Duke Engineering & Services
A Duke Energy Company

CSX/VAUGHN LAND[illegible] AND BRA[illegible]LETTE ROAD [illegible]TES

PHASE III INVESTIGATION AND SITE ASSESS[illegible]NT REPORT

VOLUME I

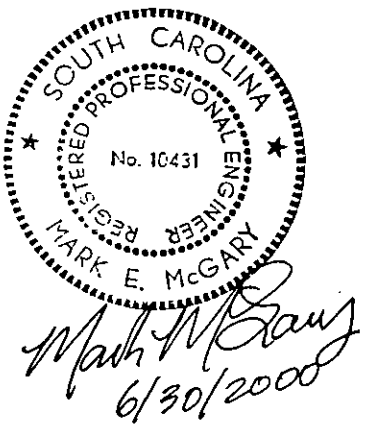
PREPARED BY:

SITE REMEDIATION SERVICES GROUP
DUKE ENGINEERING & SERVICES, INC.
400 SOUTH TRYON STREET
P.O. BOX 1004
CHARLOTTE, NORTH CAROLINA
28201-1004

JUNE 2000

CSX/VAUGHN LANDFILL
AND
BRAMLETTE ROAD MGP SITES

PHASE III
INVESTIGATION AND SITE ASSESSMENT REPORT



Prepared by:

SITE REMEDIATION SERVICES GROUP
DUKE ENGINEERING & SERVICES
JUNE 2000

Table of Contents

Section		Page
1.0	**Introduction**	**1**
2.0	**Site Description and History**	**1**
3.0	**History of Site Investigations**	**3**
3.1	AES Phase I Site Investigation - March 1995	3
3.2	AES Phase II Site Investigation - September 1996	5
3.3	AES Wetland Delineation Report - April 1999	7
4.0	**Site Topography**	**7**
5.0	**Site Geology**	**9**
6.0	**Monitoring Wells and Site Hydrogeology**	**11**
6.1	MGP Site Monitoring Wells	11
6.2	CSX/Vaughn Landfill Monitoring Wells	12
6.3	Groundwater Elevations - June 1999	15
7.0	**Soil and Sediment Assessment**	**16**
7.1	MGP Site - Soil Analytical Results	17
7.2	CSX/Vaughn Landfill Site - Soil Analytical Results	18
7.3	CSX/Vaughn Landfill Site - Sediment Analytical Results	20
8.0	**Groundwater Assessment**	**21**
8.1	Phase I Investigation Sampling	21
8.2	Phase II Investigation Sampling	22
8.3	Phase III Investigation Sampling	23
8.4	MGP Site - Groundwater Analytical Results	24
8.5	CSX/Vaughn Landfill Site - Groundwater Analytical Results	26
8.6	Extent of Groundwater Contamination	28
8.7	Changes in Groundwater Contamination	29
9.0	**Surface Water Assessment**	**29**
9.1	Phase I Investigation - Surface Water Assessment	30
9.2	Phase II Investigation - Surface Water Assessment	30
9.3	Phase III Investigation - Surface Water Assessment	31
10.0	**Biological Assessments**	**33**
10.1	Phase II Biological Assessment	33
10.2	Phase III Biological Assessment	34
11.0	**Risk Characterization**	**35**
11.1	Chemicals of Concern	35
11.2	Potential Exposure Pathways	35
11.3	Exposure Pathway Analysis	36
12.0	**Conclusions**	**37**
13.0	**Recommendations**	**38**
14.0	**References**	**39**

List of Tables

Table 1	Monitoring Well Construction Details Summary
Table 2	Groundwater Field Monitoring Summary, June 15-17, 1999
Table 3	Groundwater Level Summary, June 15-17, 1999
Table 4	Soil Data Summary - March 1995 Phase I Investigation Volatile Organics by EPA Method 8260
Table 5	Soil Data Summary - March 1995 Phase I Investigation Semi-Volatile Organics by EPA Method 8270
Table 6	Soil Data Summary - March 1995 Phase I Investigation RCRA Metals
Table 7	Soil Data Summary - March 1995 Phase I Investigation PCBs by EPA Method 8080
Table 8	Soil Data Summary - September 1996 Phase II Investigation Volatile Organics by EPA Method 8260
Table 9	Soil Data Summary - September 1996 Phase II Investigation Semi-Volatile Organics by EPA Method 8270
Table 10	Soil Data Summary - September 1996 Phase II Investigation RCRA Metals
Table 11	Soil Data Summary - Phase III Investigation Volatile Organics by EPA Method 8260
Table 12	Soil Data Summary - Phase III Investigation Semi-Volatile Organics by EPA Method 8270
Table 13	Sediment Data Summary - March 1995 Phase I Investigation Volatile Organics by EPA Method 8260
Table 14	Sediment Data Summary - March 1995 Phase I Investigation Total Petroleum Hydrocarbons by EPA Method 9071
Table 15	Sediment Data Summary - March 1995 Phase I Investigation Semi-Volatile Organics by EPA Method 8270
Table 16	Sediment Data Summary - March 1995 Phase I Investigation RCRA Metals
Table 17	Sediment Data Summary - March 1995 Phase I Investigation PCBs by EPA Method 8080
Table 18	Sediment Data Summary - September 1996 Phase II Investigation Volatile Organics by EPA Method 8260

