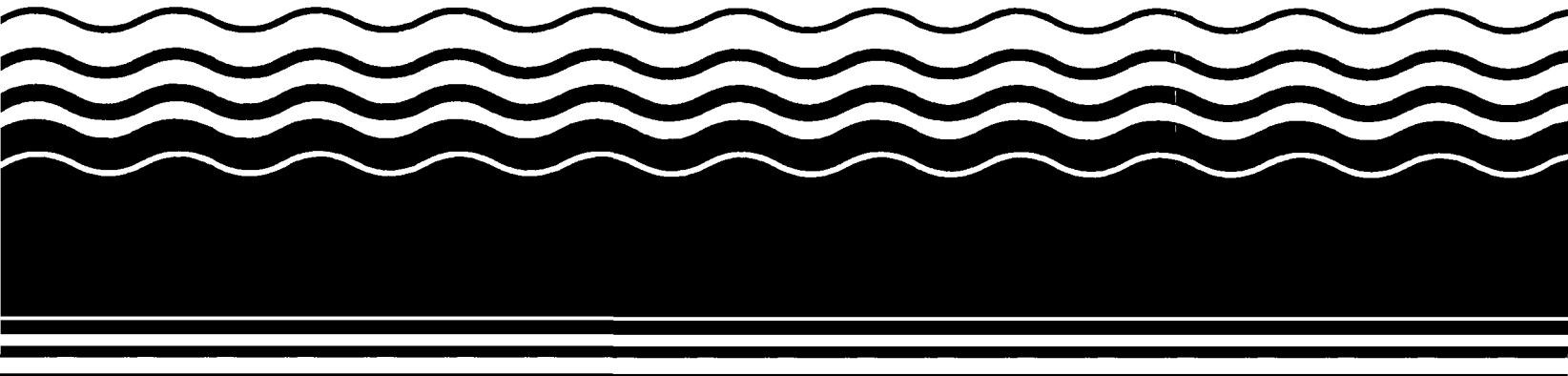




# **Superfund Record of Decision:**

## **Benfield Industries, NC**



## **NOTICE**

The appendices listed in the index that are not found in this document have been removed at the request of the issuing agency. They contain material which supplement, but adds no further applicable information to the content of the document. All supplemental material is, however, contained in the administrative record for this site.

<b>REPORT DOCUMENTATION PAGE</b>	<b>1. REPORT NO.</b> EPA/ROD/R04-92/104	<b>2.</b>	<b>3. Recipient's Accession No.</b>
<b>4. Title and Subtitle</b> SUPERFUND RECORD OF DECISION Benfield Industries, NC First Remedial Action - Final			<b>5. Report Date</b> 07/31/92
<b>7. Author(s)</b>			<b>6.</b>
<b>9. Performing Organization Name and Address</b>			<b>8. Performing Organization Rept. No.</b>
			<b>10. Project/Task/Work Unit No.</b>
			<b>11. Contract(C) or Grant(G) No.</b> (C) (G)
<b>12. Sponsoring Organization Name and Address</b> U.S. Environmental Protection Agency 401 M Street, S.W. Washington, D.C. 20460			<b>13. Type of Report &amp; Period Covered</b> 800/000
			<b>14.</b>
<b>15. Supplementary Notes</b> PB93-964018			
<b>16. Abstract (Limit: 200 words)</b>  <p>The 3.5-acre Benfield Industries site is a former bulk chemical mixing and repackaging plant in Hazelwood, Haywood County, North Carolina. Land use in the area is mixed, with surrounding light industrial, commercial, and residential areas. The estimated 3,258 area residents use ground water as their sole source of drinking water, and approximately 2,056 people in Hazelwood are connected to the local public water supply system. From 1904 until Benfield Industries purchased the property in 1976, site ownership changed several times and was used for furniture manufacture and sewing operations. Products handled and stored at the facility by Benfield Industries included paint thinners; solvents; sealants; cleaners; de-icing solutions; and wood preservers, including creosote. During site operations, complaints from citizens concerning the improper disposal of hazardous waste prompted initial site investigations by the state. On April 21, 1982, a series of explosions at the Benfield site started a fire that destroyed most of the onsite facilities and resulted in permanent closure of the Benfield Industries plant. None of the onsite tanks or gas cylinders ruptured during the fire; however, dense toxic fumes emanating from the site</p> <p>(See Attached Page)</p>			
<b>17. Document Analysis a. Descriptors</b> Record of Decision - Benfield Industries, NC First Remedial Action - Final Contaminated Media: soil, gw Key Contaminants: VOCs (benzene), other organics (PAHs), metals (arsenic, lead)			
<b>b. Identifiers/Open-Ended Terms</b>			
<b>c. COSATI Field/Group</b>			
<b>18. Availability Statement</b>	<b>19. Security Class (This Report)</b> None	<b>21. No. of Pages</b> 174	
	<b>20. Security Class (This Page)</b> None	<b>22. Price</b>	

