SIERRA CLUB

QUARLES EXHIBIT 1

QUARLES RESUME

Docket No. e-2, Sub 1219

Mark Quarles, P.G.
Senior Geologist, Nashville Branch Manager

Education
MBA Vanderbilt – Owen Graduate School of Management, 2001

B.S., Environmental Engineering Technology, Western Kentucky University, 1985

Professional Registration

Professional Geologist – Tennessee (#3834)

Professional Geologist – New York (#779)

Professional Geologist – Georgia (#2266)

Water Pollution Control Operator (Class II) - Massachusetts

GENERAL CAREER BACKGROUND

Mr. Quarles has provided consulting services to a variety of local, state, US EPA, and international regulatory programs for a diverse list of clients — including industrial manufacturers, law firms, municipal governments, commercial developers, and non-profit organizations. He has served as Client Manager, Project Manager, and Senior Geologist for projects in multiple states and has managed teams of geologists, chemists, natural resource specialists, environmental engineers, and environmental scientists.

Coal combustion waste experience has included investigations for over 100 coal combustion waste disposal sites across the United States, with a particular emphasis on these states: Alabama, Florida, Georgia, Illinois, Iowa, Kentucky, New York, North Carolina, South Carolina, and Tennessee. The work has evaluated disposal site designs, operation and monitoring programs, and closure plans relative to the US EPA RCRA Subtitle D, Coal Combustion Residuals Rule ("CCR Rule") and state-equivalent programs.

In addition to coal combustion wastes, Mr. Quarles has experience with environmental compliance programs associated with US EPA and state-equivalent standards for voluntary Brownfield programs, hazardous wastes (RCRA Subtitle C), corporate environmental audits, Superfund (CERLCA), municipal and industrial landfill siting and design (RCRA Subtitle D), due diligence property transactional standards (ASTM), wastewater and stormwater discharges (Clean Water Act), potable water supply (Safe Drinking Water Act), oil storage (Oil Pollution Control Act), threatened and endangered species (Endangered Species Act), dredge and Fill (404 Permits), sediment contamination, stream alternation permits, and wetlands.

Mr. Quarles has testified as a subject matter expert in Federal and State Courts, administrative hearings, and public hearings.

REPRESENTATIVE CCR PROGRAM EXPERIENCE

General CCR Rule Compliance
Mr. Quarles has evaluated site conditions and compared them to the technical standards associated with the CCR Rule and state-equivalent programs, in addition to standards established by the Electric Power Research Institute. The services have included expert opinion technical reports, expert testimonies, and comments at public hearings regarding Environmental Impact Statements, CCR Rule compliance, proposed investigations to define the nature and extent of contamination, proposed closure plans, and proposed corrective action measures.

Electric Power Industry and Governmental Research
Mr. Quarles has used historical research dating to the 1970s by the Electric Power Research Institute, the US EPA, internal utilities, peer-reviewed publications, and governmental research organizations to determine coal-fired power plant operational standards and known risks to water quality.

Forensic Analyses
Mr. Quarles has reviewed historical reports, topographic maps, and aerial photographs to determine where historical disposal operations occurred, the likelihood of wastes being placed below the seasonal high groundwater table, and when groundwater contamination mostly likely occurred.

Utility Rate Case Support
Mr. Quarles has testified at rate case hearings regarding compliance with the CCR Rule and state-equivalent programs. Services have included reviewing proposed investigations to identify legacy waste disposal activities, estimating when groundwater contamination most likely occurred, reviewing investigations to determine the nature and extent of contamination, and reviewing proposed groundwater corrective actions.

REPRESENTATIVE CCR PROJECT EXPERIENCE

CCR Rate Case Hearings – Raleigh, North Carolina
Served as Senior Geologist associated with rate casing hearings before the North Carolina Utilities Commission. Services included an extensive review of historical internal documents and discovery, proposed closure plans for landfills and surface impoundments, and groundwater monitoring plans relative to the CCR Rule and the Coal Ash Management Act.

CCR Compliance – Memphis, Tennessee
Served as Senior Geologist and subject matter expert reviewing site investigative activities associated with unlined surface impoundments along the Mississippi River. The primary concerns were arsenic in groundwater, the surface impoundments being located over the Memphis Sand Aquifer (a sole source public drinking water aquifer), and whether or not a confining layer existed to prevent downward migration.

CCR Compliance and Litigation – Gallatin, Tennessee
Served as Senior Geologist and litigation subject matter expert regarding CCR contamination of groundwater, surface and groundwater used as public drinking water supplies, connectivity of groundwater to surface waters, off-site contamination of river sediments, and leaching of constituents with the proposed cap-in-place closure. Forensic investigations demonstrated that wide-spread karst conditions of

sinkholes and sinking streams exist beneath the impoundments, impounded conditions have raised the localized groundwater, wastes have been submerged in groundwater, and continued leaching would occur with the proposed closure-in-place.

Remedy Selection – Multiple Locations, Illinois
Served as Senior Geologist to evaluate proposed remedies required by the Illinois Pollution Control Board at four power plants. The work included a review of site investigative activities and historical aerials to understand the extent of the wastes — information needed to select a remedy.

CCR Rule Compliance – Multiple Sites, Iowa
Served as Senior geologist to review surface impoundment and landfill historic construction documents, groundwater monitoring reports, alternate source determinations, and / or proposed groundwater remedies at eight power plants.

CCR Compliance and Litigation – Kingston, Tennessee
Served as Senior Geologist and field sampling team member in response to a dike failure that released 5.4 million cubic yards of coal combustion wastes into the Emory, Clinch, and Tennessee Rivers. Services included reviewing defendant discovery documents and field sampling results and completing surface water and private property sampling (including polarized microscopic analyses).

CCR NPDES Permit Comments – Ithaca, New York
Reviewed a proposed NPDES permit for a leachate and stormwater collection pond associated with a Part 360 landfill permit.

CCR Environmental Impact Statement – Kingston, Tennessee
Reviewed an EIS associated with a proposed bottom ash dewatering system. Compared the proposed plan to other utility-owned power plants and systems for water minimization, waste avoidance, and land disposal.

CCR Compliance and Litigation – Eden, North Carolina
Served as Senior Geologist and litigation subject matter expert regarding the nature and extent of contamination due to the failure of an unlined CCR surface impoundment. Services included an extensive review of historical industry practices and defendant discovery documents regarding construction, operation and maintenance, inspections, and the life expectancy of the underlying corrugated metal pipe that ultimately failed. Private property sampling was also completed.

Flue Gas Desulfurization (FGD) Landfill – Gallatin, Tennessee
Reviewed the Part 1 / 2 permit application for a proposed Subtitle D CCR

landfill. The services included a review of the hydrogeologic characterization plan, the proposed groundwater monitoring system, and the proposed landfill design regarding separation from the uppermost aquifer and leachate control.

CCR Impoundment Dewatering Plans – Multiple Locations, Georgia
Served as Senior Geologist to review dewatering plans associated with closure of surface impoundments. The work included research regarding changes in water quality associated with standing water in the impoundments, pore water within the submerged solid wastes, and groundwater. Those results were then compared to the NPDES permits to understand likely compliance, expected changes in water quality over time, and protection of the receiving streams.

UTILITY-RELATED LEGAL TESTIMONIES

Michael Beck et al versus Duke Energy Carolinas and Duke Energy Business Services. North Carolina State Court. Written testimony regarding the Dan River Plant spill and damage to private property and the Dan River. 2019.

Application of Duke Energy Carolinas, LLC for Adjustment of Rates and Charges Applicable to Electric Service in North Carolina before the North Carolina Utilities Commission on behalf of the Sierra Club. Written and oral testimonies. January 2018.

Application of Duke Energy Progress, LLC for Adjustment of Rates and Charges Applicable to Electric Service in North Carolina before the North Carolina Utilities Commission on behalf of the Sierra Club. Written and oral testimonies. October 2017.

Joint Intervenors versus the Nuclear Regulatory Commission, Atomic Safety and Licensing Board Panel on behalf of the Southern Alliance for Clean Energy, the National Parks and Conservation Association, the Emory University Law Clinic, and the Everglades Law Center. Evidentiary hearing. Written and oral testimonies. 2017.

SELC on behalf of the Tennessee Clean Water Network and Tennessee Scenic Rivers Association versus Tennessee Valley Authority, US District Court, Middle District of Tennessee. Written and oral testimonies. 2017.

Tulane Environmental Law Clinic on behalf of the Town of Abita Springs (LA) and the Concerned Citizens of St. Tammany Parish, New Orleans, Louisiana. Office of Conservation evidentiary hearing. Written and oral testimonies. 2014.

PEER-REVIEWED PUBLICATIONS

Quarles, M. and Chris Groves, "Forensic Hydrogeology: Evaluating a Karst Critical Zone Enormously Altered by Coal Combustion Residuals," Geologic Society of America conference, Denver, Colorado, September 2016.

Quarles, M., "A Case Study in Karst Hydrogeology and Contaminant Fate and Transport," National Groundwater Association 51st Annual Convention and Exposition, December 1999.

Quarles, M. and Allen P. Lusby, "Enhanced Biodegradation of Kerosene-Affected Groundwater and Soil," 1994 Annual Conference of the Academy of Hazardous Materials Managers, October 1994.

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QUARLES EXHIBIT 2

1985 AD LITTLE WASTE REPORT EXCERPTS

Docket No. e-2, Sub 1219

EPA-600/7-85-028a
June 1985

FULL-SCALE FIELD EVALUATION OF WASTE DISPOSAL FROM COAL-FIRED ELECTRIC GENERATING PLANTS

Volume I. Sections 1 Through 5

by

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Itamar Bodek, and Charles B. Cooper

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15. SUPPLEMENTARY NOTES AEERL project officer is Julian W. Jones, Mail Drop 61, 919/541-2489. (*)Haley and Aldrich, Inc., Cambridge, MA 02142. (**)Geologic Associates, Inc., Knoxville, TN 37922. Volume II is Section 6 through 9.

16. ABSTRACT The six-volume report summarizes results of a 3-year study of current coal ash and flue gas desulfurization (FGD) waste disposal practices at coal-fired electric generating plants. The study involved characterization of wastes, environmental data gathering, evaluation of environmental effects, and engineering/cost evaluations of disposal practices at six sites around the country. Study results provide technical background data and information for EPA, state and local permitting officials, and the utility industry for implementing environmentally sound disposal practices. Study data suggest that no environmental effects have occurred at any of the six sites; i.e., data from wells downgradient of the disposal sites indicate that waste leachate has resulted in concentrations of chemicals less than the EPA primary drinking water standards. A generic environmental evaluation--based on a matrix of four waste types, three disposal methods, and five environmental settings--shows that, on balance, technology exists for environmentally sound disposal of coal ash and FGD wastes for ponding, interim ponding/landfilling, and landfilling. For some combinations of waste types, disposal methods, and environmental settings, mitigation methods must be taken to avoid adverse environmental effects. Costs of waste disposal operations are highly system and site specific.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS		b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group	
Pollution	Ashes	Pollution Control	13B	21B
Waste Disposal	Flue Gases	Stationary Sources		
Wastes	Desulfurization		14G	07A, 07D
Coal	Cost Engineering		21D	14A
Combustion				
Electric Power Plants			10B	

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ABSTRACT

This report summarizes results of a 3-year study of current coal ash and flue gas desulfurization (FGD) waste disposal practices at coal-fired electric generating plants. The study was conducted by Arthur D. Little, Inc., under EPA contract 68-02-3167, and involved characterizing wastes, gathering environmental data, assessing environmental effects, and evaluating the engineering/costs of disposal practices at six selected sites in various locations around the country. Results of the study are providing technical background data and information to EPA, State and local permitting officials, and the utility industry for implementing environmentally sound disposal practices.

Data from the study suggest that no major environmental effects have occurred at any of the six sites. For example, data from wells downgradient of the disposal sites indicate that the contribution of waste leachate to the groundwater has generally resulted in concentrations of chemicals less than the primary drinking water standards established by EPA. Although occasional exceedances of the standards were observed, these were not necessarily attributable to coal ash and FGD waste. A generic environmental evaluation based on a matrix of four waste types, three disposal methods, and five environmental settings (based on climate and hydrogeology) shows that technology exists for environmentally sound disposal of coal ash and FGD wastes for ponding, interim ponding/landfilling, and landfilling. For some combinations of waste types, disposal methods, and environmental settings, measures must be taken to avoid adverse environmental effects. However, site-specific application of good engineering design and practices can mitigate most potentially adverse effects of coal ash and FGD waste disposal. Costs of waste disposal operations are highly system- and site-specific.

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(*) All Volumes.
(**) Volume I starts.

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TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

(*) Volume II starts.

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

SECTION 5

RESULTS AND CONCLUSIONS FOR THE SIX STUDY SITES

5.1 OVERVIEW

This section summarizes the environmental assessment and engineering cost results for each of the six sites. Some of the significant, general, environmental assessment conclusions are that:

(1) Major dissolved species, especially sulfate, can be expected to migrate off-site, in exceedance of secondary drinking water standards, and remain unattenuated. However, in all cases except direct, upgradient hydrogeologic proximity to drinking water or a very small surface water body, such migration would have little environmental significance. This is because the elevated concentrations would prevail only in a fairly small area and are generally below damage thresholds. Thus, they would have few, if any, adverse ecological effects.

(2) Releases of most trace metals are generally within acceptable limits (e.g., drinking water and aquatic life standards), because of the combined effects of receiving water dilution and the chemical immobilization of most waste-related species. Arsenic is a significant exception that would require case-by-case evaluation for analogous wastes. In this study, elevated concentrations of arsenic in the in-situ liquid phase and/or off-site mobility of arsenic were observed at three of the six sites.

(3) In settings characterized by at least modest precipitation and fairly pervious soils where disposal occurs in direct hydrogeologic proximity to a subsurface drinking water supply or small, high-quality surface water body, an artificial disposal site liner may be needed to minimize contamination by (at least) the major species. A minimum liner thickness of about 0.5 m (1.5 ft) would suffice for proper engineering placement of soil-like liners.

(4) Isolated areas of high-quality surface or groundwater may be expected at disposal site settings where most of the ambient water is highly mineralized. This phenomenon was observed

in the highly mineralized western and acid-mine drainage settings studied in this program.

(5) In many cases, adverse environmental water quality impacts that may occur can be adequately mitigated by careful location of the disposal site. Areas with less permeable and more chemically attenuative soils are preferable, as are locations that are removed from drinking water supplies or key small surface water bodies.

The results and conclusions are discussed in more detail below for each individual site studied in this program.

5.2 PLANT ALLEN

5.2.1 Site Description

5.2.1.1 Background--

Plant Allen of Duke Power Company is located in Gaston County, North Carolina, four miles southeast of the town of Belmont. The plant site is adjacent to the west bank of Lake Wylie, one of eleven impoundments that comprise the 386 km (240 miles) Catawba River Development. The site location is shown on Figure 5.1.

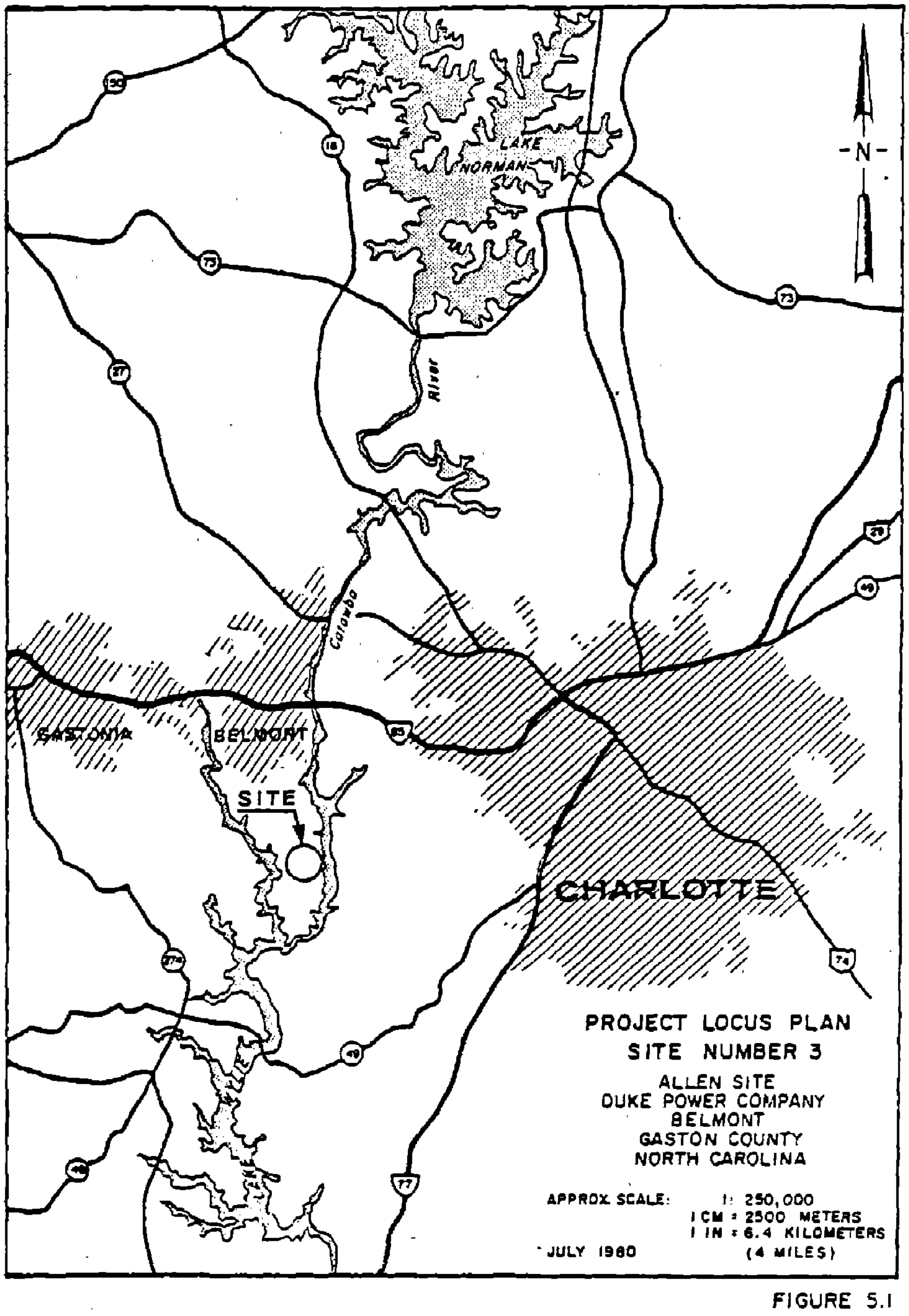
The coal ash disposal site at Plant Allen consists of two separate, major units. The first unit is comprised of retired ash ponds, approximately 206,000 m^2 (127 acres) in total area, that were used and expanded from 1957 to 1973. The second unit is the active ash pond, approximately 239,000 m^2 (146 acres) in area, that was constructed in 1973. A combination of fly ash and bottom ash is presently sluiced directly into this pond located immediately south of and adjacent to the retired pond complex. The liquid overflow from the ash pond is discharged untreated into adjacent Lake Wylie. The ash ponds are retained by earth dikes constructed from residual soils excavated from within the ash pond limits.

The following factors were important in the selection of the combined fly ash/bottom ash disposal ponding operation at Plant Allen for study:

- The practice of pond disposal of combined fly ash and bottom ash is the most common FGC waste disposal practice in the United States and virtually the only disposal practice in the Piedmont Region.

- The amount of precipitation and the mix of residual and alluvial soils at the Plant Allen site represent environmental conditions typical of many other locations in the eastern half of the United States and are particularly representative of the Piedmont Region, which supports significant coal-fired generating capacity.

- Co-disposal of intermittent, contaminant-rich waste streams (i.e., boiler cleaning wastes and coal pile run-off) in ash ponds occurs at



N
LAKE NORMAN
River
Catawba
GASTONIA
BELMONT
SITE
CHARLOTTE
PROJECT LOCUS PLAN
SITE NUMBER 3
ALLEN SITE
DUKE POWER COMPANY
BELMONT
GASTON COUNTY
NORTH CAROLINA
APPROX. SCALE: 1: 250,000
1 CM = 2500 METERS
1 IN = 6.4 KILOMETERS
(4 MILES)
JULY 1980

FIGURE 5.1

Plant Allen and is widely practiced, with potentially broad applicability in the future.

5.2.1.2 Geologic Conditions--

The site area lies within the upland section of the Piedmont Physiographic Province and is characterized by broad, rolling topography and isolated Monadnock-type hills and ridges. The majority of the overburden soils were formed from the chemical decomposition of the underlying micaceous diorite bedrock. These deposits are referred to as residual soils and consist primarily of slightly plastic silts and sands with varying amounts of clay and quartz pebbles. The weathering profile is moderately deep but highly irregular. The bedrock and overburden soils are also characterized by a variety of younger, more permeable igneous dikes and sills which have intruded the original bedrock unit.

Active and ephemeral surface drainage systems have created several major surface drainage valleys with gradients lying at right angles to the Catawba River. Several small, localized alluvial deposits, filled with relatively loose and permeable material, are now incorporated within the ash basin complex.

Figure 5.2 summarizes the site area surficial geologic conditions, and Figure 5.3 presents an idealized subsurface geologic profile sketch.

5.2.1.3 Hydrologic Conditions--

The Plant Allen site lies within the Piedmont Groundwater Province. All groundwater is derived from local precipitation which varies from 1.12 to 1.38 m (44 to 55 in) annually, resulting in approximately 0.26 to 0.38 m (10-15 in) of percolation to the watertable. The plant obtains all of its cooling and process waters from Lake Wylie; approximately 50,000 m^3/day (14.4 million gal/day) are used for sluicing ash into the disposal pond, and ultimately return to Lake Wylie.

The original groundwater table depth varied considerably with the site topography, from at or above ground surface in the low-lying alluvial areas, to an approximate depth of 10 m (33 ft) beneath the higher elevations of the site. The limited data available indicate that plant discharges into the disposal ponds have created groundwater mounding in their immediate vicinity, saturating the former vadose zone above the regional piezometric level. All local surface and groundwater flow is easterly towards Lake Wylie (see Figure 5.2).

5.2.2 Site Evaluation Plan and Site Development

Duke Power Company conducted several environmental studies at Plant Allen that supplied valuable hydrogeologic baseline information; in addition, subsurface exploration information obtained in 1972 for the active ash pond dike construction was made available to the study team. Twenty existing observation wells installed throughout the plant site by Duke Power provided supplemental groundwater level monitoring locations.