Table 19	Sediment Data Summary - September 1996 Phase II Investigation Semi-Volatile Organics by EPA Method 8270
Table 20	Groundwater Data Summary - March 1995 Phase I Investigation Volatile Organics by EPA Method 8260
Table 21	Groundwater Data Summary - March 1995 Phase I Investigation Semi-Volatile Organics by EPA Method 8270
Table 22	Groundwater Data Summary - March 1995 Phase I Investigation RCRA Metals
Table 23	Groundwater Data Summary - March 1995 Phase I Investigation PCBs by EPA Method 608
Table 24	Groundwater Data Summary - September 1996 Phase II Investigation; Volatile Organics by EPA Method 8260
Table 25	Groundwater Data Summary - September 1996 Phase II Investigation; Semi-Volatile Organics by EPA Method 8270
Table 26	Groundwater Data Summary - September 1996 Phase II Investigation; Sulfate
Table 27	Groundwater Data Summary - June 15-17, 1999 Volatile Organics by EPA Method 8260
Table 28	Groundwater Data Summary - June 15-17, 1999 Semi-Volatile Organics by EPA Method 8270
Table 29	Groundwater Data Summary - June 15-17, 1999 RCRA Metals, Iron and Total Cyanide
Table 30	Groundwater Data Summary - June 15-17, 1999 Miscellaneous Parameters
Table 31	Surface Water Data Summary - March 1995 Phase I Investigation Volatile Organics by EPA Method 8260
Table 32	Surface Water Data Summary - March 1995 Phase I Investigation Semi-Volatile Organics by EPA Method 8270
Table 33	Surface Water Data Summary - March 1995 Phase I Investigation RCRA Metals
Table 34	Surface Water Data Summary - March 1995 Phase I Investigation PCBs by EPA Method 608
Table 35	Surface Water Data Summary - September 1996 Phase II Investigation; Volatile Organics by EPA Method 8260
Table 36	Surface Water Data Summary - September 1996 Phase II Investigation; Semi-Volatile Organics by EPA Method 8270
Table 37	Surface Water Field Monitoring Summary - June 15-17, 1999

Table 38 Surface Water Data Summary - June 15-17, 1999
Volatile Organics by EPA Method 8260

Table 39 Surface Water Data Summary - June 15-17, 1999
Semi-Volatile Organics by EPA Method 8270

Table 40 Surface Water Data Summary - June 15-17, 1999
RCRA Metals and Total Cyanide

Table 41 Surface Water Data Summary - June 15-17, 1999
Miscellaneous Parameters

List of Figures

Figure 1	Site Location Map
Figure 2	Partial USGS Topo Map; Greenville, South Carolina
Figure 3	Historical MGP Site Facilities
Figures 4 through 6	CSX Vaughn Landfill and Bramlette Road MGP Site Plans
Figures 7 through 9	Monitoring Well and Groundwater Sampling Locations
Figures 10 through 12	Groundwater Elevations, June 15-17, 1999
Figures 13 and 14	Soil and Sediment Sampling Locations
Figures 15 and 16	Soil and Sediment Data Summary Total BTEX - EPA Method 8260
Figures 17 and 18	Soil and Sediment Data Summary Total PAH - EPA Method 8270
Figures 19 through 21	Groundwater Data Summary; June 15-17, 1999 Benzene - EPA Method 8260
Figures 22 through 24	Groundwater Data Summary; June 15-17, 1999 Total BTEX - EPA Method 8260
Figures 25 through 27	Groundwater Data Summary; June 15-17, 1999 Naphthalene - EPA Methods 8260 and 8270
Figures 28 through 30	Groundwater Data Summary; June 15-17, 1999 Total PAHs - EPA Method 8270
Figure 31	Hydrogeologic Cross-Section A-A
Figure 32	Hydrogeologic Cross-Section B-B
Figure 33	Hydrogeologic Cross-Section C-C
Figure 34	Hydrogeologic Cross-Section D-D
Figure 35	Hydrogeologic Cross-Section E-E
Figure 36	Hydrogeologic Cross-Section F-F
Figure 37	Hydrogeologic Cross-Section G-G
Figure 38	Hydrogeologic Cross-Section H-H
Figure 39	Change in Groundwater Naphthalene Concentration: Sep. 1996 to Jun. 1999
Figures 40 through 42	Groundwater Data Summary; June 15-17, 1999 Sulfate and Iron

Figures 43 through 45	Surface Water Sampling Locations and Analytical Results Summary
Figure 46	Ditch 5 Surface Water Samples; Miscellaneous Parameters
Figure 47	Ditch 5 Surface Water Samples; Miscellaneous Parameters
Figure 48	Reedy River Surface Water Samples; Miscellaneous Parameters
Figure 49	Reedy River Surface Water Samples; Miscellaneous Parameters
Figures 50 and 51	Faunal Study Sampling Locations

List of Appendices

Appendix A	Correspondence
Appendix B	Phase III Workplan
Appendix C	Summary of MGP Site Development
Appendix D	Aerial Photographs
Appendix E	Phase III Faunal Assessment Report
Appendix F	Phase III Monitoring Well Construction Records
Appendix G	Phase III Chain of Custody Records and Analytical Data

CSX/VAUGHN LANDFILL
AND
BRAMLETTE ROAD MGP SITES

PHASE III
INVESTIGATION AND SITE ASSESSMENT REPORT

1.0 Introduction

This report documents the results of a Phase III Site Investigation of the Bramlette Road Manufactured Gas Plant and CSX/Vaughn Landfill sites in Greenville, South Carolina. This report also summarizes the results and conclusions of previously conducted site investigations.

The Phase III Site Investigation was conducted as a follow up to a Phase II Site Assessment Report previously submitted to the South Carolina Department of Health and Environmental Control (SCDHEC). SCDHEC provided comments to the Phase II report, and provided suggestions for additional assessment work, via letter dated December 6, 1996 from Tom Knight to Charles Bristow (Appendix A). Further guidance was provided by SCDHEC in a December 18, 1996 meeting held between SCDHEC and representatives from CSX Transportation, Duke Power Company, Applied Engineering & Science (AES), and the Army Corps of Engineers (ACE). Specifically, SCDHEC requested additional work to complete the following:

- Evaluate the potential impact to the fauna from the site contaminants
- Determine the horizontal and vertical extent of groundwater contamination
- Determine the extent of free product coal tar
- Resample wells and surface waters, and include analyses for Fe and Mn

Duke Power submitted a Phase III Workplan to SCDHEC in March 1997 outlining the various assessment activities necessary to provide SCDHEC with the requested information (Appendix B). SCDHEC approved the workplan via letter dated November 13, 1998 (Appendix A). Phase III assessment activities were initiated in February 1999.

