Assessment of Dam Safety
Coal Combustion Surface Impoundments (Task 3)
Final Report

Progress Energy
Carolinas
Cape Fear Plant

Moncure, North Carolina

Prepared for

Lockheed Martin
2890 Woodridge Ave #209
Edison, New Jersey 08837

September 14, 2009

CHA Project No. 20085.3000.1510

I acknowledge that the management units referenced herein:

- 1985 Ash Pond
- 1978 Ash Pond
- 1963/1970 Ash Ponds
- 1956 Ash Pond

Have been assessed on June 15 through 17, 2009.

Signature: Malcolm D Hargraves
Malcolm D. Hargraves, P.E.
Senior Geotechnical Engineer
Registered in the State of North Carolina

Signature: Kath E Adnams
Katherine E. Adnams, P.E.
Senior Geotechnical Engineer

Reviewer:
John P. Sobiech, P.E.
Partner

SEAL
028061
JOHN P. SOBIECH, P.E.

TABLE OF CONTENTS

TABLES

FIGURES

APPENDIX

1.0 INTRODUCTION & PROJECT DESCRIPTION

1.1 Introduction

CHA was contracted by Lockheed Martin (a contractor to the United State Environmental Protection Agency) to perform site assessments of selected coal combustion surface impoundments (Project #0-381 Coal Combustion Surface Impoundments/Dam Safety Inspections). As part of this contract, CHA was assigned to perform a site assessment of Progress Energy Carolinas' Cape Fear Plant, which is located in Moncure (Chatham County), North Carolina as shown on Figure 1 – Project Location Map. Progress Energy Carolinas formerly operated as Carolina Power and Light Company.

CHA made a site visit on June 15 through June 17, 2009 to inventory coal combustion surface impoundments at the facility, to perform visual observations of the containment dikes, and to collect relevant information regarding the site assessment.

CHA Engineers Malcolm Hargraves, P.E. and Katherine Adnams, P.E. were accompanied by the following individuals:

Company or Organization	**Name and Title**
US EPA	Davey Simonson
Progress Energy Carolinas	Leigh Barr, Environmental Engineer
Progress Energy Carolinas	Danny Wimberly, Acting Plant Manager
Progress Energy Carolinas	Robin Bryson, Water
Progress Energy Carolinas	John Toepfer, Environmental Hazardous Waste
Progress Energy Carolinas	Bill Forester, Dam & Dikes
North Carolina DENR	Autum Hoban
North Carolina DENR	Elizabeth Werner
North Carolina DENR	Geof Little

1.2 Project Background

The Cape Fear Plant has five basins (ash ponds) that have received or currently receive coal combustion waste (CCW). The location of the ash ponds are shown in Figures 2A and 2B and are identified by the year during which they were substantially completed: 1956, 1963, 1970, 1978, and 1985. Two of these basins, the 1963 Ash Pond and the 1970 Ash Pond are often considered as one structure because the 1970 Ash Pond was constructed as an extension of the 1963 Ash Pond as discussed later in this document. As a result, there may be question as to how the combined present 1963/1970 Ash Ponds are regulated with respect to North Carolina Dam Safety Act of 1967. At a minimum, CHA understands that the 1970 portion is subject to this regulation. The 1978 and 1985 Ash Ponds are currently permitted to receive sluiced CCW with the 1985 Ash Pond actively receiving CCW. None of the impoundments are listed on the National Inventory of Dams (NID) database or the North Carolina Dam Inventory. In the State of North Carolina, because of the association with electric power generation, the North Carolina Utilities Commission (NCUC) has regulatory jurisdiction over the permitted impoundments and the 1970 Ash Pond. As a consequence, the hazard classification given the impoundments in the past has been based on United States Corps of Engineers' criteria. The permitted ash ponds have been given a "significant" hazard rating based on property damage but not loss of life, while the older 1970 Ash Pond has been given a "low" rating based on lower potential property damage and no loss of life by Mactec Engineering and Consulting, Inc.

1.2.1 State Issued Permits

Progress Energy Carolinas has received the following state issued permits for the 1978 and 1985 Ash Ponds:

- **1985 Ash Pond** - North Carolina State Permit No. NC0003433 has been issued to Progress authorizing discharge under the USEPA National Pollutant Discharge Elimination System (NPDES) to the Cape Fear River in accordance with effluent limitations, monitoring requirements and other conditions set forth in the permit. The permit became effective on September 1, 2006 and will expire on July 31, 2011. (Note this permit also covers the 1978 Ash Pond and other surface runoff locations not containing coal combustion waste controlled by Progress Energy Carolinas on the site).

- **1978 Ash Pond** - North Carolina State Permit No. NC0003433 has been issued to Progress authorizing discharge under the USEPA National Pollutant Discharge Elimination System (NPDES) to the Cape Fear River in accordance with effluent limitations, monitoring requirements and other conditions set forth in the permit. The permit became effective on September 1, 2006 and will expire on July 31, 2011. (Note this permit also covers the 1985 Ash Pond and other surface runoff locations not containing coal combustion waste controlled by Progress Energy Carolinas on the site).

1.3 Site Description and Location

The Cape Fear Plant is a 400 megawatt facility located in a generally forested, rural area adjacent to the confluence of the Haw and Deep Rivers in southern Chatham County, North Carolina. It was constructed in 1923. A system of levees, flood walls, and flood gates was constructed around the power plant as protection against high river levels, a problem that has been controlled with the construction of the B. Everett Jordan Dam upstream on the Haw River. Since the mid to late 1950's, five CCW disposal basins (ash ponds) have been constructed and have operated for a period of time accepting liquid borne waste ash material. They are in varying states of activity and vegetative overgrowth as summarized in Sections 1.3.1 to 1.3.5.

An aerial photograph of the region indicating the location of the Cape Fear Plant and identifying schools, hospitals, or other critical infrastructure located within approximately five miles down gradient of the primary and secondary ash ponds is provided as Figure 4.

1.3.1 1985 Ash Pond

The 1985 Ash Pond is the second of the two permitted CCW impoundments at the Cape Fear Plant and is located south of CP&L Drive between a railway service spur and SR 1916 (Corinth Road), roughly 500 feet northeast of the 1978 Ash Pond. It has a surface area of approximately 65 acres and an approximate capacity of 1,764 acre-feet. Figure 3A shows a typical cross section of a 1985 Ash Pond dike. Currently the ash pond impounds roughly 1,188 acre-feet of waste material and water and actively receives sluiced CCW. In 2007, Progress Energy Carolinas decided to construct an interior ash pond on top of the sedimented CCW in a “Pond within a Pond” concept to increase the overall pond capacity.

Available documents indicate that the 1985 Ash Pond is a stand-alone diked structure with a maximum height of 28 feet. It was designed with 2:1 slopes on the dikes however, during construction, excess unsuitable soil material was wasted on the northern and eastern slopes. Based on historical information, this effectively reduced the slopes in these areas to approximately 3:1 or flatter. Design information on the “Pond within a Pond” concept was not available at the time this report is written, but engineering inspection reports suggest that the interior pond dikes are on the order of about 10 feet high.

1.3.2 1978 Ash Pond

The 1978 Ash Pond is one of the two permitted CCW impoundments on the Cape Fear facility. It is located south of the existing generation facility between the inactive 1963/1970 Ash Ponds and the effluent discharge canal. Figure 3B shows a typical cross section of a 1978 Ash Pond dike. Available documentation indicates that the ash pond has a surface area of approximately 43 acres and currently impounds roughly 864 acre-feet of its estimated 1,161 acre-foot capacity. Based on a fairly recent aerial photo, it appears that roughly one-half to two-thirds of the pond area is vegetated with grass and light to moderate tree growth. The pond currently does not receive any CCW and serves as a receptacle for the storm water, coal pile run off, and low-volume categorical waste water the plant generates.

Historical design information and facility operation documents indicate that the 1978 Ash Pond has a maximum dike height of 27 feet and was constructed with 2:1 slopes. It shares a common dike with the 1963/1970 Ash Ponds and incorporates part of the steam plant's pre-existing flood control levee system in its design. A height increase of approximately 11 feet in these older structures was required to accommodate the final operating elevation at 197 feet and discontinued any overflow into the older pond structure that had been taken out of service.

1.3.3 1963/1970 Ash Pond

The 1963/1970 Ash Pond is located south of the steam generation facilities and constructed so that the west dike walls are essentially parallel to the Cape Fear River. Its configuration was developed by extending the west and east dikes of the 1963 Ash Pond, constructing the southern dike at the current location, and breaching the south dike of the 1963 Ash Pond to allow sluiced CCW flow to fill the added pond area. The ash pond dikes range in height from 22 feet in the original 1963 section to about 27 feet in the 1970 section. Figure 3B shows a typical cross section of a 1970 Ash Pond dike. These dikes, particularly those along the Cape Fear River, are generally heavily vegetated with trees and brush cover on the upstream and downstream slopes. Available documentation Progress Energy Carolinas provided indicates that the 1963/1970 Ash Ponds have a surface area of approximately 50 acres, most of which is forested with trees in a similar fashion to the dikes. Presently there is roughly two acres of open standing water that collects in a low area at the southern extremity of the pond. This water is generally storm water runoff from the present pond area and generally maintains a surface elevation approximately 7 to 10 feet below the southern dike crests. According to previous engineering reports, this ability to pond water and the likelihood of CCW in the pond bottom being exposed and transported via erosion or a dike failure is the basis for continued NCUC regulatory jurisdiction as a utility impoundment.

1.3.4 1956 Ash Pond

The 1956 Ash Pond is the oldest of the Cape Fear Plant's liquid borne CCW impoundments and was in service impounding sluiced CCW until 1963. It is located to the north of the power generation structures adjacent to the Haw River, and was constructed so that the southeast wall of the pond was a portion of the plant's flood control levee system. Its dike walls are on the order of about 20 feet tall from toe to crest and appear to have been constructed with fairly steep exterior slopes from 1.5:1 to approximately 1:1 (horizontal to vertical). At the time it was in operation, the CCW sluiced into the pond was primarily bottom ash and boiler slag because the technology to capture the lighter fly ash and fume materials did not exist. No documents were available detailing the basis of design or construction specifications. At present, the pond no longer impounds water and is overgrown with trees and heavy vegetation.

1.3.5 Other Impoundments

There are no other impoundments at the Cape Fear Plant.

1.4 Previously Identified Safety Issues

There have not been any documented unpermitted releases of CCW at the Cape Fear Plant facility associated with dike failures. There have been, however, some seepage, slope stability, and erosion issues in the past. These are identified in the following sections.

1.4.1 1985 Ash Pond

The 1985 Ash Pond exhibited longitudinal cracking along the crest centerline in the north dike shortly after the pond was constructed but prior to being put into service. As much as a 2-inch vertical displacement between the center and outside of the dike was observed. Concurrently, numerous holes and subterranean tunnels were observed adjacent to the top of the slope in areas where unsuitable soil was wasted during construction. The centerline cracking was attributed to foundation soil consolidation beneath the embankment. A compacted clay cap above the cracks and an impervious roadway surface was the recommended and implemented repair. Erosion due rainwater infiltration was deemed to be the cause of the holes in the slope surface.

Longitudinal cracking along with slope surface erosion was also noted on the west and southwest dikes in 1990. The slope surface erosion and instability continues to be present. These areas have been repaired intermittently with compacted gravel. An independent slope stability study indicated that the factor of safety (about 1.35) is lower than typical design requirements (1.5) possibly giving rise to the continued distress in this area.

Ground cover loss, erosion, and excessive moisture has been observed along the west dike toe, adjacent to the railroad spur. According to Progress Energy Carolinas' engineering consultant, the wet area is typically intermittent and associated with an old drainage swale that traversed that area of the dike, and caused some difficulty during construction. The consultant does not deem it to be a threat to embankment stability. The ground cover loss and erosion has been attributed to ineffective drainage in this area that causes water to back up prior to going beneath the double culverts under the railway spur. This is considered a maintenance issue and also not a threat to embankment stability.

1.4.2 1978 Ash Pond

The 1978 Ash Pond has had an issue with shallow groundwater at the north dike toe in the area of the plant cooling towers. According to available documentation, this area was originally observed during pond construction as the subgrade was being stripped for the dike fill and noted after the pond was completed since 1986. In 1990, plant personnel installed a trench drain in this location to capture groundwater and convey it to a point beyond the dike toe adjacent to the cooling towers. Details regarding this construction are not available but a historical site observation of the open trench suggests that it is approximately 15 feet beyond the dike toe and 5 feet deep, excavated in what appeared to be alluvium. A 6-inch diameter pipe functions as the trench drain outlet. Periodic inspections have noted clear seepage from the pipe since it was installed and the facility's independent engineering consultant is of the opinion that the seepage does not pose a stability problem for the dike.

The discharge canal adjacent to the toe of the ash pond had a large tree fall and rupture the soil in late 2006 – early 2007. This required placing a geotextile with rip-rap armoring in the area of the fall to stabilize the bank and protect against continued erosion. Though the dike toe is very close to discharge canal in this area, the tree fall and resulting soil rupture was not believed to be a detriment to the dike stability. Other large trees adjacent to the canal in this area were subsequently removed as a precautionary measure.

Beaching erosion along the upstream face of the dikes in the open pond areas has been cited in previous field inspection reports. In some cases this erosion appears to have been linked to rodent burrowing activities. Typically the recommendation has been to repair these areas with compacted granular material or rip-rap.

1.4.3 1963/1970 Ash Pond

In 1982, a slope failure occurred on the north end of the west dike in the 1963/1970 ash pond adaject to the Cape Fear River. According Progress Energy Carolinas' engineering consultant (MACTEC), at that time it was proposed to repair the failure with a rip-rap berm placed at the dike toe on the banks of the river channel. As the repair was being implemented, construction activity initiated additional instability and deformation (possibly localized vibratory induced liquefaction) and the work was halted with only a portion of the proposed rip-rap being placed at the river's edge and base of the dike. An independent engineering review and analysis of the failure was completed after the partial repair construction was halted and concluded that the dike was acceptable because the pond had been inactive since 1970 and the dike was impounding mostly sedimented ash.

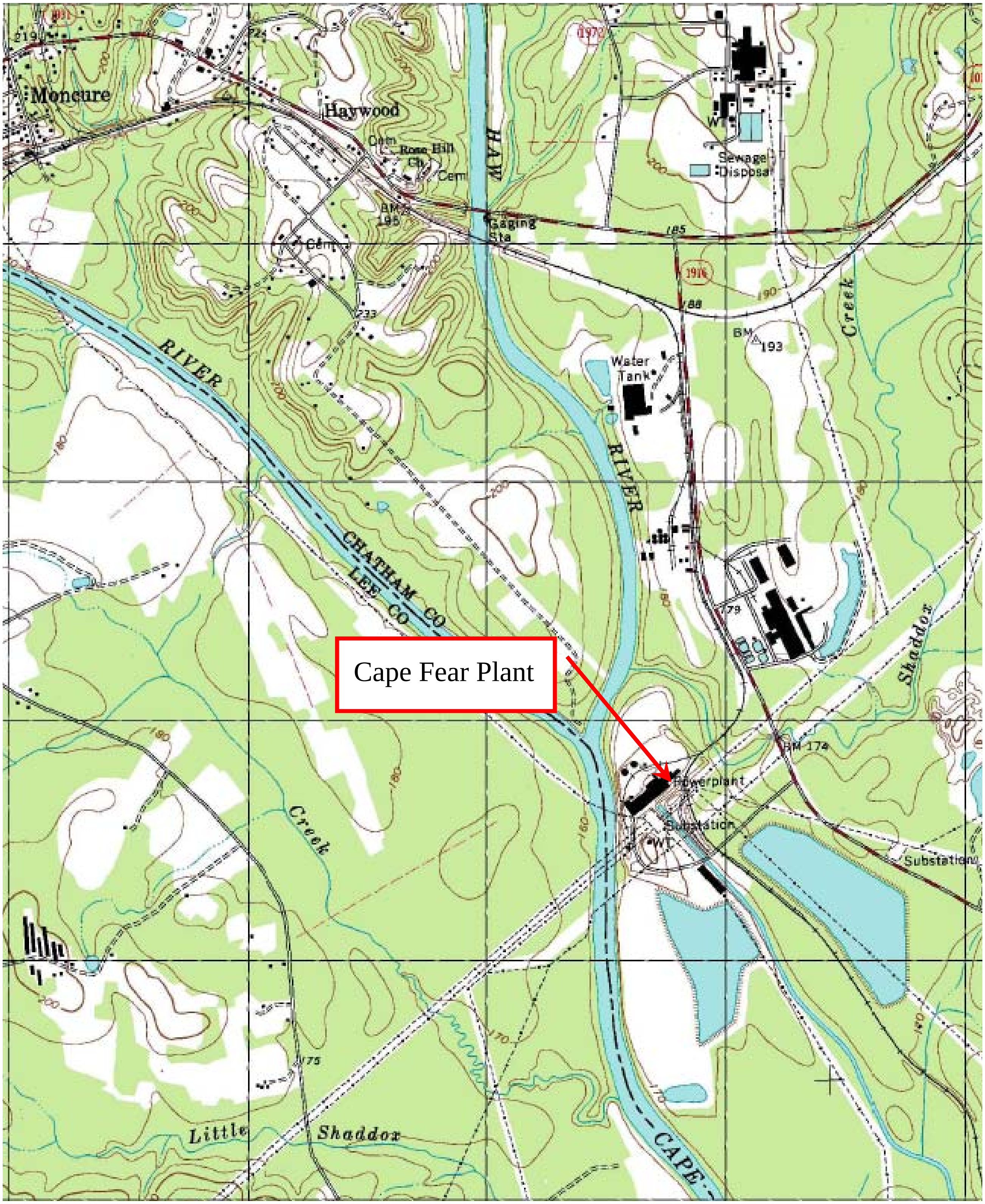
1.5 Site Geology

Based on a review of available surficial and bedrock geology maps, and reports by others, the site is of the Upper Triassic age. Chemical weathering of the sedimentary rock (sandstones, conglomerates and mudstones) formed layers of the residual soil comprising generally of silt, clay, silty clay, silty sand or sandy silt.

1.6 Bibliography

CHA reviewed the following documents provided by Progress Energy Carolinas in preparing this report:

- *Evaluation of Inactive Ponds*, June 8, 2009, Mactec Engineering and Consulting, Inc.
- *Report of Limited Field Inspection,* October 8, 2008, Mactec Engineering and Consulting, Inc.
- *Report of Limited Field Inspection*, July 17, 2007, Mactec Engineering and Consulting, Inc.
- *Five-Year Independent Consultant Inspection Report*, December 21, 2006, Mactec Engineering and Consulting, Inc.
- *Five-Year Independent Consultant Inspection Report*, December 2, 1996, Mactec Engineering and Consulting, Inc.



N

Figure 1
Project Location Map

Scale: 3" = 1 mile

Project No.:
20085.3000.1510

Progress Energy Carolinas
Cape Fear Plant
Moncure, North Carolina

IMAGE REFERENCE: GOOGLE EARTH, IMAGE DATED
JANUARY 24, 2004.

0 685 1370
Scale in feet

N

Drawing Copyright © 2007 CHA

CHA

PHOTO SITE PLAN
Cape Fear Plant
Progress Energy Carolinas
Moncure, North Carolina

PROJECT NO.
20085.3000

DATE: JULY 2009

FIGURE 2A

File: K:\20085\CADD\ACAD\FIGURES\GEO\3000 CAPE FEAR\3000 CF PLANS-MAPS.DWG Saved: 7/30/2009 2:03:32 PM PLotted: 9/14/2009 11:59:58 AM User: Filkins, Rebecca

