

**MTBE Case Study**  
**Multi-Phase Extraction and Air Sparging/Soil Vapor Extraction at**  
**Scotchman #94, Florence, South Carolina**

**Site Name:** Scotchman #94

**Site Location:** Florence, SC

**Contaminants:** MTBE, BTEX, Naphthalene

**Media:** Groundwater and Soil

**Technology:** Multi-Phase Extraction (MPE) and Air Sparging/Soil Vapor Extraction (SVE)

**Technology Scale:** Full

**Type of Cleanup:** RCRA UST

**Period of Operation:** April 1998 - present (data available through March 2000)

**Site Contact:**

Worsley Companies, Inc.  
P.O. Box 3227  
Wilmington, SC 28406  
Telephone: (910) 395-5300

**State Contact:**

Kimberly Wilson, P.G.  
Hydrogeologist  
South Carolina Dept. of Health and Environmental Control  
2600 Bull St.  
Columbia, SC 29201  
Telephone: (803) 898-4350  
Fax: (803) 898-4330  
E-mail: wilsonka@columb26.state.sc.us

**Contractor:**

CBM Environmental  
P.O. Box 411387  
Charlotte, NC 28241  
Telephone: (800) 743-1226  
Fax: (803) 548-5892  
E-mail: cbm@celink.net

**Site History [1,2]:**

Scotchman #94 is a gasoline service station located in Florence, South Carolina. In December 1991, a release was reported from the station's underground storage tanks (USTs), and an assessment of the release was completed in September 1997. Soil and groundwater at the site were found to be contaminated with MTBE, BTEX, and naphthalene, and free product was present in the groundwater. Data from July 1997 showed concentrations of contaminants in groundwater as high as 87,000 ug/L for MTBE, 23,000 ug/L for benzene, 140,000 ug/L for toluene, 18,000 ug/L for ethylbenzene, 91,000 ug/L for xylenes, and 4,600 ug/L for naphthalene. A Corrective Action Plan (CAP) was implemented in March 1999 under Subtitle I of the RCRA program. The CAP included free product recovery using MPE and treatment of dissolved-phase groundwater contamination using air sparging/SVE.

The soil at the site consists of clayey sands and sandy-clays. A hard clay layer is present at approximately 10 feet below ground surface (bgs). The average hydraulic gradient is 0.004 feet/foot with a calculated seepage velocity of 4.415 feet per year. The depth to groundwater is 5.4 to 23 feet below ground surface (bgs).

**Technology Description [1,2]:**

The groundwater treatment system at the site includes an MPE system consisting of five extraction (recovery) wells, shown on Figure 1 as RW-1 through RW-5. The air sparging/SVE system includes 28 air sparging wells, arranged in seven groups of air sparging wells, as shown on Figure 2. Both systems began operating in March 1999. In December 1999, the systems were shut off to allow verification sampling. The systems were restarted immediately upon completion of sampling.

There are 19 monitoring wells (MW-1 through MW-19) at the site, installed at depths ranging from 14 to 30 feet bgs. Each well includes a 10-foot screened interval, with the depths of the screened intervals ranging from about 10 to 27.5 feet bgs. In addition, an outfall at the site (OS-1) was monitored.

**Technology Performance [1,2]:**

Site-specific target levels (SSTLs) were established by SCDHEC for MTBE, benzene, toluene, ethylbenzene, xylenes, and naphthalene, with seven monitoring wells (MW-1, MW-2, MW-6, MW-11, MW-15, MW-18, MW-19) and outfall OS-1 used in setting the total SSTLs. Table 1 shows the SSTLs for these individual points and for the total site.