2.0 Site Description and History

The CSX/Vaughn Landfill and Bramlette Road MGP sites are located in the community of City View in Greenville County, South Carolina as indicated on Figures 1 and 2. The Bramlette Road MGP site covers 3.69 acres and is located at 400 South Bramlette Road in the western quadrant of the intersection of Bramlette Road and West Washington Street (Figure 4). The CSX/Vaughn Landfill site covers approximately 7

acres and is located approximately 800 feet west of this intersection across and south of Bramlette Road (Figures 5 and 6). Both sites lie just outside of the Greenville City limits.

Both the Bramlette Road MGP and the CSX/Vaughn Landfill sites are owned by CSX Transportation (CSXT). The two sites are part of more extensive CSXT property holdings in the Bramlette Road area that total approximately 40 acres and contain rail lines and an office for crew transfers and scheduling activities. The majority of these properties lie within the floodplain of the Reedy River located to the west. Land use immediately east of the MGP and Landfill sites is primarily residential with the exception of the property located in the southern quadrant of the intersection of Bramlette Road and West Washington Street. This property contains a school building and is owned by the Greenville County School District. The property bordering the MGP site to the north is owned by Suburban Propane as described below.

The Bramlette Road MGP site was originally developed as a manufactured gas plant by Southern Public Utilities in 1917. The Bramlette Road plant was constructed as a replacement for an existing gas plant located at Broad Street in Greenville; and was a larger plant that produced gas using the more economical coal gas process. The site eventually contained a retort house, 3 gas holders, a water gas plant, tar and ammonia washer tanks, purifiers, a tar extractor and holder, and an underground heating oil tank. Locations of site structures are indicated on Figure 3, and a summary of MGP site development is provided in Appendix C. Historical aerial photographs of the CSX/Vaughn Landfill and Bramlette Road MGP sites are provided in Appendix D.

Gas plant ownership and operation transferred to Duke Power Company in 1935. The Piedmont Natural Gas Company purchased the site in 1951 and subsequently demolished the gas plant sometime in the late 1950s. Site ownership transferred to Piedmont and Northern Railway in 1963. Piedmont and Northern Railway became part of Seaboard Coast Line (CSX) in 1967. The site was used as a trucking facility in the 1970s and 1980s.

The site is currently vacant and access is restricted by perimeter fencing. Lockable gates are located at the southern corner of the site along Bramlette Road and at the northern corner of the site on West Washington Street. Texas Oil Company operated a petroleum bulking facility during the same timeframe as the gas plant operation on property immediately north and adjacent to the MGP site. This property is now owned by Suburban Propane and is currently used as a propane tank storage facility.

The CSX/Vaughn Landfill site is located within the eastern bank floodplain of the Reedy River. The site was developed as an unpermitted landfill by Mr. Robert Vaughn of Vaughn Construction and Demolition Company in Greenville. Mr. Vaughn attempted to purchase approximately 16 acres from CSXT in 1988 for the purpose of constructing a solid waste landfill. Following payment of a deposit, Mr. Vaughn began unpermitted landfilling activities on the property. The property transfer was never finalized, however, Mr Vaughn continued to operate the landfill. The South Carolina Department of Health and Environmental Control (SCDHEC) advised Mr. Vaughn in 1993 that his landfilling activities were improper. In February of 1994, the U.S. Army Corps of Engineers (ACE) notified CSXT that the property on which the landfill is located is considered a wetlands, and the landfilling operation was a violation of Section 301 of the Clean Water Act.

Following notification by the ACE, CSXT ordered Mr. Vaughn to cease landfilling activities and the site was closed.

3.0 History of Site Investigations

A Phase I investigation was conducted in early 1995 at the CSX/Vaughn Landfill site by Applied Engineering and Science (AES) of Atlanta, Georgia. This investigation included soil, sediment, surface water and groundwater sampling across and around the Landfill. The results of this investigation were documented in an AES report entitled "Site investigation; Soil, Sediment, and Groundwater Sampling; Vaughn Landfill, CSX Real Property; March 1995".

A Phase II investigation was conducted by AES in 1996. This investigation included the installation of 8 monitoring wells to assess groundwater quality at the MGP site and at the Landfill site; and soil sampling at the MGP site to assess the extent of coal tar. This investigation also included a biological survey conducted in the wetlands area surrounding the Landfill site, and included a site characterization and contaminant pathway/exposure evaluation. The results of this investigation were documented in an AES report entitled "Site Investigation Phase II, Vaughn Landfill/Duke Power Sites, CSXT Real Properties, Bramlette Road, Greenville, South Carolina, September 1996".

A wetlands delineation study was conducted by AES during February 1999. The results of this investigation were documented in an AES report entitled "Wetland Delineation Report, CSX Bramlette Road Property, Greenville, South Carolina, April 1999".

The extent and results of these investigations are summarized below:

3.1 AES Phase I Site Investigation - March 1995

SCDHEC and U.S. Army Corps of Engineers personnel performed inspections of the landfill site in April and May 1994. During these visits, petroleum sludge-type material was observed in the wetlands on the western side of the landfill. In August, 1994, the SCDHEC, in conjunction with the U.S. Army Corps of Engineers, requested that CSXT submit a work plan for an environmental assessment of the landfill site. CSXT retained Applied Engineering and Science, Inc. (AES) of Atlanta, Georgia to prepare and implement the subject work plan. AES submitted the work plan in November 1994, and SCDHEC approved the plan in December 1994. The work plan outlined a program of soil, sediment and surface water sampling to be conducted on the landfill and in the wetlands surrounding the landfill to assess the nature, extent and source of any contamination. AES began work plan implementation in February 1995.

Thirty-three soil samples were collected from sampling grid locations established across the landfill. Samples were collected from native soils below the fill material. The thickness of the fill material ranged from 8 feet in the northern area of the landfill near Bramlette Road to 14 feet in the south-central area of the landfill. Samples were primarily collected by direct-push methods (Strataprobe). A trackhoe was used to collect samples at locations inaccessible by the Strataprobe unit, or at locations where subsurface debris prevented direct-push sampling. At these locations, the trackhoe was

used to excavate through the fill material down to native soils. This technique allowed for inspection of the fill material which consisted of demolition debris comprised of wood, concrete, bricks, metal, roofing material, plastic and fiberglass insulation. Appliances and yard waste were also observed among the debris. The fill contained some soil that apparently had been used as cover material during the landfilling operation. No drums, tanks, cylinders or other containers containing potentially hazardous materials were observed. Groundwater samples were also collected from 7 of the soil sampling locations. These samples were collected from boreholes using a peristaltic pump, or were collected by stainless steel screen and tubing placed in groundwater that had entered open excavations.

