ALLIANT ENERGY

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An Alliant Energy Company

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August 23, 2011

Via E-mail to: Hoffman.Stephen@epamail.epa.gov

Mr. Stephen Hoffman
U.S. Environmental Protect ion Agency (5304P)
1200 Pennsylvania Avenue, N.W.
Washington, DC 20460

Re: Wisconsin Power and Light Company – Columbia Energy Center Response to July 26, 2011 EPA letter and Final Report Round 7 Dam Assessment

Dear Mr. Hoffman:

On July 26, 2011, Wisconsin Power and Light Company's Columbia Energy Center ("WPL") received the United States Environmental Protection Agency's ("EPA") "Final Report Round 7 Dam Assessment" ("Report") and corresponding cover letter. The cover letter provided recommendations that the EPA believes are necessary to ensure the stability of the coal combustion residual impoundments. In addition, the letter requested that WPL respond by August 23, 2011 with specific plans and schedules for implementing the recommendations.

WPL has carefully reviewed the findings and recommendations contained in the Report. Attachment 1 provides WPL's response regarding the applicability and implementation of the recommendations pursuant to your request. If you have any questions, feel free to contact me at (608) 742-0715.

Sincerely,

Jerry Lokenvitz

Jerry Lokenvitz
Plant Manager

Enclosure

Cc: Bill Skalitzky
Jenna Wischmeyer

Attachment 1

Columbia Energy Center
Final Report Round 7 Dam Assessment
Recommendations

3.2 Studies and Analyses

EPA's Observation and Recommendation:
GZA recommends the following studies and analyses:

1. Evaluate the extent of wave action erosion on the upstream slopes of the PAP;
2. Perform a hydrologic/hydraulic analysis of the PP to determine the adequacy of the current and designed operating conditions and design to accommodate the appropriate precipitation event;
3. Evaluate the slope and seepage stability of the LSP based on current operating conditions and methodologies;
4. Confirm the soil and seepage parameters assumed in stability analysis of the PAP and SAP; and,
5. Develop an EAP for the impoundments.

WPL's Response:

1. **Evaluate the extent of wave action erosion on the upstream slopes of the PAP**

WPL and Aether DBS will complete an analysis to determine if the erosion area is created by wind generated waves. The conclusion of this analysis will be provided to the EPA in a technical letter no later than September 30, 2011. Inspections of this area will be incorporated in the Operations and Maintenance Plan (O&M Plan) being developed by plant staff and Aether DBS. See item 3.3.3 below for further details regarding the O&M Plan.

2. **Perform a hydrologic/hydraulic analysis of the polishing pond to determine the adequacy of the current and designed operating conditions and design to accommodate the appropriate precipitation event**

Aether DBS will conduct a hydraulic analysis of the polishing pond and provide a technical letter documenting its conclusions to the EPA no later than September 30, 2011. Currently, the polishing pond does not have any inflows and only receives runoff from a localized area of the site.

3. **Evaluate the slope and seepage stability of the LSP based on current operating conditions and methodologies;**

Aether DBS will conduct a stability analysis of the Landfill Pond and provide a technical letter documenting its conclusions to the EPA no later than September 30, 2011.

4. **Confirm the soil and seepage parameters assumed in the stability analysis of the PAP and SAP**

A July 6, 2011 letter from Aether DBS contained soil boring information collected from various locations of the impoundments to confirm that the parameters assumed in Aether DBS' stability analysis were conservative and would not affect the outcomes of the February 16, 2011 Ash Pond Slope Stability and Hydraulic Analysis letter report. These letters have been attached for your reference. WPL believes this recommendation has been addressed.

5. **Develop an EAP for the impoundments**

Stability analyses have been completed for all of the berms except the Landfill Pond. Aether DBS will complete a stability analysis for this pond by September 31, 2011. Aether expects that there will not be any stability issues with the Landfill pond berm. If no stability issues exist for the berms onsite, WPL does not believe that an EAP will be necessary for the berms.

3.3 Recurrent Operation & Maintenance Recommendations

EPA's Observation and Recommendation:

GZA recommends the following operation and maintenance level activities:

1. Documentation of the periodic visual observations of the PAP, SAP, and LSP;
2. Maintain copies of the impoundment design and construction documentation on Site;
3. Semi-annual inspection of the PP and LSP in addition to the inspections being completed on the PAP and SAP;
4. Clear deep rooted vegetation stumps from the PAP embankment;
5. Clear deep rooted vegetation from the embankments and crest of the LSP;
6. Add topsoil and reseed areas of sparse vegetation in the LSP; and,
7. Remove excess water from LSP and relocate marker stake to accommodate current maximum water level of 794.85 feet.

WPL's Response:

1. **Documentation of the periodic visual observations of the PAP, SAP, and LSP**

WPL will document the visual inspections performed by plant operations personnel. The frequency will be determined by the guidance in the technical documents listed below. The inspection form will be part of the O&M Plan referred to in 3.3.3 below that will be developed by WPL and Aether DBS no later than May 1, 2012.

2. **Maintain copies of the impoundment design and construction documentation on Site**

WPL has all available documents and drawings regarding the design and construction of the impoundments on-site

3. **Semi-annual inspection of the PP and LSP in addition to the inspections being completed on the PAP and SAP**

WPL, along with our independent consulting engineer Aether DBS, will prepare a site-specific O&M Plan based on the following criteria:

- Corps of Engineers EM 111 0.2.301, *Guidelines for Landscape Planting and Vegetation Management at Floodwalls, Levees, and Embankment Dams*
- FEMA 534, *Technical Manual for Dam Owners: Impacts of Plants on Earthen Dams*
- FEMA 473, *Technical Manual for Dam Owners: Impacts of Animals on Earthen Dams*
- U.S. Department of Labor, Second Edition, May 2009: *Engineering and Design Manual for Coal Refuse Disposal Facilities, Chapter 12: Monitoring, Inspections, & Facility Maintenance*

The O&M plan will include semi-annual inspections by plant staff and an annual inspection by a professional engineer from Aether DBS. The Plan will be developed and implemented, including training for selected power plant personnel, no later than May 1, 2012. The first PE semi-annual inspection of all ponds will be completed no later than December 31, 2011.

4. **Clear deep rooted vegetation stumps from the PAP embankment**

WPL and Aether DBS will evaluate the necessity to remove the larger trees and tree stumps based on the slope stability reports and the impact the removal may have on the overall integrity of the dikes. This evaluation will be made based on the technical guidance listed above. WPL and Aether DBS will complete the evaluation no later than November 30, 2011. If trees and/or tree stumps are identified for removal, removal will take place no later than May 1, 2012.

5. **Clear deep rooted vegetation from the embankments and crest of the LSP**

WPL and Aether DBS will evaluate the necessity to remove the larger trees and tree stumps based on the slope stability reports and the impact the removal may have on the overall integrity of the dikes. This evaluation will be made based on the technical guidance listed above. WPL and Aether DBS will complete the evaluation no later than November 30, 2011. If trees and/or tree stumps are identified for removal, removal will take place no later than May 1, 2012.

6. **Add topsoil and reseed areas of sparse vegetation in the LSP**

WPL will repair and reseed the exposed areas of the landfill pond no later than September 30, 2011.

7. **Remove excess water from LSP and relocate marker stake to accommodate current maximum water level of 794.85 feet**

WPL has resurveyed the landfill pond area and has installed a new marker indicating the location of the geo-membrane liner and the level the pond will be maintained at to ensure it can handle a 25 year rain event based on Wisconsin Department of Natural Resource NR 500 regulations.

3.4 Repair Recommendations

EPA's Observation and Recommendation:

1. Repair erosion ditches present in the PAP, SAP and LSP

WPL's Response:

WPL will repair these erosional areas of concern no later than October 1, 2011. Inspection of these areas will be part of the O&M Plan developed by WPL and Aether DBS.

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September 30, 2011

Via E-mail to: Hoffman.Stephen@epamail.epa.gov

Mr. Stephen Hoffman
U.S. Environmental Protect ion Agency (5304P)
1200 Pennsylvania Avenue, N.W.
Washington, DC 20460

Re: Wisconsin Power and Light Company – Columbia Energy Center Supplemental Response to July 26, 2011 EPA letter and Final Report Round 7 Dam Assessment

Dear Mr. Hoffman:

On August 23, 2011, Wisconsin Power and Light Company's Columbia Energy Center ("WPL") responded to the United States Environmental Protection Agency's ("EPA") July 26, 2011 "Final Report Round 7 Dam Assessment" ("Report") and corresponding cover letter. In that response, WPL committed to providing additional technical information by September 30, 2011, to address several of the recommendations in the Report.

Enclosed is WPL's technical assessment, prepared by our consultant, Aether dbs. We appreciate EPA's willingness to allow extra time in which to complete our analysis. WPL believes this technical information adequately responds to the remaining recommendations contained in the Report. If you have any questions, feel free to contact me at (608) 742-0715.

Sincerely,

Jerry Lokenvitz

Jerry Lokenvitz
Plant Manager

Enclosure

Cc: Bill Skalitzky
Jenna Wischmeyer

aether dbs
elemental design build solutions

September 30, 2011

Mr. William Skalitzky 154.017.001
Alliant Energy
4902 N. Biltmore Lane
Madison, WI 53718

Re: Technical Assessment
Response to EPA Comments of July 26, 2011
Columbia Energy Center – Pardeeville, WI

Mr. Skalitzky;

Aether dbs, reports our response to each of the five observations and recommendations made by GZA in the USEPA comment letter of July 26, 2011. The USEPA comment letter is based on review of the Aether dbs report submitted on February 16, 2011 analyzing the stability and hydraulic capacity of the ash ponds at Columbia Energy Center. The response to each observation / recommendation is provided after the enumerated GZA observation / recommendation.

1. **Evaluate the extent of wave action erosion on the upstream slopes of the Primary Ash Pond (PAP)**

   The PAP holds water for recycle to the bottom ash sluicing system from the boilers to the settling trench where the bottom ash is recovered. The PAP receives the fine components of the bottom ash for settling prior to returning the water for reuse. The pond is normally operated with water at elevation 795 approximately 7-feet below the crest elevation of the embankment. The elevation may vary up or down as precipitation into the pond or evaporation changes the water elevation.

   In the north-south direction the PAP is 510 feet wide at its widest point and in the east-west direction the pond is 1320 feet long, including the bottom ash settling sluice on the western end of the pond, Figure 1. Waves are generated by wind traction on the pond water surface and the longest fetch direction of 1320 feet with a westerly prevailing wind will produced the largest wave in the pond. The median wind speed not the maximum gust speed controls the setup of the fetch induced wave. For Madison Wisconsin, the 5% probability and 1% probability median wind speed are 25 and 30 miles per hour, respectively[1].