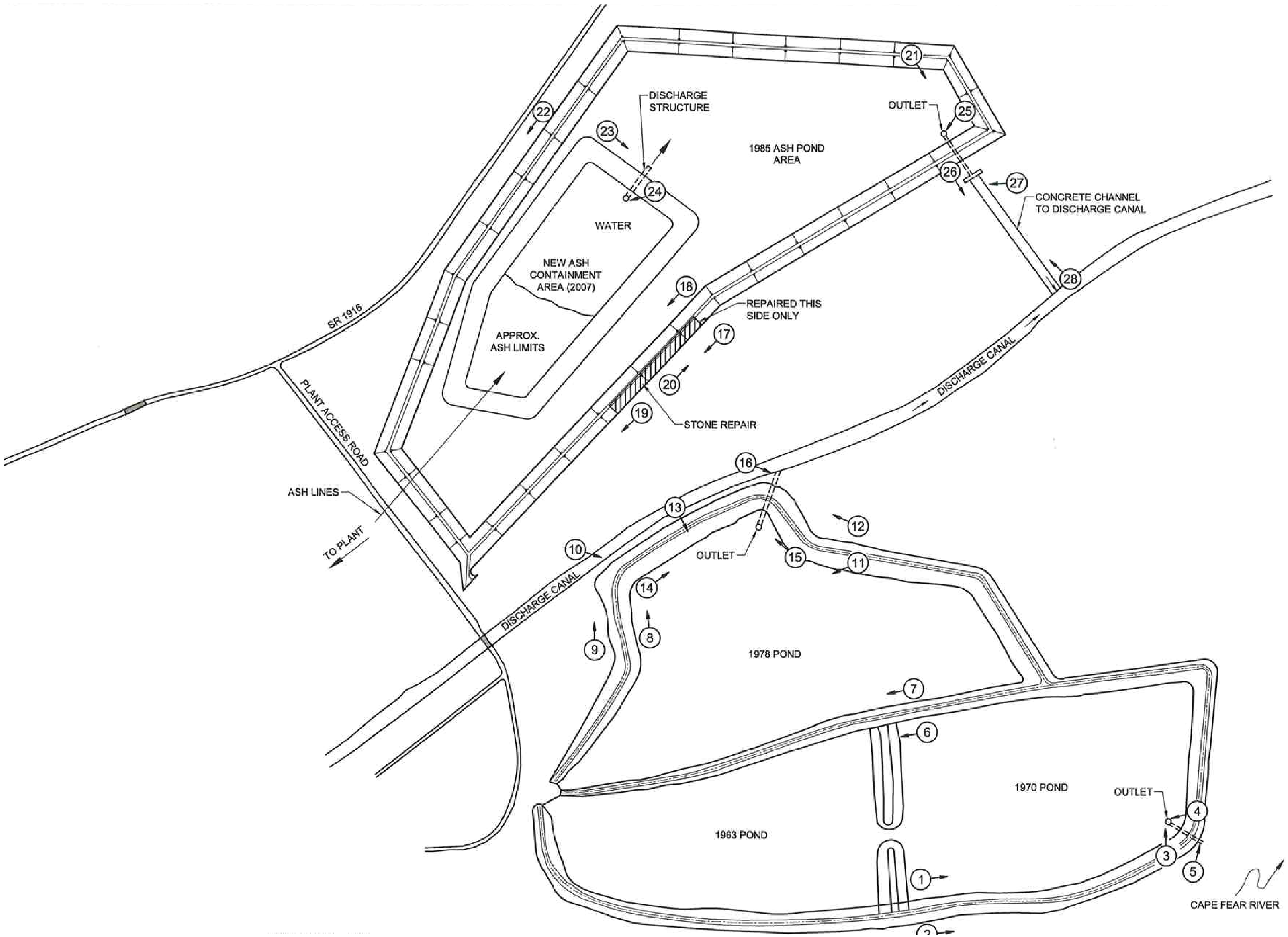


IMAGE REFERENCE: REPORT OF LIMITED FIELD INSPECTION,
MACTAC, OCTOBER 2008, ATTACHEMENT A, DRAWING 1

CHA

SITE PLAN

Cape Fear Plant
Progress Energy Carolinas
Moncure, North Carolina

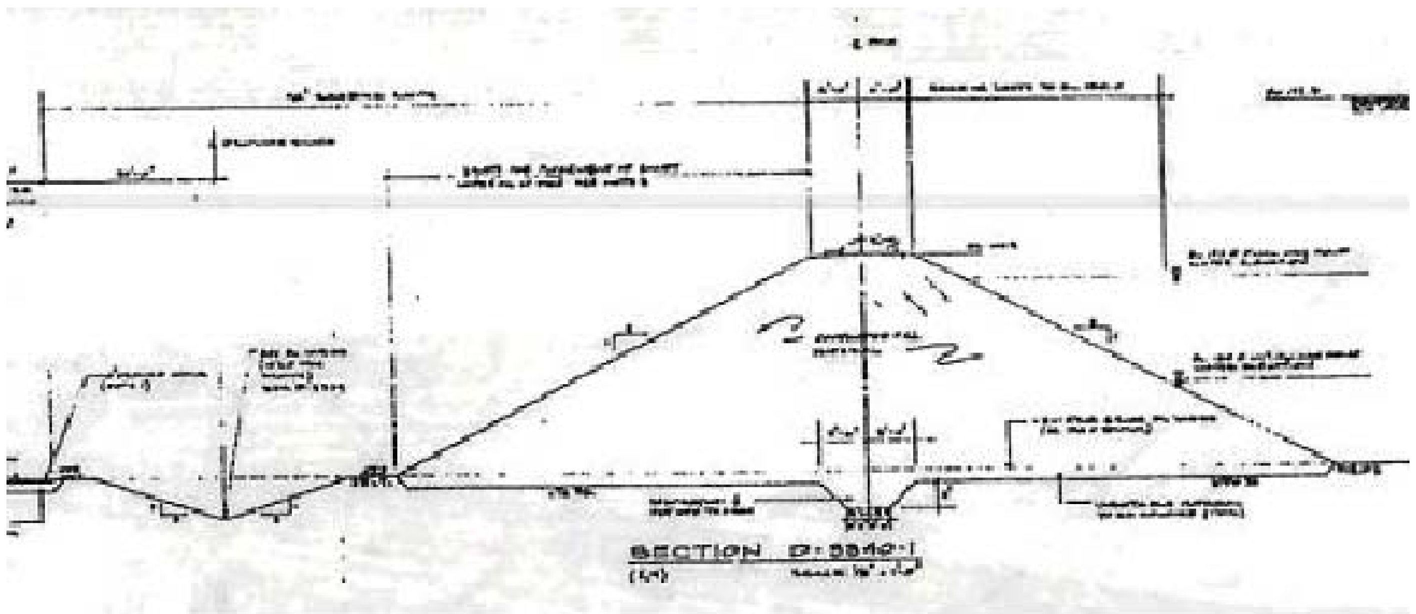
PROJECT NO.
20085.3000

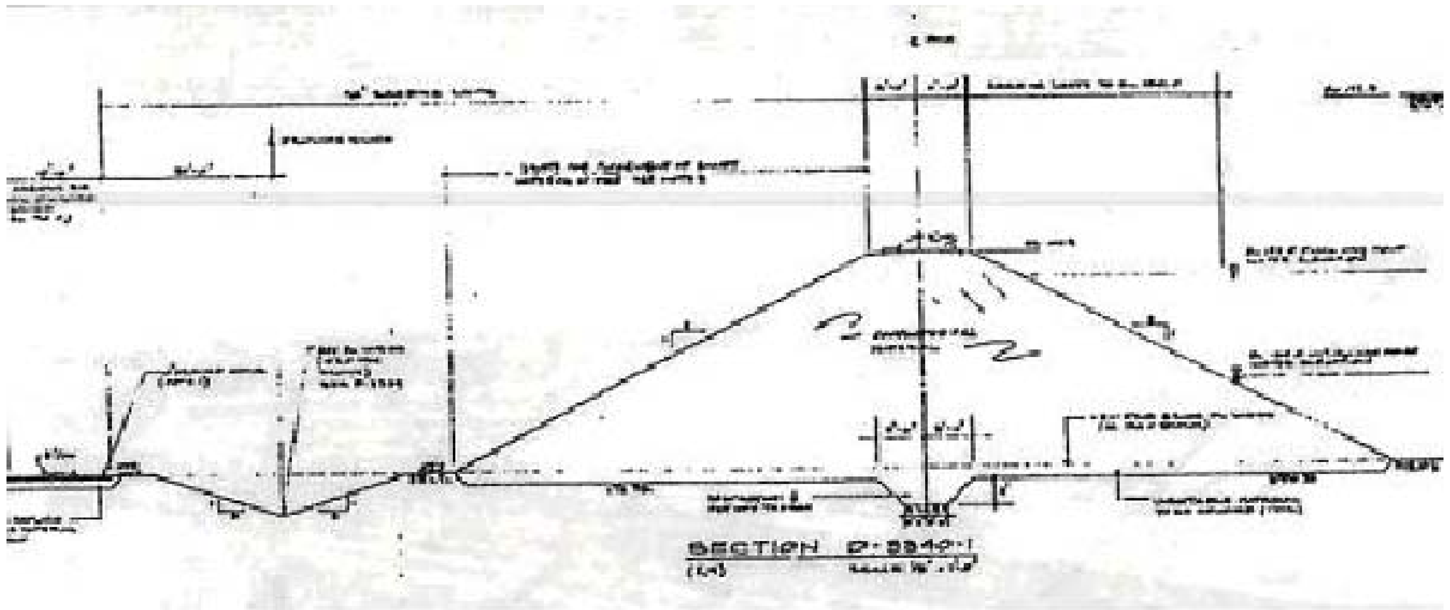
DATE: JULY 2009

FIGURE 2B

File: K:\20085\CADD\ACAD\FIGURES\GEO\3000 CAPE FEAR\3000 CF PLANS-MAPS.DWG Saved: 7/15/2009 2:55:49 PM Plotted: 7/15/2009 3:05:14 PM User: Filkins, Rebecca

File: K:\20085\CADD\ACAD\FIGURES\GEO\3000 CAPE FEAR\3000 CF XSECTS.DWG Saved: 7/16/2009 4:16:24 PM PLotted: 7/17/2009 10:34:23 AM User: Filkins, Rebecca





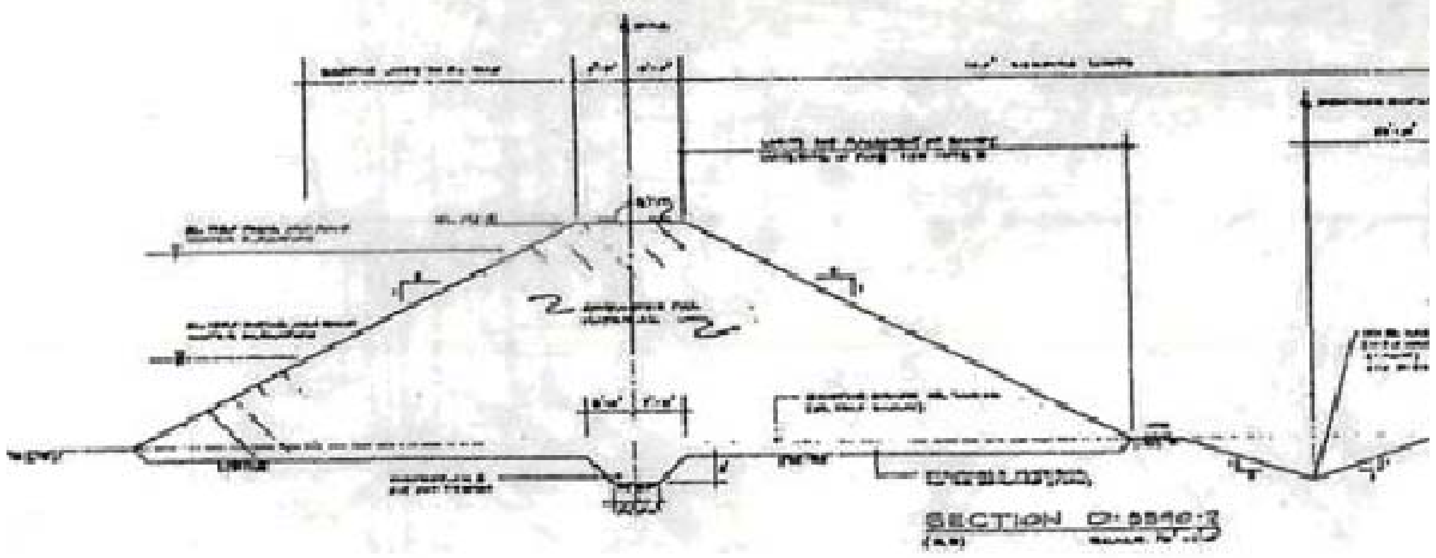


IMAGE REFERENCE: INDEPENDENT CONSULTANT INSPECTION, LAW (MACTEC), DECEMBER 1996, EXIBIT NO. 1, CAPE FEAR STEAM ELECTRIC PLANT, NEW (1983) ASH POND, SITE PLAN, CP&L DRAWING NO. D-3336

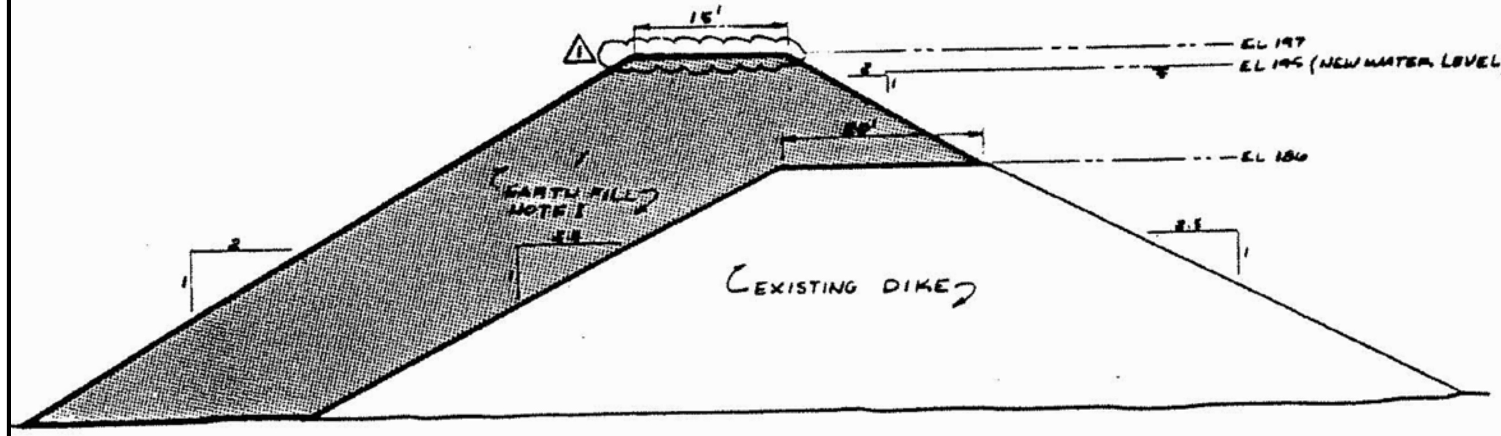
CHA

CROSS SECTIONS OF 1985 ASH POND
Cape Fear Plant
Progress Energy Carolinas
Moncure, North Carolina

PROJECT NO.
20085.3000

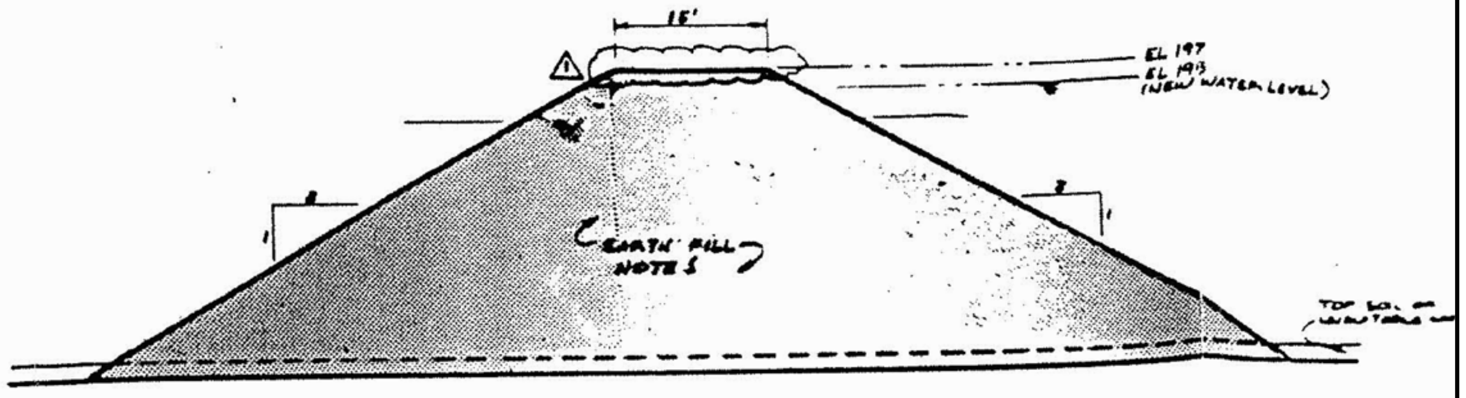
DATE: JULY 2009

FIGURE 3A



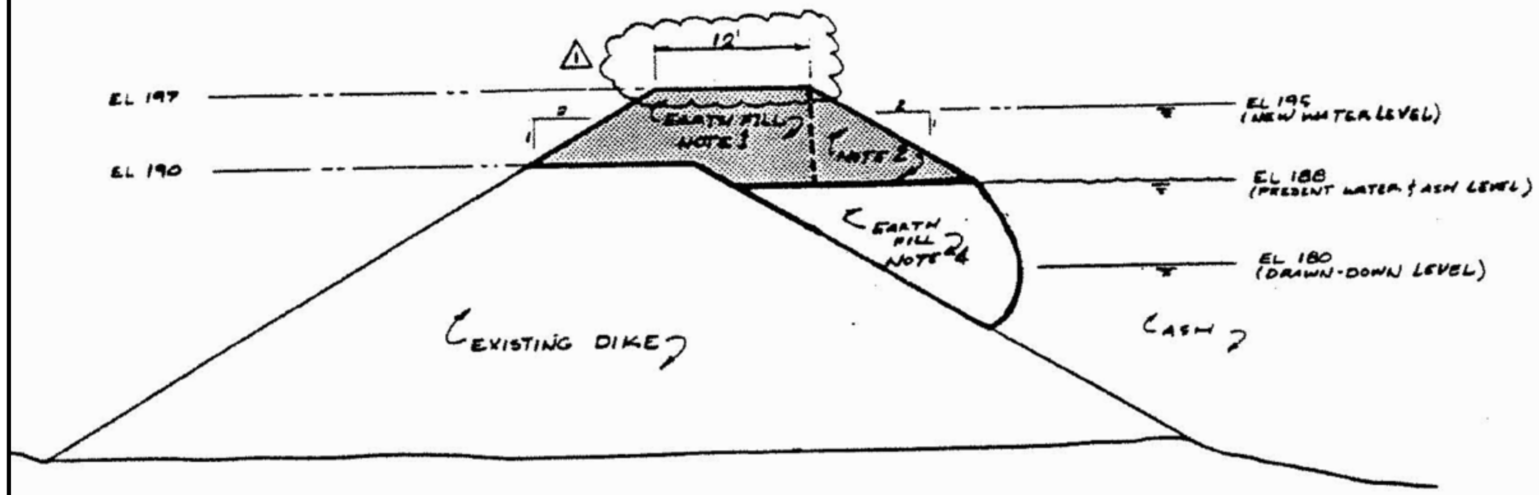
SECTION A-A

RAISED COOLING TOWER DIKE



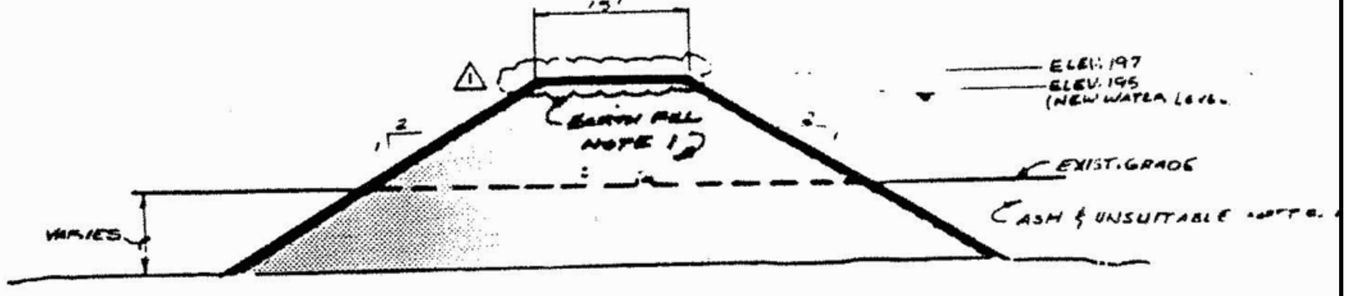
SECTION B-B

NEW DIKE (TYPICAL)



SECTION C-C

RAISED EXISTING DIKE



NOTE: EXISTING ASH & UNSUITABLE MATERIALS TO BE EXCAVATED TO SUITABLE FOUNDATION CONDITION AS DEFINED BY SPEC. 78-S-090.

SECTION D-D

NEW DIKE ACROSS EXISTING ASH POND

IMAGE REFERENCE: EVALUATION OF INACTIVE ASH PONDS, MACTEC, JUNE 2009, EXHIBIT 11, DRAWING RCD-362

CHA

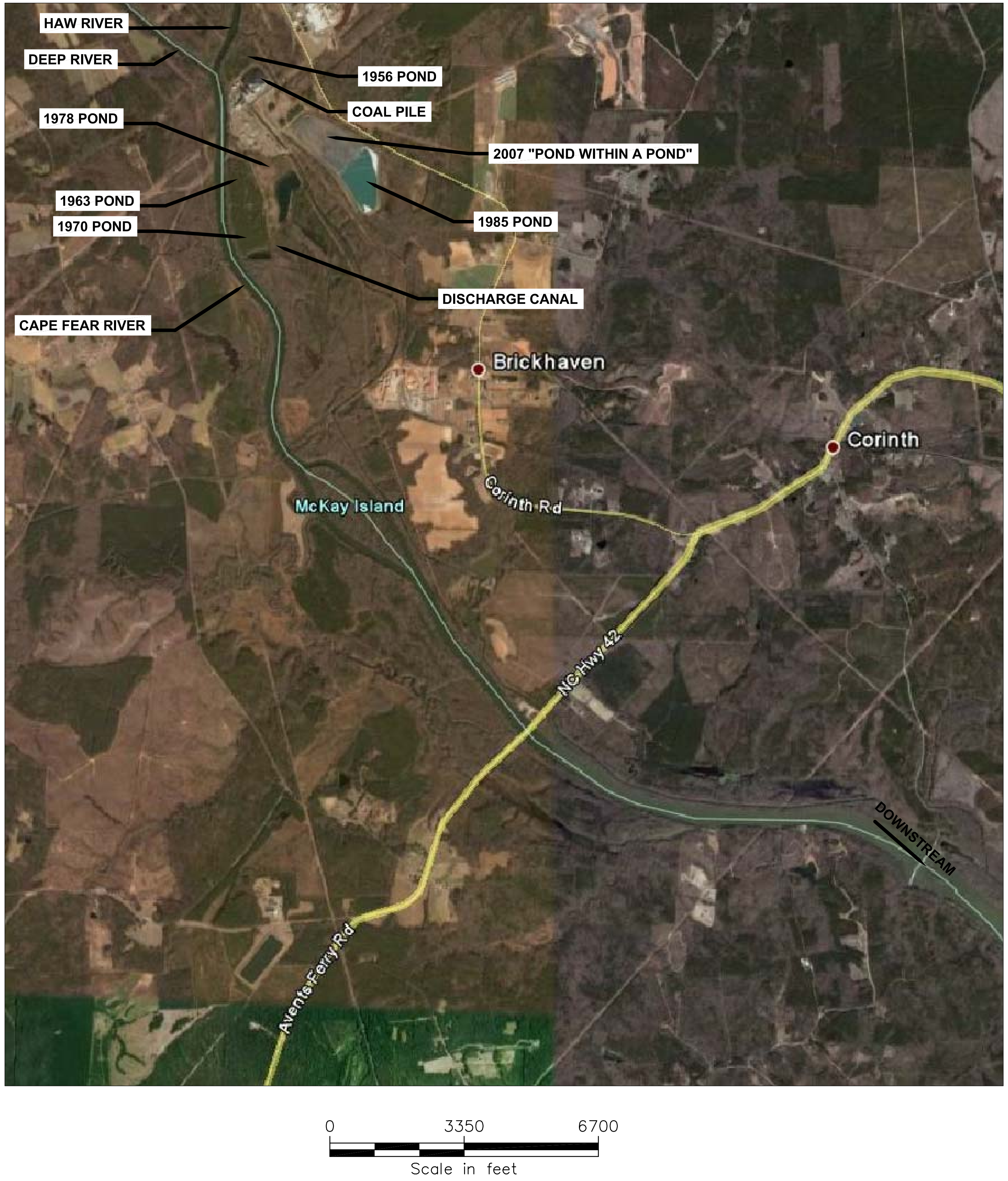
CROSS SECTION OF 1978 ASH POND AND 1970 ASH POND DIKE RAISING
Cape Fear Plant
Progress Energy Carolinas
Moncure, North Carolina

PROJECT NO.
20085.3000

DATE: JULY 2009

FIGURE 3B

File: K:\20085\CADD\ACAD\FIGURES\GEO\3000 CAPE FEAR\3000 CF XSECTS.DWG Saved: 7/15/2009 3:26:00 PM PLotted: 7/15/2009 3:53:32 PM User: Filkins, Rebecca



MAP SHOWING TO APPROXIMATELY 5 MILES DOWNSTREAM

APPROXIMATE SCALE

2 mi
5 km

NOTE: APPROXIMATELY 25 MILES FROM 1970 ASH POND (NEAR POINT A) TO LILLINGTON AND CAPE FEAR.

MAP SHOWING CLOSEST DOWNSTREAM INFRASTRUCTURE

IMAGE REFERENCES: GOOGLE EARTH, IMAGE DATED
JANUARY 24, 2009 & GOOGLE MAPS 2009

CHA

CRITICAL INFRASTRUCTURE MAP
Cape Fear Plant
Progress Energy Carolinas
Moncure, North Carolina

PROJECT NO.
20085.3000

DATE: JULY 2009

FIGURE 4

2.0 FIELD ASSESSMENT

2.1 Visual Observations

CHA performed visual observations of the 1956, 1963/1970, 1978, and 1985 Ash Ponds following the general procedures and considerations contained in Federal Emergency Management Agency's (FEMA's) *Federal Guidelines for Dam Safety* (April 2004), and Federal Energy Regulatory Commission (FERC) Part 12 Subpart D to make observations concerning settlement, movement, erosion, seepage, leakage, cracking, and deterioration. A Coal Combustion Dam Inspection Checklist and Coal Combustion Waste (CCW) Impoundment Inspection Form, prepared by the US Environmental Protection Agency, were completed on-site during the site visit. Copies of the completed forms were submitted via email to a Lockheed Martin representative approximately three days following the site visit to the Cape Fear Plant. A copy of these completed forms are included in Appendix A. A photo log and Site Photo Location Maps (Figures 5A, 5B and 5C) for the Cape Fear Ash Ponds are also located at the end of Section 2.6.

CHA's visual observations were made on June 15, 2009 and June 16, 2009. The weather varied from hot and sunny with temperatures between 60 and 90 degrees Fahrenheit on June 15th, to rainy and cloudy with a high of 73 degrees Fahrenheit on June 16th. Prior to the days we made our visual observations, the following approximate rainfall amounts occurred (as reported by www.weather.com).

Table 1– Approximate Precipitation Prior to Site Visit

Date of Site Visit - June 15, 2009 & June 16, 2009		
Day	**Date**	**Precipitation (inches)**
Monday	6/8/09	0.00
Tuesday	6/9/09	0.14
Wednesday	6/10/09	0.09
Thursday	6/11/09	0.02
Friday	6/12/09	0.00
Saturday	6/13/09	0.00
Sunday	6/14/09	0.00
Monday	6/15/09	0.12
Tuesday	6/16/09	0.26
Total	**Week Prior to Site Visit**	**0.63**
Total	**Month of June**	**6.90**

2.2 1985 Ash Pond

CHA performed visual observations of the 1985 Ash Pond dikes. The dikes in total are about 7,385 feet long and about 30 feet high. The dikes are mowed annually and were reportedly last mowed in November 2008 so heavy vegetation growth hampered visual observations. This impoundment is one of the two impoundments permitted by NCUC.

2.2.1 Embankments and Crest

In general, the alignment of the 1985 Ash Pond dike crests do not show signs of change in their horizontal alignment based on general alignment of the roadway that runs along the crest of the dikes. Heavy vegetation obscured direct observation of the break between the crest and the embankment slopes.

In the northern portion of the pond, sluiced ash is approximately at the design elevation leaving about 2 to 3 feet of freeboard. Cattails and grasses are growing on the deposited ash and the upstream dike slope as shown in Photos 27, 33 and 40. In the area where the sluice lines run across the 1985 north dike crest, the ash is level with the top of the dike as shown in Photo 25. Within this area there is a ramp up to the 2007 “pond within a pond”.

The southern portion of the pond contains free water with about 4 to 5 feet of freeboard. Heavy vegetation and small trees cover the upstream slopes as shown in Photos 28 and 31.

The downstream slope along the north dike is mowed, appropriate grass vegetation as shown in Photo 23. In this area, the downstream slope appeared uniform. A bare patch was observed just beyond the toe of the north dike as shown in Photo 22. Progress Energy Carolinas personnel indicated that they had recently observed this area and that they did not know of something having been placed in this area to cause the grass to die off.

Along the west dike, many voids were observed in the upper portion of the downstream slope. Progress Energy Carolinas personnel indicated that these were rodent holes that were filled with gravel fill during routine maintenance. Photo 10 shows an area of this stone fill. Photo 12 shows an open void.

In the southern portion of the west dike, a 3 to 4 foot high scarp was observed near the top of the slope as shown in Photo 13. CHA observed that in the area of the voids discussed in the paragraph above, and at the edges of the scarp, the vegetation was dead.

Along the toe of the northern portion of the west dike there is an area, which Progress Energy Carolinas personnel indicated storm water ponds between the toe of the dike and the access road that runs between the dike and the railroad tracks. The area is devoid of vegetation and was dry during our site visit as shown in Photo 2. The ponding water in this area has resulted in some “beaching” erosion at the toe of the northern portion of the west dike as shown in Photo 3.