Most soil samples were field screened for the presence of volatile organics using an Organic Vapor Analyzer (OVA). Several samples collected from native soil below the fill material exhibited strong hydrocarbon-like odors, and appeared oily and discolored. Some samples contained visible black, tarry material. Samples exhibiting the strongest odors and/or evidence of contamination were located in the northern and western area of the landfill. Samples collected from locations in the southern area of the landfill had little to no evidence of contamination. Some groundwater samples exhibited indications of petroleum odors.

Sediment samples were collected from 8 locations in the wetlands surrounding the landfill. Analytical results from 4 sediment sampling locations indicated petroleum contamination. Surface water samples were collected from 4 locations in the wetlands surrounding the landfill. No individual petroleum compounds were indicated in analytical results from surface water samples, however 3 surface water samples exhibited indications of total petroleum hydrocarbons.

Conclusions and recommendations from the Phase I Investigation are summarized as follows:

1. Tar-like substances and high lead concentrations are present in soils beneath the landfill at the fill/native soil interface and in floodplain soils surrounding the landfill. Volatile and semi-volatile organic compounds and lead are present in a band trending northeast to southwest beneath the landfill; and extends into the surrounding floodplain both northeast and southwest from the landfill.
2. Groundwater beneath the landfill has been impacted by volatile and semi-volatile organics.
3. No likely sources of tar, organic compounds and/or lead were discovered within the landfill materials observed.
4. The tar-like substances and organic compounds discovered beneath the landfill are consistent with the types of contaminants typically encountered at MGP sites.
5. The site for a former coal gasification facility lies across Bramlette Road immediately northeast and up-gradient from the landfill site. Wastewater containing coal tars apparently was discharged from the facility. This wastewater proceeded southwest from the MGP site in a ditch running parallel to Bramlette

Road before being routed into the wetlands/floodplain through a culvert beneath Bramlette Road.

6. Additional soil sampling is recommended to assess the extent and source of the organic contamination. Monitoring wells are recommended to assess the horizontal and vertical extent of groundwater contamination.

7. Grading should be conducted to cover exposed debris on the south end of the landfill.

Soil and sediment analytical results are discussed in Section 7.0, and groundwater analytical results are discussed in Section 8.0.

3.2 AES Phase II Site Investigation - September 1996

Following submittal of the March 1995 Report, SCDHEC requested by letter dated May 11, 1995 that CSXT submit a work plan outlining further assessment activities at the site. SCDHEC requested that CSXT determine the extent and source of the tar substance and the horizontal and vertical extent of groundwater contamination at the site. SCDHEC also requested that CSXT fully characterize the site, determine pathways of contaminant migration (to possible receptors), and further assess one landfill sampling location for the source of heavy metals present there. CSXT again retained Applied Engineering and Science, Inc. (AES) of Atlanta, Georgia to prepare and implement the subject work plan. AES submitted a general work plan in August 1995. This work plan described a program of soil sampling in the floodplain surrounding the landfill, along drainage pathways leading from the MGP site, and within the MGP site area. The work plan also proposed the installation of six monitoring wells (MW1 though MW6) south of Bramlette Road. SCDHEC approved the plan in November 1995 with the following adjuncts:

a. Groundwater sampling should be included with soil assessment at the MGP site.

b. A second shallow well should be installed adjacent to the proposed deep well (MW3D) within the landfill area.

c. A monitoring well proposed within the floodplain/wetland area east of the landfill (MW4) should be installed by hand auger to minimize impact to the wetland habitat.

d. Groundwater samples from wells within the landfill should be analyzed for sulfates in addition to organics.

e. A biological survey should be conducted to assess the impact of coal tar contamination on plant species within the floodplain.

f. The landfill should be reseeded following completion of grading activities.

AES began work plan implementation in March 1996.

For this investigation, soil sampling was conducted within 3 primary areas of the CSXT properties. Soil samples were collected from various locations within the former MGP site, from the area west of the MGP site and north of Bramlette Road, and from the Vaughn Landfill site. Soil sampling was conducted by direct-push methods

(Strataprobe) or by hand auger. Continuous samples were collected from each sampling location until the presence of coal tar was detected (visually or by odor), or until groundwater was reached. A limited number of soil samples were submitted for laboratory analyses.

Soil sampling was performed at 29 locations within the MGP site at depths varying from 3 to 14 feet. Coal tar residuals were indicated in a broad north-south band extending from the northern access gate on West Washington Street through the center of the site to the southernmost corner on Bramlette Road. Within this band, coal tar residuals or odors were indicated at various depths ranging from the surface down to 14 feet deep. Site reconnaissance and sampling efforts also revealed the presence of large quantities of surface and buried debris at the MGP site. The debris consists of bricks, concrete, metal, reinforcing bars, wood and other demolition materials that appear to be the remains of the coal gasification plant buildings demolished in the late 1950s. No coal tar residuals were indicated in soils in the eastern and western corners of the MGP site.

Soil sampling was performed at 9 locations in the area west of the MGP site and north of Bramlette Road. Sampling in this area was primarily limited to suspected surface drainage pathways of wastewater discharged from the former coal gasification plant. Sampling results indicated the presence of coal tars in a drainage ditch running southwest from the MGP site along the north side of Bramlette Road to a culvert that discharges surface runoff into the wetlands area south of Bramlette Road. The sampling results confirmed that coal tars and coal tar laden wastewaters were likely discharged into this ditch and eventually into the wetlands. The discharge point for this culvert lies on Greenville County School District property.

Four additional soil samples were collected in the seasonally flooded area of the floodplain west of the Vaughn Landfill. These samples confirmed the presence of coal tars in floodplain soils and in soils in the man-made drainage ditch running south through the floodplain. Samples were also obtained from one previous Landfill sampling location from the March 1995 investigation.