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[1] University of Wisconsin Extension Agency, Annual Frequency of Median Wind Speed

The methodology for forecasting an open water wave height and wave period is presented in the Shore Protection Manual[2]. The maximum wave height is 0.6 feet for a 1% return period wind and 0.4 feet for a 5% return period wind. The wave height is the distance from the crest of a wave to the following trough of the wave (i.e., a wave that is 3-inches above static water at the crest and 3-inches below static water in the trough is a wave height of 6-inches). The length of the wave from crest to crest is directly related to the wave period and is approximately 8-feet.

The embankment is constructed from the gravelly sand till that is found at the Columbia Station upland site areas. The till was excavated from the area of the plant and used to construct the ash pond embankments with both interior and exterior slopes of one vertical on four horizontal. When a wave breaks on this interior slope there will be tendency to either erode or accrete the slope sediment at the point of wave attack. If the wave energy is low in comparison to the slope of the beach, particles of the beach will accrete above the static water elevation. If the energy is high the waves will erode the area of wave attack and accrete the sediment in deeper areas away from the wave attack. In accordance with beach profile methods provided in the Handbook of Coastal Engineering[3], soil grains smaller than 0.5mm will be eroded from the beach formed by the waves and particles larger than 2mm will be accreted on the beach. With time and with the water elevation remaining constant a beach of coarse sand and gravel will form at the point of wave attack with the finer grain soil deposited on a underwater slope of 1:10 to 1:20 immediately below elevation 795. Because the soil used to construct the embankments contains some coarse sand and gravel, a naturally protective beach will form with time at the operating water elevation. The natural beach formed on the north bank of the PAP shows the exposure of the coarser soil particles as shown in Attachment A.

Since there is no longshore current in a small pond, transport of the eroded sand by littoral drift will not move the sediment from the natural beach and armor is not needed to protect the interior slope from erosion loss. The analysis of the natural beach is presented in Attachment A.

2. **Perform a hydrologic/hydraulic analysis of the polishing pond to determine the adequacy of the current and designed operating conditions and design to accommodate the appropriate precipitation event.**

The polishing pond (PP), Figure 1, was originally used as the final settling pond for the discharge at WPDES Outfall 002. As presently operated, the facility maintains the water level in the SAP to eliminate discharges to the PP. Consequently there is no discharge from WPDES Outfall 002. The PP still collects surface water that falls directly into the basin and on approximately 1 acre of adjacent ground surface that drains to the pond. The flat transformer yard directly west of the PP drains to WPDES outfall 003.

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[2] United States Army Corps of Engineers, Shore Protection Manual, Volume 1, Second Printing 1984.
[3] Herbich, John B., Handbook of Coastal Engineering, Chapter 7, McGraw Hill, 2000.

The 24-hour Type II SCS 100-year storm of 6.0 inches on the watershed of the PP will cause impoundment of 9.7 inches of water in the PP without accounting for seepage loss or overflow out of the discharge flume. The PP will not overflow under a design storm event. The analysis is presented in Attachment B including two pictures of the PP taken June 1, 2011.

3. **Evaluate the slope and seepage stability of the Landfill Seepage Pond (LSP) based on current operating conditions and methodologies.**

The LSP is a pond that is between two sections of the ash landfill used to place dry collected fly ash. The pond is located on the bottom liner of the ash fill at elevation 792 feet. The ground surface to the west (toward the river) is at approximately elevation 800 feet whereas an embankment exists to the east. Ash is placed to the north and south of the LSP up to elevation 828 feet with side slopes of 3 horizontal to 1 vertical. In both the east and west direction the pond is incised below natural ground and slope failures would be into the LSP which would not release ash from the LSP. The natural ground water elevation at the LSP is approximately seven feet below the pond's bottom at elevation 785, Attachment C, and there is no seepage into the pond. Water that accumulates in the pond is from rainfall and/or runoff from the ash fill.

An analysis of the ash fill was made to determine the stability of the ash fill. The analysis assumes that the fill is compacted dry ash presently handled at the facility. The analysis shows that the static factor of safety for the landfill slope is an acceptable 1.5 and the Earthquake loading case factor of safety is an acceptable 1.1 . The Site information shows that there is no groundwater seepage into the LSP other than what may infiltrate through the landfilled ash. The LSP is incised and the only possible slope failure is into the pond from the landfilled ash. Analysis shows that the factor of safety for an inward failure is acceptable.

The results of the slope stability analysis are in Attachment D.

4. **Confirm the soil and seepage parameters assumed in the stability analysis of the PAP and Secondary Ash Pond (SAP).**

Soil borings and cone penetrometers were taken in June 2011 on the PAP, SAP and PP to confirm the materials of construction. The results were presented in a letter dated July 6, 2011, Attachment E. The results indicate that the internal friction angle of the embankment soil is equal to or greater than 35°. Since the analysis reported February 6, 2011 used a shear strength of 30°, the actual strength of the embankments is higher than report in February.

In addition to measuring the strength of the existing embankment soil, the testing showed that the peat layer in the adjacent low areas was removed prior to construction of the embankments.

Soil borings on the PP show that the embankment of the PP on the downstream slope of the channel is constructed of the sand and gravel found at the Site. The elevation of the embankment is at most five feet above the toe and the embankment slope is four horizontal on one vertical or flatter and is not a stability concern.

5. **Develop an Emergency Action Plan (EAP) for the impoundments.**

   Stability analyses are now complete for all of the ash ponds including the LSP and all have acceptable factors of safety for static stability and for seepage stability where seepage occurs on the slope of the embankment. There is no need for an emergency action plan to address stability or hydrologic/hydraulic issues with the ponds.

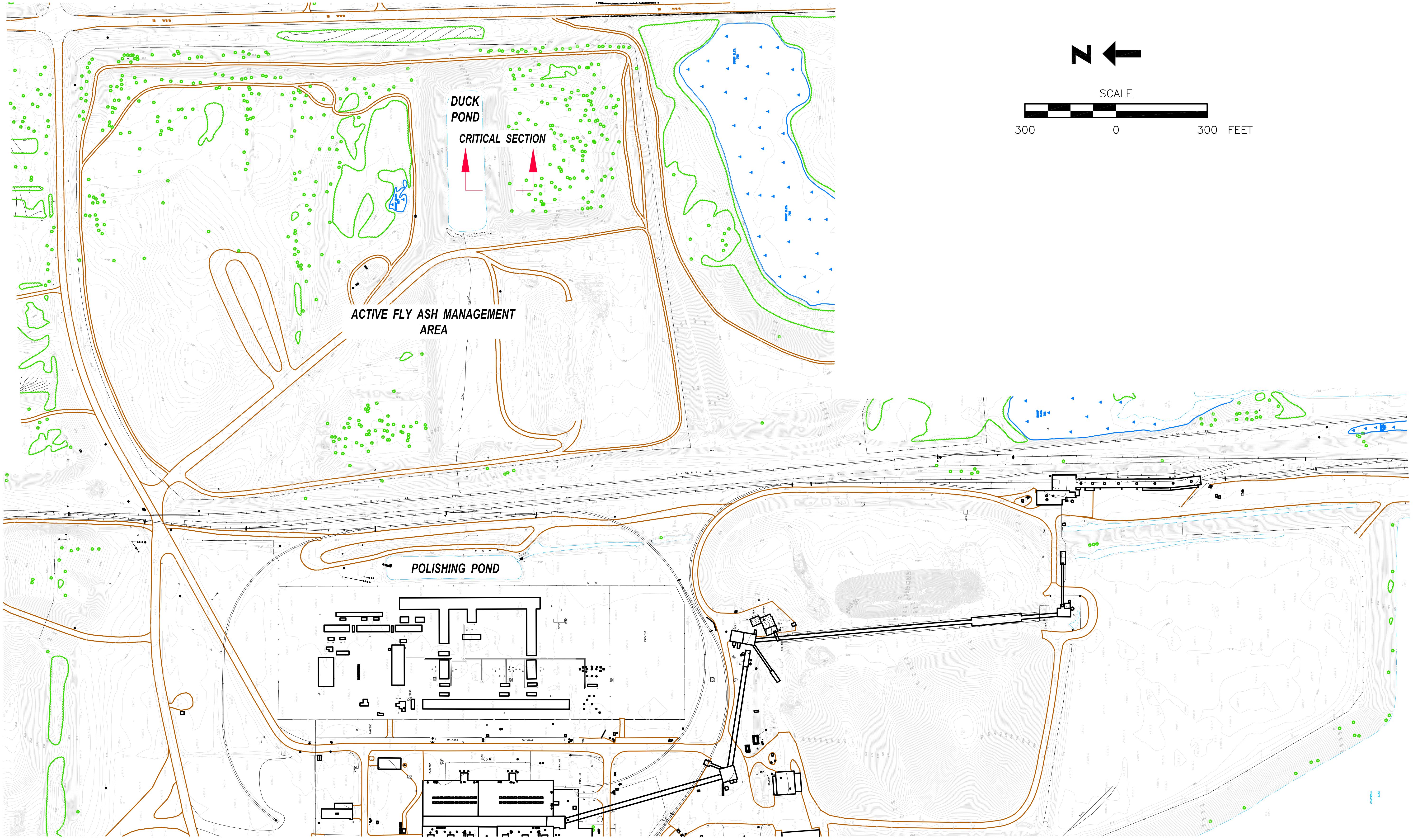
The findings based on our analysis of the observations and recommendations show that the stability and the hydraulic capacity of the ash ponds at Columbia Energy Center are adequate for a low risk embankment.

Respectfully Submitted,

Thomas C Wells

Thomas C. Wells, P.E.

Timothy J. Harrington, P.E.



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REV	DATE	BY	DESCRIPTION
5			
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SCALE:	AS SHOWN
DATE:	09-27-2011
DRAWN BY:	MM
CHKD. BY:	TCW
APPROVED:	09-27-2011

CLIENT / LOCATION

ALLIANT ENERGY
COLUMBIA ENERGY CENTER
PARDEEVILLE, WISCONSIN

DRAWING DESCRIPTION

SITE PLAN
ADDITIONAL ASSESSMENT

JOB 154
SHT. FIGURE 1
DWG. SITE PLAN

Attachment A

Primary Ash Pond
Wave Analysis & Impacts + Picture
Columbia Generating Station

Source: Aether DBS

North Shore of the Primary Settling Pond looking West

SHEET NO. 1 OF 2
PROJECT NO. 154.017.001
DATE 9/21/11.
BY TJH CKD

WAVE PREDICTION
PRIMARY ASH POND

PRIMARY ASH POND

NORMAL OPERATING ELEVATION 795'

MAXIMUM FETCH(1) WEST WIND
1320 FEET

DURATION AVERAGED WIND SPEEDS (MADISON, WI)(2)

1% RETURN U = 30 MPH
5% RETURN U = 25 MPH

SHORE PROTECTION MANUAL, VOLUME 1 USACE, 1984
FIGURES 3-27 & 3-28

$U_A = 0.589\,U^{1.23}$ 3-28(b) U (MPH)

	WATER DEPTH	U_A (MPH)	H	T	I
1% RETURN	5 ft	39	0.6	1.2	5
"	10 ft	39	0.6	1.3	6
5% RETURN	5 ft	31	0.4	1	6
"	10 ft	31	0.4	1.1	7

H = WAVE HEIGHT (FT)
T = WAVE PERIOD (SEC)
I = REQUIRED SET-UP DURATION (MINUTES)

(1) SEE ATTACHED DRAWING
(2) SEE ATTACHED TABLE

SHEET NO. 2 OF 2
PROJECT NO. 154.017.001
DATE 9/21/11 – 9/27/11
BY TJH CKD TCW

WAVE PREDICTION
BEACH PROFILE

HANDBOOK OF COASTAL ENGINEERING, HERBICH 2000
CHAPTER 7

$H_0 = 0.5^{FT}$ D = PARTICLE DIAMETER, FT.