Figure 1. Site Map Showing Extraction Wells [4]

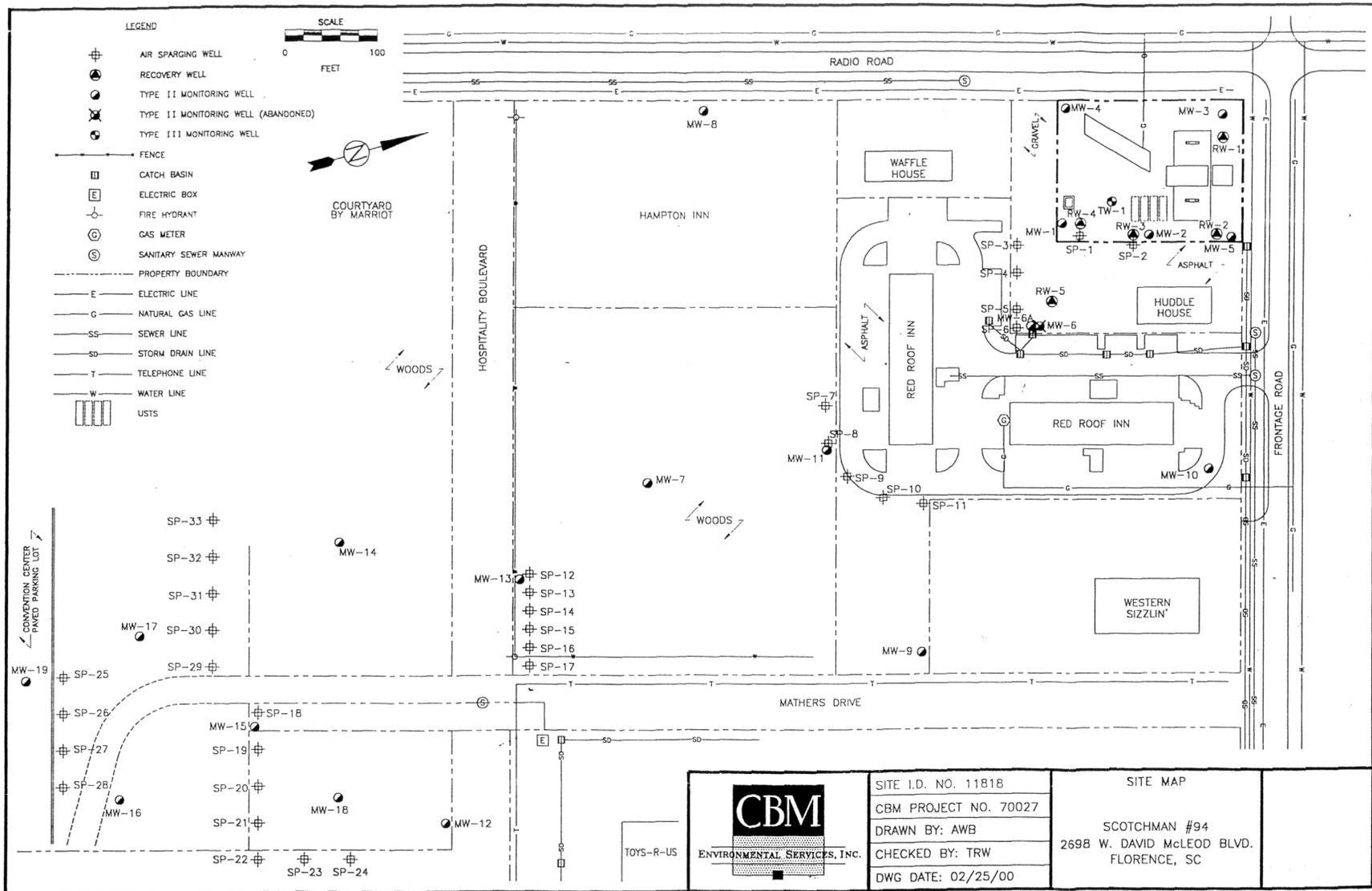
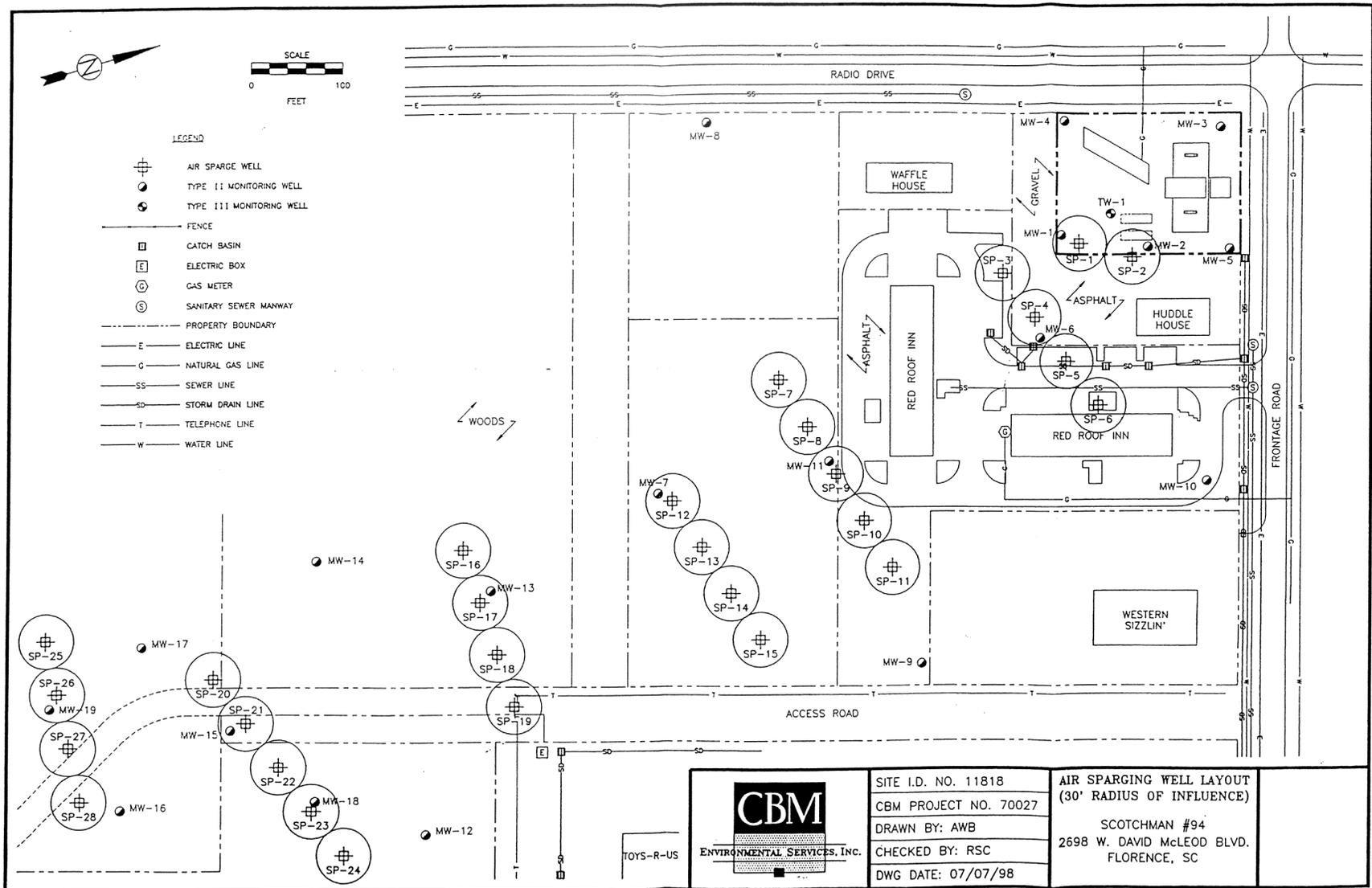