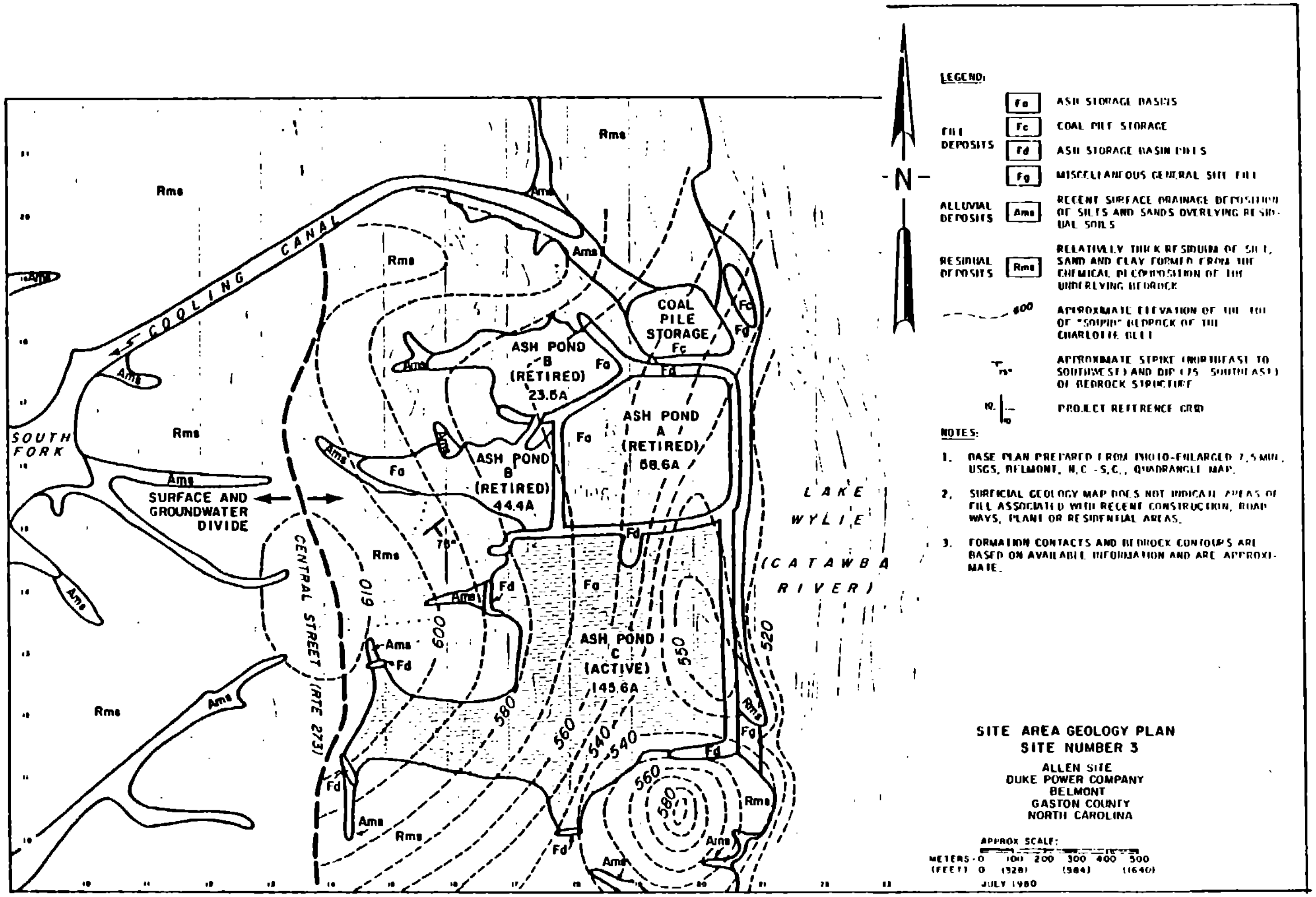
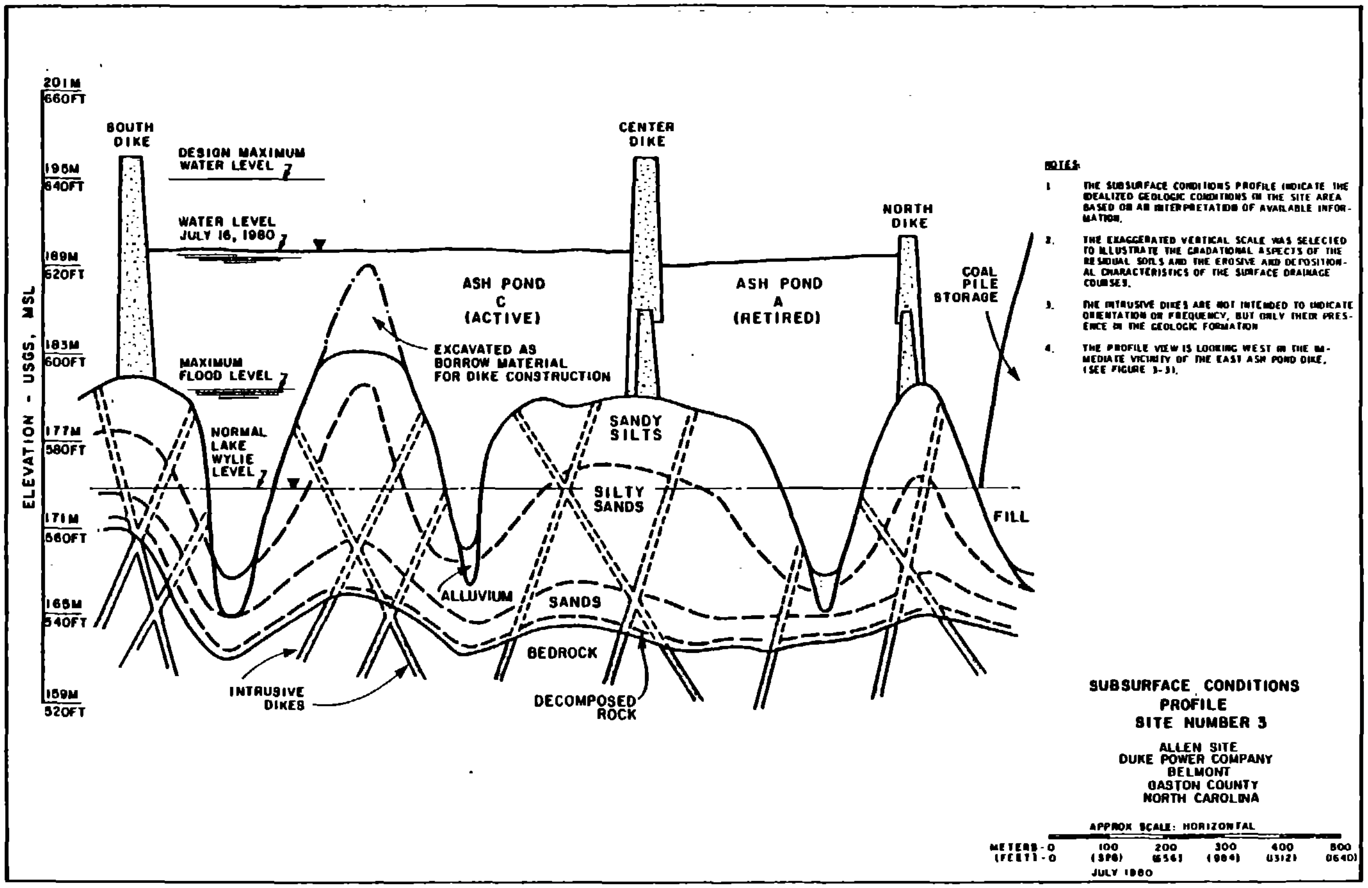

LEGEND:
FILL DEPOSITS
Fa ASH STORAGE BASINS
Fc COAL PILE STORAGE
Fd ASH STORAGE BASIN FILLS
Fg MISCELLANEOUS GENERAL SITE FILL
ALLUVIAL DEPOSITS
Ams RECENT SURFACE DRAINAGE DEPOSITION OF SILTS AND SANDS OVERLYING RESIDUAL SOILS
RESIDUAL DEPOSITS
Rms RELATIVELY THICK RESIDUUM OF SILT, SAND AND CLAY FORMED FROM THE CHEMICAL DECOMPOSITION OF THE UNDERLYING BEDROCK
600 APPROXIMATE ELEVATION OF THE TOP OF "SOUND" BEDROCK OF THE CHARLOTTE BELT
APPROXIMATE STRIKE (NORTHEAST TO SOUTHWEST) AND DIP (75° SOUTHEAST) OF BEDROCK STRUCTURE
PROJECT REFERENCE GRID
NOTES:
1. BASE PLAN PREPARED FROM PHOTO-ENLARGED 7.5 MIN. USGS, BELMONT, N.C.-S.C., QUADRANGLE MAP.
2. SURFICIAL GEOLOGY MAP DOES NOT INDICATE AREAS OF FILL ASSOCIATED WITH RECENT CONSTRUCTION, ROAD WAYS, PLANT OR RESIDENTIAL AREAS.
3. FORMATION CONTACTS AND BEDROCK CONTOURS ARE BASED ON AVAILABLE INFORMATION AND ARE APPROXIMATE.
N
COOLING CANAL
SOUTH FORK
SURFACE AND GROUNDWATER DIVIDE
CENTRAL STREET (RTE 273)
COAL PILE STORAGE
ASH POND B (RETIRED) 23.5A
ASH POND B (RETIRED) 44.4A
ASH POND A (RETIRED) 58.6A
ASH POND C (ACTIVE) 145.6A
LAKE WYLIE (CATAWBA RIVER)
Rms
Ams
Fa
Fc
Fd
75°
610
600
580
560
550
540
520
SITE AREA GEOLOGY PLAN
SITE NUMBER 3
ALLEN SITE
DUKE POWER COMPANY
BELMONT
GASTON COUNTY
NORTH CAROLINA
APPROX SCALE:
METERS-0 100 200 300 400 500
(FEET) 0 (328) (984) (1640)
JULY 1980

FIGURE 5.2



ELEVATION - USGS, MSL
201M
660FT
195M
640FT
189M
620FT
183M
600FT
177M
580FT
171M
560FT
165M
540FT
159M
520FT
SOUTH DIKE
DESIGN MAXIMUM WATER LEVEL
WATER LEVEL JULY 16, 1980
MAXIMUM FLOOD LEVEL
NORMAL LAKE WYLIE LEVEL
CENTER DIKE
NORTH DIKE
ASH POND C (ACTIVE)
ASH POND A (RETIRED)
COAL PILE STORAGE
EXCAVATED AS BORROW MATERIAL FOR DIKE CONSTRUCTION
SANDY SILTS
SILTY SANDS
FILL
ALLUVIUM
SANDS
BEDROCK
INTRUSIVE DIKES
DECOMPOSED ROCK
NOTES:
1. THE SUBSURFACE CONDITIONS PROFILE INDICATE THE IDEALIZED GEOLOGIC CONDITIONS IN THE SITE AREA BASED ON AN INTERPRETATION OF AVAILABLE INFORMATION.
2. THE EXAGGERATED VERTICAL SCALE WAS SELECTED TO ILLUSTRATE THE GRADATIONAL ASPECTS OF THE RESIDUAL SOILS AND THE EROSIVE AND DEPOSITIONAL CHARACTERISTICS OF THE SURFACE DRAINAGE COURSES.
3. THE INTRUSIVE DIKES ARE NOT INTENDED TO INDICATE ORIENTATION OR FREQUENCY, BUT ONLY THEIR PRESENCE IN THE GEOLOGIC FORMATION
4. THE PROFILE VIEW IS LOOKING WEST IN THE IMMEDIATE VICINITY OF THE EAST ASH POND DIKE. (SEE FIGURE 3-3).
SUBSURFACE CONDITIONS PROFILE
SITE NUMBER 3
ALLEN SITE
DUKE POWER COMPANY
BELMONT
GASTON COUNTY
NORTH CAROLINA
APPROX SCALE: HORIZONTAL
METERS - 0
(FEET) - 0
100
200
300
400
500
JULY 1980

FIGURE 5 3

The project site development plan for Plant Allen included the installation of multi-purpose wells and exploratory borings for hydrogeological and geotechnical evaluation purposes. Two upgradient observation wells were installed for background monitoring purposes, and seven downgradient wells were installed at various locations and elevations to determine the presence and vertical extent of any leachate movement. One well was installed in the retired ash disposal pond to determine the piezometric surface (which was in a state of hydrologic non-equilibrium), and two wells were installed within the active ash pond using floating equipment. A piezometer was also placed within the active ash disposal area for sampling purposes.

At the completion of installation of all monitoring apparatus in January 1981, the wells were flushed and bailed, and initial samples were obtained for chemical evaluation purposes.

The locations of all explorations and monitoring/sampling installations are indicated on Figure 5.4. A summary of all field tests and results, the types of samples collected, sampling locations, well types and well depths is presented in Table 5.1.

5.2.3 Physical Testing Results

Figure 5.5 shows the results of field and laboratory permeability tests performed on the fly ash and bottom ash wastes at the Allen site. In addition, results of standard penetration unified soil classification tests are presented.

One boring (3-1) was drilled in the abandoned ash pond that contains fly ash from mechanical collectors and from electrostatic precipitators and bottom ash. Apparently, ash has been discharged at various locations at the site resulting in the segregation of fly ash and bottom ash in Boring 3-1. It is estimated that the bottom ash, located near the center of the abandoned ash deposit, has a coefficient of permeability greater than or equal to 3×10^{-3} cm/sec. The fly ash located near the surface and near the bottom of the abandoned pond is much finer (87 percent of the particles passing a U.S. No. 200 sieve) with a coefficient of permeability ranging between 1×10^{-4} cm/sec and 1×10^{-5} cm/sec.

Two borings (3-2 and 3-3) were advanced through the active ash disposal pond that contains fly ash from both mechanical collectors and electrostatic precipitators as well as bottom ash, all of which have been disposed throughout the life of the active pond. Unlike the abandoned pond, the active pond had no distinct zones of fly ash and bottom ash. Instead, thin lenses of coarser ash were noticed throughout the ash deposit. Results of field permeability tests indicate a range in permeabilities of 2×10^{-4} to 4×10^{-3} cm/sec at those locations tested. Because of the horizontal layering of the ash in both ponds, it is estimated that the coefficient of permeability of the waste deposit in the vertical direction will be approximately the coefficient of permeability of the fly ash (approximately 1×10^{-4} cm/sec). The coefficient of permeability of the waste deposit in the horizontal direction

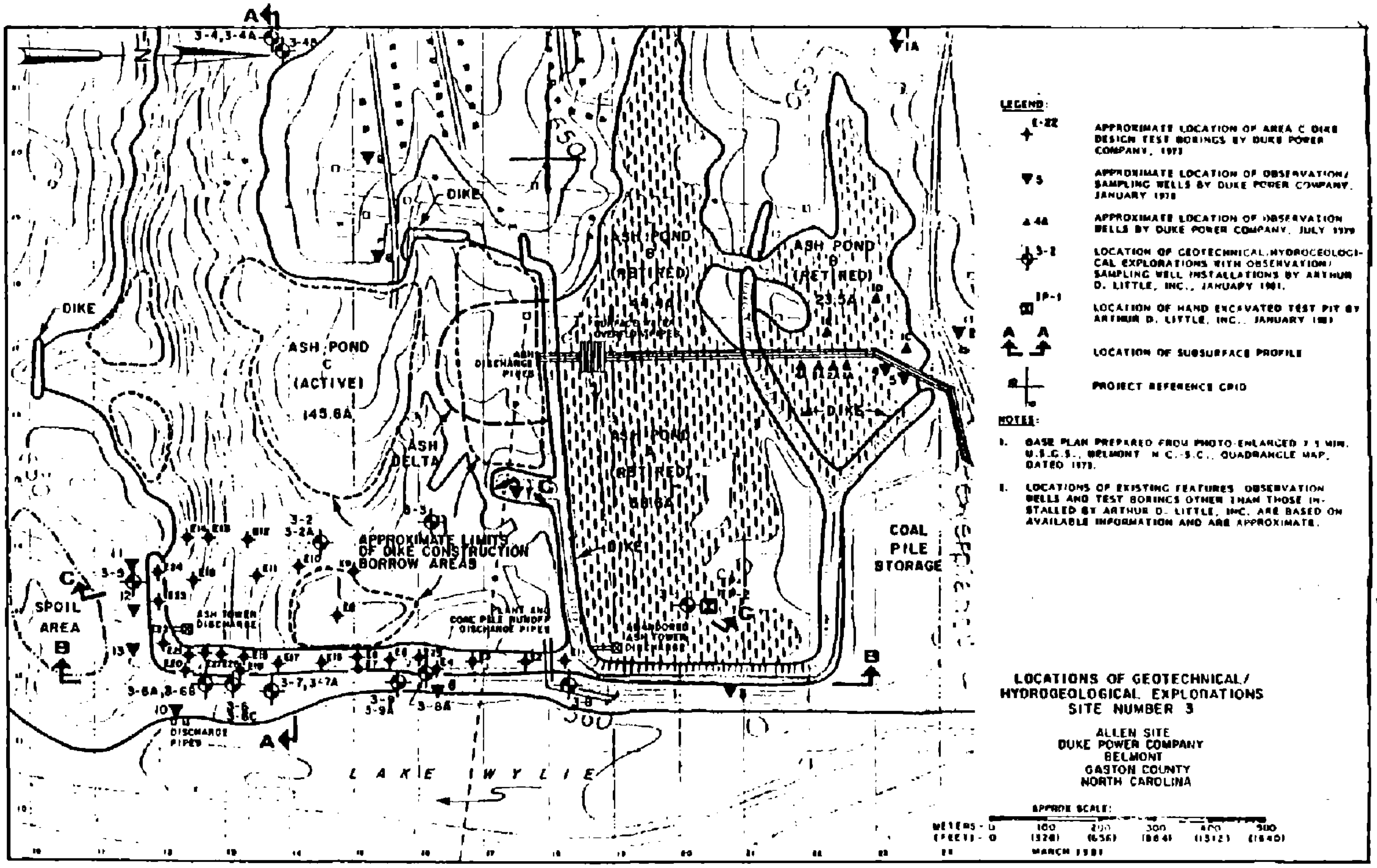

DIKE
ASH POND C (ACTIVE)
145.6A
ASH DELTA
APPROXIMATE LIMITS OF DUKE CONSTRUCTION BORROW AREAS
ASH POND B (RETIRED)
ASH POND A (RETIRED)
ASH POND B (RETIRED)
23.5A
COAL PILE STORAGE
SPOIL AREA
LAKE WYLIE
ASH DISCHARGE PIPES
ASH TOWER DISCHARGE
PLANT AND COAL PILE RUNOFF DISCHARGE PIPES
ABANDONED ASH TOWER DISCHARGE
DISCHARGE PIPES
LEGEND:
APPROXIMATE LOCATION OF AREA C DIKE DESIGN TEST BORINGS BY DUKE POWER COMPANY
APPROXIMATE LOCATION OF OBSERVATION/ SAMPLING WELLS BY DUKE POWER COMPANY, JANUARY
APPROXIMATE LOCATION OF OBSERVATION WELLS BY DUKE POWER COMPANY, JULY
LOCATION OF GEOTECHNICAL/HYDROGEOLOGICAL EXPLORATIONS WITH OBSERVATION/ SAMPLING WELL INSTALLATIONS BY ARTHUR D. LITTLE, INC., JANUARY
LOCATION OF HAND EXCAVATED TEST PIT BY ARTHUR D. LITTLE, INC., JANUARY
LOCATION OF SUBSURFACE PROFILE
PROJECT REFERENCE GRID
NOTES:
1. BASE PLAN PREPARED FROM PHOTO-ENLARGED 7.5 MIN. U.S.G.S., BELMONT N.C.-S.C., QUADRANGLE MAP.
2. LOCATIONS OF EXISTING FEATURES, OBSERVATION WELLS AND TEST BORINGS OTHER THAN THOSE INSTALLED BY ARTHUR D. LITTLE, INC. ARE BASED ON AVAILABLE INFORMATION AND ARE APPROXIMATE.
LOCATIONS OF GEOTECHNICAL/ HYDROGEOLOGICAL EXPLORATIONS SITE NUMBER 3
ALLEN SITE
DUKE POWER COMPANY
BELMONT
GASTON COUNTY
NORTH CAROLINA
APPROX SCALE:
METERS - 0 100 200 300 400 500
(FEET) - 0 (328) (656) (984) (1312) (1640)
MARCH 1981

FIGURE 5.4

TABLE 5.1

SITE DEVELOPMENT SUMMARY

SITE: PLANT ALLEN SITE
GASTON COUNTY, NORTH CAROLINA

DATES: January 6, 1981 - January 28, 1981
FILE NO. 453503

TOTAL NO. EXPLORATIONS ON SITE: 9

Boring #	3-1	3-2	3-3	3-4
Soils Classification [depth (m); class]	0-17.4; Fly Ash 17.4-18.4; Alluvium 18.4-18.7; Weathered Rock	0-12.3; Fly Ash 12.3-13.6; Alluvium 13.6-14.3; Residual Soils	0-7.5; Fly Ash 7.5-8.5; Alluvium 8.5-11.4; Residual Soil	0-3.3; Fill 3.3-6.2; Alluvium 6.2-6.9; Weathered Rock
Number of Samples Obtained	20	23	16	12
Field Permeability Test [depth (m); Results (m/sec)]		13.3-14.5; 3 x 10^{-7} 3-2 7.6-8.8; 4 x 10^{-6} 3-2A	9.8-11.4; 2 x 10^{-7} 1.2-3.2; 3.1 x 10^{-6} to 11.0' - 16.0'	3.4-5.8; 2.7 x 10^{-7}
Well Installation [wellpoint type; diameter (in); location (m)]	0.020" slot; 2.0 ID 17.1-18.3	Vyon fabric; 1.0 ID 3-2 13.3-14.5 7.6-8.8 3-2A	Vyon fabric; 1.0 ID 9.9-11.1	0.020" slot; 2.0 ID 3-4 3.4-4.9 0.020" slot; 2.0 ID 3-4A 1.4-2.9

Boring #	3-4B	3-5	3-6	3-6A,C
Soils Classification [depth (m); class]	0-1.7; Fill 1.7-3.0; Alluvium 3.0-6.2; Rock	0-0.9; Fill 0.9-14.3; Weathered Rock	0-9.8; Fill 9.8-10.8 Alluvium 10.8-18.1; Decomposed Rock	0-9.8; Fill 3-6A 9.8-11.0; Alluvium 0-12.3; Residuals 3-6C 12.3-13.0; Rock
Number of Samples Obtained	6	13	24	4
Field Permeability Tests [depth (m); results (M/sec)]	4.1-5.0; 4.0 x 10^{-6} m/s	10.1-13.2; 10 x 10^{-6} m/s	No Test in Piezometer	10.1-11.0; 1.5 x 10^{-6} m/s 3-6 3.1-6.1; 6.0 x 10^{-7} to 5.2 x 10^{-7} m/s 3-6B
Well Installation [Well point type; diameter (in); location (m)]	0.020" slot; 2.0 ID; 4.1-5.6	0.020" slot; 2.0 ID; 10.1-13.2	Vyon fabric; 1.0 ID; 11.1-13.0	0.020" slot; 2.0 ID 6A 10.1-10.7 0.020" slot; 2.0 ID 6B 3.8-5.3 Vyon fabric; ID 6C 10.8-12.9

(continued)

TABLE 5.1

Boring #	3-7, 7A		3-8, 8A		3-9	3-9A
Soils Classification [depth (m); class]	0.6.2; Residual Soil 6.2-8.0; Quartzite		0-4.0; Fill 4.0-10.7; Weathered Rock		0-3.4; Fill 3.4-5.2; Weathered Rock	0-3.4; Fill 3.4-4.3; Alluvium 4.3-9.9; Weathered Rock
Number of Samples Obtained	9		11		6	5
Field Permeability Tests [depth (m); Results (M/sec)]	6.1-7.6; 4.6×10^{-5} 2.6-4.1; 3.7×10^{-6}	3-8 3-8A	9.1-10.7; 4.7×10^{-6} 2.6-4.1; 3.7×10^{-6}	3-8 3-8A	3.7-4.4: 1.0×10^{-5}	7.5-9.0; 4.1×10^{-6} m/s
Well Installation [well point type; diameter (in);	0.020" slot; ID; 6.1-7.6 Vyon fabric; 1.0 ID;	7	0.020" slot; 2.0 ID; 9.1-10.7 0.020' slot; 2.0 ID;	3-8	0.020"; 2.0 ID; 3.7-4.4	0.020 slot; 2.0 ID; 7.5-9.0

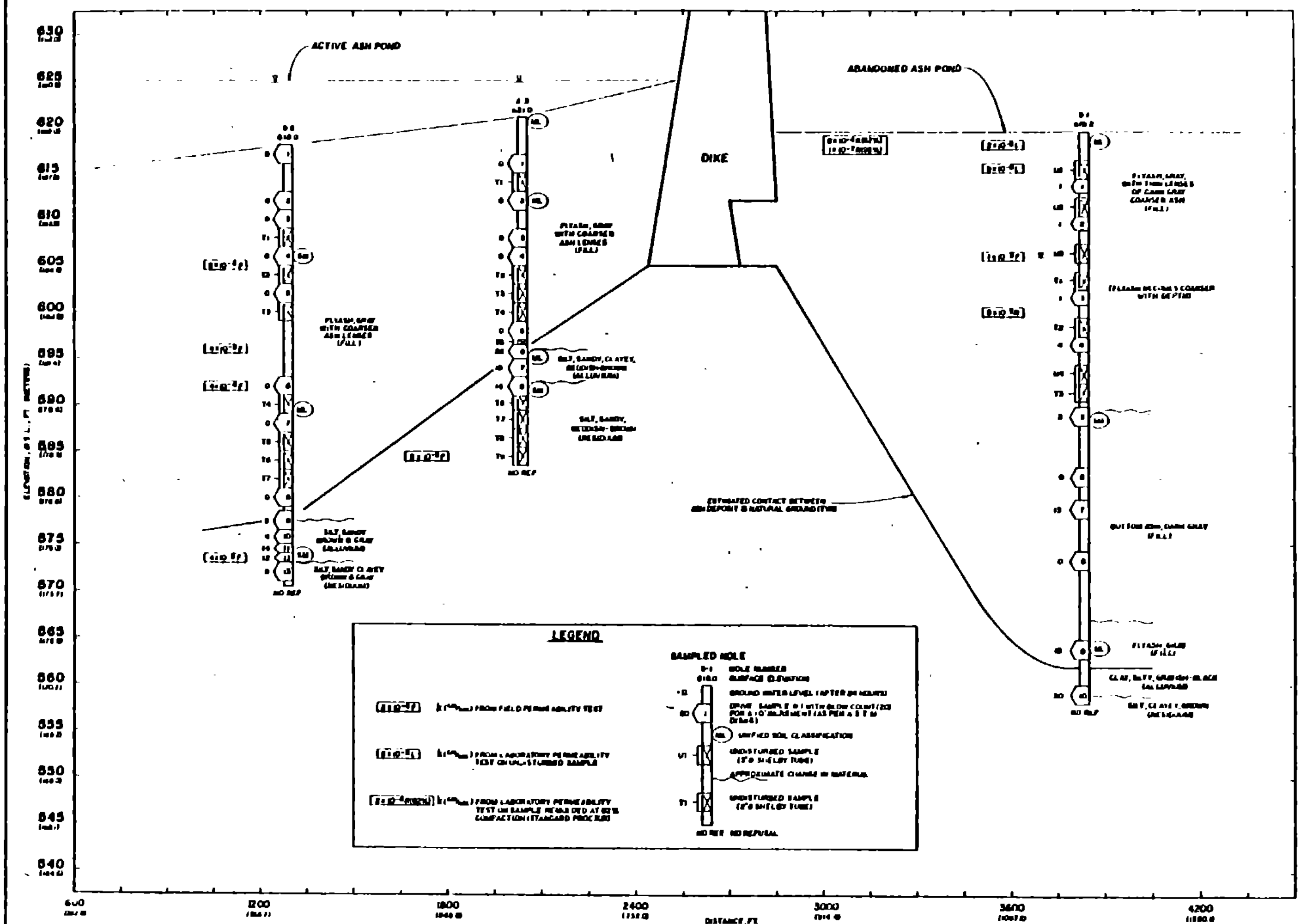


FIGURE 5.5 GEOTECHNICAL EVALUATION RESULTS, ALLEN PLANT, DUKE POWER CO., GASTON COUNTY, N.C.

is approximately equal to the coefficient of permeability of the coarser ash lenses (approximately 3×10^{-3} cm/sec).

A more detailed presentation of the physical testing results for Plant Allen wastes is provided in Appendix E. Table 5.2 provides a summary of selected physical testing results.

5.2.4 Chemical Testing Results

The site monitoring infrastructure was developed in January 1981, with emphasis on the active ash pond. At that time, samples of wastes and soils were collected for physical and chemical testing; surface water and groundwater samples were obtained for chemical testing. Subsequent water sampling occurred in late February through early March 1981 and in July 1982. Year-to-date precipitation was somewhat below normal prior to the 1981 visits, but it was in the high to normal range prior to the 1982 visit. Boiler cleaning wastes were collected for analysis in November and December 1981.

Selected results of chemical analyses of samples from the Allen site are presented in Table 5.3. A summary of chemical attenuation test results is presented in Table 5.4. A compilation of the chemical analysis results is presented in Appendix F.

5.2.5 Environmental Assessment

5.2.5.1 Approach for Plant Allen--
The environmental assessment of the Allen site results focused on the following three issues:

1) effects of the ash pond leachate on downgradient groundwater quality;

2) effects of the ash pond leachate on water quality in Lake Wylie, including comparison with the magnitude of ash pond point source (overflow) discharge; and

3) effects of co-disposal of intermittent, metal-rich waste streams (especially boiler cleaning wastes) on Items 1 and 2 above.