Abstract (Continued)

resulted in the temporary evacuation of nearly 2,000 area residents. Investigations conducted by EPA, state, local agencies, and academic institutions revealed a wide range of organic and inorganic contaminants, including elevated levels of lead and chromium. Following the fire, the state ordered the site owner to remove all fire debris, chemicals, and creosote storage tanks from the site. This ROD addresses the remediation of contaminated soil and ground water. The primary contaminants of concern affecting the soil and ground water are VOCs, including benzene; other organics including PAHs; and metals, including arsenic and lead.

The selected remedial action for the site includes excavating, separating, sizing, and treating the contaminated soil using onsite soil washing; transferring the smaller soil particles to an ex-situ slurry biological treatment system; replacing coarse soil fraction and the treated soil fines in the onsite excavations, and grading and revegetating the area; treating and/or disposing of any remaining hazardous waste residual offsite; extracting and pretreating ground water onsite using aeration to remove iron and manganese, followed by treatment using ion exchange to remove heavy metals; ex-situ biotreatment using a submerged fixed-film bioreactor; and a polishing step using granular activated carbon; reintroducing the nutrient-enriched water into the onsite aquifer to facilitate in-situ biodegradation, or if necessary offsite discharge to a POTW. The estimated present worth cost for this remedial action is \$3,079,900, which includes a present worth O&M cost of \$424,360 for 5 years.

PERFORMANCE STANDARDS OR GOALS: Chemical-specific ground water clean-up goals are based on SDWA MCLs and state standards, including benzene 5 ug/l; antimony 6 ug/l; barium 1,000 ug/l; beryllium 4 ug/l; and lead 15 ug/l. Chemical-specific soil clean-up goals are based on SDWA MCLs and state standards, including benzo-(a)-anthracene 0.8 mg/kg; chrysene 1.6 mg/kg; naphthalene 10 mg/kg; and benzo-(a)-pyrene 0.3 mg/kg (health-based).

**RECORD OF DECISION  
REMEDIAL ALTERNATIVE SELECTION**

**BENFIELD INDUSTRIES SITE**

**HAZELWOOD, HAYWOOD COUNTY  
NORTH CAROLINA**

**PREPARED BY:**

**U.S. ENVIRONMENTAL PROTECTION AGENCY  
REGION IV  
ATLANTA, GEORGIA**

## **DECLARATION FOR THE RECORD OF DECISION**

### **SITE NAME AND LOCATION**

Benfield Industries  
Hazelwood, Haywood County, North Carolina

### **STATEMENT OF BASIS AND PURPOSE**

This decision document presents the selected remedial action for the Benfield Industries Superfund site in Hazelwood, North Carolina chosen in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended by the Superfund Amendments and Reauthorization Act of 1986 and, the extent practicable, the National Contingency Plan. This decision is based on the administrative record file for this Site.

The State of North Carolina conditionally concurs with the selected remedy.

### **ASSESSMENT OF THE SITE**

Actual or threatened releases of hazardous substances from this Site, if not addressed by implementing the response action selected in this Record of Decision, may present an imminent and substantial endangerment to public health, welfare, or the environment. Presently, no unacceptable current risks were identified associated with the Benfield site, the principle threat pertains to the future and potential use of the groundwater beneath and downgradient of the Site and the continuing adverse impact contaminated soils will have on the quality of the groundwater.

### **DESCRIPTION OF THE SELECTED REMEDY**

The selected remedy addresses the future unacceptable risks posed by the Site to human health and the environment.

Alternative SS3 will permanently remove and destroy contamination in the soil through on-site treatment. This alternative involves soil washing and microbial biodegradation of the slurry generated by the soil washing process. Below are the activities associated with this alternative:

- Excavate and wash approximately 4,600 cubic yards of contaminated soils.
- Replace the cleaned coarse soil material, following confirmation sampling, in the excavated areas and biotreat the slurry which contains the soil fines and the associated contaminants.

- Following biotreatment and confirmation sampling, the cleaned soil fines will be backfilled into the excavated areas.

