

**CORRECTIVE ACTION PLAN  
DUKE ENERGY CORPORATION  
BRAMLETTE ROAD MGP and CSX/VAUGHN LANDFILL SITE  
SCDHEC SITE ID # 00801  
400 South Bramlette Road  
Greenville, South Carolina  
S&ME Project No. 1264-05-645**

Prepared for:



South Carolina Department of Health and Environmental Control  
2600 Bull Street  
Columbia, South Carolina 29201

Prepared by:



301 Zima Park Drive  
Spartanburg, South Carolina 29301

March 2010



March 4, 2010

South Carolina Department of  
Health and Environmental Control  
Bureau of Land and Waste Management  
2600 Bull Street  
Columbia, South Carolina 29201

Attention: Ms. Addie Walker, Hydrogeologist

Reference: **CORRECTIVE ACTION PLAN (CAP)**  
**Duke Energy Corporation**  
**Bramlette Road MGP and CSX/Vaughn Landfill Site**  
400 South Bramlette Road, Greenville, SC  
Site ID# 00801  
S&ME Project No. 1264-05-645

Dear Ms. Walker:

S&ME, Inc. (S&ME) herein submits a Corrective Action Plan (CAP) for the referenced site. This plan has been prepared in general accordance with the South Carolina Department of Health and Environmental Control (SCDHEC) guidelines. S&ME proposes to introduce oxygen releasing compound (ORC®) in the area around MW-2 to enhance degradation of the volatile and semi-volatile compounds. Delivery of the ORC will be accomplished through a series of socks inserted into two wells to be installed upgradient of MW-2. Groundwater sampling of the site will continue on a semi-annual basis (May/November) for select wells by EPA Method 8260B/8270C as outlined in your December 2, 2009 letter.

If you have any questions concerning this plan, please contact us at (864) 574-2360. We look forward to your approval of this CAP.

Sincerely,  
**S&ME, Inc.**

John Nyvall, P.E.  
Environmental Services

Stanford Lummus, P.E.  
Senior Environmental Engineer

cc: Ms. Jessica Bednarcik, Duke Energy

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## 1.0 INTRODUCTION

### 1.1 Site Location

The Bramlette Road manufactured gas plant (MGP) and CSX/Vaughn Landfill site is located at 400 South Bramlette Road in Greenville, South Carolina. The site is shown on the United States Geological Survey (USGS) Greenville, South Carolina Quadrangle, 1983 photo revised edition as shown in **Figure 1**. A site plan is included as **Figure 2**.

### 1.2 Purpose of the Corrective Action Plan

The purpose of this Corrective Action Plan (CAP) is to outline methods that will be used to remediate shallow groundwater in the immediate vicinity of monitoring well MW-2 at the referenced site. This CAP was prepared as required by the South Carolina Department of Health and Environmental Control (SCDHEC).

### 1.3 Site History

The Bramlette Road MGP site was originally developed as a manufactured gas plant by Southern Public Utilities in 1917. The site eventually contained a retort house, three gas holders, a water gas plant, tar and ammonia washer tanks, purifiers, a tar extractor and holder, and an underground heating oil tank.

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 is currently vacant and access is restricted by perimeter fencing.

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

The Bramlette Road MGP site is owned by CSX and has been investigated in conjunction with the adjacent CSX/Vaughn Landfill site. The Landfill site and the MGP site cover approximately 6.4 and 3.7 acres, respectively. Both the Bramlette Road MGP and CSX/Vaughn Landfill sites

are parts of more extensive CSX property holdings in the Bramlette Road area that total approximately 40 acres and contain rail lines, an office for crew and scheduling activities, and an asphalt transfer station. The asphalt transfer station lies immediately west and adjacent to the MGP site. CSX holdings also include tracts immediately north and adjacent to the MGP site and referred to herein as the Suburban Propane property and the Northwest Area property. The majority of these properties lie within the floodplain of the Reedy River located to the west. Land use immediately east of the sites is primarily residential with one school building.

#### 1.4 Remedial Action to Date

Currently, there are sixteen (16) active groundwater monitoring wells on the Bramlette Road MGP and CSX/Vaughn Landfill site. These wells are gauged and sampled semi-annually.