Eight monitoring wells (MW1 through MW7, and MW3D) were installed as part of this investigation. MW1, MW3, MW3D and MW6 were installed on the Vaughn Landfill. MW2 was installed near the CSXT office building west of the Landfill. MW4 was installed by hand auger in the wetlands east of the Landfill. MW5 was installed southwest of the Landfill adjacent to CSXT rail lines. MW7 was installed within the MGP site area.

Site geology, surface runoff patterns, and the results of a biological survey were also assessed during this investigation. Site geologic conditions are discussed in Section 5.0. Site topography and runoff patterns are discussed in Section 4.0. Site biological assessment results are discussed in Section 10.0.

Conclusions from the Phase II Investigation are summarized as follows:

1 Coal tar contaminated soils are widespread across the MGP site, and coal tar saturated soils were observed at 2 locations within the MGP site. Coal tars in soils at the Landfill site are either covered with landfill material or are underwater

within the floodplain/wetlands. Sampling results confirm that coal tars, and likely coal tar laden wastewaters, were discharged into a ditch leading from the MGP site and into the floodplain/wetlands south of Bramlette Road.

2 Groundwater at both the MGP site and the Landfill site is contaminated. The plume of contamination extends in a long, narrow band from the MGP site southwest through the Landfill site. The plume appears to be wholly within CSXT property. The plume may extend to the Reedy River, however, laboratory analytical results from Reedy River samples indicated no surface water contamination.

3 Contaminants in soil and groundwater within CSXT properties are the result of coal tar and coal tar laden wastewater from the former Duke Power coal gasification plant.

4 Much of the groundwater contamination at the Landfill site has likely occurred from coal tars from the MGP site that have settled in the floodplain/wetlands south of Bramlette Road.

5 Free product coal tar is present in deep monitoring well MW3D located within the Landfill. The free product appears to reside at a depth of 18 to 20 feet at the interface between overlying alluvial soils and underlying saprolite.

6 Coal tar saturated soils at the former MGP site represent a potentially continuing source of contamination.

7 No surface water contamination is indicated down-gradient from the Landfill site, no downstream users of Reedy River water were identified, and no drinking water supply wells were found within 0.5 miles of the CSXT properties. There are no earth disturbing activities on-going on the CSXT properties that could potentially result in exposure to, or transportation of, contaminated soils.

Soil analytical results are discussed in Section 7.0, and groundwater analytical results are discussed in Section 8.0.

3.3 AES Wetland Delineation Report - April 1999

In association with legal actions taken on the part of CSXT against Mr. Robert Vaughn for improper landfilling of the wetlands previously discussed; CSXT contracted with Applied Engineering and Science, Inc. (AES) of Atlanta, Georgia to perform a wetland delineation survey. This survey was performed to determine the valuation of the wetlands impacted by the landfill, and to submit an after-the-fact permit to the U.S. Army Corps of Engineers. This assessment was performed during February 1999.

4.0 Site Topography

The former MGP site occupies the highest elevations of the CSXT properties containing the MGP site, the Vaughn Landfill, and the floodplain areas of the Reedy River as indicated on Figures 3 through 6. Elevations within the MGP site vary from approximately 944 to 930 feet above mean sea level. The highest elevation occurs at the intersection of West Washington Street and Bramlette Road. The lowest elevation

occurs along the fenceline in the southern corner of the site. The site contains several shallow depressions that collect surface runoff. The western and southwestern areas of the site lie within the 100 year flood boundary of the Reedy River. The area west of the MGP site and north of Bramlette Road lies almost entirely within the 100 year flood boundary and varies in elevation from approximately 940 to 923 feet above mean sea level. Changes to the natural topography of this area and the MGP site have occurred as a result of grading and landfilling activities over time. Demolition debris was buried on the MGP site following dismantling of site facilities in the late 1950s. Over time, significant quantities of construction and demolition type debris has been placed within the floodplain area north of Bramlette Road from the western area of the MGP site to the rail lines east of the site. A test pit excavated in the western corner of the MGP site revealed approximately 7 feet of fill material placed over native clay soils. This fill consisted of a mixture of soil, brick, wood, broken concrete, coal dust and other inert materials. No MGP related contamination was indicated in this test pit.

Elevations of the floodplain area south of Bramlette Road vary little with the exception of that portion covered by the Vaughn Landfill. The floodplain area lies at an approximate elevation of 923 feet above mean sea level. The Vaughn Landfill varies in elevation from 923 to 937 feet. Borings taken across the top of the Landfill have indicated debris has been placed in thicknesses varying from 7 to 14 feet.

Stormwater runoff enters the northern corner of the MGP site from West Washington Street and to a lesser degree from the adjacent Suburban Propane property. This runoff tends to settle in depressions within the north-central area of the site. For the remainder of the site, surface runoff was generally toward the southern corner of the site with the majority of runoff exiting near the gate along Bramlette Road. Runoff from the extreme southwestern area of the site flows into a ditch (Ditch 1) running southwest along Bramlette Road. This ditch discharges into the floodplain/wetlands area south of Bramlette through a 24 inch diameter culvert beneath the road. The runoff spreads south and collects behind the Landfill that acts as a dam to the natural flow. Surface runoff from the school property and other properties along West Washington Street also discharges into this area. A 30 inch diameter culvert and narrow man-made channel (Ditch 4) was constructed through the Landfill to allow runoff to flow to the western side of the Landfill.

A 72 inch diameter culvert beneath Bramlette Road directs runoff from the area north of the road (Ditch 2) into the floodplain/wetlands area west of the Landfill. This runoff flows south in a ditch (Ditch 3) along the western side of the Landfill and joins runoff from the ditch that cuts through the Landfill (Ditch 4) from the east. The floodplain area west of the Landfill contains varying amounts of standing water throughout the year. During wet periods, considerable amounts of standing water are present in this area. This water is prevented from directly entering the Reedy River by an elevated CSXT rail line and rail yard embankment that lies between this area and the river.

