Tennessee Valley Authority
Regulatory Submittal for Kingston Fossil Plant

Documents submitted:
Revised Site Dredging Plan July 2009 with Attachments

Date submitted
8/ 3/ 2009

Submitted to whom
Leo Francendese, EPA

Concurrence

Received	Not Applicable	TVA
☒	☐	Anda Ray
☒	☐	Mike Scott
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Approvals

TVA Michael T Scott Date 8/3/09

EPA Leo Francendese Date 8/3/09

Consulted w TDEC P. Davis

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- ☒ Anda Ray, TVA
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- ☒ David Stephenson, TVA
- ☒ Michelle Cagley, TVA
- ☐ Greg Signer, TVA
- ☒ KIF Incident Document Control
- ☐ Katie Kline, TVA
- ☐ Gretchen Wahl, Jacobs
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Revised Emory River Dredging Plan
Kingston Fossil Plant Ash Recovery Project

Tennessee Valley Authority
Kingston Fossil Plant

Prepared by:

Jacobs Engineering

February 2009
Revised July 2009

Table of Contents

List of Figures (follows text)

List of Attachments

List of Acronyms

BMP	best management practices
CFR	Code of Federal Regulations
cfs	cubic feet per second
CY	cubic yard
DGPS	differential global positioning system
EPA	U.S. Environmental Protection Agency
ERM	Emory River Mile
GPS	Global Positioning System
HDPE	high density polyethylene
KIF	Kingston Fossil Plant
msl	mean sea level (National Geodetic Vertical Datum, 1929)
NTU	nephelometric turbidity unit
TDEC	Tennessee Department of Environment and Conservation
TVA	Tennessee Valley Authority
USACE	U.S. Army Corps of Engineers
USCG	U.S. Coast Guard

1.0 Dredging Plan Scope and Objectives

The Tennessee Valley Authority (TVA) is recovering the fly ash released into the Emory River, Roane County, Tennessee through dredging. The dredging activity was originally planned to be conducted in three phases. This plan is being revised based on experience gained from dredging operations which began on March 19, 2009 and changes in overall management of the recovery operations.

The approved plan called for a Pilot Dredging Operation to verify the designs and concepts of the plan. The plan also called for dredging to proceed in phases with very proscriptive protocols for the dredging operations. The proscriptive nature of the plan reflected concerns that the ash in the river could be mobilized by the dredging operations and that turbidity from the dredging would be highly problematic. Also, one of the assumptions of the original plan was that three 10" dredges, with a capacity of 3,000 cubic yards per day would be utilized to remove 9,000 cubic yards of ash per day. Experience gained during the Pilot Dredging Operations has shown that some of these concerns are unfounded and unnecessarily impacting dredging production. Also, the expected production of the 10" was not realized.

TVA and EPA have entered into an Administrative Order and Agreement on Consent for the ash recovery project at Kingston. Removal of ash from the Emory River and the areas east of Dike 2 were established as Time-Critical Removal Actions. EPA has assigned an On-Scene Coordinator to oversee TVA's implementation of these activities.

Experience gained from the Pilot Dredging Operations can be summarized as follows:

- The ash is a relative stable mass, thus the original restrictions on maintaining underwater side slope of 10' horizontal to 1' vertical is not necessary.
- Hydraulic dredging has not created unmanageable turbidity problems.
- Mechanical removal of debris and "near surface" ash has not created unmanageable turbidity problems.
- Ten-inch hydraulic dredges have experienced great difficulty in removing ash from the river. Larger and more powerful and durable equipment will be necessary to effectively remove the ash from the river.

- The size and quantity of debris in the ash impact dredging progress. Mechanical debris removal in advance of the hydraulic dredges will increase production.

- The dewatering and processing operations performed as designed, although a sustained production rate of 9,000 cubic yards per day was not achieved.

This plan describes the requirements for mass removal of the ash from the river and the intake channel. The original phased approach is being replaced with a more aggressive approach to remove most of the ash from the river and the area east of Dike 2 by spring of 2010. This approach will allow the dredging contractor to use the most effective means and methods to recover the ash.

1.1 Objectives of the Dredging Plan

This Dredging Plan provides the general approach and objectives for dredging operations in the Emory River to remove ash and debris. Currently, the main river channel is blocked by ash and the river is diverting around the blockage. The dredging of the Emory River will be prioritized as follows:

- Priority 1: Clear the Emory River channel to the pre-slide sediments to restore flow to the channel, to minimize flooding, and to prevent further migration of the ash. This reach of the river is generally depicted as segments 5, 1, 2, and 3 in Figure 5.

- Priority 2: Clear the remaining ash within the river and intake channel. This includes Segment 4 down to Emory River mile 0, north of Segment 5, ash deposition existing east of Segment 1, the intake channel, and the ash and debris at the skimmer wall. Removing ash from the intake channel will prevent ash from flowing through the Plant into the Clinch River. Caution will be exercised to minimize disturbance of legacy sediments near Emory River mile 0.

In Priority 1 dredging, the river channel will be cleared to the pre-slide sediments in Segments 5, 1, 2, and 3 using hydraulic dredging with mechanical debris removal. As part of Priority 1, the recently constructed underwater weir (referred to as Weir 1) will be removed. Ash recovery, disposal, and water treatment are addressed in the Ash Processing Area Construction and Operation Plan.

Priority 2 dredging will focus on removing any remaining deposits of ash in the river while minimizing disturbance of legacy sediment. This will include Segment 4, ash in shallow areas east of Segment 1, and reaches above Segment 5 and below Segment 4 to near the confluence with the Clinch River. Dredging limits in the confluence area will be defined by Department of

Energy sampling to ensure that no nuclear contaminated sediment is dredged. On May 4, 2009, the Emory River experienced a five-year flood event, resulting in flows increasing from 1,000 cfs to 70,000 cfs and returning to about 1,500 cfs, all in a 24-hour period. This resulted in an inversion of ash and silt as the ash settled faster than the upriver silt brought down by the flood. This inversion has been verified by samples from Eckman-type sample dredges. A Sub Bottom Profiler and/or Eckman-type sample dredges will be used to better characterize the appropriate dredge depth, in such cases.

During dredging operations, the ash is disturbed and some dredged ash is re-suspended in the water column and not captured by the dredge. Turbidity will increase in the immediate area of the dredging. Control practices and monitoring will be implemented to minimize suspended solids from the dredging operations. Turbidity curtains will be used and other best management practices (BMPs) will be identified in the dredging contractor's work plan to minimize impacts to the river. BMPs could include operational controls (i.e., reduce cutter head speed, reduce rate of advance, reverse cutter head rotation) and/or engineering controls (i.e., additional turbidity curtains).

Water quality monitoring procedures are presented as part of the Sampling Plan for Phase 1 Dredging Operations, May 2009, and are currently being incorporated into the Surface Water Monitoring Plan for the Emory, Clinch and Tennessee Rivers (currently under revision).

1.2 Scope of Work

The scope of this Dredging Plan is to accomplish the following:

- Develop a Dredging Plan to provide the general methods and quality criteria for the dredging operations.
- Develop dredging methods that will clear the impacted river channel.
- Develop dredging methods that will address areas outside the main river channel in the Emory River.
- Describe dredging operations associated with clearing the KIF intake channel to an elevation of 701 feet msl or hard bottom.
- Define methods to dredge the Emory River to restore flow in the channel without further impacting legacy, native river sediment.
- Define surveys and monitoring to be performed to confirm that project objectives and regulatory criteria have been met.
- Describe the Site Wide Safety and Health Plan for the TVA Kingston Fossil Plant Ash Release Response.

1.3 Organization of the Dredging Plan

This Dredging Plan describes the work elements for the dredging of the Emory River that are required to open the main river channel for flow, flood control, potential ash migration, and meet the requirements of the EPA Consent Order and Agreement. The plan provides the basic proposed methods for conducting the work and monitoring the completion of the work. Monitoring of the water quality during dredging operations is included as part of the Sampling Plan for Phase 1 Dredging Operations, May 2009, and is currently being incorporated into the Surface Water Monitoring Plan for the Emory, Clinch and Tennessee Rivers (currently under revision). Management of ash and water discharge from dredging operations is provided in the Ash Processing Area Construction and Operation Plan.

Organization of the Dredging Plan is as follows:

Section 1: Plan Scope and Objectives
Section 2: Site Background
Section 3: Dredging Operations
Section 4: Monitoring of Construction Activities
Section 5: Health and Safety Plan

1.4 Project Organization

TVA (and/or its contractor(s)) is responsible to oversee work and ensure work is conducted in accordance with EPA approved work plans. The EPA OSC will verify that work is accomplished in accordance with approved plans.

Key Personnel:

- Anda Ray – TVA Kingston Ash Recovery Executive and Spokesperson
- Mike Scott - TVA Kingston Ash Recovery Project Manager
- Leo Francendese - EPA On-Scene Coordinator
- John Moebes - Jacobs Kingston Ash Recovery Program Manager
- Julie Pfeffer – Jacobs Kingston Ash Recovery Deputy Program Manager
- Mike Anderson - Jacobs Dredging Project Manager
- Michelle Cagley - TVA Environmental Compliance and Liaison with TDEC, EPA, and other regulators
- Paul Clay - Jacobs Sampling and Monitoring Coordinator

1.5 Project Schedule

Dredging operations began on March 19, 2009 with a Pilot Dredging program to validate the design components of this Dredging Plan. In addition to three 10" hydraulic dredges, the program was augmented by a TVA owned and operated 14" hydraulic dredge and mechanical debris/ash removal in Segment 1. This initial dredging will continue until the Pilot program objectives are achieved and the primary dredging contractor is selected, mobilized and operational. This selection occurred in late June and the contractor will mobilize in July.

2.0 Site Background

This section provides background information for the Kingston Fossil Plant (KIF) and the Emory River. Figure 1 shows the location of KIF in the vicinity of Kingston, Tennessee and the Emory and Clinch Rivers.

2.1 Description of the Area and Location

The KIF is located at the confluence of the Emory and Clinch Rivers on Watts Bar Reservoir near Kingston, Tennessee. Kingston is one of TVA's larger fossil plants. It generates 10 billion kilowatt-hours of electricity a year, enough to supply the needs of about 670,000 homes in the Tennessee Valley. Plant construction began in 1951 and was completed in 1955. Kingston has nine coal-fired generating units. The winter net dependable generating capacity is 1,456 megawatts. The plant consumes some 14,000 tons of coal a day at full operation.

The KIF is located on the Emory River arm of Watts Bar Reservoir, which feeds into the Clinch River (Figure 2). The Emory River borders the KIF ash cells to the east. The Emory River rises on the Cumberland Plateau in Morgan County, Tennessee and crosses into Roane County near Harriman, Tennessee. Flow on the Emory River in the vicinity of KIF is not controlled upstream by flood control or navigation structures. The river elevation is controlled by Watts Bar Dam located downstream of KIF. Summer pool elevation for the Emory River at KIF is approximately 740 to741 feet msl and winter pool elevation is 735 to 740 feet msl based on Watts Bar headwater. The Watts Bar annual spring reservoir fill-period is from March 15 to May 15. The Emory River typical flow volume in the winter and spring ranges from 500 to 50,000 cubic feet per second (CFS). The 10 year flood flow rate is anticipated to be 110,000 CFS and at an estimated flow rate of 12 feet per second. A five-year flood event was experienced on May 4, 2009 during the pilot dredging operations. Flow in the river increased from 1,000 cfs to 70,000 cfs as measured at the Oakdale monitoring station. This event lasted less than 24 hours and was a result of localized rain storm in the mountainous headwater of the Emory. Equipment was secured and all on-water operations were suspended for one day.

Flows at the Oakdale station and National Weather Service reports of rainfall in the watershed will be monitored. A rapidly increasing flow at Oakdale will trigger an assessment of continuing or shutting down river operations until flows normalize. In general, dredging operations will cease when flow velocity exceeds 5 feet per second and the Oakdale station records a rapidly increasing flow in the river.

2.2 Description of the Ash Release

On Monday, December 22, 2008, just before 1 a.m., a coal fly ash spill occurred at TVA's Kingston Fossil Plant, allowing a large amount of fly ash to escape into the adjacent waters of the Emory River. Ash, a by-product of a coal-fired power plant, is stored in containment areas. Failure of the dredge cell dike caused about 60 acres of ash in the 84-acre containment area to be displaced. At the time of the slide, the area contained about 9.4 million cubic yards of ash. The dike failure released about 5.4 million cubic yards (CY) of coal ash that now covers about 275 acres (Figures 3 and 4).

Fly ash filled the Swan Pond Embayment on the north side of the KIF property adjacent to the failed dredge cell. A dike has been constructed in the eastern portion of the Swan Pond Embayment to contain the fly ash to the west of the dike until a remedial action plan is developed, approved by the regulators, and implemented. Fly ash also entered the channel and overbank areas of the riverine section of the Emory River. TVA plans to recover the fly ash outside of the Swan Pond Embayment by use of dredging operations.

The U.S. Coast Guard issued an advisory that the Emory River is not navigable from mile marker zero through mile marker 4. Work is complete on an underwater rock weir (Weir 1) built in the Emory River, just north of the existing plant intake skimmer wall. Weir 1 allows water to continue flowing and retain the ash at the bottom of the river channel. Weir 1 is about 615 feet long. Figure 5 shows the known thickness of ash on the approximate Emory River channel centerline.

3.0 Dredging Operations

The dredging operations include six major components, along with a monitoring component described as part of the Sampling Plan for Phase 1 Dredging Operations, May 2009, and is currently being incorporated into the Surface Water Monitoring Plan for the Emory, Clinch and Tennessee Rivers (currently under revision). These six major components include:

- Site preparation,
- Dredging (including installation of controls to minimize turbidity),
- Hydraulic dredge ash dewatering and ash handling,
- Mechanical debris/ash removal and processing,
- Rail shipment of ash to off-site disposal in a Subtitle D landfill, and
- Site restoration.

3.1 Site Preparation

The "Pilot" dredging contractor mobilized to the site and constructed the ash recovery trench system. In general, Site preparation activities included the following:

- Installation of erosion control features on the ash processing site,
- Clearing and grubbing, grading, and surfacing of the staging area,
- Delivery of the heavy equipment including excavators, dozers, loaders, forklifts, pumps, and tanks (as required),
- Delivery and installation of office, break, storage, and tool trailers (as required),
- Delivery of all remaining equipment,
- Installation of ash pond or other processing pond controls (as needed),
- Installation of turbidity monitoring system in dredged area,
- Preparation of lay down areas for equipment, and
- Launch of marine equipment into Project area.

TVA's Civil Projects Group constructed the ash processing area. The overall site plan showing the dewatering and ash processing areas for the Project is shown on Figure 7.

All work performed and equipment utilized will conform to the Site Wide Safety and Health Plan. All marine equipment including hydraulic dredges, mechanical dredge equipment on barges, debris barges and work boats will conform to the Site Wide Safety & Health Plan, Appendix H, Marine Operations HSE Requirements.

3.2 Pilot Dredging Program

3.2.1 Pilot Dredging Program Objectives

The approved Phase 1 Emory River Dredging Plan called for a Pilot Dredging Program to determine the dredging production that would be sustainable on a continuous basis. The pilot called for a dredge "capable of moving at least 3,000 in-situ cubic yards per day. After proof-of-process, the capacity will be selected for full-scale dredging. A single dredge or series of hydraulic cutterhead dredge(s) will be retained to dredge at the total operable rate as determined in the pilot as sustainable on a continuous basis." Attachment 1 of the Plan, "KIF Dredging Material Flow Analysis Summary", contained an analysis that concluded that a dredge rate of 4,000 gpm, at 15% solids, would produce 2,978 CY/20 hour day of ash at 70% solids. The analysis further assumes that three dredges would be utilized removing approximately 9,000 CY/ 20 hour day, with a flow of 12,000 gpm and a daily flow of 14.4MGD. The processing (rim) ditch was designed to remove 90% of the dredged solids before discharging into the adjacent ash sluice ditch. The overall objective of the pilot program was to determine if the assumptions, on which the Plan was based, were valid and if the infrastructure, such as the recovery ditches and processing areas being designed and built were adequate.

3.2.2 Hydraulic Dredging

Hydraulic dredging of the Emory River began on March 20th with one 10" dredge named Emory). A second 10" dredge (Clyde) was added on March 30th and a third 10" (Luzon) was added on April 6th. Through July 11, these three dredges had removed approximately 323,000 CY from the river. This is based on pump rates of 4000 gpm for each of the dredges and a production rate of 113 CY/hr for each dredge. Operational efficiencies (time available verses actual) of the three dredges based on scheduled 20 hours six days per week were about 53%. All three of the dredges experienced significant mechanical failures. Most of the failures were attributable to the difficulties of removing the debris laden ash from the river and the inability to conduct ash removal operations in advance of the dredges. The water on the top of the ash in Segment 1 is too shallow for debris removal operations to work in front of the dredges. It also appears that the age and condition of the dredges impacted production. Several mechanical failures can be directly attributable to debris, such as punctured seals on the cutterhead and a cracked cutterhead housing. During the period from March 20th through July11, Emory had a total production of approximately102,000 CY, with a daily average of ~1,300 CY; Clyde had a total of ~129,000 CY, with a daily average of ~1,600 CY; and Luzon had a total production of ~92,000 CY, with a daily average of ~1,400 CY. Production data is contained in Attachment 2, "Pilot Dredging Production Summary".

During the first 10 days of dredging operations, TSS in the discharge from the stilling pond to the intake channel spiked above the monthly average NPDES permit limit of 29.9 mg/l but remained below the maximum daily average of 92.2 mg/l. The average TSS for the month was 28.7 mg/l, with a high of 46.2 mg/l. To mitigate the TSS problem, polymer was added to the discharge from the settling pond to the stilling pond and a plan to dredge both ponds was developed and implemented. Approximately 49,000 CY were removed from the settling pond between April 17th and May 8th using a 14" dredge owned and operated by TVA. Approximately 20,000 CY have been removed from the stilling pond beginning on May 19th and continuing to July 12th using a 10" dredge owned and operated by TVA. Since taking these actions, there have been no further TSS spikes.

Following the completion of the settling pond dredging, the TVA 14" dredge was moved to the Emory River and started dredging on June 16th. After being fitted with hospital grade mufflers, 20 hour/day operations commenced on July 1st. During the period from June 16th through July 13th, this dredge had a total production of 86,300 CY, with a daily average production of ~3,800 CY. This dredge is approximately 30 years old and has experienced few mechanical difficulties since the start of river dredging. The 14" dredge exceeded the combined production of the three 10" dredges by 13% during five days when all four were dredging on a 20 hour day operation.

The 10" dredges have proven to be ineffective in removing the debris laden ash from the river. The TVA 10" utilized to dredge the stilling pond has operated without mechanical failures and averages about 1,000 CY/ 10 hour day. Only one of the five dredges utilized in the pilot dredging was equipped with a mass meter and that meter proved unreliable.

3.2.3 Ash Recovery

Jacobs contracted with HARD HAT SERVICES to evaluate the effectiveness of the recovery of the ash from the dredge slurry from the rim ditch. The results of the study are contained in the Fly Ash Separation Analysis. The analysis report is contained in Attachment 3, "Fly Ash Separation Performance Analysis (Hard Hat)". The significant results of the study are:

- The ash and water slurry pumped from the dredges into the Rim Ditch had an average solids content of 8.4 percent (by dry weight), compared to the Phase 1 Plan expected 15 percent. The result is reasonable for the probable in-situ density and grain size of the fly ash in the Emory River.

- The fly ash from the river had a consistent grain size with 20 percent by weight sand, 70 percent by weight silt, and 10 percent by weight clay, on average.

- The settling capacity of the Rim Ditch is approximately 11.8 MGD (million gallons per day), or approximately 10,000 GPM (gallons per minute) for 20 hours a day at 8.4 percent solids by dry weight. Operation of the Rim Ditch at flows greater than 11.8 MGD results in much of the sediment going to the Sluice Trench.

- The Rim Ditch forms a "slurry blanket" that builds up at its downstream end as the peak settling capacity is reached. This slurry blanket averages between 30 and 35 percent solids by weight two feet below the water surface elevation. The slurry blanket is composed primarily of uniform silt with less than 10 percent clay by weight.

- The Rim Ditch provides adequate settling area to allow 100 percent of the particles larger than silt in the slurried fly ash to settle out prior to entering the Sluice Trench. The transition between sand to silt occurs at 75 microns (0.075 millimeters or 0.003 inches).

- The Rim Ditch removal efficiency is greater than 90 percent when operating within its settling capacity. The removal efficiency was measured as low as 30 percent as the settling capacity limit of 11.8 MGD is exceeded.

During the Pilot Dredging, a hydrocyclone alternate and a geotextile dewatering bag alternate were assessed to determine if the thickened slurry in the Rim Ditch could be processed to improve ditch performance. The results indicate that a small diameter hydrocyclone provided only nominal improvement of steady-state solids content in the thickened slurry found in the Rim Ditch. The geotextile bag test produced better solids thickening than the hydrocyclone, but not superior to allowing the ash to gravity dewater on the dewatering pad.

The results of the alternate testing did not indicate that a system other than gravity dewatering was warranted in a full scale application.

3.2.4 Ash Processing

Ash is recovered from the rim ditch by a long reach excavator and placed in a dewatering trough that runs parallel to the rim ditch for primary dewatering. A standard reach excavator removes the ash from the dewatering trough and stockpiles the ash in the first of two windrows for further dewatering. The ash is moved by an excavator to a third windrow that is the loadout stockpile for transport to storage area to await off-site disposal.

This process has proven to be effective for the overall transition from slurry to a 20 to 30% solids material that can be loaded and transported to offsite disposal.

3.3 Dredging

The river dredging operation is described in five segments as defined on Figure 6. The segments are:

- Segment 1 is approximately 3,000 feet long by 600 feet wide directly east of the ash spill event along the Emory River navigation channel and contains approximately 1,009,000 cubic yards of ash.
- Segment 2 is approximately 800 feet long by 600 feet wide immediately south or downstream of Segment 1 along the Emory River navigation channel up to Weir 1 or Segment 3 and contains approximately 168,000 cubic yards of ash.
- Segment 3 is approximately 440 feet long by 500 feet wide and is the location of Weir 1. Segment 3 contains approximately 99,000 cubic yards of ash and stone.
- Segment 4 is approximately one mile long by 500 feet wide along the Emory River navigation channel immediately south or downstream of Segment 3 and contains approximately 122,000 cubic yards of ash.
- Segment 5 is approximately 3,010 feet long by 600 feet wide along the Emory River navigation channel immediately north or upstream of Segment 1 and contains approximately 533,000 cubic yards of ash.
- Above Segment 5, ash is deposited for approximately 6,210 feet. The volume of ash in this reach of the Emory River is approximately 206,000 cubic yards.
- Below Segment 4 to near the confluence with the Clinch River. This reach of Emory River is approximately 4,900 feet long and contains approximately 122,000 cubic yards of ash.
- Ash in the shallow area east of Segment 1. This area is approximately 1,000 feet long by 500 feet wide and contains approximately 50,000 cubic yards of ash.

Figure 5 shows the depth of ash in the segments and shows an approximate volume of ash in each segment. The approximate total for all segments (as measured by a bathymetric survey in early May 2009) is 2,259,000 cubic yards.

3.3.1 Segment 1

Segment 1 contains 45% of the ash mass that is essentially plugging the main river channel. Removing this ash and removing the under water weir eliminates much of the flood danger and is the highest priority for dredging. Priority 1 dredging will remove ash to the pre-slide channel.

Ash in the shallow areas of Segment 1 on the east side of the channel will be removed as either Priority 1 or 2 dredging.

3.3.2 Segment 2

Segment 2 dredging is included in Priority 1 dredging and will remove ash to the pre-slide sediments.

3.3.3 Segment 3

Weir 1 will be removed to the pre-slide sediments as part of Priority 1 dredging only after the satisfactory completion of Segment 1, Segment 2 and Segment 5.

3.3.4 Segment 4

Dredging in Segment 4 to remove ash to the pre-slide sediments is Priority 2. The dredging may continue down to the pre-slide sediments if planned sampling confirms the absence of legacy sediments from the Clinch River. Also, dredging the intake channel to pre-slide depth is Priority 2.

3.3.5 Segment 5

The southern portion (1,000 feet) of Segment 5 is Priority 1 dredging and will be dredged either concurrently with Segment 1 or before Segment 1. Remainder of Segment 5 is Priority 2 dredging and the ash in Segment 5 will be removed to the pre-slide sediments.

3.3.6 North of Segment 5

Ash in the Emory River, north of Segment 5 is Priority 2 dredging. This dredging operation will remove ash deposits to pre-slide sediments from all areas including coves and shallow areas outside the main channel.

3.3.7 South of Segment 4

Ash in the Emory River south of Segment 4 is Priority 2 dredging. This dredging operation will remove ash deposits to pre-slide sediments in the Emory down to near the confluence with the Clinch River. Care must be exercised to avoid dredging any legacy sediments deposited in the Emory from the Clinch. Sediment sampling to be conducted during July 2009 as well as previous sampling data, will define the southern most limit of Emory River dredging and the depth of ash, if any that will remain.

3.3.8 Intake Channel Dredging

Ash at the failed skimmer wall and the intake channel is Priority 2 dredging. Initially, ash will be removed at the skimmer wall to expose the debris from the failed wall. This activity will be followed by removal of the debris. The concrete filled caissons will be removed or moved if they are found to be in locations that impede channel flow. They may be moved under water to locations that eliminate the flow restrictions. Following removal of the debris, all ash will be removed from the intake channel to prevent further ash immigration through the Plant to the Clinch River.

3.4 Hydraulic Dredging

TVA has selected Sevenson Environmental Services, Inc. (Sevenson) to clear the ash from the Emory River. Sevenson will use two cutterhead dredges to accomplish this work. The first is a 20" conventional cutterhead dredge called "Little Rock", which is capable of dredging 800 cy/hour. The second dredge is a 14" conventional cutterhead dredge 670 series manufactured by Ellicott. The dredge is 69.5' x 20' with a 42' ladder capable of dredging 600 cy/hour. Sevenson also plans to utilize TVA's 14" dredge when necessary.

The SES 670 cutterhead will be set up initially at the southern end of Segment 1 and commence dredging toward the north, cutting an approximate 100' wide channel, 10' deep. The dredge will make a 10' deep cut moving north for a distance of 1,000' – 1,500'. After the dredge has completed its first pass, it will be moved east into a position that overlaps and is parallel to the previous cut and repeat the process until the entire width of the channel has been cleared. Upon completing Segment 1, the dredge will move to Segment 2 and repeat the above process. The dredge will discharge through an in-water 18" HDPE pipeline into the Rim Ditch. The pipeline will terminate within the rim trench and be equipped with a spreader/energy diffuser.

The 20" dredge Little Rock will be floated through the channel and set up at the southern end of Segment 5. Dredging will commence from the southern end of Segment 5 and continue to the south through Segment 1. The dredge will initially make a pilot cut 150' wide, 10' deep . Parallel 150' wide cuts will be made until the entire 600' of channel width is cleared. The dredge will discharge through 3,000' of floating 20" HDPE pipeline supported by steel pontoon floats. The floating discharge line will leave the water and transition to welded steel to the rim trench and be equipped with a spreader/energy diffuser.

Final cleanup passes will follow the initial mass removal cut to remove ash to the pre-slide sediments. This will include remaining ash east of Segment 1 and any remaining ash outside the main channel.

The discharge from the 20" dredge is 12,000 gpm to 15,000 gpm with an expected ash removal of 800 CY/hour or 16,000 cubic yards per 20-hour day at about 15% solids. The 14" dredge is anticipated to have a discharge of 5,500 gpm to 6,000 gpm with an expected ash removal of between 300 to 350 CY/hour or 6,000 to 7,000 cubic yards per 20-hour day. Thus, the combined flows from the dredges for a 20-hour day will range from 21 MGD to 25.2 MGD.

To accommodate the higher flows, the rim ditch will be modified to increase settling efficiencies:

- The cross-sectional area of the first 800' will be increased by 50% by increasing the dept to 15 feet;
- The west side of the rim ditch will be shored up with an interlocking sheet piling wall. The first 800 feet of sheet, starting at the north end, will be driven to 40' and the last 1,000' will be driven to 25'. A geotechnical analysis and design was conducted and are included as Attachment 4, "Global Stability Evaluation of Sheet Pile Wall, TVA Kingston Fossil Plant – Rim Ditch Dredging Support, July 17, 2009" and Attachment 5, "Cantilevered Sheet Piling Design Calculations, Rim Ditch Dredge Support, July 17,2009".
- Baffels will be installed on alternating sides of the rim ditch to enhance settling;
- An overflow weir will be added to the end of the rim ditch prior to discharge to the sluice ditch;
- The rim ditch will be dipped on a 20-hour basis instead of the 10-hour schedule during the pilot phase;
- Large and more robust excavators will be used for dipping to ensure maximum settling volume and minimum velocities; and
- A crawler crane with a 4 to 6 cubic yard clamshell bucket will be utilized to keep the sluice ditch clean.

During June and July, three 10" dredges and one 14" dredge have been operational on the Emory. Flows of 20 to 22 MGD have occurred. While ash carried over into the sluice trench, the rim ditch functioned satisfactorily. With the enhancements listed above, it is anticipated that the ash processing and recovery system will handle the higher loading.

The dredge(s) will be capable of performing the work in a safe, orderly, and environmentally acceptable manner and will meet the requirements defined in the Marine Safety and Transportation Plan.

The dredges have 42’ ladders that are long enough to reach the final cut depth. The cutter head will be positioned with a global positioning system (GPS) operated onboard to maintain dredging with the specified Project limits (the main channel of the Emory River as defined by the United States Army Corps of Engineers and channel depth limits).

The Emory River will be closed from ERM4 to ERM1 during dredging operations. Unaffected areas in the Emory River navigation channel containing navigable depths will not be impaired except as allowed by applicable laws or regulations. Management of the dredge discharge lines will conform to appropriate Federal and State regulations. If a submerged line is placed in shallow water, outside the navigable channel, where the possibility exists for small outboard powered skiffs to cross over the submerged pipeline, the pipeline will be marked with fluorescent orange buoys and signs stating "DANGER SUBMERGED PIPELINE" every 150-feet throughout the length of the submerged pipeline.

Dredge discharge pipes that are floating or supported on trestles will display appropriate lights at night and in periods of restricted visibility in accordance with USCG regulation and "33 CFR 88.15." Floating discharge pipes are any pipelines that are not laid along the bottom and include rubber discharge hoses.

Ash processing capacity, discharge line capacity and water quality restrictions may vary the dredge rate during dredging operations. Booster pumps may be required to convey the dredge discharge to the dewatering and processing areas shown on Figure 7. Flow meters and mass density meters will be utilized to monitor and record the dredge discharge conveyed to the processing area.

Dredging operations will be staffed and operated 24 hours per day, 7 days per week. The seventh day will be used for dredge maintenance and dredging progress review although it may be utilized for dredging. Dredging 7 days per week will be considered if necessary to achieve project schedules. The dewatering and process equipment will be staffed as required to meet the needs of dredging. It is expected that the overall operation of the dredging, dewatering, and processing area will be approximately 20 hours of the 24 hour day. During the pilot dredging operations, sustained 20-hour per day operation was difficult to obtain with the 10” dredge. However, the 14” dredge has had little difficulty in achieving that goal. Sevenson is deploying a new 14” dredge and a 20” dredge with a crew experienced in river dredging on the Mississippi River and should be fully capable of sustained 20-hour per day operations. Light plants will be installed on land and on barges in the work area as necessary to provide lighting required for dredging work performed at night. To the extent possible, these lights will be positioned and aimed to reduce glare on inhabited residential homes. The dredges and booster pumps will utilize hospital grade mufflers to reduce noise as well as sound reduction enclosures for some equipment. Noise will be monitored on both day and night shifts at the beginning of new or different operations and periodically through the dredging activities.

3.5 Mechanical Dredging

Mechanical dredging, using clamshells, backhoes, and draglines may be used in conjunction with hydraulic dredging. If mechanical dredging is utilized, barge-mounted clamshell excavators will be used to recover near or above surface ash and debris. The ash/debris will be pulled and deposited onto material barges fitted with turbidity curtains. Turbidity curtains will be deployed around the debris removal operations. The recovered material will be off-loaded at the north barge off-loading station. Debris will be segregated at the station and transported to the debris processing station near the gypsum pond construction site. The ash will be trucked to the ash processing area.

Mechanical dredging was employed during the pilot dredging operation. Initially, this was limited to debris removal in support of hydraulic dredging. This activity was expanded in an attempt to cut a channel through Segment 1. This activity is described in Attachment 6, "Access Channel Construction and Debris Removal Operations Work Plan" attached to this plan. Production from the mechanical dredging operation averaged about 1,000 cubic yards per day. The channel was not completed prior to the end of the pilot dredging.

3.6 Mechanical Removal of Debris

Debris (e.g., trees, debris from demolished structures, boulders, large rocks, and any other dense or large objects that hinder dredging operations) is present in significant quantities in the ash. At this time, TVA cannot make a total assessment of the amount of debris that will be encountered or the extent of mechanical removal of debris that will be required. Mechanical dredging will be used to support hydraulic dredging as required throughout dredging operations.

A floating silt curtain containment system fastened to the crane and debris barges will be deployed prior to initiation of mechanical dredging operations in all dredging areas (i.e., weir removal). The top of the silt curtain will float with the curtain hanging in the water stopping the movement of suspended ash that has reached the surface from moving out of the immediate area where debris is being removed.

3.7 Hydraulic Dredge Ash Dewatering and Ash Handling

The hydraulic dredge ash dewatering and material handling will be performed in the dewatering and processing areas shown on Figure 7. The extent and definition of this activity is defined elsewhere. The material flow balance summary for managing dredged solids and water is included in Attachment 1 of this Plan.

The dredge discharge water flows from the rim ditch into the sluice trench where it combines with the Plant discharges. The sluice discharges to the ash settling pond. The ash settling pond discharges through five overflow structures to the stilling pond. Polymer is added at one of the overflow structures to enhance settling. The discharge from the stilling pond is to the Plant water intake channel and must meet Total Suspended Solids (TSS) limitations of 29.9 mg/l monthly average and 92.2 mg/l daily maximum. While it is understood that these limits were developed for Plant Operations with no dredging discharge, TVA will strive diligently to maintain those limitations at full dredging production. The dredging contractor has a contract requirement to meet a daily monthly average TSS of 350 mg/l and a daily maximum of 1500 mg/l as measured from the outflow of the sluice trench to the settling pond. Turbidity at this measuring point must be no greater than 550 NTU. Data collected during the pilot dredging operation shows these requirements were met as long as the rim ditch was adequately dipped. If these limits are exceeded, the contractor and TVA will discuss available options and develop path forward that balance production, implementation of options to improve settling, and compliance with the established limit. TVA is responsible for maintaining compliance with the NPDES permit. In accordance with CERCLA, the OSC will evaluate degrees of compliance with existing Applicable or Relevant and Appropriate Requirements (ARARs) and make a determination as to the appropriate action to take in protection of public health and the environment.

3.8 Demobilization

Upon completing all work for the Emory River dredging activities in all phases, the Project site will be demobilized. Demobilization will include the following:

- Removal of office, break, storage, and tool trailers,
- Removal of all heavy equipment used for the Project,
- Breakdown and removal of the dredge discharge piping, dredge traverse materials and any markers, and
- Removal of all debris, trash, and garbage resulting from construction activities.

4.0 Monitoring of Construction Activities

This section provides a general overview of monitoring activities for the Emory River ash dredging.

4.1 Utility Clearance Survey

Dredging activities may cause significant property damage to utilities, structures, and operational equipment, which can result in electrocution from damaged electrical lines, fires from broken fuel/gas lines, and disruption of telephone service. Underground/underwater utilities have been found in areas that have been properly investigated and thought not to have utilities present. Before dredging activities commenced, an underground utility clearance survey was conducted to determine if the area contains underground utilities or overhead hazards. The purpose of the utility clearance survey was to identify and protect underground utilities or indicate that none exists in each given area. The survey consisted of the following procedures:

- Preparation of a map indicating the area(s) where dredging activity is planned to occur and perform the necessary KIF department and utility company reviews.
- Contacting the utility notification service, where available. This notification is to be made a minimum of two working days prior to the initiation of intrusive activity (excluding Saturdays, Sundays, and Holidays). The contact information to locate utilities for the Project site is as follows.

Tennessee One Call System
www.tnonecall.com/
(800) 351-1111 or (615) 367-1110

- Contacting the utility companies, landowners, or responsible authorities to locate and mark the locations of the underground installations and, if they so desire, direct or assist with protecting the underground installations.
- Verifying that all underground installations have been located, physically marked, and then noted on the map.
- Marking all overhead utilities with kilovolts rating on the map (work with heavy equipment should not be performed directly below overhead utilities).
- Recalling utility location service for utility mark outs that have been removed, covered, or destroyed during site activities.

4.2 Bathymetric Surveying

Bathymetric surveys have commenced and will continue to be performed to track dredging progress. These surveys will also be the basis for determining removal quantities throughout the Project. A combination of surveying equipment may be used to ensure that the dredging is accomplished to the required depths. All dredges will be outfitted with GPS position devices that allow the operator to track the location of the dredge to ensure that cutting is within the main channel. Mechanical or electronic indicators will provide cutting depth control to limit cutting to the approved limits.

TVA will conduct hydrographic surveys as needed to verify progress of ash removal. The hydrographic surveys utilize RTK GPS equipment for location and elevation, an echo sounder for depth, and other associated computer programs and equipment to coordinate the data. These surveys are conducted from a dedicated survey boat set up for this task and will comply with Engineering & Design Hydrographic Surveying EM-1110-2-1003.

4.3 Water Quality Monitoring

Water quality monitoring has commenced and will be performed throughout the dredging activities as described in the Sampling Plan for Phase 1 Dredging Operations, May 2009, and is being incorporated into the Surface Water Monitoring Plan for the Emory, Clinch and Tennessee Rivers (currently under revision). A key component of the monitoring plan is the monitoring of turbidity which might be caused by the dredging.

During the pilot dredging operations, excessive turbidity has not been experienced. An action level of 200 NTU turbidity increase between an upstream monitor and downstream monitor was established by the original monitoring plan. Monitoring during the pilot program showed little to no increase in turbidity between the upstream and downstream monitoring stations. Turbidity monitoring will continue throughout the dredging operations.

4.4 Daily Dredging Operations Reporting

A Daily Dredging Operations Report will be prepared. The report will include, at a minimum, the following information:

- Daily production reports including a summary of estimated volumes dredged, etc.,
- Debris removal summary,
- Environmental monitoring data (turbidity),
- Survey information (as available), and
- Post dredging survey results (as available).

5.0 Health and Safety Plan

A ”Site Wide Safety and Health Plan for the TVA Kingston Fossil Plant Ash Release Response” has been prepared to supplement the Dredging Plan to identify, evaluate, and provide control measures for safety and health hazards associated with this Project. All site operations will be performed in accordance with applicable state, local, TVA corporate regulations and procedures, and Occupational Safety and Health Administration requirements, specifically 29 CFR 1910 and EPA's Standard Operating Safety Guide (PUB 9285.1-03, PB 92-963414, June 1992). All TVA employees and subcontractors must comply with the requirements of the site wide plan.

6.0 References

U.S. Environmental Protection Agency, ***Administrative Order and Agreement on Consent*, *CERCLA-04-2009-3766,*** May 2009

State of Tennessee Department of Environment and Conservation, ***Commissioner's Order, Case No. OGC09-0001***, January 2009

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U.S. Army Corps of Engineers (USCOE), 2000, ***EM 385-1-1, EM 385-1-1 (Current Revision) Safety - Safety and Health Requirements Manual.***

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Tennessee Valley Authority, February 2009, ***Ash Processing Area Construction and Operation Plan.***

FIGURES

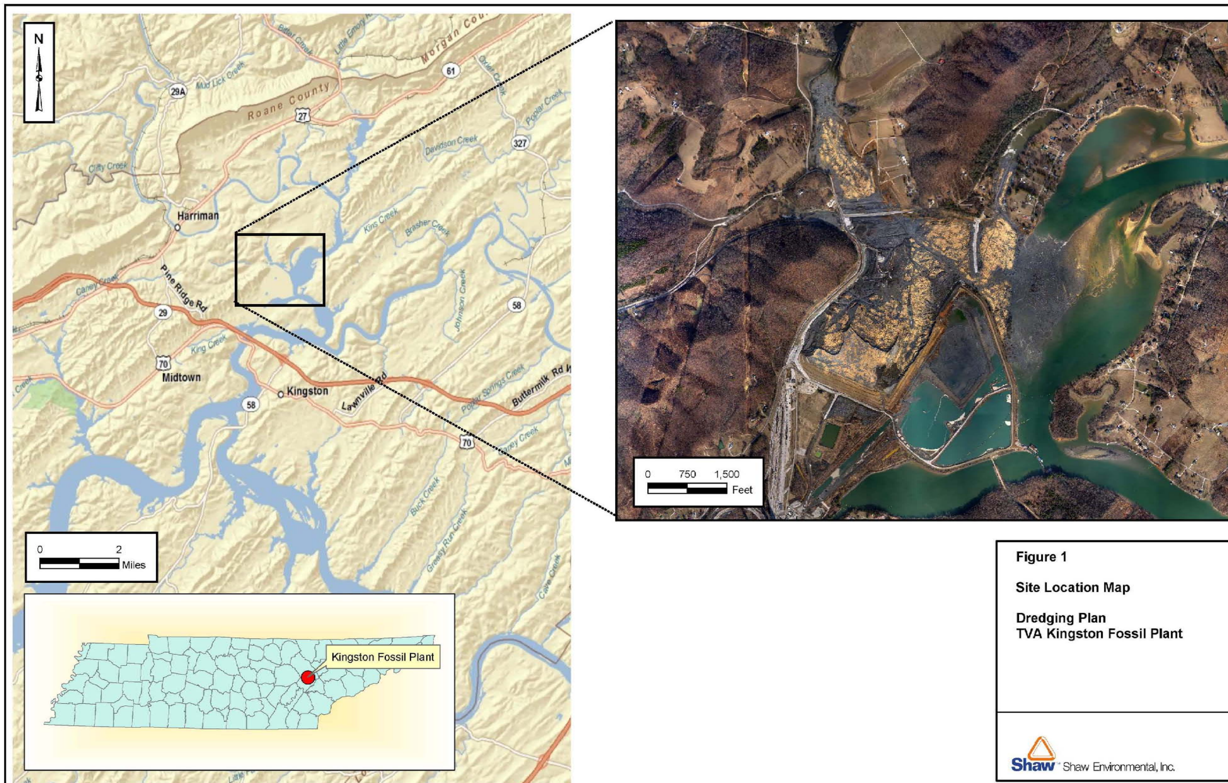
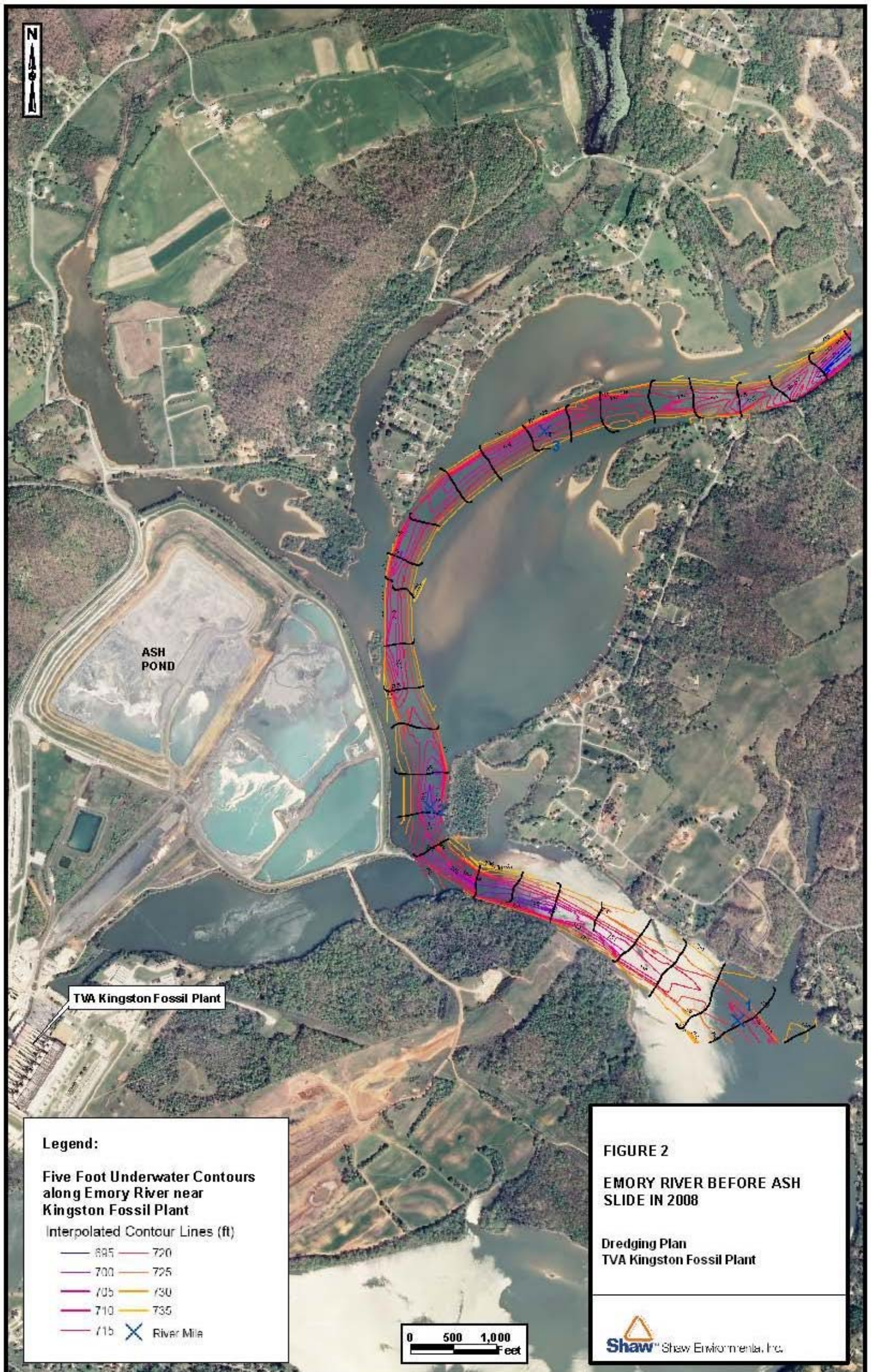


Figure 1

Site Location Map

Dredging Plan
TVA Kingston Fossil Plant

Shaw Environmental, Inc.



