

## **2.BACKGROUND SITE INFORMATION**

### **A. Site History**

The site is located in the south-central portion of Scott County and more specifically in Oneida, Tennessee. In the early 1950s, a cross-tie treatment facility was established at the site by the owner, The Tennessee Railway Company. Reportedly, the facility was in continual use until the end of 1960. Intermittent use was experienced from 1960 to 1966 and a period of inactivity followed from 1966 until late 1968. In 1973, the Tennessee Railway Company was purchased by the Southern Railway Company. At this time, cross-tie treatment operations ceased. Relevant equipment was dismantled and removed from the site subsequent to 1973. On December 31, 1990, Southern Railway Company changed its name to Norfolk Southern Railway Company.

The cross-tie treatment facility included an above ground storage tank (AST) creosote holding tank, a treatment unit, and a spur track (See Figure 1). Excess creosote derived from the pressure treatment of cross-ties was reportedly conveyed to a holding pond, via a 6-inch transfer, east of the treatment unit. According to a Norfolk Southern representative, the treatment unit was located on concrete footings approximately 100 feet north of Pine Creek. Plant runoff was allegedly collected in nearby sump pits that are no longer visible.

Currently, the area adjacent to the site contains an active rail-yard facility. A scale platform, fueling and maintenance facilities are present at the facility. Two diesel fuel ASTs, spill containment facilities, and an

Figure 1: Site Layout (Geraghty & Miller, 1997)  
(figure1.gif, 62 K)

oil/water separator are located at the fueling facility.

In 1997, the Tennessee Department of Environment and Conservation recently approved a remedial action plan prepared by Geraghty & Miller, Inc., for the site. The site is in the initial stages of a phytoremediation and intrinsic bioremediation demonstration.

#### **B. Developments Leading to Remediation Efforts**

In October 1990, the U.S. Corps of Engineers initiated construction of a drainage channel on Pine Creek as part of the Pine Creek Watershed Project. Pine Creek is located adjacent to the southern portion of the site. During excavation near the railroad bridge, evidence of creosote contamination was observed and reported to the Tennessee Department of Health and Environment (TDHE). In early November 1990, TDHE sampled subsurface soil and ground water on-site and surface water and sediment under the railroad bridge from Pine Creek. The samples were analyzed for benzene, toluene, ethlybenzene and xylene (BTEX) and PAH constituents. PAH and BTEX constituents were detected in on-site subsurface soil at a 4 to 4.5 foot depth and in creek sediments. In January 1991, TDHE continued to observe creosote seepage along the creek bank.

Environmental Technology, Inc. (ETI) performed initial abatement and preliminary site assessment (PSA) activities from March thru July 1991. Prevention of further release of creosote into Pine Creek was the primary objective of the initial abatement measures. The purpose of the PSA was to evaluate the extent of creosote contamination in site soils, ground water and adjacent surface waters. Five soil boring holes were drilled and five monitoring wells (MW-1 thru MW-5) were installed at the site. PAHs and BTEX

compounds were both detected in ground water at MW-5. At a depth of 5 feet in the MW-5 soil boring, the highest concentration of total PAHs, 2,733 mg/kg, was found.

In March 1991, ETI excavated 11 test pits to assist in characterization of the former creosote treatment and down gradient areas. The test pits, which were located in the southeastern part of the site, were connected to form a ground water collection trench. The ground water collection trench is approximately 330 feet long, 20 feet wide at the top and 3 feet wide at the bottom. Four-inch slotted drain tile was placed in the bottom of the trench and connected into a 24-inch stand pipe. A submersible pump located in the standpipe directs flow to the on-site oil/water separator. The oil/water separator discharges to the sanitary sewer system that is treated at the Oneida publicly-owned treatment works (POTW). The ground water collection trench, which provides hydraulic control for the site and impedes contaminant seepage into Pine Creek, has been intermittently operational over the past 6 years.

In August 1991, additional sampling and analyses were performed at various locations on- and off-site. Results of the sampling indicated no impact to off-site ground water wells. PAHs were detected in Pine Creek surface water and sediments. BTEX was detected in discharge from the oil/water separator unit and the Oneida POTW effluent contained trihalomethanes (THMs).

In January 1993, an expanded site investigation (ESI) and additional sampling was performed at the site. The results of sampling indicated that PAHs were impacting Pine Creek sediments downstream of the site. PAHs and BTEX were again detected in MW-5 on-site and nearby water-supply wells were still not being impacted.

In 1994 and 1995, Norfolk Southern retained Roy F. Weston, Inc., to perform additional on- and off-site field work and data collection. In 1995, the following information was reported by Roy F. Weston. MW-1 thru MW-4 did not have detectable levels of PAHs in ground water. However, MW-5 contained 2.91 mg/L of total PAHs. Ground water generally flowed in a southeasterly direction towards Pine Creek. Creosote was not observed seeping into Pine Creek from the edge of the banks. However, the presence of rip-rap prevented observation of the entire area. Seven locations were selected for sub-rip-rap investigation along the northern bank of the creek. One location exhibited noticeable impacts. Soil PAH analysis at the six other locations was performed and results found total PAHs ranging from 1.4 to 154.7 mg/kg. A review of the historical aerial photographs did not assist in locating the former holding pond that supposedly received excess creosote. Based on information from various sources and information provided in the Division of Superfund (DSF) ESI, the holding pond was east of the cross-tie treatment unit and adjacent to the original channel of Pine Creek.