Just north of the slight bend in the west dike, a clump of trees is growing just beyond the toe of the dike as shown in Photo 4. In this area, the embankment soils at the toe were soft as evidenced by the ease at which a rod was pushed into the soil (see Photo 8). And an area of possible seepage was observed as shown in Photo 9. The drainage from this area which is at the southern end of the area in which water reportedly ponds passes into culverts under the access road and railroad tracks as shown in Photo 6.

There were no other remarkable features on remaining downstream slopes of the 1985 dikes. However, as shown in Photos 16 through 21, heavy brush, weeds, blackberry brambles, and other vegetation hampered observations.

2.2.2 1985 Ash Pond Outlet Control Structure and Discharge Channel

The outlet control structure in the 1985 Ash Pond is located in the southwest corner of the pond and consists of a drop inlet riser pipe conveying decanted water below the west dike through a 36-inch diameter reinforced concrete pipe (RCP). Photo 30 shows the outlet control structure. Photo 14 shows the culvert conveying the discharge from the 1985 ash pond below the access road that runs along the west side of the pond.

2.2.3 2007 "Pond within a Pond"

In 2007, Progress Energy Carolinas constructed an impoundment on top of settled ash within the footprint of the 1985 Ash Pond. Based on the 2008 inspection report by MACTEC, CHA understands that the dikes for this "pond within a pond" were constructed with compacted ash from the 1985 pond and are covered with a veneer of soil and vegetation. The ash is sluiced into the north end of this pond, and is decanted from the south end into the 1985 Ash Pond. The dikes for this pond are currently about 10 feet high, with slopes of about 3H:1V. We understand that Progress Energy Carolinas has plans to raise this "pond within a pond" when more ash storage capacity is needed. Photo 34 shows the 2007 pond, Photo 35 shows the outlet control structure, which like the 1985 Ash Pond outlet is a drop inlet riser pipe, and Photo 36 shows the discharge pipe where it empties into the 1985 Ash Pond. Photo 38 shows the dike construction.

2.3 1978 Ash Pond

CHA performed visual observations of the 1978 Ash Pond. The 1978 Ash Pond dikes are about 5,880 feet long and about 27 feet high. The 1978 Ash Pond dikes were heavily vegetated, which hampered CHA's observations. This ash pond is one of the two ash ponds permitted by NCUC. This pond no longer receives CCW, but does receive discharge from the plant yard drains.

2.3.1 Embankments and Crest

The crest alignment of the 1978 dikes do not appear changed from historic site plans. The 1978 Ash Pond contains water at the southern end of the pond and sluiced, but dried ash in the northern portion of the pond. In the northern portion of the pond, trees and other vegetation has established on the exposed ash as shown in Photo 66. Photos 41, 42, 45, and 50 show the typical vegetation conditions on the dikes.

As described in Section 1.42, in 1990, plant personnel installed a trench drain in this location to capture groundwater and convey it to a point beyond the dike toe adjacent to the cooling towers.

There are areas on the embankment where lack of appropriate grass cover has resulted in erosion and exposed soil. These areas through the 1978 dikes are shown in Photos 44, 48, 51, 53, 60, and 62. As can be seen in these photos, the exposed soil is susceptible to erosion and various areas have experienced various degrees of erosion and sloughing.

Along the easternmost portion of the dike where it parallels the Discharge Canal, undercutting of the dike toe from flows in the Discharge Channel in combination with fallen (uprooted) trees has resulted in sloughing of the slope. An area where a tree reportedly had uprooted was repaired in late 2006 or early 2007 with rip rap as shown in Photo 47. Photo 48 shows sloughing in this area and Photo 49 shows the undercutting of the toe from the Discharge Channel flows.

Evidence of soil disturbance from animal activity was observed in a few locations. Photo 52 shows a slide likely resulting from beaver or muskrat activity, and Photo 63 shows an animal burrow.

To the west of the outlet pipe discharge is an area of ponded water. The nature of the silty/clayey soils comprising the dikes is to be susceptible to softening when subjected to excess moisture. Photo 58 shows this area.

The 1978 Ash Pond shares its west side with the east side of the 1963/1970 Ash Pond. Along this dike, ash is impounded approximately equally on both sides of the dike. Photo 65 shows a portion of this dike between overgrown areas of exposed ash within the 1978 and 1963/1970 Ash Ponds.

2.3.2 1978 Ash Pond Outlet Control Structure

The outlet control structure in the 1978 Ash Pond is located in the southeast corner of the pond and consists of a drop inlet riser pipe conveying decanted water below the west dike through an 18-inch diameter RCP pipe. Photo 57 shows the outlet control structure. Photos 55 and 56 show the outlet pipe discharging into the discharge channel.

2.4 1963/1970 Ash Ponds

The 1963/1970 Ash Ponds are described here as one impoundment. When the 1963 pond filled with ash, the 1970 pond was constructed by extending the east and west dikes of the 1963 pond to the south, and then breaching what had been the south dike of the 1963 pond. This pond is inactive and no longer receives CCW or storm water discharges from the plant. Storm water is free to flow across the whole pond unobstructed as a result of the breach in the original south dike of the 1963 pond.

CHA performed visual observations of the 1963/1970 Ash Ponds. The dikes are about 7,400 feet long and about 27 feet high. The 1963/1970 Ash Pond dikes were heavily vegetated, which hampered CHA's observations. This ash pond was constructed prior to regulatory purview under the NC Dam Safety Law. However, the storm water discharge from this pond is permitted by the site's NPDES Permit.

2.4.1 Embankments and Crest

As mentioned in Section 2.3.1 above, the majority of the east dike for the 1963/1970 pond is shared with the 1978 pond. However, the east dike extends south of the 1978 pond to contain the southern end of the 1963/1970 pond. Photos 68 through 70 show the large trees growing along the downstream slope of the east dike. Because of the forested nature of this slope, there is very little erosion protecting vegetation, although the woodland debris does provide some protection during small rainstorms. The upstream slope of the east dike is covered with heavy brush as shown in Photo 71.

The south dike conditions are very similar to those of the east dike. At these two dikes, the dikes are about 8 to 10 feet high, and the slopes were relatively uniform. Photos 73 and 74 show the condition of the south dike.

The west dike of the 1963/1970 ash pond parallels the Cape Fear River. There was generally about 20 to 40 feet between the toe of dike and the waters edge during CHA's site visit, although some sections were as close as 15 feet. As with the other dikes, the west dike is heavily wooded. The general conditions of the west dike are shown in Photos 76, 81, and 85. The west dike is about 30 feet high, and was noted to be irregular resulting from erosion, sloughing, and fallen (uprooted) trees. As can be seen in Photos 83, 84, 86, 87, and 88 the erosion and sloughing has resulted in exposed soil, and a steepened slope condition. CHA did not observe cracking of settlement of the crest suggesting that these sloughs are surficial in nature and not signs of global movements.

Photo 89 shows an area at the north end of the west dike that experienced a significant slough in 1982, which was stabilized by placing large rip rap on the slope.

2.4.2 1963/1970 Ash Pond Outlet Control Structure

The only remaining water in the 1963/1970 ash pond is contained in the southern end of the pond and covers an area of about 2 to 3 acres, as compared with the approximately 50-acre surface area of the pond; the remaining portion of the pond is forested. The water that is contained in the pond is lower than the outlet control structure which is shown in Photos 77 and 78 and is located in the southwest corner of the pond. The outlet pipe is shown in Photo 79 at the bank of the Cape Fear River. Reports and plans indicate that the outlet control structure originally associated with the 1963 pond was removed in 1970 when the pond was expanded.

2.5 1956 Ash Pond

CHA performed visual observations of the 1956 Ash Pond. The 1956 Ash Pond is inactive and no longer receives CCW or storm water discharges from the plant and contained no water during CHA's site visit. The 1956 Ash Pond dikes are about 2,800 to 2,900 feet long and about 20 feet high. The 1956 Ash Pond dikes were heavily vegetated, which hampered CHA's observations. This ash pond was constructed prior to regulatory purview under the NC Dam Safety Law. However, the storm water discharge from this pond is permitted by the site's NPDES Permit

2.5.1 Embankments and Crest

The south dike of the 1956 Ash Pond is a portion of a flood control levee system that was installed around the plant to protect it from flooding from the Cape Fear River. As noted in Section 1.3 the construction of B. Everett Jordan Dam has resulted in this levee system to not be required. Photos 92 and 93 show this south dike of the 1956 Ash Pond. The ash pond is accessible from the plant through a locked gate in the chain link fence that runs along the pond's upstream edge of the crest of the south dike.

At the southwest corner of the 1956 pond, the ash is level with the top of the dike. The downstream slope of the west dike, as shown in Photo 97, is very steep and was field measured to be about a 1:1 slope. A field survey cross section included in Mactec's 2009 assessment report on the inactive ash ponds shows the slope of the dikes for the 1956 pond at 1.2H:1V to 1.8H:1V. The west side of the pond roughly parallels the Haw and Cape Fear Rivers. There was approximately 15 feet between the toe of the dike and the river bank at its closest location.

Along the northwest to east sides of the 1956 Ash Pond there is 3 to 8 feet of freeboard between the top of the deposited ash and the crest of the dikes. The downstream slopes are severely eroded, have experienced fallen (uprooted) trees, and sloughing. Examples of these conditions and the resulting steepening of the downstream slopes are shown in Photos 98 through 101, and 103.

A typical view of the narrow crest is shown in Photo 104. The ash pond is to the left side of the dike in this photo.

2.5.2 1956 Ash Pond Outlet Control Structures

The remains of the original outlet control structure are located in the southwest corner of the 1956 Ash Pond and are shown in Photos 95 and 96 within the pond and on the downstream slope, respectively.

More recently, a storm water discharge system was installed at the east side of the pond as shown in Photo 106. Progress Energy Carolinas personnel indicated that the discharge pipe for these storm water collection structures was installed through the dike.

2.6 Monitoring Instrumentation

There is no active instrumentation monitoring of the dikes at the Cape Fear Plant.

File: K:\20085\CADD\ACAD\FIGURES\GEO\3000 CAPE FEAR\3000 CF PLANS-MAPS.DWG Saved: 7/17/2009 9:05:18 AM PLotted: 7/17/2009 11:01:48 AM User: Filkins, Rebecca

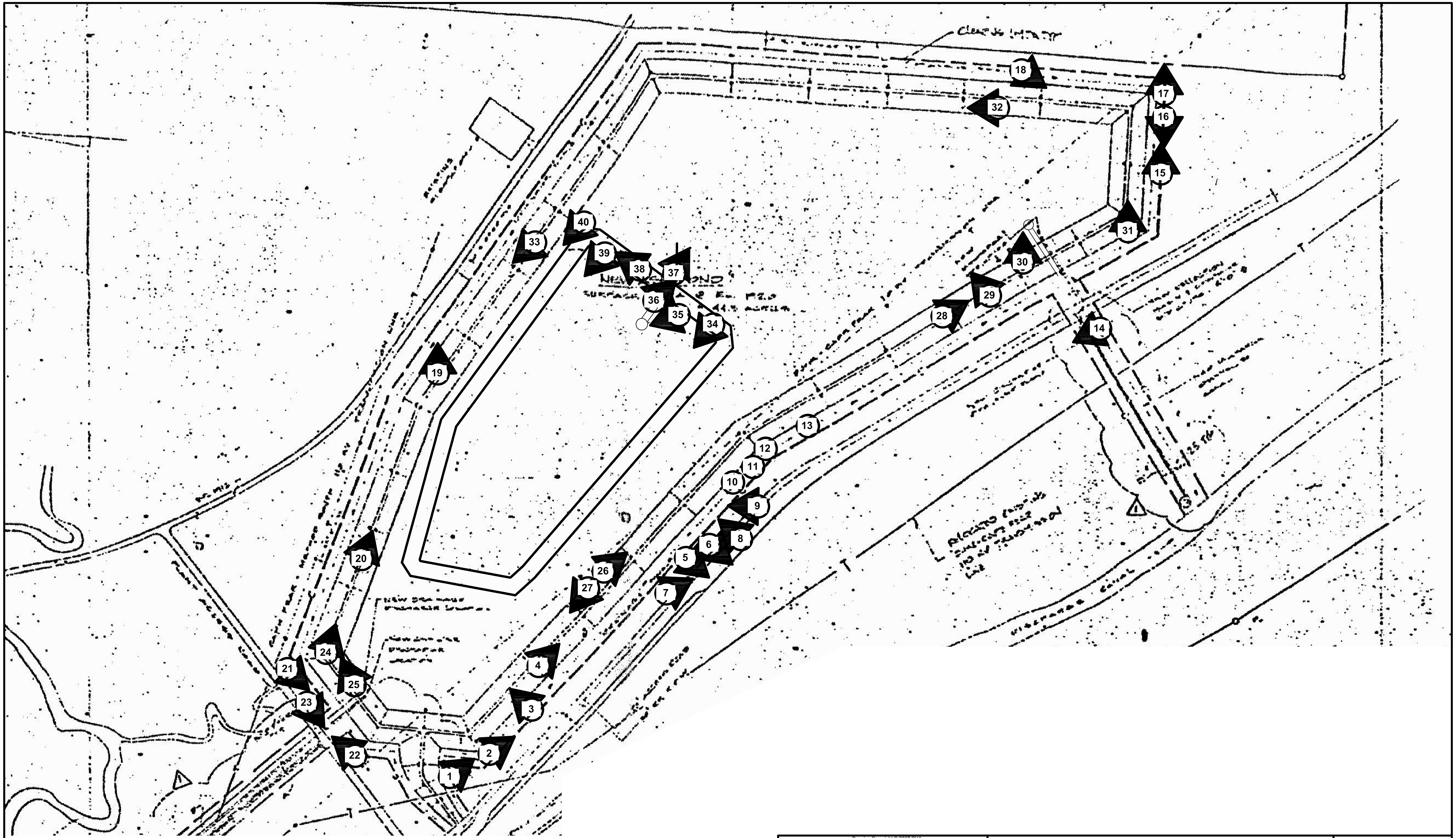


IMAGE REFERENCE: INDEPENDENT CONSULTANT INSPECTION, LAW (MACTEC), DECEMBER 1996, EXHIBIT NO. 1, CAPE FEAR STEAM ELECTRIC PLANT, NEW (1983) ASH POND, SITE PLAN, CP&L DRAWING NO. D-3336

CHA

PHOTO LOCATION PLAN
1985 AND 2007 ASH PONDS

Cape Fear Plant
Progress Energy Carolinas
Moncure, North Carolina

PROJECT NO.
20085.3000

DATE: JULY 2009

FIGURE 5A

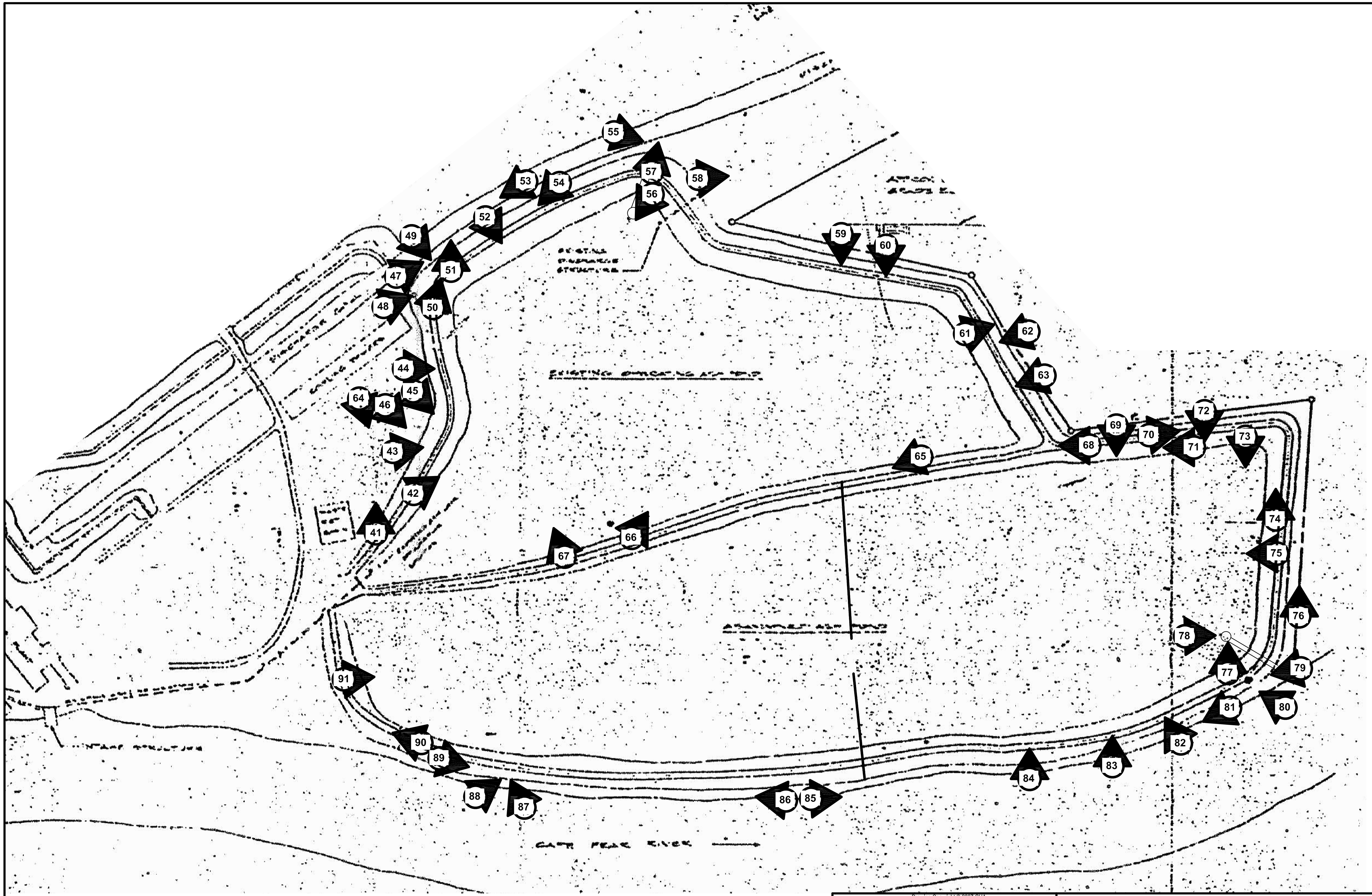


IMAGE REFERENCE: INDEPENDENT CONSULTANT INSPECTION, LAW (MACTEC), DECEMBER 1996, EXIBIT NO. 1, CAPE FEAR STEAM ELECTRIC PLANT, NEW (1983) ASH POND, SITE PLAN, CP&L DRAWING NO. D-3336

CHA

PHOTO LOCATION PLAN
1978, 1963, AND 1970 ASH PONDS
Cape Fear Plant
Progress Energy Carolinas
Moncure, North Carolina

PROJECT NO.
20085.3000

DATE: JULY 2009

FIGURE 5B

File: K:\20085\CADD\ACAD\FIGURES\GEO\3000 CAPE FEAR\3000 CF PLANS-MAPS.DWG Saved: 7/17/2009 11:26:56 AM PLotted: 7/17/2009 11:29:02 AM User: Filkins, Rebecca

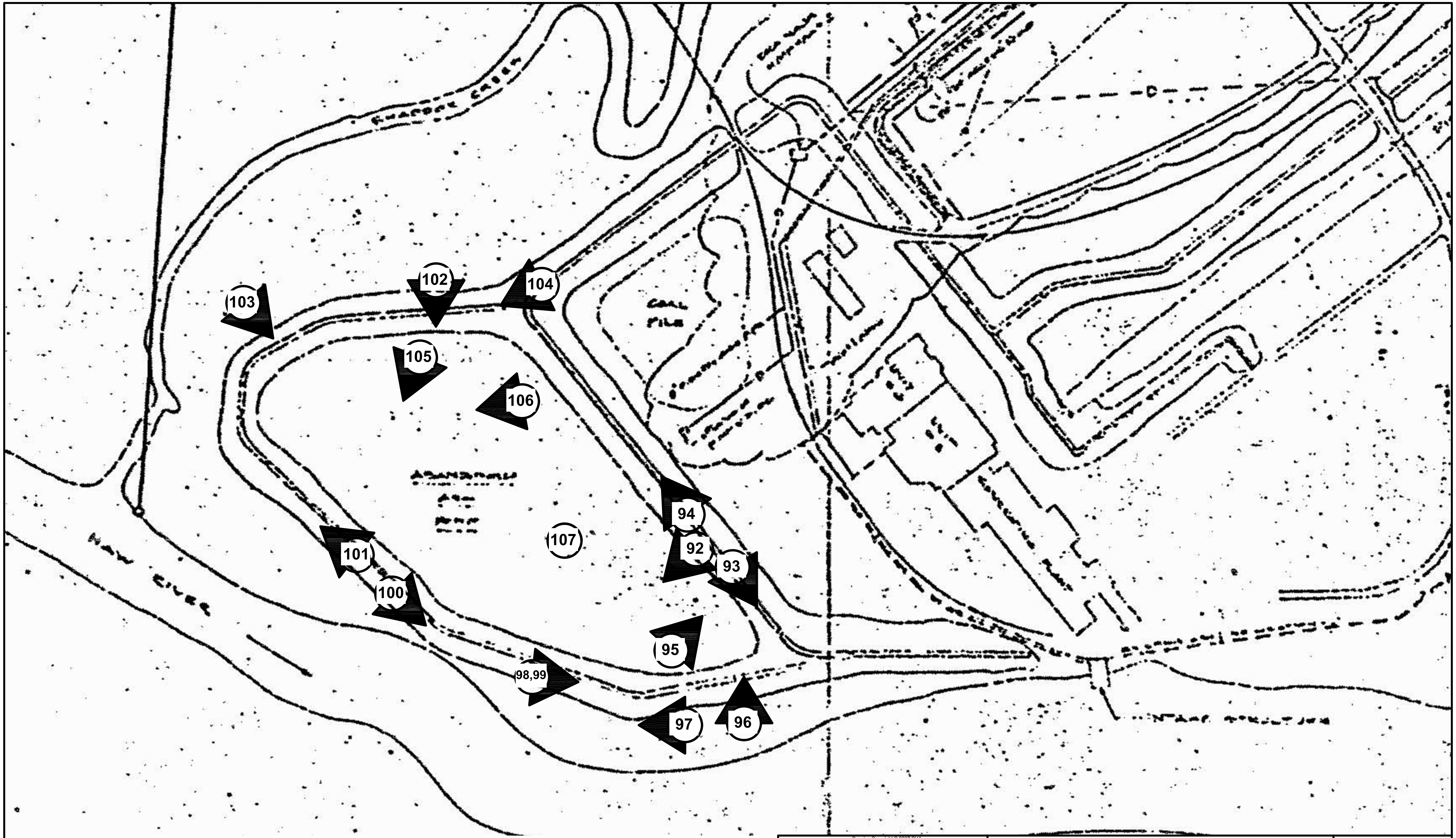


IMAGE REFERENCE: INDEPENDENT CONSULTANT INSPECTION, LAW (MACTEC), DECEMBER 1996, EXHIBIT NO. 1, CAPE FEAR STEAM ELECTRIC PLANT, NEW (1983) ASH POND, SITE PLAN, CP&L DRAWING NO. D-3336

N

CHA

PHOTO LOCATION PLAN
1956 ASH POND

Cape Fear Plant
Progress Energy Carolinas
Moncure, North Carolina

PROJECT NO.
20085.3000

DATE: JULY 2009

FIGURE 5C

1

Northwest end of 1985 Ash Pond West Dike, looking southeast.

2

1985 Ash Pond West Dike toe along the northern portion of Dike.

3

Erosion at the toe of the 1985 Ash Pond West Dike in an area of poor drainage.

4

1985 Ash Pond West Dike approaching bend, looking southeast.

5

Woody growth along the West Dike of the 1985 Ash Pond.

6

Double culvert under railroad spur for ditch line along West Dike of 1985 Ash Pond.

7

Tree growth at the toe of the 1985 Ash Pond West Dike.

8

Soft soil at the toe of the 1985 Ash Pond West Dike. Probe pushed into the ground about 2 feet.

9

Possible seepage at the toe of the 1985 Ash Pond West Dike.

10

Stone filled erosion and /or abandoned rodent hole on the 1985 Ash Pond West Dike.
Progress Energy reports filling rodent holes and erosion features with gravel.

11

Sparse and weedy vegetation cover on the 1985 Ash Pond West Dike.

12

Rodent hole on the 1985 Ash Pond West Dike.

13

Scarp about 3 to 4 feet high near the top of the 1985 Ash Pond West Dike.

14

Culvert under the access road at the toe of the 1985 Ash Pond West Dike outlet channel.

15

Drainage swale/channel adjacent to toe of 1985 Ash Pond.

16

Southeast corner of the 1985 Ash Pond Dike, looking southwest.

17

South Dike of the 1985 Ash Pond, looking northeast.

18

East Dike of the 1985 Ash Pond, looking south.

19

East Dike of the 1985 Ash Pond, looking southeast.

20

Corner at the north and northeast Dike of the 1985 Ash Pond, looking east.