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LEGEND

PROFILE BASELINE

RIVER NAVIGATION CHANNEL

0 400 800
Feet

FIGURE 3

ASH SLIDE EXTENT IN EMORY RIVER DECEMBER 30, 20098

Dredging Plan
TVA Kingston Fossil Plant

LEGEND

PROFILE BASELINE

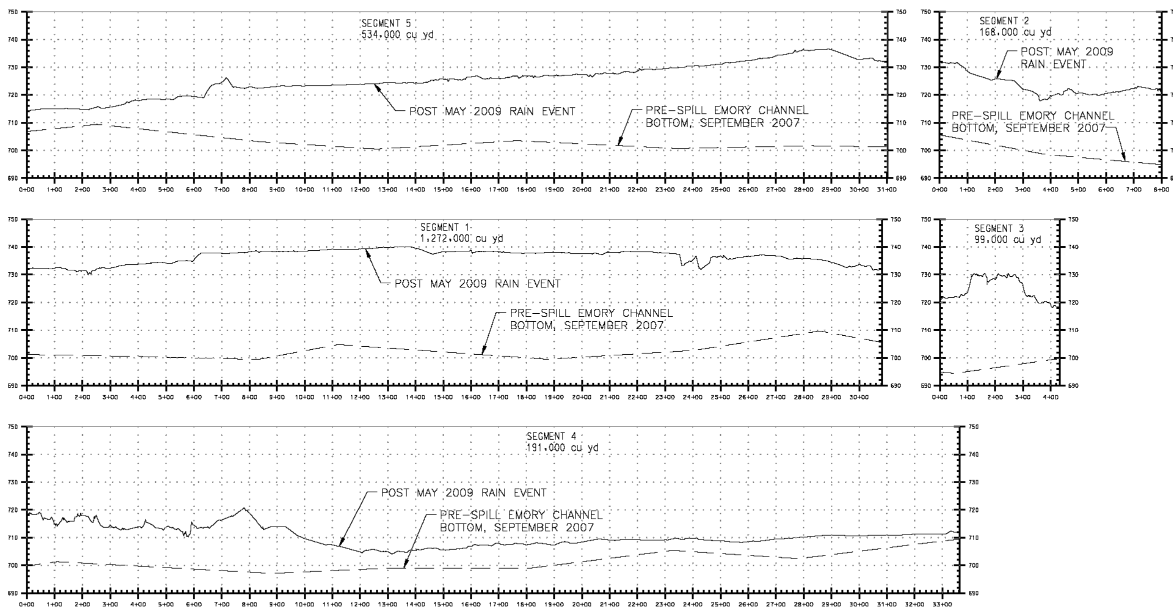
RIVER NAVIGATION CHANNEL

0 400 800 Feet

FIGURE 4

ASH SLIDE EXTENT IN EMORY RIVER JANUARY 17, 2009

Dredging Plan
TVA Kingston Fossil Plant

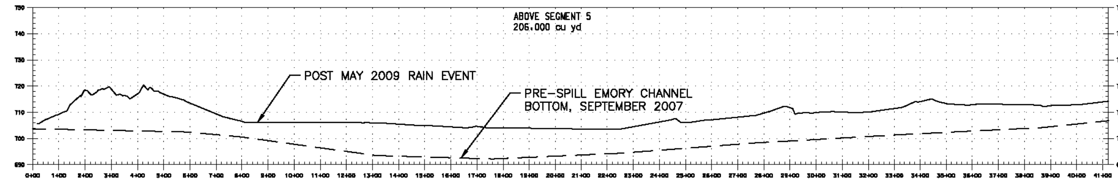


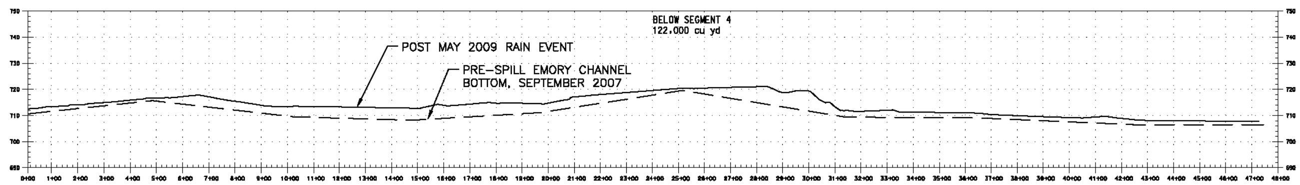
ASH VOLUMES ROUNDED TO NEAREST THOUSAND

FIGURE 5

EMORY RIVER DREDGING
SEGMENT PROFILE

Dredging Plan
TVA Kingston Fossil Plant



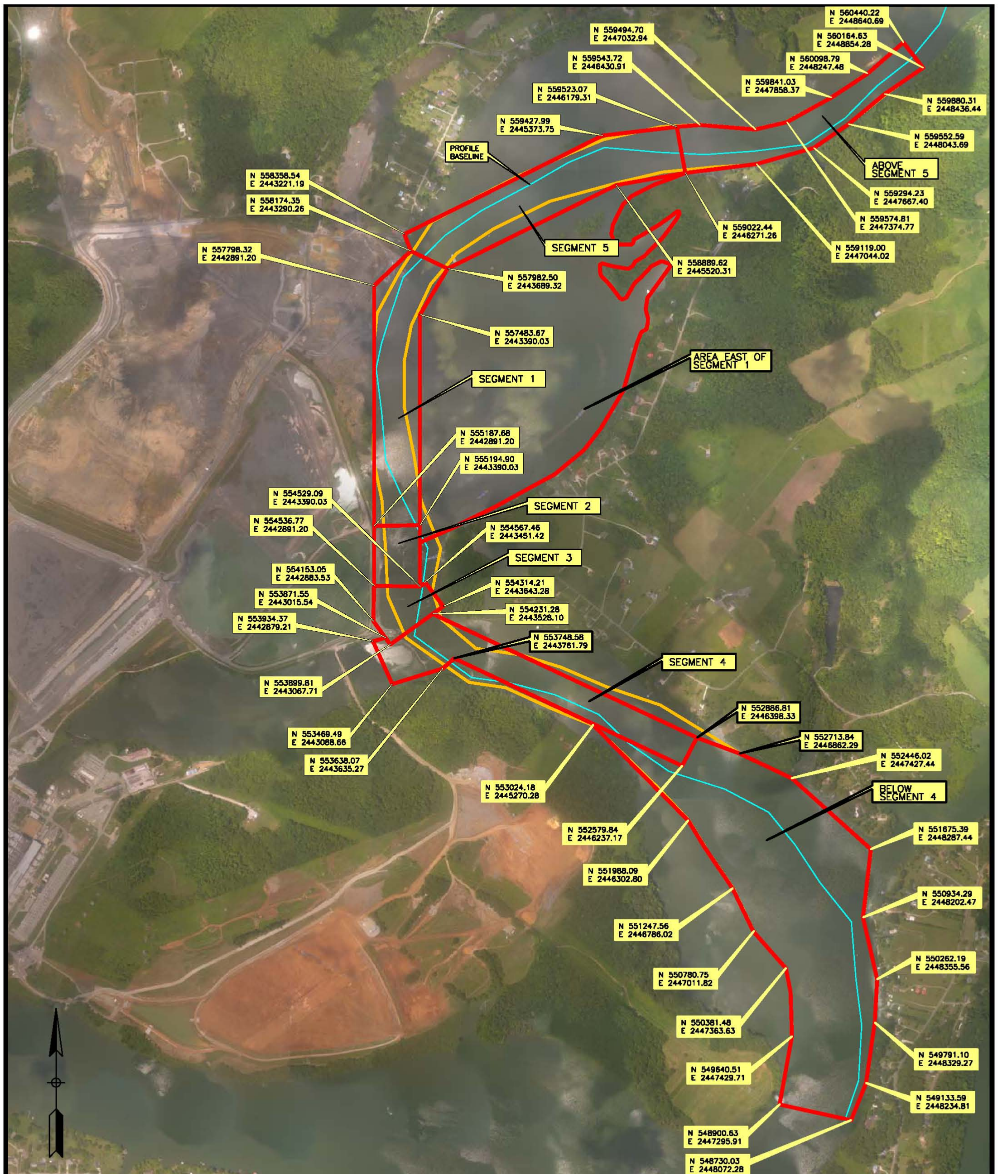


ASH VOLUMES ROUNDED TO NEAREST THOUSAND

FIGURE 5A

EMORY RIVER DREDGING
SEGMENT PROFILE

Dredging Plan
TVA Kingston Fossil Plant



LEGEND

DREDGE SEGMENTS

RIVER NAVIGATION CHANNEL

0 400 800 Feet

FIGURE 6

EMORY RIVER SEGMENTS FOR DREDGING

Dredging Plan
TVA Kingston Fossil Plant

FIGURE 7

ASH RECOVERY, PROCESSING AND LOADING AREA

Dredging Plan
TVA Kingston Fossil Plant

ERM 12.2
ERM 4
BMR 4
ERM 2.1
ERM 1.75
KIF Intake
BMR 0.5
CRM 5.5
ERM 0.1
CRM 4
CRM 2
CRM 0
TRM 568.5
Legend
Continuous Sampling Location
River Sampling Location
River and Continuous Sampling Location
0 1,250 2,500
Feet
FIGURE 8
TVA SAMPLING AND MONITORING STATIONS
DREDGING PLAN
TVA KINGSTON FOSSIL PLANT
Shaw Shaw Environmental, Inc.

ATTACHMENT 1

KIF Dredging Material Flow Analysis Summary

KIF Dredging Material Flow Analysis Summary
Phase 1
February 2009

Two parts to material flow analysis:

1. Solids flow questions
   a. What are the possible solids removal rates?
   b. How much dredge supernatant water produced?
   c. Does total combined flow of supernatant water & plant production exceed ash pond capacity/diffuser capacity?
   d. Will adding dredge water cause short-circuiting or other problems in pond?

2. Metals mass questions
   a. Which metals are of concern?
   b. Will they have an unacceptable/unmanageable impact on the environment?

Information required:

1. Solids mass balance
   a. Daily solids recovery production rates
      (# Dredges, dredge volume rates, daily duration of dredging, % solids pumped, % solids dipped, drying time, % solids in dried ash for disposal; specific gravity of 15%, and 70% ash slurries)
   b. Water flows (plant flows--by category, volume per dredge operated)
   c. Rate of plant ash production.

2. Metals mass balance
   a. Concentrations of metals of interest in materials to be dredged
   b. Concentrations of metals expected in water in contact with materials to be stacked (Settled material supernatant dissolved results)

Assumptions:

1. 4000 gpm dredge rate
2. 20 hr/day dredging
3. Specific gravities: fly ash = 2.6, 15% slurry = 1.24, 70% = 2.12
4. Dipped material will be 30% solids, "Dried" material to move will be 20% moisture

Analysis:

1. Dredged solids production mass balance
   a. Solids production @ 4000 gpm dredge rate, average 15% solids
      i. Per Joe Kalmo, this will be 3000 cu yd/day
      ii. Calculation to verify - daily basis:

   (4000 gal/min)(60 min/hr)(20 hr/day) = 4.8 MGD of 15% solids slurry

   (4.8 MGD)(1.24 sp gr)(8.35 lb/gal) = 49.70 Mlb/day 15% slurry

   (49.70 Mlb/day)(0.15) = 7.46 Mlb dry solids/day

Comment [a1]: MSA – Seems like an optimistic number. What are the assumptions here regarding drying time and drying operations?

Comment [a2]: MSA – 15% by weight or by volume? If 15% by weight I make the SG of the 15% slurry to be 1.09.

Comment [a3]: MSA – Seems optimistic unless there is extensive processing of the material.

(7.46 Mlb/day dry)(1/0.7)(1gal/8.35 lb)(1/2.12 spgr)(1 cu yd/202 gal) = **2,978 cu yd/day @ 70% solids**

b. Supernatant volume from 4.8 MGD is 4.8 MGD, less water removed with 70% slurry ((3000 cu yd) (.3) (202 gal/cu yd) = 0.18 MGD) = **4.6 MGD.** Because the processing area will be adjacent to the ash sluice channel, we estimate that all of the supernatant volume will drain into the ash sluice channel and go through the ash pond and be discharged into the plant intake.

c. Solids to be moved to temporary storage:

   i. Assuming 15% shrinkage to 20% moisture yields **2550 cu yd/day @ 20% moisture**

1. Flow analysis:
   Current ash pond flow is 40.512 MGD, of which ~7.7 MGD is station sump
   Capacity of diffusers is 88 MGD

   Diverting station sump flow directly to ash pond and combining fly ash & bottom ash sluice flows will give 32.0 MGD through large sluice ditch.

   Each dredge will add 4.6 MGD to the flow

# Dredges	Flow through ash ditch	Station Sump	Total flow
0	32.0 MGD	7.7 MGD	39.7 MGD
1	36.6	7.7	44.3
2	41.2	7.7	48.9
3	45.8	7.7	53.5

   So, adding 3 dredges would result in a total flow 34.5 MGD (38%) less than the design capacity of the ash pond diffusers.

2. Metals Balance

The metals are primarily bound in the solids matrix as metallic oxides and other compounds, so the metals in the solids processing area will be related to the solids amounts. Analytical methods to be used are provided in Section 5.2, Table 3 and analytical detection methods in Table 4, of the Phase 1 dredging plan. The earlier solids mass balance calculations indicated that each 3,000 cu. yard per day dredge would produce 7.46 Mlb dry solids/day. The ash processing is estimated to capture 90% of the dredged solids with approximately 10% of the solids (0.746 Mlb/day) entering the ash sluice system. Those same calculations showed that each dredge would produce 4.6 MGD of supernatant. Three dredges would produce 22.4 Mlb/day. The amount entering the ash sluice system is calculated to be 2.24 Mlb/day (10%) of dry solids and 13.8 MGD of supernatant. .

KIF usually produces 390,000 dry tons of ash per year, which is 2.14 Mlb/day. The current plan includes dredging from the ash pond itself to ensure capacity is maintained, so ultimately the 10% solids from the external dredging (5.578 Mlb/day) plus a portion of 2.14 Mlb/day normal ash production will be removed routinely from the ash pond. This will be processed together with the material dredged from the river, then temporarily stored for ultimate disposal. Because the metals are primarily in the solids, the planned dredging from within the ash pond should remove these metal loadings such that they aren't available to impact the ash pond discharge. The calculations in Part 1 show that these solids and flow should not cause any problems in the ash pond. Therefore, the total metals are not considered again in the following mass balance.

The TDEC Water Quality Standards for Fish & Aquatic Life are stated as dissolved metals. A quantity of ash was thoroughly mixed with river water and then allowed to settle for 1 hour to simulate dredging followed by minimum time in the ash pond system. Then a sample was taken of the liquid above the settled ash. The table below lists the dissolved metals concentrations in that supernatant.

Analyte	Dissolved fraction (mg/l)	
Aluminum	0.989	
Arsenic	0.127	
Barium	0.147	
Beryllium	0.001	<
Cadmium	0.001	<
Chromium	0.02	<
Copper	0.02	<
Iron	0.309	
Lead	0.02	<
Mercury	0.0002	<
Magnesium	2.66	
Manganese	0.077	
Nickel	0.02	<
Selenium	0.01	
Silver	0.01	<
Thallium	0.107	
Tin	0.01	<
Titanium	0.039	
Zinc	0.02	

Based on the concentrations above and estimated flows of 4.6 MGD per dredge or 0.746 Mlb/dredge/day, the estimated metals loadings from the supernatant should be those listed in the table below.

Loadings from Supernatant from Dredged Liquid to the Ash Pond, Dissolved			
Analyte	**Normal Ash Pond Loading, lb/day**	**1 dredge loading, lb/day**	**3 dredges loading, lb/day**
Aluminum	270	38	114
Arsenic	7.43	4.9	14.6
Barium	128	5.6	16.9
Beryllium	0.34	≤0.04	≤0.12
Cadmium	0.17	≤0.04	≤0.12
Chromium	4.06	≤0.77	≤2.3
Copper	0.88	≤0.77	≤2.3
Iron	40.6	11.9	35.6
Lead	0.34	≤0.77	≤2.3
Mercury	0.07	≤0.0077	≤0.023

Loadings from Supernatant from Dredged Liquid to the Ash Pond, Dissolved			
Analyte	**Normal Ash Pond Loading, lb/day**	**1 dredge loading, lb/day**	**3 dredges loading, lb/day**
Manganese	5.41	2.96	8.87
Nickel	1.79	≤0.77	≤2.3
Selenium	2.84	0.38	1.15
Silver	0.17	≤0.38	≤1.15
Thallium	0.34	4.1	12.3
Zinc	6.08	0.77	2.3

Adding the estimated loadings from the dredged supernatant above to the normal ash pond loadings results in the estimated total ash pond loadings in the table below. The normal ash pond discharge concentrations were obtained from the NPDES permit application. The estimated total combined ash pond discharge loadings in pounds per day are maximum probable loadings because some of the dissolved metals in the original supernatant would probably precipitate and be removed in the ash pond. Therefore, the combined loadings below should be conservative.

Combined Dredging & Normal Ash Pond Discharge Loadings				
Indicator Metal	Normal Ash Pond Discharge mg/L	Normal Ash Pond Discharge lb/day	3 dredge to Ash Pond lb/day	Total Ash Pond Discharge lb/day
Aluminum	0.8	270	114	384
Arsenic	0.022	7.43	14.6	22
Barium	0.38	128	16.9	145
Beryllium	<0.001	≤0.34	≤0.12	≤0.45
Cadmium	<0.0005	≤0.17	≤0.12	≤0.29
Chromium	0.012	4.06	≤2.3	≤6.36
Copper	0.0026	0.88	≤2.3	≤3.18
Iron	0.12	40.6	35.6	76.1
Lead	<0.001	≤0.34	≤2.3	≤2.64
Mercury	<0.0002	≤0.07	≤0.023	≤0.093
Manganese	0.016	5.14	8.87	14.27
Nickel	0.0053	1.79	≤2.3	≤4.09
Selenium	0.0084	2.84	1.15	3.99
Silver	<0.0005	≤0.17	≤1.15	≤1.32
Thallium	<0.001	0.34	12.3	≤12.66
Zinc	0.018	6.08	2.3	8.39

The Kingston ash pond (NPDES Internal Monitoring Point 001) discharges to the plant intake. The Kingston plant intake flow is 1,297 MGD and the intake concentrations from the NPDES permit application are listed in the table below together with the calculated loadings. When combined with the calculated ash pond discharge loadings, we can calculate the mixed concentrations in the Kingston mixed condenser cooling water (CCW) NPDES Discharge 002 discharge and compare them to the TDEC criteria. Because most of the intake concentrations are routinely below the minimum detection limits, we used half of the intake concentration in these calculations.

Mixed Ash Pond & CCW concentrations & TDEC Criteria					
Analyte	Intake Conc. mg/L	River* Loadings lb/day	Total Ash Pond + CCW lb/day	Total Ash Pond + CCW mg/L	TDEC's Lowest Criteria** mg/L
Aluminum	0.5	5411	5795	0.51	0.2
Arsenic	<0.001	5.41	27.5	0.0024	0.01
Barium	0.041	444	589	0.052	2
Beryllium	<0.001	5.41	5.64	0.0005	0.004
Cadmium	<0.0005	2.71	2.85	0.0003	0.00025
Chromium	<0.001	5.41	10.6	0.0009	0.011
Copper	0.0013	14.07	16.1	0.0014	0.009
Iron	0.3	3247	3323	0.295	0.3
Lead	<0.001	5.41	6.73	0.0006	0.0025
Mercury	<0.0002	1.08	1.13	0.0001	0.00077
Manganese	0.049	530	545	0.048	0.05
Nickel	<0.002	10.82	13.8	0.0012	0.052
Selenium	<0.001	5.41	9.4	0.0008	0.005
Silver	<0.0005	2.71	3.37	0.0003	0.0032
Thallium	<0.001	5.41	17.9	0.0016	0.002
Zinc	<0.01	54.1	62.5	0.0055	0.12

*River Loadings were calculated using 0.5 the MDL.
**TDEC Criteria, Rule 1200-4-3-.03

The table above shows that even using conservative assumptions, such as no removal in the ash pond, all of the estimated mixed discharge concentrations should meet the lowest most stringent TDEC limits except for aluminum and cadmium. Aluminum is primarily part of the ash matrix and probably associated with fine particulate which should have significant removal in the ash pond system. The aluminum level is also a secondary drinking water standard and should not cause any significant impact to aquatic life downstream. The cadmium exception is primarily because the TDEC level of 0.00025 mg/L is below the detection limit of 0.005. Because no measurements above the MDL have been seen in the plant intake, if one-fourth the MDL is used then the apparent estimated level in Discharge 002 would be below the TDEC standard. Therefore, the proposed dredging and processing operations should have no significant impact on the final discharges from the KIF ash pond and CCW discharges (NPDES Discharges 001 and 002).

ATTACHMENT 2

Pilot Dredging Production Summary

Pump rate based on;			Production based on an estimated per hour rate of	
Emory	4,000	[gal/min]	113	[yd^3/hr]
Clyde	4,000	[gal/min]		
Luzon	4,000	[gal/min]		

Date	Production Time [min/day]			Production Rate [yd^3/day]			Daily Hyd Total	Loads from Mech	Daily Mech Total	TVA Dredge Reported Quantity	Daily Total
	D16 Emory	D14 Clyde	D17 Luzon	D16 Emory	D14 Clyde	D17 Luzon					
Friday, March 20, 2009	470	-	-	885	-	-	885				885
Saturday, March 21, 2009	455	-	-	857	-	-	857				857
Monday, March 23, 2009	385	-	-	725	-	-	725				725
Tuesday, March 24, 2009	490	-	-	923	-	-	923				923
Wednesday, March 25, 2009	526	-	-	991	-	-	991				991
Thursday, March 26, 2009	495	-	-	932	-	-	932				932
Friday, March 27, 2009	370	-	-	697	-	-	697				697
Saturday, March 28, 2009	250	-	-	471	-	-	471				471
Monday, March 30, 2009	75	336	-	141	633	-	774				774
Tuesday, March 31, 2009	535	630	-	1,008	1,187	-	2,194				2194
Wednesday, April 01, 2009	335	505	-	631	951	-	1,582				1582
Thursday, April 02, 2009	-	490	-	-	923	-	923				923
Friday, April 03, 2009	243	540	-	458	1,017	-	1,475				1475
Saturday, April 04, 2009	715	460	-	1,347	866	-	2,213				2213
Monday, April 06, 2009	1,068	1,152	197	2,011	2,170	371	4,552				4552
Tuesday, April 07, 2009	768	700	568	1,446	1,318	1,070	3,834				3834
Wednesday, April 08, 2009	1,171	1,000	421	2,205	1,883	793	4,882				4882
Thursday, April 09, 2009	1,440	317	475	2,712	597	895	4,204				4204
Friday, April 10, 2009	330	-	-	622	-	-	622				622
Saturday, April 11, 2009	530	-	-	998	-	-	998				998
Monday, April 13, 2009	797	947	145	1,501	1,784	273	3,558				3558
Tuesday, April 14, 2009	1,013	1,190	675	1,908	2,241	1,271	5,420				5420
Wednesday, April 15, 2009	1,165	1,230	425	2,194	2,317	800	5,311				5311
Thursday, April 16, 2009	1,213	1,000	145	2,284	1,883	273	4,441				4441
Friday, April 17, 2009	1,193	1,200	420	2,247	2,260	791	5,298				5298
Saturday, April 18, 2009	1,343	840	625	2,529	1,582	1,177	5,288				5288
Monday, April 20, 2009	1,230	1,370	1,127	2,317	2,580	2,123	7,019				7019
Tuesday, April 21, 2009	1,290	1,210	916	2,430	2,279	1,725	6,433				6433
Wednesday, April 22, 2009	1,223	1,200	904	2,303	2,260	1,703	6,266				6266
Thursday, April 23, 2009	590	1,180	400	1,111	2,222	753	4,087				4087
Friday, April 24, 2009	975	1,015	825	1,836	1,912	1,554	5,302				5302
Saturday, April 25, 2009	1,250	1,215	1,127	2,354	2,288	2,123	6,765				6765
Monday, April 27, 2009	390	1,045	791	735	1,968	1,490	4,192				4192
Tuesday, April 28, 2009	1,065	1,335	960	2,006	2,514	1,808	6,328				6328
Wednesday, April 29, 2009	610	665	600	1,149	1,252	1,130	3,531				3531
Thursday, April 30, 2009	-	-	-	-	-	-	0				0
Friday, May 01, 2009	-	-	-	-	-	-	0				0
Saturday, May 02, 2009	-	-	-	-	-	-	0				0
Sunday, May 03, 2009	-	-	-	-	-	-	-	-	-	-	-
Monday, May 04, 2009	-	-	-	-	-	-	0				0
Tuesday, May 05, 2009	-	-	-	-	-	-	0				0
Wednesday, May 06, 2009	-	-	-	-	-	-	0				0
Thursday, May 07, 2009	45	915	720	85	1,723	1,356	3,164				3164
Friday, May 08, 2009	-	815	601	-	1,535	1,132	2,667				2667
Saturday, May 09, 2009	-	753	539	-	1,418	1,015	2,433				2433
Monday, May 11, 2009	-	925	670	-	1,742	1,262	3,004				3004
Tuesday, May 12, 2009	-	845	560	-	1,591	1,055	2,646				2646
Wednesday, May 13, 2009	-	765	903	-	1,441	1,701	3,141				3141
Thursday, May 14, 2009	-	680	735	-	1,281	1,384	2,665				2665
Friday, May 15, 2009	-	503	46	-	947	87	1,034				1034
Saturday, May 16, 2009	455	875	-	857	1,648	-	2,505				2505
Monday, May 18, 2009	795	775	-	1,497	1,460	-	2,957				2957
Tuesday, May 19, 2009	695	1,020	-	1,309	1,921	-	3,230				3230

Date	Production Time [min/day]			Production Rate [yd^3/day]			Daily Hyd Total	Loads from Mech	Daily Mech Total	TVA Dredge Reported Quantity	Daily Total
	D16 Emory	D14 Clyde	D17 Luzon	D16 Emory	D14 Clyde	D17 Luzon					
Wednesday, May 20, 2009	790	879	10	1,488	1,655	19	3,162				3162
Thursday, May 21, 2009	945	1,065	645	1,780	2,006	1,215	5,000				5000
Friday, May 22, 2009	900	970	-	1,695	1,827	-	3,522				3522
Saturday, May 23, 2009	-	-	-	-	-	-	-	-	-	-	-
Sunday, May 24, 2009	-	-	-	-	-	-	-	-	-	-	-
Monday, May 25, 2009	-	-	-	-	-	-	-	-	-	-	-
Tuesday, May 26, 2009	905	995	423	1,704	1,874	797	4,375				4375
Wednesday, May 27, 2009	829	1,092	973	1,561	2,057	1,832	5,450				5450
Thursday, May 28, 2009	240	425	923	452	800	1,738	2,991				2991
Friday, May 29, 2009	257	950	490	484	1,789	923	3,196				3196
Saturday, May 30, 2009	728	1,135	-	1,371	2,138	-	3,509				3509
Sunday, May 31, 2009	-	-	-	-	-	-	-	-	-	-	-
Monday, June 01, 2009	290	1,050	-	546	1,978	-	2,524				2524
Tuesday, June 02, 2009	585	1,060	545	1,102	1,996	1,026	4,125				4125
Wednesday, June 03, 2009	841	550	850	1,584	1,036	1,601	4,221				4221
Thursday, June 04, 2009	688	851	1,191	1,296	1,603	2,243	5,142				5142
Friday, June 05, 2009	-	615	1,060	-	1,158	1,996	3,155				3155
Saturday, June 06, 2009	-	725	1,043	-	1,365	1,964	3,330				3330
Sunday, June 07, 2009	-	-	-	-	-	-	-	-	-	-	-
Monday, June 08, 2009	968	475	1,127	1,823	895	2,123	4,840				4840
Tuesday, June 09, 2009	722	805	971	1,360	1,516	1,829	4,705				4705
Wednesday, June 10, 2009	452	710	695	851	1,337	1,309	3,497				3497
Thursday, June 11, 2009	630	365	615	1,187	687	1,158	3,032				3032
Friday, June 12, 2009	947	960	566	1,784	1,808	1,066	4,657				4657
Saturday, June 13, 2009	340	450	1,050	640	848	1,978	3,465				3465
Sunday, June 14, 2009	-	-	-	-	-	-	-	-	-	-	-
Monday, June 15, 2009	511	845	821	962	1,591	1,546	4,100				4100
Tuesday, June 16, 2009	1,035	995	1,047	1,949	1,874	1,972	5,795			1100	6895
Wednesday, June 17, 2009	398	225	565	750	424	1,064	2,237			2310	4547
Thursday, June 18, 2009	764	890	970	1,439	1,676	1,827	4,942			3026	7968
Friday, June 19, 2009	0	1,129	1,015	0	2,126	1,912	4,038			4510	8548
Saturday, June 20, 2009	0	775	852	0	1,460	1,605	3,064	15	330	4160	7554
Sunday, June 21, 2009	-	-	-	-	-	-	-	-	-	1,200	1,200
Monday, June 22, 2009	0	720	691	0	1,356	1,301	2,657	15	300	5160	8117
Tuesday, June 23, 2009	684	1,098	1,128	1,288	2,068	2,124	5,481	34	680	5260	11421
Wednesday, June 24, 2009	1,104	948	906	2,079	1,785	1,706	5,571	18	360	5240	11171
Thursday, June 25, 2009	768	864	1,050	1,446	1,627	1,978	5,051	55	1100	5040	11191
Friday, June 26, 2009	867	950	1,053	1,633	1,789	1,983	5,405	69	1380	3770	10555
Saturday, June 27, 2009	502	995	990	945	1,874	1,865	4,684	74	1480.0	0	6164
Sunday, June 28, 2009	-	-	-	-	-	-	-	-	-	-	-
Monday, June 29, 2009	0	1,160	1,120	0	2,185	2,109	4,294	65	1170.0	0	5464
Tuesday, June 30, 2009	319	774	777	601	1,458	1,463	3,522	75	1350.0	2800	7672
Wednesday, July 01, 2009	935	1,085	555	1,761	2,043	1,045	4,850	65	1170	6033	12053
Thursday, July 02, 2009	1,001	1,160	600	1,885	2,185	1,130	5,200	27	486	6819	12505
Friday, July 03, 2009	-	-	-	-	-	-	-	-	-	-	-
Saturday, July 04, 2009	-	-	-	-	-	-	-	-	-	-	-
Sunday, July 05, 2009	-	-	-	-	-	-	-	-	-	-	-
Monday, July 06, 2009	798	860	705	1,503	1,620	1,328	4,450	71	1278	4866	10594
Tuesday, July 07, 2009	1,060	1,030	845	1,996	1,940	1,591	5,528	22	396	0	5924
Wednesday, July 08, 2009	947	1,135	950	1,784	2,138	1,789	5,710	0	0	4093	9803
Thursday, July 09, 2009	727	955	530	1,369	1,799	998	4,166	32	640	5770	10576
Friday, July 10, 2009	926	1,175	950	1,744	2,213	1,789	5,746	32	640	5,770	12,156
Saturday, July 11, 2009	786	950	1,075	1,480	1,789	2,025	5,294				
Sunday, July 12, 2009	-	-	-	-	-	-	-	-	-	-	-
Monday, July 13, 2009											
Tuesday, July 14, 2009											
Wednesday, July 15, 2009											
Thursday, July 16, 2009											
Friday, July 17, 2009											

Date	Production Time [min/day]			Production Rate [yd^3/day]			Daily Hyd Total	Loads from Mech	Daily Mech Total	TVA Dredge Reported Quantity	Daily Total
	D16 Emory	D14 Clyde	D17 Luzon	D16 Emory	D14 Clyde	D17 Luzon					
Average	695	878	741	1,308	1,654	1,395	3437.2	42	798	3663.2	4335.0
Total	**54,177**	**68,488**	**48,892**	**102,033**	**128,986**	**92,080**	**323,099**	**669**	**12,760**	**76927**	
								Total yd^3 to date dredged from Emory River channel			**412,786**

Ash Pond Dredging		
DATE	EST CU YDS	TOTAL
Friday, April 17, 2009	1100	1100
Sunday, April 19, 2009	4200	5300
Friday, April 24, 2009	4140	9440
Saturday, April 25, 2009	4410	13850
Sunday, April 26, 2009	3690	17540
Monday, April 27, 2009	2900	20440
Tuesday, April 28, 2009	4140	24580
Wednesday, April 29, 2009	4620	29200
Thursday, April 30, 2009	4440	33640
Friday, May 01, 2009	3690	37330
Tuesday, May 05, 2009	3990	41320
Thursday, May 07, 2009	4200	45520
Friday, May 08, 2009	3480	49000

Stilling Pond Dredging		
DATE	EST CU YDS	TOTAL
Tuesday, May 19, 2009	633	
Wednesday, May 20, 2009	900	1533
Thursday, May 21, 2009	733	2266
Friday, May 22, 2009	820	3086
Tuesday, May 26, 2009	866	3952
Wednesday, May 27, 2009	586	4538
Thursday, May 28, 2009	1000	5538
Friday, May 29, 2009	1120	6658
Monday, June 01, 2009	1253	7911
Tuesday, June 02, 2009	1280	9191
Wednesday, June 03, 2009	1146	10337
Thursday, June 04, 2009	1280	11617
Friday, June 05, 2009	1573	13190
Monday, June 08, 2009	1120	14310
Friday, June 26, 2009	1555	15865
Saturday, June 27, 2009	979	16844
Sunday, June 28, 2009	848	17692
Monday, June 29, 2009	424	18116
Wednesday, July 01, 2009	942	19058
Sunday, July 12, 2009	1058	20116
		20116

ATTACHMENT 3

Fly Ash Separation Performance Analysis

FLY ASH SEPARATION PERFORMANCE ANALYSIS

Prepared for:
Jacobs Engineering Group, Inc.

June 9, 2009

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• EXECUTIVE SUMMARY

The report Fly Ash Separation Performance Analysis provides the results of water sampling and fly ash analysis performed between March 21, 2009 and May 7, 2009 at the TVA/KIF site in Kingston, Tennessee. During a Pilot Dredging Phase of fly ash removal, ash was dredged from the Emory River and pumped into a Rim Ditch constructed for the pilot dredging and running parallel to the KIF Sluice Trench. The Rim Ditch is a 40 feet wide by 1,800 feet long by 10-12 feet deep settling basin to settle ash from hydraulic dredge slurry.

The dredge slurry is pumped to the north end of the Rim Ditch and allowed to flow south in the ditch with the ash settling out as the water flows to the overflow at the south end of the ditch. The overflow from the Rim Ditch is constructed of rip rap stone placed on a geotextile liner with the overflow elevation approximately 3-feet below ground surface at the Rim Ditch. The KIF Sluice Trench, which runs south to north, carries fly ash from the KIF power plant into a settling ash pond, a stilling basin, and eventually into the KIF intake channel at Outfall 001. Several water and ash sampling points were sampled daily and analyzed to determine the performance of the Rim Ditch removal system.

The significant results of the assessment are:

- The ash and water slurry pumped from the dredges into the Rim Ditch had an average solids content of 8.4 percent (by dry weight), compared to the Phase 1 Plan expected 15 percent. The result is reasonable for the probable in-situ density and grain size of the fly ash in the Emory River.

- The fly ash from the river had a consistent grain size with 20 percent by weight sand, 70 percent by weight silt, and 10 percent by weight clay, on average.

- The settling capacity of the Rim Ditch is approximately 11.8 MGD (million gallons per day), or approximately 10,000 GPM (gallons per minute) for 20 hours a day at 8.4 percent solids by dry weight. Operation of the Rim Ditch at flows greater than 11.8 MGD results in most of the sediment going to the Sluice Trench.

- The Rim Ditch forms a “slurry blanket” that builds up at its downstream end as the peak settling capacity is reached. This slurry blanket averages between 30 and 35 percent solids by weight two feet below the water surface elevation. The slurry blanket is composed primarily of uniform silt with less than 10 percent clay by weight.

- The Rim Ditch provides adequate settling area to allow 100 percent of the particles larger than silt in the slurried fly ash to settle out prior to entering the Sluice Trench. The transition between sand to silt occurs at 75 microns (0.075 millimeters or 0.003 inches).

- The Rim Ditch removal efficiency is greater than 90 percent when operating within its settling capacity. The removal efficiency was measured as low as 30 percent as the settling capacity limit of 11.8 MGD is exceeded.

During the Pilot Dredging, a hydrocyclone alternate and a geotextile dewatering bag alternate were assessed to determine if the thickened slurry in the Rim Ditch could be processed to improve ditch performance. The results indicate that a small diameter hydrocyclone provided only nominal improvement of steady-state solids content in the thickened slurry found in the Rim Ditch. The geotextile bag test produced better solids thickening than the hydrocyclone, but not superior to allowing the ash to gravity dewater on the dewatering pad.

The results of the alternate testing did not indicate that a system other than gravity dewatering was warranted in a full scale application.

1.0 INTRODUCTION

Hard Hat Services (HHS) was retained by Jacobs Engineering Group, Inc. (Jacobs) to perform services involving a review and evaluation of the Phase I dredging operations conducted in response to a release of fly ash into the Emory River adjacent to the Tennessee Valley Authority's (TVA) Kingston Fossil Plant (KIF) located near the town of Kingston in Roane County, Tennessee. The purpose of the review and evaluation was to evaluate the proposed dredging system performance and to provide recommendations for alterations or alternatives to the proposed system.

This report summarizes the performance of the first 60-days of dredging (pilot study) of the Emory River channel. The specific areas of interest for this report are:

- Physical properties of the dredge slurry pumped from the Emory River channel
- Rim Ditch settling performance
- Evaluation of alternative dewatering systems

2.0 PROJECT BACKGROUND

The TVA Kingston Fossil Plant (KIF) is located at the intersection of the Emory and Clinch Rivers, near their convergence with the Tennessee River in the upper end of the Watts Bar Reservoir. When operating at full power, the plant uses approximately 14,000 tons of coal per day and produces approximately 1,000 tons of fly ash daily. The fly ash is sluiced with water and discharged to a sluice trench; the sluice trench discharges to an ash settling pond which discharges to an ash stilling pool. The stilling pool is discharged into the KIF intake channel at Outfall 001. Historically, ash deposited in the settling pond was hydraulically dredged and pumped to long□term storage cells.

On December 22, 2008, a failure of the long□term storage cell dike allowed approximately 5.4 million cubic yards of fly ash to flow into the surrounding area with up to half of the displaced ash coming to rest in the Emory River. In February 2009, the TVA prepared a plan to remove the fly ash deposited in the river channel using hydraulic dredging; the plan was detailed in the work plan “Phase 1 Emory River Dredging Plan (Phase I Plan)” prepared for the TVA by Shaw Environmental, Inc. The Phase I plan was approved by the Tennessee Department of Environmental Compliance (TDEC) on March 3, 2009.

The Phase I dredging operations proposed the use of three Ellicott 370 hydraulic dredges (named Emory, Clyde, and Luzon) with 12 inch diameter suction and 10 inch diameter discharge main pump (approximately 400HP on the main pump). Each dredge had a published maximum pump rate of 4,000 gallons per minute (gpm) at 835 RPM[1] with a daily production rates of 3,000 *in-situ* cubic yards of sediment per dredge (for a total of 9,000 cubic yards per day) and 9,500 tons per day of dry solids. Daily production rates were based on the following assumed parameters:

Parameter	**Phase I Dredge Plan Values**
Dredge Slurry % Dry Solids	15%
Dredge Slurry Density	1.10g/cc
Fly Ash Specific Gravity	2.6 g/cc
Sediment % Dry Solids	70% (unit weight 2,965 lbs/CY)

[1] Ellicott Dredge Website Model 370 Dragon Series

The dredge slurry is pumped to a newly constructed settling trench (referred to as the Rim Ditch) where the ash is allowed to separate from the dredge slurry. The Rim Ditch is approximately 1,800-foot long x 40-foot wide x 10-foot deep and was constructed adjacent and parallel to the existing KIF sluice trench. The dredge slurry is pumped to the north end of the Rim Ditch and discharges at the south end to the upstream end of the Sluice Trench through an overflow channel.

The Phase I Plan assumed that the ash settling in the Rim Ditch would contain the same solids content as the dredged sediment [or 70 percent fly ash (by dry weight)]. The Phase I plan further assumed that 90% of the ash would settle in the Rim Ditch. Based on the provided assumptions, the following was the expected performance of the Rim Ditch:

Parameter	**Phase I Dredge Plan**
Rim Ditch Slurry % Dry Solids	70%
Dry Solids Removed Daily	8,500tons/day
Volume of Rim Ditch Slurry	8,200 CY/day
Dry Solids Entering Sluice Trench/Settling Pond	1,000 tons/day

The assumption that the solids content in the Rim Ditch slurry would be the same as *in-situ* solids content in the River appears to be unrealistic based on many years of experience on the part of the United States Army Corps of Engineers. A bulking ratio (or swell) of 30% is generally used for uniform silt. Based on a 30 percent bulking ratio and the proposed solids production rate, the estimated accumulation rate for the Rim Ditch slurry would be approximately 10,600CY/day.

The settled solids were removed from the Rim Ditch using backhoes and stockpiled adjacent to the ditch (to allow the material to dewater/dry). The Phase I Plan did not provide production rates for the backhoes used to remove the Rim Ditch slurry; however, based on observations of equipment on-site during the period March 21 through May 07, 2009, HHS generally observed a maximum production rate of 3,750 cubic yards per day per backhoe)(see Appendix C).

Given the estimated Rim Ditch slurry accumulation rate of 10,600 CY/day associated with the proposed dry solids ash production rate approximately 3 backhoes (operating 20-hours per day) would be required to remove ash from the Rim Ditch as fast as it was being added to the ditch.

The anticipated solids content of the dewatered/dried solids/ash material stockpiled for shipping after drying was 80 percent (by weight).

Locations for the Sluice Trench, Settling Pond, Rim Ditch, and ash storage area are indicated on Figure 1.

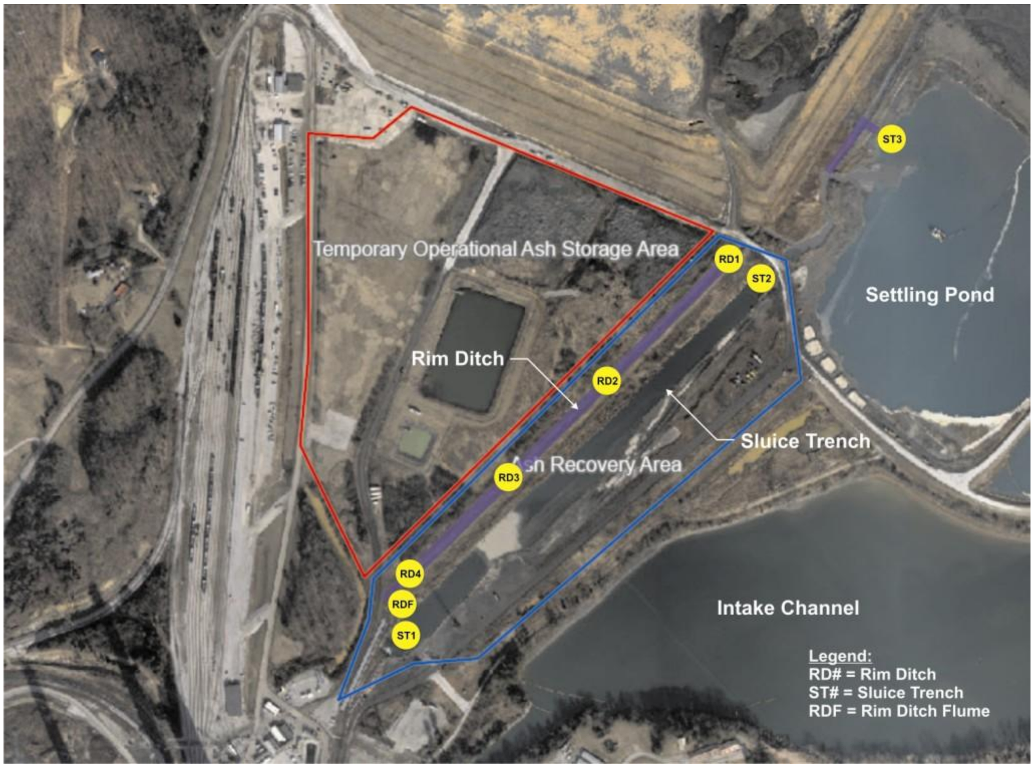

Figure 1: Site Map

3.0 PHYSICAL PROPERTIES OF DREDGE SLURRY

In order to evaluate the physical properties of the ash dredge slurry, bulk water samples (RD1) were collected from the Rim Ditch influent at the dredge inlet pipes and analyzed for Grain Size, Total Suspended Solids (TSS) and/or Percent Solids. The sample location is indicated on Figure 1.

RD1 samples were generally collected once per day (when dredges were operating) during the period March 21 through May 07, 2009 in accordance with the protocols provided in Appendix A. Analytical data is provided in Appendix B; Turbidity, TSS and Percent Solids analytical results are summarized in the attached Table 21.

3.1 Grain Size Analysis

A grain size distribution graph for RD1 is provided below as Figure 2.

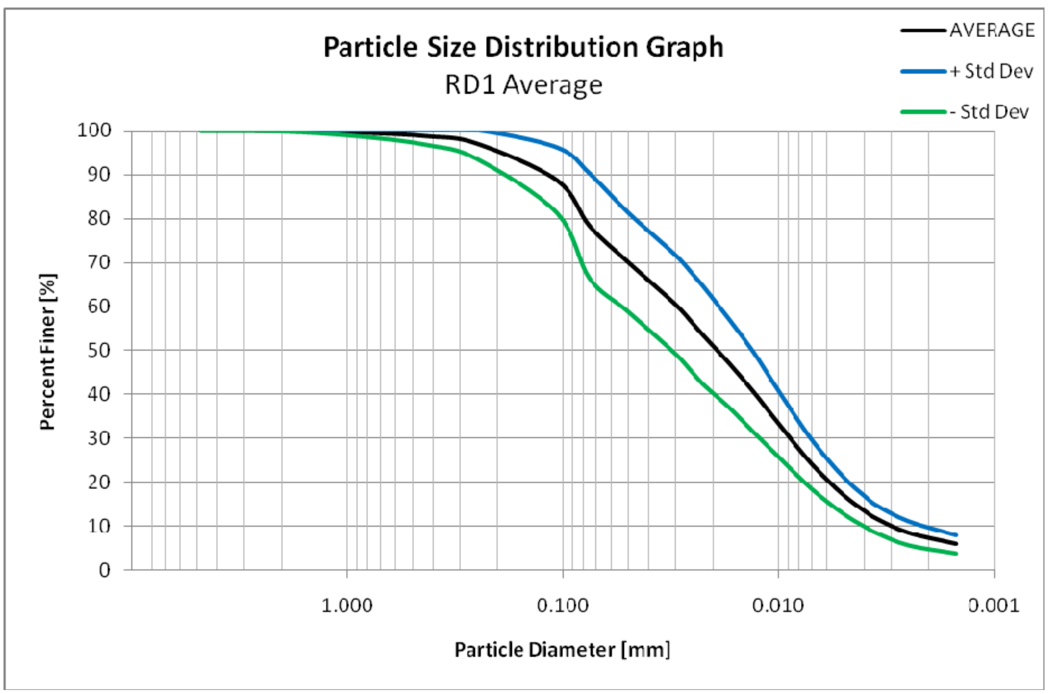

Figure 2: Grain Size Distribution for Fly Ash in Dredge Slurry (RD1)

The average results of the grain size analysis are summarized below in Tables 1 and 2 and depicted on the attached Figure 2.