$T = 1.25$ SEC

$L_0 = gT^2/2\pi = 8^{FT}$

$\beta = 14°$ (1V:4H)

BEACH IS SANDY GRAVEL. $d_{50} = 0.4$ mm (0.02 IN)
WELL GRADED

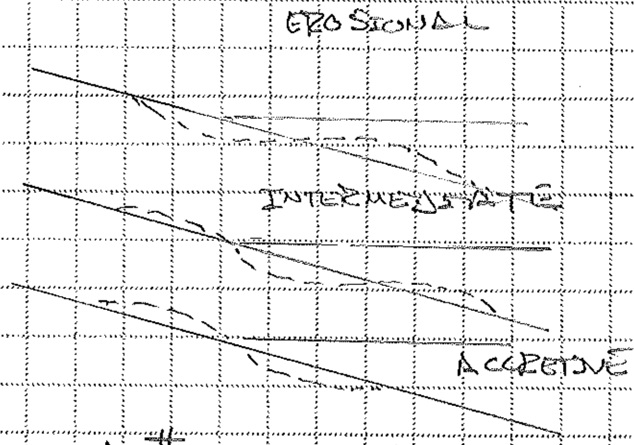
$$C_3 = \left(\frac{H_0}{L_0}\right)\left(\frac{D}{L_0}\right)^{-0.67} (\tan\beta)^{0.21}$$ BEACH PROFILE EQUATION

$C_3 > 13$ EROSIVE BEACH
$C_3 < 13 > 5$ INTERMEDIATE
$C_3 < 5$ ACCRETIVE BEACH

DETERMINE LIMIT FOR VARIOUS GRAIN SIZES

D (mm)	C_3
0.1	37
0.5	13
0.75	10
1.0	8
1.5	6
2.0	5

ACCRETIVE BEACH > #10 SCREEN



– WAVES WITHOUT SIGNIFICANT [illegible]
–

WISCONSIN WIND DATA

ANNUAL FREQUENCY OF WIND SPEED (PERCENT):

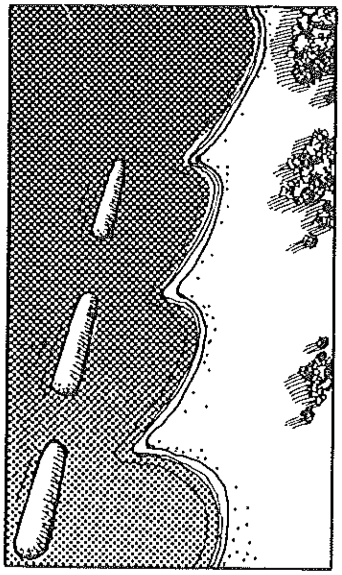
Station	1-4 mph	5-7 mph	8-12 mph	13-18 mph	19-24 mph	25-31 mph	32-38 mph
Madison (WI)	7.1	21.9	31.9	25.3	4.9	1.1	0.2
Milwaukee (WI)	5.5	17.8	34.2	30.6	7.5	1.9	0.3
Green Bay (WI)	6.6	25.6	33.0	24.2	5.4	0.9	0.1
Duluth (MN)	3.7	19.4	35.0	29.9	6.4	1.8	0.4
Rochester (MN)	4.5	14.8	32.5	31.1	10.9	2.7	0.4
Minneapolis (MN)	6.7	21.1	33.6	28.0	5.9	1.2	0.1
Rockford (IL)	6.9	23.4	31.8	26.9	4.7	0.9	0.1

Note: *This table shows the annual frequency of wind speed from hourly observations by category, in percent.*

This table does <u>not</u> include information on wind gusts, which are of much shorter duration.

HOME

US Army Corps
of Engineers



SHORE PROTECTION MANUAL

VOLUME I

Coastal Engineering Research Center

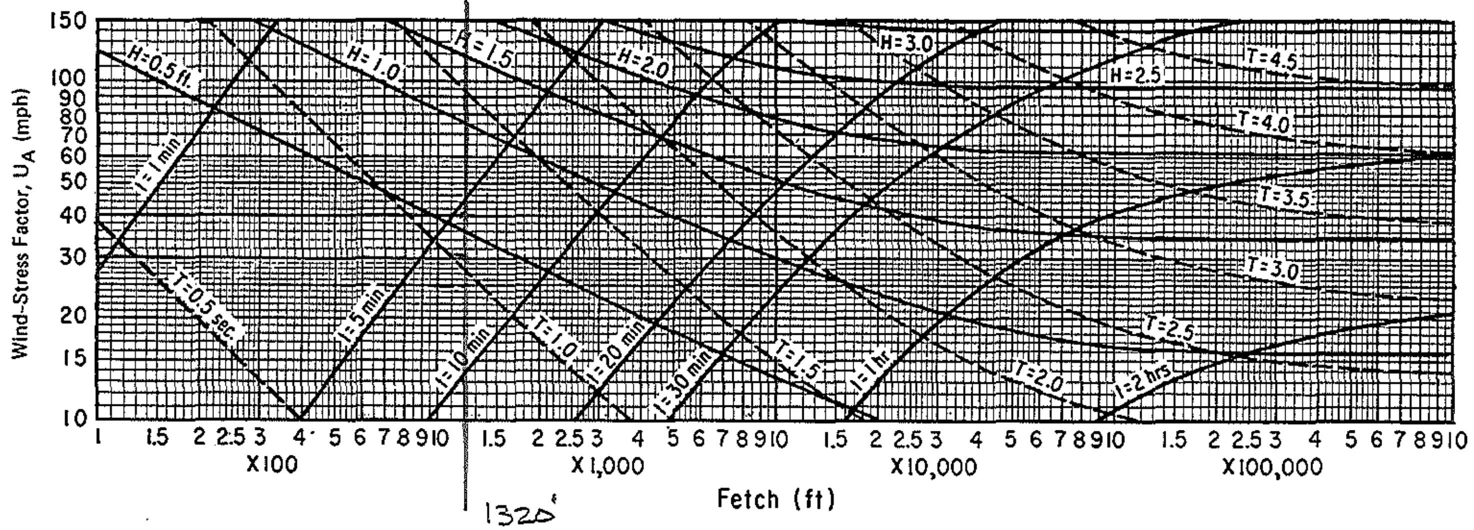
DEPARTMENT OF THE ARMY
Waterways Experiment Station, Corps of Engineers
3909 Halls Ferry Road
Vicksburg, Mississippi 39180-6199

1984
Second Printing

Approved For Public Release; Distribution Unlimited

Prepared for
DEPARTMENT OF THE ARMY
US Army Corps of Engineers
Washington, DC 20314

Note: Waves in a water depth of 5 feet with wave periods less than 1.4 secs. are considered to be deepwater waves, i.e. $d/T^2 > 2.56$.



Note: Waves in a water depth of 1.5 meters with wave periods less than 1.4 seconds are considered to be deepwater waves, i.e., $d/T^2 > 0.78$.

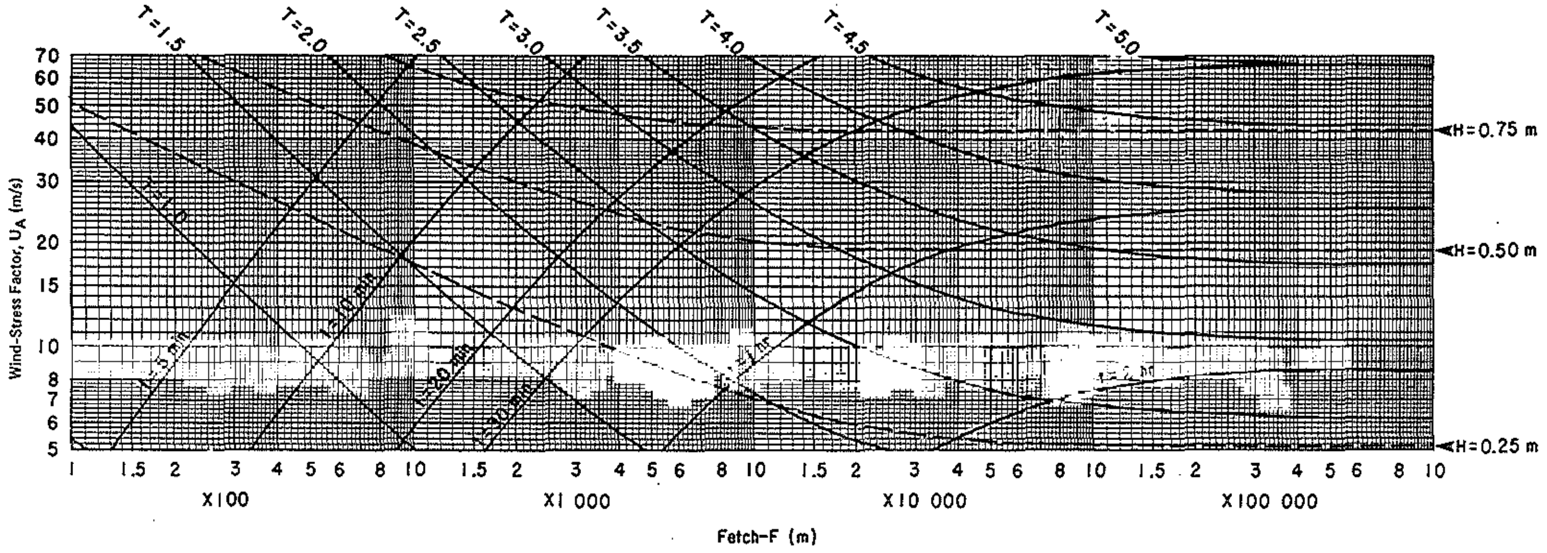
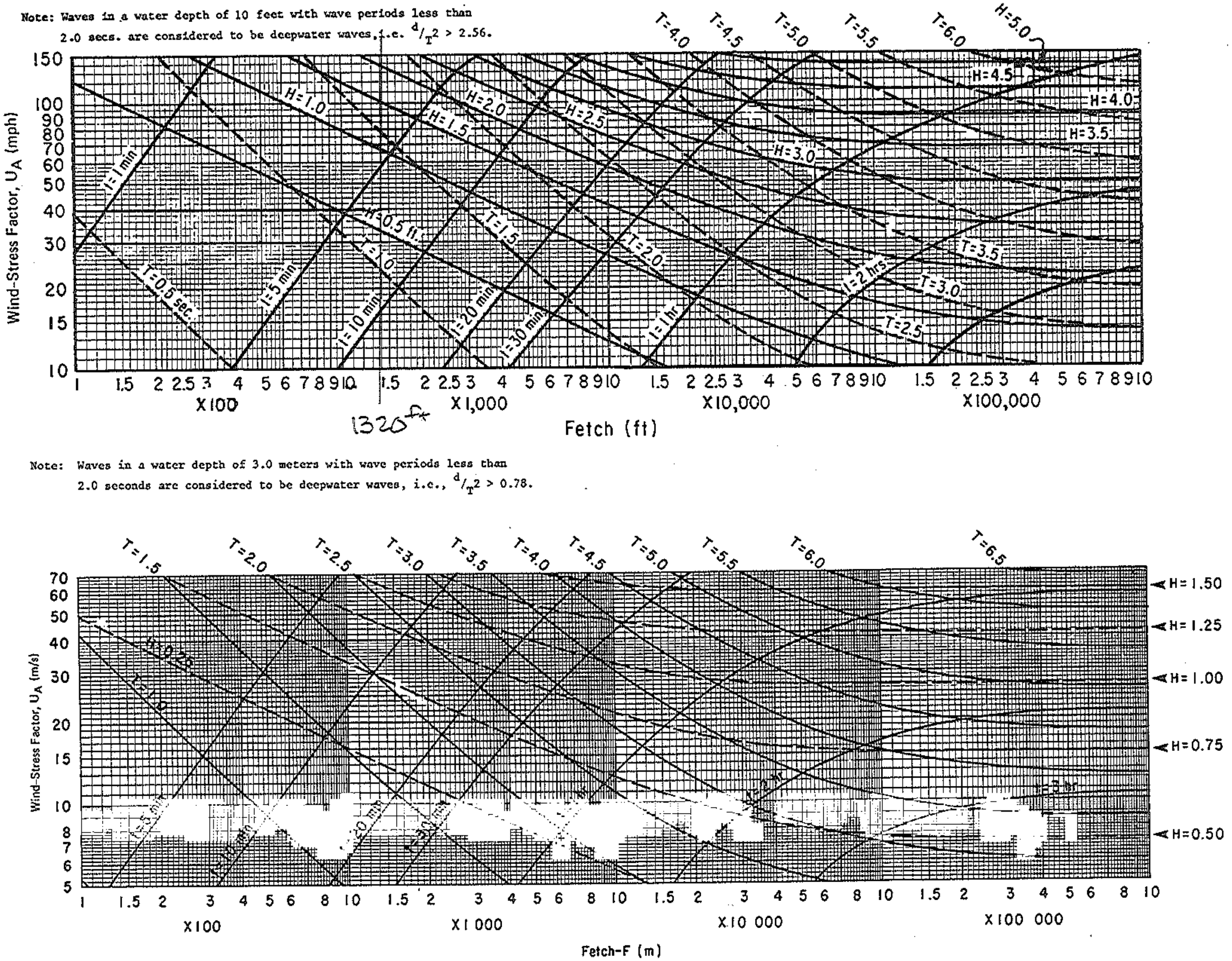