21

North Dike of the 1985 Ash Pond, looking southwest.

22

Toe of the North Dike of the 1985 Ash Pond, looking northeast.
Note: Bare patch at the toe of the Dike.

23

North Dike of the 1985 Ash Pond, looking southwest.

24

Dike crest at the north corner of the 1985 Ash Pond, near the ash line crossing.

25

North Dike crest of the 1985 Ash Pond, looking northeast.
Note: Ash level is approximately at the crest of the Dike.

26

West Dike crest of the 1985 Ash Pond, looking southeast. Note: "Pond within a pond" to the upstream side of the crest. Ash in 1985 Ash Pond approximately at the crest of the dike.

27

1985 Ash Pond, looking north.
Note: stacked ash in the "Pond within a pond".

28

South end of west Dike crest at the 1985 Ash Pond, looking southeast.

29

Looking east across the 1985 Ash Pond at the east Dike.

30

Outlet structure in the 1985 Ash Pond.

31

South end of the 1985 Ash Pond, looking southeast.

32

Crest of the east Dike of the 1985 Ash Pond, looking north.

33

Northeast Dike crest of the 1985 Ash Pond, looking west.

34

Current ash disposal in a “Pond within a pond”. Pond was constructed with earthen dikes placed on top of ash in 1985 Pond, looking northwest.

35

Close up of the outlet control structure in “Pond within a pond”.

36

Outlet of “Pond within a Pond” into 1985 Ash Pond, looking southeast. Notice ash stockpiles within the pond.

37

Close up of “Pond within a Pond” outlet.

38

East Dike of “Pond within a Pond” upstream slope, looking northeast.

39

East Dike of “Pond within a Pond” crest. Notice ash stockpiles within the pond.

40

Space between “Pond within a pond” north Dike and 1985 Ash Pond northeast Dike, looking northwest.

41

North end of 1978 Ash Pond Dike, downstream slope is covered with large brush.

42

North end of 1978 Ash Pond Dike crest. Brush and small Pine trees are in the left of the photo and are on the downstream slope. Tall Pine trees on the right of the photo are in deposited ash within the pond.

43

Apparent trench/field drain outlet at north dike toe on 1978 pond adjacent to cooling towers.

44

Example of poor vegetative cover, erosion, and probable human activity on the downstream slope of the 1978 Ash Pond Dike.

45

General vegetation conditions on the north end of the 1978 Ash Pond Dike downstream slope.

46

Toe of the 1978 Ash Pond Dike at the north corner, looking west.

47

Rip rap fill at the toe of the 1978 Ash Pond Dike along the discharge canal.

48

Erosion/surface sloughing around the tree stump on the 1978 Ash Pond Dike.

49

Erosion at the toe of the 1978 Ash Pond at discharge canal. Also note the fallen tree.

50

Crest of the 1978 Ash Pond Dike approaching the east corner of the Dike, looking south. Note: Taller trees are on the downstream slope in the left of the photo and shorter brush is on the upstream slope in right of the photo.

51

Irregular ground surface on the downstream slope at the east side of the 1978 Ash Pond Dike.

52

Animal slide (likely beaver or muskrat) on the downstream slope of the 1978 Ash Pond Dike.

53

Generally wooded conditions along the east side of the 1978 Ash Pond Dike downstream slope.

54

Slough on the downstream slope, east side of the 1978 Ash Pond Dike.

55

Discharge end of outlet pipe in the 1978 Ash Pond.

56

Discharge end of the outlet pipe in the 1978 Ash Pond.

57

Outlet structure in 1978 Ash Pond.

58

Ponded area south of the discharge pipe at the toe of the 1978 Ash Pond Dike.
Reportedly excavated area from former adjacent property owner, who was a brick manufacturer.

59

Surface erosion southeast of the downstream slope of the 1978 Ash Pond Dike.

60

Surface erosion southeast of the downstream slope of the 1978 Ash Pond Dike.

61

Downstream slope of the 1978 Ash Pond Dike.
Note: Rows of trees are immediately beyond the toe.

62

Downstream slope at the south end of the 1978 Ash Pond Dike is devoid of vegetation.

63

Evidence of animal burrow at the south end of the 1978 Ash Pond Dike.

64

Example of erosion around sparse surface vegetation at the south end of the 1978 Pond.

65

West Dike of 1978 Ash Pond shared with 1963/1970 Ash Ponds. Looking north,
trees on either side are growing in deposited ash within the 1970 (left) and 1978 (right) ponds.

66

1978 Ash Pond from west dike looking southeast.

67

1978 Ash Pond from west dike looking east.

68

Toe of 1970 Ash Pond east dike, south end looking north. Road is at toe of dike.

68A

Example of tree coverage on 1978 pond east dike.

69

1970 Ash Pond east dike downstream slope. Note photographer is standing
at the toe of the dike and the person in the photograph is standing at the crest.

70

1970 Ash Pond east dike toe looking south. Note road runs along toe of dike in this area.

71

Upstream slope of 1970 Ash Pond east dike looking north.

72

Southern portion of 1970 Ash Pond contains water. Looking west from east dike.

73

Upstream slope of south dike at 1970 Ash Pond looking southwest from east dike.

74

1970 Ash Pond south dike downstream slope looking east.

75

1970 Ash Pond looking north across the pond from the south dike.

76

1970 Ash Pond downstream slope near southwest corner.

77

1970 Ash Pond outlet control structure. Note: water level in south end of pond was several feet lower than outlet during our visit.

78

Close up of 1970 Ash Pond outlet control structure.

79

Downstream end of 1970 Ash Pond outlet.

80

1970 Ash Pond downstream slope near outlet structure.

81

Typical condition of 1970 Ash Pond west dike downstream slope (looking north).

82

Erosion feature along 1970 Ash Pond west dike toe. Work
glove placed below 4’ probing rod supported at edge of feature for scale purposes.

83

Surface erosion on 1970 Ash Pond west dike downstream slope.

84

Surface erosion and sloughing on 1970 Ash Pond west dike downstream slope.

85

Downstream slope of 1963 Ash Pond west dike. Note suburban parked on crest for scale.

86

Steepened conditions on 1963 Ash Pond west dike from surface erosion and sloughing.

87

Steepened conditions on 1963 Ash Pond west dike from surface erosion and sloughing.

88

Steepened conditions on 1963 Ash Pond west dike from surface erosion and sloughing from the partially repaired1982 slide.

89

North end of 1963 Ash Pond west dike looking south. This is adjacent to the 1982 slide area. Water in background is the Cape Fear River.

90

North end of 1963 Ash Pond west dike, looking northwest. Water is Cape Fear River.

91

North end of 1963 Ash Pond.

92

Flood control dike which contained the south side of the 1956 Ash Pond, looking northeast.

93

Flood control dike which contained the south side of the 1956 Ash Pond, looking southwest.

94

1956 Ash Pond from the south Dike, looking north.
Note: This pond does not contain free water and is overgrown with trees.

95

Remains of outlet structure at southwest corner of 1956 Ash Pond.

96

Former outlet pipe from 1956 Ash Pond. Pond no longer contains free water.

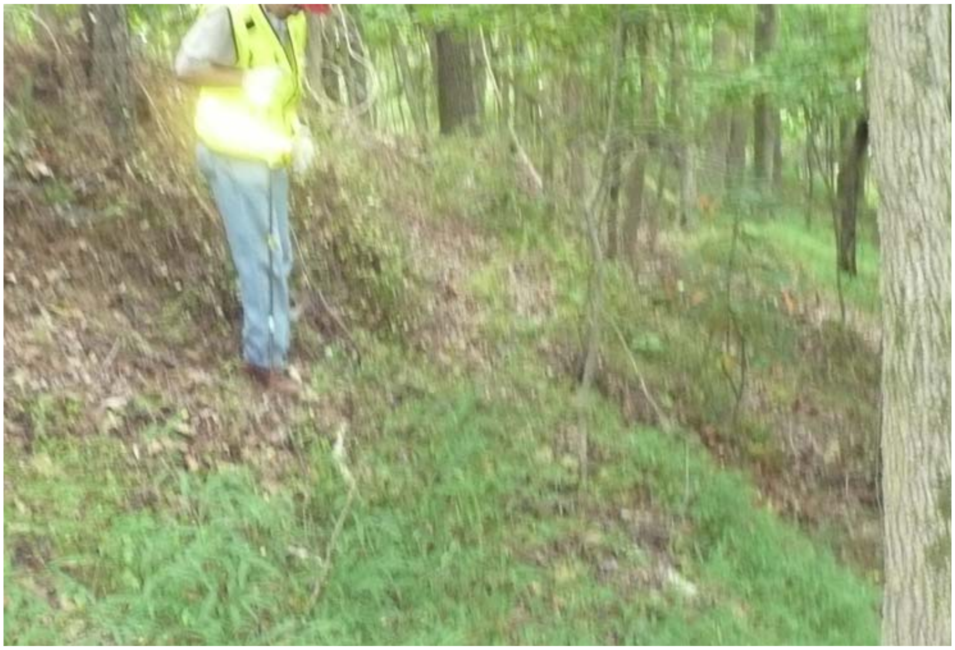
97

Downstream slope of the west Dike, looking north.

98

Typical of frequent areas of erosion on the downstream slopes of the 1956 Ash Pond Dikes.

99



Same location as the previous photo with a person for scale.

100

Typical size of fallen trees on the 1956 Ash Pond Dike slopes.

101

Uprooted tree on the 1956 Ash Pond Dike.

102

Top of probable stormwater outlet pipe on the 1956 Ash Pond Dike.

103

Typical slope sloughing and erosion on the 1956 Ash Pond Dikes.

104

Crest of the 1956 Ash Pond Dike.
Note: Some areas of the ash surface inside the pond was approximately equal to the top of the Dike.

105

Typical forest cover on the 1956 Ash Pond.

106

Storm water drainage structure at the northeast end of the 1956 Ash Pond.

107

Exposed ash at the ground surface within the 1956 Ash Pond.

3.0 DATA EVALUATION

3.1 Design Assumptions

CHA has reviewed the available design assumptions related to the design and analysis of the stability and hydraulic adequacy of the CCW impoundments, which were available at the time of our site visits and provided to us by Progress Energy Carolinas. The design assumptions are listed in the following sections.

3.2 Hydrologic and Hydraulic Design

The 1985 and 1978 dikes have been classified as Significant Hazard, which is the appropriate classification and the 1963/1970 dike has been classified by Progress Engineer's consultant engineer as a Low Hazard. In keeping with the EPA *Coal Combustion Dam Inspection Checklist Form*, the 1963/1970 dike will be classified as Significant Hazard. As such, based on the height of the dikes and their hazard classification, in accordance with NC dam safety regulations the 1985 and 1978, 1963/1970 impoundments are required to safely pass or store the inflows resulting from 1/3 of the Probable Maximum Precipitation (PMP).

The 1956 dike has not been provided a rating according to Progress Energy Carolinas but based on the EPA *Coal Combustion Dam Inspection Checklist Form*, the 1956 impound is a Significant Hazard and is required to safely pass or store the inflows resulting from 1/3 of the Probable Maximum Precipitation (PMP).

3.2.1 1985 Ash Pond

A summary of hydrologic and hydraulic analyses provided in the 1996 MACTEC 5-year independent inspection report indicates that design calculations for the 1985 Ash Pond indicated that the pond could store the ½ PMP while accommodating inflow from the plant's drainage system, which is currently discharged into the 1978 Ash Pond. A subsequent evaluation during the 1991 5-year independent inspection concluded that the 1985 Ash Pond could store the full PMP but could not accept flows from the plant during this design storm without taking into account outflow from the discharge structure. CHA was not provided with calculations backing up these claims for review.

Since these calculations were made, the 2007 “pond within a pond” has been constructed in the north end of the 1985 Ash Pond as shown on Figure 2A. CHA was not provided with a site plan showing the exact layout of the 2007 pond. Therefore, CHA could not provide a revised determination of the 1985 Ash Pond’s ability to safely pass or store the ½ PMP as required by North Carolina Dam Safety regulations.

3.2.2 1978 Ash Pond

The 1978 Ash Pond still receives storm water flows from yard sumps at the plant. These storm water discharges are pumped into the north end of the pond and flow across the surface of the impounded ash. The southern end of the pond contains standing water (i.e., the impounded ash at the north end is higher in elevation than the surface of the water in the southern end of the pond).

A summary of hydrologic and hydraulic analyses provided in the 1996 MACTEC 5-year independent inspection report indicates that during storm events the 1978 Ash Pond receives runoff captured in sumps from about 18 acres of the main plant area, which is pumped to the pond, and the rain that falls on the pond itself. The 1996 report indicates that a storm delivering the ½ probable maximum precipitation (PMP) will result in a rise in water level of 22 inches, and a full PMP will result in a rise in water level of 42 inches. These calculations neglected the outflow capacity of the discharge pipe, which is conservative. The engineers involved in this evaluation concluded that with the 4.5 feet of available freeboard, the 1978 impoundment would safely store both the ½ and full PMP storms. CHA was not provided with calculations backing up these claims for review.

Based on the current hazard classification (Significant) and the North Carolina Dam Safety regulation, the 1978 impoundment must safely pass or store the 1/3 PMP. Based on the past evaluations, the 1978 Ash Pond should safely store the 1/3 PMP. However, CHA observed that while there was anywhere from 3 to 8 feet of freeboard near the south end of the pond, the available freeboard reduces to essentially none by the north end of the impoundment because of the way the sluiced ash settled out closer to the inflow point. Therefore, without current survey information, CHA cannot provide a conclusion on the 1978 pond's ability to safely pass or store the 1/3 PMP.

3.2.3 1963/1970 Ash Ponds

The south end of the connected 1963/1970 Ash Ponds contain storm water. The water level during our site visit was below the level of the outlet control structure in the southwest corner of the impoundment. CHA was not provided with hydraulic calculations for this impoundment. The surface of the impounded ash slopes from the north end, where ash was sluiced into the pond, towards the south end where the impounded water and outlet structure are. CHA was not provided with a survey plan from which the volume of available storage could be determined. Therefore, a calculation of the impoundment's ability to safely pass or store the 1/3 PMP as required based on the current hazard classification and North Carolina Dam Safety regulations could not be performed.

3.2.4 1956 Ash Pond

Very little information is available on the 1956 Ash Pond. The pond does not currently receive or contain wet ash, although in some portions of the pond there is 3 to 8 feet of freeboard between the surface of impounded ash and the top of the dike. Progress Energy Carolinas personnel indicated that they have not observed standing water from rainwater within the pond.

A storm water outlet structure, separate from the original decant discharge structure was installed on the east side of the pond.

As a pond designed to impound water that has not been closed (capped), the 1956 dike should continue to be treated as an impoundment structure unless documentation can be provided showing why it will not impound water.

3.3 Structural Adequacy & Stability

The North Carolina Department of Environmental and Natural Resources (NC-DENR), Land Quality Section, Dam Safety Program regulations state, as shown in Table 2, "a minimum factor of safety of 1.5 for slope stability for normal loading conditions, and 1.25 for quick (rapid) drawdown conditions and for construction conditions are required, unless the design engineer provides a thoroughly documented basis for using other safety factors."

Table 2 - Minimum Safety Factors Required by NC-DENR

Load Case	Required Minimum Factor of Safety
Steady State Conditions at Present Pool or Flood Elevation	1.50
Rapid Draw-Down Conditions from Present Pool Elevation	1.25

NC-DENR regulations also state that "Foundation bearing capacity and sliding base analyses should be considered for all dams and may be required. Where bearing capacity or sliding base analyses are required, documentation of assumptions, computations, and safety factors shall be included in the final design report. A minimum factor of safety against bearing capacity and sliding wedge failure of 2.0 shall be required unless the design engineer provides a thoroughly documented basis for using other safety factors."

Additional industry guidelines such as those published in the United States Army Corps of Engineers EM 1110-2-1902, Table 3-1 suggest the following guidance values for minimum factors of safety as shown in Table 3.

Table 3 - Minimum Safety Factors Recommended by US Army Corps of Engineers

Load Case	Required Minimum Factor of Safety
Maximum Surcharge Pool (Flood) Condition	1.4
Seismic Conditions from Present Pool Elevation	1.0

CHA reviewed inspection reports for the Cape Fear Plant provided by Progress Energy Carolinas. Sections 3.3.1 through 3.3.4 discuss our review of the stability analyses and performance of the 1985, 1978, 1970, 1963 and 1956 Ash Ponds, respectively.

3.3.1 1985 Ash Pond

A stability analysis for the design of the 1985 Ash Pond was performed by Consulting Engineer William Wells in December 1983. Foundation conditions along the alignment of the enclosing dike system were investigated by the advancement of 16 borings. It was noted that at one boring location, B-1, seven feet of very soft ash was found on the ground surface and at boring B-19, 3.5 feet of ash, coal and wood were encountered at the ground surface underlain by 6.5 feet of very soft sandy, silty clay. It was recommended that these materials be removed prior to construction of the dikes. CHA was not provided with construction records indicating whether this recommendation was carried out.

Laboratory testing was performed on borrow source material samples and average shear strength parameters for both the total stress and effective stress conditions were assumed for the analysis. The end of construction, downstream slope steady state, earthquake and steady state and earthquake loading conditions were analyzed and Table 4 provides a summary of the results and Figure 6 show details of the analysis.

Table 4 – Summary of Design Stability Analysis for the 1985 Ash Pond

Loading Condition	**Shear Strength Assumptions**	
	c = 330, phi = 16.3°	**c = 220, phi = 28.5°**
End of Construction	1.5	1.8
Steady State	1.2	1.3
Earthquake	1.3	1.6
Steady State & Earthquake	1.1	1.2

In December 1984, Soil & Material Engineers, Inc. conducted a borrow investigation for the completion of the 1985 Ash Pond Dikes. Two areas were looked at for potential borrow sources and during the investigation test pits were excavated and laboratory testing was performed on retrieved samples. It was concluded that the remaining borrow from the ash pond bottom area was too wet for continued use and it would be difficult to obtain compaction in the dike using materials having a high natural moisture content. Borrow material from the east borrow was found to be adequate for construction fill in the dike, with the exception of material that was encountered at the toe of the borrow hillside. The report did note that although the borrow material in the east borrow area were silts (and not clays) the high percentage of fine material (minus No. 200 sieve) would result in a similar low permeability soil characteristic to the clay.

It is unclear from review of the documentation provided by Progress Energy Carolinas what materials or combination of material the dikes were constructed. This is also complicated by the fact that the project specifications provided an alternative dike construction method (Section 02290 – Embankment and Dam Construction, Part 2.07) which included sand fill on the downstream portion of the dam rather than maintaining a completely homogeneous section.

The stability analysis was later updated by Law Engineering in 1986 and GEI Consultants (GEI) in 1991. The soil parameters were reviewed and additional stability analyses conducted as part of these updates. The 1986 analysis by Law Engineering was performed for the final design pond elevation with 2.5 feet of freeboard and an estimated phreatic surface. The analyses concluded that the dike, under steady state seepage conditions and effective strength parameters, had a factor of safety of 1.35 as shown in Figure 7. Although the factor of safety was less than the 1.5 recommended by the US ACOE, Law Engineering concluded that it “did not indicate a deficiency in the design or a threat to the safety of the structure.”

In 1991, GEI performed an analysis for the then current pond elevation which left 8 feet of freeboard and a pheratic surface estimated from temporary piezometers installed in the toe of the slope. The analysis indicated a factor of safety of 1.34 as shown in Figure 8. This factor of safety was for a relatively shallow failure. GEI indicated that this modeled failure type was consistent with some longitudinal cracking observed on the south and southwest dikes during GEI’s site visits. Further subsurface study and analyses were recommended in the 1991 report by GEI.

In 1993, Law Engineering, when asked to review the analysis and recommendations by GEI, indicated that “additional subsurface investigations and slope stability calculations are unlikely to significantly alter the calculated factor of safety. As a result, remedial earthwork would likely be required to increase the factor of safety.” Law Engineering further concluded that based on the periodic inspection and maintenance that further investigations or remediation was unnecessary for the 1985 dikes.

The interpretation and analyses of all three consultants, William Wells, Law and GEI, although resulting in slightly different soil strength parameters and slightly different factors of safety under steady state conditions, they resulted in similar conclusions on the factor of safety with 1.2 to 1.3, 1.35, and 1.34 under slightly lower pool elevation, respectively.

CHA can see two reasons for revisiting these analyses based on the above discussion:

1. The laboratory testing was performed on borrow samples, reconstituted in the laboratory. While the intention of a laboratory testing program like this would be to recreate the

anticipated conditions of the field compacted soil, they are not test results on the actual in-situ conditions within the embankment now present 24 years following placement with possible strengthening from long term consolidation of the silty/clayey soils comprising the embankments.

2. There are no permanent piezometers within the 1985 dike so phreatic surfaces used are theoretical and may vary significantly in the field.

3.3.1.1 December 1985 Sinkholes and Crest Cracks

In December 1985, William Wells made a site visit to the 1985 Ash Pond to observe many small sinkholes that were found in the crown of the dikes in areas where material during construction, was left in a loose condition on the landside slope. Subsequent to the completion of construction rainfall had seeped down and outward through the loose material creating by erosion small sinkholes in the crown and subterranean tunnels outcropping on the slope several feet below the crown. Some sinkholes were observed on the pond side of the dikes which one area on the south dike with an appreciable amount of soil and sod that had been washed away. Wells noted in a December 16, 1985 letter that the sinkholes were not serious but would become worse if neglected. It was recommended that the sinkholes and tunnels be broken down to the extent feasible by surface operations (passing a heavily loaded vehicle over the affected areas). The depressions left were to be filled with compacted clay. In the 1993 report prepared by Law Engineering, similar sinkholes were observed and it was recommended the areas be repaired by filling the interconnected tunnels with stone and cap the stone with clayey soil to reduce surface water infiltration.

The December 1985 letter also noted a “potentially much more serious condition” that was observed near the east end or southward bend of the north dike. Two longitudinal cracks running along the centerline of the dikes were found. Vertical movement of about 2 inches was observed at one of the cracks and was noted as being “typical of slight yielding, vertically and laterally, of a soft foundation material." It was noted that borings advanced in the location of the cracks during the design of the ash pond (Borings B-7, B-8 and B-9) encountered three to four feet of very soft material at the ground surface. It was recommended that the cracks be filled and sealed in the same manner as the sinkhole to minimize lateral pressure from rainwater. The report also recommended that the areas be monitored for the redevelopment of cracks and if cracks were observed that the entire crown width for the length of the cracking be covered with plastic until a proper repair could be made.

3.3.1.2 2007 Ash Pond Dikes Constructed in the 1985 Ash Pond

The July 17, 2007 Report of Limited Field Inspection of the Cape Fear Plant Ash Pond Dikes prepared by Mactec notes that at the time of the March 28, 2007 site visit the construction of the 2007 Ash Pond was in progress and that the plant began discharging ash sluice flow into the new containment area on April 9, 2007. It was reported that this new area was designed by Mactec. CHA was not provided with a copy of the design report and it is not known whether or not a stability analysis was performed as part of the scope of work.

CHA, using the soil parameters, pheratic surfaces and cross section geometries provided in the Law Engineering and GEI analyses, was able to recreate the slope stability models and reported factors of safety as summarized in Section 3.3.1. Figures 9 and 10 show our recreated models. Our models were used to elevate the effects of the 2007 Ash Pond Dikes constructed in the 1985 Ash Pond. CHA used assumed parameters for the sluiced ash on which the 2007 dikes are constructed.

Based on CHA's analyses, it appears that the 2007 Ash Pond Dikes are located at a great enough distance from the 1985 Ash Pond Dikes such that the factor of safety is only slightly decreased when looking at full pool elevation in both ponds. It should be noted however that the calculated factor of safety for the 1985 Ash Pond Dike (downstream slope, steady state) was already below the minimum factor of safety of 1.5 as recommended by the US ACOE. During CHA's site visit plant personnel noted that the facility was considering raising the 2007 Ash Pond dikes by an additional 15 feet. The impacts of this additional height on the 1985 dikes must be considered prior to construction.

3.3.2 1978 Ash Pond

Based on the documents reviewed for the 1978 Ash Pond, it is not clear if the 1978 Ash Pond embankment was constructed on wet ash, slag or other unsuitable materials. CHA was not provided documentation of foundation preparation for the pond. Reportedly this information was reviewed by a 3rd party consultant. The consultant's report indicated "undercut soft areas". Design borings showed ash and other soft soils in some areas.

Independent Consultant Inspection Reports for the 1978 Ash Pond reviewed by CHA indicate that there are no records available of stability analyses performed for the dikes prior to construction. A stability analysis was performed by William Wells in 1981. The factor of safety was reported to be 1.40 for the undrained case, which was considered by Wells to be satisfactory. No documentation of this computation was found in review of the data provided by Progress Energy Carolinas.

In a 1982 study of the ash pond by Law Engineering, the condition of dikes were reported as well and concluded that the dikes should perform satisfactory as designed and constructed with pond level at Elevation 195 feet.

In 1982 Law Engineering performed a limited study of the 1978 Ash Pond east dike (among others) as a result of plant personnel noting some longitudinal cracking in the crest of the east dike adjacent to the discharge canal. A report of that study was issued October 25, 1982.