Table 1 – RD1/Dredge Slurry Particle Size Distribution

Percent Finer,%	Particle Diameter, micron
85/D_{85}	90
50/D_{50}	20
15/D_{15}	4

Table 2 – RD1/Dredge Slurry Grain Size Analysis Percent by Dry Weight

Gravel Content,%	Sand Content, %	Silt Content, %	Clay Content, %
0	22	70	8

The results indicate that the fly ash measured in 24 separate samples at the influent to the Rim Ditch is uniform sandy silt that may be expected to settle easily within a few hours of entering the Rim ditch. Only 10% or less is clay size particles that will stay suspended for longer than one day. The results also indicate that there is little variation in grain size over the time of the sampling indicating that the material is very uniform as found in the Emory River.

3.2 Turbidity, TSS, and Percent Solids by Weight

The average results for the Turbidity, TSS, and Percent Solids analyses for sample RD1 are summarized below in Table 3.

Table 3 – RD1/Dredge Slurry Average Turbidity, TSS, and Percent by Weight & Volume

Analysis	Average	MIN	MAX	STD DEV
TSS, mg/L	84,300	10,600	206,400	47,400
Percent Solids (by Dry Weight)	8.4	1.1	20.6	4.7
Percent Solids (by Volume)	3.4	0.40	8.9	2.0

As indicated above, the average observed percent solids (by weight) of the dredge slurry was 8.4 percent with the majority of results distributed between 4% and 12% solids by dry weight; this compares to the initial assumption of 15 percent solids by dry weight provided in the Phase I Plan.

3.3 Settling Analysis

The settling properties and characteristics of sediment are generally measured using the large diameter settling test [reference United States Army Corps of Engineers Engineering Manual, Confined Disposal of Dredged Material (EM 1110-2-5027)]. This settling test is designed to measure the rate at which solids would settle in a water column under quiescent conditions. If run for a substantially long time the settling test will provide a measure of the constant flocculent settling rate, a variable hindered settling rate and a compression-settling rate. These three types of settling correspond to the following:

1. Flocculent Settling – settling of particles in suspension that may be affected by the proximity of the particles, but not by the rate at which water can move to the top of the settling basin
2. Hindered Settling – settling of particles in suspension where the water that is trying to go to the top or bottom of the settling basin is hindered by the particles.
3. Compression Settling – settling that occurs when the particles have come in contact with each other and further settlement is caused by the weight of the particles expelling water from the remaining void space.

A large diameter settling test was not performed on the dredge slurry/RD1. However, the results from a large diameter settling test conducted on a fly ash sample (identified as SW) with similar grain size characteristics to the Emory River fly ash indicate that the settling characteristics of the dredge slurry/RD1 can likely be approximated by the SW sample settling rates summarized below in Table 4.

Table 4 – Approximated Settling Rates for Dredge Slurry/RD1

Flocculent Settling Rate (in/hr)	Compression Settling Rate (in/hr)	Solids Content at 1,000 Hours (% dry weight)
11	0.008	35

A copy of the grain size analysis and large diameter settling test data for the referenced fly ash sediment sample SW are provided in Appendix D.

4.0 RIM DITCH PERFORMANCE EVALUATION

4.1 Estimated Rim Ditch Settling Performance

Assuming that Flocculent Settling is the dominate settling phenomena occurring in the Rim Ditch, the expected maximum loading/dredge flow rate to the Rim Ditch can be approximated using the following formula:

$$Q_{MAX} = A \times V$$

Where,

Q_{MAX} = maximum loading/dredge flow rate (or clarification rate)
A = Rim Ditch surface area
V = flocculent settling rate

Based on the above formula, Q_{MAX} for the Rim Ditch would be 11.8 MGD (see Appendix C). This equates to three dredges (with an assumed pumping rate of 4,000 gpm per dredge) operating approximately 16.5 hrs per day with the solids being removed as fast as they accumulate.

4.2 Observed Rim Ditch Settling Performance

In order to evaluate the settling/clarification performance of the Rim Ditch, HHS evaluated surface water TSS concentrations for the following three locations downstream of the Rim Ditch inlet:

- RD2 – Collected from two feet below water surface approximately 600 feet (or 1/3rd of the Rim Ditch length) downstream of RD1;
- RD3 – Collected from two feet below water surface approximately 1,200 feet (or 2/3^{rds} of the Rim Ditch length) downstream of RD1; and
- RD4 – Collected from two feet below water surface at the downstream end of the Rim Ditch.

The downstream TSS concentrations were then compared to the RD1 TSS concentrations. Sample locations are indicated on Figure 1.

RD2, RD3, and RD4 samples were generally collected once per day (when dredges were operating) in accordance with the protocols provided in Appendix A. Complete analytical data is provided in Appendix B; analytical results are summarized in the attached Table 21.

Based on the TSS analysis, the settling performance of the Rim Ditch at each of the downstream sampling locations was calculated as follows:

Percent Solids Removed, % = [(RD1 TSS, mg/L) - (RDn TSS, mg/L)] / (RD1 TSS, mg/L)

Where,

RDn represents RD2, RD3, or RD4

The percent solids removed was then compared to the dredge slurry flow rate to the Rim Ditch. The dredge slurry flow rate was calculated as follows:

Dredge Slurry Flow Rate, MGD = (Total Dredge Production Time, min/day) x (Q_D gal/min)

Where,

Total Dredge Production Time = reported production time for Emory, Clyde, and Luzon Dredges
Q_D = assumed dredge pumping rate = 4,000 gpm

The calculated percent solids removed and corresponding dredge slurry flow rate are summarized on the attached Table 21.

Based on this analysis, for the period March 21st through April 7th, the Rim Ditch was operated with an average dredge slurry flow rate of 3.72 MGD and provided an average solids removal rate of 98 percent (as represented by the percent solids removed at RD4). A summary of the average solids removal rate measured at all three downstream sampling locations during this period is provided in Table 5.

Table 5 – Rim Ditch Settling Performance (March 21st through April 8th)

	Solids Removal Rate, %			Dredge Slurry Flow Rate, MGD
	RD2	RD3	RD4	
Average	84	93	98	3.72
Maximum	99	100	100	10.37
Minimum	21	9	87	1.00

On April 9th and 10th, the surface water samples obtained from RD2, RD3, and RD4 consisted of an ash slurry with an average TSS concentration approximately five times greater than the dredge slurry TSS concentration (as measured at RD1). Based on the TSS analysis, HHS assumes that settled ash slurry had accumulated throughout the length of the Rim Ditch to within two feet of the water surface (the sampling depth), indicating that the removal of solids from the Rim Ditch for the period up to April 9th was inadequate to support the dredging production rate. A summary of the average TSS concentrations at RD1, RD2, RD3, and RD4 during this period is provided in Table 6.

Table 6 – Rim Ditch TSS Concentrations (April 9th through April 10th)

	RD1	RD2	RD3	RD4
Average TSS, mg/L	78,200	366,800	356,900	457,000

For the period April 13th through April 16th, the TSS analysis of the downstream surface water samples indicated that the ash slurry had generally been removed from the downstream half of the Rim Ditch. A summary of the average TSS concentrations at RD1, RD2, RD3, and RD4 during this period is provided in Table 7.

Table 7 – Rim Ditch TSS Concentrations (April 13th through April 16th)

	RD1	RD2	RD3	RD4
Average TSS, mg/L	37,400	136,600	4,100	1,300

During this period, the Rim Ditch was operated with an average dredge slurry flow rate of 9.95 MGD and provided an average solids removal rate of 95 percent (as represented by the percent solids removed at RD4). A summary of the average solids removal rate measured at the RD3 and RD4 sampling locations during this period is provided in Table 8.

Table 8 – Rim Ditch Settling Performance (April 13th through April 16th)

	Solids Removal Rate, %		**Dredge Slurry Flow Rate, MGD**
	RD3	RD4	
Average	87	95	9.95
Maximum	96	99	11.51
Minimum	66	90	7.56

From April 17th through May 7th (the remainder of the observed period), the TSS analysis of the downstream surface water samples indicated that a settled ash slurry had again accumulated throughout the length of the Rim Ditch to within two feet of the water surface. A summary of the average TSS concentrations and Percent Solids at RD1, RD2, RD3, and RD4 during this period is provided in Table 9.

Table 9 – Rim Ditch TSS Concentrations (April 17th through May 7th)

	RD1	RD2	RD3	RD4
Average TSS, mg/L	112,900	226,200	308,600	337,900

To evaluate the solids removal rate for the Rim Ditch under this condition, HHS began collecting and analyzing a water sample collected from the Rim Ditch discharge flume (RDF). RDF samples were generally collected once per day (when dredges were operating) in accordance with the protocols provided in Appendix A. Complete analytical data is provided in Appendix B; analytical results are summarized in the attached Table 21.

A comparison of the TSS concentrations for RD1 and RDF, for the period April 21st through May 7th, indicates that the Rim Ditch was operated with an average dredge slurry flow rate of 9.28 MGD and provided an average solids removal rate of 72 percent (as represented by the percent solids removed at RDF). A summary of the average solids removal rate measured at RDF during this period is provided in Table 10.

Table 10 – Rim Ditch Settling Performance (April 21st through May 7th)

	Solids Removal Rate, %	Dredge Slurry Flow Rate, MGD
Average	72	9.28
Maximum	99	13.66
Minimum	32	0

During the period Mar 21st through April 16th, prior to the Rim Ditch becoming filled with settled ash slurry, the estimated solids/ash discharged to the Sluice Trench was 0.68 MLbs as follows:

Ash/solids entering the Sluice Trench, MLbs/day = (RD1 TSS mg/L) x (1-RD4 removal rate, %) / (1,000,000 mg/Kg) x (2.2 Kg/lb) / (0.264 gal/L) x (Flow to rim ditch, MGD).

A summary of calculated values for each observed day is provided in the attached Table 22.

During the period April 21st through May 7th, after the Rim Ditch became filled with settled ash slurry, the estimated solids/ash discharged to the Sluice Trench was 27.2 MLbs as follows:

Ash/solids entering the Sluice Trench, MLbs/day = (RD Flume TSS mg/L) / (1,000,000 mg/Kg) x (2.2 Kg/lb) / (0.264 gal/L) x (Flow to rim ditch, MGD).

A summary of calculated values for each observed day is provided in the attached Table 22.

4.3 Rim Ditch Ash Slurry

To further evaluate the physical properties of the Rim Ditch ash slurry, selected RD2, RD3, RD4, and RDF samples were analyzed for Grain Size and Percent Solids. Complete analytical data is provided in Appendix B; Percent Solids analytical results are summarized in the attached Table 21.

The average results for the Percent Solids analyses are provided below in Table 11.

Table 11 – Rim Ditch Slurry Average Percent by Weight & Volume

	RD2	RD3	RD4
Average Percent Solids (by Weight)	19.8	27.2	34.5
Average Percent Solids (by Volume)	9.1	13.0	17.0

Based on the calculated average Percent Solids for samples RD2, RD3, and RD4, the average observed percent solids (by weight) of the Rim Ditch slurry was 27.2 percent (by weight) and 13.0 percent (by volume); this compares to the settled solids concentration measured in the large diameter settling column test of 35% solids (Appendix C), where a equilibrium solids content was reached after several days of settling.

The average grain size distribution curves for samples RD1, RD2, RD3, RD4, and RDF are provided below as Figure 3.

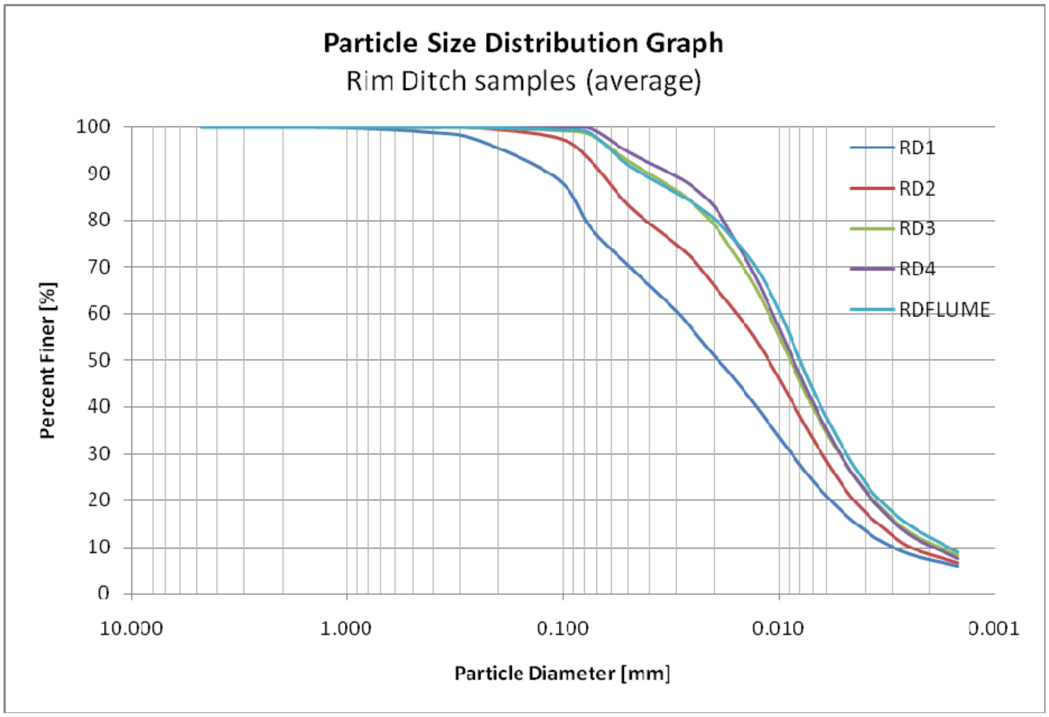

Figure 3: Grain Size Distribution for Dredge Slurry (RD1) and Rim Ditch Slurry (RD2, RD3, RD4, & RDF)

The average results of the grain size analysis are summarized below in Tables 12 and 13 and depicted on attached Figure 3.

Table 12 – Rim Ditch Slurry Particle Size Distribution

Percent Finer,%	Particle Diameter, micron			
	RD2	RD3	RD4	RDF
85/D_{85}	55	28	23	28
50/D_{50}	11	9	9	8
15/D_{15}	3.5	2.8	2.9	2.6

Table 13 – Rim Ditch Discharge Slurry Grain Size Analysis by Dry Weight

Gravel Content,%	Sand Content, %	Silt Content, %	Clay Content, %
0	0	88	12

The results indicate that the Rim Ditch accumulates a sludge blanket over the length of the ditch that eventually reaches a steady state concentration of 30% to 35% dry solids. The solids in suspension are the silt and clay fraction of the fly ash with the sand fraction settled in the Rim Ditch. The overflow from the Rim Ditch to the Sluice Trench is uniform silt with approximately 12% by weight clay.

4.4 Observed Impacts to Sluice Trench

As noted in Section 4.2, the estimated solids/ash discharged to the Sluice Trench was as follows:

- 0.68 MLbs (340 tons) during the period Mar 21st through April 16th (prior to the Rim Ditch becoming filled with a settled ash slurry); and
- 27.2 MLbs (13,600 tons) during the period April 21st through May 7th (after the Rim Ditch became filled with settled ash slurry).

The discharge of solids/ash to the Sluice Trench likely resulted in the accumulations of 1,200 CY and 50,000 CY, respectively, for these observed periods (see Appendix C for more details).

A summary of calculated values for each observed day is provided in the attached Table 22.

In order to monitor impacts to the Sluice Trench water quality, HHS evaluated surface water TSS concentrations for the following Sluice Trench locations:

- ST1 – Collected from two feet below water surface at the upstream end of the Sluice Trench in the vicinity of the KIF plant ash sluice discharge pipes. This sample was considered representative of the water quality at the inlet of the Sluice Trench prior to mixing with the discharge from the Rim Ditch.

- ST2 – Collected from two feet below water surface approximately 1,800-feet (or 2/3^{rds} of the Sluice Trench) downstream of ST1, where the Sluice Trench overflow discharges through a culvert to the remaining 1/3rd of the trench. This sample was considered representative of the water quality/settling performance of the Sluice Trench after mixing with the discharge from the Rim Ditch.
- ST3 - Collected as a grab sample from a location in the vicinity of where the Sluice Trench discharges to the Settling Pond.

The sample locations are indicated on Figure 1. These samples were generally collected once per day (when dredges were operating) in accordance with the protocols provided in Appendix A. Complete analytical data is provided in Appendix B; analytical results are summarized in the attached Table 21.

Based on the TSS analysis, from March 21st through May 28th, discharges from the Rim Ditch appeared to have little to no impact on the quality of water discharging from the Sluice Trench to the Settling Pond. However, on May 28th and May 29th, water samples obtained from ST3 were found to contain a significantly elevated TSS concentrations not noted at the upstream sampling location (ST2). An inspection of the Sluice Trench indicated that a submerged culvert located at the base of the Sluice Trench in the vicinity of ST2 was allowing accumulated ash slurry to be swept into the downstream channel and discharged to the Settling Pond indicating that discharges from the Rim Ditch were resulting in an accumulation of an ash slurry in the Sluice Trench.

4.5 Rim Ditch Performance Conclusions

Based on a review of the likely settling characteristics of the dredge slurry, the estimated maximum loading/dredge flow rate (Q_{MAX}) for the Rim Ditch is 11.85 MGD (reference Section 4.1). This conclusion is generally supported by water quality data obtained during dredging operations, indicating that the Rim Ditch was operated with a dredge slurry flow rate of up to 11.28 MGD while providing a solids removal rate of greater than 95 percent.

However, observations also indicated that the performance of the Rim Ditch was significantly degraded due to the accumulation of ash slurry in the Rim Ditch. This resulted in a significant deposition of ash into the Sluice Trench. As indicated in Section 4.4, during an eleven day period between April 21st and May 7th, an estimated 13,600 tons of ash were discharged from the Rim Ditch to the Sluice Trench corresponding to a displaced volume of 50,000 cubic yards to the Sluice Trench and/or Settling Pond.

The calculated Q_{MAX} corresponds to a total dredge production time of 2,963 minutes (assuming a dredging rate of 4,000 gpm) or approximately 16.5 hrs/dredge/day using three dredges.

If the ditch is operating at its capacity of 11.85 MGD, with an average of 8.4% solids for the dredge slurry, approximately 4,240 CY of ash sediment will be delivered to the Rim Ditch each day, corresponding to 4,240 tons of dry ash solids (Appendix C). This corresponds to the following Rim Ditch slurry production parameters (Appendix C):

Table 14 – Projected Rim Ditch Slurry Production Parameters for Q_{MAX}

Solids Content [%]	Volume of Rim Ditch Slurry [CY/day]	Number of Backhoe's (at 20-hour/day)
40	8,859	2.36
50	6,509	1.74
60	4,942	1.32
70	3,823	1.01

5.0 ALTERNATIVE DEWATERING SYSTEM

Two (2) alternative methods of dewatering the fly ash dredged from the Emory River were researched and tested. The first alternative was the use of a Hydrocyclone, commonly referred to as a cyclone. The second alternative was testing the use of Geotextile bags.

5.1 Hydrocyclone System Overview

Cyclones are based on the principle of centrifugal forces. Slurry material is pumped into the hydrocyclone at a uniform flow rate and pressure and accelerated towards the outer walls. This causes a separation of the slurry by particle size with a more concentrated slurry (containing the coarser particles) discharging through the base of the hydrocyclone or the underflow and the remainder of the slurry (containing the finer particles) discharged through the overflow. Consequently, the percent solids content of the underflow is significantly increased over the solids content of the influent slurry.

The use of a hydrocyclone was evaluated under the following two scenarios:

- Pumping the dredge slurry directly through hydrocyclones; and
- Pumping the ash slurry accumulated in the Rim Ditch through hydrocyclones.

5.1.1 Pumping Dredge Slurry Directly into Hydrocyclone(s)

Projected operating parameters for a hydrocyclone processing the dredge slurry are summarized below in Table 15.

Table 15 – Projected Hydrocyclone Parameters for Dredge Slurry

Parameter	Influent	Overflow	Underflow
Percent Solids (by Weight)	11	0.7	38
Percent Solids (by Volume)	4.5	.3	19.1
S.G. of Slurry	1.073	1.004	1.305
Flow, gpm	174	134	40

The operating parameters were provided by FLSmidth-Krebs (Krebs) based on data provided for an RD1 sample (i.e. particle size distribution and percent solids). A copy of the simulation is provided in Appendix E. It should be noted that the average percent solids for the RD1 samples for the entire observed period were 8.34 (by weight) and 3.44 (by volume); therefore, the achievable percent solids for the underflow may be less than indicated in the above table.

Based on the above analysis, the hydrocyclone would be expected to generally achieve the same results as the Rim Ditch. Under this scenario, the underflow would be directed to a storage area for further dewatering and the overflow would be directed to the Rim Ditch for further clarification ultimately discharging to the Sluice Trench. Accumulated solids in the Rim Ditch (associated with the overflow) would be mechanically dredged using backhoes. The advantages for this system are as follows:

- Significantly reduces mechanical dredging of the Rim Ditch.

- Increases the maximum dredge flow rate (Q_D) (reference Section 4.1) from 11.85 MGD to approximately 15 MGD since only the overflow (or 77 percent of the total flow) is directed to the Rim Ditch. This would allow three dredges to operate approximately 21 hrs per day at a production rate of 4,000 gpm per dredge rather than 16.5 hrs per day.

Directing the dredge flow to hydrocyclones would require approximately 23 cyclones per dredge (or a total of 69 cyclones). Generally, the cyclones would be mounted to a central distribution stand in a 23-cyclone circular configuration. Additionally, strainers would be required upstream of each distribution stand to remove any gravel greater than 0.75-inches. The expected capital costs associated with this system are summarized below in Table 16.

Table 16 – Dredge Slurry Hydrocyclone System Capital Costs

	Number	Unit Cost	Total Cost
Hydrocyclones	69	$5,000	$345,000
Hydrocyclone Distribution Stands	3	$200,000	$600,000
Strainers	3	$15,000	$45,000
TOTAL	NA	NA	$990,000

5.1.2 Pumping Rim Ditch Slurry to Hydrocyclone(s)

Projected operating parameters for a hydrocyclone processing the Rim Ditch slurry are summarized below in Table 17.

Table 17 – Projected Hydrocyclone Parameters for Rim Ditch Slurry

Parameter	Influent	Overflow	Underflow
Percent Solids (by Weight)	35	28.1	55
Percent Solids (by Volume)	16.9	12.9	31.6

Flow, gpm	200	160	43.1

The simulation was provided by Krebs based on a data provided for an RD3 sample (i.e. particle size distribution and percent solids). A copy of the simulation is provided in Appendix E. It should be noted that the average percent solids for the Rim Ditch slurry for the entire observed period were 27.16 (by weight) and 12.98 (by volume); therefore, the achievable percent solids for the underflow may be less than indicated in the above table.

Under this scenario, the ash slurry accumulated in the Rim Ditch would be pumped to hydrocyclones rather than being removed by mechanical dredging (using backhoes). The underflow would be directed to a storage area for further dewatering and the overflow would be directed back to the Rim Ditch for further clarification ultimately discharging to the Sluice Trench. The advantage of this system would be the elimination of mechanical dredging of the Rim Ditch.

As indicated in Section 4.5, the projected accumulation rate for the Rim Ditch slurry associated with a dredge slurry flow rate of 11.85 MGD is approximately 8,900 cubic yards per day (or approximately 2,500 gpm) assuming 40 percent solids by weight. Therefore, approximately 14 hydrocyclones would be required to process the Rim Ditch slurry. Generally, the cyclones would be mounted to a single central distribution stands with the cyclones in a circular configuration. The expected capital costs associated with this system would be as follow:

Table 18 – Rim Ditch Slurry Hydrocyclone System Capital Costs

	Number	Unit Cost	Total Cost
Hydrocyclones	14	$5,000	$70,000
Hydrocyclone Distribution Stands	1	$200,000	$200,000
TOTAL	NA	NA	$270,000

This configuration would also require submersible pump(s) positioned in the Rim Ditch to pump the slurry to the hydrocyclones.

To evaluate the performance of a hydrocyclone in processing/dewatering the Rim Ditch slurry, HHS conducted a pilot test of a single Krebs model GMAXU-3340 Hydrocyclone on 29 April, 2009. For the pilot test, a submersible pump was lowered into the Rim Ditch approximately 5-feet below the water surface near sample location RD4 and provided a flow rate of approximately 180 gpm to the hydrocyclone inlet (as measured by a clamp-on Doppler flow meter). The overflow was directed back to the Rim Ditch and the underflow was discharged to the ground. Inlet (FEED_01), underflow (UNDERFLOW_01, UNDERFLOW_02, and UNDERFLOW_03), and overflow (OVERFLOW_01 and OVERFLOW_02) samples were collected and analyzed for Percent Solids (by weight) and GSA. The analytical data is provided in Appendix F; the averages for the Percent Solids analyses are summarized below in Table 19.

Table 19 – Measured Hydrocyclone Parameters for Rim Ditch Slurry

Parameter	Influent	Overflow	Underflow
Percent Solids (by Weight)	40	37.8	57.9
Flow, gpm	180	134	35

The pilot test results indicate that the hydrocyclone generally performed within the parameters provided in Table 17.

Grain size distribution curves for the inlet, overflow, and underflow samples are provided below as Figure 4.

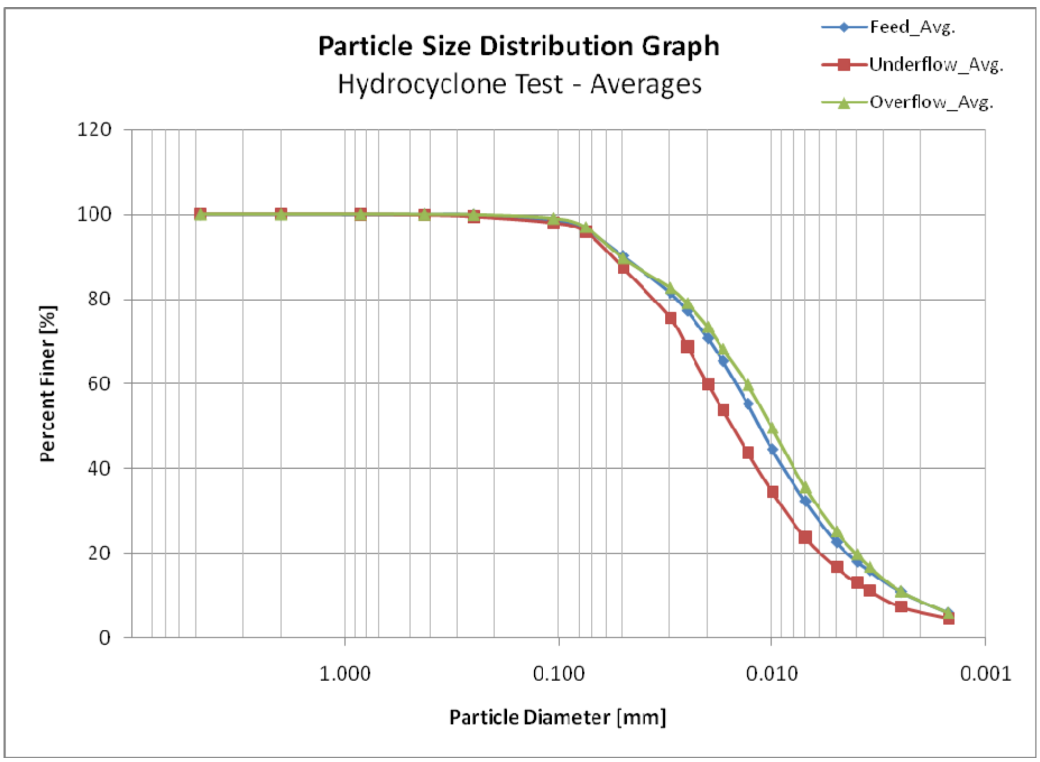

Figure 4: Grain Size Distribution for Hydrocyclone Influent/Feed, Underflow, and Overflow

5.2 Geotextile Bags

Geotextile Bags, commonly referred to as geotubes, are large bags constructed of synthetic fabric that can be used to dewater solids slurry. Slurry is pumped into the bag where solids are trapped and water is decanted through the fabric. As the slurry in a bag is dewatered, additional slurry should be pumped into the bag. This continues until the bag is filled with solids.

To evaluate the dewatering performance of geotextile bags, HHS conducted a pilot test using two Maccaferri MacTube MTOS400. The bag is 50-feet long, has a 30-foot circumference and would be approximately 5-foot high filled, containing a volume of approximately 130 cubic yards. On April 29th, a geotube (designated GEOTUBE_01) was filled to a height of approximately 5-feet with the hydrocyclone pilot test overflow (reference Section 5.2); a second geotube (designated GEOTUBE_02), was filled to a height of approximately two feet with Rim Ditch slurry using the hydrocyclone pilot test submersible pump (reference Section 5.2). Core samples were then obtained from each geotube after 24 hours, 48 hours, and 96 hours and analyzed for water content in accordance with ASTM D2216. The analytical data is provided in Appendix F; the analytical results are summarized below in Table 20.

Table 20 – Measured Geotube Dewatering Performance

Geotube ID	Percent Solids Content (by Weight)			
	Initial	**24 hours**	**48 hours**	**96 hours**
GEOTUBE_01	[1]40	47	47	43
GEOTUBE_02	[2]37.8	49	43	46

Notes:
1. Rim Ditch slurry/hydrocyclone influent percent solids (by weight) (reference Table 19).
2. Hydrocyclone overflow percent solids (by weight) (reference Table 19).

The most likely scenario for the use of geotubes would be to pump the Rim Ditch slurry to a geotube for additional dewatering. However, given that only 43 to 46 percent solids content was achieved after 4 days, this option appears impractical. Even assuming that 70 percent solids content could be achieved after 4 days and that the bags would be refilled once, more than 400 active bags could be required on-site at any given time. Given the dimensions of the bags, this would require geotubes lined up along the entire length of the Rim Ditch, 3 bags deep (or an area approximately 1,800-feet long by 175-feet wide).

The Appendices to Attachment 3, "Fly Ash Separation Performance Analysis Report" are posted to following ftp site under the folder entitled "Dredge Plan".

ftp://TVA:5o5zMIBo@ftp.jacobs.com

ATTACHMENT 4

Global Stability Evaluation of sheet Pile Wall
TVA Kingston Fossil Plant – Rim Ditch Dredging Support
July 17, 2009
(separate file attached)

ATTACHMENT 5

Cantilevered Sheet Piling Design Calculations
“Rim Ditch” Dredge Support
July 17, 2009
(separate file attached)

ATTACHMENT 6

Access Channel Construction and Debris Removal Operations Work Plan
(separate file attached)

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TABLE 21 - Rim Ditch & Sluice Trench Water Analysis Summary

Dredging Production Time and Rim Ditch Analytical Data – Sample RD1

Date	[1]Dredging Production Time [min/day] Emory	Clyde	Luzon	[2]TVA	[2]Total	Sample RD1 Turbidity [NTU]	TSS [mg/L]	% Solid (by Wt)	% Solids (by Vol)
03/21/09	455	0	0	N	455	> 1,100	77,114	7.71	3.06
03/23/09	385	0	0	N	385	> 1,100	63,883	6.39	3.06
03/24/09	490	0	0	N	490	> 1,100	110,148	11.01	4.46
03/25/09	526	0	0	N	526	> 1,100	143,821	14.38	5.96
03/26/09	495	0	0	N	495	> 1,100	115,370	11.54	4.69
03/27/09	370	0	0	N	370	> 1,100	NC	NC	NC
03/28/09	250	0	0	N	250	> 1,100	NC	NC	NC
03/30/09	75	336	0	N	411	> 1,100	30,405	3.04	1.17
03/31/09	535	630	0	N	1,165	> 1,100	66,926	6.69	2.64
04/01/09	335	505	0	N	840	> 1,100	97,285	9.73	3.91
04/02/09	0	490	0	N	490	> 1,100	10,640	1.06	0.40
04/03/09	243	540	0	N	783	> 1,100	27,564	2.76	1.06
04/04/09	715	460	0	N	1,175	> 1,100	85,806	8.58	3.42
04/06/09	1,068	1,152	197	N	2,417	> 1,100	110,178	11.02	4.46
04/07/09	768	700	568	N	2,036	> 1,100	27,251	2.73	1.05
04/08/09	1,171	1,000	421	N	2,592	> 1,100	71,773	7.18	2.84
04/09/09	1,440	317	475	N	2,232	> 1,100	93,812	9.38	3.76
04/10/09	330	-	-	N	330	> 1,100	62,604	6.26	2.46
04/13/09	797	947	145	N	1,889	> 1,100	25,387	2.54	0.97
04/14/09	1,013	1,190	675	N	2,878	> 1,100	27,441	2.75	1.06
04/15/09	1,165	1,230	425	N	2,820	> 1,100	66,037	6.60	2.60
04/16/09	1,213	1,000	145	N	2,358	> 1,100	30,876	3.09	1.19
04/17/09	1,193	1,200	420	N	2,813	> 1,100	30,706	3.07	1.18
04/18/09	1,343	840	625	N	2,808	> 1,100	83,418	8.34	3.32
04/20/09	1,230	1,370	1,127	N	3,727	> 1,100	86,133	8.61	3.43
04/21/09	1,290	1,210	916	N	3,416	> 1,100	146,404	14.64	6.08
04/22/09	1,223	1,200	904	N	3,327	> 1,100	83,671	8.37	3.33
04/23/09	590	1,180	400	N	2,170	> 1,100	161,562	16.16	6.78
04/24/09	975	1,015	825	Y	2,815	> 1,100	80,407	8.04	3.19
04/27/09	390	1,045	791	Y	2,226	> 1,100	134,456	13.45	5.54
04/28/09	1,065	1,335	960	Y	3,360	> 1,100	92,128	9.21	3.69
04/29/09	610	665	600	Y	1,875	> 1,100	206,377	20.64	8.94
05/05/09	0	0	0	Y	0	> 1,100	79,972	8.00	3.18
05/07/09	45	915	720	Y	1,680	> 1,100	169,392	16.94	7.15
AVG Values	**700**	**681**	**344**				**84,342**	**8.43**	**3.44**
TOTAL	**23,793**	**22,472**	**11,339**						
MAX Values	**1,440**	**1,370**	**1,127**				**206,377**	**20.64**	**8.94**
MIN Values	**0**	**0**	**0**				**10,640**	**1.06**	**0.40**
STD DEV	**436**	**483**	**367**				**47,403**	**4.74**	**2.03**

Rim Ditch Analytical Data – Samples RD2 and RD3

Date	Sample RD2 Turbidity [NTU]	TSS [mg/L]	% Solid (by Wt)	% Solids (by Vol)	[3]Percent Solids Removed	Sample RD3 Turbidity [NTU]	TSS [mg/L]	% Solid (by Wt)	% Solids (by Vol)	[3]Percent Solids Removed
03/21/09	> 1,100	945	NC	NC	98.8	693	375	NC	NC	99.5
03/23/09	255	320	NC	NC	99.5	258	316	NC	NC	99.5
03/24/09	890	1,155	NC	NC	99.0	249	212	NC	NC	99.8
03/25/09	> 1,100	2,708	NC	NC	98.1	144	242	NC	NC	99.8
03/26/09	> 1,100	8,768	NC	NC	92.4	> 1,100	347	NC	NC	99.7
03/27/09	67	95	NC	NC	NA	37	73	NC	NC	NA
03/28/09	> 1,100	21,126	NC	NC	NA	161	90	NC	NC	NA
03/30/09	> 1,100	1,970	NC	NC	93.5	129	60	NC	NC	99.8
03/31/09	> 1,100	268,806	26.97	12.23	NA	450	220	26.79	12.13	99.7
04/01/09	NC	NC	NC	NC	NA	> 1,100	1,130	NC	NC	98.8
04/02/09	> 1,100	11,502	1.15	0.44	NA	> 1,100	9,637	1.00	0.38	9.4
04/03/09	> 1,100	3,848	0.34	0.13	86.0	232	506	NC	NC	98.2
04/04/09	> 1,100	348,343	34.84	16.79	NA	196	163	NC	NC	99.8
04/06/09	> 1,100	87,006	8.70	3.47	21.0	494	690	NC	NC	99.4
04/07/09	> 1,100	36,669	3.67	1.42	NA	295	406	NC	NC	98.5
04/08/09	> 1,100	22,483	2.25	0.86	68.7	215	620	NC	NC	99.1
04/09/09	> 1,100	348,430	34.84	16.79	NA	> 1,100	330,680	33.07	15.71	NA
04/10/09	> 1,100	385,173	38.52	19.12	NA	> 1,100	383,145	38.31	18.99	NA
04/13/09	> 1,100	5,239	NC	NC	79.4	957	1,500	NC	NC	94.1
04/14/09	> 1,100	55,378	5.55	2.17	NA	> 1,100	9,400	1.06	0.40	65.7
04/15/09	> 1,100	114,785	11.48	4.66	NA	> 1,100	4,265	NC	NC	93.5
04/16/09	> 1,100	371,068	37.11	18.21	NA	> 1,100	1,256	NC	NC	95.9
04/17/09	> 1,100	330,084	33.01	15.68	NA	> 1,100	356,428	35.64	17.29	NA
04/18/09	> 1,100	336,558	33.66	16.07	NA	> 1,100	320,483	32.05	15.11	NA
04/20/09	NC	NC	NC	NC	NA	> 1,100	414,600	33.68	16.08	NA
04/21/09	> 1,100	233,104	23.31	10.29	NA	> 1,100	448,095	44.81	23.45	NA
04/22/09	> 1,100	110,899	11.09	4.50	NA	> 1,100	441,648	44.16	22.99	NA
04/23/09	> 1,100	220,787	22.08	9.66	NA	> 1,100	241,193	24.12	10.71	NA
04/24/09	> 1,100	102,958	10.30	4.15	NA	> 1,100	145,827	14.58	6.05	NA
04/27/09	> 1,100	180,231	18.02	7.66	NA	> 1,100	183,177	18.32	7.80	NA
04/28/09	> 1,100	283,936	28.39	13.02	NA	> 1,100	310,984	31.10	14.55	NA
04/29/09	> 1,100	243,499	24.35	10.83	NA	> 1,100	235,299	23.53	10.40	NA
05/05/09	> 1,100	124,507	12.45	5.09	NA	> 1,100	262,363	26.24	11.83	NA
05/07/09	> 1,100	321,415	32.14	15.16	NA	> 1,100	342,572	34.26	16.43	NA
AVG Values		**143,243**	**19.75**	**9.06**	**83.6**		**130,824**	**27.22**	**12.96**	**91.7**
TOTAL										
MAX Values		**385,173**	**38.52**	**19.12**			**448,095**	**44.81**	**23.45**	
MIN Values		**95**	**0.34**	**0.13**			**60**	**1.00**	**0.38**	
STD DEV		**140,304**					**167,259**			

Rim Ditch Analytical Data – Samples RD4 and RD-Flume

Date	Sample RD4 Turbidity [NTU]	TSS [mg/L]	% Solid (by Wt)	% Solids (by Vol)	[3]Percent Solids Removed	Sample RD-Flume Turbidity [NTU]	TSS [mg/L]	% Solid (by Wt)	% Solids (by Vol)	[3]Percent Solids Removed
03/21/09	600	318	NC	NC	99.6	NC	NC	NC	NC	NA
03/23/09	253	175	NC	NC	99.7	NC	NC	NC	NC	NA
03/24/09	299	231	NC	NC	99.8	NC	NC	NC	NC	NA
03/25/09	124	231	NC	NC	99.8	NC	NC	NC	NC	NA
03/26/09	451	935	NC	NC	99.2	NC	NC	NC	NC	NA
03/27/09	30	31	NC	NC	NA	NC	NC	NC	NC	NA
03/28/09	131	80	NC	NC	NA	NC	NC	NC	NC	NA
03/30/09	88	10	NC	NC	100.0	NC	NC	NC	NC	NA
03/31/09	312	140	NC	NC	99.8	NC	NC	NC	NC	NA
04/01/09	> 1,100	1,153	NC	NC	98.8	NC	NC	NC	NC	NA
04/02/09	827	1,337	NC	NC	87.4	NC	NC	NC	NC	NA
04/03/09	407	891	NC	NC	96.8	NC	NC	NC	NC	NA
04/04/09	136	121	NC	NC	99.9	NC	NC	NC	NC	NA
04/06/09	344	610	NC	NC	99.4	NC	NC	NC	NC	NA
04/07/09	262	412	NC	NC	98.5	NC	NC	NC	NC	NA
04/08/09	132	329	NC	NC	99.5	NC	NC	NC	NC	NA
04/09/09	> 1,100	456,973	45.70	24.10	NA	NC	NC	NC	NC	NA
04/10/09	NC	NC	NC	NC	NA	NC	NC	NC	NC	NA
04/13/09	970	1,483	NC	NC	94.2	NC	NC	NC	NC	NA
04/14/09	> 1,100	2,619	NC	NC	90.5	NC	NC	NC	NC	NA
04/15/09	466	722	NC	NC	98.9	NC	NC	NC	NC	NA
04/16/09	741	501	NC	NC	98.4	NC	NC	NC	NC	NA
04/17/09	> 1,100	359,076	35.91	17.45	NA	NC	NC	NC	NC	NA
04/18/09	> 1,100	418,634	41.86	21.37	NA	NC	NC	NC	NC	NA
04/20/09	> 1,100	280,800	25.52	11.45	NA	NC	NC	NC	NC	NA
04/21/09	> 1,100	416,764	41.68	21.24	NA	> 1,100	19,507	1.69	0.65	86.7
04/22/09	> 1,100	432,561	43.26	22.34	NA	> 1,100	17,033	1.52	0.58	79.6
04/23/09	> 1,100	424,263	42.43	21.76	NA	> 1,100	17,178	1.75	0.67	89.4
04/24/09	> 1,100	239,698	23.97	10.63	NA	> 1,100	20,908	2.15	0.82	74.0
04/27/09	> 1,100	173,147	17.31	7.32	NA	> 1,100	90,985	9.10	3.64	32.3
04/28/09	> 1,100	326,883	32.69	15.49	NA	> 1,100	29,339	2.99	1.15	68.2
04/29/09	> 1,100	283,691	28.37	13.00	NA	> 1,100	129,469	12.95	5.31	37.3
05/05/09	> 1,100	309,718	30.97	14.48	NA	160	502	NC	NC	99.4
05/07/09	> 1,100	389,507	38.95	19.40	NA	> 1,100	31,580	3.16	1.22	81.4
AVG Values		**137,092**	**34.51**	**16.93**	**97.8**		**39,611**	**4.41**	**1.76**	**72.0**
TOTAL										
MAX Values		**456,973**	**45.70**	**24.10**			**129,469**	**12.95**	**5.31**	
MIN Values		**10**	**17.31**	**7.32**			**502**	**1.52**	**0.58**	
STD DEV		**179,833**					**42,101**			

Sluice Trench Analytical Data and Dredge Flow

Date	Sample ST1 Turbidity [NTU]	TSS [mg/L]	Sample ST2 Turbidity [NTU]	TSS [mg/L]	Sample ST3 Turbidity [NTU]	TSS [mg/L]	% Solid (by Wt)	% Solids (by Vol)	[4]Dredge Flow to Rim Ditch, [MGD]
03/21/09	NC	NC	96	146	NC	NC	NC	NC	1.82
03/23/09	NC	NC	NC	NC	NC	NC	NC	NC	1.54
03/24/09	NC	NC	NC	NC	NC	NC	NC	NC	1.96
03/25/09	NC	NC	NC	NC	NC	NC	NC	NC	2.10
03/26/09	274	510	33	629	NC	NC	NC	NC	1.98
03/27/09	NC	NC	69	95	NC	NC	NC	NC	1.48
03/28/09	NC	NC	176	191	NC	NC	NC	NC	1.00
03/30/09	476	1,424	238	342	NC	NC	NC	NC	1.64
03/31/09	575	1,384	103	131	NC	NC	NC	NC	4.66
04/01/09	522	880	100	141	NC	NC	NC	NC	3.36
04/02/09	585	990	125	168	NC	NC	NC	NC	1.96
04/03/09	445	851	38	51	NC	NC	NC	NC	3.13
04/04/09	478	794	65	100	NC	NC	NC	NC	4.70
04/06/09	668	1,267	267	305	NC	NC	NC	NC	9.67
04/07/09	643	1,293	166	177	NC	NC	NC	NC	8.14
04/08/09	569	1,160	77	91	84	135	NC	NC	10.37
04/09/09	426	929	146	214	85	133	NC	NC	8.93
04/10/09	781	1,524	85	153	130	182	NC	NC	1.32
04/13/09	603	1,208	65	101	79	120	NC	NC	7.56
04/14/09	737	1,410	65	92	101	162	NC	NC	11.51
04/15/09	705	1,267	170	184	568	1,578	NC	NC	11.28
04/16/09	809	1,364	424	287	419	367	NC	NC	9.43
04/17/09	839	1,663	173	348	193	356	NC	NC	11.25
04/18/09	906	1,789	159	165	136	127	NC	NC	11.23
04/20/09	771	1,505	128	184	125	305	NC	NC	14.91
04/21/09	1,028	2,263	259	387	264	412	NC	NC	13.66
04/22/09	745	1,586	191	220	183	257	NC	NC	13.31
04/23/09	> 1,100	2,315	317	477	181	291	NC	NC	8.68
04/24/09	945	2,056	62	78	91	152	NC	NC	11.26
04/27/09	> 1,100	3,940	136	392	125	380	NC	NC	8.90
04/28/09	554	1,422	184	372	> 1,100	4,406	0.47	0.18	13.44
04/29/09	> 1,100	2,725	298	684	> 1,100	64,066	6.21	2.44	7.50
05/05/09	606	1,270	250	330	328	563	NC	NC	0.00
05/07/09	> 1,100	2,477	45	144	104	348	NC	NC	6.72
AVG Values	**654**	**1,545**	**152**	**238**	**188**	**3,913**			**6.78**
TOTAL									**230.42**
MAX Values		**3,940**		**684**		**64,066**	**6.21**	**2.44**	
MIN Values		**510**		**51**		**120**	**0.47**	**0.18**	
STD DEV		**703**		**157**		**14,600**			

NOTES:

1. Dredging Production Time [min/day] obtained from "Trans Ash Running Dredge Report" (supplied by Trans Ash)
2. Operation of the TVA dredge (which pumped ash dredge from the settling pond to the rim ditch) is indicated by "Y" for yes and "N" for no; total dredge minutes and the flow rate to the rim ditch does not account for the TVA dredge.
3. Percent solids removed = [1-(RD1 TSS / RDN TSS)]; where RDN corresponds to RD2, RD3, RD4, or RD Flume, as applicable. For RD1, RD2, RD3, and RD4, "NA" generally indicates that an ash slurry had accumulated in the rim ditch to within 2-feet of the surface; therefore, the sampling collected was representative of the ash slurry rather than the rim ditch surface water
4. Dredge Flow Rate to Rim Ditch, MGD = (4,000 gal/min) x (Total Dredge time, min) / 1,000,000.
5. NC: Not Conducted.
6. NA: Available data does not allow for an accurate estimate.