The steps employed in the environmental assessment at this site were as follows:

- A site subsurface geological profile and a site water balance were prepared.

- The values of and trends in chemical sampling and analysis results for the various areas of the site were compared with the results of previous sampling by Duke Power Company and with relevant EPA standards for groundwater protection.

TABLE 5.2

SELECTED PHYSICAL TESTING RESULTS

ALLEN PLANT[a]

Permeability (cm/sec)	$1 \times 10^{-7} - 2 \times 10^{-4}$
Specific Gravity	1.96 - 2.20
Grain Size Distribution (Weight Percent)	
• > 74 µm	13 - 69
• 2 - 74 µm	22 - 85
• < 2 µm	0 - 15
Moisture Content (Weight Percent)	10.9 - saturated
Effective Strength Parameters	
• Angle of Internal Friction	28.8°
• Effective Cohesion (PA;psi)	0.0; 0.0

[a]See Appendix E for more detailed data.

Source: Arthur D. Little, Inc., and Bowser-Morner Testing Laboratories, Inc.

TABLE 5.3

SELECTED DATA FOR REPRESENTATIVE SAMPLING LOCATIONS
AT ALLEN PLANT

CONCENTRATION (mg/ℓ or ppm except where noted)

LOCATIONS	SO_4	Ca	B	Sr	As(ug/ℓ)
Well 3-4B (Background)	2.1	9.95-10.9	<0.005-0.016	0.141-0.166	<0.2-7.0
Well 3-1 (Under Retired Pond)	89.9-100	59.4-64.1	1.71-1.87	3.60-4.71	56.3-57.2
Well 3-2A (In Active Ash Pond)	169.4-320	63.7-129	1.99-3.68	1.35-4.13	318-2425
Well 3-2 (Under Active Ash Pond)	1.4	15.8-17	0.057-0.76	0.241-0.274	<0.15-1.6
Wells 3-7A and 3-8 (Downgradient)	13-76.2	18.1-37.9	0.05-0.999	0.231-0.411	<0.10-0.78
Wells 3-6 and 3-9 (Downgradient)	4-5.4	11.2-18.0	<0.005-0.116	0.078-0.164	<0.2
Pond Overflow 3-13	56-62	19.6-21.4	0.205-0.238	0.297-0.342	58
Ash Solids 3-2 and 3-3	--	2251-4578	--	112-239	16.2-57.1
Background Soils 3-4	--	471-4056	--	8.85-33.1	0.6-1.41

EPA Interim Primary Drinking Water Standards for As - 50 ug/ℓ
EPA Proposed Secondary Drinking Water Standards are: Cu - 1 mg/ℓ
SO_4 - 250 mg/ℓ
Zn - 5 mg/ℓ
Fe - 0.3 mg/ℓ
Mn - 0.05 mg/ℓ
EPA Criterion for Protection of Sensitive Crops: B - 0.750 mg/ℓ

continued

TABLE 5.3

CONCENTRATION (mg/ℓ or ppm except where noted)

LOCATIONS	Cu	Ni	Zn	V	Fe	Mn
Well 3-4B (Background)	<0.008	<0.05	<0.05	<0.005-0.016	<0.01	<0.01-0.07
Well 3-1 (Under Retired Pond)	<0.008	<0.05	<0.05	0.018-0.034	<0.01	<0.01
Well 3-2A (In Active Ash Pond)	<0.008	<0.05	<0.05	0.035-0.043	<0.01-0.02	0.06-0.16
Well 3-2 (Under Active Ash Pond)	<0.008	<0.05	<0.05	<0.005	25.9	6.44-14
Wells 3-7A and 3-8 (Downgradient)	<0.005-0.013	<0.05	<0.05	<0.006	<0.01-0.02	<0.01-0.07
Wells 3-6 and 3-9 (Downgradient)	<0.008	<0.05	<0.05	<0.005-0.014	0.01-14.4	<0.01-2.72
Pond Overflow 3-13	<0.008	<0.05	<0.05	0.030-0.047	<0.01	<0.01-0.09
Ash Solids 3-2 and 3-3	20.8-45.1	15.3-26.0	18.5-45.7	22.2-41.5	11,700-29,491	83-171
Background Soils 3-4	9.52-17.6	4.48-10.8	22.8-36.2	28.1-49.1	11,164-16,558	155-303

EPA Interim Primary Drinking Water Standards for As - 50 ug/ℓ
EPA Proposed Secondary Drinking Water Standards are: Cu - 1 mg/ℓ
SO_4 - 250 mg/ℓ
Zn - 5 mg/ℓ
Fe - 0.3 mg/ℓ
Mn - 0.05 mg/ℓ
EPA Criterion for Protection of Sensitive Crops: B - 0.750 mg/ℓ

TABLE 5.4

SELECTED RESULTS OF SOIL ATTENUATION STUDIES
ALLEN SITE[a]

Element and Soil Sample[a]		Solution Concentration (ppb)	Soil Capacity (μg/gm)	Soil Capacity ÷ Solution Concentration
Arsenic	(A)	<0.2-413	1.0-215	>5500-261
	(B)	<0.2-225	0.3-47	>5500-128
	(C)	2.4-492	1.1-66.9	458-136
Selenium	(A)	0.2-113	0.25-127	90-9844
	(B)	<0.1-96	0.25-124	2500-92
	(C)	2.8-138	0.24-1.73	86-5.1
Calcium	(A)	42.3-73 mg/ℓ	68-590	1.6-8.1
	(B)	12.4-368 mg/ℓ	130-322	0.5-10
	(C)	52.5 mg/ℓ	44 ± 5	0.8
Cadmium	(A)	40-120	0.24-42	6-350
	(C)	70-150	0.17-12	2.4-8.0
Chromium	(A)	0.040-0.190	0.03-0.96	<0.35-11.8
	(B)	0.040-0.130	0.47-1.45	11.8
	(C)	0.030-0.250	0.06-0.49	<0.35-16.3
Copper	(A)	<0.008-0.072	>0.03-328	12-4500
	(B)	0.012-0.159	0.14-290	8.3-1800
	(C)	0.013-0.179	0.69-220	15-1200
Nickel	(B)	0.210	4.5 ± 1.3	---
	(C)	0.220	0.31	1.4
Vanadium	(A)	0.009-0.030	0.05-6	5.5-200
	(B)	0.008-0.014	0.05-2.20	6-157
	(C)	0.021-0.031	0.03-0.05	1.4-1.6

[a]Soil types used were as follows: (A) boring 3-2, alluvial material, ~30% clay; (B) boring 3-3, residual soil, silty sand; and (C) boring 3-6, alluvial material, ~20% clay.

- Using the chemical analysis results and the gross and net water balance, mass balance estimates were made for selected contaminants entering the ash pond via the fly ash and bottom ash discharges and through the addition of boiling cleaning wastes, and for contaminants leaving the pond via overflow to Lake Wylie and leaching to groundwater.

- The water balance, geological profile, and chemical and physical testing results were considered together to structure and evaluate hypotheses concerning the nature of leachate generation and movement at the site. The importance of events such as the temporary cessation of the point source (pond overflow) discharge during boiler cleaning was considered in this step.

- To evaluate further hypotheses concerning chemical attenuation of leached trace metals by the soils surrounding the ash pond, a series of attenuation tests were executed using ash pond liquor and local soils.

- The results of the attenuation tests were evaluated along with the water balance, geological profile, mass balance and physical testing data to estimate the potential for long-term leaching of arsenic from the ash ponds to Lake Wylie.

- The broader implications of the Allen site results were considered in terms of their applicability to similar combinations of waste types, disposal methods and environmental settings. This step can be considered particularly important for the Allen site because the combination represented there is quite prevalent at other sites.

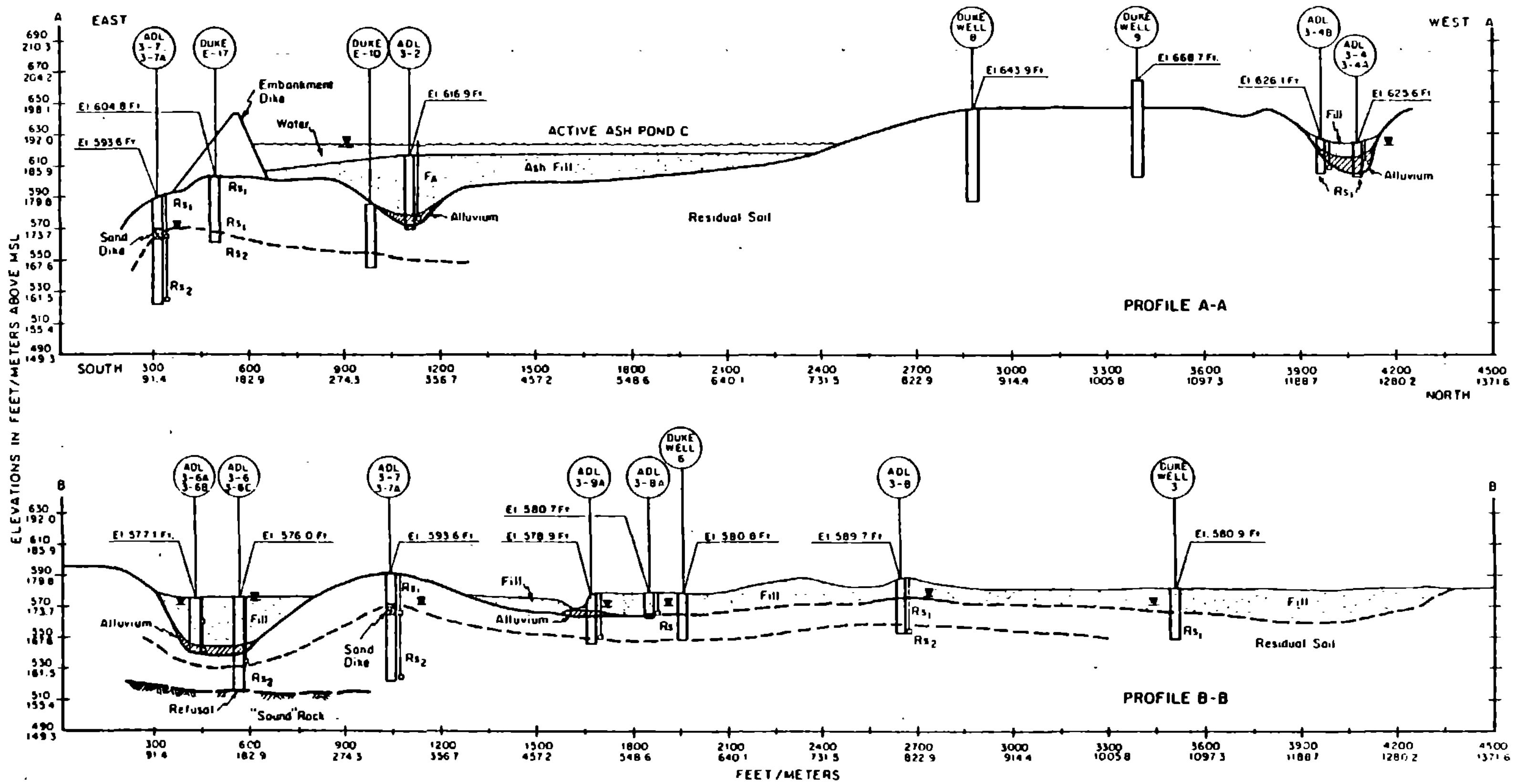
5.2.5.2 Geological Profile and Water Balance--

Figure 5.6 illustrates the subsurface geological profiles for three areas of the Allen waste disposal site as delineated above in Figure 5.4. These profiles were prepared on the basis of the site development results for this program along with the available site background information.

The annual water balance estimated for the Allen site is summarized briefly below and illustrated in Figure 5.7.

Definition of Terms

P = Precipitation
Ev = Evaporation
I_{PS} = Point Source Input to Pond
O_{PS} = Point Source Output from Pond
R_{SW} = Surface Water Runoff into Pond
R_{GW} = Groundwater Runoff beneath Pond
G_F = Groundwater Movement through Fill
G_A = Groundwater Movement through Alluvium
G_R = Groundwater Movement through Residual Soil

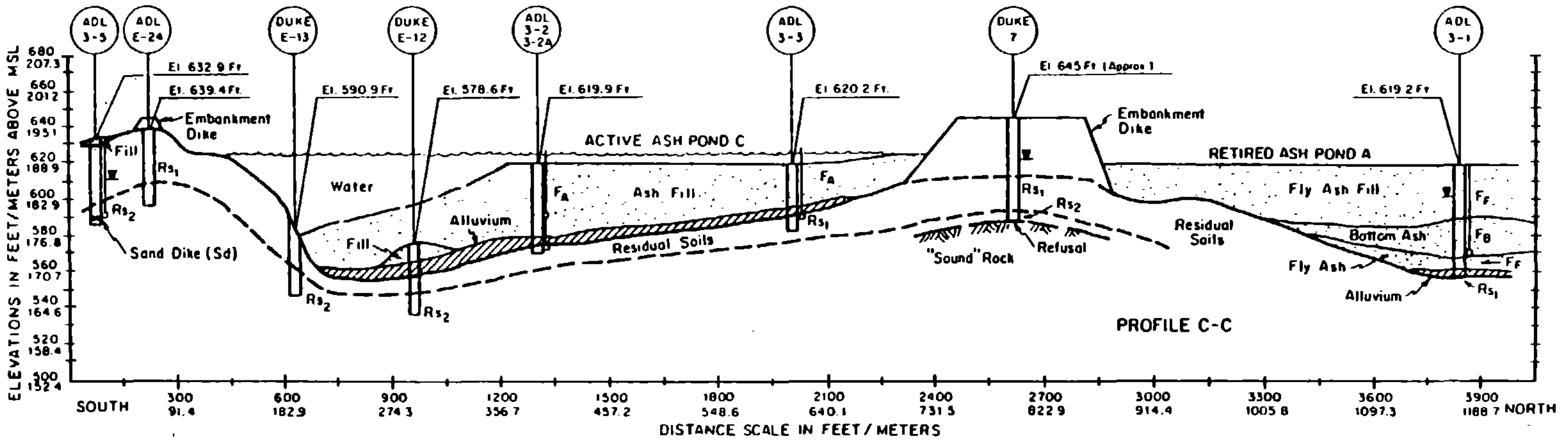


SUBSURFACE GEOLOGICAL PROFILES - ALLEN SITE

DUKE POWER COMPANY, GASTON COUNTY, N.Y.

FIGURE 5.6

(continued)



LEGEND

Alluvium A – Recent stream alluvial deposits varying from loose silty fine sands to soft, very slightly organic clayey silts with trace amounts of organic matter, overlying residual soils.

Residual Soils Rs – Generally fine grained, cohesive soils formed from the chemical decomposition of the bedrock. General increase in grain size and density with increasing depth

Rs_1 – Soft to stiff, reddish brown to gray-white clayey silt to silt, little clay with trace sand, mica & occasional gravel

Rs_2 – Medium compact to compact, yellow brown to greenish brown silt to fine sandy silt with trace amounts of clay, mica and gravel (gravel content increases with depth).

Sand Dikes (Sd) – Younger intrusive igneous dikes varying in thickness from a few centimeters (inches) to several meters (feet) have intruded the overall older bedrock unit. Many of those dikes were observed in surface exposures and were encountered in several test borings. The dikes have decomposed to a coarse sand and gravel.

"Sound" Rock – In test borings, where abrupt auger penetration "refusal" was encountered at depths, it is assumed to be the top of the relatively unweathered, sound, competent bedrock.

Fills – Relatively recent overburden materials associated with construction of the ash pond disposal facility or disposed ash.

F – General excess site construction fill materials utilized in increasing available land area downgradient of the disposal facility. Occasional fill materials were encountered which predated the disposal construction. Reddish brown to dark brown clayey silts to fine sandy silts with varying amounts of mica, sand, gravel and organic matter.

F_A – Miscellaneous, very loose to very soft, dark gray to black, intermixed ash fill with occasional stiff leaves and layers, undifferentiated from Bottom Ash and Fly Ash.

F_B – Very loose to very soft, black, coarse grained bottom ash fill.

F_F – Very loose to very soft, gray, fine grained fly ash fill with occasional stiff layers and leases.

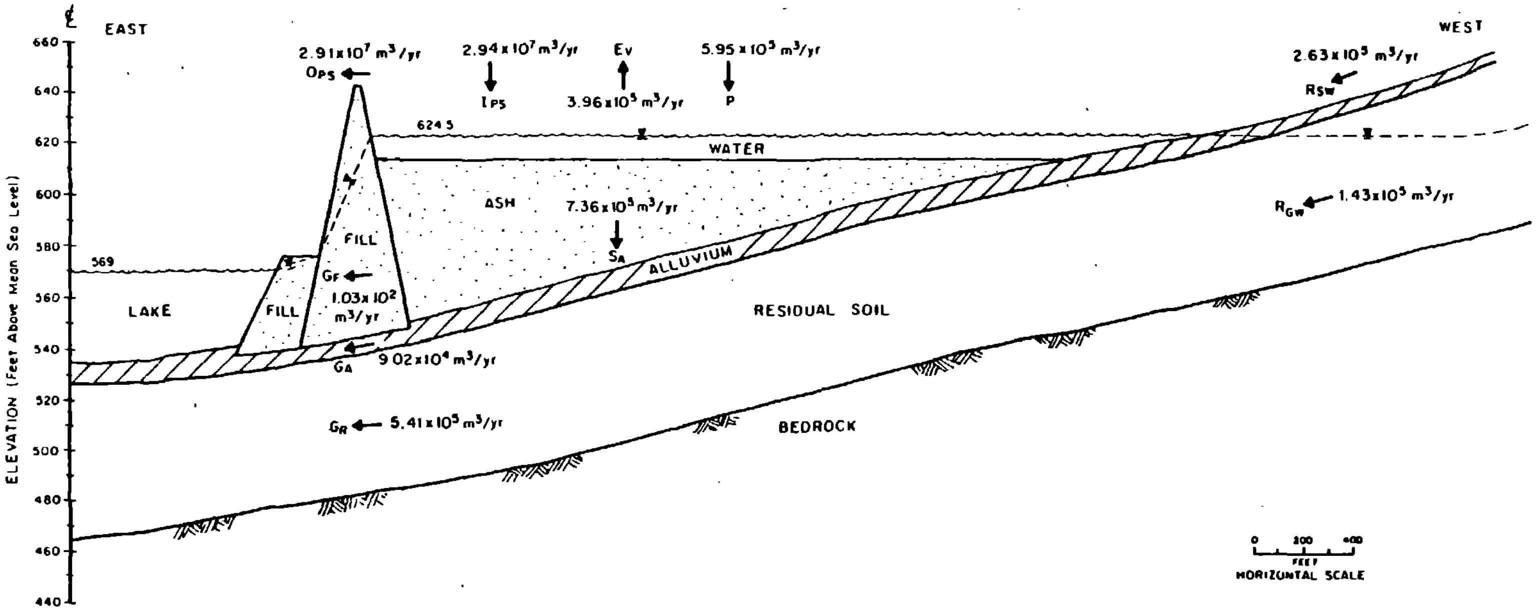
Symbol representing water depth in completed borehole or groundwater monitoring well at time of installation

Symbol representing location of installed groundwater monitoring well or piezometer.

SUBSURFACE GEOLOGICAL PROFILE - ALLEN SITE

DUKE POWER COMPANY, GASTON COUNTY, N.C.

FIGURE 5.6



Refer to text for definition of terms

PLANT ALLEN WATER BALANCE (Annual Basis)

FIGURE 5.7

S_A = Water Seepage through Bottom of Pond

Calculation of O_{PS}

$$\text{Inflow to Pond} = \text{Outflow from Pond}$$

$$P + R_{SW} + I_{PS} = Ev + S_A + G_F + O_{PS}$$

$$O_{PS} = [5.95 \times 10^5 + 2.63 \times 10^5 + 2.94 \times 10^7 - 7.36 \times 10^5 - 1.03 \times 10^2]\ m^3/yr$$

$$O_{PS} = 2.91 \times 10^7\ m^3/yr$$

Balance of Groundwater Flow

$$\text{Groundwater Inflow} = \text{Groundwater Outflow}$$

$$R_{GW} + S_A = G_A + G_R$$

$$1.43 \times 10^5\ m^3/yr + 7.36 \times 10^5\ m^3/yr = 9.02 \times 10^4\ m^3/yr + 5.42 \times 10^5\ m^3/yr$$

$$8.79 \times 10^5\ m^3/yr \cong 6.31 \times 10^5\ m^3/yr$$

5.2.5.3 Evaluation of Testing Results--

The results of chemical analyses of samples, in conjunction with available background data, indicate the following:

- Absolute and relative concentration values measured on different dates at the same sampling locations were similar.
- Concentrations of likely ash-related "tracers" (boron, sulfate, calcium, strontium, vanadium and arsenic) were significantly higher in groundwater obtained from wells placed <u>within</u> the ash than in water from the other wells at the site; with the exception of vanadium, concentrations were significantly higher in the ash solids than in background soils (see Table 5.3).
- Concentrations of these same "tracers" exhibited a generally consistent pattern in downgradient wells, as follows:
  - Elevations of concentrations versus background concentrations were evident at some of the downgradient wells (wells 3-7A and 3-8, Figure 5.4);
  - Elevations of concentrations versus background concentrations were slight or lacking in samples from the other downgradient wells (e.g., wells 3-2, 3-6 and 3-9, Figure 5.4); and
  - High levels of iron and manganese in background soils (approximately 17,500 ppm and 400 ppm, respectively), groundwaters

(0.01 to 16 ppm and 0.014 to 11 ppm, respectively), and the River/Lake upgradient and upstream of the site (0.100 to 2.5 mg/l and up to 0.050 mg/l, respectively) were measured in this program and/or previous studies.

- Arsenic was measured at significantly elevated concentrations in groundwaters from lower strata within the ash (over 1000 µg/l at 12 to 14 m (38 to 40 ft); 50 to 100 µg/l in higher strata). The results of the EPA Extraction Procedure (EP) on samples from this site indicated arsenic levels about two orders of magnitude lower than the in situ field values (see Table 5.3). As noted above, arsenic was measured at near background levels in downgradient wells.

- Attenuation tests with ash pond liquor and site soils (see Table 5.4) indicated that the local soil attenuation capacity for arsenic was at least 10 µg/g soil; the attenuation capacity of the site soils was generally greater for the various trace metals than that measured for soils at any of the other five sites in the program.

- The amounts of copper, nickel, and zinc added to the pond during a boiler cleaning event represent 3 to 22 percent (280 kg, 71 kg and 80 kg, respectively) of the total amount of these same elements added in ash sluice water plus ash solids over a period of 18 months (time between boiler cleaning events). Other constituents added by boiler cleaning represented less than two percent of the total amount added over 18 months, and the contributions of most were less than 0.1 percent of the total amount added to the pond.

- The chemical analysis results of all sampling trips showed copper, nickel and zinc concentrations in well water, pond toe drains and pond overflow to be consistently low, approximately at or below the applicable detection limits. These were also generally at comparable levels in the ash and background soils, (Copper was somewhat elevated in the ash, as shown in Table 5.3).

- Natural soils under the site, treated with partial extraction, did not show much difference in concentrations of these three elements (Copper: 11-19 ppm; Nickel: 5-6 ppm; Zinc: 21-35 ppm) from similar background soils.

5.2.5.4 Cause and Effect Relationships--

The results from the investigations at Plant Allen are consistent with the following hypotheses:

- Leachate generated within the ash ponds contains elevated concentrations of several waste-related components. The surrounding soils in the immediate vicinity of the ponds have thus far been able to attenuate significant fractions of such leachate contaminants as arsenic and vanadium.

- Leachate water from the upgradient (western) portions of the ash ponds has not yet moved sufficiently to create steady-state concentrations of unattenuated parameters at the downgradient wells. This applies particularly to the active pond, but also appears to apply, to a lesser degree, to the most recently deactivated pond.

- Based on the results of the attenuation tests (Table 5.4) and analyses of site wastes and soils (Table 5.3), it appears likely that arsenic is chemically attenuated by iron and/or manganese in the soils under and around the ash ponds. Combining this information with the available information on arsenic inputs to the pond, the water balance and supporting hydrogeologic data, it also appears that the attenuative capacity of the surrounding soils would be sufficient to prevent passage of arsenic leachate with concentrations in exceedance of drinking water standards into Lake Wylie for longer than the estimated 15 year operating life of the active pond. This estimate would apply even if the pond remained active for almost 100 years, and for considerably longer (in excess of 500 years) if the pond is retired as scheduled.

- The chemical nature of various boiler cleaning wastes and the ash pond liquor (into which the former is periodically added) are such that chemical interactions likely alter the distribution of elements between the liquid and solid states. For example, while copper represents the most significant element added with boiler cleaning (by percent increment), precipitation of copper may occur upon decrease of the cleaning waste ammonia concentration by dilution in the pond. Copper and other elements, such as nickel or zinc, could be precipitated by additional interactions between boiler cleaning wastes and ash pond liquors. Such hypotheses are supported strongly by the lack of concentration elevation (availability) of these elements in pond liquor, the pond discharge well water and soil samples under the site (see Table 5.3).

Selected aspects of the above hypotheses are discussed further below.

Geohydrologic conditions at the site and the site water balance (Figures 5.6 and 5.7) reflect the fact that the spatial distribution of subsurface materials is relatively complex, leading to great uncertainties in defining leachate movement and admixing patterns. However, several pieces of information suggest that the downgradient wells have not yet reached steady state conditions with respect to the movement and admixing of leachate generated by the pond.

The water balance calculations suggest that downward leachate flow driven by the head of standing water in the pond is an important flow feature in the alluvial deposits under part of the pond. There is no analogous data to define vertical flow velocities in the residual soils that underlie most of the pond, which are estimated to carry the bulk of water flowing downgradient of the pond.

Given the variations and uncertainty in the length of flow paths, hydraulic gradient (especially accounting for variations over the life of the facility) and hydraulic conductivity at this site, it is only possible to conclude that leachate generated in eastern portions of the pond has begun to reach the downgradient well locations. It is not clear whether leachate from western portions of the pond has yet reached to downgradient locations, or what fraction of the total leachate emanating from the pond has actually migrated toward or reached the downgradient wells. Since steady state conditions would not be achieved until the whole pond (all potential flow paths carrying leachate) contributes leachate to downgradient locations, it is plausible that steady state conditions have not been achieved.