A circular arc stability analysis was performed by Mactec Engineering and Consulting in July 2005 using the 1982 cross section and soil parameters from the 1982 report. The report noted for the estimated condition of the discharge canal at that time, a factor of safety of about 1.6 was indicated for a failure surface that extended through the dike and natural ground and exited at the discharge canal slope. It was also noted that if erosion were to remove a 10-foot width of ground between the discharge canal edge and the base of the natural ground slope and leave a vertical discharge canal bank, the factor of safety would be reduced to about 1.33. The report recommended that the area be monitored by placing marker stakes along the slope toe to measure the horizontal distance to the bank edge at locations where erosion was observed. It was also recommended that should a 10-foot horizontal distance be lost to erosion, rip rap would need to be placed to increase the calculated factor of safety to greater than 1.5. Based on our recent observation of this area, it appears that approximately 3 to 4 feet has been removed by erosion and rip rap has not been placed.

3.3.2.1 September 1990 Seepage Investigation

An investigation was conducted in September 1990 on the north side of the 1978 Ash Pond expansion dike in the terraced area just west of the existing cooling tower. The area was noted in the 1986 dam inspection report as being generally wet but no seepage was seen at the time of the 1986 site visit. According to plant personnel the area had become progressively wetter since 1986 with some water observed at the ground surface and water seen emerging from the sloping side of the terraced area. During the September 1990 site visit, an exploratory trench was excavated to observe subsurface conditions. Reportedly several options were discussed for dealing with the seepage. The September 1990 letter report noted that “the fact that no danger appears to exist to the dike stability indicates measures to control or correct the seepage can be done at the facility’s convenience and only as needed to minimize the effect of the seepage on the normal plant maintenance and operation.”

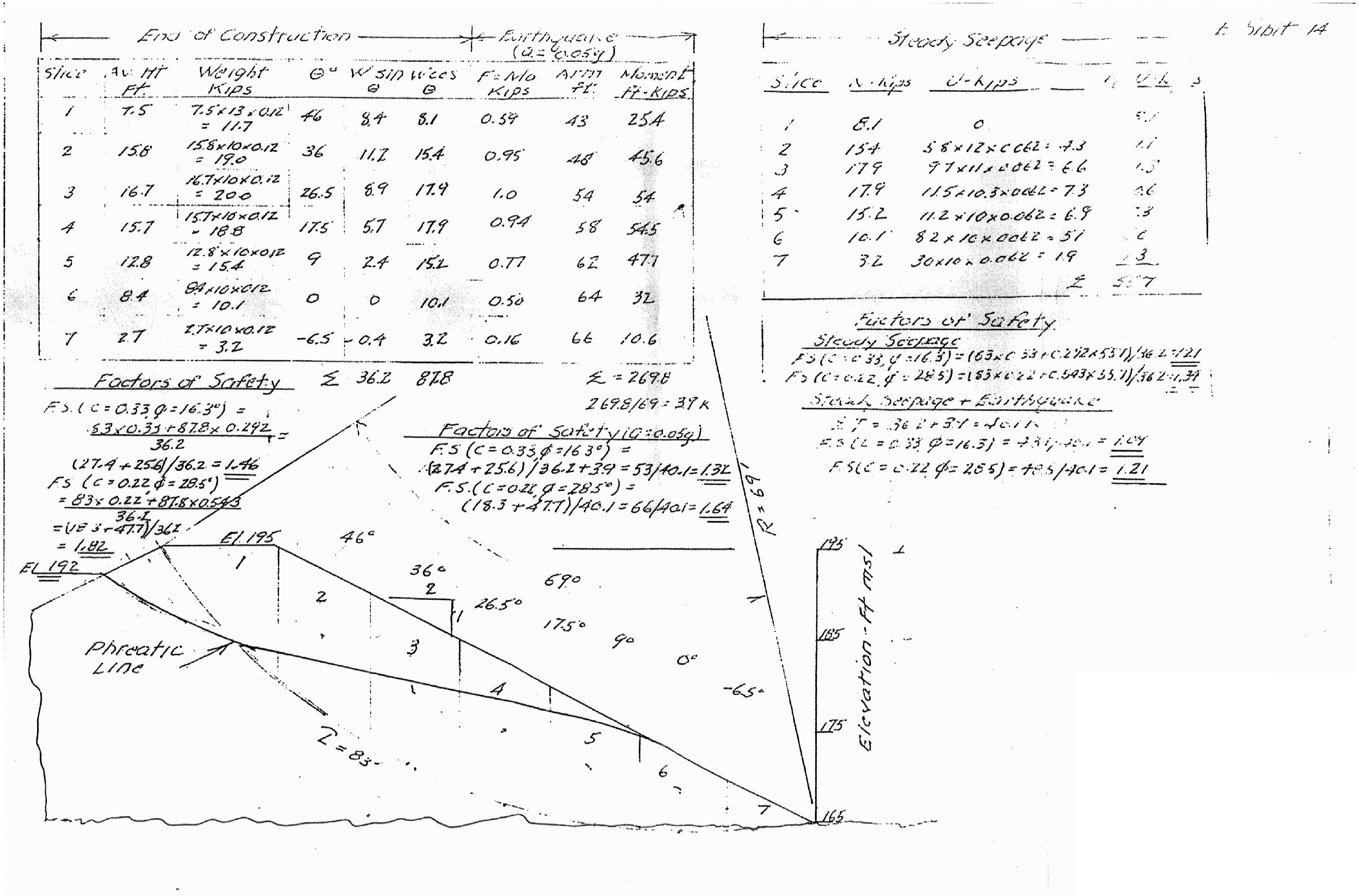
3.3.3 1963/1970 Ash Pond

Based on the documents reviewed by CHA, it is unknown if the 1963/1970 Ash Pond embankments were constructed on wet ash, slag or other unsuitable materials. CHA was not provided documentation of foundation preparation for the pond. The raised sections of the embankments were possibly constructed on ash. Drawings suggest steps were taken to remove some ash from below raised sections but details of these efforts are not clear.

In 1982, cracking and slumping was noted on the north end of the west dike of the 1963 Ash Pond, adjacent to the Cape Fear River. At the time the area did not have significant water impounded against it, mostly sediment ash. Repairs made for stability reportedly included placing a rock toe berm. The 1963 Ash Pond was considered inactive by Progress Energy Carolinas at the time the slumping occurred in 1982. Law Engineering conducted a review of the dike stability for the 1963, 1970 and 1978 Ash Ponds at the time and concluded that the under the plants plans to cease use of the 1963/1970 Ash Pond, the dike were acceptable.

3.3.4 1956 Ash Pond

It is not know whether the embankment was constructed on wet ash, slag or other unsuitable materials. CHA was not provided documentation of foundation preparation for the pond. Based on review of information provided to CHA by Progress Energy Carolinas, there are several notebooks of construction photographs taken in the middle to late 1950's which include photographs of the work in progress for the 1956 Ash Pond Dike. CHA was provided with some of these photographs in the 2009 report of inactive ash ponds. There are reportedly no other available records, drawings or reports for the 1986 Ash Pond. It is unknown if a stability analysis was performed for the construction of the 1956 Ash Pond.



End of Construction						Earthquake (a = 0.05g)		
Slice	Av. Ht Ft.	Weight Kips	θ°	W sin θ	W cos θ	F = Ma Kips	Arm Ft.	Moment Ft-Kips
1	7.5	7.5×13×0.12 = 11.7	46	8.4	8.1	0.59	43	25.4
2	15.8	15.8×10×0.12 = 19.0	36	11.2	15.4	0.95	48	45.6
3	16.7	16.7×10×0.12 = 20.0	26.5	8.9	17.9	1.0	54	54
4	15.7	15.7×10×0.12 = 18.8	17.5	5.7	17.9	0.94	58	54.5
5	12.8	12.8×10×0.12 = 15.4	9	2.4	15.2	0.77	62	47.7
6	8.4	8.4×10×0.12 = 10.1	0	0	10.1	0.50	64	32
7	2.7	2.7×10×0.12 = 3.2	-6.5	-0.4	3.2	0.16	66	10.6
			Σ	36.2	87.8			Σ = 269.8

269.8/69 = 3.9 K

Factors of Safety

F.S. (c = 0.33 φ = 16.3°) = $\frac{83 \times 0.33 + 87.8 \times 0.292}{36.2}$ =

(27.4 + 25.6)/36.2 = 1.46

FS (c = 0.22 φ = 28.5°)

= $\frac{83 \times 0.22 + 87.8 \times 0.543}{36.2}$

= (18.3 + 47.7)/36.2

= 1.82

Factors of Safety (a = 0.05g)

F.S (c = 0.33 φ = 16.3°) =

(27.4 + 25.6)/36.2 + 3.9 = 53/40.1 = 1.32

F.S. (c = 0.22 φ = 28.5°) =

(18.3 + 47.7)/40.1 = 66/40.1 = 1.64

Exhibit 14

Steady Seepage

Slice	N-kips	U-Kips		N-U
1	8.1	0		8.1
2	15.4	5.8×12×0.062 = 4.3		11.1
3	17.9	9.7×11×0.062 = 6.6		11.3
4	17.9	11.5×10.3×0.062 = 7.3		10.6
5	15.2	11.2×10×0.062 = 6.9		8.3
6	10.1	8.2×10×0.062 = 5.1		5.0
7	3.2	3.0×10×0.062 = 1.9		1.3
			Σ	55.7

Factors of Safety

Steady Seepage

F.S (c = 0.33, φ = 16.3) = (83×0.33 + 0.292×55.7)/36.2 = 1.21

F.S (c = 0.22, φ = 28.5) = (83×0.22 + 0.543×55.7)/36.2 = 1.34

Steady Seepage + Earthquake

Σ T = 36.2 + 3.9 = 40.1 K

F.S (c = 0.33 φ = 16.3) = 43.7/40.1 = 1.09

F.S (c = 0.22 φ = 28.5) = 48.5/40.1 = 1.21

IMAGE REFERENCE: NEW (1983) ASH POND, WILLIAM L. WELLS CAPE FEAR 12/4/83, REVISED 12/15/83

File: K:\20085\CADD\ACAD\FIGURES\GEO\3000 CAPE FEAR\3000 CF XSECTS.DWG Saved: 7/16/2009 4:16:24 PM PLotted: 7/17/2009 10:05:36 AM User: Filkins, Rebecca

CHA

STABILITY ANALYSIS CROSS SECTION
Cape Fear Plant
Progress Energy Carolinas
Moncure, North Carolina

PROJECT NO.
20085.3000

DATE: JULY 2009

FIGURE 6

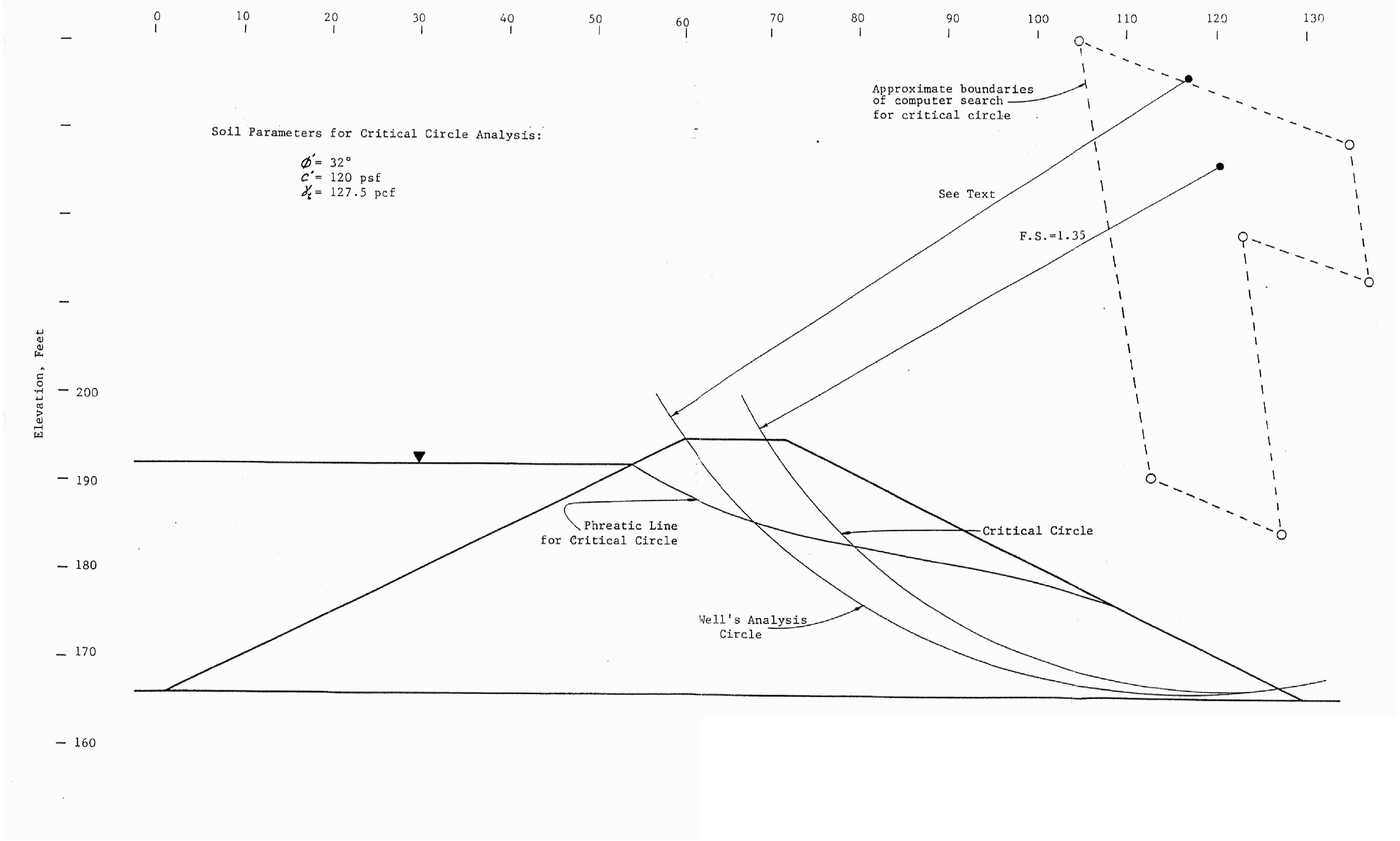


IMAGE REFERENCE: LAW ENGINEERING TESTING CO., STABILITY ANALYSIS, 1985 ASH POND, EXHIBIT 12, 7/25/86.

STABILITY ANALYSIS CROSS SECTION

Cape Fear Plant
Progress Energy Carolinas
Moncure, North Carolina

PROJECT NO.
20085.3000

DATE: JULY 2009

FIGURE 7

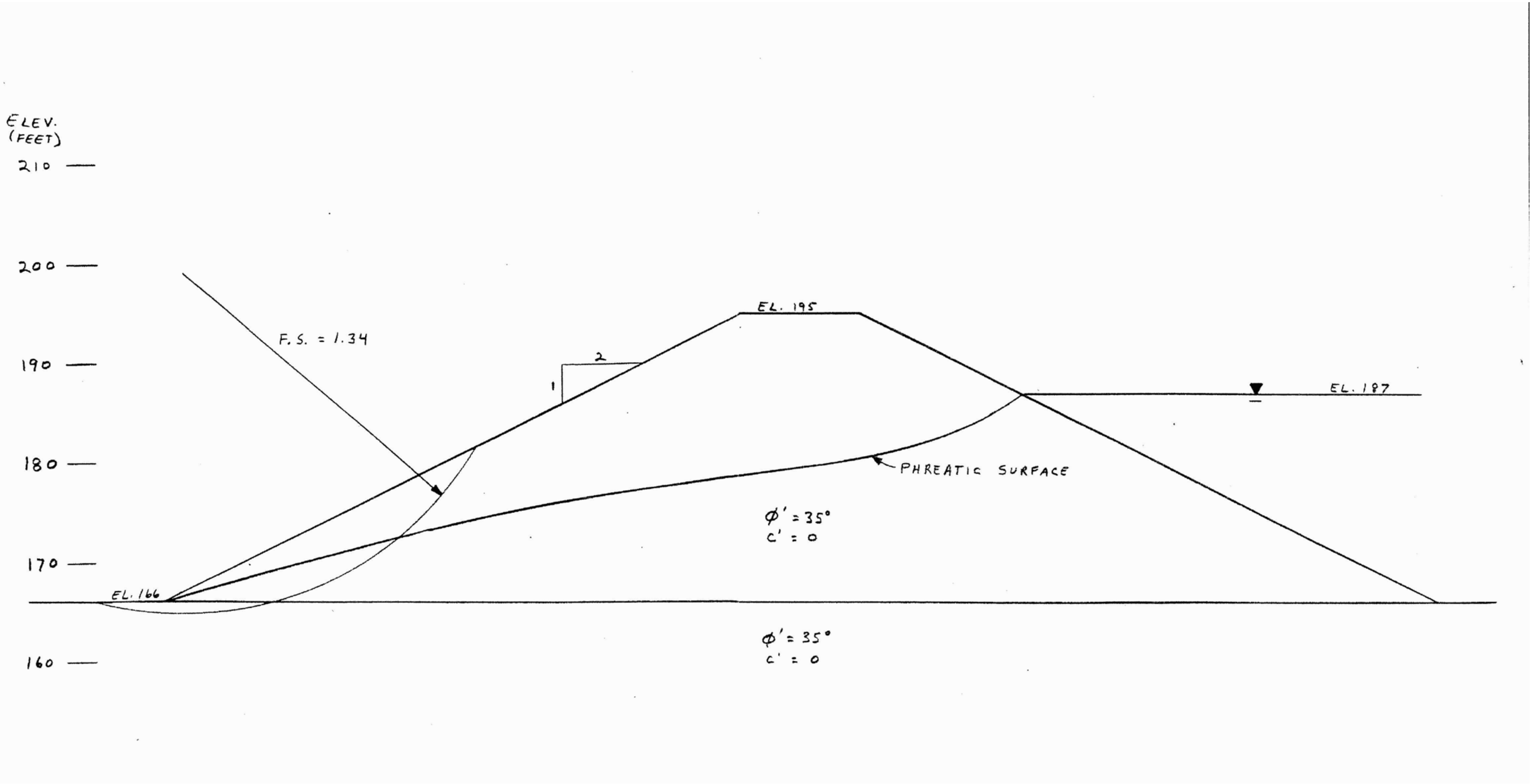


IMAGE REFERENCE: GEI CONSULTANTS INC., FIVE YEAR DAM SAFETY INSPECTION, CAPE FEAR ASH PONDS, MONCURE, NC, STABILITY ANALYSIS, EXHIBIT 13

CHA

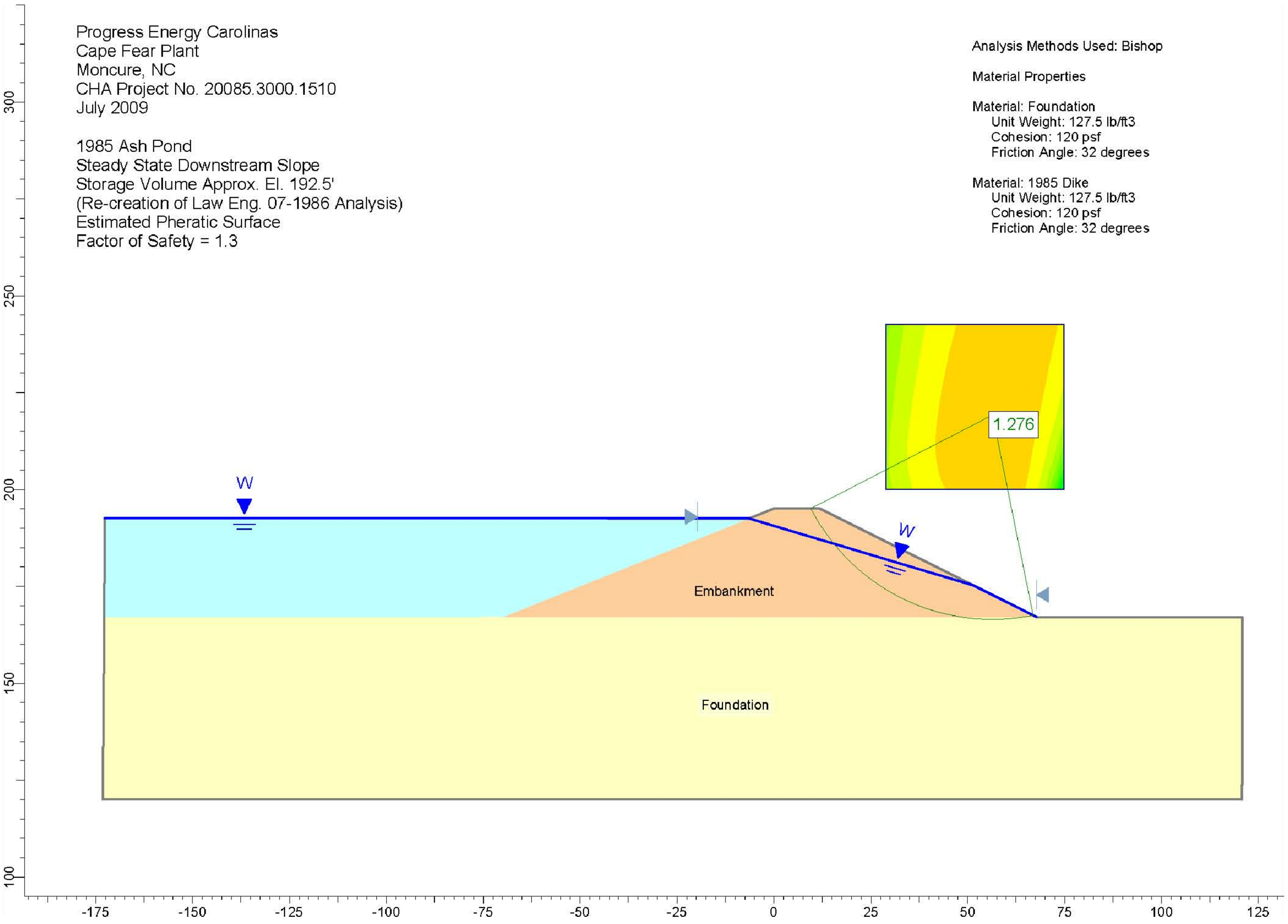
STABILITY ANALYSIS CROSS SECTION
Cape Fear Plant
Progress Energy Carolinas
Moncure, North Carolina

PROJECT NO.
20085.3000

DATE: JULY 2009

FIGURE 8

File: K:\20085\CADD\ACAD\FIGURES\GEO\3000 CAPE FEAR\3000 CF XSECTS.DWG Saved: 7/16/2009 4:16:24 PM PLotted: 7/17/2009 10:18:09 AM User: Filkins, Rebecca



Progress Energy Carolinas
Cape Fear Plant
Moncure, NC
CHA Project No. 20085.3000.1510
July 2009

1985 Ash Pond
Steady State Downstream Slope
Storage Volume Approx. El. 192.5'
(Re-creation of Law Eng. 07-1986 Analysis)
Estimated Pheratic Surface
Factor of Safety = 1.3

Analysis Methods Used: Bishop

Material Properties

Material: Foundation
Unit Weight: 127.5 lb/ft3
Cohesion: 120 psf
Friction Angle: 32 degrees

Material: 1985 Dike
Unit Weight: 127.5 lb/ft3
Cohesion: 120 psf
Friction Angle: 32 degrees

