the south end of the berm, where some soft soils were encountered in the berm.

The details of the analysis methods and results are presented in the attached report prepared by CGC.

Recommendations

If Alliant chooses to move forward with the development of the proposed expansion of the ash disposal area, the next step in the process will be to obtain IDNR approval. To complete the permitting process, we anticipate that the following steps will need to be implemented:

- Obtain current topography of the plateau area.
- Locate existing monitoring wells and install new monitoring wells (assume two new wells).
- Collect hydrogeologic data and groundwater quality data.
- Evaluate operational options for ash dredging, dewatering, and hauling/placement.
- Develop design/permit drawings and specifications and perform associated calculations.
- Prepare feasibility report presenting data collected and analysis performed with updated construction cost estimate.
- Submit permit application to IDNR.

The estimated cost for these tasks in our August 2000 Ash Fill Options Evaluation report was $37,400.

It may also be beneficial to discuss the potential expansion with the IDNR and obtain clarification and approval for the scope of work to be performed for the permit application.

If you have any questions concerning this report, please call us at 608-224-2830. We appreciate the opportunity to work with you on this project.

Sincerely,
BT^2, Inc.

Sherren Clark, P.G., P.E.
Project Manager

Debra Nelson
Debra Nelson, P.E.
Senior Engineer

Attachments: Figures 1-3
Appendix - CGC Report

cc: Mike Schultz, CGC

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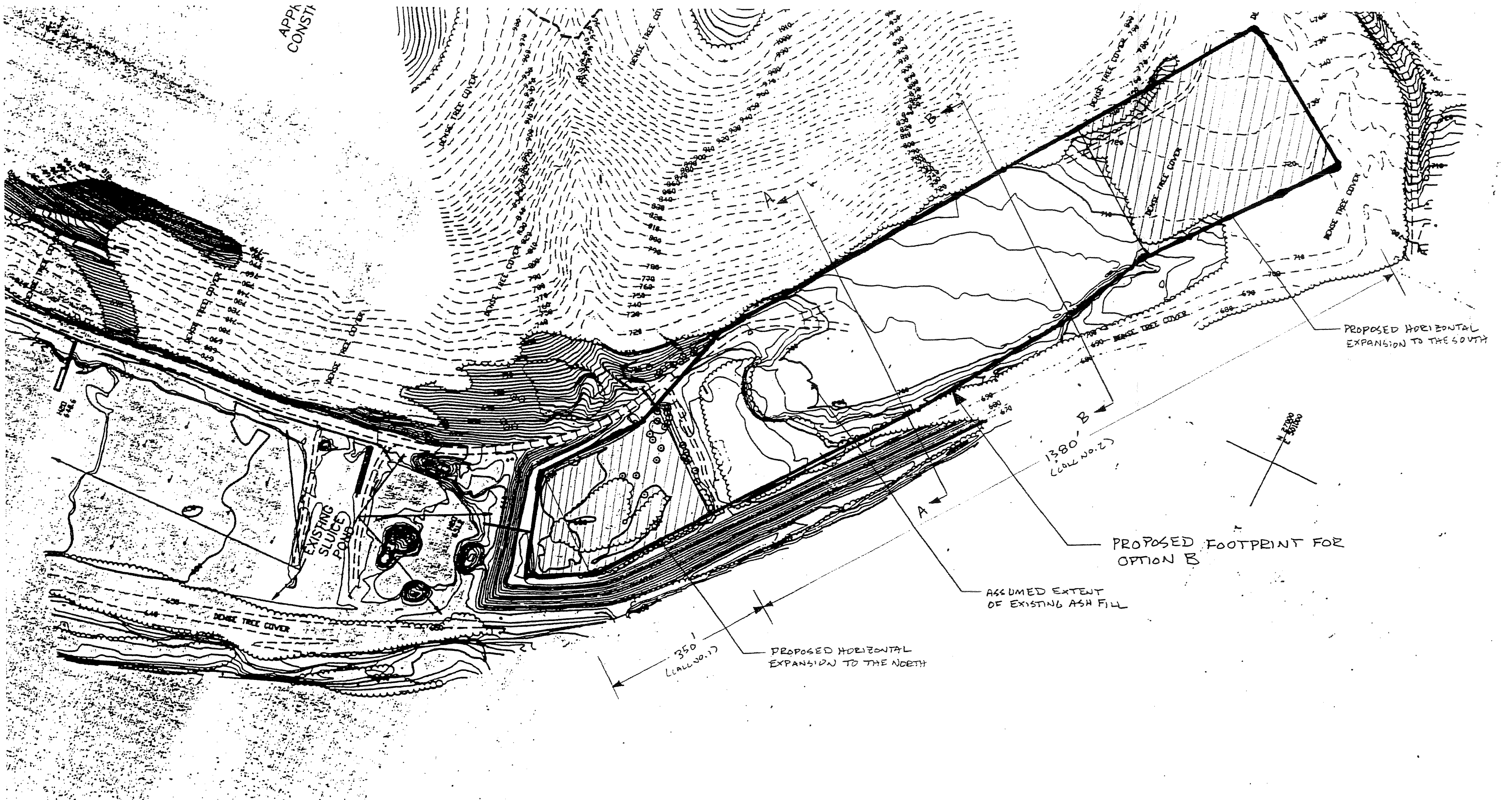
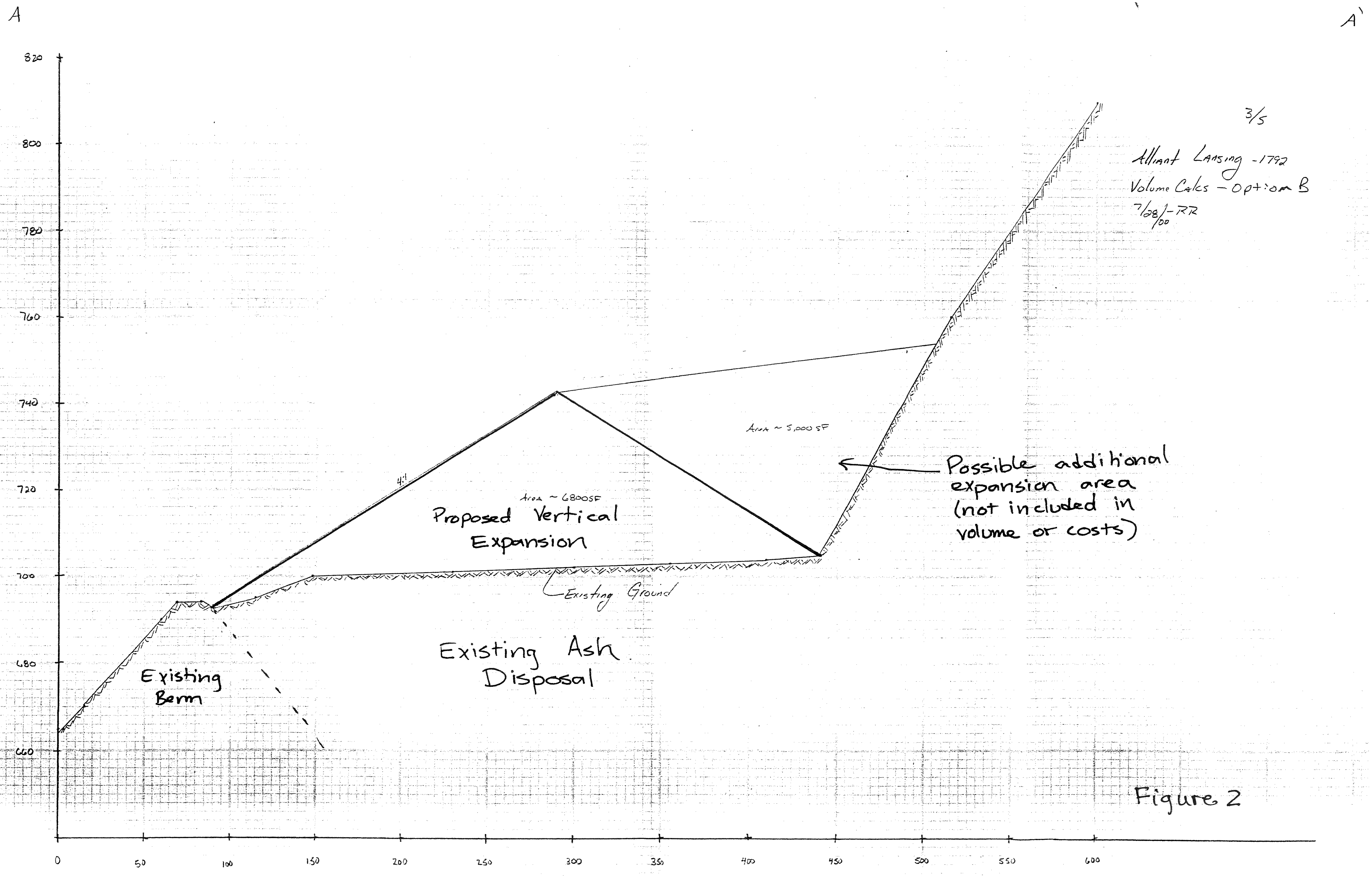