Another element of the water balance (see Section 5.2.5.2) also suggests that steady state conditions have not been achieved. Again, the magnitude of geohydrologic uncertainty compromises the conclusion. The water balance indicates that leachate seepage from the base of the pond exceeds groundwater underflow from upgradient areas by roughly an order of magnitude. The estimated seepage rate also exceeds the estimated groundwater flow rate away from the site by roughly a factor of two. This discrepancy probably roughly indicates the magnitude of error associated with the seepage rate estimate, but may be partly associated with the fact that water movement patterns at the site are still dynamically responding to pond seepage. (Seepage from all parts of the pond bottom has not yet reached downgradient locations.) At face value, the water balance estimates suggest that at steady state nearly all the downgradient flow would be leachate. Even if the seepage rate is one half of the estimated value, downgradient water at steady state would still be roughly 80 percent leachate plus 20 percent underflowing groundwater. Observed concentration levels for major constituents indicate that downgradient wells are sampling a mixture of roughly 20 percent leachate plus 80 percent underflowing groundwater. Thus, allowing for reasonable levels of uncertainty in the water balance, it appears that downgradient locations have not reached steady state, and increasing concentrations over the next several years would be expected.

Available data, however, cannot support a precise estimate of future groundwater quality at the site, although it is clear that steady state concentrations may range between existing concentrations and concentrations typical of ash leachate (e.g., as in well 3-2A at present).

5.2.5.5 Environmental Effects Implications--

Existing levels of most constituents in almost all groundwater sampling locations at the site do not exceed present water quality standards (see Table 5.3). The exceptions include:

- iron and manganese, which exceed secondary drinking water standards in background waters and over most of the site. (It has been noted that these elements may aid in attenuating constituents such as arsenic.); and

- sulfate, arsenic and boron in the "in-waste" well, with the concentrations of the latter two also high in groundwater under the waste, and in some cases, in the pond overflow.

As illustrated by the definition of water balance given in Section 5.2.5.2, the potential incremental leachate impacts at this site can be put in perspective by comparison with the point source discharge from the ash pond. Considering the mass transport rates of selected constituents from the Plant Allen pond, the following conclusions may be readily drawn:

- leachate generation rates are typically one to two orders of magnitude less than point source discharge rates;

- present downgradient transport of leachate into Lake Wylie appears to be about 8 times less than leachate generation rates; and

- the mass of ash-related contaminants entering Lake Wylie by non-point source transport appears to be about two orders of magnitude less than the mass entering by point source discharge.

The reasons why downgradient transport rates appear to be less than leachate generation rates have been discussed earlier, but are summarized as follows:

- downgradient locations may not be at steady state;

- some constituents have been attenuated; and

- leachate generation rates may be overestimated.

Exceptions to the above conclusions may be noted for iron and manganese, whose presence at greater concentrations in background water dominates the leachate contribution.

Considering the maximum observed concentrations of non-attenuated species (e.g., sulfate) in the leachate and the dominant influence of the point source discharge, the long-term impacts of leachate migration to Lake Wylie at this site are expected to be insignificant.

The results from the Allen site support conclusions 1,2,3, and 5 in Section 5.1 and have the following broader implications for similar disposal practices:

1. Concentrations of at least one trace metal (arsenic) in coal ash leachate can significantly exceed the applicable drinking water standards, and can be present at orders of magnitude higher in situ concentrations than would be indicated by the results of the EP test.

2. Chemical attenuation of leachate trace metals by surrounding soils can be a significant mitigative factor affecting the potential for downgradient water quality effects of coal ash disposal sites. This further implies that siting new disposal areas which are surrounded by such attenuative soils, or importing such soils for use as site liners may be important mitigative practices on a case-by-case basis.

3. In situations where pond disposal is practiced, the relative importance of a point source discharge can far exceed that of leachate contributions to changes in receiving water quality. However, because of the wide range of variation in disposal site water management practices, this is very much a case-by-case consideration.

4. The use of coal ash ponds as neutralization and admixing media for other intermittent, acidic, metal-rich waste streams (specifically boiler cleaning wastes and possibly coal pile runoff) appears to be an effective mitigative practice under conditions analagous to those at the Allen site. Boiler cleaning wastes were sampled and considered in some detail at this site; coal pile runoff, while not sampled in this program, was a known input to the ash ponds.

5.2.6 Engineering Cost Assessment

5.2.6.1 Engineering Assessment--

Plant Allen, a baseload facility, has a current total nameplate generating capacity of 1,155 MW, employing five units. Plant operation commenced in 1957, with the startup of Units 1 and 2, each unit having a 165 MW nameplate generating capacity. During the three-year period of 1959-1961, inclusive, three units with 275 MW nameplate generating capacities were installed at a frequency of one unit per year. Plant Allen boilers are pulverized coal, tangentially-fired units. Average annual boiler capacity factors during 1979 were 32 and 39 percent for Units 1 and 2, respectively. The newer boilers, Units 3, 4, and 5 had higher load factors during the same period, 57, 61, and 56 percent, respectively.

Air Pollution Control--Units 1 and 2 are equipped with conventional multiple-cyclone, reverse-flow particulate collectors. Units 3, 4, and 5 are equipped with cold-side electrostatic precipitators (ESPs). During the early 1970's, hot-side ESPs were added to each of the five units to effect more efficient fly ash removal. Experimental flue gas conditioning systems have recently been added to Units 1 and 2 in order to improve fly ash collection efficiency. Proprietary chemical additives injected directly into the boiler combustion zone are used for flue gas conditioning. The particulate control systems in use at Plant Allen were tested in October 1979, and were shown to be 97 to 98 percent efficient.

Coal Consumption--Bituminous coal used by this plant is obtained from a number of sources in Virginia, Kentucky, Tennessee and West Virginia. Annual coal consumption for the years 1977 through 1979, inclusive, ranged from 1.72 to 1.95 million metric tons (1.90 to 2.15 million tons). Annual average coal sulfur content remained constant over this period at 1.0 percent, by weight (dry basis). The average annual coal ash content during this period was 12 to 15 percent, by weight. Average heating value of the coal ranged from 28.1 to 28.4 million joules/kg (12,000 to 12,200 Btu/lb).

Waste and Water Management--Fly ash and bottom ash are the only high volume solid wastes produced by this plant. Annual ash production during the next decade is projected to remain constant at approximately 227,000 metric tons (250,000 tons).

Fly ash is conveyed by a vacuum pneumatic system to a hydro-ejector that is used to mix a fly ash/water slurry. The waste is sluiced to the disposal pond. Bottom ash collected in hoppers is directed to clinker grinders and is also sluiced to the disposal pond. Four pipelines are used to transport fly ash and bottom ash to the pond.

Coal pile runoff and plant drainage are intermittently pumped to the disposal pond by way of separate lines. There are two sumps at the Plant Allen site; one collects plant drainage, boiler blowdown, water treatment wastes, and pump sealing water, etc., and a second services surface water runoff from the coal storage area. The sump pumps automatically engage once a specified level of liquid is in the sump. Both sumps discharge into the northeast corner of the disposal pond.

Process flow diagram F-100, Figure 5.8, depicts the waste handling/transport scheme and provides a material balance for this operation.

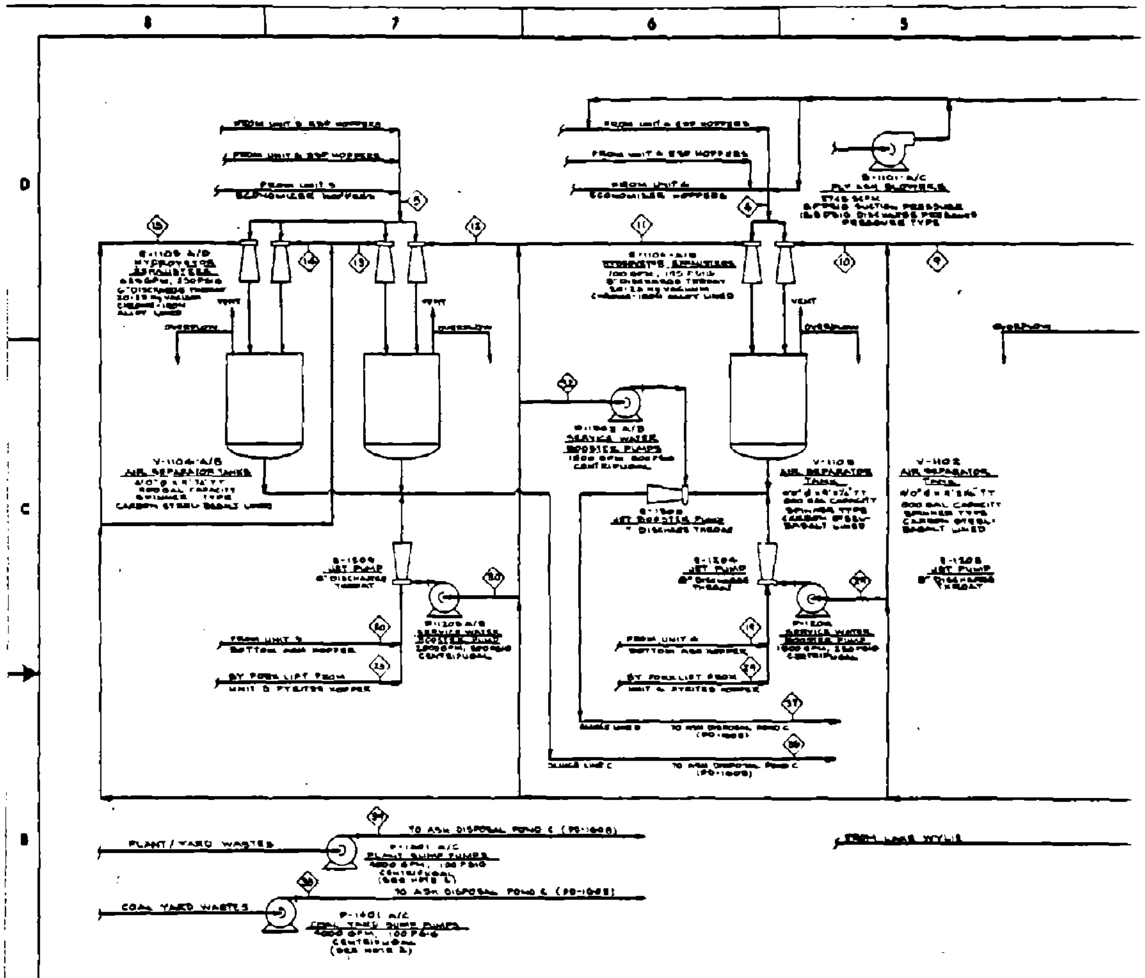
Disposal Operation--The current disposal pond, denoted Pond C, is 590,000 m^2 (146 acres) in size. Effluent from this pond is discharged to Lake Wylie. In prior years, two adjoining ponds, Ponds A and B, were used for coal ash disposal. These ponds were filled with ash and are now retired. Duke Power has undertaken a program of groundwater monitoring at the site and, hence, has installed monitoring wells at various locations around both the active and retired disposal ponds.

In addition to the process descriptions and process flow diagram developed for the Plant Allen coal ash handling and disposal operation, a list of Plant Allen area accounts and a detailed equipment list (divided among modular area accounts) were developed. These are provided as Tables G-1 and G-7, respectively, in Appendix G.

5.2.6.2 Cost Assessment--

Capital and first year annual cost estimates were developed for the coal ash handling and disposal operation at Plant Allen. These were based primarily on the engineering assessment results. However, to provide for consistency among the cost estimates developed for the six sites, it was necessary to specify certain engineering design premises that were consistent for all study sites (e.g., plant service life, load factor, heat rate, etc.). The engineering design premises that pertain to the Plant Allen cost estimates were listed in Table 5.5.

Detailed capital cost estimates for the Plant Allen coal ash handling and disposal system are presented in Appendix G, Table G-13. A summary of the modular capital cost estimates for the Plant Allen system is presented in Table 5.6. This table provides the modular capital costs broken down by waste type. As can be seen from this summary, the cost of the air pollution control system comprises a significant fraction (approximately 65 percent) of the total cost of the environmental control system for the plant. It is also



DESIGN CONDITIONS - TOTAL STREAM FLOW PER NORMAL 24 HOUR DAY (NOTE-5)

DETAIL \ STREAM NO	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16 NOTE 4
K TONS ASH/DAY	0.16	0.16	0.29	0.29	0.29	—	—	—	—	—	—	—	—	—	—	0.06
K TONS WATER/DAY	—	—	—	—	—	2.1	2.1	2.1	2.1	2.1	2.1	1.9	1.9	1.9	1.9	N/A
MGPD (WATER)	—	—	—	—	—	0.50	0.50	0.50	0.50	0.50	0.50	0.46	0.46	0.46	0.46	N/A
% SOLIDS	100.0	100.0	100.0	100.0	100.0	0	0	0	0	0	0	0	0	0	0	N/A
SPECIFIC GRAVITY	2.5	2.5	2.5	2.5	2.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	N/A

DETAIL \ STREAM NO	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
K TONS ASH/DAY	0.007	0.007	0.012	0.012	0.012	—	—	—	—	—	—	—	—	0.45	0.59	0.59
K TONS WATER/DAY	0	0	0	0	0	5.4	5.4	5.4	5.4	8.4	14.6	8.4	66.4	20.4	15.0	16.0
MGPD (WATER)	0	0	0	0	0	1.3	1.3	1.3	1.3	2.0	2.6	1.3	15.9	4.9	3.6	3.8
% SOLIDS	100.0	100.0	100.0	100.0	100.0	0	0	0	0	0	0	0	0	2.2	2.6	3.4
SPECIFIC GRAVITY	2.5	2.5	2.5	2.5	2.5	1.0	1.0	1.0	1.0	[illegible]	1.0	1.0	1.0	1.02	1.02	1.02

N/A = INFORMATION NOT AVAILABLE

FIGURE 5.8

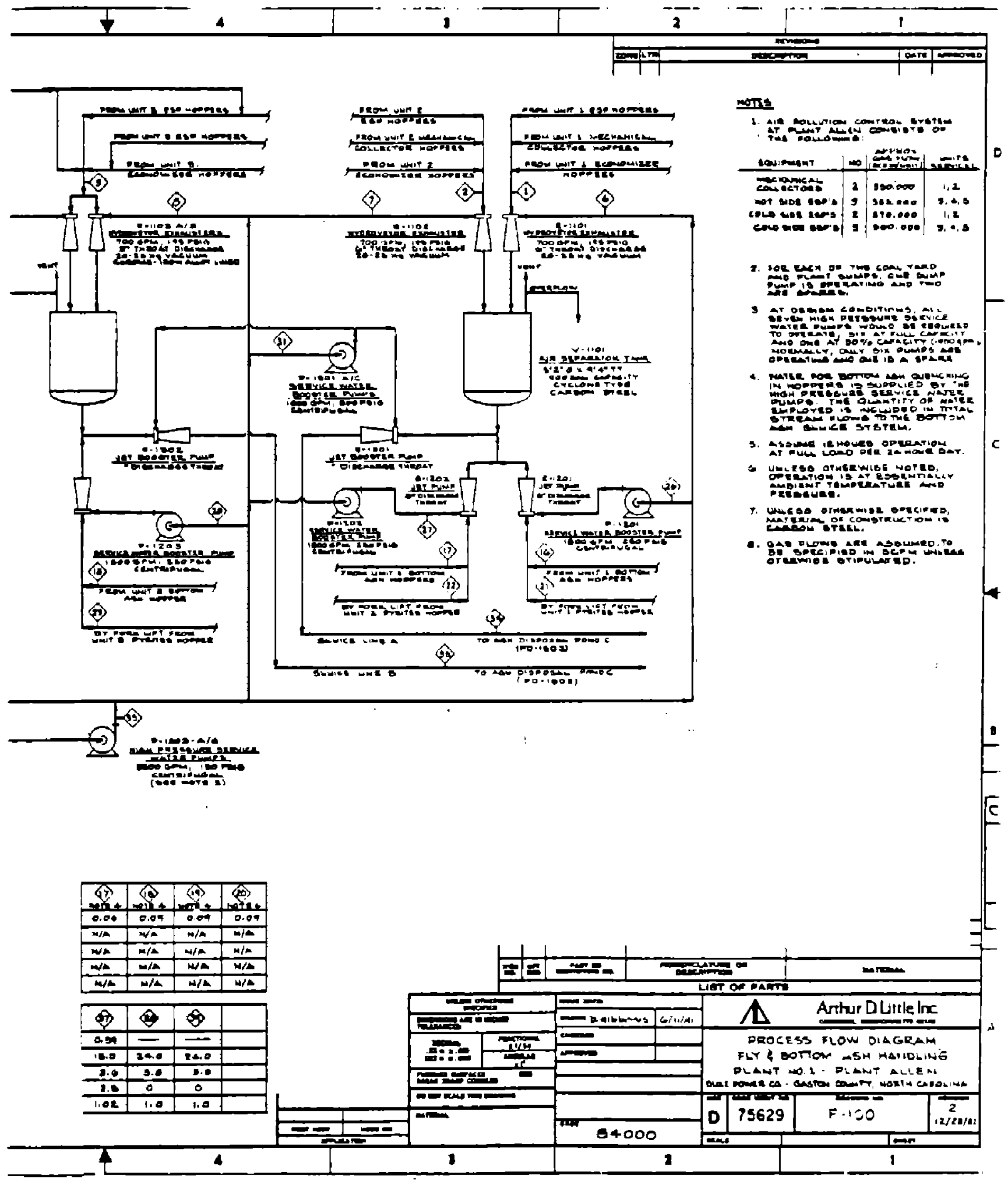

NOTES
Arthur D Little Inc
PROCESS FLOW DIAGRAM
FLY & BOTTOM ASH HANDLING
PLANT NO. 1 - PLANT ALLEN
DUKE POWER CO. - GASTON COUNTY, NORTH CAROLINA
D
75629
F-100
64000

FIGURE 5.8

TABLE 5.5

SUMMARY OF BASIC ENGINEERING DESIGN PREMISES FOR
ALLEN PLANT
FGC WASTE HANDLING AND DISPOSAL

ENGINEERING DESIGN PREMISES	
Power Plant	
Plant Size (MW)	1155
Boiler Type	Pulverized Coal
Heat Rate (M joules/kWh; Btu/kWh)	12; 11,400
Location	North Carolina
Service Life (yr)	30
Load Factor (Lifetime Average Percentage)	70
Waste Generated (dry basis)	
Fly Ash/Bottom Ash Ratio	75/25
Fly Ash Generation (metric tons/yr; tons/yr)	275,900; 304,200
Bottom Ash Generation (metric tons/yr; tons/yr)	102,000; 112,500
FGD Waste Generation (metric tons/yr; tons/yr)	--
Ash Utilization	None
Coal Properties	
Coal Type	Bituminous
Sulfur Content (Percent)	1.0
Ash Content (Percent)	12.0
Heating Value (M joules/kg; Btu/lb)	27.9; 12,000
Air Pollution Control	
Particulate Control	Mechanical Collectors (Units 1&2) Cold-Side ESP's (Units 3,4,5) Hot-Side ESP's (Units 1-5)
Particulate Removal (Percent)	>99
Sulfur Oxides Control	None
Disposal Site	
Type	Pond
Design Life (yr)	30
Land Area (m^2; acre)	1,104,800; 273
Groundwater Monitoring Wells (Number)	6
Reclamation (Closure)	0.45 m cover soil; 0.15 m top soil: reseeding
Liner (type; m; ft)	None
Distance from Plant (km; mile)	1.6; 1.0

TABLE 5.6

CAPITAL COST SUMMARY[a]
(Late 1982 Estimates)

Plant Name: Allen
Plant Location: Gaston County, North Carolina
Utility Name: Duke Power Company
Nameplate Generating Capacity (MW): 1155

WASTES	CAPITAL COSTS ($1000) Fly Ash	Bottom Ash	Coal Pile Runoff/Plant Wastes	Total
MODULES				
• Waste Handling and Processing	$3,771	$1,433	$ -	$5,204
• Waste Transport	7,920	2,930	-	10,850
• Waste Placement and Disposal (Includes Site Monitoring and Reclamation)	18,349	6,790	-	25,149
SUBTOTAL MODULAR COSTS	$30,050	$11,153	$ -	$41,203($36/KW)
RELATED ENVIRONMENTAL SYSTEMS				
• Miscellaneous Plant Wastes Handling, Transport, and Disposal	-		1,940	1,940
• Air Pollution Control	84,373	-	-	84,373
TOTAL CAPITAL COSTS	$114,423	$11,153	$1,940	$127,516 ($110/KW)

[a] ENR Cost Index = 3931.11 (1913=100)
= 365.97 (1967=100)

Source: Arthur D. Little, Inc. estimates.

evident that the capital cost of solid waste placement and disposal is the largest cost element (approximately 60 percent) when the air pollution control system is not considered. This is commonly the case for ponding operations; in this study the waste placement and disposal module for ponding operations typically comprised 55 to 65 percent of the non-air pollution control environmental system costs. The Plant Allen capital cost estimate is consistent with this thesis.

Comparison of the Plant Allen waste handling and disposal system (excluding related environmental systems) capital costs ($36/kW) to those for other plants evaluated under this program that practice pond disposal (the Sherburne County Plant at $43/kW and the Smith Plant at $47/kW) indicates that this system has the lowest capital costs. This is primarily due to savings that result from economies of scale (i.e., Plant Allen has a nameplate generating capacity of 1155 MW, while that for the Smith Plant is only 340 MW) and from the fact that the pond construction did not require expensive materials (i.e., the Plant Allen pond is unlined, compared to that at the Sherburne County Plant that was lined with clay at an added expense). However, the difference among the Plant Allen capital cost estimate and those for the other plants that use pond disposal is not as pronounced as one might expect. This is because Plant Allen, with five boilers, has four distinct and separate coal ash handling and transport systems. The capital cost for this module is relatively high, since it is actually comprised of four small-scale systems and therefore exhibits very little economy of scale. In addition, the distance from the plant to the disposal site at Plant Allen is approximately four times as great as that at the Smith Plant.

A detailed annual cost estimate was prepared for the Plant Allen system (Table G-19, Appendix G). A modular summary of this estimate, Table 5.7, provides a less detailed account of these costs.

Annual costs for the three sites evaluated which practice ponding of FGC wastes were relatively similar in value. The unit annual cost for ponding at Plant Allen ($23.70/dry metric ton) is the lowest of the three; the unit cost for the Smith Plant is $25.10/dry metric ton while the Sherburne County Plant cost is $26.60/dry metric ton. The lower cost at Plant Allen (1155 MW) indicates some cost savings due to economies of scale (with respect to the Smith Plant 340 MW), however, one might expect this to be more dramatic. The fact that Plant Allen, with five boilers, has four distinct and separate coal ash handling and transport systems reduces economies of scale that one might expect. As with the capital costs, the major annualized cost element is due to the waste placement and disposal module, which typically contributes 45 to 55 percent of the total annual cost. This is primarily due to the large contribution of disposal ponds capital charges to the annualized cost. This, again, illustrates that pond disposal is highly capital intensive.

TABLE 5.7

ANNUAL COST SUMMARY
(Late 1982 Estimates)[a]

Plant Name: Allen
Plant Location: Gaston County, North Carolina
Utility Name: Duke Power Company

Operating Load Factor (percent): 70
Name Plant Generating Capacity (MW): 1155
Waste Generation (dry metric tons/yr):
Fly ash - 275,900; Bottom ash - 102,000

	ANNUAL COSTS ($1000)			
WASTES	Fly Ash	Bottom Ash	Coal Pile Runoff and Plant Wastes	Total
MODULES				
• Waste Handling and Processing	$1,216.1	$ 687.6	$ -	$2,103.7
• Waste Transport	1,903.6	703.5	-	2,607.1
• Waste Placement and Disposal (Includes Site Monitoring and Reclamation)	3,092.9	1,143.8	-	4,236.7
SUBTOTAL - MODULAR COSTS	$6,212.6	$2,734.9	$ -	$8,947.5 ($23.70/dry metric ton)
RELATED ENVIRONMENTAL SYSTEMS				
• Miscellaneous Plant Waste Handling and Transport	$ -	$ -	$551.5	$ 551.5
• Air Pollution Control	NA[b]	-	-	NA[b]
TOTAL ANNUAL COSTS	$6,212.6 + NA[b]	$2,734.9	$551.5	$9,499.0 + NA[b]

[a] ENR Cost Index = 3931.11 (1913=100)
365.97 (1967=100)

[b] NA = Information not available

Source: Arthur D. Little, Inc. estimates.

SIERRA CLUB

QUARLES EXHIBIT 3

1976 MINGLE MEMO RE: SUTTON

Docket No. e-2, Sub 1219

TOM CRAWFORD

FYI

FILE COPY

573-13-C

Form 244

Carolina Power & Light Company

Company Correspondence

Raleigh, North Carolina

August 4, 1976

FILE: Sutton 0-10-a

MEMORANDUM TO: Mr. R. E. Jones
Mr. F. D. Poisson
Mr. W. L. Wallace

FROM: G. B. Mingle

SUBJECT: Chloride Contamination of Hercules Wells

On June 21, 1976, Mr. K. Littlefield of Hercules contacted J. H. Humphrey concerning three of their wells that were contaminated with chlorides. These wells were the closest to our cooling lake. They were concerned that the contamination was from the lake and that it might spread to their other wells. Mr. Humphrey then contacted me and we agreed that I should contact Mr. Littlefield on my previously scheduled visit to Wilmington the next day.

During my discussion with Mr. Littlefield, he indicated that they were using 125 million gallons of well water per month. This water was being used for process and make-up water for their closed cooling system. The evaporation from their closed cooling system concentrated the chlorides in the system. High chlorides would then affect the stainless steel piping in the system.

He indicated that the normal well water was running 5PPM of chlorides or less. The affected wells were running from 20 to 30PPM with a high of 40PPM. He also indicated that the two wells closest to the lake (K and Q) became contaminated in late 1975 and that the next closest well (J) became contaminated during the first half of 1976.