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TABLE 22 - Rim Ditch & Sluice Trench Production Summary

Date	[1]Dredging Production Time [min/day] Emory	Clyde	Luzon	[2]TVA	[2]Total	RIM DITCH ANALYTICAL DATA: Sample RD1 Turbidity [NTU]	RD1 TSS [mg/L]	RD1 % Solid (by Wt)	RD1 % Solids (by Vol)	Sample RD4 Turbidity [NTU]	RD4 TSS [mg/L]	RD4 % Solid (by Wt)	RD4 % Solids (by Vol)	RD4 [3]Percent Solids Removed	Sample RD-Flume Turbidity [NTU]	RD-Flume TSS [mg/L]	RD-Flume % Solid (by Wt)	RD-Flume % Solids (by Vol)	RD-Flume [3]Percent Solids Removed	[4]Dredge Flow to Rim Ditch, [MGD]	[5]Ash/Solids Production Rate, [MLbs Ash/day]	[6,7]Ash Slurry Deposited in Rim Ditch, [CY/day]	[8,9]Ash/Solids Entering Sluice Trench from Rim Ditch, [MLbs/day]	[10]Ash Slurry Deposited in Sluice Trench, [CY/day]
03/21/09	455	0	0	N	455	> 1,100	77,114	7.71	3.06	600	318	NC	NC	99.6	NC	NC	NC	NC	NA	1.82	1.21	2,190	0.005	8.8
03/23/09	385	0	0	N	385	> 1,100	63,883	6.39	3.06	253	175	NC	NC	99.7	NC	NC	NC	NC	NA	1.54	1.02	1,856	0.002	4.1
03/24/09	490	0	0	N	490	> 1,100	110,148	11.01	4.46	299	231	NC	NC	99.8	NC	NC	NC	NC	NA	1.96	1.90	3,444	0.004	6.9
03/25/09	526	0	0	N	526	> 1,100	143,821	14.38	5.96	124	231	NC	NC	99.8	NC	NC	NC	NC	NA	2.10	2.72	4,943	0.004	7.4
03/26/09	495	0	0	N	495	> 1,100	115,370	11.54	4.69	451	935	NC	NC	99.2	NC	NC	NC	NC	NA	1.98	2.01	3,637	0.015	28.1
03/27/09	370	0	0	N	370	> 1,100	NC	NC	NC	30	31	NC	NC	NA	NC	NC	NC	NC	NA	1.48	NA	NA	NA	NA
03/28/09	250	0	0	N	250	> 1,100	NC	NC	NC	131	80	NC	NC	NA	NC	NC	NC	NC	NA	1.00	NA	NA	NA	NA
03/30/09	75	336	0	N	411	> 1,100	30,405	3.04	1.17	88	10	NC	NC	100.0	NC	NC	NC	NC	NA	1.64	0.42	759	0.000	0.2
03/31/09	535	630	0	N	1,165	> 1,100	66,926	6.69	2.64	312	140	NC	NC	99.8	NC	NC	NC	NC	NA	4.66	2.67	4,847	0.005	9.9
04/01/09	335	505	0	N	840	> 1,100	97,285	9.73	3.91	> 1,100	1,153	NC	NC	98.8	NC	NC	NC	NC	NA	3.36	2.85	5,126	0.032	58.8
04/02/09	0	490	0	N	490	> 1,100	10,640	1.06	0.40	827	1,337	NC	NC	87.4	NC	NC	NC	NC	NA	1.96	0.17	271	0.022	39.8
04/03/09	243	540	0	N	783	> 1,100	27,564	2.76	1.06	407	891	NC	NC	96.8	NC	NC	NC	NC	NA	3.13	0.72	1,268	0.023	42.3
04/04/09	715	460	0	N	1,175	> 1,100	85,806	8.58	3.42	136	121	NC	NC	99.9	NC	NC	NC	NC	NA	4.70	3.49	6,338	0.005	8.6
04/06/09	1,068	1,152	197	N	2,417	> 1,100	110,178	11.02	4.46	344	610	NC	NC	99.4	NC	NC	NC	NC	NA	9.67	9.35	16,931	0.049	89.5
04/07/09	768	700	568	N	2,036	> 1,100	27,251	2.73	1.05	262	412	NC	NC	98.5	NC	NC	NC	NC	NA	8.14	1.85	3,325	0.028	50.9
04/08/09	1,171	1,000	421	N	2,592	> 1,100	71,773	7.18	2.84	132	329	NC	NC	99.5	NC	NC	NC	NC	NA	10.37	6.38	11,573	0.028	51.8
04/09/09	1,440	317	475	N	2,232	> 1,100	93,812	9.38	3.76	> 1,100	456,973	45.70	24.10	NA	NC	NC	NC	NC	NA	8.93	7.28	NA	NA	NA
04/10/09	330	-	-	N	330	> 1,100	62,604	6.26	2.46	NC	NC	NC	NC	NA	NC	NC	NC	NC	NA	1.32	0.70	NA	NA	NA
04/13/09	797	947	145	N	1,889	> 1,100	25,387	2.54	0.97	970	1,483	NC	NC	94.2	NC	NC	NC	NC	NA	7.56	1.59	2,725	0.093	170.0
04/14/09	1,013	1,190	675	N	2,878	> 1,100	27,441	2.75	1.06	> 1,100	2,619	NC	NC	90.5	NC	NC	NC	NC	NA	11.51	2.65	4,358	0.251	457.5
04/15/09	1,165	1,230	425	N	2,820	> 1,100	66,037	6.60	2.60	466	722	NC	NC	98.9	NC	NC	NC	NC	NA	11.28	6.36	11,453	0.068	123.6
04/16/09	1,213	1,000	145	N	2,358	> 1,100	30,876	3.09	1.19	741	501	NC	NC	98.4	NC	NC	NC	NC	NA	9.43	2.43	4,360	0.039	71.7
04/17/09	1,193	1,200	420	N	2,813	> 1,100	30,706	3.07	1.18	> 1,100	359,076	35.91	17.45	NA	NC	NC	NC	NC	NA	11.25	2.88	NA	NA	NA
04/18/09	1,343	840	625	N	2,808	> 1,100	83,418	8.34	3.32	> 1,100	418,634	41.86	21.37	NA	NC	NC	NC	NC	NA	11.23	8.09	NA	NA	NA
04/20/09	1,230	1,370	1,127	N	3,727	> 1,100	86,133	8.61	3.43	> 1,100	280,800	25.52	11.45	NA	NC	NC	NC	NC	NA	14.91	11.09	NA	NA	NA
04/21/09	1,290	1,210	916	N	3,416	> 1,100	146,404	14.64	6.08	> 1,100	416,764	41.68	21.24	NA	> 1,100	19,507	1.69	0.65	86.7	13.66	18.01	28,432	2.221	4,044.6
04/22/09	1,223	1,200	904	N	3,327	> 1,100	83,671	8.37	3.33	> 1,100	432,561	43.26	22.34	NA	> 1,100	17,033	1.52	0.58	79.6	13.31	9.61	13,936	1.889	3,439.6
04/23/09	590	1,180	400	N	2,170	> 1,100	161,562	16.16	6.78	> 1,100	424,263	42.43	21.76	NA	> 1,100	17,178	1.75	0.67	89.4	8.68	12.76	20,766	1.243	2,262.6
04/24/09	975	1,015	825	Y	2,815	> 1,100	80,407	8.04	3.19	> 1,100	239,698	23.97	10.63	NA	> 1,100	20,908	2.15	0.82	74.0	11.26	7.79	10,495	1.962	3,572.4
04/27/09	390	1,045	791	Y	2,226	> 1,100	134,456	13.45	5.54	> 1,100	173,147	17.31	7.32	NA	> 1,100	90,985	9.10	3.64	32.3	8.90	10.70	6,297	6.751	12,293.1
04/28/09	1,065	1,335	960	Y	3,360	> 1,100	92,128	9.21	3.69	> 1,100	326,883	32.69	15.49	NA	> 1,100	29,339	2.99	1.15	68.2	13.44	10.75	13,346	3.286	5,983.4
04/29/09	610	665	600	Y	1,875	> 1,100	206,377	20.64	8.94	> 1,100	283,691	28.37	13.00	NA	> 1,100	129,469	12.95	5.31	37.3	7.50	14.54	9,866	8.092	14,734.5
05/05/09	0	0	0	Y	0	> 1,100	79,972	8.00	3.18	> 1,100	309,718	30.97	14.48	NA	160	502	NC	NC	99.4	0.00	0.00	0	0.000	0.0
05/07/09	45	915	720	Y	1,680	> 1,100	169,392	16.94	7.15	> 1,100	389,507	38.95	19.40	NA	> 1,100	31,580	3.16	1.22	81.4	6.72	10.42	15,435	1.768	3,220.2

	Emory	Clyde	Luzon	RD1 TSS	RD1 % Solid (by Wt)	RD1 % Solids (by Vol)	RD4 TSS	RD4 % Solid (by Wt)	RD4 % Solids (by Vol)	RD4 Percent Solids Removed	RD-Flume TSS	RD-Flume % Solid (by Wt)	RD-Flume % Solids (by Vol)	RD-Flume Percent Solids Removed	Dredge Flow	Ash/Solids Production Rate	Ash Slurry Deposited in Rim Ditch	Ash/Solids Entering Sluice Trench	Ash Slurry Deposited in Sluice Trench
AVG Values	**700**	**681**	**344**	**84,342**	**8.43**	**3.44**	**137,092**	**34.51**	**16.93**	**97.8**	**39,611**	**4.41**	**1.76**	**72.0**	**6.78**	**5.45**	**7,703**	**1.03**	**1,881**
TOTAL	**23,793**	**22,472**	**11,339**												**230.42**	**174.40**	**207,978**	**27.89**	**50,780**
MAX Values	**1,440**	**1,370**	**1,127**	**206,377**	**20.64**	**8.94**	**456,973**	**45.70**	**24.10**		**129,469**	**12.95**	**5.31**						
MIN Values	**0**	**0**	**0**	**10,640**	**1.06**	**0.40**	**10**	**17.31**	**7.32**		**502**	**1.52**	**0.58**						
STD DEV	**436**	**483**	**367**	**47,403**	**4.74**	**2.03**	**179,833**				**42,101**								

NOTES:

1. Dredging Production Time [min/day] obtained from "Trans Ash Running Dredge Report" (supplied by Trans Ash)
2. Operation of the TVA dredge (which pumped ash dredge from the settling pond to the rim ditch) is indicated by "Y" for yes and "N" for no; total dredge minutes and the flow rate to the rim ditch does not account for the TVA dredge
3. Percent solids removed = [1-(RD1 TSS / RDN TSS)]; where RDN corresponds to RD2, RD3, RD4, or RD Flume, as applicable. For RD1, RD2, RD3, and RD4, "NA" generally indicates that an ash slurry had accumulated in the rim ditch to within 2-feet of the surface; therefore, the sampling collected was respresentative of the ash slurry rather than the rim ditch surface water
4. Dredge Flow Rate to Rim Ditch, MGD = (4,000 gal/min) x (Total Dredge time, min) / 1,000,000.
5. Solids production rate, MLbs/day = (flow to rim ditch, MGD) x (RD1 % solids by volume) x (2.6 x 8.34 lbs/gal).
6. For 3/21 through 4/20: Ash slurry deposited in Rim Ditch, CY/day = (Ash/Solids production rate, MLbs/day) x (RD4 Percent Solids Removed, %) / (0.2716 lbs ash/lb slurry) / (2,022 lb slurry/CY) x 1,000,000.
7. For 4/21 through 5/7: Ash slurry deposited in Rim Ditch, CY/day = (Ash/Solids production rate, MLbs/day) x (RD Flume Percent Solids Removed, %) / (0.2716 lbs ash/lb slurry) / (2,022 lb slurry/CY) x 1,000,000.
8. For 3/21 through 4/20: Ash/solids entering the sluice trench, MLbs/day = (RD1 TSS mg/L) x (1-RD4 removal rate, %) / (1,000,000 mg/Kg) x (2.2 Kg/lb) / (0.264 gal/L) x (Flow to rim ditch, MGD).
9. For 4/21 through 5/7: Ash/solids entering the sluice trench, MLbs/day = (RD Flume TSS mg/L) / (1,000,000 mg/Kg) x (2.2 Kg/lb) / (0.264 gal/L) x (Flow to rim ditch, MGD).
10. Ash slurry deposited in sluice trench, CY/day = (Ash/Solids entering sluice trench, MLbs/day) / (0.2716 lbs ash/lb slurry) / (2,022 lb slurry/CY) x 1,000,000.
11. NC: Not Conducted.
13. NA: Available data does not allow for an accurate estimate.

Geosyntec consultants

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Memorandum

Date: 17 July 2009

To: Mr. Michael Anderson, P.E. – Jacobs
Mr. Mark Glynn, P.E. – Glynn Geotechnical Engineering
Mr. David Pauls, P.E. – U.S. Bureau of Reclamation

From: Robert C. Bachus, Ph.D., P.E. – Geosyntec Consultants

Subject: Global Stability Evaluation of Sheet Pile Wall
TVA Kingston Fossil Plant - Rim Ditch Dredging Support

This memorandum transmits the calculation package consisting of: (i) independent check of the internal stability calculations regarding design of the sheet pile wall along the Rim Ditch at the TVA Kingston Ball Field Site as performed by Glynn Geotechnical Engineering (GGE) dated July 17, 2009; and (ii) global stability analyses performed by Geosyntec.

Geosyntec has independently checked the internal stability calculations provided by GGE using the computer program SPW911 (Version 2.20). Using the same subsurface stratigraphy, material properties, groundwater tables, and sheet pile properties presented in the calculation package prepared by GGE, Geosyntec was able to replicate the results reported by GGE.

Based on the sheet pile lengths calculated by GGE, Geosyntec performed the global stability analyses for the proposed sheet pile wall. The results indicate the calculated values for Factor of Safety (FS) are greater than the target FS value of 1.5 for the global stability of the proposed sheet pile wall under the long-term loading conditions.

* * * * *

Geosyntec consultants

COMPUTATION COVER SHEET

Client: **TVA** Project: **Dredge Cells Recovery** Project/ Proposal No.: Task No. **GR4327**

Title of Computations **Global Stability Analyses for Sheet Pile Wall**

Computations by:	Signature		7/17/09
	Printed Name	Justin Wang	Date
	Title	Project Engineer	
Assumptions and Procedures Checked by: (peer reviewer)	Signature		7/17/09
	Printed Name	Robert C. Bachus	Date
	Title	Principal	
Computations Checked by:	Signature		7/17/09
	Printed Name	Ming Zhu	Date
	Title	Engineer	
Computations backchecked by: (originator)	Signature		7/17/09
	Printed Name	Justin Wang	Date
	Title	Project Engineer	
Approved by: (pm or designate)	Signature		7/17/09
	Printed Name	Robert C. Bachus	Date
	Title	Principal	

ROBERT C. BACHUS REGISTERED ENGINEER AGRICULTURE COMMERCE No. 113195 STATE OF TENNESSEE

Approval notes:

Revisions (number and initial all revisions)

No.	Sheet	Date	By	Checked by	Approval

Written by:	Justin Wang	Date:	07/17/09	Reviewed by:	Ming Zhu / Bob Bachus	Date:	07/17/09
Client:	TVA	Project:	Dredge Cells Recovery	Project/ Proposal No.:	GR4327	Task No.:	105

GLOBAL STABILITY ANALYSES FOR SHEET PILE WALL AT RIM DITCH

PURPOSE

The purpose of this calculation package is to: (i) independently check the internal stability calculations for the proposed sheet pile wall performed by Glynn Geotechnical Engineering (GGE); and (ii) present static global stability analyses for the proposed sheet pile wall designed by GGE.

BACKGROUND

A sheet pile wall is being designed for the existing rim ditch located to the west of the Temporary Ash Storage Site (Ball Field Site). The total length of the rim ditch is approximately 1,800 feet. For design purposes, the rim ditch was divided into 2 sections. The initial 800 feet long section will be used primarily to capture the coarse and fine grained fractions while the following 1,000 feet long section will be needed to capture the fine grained dredged materials. A Komatsu PC-800 excavator was selected by the Contractor to operate in the northern 800 feet section (Section 1), and the southern 1,000 feet section (Section 2).

Based on GGE's sheet pile wall design, for Section 1, the total vertical length of the sheet pile wall was 40 feet and the cantilever portion was 15 feet long. For Section 2, the total vertical length of the sheet pile wall was 25 feet and the cantilever portion was 10 feet long.

INDEPENDENT CHECK

With regarding to the independent verification of the GGE design, Geosyntec provides the following points:

- Assumption: Stratigraphy and subsurface material properties are consistent with recommendations provide to TVA, Jacobs, and GGE on 16 July 2009.

- Water Levels: GGE assumed that water levels in processing area will be maintained at elevation 762.8 feet in Section 1 and elevation 762.6 feet in Section 2. Geosyntec infers that the condition will likely require sumps, trenches, etc. for effective control of water levels beneath and adjacent to the processing area.

- Pile Buck Analyses: Geosyntec has independently checked the internal stability calculations provided by GGE using the computer program SPW911 (Version 2.20). Using the same subsurface stratigraphy, material properties, groundwater tables, and sheet pile properties presented in the calculations by GGE, Geosyntec was able to replicate the results reported by GGE.

- Hand Calculation: GGE provided few pages of hand calculations in support of the design. Geosyntec concurs with GGE calculation regarding vertical stress distribution beneath the mats. With regards to assessing the potential influence of the casting area stockpile on the sheet pile wall design, Geosyntec typically uses a more conservative depth (i.e. M=0) than used by GGE (i.e. P=0). However, Geosyntec concurs with GGE that even at the lower depth of the active wedge, the casting area stockpile anticipated in the design is outside of the zone of influence for the sheet pile wall.

GLOBAL STABILITY ANALYSES METHODOLOGY

Static global stability analyses were performed using Spencer's method [Spencer, 1973], as implemented in the computer program SLIDE, version 5.0 [Rocscience, 2006]. Spencer's method, which satisfies both vertical and horizontal force equilibrium and moment equilibrium, is considered to be more rigorous than other methods, such as the simplified Janbu method [Janbu, 1973] and the simplified Bishop method [Bishop, 1955].

The rotational failure mode was considered in the analyses. The target factor of safety (FS) to be achieved for the long-term condition was 1.5 according to U.S. Army Engineer Waterways Experiment Station Technical Report D-77-9 [Hammer and Blackburn, 1977] and U.S. Army Corps of Engineers Engineering Manual 1110-2-1902 [USACE, 2003].

Information required for the static global stability analyses included the slope geometry, the subsurface soil stratigraphy, the groundwater table elevation, the material properties of the subsurface soils, and the external surface loading, at the selected cross section locations.

SUBSURFACE STRATIGRAPHY & MATERIAL PROPERTIES

Based on review of several soil test borings, the anticipated subsurface conditions and material properties along the rim ditch Section 1 and Section 2 were summarized in Table 1 and Table 2, respectively.

Based on information provided in GGE design package, the elevation of the water level in the rim ditch side was 766.5 feet, 1 foot below the top of the sheet pile wall for both Sections 1 and 2. The elevation of water level on the retaining side was 762.8 feet (or 1.7 ft below the ground) for Section 1 and 762.6 feet (or 1.9 ft below the ground) for Section 2.

ANALYZED CROSS SECTIONS

Two cross sections, Sections 1 and 2, were analyzed for the global stability of the sheet pile wall along the rim ditch. The geometries for Sections 1 and 2 are presented in Figures 1 and 2, respectively.

Based on GGE's calculation results, a surcharge load of 624 pounds per square foot (psf) from the construction equipment will be applied to the ground surface between the sheet pile wall and the bottom of the dredged ash slope. To better understand the influence of the surcharge load to the global stability, Geosyntec has analyzed 2 conditions for each section - with and without surcharge load from the construction equipment.

RESULTS AND CONCLUSIONS

The results of the slope stability analyses are summarized in Table 3 and also shown graphically in Figures 3 through 6. The associated SLIDE input files are presented in Attachment 1 of this calculation package.

Written by:	**Justin Wang**	Date:	**07/17/09**	Reviewed by:	**Ming Zhu / Bob Bachus**	Date:	**07/17/09**
Client:	**TVA**	Project:	**Dredge Cells Recovery**	Project/ Proposal No.:	**GR4327**	Task No.:	**105**

The results indicate that the calculated FS for the condition without the surcharge load from the construction equipment is smaller than that for the condition with the surcharge load.

The results indicate the calculated FSs for all analyzed condition are greater than the target FSs for the global stability of the proposed sheet pile wall under the long-term condition.

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Client:	TVA	Project:	Dredge Cells Recovery	Project/ Proposal No.:	GR4327	Task No.:	105

REFERENCES

Bishop, A., “The Use of the Slip Circle in the Stability Analysis of Slopes,” Geotechnique, Volume 5, No. 1, Jan 1955, pp. 7-17.

Hammer, D.P., and Blackburn, E.D. , “Design and Construction of Retaining Dikes for Containment of Dredged Material”, Technical Report D-77-9, U.S. Army Engineer Water Experiment Station, Vicksburg, Mississippi, August 1977, pp. 93.

Janbu, N., “Slope Stability Computations,” Embankment Dam Engineering, Casagrande Memorial Volume, R. C. Hirschfield and S. J. Poulos, Eds., John Wiley, New York, 1973, pp. 47-86.

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Spencer, E., “The Thrust Line Criterion in Embankment Stability Analysis,” Géotechnique, Vol. 23, No. 1, pp. 85-100, March 1973.

U.S. Army Corps of Engineers (USACE), “Engineering and Design – Slope Stability”, Engineering Manual EM 1110-2-1902, October 2003, pp. 3-2.

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Client:	**TVA**	Project:	**Dredge Cells Recovery**	Project/ Proposal No.:	**GR4327**	Task No.:	**105**

TABLES

Written by:	Justin Wang	Date:	07/17/09	Reviewed by:	Ming Zhu / Bob Bachus	Date:	07/17/09
Client:	TVA	Project:	Dredge Cells Recovery	Project/ Proposal No.:	GR4327	Task No.:	105

Table 1. Summary of Subsurface Stratigraphy and Material Properties for Section 1 (800 feet section)

Material	Layer[(1)]	Unit Weight (pcf)[(2)]	Drained Shear Strength[(2)]
Dredged Ash	above ground surface and 15 feet in height	75	c=0, ϕ = 20^o
Ash Layer 1	ground surface to EL 760 ft	90	c=0, ϕ = 30^o
Ash Layer 2	EL 760 – 735 ft	80	c=0, ϕ = 28^o
Ash Layer 3	EL 735 – 708 ft	80	c=0, ϕ = 25^o

Table 2. Summary of Subsurface Stratigraphy and Material Properties for Section 2 (1000 feet section)

Material	Layer[(1)]	Unit Weight (pcf)[(2)]	Drained Shear Strength[(2)]
Dredged Ash	above ground surface and 15 feet in height	75	c=0, ϕ = 20^o
Ash Layer 1	ground surface to EL 757 ft	90	c=0, ϕ = 30^o
Ash Layer 2	EL 757 – 705 ft	80	c=0, ϕ = 28^o

Notes:

1. Layer stratigraphy based on review of subsurface borings previously advanced in the Ball Field Area for assessment of global stability as an ash stockpile area.
2. Material properties for Material/Layer based on following rationale:
    a. Dredged Ash – low total unit weight and low frictional strength due to high moisture content from casting operation;
    b. Ash Layer 1: - relatively stiff upper portion of area modeled as frictional material to conservatively account for small amount of cohesion;
    c. Ash Layer 2 – layer below crust layer exhibited higher blowcount and CPT tip resistance compared to lower zone and was modeled to reflect measured frictional strength; and
    d. Ash Layer 3 – borings advanced near Section 1 showed zone of low blowcount/CPT resistance and was modeled as a weak frictional material.

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Table 3: Results of Slope Stability Analysis

Section	Surcharge Load	Calculated FS	Target FS	Is FS OK?	Results Shown in Figure
1	Applied	1.86	1.5	Yes	3
1	Not applied	1.75	1.5	Yes	4
2	Applied	2.17	1.5	Yes	5
2	Not Applied	1.91	1.5	Yes	6

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FIGURES

Written by:	**Justin Wang**	Date:	**7/17/09**	Reviewed by:	**Ming Zhu / Bob Bachus**	Date:	**7/17/09**
Client:	**TVA**	Project:	**Dredge Cells Recovery**	Project/ Proposal No.:	**GR4327**	Task No.:	**105**

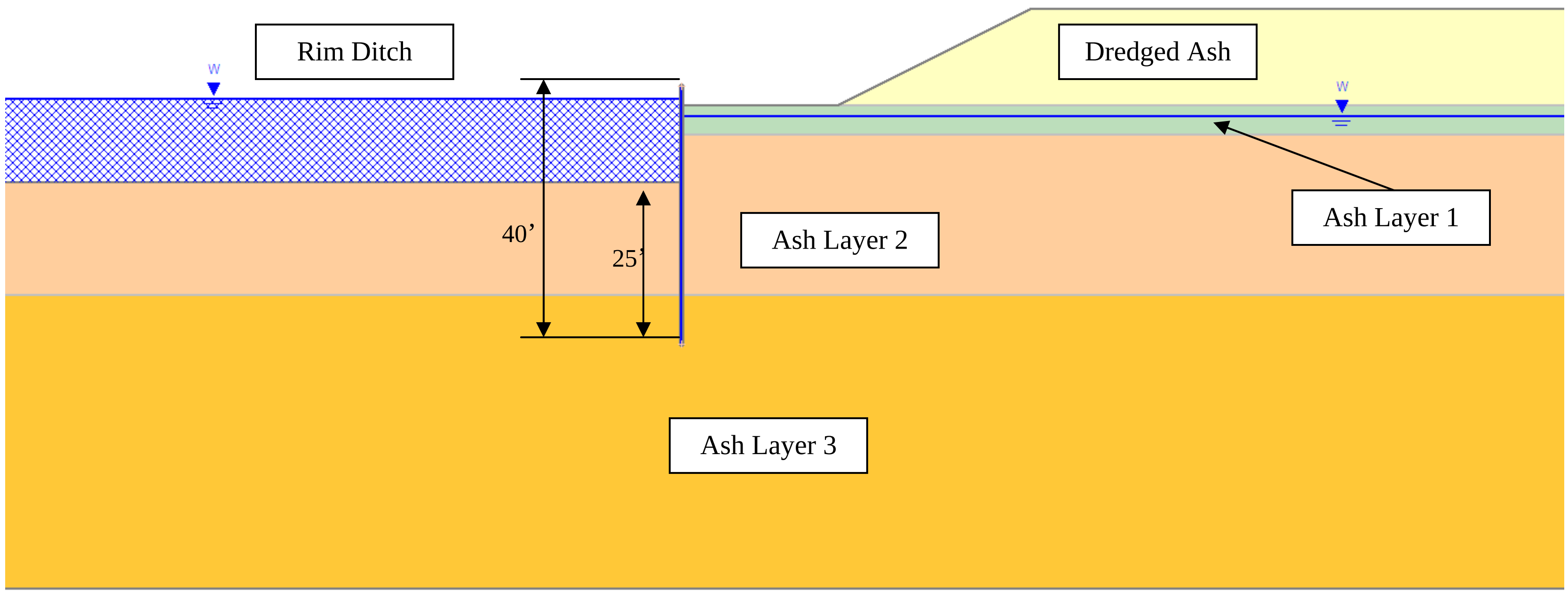

Figure 1. Geometry of Section 1 (800 feet Section)

Written by:	**Justin Wang**	Date:	**7/17/09**	Reviewed by:	**Ming Zhu / Bob Bachus**	Date:	**7/17/09**
Client:	**TVA**	Project:	**Dredge Cells Recovery**	Project/ Proposal No.:	**GR4327**	Task No.:	**105**

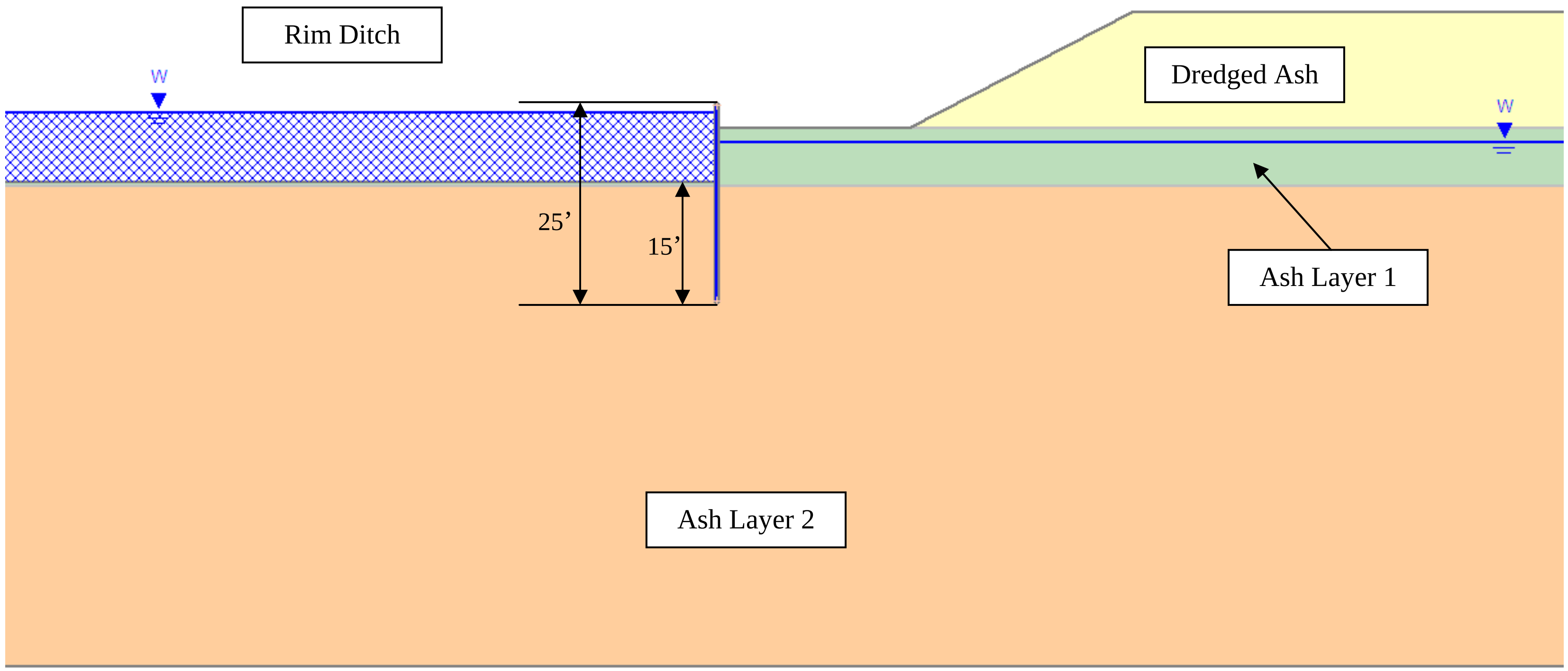

Figure 2. Geometry of Section 2 (1000 feet Section)

Written by:	**Justin Wang**	Date:	**7/17/09**	Reviewed by:	**Ming Zhu / Bob Bachus**	Date:	**7/17/09**
Client:	**TVA**	Project:	**Dredge Cells Recovery**	Project/ Proposal No.:	**GR4327**	Task No.:	**105**

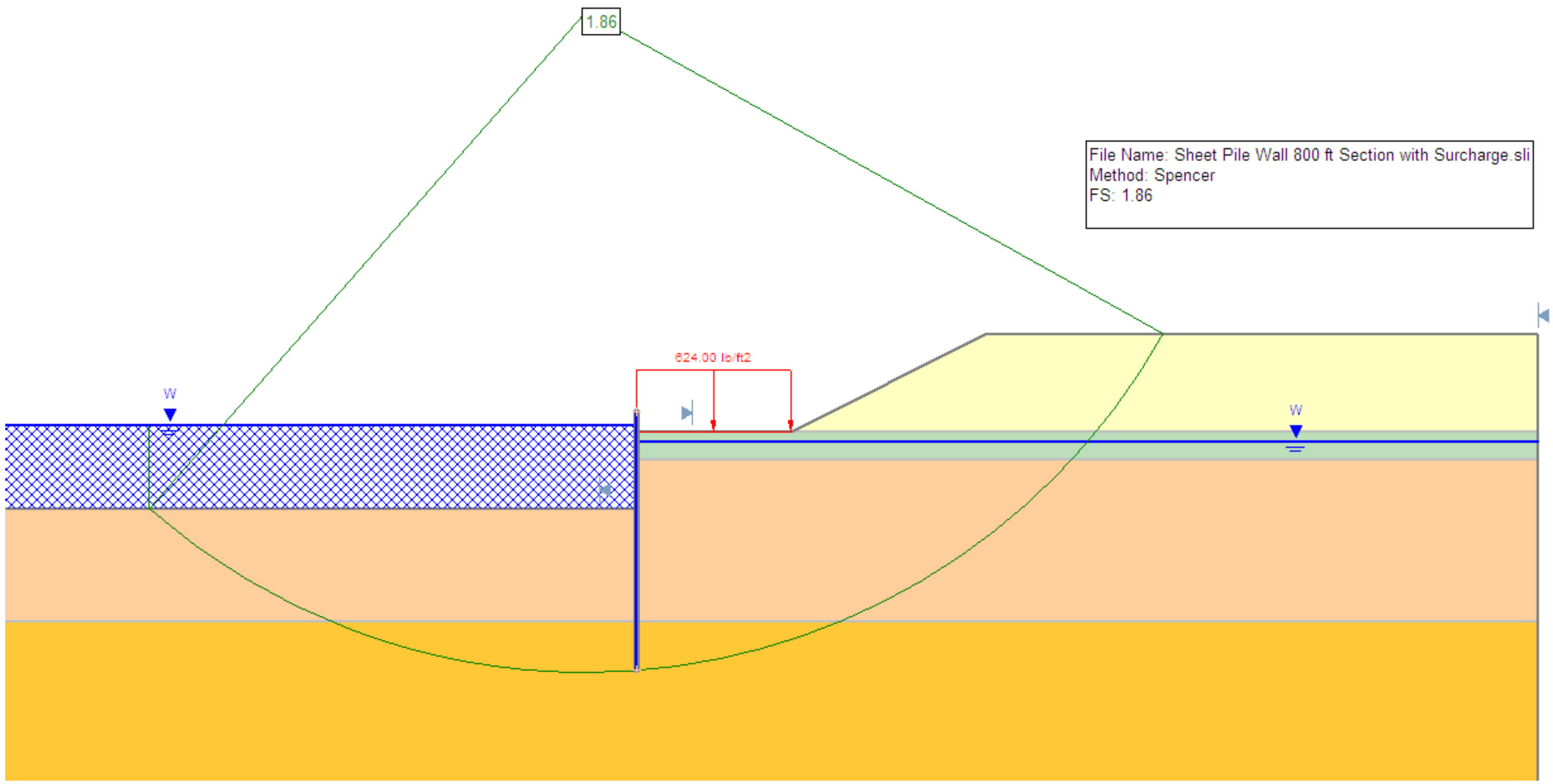

Figure 3. Global Stability Analysis Result for Section 1 with Surcharge

Written by:	**Justin Wang**	Date:	**7/17/09**	Reviewed by:	**Ming Zhu / Bob Bachus**	Date:	**7/17/09**
Client:	**TVA**	Project:	**Dredge Cells Recovery**	Project/ Proposal No.:	**GR4327**	Task No.:	**105**

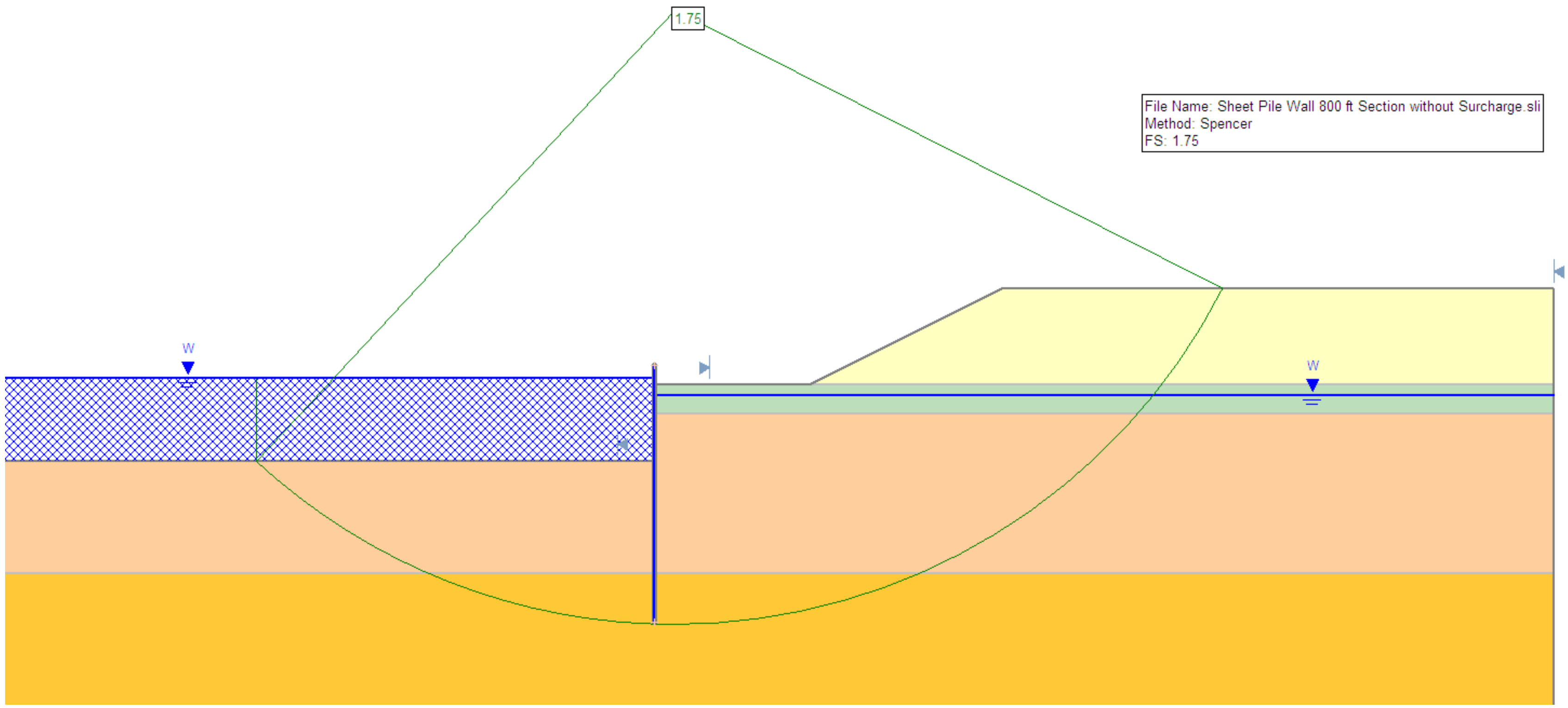

Figure 4. Global Stability Analysis Result for Section 1 without Surcharge

Written by:	**Justin Wang**	Date:	**7/17/09**	Reviewed by:	**Ming Zhu / Bob Bachus**	Date:	**7/17/09**
Client:	**TVA**	Project:	**Dredge Cells Recovery**	Project/ Proposal No.:	**GR4327**	Task No.:	**105**

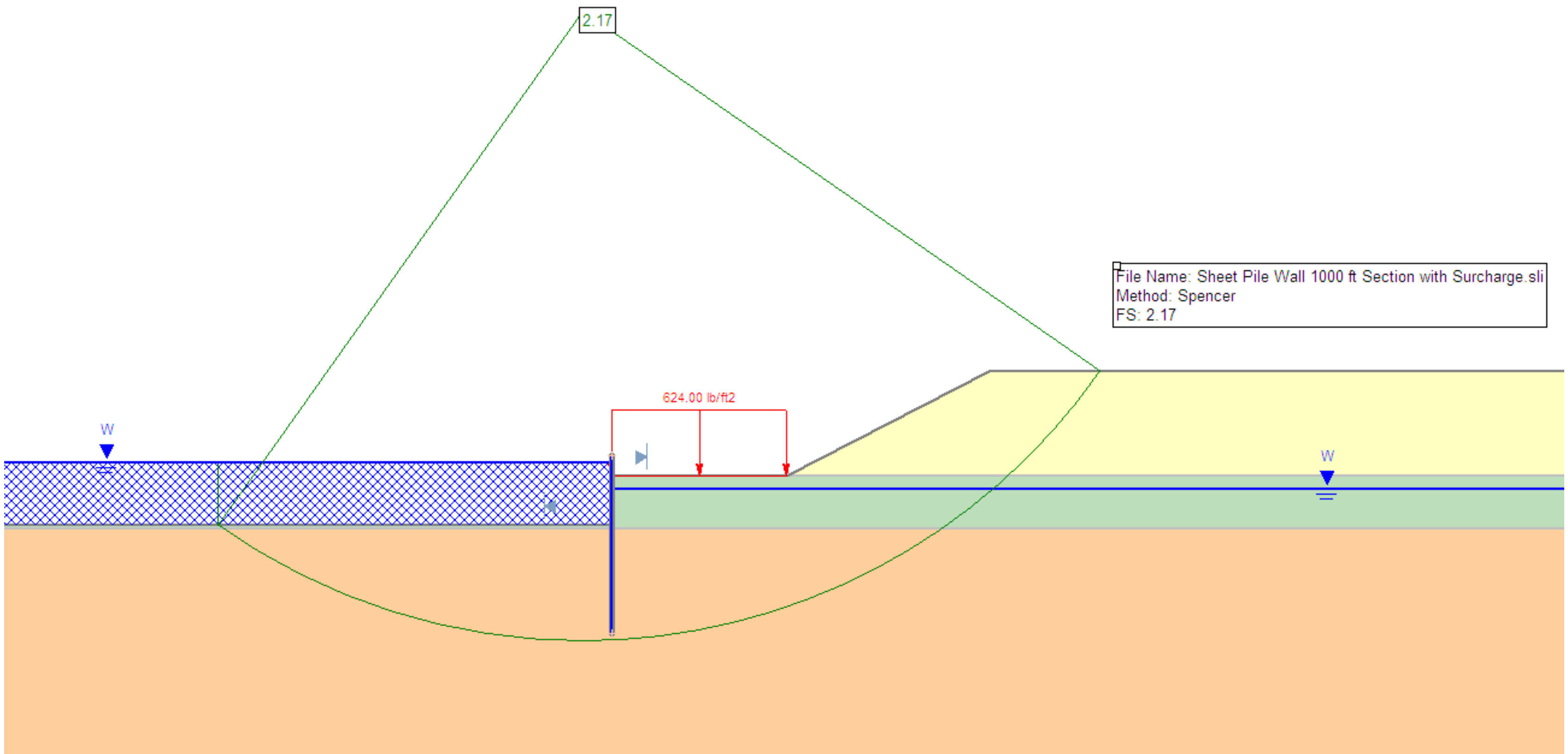

Figure 5. Global Stability Analysis Result for Section 2 with Surcharge

Written by:	**Justin Wang**	Date:	**7/17/09**	Reviewed by:	**Ming Zhu / Bob Bachus**	Date:	**7/17/09**
Client:	**TVA**	Project:	**Dredge Cells Recovery**	Project/ Proposal No.:	**GR4327**	Task No.:	**105**

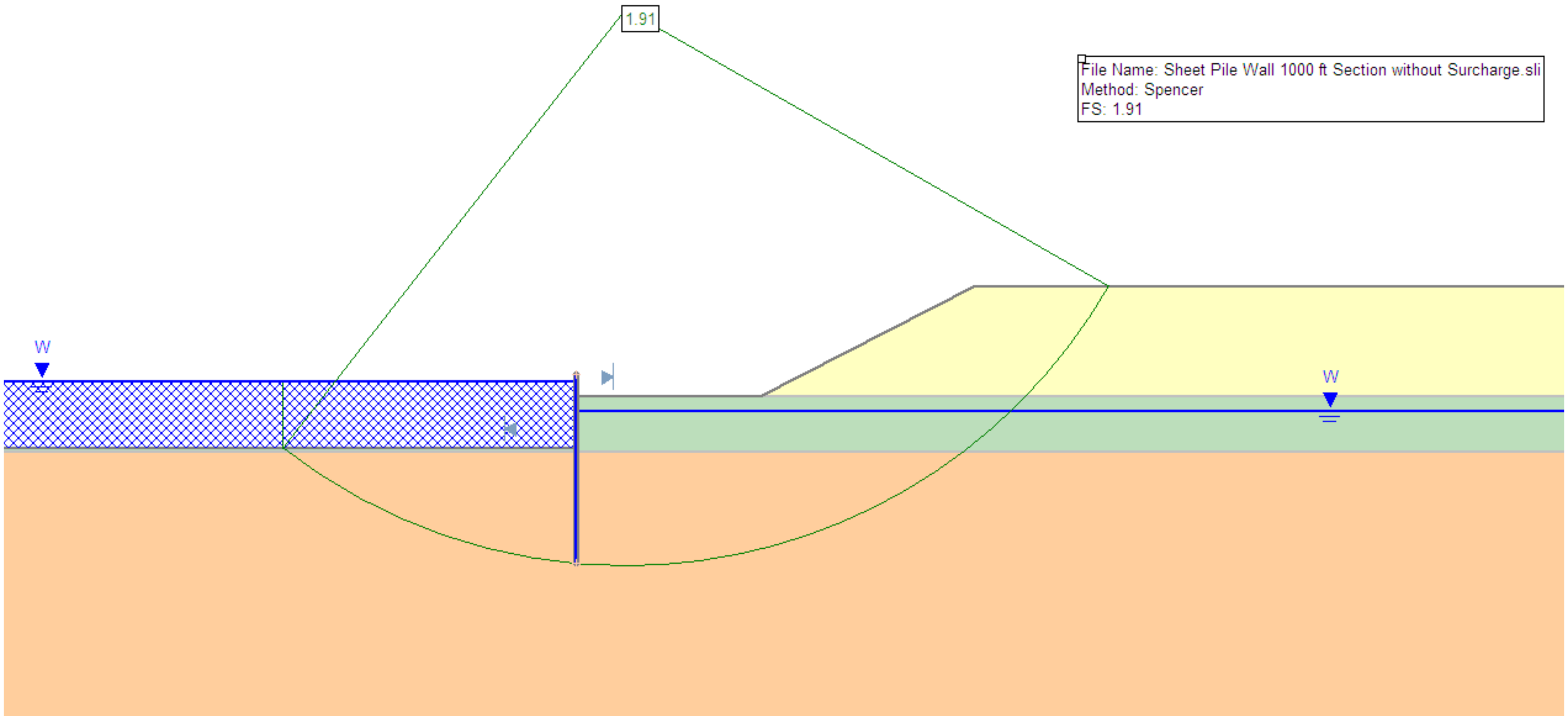

Figure 6. Global Stability Analysis Result for Section 2 without Surcharge

Written by:	**Justin Wang**	Date:	**7/17/09**	Reviewed by:	**Ming Zhu / Bob Bachus**	Date:	**7/17/09**
Client:	**TVA**	Project:	**Dredge Cells Recovery**	Project/ Proposal No.:	**GR4327**	Task No.:	**105**