Figure 1

APPROXIMATE SCALE 1" = 200'



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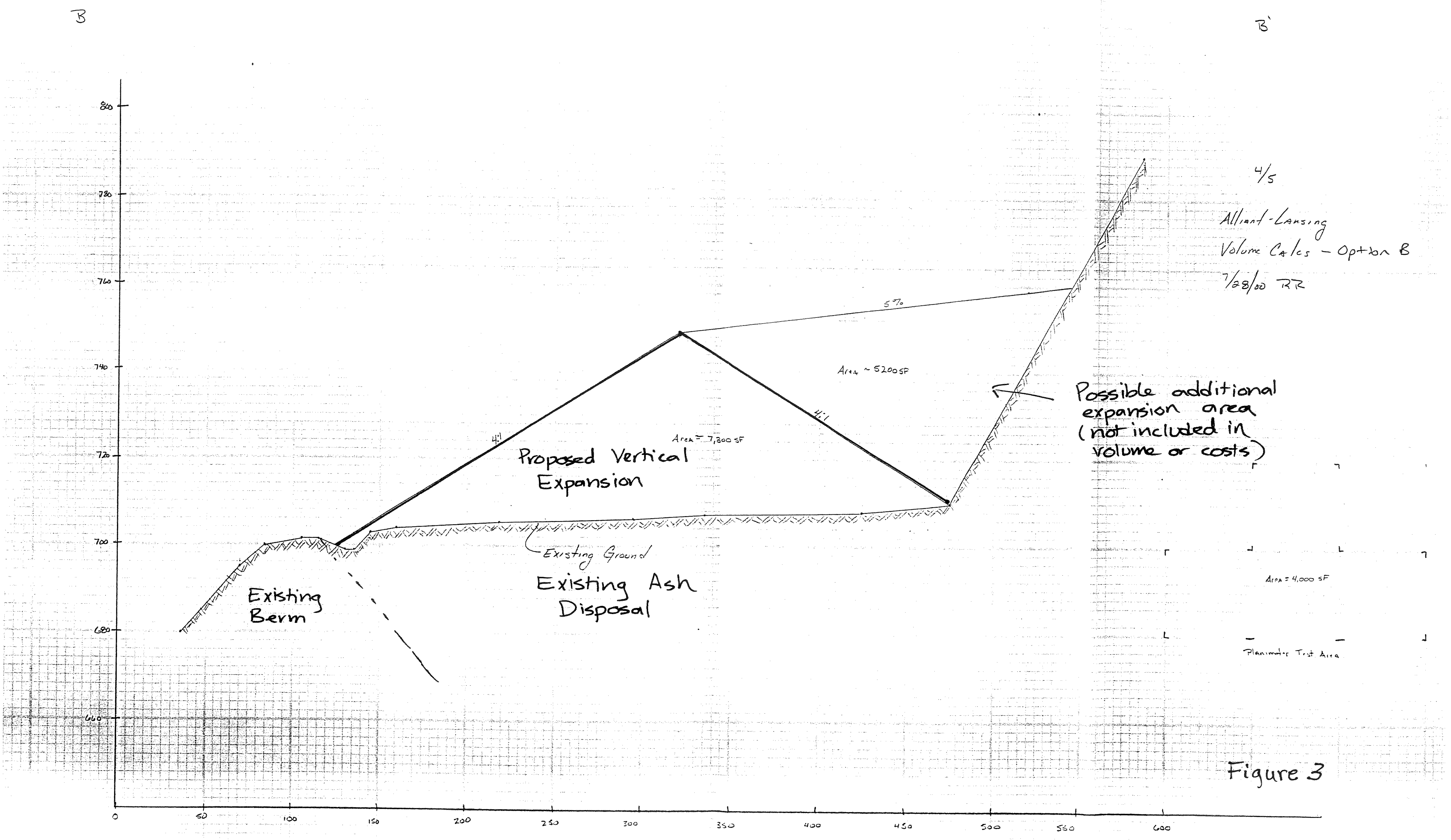
Alliant Lansing -1792
Volume Calcs - Option B
7/28/00 - RR