He stated that they are concerned that the contamination may be coming from our lake and that their other wells may become contaminated. They are particularly concerned about their well P which is only 2000 feet from one of the contaminated wells and is their largest producing well.

I told him that we would be investigating this situation and at that time I had no way of knowing where the contamination was coming from or if it might spread. One week later, I again visited the Hercules Plant and requested samples of the well water from three of their wells. During this visit, Mr.

Littlefield was unavailable and Mr. Lowell Avery assisted in collecting the samples. I requested copies of the well water analysis graphs that they had been keeping from Mr. Avery. Mr. Avery said that they would send these to me due to the unavailability of a copy machine in that area of the plant. These were sent to me with the attached cover letter which is the only formal correspondence to date.

These samples along with a sample of lake water were analyzed by the Harris Environmental lab to confirm the chloride concentrations in their wells and the chlorides in the lake. The results are on the attached tabulation.

I have reviewed this data with our Engineering Department and they believe that the only way to be sure of the origin of the chlorides in the Hercules' wells is to do a study such as mapping the water table or using a tracer in the lake and monitoring for it in the wells. They believe that the chlorides could be coming from either the lake or one of the rivers. They do not know if it will spread to the other wells.

We have also seen chloride contamination of one of our wells at the Sutton Plant shortly after the lake was filled. Another of our wells has just recently shown chloride contamination. The first well was in the plant by the parking lot and as such is surrounded on three sides by water either from the lake or the intake or discharge canals. The other well is in close proximity to the discharge canal.

Please advise us as to the possible legal actions that could be taken by Hercules. Also advise your recommended approach to this situation.

G. B. Mingle

GBM:ka
Attachment
cc: Mr. A. G. Smith

HERCULES WELLS

Well Well	Distance from Lake (ft)	Pumping Rate GPM
K*	1250	300
Q*	1390	250
J*	1650	350
H	2310	200
P	2310	490
G	2350	300
N	2410 A	Out of Service
F	2110 A	100
U	1880 A	175

* Contaminated with chlorides to date

A - Distance to ash pond when distance to lake is larger

CP&L ANALYSIS

	Chlorides
Lake Water	62
Well K	25
Well P	6
Well U	7

HERCULES INCORPORATED
SYNTHETICS DEPARTMENT • P. O. BOX 327, WILMINGTON, NORTH CAROLINA 28401

July 1, 1976

Mr. G. B. Mingle
Carolina Power & Light Co.
P. O. Box 1551
Raleigh, NC 27602

Dear Mr. Mingle:

Enclosed you will find copies of the well data that you requested.

If I can be of any further assistance, I will be glad to do so.

Very truly yours,

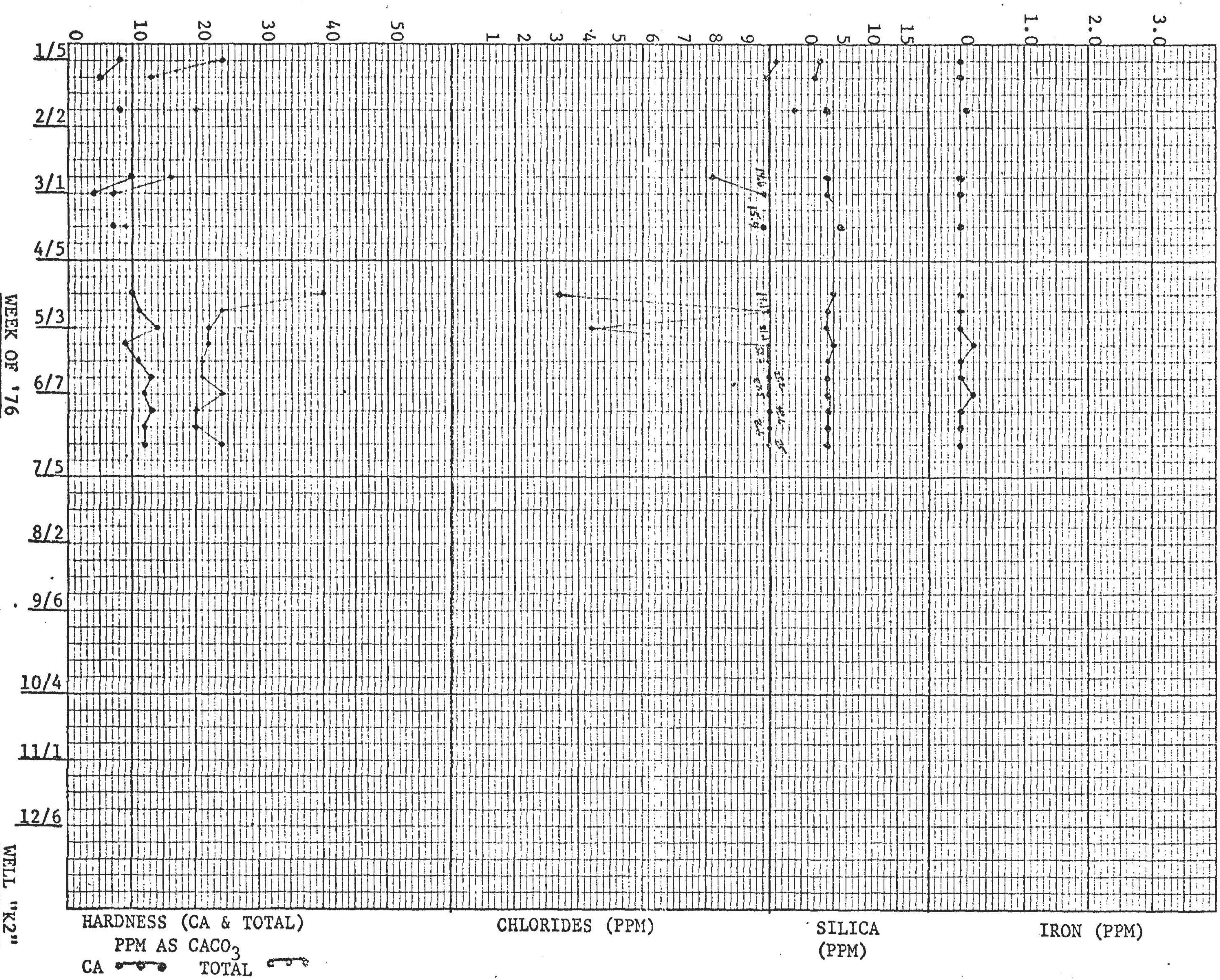
J. R. Ross
Plant Manager

by Lowell S. Avery
Mr. L. S. Avery

LSA/th

Enclosures

CHEMICAL ANALYSIS



SHT. 1 OF 2

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Printed in U.S.A.
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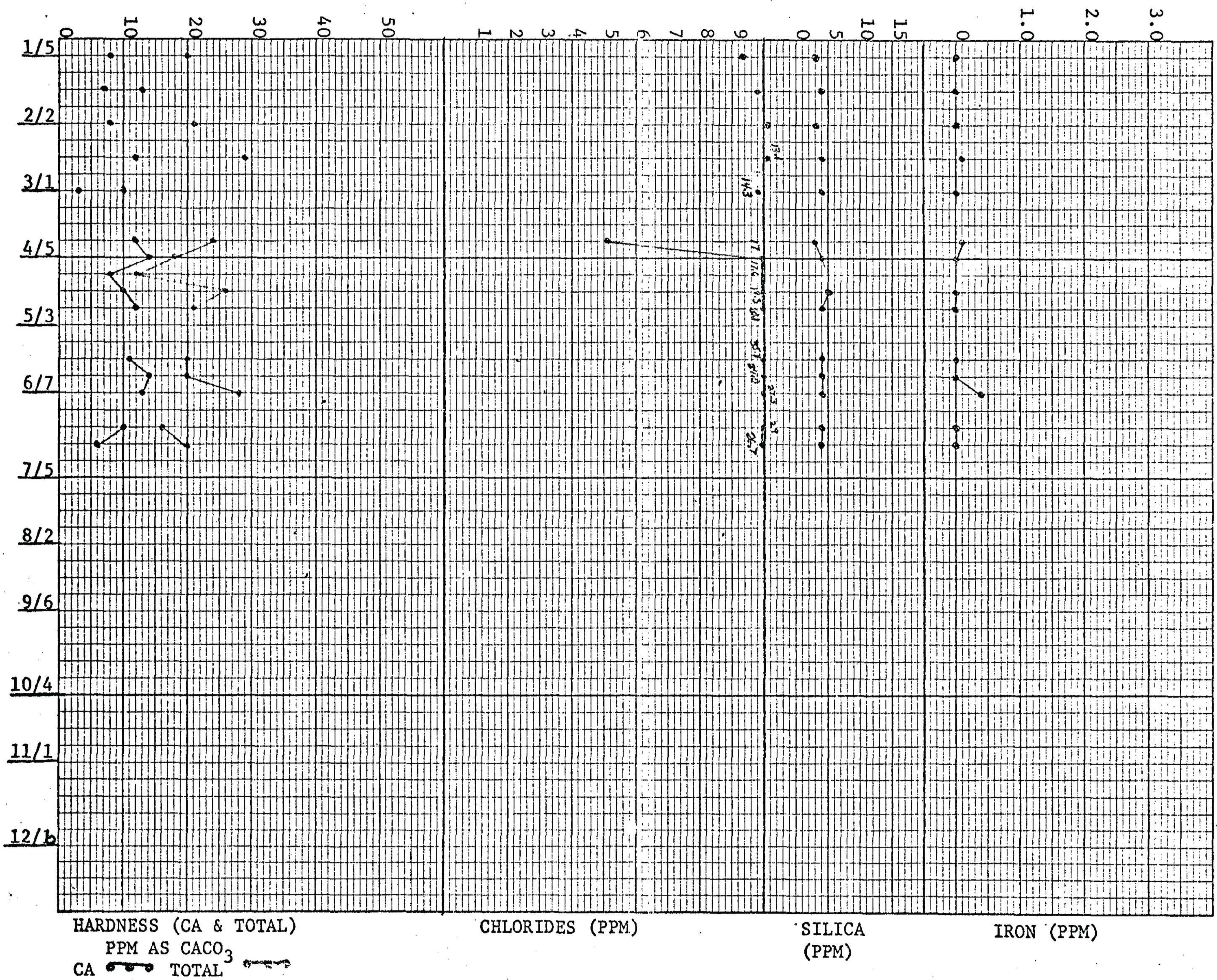
AR-0524-GO

CHEMICAL ANALYSIS



SH. 1 OF 2

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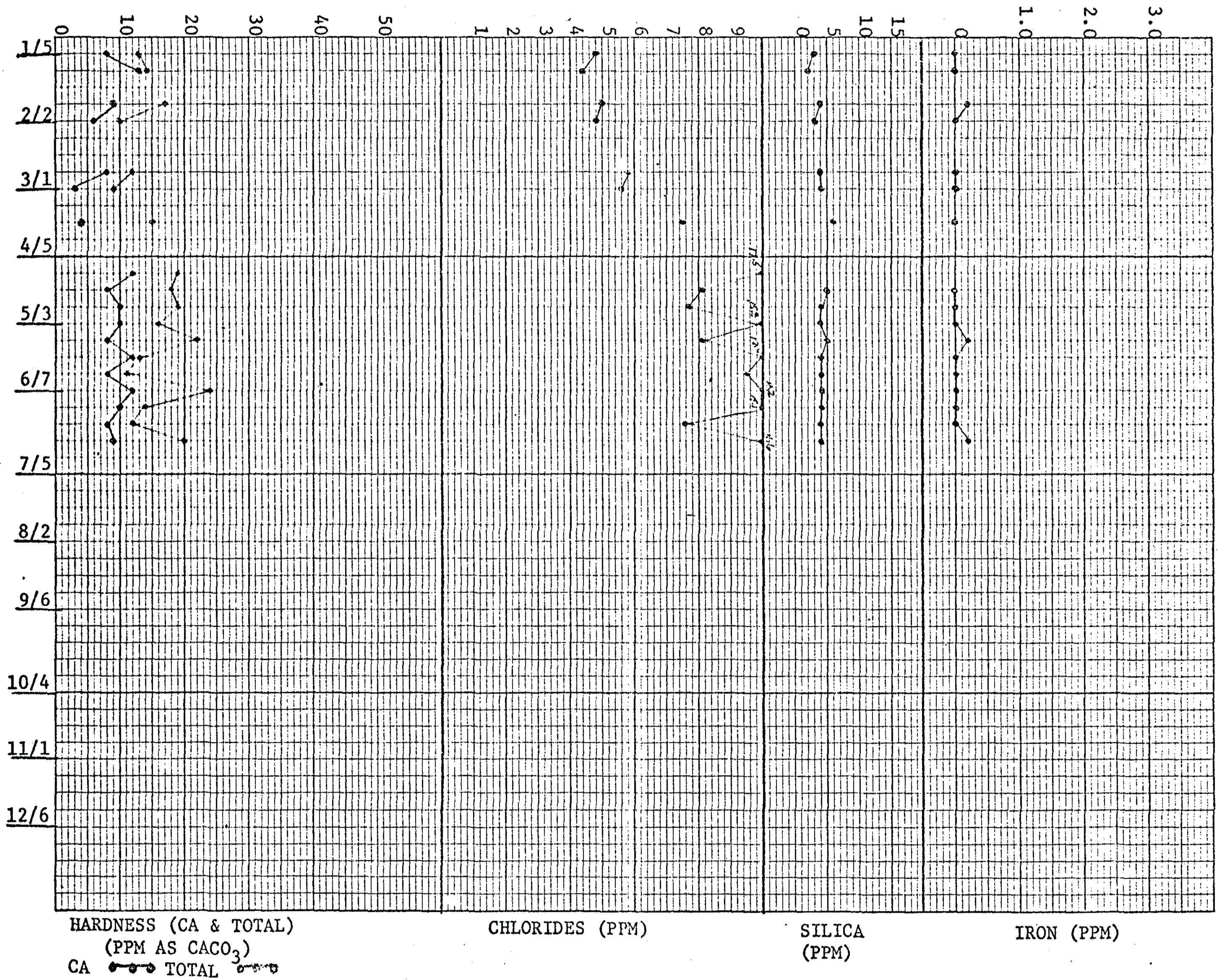
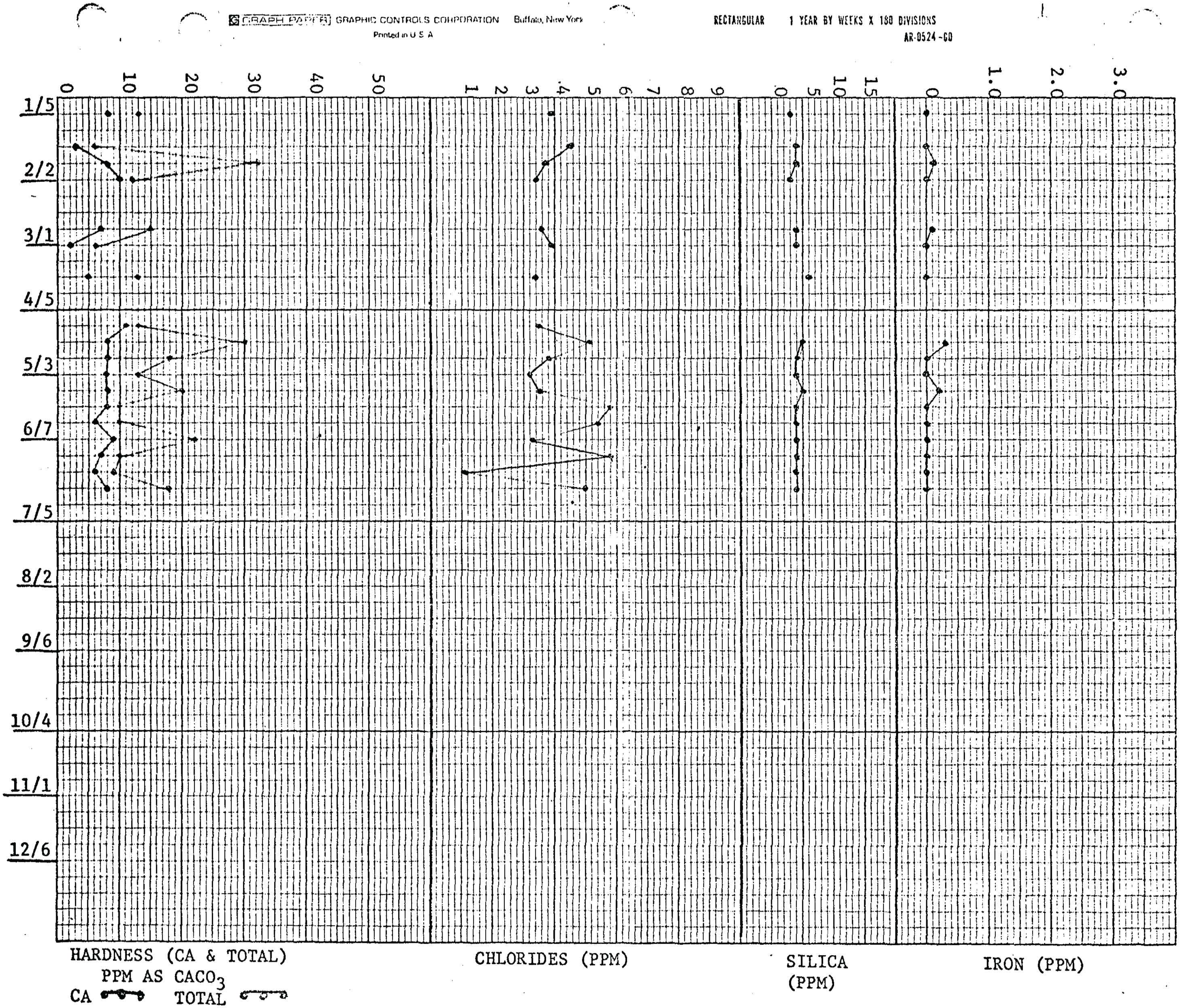
Printed in U.S.A.

RECTANGULAR 1 YEAR BY WEEKS X 100 DIVISIONS
AR-8524-GO

CHEMICAL ANALYSIS

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RECTANGULAR 1 YEAR BY WEEKS X 180 DIVISIONS
AR-0524-GO
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0 5 10 15
0 1.0 2.0 3.0
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4/5
5/3
6/7
7/5
8/2
9/6
10/4
11/1
12/6
HARDNESS (CA & TOTAL)
PPM AS CACO3
CA
TOTAL
CHLORIDES (PPM)
SILICA
(PPM)
IRON (PPM)

SHT. 1 OF 2

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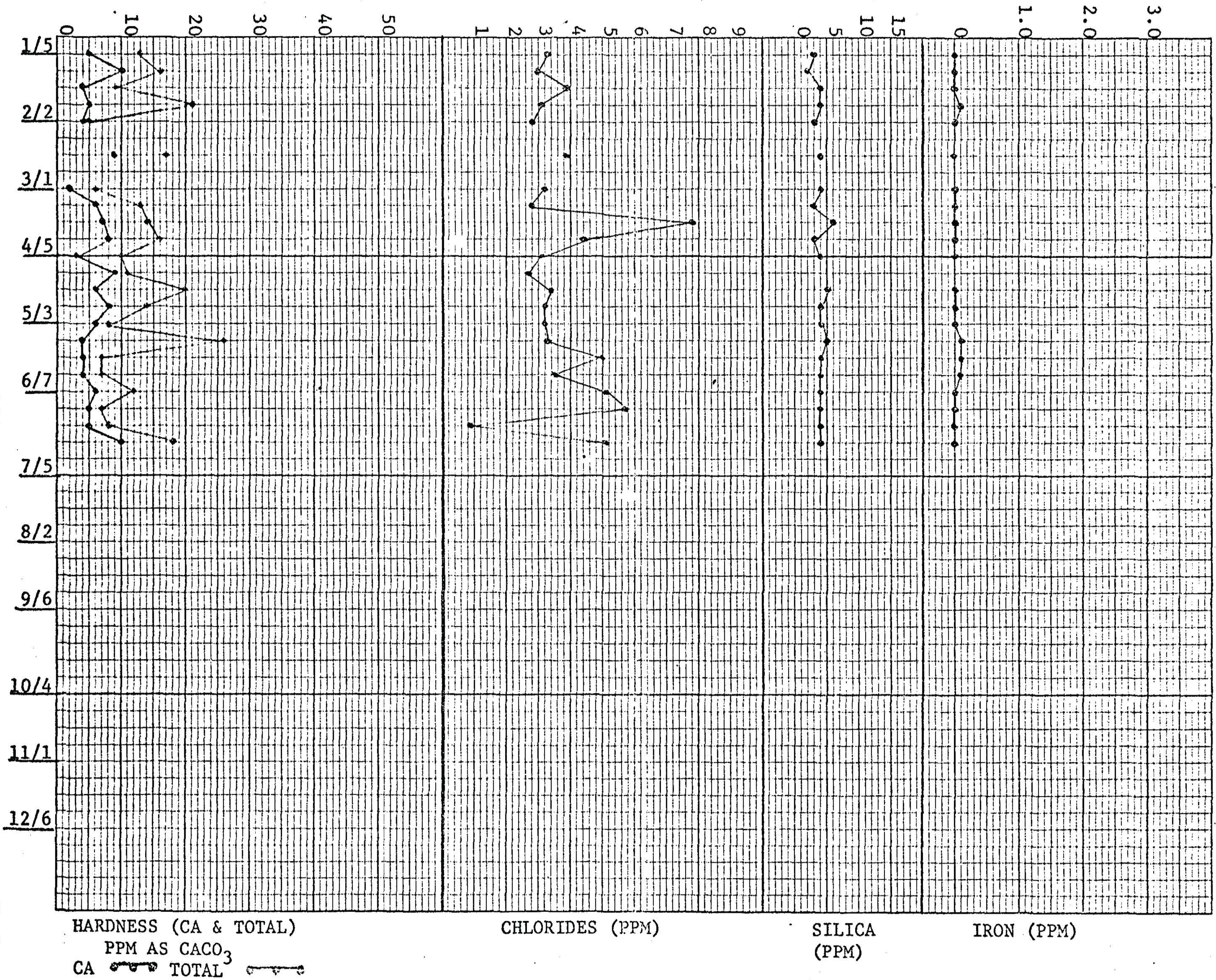
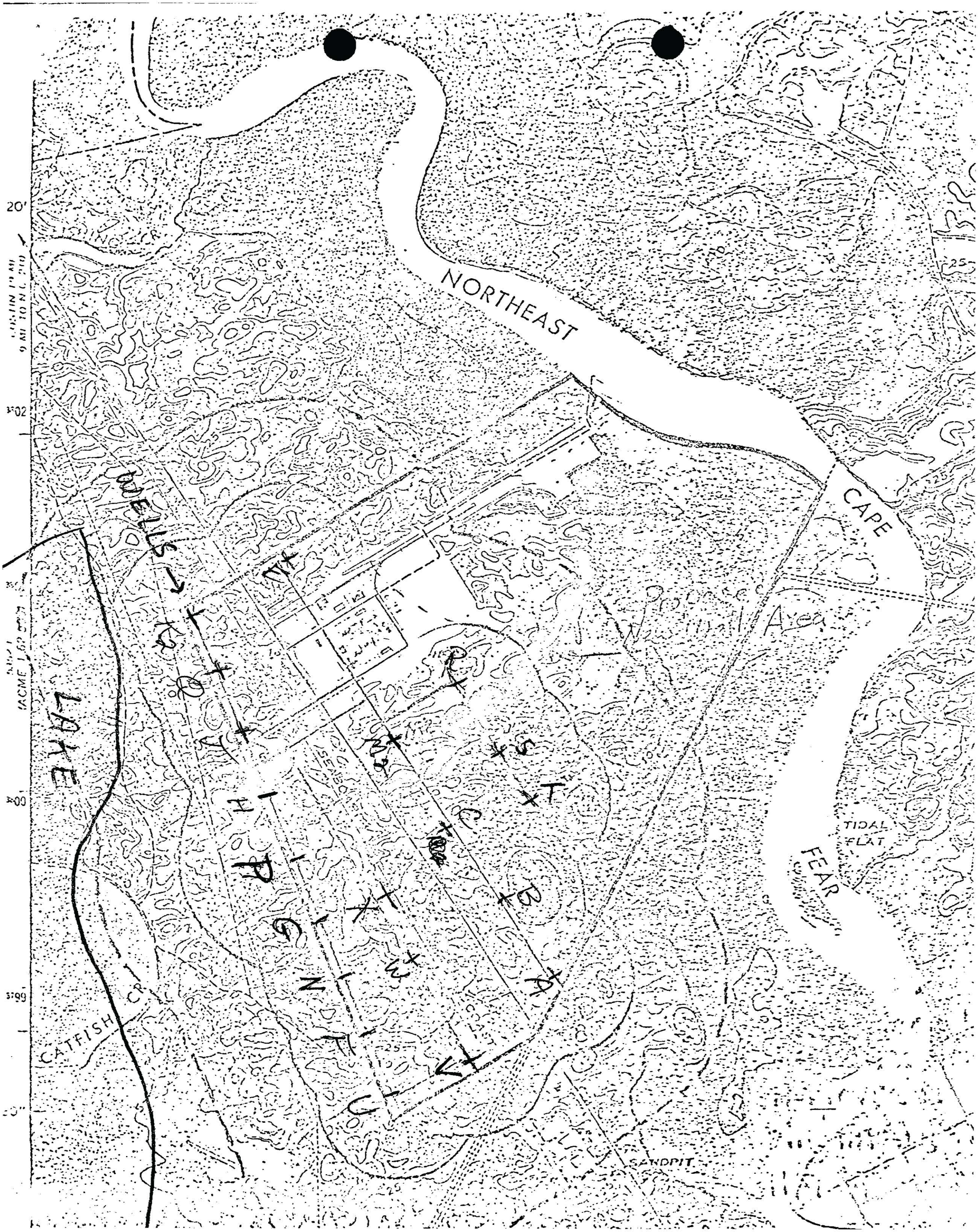
AR-0524-GD