Some amount of stormwater runoff from this rail line and rail yard area directly enters the wetlands from the west. During drier periods, water is primarily confined to a few pools and a man-made canal running through this area (Ditch 5). This canal directs floodplain waters south toward Willard Street and runs beneath a railroad trestle before

discharging into the Reedy River. This appears to be the only discharge point for surface runoff from CSXT properties located east of the Reedy River.

5.0 Site Geology

The CSX/Vaughn Landfill and Bramlette Road MGP sites lie within the Inner Piedmont belt, one of several northeast-trending geologic belts of the southern crystalline Appalachians. The Inner Piedmont belt lies between the Charlotte and Kings Mountain belts to the east and the Blue Ridge province to the west. The Inner Piedmont belt is a fault-bounded composite stack of thrust sheets containing a variety of gneisses, schists, amphibolites, sparse ultramafic bodies, and intrusive granitoids (Goldsmith and others, 1998). The general structure within the belt is characterized by irregular foliation of low dip and folds transverse to the northeast regional trend.

The stratified rocks of the belt consist of thinly layered mica schist and biotite gneiss that are interlayered with lesser amounts of amphibolite, calc-silicate rocks, hornblende gneiss, and quartzite. Protoliths of these rocks were largely sedimentary and in part volcanic. Large and small masses of granite and granodiorite are present throughout the belt and form concordant to semi-concordant bodies in the country rock. Some of these granitoid bodies are gneissic and are probably older than the poorly foliated to non-foliated facies. Small, ultramafic masses are present along the eastern and western edges of the belt. The rocks of the central core of the Inner Piedmont are in the sillimanite zone of amphibolite metamorphism. The flanks are primarily ion the staurolite-kyanite zone.

In the Piedmont region, crystalline bedrock is typically overlain by a variable thickness and degree of weathered rock. The degree of weathering typically decreases with depth with a thoroughly weathered and structureless material at the surface termed residuum. The residuum grades into a coarse-grained material that retains the structure of the parent bedrock and is termed saprolite. Beneath the saprolite, partially weathered bedrock occurs with depth until sound bedrock is encountered. Groundwater in this region generally occurs in a system composed of interconnected layers of saprolite overlying fractured metamorphic and igneous rocks.

Two borings advanced to refusal within the MGP site indicated refusal depths of 30.4 and 58.4 feet (elevations 903.14 and 878.12). Two borings advanced to refusal within the Landfill area indicated refusal depths of 18.0 and 25.5 feet (elevations 907.33 and 914.14). According to a report entitled *Groundwater Resources of Greenville County South Carolina*, seven former industrial wells located within 1/4 mile of the CSXT properties were installed with casings varying in length from 10 to 41 feet. Since production well casings typically extended from the ground surface into fractured rock, these casing lengths are another indicator of refusal depths in the vicinity of the subject property. These seven wells were reported as destroyed or abandoned. One of these wells was located at the MGP site. This well was installed to a total depth of 298 feet in fractured gneiss and was reported to have yielded 50 gpm. The exact location of this well is unknown.

The Piedmont region is characterized by rolling hills, uplands, and stream valleys that contain narrow floodplains. The general flow patterns of streams in this region is toward the southeast. Greenville County lies within the Santee River basin that includes several sub-basins such as the Reedy River basin. Alluvial soils found within river floodplains are typically the result of eroded and deposited residuum and saprolite. These soils vary in structure from fine to coarse depending on the depositional environment.

According to the Soil Conservation Service *Soil Survey of Greenville County*, soils found on the subject CSXT properties include the Cartecay, Chewacla and Cecil-Urban series types. Cartecay soils are described as alluvial sandy loams commonly found as deposits on floodplains. Chewacla soils are also described as alluvial deposits consisting of finer silty clay loams, and are considered hydric soils typical of those found in wetland environments. Cartecay and Chewacla soils are commonly intermixed within floodplain areas.

Borings for soil sampling and well installations conducted within the MGP site have indicated highly disturbed soils, intermixed with MGP debris (coal, coal tar, coal ash, coke, brick and other demolition materials), from the surface to generally between 2 and 6 feet deep. The greater depths of the debris layer tend to occur in the southern area of the site. A test pit dug in the western corner of the site indicated approximately 7 feet of landfill type debris mixed with soil overlying virgin clay. This landfill debris did not appear to contain demolition materials or contaminants related to the MGP facility, however some coal was present in the mixture. Virgin soil types underlying the debris at the MGP site tended to be silty clays and clayey sands extending to depths between 7 and 16 feet below the surface. Silty sands typically occurred below the clayey soils, eventually grading into saprolite with depth.

Borings for soil sampling and well installations conducted at the Vaughn Landfill site have indicated between 7 and 14 feet of demolition-type landfill debris and soil backfill. A 2 to 6 feet thick layer of clay or clayey soils was typically encountered below the Landfill debris. Sands and silty sands were present below the clay layer. The sandy soils typically graded into stiffer saprolite material at 17 to 19 feet below the Landfill surface. The lithologic units (clays, silty sands, and sands) across the Landfill site vary in thickness, location and in transition (gradual to abrupt) from one unit to another, indicative of alluvial deposits that might be found within a floodplain environment. Free coal tars were encountered at both the top of the clay layer immediately below the landfill debris, and near the sandy soil-saprolite interface.

Coal tar released from the MGP site had apparently settled into pools and depressions within the wetlands. Some of the coal tar remained pooled on the more impermeable clays. Over time, some of the coal tar migrated through narrow lenses of clay, or through gaps in the clay layer, and down through the underlying sand units. Split spoon samples retrieved from 2 borings drilled for the installation of monitoring wells (MW19 and MW20 discussed in Section 6.0) indicated coal tar in both the clayey soil beneath the debris, and at the sandy soil-saprolite interface.

6.0 Monitoring Wells and Site Hydrogeology

To-date, 25 permanent monitoring wells have been installed at the Landfill and MGP sites as indicated on Figures 7 through 9. Eight wells (MW1 through MW7) were installed in March 1996 as part of the AES September 1996 Phase II Investigation. The remaining wells (MW8 through MW25) were installed in the period from February through May, 1999, as part of this Duke Power Phase III Investigation. All 25 wells were installed using standard 2 inch diameter PVC casings and slotted well screens. All wells were installed using conventional drill rigs with the exception of MW4 which was installed by hand auger. A graded sand was used in all wells to fill the annular space between the screen and the borehole wall up to and over the screened section. Bentonite was used in all wells to seal the annular space above the sand pack. With the exception of MW4, cement grout was used in all wells to complete the seal up to the ground surface. MW4 was sealed with bentonite up to the ground surface. Wells MW3D, MW9 and MW20 were installed with double casings as discussed below. Well construction details are summarized in Table 1.