Figure 2



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Alliant-Lansing
Volume Calcs – Option B
7/28/00 RR

Figure 3

CGC, Inc.

Construction • Geotechnical
Consulting Engineering/Testing

January 2, 2001
C20207

Ms. Sherren Clark
BT^2, Inc.
2830 Dairy Drive
Madison, WI 53718

Re: Subsurface Investigation
Fly Ash Landfill Expansion
Alliant Energy Site
Lansing, Iowa

Dear Ms. Clark:

CGC, Inc. has completed the geotechnical investigation for the potential expansion to the fly ash landfill at the Alliant Energy site in Lansing, Iowa. This report presents the findings of the exploration program consisting of Standard Penetration Test (SPT) borings , Cone Penetration Test (CPT) probes, field density tests and laboratory tests. The report also provides slope stability analyses for the proposed vertical expansion to the landfill. CGC's analysis and report were performed under subcontract to BT^2.

PROJECT DESCRIPTION

Our understanding of the potential landfill expansion is as follows. The landfill expansion option involves increasing the capacity of the existing landfill by vertically expanding the present fly ash surface about 40 ft above the existing plateau area. The plateau area was created by placing ash within a basin created by the construction of an earthen dike along the west and north edges of the landfill area. Expansion will establish a new fly ash landfill height at about EL 743 using 4H:1V exterior slopes and a 20H:1V slope extending from the peak to the original bluff slope. A final cover measuring about 3 ft thick will be placed over the ash, with berms and diversion ditches also to be constructed to control surface water runoff. Fly ash will be dredged and dewatered on site prior to placement, with placement to be done over a 10-year period using truck hauling and dozer spreading/compaction.

INVESTIGATION

The subsurface conditions of the existing plateau area were investigated by drilling six SPT borings on the present fly ash surface or perimeter dike. Five CPT probes were also conducted on the ash or dike until probe refusal occurred. Locations of the SPT and CPT borings/probes are presented in Attachment B. A sixth location was planned (CPT-5), but could not be conducted because access to the area was prevented by snow.

The SPT borings were drilled by Boart-Longyear (under subcontract to BT^2) on November 27 and 28, 2000. The boring logs are presented in Attachment D. The CPT probes were conducted by Stratigraphics on November 21, 2000, with that data presented in Attachment C. A monitoring well (MW-10) was also installed in SPT-2 by Boart-Longyear to a depth of 29 ft. Additional details regarding drilling and sampling are described in Attachment A.