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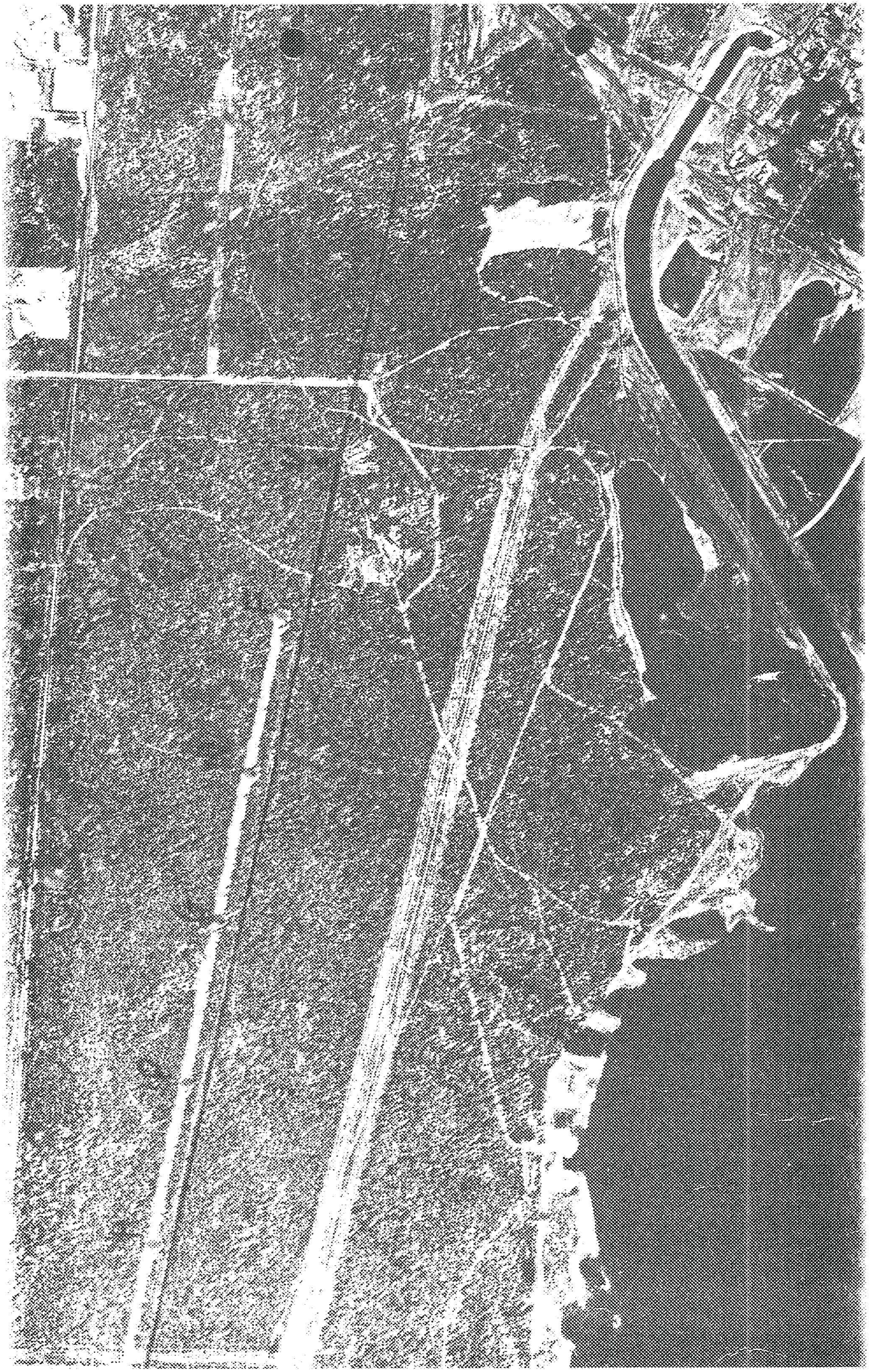
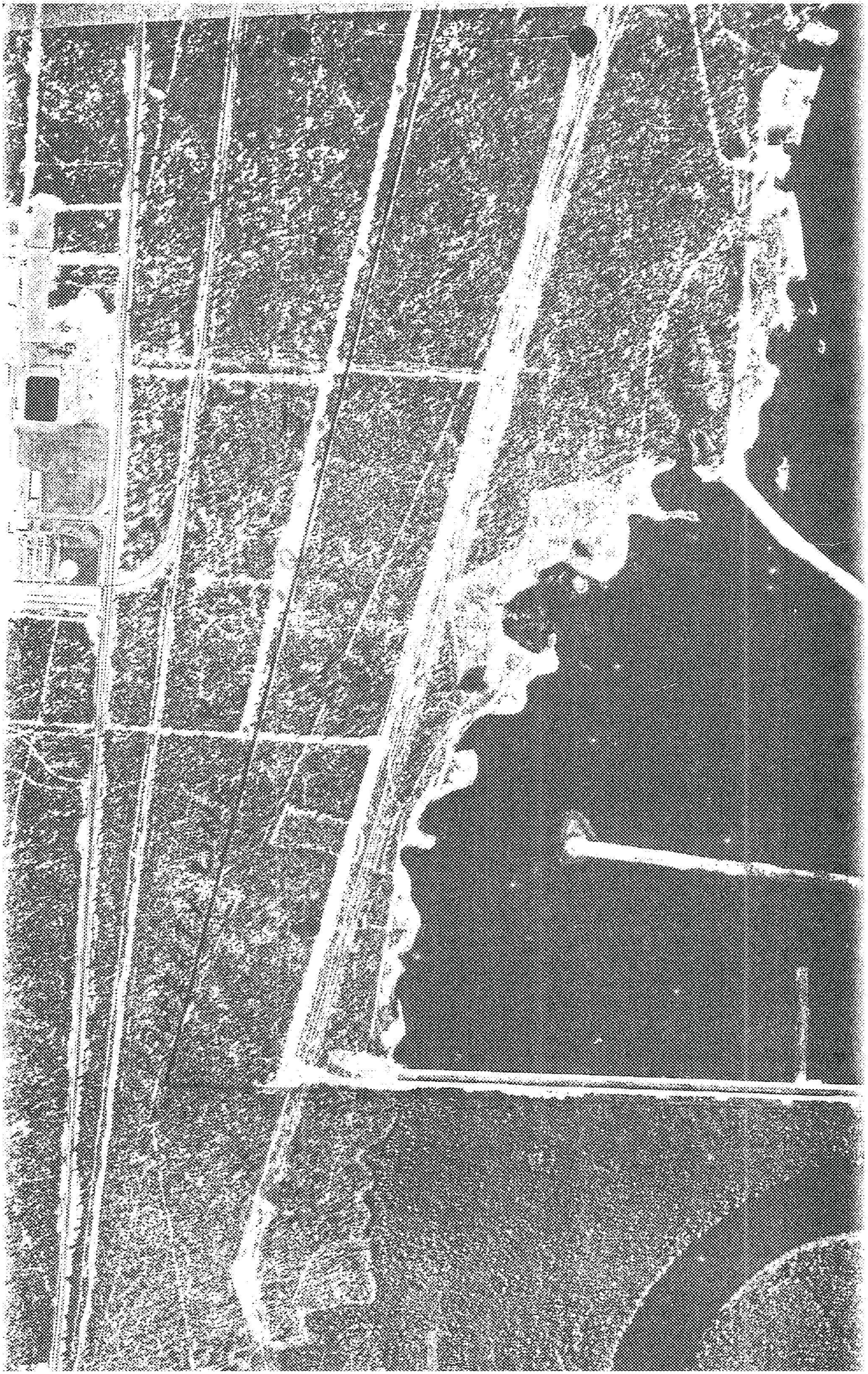
CAPE
FEAR
TIDAL FLAT
LAKE
CATFISH CR
SANDPIT
WELLS





SIERRA CLUB

QUARLES EXHIBIT 4

1978 ZIMMERMAN SUMMARY RE: SUTTON

Docket No. e-2, Sub 1219

EXECUTIVE SUMMARY

DATE: 8 / 22 / 83	DATE: 8 / 23 / 83	DATE: / /
TO: W. Hurford	TO: L. Eury	TO:
FROM: S. Zimmerman	FROM: W. Hurford	FROM:
ACTION REQUIRED:	ACTION REQUIRED:	ACTION REQUIRED:
For Your Information	For Your Information	For Your Information
Response Required	Response Required	Response Required
To Be Approved	To Be Approved	To Be Approved
DATE REQUIRED: / / to	DATE REQUIRED: / / to	DATE REQUIRED: / / to

SUBJECT: Hercofina/Sutton Background Information

BACKGROUND/SITUATION

CONCLUSIONS

RECOMMENDATIONS/JUSTIFICATION

1. Attached is some background information for your Wednesday meeting.

2. In addition, the following questions were raised:

Q. Does Sutton Plant cooling pond/ash pond presently comply with the law.

A. The Sutton facility complies with current relevant groundwater statutes and regulations. Hercofina could attempt to show that the chlorides entering their well is from CP&L's cooling pond. Whether this would be judged to be caused by CP&L or by Hercofina's ~~exclusive~~ excessive pumping is arguable.

Q. Will the Sutton Plant cooling pond/ash pond comply with the proposed groundwater regulations.

A. No. As soon as those regulations become effective, the plant will be out of compliance.

Q. Should the new ash pond be relocated to another site.

A. If Hercofina's current interest were genuinely the ash pond, then relocation might be in order. If the cooling pond chemistry is Hercofina's real contention, as we suspect, then ash pond relocation would not solve Hercofina's problem.

Form 244

COPY

CP&L

Carolina Power & Light Company

Raleigh, North Carolina
August 22, 1983

Company Correspondence

M E M O R A N D U M

TO: Mr. L. W. Eury

FROM: W. J. Hurford

SUBJECT: Sutton Plant and Hercofina Groundwater Issues

With respect to the current allegations by Hercofina that the Sutton Plant's cooling lake and ash pond are having adverse impact on the quality of groundwater pumped by Hercofina and that the ash pond under construction, when operational, will further degrade groundwater quality, there are a number of courses available that could be tried to satisfy Hercofina and environmental regulatory interests. The remedial courses listed are not exclusive and can be varied.

Background

In 1977 Hercofina presented allegations that the closed cycle Sutton cooling pond was a source of chloride contamination of their groundwater and impacted their process and cooling water operations. In that there was no conclusive evidence to confirm that CP&L was having a material impact and based on the then current environmental laws and regulations, the claims by Hercofina were denied by CP&L and the issue drifted.

It would appear that when Hercofina became aware this year of the construction plans for the ash pond, their earlier interest and charges have been rekindled. This summer they have approached CP&L Wilmington personnel as well as the N. C. Division of Environmental Management for redress of their grievance. Hercofina has stated that unless their concerns are seriously addressed and resolved by CP&L they will seek a court injunction preventing completion of the new ash pond. Similarly it would appear that Hercofina is aware of the State's proposed new groundwater regulations (scheduled to be effective in November or December 1983) that clearly have the ability to implicate CP&L as a contributor to groundwater pollution.

Scheme 1 - Optimize the operation of the Sutton cooling pond such that frequency and amount of blowdown and makeup will produce the least practicable concentration of chlorides. If material improvement is achieved, this alternative could satisfy both Hercofina and the regulatory interests. The complete success of the alternative is influenced to large degree by natural phenomena. No capital expenditures associated with this approach.

Scheme 2 - Conveyance of freshwater (pipe, open channel, etc.) from upstream surface waters of the Cape Fear river to Hercofina property - a distance of approximately 25 miles. This alternate would probably be considered the best by Hercofina in that it would solve their fundamental problem of a dependable water supply. While satisfactory to Hercofina, it would leave unresolved the regulatory question of groundwater contamination. Similar allegations could readily arise if a new industry were to locate in the area or existing industry increase their pumpage rate. Capital costs to install pipe line to surface supply probably are in excess of $3 million.

Scheme 3 - Construct a slurry or sheet pile wall that would physically block the migration of cooling pond/ash pond seepage from entering the Hercofina wells. This alternate would effectively eliminate the groundwater contamination charges but would not solve Hercofina's water supply problems and most probably worsen them. Capital costs to install a slurry curtain are in the range of $1 to $2 million.

Scheme 4 - This is a variation of Scheme 1 and entails relocation of the cooling pond intake structure further upstream on the Cape Fear river near the northern terminus of the cooling pond. Location in this area would generally provide for a lower chloride concentration of intake water. This would satisfy both Hercofina and the regulatory agency with respect to groundwater contamination. There could be changes in the fishery and aquatic populations at the pond if a significantly lower chloride pond is developed. Capital costs to relocate the intake structure could be in the $1 to $2 million range.

Beyond the actions noted above is always the course of no action. Essentially this would be reaffirming our position of 1977 and calling Hercofina's hand.

Please let me know if I can provide additional information.

Original Signed By
WALTER J. HURFORD

TJC
8/2/7

WJH/lcv (7731TJC)

SIERRA CLUB

QUARLES EXHIBIT 5

1984 WILSON LETTER RE: SUTTON

Docket No. e-2, Sub 1219

21

CP&L
Carolina Power & Light Company
Raleigh, N. C. 27602

COPY

File: SXDE-001-020-XXX CO-10059

May 21, 1984

FILE COPY
593-13-C

Mr. W. T. Bouras, Plant Manager
L.V. Sutton Steam Electric Plant
Route 6, Box 46
Wilmington, North Carolina 28405

L.V. SUTTON STEAM ELECTRIC PLANT
1984 ASH POND EXPANSION
DESIGN BASIS EXPLANATION

Dear Mr. Bouras:

As requested, this letter will explain the design basis for the 1984 ash pond expansion plan as follows:

1. During 1983, the North Carolina Commission of Environmental Management provided "Authorization to Construct" approval of the new unlined ash pond, under the plant's NPDES Permit for ash pond discharge. The 1983 ash pond expansion plan was intended to provide one new ash pond area with a maximum operating level at Elevation +26, and maximum dike Elevation +28, to include the existing ash pond area and expansion toward the north end. The 1983 expansion was partially completed, including construction of dikes to Elevation +22, installation of a new discharge structure, and earthwork for perimeter drainage. A temporary separating dike was also constructed to keep water out of the new pond area, which would allow continued operation of the existing pond area up to Elevation +20.

2. In consideration of local groundwater concerns for the project by Hercofina, and changes in regulatory requirements concerning groundwater, FE&CD initiated a review of the 1983 expansion plan. Based on this review, the expansion plan was revised to include a liner for the new pond area. The purpose of the liner is to provide a barrier to flow of water from the pond into the groundwater.

3. The maximum operating level for the new ash pond area to be lined is at Elevation +32, and maximum dike Elevation +34. This is the maximum possible dike elevation that can be obtained using earth borrow material from the inside of the pond for construction of the new dikes, and limiting borrow to the level of existing natural groundwater (with approximately two foot cover).

4. Any plans that would include raising the operating level of the existing ash pond area above Elevation +26 would require a permit application to the State. We have been advised that this action would result in the requirement of a liner for the existing pond. Therefore, the revised expansion plan provides for operation of the existing ash pond to Elevation +26, which actually represents no change to the 1983 expansion plan. This requires a separating dike between the new and existing pond areas, to allow operation of the two areas at different elevations, and provide for termination of the new pond liner.

5. Construction of existing ash pond dikes above Elevation +28, would require removal of ash deposits or other special stabilization methods for widening the dike base inside the pond. The existing dikes have been constructed to be raised from Elevation +22 to +28 without any change in base width.

6. The revised plan, as described, has been reviewed and approved by the North Carolina Commission of Environmental Management. The approval includes a request for providing a groundwater monitoring system.

7. The present expansion plan can minimize any required modifications to the plant ash handling system and drainage system. A sequenced filling of the new ash pond area and existing ash pond area will allow operation of the Unit Nos. 1 and 2 ash handling system and plant drainage system below Elevation +28. Operation of the Unit Nos. 1 and 2 ash handling system above Elevation +28 will require an increase in ash sluice pump discharge capacity, and a booster pump installation on the ash discharge. The plant drainage pumps must be modified to maintain the design discharge capacity for the increased operating head.

8. The proposed scope for ash handling system modifications will include increasing the Unit Nos. 1 and 2 ash pipe size from 10" diameter to 12" diameter and raising the Unit No. 3 air separator tank. All of this work is included in the present scope.

Please advise if you have any questions.

For your information, this explanation has been reviewed with Mr. John Ruble.

Yours very truly,
ORIGINAL SIGNED BY
L. B. WILSON

L.B. Wilson - Manager
Fossil Engineering & Construction

RSA/fpf (310105)

cc: Mr. T. J. Crawford
Mr. J. B. McGirt
Mr. J. T. Cox

SIERRA CLUB

QUARLES EXHIBIT 6

GREESON MEMO RE SUTTON

Docket No. e-2, Sub 1219

FILE COPY
830-21-D6

Memorandum from
MICK GREESON

3/6

Larry,

I looked at what Tom provided you and tried to concentrate on ground water as a result. I had a difficult time trying to orient myself to write this in terms of day to day operations, but I tried. I work mostly w/ regulators you know. This is rough because I dictated. It's a busy time.

CI 04 02 0116

CP&L P. O. Box 1551, Raleigh, N.C. 27602 Telephone 836-6045

[redacted]

L. V. Sutton Steam Electric Plant - Ash Pond Expansion

In late 1982, it was apparent that the Sutton Plant was in critical need of additional ash storage capacity. Accordingly, the Fossil Engineering and Construction Department had initiated efforts to design an expansion of the existing ash pond. The design of that ash pond expansion was completed and in early 1983. Since the discharge location from the ash pond would be the same, the Plant's NPDES permit did not require ~~a~~ modification. However, that permit did ~~does~~ require that any modification to a waste water treatment facility be approved by the North Carolina Division of Environmental Management (DEM) by way of an Authorization to Construct. Accordingly, a request for an Authorization to Construct was submitted to the State on February 21, 1983. This Authorization to Construct was granted on June 15, 1983. It is important to note that at this point ~~and~~ time we had all the approvals necessary to construct our new expanded ash pond.

In the same time frame, ~~the North Carolina Division of Environmental Management~~ DEM was in the process of proposing groundwater protection regulations. Specifically, DEM announced public hearings for the proposed groundwater rules in early April, 1983. Those hearings were held in late May, 1983, and the comment period actually ended on June 30, 1983.

In the past, a neighboring industry located adjacent to the Sutton Plant had complained of elevated chloride concentrations in the groundwater. This particular company used the groundwater as makeup to their circulating cooling water. They claimed that the elevated chloride concentrations were causing corrosion problems for them. The proposed groundwater regulations renewed this neighboring industry's concerns about chlorides. Also about this same time, that is the summer of 1983, clearing had started for the new ash pond at the Sutton Plant. This activity on our plant site further intensified our neighbors' interest. In an effort to address their concerns and to assure them that our new ash pond would not worsen their perceived problem, CP&L entered into negotiations with our neighbor to try and seek a mutually agreeable solution. Those negotiations which included the identification of various alternatives had continued until November, 1983.

CI 04 02 0117

In September, 1983, the DEM adopted their groundwater regulations and specifically adopted a 250 a part for million standard of chlorides. The regulations also stated that "should a facility cause the concentration of a particular contaminate to reach 50 percent of the groundwater standard, the DEM could initiate action to prevent further degradation of the groundwater.

Our neighbor was not at all pleased with the regulations that were adopted and in December, 1983, wrote the letter to DEM specifically recommending that our cooling lake and ash pond be "sealed". Our neighbor went further in the letter to suggest to the state that ~~they~~ revised their regulations such that not only would public health be protected by the adoption of groundwater quality standards which were equal to primary drinking water standards, but that the regulations should also protect existing ~~usage~~ of groundwater, either by industry or other parties, such that that existing use would not be precluded, even though the groundwater quality standard had not been exceeded. In response to these accusations and suggestions by our neighbor, ~~CP&L Company~~ decided that it would be in our best interest to go ahead and commit to lining the new ash pond. It should be noted that at this point and time, that is around at the end of 1983, CP&L already had all the approvals that were needed to construct the ash pond, but we could not ignore the accusations by our neighbor or the new groundwater regulation. For additional clarification, it should be noted that the groundwater regulations did not specifically require liners. Instead, they simply established standards, and it was up to the facility to design their ponds such that these standards would not be violated.

To follow up on this Company decision, CP&L submitted a request to ammend its Authorization to Construct such that a 1-foot clay liner would be installed in the new ash pond. We did this on March 26, 1984, and on May 8, 1984, that ammended Authorization to Construct was granted. The May 8, 1984, Authorization to Construct, however, for the first time, required specifically six groundwater monitoring wells.

The groundwater quality regulations were ammended further in the summer of 1984 and again at that time our neighboring industry urged the Division of

Environmental Management to adopt more stringent regulations such that we would have to line our cooling lake. The Division of Environmental Management considered those comments but did not incorporate them into the final version of the groundwater quality standards.

In summary, the Sutton Plant was in desperate need of additional ash pond capacity. The regulatory process which was going on at the time to adopt groundwater regulations and our neighbor's allegations concerning chloride contamination of the groundwater greatly complicated the choices that had to be made with regard to the ash pond designed. While the groundwater regulations are final now ~~and are not subject to change~~, the allegations from our neighbor continue. We must be aware of those allegations on a daily basis and continue to monitor the groundwater at this site in such a way as to refute their allegations and prevent a regulatory change which may require us to alter our plant operations.

CI 04 02 0119

FORM 21

tom Crawford
Bobby Ward } FYI

CP&L
Carolina Power & Light Company
Raleigh, N. C. 27602

COPY

FILE COPY
830-21-D-6

RECEIVED
AUG 20 1984
ENVIRONMENTAL SERVICES

August 15, 1984

FE&CD-84667

MEMORANDUM TO: Mr. R. L. Lively

FROM: L. B. Wilson

SUBJECT: L. V. Sutton Ash Pond Expansion
Status of Engineering and Construction

This memorandum will respond to your request for an update on the new Sutton ash pond design and construction as it relates to past concerns raised by Hercofina. The new ash pond will include a 12-inch thick clay liner having a permeability of less than 10^{-7} centimeters/second. The liner will cover the interior surface of the dikes and area within the new impoundment. The upper surface of the clay liner will provide a minimum cover of approximately three feet over the natural groundwater elevation.

With the introduction of the clay liner, the top elevation of the new ash pond dikes will be set at 34 feet msl. The dikes in the area of the existing ash pond will be increased to 28 feet msl. Most of the material for dike construction will be taken from within the ash pond; however, there will be a need for borrow areas outside and adjacent to the pond for dike construction. The clay material for the liner will come from an off-site location.

Information to assess the effects of the ash pond on local groundwater will be provided with the installation of three pairs of observation wells and a background monitoring well. The location and general construction of these monitoring wells have been based upon input from the North Carolina Division of Environmental Management.

Our current estimate for completing construction on the new ash pond is December 31, 1984. Please let me know if you have any further questions or need other details regarding the construction or design of the new facilities.

ORIGINAL SIGNED BY
L. B. WILSON

JMS/wgh

CI 04 02 0128

cc: Mr. L. W. Eury
Mr. J. B. McGirt
Mr. W. T. Bouras
Mr. R. E. Starkey, Jr. LWE 8/22

DUKE_CAIR_003991148

FORM 21

Charlie Ross

CP&L
Carolina Power & Light Company
Raleigh, N. C. 27602

COPY

FILE COPY
830-21-D-6

File: SXDE-001-020-XXX FE&CD-84523

June 25, 1984

MEMORANDUM TO: Mr. L. B. Wilson

FROM: R. W. Cooksey

SUBJECT: L. V. Sutton Steam Electric Plant
1984 Ash Pond Expansion
Meeting June 19, 1984

This is to provide information concerning the results of a meeting held with Mr. Rick Shiver, the Regional Hydrologist of the North Carolina Department of Natural Resources and Community Development, at the Sutton Plant on June 19, 1984. The purpose of the meeting was to discuss the State's monitoring requirements as outlined in their letter of May 21, 1984. The following individuals were in attendance: Mr. Tom Crawford (CP&L-Environmental Services), Mr. Charlie Ross (CP&L-Environmental Services), Mr. John Ruble (CP&L-Sutton Plant), Mr. Claude Henderson (CP&L-Sutton Plant), Mr. Phil Williams (CP&L-FE&CD), Mr. R. W. Cooksey (CP&L-FE&CD), and Mr. Rick Shiver (NCDEM).

The following points were discussed:

1. Monitoring requirements outlined in the letter of May 21 concern the existing ash pond only due to raising the dike.

2. The definition of downgradient with respect to monitoring was defined by Mr. Shiver as being from the existing ash pond toward Hercofina. Therefore, any monitoring wells would be installed east/northeast of the existing ash pond. The basis of this statement was Mr. Shiver's interpretation of the induced flow of groundwater based upon the effect of the existing ash pond, the new ash pond expansion, the cooling lake, as well as the effect of the pumping by Hercofina.

3. The monitoring well requirement was described by Mr. Shiver. This included the installation of one well station at the toe of the dike consisting of two wells, one at 10-20 foot depth and one at greater than 20 foot depth, and then another well station 250 feet downgradient from this location in the east/northeasterly direction. Mr. Crawford proposed that another well station be installed 500 feet from the base of the existing ash pond dike.

CI 04 02 0132

4. Mr. Shiver stated that a background well would be required at screened interval 20-30 foot depth. All the wells would be PVC lined. After further discussion with plant personnel, it was stated that if possible the background well would be constructed as a producing well such that the water could be utilized as well as providing background information. The background well would be located in an area not influenced by either ash ponds, cooling lake, or pumping by Hercofina. This would be east of the plant area and possibly south of the plant's present well No. 3.

5. Mr. Shiver requested that as the wells were completed that samples would be obtained and split between himself and CP&L personnel such that analysis could be compared. He stated that the final sampling frequency and analysis parameters would be finalized based upon these initial samplings. It is possible that the constituents indicated in the letter of May 21 may be revised based on what might be expected from an ash pond and what was found as a result of the initial sampling. Samples would be obtained by pumping.

6. The renewal of the monitoring requirements was discussed briefly, and it was stated that this could be part of the renewal for the NPDES Permit for Sutton Plant, that is the monitoring requirements for the ash pond could be subject to renewal on a five-year basis.