Figure 3-27. Forecasting curves for shallow-water waves; constant depths = 5 feet (upper graph) and 1.5 meters (lower graph).


Note: Waves in a water depth of 10 feet with wave periods less than 2.0 secs. are considered to be deepwater waves, i.e. $^{d}/_{T}2 > 2.56$.

Note: Waves in a water depth of 3.0 meters with wave periods less than 2.0 seconds are considered to be deepwater waves, i.e., $^{d}/_{T}2 > 0.78$.

Figure 3-28. Forecasting curves for shallow-water waves; constant depths = 10 feet (upper graph) and 3.0 meters (lower graph).

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Handbook of Coastal Engineering

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HANDBOOK OF COASTAL ENGINEERING

JOHN B. HERBICH

small-scale experiments are capable of reproducing prototype scale experiments. The sediment size in the small-scale model was determined so that the undistorted Froude model had the same C_2 value as the prototype scale experiments. They concluded that the beach profiles under the undistorted model were similar to those under prototype scale experiments and that the beach profiles in small-scale experiments and prototype experiments can be classified by the same C_1 or C_2 values, although the critical values they found were different from those originally proposed by Dean [9]. They suggested the difference is the scale effects incorporated in Dean's original criteria.

as et al. [18] evaluated the applicability of various criteria on the basis of laborato- in large wave tanks using monochromatic waves and field data. They examined the classification of beach profiles by the combination of various nondimensional parameters, including C_1 and C_2, and concluded that simple criteria successfully predict the beach profiles for both large wave tank data using monochromatic waves and field data using random waves if the mean wave height was used in the field application.

Sunamura and Horikawa [41] classified the beach profiles into three types—erosional, accretive, and the intermediate—and showed that the development of each type was dependent on the following C_3 value:

$$C_3 = \left(\frac{H_0}{L_0}\right)\left(\frac{D}{L_0}\right)^{-0.67}(\tan\beta)^{0.27} \tag{3}$$

where D is the sediment grain size and $\tan\beta$ the initial beach slope. They showed that beach profiles change from accretive to intermediate and intermediate to erosional as C_3 increases, and found the boundary C_3 values to be 4 and 7, respectively, for the condition of laboratory monochromatic waves. The boundaries were 9 and 18 for field data, where significant wave height was used to calculate C_3.

Mimura et al. [22] performed a series of small-scale laboratory experiments to study beach profile change due to random waves. Figure 7.1 is the classification of beach

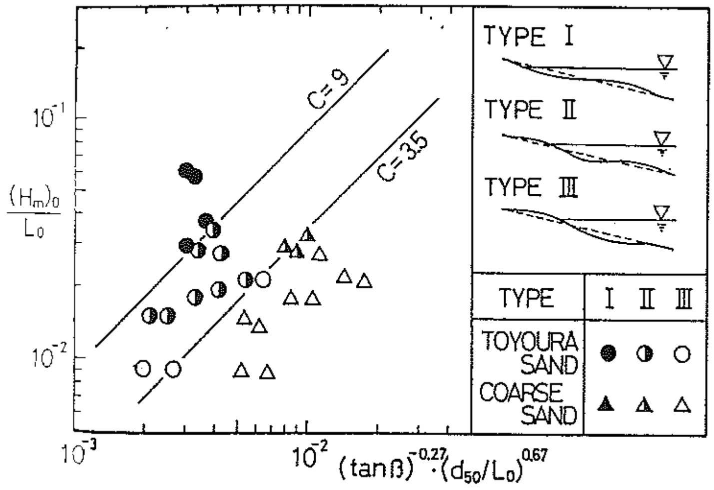


FIGURE 7.1. Classification of beach profiles for random waves in a laboratory flume [22].

profiles. Circular symbols are for 0.18 mm fine sand (Toyoura sand in the figure) and triangles are for 0.75 mm coarse sand. Mimura et al. [22] found that the boundary between accretive and intermediate profiles was expressed by $C_3 = 3.5$ and that between intermediate and erosional profiles by $C_3 = 9$ when the C_3 value was estimated on the basis of mean wave height. When the significant wave was used instead of the mean wave, the critical values of C_3 changed from 3.5 to 5 and 9 to 13, respectively. The correspondence between the boundary C_3 laboratory data values obtained with random waves and those obtained with monochromatic waves is better when the mean wave height is used, which agrees with the conclusion of Kraus et al. [18]. The difference between the boundary C_3 laboratory data values ($C_3 = 5$ and 13) obtained by random waves and those obtained by field data ($C_3 = 9$ and 18) is considered to be due to the scale effect and three-dimensionality in the field.

The use of simple criteria to determine beach profile types is thus found to be promising even for the condition of random waves to understand the macroscopic trend of beach profile change. However, in order to predict the dynamic response of beach profiles to variable sea states, more sophisticated models based on the physical processes of local sand transport are required.

Mimura et al. [22] also observed that beach transformation under random waves is different from that under monochromatic waves as follows:

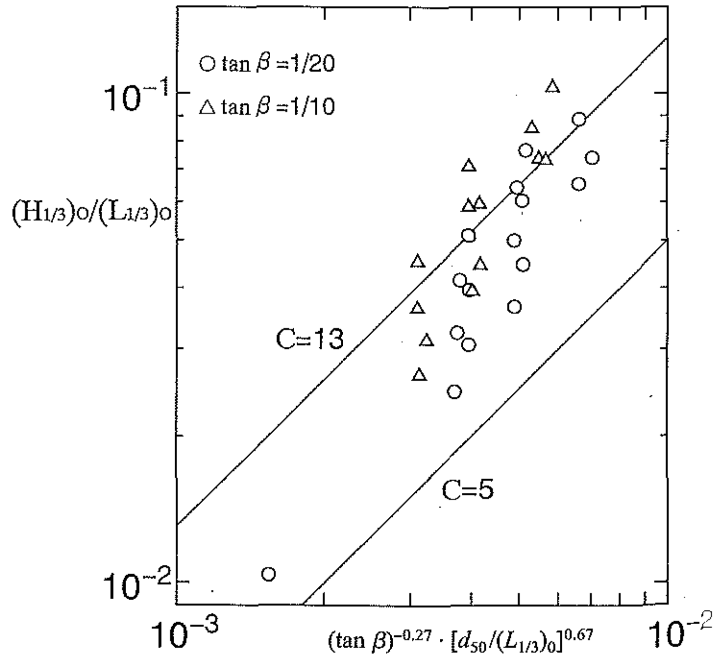


FIGURE 7.2. Classification of beach profiles for bichromatic grouping waves in a laboratory flume.