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The SPT soil borings and CPT probes reveal that fly ash extends to depths averaging near 35 ft in the northern portion of the basin. The ash thickness tapers off going toward the south. The ash is generally a mix of loose to medium dense sand size particles and/or soft to stiff silt and clay size particles. It is underlain by a weathered rock zone followed by more competent dolomite. The confining berm to the west is generally comprised of medium dense sands and relatively stiff clays. As an exception, the dike near CPT-6 has a tendency to be softer and less dense.

Additional soil borings were conducted by Terracon as part of a study done in 1996. That information is contained in Attachment E of this submittal. Conditions were similar, with the fly ash depths extending to 44 ft in one of their borings.

Free standing groundwater was generally not encountered in the SPT borings or well MW-10. The CPT data suggests a perched condition on the surface of the weathered bedrock/dolomite (refer to "generated pore pressure" column on "CPTU-EC log with Lithologic Evaluation" data sheet for each CPT probe in Attachment C).

LABORATORY TESTING

A sample of the fly ash was obtained by CGC in conjunction with CPT activities on November 21, 2000. It was obtained from on-site stockpiles and appeared to have a grain size distribution that was representative of some of the finest (i.e., least coarse) material on site. This material was selected because it is more susceptible to slope stability failure than the coarse-grained ash. Atterberg limits and grain size/hydrometer tests were performed on that sample by CGC, with those results presented in Attachment F. The results indicate that the tested sample has soil properties that would classify it as a silt.

Two sand cone field density tests on similar ash were conducted by CGC in the field on November 21 and revealed a wet density of 82 pcf for both tests.

Samples of the fly ash from the stockpiles were submitted to the UW Madison geotechnical laboratory for triaxial testing to evaluate shear strength parameters for implementation during slope stability modeling. A series of three unconsolidated-undrained (UU) tests were conducted on ash samples compacted to 82 pcf at moisture contents of 25%, 35% and 45% to simulate anticipated field conditions in the short term. Two additional consolidated-undrained (CU) tests with pore pressure measurements were also done to simulate long term conditions. The results of these tests are presented in Attachment F. Strength test results from the UU and CU laboratory testing found in ~~Appendix~~ Attachment F correlate well with data obtained from the CPT probes for the in-place ashes depicted on ~~Appendix D~~ Attachment C data sheets labeled "Evaluated Properties Using Global Database" under the drained friction angle and undrained shear strength columns.

DISCUSSION AND RECOMMENDATIONS

Based on the laboratory testing and field analysis, a series of cross-sections of the proposed expansion area were evaluated from a slope stability viewpoint. The slope stability evaluation revealed that the proposed expansion is feasible because resulting safety factors against movement exceed typical acceptable levels. The following paragraphs present the stability analysis results, along with soil parameters used in the conceptual design. Important information about the limitations of this report is presented in Attachment H.

Incorporating soil parameters determined from CPT, SPT, field density and laboratory testing programs, CGC performed a slope stability analysis using the computer program STABL5. The program uses the Modified Bishop Method of analysis to calculate factors of safety against sliding along various semicircular arcs, accounting for soil loads, soil shear strength, water levels and other factors.

Key assumptions used in these analyses include the following:

- Soil profile: A soil profile consisting of a composite of the SPT and CPT borings was developed by roughly averaging existing ash depths and natural layer thicknesses. We analyzed for the full expansion option that includes a 20H:1V slope extending from the initial peak at EL 743 to the original bluff slope. This configuration would be more critical from a slope stability point of view than just the initial phase of the vertical expansion. The assumed soil profile is indicated in the figures in Attachment G.

- Water level: Based on water levels encountered in the recent borings, the slope was modeled with groundwater at the base of the existing ash fill.

- Ash Shear Strength Parameters: Because the ash will be placed in the landfill at a relatively slow rate and the ash is moderately permeable, both the existing and future ash fill is expected to develop its shear strength primarily from frictional resistance. Using parameters determined from CU shear strength testing which correlated well with in-situ CPT data, we have conservatively modeled the fly ash as material with a friction angle of 29° and zero cohesion. (Note that the triaxial laboratory testing and CPT probe strength data suggests friction angles as great as approximately 42° on the average could be considered for modeling).