7. The planned sequence of construction and filling of the ash ponds was discussed. Present plans are that once the ash pond expansion is completed, lines from all three units will be discharged into the expansion area such that this pond could be filled starting at Elevation 14'. As this pond fills, the lines for 1&2 would be relocated back to the existing ash pond and used to fill this area. This scheme would provide equal filling in both areas and minimize the impact on ash systems on 1&2 units. This also would be a sequence filling, that is beginning at Elevation 14', increasing to 18', increasing in steps up to the maximum fill up to Elevation 36'. Mr. Shiver stated that this filling sequence would require further study by DEM as to the possible effects on any monitoring requirements. Given the discussion, DEM may request that additional wells be located adjacent to the ash pond expansion.

8. Mr. Shiver stated that the well construction standards are outlined in 15-NCAC-2L. However, he stated that an application should be made for variance because the requirements outlined in this code were greater than required for our monitoring program. He stated that the application should be made to Mr. Chuck Wakild.

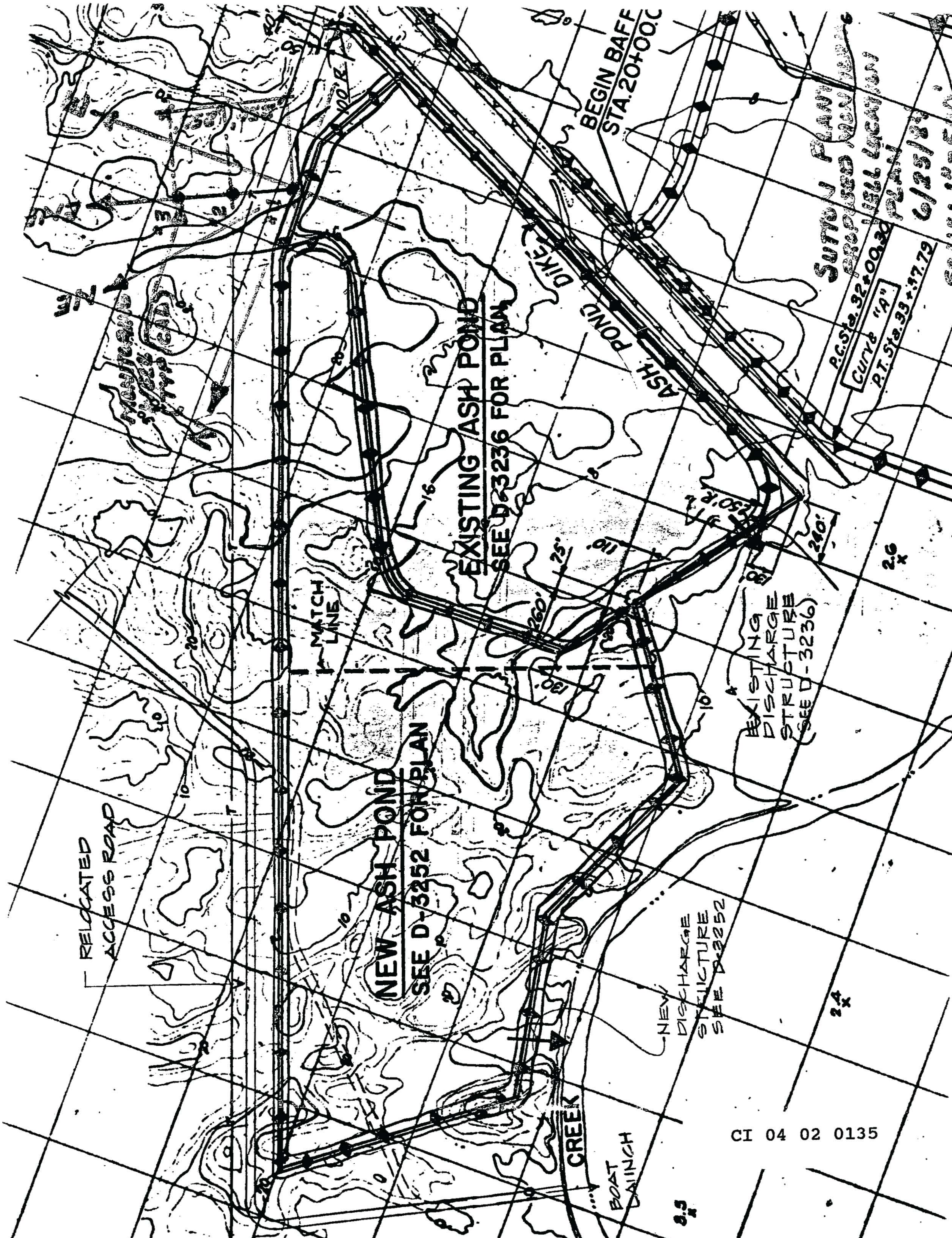
9. It was stated that the present cooling lake chloride content was approximately 150 parts per million. A discussion was also held with respect to the use of the drinking water standard as the groundwater standard and the fact that given the present chloride level in the cooling lake that the impact on groundwater as far as reaching the limits defined by the present water standards was very improbable.

Mr. Shiver agreed to contact Mr. Ross with any detailed follow up with respect to additional monitoring as well as to obtain additional technical clarifications with respect to groundwater comments of CP&L. The meeting was adjourned at 12:00 p.m.

ORIGINAL SIGNED BY
R. W. CORNEY

RWC/sht
Attachment
cc: Attendees (CP&L)
Mr. W. T. Bouras
Mr. J. M. Sell
Mr. R. B. Starkey, Jr.

CI 04 02 0134



CI 04 02 0135

DUKE_CAIR_003991152

FORM 21

CP&L
Carolina Power & Light Company
Raleigh, N. C. 27602

FILE COPY COPY

830-21-D-6 Charlie Mick Ricky Tom

File: SXDE-001-020-XXX CO-10059

May 21, 1984

Mr. W. T. Bouras, Plant Manager
L.V. Sutton Steam Electric Plant
Route 6, Box 46
Wilmington, North Carolina 28405

L.V. SUTTON STEAM ELECTRIC PLANT
1984 ASH POND EXPANSION
DESIGN BASIS EXPLANATION

Dear Mr. Bouras:

As requested, this letter will explain the design basis for the 1984 ash pond expansion plan as follows:

1. During 1983, the North Carolina Commission of Environmental Management provided "Authorization to Construct" approval of the new unlined ash pond, under the plant's NPDES Permit for ash pond discharge. The 1983 ash pond expansion plan was intended to provide one new ash pond area with a maximum operating level at Elevation +26, and maximum dike Elevation +28, to include the existing ash pond area and expansion toward the north end. The 1983 expansion was partially completed, including construction of dikes to Elevation +22, installation of a new discharge structure, and earthwork for perimeter drainage. A temporary separating dike was also constructed to keep water out of the new pond area, which would allow continued operation of the existing pond area up to Elevation +20.

2. In consideration of local groundwater concerns for the project by Hercofina, and changes in regulatory requirements concerning groundwater, FE&CD initiated a review of the 1983 expansion plan. Based on this review, the expansion plan was revised to include a liner for the new pond area. The purpose of the liner is to provide a barrier to flow of water from the pond into the groundwater.

3. The maximum operating level for the new ash pond area to be lined is at Elevation +32, and maximum dike Elevation +34. This is the maximum possible dike elevation that can be obtained using earth borrow material from the inside of the pond for construction of the new dikes, and limiting borrow to the level of existing natural groundwater (with approximately two foot cover).

CI 04 02 0136

4. Any plans that would include raising the operating level of the existing ash pond area above Elevation +26 would require a permit application to the State. We have been advised that this action would result in the requirement of a liner for the existing pond. Therefore, the revised expansion plan provides for operation of the existing ash pond to Elevation +26, which actually represents no change to the 1983 expansion plan. This requires a separating dike between the new and existing pond areas, to allow operation of the two areas at different elevations, and provide for termination of the new pond liner. ? old pond ?

5. Construction of existing ash pond dikes above Elevation +28, would require removal of ash deposits or other special stabilization methods for widening the dike base inside the pond. The existing dikes have been constructed to be raised from Elevation +22 to +28 without any change in base width.

6. The revised plan, as described, has been reviewed and approved by the North Carolina Commission of Environmental Management. The approval includes a request for providing a groundwater monitoring system.

7. The present expansion plan can minimize any required modifications to the plant ash handling system and drainage system. A sequenced filling of the new ash pond area and existing ash pond area will allow operation of the Unit Nos. 1 and 2 ash handling system and plant drainage system below Elevation +28. Operation of the Unit Nos. 1 and 2 ash handling system above Elevation +28 will require an increase in ash sluice pump discharge capacity, and a booster pump installation on the ash discharge. The plant drainage pumps must be modified to maintain the design discharge capacity for the increased operating head.

8. The proposed scope for ash handling system modifications will include increasing the Unit Nos. 1 and 2 ash pipe size from 10" diameter to 12" diameter and raising the Unit No. 3 air separator tank. All of this work is included in the present scope.

Please advise if you have any questions.

For your information, this explanation has been reviewed with Mr. John Ruble.

Yours very truly,
ORIGINAL SIGNED BY
L. B. WILSON

L.B. Wilson - Manager
Fossil Engineering & Construction

RSA/fpf (310105)

cc: Mr. T. J. Crawford
Mr. J. B. McGirt
Mr. J. T. Cox

CI 04 02 0137

FILE COPY
830-21-D-6

Aug. 19, 1987

Meeting - Joe Tomlinson, Hollar, McDowell

Bill Jerbowski - CEO Cape Ind

CI Board met - said their atty will contact us

Fred Day feels we need local atty to represent us

Law has been taking samples to help regulate (2 or 3)

Law called Monday, told not to come on-site

Met today Dick + C. Barham met - Barham will ask J. Davis to form a group (TF)

Letter will come from EPA requesting permission to put piezometers on our land

EPA contacted Jimmy Robinson yesterday, will hand deliver letter today

Has EPA contacted CP+L (Sutton) about Flemington?

1. Need to talk to New Hanover Co. + find out what is going on
2. Call Jimmy Robinson about piezometers 4-851-1205
3. Need formal agreement with EPA or NH Co.

Lee Crosby - DHS 733-~~2448~~ 2801

CKR

CP&L

Carolina Power & Light Company

FILE COPY
830-21-D-6

Shearon Harris Energy & Environmental Center
Route 1, Box 327
New Hill, North Carolina 27562

Serial No.: ESS-88-525

NOV 03 1988

Mr. Preston Howard
Regional Supervisor
7225 Wrightsville Avenue
North Carolina Division of Environmental Management
Wilmington, North Carolina 28403

RE: LV Sutton SEG Plant
NPDES Permit No. NC0001422

Dear Mr. Howard:

As you are aware, CP&L has been working with NCDEM for several years to assure compliance with groundwater GA standards in the area of the Sutton SEG Plant and it's associated lake and ash pond. Since early 1984, CP&L has maintained the lake and ash pond well within the groundwater GA standards for chlorides and TDS to prevent those facilities from being a source of groundwater exceedances. Not withstanding these efforts, exceedances have occurred in the groundwater near these facilities and, in 1987, NCDEM issued a Notice of Noncompliance for groundwater parameters of chlorides and TDS in monitoring wells associated with the Sutton lake and ash pond. CP&L has maintained and presented evidence that these exceedances are the result of the actions of third parties over which CP&L has no control.

In subsequent meetings CP&L explained efforts and expenditures made to assure that the lake and ash pond will not be a source of chlorides or TDS and proposed a voluntary NPDES permit change to formalize those efforts by placing limits on the lake and ash pond consistent with groundwater GA standards.

In our meeting of September 9, 1988, you proposed NCDEM's wording for that permit change. As discussed in that meeting, the proposed permit language is unacceptable to CP&L. It was our understanding from earlier discussions with Mr. Wakild that placing NPDES limits for chlorides and TDS on the lake and ash pond, and maintenance of those limits, would preclude the lake and ash pond from being implicated as a source of chlorides and TDS groundwater contamination. We understood from Mr. Wakild that wording to that effect could be included in the permit. Because no such wording is currently included in DEM's proposed permit wording, committing to the additional limits and monitoring detailed in the proposed permit change would not be in CP&L's interest. In addition, CP&L maintains that a voluntary permit change should serve to close out the Notice of Non Compliance issue.

CI 04 02 0007

CP&L strongly believes that a permit change as described above, with recognition that compliance for TDS and chlorides should be measured within the Sutton lake and ash pond, is the correct method to resolve this problem. If this point can be resolved, CP&L will be pleased to continue to negotiate a permit change to reach a mutually desirable result.

Yours very truly,

Original Signed By
G. H. Warriner

G. H. Warriner
Manager
Environmental Services

JMM/jww (88-15JMM)

bcc: Mr. F. N. Day
Mr. M. R. Greeson
Mr. D. E. Hollar
Mr. J. B. McGirt
Mr. R. B. Richey
Mr. J. M. Sell
Mr. J. Tomlinson
Mr. D. L. Wiley

CI 04 02 0008

FILE COPY
830-21-D-6

From: E85367 --VMRSCS Date and time 09/16/87 12:05:12
To: E27435 --VMRSCS I41797 --VMRSCS
I27899 --VMRSCS I41209 --VMRSCS Dale Hollar
E22267

From: G. H. Warriner
Subject: Sutton/Cape Industries Team "Notice of Noncompliance"

Received "Notice of Noncompliance" from Chuck Wakild, NC-DEM, Wilmington. I will send a copy by Company mail. Although the notice received is less severe than a Notice of Violation (NOV), the Notice of Content is explicit that Sutton surface water impoundments have resulted in surficial aquiter contamination.

From my regulatory perspective, the first issue is to establish understanding of cause with DEM. Therefore, my plan continues as before receiving the Notice, to arrange a technical review meeting with DEM via Wakild. I've discussed with Jim Sell and will be relying primarily on Jim for technical support, including the presentation.

Although important, presently this does not appear to be a fast-tracking issue. I expect meeting with Wakild at least a couple of weeks off since he is out this entire week. Ultimately, unless DEM has definitive technical information we are unaware of, a possibility exists that DEM at some point may bring others; e.g., Cape Industries, together to help pinpoint cause with specific technical basis. Will keep team advised.

If questions or some ideas, I would welcome them from the team. Please contact me directly by phone or Profs. Thanks.

George H. Warriner
Manager
Environmental Services Section

GHW/gg
cc: Mr. R. E. Jones
Mr. J. M. McDowell
Mr. J. B. McGirt
Mr. R. B. Starkey, Jr.

CI 04 02 0019

Charlie **FILE COPY**

830-21-D-6

Form 244

CP&L

Carolina Power & Light Company

New Hill, North Carolina
May 21, 1986

Company Correspondence

NERPU

MAY 22 1986

RECEIVED

Serial: ESS-86-718

MEMORANDUM TO: Mr. T. J. Crawford

FROM: G. H. Warriner

SUBJECT: Groundwater Near Sutton Plant

Based on the meeting you, Mr. Bill Bouras, and I had with Mr. Charles Wakild and Mr. Rick Shiver (DEM Wilmington Regional Office) on May 21, 1986, we have been requested to propose to the DEM an expanded groundwater monitoring (wells) program for demonstrating compliance with North Carolina Groundwater Quality Standards. We are to submit the proposed response within two to three weeks of the May 21 meeting date. The response should include an area map illustrating, as a minimum, sources, existing test wells, and any additional proposed test wells.

As discussed, the requested expanded groundwater monitoring program is significantly different and preferable to the April 30 request for a "study," including impact on the New Hanover County water system. DEM recognizes other forces exist influencing the area groundwater. Because of the Cape Fear Industries dispute over water quality and some CP&L data showing 50 percent of the chloride standard, DEM is compelled for public record to insist that CP&L at Sutton Plant demonstrate compliance of North Carolina groundwater standards. Mr. Wakild realizes this will not solve Cape Fear Industries problems.

Therefore, please coordinate directly with Sutton Plant, Fossil Operations Department, and Mick Greeson to develop a response to the expanded well monitoring request. Provide the response to me no later than June 4.

Should you have any questions, please call me.

Original Signed By

G. H. WARRINER

GHW/gl

cc: Mr. W. T. Bouras
Mr. F. N. Day
Mr. M. R. Greeson
Mr. J. B. McGirt
Mr. R. B. Starkey, Jr.
Mr. D. L. Wiley

CI 04 02 0103

SIERRA CLUB

QUARLES EXHIBIT 7

1979 MAYO GROUNDWATER REPORT

Docket No. e-2, Sub 1219

EVALUATION OF THE POTENTIAL FOR CONTAMINATION OF THE GROUND-WATER AQUIFER BY LEACHATE FROM THE COAL-ASH STORAGE POND AT THE MAYO ELECTRIC GENERATING PLANT SITE

Prepared By

Edwin O. Floyd, P.E.
Ground-Water Hydrologist

Moore, Gardner & Associates, Inc.
Consulting Engineers

Cary, North Carolina

January 31, 1979

EVALUATION OF THE POTENTIAL FOR CONTAMINATION OF THE GROUND-WATER AQUIFER BY LEACHATE FROM THE COAL-ASH STORAGE POND AT THE MAYO ELECTRIC GENERATING PLANT SITE

Introduction

This report discusses the results of an on-site investigation of the geology and ground-water conditions and the potential for ground-water contamination by certain trace elements in ash sludge to be deposited in a proposed ash-disposal pond at the Carolina Power and Light Company generating plant site on Mayo Creek in Person County, North Carolina.

The scope of the investigation included research of existing records and reports, test drilling, sampling and laboratory testing of soils and water to determine the relation of the water table to topography, the physical condition of the soil and underlying rock, and the concentrations of certain trace elements in the ground water. Using the data collected, an evaluation is to be made of the potential impact on the ground-water aquifer by contamination from the ash pond and coal-storage yard.

GEOLOGY AND HYDROLOGIC CONDITIONS [1)]

The site of the proposed ash pond comprises approximately 160 acres. It is situated on Crutchfield Branch about 3/4 mile

1) "Report of Subsurface Investigation, Mayo Creek Site, Person County, North Carolina. Volume 1, Section 2, pp.4-10. Law Engineering Testing Company, Raleigh, N. C."

west of Mayo Creek and about 1/2 mile south of Virginia State Line.

The terrain is typical of the Piedmont Province with rolling to moderately steep slopes. At the pond site, the elevations range from about 400 feet to about 540 feet above mean sea level. At present, the site is completely wooded with mixed hardwood trees and pines.

The watershed for the proposed ash pond is small. It extends from N. C. Highway 501 on the west to a low ridge about 200 yards east of the pond site and to S. R. 1501 on the south, and it is limited by the pond dam on the north. It contains an area of less than 500 acres.

In the vicinity of the ash pond and generally on the west side of Crutchfield Branch the area is predominantly underlain by granitic gneiss and hornblende gneiss.

The granitic gneiss is a light to medium gray, medium to coarse-grained rock ranging from granite to quartz monzonite to quartz diorite in mineral composition. The degree of gneissic banding varies widely at different locations, and at some locations where no banding is visible the term granite or quartz monzonite may be more appropriate.

The foliation trend is N 10°- 30°E and dips 50° to 70° SE. Moderate to steeply dipping joints are commonly spaced 2 to 5 feet apart.

Included in the granitic gneiss are layers of hornblende gneiss. The hornblende gneiss was not seen in outcrop or saprolite, but based on the literature and previous mapping, it may be encountered in extensive excavations or drilling near the west edge of the site. The hornblende gneiss may be genetically equivalent to the chloritic rocks in the Mayo Creek-Calvary Church area.

The granitic rocks weather to saprolites, including light-colored, slightly micaceous sandy silt, overlain in upland areas by a veneer of reddish colored clayey silts that reflect an advanced weathering state. The depth of soil development is on the order of 5 to 20 feet.

The rocks east of Crutchfield Branch consist mainly of the Hyco formation, primarily a fine to medium grained light gray quartzo-feldspathic rock with varying degrees of porphyritic or porphyroblastic texture and varying development of cleavage and schistocity. It grades from a gneiss quartz porphyry most commonly seen toward Crutchfield Branch to a quartzo-feldspathic sericitic phyllite, most common east of Mayo Creek. Epidote is common as a plagioclase alteration product. The feldspars are predominantly sodic plagioclase. The Hyco quartz porphyry appears to be a metamorphosed rhyolitic lappilli tuff. The coarser-grained gneissic quartz prophyry closely resembles the granitic gneiss to the west, and suggests a gradation from Hyco lithology to granitic gneiss.

In the site area, cleavage in this rock is for all practical purposes parallel to compositional banding. Cleavage planes are generally spaced 2 to 3 feet apart in the western part of the belt and 4 to 6 inches apart east of Mayo Creek. The cleavage strikes N 10° - 60° E and dips 60° to 80° SE, the steepest dips being more common on the east side of the belt. Lineations caused by mineral elongation usually plunge parallel or obliquely to maximum cleavage dip. Crenulations on cleavage surfaces are usually aligned approximately parallel to the strike trend. Joint spacing varies widely; most commonly the joints are moderately to steeply dipping and are spaced 1 to 3 feet apart.

Included in the Hyco formation are sills of chloritic phyllite and chlorite schist that are usually 0.5 to 5 feet thick. These chloritic seams are thought to be meta-andesites and metabasalts, sometimes resembling, in hand specimen, sheared metagabbro. They are usually somewhat softer and more deeply weathered than the enclosing rocks. Cleavage and joint development is similar to that in the Hyco quartz porphyry.

Also included are northeast-trending lenticular bodies of granitic gneiss in the western half of the belt near Crutchfield Branch.

The upper soils in the Hyco formation consist of very light gray to white saprolites, including slightly micaceous fine sandy silt, overlain in upland areas by 5 to 10 feet of red brown clayey residuum. The bands of chloritic rocks usually weather to ochre-colored very micaceous saprolites and clayey surface soils.

The upper soil zone is usually underlain by 10 to 20 feet of soft weathered rock, with minor lenses of moderately hard rock.

In addition to the major rock groups described above, quartz veins occur as small veinlets throughout the area. Quartz veins 1 to 10 feet thick outcrop about 1/4 mile south of the location of the ash pond dam site. The main veins trend northerly, reflecting the orientation of mineralized veins east of the site area, mapped by Laney.[1)] The veins in the site area contain small amounts of metallic sulphides and oxides.

Alluvial soils occur along the channel of Crutchfield Branch. Field inspection and study of the agricultural soil map show that the alluvium is restricted to present day flood plains, with no high level terrace deposits existing in the site area. Previous experience in similar areas suggests that generally the alluvial cover consists of sandy clayey

[1)] Laney, F.B., 1917, The Geology and Ore Deposits of the Virgilina District of Virginia and North Carolina, Virginia Geological Survey Bulletin No. XIV pp.176

silts near the surface, grading downward into silty sands overlying a sandy gravel base which rests on clay or saprolite.

Figure 1 is a generalized map of the water-table at the ash pond site as it appeared on October 2, 1978. The water levels reflect the late summer dry season and are at, or very near, the yearly lowest levels. Seasonal fluctuations are probably within the range of 5 to 15 feet in upland areas and 2 to 5 feet in the valleys.

The water table configuration is determined mostly by topography, with depths to water usually being greatest in the upland areas and shallowest in the valleys. Ground-water depths at test well locations are shown on Figure 1. The phreatic surface is sub-parallel to the ground surface, with occasional shallow ground water in the upland areas occurring in a perched condition as anomalously trapped ground-water bodies over relatively impermeable soils.

Beneath the water table, the overall movement of ground water is determined by a combination of topography and the orientation and abundance of rock joints and cleavage. Considering the overall site vicinity, the Crutchfield Branch surface drainage basin also constitutes a small ground-water regime, with ground-water divides occurring beneath the drainage divides. From these divides the water table slopes downward toward Crutchfield Branch and its tributaries, and ground-water seepage provides a part of the water supply to these streams.

Within this general framework, the localized movement of ground-water follows erratic paths along joints and cleavage planes. Between joints and cleavage planes, the rocks at this site are virtually impermeable. Pressure tests by Law Engineering Testing Company at the site confirm the visual conclusion that the rock joints are tight. Only two holes showed relatively high intake with calculated permeabilities ranging from 50 to 850 feet per year (5×10^{-5} to 8.5×10^{-4} cm/sec). No measurable quantities of drilling water were lost in any of the test holes completed by Law Engineering.

EVALUATION OF DATA

One of the main questions regarding the construction of the ash pond is whether or not certain trace elements contained in the fly ash will infiltrate from the bottom of the pond into the ground-water aquifer. To answer that question, this investigation was initiated. During the summer and early fall of 1978, thirteen test holes were drilled at the ash pond site. Records and reports of previous studies in the area were researched, and water samples from the test wells were analysed to determine the natural concentrations of the trace elements in the ground water. The results of the water analyses are shown in table 1. The locations of the twelve test holes are shown on figure 1, and the driller's logs are given in the appendix.

Also shown in figure 1 are contours delineating the elevations of the water table. These contours were drawn by relating the depth-to-water to the topography of the site and by extending lines from areas of known elevations into areas of unknown elevations. The map illustrates that the ground-water movement is across the contours and towards Crutchfield Branch or its tributaries. This movement is significant in that it demonstrates that any leakage that might occur from the ash pond will not flow away from the pond except it may flow under the dam through possible fractures in the rocks and then into Crutchfield Branch.

Except in and along the stream channels and at isolated outcrops of hard rock, the site of the ash pond is overlain by clay or sandy clay and silt ranging from a few inches to about 8 feet in thickness. It is underlain by saprolite that grades into hard rock generally below depths of 20 to 25 feet.

Three "undisturbed" soil samples were taken from the ash pond site for the purpose of measuring permeabilities and sorption properties of the actual bottom of the proposed pond. (Permeabilities of the samples were too small to be measured by the available laboratory methods. Permeability tests made by the Radian Corporation on similar materials indicate that permeabilities of the samples would probably be in the range of 5×10^{-8} to 1×10^{-5} cm/sec. With these conditions, there should be almost no leakage through the pond bottom where there is a foot or more soil cover over the rocks. In the outcrops and along the stream channels where leakage could possibly occur under the existing conditions, steps will be taken to seal those areas prior to filling the pond. A suggested method for sealing those areas with natural clay and bentonite is illustrated in figures 2 and 3.)

In a study of the role of trace elements in the disposal of ash sludge made by Radian Corporation[1)], five ash disposal ponds, each in different geological settings, were investigated. The following statements are from the abstract of the report on that study:

"Actual samples of ash and sludge from five operating generating stations were exposed to leaching conditions to simulate ponding. The levels of the dissolved trace elements were in general low, near the analytical detection limit.