Past site investigations can be further researched in the following reports/correspondence:

CSX/Vaughn Landfill and Bramlette Road MGP Sites – Phases I, II, and III Investigation and Site Assessment Reports (Phase I, March 1995; Phase II, Sept. 1996; Phase III, June 2000) by AES (I, II) and Duke Power Company (III)

Vaughn Landfill and Bramlette Road MGP Sites – Remedial Action Plan; September 2000 by Duke Power Company.

Suburban Propane Property and Northwest Area Investigation Report; July 2002 by Duke Power Company.

CSX/Vaughn Landfill and Bramlette Road MGP Sites Remedial Action Plan – Final Report; June 2003 by Duke Power Company.

Various Semi-annual Groundwater Monitoring Reports; from 2002 to present by Duke Power Company, Duke Energy, and S&ME.

#### 1.5 Current Site Conditions

Current site conditions for the entire site are detailed in the Semi-Annual Groundwater Monitoring Reports. As the focus of this CAP is on the area in the immediate vicinity of MW-2, the remainder of this report only deals only with the information in that well. The location of MW-2 has been called out on **Figure 2**.

Elevated concentrations have historically been detected in MW-2 since sampling began, as shown in **Figure 5** for benzene and **Figure 6** for naphthalene. While the constituent concentration trends in the other wells on the site have either remained relatively constant or have slightly decreased over time, the concentration trends in MW-2 have slightly increased. Based on this slight increasing trend, the area in the immediate area surrounding MW-2 needs to be addressed.

No significant drinking water receptors exist at the site. The area is served by the municipal drinking water system. The only significant known receptor in the area is the Reedy River which borders the site to the west. Therefore the current human health risks on the site are minimal.

## **2.0 CORRECTIVE ACTION OBJECTIVES**

The objective of this CAP is to protect human health and the environment as determined by the SCDHEC and to achieve required site-specific target levels of concentrations in the vicinity of MW-2. Additional groundwater concerns at the remainder of the site will be addressed in a future Continuous Action Plan.

### **2.1 Groundwater Parameters and Target Cleanup Concentrations**

Target cleanup concentrations for the shallow groundwater have been established by the SCDHEC. Laboratory analyses from historical semi-annual sampling events indicate that concentrations for both benzene and naphthalene have exceeded target concentrations in MW-2. Table 1 summarizes the groundwater quality data from the two most recent sampling events (May/November 2009). **Figure 3** and **Figure 4** show summaries of the results from the two groundwater sampling events in 2009. **Figure 5** and **Figure 6** show benzene and naphthalene concentration history for monitoring well MW-2. Based the most recent sampling event, benzene and naphthalene are currently the prominent contaminants of concern.

## **3.0 PROPOSED REMEDIATION TECHNOLOGY**

### **3.1 Recommended Remedial Strategy**

Based on current levels, dissolved oxygen (D.O.) concentrations in and around the area of MW-2 are relatively low (Table 2). Therefore, the use of oxygen releasing compound (ORC®) is proposed to enhance biodegradation and potentially volatilize contaminants of concern in this area. ORC is designed to slowly release oxygen into the subsurface for periods of up to 12 months on a single application. With this consistent oxygen delivery, D.O. in the immediate area of the application is expected to increase causing aerobic microbes to enhance biodegradation of the contaminants of concern.

We recommend this technology for two reasons. First, this system is not as prone to iron-fouling as some of the other available subsurface oxygen delivery technologies. Should a sock become fouled, a simple cleaning or sock exchange can be implemented. Second, the ORC socks have significantly lower initial and continual maintenance costs than similar oxygen delivery systems. Sock maintenance will coincide with the semi-annual sampling events, reducing operations and

maintenance costs. Based on the rate of ORC usage observed, additional visits may need to be scheduled between semi-annual sampling events, but should still require a minimum effort.

### 3.2 Proposed Corrective Action Schedule

The proposed corrective action chosen for this site is the installation of ORC filter socks in two new wells to be installed upgradient of monitoring well MW-2. The proposed location of these wells is shown in Figure 7. The socks will slowly release oxygen into the aquifer enhancing biodegradation in the immediate area of MW-2. Enough socks will be installed to cover the entire length of the screened interval in the two new wells.