CHA

CROSS SECTION OF 1985 ASH POND

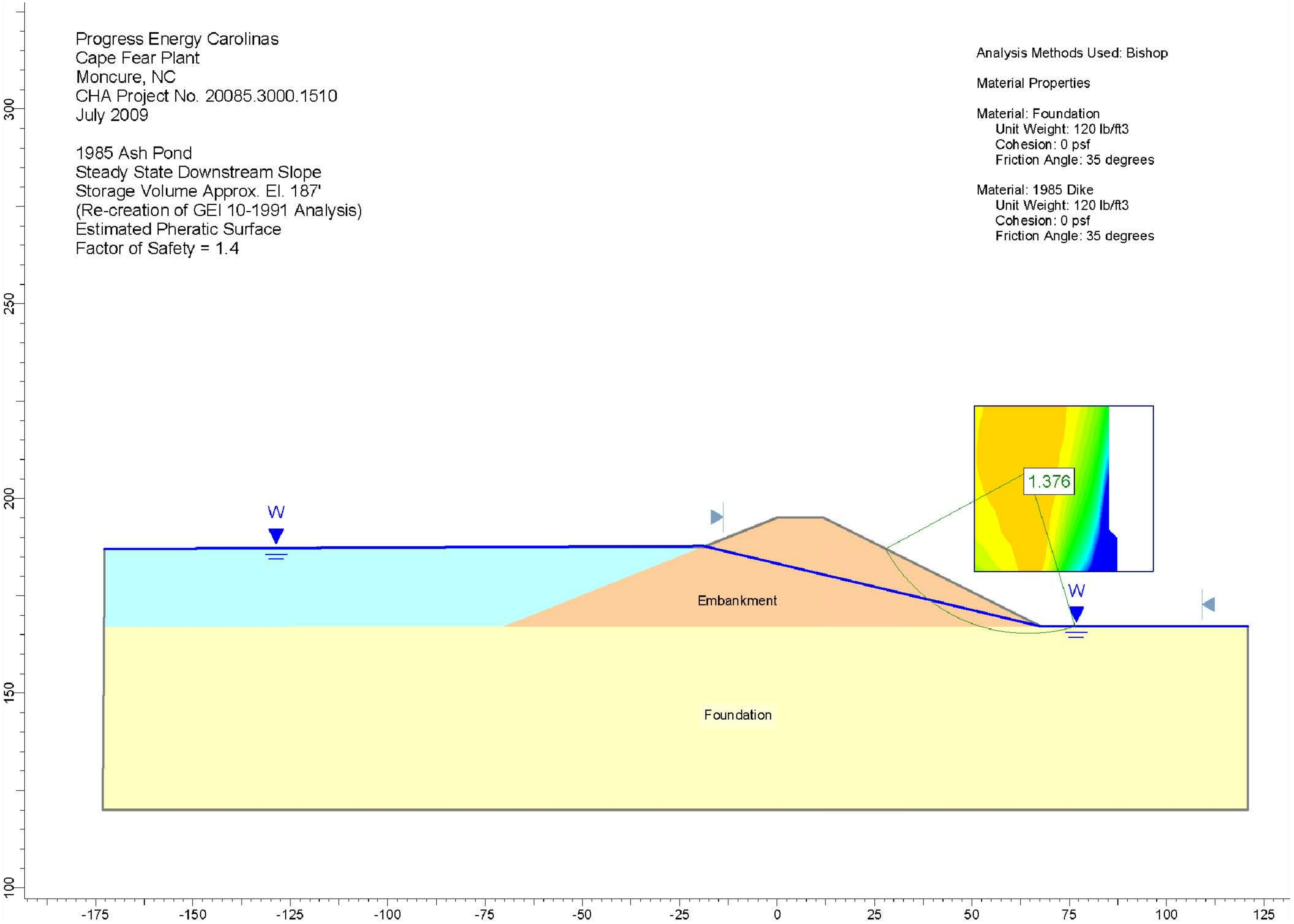
Cape Fear Plant
Progress Energy Carolinas
Moncure, North Carolina

PROJECT NO.
20085.3000

DATE: JULY 2009

FIGURE 9

File: K:\20085\CADD\ACAD\FIGURES\GEO\3000 CAPE FEAR\3000 CF XSECTS.DWG Saved: 7/16/2009 4:16:24 PM PLotted: 7/17/2009 9:28:54 AM User: Filkins, Rebecca



Progress Energy Carolinas
Cape Fear Plant
Moncure, NC
CHA Project No. 20085.3000.1510
July 2009

1985 Ash Pond
Steady State Downstream Slope
Storage Volume Approx. El. 187'
(Re-creation of GEI 10-1991 Analysis)
Estimated Pheratic Surface
Factor of Safety = 1.4

Analysis Methods Used: Bishop

Material Properties

Material: Foundation
- Unit Weight: 120 lb/ft3
- Cohesion: 0 psf
- Friction Angle: 35 degrees

Material: 1985 Dike
- Unit Weight: 120 lb/ft3
- Cohesion: 0 psf
- Friction Angle: 35 degrees

CHA

CROSS SECTION OF 1985 ASH POND
Cape Fear Plant
Progress Energy Carolinas
Moncure, North Carolina

PROJECT NO.
20085.3000

DATE: JULY 2009

FIGURE 10

File: K:\20085\CADD\ACAD\FIGURES\GEO\3000 CAPE FEAR\3000 CF XSECTS.DWG Saved: 7/16/2009 4:16:24 PM PLotted: 7/17/2009 9:36:48 AM User: Filkins, Rebecca

4.0 CONCLUSIONS/RECOMMENDATIONS

4.1 Acknowledgement of Management Unit Condition

I acknowledge that the management units referenced herein was personally inspected by me and was found to be in the following condition: **Poor.**

A management unit found to be in poor condition is defined one in which a management unit safety deficiency was recognized for any required loading condition (static, hydrologic, seismic) in accordance with the applicable dam safety regulatory criteria. Remedial action is necessary. A poor condition rating also applies when further critical studies or investigations are needed to identify any potential dam safety deficiencies.

CHA's assessment of the 1985, 1978, 1963/1970 and 1956 Ash Ponds indicate that they are in poor condition. As described in the following section, maintenance and additional analyses are recommended for these ash ponds.

4.2 Maintaining Vegetation Growth

All of the ash pond dikes at the Cape Fear Plant lack appropriate vegetation cover, and thick brush and weeds in non-wooded areas hampered field observations. CHA recommends an increased mowing schedule on the 1985 Ash Pond dikes, and tree and brush removal on all of the ash pond dikes. Proper, short vegetation cover allows for more thorough observation on changing conditions that may require routine maintenance before they become larger problems.

On impoundments with either standing water, or high water levels within the deposited ash (i.e., not at the surface of the ash, but not as low as the toe of the dike either), tree roots can allow for seepage of the retained water through the dikes, which could lead to internal erosion such as is the concern in an impoundment with free water. Internal erosion would weaken the dike, and could result in a slope failure.

Additionally, the uprooting of trees during storms can create large voids in the embankment that are then susceptible to erosion. Considering the progressive erosion that could occur during a storm which blows the tree over during heavy rains (i.e., hurricane type storm systems) progressive erosion could potentially result in enough loss of soil from the dike to create an unstable situation, which if failure occurs could result in a release of ash.

4.3 Toe Drainage and Buttressing Against Softened Toe

CHA recommends improved drainage and/or buttressing of the toe in this area where water flows or is ponded against the toe of the dikes with erosion resistant materials, to reduce the risk of dike instability from a softened or eroded toe.

Ponding water at the toe of an embankment constructed from silty/clayey soils can result in weakening of the soils where saturated, a condition that can be observed by the softened ground that provides little resistance to the penetration of a steel rod, such as exhibited in Photos 8 and 9.

Along the west dike of the 1985 Ash Pond, an area of ponded water occurs between the toe of the dike and the access road. While there is a twin culvert extending below the access road and railroad tracks, it appears from evidence of the depth of ponding and erosion from this ponding observed during CHA's visit, that the capacity and or pitch of these culverts is inadequate to drain the area. The result of the standing water is not only the softening exhibited in Photos 8 and 9 but beaching erosion resulting in toe loss as shown in Photo 3.

The 1978 Ash Pond dike parallels the Discharge Canal. This area exhibits erosion from the flows in the Discharge Canal, and surficial sloughing has occurred. This area needs to be protected not only from toe softening, but from the velocities in the discharge canal eroding the toe.

At the southeast corner of the 1978 dike to the south of the outlet pipe, there is a large area of ponded water. The grading in this area should be improved to minimize the ponding of the water in this area, and if the area cannot be fully drained, the toe buttressed.

4.4 Stability Monitoring at the 1985 Ash Pond West Dike

During CHA's site visit, Progress Energy Carolinas personnel indicated that filled holes, and voids in the downstream slope of the west dike on the 1985 Ash Pond were rodent burrows. In CHA's review of historic documents, we found descriptions of similar voids dating back to 1985 immediately following construction. While different consultants had differing opinions on the cause of these voids, a general theme was that the voids were likely related to differential settlement from underlying soft soil resulting in cracks that then eroded from storm water runoff, or were related to shallow slope strain surfaces.

CHA recommends that these voids be filled and an engineered monitoring program be implemented. The monitoring program should include the use of piezometric measurements in the embankment and foundation soils and inclinometers to monitor movement within the embankment at various depths.

4.5 Erosion Protection and Repair

Many areas of the Cape Fear Ash Ponds show surficial erosion and sloughing resulting from exposed soil because of poor vegetation coverage. CHA recommends areas of erosion and sloughing be re-graded and properly vegetated. Not only does erosion and slough steepen the embankment slopes reducing overall stability, but the erosion areas concentrate storm water runoff which leads to further erosion and worsening of the condition.

4.6 Animal Control

Evidence of animal burrows and slides were observed on the 1985 and 1978 Ash Pond dikes. CHA recommends vigilance by Progress Energy Carolinas to make note of areas disturbed by animal activity, trapping of the animals responsible, and repair to the areas to protect the integrity of the dikes. Although not seen on other dikes, vegetation cover hides these features.

4.7 Closure of Non-Permitted Ash Ponds

The 1956 and 1963/1970 Ash Ponds were installed prior to current regulations requiring permits for these types of facilities. CHA recommends that best management practices be applied to these facilities for consideration of stabilization of the dike slopes so as to reduce the risk of a release. In CHA’s experience, tree growth on slopes of dams and landfills is not desirable.

4.8 Hydraulic Analysis Recommendations

Hydraulic analyses are needed at each of the ash ponds as summarized below:

- Since the hydrology evaluation of the 1985 impoundment was performed, the 2007 “pond within a pond” has been constructed. CHA recommends that the hydraulic and hydrologic analyses be updated to evaluate the ability of the 2007 and 1985 combined pond capacity to safely pass the 1/3 PMP.

- The summary of the 1978 hydraulic and hydrologic analyses concluded that the available freeboard was available throughout the 1978 Ash Pond to safely store the ½ PMP. While only a 1/3 PMP storm is currently required to be used as the design storm based on North Carolina Dam Safety Regulations and therefore, should be safely stored, CHA observed that the freeboard ranges from about 0 at the north end of the pond, to 3 to 8 feet at the south end of the pond. CHA recommends that an updated evaluation be prepared accounting for the actual available storage capacity of the 1978 Ash Pond.

- No analysis appears to have been performed for the 1963/1970 or the 1956 Ash Ponds. Similar to the 1978 Ash Pond, the surface of the deposited ash slopes from north to south in the 1963/1970 Ash Ponds and from west to east in the 1956 Ash Pond, resulting in almost no freeboard at one end of the impoundments to about 8 to 10 feet at the other end. CHA recommends that an evaluation be prepared for the ability of the 1963/1970 and 1956 Ash Ponds to safely store or pass the 1/3 PMP with the actual available storage capacity.

4.9 Additional Stability Analyses – 1985 Ash Pond

Based on our review of available information for the 1985 Ash Pond, we recommend that the following tasks be performed to confirm that the embankments are indeed stable under the various loading conditions outlined in Section 3.3.1.

- We recommend that an investigation be performed in which the properties of the embankment and the foundation soils are determined. Stability models indicate failure surfaces through the embankment and have assumed that foundation soils have strength properties that are consistent with or better than the embankment soils. In the design report, it indicates that a layer of soft soil should be removed prior to construction of the dike, but documentation confirming that this was done was not provided to CHA and several of the summaries of observation on the dikes were attributed to soft foundation soils compressing. It should be verified through the recommended investigation that the soft layer is appropriately accounted for or that the layer does not exist. This scope of work should include laboratory testing of samples retrieved from the embankment and foundation soils and installation of piezometers in the embankments for accurate measurement and monitoring of the phreatic surface in for stability analysis and for long term monitoring.

- CHA was not provided with stability analyses of the 2007 "pond within a pond". CHA recommends that Progress Energy Carolinas should perform stability analyses for the current conditions as well as any changes should additional capacity be required such as moving forward with their plan to increase the height of the existing 2007 Ash Pond embankments. An investigation should be performed to sample and test the sluiced ash on which the 2007 pond is sitting, as well as the in-situ strength of the compacted ash from which the 2007 dikes are constructed.

- We recommend that remediation work, if-required, be performed by Progress Energy Carolinas on the embankment slopes to improve the factor of safety to the minimum values required by North Carolina Dam Safety Regulations and as recommended by the USACOE for all loading conditions. The design of the remediation work should be based on the findings of the subsurface investigation described above.

4.10 Additional Stability Analyses – 1978 Ash Pond

CHA was not provided with results of the stability analyses reportedly performed for the 1978 Ash Pond dikes. Previous inspection reports summarize that a factor of safety of 1.4 was determined for the steady state conditions at the 1978 Ash Pond. CHA recommends that a detailed analysis be performed for the pond that includes flood pool and seismic loading and that appropriate modifications be made to the slopes to ensure that the calculated factors of safety meet those required and/or recommended by North Carolina Dam Safety and the USACOE, respectively. These stability analyses should be performed with actual phreatic surface evaluations through the installation of piezometers on the dikes of the 1978 Ash Pond.

4.11 Additional Stability Analyses – 1963/1970 and 1956 Ash Ponds

No stability analyses were provided for the 1963/1970 or 1956 Ash Ponds. CHA recommends that a detailed analysis be performed for these ash ponds. As described in Sections 4.9 and 4.10, these analyses should be based on in-situ soil properties of the embankment fills, foundation soils and existing phreatic surfaces. Subsurface investigations will be required to determine these properties.

5.0 CLOSING

The information presented in this report is based on visual field observations, review of reports by others and this limited knowledge of the history of the Cape Fear Plant surface impoundments. The recommendations presented are based, in part, on project information available at the time of this report. No other warranty, expressed or implied is made. Should additional information or changes in field conditions occur, the conclusions and recommendations provided in this report should be re-evaluated by an experienced engineer.

APPENDIX A

Completed EPA Coal Combustion Dam Inspection Checklist Forms

&

Completed EPA Coal Combustion Waste (CCW) Impoundment Inspection Forms

Coal Combustion Dam Inspection Checklist Form

US Environmental
Protection Agency

Site Name: Cape Fear Steam Plant

Date: June 15, 2009

Unit Name: 1985 Ash Pond

Operator's Name: CP&L d/b/a Progress Energy

Unit I.D.:

Hazard Potential Classification: High [✓ Significant] Low

Inspector's Name: Katherine Adnams/Malcolm D. Hargraves

Check the appropriate box below. Provide comments when appropriate. If not applicable or not available, record "N/A". Any unusual conditions or construction practices that should be noted in the comments section. For large diked embankments, separate checklists may be used for different embankment areas. If separate forms are used, identify approximate area that the form applies to in comments.

	Yes	No		Yes	No
1. Frequency of Company's Dam Inspections?	see note		18. Sloughing or bulging on slopes?		x
2. Pool elevation (operator records)?	approx. 190		19. Major erosion or slope deterioration?		x
3. Decant inlet elevation (operator records)?	approx. 190		20. Decant Pipes:		
4. Open channel spillway elevation (operator records)?	n/a		Is water entering inlet, but not exiting outlet?		x
5. Lowest dam crest elevation (operator records)?	195		Is water exiting outlet, but not entering inlet?		x
6. If instrumentation is present, are readings recorded (operator records)?		x	Is water exiting outlet flowing clear?	x	
7. Is the embankment currently under construction?		x	21. Seepage (specify location, if seepage carries fines, and approximate seepage rate below):		
8. Foundation preparation (remove vegetation,stumps, topsoil in area where embankment fill will be placed)?	n/a		From underdrain?	n/a	
9. Trees growing on embankment? (If so, indicate largest diameter below)		x	At isolated points on embankment slopes?		x
10. Cracks or scarps on crest?		x	At natural hillside in the embankment area?		x
11. Is there significant settlement along the crest?		x	Over widespread areas?		x
12. Are decant trashracks clear and in place?	x		From downstream foundation area?	x	
13. Depressions or sinkholes in tailings surface or whirlpool in the pool area?		x	"Boils" beneath stream or ponded water?		x
14. Clogged spillways, groin or diversion ditches?		x	Around the outside of the decant pipe?		x
15. Are spillway or ditch linings deteriorated?		x	22. Surface movements in valley bottom or on hillside?		x
16. Are outlets of decant or underdrains blocked?		x	23. Water against downstream toe?		x
17. Cracks or scarps on slopes?	x		24. Were Photos taken during the dam inspection?	x	

Major adverse changes in these items could cause instability and should be reported for further evaluation. Adverse conditions noted in these items should normally be described (extent, location, volume, etc.) in the space below and on the back of this sheet.

Inspection Issue #	Comments

The Hazard Potential Classification is based on environmental impact.

1 Progress Energy performs weekly inspections has outside consultant perform yearly and 5-year inspections.

9 Much of slope was heavily vegetated with high weeds, briars, and thick brush (2 to 3-inch diameter).

17,18,19 Small, isolated scarps/sloughs noted in a couple of locations on west dike. Rodent burrows and dying grass where burrows had been filled also noted on west dike. Heavy vegetation partially obscured several locations where grass cover loss was evident on west dike.

21 Soft, wet area on west dike toe adjacent to double culvert under train tracks noted; penetrate 3 feet with probe

U. S. Environmental Protection Agency

Coal Combustion Waste (CCW)
Impoundment Inspection

Impoundment NPDES Permit # NC0003433 INSPECTOR Adnams/Hargraves
Date June 15, 2009

Impoundment Name 1985 Ash Pond
Impoundment Company CP&L d/b/a Progress Energy
EPA Region 4
State Agency (Field Office) Addresss NC Dept. of Environment and Natural Resources
401 Oberlin Road, Suite 150; Raleigh, NC 27699-1646
Name of Impoundment 1985 Ash Pond
(Report each impoundment on a separate form under the same Impoundment NPDES Permit number)

New ________ Update x

	Yes	No
Is impoundment currently under construction?		x
Is water or ccw currently being pumped into the impoundment?	x	

IMPOUNDMENT FUNCTION: Fly/Bottom Ash, Boiler Slag, domestic wastewater, storm water

Nearest Downstream Town : Name LiIlington, North Carolina
Distance from the impoundment 20+ miles
Impoundment
Location: Longitude 79 Degrees 2 Minutes 27.94 Seconds
Latitude 35 Degrees 35 Minutes 24.46 Seconds
State NC County Chatham

Does a state agency regulate this impoundment? YES x NO ______

If So Which State Agency? North Carolina Utilities Commission

<u>HAZARD POTENTIAL</u> (In the event the impoundment should fail, the following would occur):

______ **LESS THAN LOW HAZARD POTENTIAL:** Failure or misoperation of the dam results in no probable loss of human life or economic or environmental losses.

______ **LOW HAZARD POTENTIAL:** Dams assigned the low hazard potential classification are those where failure or misoperation results in no probable loss of human life and low economic and/or environmental losses. Losses are principally limited to the owner's property.

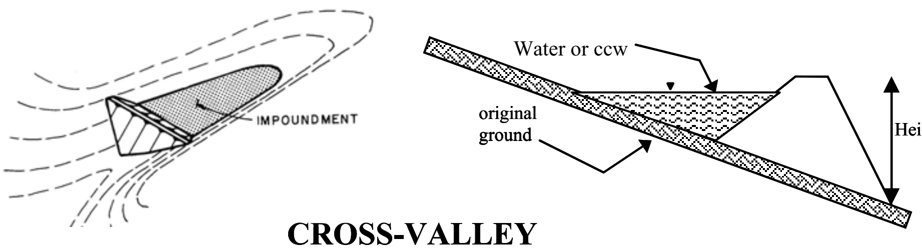
x______ **SIGNIFICANT HAZARD POTENTIAL:** Dams assigned the significant hazard potential classification are those dams where failure or misoperation results in no probable loss of human life but can cause economic loss, environmental damage, disruption of lifeline facilities, or can impact other concerns. Significant hazard potential classification dams are often located in predominantly rural or agricultural areas but could be located in areas with population and significant infrastructure.

______ **HIGH HAZARD POTENTIAL:** Dams assigned the high hazard potential classification are those where failure or misoperation will probably cause loss of human life.

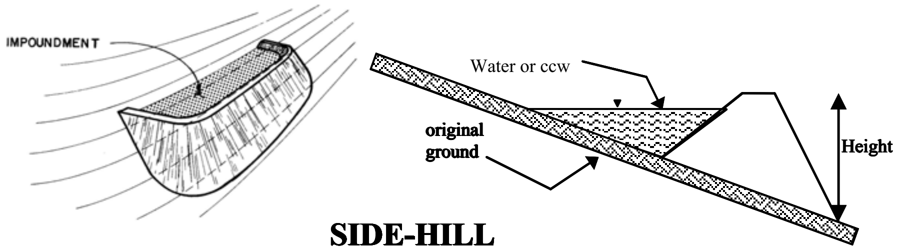
DESCRIBE REASONING FOR HAZARD RATING CHOSEN:

An uncontrolled release of CCW from this impoundment could impact tributaries to the Haw and Cape Fear Rivers as well as Corinth Road, approximately 200 to 300 feet to the east of the basin. Environmental impacts to the river, aquatic life, and terrestrial vegetation is probable.

CONFIGURATION:

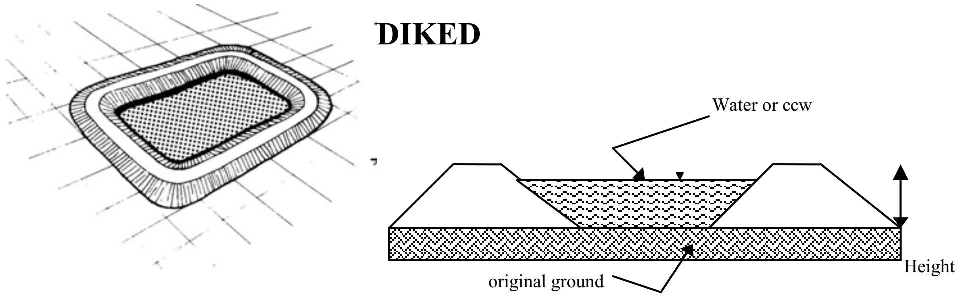


CROSS-VALLEY

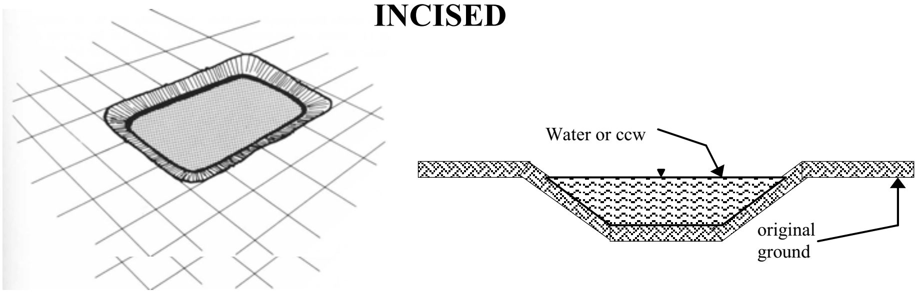


SIDE-HILL

DIKED



INCISED



______ Cross-Valley
______ Side-Hill
x______ Diked
______ Incised (form completion optional)
______ Combination Incised/Diked

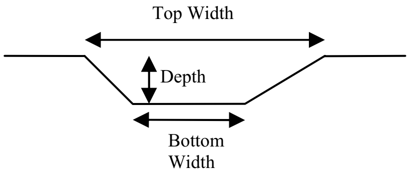
Embankment Height 28 feet
Embankment Material Native Borrow
Pool Area 65 acres
Liner none
Current Freeboard approx. 5 feet
Liner Permeability n/a

TYPE OF OUTLET (Mark all that apply)

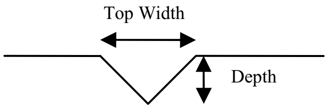
n/a ____ **Open Channel Spillway**
______ Trapezoidal
______ Triangular
______ Rectangular
______ Irregular

______ depth
______ bottom (or average) width
______ top width

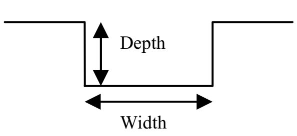
TRAPEZOIDAL



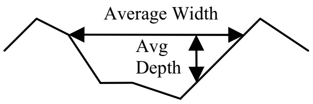
TRIANGULAR



RECTANGULAR

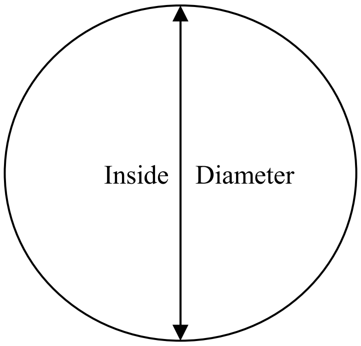


IRREGULAR



x ____ **Outlet**

30 ____ inside diameter



Material
______ corrugated metal
______ welded steel
x ____ concrete
______ plastic (hdpe, pvc, etc.)
______ other (specify) ______________________

Is water flowing through the outlet? YES x ______ NO _______

_____ **No Outlet**

_____ **Other Type of Outlet** (specify) ____________________________________

The Impoundment was Designed By Carolina Power & Light (CP&L)

Has there ever been a failure at this site? YES __________ NO x__________

If So When? ____________________________

If So Please Describe :

Has there ever been significant seepages at this site?   YES _______ NO x_______

If So When? ____________________________

IF So Please Describe:

Has there ever been any measures undertaken to monitor/lower
Phreatic water table levels based on past seepages or breaches
at this site? YES ________NO x________

If so, which method (e.g., piezometers, gw pumping,...)? ____________________

If so Please Describe :

Coal Combustion Dam Inspection Checklist Form

US Environmental
Protection Agency

Site Name: Cape Fear Steam Plant

Date: June 16, 2009

Unit Name: 1978 Ash Pond

Operator's Name: CP&L d/b/a Progress Energy

Unit I.D.:

Hazard Potential Classification: High [✓ Significant] Low

Inspector's Name: Katherine Adnams/Malcolm D. Hargraves

Check the appropriate box below. Provide comments when appropriate. If not applicable or not available, record "N/A". Any unusual conditions or construction practices that should be noted in the comments section. For large diked embankments, separate checklists may be used for different embankment areas. If separate forms are used, identify approximate area that the form applies to in comments.