1) "Environmental Effects of Trace Elements from Ponded Ash and Scrubber Sludge"; Radian Corporation, Austin, Texas; 1975.

t = Thickness of overburden on hard rock.

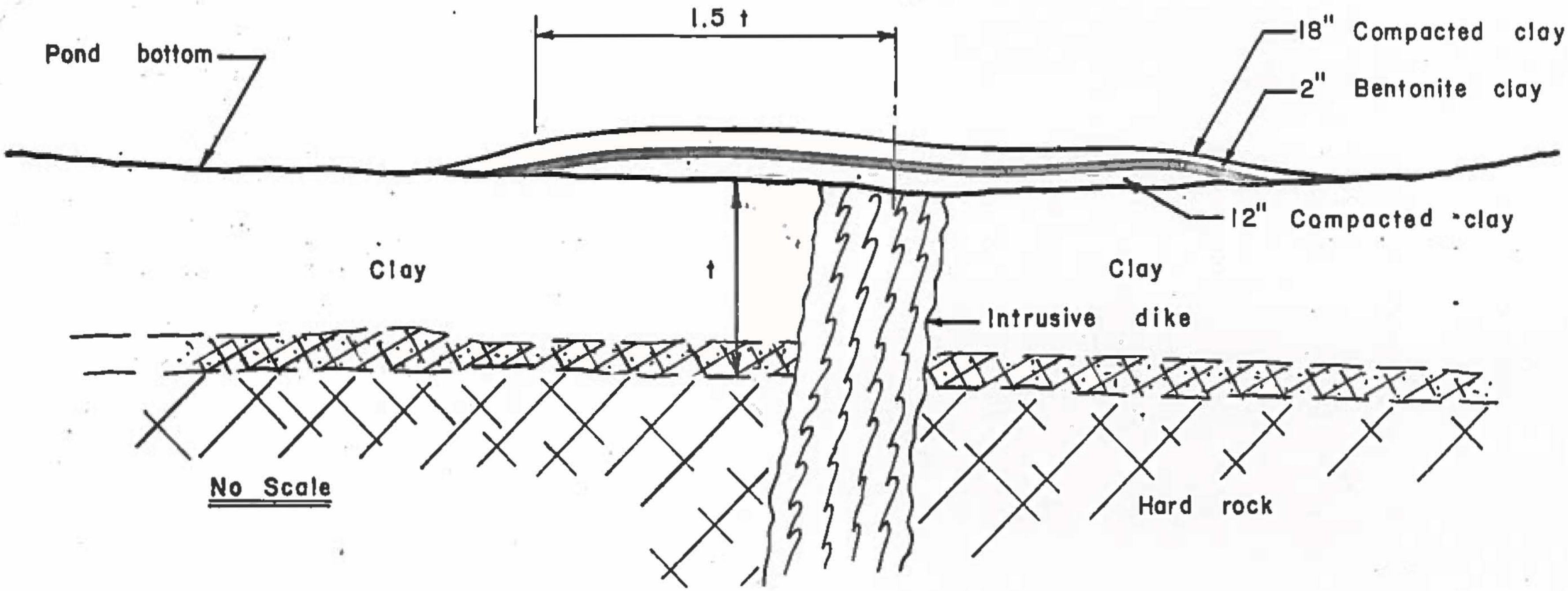


Figure 3. Diagrammatic section showing method of sealing possible routes of infiltration at intrusive dikes.

t_n = Average thickness of overburden within 100 ft. radius of possible infiltration point.

t_m = Minimum thickness of overburden at point of possible infiltration.

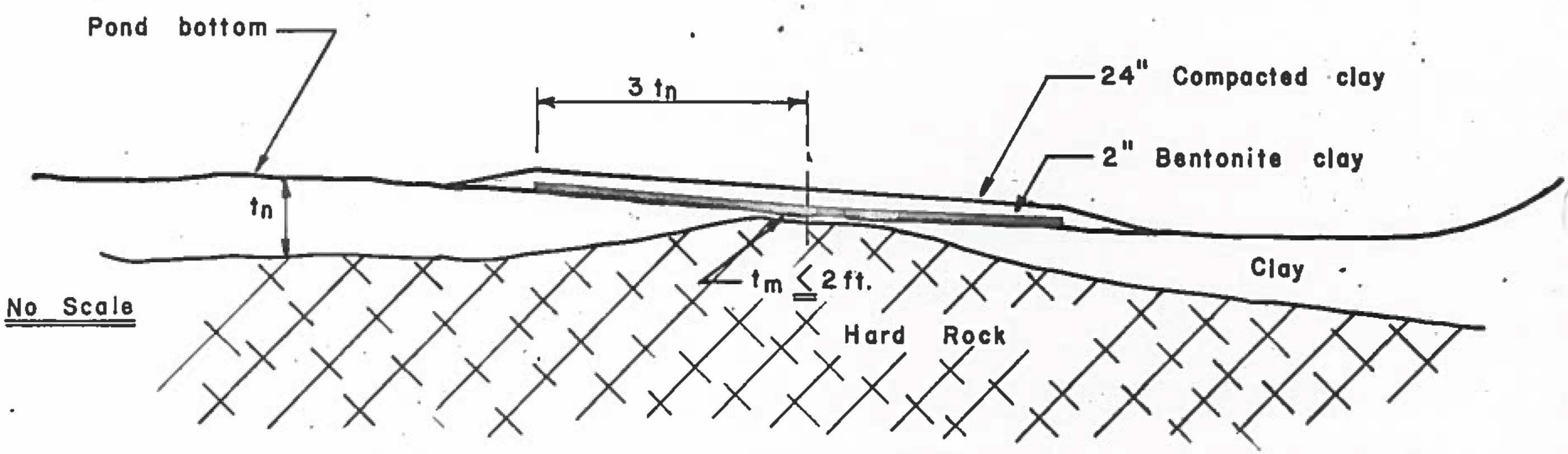


Figure 2. Diagrammatic section showing method of sealing possible routes of infiltration where overburden is thin or absent.

CP&L Carolina Power & Light Company	Section: Environmental Technology	Application: Special Analyses	Remarks:
	Effective Date: 5/16/77	Revision Date: 5/16/77	1) Mayo Creek - Well Water 2) Duplicate analyses performed for Quality Control 3) 78-3609 - Large amount of SiO_2

Sample Nos: 78-3603 – 78-3613

Sample No		Date Received 1978	Date Sampled 1978	Identification	Total Arsenic mg/1	Total Cadmium mg/1	Total Chromium mg/1	Total Copper mg/1	Total Selenium mg/1	Total Iron mg/1	Total Lead mg/1	Total Mercury mg/1	Total Nickel mg/1	Total Zinc mg/1	
78	3603	10-3	10-3	Well Water - #2	<0.01	<0.01	<0.05	<0.02	<0.01	1.10	<0.05	<0.001	<0.05	<0.05	
78	3604	10-3	10-3	Well Water - #3	<0.01	<0.01	<0.05	<0.02	<0.01	2.64	<0.05	<0.001*	<0.05	<0.05	
78	3605	10-3	10-3	Well Water - #4	<0.01	<0.01	<0.05*	<0.02*	<0.01	13.98*	<0.05	<0.001	<0.05*	0.05*	
78	3606	10-3	10-3	Well Water - #5	<0.01	<0.01	<0.05*	<0.02	<0.01	2.09	<0.05	<0.001	<0.05	<0.05	
7	3607	10-3	10-3	Well Water - #6	<0.01	<0.01	<0.05	0.02	<0.01	5.62	<0.05	<0.001	<0.05	0.05	
78	3608	10-3	10-3	Well Water - #8	<0.01	<0.01	<0.05	<0.02	<0.01	4.28	<0.05	<0.001	<0.05	<0.05	
78	3609	10-3	10-3	Well Water - #9	<0.01	<0.01	<0.05	0.24	<0.01	40.50	0.15	<0.001*	0.05	0.38	
78	3610	10-3	10-3	Well Water-#10	<0.01	<0.01	<0.05	0.08	<0.01	6.97	0.10	<0.001	<0.05	<0.05	
78	3611	10-3	10-3	Well Water-#11	<0.01	<0.01	<0.05	0.02	<0.01	2.09	0.07	<0.001	<0.05	<0.05	
78	3612	10-3	10-3	Well Water-#12	<0.01	<0.01	<0.05	0.05*	<0.01	3.38*	0.08	<0.001	<0.05	<0.05*	
78	3613	10-3	10-3	Well Water-#14	<0.01	<0.01	<0.05	0.03	<0.01	6.10	0.06	<0.001	<0.05	0.05	

Note: Wells 1 & 7 did not yield sufficient water for sampling.

Table 1 – Analyses of water from test holes at the Ash Pond Site on Crutchfield Branch

Analysis Requested by: Tom Crawford

Analysis Performed By: G. Dean, W. Brown

10-13-78
Reporting Date

Lawrence L. Ball
Supervisor - Analytical Laboratory

Selenium, chromium, boron, and, in isolated instances, mercury and barium exceeded the proposed EPA Public Water Supply Guidelines."

"Water leaking from a pond will pass through a soil layer before mixing with ground waters. A series of batch and column tests using ash and sludge leachate in contact with natural soils was used to determine the degree of removal of trace elements in pond subsoil. Passage of pond effluent through soil was found to provide significant protection against ground-water contamination by trace elements."

Similar sorption tests were made on the soils from the upper two feet of test holes B-11, B-12 and near the site of B-13 adjacent to the property lines in the proposed ash pond site and also on the ash sludge from the bottom of the existing ash pond at the Hyco Plant near Roxboro. A water sample was taken from the ash pond and analyzed to determine the concentrations of certain trace elements prior to any contact with the soils. The water sample was then filtered through a 3 3/4-inch re-packed column of material from each test hole and the ash pond sludge. The results of the analyses are given in table 2. In contact with the ash pond sludge, the water sbsorbed additional arsenic and selenium as shown in the table. However, after passing through the 3 3/4-inch columns of soils from the test holes, the concentrations of all measured constituents, except iron, were

Date Rec'd.	Identification	Total Arsenic mg/l	Total Cadmium mg/l	Total Chromium mg/l	Total Copper mg/l	Total Iron mg/l	Total Lead mg/l	Total Mercury mg/l	Total Nickel mg/l	Total Selenium	Total Zinc mg/l
1/15/79	Raw water from Hyco Ash Pond	< 0.01	< 0.01*	< 0.05*	< 0.05	11.75	< 0.05*	< 0.001*	< 0.05*	< 0.01	0.05*
1/15/79	Water from Hyco Ash Pond after filtration through 3 3/4" column of ash sludge	0.06	-	-	< 0.05	1.37	-	-	-	0.16	-
1/15/79	Water from Hyco Ash Pond after filtration through 3 3/4" column of soil from test holes at:										
	B-11	< 0.01	< 0.1	< 0.05	< 0.05	17.3**	0.06	< 0.001	< 0.05	< 0.01	0.14
	B-12	< 0.01	< 0.1	0.07	< 0.05	0.61	0.18	< 0.001	< 0.05	< 0.01	0.24
	Near site of B-13	< 0.01	< 0.1	0.06	< 0.05	4.97	0.09	< 0.001	< 0.05	< 0.01	< 0.05

* Typical values from previous water samples.

** High concentration of Iron may be due to presence of iron-stained sediment in water sample.

Table 2 - Analyses of filtered water from test holes at Crutchfield Branch Ash Pond Site and water from the Ash Pond at the Hyco Electric Generating Plant

substantially reduced, and in most cases were less than the laboratory's limit of detection.

These results are quite similar to those determined by the Radian Corporation in the study mentioned earlier.

It must be emphasized here that if only 3 3/4 inches of the natural material from the proposed pond bottom can remove such quantities of the trace elements in 48 hours as illustrated, there cannot be much threat of contamination to the water table aquifer by leachate from the ash pond.

In the "Summary and Conclusion" section of the Radian Corporation report, on page 3, it further states, "Even for those few elements exceeding the proposed water standards, typical soils were found to give some degree of protection. The soils studied ranged from a clay which gives complete protection to a sandy soil typical of Southwestern conditions. For example, 40 feet of soil similar to that at Station 3 (clay - 90% Kaolinite, 10% Montmorillonite, permeability 7.4×10^{-6}) will remove over 95% of the selenium and chromium from pond leachate after 10 years of continuous flow. Soil with a high percentage of sand provides the least protection. However, 50 feet of even this type of soil will remove over 95% of copper, arsenic, or zinc after 10 years flow."

"The assumptions used in the calculations of sorption of trace elements by soil are conservative. Trace elements do not appear to be a serious barrier to the use of ponding as a disposal method for sludge or ash. The initial concentration levels in pond waters are generally low."

From page 47 of the same report, "Over even an estimated 30-50 year active life most soils will provide substantial protection against trace elements reaching an aquifer. The assumption used in these calculations are very conservative in that ash and sludge materials will tend to be self-sealing due to the small particles plugging the soil formation. This will reduce the actual flow giving even more protection than is calculated."

The point to be considered here is that the proposed ash pond bottom can be made virtually impermeable by sealing the creek channels and outcrops as mentioned above. Furthermore, as stated in the Radian Corporation's report, the degree of impermeability will increase with use as more ash and sludge are deposited on the bottom.

Early in the summer of 1978, a brief study was made of the effects on the water table of the twelve-year old ash pond at the Hyco Electric Generating Plant. Three wells tapping the water table aquifer were drilled downstream from the pond near the dam as shown in figure 4. A water sample was collected from the ash pond, from wells 1 and 2 and also from a privately-owned well about 2500 feet from

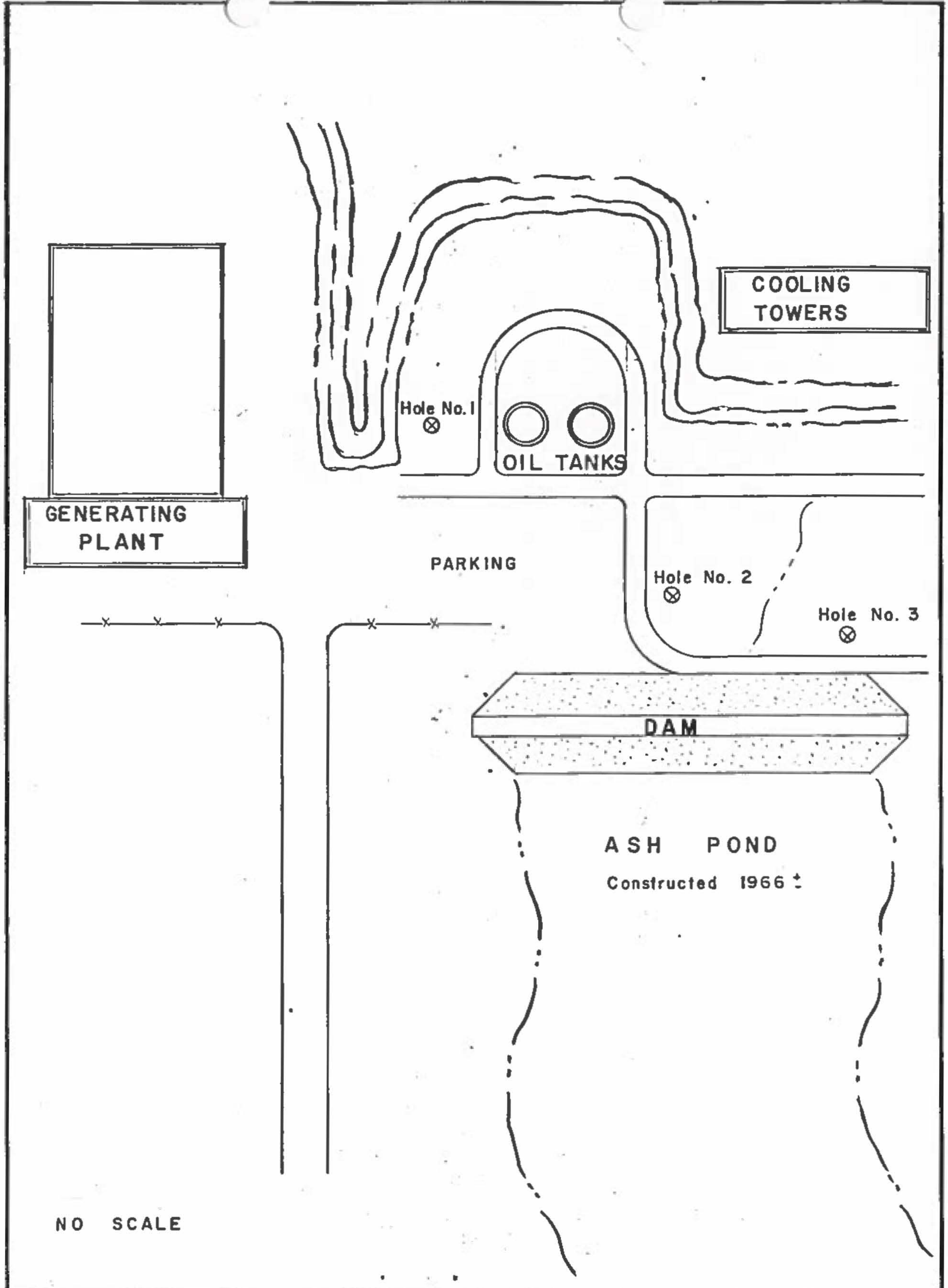


FIGURE 4. MAP OF ROXBORO ELECTRIC GENERATING PLANT SHOWING LOCATION OF TEST HOLES

CP&L Carolina Power & Light Company

Section: Environmental Technology	Application: Special Analyses	Remarks: Mayo Creek Well Waters - Tom Crawford	Sample Nos. 78-2181, 78-2188
Effective Date: 5/16/77	Revision Date: 5/16/77		

Sample No.		Date Received 1978	Date Sampled	Identification	µg/ml Arsenic	µg/ml Cadmium	µg/ml Chromium	µg/ml Copper	µg/ml Iron	µg/ml Lead	µg/ml Mercury	µg/ml Nickel	µg/ml Selenium	µg/ml Zinc
78	2181	6/6		Rox. Robinson Well	< 0.01	< 0.01	< 0.05	0.04	< 0.05	< 0.05	<0.001	< 0.05	≤ 0.01	0.16
78	2182	6/6		Hole #1 (Rox Oil)	< 0.01	< 0.01	< 0.05	< 0.02	< 0.05	< 0.05	"	< 0.05	< 0.01	2.29
78	2184	6/6		Rox Hole #3 (Dam)	< 0.01	< 0.01	< 0.05	0.04	< 0.05	< 0.05	"	< 0.05	< 0.01	1.93
78	2185	6/6		Mayo - Crutchfield	< 0.01	< 0.01	< 0.05	< 0.02	< 0.05	< 0.05	"	< 0.05	< 0.01	< 0.05
78	2186	6/6		Mayo -CA-17(S)	< 0.01	< 0.01	< 0.05	< 0.02	< 0.05	< 0.05	"	< 0.05	< 0.01	< 0.05
78	2187	6/6		Mayo -CA-18	< 0.01	< 0.01	< 0.05	< 0.02	< 0.05	< 0.05	"	< 0.05	< 0.01	< 0.05
78	2188	6/6		Mayo CA-32	< 0.01	< 0.01	< 0.05	< 0.02	< 0.05	< 0.05	"	< 0.05	< 0.01	< 0.05

Table 3—Analyses of water samples from test wells at the Hyco Plant and Crutchfield Branch and older test holes at the Ash Pond Site.

Analysis Requested by:

Analysis Performed By: W. Brown

Reporting Date:

Supervisor — Analytical Laboratory

the ash pond. The samples were analyzed for certain trace elements as shown in table 3. With the exception of zinc and copper, all tested constituents were below the limits of detection. These results again reinforce the Radian Corporation report that a few feet of clay can give essentially complete protection against the trace elements that occur in ash pond sludge.

The twelve test holes drilled during the summer of 1978 were finished as observation wells in order that periodic water-level measurements can be made and samples of water can be taken for analyses of the trace elements. They will provide a monitoring system to detect the trace elements in the ground water if contamination should occur in the future. Analyses of the natural ground water in the observation wells are shown in table 1. The data in the table indicate that the natural concentrations of most of the trace elements are too small to be detected by the available laboratory methods.

SUMMARY

Coal-fired electric generating plants produce significant quantities of ash that contain certain heavy minerals or trace elements. When disposed of by ponding, these heavy minerals can solubilize and, under some hydrologic conditions, may infiltrate through the pond bottom to the underlying ground-water aquifer. It has been determined through actual field and laboratory studies that the concentrations of the heavy minerals can be significantly reduced by filtering the leachate from the ash ponds through natural soils. Soils containing large proportions of clay afford the most efficient filtration. For instance, soils containing at least 90% clay can remove over 95% of the selenium and chromium after 10 years of continuous flow through a 40-foot section.

Soil conditions at the proposed ash pond site at the Mayo Electric Generating Plant are adequate to provide excellent protection to the ground-water aquifer both in preventing significant leakage from the pond and in reducing the concentrations of the heavy minerals by filtration before the leachate reaches the aquifer. Average permeability of the natural soil should be in the order of 3×10^{-6}. In those parts of the ash pond where soil cover over the rocks is thin or absent, such as at rock outcrops and in the stream channels, special effort must be made to seal the possible leakage paths with the addition of natural clay and bentonite. Settlement of ash and sludge will continually reduce the permeability of the pond bottom with usage.

Subsurface flow in the aquifer will not be laterally away from the pond but rather towards the existing stream channels. Some flow could occur under the dam and subparallel to the channel of Crutchfield Branch for a relatively short distance and then discharge upwardly into the stream.

The small amount of leachate that may flow under the dam should be rendered essentially free of excess heavy minerals through the action of filtration through the soil and dilution with the natural ground waters within a few hundreds of feet below the dam or by the time natural discharge returns it to the stream. Periodic sampling of the ground water from the observation wells around the pond will detect any evidence to the contrary.

In consideration of the natural action of the soils on heavy minerals in the leachate, the dilution effects of mixing with the natural ground water, and the fact that there are no water supply sources or major water courses for miles downstream from the ash pond dam, it is difficult to imagine that any significant adverse impact on the ground water aquifer could be caused by ponding of the ash wastes at the proposed site.

I certify that this report on the ground-water conditions at the ash storage pond at the Mayo Electric Generating Plant site was prepared by me or under my direct supervision.

Signed Edwin O. Floyd

Edwin O. Floyd, P.E.

January 31, 1979

NORTH CAROLINA REGISTERED SEAL 4820 ENGINEER EDWIN O. FLOYD

APPENDIX

Depth Interval	Soil Description
Boring No. 3	
0' - 1'	Reddish brown silty clay
1 - 12	Brown sandy clayey silt with boulders
12 - 13.5	Brown micaceous silt with boulders (Very hard drilling)
13.5	Auger refusal
13.5 - 17.0	Green hard rock with thin seams of quartz
17 - 39	Gray-white hard granite with seams of quartz
Boring No. 4	
0' - 1.5'	Brown silty sandy topsoil
1.5 - 5.5	Brown silty gray clayey sand
5.5 - 7.0	Brown weathered rock Auger refusal
7.0 - 10.0	Gray-brown granite with weathered seams
10 - 17	Gray hard granite
Boring No. 5	
0' - 0.5'	Reddish brown topsoil with gray clayey sand
0.5 - 6.0	Brown silty soil with gray sandy clay
6.0 - 10.0	Gray-tan soil with gray silty clay and gravel
10.0 - 13.5	Brown-tan sandy silty weathered rock
13.5	Auger refusal
13.5 - 29	Gray very broken granite

Depth Interval	Soil Description
Boring No. 6	
0' - 1.0'	Brown silty sandy clay
1.0 - 7.0	Brown sandy silt with some clay and weathered rock layers
7.0 - 9.0	Brown weathered rock - hard drilling
9.0	Auger refusal
9.0 - 15.0	Brown sandy soft granite
15.0 - 30.5	Gray granite with weathered seams
Boring No. 7	
0' - 5.0'	Reddish Brown silty clay
5.0 - 29.0	Brown-tan fine sand with silty tan clay
25.0 - 35.0	Brown-tan weathered rock with fine silty sand
Boring No. 8	
0' - 0.5'	Reddish brown silty clay
0.5 - 6.0	Tan weathered siltstone
6.0 - 11.0	Brown fine sandy silt
11.0	Auger refusal
11.0 - 17.0	Greenish-tan broken granite and quartz with limestone layers
17.0 - 24.0	Greenish limestone with layers of quartz and granite
24.0 - 40.0	Gray broken granite with thin layers of limestone and seams of quartz

Depth Interval	Soil Description
Boring No. 9	
0' - 0.7'	Brown clayey sandy topsoil
0.7 - 8.0	Brown tan with gray silty sand with some clay
8.0 - 14.5	Pinkish-gray micaceous silty weathered rock
14.5	Auger refusal
14.5 - 30.0	Pinkish gray broken granite with thin quartz layers. Silty layer from 25.5' to 26.5'
Boring No. 10	
0' - 0.4'	Gray-brown fine sandy topsoil
0.4 - 9.5	Gray-brown medium to hard highly weathered rock
9.5 - 18.8	Gray-brown medium to hard highly weathered rock with pebbles
18.8	Auger refusal
18.8 - 40.1	No logs
Boring No. 11	
0' - 7.0'	Brown-tan sandy micaceous silt and weathered rock
7.0 - 10.0	Tan weathered rock
10.0	Auger refusal
10.0 - 18.5	Gray broken granite
18.5 - 30.5	Gray granite with thin quartz layers

Depth Interval	Soil Description
Boring No. 12	
0' - 0.4'	Brown clay and sandy topsoil
0.4 - 7.0	Reddish brown silty clay with trace of fine sand
7.0 - 17.0	Yellowish-tan silty sandy weathered rock with small pieces of broken quartz
17.0 - 20.0	Gray-tan weathered rock
20.0	Auger refusal
20 - 37.5	No logs
Boring No. 13	
Not drilled	
Boring No. 14	
0' - 17.0'	Yellowish brown silty clay with broken rock fragments
17.0 - 31.5	Gray weathered rock
31.5	Auger refusal
31.5 - 42.5	Gray-tan granite with weathered seams