A proposed schedule of site implementation activities is as follows:

Submit CAP	February 2010
Submit Necessary Injection Permits	Within 3 months of CAP approval
Install ORC socks in MW-2	Within 3 months of Injection Permit Approval
Semi-Annual Monitoring Reports	May/November for volatiles and semi-volatiles
Evaluation of Test Period	The semi-annual reports will include evaluation of the selected remediation technology. Recommendations will be made based on effectiveness.

## 4.0 GROUNDWATER MONITORING PLAN

No deviations to the current sampling plan are proposed. Previously identified indicator wells will continue to be sampled in the May event with all of the wells sampled in the November event. The wells will be analyzed for constituents by EPA Methods 8260 and 8270. ORC effectiveness and recommendations will be included within each submitted semi-annual monitoring report.

## 5.0 PERMITTING

Necessary permits will be obtained prior to remedial actions taking place on the site.

## **6.0 SYSTEM ABANDONMENT**

Should ORC sock change out be necessary as identified in semi-annual reports, the used socks will be properly stored and disposed at an acceptable facility. Once it is determined that ORC socks are no longer needed, all materials associated with the installation will also be properly stored and disposed.

The groundwater monitoring wells will be properly abandoned by a certified South Carolina well driller of the appropriate grade once remediation goals have been met. However, no currently existing monitoring wells are planned for immediate abandonment.

## **7.0 CONCLUSIONS**

ORC socks installed in two new wells to be installed upgradient of monitoring well MW-2 are the recommended remedial strategy for the Bramlette Road MGP site. Based on current site conditions and characteristics of the contaminant plume, ORC is considered an appropriate and economical remediation technology. Use of ORC is expected to result in contaminant removal through oxygenation of the shallow groundwater aquifer. The approach is anticipated to effectively remediate the shallow impacted groundwater in the immediate vicinity of MW-2.

## **8.0 STATEMENT OF PROVISIONS AND QUALIFICATIONS**

This plan has been prepared for the use of Duke Energy Corporation and the SCDHEC for the specific application to this project. This plan has been prepared in accordance with generally accepted engineering and hydrogeologic practices for projects of this type. The findings and conclusions are based on the applicable standards of our profession at the time this plan was prepared. No other warranty, expressed or implied, is made.

## **9.0 REFERENCES**

- Bureau of Water. R.61-68, Water Classifications and Standards. South Carolina Department of Environmental Control, effective April 25<sup>th</sup>, 2008.
- Dacus, Scott and Whitehead, John. Groundwater Monitoring Report. Spartanburg, South Carolina: S&ME, Inc., June 2009.
- Drinking Water Contaminants (MCLs). US EPA, 2010. <http://www.epa.gov/safewater/contaminants/index.html>.



McGary, Mark. CSX/Vaughn Landfill and Bramlette Road MGP Sites Phase III Investigation and Site Assessment Report. Site Remediation Services Group – Duke Engineering and Services, June 2000.

McGary, Mark. CSX/Vaughn Landfill and Bramlette Road MGP Sites Remedial Action Plan Final Report. Site Remediation Services Group – Duke Engineering and Services, June 2003.

Sheehan, Michael and Armstrong, Larry. Groundwater Monitoring Report. Spartanburg, South Carolina: S&ME, Inc., January 2010.

Regenesis Oxygen Release Compound (ORC®) Overview and How It Works Sections.  
Regenesis, 2010. <http://www.regenesis.com>.