	Yes	No		Yes	No
1. Frequency of Company's Dam Inspections?	see note		18. Sloughing or bulging on slopes?		x
2. Pool elevation (operator records)?	approx. 193		19. Major erosion or slope deterioration?		x
3. Decant inlet elevation (operator records)?	approx. 193		20. Decant Pipes:		
4. Open channel spillway elevation (operator records)?	n/a		Is water entering inlet, but not exiting outlet?		x
5. Lowest dam crest elevation (operator records)?	197		Is water exiting outlet, but not entering inlet?		x
6. If instrumentation is present, are readings recorded (operator records)?	n/a		Is water exiting outlet flowing clear?	x	
7. Is the embankment currently under construction?		x	21. Seepage (specify location, if seepage carries fines, and approximate seepage rate below):		
8. Foundation preparation (remove vegetation,stumps, topsoil in area where embankment fill will be placed)?	n/a		From underdrain?	n/a	
9. Trees growing on embankment? (If so, indicate largest diameter below)	x		At isolated points on embankment slopes?		x
10. Cracks or scarps on crest?		x	At natural hillside in the embankment area?		x
11. Is there significant settlement along the crest?		x	Over widespread areas?		x
12. Are decant trashracks clear and in place?	x		From downstream foundation area?		x
13. Depressions or sinkholes in tailings surface or whirlpool in the pool area?		x	"Boils" beneath stream or ponded water?		x
14. Clogged spillways, groin or diversion ditches?		x	Around the outside of the decant pipe?		x
15. Are spillway or ditch linings deteriorated?		x	22. Surface movements in valley bottom or on hillside?		x
16. Are outlets of decant or underdrains blocked?		x	23. Water against downstream toe?		x
17. Cracks or scarps on slopes?		x	24. Were Photos taken during the dam inspection?	x	

Major adverse changes in these items could cause instability and should be reported for further evaluation. Adverse conditions noted in these items should normally be described (extent, location, volume, etc.) in the space below and on the back of this sheet.

Inspection Issue # Comments

The Hazard Potential Classification is based on environmental impact.

1 Progress Energy performs weekly inspections has outside consultant perform yearly and 5-year inspections.

9 Up to 4-inch diameter trees noted on embankment; 18 to 24-inch diameter near dike toe. Heavy vegetation.

19 Outlet channel at southern end of dike should be shored appropriately with rip-rap to impede erosion and and establish stability. Continued erosion could impact dike toe. Exposed soil noted in several areas on south dike where grass cover has not been established after reportedly repeated efforts. Accumulation of eroded soil not readily observable at the base of the dike at these areas.

U. S. Environmental Protection Agency

Coal Combustion Waste (CCW)
Impoundment Inspection

Impoundment NPDES Permit # NC0003433 INSPECTOR Adnams/Hargraves
Date June 16, 2009

Impoundment Name 1978 Ash Pond
Impoundment Company CP&L d/b/a Progress Energy
EPA Region 4
State Agency (Field Office) Addresss NC Dept. of Environment and Natural Resources
401 Oberlin Road, Suite 150; Raleigh, NC 27699-1646
Name of Impoundment 1978 Ash Pond
(Report each impoundment on a separate form under the same Impoundment NPDES Permit number)

New ________ Update x

	Yes	No
Is impoundment currently under construction?		x
Is water or ccw currently being pumped into the impoundment?	x	

IMPOUNDMENT FUNCTION: Fly/Bottom Ash, Boiler Slag, waste/stormwater, coal pile runoff

Nearest Downstream Town : Name LiIlington, North Carolina
Distance from the impoundment 20+ miles
Impoundment
Location: Longitude 79 Degrees 2 Minutes 46.40 Seconds
Latitude 35 Degrees 35 Minutes 16.23 Seconds
State NC County Chatham

Does a state agency regulate this impoundment? YES x NO ______

If So Which State Agency? North Carolina Utilities Commission

<u>HAZARD POTENTIAL</u> (In the event the impoundment should fail, the following would occur):

______ **LESS THAN LOW HAZARD POTENTIAL:** Failure or misoperation of the dam results in no probable loss of human life or economic or environmental losses.

______ **LOW HAZARD POTENTIAL:** Dams assigned the low hazard potential classification are those where failure or misoperation results in no probable loss of human life and low economic and/or environmental losses. Losses are principally limited to the owner's property.

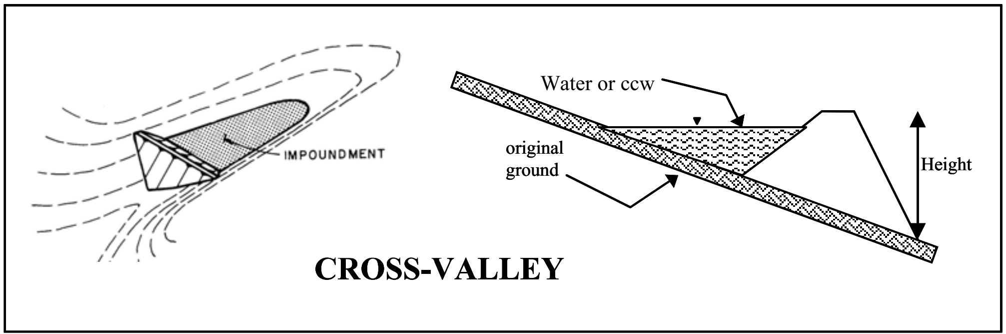
x______ **SIGNIFICANT HAZARD POTENTIAL:** Dams assigned the significant hazard potential classification are those dams where failure or misoperation results in no probable loss of human life but can cause economic loss, environmental damage, disruption of lifeline facilities, or can impact other concerns. Significant hazard potential classification dams are often located in predominantly rural or agricultural areas but could be located in areas with population and significant infrastructure.

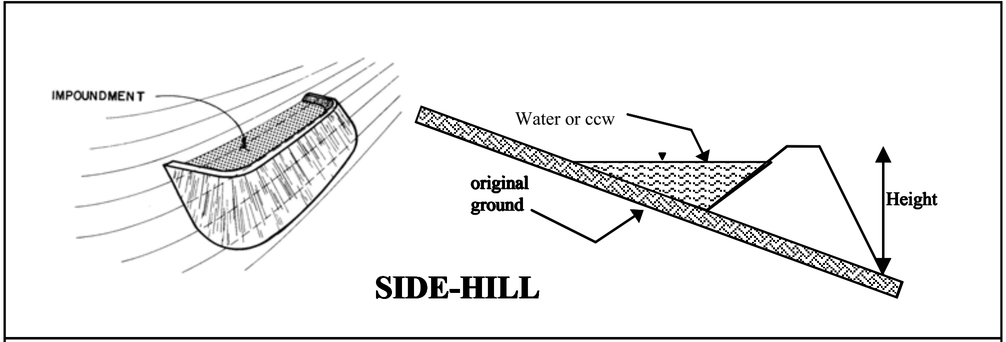
______ **HIGH HAZARD POTENTIAL:** Dams assigned the high hazard potential classification are those where failure or misoperation will probably cause loss of human life.

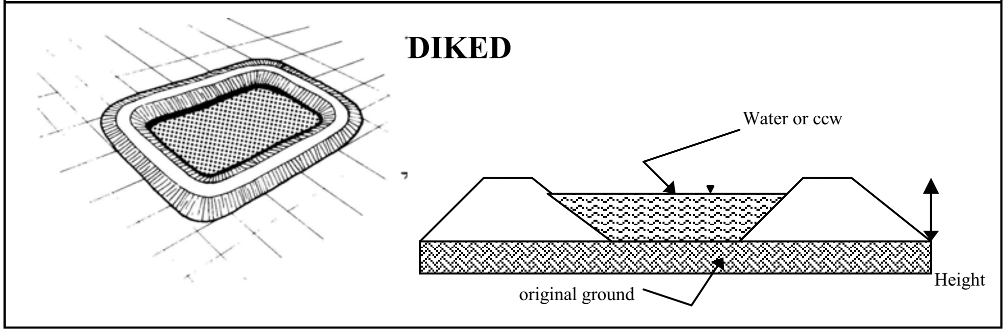
DESCRIBE REASONING FOR HAZARD RATING CHOSEN:

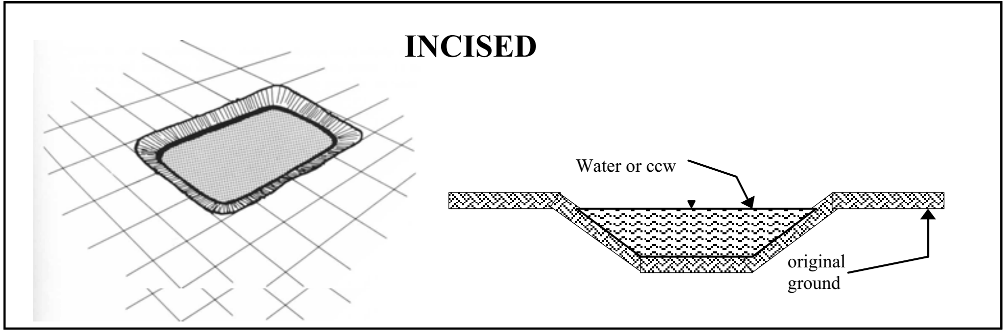
An uncontrolled release of CCW from this impoundment would impact the Cape Fear River. Environmental impacts to the river and aquatic life is probable.

CONFIGURATION:


CROSS-VALLEY


SIDE-HILL


DIKED


INCISED

______ Cross-Valley
______ Side-Hill
x______ Diked
______ Incised (form completion optional)
______ Combination Incised/Diked

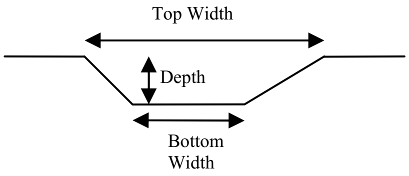
Embankment Height 27 feet
Embankment Material Native Borrow
Pool Area 43 acres
Liner none
Current Freeboard approx. 4 feet
Liner Permeability n/a

TYPE OF OUTLET (Mark all that apply)

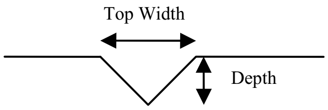
n/a **Open Channel Spillway**
______ Trapezoidal
______ Triangular
______ Rectangular
______ Irregular

______ depth
______ bottom (or average) width
______ top width

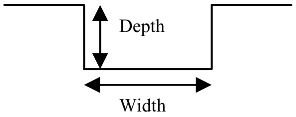
TRAPEZOIDAL



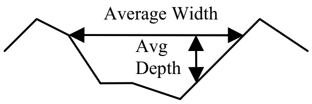
TRIANGULAR



RECTANGULAR



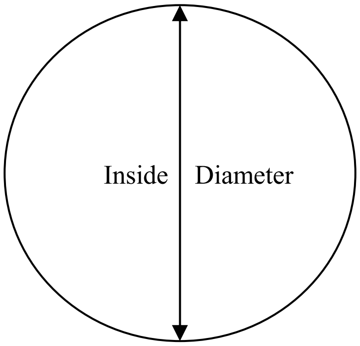
IRREGULAR



x **Outlet**

18 inside diameter

Material
______ corrugated metal
______ welded steel
x concrete
______ plastic (hdpe, pvc, etc.)
______ other (specify) ______________________



Is water flowing through the outlet? YES x NO ______

______ **No Outlet**

______ **Other Type of Outlet** (specify) ________________________________

The Impoundment was Designed By Carolina Power & Light (CP&L)

Has there ever been a failure at this site? YES __________ NO x__________

If So When? ____________________________

If So Please Describe :

Has there ever been significant seepages at this site? YES _______ NO x_______

If So When? ___________________________

IF So Please Describe:

Has there ever been any measures undertaken to monitor/lower
Phreatic water table levels based on past seepages or breaches
at this site? YES ________ NO x________

If so, which method (e.g., piezometers, gw pumping,...)? ____________________

If so Please Describe :

Coal Combustion Dam Inspection Checklist Form

US Environmental
Protection Agency

Site Name: Cape Fear Steam Plant

Date: June 16, 2009

Unit Name: 1970 Ash Pond

Operator's Name: CP&L d/b/a Progress Energy

Unit I.D.:

Hazard Potential Classification: High [✓ Significant] Low

Inspector's Name: Katherine Adnams/Malcolm D. Hargraves

Check the appropriate box below. Provide comments when appropriate. If not applicable or not available, record "N/A". Any unusual conditions or construction practices that should be noted in the comments section. For large diked embankments, separate checklists may be used for different embankment areas. If separate forms are used, identify approximate area that the form applies to in comments.

	Yes	No		Yes	No
1. Frequency of Company's Dam Inspections?	see note		18. Sloughing or bulging on slopes?	x	
2. Pool elevation (operator records)?	about 178		19. Major erosion or slope deterioration?		x
3. Decant inlet elevation (operator records)?	182		20. Decant Pipes:	■	■
4. Open channel spillway elevation (operator records)?	n/a		Is water entering inlet, but not exiting outlet?		x
5. Lowest dam crest elevation (operator records)?	185		Is water exiting outlet, but not entering inlet?		x
6. If instrumentation is present, are readings recorded (operator records)?		x	Is water exiting outlet flowing clear?	n/a	
7. Is the embankment currently under construction?		x	21. Seepage (specify location, if seepage carries fines, and approximate seepage rate below):	■	■
8. Foundation preparation (remove vegetation,stumps, topsoil in area where embankment fill will be placed)?	n/a		From underdrain?		x
9. Trees growing on embankment? (If so, indicate largest diameter below)	x		At isolated points on embankment slopes?		x
10. Cracks or scarps on crest?		x	At natural hillside in the embankment area?		x
11. Is there significant settlement along the crest?		x	Over widespread areas?		x
12. Are decant trashracks clear and in place?	x		From downstream foundation area?		x
13. Depressions or sinkholes in tailings surface or whirlpool in the pool area?		x	"Boils" beneath stream or ponded water?		x
14. Clogged spillways, groin or diversion ditches?		x	Around the outside of the decant pipe?		x
15. Are spillway or ditch linings deteriorated?	x		22. Surface movements in valley bottom or on hillside?		x
16. Are outlets of decant or underdrains blocked?		x	23. Water against downstream toe?		x
17. Cracks or scarps on slopes?		x	24. Were Photos taken during the dam inspection?	x	

Major adverse changes in these items could cause instability and should be reported for further evaluation. Adverse conditions noted in these items should normally be described (extent, location, volume, etc.) in the space below and on the back of this sheet.

Inspection Issue #	Comments

The Hazard Potential Classification is based on environmental impact.

1 Progress Energy has outside consultant perform yearly and 5-year inspections.

9 Up to 12 to 18-inch diameter trees noted on embankment and at embankment toe.

12, 15 Pond inactive since 1978; trashrack not functioning. Spillway/ditch lining littered and partially vegetated

18 Vegetated sloughs are evidence of creep movements due to slope steepness (2:1).

U. S. Environmental Protection Agency

Coal Combustion Waste (CCW)
Impoundment Inspection

Impoundment NPDES Permit # NC0003433 INSPECTOR Adnams/Hargraves
Date June 16, 2009

Impoundment Name 1970 Ash Pond
Impoundment Company CP&L d/b/a Progress Energy
EPA Region 4
State Agency (Field Office) Addresss NC Dept. of Environment and Natural Resources
401 Oberlin Road, Suite 150; Raleigh, NC 27699-1646
Name of Impoundment 1970 Ash Pond
(Report each impoundment on a separate form under the same Impoundment NPDES Permit number)

New ________ Update x

	Yes	No
Is impoundment currently under construction?		x
Is water or ccw currently being pumped into the impoundment?		x

IMPOUNDMENT FUNCTION: Fly Ash, Bottom Ash, Boiler Slag, low volume wastewater (?)

Nearest Downstream Town : Name LiIlington, North Carolina
Distance from the impoundment 20+ miles

Impoundment Location:	Longitude	79	Degrees	2	Minutes	54.90	Seconds
	Latitude	35	Degrees	34	Minutes	58.71	Seconds
	State	NC	County	Chatham			

Does a state agency regulate this impoundment? YES x NO ______

If So Which State Agency? North Carolina Utilities Commission

<u>HAZARD POTENTIAL</u> (In the event the impoundment should fail, the following would occur):

______ **LESS THAN LOW HAZARD POTENTIAL:** Failure or misoperation of the dam results in no probable loss of human life or economic or environmental losses.

______ **LOW HAZARD POTENTIAL:** Dams assigned the low hazard potential classification are those where failure or misoperation results in no probable loss of human life and low economic and/or environmental losses. Losses are principally limited to the owner's property.

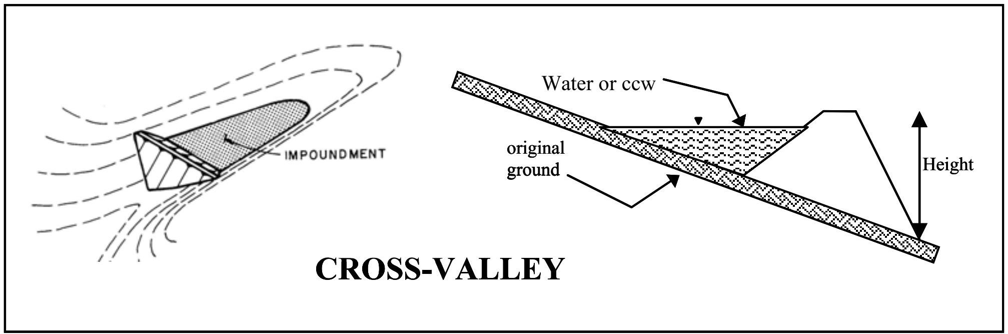
x______ **SIGNIFICANT HAZARD POTENTIAL:** Dams assigned the significant hazard potential classification are those dams where failure or misoperation results in no probable loss of human life but can cause economic loss, environmental damage, disruption of lifeline facilities, or can impact other concerns. Significant hazard potential classification dams are often located in predominantly rural or agricultural areas but could be located in areas with population and significant infrastructure.

______ **HIGH HAZARD POTENTIAL:** Dams assigned the high hazard potential classification are those where failure or misoperation will probably cause loss of human life.

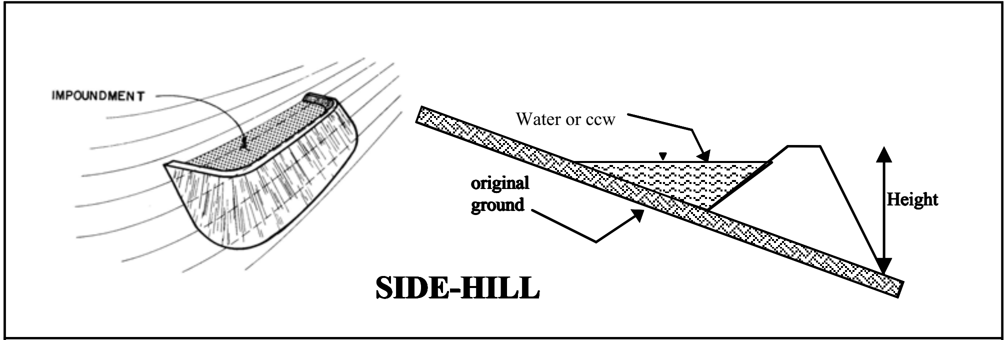
DESCRIBE REASONING FOR HAZARD RATING CHOSEN:

An uncontrolled release of CCW from this impoundment could impact the Cape Fear River. Environmental impacts to the river and aquatic life is probable. Most of the basin, save approximately 2 acres at the southern end of the basin, is vegetated and forested.

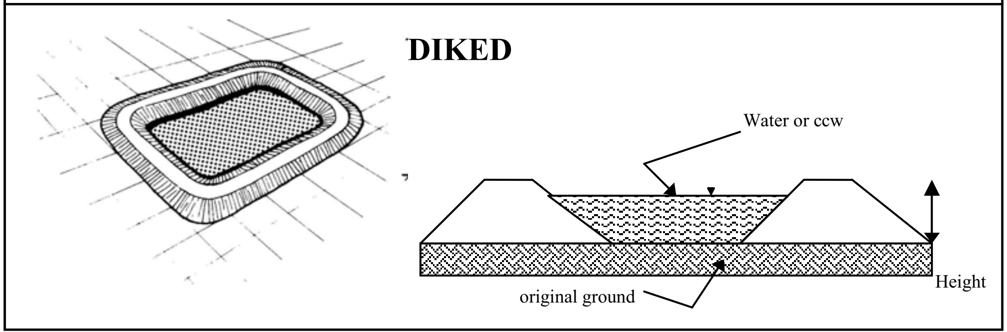
CONFIGURATION:



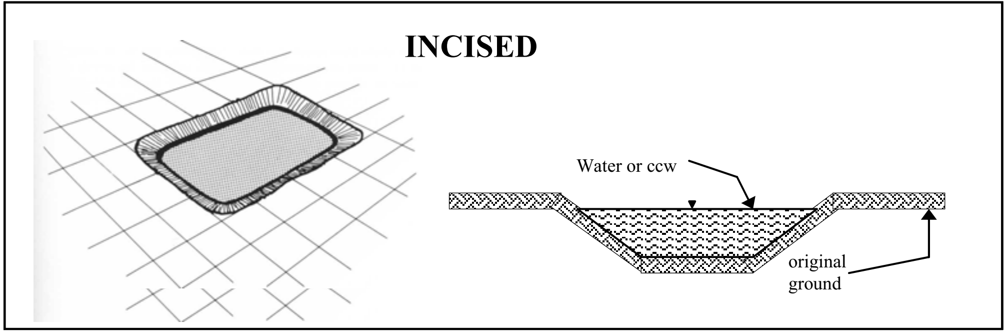
CROSS-VALLEY



SIDE-HILL



DIKED



INCISED

______ Cross-Valley
______ Side-Hill
x______ Diked
______ Incised (form completion optional)
______ Combination Incised/Diked

Embankment Height 27 feet

Embankment Material Native Borrow

Pool Area 50 acres

Liner none

Current Freeboard approx. 7 to 10 feet

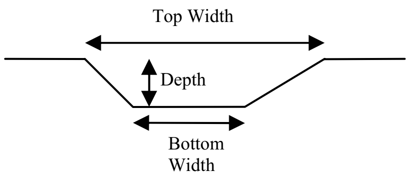
Liner Permeability n/a

TYPE OF OUTLET (Mark all that apply)

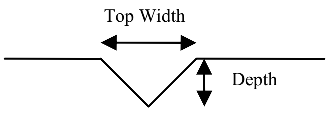
n/a ____ **Open Channel Spillway**
______ Trapezoidal
______ Triangular
______ Rectangular
______ Irregular

______ depth
______ bottom (or average) width
______ top width

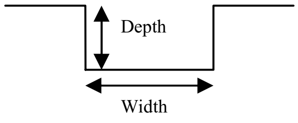
TRAPEZOIDAL



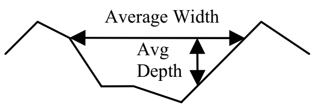
TRIANGULAR



RECTANGULAR

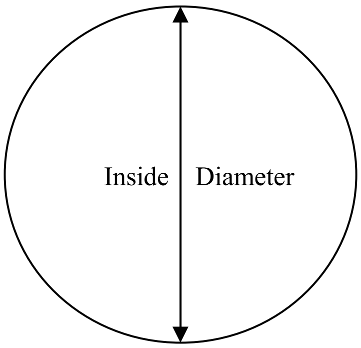


IRREGULAR



yes ____ **Outlet**

20 in. ____ inside diameter



Material
______ corrugated metal
______ welded steel
______ concrete
______ plastic (hdpe, pvc, etc.)
x ______ other (specify) plastic coated steel

Is water flowing through the outlet? YES ________ NO x ________

n/a ____ **No Outlet**

______ **Other Type of Outlet** (specify) ________________________________

The Impoundment was Designed By Carolina Power & Light (CP&L)

Has there ever been a failure at this site? YES __________ NO x__________

If So When? ____________________________

If So Please Describe :

Has there ever been significant seepages at this site?   YES _______ NO x_______

If So When? ___________________________

IF So Please Describe:

Has there ever been any measures undertaken to monitor/lower Phreatic water table levels based on past seepages or breaches at this site? YES ________NO x________

If so, which method (e.g., piezometers, gw pumping,...)? ____________________

If so Please Describe :

Coal Combustion Dam Inspection Checklist Form

US Environmental
Protection Agency

Site Name: Cape Fear Steam Plant

Date: June 17, 2009

Unit Name: 1963 Ash Pond

Operator's Name: CP&L d/b/a Progress Energy

Unit I.D.:

Hazard Potential Classification: High Significant [✓ Low]

Inspector's Name: Katherine Adnams/Malcolm D. Hargraves

Check the appropriate box below. Provide comments when appropriate. If not applicable or not available, record "N/A". Any unusual conditions or construction practices that should be noted in the comments section. For large diked embankments, separate checklists may be used for different embankment areas. If separate forms are used, identify approximate area that the form applies to in comments.