Figure 2. Site Map Showing Air Sparging Wells [4]



	SITE I.D. NO. 11818	<b>AIR SPARGING WELL LAYOUT</b> (30' RADIUS OF INFLUENCE)  SCOTCHMAN #94 2698 W. DAVID McLEOD BLVD. FLORENCE, SC
	CBM PROJECT NO. 70027	
	DRAWN BY: AWB	
	CHECKED BY: RSC	
DWG DATE: 07/07/98		

**Table 1. SSTLs for the Scotchman #94 Site (ug/L) [1]**

Well No.	Benzene	Toluene	Ethylbenzene	Xylenes	MTBE	Naphthalene
MW-1	224	9,900	1,000	5,000	1,793	57
MW- 2	311	62,393	18,000	91,000	2,495	1,559
MW-6	232	46,442	18,000	91,000	1,857	1,161
MW-11	124	400	60	340	996	12
MW-15	24	41	7	94	194	<5
MW-18	29	58	5	67	234	5
MW-19	8	6	<5	5	71	4
OS1	5	5	5	5	40	5
Total Mass	957	119,250	37,082	187,511	7,700	2,808

\* The total “mass” for each contaminant at the site was calculated as the sum of the concentrations in the individual wells (MW-1, -2, -6, -11, -15, -18, -19, and OS1)

After the system began operating, groundwater data were collected in March 1999, June 1999, September 1999, December 1999, and March 2000, as shown on Table 2. This table summarizes the data on the total mass of contaminants (sum of the concentrations measured in each of the wells listed in Table 1) in the groundwater and the maximum concentration of contaminants measured in an individual well.