6.1 MGP Site Monitoring Wells

Eleven monitoring wells (MW7 through MW17) have been installed within the MGP site as indicated on Figure 7. Well MW7 was installed in March 1996 as part of the AES Phase II Site Investigation in an area of heavily stained soils south of the former retort house location. Wells MW8 through MW17 were installed in February-March, 1999 by Duke Power as part of the Phase III Assessment.

As outlined in the Phase III Workplan (Appendix B), the Duke wells were installed as nested wells consisting of shallow wells grouped with mid-depth wells. The Duke wells were generally installed in the 4 corners of the site and near existing well MW7 as indicated on Figure 7. The shallow wells (MW12, MW14 and MW16) were installed with 10 feet of PVC well screen placed to intersect the surficial aquifer. Shallow well depths were 12, 13 and 16 feet for MW12, MW14 and MW16, respectively. No split spoon samples were taken in these wells, however, samples were taken from adjacent wells MW11, MW13 and MW15 as discussed below.

The mid-depth wells (MW11 and MW13) were augered until stiffer saprolite material was encountered, and were fitted with 10 foot screens placed at the top of the saprolite layer. Well depths were 25.7 and 23.1 feet for MW11 and MW13, respectively. Split spoons from MW11 primarily contained silty sand type soils with no indications of debris or coal tar odors. Split spoons from MW13 contained silty sand type soil from the surface to 5.5 feet, sandy silty clay from 5.5 to 11 feet, clayey sandy silty from 11 to 14 feet, and silty sand from 14 to 23.1 feet. Very soft soil was encountered from 11 to 14 feet deep. There were no indications of debris or coal tar odors in MW13.

Three wells (MW8, MW10 and MW17) were installed as combined shallow/mid-depth wells with screen lengths of 13, 15 and 13.9 feet, respectively. Combined wells were stipulated for conditions in which the distance between the surficial water table and the saprolite layer was less than 13 feet. Combined well depths were 17, 19.5 and 16 feet for MW8, MW10 and MW17, respectively. Demolition-type debris was encountered from the surface to 2 feet in MW8. Silty sand with coal tar odors was indicated in split

spoons from 2 to 6 feet. Silty clay and silty sand with clay seams and coal tar odors were indicated in spoon samples from 6 to 9.5 feet; and silty sand with coal tar odors was indicated in the remaining spoons taken from 9.5 to 17 feet deep. There were no indications of debris or tar-like odors in split spoons retrieved from MW10. In MW17, black coal-like material and strong odors were present in split spoons from the surface to 2.5 feet deep. Rubber-like tar material with no soil was indicated in the subsequent spoon sample retrieved from 2.5 to 4 feet. Sandy silt and silty sand with coal tar odors were indicated in the remaining split spoons taken from 4 to 17.5 feet in MW17. The boring for MW17 was terminated at 16 feet.

Well MW9 was located adjacent to MW7 and MW8, and was constructed as a deep well. MW9 was drilled with a 10 inch auger to stiff, saprolite material previously encountered at 18 feet deep in adjacent well MW8. An 8 inch PVC casing was grouted into the hole and the boring was continued by augering with a standard 7.25 inch auger through the 8 inch casing. The auger was advanced to refusal at 30.4 feet and the well was fitted with 5 feet of screen placed at refusal. No tar-like odors were indicated in split spoons retrieved from below 18 feet in MW9.

Well MW15 was originally planned as a mid-depth well to be constructed adjacent to MW16. While augering for MW15, no noticeably stiffer saprolite layer was indicated until refusal was encountered at 58.4 feet. The well was fitted with 5 feet of screen placed at refusal. Landfill type debris (brick, wood and cloth) was indicated in split spoons taken from the surface to 8.5 feet deep in MW15. No coal tar odors were indicated in any split spoons from MW15.

Hydrogeologic cross-sections through monitoring well and soil sampling locations within the MGP site are shown on Figure 13, and on Figures 31 through 36.

6.2 CSX/Vaughn Landfill Monitoring Wells

Fifteen monitoring wells (MW1 through MW6, and MW18 through MW25) have been installed on and around the CSX/Vaughn Landfill site south of Bramlette Road as indicated on Figures 8 and 9. Wells MW1 through MW6 were installed in March 1996 as part of the AES Phase II Investigation. Wells MW18 through MW25 were installed in March-April, 1999 by Duke Power as part of the Phase III Assessment.

Wells MW1, MW3 and MW6 were installed as shallow wells at the Landfill site. These wells were augered through 8 to 10 feet of landfill debris and into underlying virgin sandy and silty clay soil. MW1 was augered to 15 feet and fitted with 10 feet of well screen. MW3 was augered to 14 feet and fitted with 5 feet of screen. MW6 was augered to 12 feet and fitted with 10 feet of screen. Coal tar and/or coal tar odors were encountered in the underlying clay soil in MW1, MW3 and MW6. MW2 was installed as a shallow well near the CSXT office building west of the Landfill. MW2 was augered to 15 feet and fitted with 10 feet of screen. MW5 was installed as a shallow well located southwest of the Landfill adjacent to CSXT rail lines. MW5 was augered to 14 feet and was also fitted with 10 feet of screen. MW4 was installed by hand auger in the wetlands east of the Landfill. MW4 was augered to 7 feet and fitted with 5 feet of screen. No coal tar or coal tar odors were indicated during the installation of MW2, MW4 and MW5.