ATTACHEMENT 1

SLIDE INPUT FILES

Written by:	**Justin Wang**	Date:	**7/17/09**	Reviewed by:	**Ming Zhu / Bob Bachus**	Date:	**7/17/09**
Client:	**TVA**	Project:	**Dredge Cells Recovery**	Project/ Proposal No.:	**GR4327**	Task No.:	**105**

File Name: Sheet Pile Wall 800 ft Section with Surcharge.sli

Written by:	Justin Wang	Date:	7/17/09	Reviewed by:	Ming Zhu / Bob Bachus	Date:	7/17/09
Client:	TVA	Project:	Dredge Cells Recovery	Project/ Proposal No.:	GR4327	Task No.:	105

Slide Analysis Information

Document Name

File Name: Sheet Pile Wall 800 ft Section with Surcharge.sli

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Right to Left
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard
Calculate Excess Pore Pressure: Off
Allow Ru with Water Surfaces or Grids: Off
Random Numbers: Pseudo-random Seed
Random Number Seed: 10116
Random Number Generation Method: Park and Miller v.3

Analysis Methods

Analysis Methods used:
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50

Surface Options

Surface Type: Circular
Search Method: Grid Search
Radius increment: 10
Composite Surfaces: Disabled
Reverse Curvature: Create Tension Crack
Minimum Elevation: Not Defined
Minimum Depth: 10

Loading

1 Distributed Load present:
Distributed Load Constant Distribution, Orientation: Vertical, Magnitude: 624 lb/ft2

Material Properties

Material: Dredged Ash
Strength Type: Mohr-Coulomb
Unit Weight: 75 lb/ft3
Cohesion: 0 psf
Friction Angle: 20 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Ash Layer 1
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 30 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Ash Layer 2
Strength Type: Mohr-Coulomb
Unit Weight: 80 lb/ft3
Cohesion: 0 psf
Friction Angle: 28 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Ash Layer 3
Strength Type: Mohr-Coulomb
Unit Weight: 80 lb/ft3
Cohesion: 0 psf
Friction Angle: 25 degrees
Water Surface: Water Table
Custom Hu value: 1

Written by:	Justin Wang	Date:	7/17/09	Reviewed by:	Ming Zhu / Bob Bachus	Date:	7/17/09
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Support Properties

Support: Support 1
Support 1
Support Type: Micro-Pile
Force Application: Passive
Out-of-Plane Spacing: 1 ft
Pile Shear Strength: 113520 lb

List of All Coordinates

Material Boundary

84.000	75.000
200.000	75.000

Material Boundary

-50.000	45.500
200.000	45.500

Material Boundary

60.000	70.500
200.000	70.500

External Boundary

-50.000	63.000
-50.000	45.500
-50.000	0.000
200.000	0.000
200.000	45.500
200.000	70.500
200.000	75.000
200.000	90.000
114.000	90.000
84.000	75.000
60.000	75.000
60.000	70.500
60.000	63.000

Water Table

-50.000	76.000
60.000	76.000
60.000	73.300
200.000	73.300

Support

60.000	78.000
60.000	38.000

Search Grid

-28.158	45.500
154.361	45.500
154.361	221.071
-28.158	221.071

Distributed Load

60.000	75.000
84.000	75.000

Written by:	**Justin Wang**	Date:	**7/17/09**	Reviewed by:	**Ming Zhu / Bob Bachus**	Date:	**7/17/09**
Client:	**TVA**	Project:	**Dredge Cells Recovery**	Project/ Proposal No.:	**GR4327**	Task No.:	**105**

Written by:	**Justin Wang**	Date:	**7/17/09**	Reviewed by:	**Ming Zhu / Bob Bachus**	Date:	**7/17/09**
Client:	**TVA**	Project:	**Dredge Cells Recovery**	Project/ Proposal No.:	**GR4327**	Task No.:	**105**

File Name: Sheet Pile Wall 800 ft Section without Surcharge.sli

Written by:	Justin Wang	Date:	7/17/09	Reviewed by:	Ming Zhu / Bob Bachus	Date:	7/17/09
Client:	TVA	Project:	Dredge Cells Recovery	Project/ Proposal No.:	GR4327	Task No.:	105

Slide Analysis Information

Document Name

File Name: Sheet Pile Wall 800 ft Section without Surcharge.sli

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Right to Left
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard
Calculate Excess Pore Pressure: Off
Allow Ru with Water Surfaces or Grids: Off
Random Numbers: Pseudo-random Seed
Random Number Seed: 10116
Random Number Generation Method: Park and Miller v.3

Analysis Methods

Analysis Methods used:
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50

Surface Options

Surface Type: Circular
Search Method: Grid Search
Radius increment: 10
Composite Surfaces: Disabled
Reverse Curvature: Create Tension Crack
Minimum Elevation: Not Defined
Minimum Depth: 10

Material Properties

Material: Dredged Ash
Strength Type: Mohr-Coulomb
Unit Weight: 75 lb/ft3
Cohesion: 0 psf
Friction Angle: 20 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Ash Layer 1
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 30 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Ash Layer 2
Strength Type: Mohr-Coulomb
Unit Weight: 80 lb/ft3
Cohesion: 0 psf
Friction Angle: 28 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Ash Layer 3
Strength Type: Mohr-Coulomb
Unit Weight: 80 lb/ft3
Cohesion: 0 psf
Friction Angle: 25 degrees
Water Surface: Water Table
Custom Hu value: 1

Support Properties

Support: Support 1
Support 1
Support Type: Micro-Pile
Force Application: Passive
Out-of-Plane Spacing: 1 ft
Pile Shear Strength: 113520 lb

Written by:	**Justin Wang**	Date:	**7/17/09**	Reviewed by:	**Ming Zhu / Bob Bachus**	Date:	**7/17/09**
Client:	**TVA**	Project:	**Dredge Cells Recovery**	Project/ Proposal No.:	**GR4327**	Task No.:	**105**

List of All Coordinates

Material Boundary

84.000	75.000
200.000	75.000

Material Boundary

-50.000	45.500
200.000	45.500

Material Boundary

60.000	70.500
200.000	70.500

External Boundary

-50.000	63.000
-50.000	45.500
-50.000	0.000
200.000	0.000
200.000	45.500
200.000	70.500
200.000	75.000
200.000	90.000
114.000	90.000
84.000	75.000
60.000	75.000
60.000	70.500
60.000	63.000

Water Table

-50.000	76.000
60.000	76.000
60.000	73.300
200.000	73.300

Support

60.000	78.000
60.000	38.000

Search Grid

-28.158	45.500
154.361	45.500
154.361	221.071
-28.158	221.071

Written by:	**Justin Wang**	Date:	**7/17/09**	Reviewed by:	**Ming Zhu / Bob Bachus**	Date:	**7/17/09**
Client:	**TVA**	Project:	**Dredge Cells Recovery**	Project/ Proposal No.:	**GR4327**	Task No.:	**105**

File Name: Sheet Pile Wall 1000 ft Section with Surcharge.sli

Written by:	Justin Wang	Date:	7/17/09	Reviewed by:	Ming Zhu / Bob Bachus	Date:	7/17/09
Client:	TVA	Project:	Dredge Cells Recovery	Project/ Proposal No.:	GR4327	Task No.:	105

Slide Analysis Information

Document Name

File Name: Sheet Pile Wall 1000 ft Section with Surcharge.sli

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Right to Left
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard
Calculate Excess Pore Pressure: Off
Allow Ru with Water Surfaces or Grids: Off
Random Numbers: Pseudo-random Seed
Random Number Seed: 10116
Random Number Generation Method: Park and Miller v.3

Analysis Methods

Analysis Methods used:
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50

Surface Options

Surface Type: Circular
Search Method: Grid Search
Radius increment: 10
Composite Surfaces: Disabled
Reverse Curvature: Create Tension Crack
Minimum Elevation: Not Defined
Minimum Depth: 10

Loading

1 Distributed Load present:
Distributed Load Constant Distribution, Orientation: Vertical, Magnitude: 624 lb/ft2

Material Properties

Material: Dredged Ash
Strength Type: Mohr-Coulomb
Unit Weight: 75 lb/ft3
Cohesion: 0 psf
Friction Angle: 20 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Ash Layer 1
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 30 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Ash Layer 2
Strength Type: Mohr-Coulomb
Unit Weight: 80 lb/ft3
Cohesion: 0 psf
Friction Angle: 28 degrees
Water Surface: Water Table
Custom Hu value: 1

Support Properties

Support: Support 1
Support 1
Support Type: Micro-Pile
Force Application: Passive
Out-of-Plane Spacing: 1 ft
Pile Shear Strength: 113520 lb

Written by:	Justin Wang	Date:	7/17/09	Reviewed by:	Ming Zhu / Bob Bachus	Date:	7/17/09
Client:	TVA	Project:	Dredge Cells Recovery	Project/ Proposal No.:	GR4327	Task No.:	105

List of All Coordinates

Material Boundary

85.000	70.000
200.000	70.000

Material Boundary

-50.000	62.500
200.000	62.500

External Boundary

-50.000	63.000
-50.000	62.500
-50.000	0.000
200.000	0.000
200.000	62.500
200.000	70.000
200.000	85.000
114.000	85.000
85.000	70.000
60.000	70.000
60.000	63.000

Water Table

-50.000	72.000
60.000	72.000
60.000	68.100
200.000	68.100

Support

60.000	73.000
60.000	47.500

Search Grid

-28.158	45.500
154.361	45.500
154.361	221.071
-28.158	221.071

Distributed Load

60.000	70.000
85.000	70.000

Written by:	**Justin Wang**	Date:	**7/17/09**	Reviewed by:	**Ming Zhu / Bob Bachus**	Date:	**7/17/09**
Client:	**TVA**	Project:	**Dredge Cells Recovery**	Project/ Proposal No.:	**GR4327**	Task No.:	**105**

File Name: Sheet Pile Wall 1000 ft Section without Surcharge.sli

Written by:	**Justin Wang**	Date:	**7/17/09**	Reviewed by:	**Ming Zhu / Bob Bachus**	Date:	**7/17/09**
Client:	**TVA**	Project:	**Dredge Cells Recovery**	Project/ Proposal No.:	**GR4327**	Task No.:	**105**

Slide Analysis Information

Document Name

File Name: Sheet Pile Wall 1000 ft Section without Surcharge.sli

Project Settings

Project Title: SLIDE - An Interactive Slope Stability Program
Failure Direction: Right to Left
Units of Measurement: Imperial Units
Pore Fluid Unit Weight: 62.4 lb/ft3
Groundwater Method: Water Surfaces
Data Output: Standard
Calculate Excess Pore Pressure: Off
Allow Ru with Water Surfaces or Grids: Off
Random Numbers: Pseudo-random Seed
Random Number Seed: 10116
Random Number Generation Method: Park and Miller v.3

Analysis Methods

Analysis Methods used:
Spencer

Number of slices: 25
Tolerance: 0.005
Maximum number of iterations: 50

Surface Options

Surface Type: Circular
Search Method: Grid Search
Radius increment: 10
Composite Surfaces: Disabled
Reverse Curvature: Create Tension Crack
Minimum Elevation: Not Defined
Minimum Depth: 10

Material Properties

Material: Dredged Ash
Strength Type: Mohr-Coulomb
Unit Weight: 75 lb/ft3
Cohesion: 0 psf
Friction Angle: 20 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Ash Layer 1
Strength Type: Mohr-Coulomb
Unit Weight: 90 lb/ft3
Cohesion: 0 psf
Friction Angle: 30 degrees
Water Surface: Water Table
Custom Hu value: 1

Material: Ash Layer 2
Strength Type: Mohr-Coulomb
Unit Weight: 80 lb/ft3
Cohesion: 0 psf
Friction Angle: 28 degrees
Water Surface: Water Table
Custom Hu value: 1

Support Properties

Support: Support 1
Support 1
Support Type: Micro-Pile
Force Application: Passive
Out-of-Plane Spacing: 1 ft
Pile Shear Strength: 113520 lb

List of All Coordinates

Material Boundary

85.000	70.000
200.000	70.000

Written by:	**Justin Wang**	Date:	**7/17/09**	Reviewed by:	**Ming Zhu / Bob Bachus**	Date:	**7/17/09**
Client:	**TVA**	Project:	**Dredge Cells Recovery**	Project/ Proposal No.:	**GR4327**	Task No.:	**105**

Material Boundary

-50.000	62.500
200.000	62.500

External Boundary

-50.000	63.000
-50.000	62.500
-50.000	0.000
200.000	0.000
200.000	62.500
200.000	70.000
200.000	85.000
114.000	85.000
85.000	70.000
60.000	70.000
60.000	63.000

Water Table

-50.000	72.000
60.000	72.000
60.000	68.100
200.000	68.100

Support

60.000	73.000
60.000	47.500

Search Grid

-28.158	45.500
154.361	45.500
154.361	221.071
-28.158	221.071

Civil • Structural • Geotechnical • Materials Testing • Consulting

Cantilevered Sheet Piling Design Calculations

TVA Kingston Fossil Plant

Kingston, Tennessee

"Rim Ditch" Dredge Support

prepared for:
Sevenson Environmental Services, Inc.
2749 Lockport Road
Niagara Falls, New York 14305

prepared by:
Glynn Geotechnical Engineering
415 South Transit Street
Lockport, New York 14094

MARK W. GLYNN
REGISTERED ENGINEER
AGRICULTURE
COMMERCE
NO. 105139
STATE OF TENNESSEE

GGE 09-1103

July 17, 2009 (Revised)

GGE
a member of the GLYNN GROUP

Cantilevered Sheet Piling Design Criteria and Summary

1. Cantilevered Sheet Piling design uses SPW911 computer software by Pile Buck, Inc.

2. Design uses Rankine Earth Pressure Coefficients.

3. Design Considers temporary (short term) support conditions and uses a factor of safety (FOS) of 1.2 applied to the estimated soil strength parameters (e.g., Kp/1.2 and c/1.2).

4. Design cases for both a 15' dredge depth (i.e., the "first" 800 l.f.) and a 10' dredge depth (i.e., the "last" 1000 l.f.) are evaluated and specified:

   a. The 15' dredge requires 40' long sheets with a min. toe depth of 25',
   b. The 10' dredge requires 25' long sheets with a min. toe depth of 15'

5. Soil parameters used in the design analyses were recommended by Geosyntec Consultants as noted in the following Tables (prepared and provided by Geosyntec)

Table 1: Material Properties for Initial 800 feet Section

Layers	Total Unit Weight (pcf)	Effective Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (deg)
Ground Surface to EL 760 ft	90	27.6	0	30
EL 760 – 735 ft	80	17.6	0	28
EL 735 – 708 ft	80	17.6	0	25

Table 2: Material Properties for Remaining 1000 Section

Layers	Total Unit Weight (pcf)	Effective Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (deg)
Ground Surface to EL 757 ft	90	27.6	0	30
EL 760 – 705 ft	80	17.6	0	28

Cantilevered Sheet Piling Design Criteria and Summary (cont'd)

6. The following design criterion applies to the cantilevered sheet piling design at the section of the Rim Ditch subject to the 15' dredge depth (the "first" 800 l.f.):

   a. The construction surcharge load includes a Komatsu PC800 Excavator, supported on 20' wide timber distribution mats at an offset distance of 2' from the interior face of the sheet piling, and founded on a 24' reinforced road (crushed stone). The road subgrade elevation is 764.5.
   b. Construction will include dewatering measures to maintain the water level on the active (working platform) side of the sheet piling at or below el. 762.8. The "active" side dewatering requirement is based on a preference to limit the total sheet piling length to 40'.

7. The following design criterion applies to the cantilevered sheet piling design at the section of the Rim Ditch subject to the 10' dredge depth (the "last" 1000 l.f.):

   a. The construction surcharge load includes a Komatsu PC800 (or alternate PC600) Excavator, supported on 20' wide timber distribution mats at an offset distance of 2' from the interior face of the sheet piling founded on a 24' reinforced road (crushed stone). The road subgrade elevation is 764.5.
   b. Construction will include dewatering measures to maintain the water level on the active (working platform) side of the sheet piling at or below el. 762.6. The "active" side dewatering requirement is based on a preference to limit the total sheet piling length to 25'.

8. Design is based on cantilevered support without additional bracing.

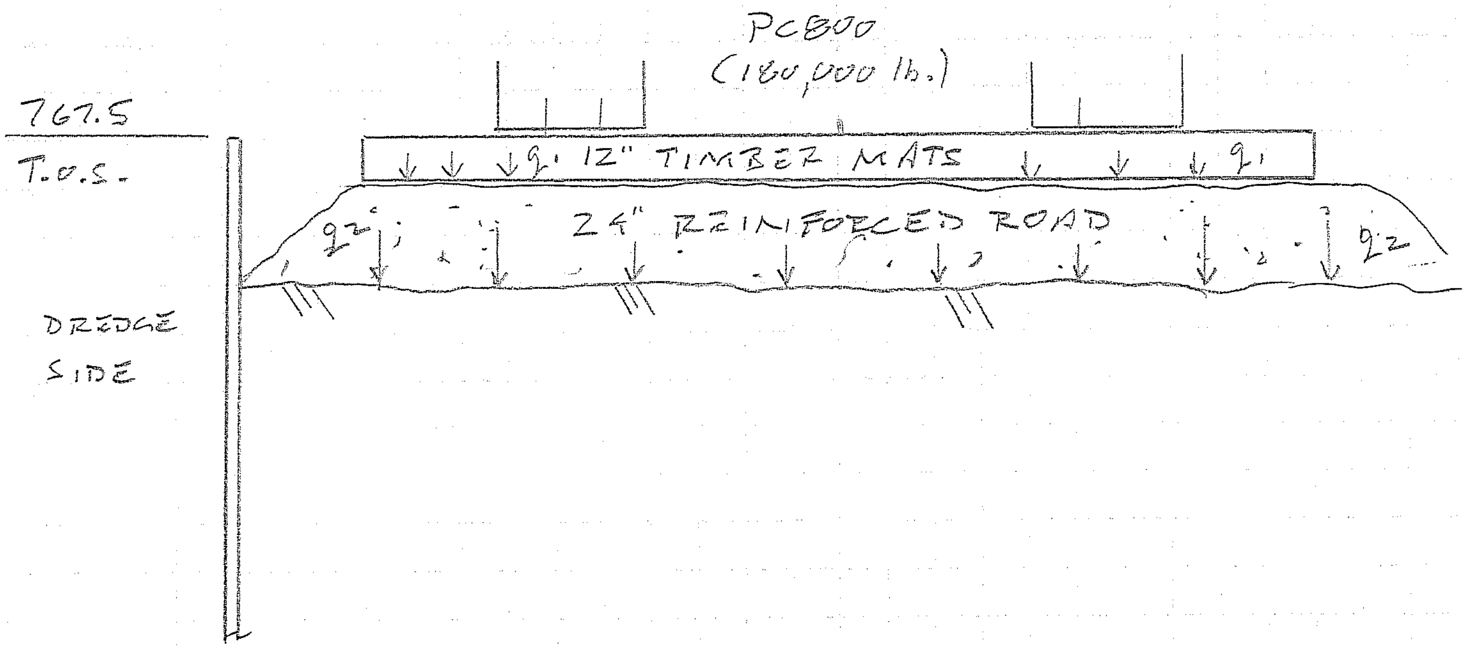
9. Design based on ASTM A 572, Gr. 50 material (Fy = 50 ksi) and evaluates AZ 19-700 sheet piling by Arcelor Mittal.

10. Design analyses includes an evaluation of the limits of the active failure zone to determine a design restrained setback distance from the cantilevered sheet piling.

11. Attachments to this design summary include:

    a. Surcharge and active failure zone evaluation calculations (4 sheets)
    b. "Pilebuck" SPW911 analysis output (8 sheets)
    c. Design cross-section drawings D1 and D2

RE-EVALUATE CONST. SURCHARGE LOAD (1ST 800 L.F.)



SURCHARGE PRESSURE:

@ ROAD SURFACE:

$$q_1 = 180{,}000^{\#} / 20' \times 20' + 60 \text{ psf}$$

$$= 510 \text{ psf}$$

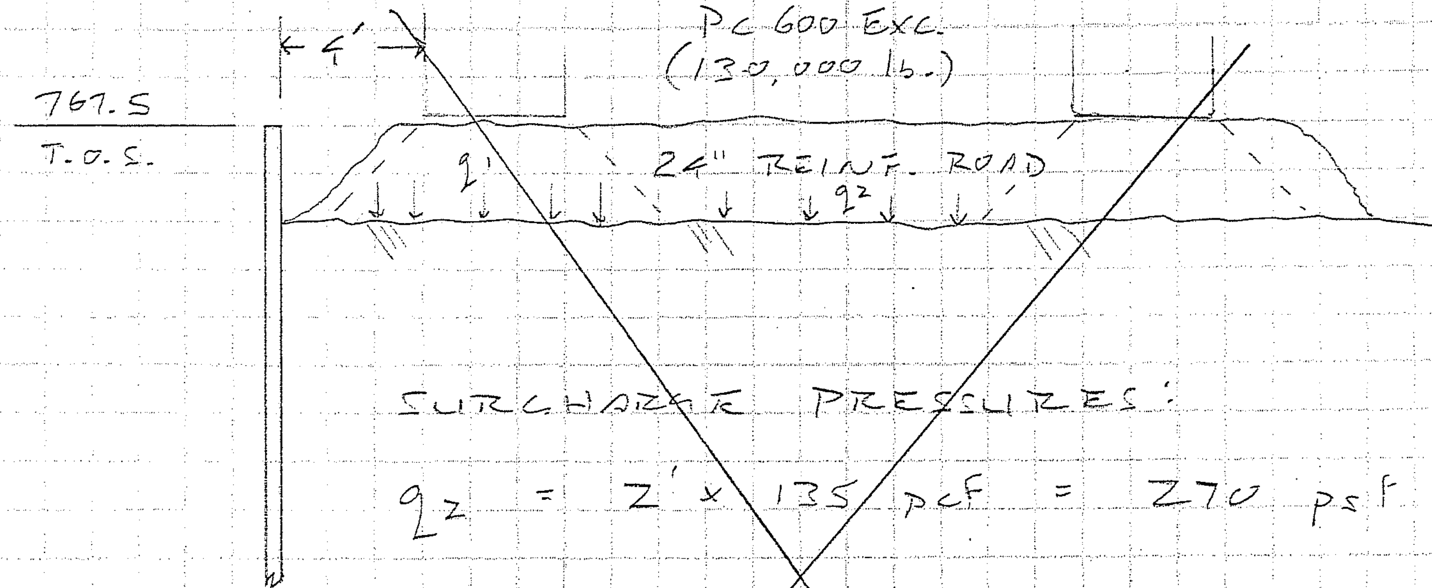
@ SUBGRADE: USE 1:1 PRISMATIC DIST. THRU REINF. ROAD SECTION

$$q_2 = \frac{510 \text{ psf} \times (20')^2}{(24')^2} + 2' \times 135 \text{ pcf}$$

$$= \underline{\underline{624 \text{ psf}}}$$

GGC ENGINEERING·DESIGN				
GLYNN GEOTECHNICAL ENGINEERING, 415 South Transit Street, Lockport, New York 14094, voice 716.625.6933 / fax 716.625.6983, www.glynngroup.com	PROJECT: TVA Kingston Fossil Plant			SHEET NO: 1/4
	SUBJECT: Rim Ditch Dredge			
	CLIENT: Sevenson			
PROJECT NO: 09-1103	SCALE: —	DATE: 7.17.09	BY: JG	CHECKED BY:

CONSTRUCTION SURCHARGE LOAD
(LAST 1000 L.F.)



SURCHARGE PRESSURES:

$$q_2 = 2' \times 135 \text{ pcf} = 270 \text{ psf}$$

$$q_1 = \frac{130,000/2}{(3'+4') \times (15.1'+4')} + 270 \text{ psf}$$

$$= 486 \text{ psf} + 270 \text{ psf} = 756 \text{ psf}$$

EQUIV. UNIFORM SURCHARGE:

$$q_{eff} = \frac{2(7') \times 756 \text{ psf} + 5.83' \times 270 \text{ psf}}{(4' + 13.83' + 2')}$$

$$= \underline{\underline{613 \text{ psf}}}$$

USE MATS / ROAD SECTION SIM. TO 1ST 800'

GGE ENGINEERING·DESIGN GLYNN GEOTECHNICAL ENGINEERING 415 South Transit Street Lockport, New York 14094 voice 716.625.6933 / fax 716.625.6983 www.glynngroup.com	PROJECT: TVA KINGSTON FOSSIL PLANT SUBJECT: RIM DITCH DREDGE CLIENT: SEVENSON			SHEET NO: 2 / 4
	PROJECT NO: 09-1103	SCALE: –	DATE: 7.17.09	BY: JG	CHECKED BY:

USING 36" REINF. ROAD:

$q_2 = 3' \times 135 \text{ pcf} = 405 \text{ psf}$

$q_1 = \dfrac{65{,}000^{\#}}{(3'+6') \times (15.1'+6')} + 405 \text{ psf}$

$= 342 \text{ psf} + 405 \text{ psf} = 747 \text{ psf}$

$q_{EFF} = \dfrac{2(9') \times 747 \text{ psf} + 2.83' \times 405 \text{ psf}}{(4' + 13.83' + 3')}$

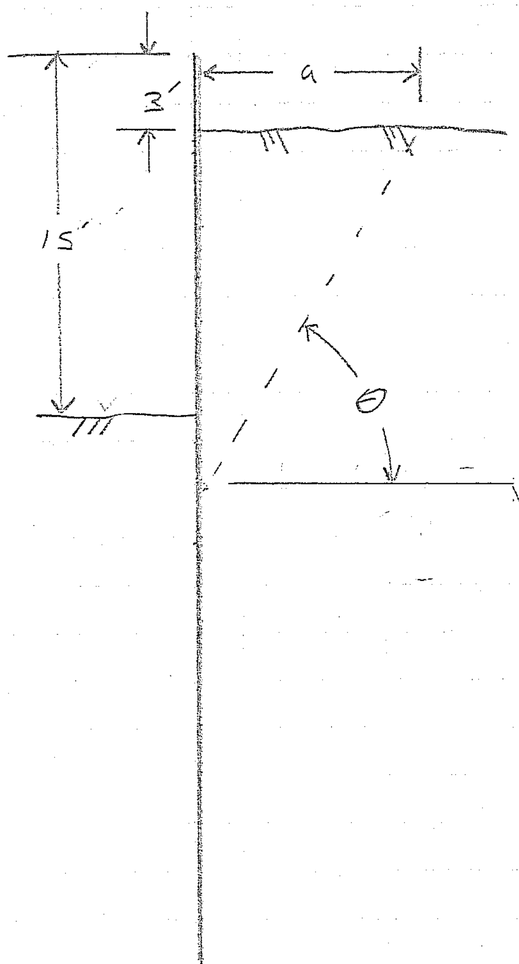
$= \underline{\underline{700.5 \text{ psf}}}$

USE TIMBER MATS/
ROAD SECTION AS SHOWN
FOR 1ST 800 L.F.

GGE ENGINEERING·DESIGN GLYNN GEOTECHNICAL ENGINEERING 415 South Transit Street Lockport, New York 14094 voice 716.625.6933 / fax 716.625.6983 www.glynngroup.com	PROJECT: TVA KINGSTON FOSSIL PLANT SUBJECT: RIM DITCH DREDGE CLIENT: SEVENSON			SHEET NO: 3/4
	PROJECT NO: 09-1103	SCALE: —	DATE: 7-17-09	BY: JJ	CHECKED BY:

CASTING AREA / SETTLING POND SETBACK

(EVALUATE 15' DREDGE)



$a = 15.5' \times \tan(90 - 59°)$

$= \underline{9.31'}$

$\theta = 45 + \phi/2 = 45° + 28°/2 = 59°$

P = 0 @ -18.5' (FROM PILE BUCK)

∴ AT A SETBACK DISTANCE OF 30', CASTING AREA / SETTLING POND WILL BE OUTSIDE OF ACTIVE FAILURE ZONE & NOT IMPACT CANT'D SHT. PLG.

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Lockport, New York 14094
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www.glynngroup.com

PROJECT: TVA KINGSTON FOSSIL PLANT			SHEET NO: 4 / 4
SUBJECT: RING DITCH DREDGING			
CLIENT: SEVENSON			
PROJECT NO: 09-1102	SCALE: –	DATE: 7.16.09 (17)	BY: JS
CHECKED BY:			

Client: Sevenson Environmental, Inc.
Attn: Mr. Mike Elia

Title: Cantilevered Sheet Piling, 800 ft Section
Ref: SES
Page: 1
Date: 7.17.09

Sheet: AZ 19-700 Gr 50
Pressure: Rankine
FOS: 1.0 (K_p÷1.2; C÷1.2)
Toe: Cantilever

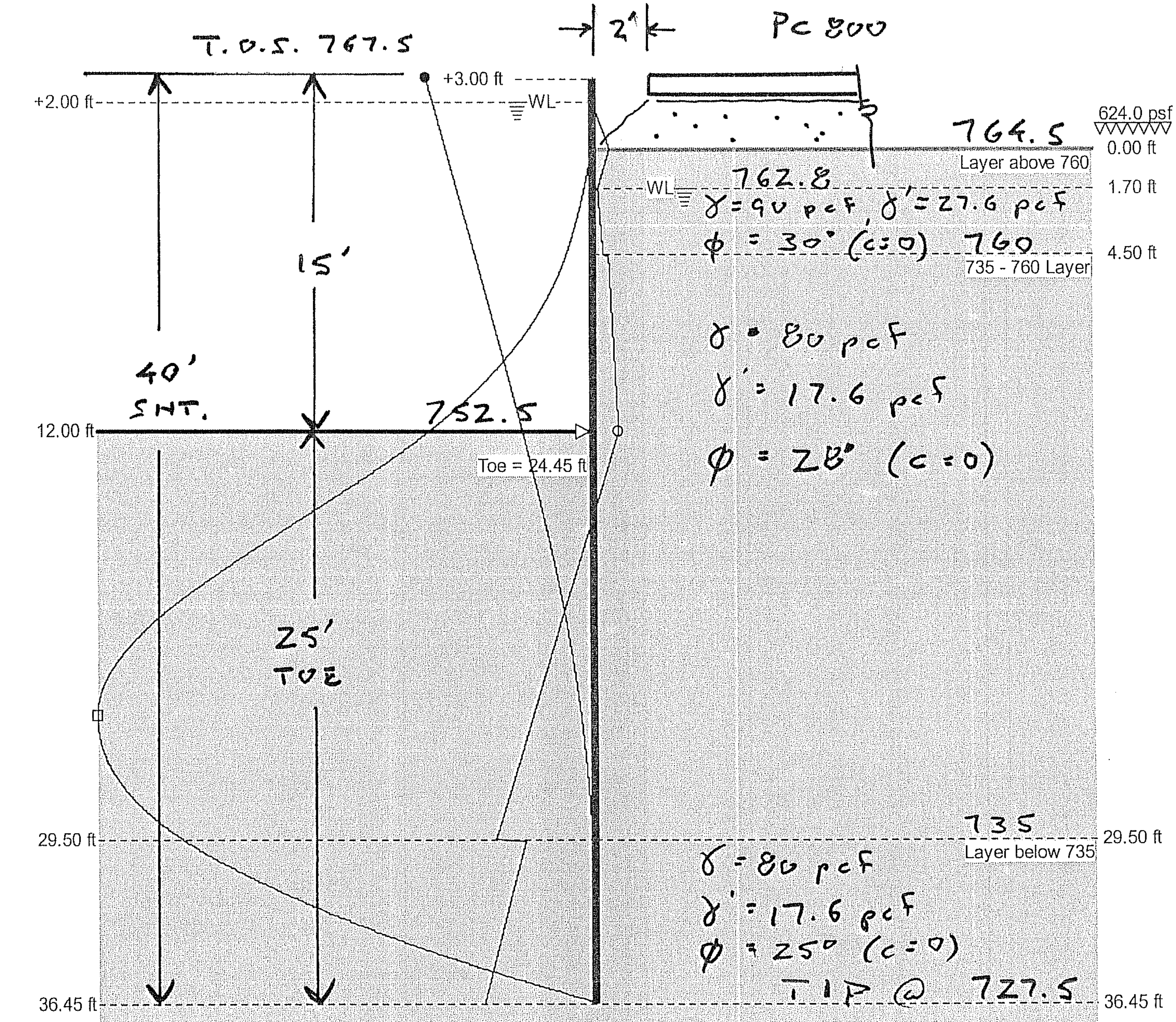
	Maximum	d (ft)
○	124.2 psf	12.00
□	17029.9 ftlb/ft	24.18
●	1.6 in	-3.00

Active W.L. @ el. 762.8 (Dewatering requirement)

Passive W.L. @ el. 766.5 (Design W.L. in Ditch, 1' below T.O.S.)

624 psf Total Const. Surcharge (PC800 / 20' x 20' timber mats offset 2' from int. face of sht plg / 1:1 prismatic dist. thru 2' reinf. road section)

Using Soil parameters as recommended by Geosyntec



Glynn Geotechnical Engineering
415 South Transit Street
Lockport, NY 14094
Tel: 716.625.6933
Fax: 716.625.6983

SPW911, v2.20

Client: Sevenson Environmental, Inc.
Attn: Mr. Mike Elia

Title: Cantilevered Sheet Piling, 800 ft Section
Ref: SES
Page: 2
Date: 7.17.09

Sheet: AZ 19-700 Gr 50
Pressure: Rankine
FOS: 1.0 (K_p÷1.2; C÷1.2)
Toe: Cantilever

Active W.L. @ el. 762.8 (Dewatering requirement)

Passive W.L. @ el. 766.5 (Design W.L. in Ditch, 1' below T.O.S.)

624 psf Total Const. Surcharge (PC800 / 20' x 20' timber mats offset 2' from int. face of sht plg / 1:1 prismatic dist. thru 2' reinf. road section)

Using Soil parameters as recommended by Geosyntec

Input Data

Depth Of Excavation = 12.00 ft
Surcharge = 624.0 psf
Depth Of Active Water = 1.70 ft
Depth Of Passive Water = +2.00 ft
Water Density = 62.40 pcf
Minimum Fluid Density = 31.82 pcf

Soil Profile

Depth (ft)	Soil Name	γ (pcf)	γ' (pcf)	C (psf)	C_a (psf)	ϕ (°)	δ (°)	K_a	K_{ac}	K_p	K_{pc}
0.00	Layer above 760	90.00	27.60	0.0	0.0	30.0	0.0	0.33	0.00	3.00 (2.50)	0.00 (0.00)
4.50	735 - 760 Layer	80.00	17.60	0.0	0.0	28.0	0.0	0.36	0.00	2.77 (2.31)	0.00 (0.00)
29.50	Layer below 735	80.00	17.60	0.0	0.0	25.0	0.0	0.41	0.00	2.46 (2.05)	0.00 (0.00)

( ) indicates factored value used in calculations. Factor(s): K_p÷1.2; C÷1.2

Solution

Sheet

Sheet Name	I (in⁴/ft)	E (psi)	Z (in³/ft)	f (psi)	Maximum Bending Moment (ftlb/ft)	Upstand (ft)	Toe (ft)	Pile Length (ft)
AZ 19-700 Gr 50	288.40	3.04E+07	34.80	32000.0	92689.5	3.00	24.45	39.44

Maxima

	Maximum	Depth
Bending Moment	17029.9 ftlb/ft	24.18 ft
Deflection	1.6 in	-3.00 ft
Pressure	124.2 psf	12.00 ft
Shear Force	1256.1 lb/ft	15.60 ft

415 South Transit Street
Lockport, NY 14094
Tel: 716.625.6933
Fax: 716.625.6983

Client: Sevenson Environmental, Inc.
Attn: Mr. Mike Elia

Title: Cantilevered Sheet Piling, 800 ft Section
Ref: SES
Page: 3
Date: 7.17.09

Sheet: AZ 19-700 Gr 50
Pressure: Rankine
FOS: 1.0 (K_p÷1.2; C÷1.2)
Toe: Cantilever

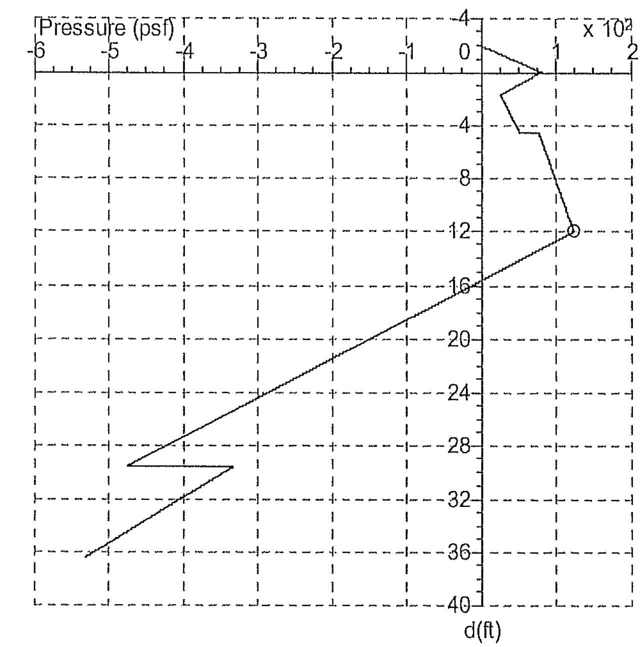
	Maximum	d (ft)
○	124.2 psf	12.00
□	17029.9 ftlb/ft	24.18
◇	1256.1 lb/ft	15.60
●	1.6 in	-3.00

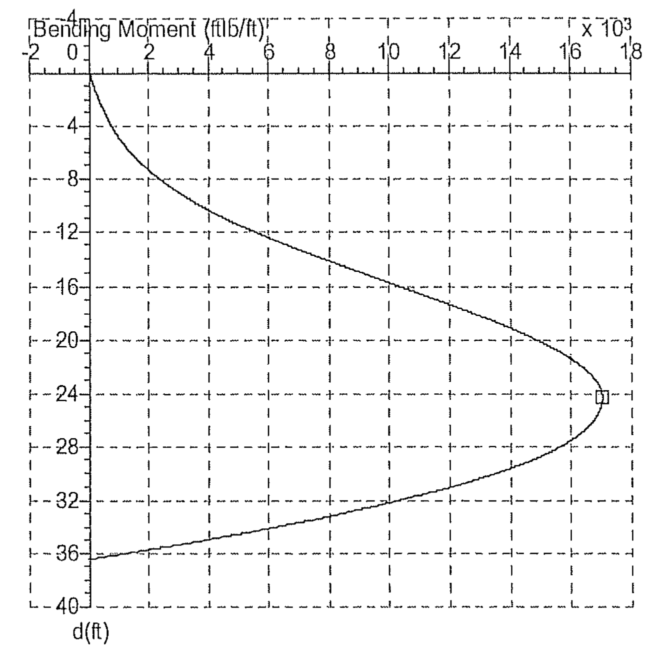
Active W.L. @ el. 762.8 (Dewatering requirement)

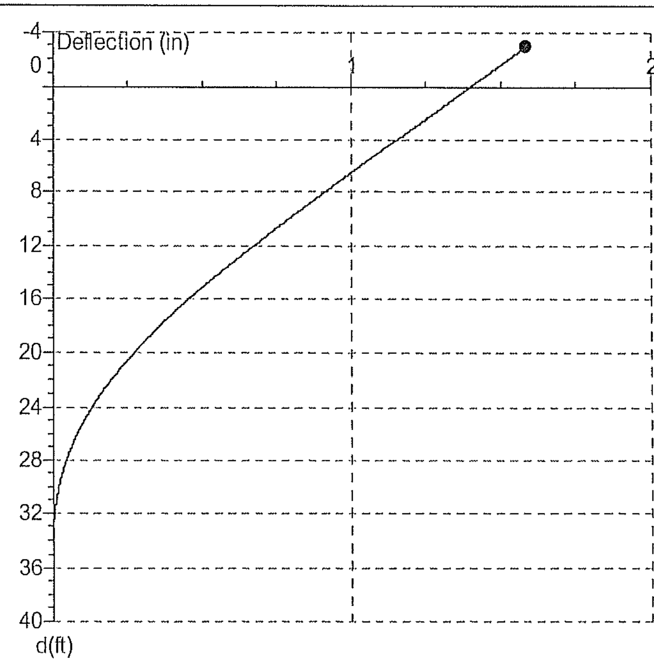
Passive W.L. @ el. 766.5 (Design W.L. in Ditch, 1' below T.O.S.)

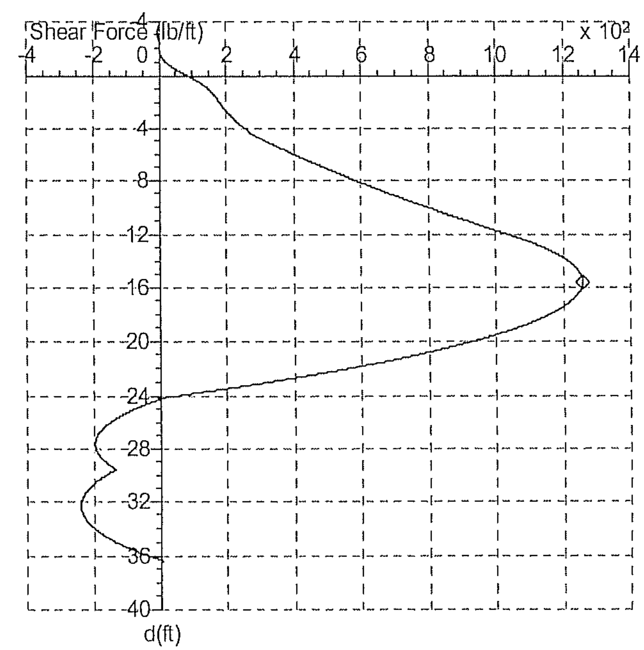
624 psf Total Const. Surcharge (PC800 / 20' x 20' timber mats offset 2' from int. face of sht plg / 1:1 prismatic dist. thru 2' reinf. road section)

Using Soil parameters as recommended by Geosyntec









Glynn Geotechnical Engineering

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Lockport, NY 14094
Tel: 716.625.6933
Fax: 716.625.6983

SPW911, v2.20

Client: Sevenson Environmental, Inc.
Attn: Mr. Mike Elia

Title: Cantilevered Sheet Piling, 800 ft Section
Ref: SES
Page: 4
Date: 7.17.09

Sheet: AZ 19-700 Gr 50
Pressure: Rankine
FOS: 1.0 (K_p÷1.2; C÷1.2)
Toe: Cantilever

Active W.L. @ el. 762.8 (Dewatering requirement)

Passive W.L. @ el. 766.5 (Design W.L. in Ditch, 1' below T.O.S.)