The total mass of MTBE in the groundwater decreased through December 1999 to 17,736 ug/L, then increased to more than 192,000 ug/L in March 2000. Similar trends were observed for BTEX constituents and naphthalene, with total mass decreasing through December 1999, then increasing in March 2000. Decreases in the maximum concentrations (as measured in an individual well) were observed for each of the constituents. For example, maximum MTBE concentrations were reduced from 37,000 ug/L to 9,800 ug/L (about 74%), and concentrations of benzene from 14,000 ug/L to 1,300 ug/L (91%).

As of March 2000, all constituents remained above the SSTLs. The system will continue to be operated until all SSTLs have been met. According to the contractor, cleanup of the site is projected to be completed by March 2001.

**Technology Cost [1,2,3]:**

The total cost for the cleanup of this site is \$383,000. The South Carolina Petroleum Cleanup Fund awarded the contract for the cleanup at this site as a fixed-price, lump sum with no change orders. No additional information on cost breakdown was available.

**Table 2. Data on Contaminants in Groundwater (ug/L) (Total Mass and Maximum Concentration) [1]**

<b>Contaminant</b>	<b>SSTL (Total Mass)</b>	<b>July 1997 Total Mass/ Max Conc.</b>	<b>March 1999 Total Mass/ Max Conc.</b>	<b>June 1999 Total Mass/ Max Conc.</b>	<b>Sept 1999 Total Mass/ Max Conc.</b>	<b>December 1999* Total Mass/ Max Conc.</b>	<b>March 2000 Total Mass/ Max Conc.**</b>
Benzene	957	38,390/23,000	23,490/14,000	5,152/1,200	3,752/1,240	3,059/1,570	48,189/1,300
Toluene	119,250	193,506/140,000	30,549/27,000	20,469/8,900	2,127/1,630	7,484/7,340	287,885/7,800
Ethylbenzene	37,082	25,370/18,000	6,200/6,200	21,915/721	234/152	1,196/1,160	38,120/2,100
Xylenes	187,511	127,507/91,000	37,292/33,000	33,414/6,500	2,286/1,918	5,699/5,400	197,053/15,000
MTBE	7,700	110,600/87,000	62,300/37,000	40,880/20,000	30,616/16,800	17,736/7,410	192,500/9,800
Naphthalene	2,808	4,759/4,600	6,641/6,400	735/310	99/21	Not detected	9,393/59

\* Well MW-2 was not sampled.

\*\* Wells MW-2 and MW-6A not sampled due to presence of free product. Wells MW-7 and MW-8 and outfall OS-1 not sampled due to insufficient water. For wells not sampled, concentrations used in calculations were set equal to SSTLs. Max. Conc. is highest actual measured concentration.

**Observations and Lessons Learned:**

After two years of operation, the MPE/AS/SVE system at Scotchman #94 has reduced concentrations of MTBE, BTEX, and naphthalene within individual wells. However, the SSTLs have not been met for the site.

**References:**

1. Art Shrader, SCDHEC. Memorandum to Richard Weisman, Tetra Tech EM Inc. Re. Scotchman #94 Permit #11818, MTBE Study, Florence County. March 1, 2000.
2. W. Scott McInnis, SCDHEC. E-mail to Richard Weisman, Tetra Tech EM Inc. MTBE Study - Information about Scotchman #94. February 25, 2000.
3. Art Shrader, SCDHEC. E-mail to Richard Weisman, Tetra Tech EM Inc. MTBE Study - Cost Data. February 23, 2000.
4. Art Shrader, SCDHEC. E-mail to Doug Maddox, EPA. Feedback on Draft Case Study. October 30, 2000.