- Potential Weak Zone in Earth Berm: To model the zone of the existing embankment near CPT/SPT 6, where somewhat loose/soft conditions were noted, we used lower strength soil parameters for the earth berm in several analyses. Because the berm fill at this location is a mixture of clay and sand, the analyses were conducted assuming the fill would behave as both a frictional and cohesive material. Shear strength parameters were estimated based on correlations with SPT blow count values and pocket penetrometer readings.

- Failure Plane Analysis: To fully evaluate various modes of failure, parameters in the STABL program were modified to force the potential slip circles through critical sections of the slope. This effort was necessary to check that potential failure surfaces with the lowest factors of safety had been identified. The two modes are identified as "failure through ash slope" and "failure through earth berm".

Out of hundreds of trial arcs of varying radii and centers, the ten arcs with the lowest factors of safety for each condition are shown in Figures G-1 through G-6 in Attachment G. The minimum factors of safety for the proposed slope are summarized in the following table:

TABLE 1

ESTIMATED MINIMUM FACTORS OF SAFETY FOR THE PROPOSED ASH LANDFILL SLOPE

	Typical Berm Strength	"Weak" Berm Parameters
Failure through Ash Slope	2.32	2.32
Failure through Earth Berm	2.31	1.55 - 1.59

Note that a factor of safety of about 1.0 or less indicates incipient slope failure or a high risk of movement.

From this analysis we conclude that the calculated factor of safety for the proposed ash landfill slope is well above the minimum factor of safety of 1.3 to 1.5 desired in this case (Sowers and Sowers, 1970).

*****

We trust this report addresses your present needs. General limitations regarding the conclusions and opinions presented in this report are discussed in Attachment H. If you have any questions, please contact us.

Sincerely,

CGC, INC.

Michael N Schultz
Michael N. Schultz, P.E.
Principal/Consulting Professional

William W Wuellner
William W. Wuellner, P.E.
Senior Geotechnical Engineer

Encl: Attachment A - Field Investigation
Attachment B - Soil Boring Location Map
Attachment C - CPT Probe Report
Attachment D - Log of Test Borings (Boart Longyear)
Well Detail
Log of Test Boring-General Notes
Unified Soil Classification System
Abandonment Forms
Attachment E - Previous Terracon Report
Attachment F - Laboratory Test Results
Attachment G - Slope Stability Analyses
- Figures G-1 through G-6

Attachment H - Document Qualifications

Reference: Sowers and Sowers, *Introductory Soil Mechanics and Foundations*, 1970, pg 517.

APPENDIX E

Seepage Potential and Karst Condition Assessment

Seepage Potential and Karst Condition Assessment

The landfill is designed and constructed to include a storm water run-on and run-off management system. Based on water table elevations from groundwater monitoring in 2014 through 2017, groundwater hydraulic gradients are downward near the landfill perimeter berm indicating that groundwater movement is not a concern for performance of the landfill. No leachate seepage has been observed along the landfill perimeter berms by Interstate Power and Light Company (IPL) staff or during annual landfill inspections by a qualified professional engineer, so leachate movement is not a concern for performance of the landfill. Therefore, there are currently no concerns that storm water, leachate, or groundwater movement will impact the stability of the landfill.

As noted in **Appendix A**, karst features were not observed in the borings within and adjacent to the disposal facility. Because the borings (**Appendix C**) near the landfill did not encounter karst features or limestone bedrock that is likely to contain karst features, it is unlikely that karst conditions are present below the landfill, so karst structures are not a concern at the landfill site.

References

BT2, Inc., 2001, Ash Disposal Area Stability Evaluation, Alliant Energy – Lansing Power Station.

SCS, 2017, 2017 Annual Water Quality Report, Lansing Generating Station CCR Landfill, Interstate Power and Light Company.

DLN/AJR/EJN

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