MW3D was installed as a double-cased deep well. MW3D was drilled using a 14 inch auger that was advanced through the landfill debris and through the underlying virgin clay soil to the clay/sand interface at 14.5 feet deep. An 8 inch outer casing was set and grouted in the hole to seal off the overlying clay layer from the underlying sand unit. The boring was continued with a standard 7.25 inch auger through the outer casing until stiffer saprolite material was encountered at 20 feet below the Landfill surface. A 3 inch layer of coal tar was indicated in a split spoon sample that was retrieved from 16 to 18 feet below the Landfill surface. Coal tar was also indicated in the final split spoon retrieved from 18 to 20 feet deep. MW3D was fitted with 5 feet of screen located from 15 to 20 feet deep. Approximately 2.75 inches of free product coal tar was indicated in the bottom of MW3D during sampling conducted on March 13, 1996 as part of the Phase II investigation. The location of the coal tar appeared to correlate with the location of the interface between the overlying sandy silty residuum and the underlying saprolite. This observation suggested that free coal tar at this location is tending to pool at the interface with the more impermeable saprolite located 7 to 9 feet below the natural grade of the floodplain.

As outlined in the Phase III Workplan, certain Duke wells were proposed as mid-depth or deep wells nested with existing AES wells MW1, MW3, MW3D, MW5 and MW6. Nested shallow and mid-depth wells were also proposed for installation in the wetlands south of the Landfill, on the CSXT rail line embankment southwest of the Landfill, and on the Greenville School District property between the school facility and the Landfill.

MW19 was installed as a mid-depth well located adjacent to MW1. MW19 was augered through 7 feet of landfill debris to stiff material at 19 feet deep, and fitted with 10 feet of screen. Significant coal tar or coal tar odors were indicated in split spoon samples taken from 7 to 16 feet in MW19. Sandy clayey silt with coal tar was present in the split spoon sample retrieved from 7 to 8.5 feet. The spoon sample from 8.5 to 10 feet contained soft sandy clayey silt with a strong coal tar odor. Soft, sandy clayey silt was indicated in the spoon sample from 10 to 13 feet deep. The final spoon sample was taken from 13 to 16 feet and indicated fine to medium sand with coal tar. No split spoon samples were taken from 16 to 19 feet.

MW20 was installed as a double-cased deep well located adjacent to MW3 and MW3D. MW20 was drilled with a 10 inch auger to stiff saprolite material at 19 feet below the Landfill surface. Landfill debris was encountered from the surface to 11.5 feet deep, and virgin sandy silty clay with coal tar was indicated in split spoons retrieved from 11.5 to 13 feet. Wood particles were indicated in split spoons from 13 to 15 feet deep. Fine to medium sand with coal tar was indicated in split spoons from 15 to 19 feet. At 19 feet an 8 inch PVC casing was set and grouted in the hole, and the drilling was continued through the 8 inch casing using a conventional 7.25 inch auger. The auger was advanced to refusal at 25.5 feet where 5 feet of screen was set. No coal tar was indicated in split spoons retrieved from depths below 19 feet.

MW21 was originally proposed as a mid-depth well to be located adjacent to MW6. While augering for MW21, no noticeably stiffer saprolite layer was indicated until refusal was encountered at 18 feet. The well was fitted with a 13 feet of screen placed at refusal. Landfill debris was indicated from the surface to 12 feet deep where fine sandy silt was encountered. Moderate coal tar odors were indicated in split spoon samples

retrieved from 12 to 15 feet deep. A split spoon sample from 15 to 17 feet deep indicated silty fine to coarse sand grading into weathered rock. No coal tar odors were indicated below 15 feet.

MW22 was installed as a mid-depth well located adjacent to MW5 on the rail line embankment south of the Landfill. MW22 was augered through 8.5 feet of embankment soils and into underlying fine sandy silt alluvium. The fine sandy silt continued with depth until stiff fine to coarse weathered rock was encountered at 35 feet. The boring was terminated at 36.5 feet and the well was fitted with 10 feet of screen placed from 25 to 35 feet. No coal tar odors were indicated in split spoons taken from MW22.

MW18 was installed as a single combined well (shallow and mid-depth) located southwest of the Landfill on the CSXT rail line embankment. MW18 was augered through 8.5 feet of embankment soils and into underlying fine sandy silty clay. Sandy silt was indicated from 10 to 12 feet, and fine to coarse sand from 12 to 21 feet. Sandy silt was indicated from 21 feet to 26.5 feet where stiff weathered rock was encountered. The boring for MW18 was terminated at 25 feet and the well was fitted with 15 feet of screen placed from 9.5 to 24.5 feet. No coal tar odors were indicated in split spoons taken from MW18, however sewer-like odors were noticed in spoons from 5 to 17 feet.

Well MW23 and MW24 were installed near Ditch 5 in the wetlands south of the Landfill. The wells were located adjacent to Ditch 5 and in an overhead power line right-of-way clearing previously cut through the wetlands. The wells were installed using a track-mounted drill rig. MW24 was installed as a shallow well at a depth of 11 feet. MW24 was fitted with 10 feet of PVC well screen located from 0.4 to 10.4 feet below the surface. No split spoons samples were taken in MW24. MW23 was installed as a mid-depth well to a depth of 43 feet. Split spoons samples taken during the installation of MW23 indicated sandy clayey silt from the surface to 4 feet, sandy silt from 4 to 7 feet, silty sands from 7 to 31 feet, and sandy silts from 31 to 44.5 feet. No stiff saprolite layer was encountered in MW23, and the boring was terminated at 43 feet. No coal tar odors were indicated.

MW25 was installed as a single combined well (shallow and mid-depth) located on the Greenville School District property between the school facility and the Landfill. Permission was secured from the Greenville School District for installation of the well (Appendix A). Split spoons taken during the installation of MW25 indicated silty sand and sandy silt from the surface to 5 feet, clayey silt and silty clay from 5 to 8.5 feet, and silty sand from 8.5 to 15 feet. Very stiff weathered rock was encountered at 16 feet, and the boring was terminated at 16.7 feet. MW25 was fitted with 15 feet of screen from 1 to 16 feet below the surface. No coal tar odors were indicated during the installation of MW25.

Hydrogeologic cross-sections through Landfill site sampling locations and monitoring wells MW1, MW19, MW3, MW3D, MW20, MW6 and MW21 are shown on Figure 14, and on Figures 37 and 38.