624 psf Total Const. Surcharge (PC800 / 20' x 20' timber mats offset 2' from int. face of sht plg / 1:1 prismatic dist. thru 2' reinf. road section)

Using Soil parameters as recommended by Geosyntec

depth (ft)	P (psf)	M (ftlb/ft)	D (in)	F (lb/ft)	depth (ft)	P (psf)	M (ftlb/ft)	D (in)	F (lb/ft)	depth (ft)	P (psf)	M (ftlb/ft)	D (in)	F (lb/ft)
0.00	80.3	56.1	1.4	84.4	12.26	114.4	5883.2	0.7	1067.2	24.51	-304.9	17021.8	0.1	-32.9
0.32	69.6	87.5	1.4	108.9	12.58	104.3	6203.3	0.6	1099.3	24.83	-316.2	16993.0	0.1	-66.0
0.65	59.9	122.3	1.4	127.8	12.90	93.0	6569.5	0.6	1131.6	25.16	-327.4	16942.8	0.1	-95.3
0.97	49.2	167.0	1.3	145.6	13.22	81.7	6945.8	0.6	1160.1	25.48	-338.7	16870.4	0.1	-121.0
1.29	38.4	217.1	1.3	159.8	13.55	70.4	7330.9	0.6	1184.9	25.80	-350.0	16775.3	0.1	-142.9
1.61	27.7	271.3	1.3	170.5	13.87	59.2	7723.6	0.6	1206.0	26.12	-361.3	16673.0	0.1	-161.2
1.94	27.9	328.6	1.3	179.2	14.19	49.0	8082.6	0.6	1221.9	26.45	-371.4	16533.6	0.1	-174.4
2.26	30.6	382.8	1.3	187.9	14.51	37.8	8486.4	0.5	1236.0	26.77	-382.7	16391.5	0.1	-185.6
2.58	33.6	446.1	1.2	198.5	14.84	26.5	8894.3	0.5	1246.3	27.09	-394.0	16205.7	0.1	-193.1
2.90	36.6	513.0	1.2	210.1	15.16	15.2	9305.1	0.5	1253.0	27.41	-405.2	15994.1	0.1	-196.9
3.23	39.6	583.9	1.2	222.7	15.48	3.9	9717.5	0.5	1256.0	27.74	-416.5	15756.3	0.0	-197.0
3.55	42.6	659.1	1.2	236.3	15.80	-7.3	10130.4	0.5	1255.2	28.06	-426.6	15526.1	0.0	-193.9
3.87	45.6	738.9	1.2	250.8	16.13	-17.5	10501.3	0.5	1251.4	28.38	-437.9	15237.3	0.0	-187.0
4.19	48.3	814.9	1.1	264.7	16.45	-28.7	10911.6	0.4	1243.6	28.70	-449.2	14920.3	0.0	-176.3
4.52	62.9	904.4	1.1	281.5	16.77	-40.0	11318.8	0.4	1232.1	29.03	-460.5	14619.4	0.0	-162.0
4.84	78.9	1000.7	1.1	307.2	17.09	-51.3	11721.6	0.4	1216.9	29.35	-471.7	14248.1	0.0	-143.9
5.16	81.0	1105.5	1.1	333.5	17.42	-62.6	12119.0	0.4	1198.0	29.67	-336.6	13898.7	0.0	-144.5
5.48	83.1	1219.1	1.1	360.5	17.74	-72.7	12470.8	0.4	1177.9	29.99	-346.1	13470.8	0.0	-167.4
5.81	85.0	1329.0	1.0	385.4	18.06	-84.0	12854.2	0.4	1151.9	30.32	-355.6	13011.9	0.0	-187.2
6.13	87.0	1459.9	1.0	413.7	18.38	-95.2	13228.6	0.3	1122.3	30.64	-365.1	12521.3	0.0	-203.9
6.45	89.1	1600.1	1.0	442.7	18.71	-106.5	13592.7	0.3	1088.9	30.96	-374.6	11998.4	0.0	-217.4
6.77	91.2	1750.0	1.0	472.3	19.03	-117.8	13945.3	0.3	1051.9	31.28	-384.1	11517.3	0.0	-227.8
7.10	93.3	1909.7	1.0	502.7	19.35	-127.9	14251.7	0.3	1015.4	31.61	-392.6	11018.4	0.0	-234.5
7.42	95.2	2062.1	0.9	530.6	19.67	-139.2	14579.1	0.3	971.3	31.93	-402.1	10425.7	0.0	-239.0
7.74	97.2	2241.2	0.9	562.2	20.00	-150.5	14891.4	0.3	923.5	32.25	-411.6	9808.7	0.0	-240.4
8.06	99.3	2430.7	0.9	594.6	20.32	-161.8	15187.4	0.3	872.0	32.57	-421.1	9166.7	0.0	-238.7
8.39	101.4	2631.0	0.9	627.6	20.64	-173.0	15466.0	0.2	816.8	32.90	-430.6	8499.3	0.0	-233.8
8.71	103.5	2842.3	0.9	661.3	20.96	-184.3	15725.8	0.2	757.9	33.22	-439.1	7894.1	0.0	-226.8
9.03	105.4	3042.0	0.8	692.2	21.29	-194.4	15942.7	0.2	701.7	33.54	-448.6	7177.5	0.0	-216.0
9.35	107.4	3274.7	0.8	727.3	21.61	-205.7	16163.7	0.2	635.7	33.86	-458.1	6528.5	0.0	-202.1
9.68	109.5	3519.0	0.8	763.0	21.93	-217.0	16362.5	0.2	566.1	34.19	-467.6	5761.0	0.0	-185.0
10.00	111.6	3775.2	0.8	799.3	22.25	-228.3	16537.8	0.2	492.7	34.51	-477.1	4965.5	0.0	-164.9
10.32	113.7	4043.4	0.8	836.4	22.58	-239.5	16688.5	0.2	415.6	34.83	-485.6	4246.2	0.0	-144.1
10.64	115.8	4323.9	0.8	874.1	22.90	-249.7	16802.0	0.2	343.1	35.15	-495.1	3397.0	0.0	-118.0
10.97	117.7	4587.0	0.7	908.7	23.22	-260.9	16902.4	0.2	259.0	35.48	-504.6	2518.3	0.0	-88.8
11.29	119.7	4891.5	0.7	947.8	23.54	-272.2	16974.7	0.1	171.2	35.80	-514.1	1609.7	0.0	-56.5
11.61	121.8	5208.9	0.7	987.5	23.87	-283.5	17017.5	0.1	79.7	36.12	-523.6	789.6	0.0	-21.1
11.93	123.9	5539.4	0.7	1027.9	24.19	-294.8	17029.7	0.1	0.0	36.45	-531.2	-54.2	0.0	9.5

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Title: Cantilevered Sheet Piling, 1000 ft Section
Ref: SES
Page: 1
Date: 7.17.09

Sheet: AZ 19-700 Gr 50
Pressure: Rankine
FOS: 1.0 (K_p÷1.2; C÷1.2)
Toe: Cantilever

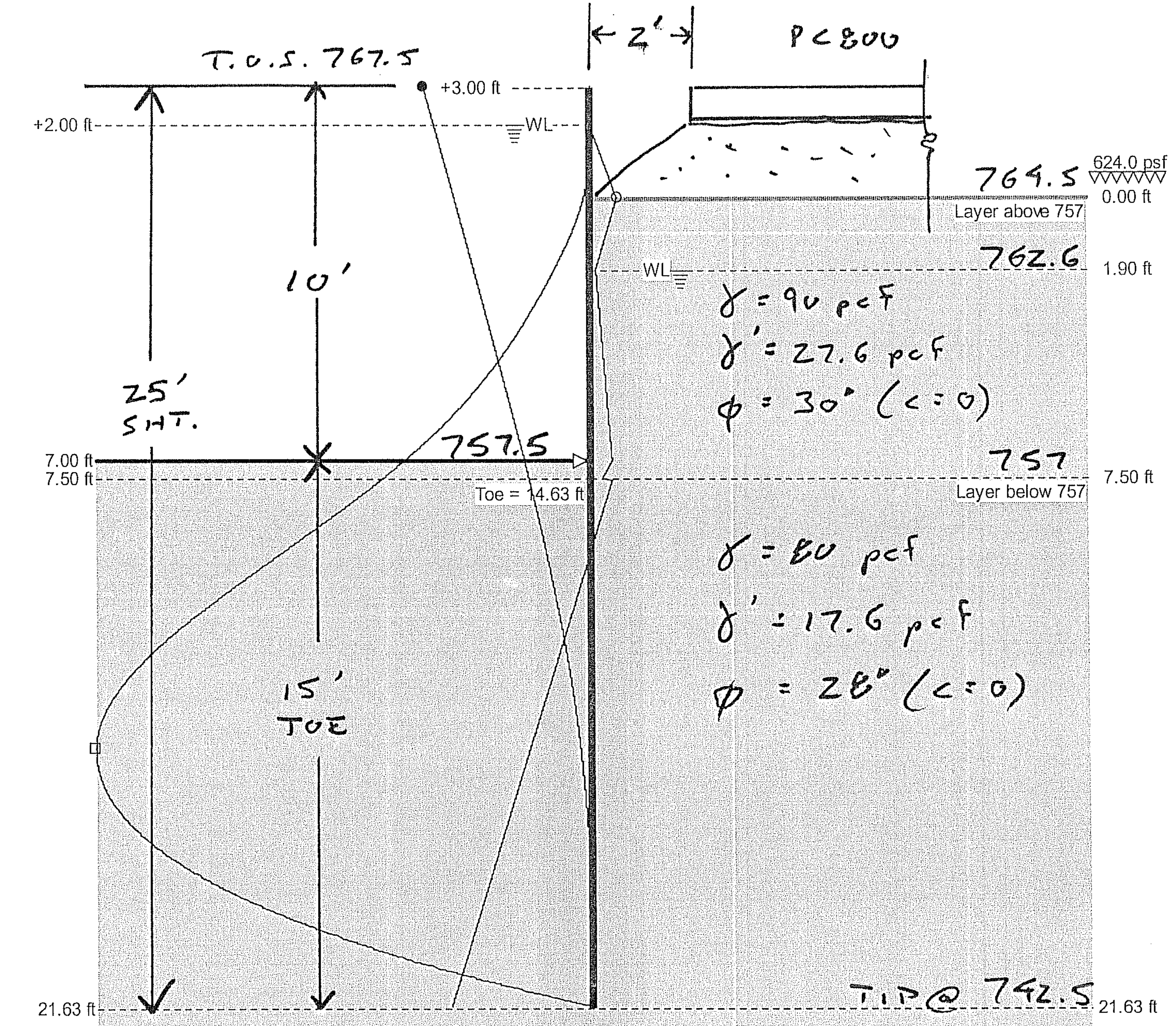
	Maximum	d (ft)
○	81.1 psf	0.00
□	4458.2 ftlb/ft	14.73
●	0.2 in	-3.00

Active W.L. @ el. 762.6 (Dewatering Reqmt.

Passive W.L. @ el. 766.5 (Design W.L. in ditch, 1' below T.O.S.)

624 psf Total Const. Surcharge (PC800 / 20' x 20' timber mats offset 2' from int. face of sht. plg. / 1:1 prismatic dist. thru 2' reinf. road section)

Using Soil Parameters as recommended by Geosyntec 7.17.09



Glynn Geotechnical Engineering

415 South Transit Street
Lockport, NY 14094
Tel: 716.625.6933
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SPW911, v2.20

Client: Sevenson Environmental, Inc.
Attn: Mr. Mike Elia

Title: Cantilevered Sheet Piling, 1000 ft Section
Ref: SES
Page: 2
Date: 7.17.09

Sheet: AZ 19-700 Gr 50
Pressure: Rankine
FOS: 1.0 (K_p÷1.2; C÷1.2)
Toe: Cantilever

Active W.L. @ el. 762.6 (Dewatering Reqmt.

Passive W.L. @ el. 766.5 (Design W.L. in ditch, 1' below T.O.S.)

624 psf Total Const. Surcharge (PC800 / 20' x 20' timber mats offset 2' from int. face of sht. plg. / 1:1 prismatic dist. thru 2' reinf. road section)

Using Soil Parameters as recommended by Geosyntec 7.17.09

Input Data

Depth Of Excavation = 7.00 ft
Surcharge = 624.0 psf
Depth Of Active Water = 1.90 ft
Depth Of Passive Water = +2.00 ft
Water Density = 62.40 pcf
Minimum Fluid Density = 31.82 pcf

Soil Profile

Depth (ft)	Soil Name	γ (pcf)	γ' (pcf)	C (psf)	C_a (psf)	ϕ (°)	δ (°)	K_a	K_{ac}	K_p	K_{pc}
0.00	Layer above 757	90.00	27.60	0.0	0.0	30.0	0.0	0.33	0.00	3.00 (2.50)	0.00 (0.00)
7.50	Layer below 757	80.00	17.60	0.0	0.0	28.0	0.0	0.36	0.00	2.77 (2.31)	0.00 (0.00)

( ) indicates factored value used in calculations. Factor(s): K_p÷1.2; C÷1.2

Solution

Sheet

Sheet Name	I (in⁴/ft)	E (psi)	Z (in³/ft)	f (psi)	Maximum Bending Moment (ftlb/ft)	Upstand (ft)	Toe (ft)	Pile Length (ft)
AZ 19-700 Gr 50	288.40	3.04E+07	34.80	32000.0	92689.5	3.00	14.63	24.63

Maxima

	Maximum	Depth
Pressure	81.1 psf	0.00 ft

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Title: Cantilevered Sheet Piling, 1000 ft Section
Ref: SES
Page: 3
Date: 7.17.09

Sheet: AZ 19-700 Gr 50
Pressure: Rankine
FOS: 1.0 ($K_p \div 1.2$; $C \div 1.2$)
Toe: Cantilever

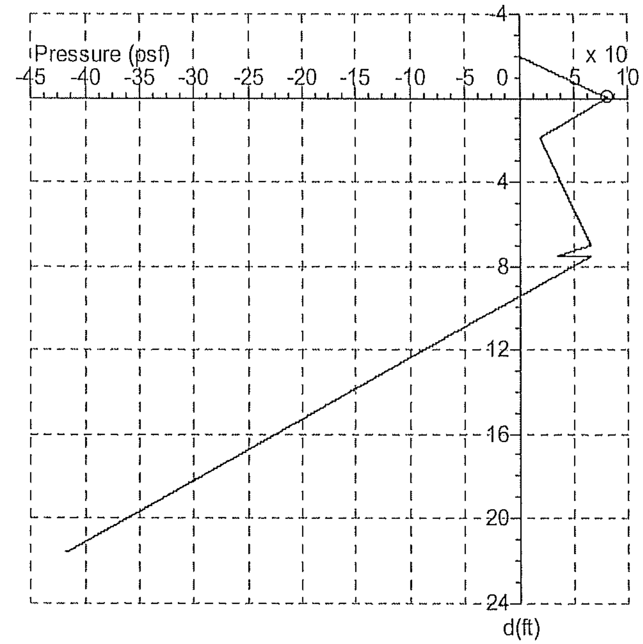
	Maximum	d (ft)
○	81.1 psf	0.00
□	4458.2 ftlb/ft	14.73
◇	481.0 lb/ft	9.44
●	0.2 in	-3.00

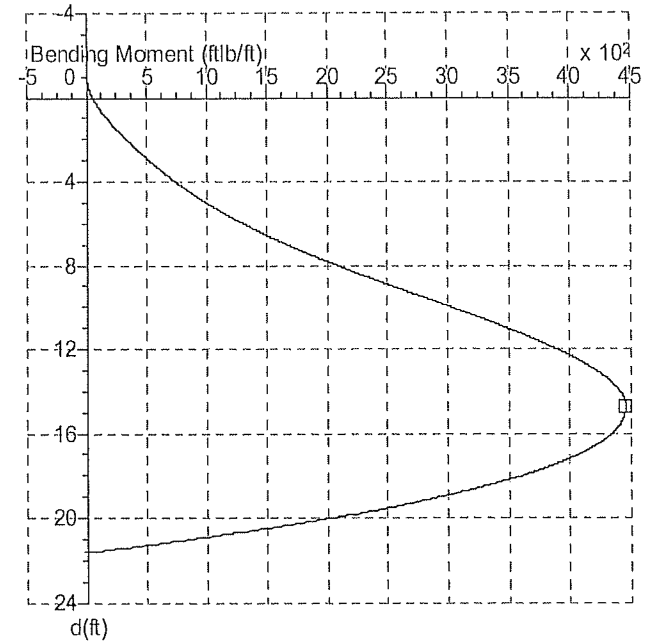
Active W.L. @ el. 762.6 (Dewatering Reqmt.

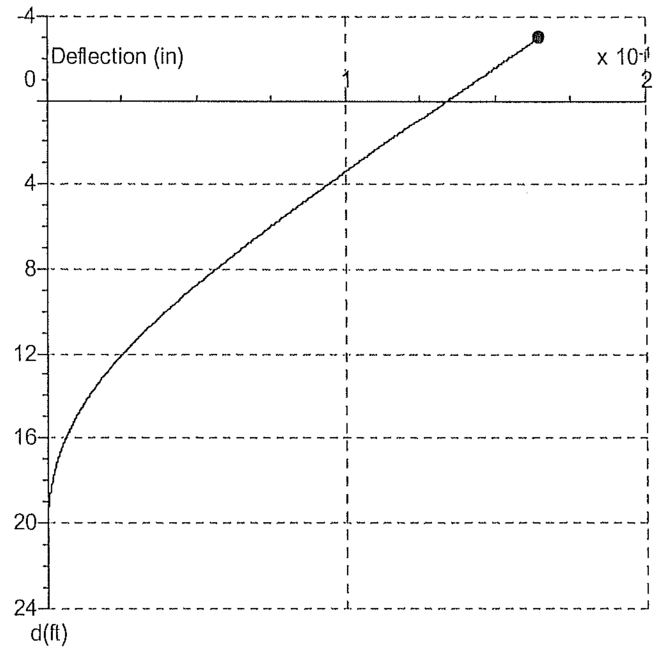
Passive W.L. @ el. 766.5 (Design W.L. in ditch, 1' below T.O.S.)

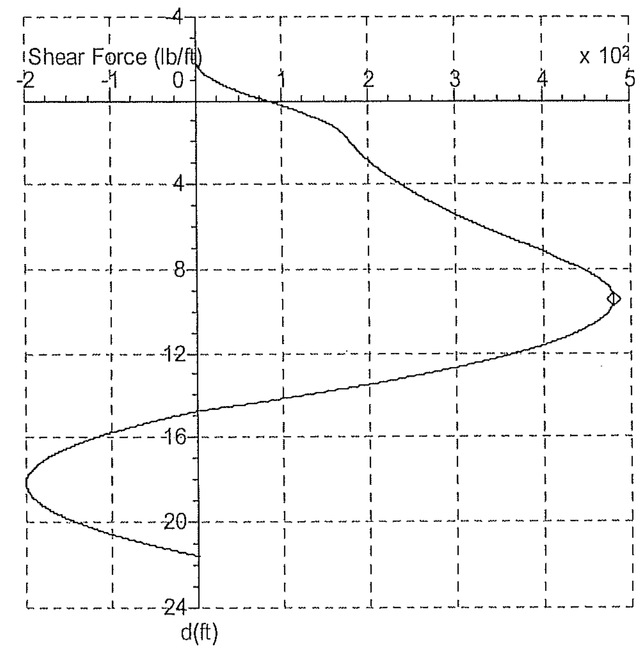
624 psf Total Const. Surcharge (PC800 / 20' x 20' timber mats offset 2' from int. face of sht. plg. / 1:1 prismatic dist. thru 2' reinf. road section)

Using Soil Parameters as recommended by Geosyntec 7.17.09









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Client: Sevenson Environmental, Inc.
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Title: Cantilevered Sheet Piling, 1000 ft Section
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Page: 4
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Sheet: AZ 19-700 Gr 50
Pressure: Rankine
FOS: 1.0 (K_p÷1.2; C÷1.2)
Toe: Cantilever

Active W.L. @ el. 762.6 (Dewatering Reqmt.

Passive W.L. @ el. 766.5 (Design W.L. in ditch, 1' below T.O.S.)

624 psf Total Const. Surcharge (PC800 / 20' x 20' timber mats offset 2' from int. face of sht. plg. / 1:1 prismatic dist. thru 2' reinf. road section)

Using Soil Parameters as recommended by Geosyntec 7.17.09

depth (ft)	P (psf)	M (ftlb/ft)	D (in)	F (lb/ft)	depth (ft)	P (psf)	M (ftlb/ft)	D (in)	F (lb/ft)	depth (ft)	P (psf)	M (ftlb/ft)	D (in)	F (lb/ft)
0.00	80.6	55.5	0.1	83.3	7.27	48.5	1777.2	0.1	408.1	14.55	-175.1	4454.9	0.0	32.4
0.19	74.5	72.0	0.1	97.6	7.46	37.5	1853.2	0.1	415.9	14.74	-182.1	4458.2	0.0	0.0
0.38	68.5	91.2	0.1	110.7	7.66	60.7	1939.6	0.1	427.9	14.93	-188.4	4455.9	0.0	-21.0
0.57	61.8	115.1	0.1	124.0	7.85	54.4	2019.6	0.1	438.5	15.12	-194.8	4448.6	0.0	-40.9
0.77	55.7	139.0	0.1	134.8	8.04	48.0	2101.3	0.1	447.9	15.31	-201.8	4434.2	0.0	-61.6
0.96	49.7	164.7	0.1	144.5	8.23	41.0	2194.1	0.1	456.9	15.50	-208.1	4415.7	0.0	-79.0
1.15	43.0	195.2	0.1	153.9	8.42	34.7	2279.1	0.1	463.9	15.70	-214.5	4391.6	0.0	-95.2
1.34	36.9	224.3	0.1	161.2	8.61	28.3	2365.3	0.1	469.6	15.89	-221.5	4361.9	0.0	-111.8
1.53	30.9	254.6	0.1	167.4	8.80	21.3	2462.2	0.0	474.6	16.08	-227.8	4326.4	0.0	-125.6
1.72	24.2	289.5	0.1	173.0	9.00	15.0	2550.1	0.0	477.9	16.27	-234.2	4284.9	0.0	-138.1
1.91	19.2	321.8	0.1	176.9	9.19	8.6	2638.6	0.0	480.0	16.46	-241.2	4230.9	0.0	-150.7
2.11	20.9	354.8	0.1	180.6	9.38	1.6	2737.2	0.0	481.0	16.65	-247.5	4176.2	0.0	-160.8
2.30	22.8	392.2	0.1	185.1	9.57	-4.7	2826.1	0.0	480.7	16.84	-253.9	4123.1	0.0	-169.8
2.49	24.5	426.8	0.1	189.5	9.76	-11.1	2914.7	0.0	479.1	17.04	-260.9	4047.4	0.0	-178.3
2.68	26.1	462.2	0.1	194.2	9.95	-18.1	3012.8	0.0	476.1	17.23	-267.3	3972.9	0.0	-184.8
2.87	28.0	502.5	0.1	199.8	10.14	-24.4	3100.5	0.0	472.1	17.42	-273.6	3891.5	0.0	-190.1
3.06	29.7	539.9	0.1	205.1	10.34	-30.8	3187.2	0.0	466.9	17.61	-280.6	3791.5	0.0	-194.6
3.25	31.4	578.2	0.1	210.8	10.53	-37.8	3282.4	0.0	459.8	17.80	-287.0	3707.4	0.0	-197.4
3.45	33.2	622.1	0.1	217.4	10.72	-44.2	3366.8	0.0	452.2	17.99	-293.3	3604.4	0.0	-199.1
3.64	34.9	662.8	0.1	223.7	10.91	-50.5	3449.6	0.0	443.3	18.18	-300.3	3479.6	0.0	-199.5
3.83	36.6	704.6	0.1	230.4	11.10	-57.5	3539.5	0.0	432.2	18.37	-306.7	3360.5	0.0	-198.7
4.02	38.5	752.6	0.1	238.1	11.29	-63.9	3618.5	0.0	420.9	18.57	-313.0	3233.5	0.0	-196.7
4.21	40.2	797.2	0.1	245.4	11.48	-70.2	3695.2	0.0	408.5	18.76	-320.0	3098.5	0.0	-193.2
4.40	41.8	843.1	0.1	252.9	11.68	-77.2	3777.7	0.0	393.3	18.95	-326.4	2955.5	0.0	-188.7
4.59	43.5	890.5	0.1	260.8	11.87	-83.6	3849.1	0.0	378.4	19.14	-332.7	2804.1	0.0	-183.1
4.79	45.4	944.9	0.1	270.0	12.06	-89.9	3917.7	0.0	362.3	19.33	-339.7	2623.7	0.0	-175.5
4.98	47.1	995.4	0.1	278.5	12.25	-96.9	3990.3	0.0	343.0	19.52	-346.1	2454.3	0.0	-167.4
5.17	48.8	1047.6	0.1	287.4	12.44	-103.3	4052.1	0.0	324.5	19.71	-352.4	2276.0	0.0	-158.1
5.36	50.6	1107.5	0.1	297.6	12.63	-109.6	4110.5	0.0	304.7	19.91	-359.5	2088.9	0.0	-146.4
5.55	52.3	1163.3	0.1	307.2	12.82	-116.6	4170.9	0.0	281.5	20.10	-365.8	1892.7	0.0	-134.7
5.74	54.0	1220.8	0.1	317.0	13.02	-123.0	4221.1	0.0	259.3	20.29	-372.1	1687.2	0.0	-121.8
5.93	55.9	1286.9	0.1	328.3	13.21	-129.3	4267.1	0.0	235.9	20.48	-379.2	1444.9	0.0	-106.1
6.12	57.5	1348.4	0.1	338.8	13.40	-135.6	4308.6	0.0	211.4	20.67	-385.5	1219.4	0.0	-90.7
6.32	59.2	1411.9	0.1	349.6	13.59	-142.7	4349.4	0.0	182.7	20.86	-391.8	1014.1	0.0	-74.2
6.51	61.1	1484.8	0.1	361.9	13.78	-149.0	4380.9	0.0	155.7	21.05	-398.9	739.2	0.0	-54.4
6.70	62.8	1552.6	0.1	373.4	13.97	-155.4	4407.4	0.0	127.5	21.25	-405.2	484.1	0.0	-35.4
6.89	64.5	1622.5	0.1	385.2	14.16	-162.4	4430.6	0.0	94.9	21.44	-411.5	218.9	0.0	-15.2
7.08	59.6	1702.8	0.1	398.2	14.36	-168.7	4445.6	0.0	64.2	21.63	-417.2	-21.6	0.0	3.7

415 South Transit Street
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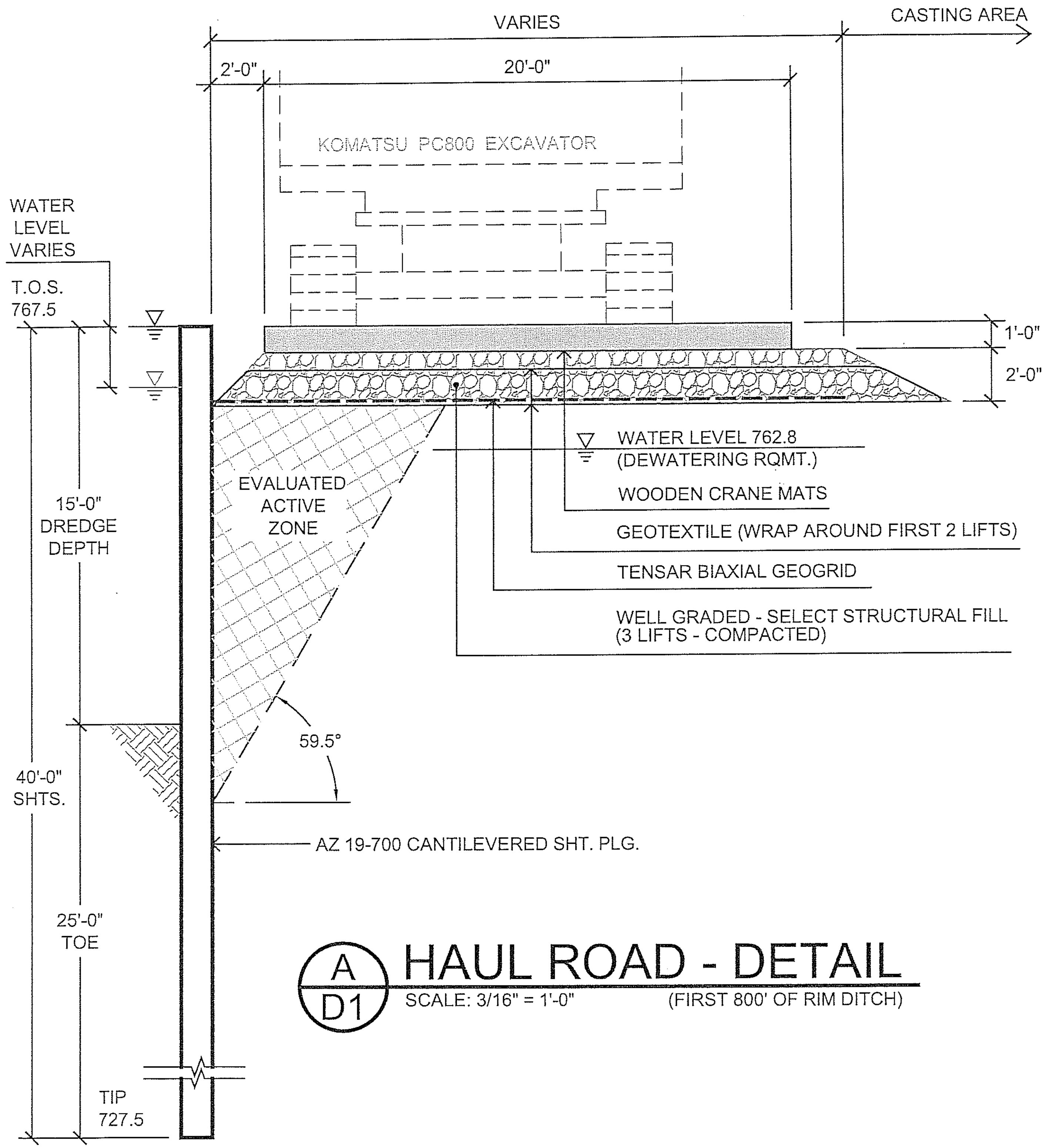

GGE
ENGINEERING • DESIGN

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415 S. TRANSIT STREET
LOCKPORT, NEW YORK 14094
VOICE (716) 625 - 6933 / FAX (716) 625-6983
www.glynngroup.com

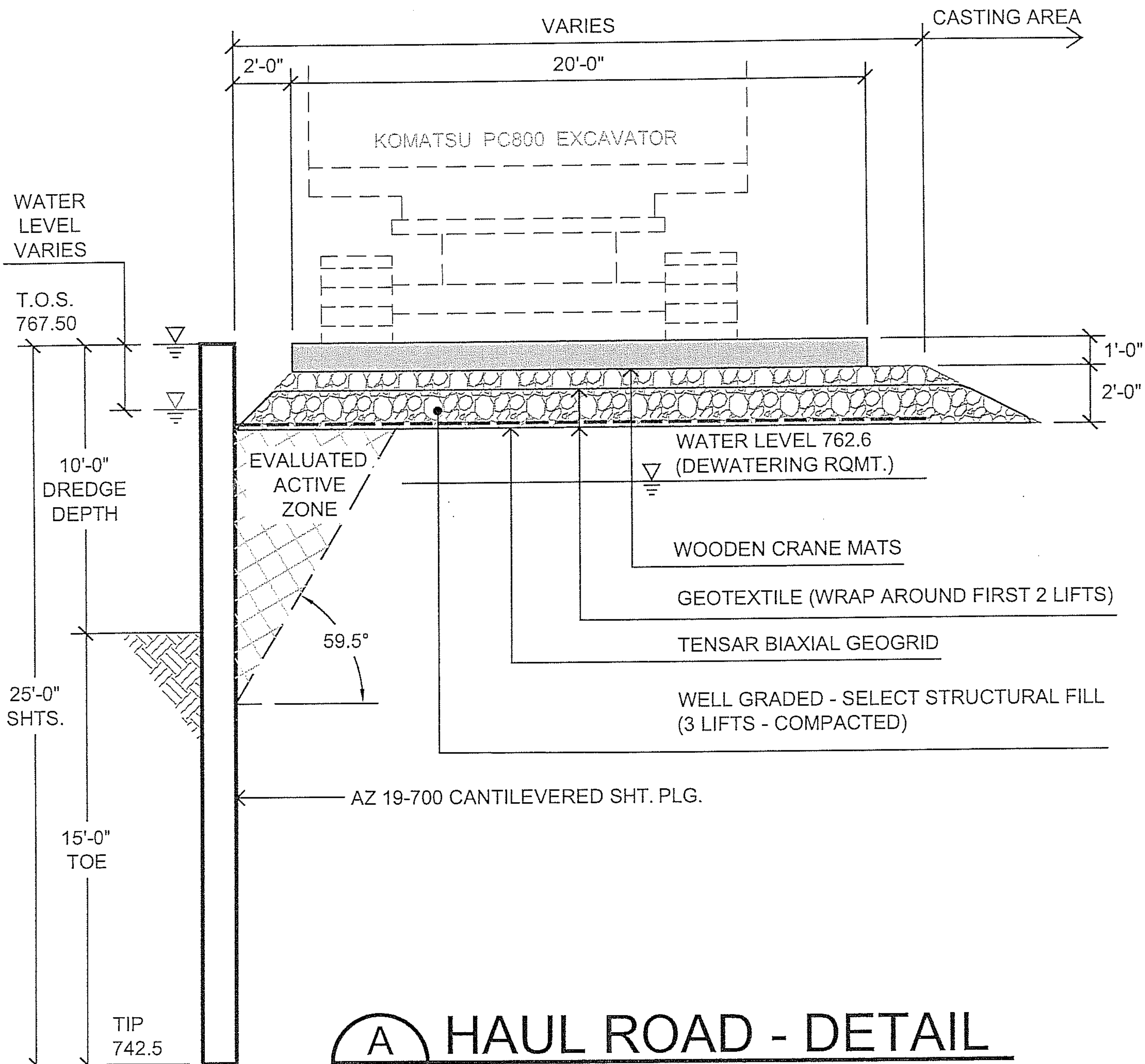
PROJECT: KINGSTON FOSSIL PLANT

SUBJECT: HAUL ROAD DETAIL (FIRST 800 LF)

CLIENT: SEVENSON ENVIRONMENTAL SERVICES, INC.

PROJ. NO.:	SCALE:	DATE:	BY:
09-1103	3/16" = 1'-0"	7.17.09	MJL

SHEET NO.: D1



A/D2 HAUL ROAD - DETAIL

SCALE: 3/16" = 1'-0" (LAST 1000' OF RIM DITCH)

GGE ENGINEERING • DESIGN	PROJECT: KINGSTON FOSSIL PLANT				SHEET NO.: D2
GLYNN GEOTECHNICAL ENGINEERING 415 S. TRANSIT STREET LOCKPORT, NEW YORK 14094 VOICE (716) 625 - 6933 / FAX (716) 625-6983 www.glynngroup.com	SUBJECT: HAUL ROAD DETAIL (LAST 1000 LF)				
	CLIENT: SEVENSON ENVIRONMENTAL SERVICES, INC.				
	PROJ. NO.: 09-1103	SCALE: 3/16" = 1'-0"	DATE: 7.17.09	BY: MJL	

Access Channel Construction and Debris Removal Operations Work Plan

1.0 Purpose

Hydraulic dredging of the ash is being severely impeded by the large amount of debris in the ash. The three dredges in operation are supported by debris removal barges with heavy equipment on board to remove trees and other objects from the dredge area. There is not enough draft to allow the debris removal operation to proceed in front of the dredges. Thus, when debris is encountered, the operators must raise the cutterhead and move to an alternate area. The debris removal barge moves in to remove the object and then the dredge operator moves back to dredge the skipped area. This constant shifting position is greatly impeding progress.

This work plan addresses mechanical dredging and debris removal to allow greater access into Segment 1, immediately east of Dike 2, such that hydraulic dredging productivity will be increased.

2.0 Design

There is no design document associated with this activity.

3.0 Construction

A barge mounted clamshell excavator will be used to cut an access channel approximately 60 feet wide and 10 feet below the water surface on the main river channel in a north to south fashion up the entire length of Segment 1. Debris and incidental ash will be pulled and loaded onto material barges that are fitted with 8" pipe to retain material and turbidity curtains. Ash removed to create the channel will be deposited in the material barge. Once the channel is established, dredging can proceed with the debris barges providing support from the front. Turbidity curtains will be deployed around the debris removal operations. Debris and ash will be off-loaded at the north barge off-loading station. Debris will be segregated at the station and transported to the debris processing station near the gypsum pond construction site. Any ash removed with the debris will be transported by truck to the ash processing area. Once the 60 ft channels is cut, a debris removal excavator barge may be used to supplement debris removal in other areas in Segment 1, using previously defined methods of collection of debris, ash, and turbidity curtains.

Attachment 1 provides visual aides to describe this operation. Best management practices to control turbidity during this operation include material control measures at the north barge off-loading station, localized turbidity control in the excavation/removal area, and water flow control in the area between the sand bar and Dike 2.

The north barge off-loading station will have rock berm on the south and west sides to contain off-loaded debris and ash. The eastern portion will be protected with barges and a floating silt barrier (5-6' deep).

Localized turbidity control will be managed with floating curtains in the work area. In addition, the ash plug itself will act as a baffle to minimize downstream flow of turbid water.

River water flow through the work area between the sand bar and Dike 2 will be controlled with a series of floating silt barriers (5-6' deep) to reduce water velocity through the work area and channel river flow into the silt barriers. A sketch of the proposed silt barrier layout is provided in Attachment 1.

4.0 Schedule

Construction of the access channel will begin on June 1, 2009 and should be complete in 4 weeks.

5.0 Waste Management

Incidental ash removed from the river with debris will be segregated and transported to the Ash processing and storage area. Debris generated will be segregated and transported to the Gypsum pond area for grinding/shredding.

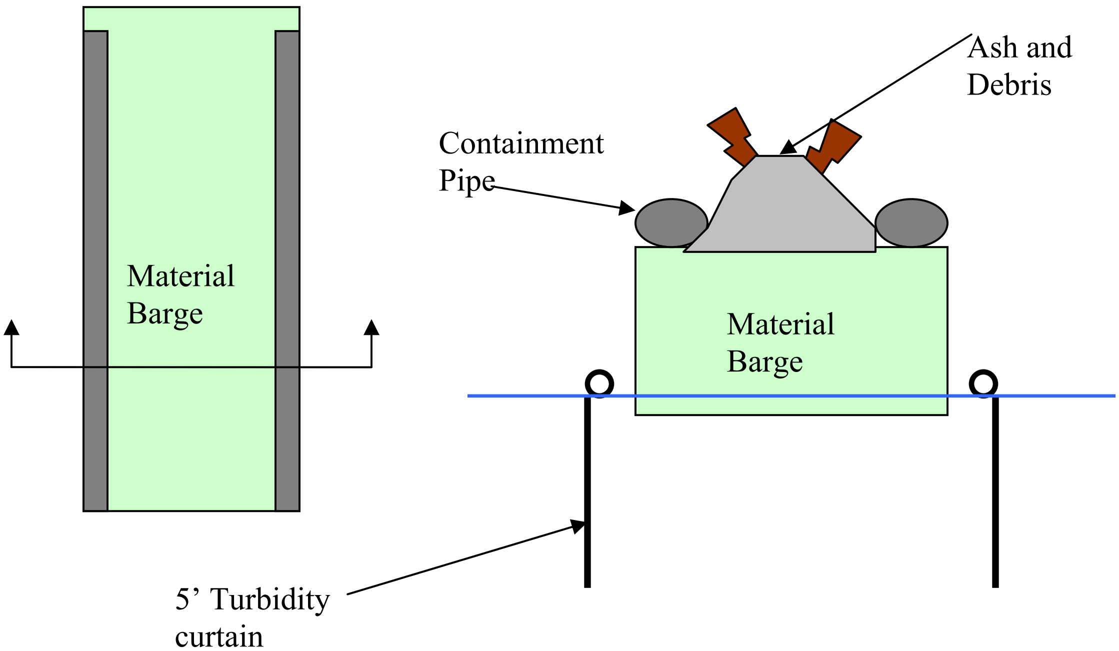
6.0 Health and Safety

The activities in this work plan will follow the site-wide health and safety plan.

Attachment 1

Example photo of debris removal

Sketch of Material Barge




North Barge Off-loading Station
Series of floating silt barriers to manage water flow
Access Channel Construction Area
Sand Bar

Appendix A

Appendix A provides the sampling locations, tests, and test procedures used to collect and analyze the daily water samples collected from the Rim Ditch and Sluice Trench.

Appendix A

A.1 Water Sample Collection Locations

Six (6) water samples were collected once per day (when dredges were operating) during the period March 21 through May 07, 2009.

- RD1 – Collected from two feet below water surface at the south end of the Rim Ditch in the vicinity of the dredge influent pipes. This sample was considered representative of the dredged ash slurry entering the Rim Ditch.
- RD2 – Collected from two feet below water surface approximately 600-feet (or 1/3rd of the Rim Ditch length) downstream of RD1. This sample was considered representative of the water quality/settling performance of the Rim Ditch.
- RD3 – Collected from two feet below water surface approximately 1,200-feet (or 2/3^{rds} of the Rim Ditch length) downstream of RD1. This sample was considered representative of the water quality/settling performance of the Rim Ditch.
- RD4 – Collected from two feet below water surface at the downstream end of the Rim Ditch. This sample was considered representative of the water quality/settling performance of the Rim Ditch.
- ST1 – Collected from two feet below water surface at the upstream end of the Sluice Trench in the vicinity of the KIF plant ash sluice discharge pipes. This sample was considered representative of the water quality at the inlet of the Sluice Trench prior to mixing with the discharge from the Rim Ditch.
- ST2 – Collected from two feet below water surface approximately 1,800-feet (or 2/3^{rds} of the Sluice Trench) downstream of ST1. This sample was considered representative of the water quality/settling performance of the Sluice Trench after mixing with the discharge from the Rim Ditch.

Sample locations are indicated on Figure A1.

For samples RD1 through RD4, ST1, and ST2, a sampling device was constructed by suspending a ¼ Hp electric submersible pump (with a 1/8" intake screen) 2 feet below the water level in the center of the water body at each sampling location. Attached to the pump was a 50 foot long hose that transferred the sample water to a 5 gallon bucket on the bank. Each bucket was rinsed thoroughly for 1 – 2 minutes prior to filling to remove foreign matter in the bucket and in the hose and to insure that the previous sample material was flushed from the system.

An additional Sluice Trench water sample (ST3) was collected once per day (when dredges were operating) during the period April 8 through May 7, 2009. Sample ST3 was collected from the discharge end of the Sluice Trench and was considered representative of the water quality

entering the Settling Pond. Sample ST3 was collected as a grab sample by laying a 5 gallon bucket horizontally on the water surface and filling at least halfway with water.
The sample location is indicated on Figure A1.

An additional Rim Ditch water sample (RDF) was collected once per day (when dredges were operating) during the period April 21 through May 7, 2009. Sample RDF was collected from the Rim Ditch discharge flume and was considered representative of the water quality entering the Sluice Trench from the Rim Ditch. Sample RDF was collected as a grab sample by laying a 5 gallon bucket horizontally on the water surface and filling at least halfway with water.
The sample location is indicated on Figure A1.

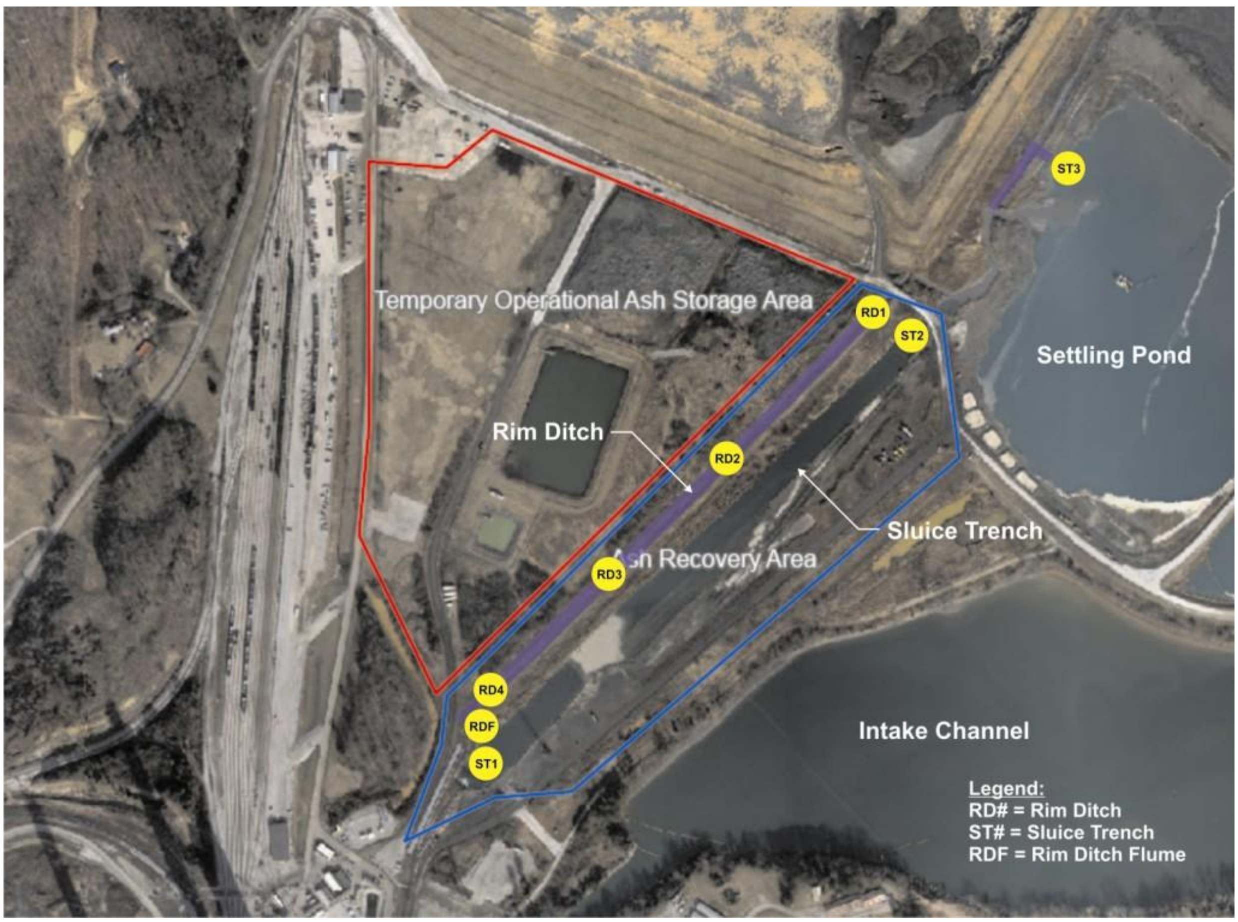


Figure A1: Daily sampling locations

A.2 Tests and Test Procedures

The following tests were performed on the daily samples:

- Turbidity using a LaMotte 2020 Turbidimeter;
- Total Suspended Solids in accordance with Standard Method 208 D;
- Percent Solids (by weight) testing in accordance with ASTM D2216; and
- Grain Size Analysis in accordance with ASTM D 422.

A.2.1 Turbidity Test

The 5-gallon bucket sample was stirred rigorously until all solids were suspended. A 15-mL turbidity jar was then filled with the stirred sample water, wiped dry with a once-used paper towel, and placed inside the LaMotte 2020 Turbidimeter. The value displayed was recorded and the turbidity jar was removed, shaken, and placed back into the Turbidimeter two more times, each time the displayed value was recorded. All three values were recorded and an average value calculated.

Figure A2: LaMotte 2020 Turbidimeter & 15mL Turbidity Jar

A.2.2 Total Suspended Solids (TSS) Test

Total Suspended Solids (TSS) testing was performed in accordance with Standard Method 208 D. The following is a general description of the procedure:

1) Prior to the test, a 70mm diameter glass microfiber filter paper was labeled, placed in a 220°F (104°C) constant temperature oven for 12 to 24-hours, removed from the oven and allowed to cool to room temperature, and weighed to the nearest thousandth of a gram.

2) The 5-gallon bucket sample was stirred rigorously until all solids were suspended. An 85 to 100-mL sample of the stirred sample water was obtained and filtered through the filter paper using a vacuum pump.

3) The wet filter paper with solids was then placed back in the oven to dry for 12 to 24 hours, removed from the oven and allowed to cool to room temperature, and then weighed.

4) The dry weight of the solids was then calculated as follows:

    a) Dry Solids, g = (Dry Filter and Solids, g) – (Filter, g)

5) The TSS was then calculated as follows:

    a) TSS, mg/L = (Dry Solids, g) x (1,000 mg/g) / (Sample Volume, mL) x (1,000 mL/L)

Due to the constraints of Standard Method 208 D, for samples with estimated TSS concentrations greater than 10,000 mg/L, this test was not performed. Rather, the TSS concentration was calculated based on the calculated percent solids (reference Section A.2.3).

Figure A3: Assembled TSS equipment

A.2.3 Percent Solids (by weight) Test

Percent Solids (by weight) testing was performed in accordance with ASTM D2216 (water content test). The following is a general description of the procedure:

1) Prior to the test, a 100-mL glass beaker was weighed to the nearest hundreth of a gram.

2) The 5-gallon bucket sample was stirred rigorously until all solids were suspended. An 85 to 100-mL sample of the stirred sample water was placed in the weighed beaker.

3) The beaker and sample were then weighed to the nearest hundreth of a gram, placed in a 220°F (104°C) constant temperature oven for 12 to 24-hours, removed from the oven and allowed to cool to room temperature, and weighed to the nearest hundreth of a gram.

4) The wet sample mass calculated as follows:

   a) Wet Sample, g = (Wet Solids and Beaker, g) – (Beaker, g)

4) The dry weight of the solids was calculated as follows:

a) Dry Solids, g = (Dry Solids and Beaker, g) – (Beaker, g)

5) The percent solids (by weight) was calculated as follows:

a) % Solids (by Weight) = (Dry Solids, g) / (Wet Sample Mass, g) x 100

6) The TSS was then calculated as follows:

a) TSS, mg/L = % Solids (by Weight)/100 % * 1,000,000 ppm (parts/million) * 1 mg/L/ 1 ppm.