**TABLE 1**  
**LABORATORY ANALYTICAL DATA - GROUNDWATER**  
**2009 MAY/NOVEMBER SAMPLING EVENTS**  
**BRAMLETTE ROAD MGP SITE**  
**GREENVILLE, SOUTH CAROLINA**

**S&ME PROJECT NO. 1264-05-645**

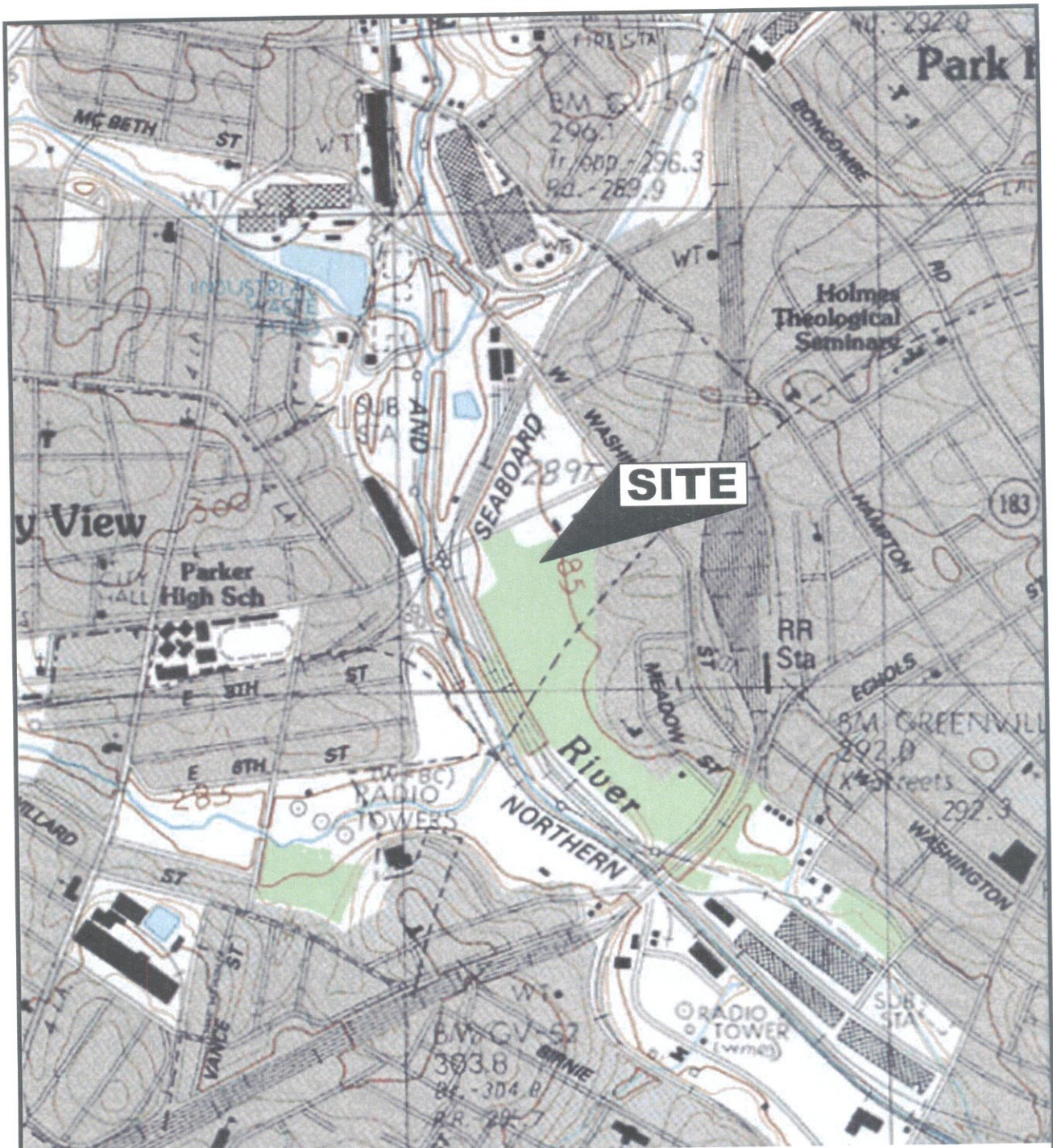
Well			MW-2	
Sample Date			5/15/2009	11/19/2009
1,2,4 - Trimethylbenzene	NE	NE	<b>2.57</b>	<1.0
1,3,5 - Trimethylbenzene	NE	NE	<1.0	<1.0
Benzene	5	2.2	<b>45.3</b>	<b>9.43</b>
Ethylbenzene	700	530	<b>8.75</b>	<1.0
Isopropylbenzene	NE	NE	<1.0	<1.0
n-Butylbenzene	NE	NE	<1.0	<1.0
Naphthalene	NE	NE	<b>123</b>	<b>14.1</b>
n-Propylbenzene	NE	NE	<1.0	<1.0
p-Isopropyltoluene	NE	NE	<1.0	<1.0
cis-1,2-Dichloroethene	70	NE	<1.0	<1.0
Toluene	1000	1300	<1.0	<1.0
Xylenes, total	10000	NE	<b>3.13</b>	<3.0
1-Methylnaphthalene	NE	NE	<10.0	<2.04
2-Methylnaphthalene	NE	NE	<b>60.1</b>	<2.04
Acenaphthene	NE	670	<b>35.6</b>	<2.04
Acenaphthylene	NE	NE	<b>25</b>	<2.04
Anthracene	NE	8300	<b>28</b>	<2.04
Bis (2-ethylhexyl) phthalate	6	1.2	<10.0	<10.2
Benzo (a)Anthracene	NE	0.0038	<b>25.8</b>	<2.04
Benzo(a)Pyrene	0.2	0.0038	<b>16.8</b>	<2.04
Benzo (b)Fluoranthene	NE	0.0038	<b>21.1</b>	<2.04
Benzo (k)Fluoranthene	NE	0.0038	<b>15.6</b>	<2.04
Carbazole	NE	NE	<b>11.3</b>	<10.2
Chrysene	NE	0.0038	<b>23.4</b>	<2.04
Dibenzofuran	NE	NE	<b>31.4</b>	<10.2
Fluoranthene	NE	130	<b>79.4</b>	<2.04
Fluorene	NE	1100	<b>46</b>	<2.04
Naphthalene	NE	NE	<b>217</b>	<b>2.85</b>
Phenanthrene	NE	NE	<b>112</b>	<2.04
Pyrene	NE	830	<b>56.4</b>	<2.04