### **C. Site-Specific Aquatic Toxicological Concerns**

The Oneida site is bordered by Pine Creek, which feeds into a larger bodies of water downstream. These bodies of water are habitats for fish and other aquatic organisms. PAHs can accumulate in aquatic organisms from water, sediments, and food (ASTDRa, 1993). Accumulation of PAHs in aquatic sediments is a major concern to the livelihood of the aquatic community.

Sved *et al.* (1997) studied the toxicity of creosote-contaminated sediments on the spot, a salt water fish commonly found in the York River, VA. In a laboratory experiment, spot were exposed to two types of creosote fractions, a high molecular weight (HMW) fraction, containing namely phenanthrene, anthracene, fluoranthene, pyrene, and chrysene and a low molecular weight (LMW) fraction, containing namely naphthalene, acenaphthene, fluorene, and phenanthrene. The HMW fraction is similar in composition to environmentally weathered creosote. Total resolved PAH concentrations in the LMW and HMW fractions were 49 and 72  $\mu\text{g/L}$ , respectively. The independent batches of spot were exposed to suspended sediments of each creosote fraction for ten days. Spot exposed to the HMW fraction experienced mortality, epidermal lesions and fin erosion. While spot exposed to the LMW fraction developed lesions only around their mouth, nares, and opercula and did not experience mortality or fin erosion. The authors suggest that HMW creosote compounds are responsible for environmental toxicity in spot.

Baumann *et al.* (1995) studied the toxicological effects on a freshwater fish, the wild brown bullhead catfish, after closure of a coking plant in 1983. Similar to creosote production facilities, coking plants can also be sources of PAHs to the environment. Prior to 1983, the group of researchers collected data to examine the effects of PAHs on catfish. Closure of the coking plant enabled examination of changes in fish liver neoplasms and decreases in sediment bound PAHs to occur. Surficial sediments were obtained beginning in 1980 and ending in 1987. Concentrations of acenaphthylene, acenaphthene,

phenanthrene, fluoranthene, pyrene and chrysene decreased substantially in dry sediment from 1980 to 1987. Concentrations of PAH residues, namely phenanthrene, fluoranthene, pyrene, and chrysene, in 3-year-old brown bullhead also decreased significantly. Correspondingly, the frequency of liver cancer in 3- and 4-year-old catfish declined to 10% by 1987 versus 39% in 1982. The authors concluded by stating that PAH exposure and high liver tumor frequencies in the catfish could be correlated. Furthermore, the authors feel that once a discharging source of PAH aqueous-phase contamination is eliminated, biologically available concentrations of PAHs will decline naturally in depositional areas.

#### **D. Selection of Monitored PAHs**

In March 1997, Geraghty & Miller, Inc., Oak Ridge, Tennessee, collected soil samples on-site and subsequent PAH analyses allowed determination of the most prevalent PAHs at the site. The soil samples were extracted and analyzed according to USEPA Method 8100. The analytical results provided soil concentrations for the 16 PAHs. See Figure 2 and Table 1 for sample locations and analytical results, respectively. Monitoring of only 6 PAH constituents represented a major percentage of the total PAH contamination at the given soil sampling locations. Therefore, acenaphthene, fluorene, phenanthrene, fluoranthene, pyrene, and chrysene were quantified in all soil samples collected from the site. These 6 PAHs were selected based on their prevalence in creosote and primarily from a review of 1997 soil boring analytical results. Soil studies focused primarily on remediation of 3- and 4-ring PAHs.

Figure 2: Location of Soil and Ground Water Sampling  
Points Prior to Virginia Tech Research Efforts  
(Geraghty & Miller, 1997) (figure2.gif, 75K)



Table 1: Geraghty & Miller Soil Auger Boring Results Used  
To Select Monitored Soil PAH Constituents  
(table1.gif, 62 K)

Selection of monitored PAHs in ground water was performed in a similar fashion. Geraghty & Miller provided Virginia Tech with analytical results from monitoring well sampling over a 6-year period ended in April 1997. The analytical results were reviewed, but determination of monitored constituents was not made immediately. Instead, ground water samples were collected from multi-level samplers (MLS) at the site on November 25, 1997, and analyzed at EnviroTech Mid-Atlantic Laboratories, Blacksburg, VA, for the 16 PAHs. Ground water analytical results were used to determine which PAHs would be monitored. In addition to the 6 PAHs monitored in the soil, acenaphthylene, anthracene, and naphthalene were prevalent in many MLS samples. The presence of benzo(b)fluoranthene in the aqueous phase would likely indicate extreme contamination. Including the 6 PAHs being monitored in soil, acenaphthylene, anthracene, benzo(b)fluoranthene, and naphthalene were monitored in ground water samples analyzed at Virginia Tech.