	Yes	No		Yes	No
1. Frequency of Company's Dam Inspections?	see note		18. Sloughing or bulging on slopes?	x	
2. Pool elevation (operator records)?	194 dry		19. Major erosion or slope deterioration?		x
3. Decant inlet elevation (operator records)?	n/a		20. Decant Pipes:		
4. Open channel spillway elevation (operator records)?	n/a		Is water entering inlet, but not exiting outlet?	n/a	
5. Lowest dam crest elevation (operator records)?	197		Is water exiting outlet, but not entering inlet?	n/a	
6. If instrumentation is present, are readings recorded (operator records)?		x	Is water exiting outlet flowing clear?	n/a	
7. Is the embankment currently under construction?		x	21. Seepage (specify location, if seepage carries fines, and approximate seepage rate below):		
8. Foundation preparation (remove vegetation,stumps, topsoil in area where embankment fill will be placed)?	n/a		From underdrain?	n/a	
9. Trees growing on embankment? (If so, indicate largest diameter below)	x		At isolated points on embankment slopes?		x
10. Cracks or scarps on crest?		x	At natural hillside in the embankment area?		x
11. Is there significant settlement along the crest?		x	Over widespread areas?		x
12. Are decant trashracks clear and in place?	n/a		From downstream foundation area?		x
13. Depressions or sinkholes in tailings surface or whirlpool in the pool area?		x	"Boils" beneath stream or ponded water?		x
14. Clogged spillways, groin or diversion ditches?	n/a		Around the outside of the decant pipe?	n/a	
15. Are spillway or ditch linings deteriorated?	n/a		22. Surface movements in valley bottom or on hillside?		x
16. Are outlets of decant or underdrains blocked?	n/a		23. Water against downstream toe?		x
17. Cracks or scarps on slopes?	x		24. Were Photos taken during the dam inspection?	x	

Major adverse changes in these items could cause instability and should be reported for further evaluation. Adverse conditions noted in these items should normally be described (extent, location, volume, etc.) in the space below and on the back of this sheet.

Inspection Issue #	Comments
	The Hazard Potential Classification is based on environmental impact.
1	Progress Energy has outside consultant perform yearly and 5-year inspections.
9	Up to 12 to 18-inch diameter trees noted on embankment and at embankment toe.
17, 18	Vegetated, weathered scarp, slough, and toe bulge from 1982 failure still evident; see explanation.

U. S. Environmental Protection Agency

Coal Combustion Waste (CCW)
Impoundment Inspection

Impoundment NPDES Permit # NC0003433 INSPECTOR Adnams/Hargraves
Date June 16, 2009

Impoundment Name 1963 Ash Pond
Impoundment Company CP&L d/b/a Progress Energy
EPA Region 4
State Agency (Field Office) Addresss NC Dept. of Environment and Natural Resources
401 Oberlin Road, Suite 150; Raleigh, NC 27699-1646
Name of Impoundment 1963 Ash Pond
(Report each impoundment on a separate form under the same Impoundment NPDES Permit number)

New ______ Update x

	Yes	No
Is impoundment currently under construction?		x
Is water or ccw currently being pumped into the impoundment?		x

IMPOUNDMENT FUNCTION: Fly Ash, Bottom Ash, Boiler Slag, low volume wastewater (?)

Nearest Downstream Town : Name LiIlington, North Carolina
Distance from the impoundment 20+ miles
Impoundment
Location: Longitude 79 Degrees 3 Minutes 0.54 Seconds
Latitude 35 Degrees 35 Minutes 16.86 Seconds
State NC County Chatham

Does a state agency regulate this impoundment? YES x NO ______

If So Which State Agency? North Carolina Utilities Commission (part of 1970 pond)

HAZARD POTENTIAL (In the event the impoundment should fail, the following would occur):

______ **LESS THAN LOW HAZARD POTENTIAL:** Failure or misoperation of the dam results in no probable loss of human life or economic or environmental losses.

x______ **LOW HAZARD POTENTIAL:** Dams assigned the low hazard potential classification are those where failure or misoperation results in no probable loss of human life and low economic and/or environmental losses. Losses are principally limited to the owner's property.

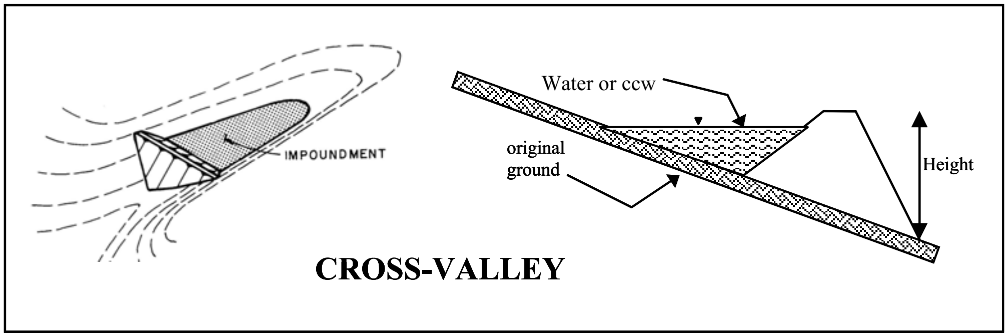
______ **SIGNIFICANT HAZARD POTENTIAL:** Dams assigned the significant hazard potential classification are those dams where failure or misoperation results in no probable loss of human life but can cause economic loss, environmental damage, disruption of lifeline facilities, or can impact other concerns. Significant hazard potential classification dams are often located in predominantly rural or agricultural areas but could be located in areas with population and significant infrastructure.

______ **HIGH HAZARD POTENTIAL:** Dams assigned the high hazard potential classification are those where failure or misoperation will probably cause loss of human life.

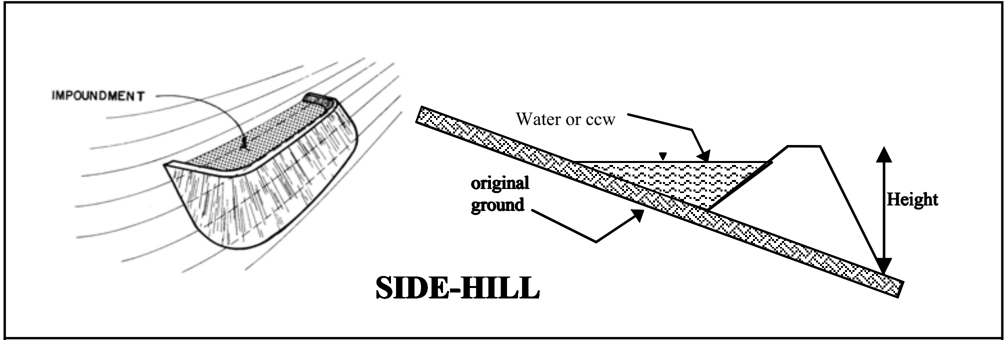
DESCRIBE REASONING FOR HAZARD RATING CHOSEN:

An uncontrolled release of CCW from this impoundment could possibly impact the Cape Fear River. Environmental impacts to the river and aquatic life is probable if any CCW would escape and reach the river. Any impact is likely to be low due to the completely vegetated and forested condition of the basin, and would have to occur as a result of an erosion of the dike and now dry CCW material, then transport via storm water runoff.

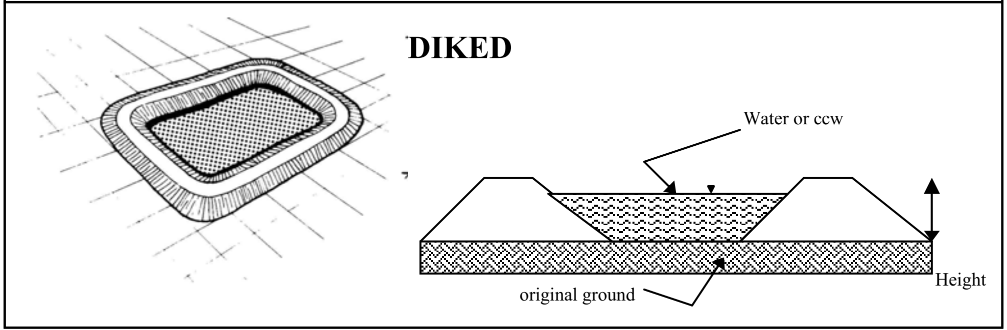
CONFIGURATION:



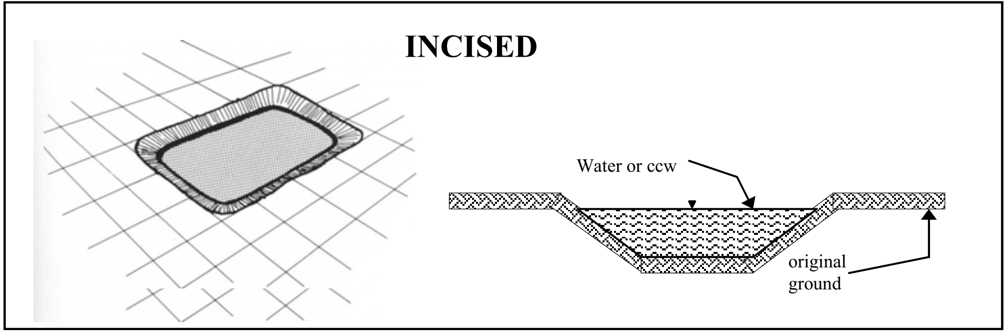
CROSS-VALLEY



SIDE-HILL



DIKED



INCISED

______ Cross-Valley
______ Side-Hill
x______ Diked
______ Incised (form completion optional)
______ Combination Incised/Diked

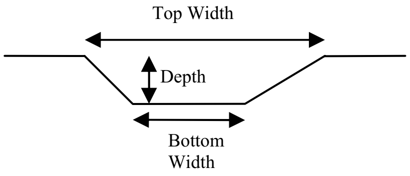
Embankment Height 22________ feet Embankment Material Native Borrow______
Pool Area ____________________ acres Liner none______________________
Current Freeboard 3___________ feet Liner Permeability n/a________________

TYPE OF OUTLET (Mark all that apply)

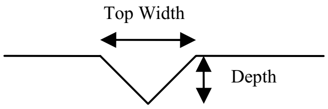
n/a **Open Channel Spillway**
______ Trapezoidal
______ Triangular
______ Rectangular
______ Irregular

______ depth
______ bottom (or average) width
______ top width

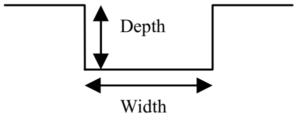
TRAPEZOIDAL



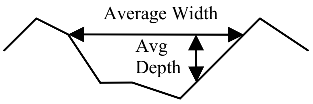
TRIANGULAR



RECTANGULAR

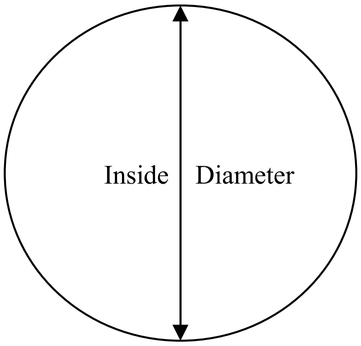


IRREGULAR



no **Outlet**

______ inside diameter



Material
______ corrugated metal
______ welded steel
______ concrete
______ plastic (hdpe, pvc, etc.)
______ other (specify) ______________________

Is water flowing through the outlet? YES _______ NO x

x **No Outlet**

______ **Other Type of Outlet** (specify) ________________________________

The Impoundment was Designed By Carolina Power & Light (CP&L)

Has there ever been a failure at this site? YES x NO ___________

If So When? 1982

If So Please Describe :

A slope failure occurred on the north end of the west dike adaject to the Cape Fear River. No coal combustion waste was released. At the time the failure was to be repaired with a rip-rap at the toe of the failure on the banks of the river channel. As the repair was being implemented, construction activity initiated additional instability (possibly localized vibratory induced liquefaction) and the work was halted with only a portion of the proposed rip-rap being placed at the river's edge and base of the dike. An independent engineering review and analysis of the failure was completed after the repair construction was halted and concluded that the dike was acceptable because the basin had been inactive since 1970 and the dike was impounding mostly sedimented ash. The scarp, slough, and toe bulge features of this failure area is currently visible but is weathered and overgrown with vegetation. Evidence of recent movement is not readily observable.

Has there ever been significant seepages at this site? YES _______ NO x_______

If So When? ____________________________

IF So Please Describe:

Has there ever been any measures undertaken to monitor/lower
Phreatic water table levels based on past seepages or breaches
at this site? YES ________NO x________

If so, which method (e.g., piezometers, gw pumping,...)? ____________________

If so Please Describe :

Coal Combustion Dam Inspection Checklist Form

US Environmental
Protection Agency

Site Name: Cape Fear Steam Plant

Date: June 15, 2009

Unit Name: 1956 Ash Pond

Operator's Name: CP&L d/b/a Progress Energy

Unit I.D.:

Hazard Potential Classification: High [✓ Significant] Low

Inspector's Name: Katherine Adnams/Malcolm D. Hargraves

Check the appropriate box below. Provide comments when appropriate. If not applicable or not available, record "N/A". Any unusual conditions or construction practices that should be noted in the comments section. For large diked embankments, separate checklists may be used for different embankment areas. If separate forms are used, identify approximate area that the form applies to in comments.

	Yes	No		Yes	No
1. Frequency of Company's Dam Inspections?	none		18. Sloughing or bulging on slopes?	x	
2. Pool elevation (operator records)?	no water		19. Major erosion or slope deterioration?		x
3. Decant inlet elevation (operator records)?	approx. 186		20. Decant Pipes:		
4. Open channel spillway elevation (operator records)?	n/a		Is water entering inlet, but not exiting outlet?		x
5. Lowest dam crest elevation (operator records)?	188		Is water exiting outlet, but not entering inlet?		x
6. If instrumentation is present, are readings recorded (operator records)?		x	Is water exiting outlet flowing clear?		x
7. Is the embankment currently under construction?		x	21. Seepage (specify location, if seepage carries fines, and approximate seepage rate below):		
8. Foundation preparation (remove vegetation,stumps, topsoil in area where embankment fill will be placed)?	n/a		From underdrain?		x
9. Trees growing on embankment? (If so, indicate largest diameter below)	x		At isolated points on embankment slopes?		x
10. Cracks or scarps on crest?	x		At natural hillside in the embankment area?		x
11. Is there significant settlement along the crest?		x	Over widespread areas?		x
12. Are decant trashracks clear and in place?		x	From downstream foundation area?		x
13. Depressions or sinkholes in tailings surface or whirlpool in the pool area?		x	"Boils" beneath stream or ponded water?		x
14. Clogged spillways, groin or diversion ditches?	x		Around the outside of the decant pipe?		x
15. Are spillway or ditch linings deteriorated?		x	22. Surface movements in valley bottom or on hillside?		x
16. Are outlets of decant or underdrains blocked?	x		23. Water against downstream toe?		x
17. Cracks or scarps on slopes?	x		24. Were Photos taken during the dam inspection?	x	

Major adverse changes in these items could cause instability and should be reported for further evaluation. Adverse conditions noted in these items should normally be described (extent, location, volume, etc.) in the space below and on the back of this sheet.

Inspection Issue # Comments

The Hazard Potential Classification is based on potential but limited environmental impact.

1 This impoundment has been dry and forested since the 1960's. Progress Energy does not routinely inspect.

9 Up to approximately 2 feet in diameter.

10,17,18 Dike slope was constructed very steep (roughly 1:1). Scarps and sloughs old and vegetated with trees.

14,16 Outlets and drains no longer convey water. Forest litter and silt have covered and obstructed outlets.

19 Slope deterioration via old, forest litter covered erosion rills/gulleys and fallen trees is evident. Exposed soil via recent erosion and fresh, active scarps not readily observable.

EPA FORM -XXXX

U. S. Environmental Protection Agency

Coal Combustion Waste (CCW)
Impoundment Inspection

Impoundment NPDES Permit # NC0003433 INSPECTOR Adnams/Hargraves
Date June 15, 2009

Impoundment Name 1956 Ash Pond
Impoundment Company CP&L d/b/a Progress Energy
EPA Region 4
State Agency (Field Office) Addresss NC Dept. of Environment and Natural Resources
401 Oberlin Road, Suite 150; Raleigh, NC 27699-1646
Name of Impoundment 1956 Ash Pond
(Report each impoundment on a separate form under the same Impoundment NPDES Permit number)

New ________ Update x

	Yes	No
Is impoundment currently under construction?		x
Is water or ccw currently being pumped into the impoundment?		x

IMPOUNDMENT FUNCTION: Formerly Bottom Ash and Boiler Slag disposal

Nearest Downstream Town : Name LiIlington, North Carolina
Distance from the impoundment 20+ miles
Impoundment
Location: Longitude 79 Degrees 3 Minutes 1.92 Seconds
Latitude 35 Degrees 35 Minutes 49.53 Seconds
State NC County Chatham

Does a state agency regulate this impoundment? YES ______ NO x

If So Which State Agency?________________________________

HAZARD POTENTIAL (In the event the impoundment should fail, the following would occur):

______ **LESS THAN LOW HAZARD POTENTIAL:** Failure or misoperation of the dam results in no probable loss of human life or economic or environmental losses.

______ **LOW HAZARD POTENTIAL:** Dams assigned the low hazard potential classification are those where failure or misoperation results in no probable loss of human life and low economic and/or environmental losses. Losses are principally limited to the owner's property.

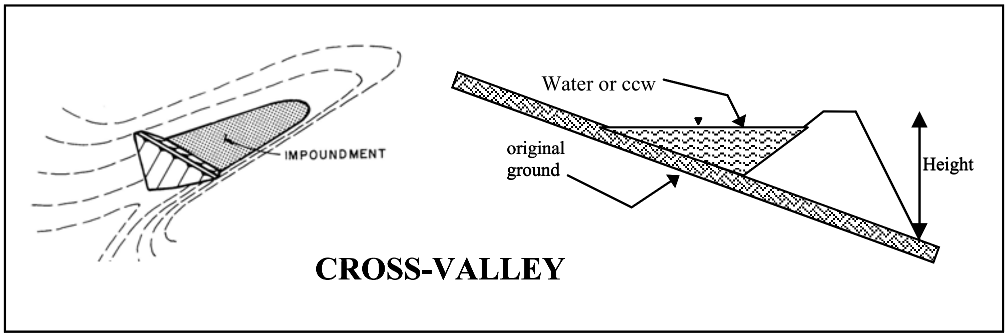
x______ **SIGNIFICANT HAZARD POTENTIAL:** Dams assigned the significant hazard potential classification are those dams where failure or misoperation results in no probable loss of human life but can cause economic loss, environmental damage, disruption of lifeline facilities, or can impact other concerns. Significant hazard potential classification dams are often located in predominantly rural or agricultural areas but could be located in areas with population and significant infrastructure.

______ **HIGH HAZARD POTENTIAL:** Dams assigned the high hazard potential classification are those where failure or misoperation will probably cause loss of human life.

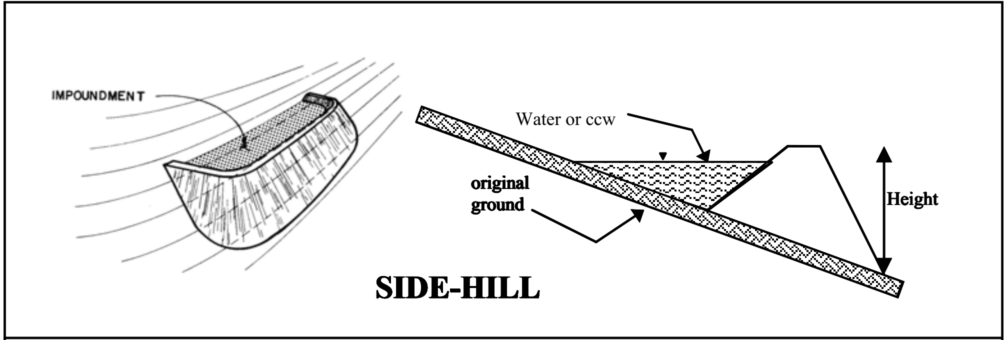
DESCRIBE REASONING FOR HAZARD RATING CHOSEN:

An uncontrolled release of CCW from this impoundment would impact the Haw and Cape Fear Rivers due to its close proximity (less than 50 to 100 feet) to these waterways. Potential environmental impacts to these rivers and aquatic life is probable but likely to be somewhat limited. It should be noted that an uncontrolled release at this basin would have to be the result of long term, unmitigated, unmonitored erosion of very old scarps and tree fall locations in the dike. A breach involving impounded liquid borne material is not realistic because water is not impounded at this location and the basin is forested.

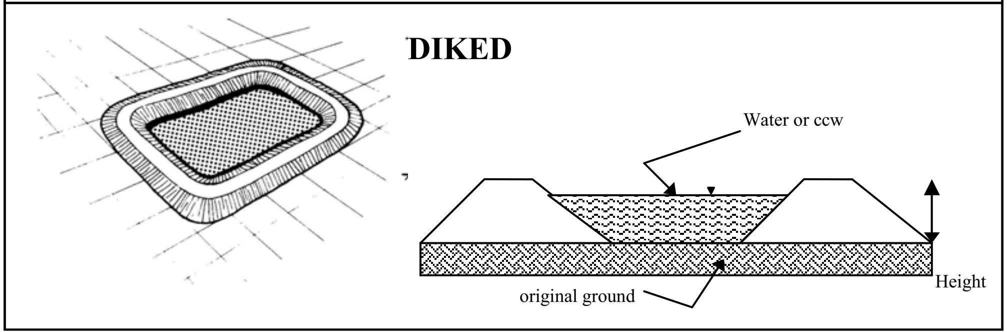
CONFIGURATION:



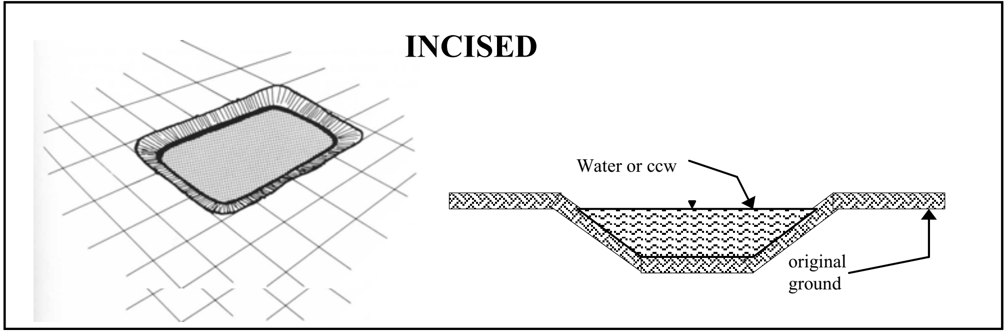
CROSS-VALLEY



SIDE-HILL



DIKED



INCISED

______ Cross-Valley
______ Side-Hill
x______ Diked
______ Incised (form completion optional)
______ Combination Incised/Diked

Embankment Height 20________ feet Embankment Material Native Borrow______

Pool Area ____________________ acres Liner none______________________

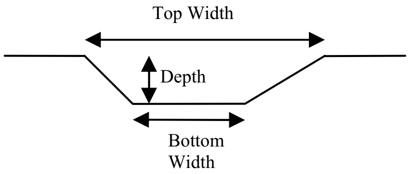
Current Freeboard 0 to 6________ feet Liner Permeability n/a________________

TYPE OF OUTLET (Mark all that apply)

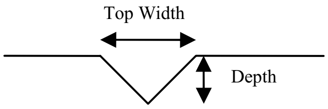
n/a ______ **Open Channel Spillway**
______ Trapezoidal
______ Triangular
______ Rectangular
______ Irregular

______ depth
______ bottom (or average) width
______ top width

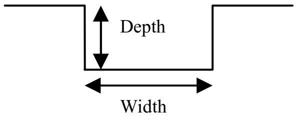
TRAPEZOIDAL



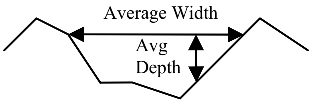
TRIANGULAR



RECTANGULAR

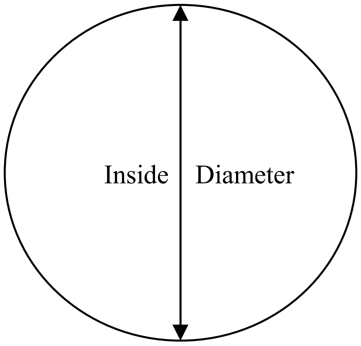


IRREGULAR



yes ______ **Outlet**

30" ______ inside diameter



Material
______ corrugated metal
______ welded steel
x ______ concrete
______ plastic (hdpe, pvc, etc.)
______ other (specify) ______________________

Is water flowing through the outlet? YES ________ NO x ________

n/a ______ **No Outlet**

______ **Other Type of Outlet** (specify) ________________________________

The Impoundment was Designed By Carolina Power & Light (CP&L)

Has there ever been a failure at this site? YES __________ NO x__________

If So When? ____________________________

If So Please Describe :

Has there ever been significant seepages at this site?   YES _______ NO x_______

If So When? ___________________________

IF So Please Describe:

Has there ever been any measures undertaken to monitor/lower Phreatic water table levels based on past seepages or breaches at this site? YES ________ NO x________

If so, which method (e.g., piezometers, gw pumping,...)? ____________________

If so Please Describe :