A.2.4 Grain Size Analysis Tests

A Grain Size Analysis (GSA) was performed on selected samples following ASTM D 422, including sieve and hydrometer analysis.

The Sieve analysis used standard sieve sizes as summarized in Table A1.

Table A1: Standard Sieve Mesh Sizes vs. Opening Sizes

Mesh Size	Opening Size		
	Metric		U.S. Standard
	[mm]	[microns]	[inches]
No. 4	4.75	4750	0.1870
No. 10	2.00	2000	0.0787
No. 20	0.850	850	0.0331
No. 40	0.425	425	0.0165
No. 60	0.250	250	0.0098
No. 140	0.106	106	0.0041
No. 200	0.075	75	0.0029

The hydrometer analysis was conducted to delineate particle sizes finer than the No. 200 mesh sieve.

Appendix B Cover Page

Appendix B combines all the Rim Ditch and Sluice Trench Water Quality data collected by Hard Hat Services Inc. from the site between March 21, 2009 and May 7, 2009. This data includes:

- Total Suspended Solids (TSS) Data
- Turbidity Data
- Percent Solids (by weight & by volume)
- Grain Size Analysis Data, including:
  - Sieve Analysis Data
  - Hydrometer Analysis Data
  - Particle Size Distribution Graphs

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Appendix C

Appendix C provides details for the performance calculations summarized in this Report.

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Appendix C
Performance Calculations

A. Excavation Rate from Rim Ditch Based on Observed Operation (reference Section 2)

1) Assumptions,

a) Backhoe bucket size (heaped) = 2.5 CY
b) Dip rate = 40 seconds/dip
c) Efficiency = 50 minutes/hour

2) Calculations,

a) Slurry Removal Rate, CY/day/backhoe

(2.5 CY slurry/dip) / (40 sec/dip) x (60 sec/min) x (50 min/hr) x (20 hrs/day) = 3,750 CY/day of slurry

B. Estimate of Slurry Volume deposited in Sluice Trench (reference Section 4.4)

1) *Assumptions,*

a) Rim Ditch slurry contains 30 percent fly ash (by weight); corresponding to a 14 percent fly ash (by volume).
b) Rim Ditch slurry SG = 1.22
c) Total Solids Deposited (3/21 thru 4/16) = 0.68 MLbs
d) Total Solids Deposited (4/21 thru 5/7) = 27.21 MLbs

2) Calculations,

a) Rim Ditch slurry weight, Lbs/CY

(1.22) x (62.4 Lbs/ft^3) x (27 ft^3/CY) = 2,055 Lbs/CY

b) Slurry Volume (3/21 thru 4/16), CY

(0.68 MLbs ash] / (0.30 Lbs ash/Lb slurry) / (2,055 Lbs slurry/CY) = 1,200 CY slurry

c) Slurry Volume (3/21 thru 4/16), CY

(27.21 MLbs ash] / (0.30 Lbs ash/Lb slurry) / (2,055 Lbs slurry/CY) = 50,000 CY slurry

C. Estimate of Production Rates Based for Q_{MAX} (reference Section 4.5):

1) Assumptions,
   a) Fly ash specific gravity (SG) = 2.6.
   b) Settled fly ash sediment deposited in the Emory River contains 70 percent fly ash (by weight); corresponding to a 47 percent fly ash (by volume); corresponding to a SG of 1.76.
   c) Dredge slurry contains 8.4 percent fly ash (by weight); corresponding to 3.4 percent fly ash (by volume); corresponding to a SG of 1.05.
   d) Rim Ditch slurry:

% Ash (by weight)	% Ash (by Volume)	SG
40	20.4	1.33
50	27.8	1.44
60	36.6	1.59
70	47.3	1.76

   e) Rim Ditch solids removal rate of 90 percent.
   f) Backhoe Rim Ditch slurry removal rate of 3,750 CY/day.

2) Calculations,

   a) Total Solids Production, MLbs/day

[(11.85 x 0.0344)MGD Ash] x [(2.6 x 8.34) lbs/gal Ash] = 8.8 MLbs/day of ash

   b) Sediment weight, Lbs/CY

(1.76) x (62.4 Lbs/ft^3) x (27 ft^3/CY) = 2,965 Lbs/CY

   c) Sediment Removal Rate, CY/day

(8.8 MLbs ash/day) / (0.70 Lbs ash/Lb sediment) / (2,965 Lbs sediment/CY) = 4,240 CY sediment/day

   d) Rim Ditch slurry weight, Lbs/CY

(SG) x (62.4 Lbs/ft^3) x (27 ft^3/CY)

% Ash (by weight)	Lbs/CY
40	2,235
50	2,434
60	2,671
70	2,960

e) Rim Ditch slurry accumulation rate, CY/day

[(8.8 x .90) MLbs ash/day] / (% weight Lbs ash/Lb slurry) / (Lbs slurry/CY)

% Ash (by weight)	CY/Day
40	8,859
50	6,509
60	4.942
70	3,823

f) Required Backhoes

(CY slurry/day) / (3,750 CY slurry/day-backhoe) = 4.08 backhoes

% Ash (by weight)	backhoes
40	2.36
50	1.74
60	1.32
70	1.01

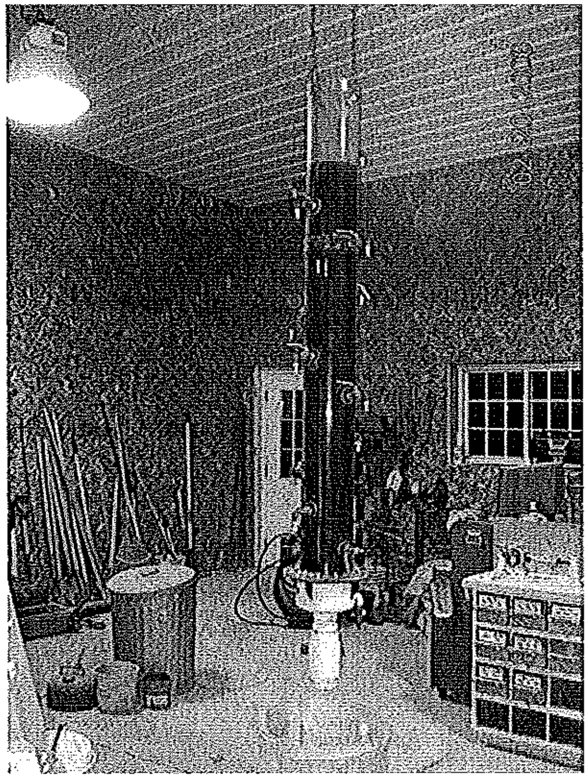


Photo 1) Settling Column During Test

Photo 2) Settling Column Showing Sediment Interface

Harrington Engineering & Construction, LLC
A HARD HAT SERVICES Company

Settling Data

Project Name: Alliant - Sutherland Generating Station

Project No.: 154.006.002

Logged By: TJH

Sample ID: SW (southwest corner of ash settling pond)

Date: Feb 13, 2006 through Feb. 21, 2006

Column Height = 84.50 inches Temperature: 50 °F

Date/ Time	Time Interval	Interface Height	Depth to Interface	At 21"		At 27"		At 45"		At 57"		At 63"	
				TSS	Turbidity	TSS	Turbidity	TSS	Turbidity	TSS	Turbidity	TSS	Turbidity
2/13/06 14:56	0:00:00	74.25	10.25										
2/13/06 19:00	4:04:00	30.00	54.50	2,230	>1,100			4,785	>1,100				
2/13/06 21:45	6:49:00	21.50	63.00	1,250	>1,100					2,041	>1,100		
2/14/06 6:00	15:04:00	16.75	67.75	600	850					653	>1,100		
2/14/06 18:30	27:34:00	15.13	69.38	346	648							480	717
2/15/06 7:00	40:04:00	14.25	70.25	192	409							600	572
2/15/06 19:00	52:04:00	13.88	70.63	184	320							256	438
2/16/06 7:00	64:04:00	13.50	71.00	153	276							236	390
2/16/06 18:30	75:34:00	13.38	71.13	166	275							212	378
2/17/06 7:00	88:04:00	13.25	71.25	144	324							191	303
2/17/06 19:00	100:04:00	13.13	71.38	100	152							146	352
2/18/06 8:00	113:04:00	13.00	71.50	91	135								
2/18/06 19:00	124:04:00	13.00	71.50	128	140								
2/19/06 19:00	148:04:00	12.88	71.63	95	162								
2/20/06 19:00	172:04:00	12.88	71.63	88	289								
2/21/06 19:00	196:04:00	12.81	71.69	166	328								

Harrington Engineering & Construction, LLC
A HARD HAT SERVICES™ Company

Settling Data

Project Name: Alliant - Sutherland Generating Station

Project No.: 154.006.002

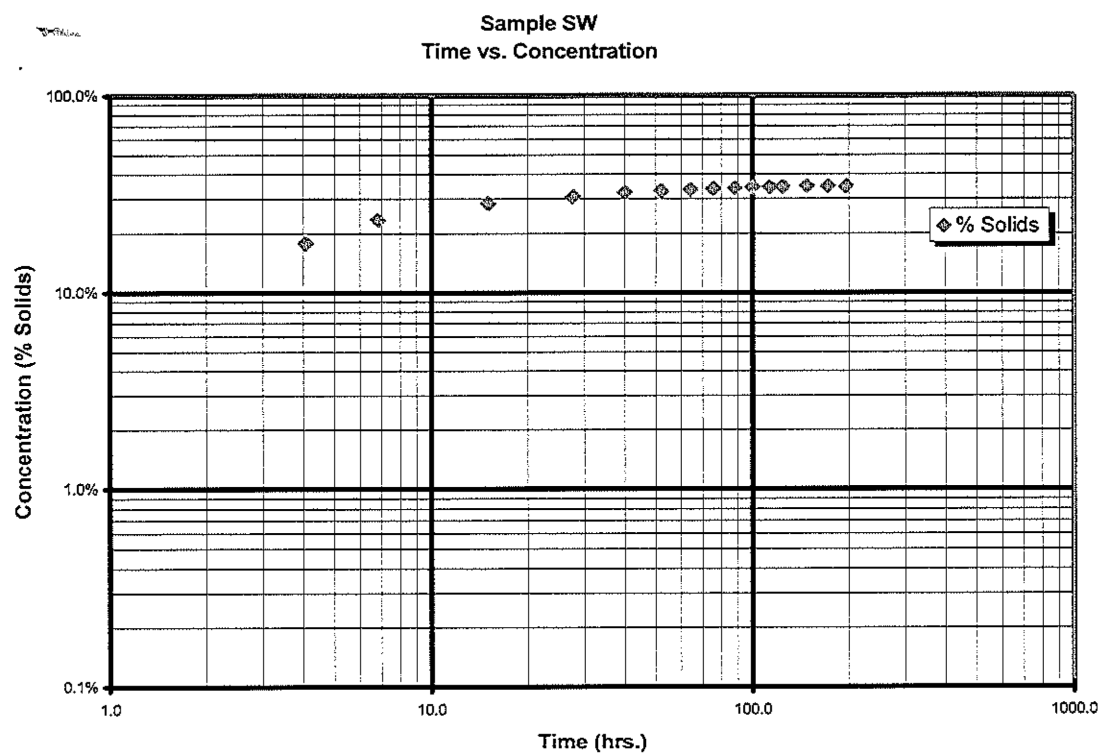
Logged By: TJH

Sample ID: SW (southwest corner of bottom ash settling pond)

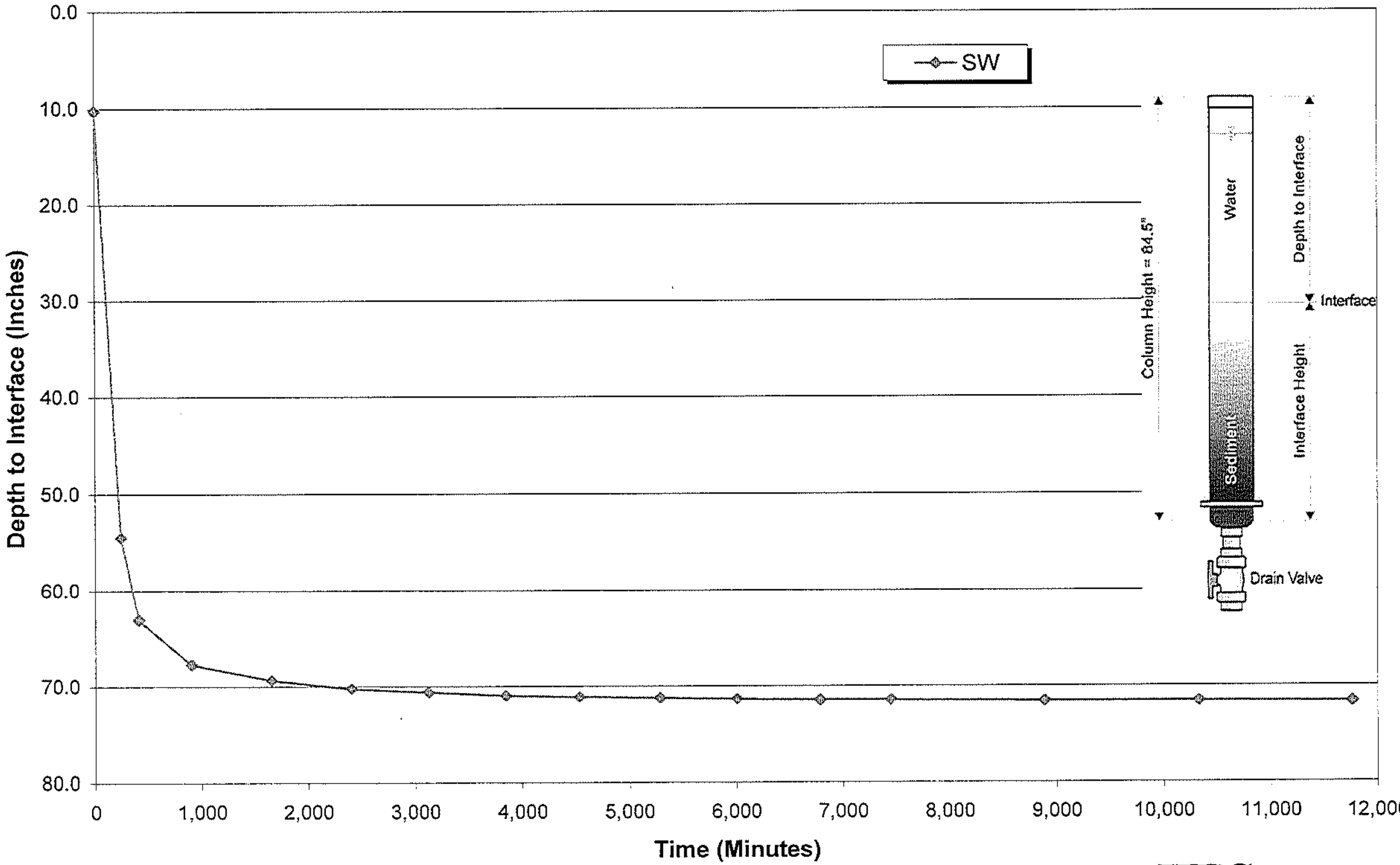
Date: Feb 13, 2006 through Feb. 21, 2006

Initial Solids 7.9%   Temperature: 50 °F

Date/ Time	Time Interval	Interface Height	Concentration %
2/13/06 14:56	0:00:00	74.25	7.9%
2/13/06 19:00	4:04:00	30.00	17.8%
2/13/06 21:45	6:49:00	21.50	23.4%
2/14/06 6:00	15:04:00	16.75	28.5%
2/14/06 18:30	27:34:00	15.13	30.7%
2/15/06 7:00	40:04:00	14.25	32.1%
2/15/06 19:00	52:04:00	13.88	32.7%
2/16/06 7:00	64:04:00	13.50	33.4%
2/16/06 18:30	75:34:00	13.38	33.6%
2/17/06 7:00	88:04:00	13.25	33.8%
2/17/06 19:00	100:04:00	13.13	34.0%
2/18/06 8:00	113:04:00	13.00	34.3%
2/18/06 19:00	124:04:00	13.00	34.3%
2/19/06 19:00	148:04:00	12.88	34.5%
2/20/06 19:00	172:04:00	12.88	34.5%
2/21/06 19:00	196:04:00	12.81	34.6%



Settling Curve - SW



HEC
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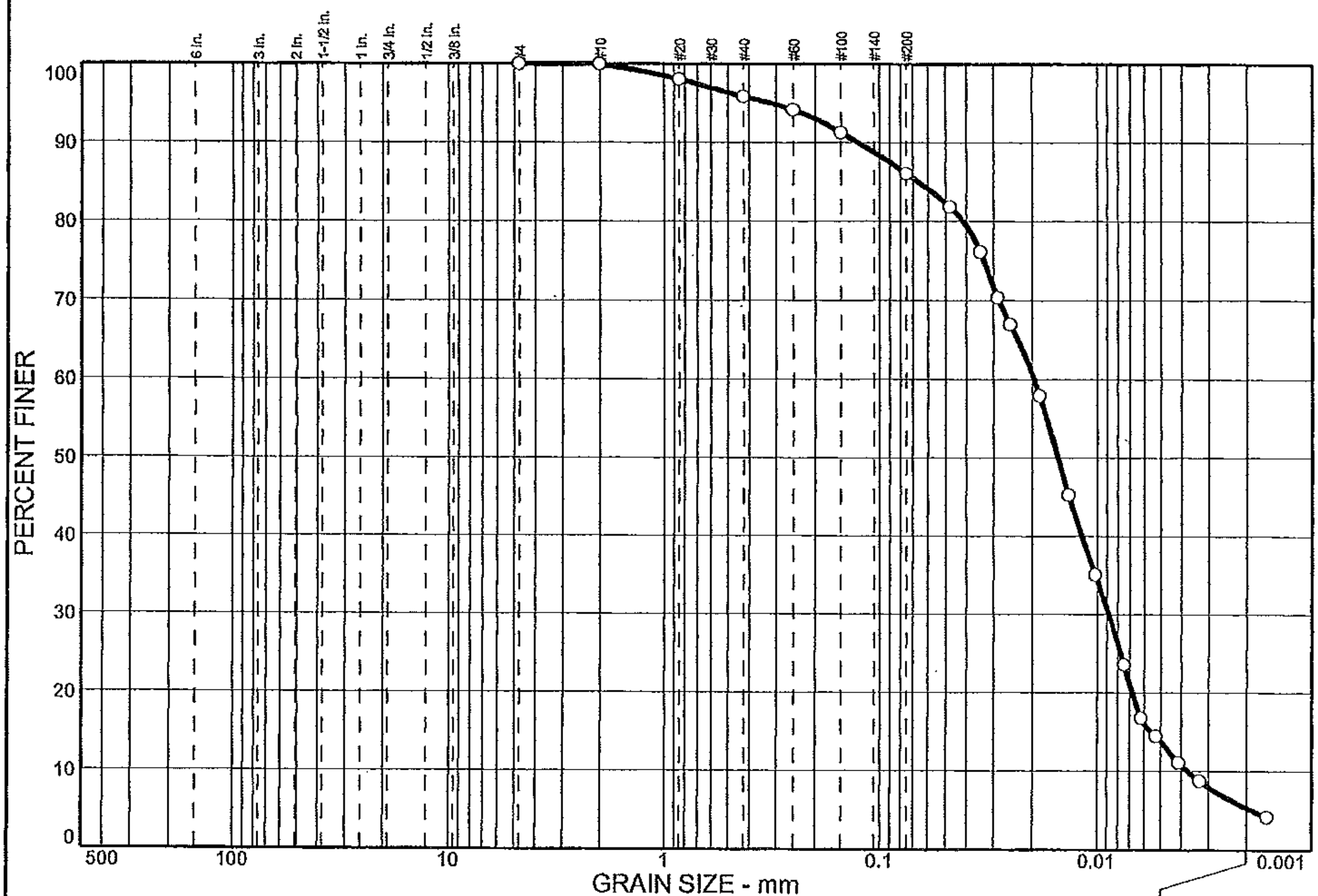
Particle Size Distribution Report



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	13.9	80.7	5.4

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	100.0		
#20	98.1		
#40	95.9		
#60	94.2		
#100	91.3		
#200	86.1		

* (no specification provided)

Soil Description

BLACK CLAYEY SILT, LITTLE SAND

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 0.0658 D_{60}= 0.0196 D_{50}= 0.0152
D_{30}= 0.0088 D_{15}= 0.0055 D_{10}= 0.0037
C_u= 5.23 C_c= 1.06

Classification

USCS= AASHTO=

Remarks

LOI = 16.9%

Sample No.: SW **Source of Sample:** **Date:** 2/17/06
Location: IOWA **Elev./Depth:**

Weaver Boos Consultants, LLC

Client: HARRINGTON ENG.
Project: MISC. LAB TESTS (HEC # 154.006.002)
Project No: 0744351-20 **Plate**

GRAIN SIZE DISTRIBUTION TEST DATA

:lient: HARRINGTON ENG.
'roject: MISC. LAB TESTS (HEC # 154.006.002)
'roject Number: 0744351-20

Sample Data

iource:
iample No.: SW
:lev. or Depth: Sample Length (in./cm.):
ocation: IOWA
escription: BLACK CLAYEY SILT, LITTLE SAND
ate: 2/17/06 PL: LL: PI:
'SCS Classification: AASHTO Classification:
esting Remarks:

Mechanical Analysis Data

	Initial
ry sample and tare=	154.31
are =	0.00
ry sample weight =	154.31

ample split on number 10 sieve
plit sample data:
Sample and tare = 49.10 Tare = .00 Sample weight = 49.10
Cumulative weight retained tare= .00
are for cumulative weight retained= .00

Sieve	Cumul. Wt. retained	Percent finer
# 4	0.00	100.0
# 10	0.06	100.0
# 20	0.95	98.1
# 40	2.03	95.9
# 60	2.83	94.2
# 100	4.26	91.3
# 200	6.82	86.1

Hydrometer Analysis Data

eparation sieve is #10
ercent -#10 based upon complete sample= 100.0
eight of hydrometer sample: 49.10
alculated biased weight= 49.10
utomati: temperature correction
Composite correction at 20 deg C = -6.5

niscus correction only= 1.0
ecific gravity of solids= 2.25
ecific gravity correction factor= 1.121
'drometer type: 152H
Effective depth L= 16.294964 - 0.164 x Rm

Elapsed time, min	Temp, deg C	Actual reading	Corrected reading	K	Rm	Eff. depth	Diameter mm	Percent finer
1.00	19.5	42.5	35.9	0.0158	43.5	9.2	0.0477	81.9
2.00	19.5	40.0	33.4	0.0158	41.0	9.6	0.0345	76.2
3.00	19.5	37.5	30.9	0.0158	38.5	10.0	0.0288	70.4

Elapsed time, min	Temp, deg C	Actual reading	Corrected reading	K	Rm	Eff. depth	Diameter mm	Percent finer
4.00	19.5	36.0	29.4	0.0158	37.0	10.2	0.0252	67.0
8.00	19.5	32.0	25.4	0.0158	33.0	10.9	0.0184	57.9
16.00	19.5	26.5	19.9	0.0158	27.5	11.8	0.0135	45.3
30.00	19.5	22.0	15.4	0.0158	23.0	12.5	0.0102	35.1
60.00	19.5	17.0	10.4	0.0158	18.0	13.3	0.0074	23.6
90.00	19.5	14.0	7.4	0.0158	15.0	13.8	0.0062	16.8
125.00	19.5	13.0	6.4	0.0158	14.0	14.0	0.0053	14.5
210.00	19.5	11.5	4.9	0.0158	12.5	14.2	0.0041	11.1
330.00	19.5	10.5	3.9	0.0158	11.5	14.4	0.0033	8.8
1410.00	19.5	8.5	1.9	0.0158	9.5	14.7	0.0016	4.2

Fractional Components

ravel/Sand based on #4
and/Fines based on #200
COBBLES = % GRAVEL = % SAND = 13.9
SILT = 80.7 % CLAY = 5.4

85= 0.07 D_{60}= 0.02 D_{50}= 0.02
30= 0.01 D_{15}= 0.01 D_{10}= 0.00
c= 1.059 C_u= 5.2287

Appendix E

Appendix E features two simulations provided by FLSmidth Krebs. These simulations provide a measure of the effectiveness expected by the operation of the specified hydrocyclone based on different Percent Solids (by weight) inlet Feed parameters.

KREBS ENGINEERS

SHEET: 1

DATE: 24-Feb-09

BY: BMB

Client: Hard Hat Services

Problem: Separate fly ash from water

Number, Model Krebs Cyclones: 1 operating Mode GMAX6U Krebs Cyclone

	Inlet Area	Vortex Finder	Apex	Pressure Drop
Orifices:	3.3 sq. in.	1.75 in.	1.0 in	30 PSI

Specific Gravity: Solids: 2.6 Liquid: 1.0 Temperature: Amb.°F Viscosity: 1 cP

	FEED	OVERFLOW	UNDERFLOW
STPH Solids	5.1	0.2	4.9
STPH Liquids	41.6	33.6	8.0
STPH Slurry	46.7	33.8	12.9
Wt Solids	11.0	0.7	38.0
S.G. Slurry	1.073	1.004	1.305
Vol% Solids	4.5	0.3	19.1
GPM Slurry	174	134	40
M3/Hr. Slurry	40	31	9

Ref: 10.2 4.0 53.0

	Micron	FEED			OVERFLOW			UNDERFLOW			ACT.	
		Cum. % +	Ind. % +	STPH	Cum. % +	Ind. % +	STPH	Cum. % +	Ind. % +	STPH	REC.	
	850	0.9	0.9	0.0	0.0	0.0	0.0	0.9	0.9	0.0	100.0	
	425	3.3	2.4	0.1	0.0	0.0	0.0	3.5	2.5	0.1	100.0	
	250	5.3	2.0	0.1	0.0	0.0	0.0	5.5	2.1	0.1	100.0	
	106	26.1	20.8	1.1	0.0	0.0	0.0	27.3	21.8	1.1	100.0	
	75	49.2	23.1	1.2	0.0	0.0	0.0	51.5	24.2	1.2	100.0	
	45	74.0	24.8	1.3	0.0	0.0	0.0	77.4	26.0	1.3	100.0	
	30	88.0	14.0	0.7	0.1	0.1	0.0	92.1	14.6	0.7	100.0	
	-30	100.0	12.0	0.6	100.0	99.9	0.2	100.0	7.9	0.4	63.1	
TOTAL				5.1			0.2			4.9	95.6	

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KREBS ENGINEERS

SHEET: 1
DATE: 27-Apr-09
BY: BMB

Client: Hard Hat Services

Problem: Separate fly ash from water

Number, Model Krebs Cyclones: 1 operating Model GMAX6U-3340 Krebs Cyclone

	Inlet Area	Vortex Finder	Apex	Pressure Drop
Orifices:	3.3 sq. in.	1.75 in.	1.0 in	40 PSI

Specific Gravity: Solids: 2.65 Liquid: 1.0 Temperature: Amb.°F Viscosity: 1 cP

	FEED	OVERFLOW	UNDERFLOW
STPH Solids	22.4	13.4	9.0
STPH Liquids	41.6	34.2	7.4
STPH Slurry	64.0	47.6	16.4
Wt Solids	35.0	28.1	55.0
S.G. Slurry	1.279	1.212	1.521
Vol% Solids	16.9	12.9	31.6
GPM Slurry	200.0	156.9	43.1
M3/Hr. Slurry	45.4	35.6	9.8

Ref: 14.1 4.0 53.0

		FEED			OVERFLOW			UNDERFLOW			ACT.
	Micron	Cum. % +	Ind. % +	STPH	Cum. % +	Ind. % +	STPH	Cum. % +	Ind. % +	STPH	REC.
	149.00	0.9	0.9	0.2	0.0	0.0	0.0	2.2	2.2	0.2	100.0
	75.00	1.2	0.3	0.1	0.0	0.0	0.0	3.0	0.7	0.1	100.0
	37.44	8.3	7.1	1.6	0.0	0.0	0.0	20.6	17.6	1.6	99.9
	27.13	12.2	3.9	0.9	0.1	0.1	0.0	30.1	9.5	0.9	98.0
	22.29	14.2	2.0	0.4	0.4	0.2	0.0	34.7	4.6	0.4	92.7
	19.53	16.2	2.0	0.4	0.9	0.5	0.1	38.9	4.2	0.4	85.6
	14.28	24.1	7.9	1.8	6.2	5.3	0.7	50.6	11.7	1.1	59.8
	10.98	35.9	11.9	2.7	17.8	11.7	1.6	62.8	12.2	1.1	41.2
	8.25	52.8	16.9	3.8	37.6	19.8	2.7	75.4	12.6	1.1	30.0
	6.13	65.0	12.2	2.7	53.0	15.4	2.1	82.8	7.4	0.7	24.3
	4.45	76.6	11.7	2.6	68.4	15.3	2.1	89.0	6.2	0.6	21.4
	3.08	86.1	9.5	2.1	81.1	12.7	1.7	93.7	4.7	0.4	19.8
	2.27	90.1	4.0	0.9	86.5	5.4	0.7	95.5	1.9	0.2	19.1
	-2.27	100.0	9.9	2.2	100.0	13.5	1.8	100.0	4.5	0.4	18.1
TOTAL				22.4			13.4			9.0	40.3

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Appendix F

Appendix F contains all the analytical data for the Alternative Dewatering Systems, which includes the Hydrocyclone tests and Geotextile bag tests. Tests performed are as follows:

- Percent Solids (by weight)
- Water Content at 24, 48, and 96 hours
- Grain Size Analysis by:
    - Sieve method
    - Hydrometer method
- Particle Size Distribution Curves

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TOTAL SUSPENDED SOLIDS AND TURBIDITY TESTS

SAMPLE DATE	Thursday, April 30, 2009		
TEST DATE	Friday, May 01, 2009		
TESTED BY	NEF		
PAGE	1	OF	1

PROJECT NAME	TVA/KIF Ash Recovery - Pilot Hydrocyclone Analysis	PROJECT No.	108.002.001
SAMPLE SOURCE	Samples were collected from the Hydrocyclone test.		
SAMPLING CONDITIONS	Sunny, 5 - 10 mph W/SW wind, mid 70's (°F)		

Test Data

Sample ID		FEED_01	UNDERFLOW_01	UNDERFLOW_02	UNDERFLOW_03	OVERFLOW_01	OVERFLOW_02	
Sample Specific Description		Cyclone & Geotube Influent @ 15:00	@ 15:00	180 GPM, 44 PSI @ 10:00	200 GPM, 44 PSI	@ 15:00	200 GPM, 44 PSI	
Sample Location		Cyclone Feed	Cyclone Underflow	Cyclone Underflow	Cyclone Underflow	Cyclone Overflow	Cyclone Overflow	
Settling Time (hours)		24	24	24	24	24	24	
Filter ID		-	-	-	-	-	-	
Sample Beaker ID		1	2	3	4	5	6	
Sample Bottle [ml]		-	-	-	-	-	-	
Turbidity Measurement [NTU]	Reading #1	-	-	-	-	-	-	
	Reading #2	-	-	-	-	-	-	
	Reading #3	-	-	-	-	-	-	
	Average	-	-	-	-	-	-	
Filter [grams]		-	-	-	-	-	-	
Dry Filter and Solids [grams]		-	-	-	-	-	-	
Dry Solids [grams]		-	-	-	-	-	-	
Solids by TSS [mg/l]		-	-	-	-	-	-	
Solids by % Solids [%]		**398,693**	**571,938**	**591,634**	**574,701**	**373,387**	**382,234**	

% Solids (by weight)

Sample ID	Beaker ID	Beaker Mass [grams]	Beaker + Wet Sample Mass [grams]	Wet Sample Mass [grams]	Beaker + Dry Sample Mass [grams]	Solids Mass [grams]	**% Solids (by weight) [%]**	**% Solids (by volume) [%]**
FEED_01	1	61.60	188.59	126.99	112.23	50.63	**39.87**	**20.01**
UNDERFLOW_01	2	60.18	203.08	142.90	141.91	81.73	**57.19**	**33.52**
UNDERFLOW_02	3	58.94	188.75	129.81	135.74	76.80	**59.16**	**35.35**
UNDERFLOW_03	4	61.71	205.75	144.04	144.49	82.78	**57.47**	**33.77**
OVERFLOW_01	5	59.40	171.00	111.60	101.07	41.67	**37.34**	**18.36**
OVERFLOW_02	6	59.00	192.74	133.74	110.12	51.12	**38.22**	**18.93**

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Water Content

Project	TVA/KIF Fly Ash Recovery - Hydrocyclone Test	Sampled by	NEF	Date	Thursday, April 30, 2009
Project No.	108.002.001	Tested by	NEF	Date	Saturday, May 02, 2009
Boring No.	N/A	Chkd. By	NEF	Date	Saturday, May 02, 2009
Sample No.	WC_01 (Geotube #1)	Depth	-		
Soil Description	Fly ash samples were collected from the Hydrocyclone test				

Sample Conditions:			
0 hours	13:30	4/30/09	Partly cloudy, 5+ mph variable wind, mid 70's (°F)
24 hours	14:30	5/1/09	Mostly cloudy, 5 - 15 mph S/SW wind, high 60's/low 70's (°F), 0.56 " precipitation since test was started
48 hours	14:00	5/2/09	Light rain, 0 - 5 mph W wind, mid 60's (°F), 1.1" precipation total
96 hours	15:00	5/4/2009	Mostly cloudy, 5 - 10 mph NW wind, high 60's (°F), 4.2" precipation total

Water Content [%]

Time Duration	24 Hours	48 Hours	96 Hours	
Beaker No.	11	18	11	
Mass of Beaker	281.20	203.54	281.17	grams
Mass of Beaker + Wet Specimen	605.88	595.69	591.28	grams
Mass of Wet Specimen	324.68	392.15	310.11	grams
Mass of Beaker + Dry Specimen	502.42	470.61	498.56	grams
Mass of Soil Solids	221.22	267.07	217.39	grams
Water Content	**46.8**	**46.8**	**42.7**	**%**

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Water Content

Project	TVA/KIF Fly Ash Recovery - Hydrocyclone Test	Sampled by	NEF	Date	Thursday, April 30, 2009
Project No.	108.002.001	Tested by	NEF	Date	Saturday, May 02, 2009
Boring No.	N/A	Chkd. By	NEF	Date	Saturday, May 02, 2009
Sample No.	WC_02 (Geotube #2)	Depth	-		
Soil Description	Fly ash samples were collected from the Hydrocyclone test				

Sample Conditions:			
0 hours	15:30	4/30/09	Mostly cloudy, 5 - 10 mph variable wind, mid 70's (°F)
24 hours	14:30	5/1/09	Mostly cloudy, 5 - 15 mph S/SW wind, high 60's/low 70's (°F), 0.56 " precipitation since test was started
48 hours	14:00	5/2/09	Light rain, 0 - 5 mph W wind, mid 60's (°F), 1.1" precipation total
96 hours	15:00	5/4/2009	Mostly cloudy, 5 - 10 mph NW wind, high 60's (°F), 4.2" precipation total

Water Content [%]

Time Duration	24 Hours	48 Hours	96 Hours	
Beaker No.	17	13	15	
Mass of Beaker	164.92	110.00	195.89	grams
Mass of Beaker + Wet Specimen	599.78	470.30	597.94	grams
Mass of Wet Specimen	434.86	360.3	402.05	grams
Mass of Beaker + Dry Specimen	456.81	361.79	472.19	grams
Mass of Soil Solids	291.89	251.79	276.3	grams
Water Content	**49.0**	**43.1**	**45.5**	%

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Water Content

Project	TVA/KIF Fly Ash Recovery - Hydrocyclone Test	Sampled by	NEF	Date	Thursday, April 30, 2009
Project No.	108.002.001	Tested by	NEF	Date	Saturday, May 02, 2009
Boring No.	N/A	Chkd. By	NEF	Date	Saturday, May 02, 2009
Sample No.	WC_03 (Open top box)	Depth	-		
Soil Description	Fly ash samples were collected from the Hydrocyclone test				

Sample Conditions:			
0 hours	13:30	4/30/09	Partly cloudy, 5+ mph variable wind, mid 70's (°F)
24 hours	14:30	5/1/09	Mostly cloudy, 5 - 15 mph S/SW wind, high 60's/low 70's (°F), 0.56 " precipitation since test was started
48 hours	14:00	5/2/09	Light rain, 0 - 5 mph W wind, mid 60's (°F), 1.1" precipation total
96 hours	15:00	5/4/2009	Mostly cloudy, 5 - 10 mph NW wind, high 60's (°F), 4.2" precipation total

Water Content [%]

Time Duration	24 Hours	48 Hours	96 Hours	
Beaker No.	15	14	18	
Mass of Beaker	195.63	106.63	203.13	grams
Mass of Beaker + Wet Specimen	597.67	503.99	573.29	grams
Mass of Wet Specimen	402.04	397.36	370.16	grams
Mass of Beaker + Dry Specimen	497.50	400.28	482.63	grams
Mass of Soil Solids	301.87	293.65	279.5	grams
Water Content	**33.2**	**35.3**	**32.4**	%

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Grain Size Analysis (Sieve Method)

Project	TVA/KIF Fly Ash Recovery - Pilot Dredge Analysis	Sampled by	NEF & JBW	Date	Thursday, April 30, 2009
Project No.	108.002.001	Tested by	NEF	Date	Tuesday, May 05, 2009
Boring No.	N/A	Chkd. By	NEF	Date	Tuesday, May 05, 2009
Sample No.	FEED_01	Depth	2 Feet		
Soil Description	Fly ash suspended in Rim Ditch water				

Sieve Analysis

Beaker ID	17	
Beaker Mass	165.20	grams
Beaker + Dry Sample Mass	416.47	grams
Dry Sample Mass	251.27	grams

Sieve Size	Sieve Opening [mm]	Cumulative Weight Retained [grams]	Percent Finer [%]
#4	4.750	0.00	100.0
#10	2.000	0.00	100.0
#20	0.850	0.07	100.0
#40	0.425	0.11	100.0
#60	0.250	0.31	99.9
#140	0.106	3.57	98.6
#200	0.075	8.82	96.5
Pan	--------	251.27	0.0

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Grain Size Analysis (Sieve Method)

Project	TVA/KIF Fly Ash Recovery - Pilot Dredge Analysis	Sampled by	NEF & JBW	Date	Thursday, April 30, 2009
Project No.	108.002.001	Tested by	NEF	Date	Tuesday, May 05, 2009
Boring No.	N/A	Chkd. By	NEF	Date	Tuesday, May 05, 2009
Sample No.	UNDERFLOW_01	Depth	2 Feet		
Soil Description	Fly ash suspended in Rim Ditch water				

Sieve Analysis

Beaker ID	17	
Beaker Mass	165.01	grams
Beaker + Dry Sample Mass	459.34	grams
Dry Sample Mass	294.33	grams

Sieve Size	Sieve Opening [mm]	Cumulative Weight Retained [grams]	Percent Finer [%]
#4	4.750	0.00	100.0
#10	2.000	0.00	100.0
#20	0.850	0.04	100.0
#40	0.425	0.14	100.0
#60	0.250	0.73	99.8
#140	0.106	5.60	98.1
#200	0.075	11.49	96.1
Pan	--------	294.33	0.0

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Grain Size Analysis (Sieve Method)

Project	TVA/KIF Fly Ash Recovery - Pilot Dredge Analysis	Sampled by	NEF & JBW	Date	Thursday, April 30, 2009
Project No.	108.002.001	Tested by	JBW	Date	Wednesday, May 06, 2009
Boring No.	N/A	Chkd. By	NEF	Date	Wednesday, May 06, 2009
Sample No.	UNDERFLOW_02	Depth	2 Feet		
Soil Description	Fly ash suspended in Rim Ditch water				

Sieve Analysis

Beaker ID	15	
Beaker Mass	195.45	grams
Beaker + Dry Sample Mass	459.40	grams
Dry Sample Mass	263.95	grams

Sieve Size	Sieve Opening [mm]	Cumulative Weight Retained [grams]	Percent Finer [%]
#4	4.750	0.00	100.0
#10	2.000	0.00	100.0
#20	0.850	0.10	100.0
#40	0.425	0.95	99.6
#60	0.250	2.05	99.2
#140	0.106	5.70	97.8
#200	0.075	10.75	95.9
Pan	--------	263.95	0.0

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Grain Size Analysis (Sieve Method)

Project	TVA/KIF Fly Ash Recovery - Pilot Dredge Analysis	Sampled by	NEF & JBW	Date	Thursday, April 30, 2009
Project No.	108.002.001	Tested by	JBW	Date	Wednesday, May 06, 2009
Boring No.	N/A	Chkd. By	NEF	Date	Wednesday, May 06, 2009
Sample No.	UNDERFLOW_03	Depth	2 Feet		
Soil Description	Fly ash suspended in Rim Ditch water				

Sieve Analysis

Beaker ID	15	
Beaker Mass	195.30	grams
Beaker + Dry Sample Mass	452.60	grams
Dry Sample Mass	257.30	grams

Sieve Size	Sieve Opening [mm]	Cumulative Weight Retained [grams]	Percent Finer [%]
#4	4.750	0.00	100.0
#10	2.000	0.00	100.0
#20	0.850	0.10	100.0
#40	0.425	0.80	99.7
#60	0.250	2.02	99.2
#140	0.106	5.70	97.8
#200	0.075	11.40	95.6
Pan	--------	257.30	0.0

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Grain Size Analysis (Sieve Method)

Project	TVA/KIF Fly Ash Recovery - Pilot Dredge Analysis	Sampled by	NEF & JBW	Date	Thursday, April 30, 2009
Project No.	108.002.001	Tested by	NEF	Date	Tuesday, May 05, 2009
Boring No.	N/A	Chkd. By	NEF	Date	Tuesday, May 05, 2009
Sample No.	OVERFLOW_01	Depth	2 Feet		
Soil Description	Fly ash suspended in Rim Ditch water				

Sieve Analysis

Beaker ID	17	
Beaker Mass	165.10	grams
Beaker + Dry Sample Mass	462.92	grams
Dry Sample Mass	297.82	grams

Sieve Size	Sieve Opening [mm]	Cumulative Weight Retained [grams]	Percent Finer [%]
#4	4.750	0.00	100.0
#10	2.000	0.00	100.0
#20	0.850	0.02	100.0
#40	0.425	0.09	100.0
#60	0.250	0.27	99.9
#140	0.106	3.07	99.0
#200	0.075	9.30	96.9
Pan	--------	297.82	0.0

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Grain Size Analysis (Sieve Method)

Project	TVA/KIF Fly Ash Recovery - Pilot Dredge Analysis	Sampled by	NEF & JBW	Date	Thursday, April 30, 2009
Project No.	108.002.001	Tested by	JBW	Date	Wednesday, May 06, 2009
Boring No.	N/A	Chkd. By	NEF	Date	Wednesday, May 06, 2009
Sample No.	OVERFLOW_02	Depth	2 Feet		
Soil Description	Fly ash suspended in Rim Ditch water				

Sieve Analysis

Beaker ID	15	
Beaker Mass	195.80	grams
Beaker + Dry Sample Mass	452.20	grams
Dry Sample Mass	256.40	grams

Sieve Size	Sieve Opening [mm]	Cumulative Weight Retained [grams]	Percent Finer [%]
#4	4.750	0.00	100.0
#10	2.000	0.00	100.0
#20	0.850	0.05	100.0
#40	0.425	0.15	99.9
#60	0.250	0.40	99.8
#140	0.106	2.45	99.0
#200	0.075	7.60	97.0
Pan	--------	256.4	0.0

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GRAIN SIZE ANALYSIS (HYDROMETER METHOD)

Sample Information

Project Number:	108.002.001
Site:	TVA/KIF Power Plant
Location:	Kingston, TN
Sample Date:	Thursday, April 30, 2009
Sample Collected by:	NEF & JBW
Sample Tested by:	NEF
Sample Test Date:	Wednesday, May 06, 2009
Sedimentation Cylinder ID:	SC #4

Hydrometer Analysis

Hydrometer #	152H		
G_S of solids	2.65		(Specific Gravity of Solids)
a =	1.00		(Unit Weight Correction Factor; a = 1 if G_S = 2.65)
Dispering Agent	Sodium Hexametaphosphate		
Sample ID	FEED_01		
W_S =	50		(Weight of original soil sample placed in suspension [grams])
Zero Correction	4	units	@ 4% Dispering Agent
Meniscus Correction	1	unit	

Test Data

Date	Reading Time [min]	Elapsed Time [hr:min:sec]	Elapsed Time [min]	Temperature [°F]	Temperature [°C]	Actual Hydrometer Reading R_a	Temperature Correction Factor C_T	Corrected Hydrometer Reading R_c	Percent Finer [%]	Hydrometer Correction only for Mensicus R	L[1] [cm]	L/t	K[2]	D [mm]
05/06/09	8:01:00	0:00:00	0.00	-	-	-	-	-	-	-	-	-	-	-
05/06/09	8:02:00	0:01:00	1.00	70	21	49	0.2	45.2	90.4	50	8.1	8.100	0.01348	0.03836
05/06/09	8:03:00	0:02:00	2.00	70	21	45.4	0.2	41.6	83.2	46	8.8	4.400	0.01348	0.02828
05/06/09	8:04:00	0:03:00	3.00	70	21	43.1	0.2	39.3	78.6	44	9.1	3.033	0.01348	0.02348
05/06/09	8:05:00	0:04:00	4.00	70	21	41.1	0.2	37.3	74.6	42	9.4	2.350	0.01348	0.02066
05/06/09	8:09:00	0:08:00	8.00	70	21	36	0.2	32.2	64.4	37	10.2	1.275	0.01348	0.01522
05/06/09	8:16:00	0:15:00	15	70	21	30.3	0.2	26.5	53.0	31	11.2	0.747	0.01348	0.01165
05/06/09	8:31:00	0:30:00	30	70	21	24	0.2	20.2	40.4	25	12.2	0.407	0.01348	0.00860
05/06/09	9:01:00	1:00:00	60	70	21	19	0.2	15.2	30.4	20	13.0	0.217	0.01348	0.00627
05/06/09	10:01:00	2:00:00	120	70	21	14.4	0.2	10.6	21.2	15	13.8	0.115	0.01348	0.00457
05/06/09	12:01:00	4:00:00	240	72	22	11.3	0.4	7.7	15.4	12	14.3	0.060	0.01332	0.00325
05/06/09	16:58:00	8:57:00	537	79	26	7	1.7	4.7	9.3	8	15.0	0.028	0.01272	0.00213
05/07/09	8:11:00	0:10:00	1450	73	23	6	0.7	2.7	5.4	7	15.2	0.010	0.01317	0.00135

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Notes:
1) L is a function of Actual Hydrometer reading (meniscus corrected). See appropriate table below
2) K is a function of Temperature and Unit Weight of Soil Solids. See appropriate table below