Attachment B

Polishing Pond
Hydrological Calculations & Pictures
Columbia Generating Station

Source: Aether DBS

Polishing Pond Looking North - Northwest

Polishing Pond Looking South

HARD HAT SERVICES™
Engineering, Construction and Management Solutions

SHEET NO. 1 OF 2
PROJECT NO. 154.017.001
DATE 9-23-11
BY JCW CKD TJH

Alliant - Columbia
Polishing Pond Hydrology

Polishing Pond shown in 1995 topo. dwg

Water Level = 802.5'

Surface Area ≅ 32,000 sq ft = 0.7 acres

Ground Surface: 804.9'

Outlet structure shown in IMG_1279.jpg

→ Flume

Details shown on drawing S-0087.pdf

Water Shed ≅ 75,000 SF = 1.7 acres

Hydraulic length ≅ 375'
Elevation Drop ≅ 806.5 - 805 = 1.5'

Curve Number (CN)

Group B soil (if not A)

Open Space: grass cover on 50%-75% of the area

⇒ CN = 69 "A Guide to Hydrologic Analysis Using SCS Methods" 1982

weighted CN (pond CN = 100)

$$CN = \frac{100 \times 0.7 + 69 \times (1.7 - 0.7)}{1.7}$$

CN = 82

SHEET NO. 2 OF 2
PROJECT NO. 154.017.001
DATE 9-26-11
BY TCW CKD TH

Alliant - Columbia
Polishing Pond Hydrology

$$S = \frac{1000}{CN} - 10 = 2.2'' \quad (\text{equ. } 8)$$

= maximum retention

$$\text{Depth} = \text{“}Q\text{''} = \frac{(P - 0.2S)^2}{P + 0.8S} = 4.0'' \quad (\text{equ. } 7)$$

note: $P = 6.0''$ (from original report)

Water Rise in the pond

$$= \frac{1.7 \text{ acres}}{0.7 \text{ acres}} \times 4.0'' = 9.7 \text{ inches}$$

ignoring any outflow

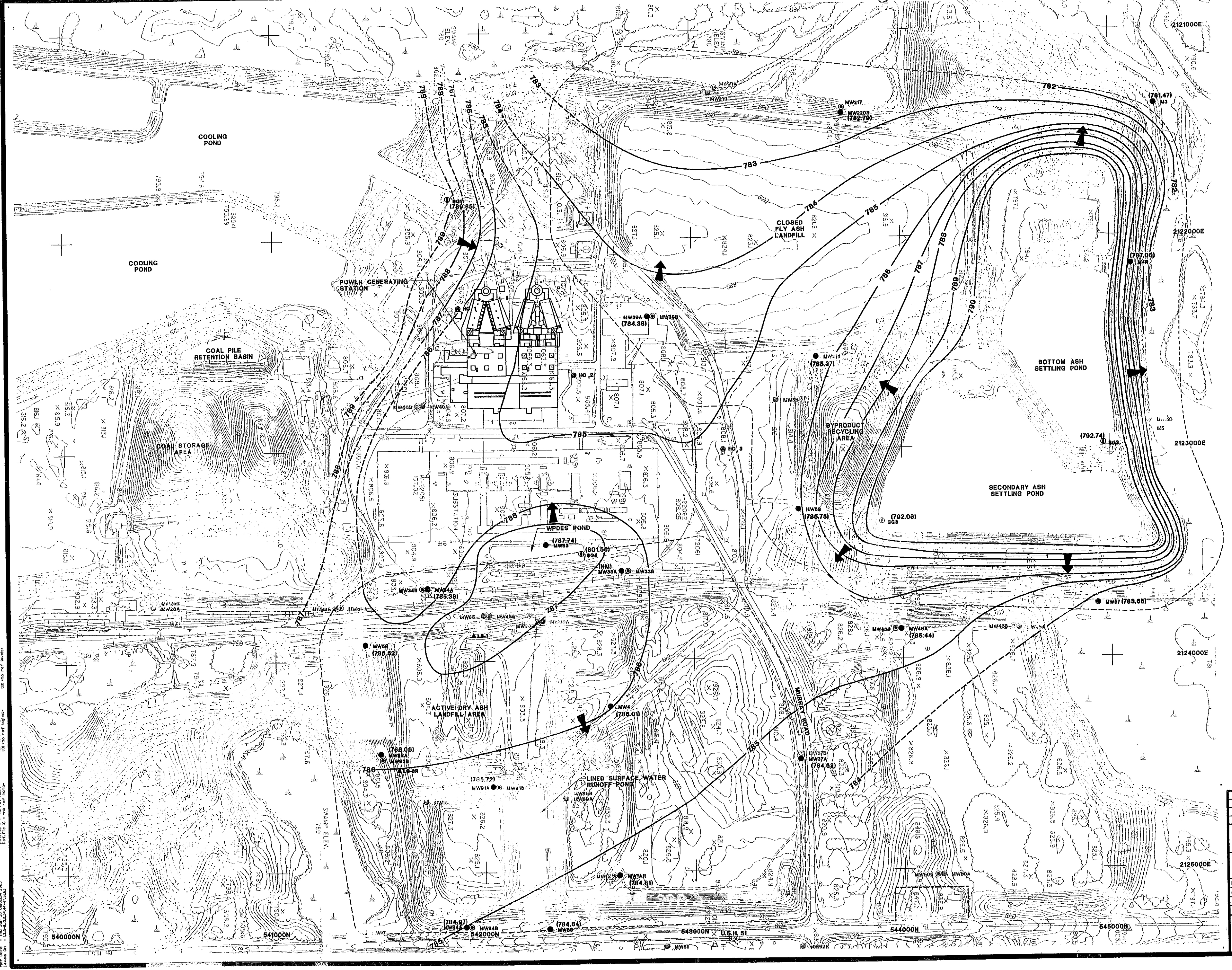
no need to flood route the flow ∴

Attachment C

Water Table Map
(October 2002)
Columbia Generating Station

Source:
RMT, Figure 3, Project Number 3024.28, January 2003

Drawing-Site Water Table Plan (2003).pdf



LEGEND

– - – - – - –	PROPERTY LINE
–+–+–+–	EXISTING RAILROAD TRACKS
— — 100 — —	EXISTING GROUND CONTOUR
	CONTOUR DEPRESSION
	EXISTING PAVED ROAD
	EXISTING UNPAVED ROAD
—×—×—×—	EXISTING FENCE
○ ▭ □	EXISTING BUILDING
766.5	EXISTING SPOT ELEVATION
	TREES AND/OR BRUSH
	WETLAND AREA
	EDGE OF WATER
⊕ HC 1	WATER SUPPLY WELL
● MW91A	WATER TABLE WELL
◎ MW91B	PIEZOMETER
MW210	ABANDONED WATER TABLE WELL
MW235	ABANDONED PIEZOMETER
⦶ SG1	STAFF GAUGE
▲ LS-1	LYSIMETER
- - - - - -	DESIGN MANAGEMENT ZONE
— — — — —	PROPERTY LINE
O.S.	OPEN STORAGE
O.H.	OVERHEAD STRUCTURE
E.P.S.	ELECTRICAL POWER STATION
T	TANK
W	WALL
(785.31)	WATER TABLE ELEVATION (FT-MSL) (N.M. = NOT MEASURED)
—— 786 ——	GROUNDWATER CONTOUR LINE (1FT INTERVAL- FT. M.S.L.) (DASHED WHERE INFERRED)
➡	GROUNDWATER FLOW DIRECTION

NOTES

1. BASE MAP IS PROVIDED BY WISCONSIN POWER & LIGHT CO. AND IS BASED ON PHOTOS TAKEN ON APRIL 6, 1995 BY AERO-METRIC ENGINEERING, SHEBOYGAN, WI.
2. HORIZONTAL DATUM IS BASED ON THE WISCONSIN STATE PLANE COORDINATE SYSTEM, SOUTH ZONE - DATUM: NAD 83(91).
3. VERTICAL DATUM IS REFERENCED TO U.S.G.S. MEAN SEA LEVEL (MSL). TOPOGRAPHIC CONTOUR INTERVAL IS TWO FEET.
4. MONITORING WELL LOCATIONS AND ELEVATIONS SURVEYED BY WISCONSIN POWER & LIGHT CO. IN DECEMBER 1994 & NOVEMBER 1996.
5. THE LOCATION OF THE DESIGN MANAGEMENT ZONE DEMARCATION LINE IS APPROXIMATE.
6. WATER ELEVATION USED TO PREPARE THIS MAP WERE MEASURED ON OCTOBER 24, 2002.
7. THE WATER LEVEL AT MW 33A AND MW 33B COULD NOT BE MEASURED DURING OCTOBER 2002 DUE TO AN OBSTRUCTION IN THE WELL CASING.

CONFIDENTIAL BUSINESS INFORMATION

NO.	BY	DATE	REVISION	APP'D.
3.				
2.				
1.				

PROJECT: ALLIANT ENERGY - WP&L
COLUMBIA ASH PONDS & DRY ASH
DISPOSAL FACILITY

SHEET TITLE: WATER TABLE MAP
(OCTOBER 2002)

DRAWN BY: defoej	SCALE: 1"=200'	PROJ. NO. 3024.28
CHECKED BY: JMR		FILE NO. WATERTBL.PLT
APPROVED BY: JCO	DATE PRINTED: JAN 30 2003	FIGURE 3
DATE: JANUARY 2003		

RMT

744 Heartland Trail
Madison, WI 53717-1934

P.O. Box 8923
Madison, WI 53708-8923
Phone: 608-831-4444

RMT COMPUTER AIDED DESIGN & DRAFTING

Attachment D

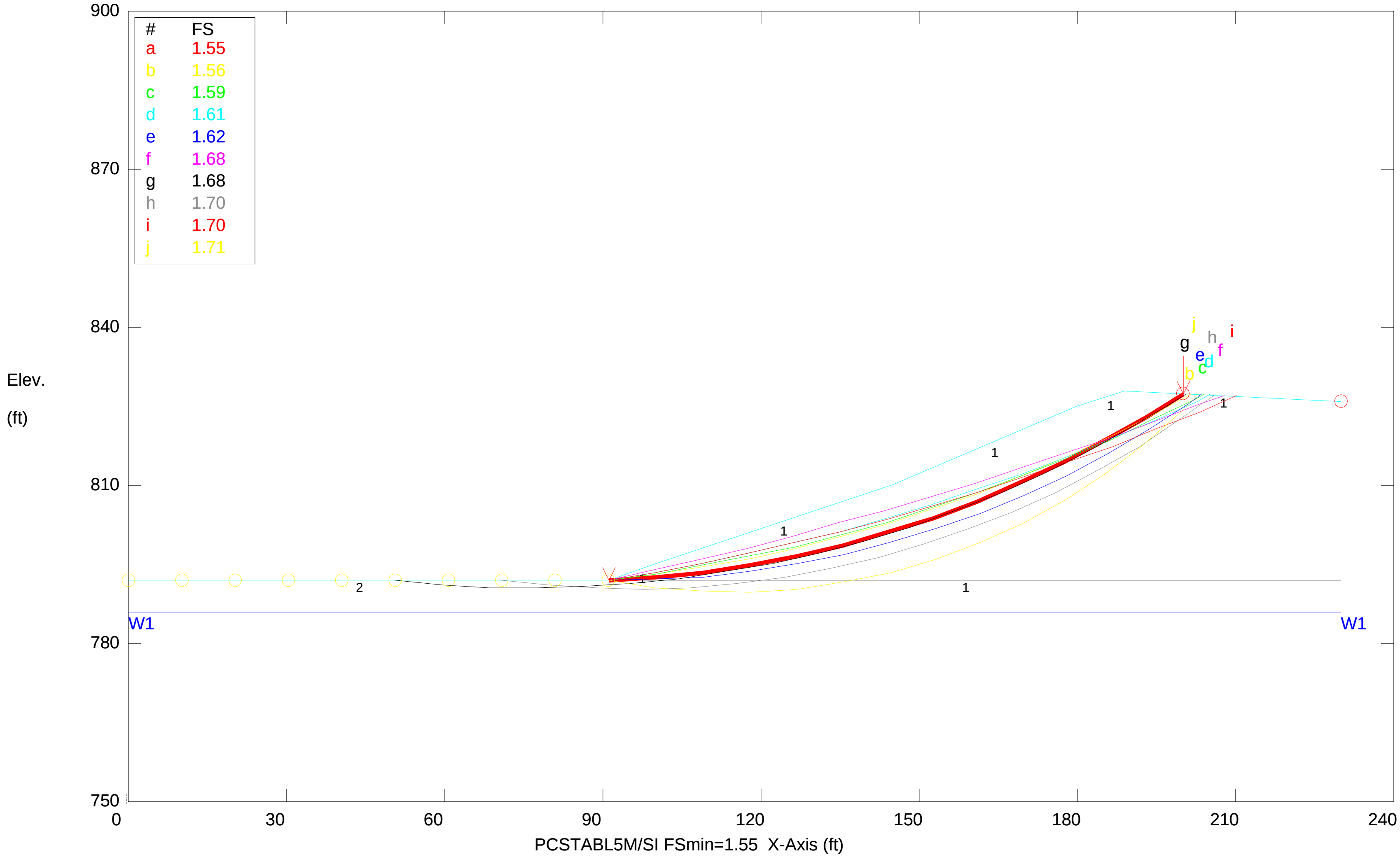
Slope Stability Analyses Results
Ten Most Critical Surfaces Per Loading Case
Columbia Generating Station