**NOTES:**

1. All concentrations are in ug/L.
2. Detected concentrations are in **bold**.
3. US EPA MCL - United States Environmental Protection Agency Maximum Contaminant Levels
4. SCDHEC HHCWO - South Carolina Department of Health and Environmental Control  
Human Health Criterion for Consumption of Water and Organisms Standards
5. NE - Not Established

**TABLE 2  
GROUNDWATER FIELD DATA  
2009 MAY/NOVEMBER SAMPLING EVENTS  
BRAMLETTE ROAD MGP SITE  
GREENVILLE, SOUTH CAROLINA  
S&ME PROJECT NO. 1264-05-645**

Well Number	MW-2	
Date Sampled	5/15/2009	11/19/2009
Measured Well Depth (feet)	18.20	18.20
Depth to Water (feet)	11.08	10.49
Groundwater Elevation (feet)	922.37	922.96
Depth to Product (feet)	none	none
Product Thickness (feet)	none	none
Odor	none	none
Well Volume (gal)	1.17	1.0
Evacuated Volume (gal)	3.0	3.0
Complete Evacuation? (yes/no)	no	no
Temp (deg C)	16	20
Specific Conductance (umho/cm)	269	371
pH (su)	5.56	5.86
Turbidity (NTU)	5.98	4.76
ORP (mV)	-103.9	-51.5
DO (mg/L)	1.07	1.71