Equations used in this spreadsheet:

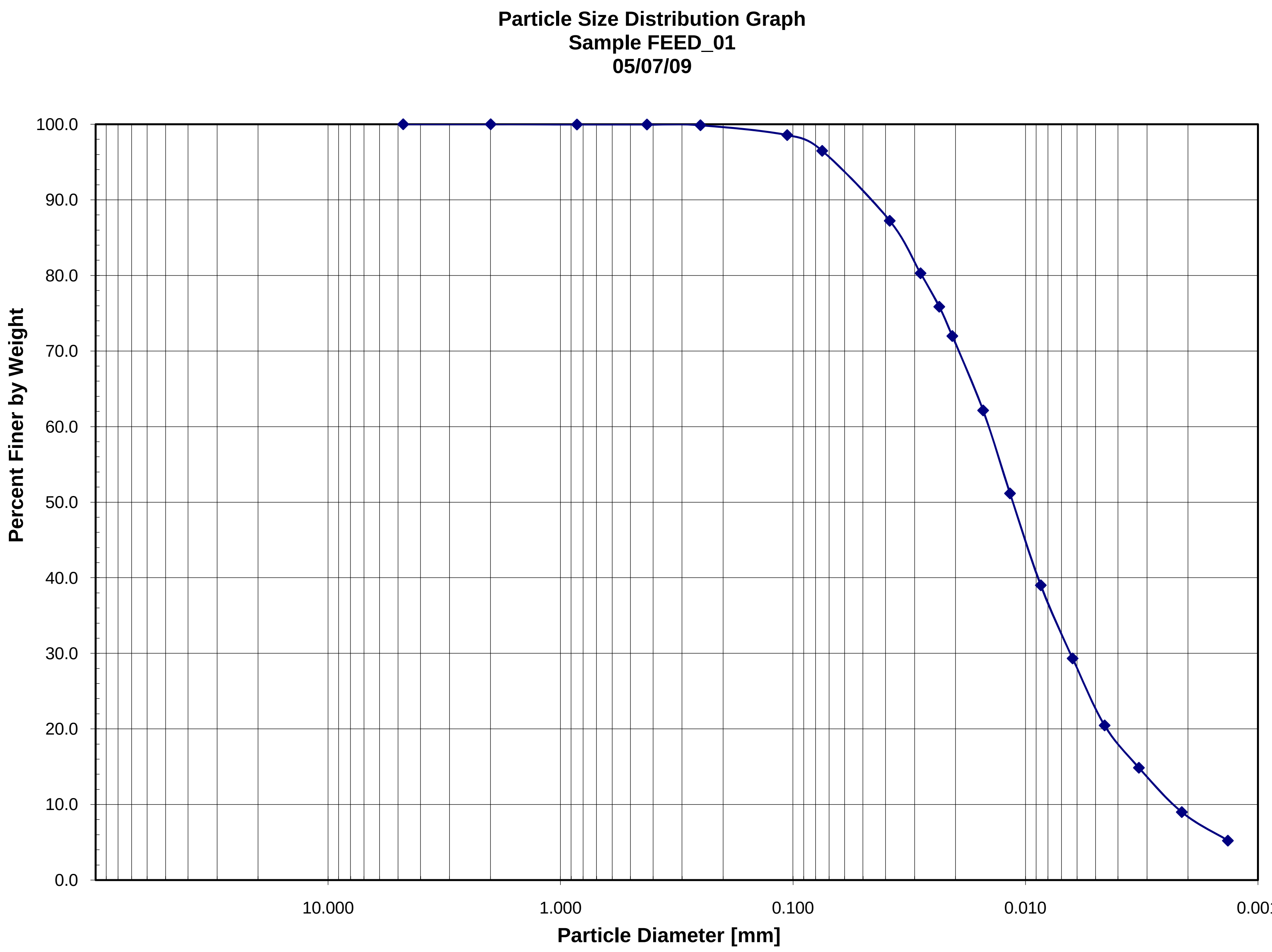
$$a = \frac{G_S*(1.65)}{(G_S-1)*2.65}$$

$$\% \text{ Finer} = \frac{R_C*a}{W_S} \times 100$$

$$D = K*sq(L/t)$$

Grain Size Distribution Graph Data Summary

	Grain Size Diameter [mm]	Percent Finer [%]	Percent Coarser [%]
Sieve Data	4.750	100.0	0.0
	2.000	100.0	0.0
	0.850	100.0	0.0
	0.425	100.0	0.0
	0.250	99.9	0.1
	0.106	98.6	1.4
	0.075	96.5	3.5
Hydrometer Data	0.03836	87.2	12.8
	0.02828	80.3	19.7
	0.02348	75.8	24.2
	0.02066	72.0	28.0
	0.01522	62.1	37.9
	0.01165	51.1	48.9
	0.00860	39.0	61.0
	0.00627	29.3	70.7
	0.00457	20.5	79.5
	0.00325	14.9	85.1
	0.00213	9.0	91.0
	0.00135	5.2	94.8



Particle Size Distribution Graph
Sample FEED_01
05/07/09
Percent Finer by Weight
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
10.000
1.000
0.100
0.010
0.001
Particle Diameter [mm]

HARD HAT SERVICES™
Engineering, Construction and Management Solutions

GRAIN SIZE ANALYSIS (HYDROMETER METHOD)

Sample Information

Project Number:	108.002.001
Site:	TVA/KIF Power Plant
Location:	Kingston, TN
Sample Date:	Thursday, April 30, 2009
Sample Collected by:	NEF & JBW
Sample Tested by:	NEF
Sample Test Date:	Wednesday, May 06, 2009
Sedimentation Cylinder ID:	SC #5

Hydrometer Analysis

Hydrometer #	152H		
G_S of solids	2.65		(Specific Gravity of Solids)
a =	1.00		(Unit Weight Correction Factor; a = 1 if G_S = 2.65)
Dispering Agent	Sodium Hexametaphosphate		
Sample ID	UNDERFLOW_01		
W_S =	50		(Weight of original soil sample placed in suspension [grams])
Zero Correction	4	units	@ 4% Dispering Agent
Meniscus Correction	1	unit	

Test Data

Date	Reading Time [min]	Elapsed Time [hr:min:sec]	Elapsed Time [min]	Temperature [°F]	Temperature [°C]	Actual Hydrometer Reading R_a	Temperature Correction Factor C_T	Corrected Hydrometer Reading R_c	Percent Finer [%]	Hydrometer Correction only for Mensicus R	L^1 [cm]	L/t	K^2	D [mm]
05/06/09	8:26:00	0:00:00	0.00	-	-	-	-	-	-	-	-	-	-	-
05/06/09	8:27:00	0:01:00	1.00	70	21	47	0.2	43.2	86.4	48	8.4	8.400	0.01348	0.03907
05/06/09	8:28:00	0:02:00	2.00	70	21	42	0.2	38.2	76.4	43	9.2	4.600	0.01348	0.02891
05/06/09	8:29:00	0:03:00	3.00	70	21	38	0.2	34.2	68.4	39	9.9	3.300	0.01348	0.02449
05/06/09	8:30:00	0:04:00	4.00	70	21	35.1	0.2	31.3	62.6	36	10.4	2.600	0.01348	0.02174
05/06/09	8:34:00	0:08:00	8.00	70	21	29	0.2	25.2	50.4	30	11.4	1.425	0.01348	0.01609
05/06/09	8:41:00	0:15:00	15	70	21	23.1	0.2	19.3	38.6	24	12.4	0.827	0.01348	0.01226
05/06/09	8:56:00	0:30:00	30	70	21	17.8	0.2	14.0	28.0	19	13.2	0.440	0.01348	0.00894
05/06/09	9:26:00	1:00:00	60	70	21	13	0.2	9.2	18.4	14	14.0	0.233	0.01348	0.00651
05/06/09	11:19:00	2:53:00	173	71	22	9	0.4	5.4	10.8	10	14.7	0.085	0.01332	0.00388
05/06/09	12:26:00	4:00:00	240	73	23	8	0.7	4.7	9.4	9	14.8	0.062	0.01317	0.00327
05/06/09	16:26:00	8:00:00	480	80	27	5.7	2.0	3.7	7.4	7	15.2	0.032	0.01258	0.00224
05/07/09	8:30:00	0:04:00	1444	73	23	5.9	0.7	2.6	5.2	7	15.2	0.011	0.01317	0.00135

Fill in grayed out boxes only

Notes:
1) L is a function of Actual Hydrometer reading (meniscus corrected). See appropriate table below
2) K is a function of Temperature and Unit Weight of Soil Solids. See appropriate table below

Equations used in this spreadsheet:

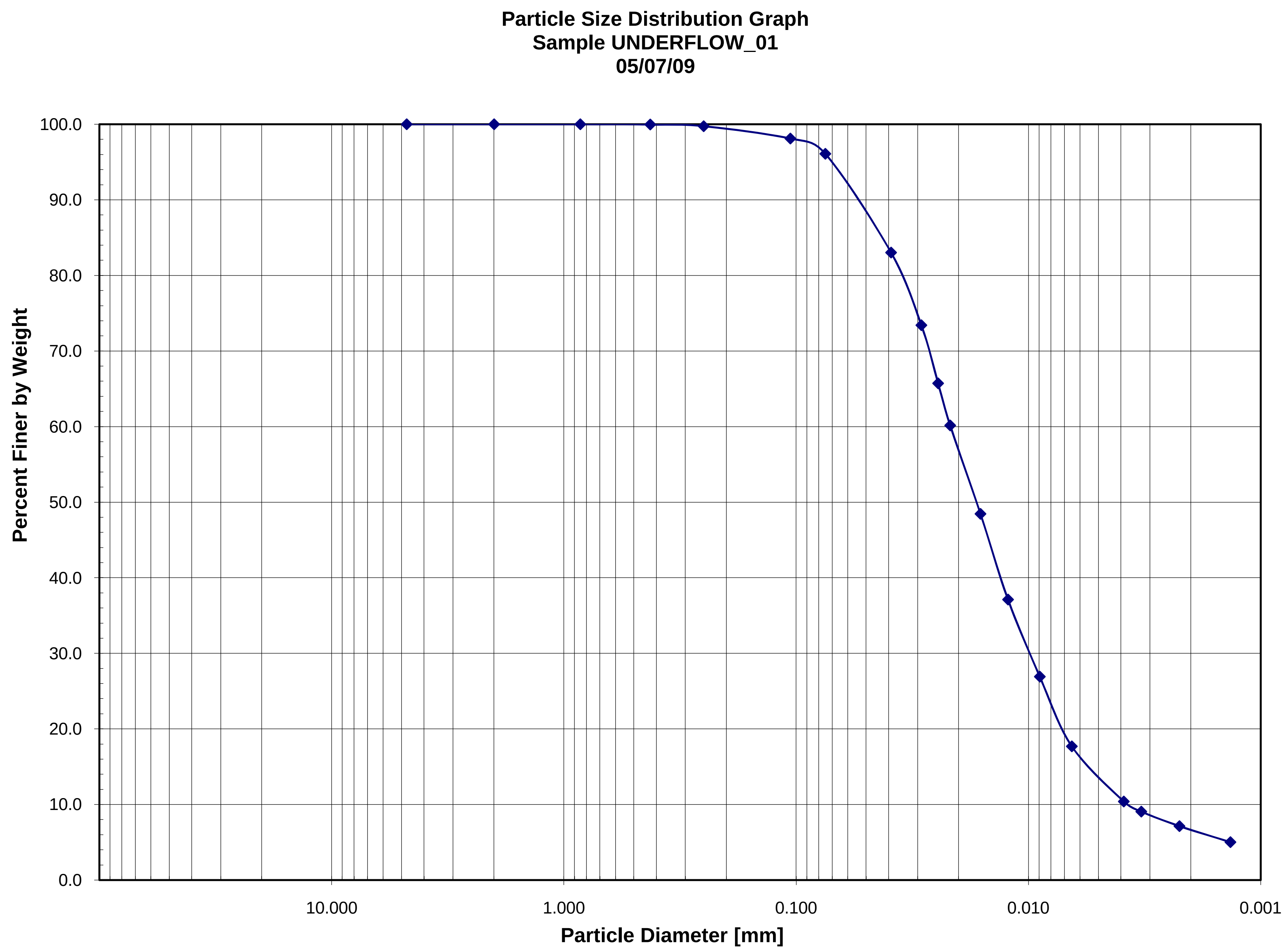
$$a = \frac{G_S*(1.65)}{(G_S-1)*2.65}$$

$$\% \text{ Finer} = \frac{R_C*a}{W_S} \text{ X } 100$$

$$D = K*sq(L/t)$$

Grain Size Distribution Graph Data Summary

	Grain Size Diameter [mm]	Percent Finer [%]	Percent Coarser [%]
Sieve Data	4.750	100.0	0.0
	2.000	100.0	0.0
	0.850	100.0	0.0
	0.425	100.0	0.0
	0.250	99.8	0.2
	0.106	98.1	1.9
	0.075	96.1	3.9
Hydrometer Data	0.03907	83.0	17.0
	0.02891	73.4	26.6
	0.02449	65.7	34.3
	0.02174	60.2	39.8
	0.01609	48.4	51.6
	0.01226	37.1	62.9
	0.00894	26.9	73.1
	0.00651	17.7	82.3
	0.00388	10.4	89.6
	0.00327	9.0	91.0
	0.00224	7.1	92.9
	0.00135	5.0	95.0


Particle Size Distribution Graph
Sample UNDERFLOW_01
05/07/09
Percent Finer by Weight
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
10.000
1.000
0.100
0.010
0.001
Particle Diameter [mm]

HARD HAT SERVICES™
Engineering, Construction and Management Solutions

GRAIN SIZE ANALYSIS (HYDROMETER METHOD)

Sample Information

Project Number:	108.002.001
Site:	TVA/KIF Power Plant
Location:	Kingston, TN
Sample Date:	Thursday, April 30, 2009
Sample Collected by:	NEF & JBW
Sample Tested by:	NEF
Sample Test Date:	Thursday, May 07, 2009
Sedimentation Cylinder ID:	SC #2

Hydrometer Analysis

Hydrometer #	152H		
G_S of solids	2.65		(Specific Gravity of Solids)
a =	1.00		(Unit Weight Correction Factor; a = 1 if G_S = 2.65)
Dispering Agent	Sodium Hexametaphosphate		
Sample ID	UNDERFLOW_02		
W_S =	50		(Weight of original soil sample placed in suspension [grams])
Zero Correction	4	units	@ 4% Dispering Agent
Meniscus Correction	1	unit	

Test Data

Date	Reading Time [min]	Elapsed Time [hr:min:sec]	Elapsed Time [min]	Temperature [°F]	Temperature [°C]	Actual Hydrometer Reading R_a	Temperature Correction Factor C_T	Corrected Hydrometer Reading R_c	Percent Finer [%]	Hydrometer Correction only for Mensicus R	L^1 [cm]	L/t	K^2	D [mm]
05/07/09	8:45:00	0:00:00	0.00	-	-	-	-	-	-	-	-	-	-	-
05/07/09	8:46:00	0:01:00	1.00	74	23	47	0.7	43.7	87.4	48	8.4	8.400	0.01317	0.03817
05/07/09	8:47:00	0:02:00	2.00	74	23	42	0.7	38.7	77.4	43	9.2	4.600	0.01317	0.02825
05/07/09	8:48:00	0:03:00	3.00	74	23	38.5	0.7	35.2	70.4	40	9.7	3.233	0.01317	0.02368
05/07/09	8:49:00	0:04:00	4.00	74	23	36	0.7	32.7	65.4	37	10.2	2.550	0.01317	0.02103
05/07/09	8:53:00	0:08:00	8.00	74	23	30.4	0.7	27.1	54.2	31	11.2	1.400	0.01317	0.01558
05/07/09	9:00:00	0:15:00	15	74	23	25.1	0.7	21.8	43.6	26	12.0	0.800	0.01317	0.01178
05/07/09	9:15:00	0:30:00	30	73	23	19.8	0.7	16.5	33.0	21	12.9	0.430	0.01317	0.00864
05/07/09	9:45:00	1:00:00	60	73	23	15.3	0.7	12.0	24.0	16	13.7	0.228	0.01317	0.00629
05/07/09	10:45:00	2:00:00	120	73	23	12	0.7	8.7	17.4	13	14.2	0.118	0.01317	0.00453
05/07/09	15:52:00	7:07:00	247	73	23	8.7	0.7	5.4	10.8	10	14.7	0.060	0.01317	0.00321
05/07/09	16:49:00	8:04:00	484	72	22	6.7	0.4	3.1	6.2	8	15.0	0.031	0.01332	0.00234
05/08/09	9:12:00	0:27:00	1467	72	22	5.5	0.4	1.9	3.8	7	15.2	0.010	0.01332	0.00136

Fill in grayed out boxes only

Notes:
1) L is a function of Actual Hydrometer reading (meniscus corrected). See appropriate table below
2) K is a function of Temperature and Unit Weight of Soil Solids. See appropriate table below

Equations used in this spreadsheet:

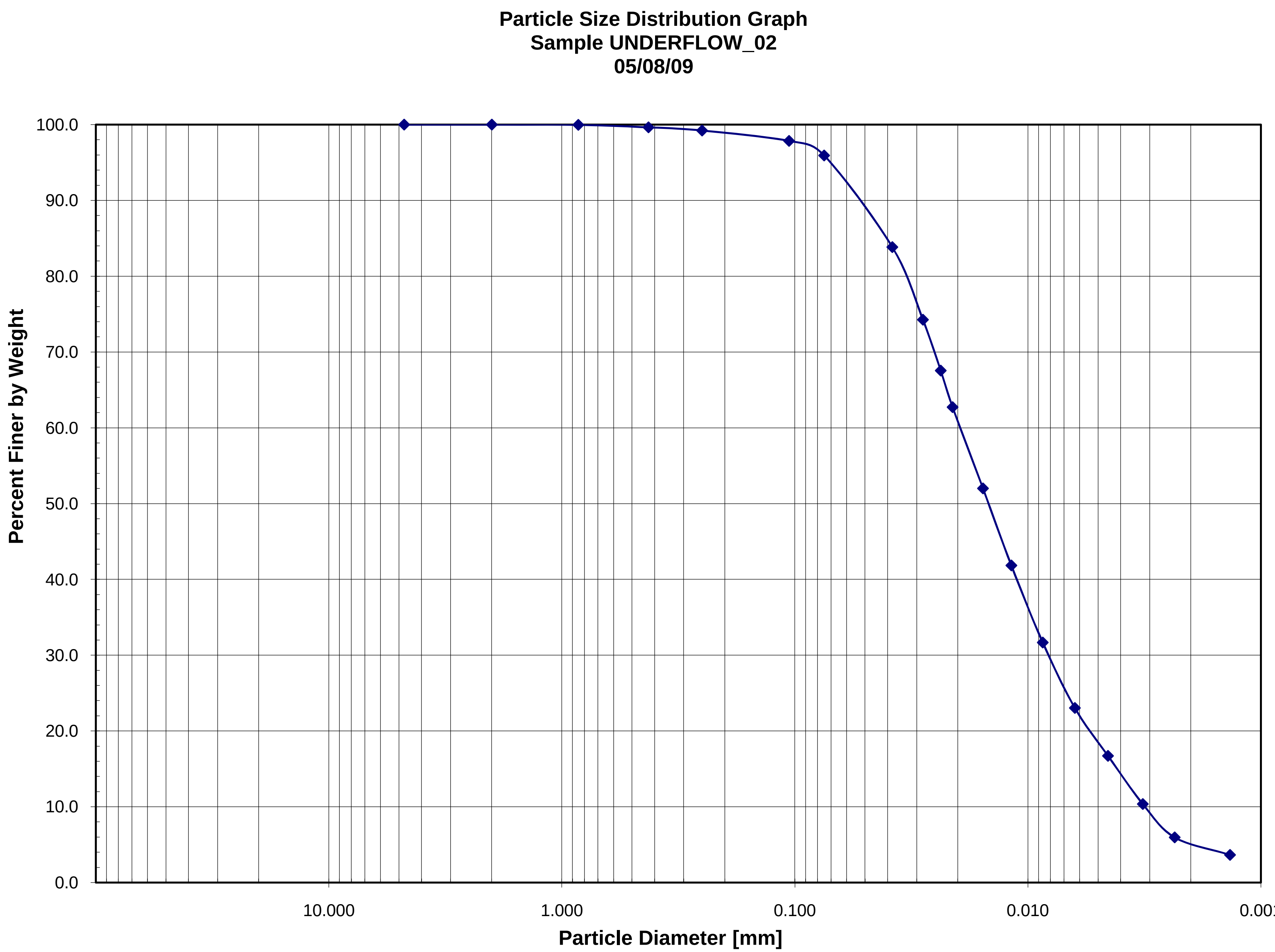
$$a = \frac{G_S*(1.65)}{(G_S-1)*2.65}$$

$$\% \text{ Finer} = \frac{R_C*a}{W_S} \text{ X } 100$$

$$D = K*sq(L/t)$$

Grain Size Distribution Graph Data Summary

	Grain Size Diameter [mm]	Percent Finer [%]	Percent Coarser [%]
Sieve Data	4.750	100.0	0.0
	2.000	100.0	0.0
	0.850	100.0	0.0
	0.425	99.6	0.4
	0.250	99.2	0.8
	0.106	97.8	2.2
	0.075	95.9	4.1
Hydrometer Data	0.03817	83.8	16.2
	0.02825	74.2	25.8
	0.02368	67.5	32.5
	0.02103	62.7	37.3
	0.01558	52.0	48.0
	0.01178	41.8	58.2
	0.00864	31.7	68.3
	0.00629	23.0	77.0
	0.00453	16.7	83.3
	0.00321	10.4	89.6
	0.00234	5.9	94.1
	0.00136	3.6	96.4



Particle Size Distribution Graph
Sample UNDERFLOW_02
05/08/09
Percent Finer by Weight
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
10.000
1.000
0.100
0.010
0.001
Particle Diameter [mm]

GRAIN SIZE ANALYSIS (HYDROMETER METHOD)

HARD HAT SERVICES™
Engineering, Construction and Management Solutions

Sample Information

Project Number:	108.002.001
Site:	TVA/KIF Power Plant
Location:	Kingston, TN
Sample Date:	Thursday, April 30, 2009
Sample Collected by:	NEF & JBW
Sample Tested by:	NEF
Sample Test Date:	Thursday, May 07, 2009
Sedimentation Cylinder ID:	SC #3

Hydrometer Analysis

Hydrometer #	152H		
G_S of solids	2.65		(Specific Gravity of Solids)
a =	1.00		(Unit Weight Correction Factor; a = 1 if G_S = 2.65)
Dispering Agent	Sodium Hexametaphosphate		
Sample ID	UNDERFLOW_03		
W_S =	50		(Weight of original soil sample placed in suspension [grams])
Zero Correction	4	units	@ 4% Dispering Agent
Meniscus Correction	1	unit	

Test Data

Date	Reading Time [min]	Elapsed Time [hr:min:sec]	Elapsed Time [min]	Temperature [°F]	Temperature [°C]	Actual Hydrometer Reading R_a	Temperature Correction Factor C_T	Corrected Hydrometer Reading R_c	Percent Finer [%]	Hydrometer Correction only for Mensicus R	L^1 [cm]	L/t	K^2	D [mm]
05/07/09	9:49:00	0:00:00	0.00	-	-	-	-	-	-	-	-	-	-	-
05/07/09	9:50:00	0:01:00	1.00	74	23	47	0.7	43.7	87.4	48	8.4	8.400	0.01317	0.03817
05/07/09	9:51:00	0:02:00	2.00	74	23	42.3	0.7	39.0	78.0	43	9.2	4.600	0.01317	0.02825
05/07/09	9:52:00	0:03:00	3.00	74	23	39	0.7	35.7	71.4	40	9.7	3.233	0.01317	0.02368
05/07/09	9:53:00	0:04:00	4.00	74	23	37	0.7	33.7	67.4	38	10.1	2.525	0.01317	0.02093
05/07/09	9:57:00	0:08:00	8.00	74	23	31.2	0.7	27.9	55.8	32	11.1	1.388	0.01317	0.01551
05/07/09	10:04:00	0:15:00	15	74	23	26	0.7	22.7	45.4	27	11.9	0.793	0.01317	0.01173
05/07/09	10:20:00	0:31:00	31	74	23	20	0.7	16.7	33.4	21	12.9	0.416	0.01317	0.00850
05/07/09	10:49:00	1:00:00	60	74	23	15.3	0.7	12.0	24.0	16	13.7	0.228	0.01317	0.00629
05/07/09	11:49:00	2:00:00	120	73	23	11.8	0.7	8.5	17.0	13	14.2	0.118	0.01317	0.00453
05/07/09	13:55:00	4:06:00	246	74	23	9	0.7	5.7	11.4	10	14.7	0.060	0.01317	0.00322
05/07/09	18:23:00	8:34:00	514	74	23	6.6	0.7	3.3	6.6	8	15.0	0.029	0.01317	0.00225
05/08/09	9:57:00	0:08:00	1448	73	23	5.4	0.7	2.1	4.2	6	15.3	0.011	0.01317	0.00135

Fill in grayed out boxes only

Notes:
1) L is a function of Actual Hydrometer reading (meniscus corrected). See appropriate table below
2) K is a function of Temperature and Unit Weight of Soil Solids. See appropriate table below

Equations used in this spreadsheet:

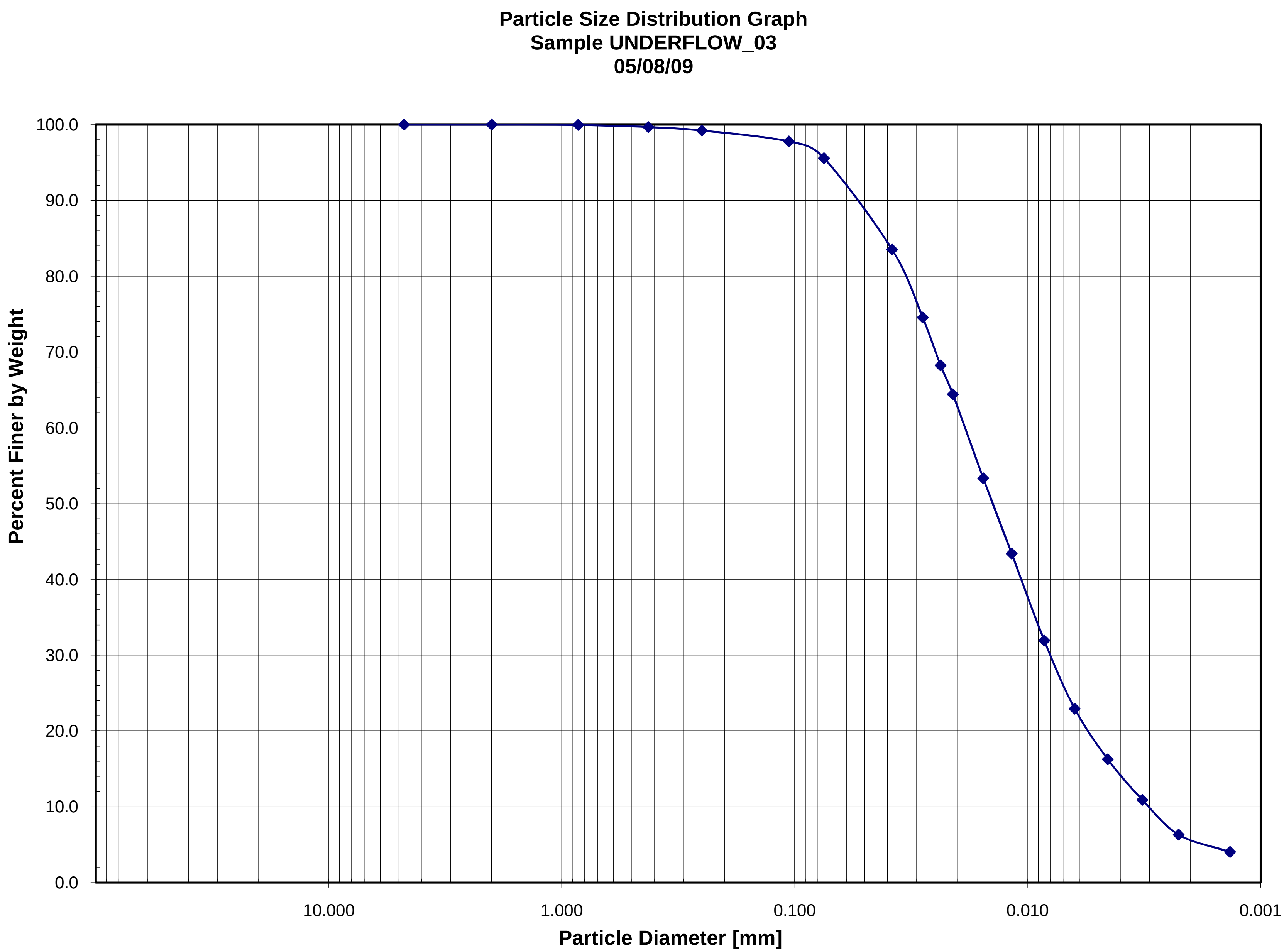
$$a = \frac{G_S*(1.65)}{(G_S-1)*2.65}$$

$$\% \text{ Finer} = \frac{R_C*a}{W_S} \text{ X } 100$$

$$D = K*sq(L/t)$$

Grain Size Distribution Graph Data Summary

	Grain Size Diameter [mm]	Percent Finer [%]	Percent Coarser [%]
Sieve Data	4.750	100.0	0.0
	2.000	100.0	0.0
	0.850	100.0	0.0
	0.425	99.7	0.3
	0.250	99.2	0.8
	0.106	97.8	2.2
	0.075	95.6	4.4
Hydrometer Data	0.03817	83.5	16.5
	0.02825	74.5	25.5
	0.02368	68.2	31.8
	0.02093	64.4	35.6
	0.01551	53.3	46.7
	0.01173	43.4	56.6
	0.00850	31.9	68.1
	0.00629	22.9	77.1
	0.00453	16.2	83.8
	0.00322	10.9	89.1
	0.00225	6.3	93.7
	0.00135	4.0	96.0


Particle Size Distribution Graph
Sample UNDERFLOW_03
05/08/09
Percent Finer by Weight
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
10.000
1.000
0.100
0.010
0.001
Particle Diameter [mm]

HARD HAT SERVICES™
Engineering, Construction and Management Solutions

GRAIN SIZE ANALYSIS (HYDROMETER METHOD)

Sample Information

Project Number:	108.002.001
Site:	TVA/KIF Power Plant
Location:	Kingston, TN
Sample Date:	Thursday, April 30, 2009
Sample Collected by:	NEF & JBW
Sample Tested by:	NEF
Sample Test Date:	Wednesday, May 06, 2009
Sedimentation Cylinder ID:	SC #1

Hydrometer Analysis

Hydrometer #	152H	
G_S of solids	2.65	(Specific Gravity of Solids)
a =	1.00	(Unit Weight Correction Factor; a = 1 if G_S = 2.65)
Dispering Agent	Sodium Hexametaphosphate	
Sample ID	OVERFLOW_01	
W_S =	50	(Weight of original soil sample placed in suspension [grams])
Zero Correction	4 units	@ 4% Dispering Agent
Meniscus Correction	1 unit	

Test Data

Date	Reading Time [min]	Elapsed Time [hr:min:sec]	Elapsed Time [min]	Temperature [°F]	Temperature [°C]	Actual Hydrometer Reading R_a	Temperature Correction Factor C_T	Corrected Hydrometer Reading R_c	Percent Finer [%]	Hydrometer Correction only for Mensicus R	L^1 [cm]	L/t	K^2	D [mm]
05/06/09	9:20:00	0:00:00	0.00	-	-	-	-	-	-	-	-	-	-	-
05/06/09	9:21:00	0:01:00	1.00	71	22	48.3	0.4	44.7	89.4	49	8.3	8.300	0.01332	0.03837
05/06/09	9:22:00	0:02:00	2.00	71	22	46	0.4	42.4	84.8	47	8.6	4.300	0.01332	0.02762
05/06/09	9:23:00	0:03:00	3.00	71	22	43.8	0.4	40.2	80.4	45	8.9	2.967	0.01332	0.02294
05/06/09	9:24:00	0:04:00	4.00	71	22	42	0.4	38.4	76.8	43	9.2	2.300	0.01332	0.02020
05/06/09	9:28:00	0:08:00	8.00	71	22	36.5	0.4	32.9	65.8	38	10.1	1.263	0.01332	0.01497
05/06/09	9:35:00	0:15:00	15	71	22	32	0.4	28.4	56.8	33	10.9	0.727	0.01332	0.01135
05/06/09	9:50:00	0:30:00	30	71	22	25.4	0.4	21.8	43.6	26	12.0	0.400	0.01332	0.00842
05/06/09	10:20:00	1:00:00	60	71	22	19.7	0.4	16.1	32.2	21	12.9	0.215	0.01332	0.00618
05/06/09	11:20:00	2:00:00	120	71	22	15.1	0.4	11.5	23.0	16	13.7	0.114	0.01332	0.00450
05/06/09	13:30:00	4:10:00	250	73	23	11.1	0.7	7.8	15.6	12	14.3	0.057	0.01317	0.00315
05/06/09	18:02:00	8:42:00	522	75	24	7.9	1.0	4.9	9.8	9	14.8	0.028	0.01301	0.00219
05/07/09	9:20:00	0:00:00	1440	72	22	6.3	0.4	2.7	5.4	7	15.2	0.011	0.01332	0.00137

Fill in grayed out boxes only

Notes:
1) L is a function of Actual Hydrometer reading (meniscus corrected). See appropriate table below
2) K is a function of Temperature and Unit Weight of Soil Solids. See appropriate table below

Equations used in this spreadsheet:

$$a = \frac{G_S*(1.65)}{(G_S-1)*2.65}$$

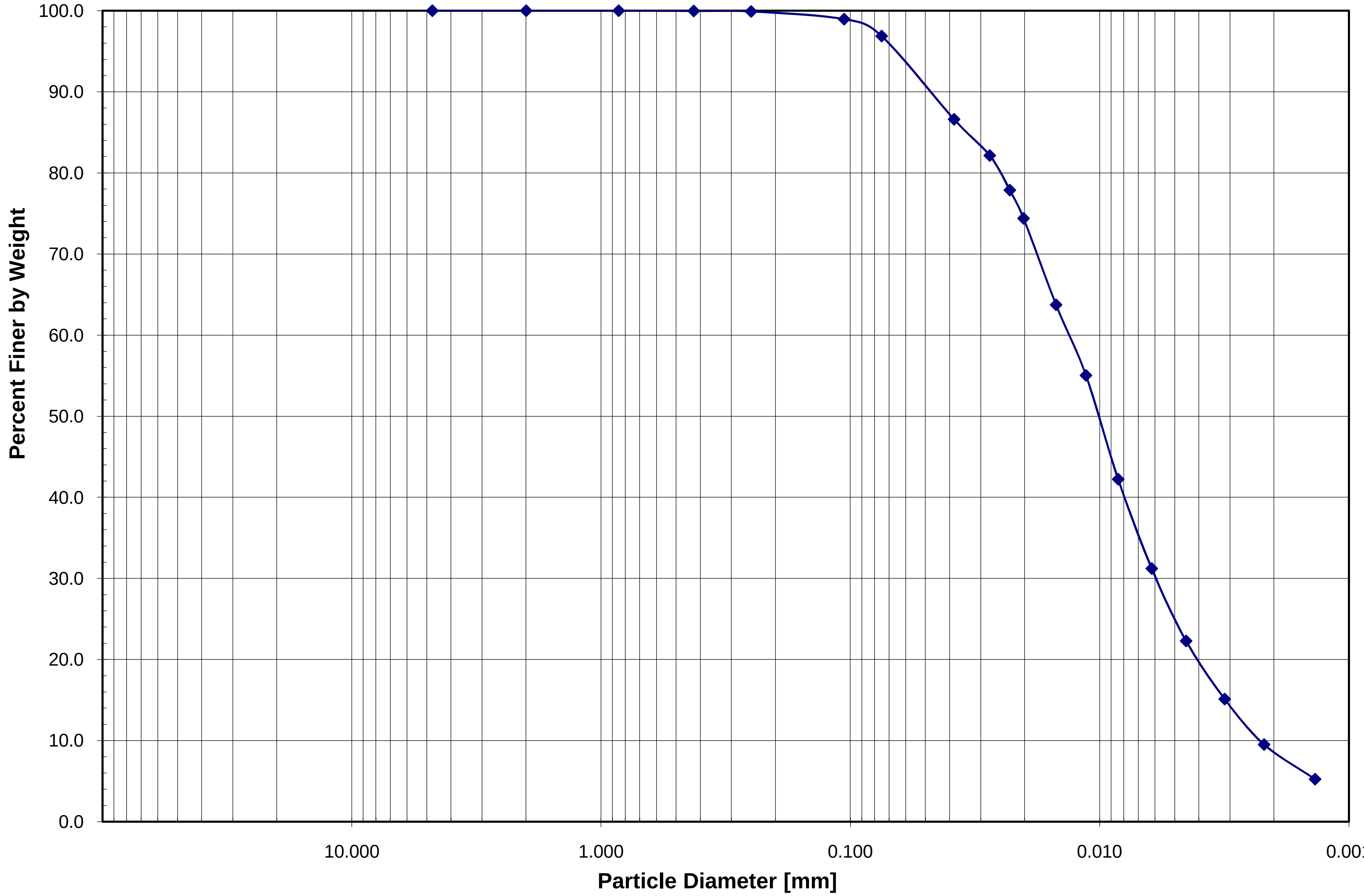
$$\% \text{ Finer} = \frac{R_C*a}{W_S} X\ 100$$

$$D = K*sq(L/t)$$

Grain Size Distribution Graph Data Summary

	Grain Size Diameter [mm]	Percent Finer [%]	Percent Coarser [%]
Sieve Data	4.750	100.0	0.0
	2.000	100.0	0.0
	0.850	100.0	0.0
	0.425	100.0	0.0
	0.250	99.9	0.1
	0.106	99.0	1.0
	0.075	96.9	3.1
Hydrometer Data	0.03837	86.6	13.4
	0.02762	82.2	17.8
	0.02294	77.9	22.1
	0.02020	74.4	25.6
	0.01497	63.7	36.3
	0.01135	55.0	45.0
	0.00842	42.2	57.8
	0.00618	31.2	68.8
	0.00450	22.3	77.7
	0.00315	15.1	84.9
	0.00219	9.5	90.5
	0.00137	5.2	94.8

Particle Size Distribution Graph
Sample OVERFLOW_01
05/07/09



HARD HAT SERVICES™
Engineering, Construction and Management Solutions

GRAIN SIZE ANALYSIS (HYDROMETER METHOD)

Sample Information

Project Number:	108.002.001
Site:	TVA/KIF Power Plant
Location:	Kingston, TN
Sample Date:	Thursday, April 30, 2009
Sample Collected by:	NEF & JBW
Sample Tested by:	NEF
Sample Test Date:	Thursday, May 07, 2009
Sedimentation Cylinder ID:	SC #4

Hydrometer Analysis

Hydrometer #	152H		
G_S of solids	2.65		(Specific Gravity of Solids)
a =	1.00		(Unit Weight Correction Factor; a = 1 if G_S = 2.65)
Dispering Agent	Sodium Hexametaphosphate		
Sample ID	OVERFLOW_02		
W_S =	50		(Weight of original soil sample placed in suspension [grams])
Zero Correction	4	units	@ 4% Dispering Agent
Meniscus Correction	1	unit	

Test Data

Date	Reading Time [min]	Elapsed Time [hr:min:sec]	Elapsed Time [min]	Temperature [°F]	Temperature [°C]	Actual Hydrometer Reading R_a	Temperature Correction Factor C_T	Corrected Hydrometer Reading R_c	Percent Finer [%]	Hydrometer Correction only for Mensicus R	L^1 [cm]	L/t	K^2	D [mm]
05/07/09	10:26:00	0:00:00	0.00	-	-	-	-	-	-	-	-	-	-	-
05/07/09	10:27:00	0:01:00	1.00	74	23	47.5	0.7	44.2	88.4	49	8.3	8.300	0.01317	0.03794
05/07/09	10:28:00	0:02:00	2.00	74	23	45	0.7	41.7	83.4	46	8.8	4.400	0.01317	0.02763
05/07/09	10:29:00	0:03:00	3.00	74	23	42.5	0.7	39.2	78.4	44	9.1	3.033	0.01317	0.02294
05/07/09	10:30:00	0:04:00	4.00	74	23	41	0.7	37.7	75.4	42	9.4	2.350	0.01317	0.02019
05/07/09	10:34:00	0:08:00	8.00	74	23	37	0.7	33.7	67.4	38	10.1	1.263	0.01317	0.01480
05/07/09	10:41:00	0:15:00	15	74	23	32	0.7	28.7	57.4	33	10.9	0.727	0.01317	0.01123
05/07/09	10:56:00	0:30:00	30	74	23	25.2	0.7	21.9	43.8	26	12.0	0.400	0.01317	0.00833
05/07/09	11:26:00	1:00:00	60	74	23	19.5	0.7	16.2	32.4	21	12.9	0.215	0.01317	0.00611
05/07/09	12:50:00	2:24:00	144	74	23	13.8	0.7	10.5	21.0	15	13.8	0.096	0.01317	0.00408
05/07/09	14:26:00	4:00:00	240	74	23	11	0.7	7.7	15.4	12	14.3	0.060	0.01317	0.00321
05/07/09	18:26:00	8:00:00	480	75	24	7.9	1.0	4.9	9.8	9	14.8	0.031	0.01301	0.00228
05/08/09	10:26:00	0:00:00	1440	73	23	6	0.7	2.7	5.4	7	15.2	0.011	0.01317	0.00135

Fill in grayed out boxes only

Notes:
1) L is a function of Actual Hydrometer reading (meniscus corrected). See appropriate table below
2) K is a function of Temperature and Unit Weight of Soil Solids. See appropriate table below

Equations used in this spreadsheet:

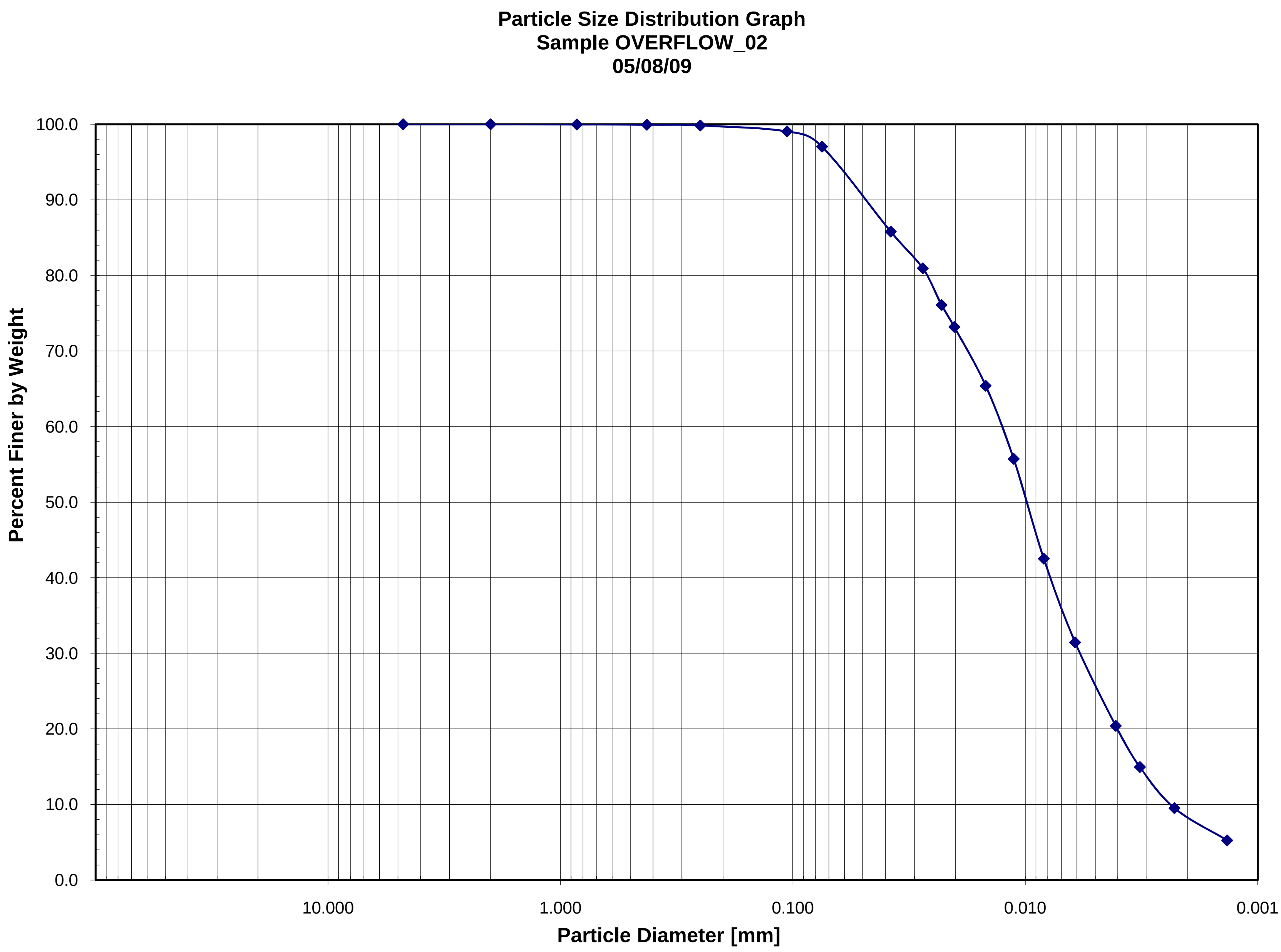
$$a = \frac{G_S*(1.65)}{(G_S-1)*2.65}$$

$$\% \text{ Finer} = \frac{R_C*a}{W_S} \times 100$$

$$D = K*sq(L/t)$$

Grain Size Distribution Graph Data Summary

	Grain Size Diameter [mm]	Percent Finer [%]	Percent Coarser [%]
Sieve Data	4.750	100.0	0.0
	2.000	100.0	0.0
	0.850	100.0	0.0
	0.425	99.9	0.1
	0.250	99.8	0.2
	0.106	99.0	1.0
	0.075	97.0	3.0
Hydrometer Data	0.03794	85.8	14.2
	0.02763	80.9	19.1
	0.02294	76.1	23.9
	0.02019	73.2	26.8
	0.01480	65.4	34.6
	0.01123	55.7	44.3
	0.00833	42.5	57.5
	0.00611	31.4	68.6
	0.00408	20.4	79.6
	0.00321	14.9	85.1
	0.00228	9.5	90.5
	0.00135	5.2	94.8



Particle Size Distribution Graph
Sample OVERFLOW_02
05/08/09
Percent Finer by Weight
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
10.000
1.000
0.100
0.010
0.001
Particle Diameter [mm]