Source:

Program pcSTABLE5m/si output by Aether dbs, September, 2011

Alliant Columbia - Duck Pond Static Analysis

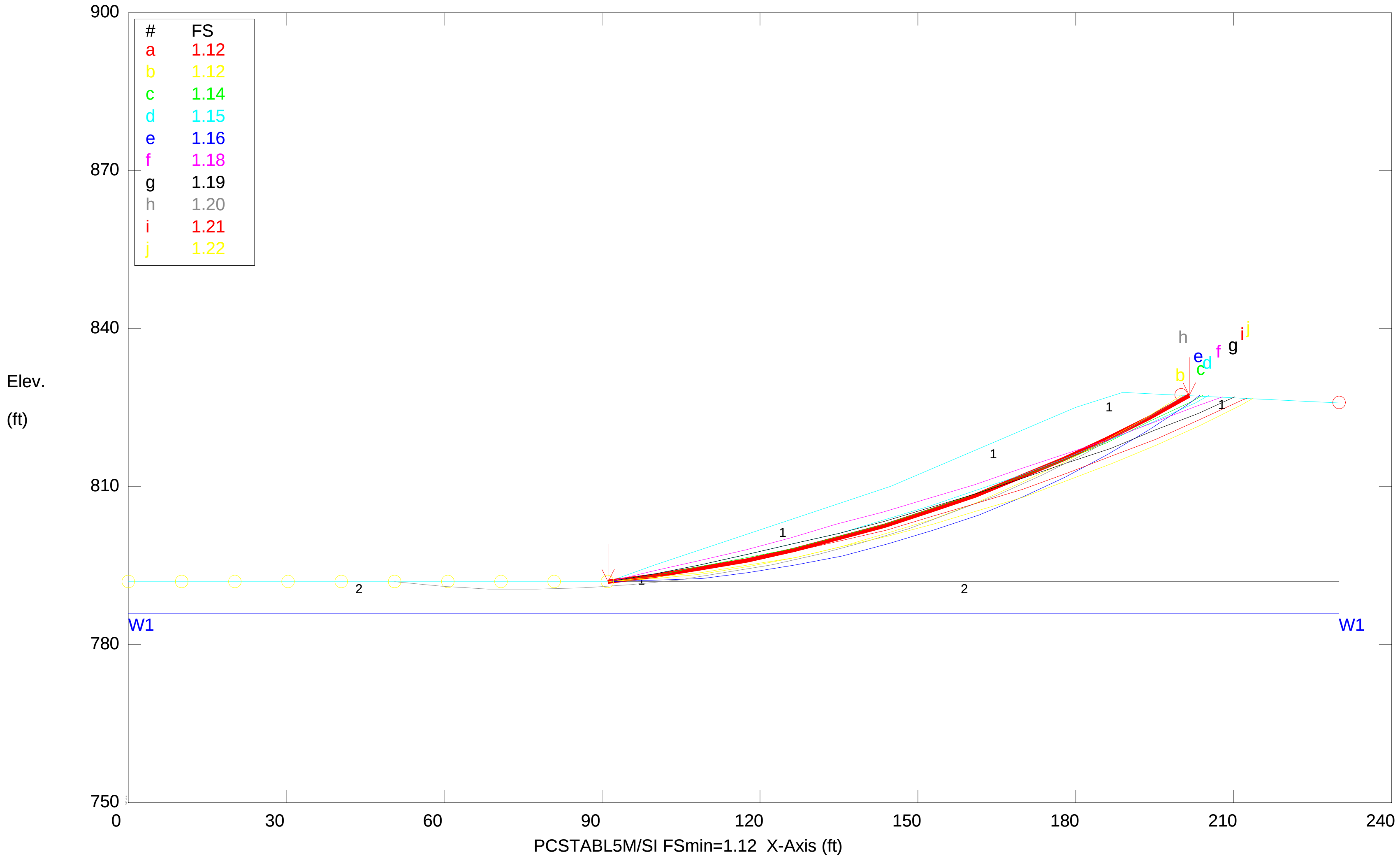
Ten Most Critical. C:COLUM21C.PLT By: TCW 09-26-11 3:19pm



Soil Type No.	Label	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	ASH	120	125	0	28	0	0	W1
2	SAND	130	135	0	30	0	0	W1

Alliant Columbia - Duck Pond EQ Analysis (H=0.11 & V=0.073)

Ten Most Critical. C:COLUM22C.PLT By: TCW 09-26-11 3:16pm



Soil Type No. Label	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1 ASH	120	125	0	28	0	0	W1
2 SAND	130	135	0	30	0	0	W1

Attachment E

Assessment of Embankment Materials
Columbia Generating Station

Source: Aether dbs, July 6, 2011

aetherdbs

elemental design build solutions

July 6, 2011

Mr. William Skalitzky
Alliant Energy
4902 N. Biltmore Lane
Madison, WI 53718

154.005.001

Re: Assessment of Embankment Materials
Columbia Energy Center – Pardeeville, WI

Mr. Skalitzky;

Aether dbs, reports our findings from field investigations of the embankments at the Columbia Energy Center Ash Ponds. The purpose of the investigation is to confirm the embankments are constructed of compacted sand and gravel and that the embankments were not placed over soft organic soil deposits.

The stability analysis of the ash ponds under normal loading, earthquake loading, and rapid drawdown were presented by Aether dbs in February 16, 2011. Based on recent topographic mapping, it was determined that the embankments were constructed with four horizontal to one vertical slopes as designated in the 1970 design documents. The specifications for the construction indicated that sands native to the site would be used for the embankment construction and a topographic map prepared prior to the construction indicated that a stockpile of the sand was available from developing the plant site.

Based on the construction documents, a conservative strength of 30 degree friction angle and no cohesion was assigned to the embankments. It was also assumed that organic soils that may have been present on the north end of the ponds where the higher ground of the plant site sloped down into a wetland area, was removed prior to construction. The result of the analysis showed that the static factor of safety was 1.8, the earthquake 1.1 (using a 2475 year return period event), and the rapid drawdown was 1.5.

Aether dbs understands that United States Environmental Protection Agency (USEPA) requested that Alliant confirm that the embankments were constructed of the on-site sand over properly prepare subgrade. To investigate the materials of construction in the embankments, Aether dbs contracted with Cabeno Environmental Services, LLC to take three cone penetrometer (CPT) borings and four geoprobe borings at the locations shown on Figure 1. The CPT borings were to measure the strength of the embankment material down to the contact with the original grade and the geoprobes were to confirm the soil type by visual observation.

Investigation

The attempts to push the CPT at locations 1 through 3 on the embankments of the primary and secondary ash ponds were met with refusal to either setting the anchors of the geoprobe or to refusal of the cone penetrometer. Geoprobe samples were advanced at SB1, SB2, and SB3 along the north end of the embankments where construction records indicate the crest of the embankment is approximately 25-feet above original grade. The geoprobe was unable to advance the sampling probe to 25-feet in SB1 and SB2, both of which indicate the embankment is sand with some gravel and silt (glacial till that is the native soil at the site). Geoprobe SB3 did advance to 26 foot depth and encounter a thin residual of the removed peat lying on the native till. The Geoprobe samples are provided in Attachment A.

Geoprobe SB5 was installed on the east side of the secondary ash pond and found refusal at 7.5 feet in dense sand. Geoprobes SB4, SB6, and SB7 were installed on a north to south line along the bermed edge of the polishing pond (the polishing pond is incised into a drainage way slope). In these three geoprobes sand is found to depths of 22-feet, 16-feet and 12-feet moving from south to north. Below the sand is silty clay that is likely the original ground surface.

Conclusions

The geoprobe results indicate that the embankment materials are dense to very dense sand with a probable internal friction angle of 35 degrees or more. The investigation indicates that an analysis of the embankment stability using the June 2011 geoprobe results will exceed the Factor of Safeties reported in February 16, 2011 letter.