SOURCE: TOPOGRAPHIC MAP OF GREENVILLE, SOUTH CAROLINA  
QUADRANGLE, 7.5 MINUTE SERIES, USGS, 1983 EDITION



SCALE:	AS SHOWN
CHECKED BY:	
DRAWN BY:	SB
DATE:	01-09-10



SITE TOPOGRAPHIC MAP BRAMLETTE ROAD MGP SITE 400 SOUTH BRAMLETTE ROAD GREENVILLE COUNTY, S.C.
JOB NO: 1264-08-105

FIGURE NO: <b>1</b>
------------------------

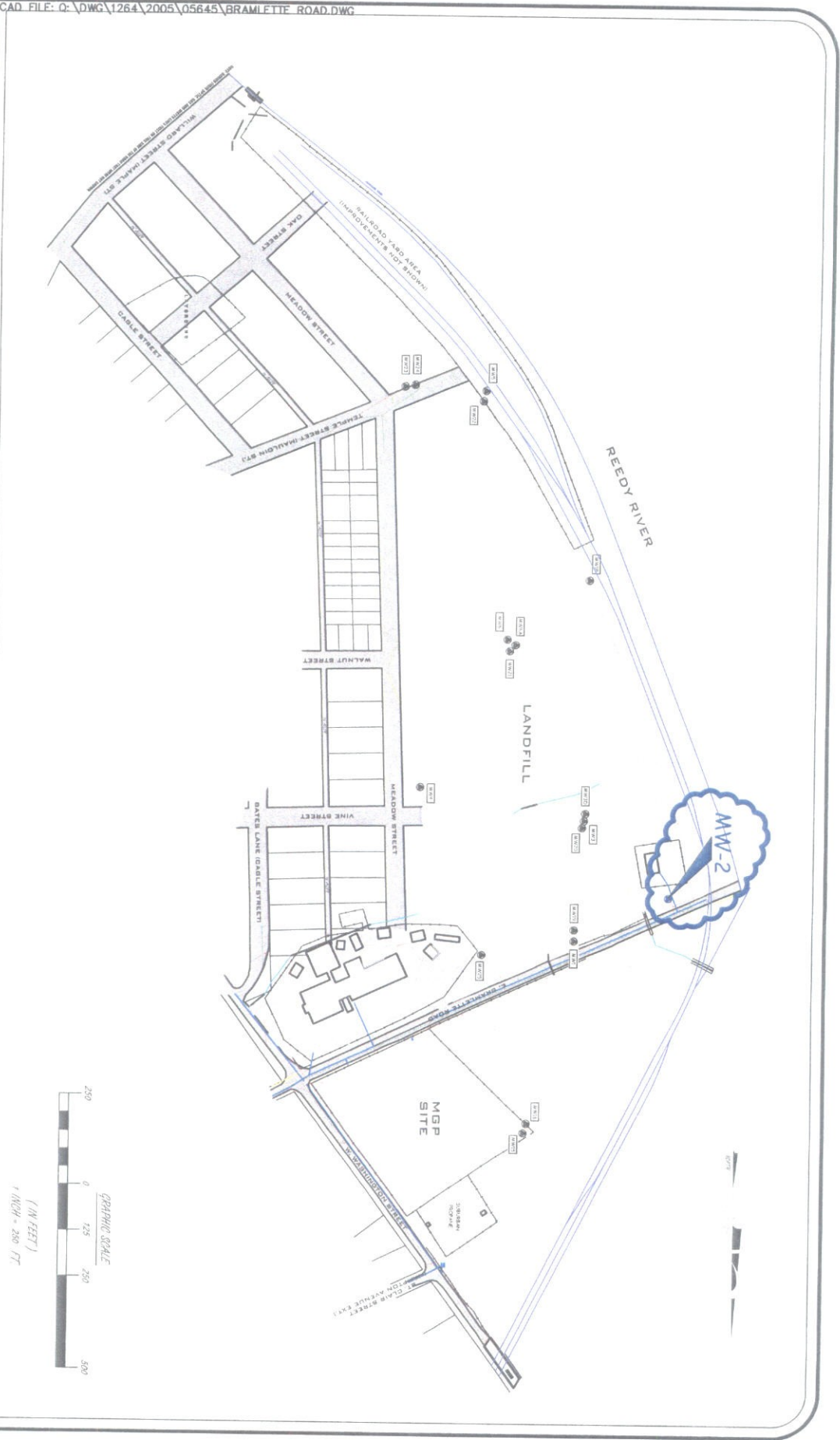
SCALE: AS SHOWN  
 PROJECT NO. 1264-05-645  
 DATE: SEPTEMBER 2009  
 DRAWN BY: L. ARMSTRONG  
 CHECKED BY:



155 TRADD STREET 29301  
 P: (803) 574-2300  
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 WWW.SMEINC.COM

SITE PLAN  
 BRAMLETTE ROAD MGP SITE  
 GREENVILLE, SOUTH CAROLINA

FIGURE NO. 2







**Figure 5**  
**Bramlette Road MGP**  
**Historic Benzene Concentration**  
**MW-2**

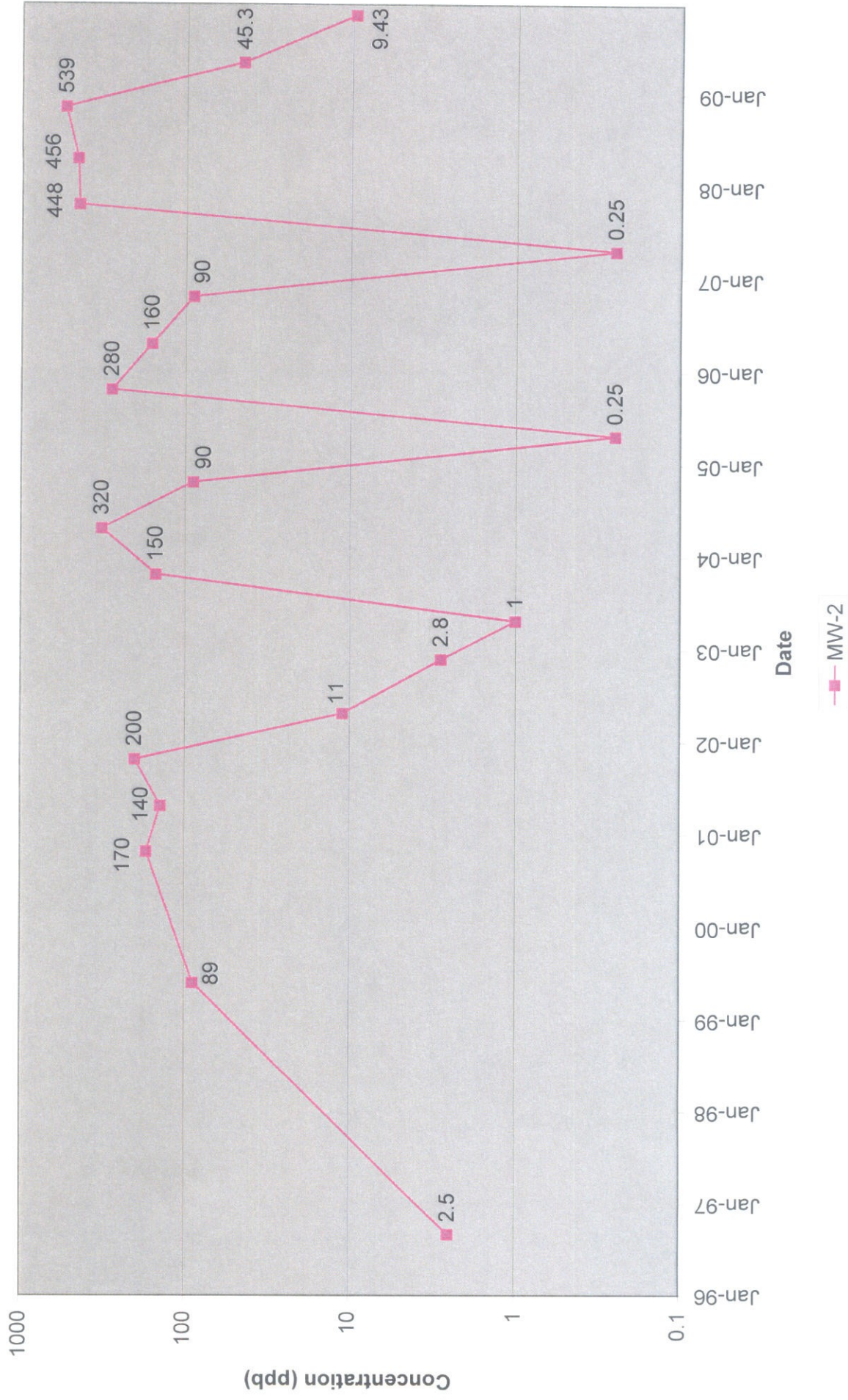
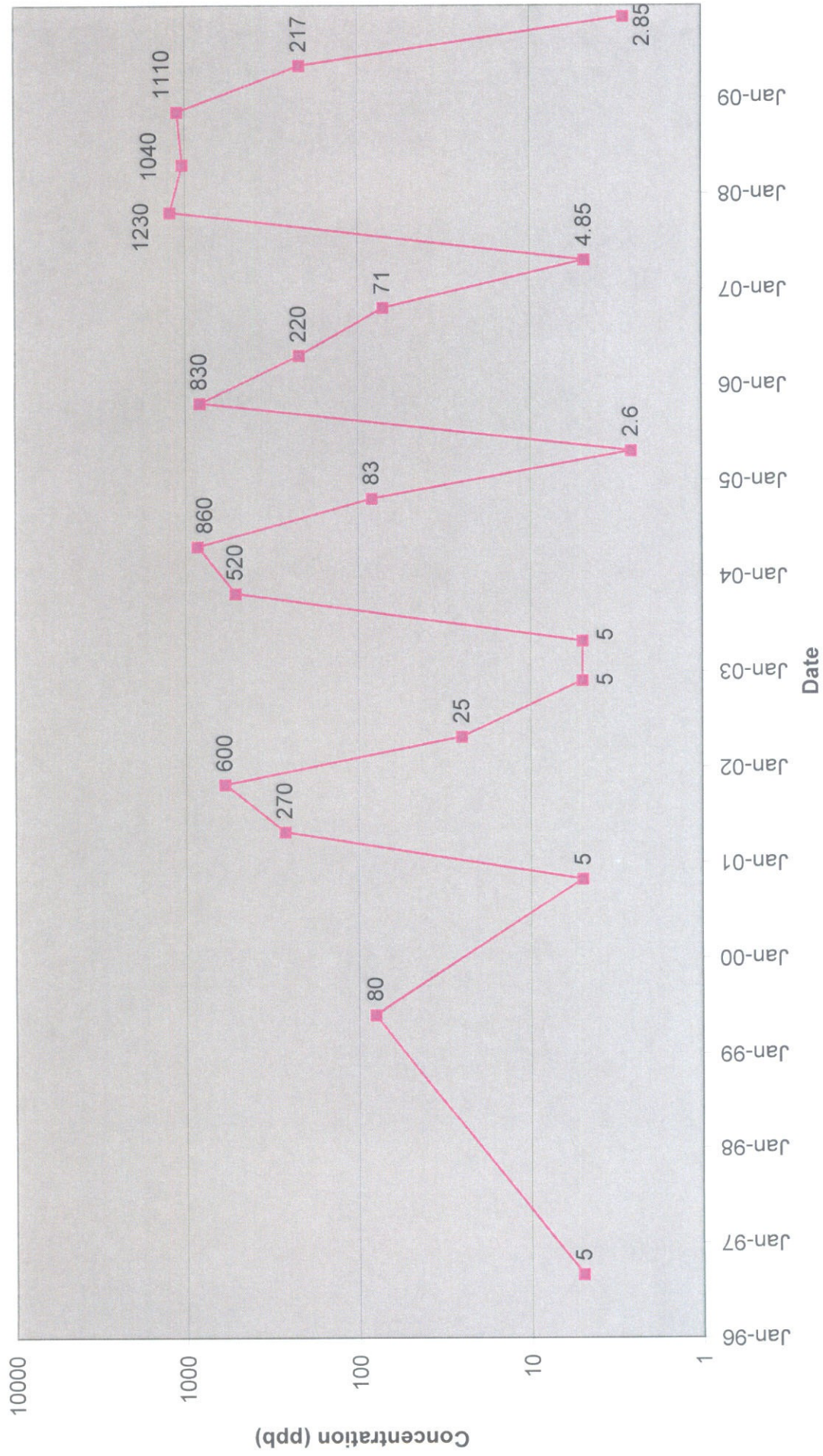




Figure 6  
 Bramlette Road MGP  
 Historic Naphthalene Concentration  
 MW-2



■ MW-2

\* Based on EPA Method 8270