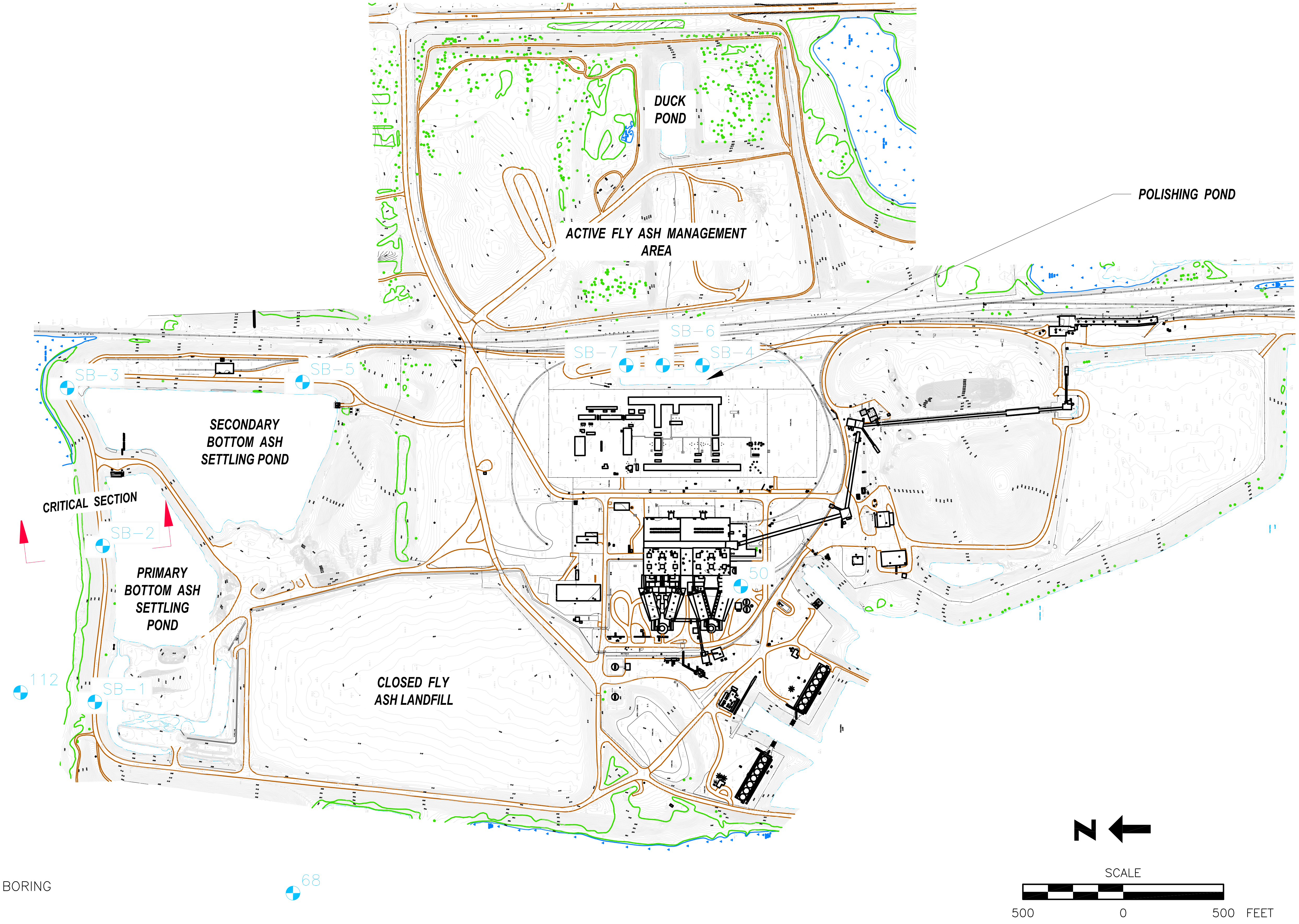
The results from the three geoprobes installed on the berm of the side slope polishing pond indicate that the slope is in fill that is sand or in some cases clayey sand and is likely the same native glacial soil fill that was used for the embankments. There are no underlying weak layers of soil in the polishing pond area that could cause it to slide into the drainage way.

Respectfully Submitted,

Thomas C Wells

Thomas C. Wells, P.E.

Timothy J. Harrington, P.E.



LEGEND:

SB-3 SOIL BORING

REV	DATE	BY	DESCRIPTION
5			
4			
3			
2			
1			

aether dbs
www.aetherdbs.com

SCALE:	AS SHOWN
DATE:	07-06-11
DRAWN BY:	MM
CHKD. BY:	TCW
APPROVED:	07-06-11

CLIENT / LOCATION

ALLIANT ENERGY
COLUMBIA ENERGY CENTER
PARDEEVILLE, WISCONSIN

DRAWING DESCRIPTION

SITE PLAN
GEOPROBE BORING LOCATIONS

JOB 154

SHT. FIGURE 1

DWG. SITE PLAN

Attachments

Boring / Geoprobe Logs

Columbia Generating Station

Source:
CABENO Environmental Field Services, LCC - June 2011

Boring Log
Legend

Sample
No: (Number) Soil samples are numbered consecutively from the ground surface. Core samples are numbered consecutively from the first core run.

Type: A= Auger Cuttings CR= Core Run MS= Modified Spoon PB= Pitcher Barrel
PT= Piston Tube ST= Shelby Tube SS= Split Spoon (2” O.D.) WC= Wash Cuttings

Interval: The depth of sampling interval in feet below ground surface

Blow Count
The number of blows required to drive a 2-inch O.D. split-spoon sampler with a 140 pound hammer falling 30-inches. When appropriate, the sampler is driven 18 inches and blow counts are reported for each 6-inch interval. The sum of blow counts for the last two 6-inch intervals is designated as the standard penetration resistance (N) expressed as blows per foot.

Recovery in Inches
The length of sample recovered by the sampling device.

U.S.C.S. Soil Type
The Unified Soil Classification System symbol for recovered soil samples determined by visual examination or laboratory tests. Refer to ASTM D2487-69 for a detailed description of procedure and symbols. Underlined symbols denote classifications based on laboratory tests (i.e. ML), all others are based on visual classification only.

Percent Moisture
Natural moisture content of sample expressed as percent of dry weight.

q_u TSF
Unconfined compressive strength in tons per square foot obtained by hand penetrometer. Laboratory compression test values are indicated by underlining.

Contact Depth
The contact depth between soil layers is interpreted from significant changes in recovered samples and observations during drilling. Actual changes between soil layers often occur gradually and the contact depths shown on the boring logs should be considered as approximate.

Soil Description and Remarks
Soil descriptions include consistency or density, color, predominant soil types and modifying constituents.

Cohesive Soils			Cohesionless Soils	
Consistency	q_u (TSF)	Blows/ft.	Density	Blows/ft.
Very Soft	less than 0.25	0-1	Very Loose	4 or less
Soft	0.25 to 0.50	2-4	Loose	5 to 10
Medium Stiff	0.50 to 1.00	5-8	Medium Dense	11 to 30
Stiff	1.00 to 2.00	9-15	Dense	30 to 50
Very Stiff	2.00 to 4.00	15-30	Very Dense	Over 50
Hard	more than 4.00	Over 30		

Particle Size Description

Boulder = Larger than 12 inches
Cobble = 3 to 12 inches
Gravel = 0.187 to 3 inches
Sand = 0.074 to 4.76 mm
Silt and Clay = smaller than 0.074 mm

Definition of Terms

Trace = 5 to 12 percent by weight
Some = 12 to 30 percent by weight
And = Approximately equal fractions
( ) = Driller’s observation

Piezo.
(Piezometer) Screened interval of the piezometer installation is denoted by cross-hatching.

General Note
The boring log and related information depicted subsurface conditions only at the specified locations and date indicated. Soil conditions and water levels at other locations may differ from conditions occurring at these boring locations. Also the passage of time may result in a change in the conditions at these boring locations.

Soil Test Boring Refusal
Defined as any material causing a blow count greater that 50 blows/6 inches. Such material may include bedrock, “floating” rock slabs, boulders, dense gravel seams, hard pan clay, or cemented soils. Refusal is usually indicated in fractional notation showing number of blows as the numerator and inches of penetration as the denominator.

CABENO

Environmental Field Services, LLC

BORING LOG

CLIENT: Aether dbs

COORDINATES: *N NOT SURVEYED*
E NOT SURVEYED

PROJECT: Alliant Columbia Station

BORING NO.: *SB1*

page 1 of 1

LOGGED BY: *John Noyes*
EDITED BY: *John Noyes*
CHECKED BY: *Chris Sullivan*
DATE BEGAN: *06-01-11*
DATE FINISHED: *06-01-11*
GROUND SURFACE ELEVATION:

DEPTH TO WATER WHILE DRILLING	SAMPLE NO. AND TYPE	SAMPLE RECOVERY	SAMPLE INFROMATION	POCKET PENETROMETER (TONS/FT2)	CONSISTENCY vs. DEPTH	DEPTH IN FEET	PROFILE	DESCRIPTION
						0		SAND & GRAVEL; light brown to orange; fine to coarse grained; well graded; dry to moist. (Fill)
	SP1	4.7'/5'						SAND; light brown; fine grained; poorly graded; moist. (Fill)
						-5		
	SP2	5'/5'						
▽								@ 8.5' grades wet
						-10		
	SP3	4'/5'						@ 13' grades yellow to light tan
						-15		@ 15' grades fine to coarse, well graded
	SP4	5'/5'						@ 17' grades fine sand w/ well rounded gravels, trace silt/clay
						-20		
								Bottom of boring @ 19'
						-25		

CABENO

Environmental Field Services, LLC

BORING LOG

CLIENT: Aether dbs

COORDINATES: *N NOT SURVEYED* *E NOT SURVEYED*

PROJECT: Alliant Columbia Station

BORING NO.: *SB2*

page 1 of 1

LOGGED BY: *John Noyes*
EDITED BY: *John Noyes*
CHECKED BY: *Chris Sullivan*
DATE BEGAN: *06-01-11*
DATE FINISHED: *06-01-11*
GROUND SURFACE ELEVATION:

DEPTH TO WATER WHILE DRILLING	SAMPLE NO. AND TYPE	SAMPLE RECOVERY	SAMPLE INFROMATION	POCKET PENETROMETER (TONS/FT2)	CONSISTENCY vs. DEPTH	DEPTH IN FEET	PROFILE	DESCRIPTION
						0	▨	SAND; light brown to orange; fine grained; poorly graded; dry to moist; trace gravels. (Fill)
	SP1	5'/5'					▨	
						-5	▨	@ 5' grades trace silt
	SP2	5'/5'					▨	
						-10	▨	@ 10' to 13', very hard & dense; seems overconsolidated; more recovery than push
	SP3	5'/3'						
						-15		Bottom of boring @ 13' Boring advanced W/ Geoprobe Model 6610DT using 60-inch Macrocore sampling system. Boring backfilled to groundsurface w/ bentonite chips on 06-1-11.
						-20		

CABENO

Environmental Field Services, LLC

BORING LOG

CLIENT: Aether dbs

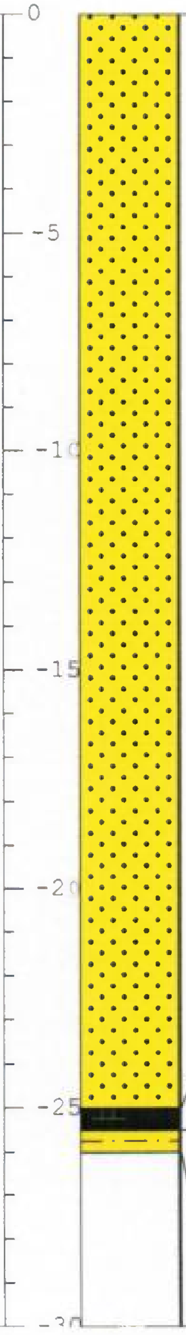
PROJECT: Alliant Columbia Station

COORDINATES: *N NOT SURVEYED* *E NOT SURVEYED*

BORING NO.: *SB3*

page 1 of 1

LOGGED BY: *John Noyes*
EDITED BY: *John Noyes*
CHECKED BY: *Chris Sullivan*
DATE BEGAN: *06-01-11*
DATE FINISHED: *06-01-11*
GROUND SURFACE ELEVATION:



DEPTH TO WATER WHILE DRILLING	SAMPLE NO. AND TYPE	SAMPLE RECOVERY	SAMPLE INFROMATION	POCKET PENETROMETER (TONS/FT2)	CONSISTENCY vs. DEPTH	DEPTH IN FEET	PROFILE	DESCRIPTION
						0		SAND; light brown to orange; fine grained; poorly graded; dry to moist; trace gravels. (Fill)
	SP1	5'/5'						
						-5		
	SP2	5'/5'						
						-10		
	SP3	5'/5'						
						-15		
▽								@ 16' grades gray and wet.
	SP4	5'/5'						
						-20		
	SP5	5'/5'						
						-25		PEAT; brown; dry; non-plastic. (PT)
	SP6	1'/1'						Clayey SILT; gray; non-plastic; hard; moist. (ML) Bottom of boring @ 26' Boring advanced W/ Geoprobe Model 6610DT using 60-inch Macrocore sampling system. Boring backfilled to groundsurface w/ bentonite chips on 06-1-11.
						-30		

CABENO

Environmental Field Services, LLC

BORING LOG

CLIENT: Aether dbs

PROJECT: Alliant Columbia Station

COORDINATES: *N NOT SURVEYED*
E NOT SURVEYED

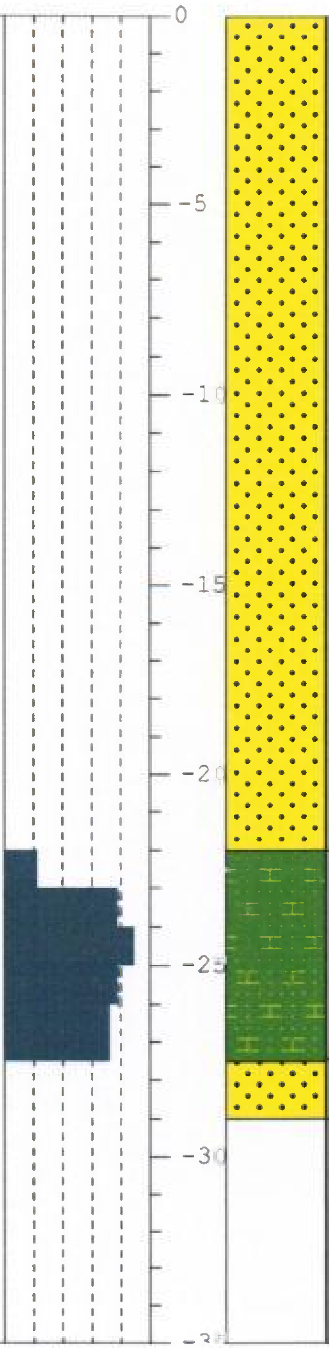
BORING NO.: *SB4*

page 1 of 1

LOGGED BY: *John Noyes*
EDITED BY: *John Noyes*
CHECKED BY: *Chris Sullivan*
DATE BEGAN: *06-01-11*
DATE FINISHED: *06-01-11*
GROUND SURFACE ELEVATION:

DEPTH TO WATER WHILE DRILLING	SAMPLE NO. AND TYPE	SAMPLE RECOVERY	SAMPLE INFROMATION	POCKET PENETROMETER (TONS/FT2)
	SP1	5'/5'		
	SP2	5'/5'		
	SP3	4'/5'		
▽				
	SP4	5'/5'		
	SP5	5'/5'		1.0
				3.5
				4.0
				3.5
		4'/5'		3.25
	SP6			

CONSISTENCY vs. DEPTH | DEPTH IN FEET | PROFILE



DESCRIPTION

SAND; light brown to orange; fine grained; poorly graded; dry to moist; trace gravels. (Fill)

@ 9' grades Clayey SAND

@ 12.5' clay grades out.

@ 16.5' grades wet.

Silty CLAY; light tan; low plasticity; soft to stiff; moist; trace gravel. (CL)

SAND; light tan; fine to coarse; well graded; wet. (SW)

Bottom of boring @ 29'

Boring advanced W/ Geoprobe Model 6610DT using 60-inch Macrocore sampling system. Boring backfilled to groundsurface w/ bentonite chips on 06-1-11.

CABENO

Environmental Field Services, LLC

BORING LOG

CLIENT: Aether dbs

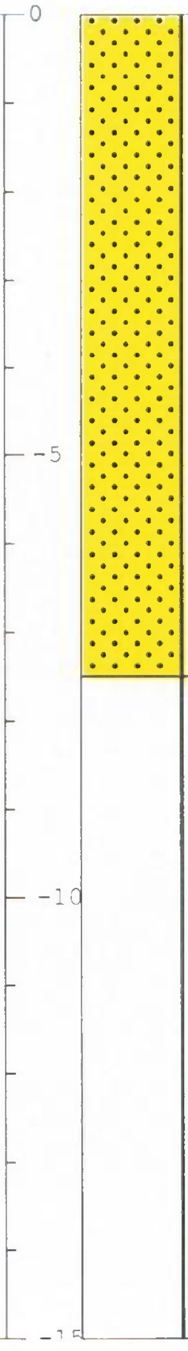
COORDINATES: *N NOT SURVEYED* *E NOT SURVEYED*

PROJECT: Alliant Columbia Station

BORING NO.: *SB5*

page 1 of 1

LOGGED BY: *John Noyes*
EDITED BY: *John Noyes*
CHECKED BY: *Chris Sullivan*
DATE BEGAN: *06-01-11*
DATE FINISHED: *06-01-11*
GROUND SURFACE ELEVATION:



DEPTH TO WATER WHILE DRILLING	SAMPLE NO. AND TYPE	SAMPLE RECOVERY	SAMPLE INFROMATION	POCKET PENETROMETER (TONS/FT2)	CONSISTENCY vs. DEPTH	DEPTH IN FEET	PROFILE	DESCRIPTION
								SAND; light brown to orange; fine grained; poorly graded; dry to moist; trace gravels. (Fill)
	SP1	5'/5'						
		4'/2.5'						
								@ 7.5' refusal.
	SP2							
								Bottom of boring @ 7.5'
								Boring advanced W/ Geoprobe Model 6610DT using 60-inch Macrocore sampling system. Boring backfilled to groundsurface w/ bentonite chips on 06-1-11.

CABENO

Environmental Field Services, LLC

BORING LOG

CLIENT: Aether dbs

COORDINATES: *N NOT SURVEYED*
E NOT SURVEYED

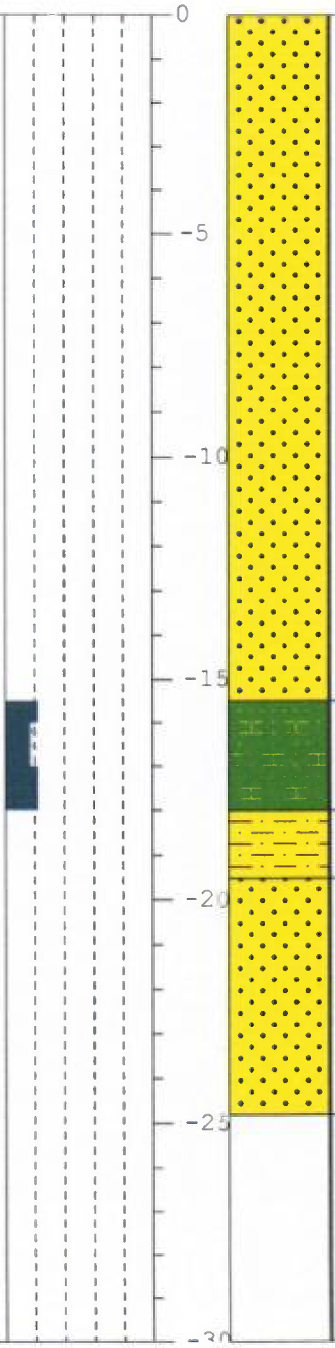
PROJECT: Alliant Columbia Station

BORING NO.: *SB6*

page 1 of 1

LOGGED BY: *John Noyes*
EDITED BY: *John Noyes*
CHECKED BY: *Chris Sullivan*
DATE BEGAN: *06-01-11*
DATE FINISHED: *06-01-11*
GROUND SURFACE ELEVATION:

DEPTH TO WATER WHILE DRILLING	SAMPLE NO. AND TYPE	SAMPLE RECOVERY	SAMPLE INFROMATION	POCKET PENETROMETER (TONS/FT2)
	SP1	4.5'/5'		
	SP2	4.5'/5'		
	SP3	4'/5'		
∇	SP4	5'/5'		1.0 0.75 1.0
	SP5	5'/5'		



DESCRIPTION

SAND; light brown to orange; fine grained; poorly graded; dry to moist; trace gravels. (Fill)

Silty CLAY; light tan; low plasticity; very soft to soft; moist. (CL)

SILT; light tan; non-plastic- wet. (ML)

SABD; light tan; fine grained; poorly graded; wet. (SW)

@ 23.5' grades some gravels.
@ 24.8' refusal.

Bottom of boring @ 24.8'

Boring advanced W/ Geoprobe Model 6610DT using 60-inch Macrocore sampling system. Boring backfilled to groundsurface w/ bentonite chips on 06-1-11.

CABENO
Environmental Field Services, LLC

BORING LOG

CLIENT: Aether dbs

COORDINATES: *N NOT SURVEYED*
E NOT SURVEYED

PROJECT: Alliant Columbia Station

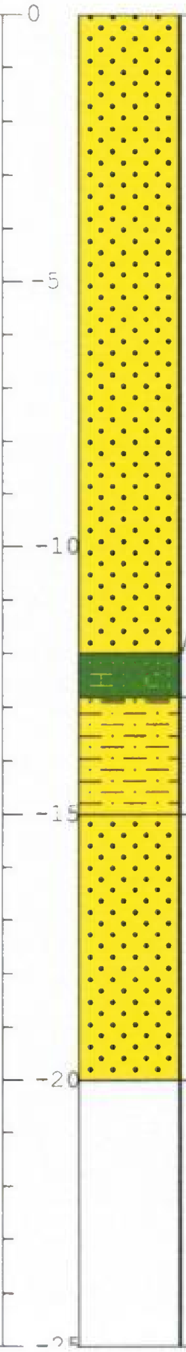
BORING NO.: ***SB7***

page 1 of 1

LOGGED BY: *John Noyes*
EDITED BY: *John Noyes*
CHECKED BY: *Chris Sullivan*
DATE BEGAN: *06-01-11*
DATE FINISHED: *06-01-11*
GROUND SURFACE ELEVATION:

DEPTH TO WATER WHILE DRILLING	SAMPLE NO. AND TYPE	SAMPLE RECOVERY	SAMPLE INFROMATION	POCKET PENETROMETER (TONS/FT2)	CONSISTENCY vs. DEPTH
	SP1	4.5'/5'			
	SP2	5'/5'			
▽	SP3	5'/5'			
	SP4	5'/5'			

DEPTH IN FEET | **PROFILE** | **DESCRIPTION**



SAND; light brown to orange; fine grained; poorly graded; dry to moist; trace gravels. (Fill)

Silty CLAY; light tan; low plasticity; moist. (CL)

SILT; light tan; non-plastic- wet. (ML)

SAND; light tan; fine grained; poorly graded; wet. (SW)

Bottom of boring @ 20'

Boring advanced W/ Geoprobe Model 6610DT using 60-inch Macrocore sampling system. Boring backfilled to groundsurface w/ bentonite chips on 06-1-11.