Alternative GW6 will permanently remove and destroy the contaminants in the groundwater through groundwater extraction and on-site above-ground biotreatment and in-situ biodegradation. The following activities are involved in this alternative:

- Contaminated groundwater will be extracted from within and at the periphery of the plume via extraction wells and piped to an onsite, above-ground treatment process.
- Treatment process includes pretreatment (aeration), heavy metals removal (ion exchange), biotreatment using submerged fixed film bioreactors, and polishing through granular activated carbon filters.
- In a holding tank, hydrogen peroxide and nutrients will be added to treated groundwater which will then be reintroduced into the aquifer through infiltration galleries to promote in-situ biodegradation of the contaminants.
- It is anticipated all extracted groundwater will be reintroduced to the aquifer; however, it may be necessary to discharge up to 25% of the water to either the City of Waynesville publicly owned treatment works, meeting specified pretreatment requirements, or Browning Creek, meeting NPDES requirements.
- Any sludge or spent activated carbon will be dealt with in the most cost efficient manner.

#### STATUTORY DETERMINATIONS

The selected remedy is protective of human health and the environment, complies with Federal and State requirements that are legally applicable or relevant and appropriate to the remedial action, and is cost-effective. This remedy utilizes permanent solutions and alternative treatment technology to the maximum extent practicable, and satisfies the statutory preference for remedies that employ treatment that reduces toxicity, mobility, or volume as a principal element. Since this remedy may result in hazardous substances remaining on-site above health-based levels, a review will be conducted within five years after commencement of remedial action to ensure that the remedy continues to provide adequate protection of human health and the environment.

*for* Greer C. Tidwell  
 Greer C. Tidwell  
 Regional Administrator

7-31-92  
 Date

**THE DECISION SUMMARY  
FOR THE  
RECORD OF DECISION**

**BENFIELD INDUSTRIES SITE**

**HAZELWOOD, HAYWOOD COUNTY  
NORTH CAROLINA**

**PREPARED BY:**

**U.S. ENVIRONMENTAL PROTECTION AGENCY  
REGION IV  
ATLANTA, GEORGIA**



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## List of Acronyms

ARAR	-	Applicable or Relevant and Appropriate
AWQC	-	Ambient Water Quality Criteria
CERCLA	-	Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (Superfund)
cm/sec	-	centimeters per second
CRP	-	Community Relations Plan
CSF	-	Cancer Slope Factor
ESD	-	Explanation of Significant Difference
EPA	-	Environmental Protection Agency
FS	-	Feasibility Study
GAC	-	Granular Activated Carbon
gpm	-	gallons per minute
HI	-	Hazard Index
HQ	-	Hazard Quotient
HRS	-	Hazardous Ranking System
LDR	-	Land Disposal Restrictions
MCLs	-	Maximum Contaminant Level
MCLGs	-	Maximum Contaminant Level Goals
mg/kg	-	milligrams per kilogram
mph	-	miles per hour
MW	-	Monitoring Well
NCAC	-	North Carolina Administrative Code
NCDHR	-	North Carolina Department of Human Resources
NCDNRCD	-	North Carolina Department of Natural Resources and Community Development
NCDEHNR	-	North Carolina Department of Environment, Health, and Natural Resources
NCP	-	National Contingency Plan
NOAA	-	National Oceanic and Atmospheric Administration
NPDES	-	National Pollution Discharge Elimination System
NPL	-	National Priority List
O&M	-	Operation and Maintenance
PAH (PAHs)	-	Polycyclic Aromatic Hydrocarbons
PCBs	-	Polychlorinated Biphenyls
POTW	-	Publicly Owned Treatment Works
ppm	-	parts per million
PRPs	-	Potentially Responsible Parties
PW	-	Present Worth
RA	-	Remedial Action
RCRA	-	Resource Conservation and Recovery Act
RfD	-	Reference Dose
RD	-	Remedial Design
RI	-	Remedial Investigation
RME	-	Reasonable Maximum Exposure
ROD	-	Record of Decision
SARA	-	Superfund Amendments and Reauthorization Act of 1986
SFFRs	-	Submerged Fixed Film Reactors
SVOCs	-	Semi-volatile Organic Compounds
TAL	-	Target Analyte List
TBC	-	To Be Considered
TCL	-	Target Compound List

# List of Acronyms

TCLP - Toxicity Characteristic Leaching Procedure  
TMV - Toxicity, Mobility, or Volume  
ug/kg - micrograms per kilogram  
ug/l - micrograms per liter  
UV/OX - Ultraviolet/Oxidation  
VOCs - Volatile Organic Compounds

**RECORD OF DECISION  
SUMMARY OF REMEDIAL ALTERNATIVE SELECTION  
FOR THE BENFIELD INDUSTRIES SUPERFUND SITE  
HAZELWOOD, HAYWOOD COUNTY, NORTH CAROLINA**

**1.0 INTRODUCTION**

The Benfield Industries Superfund site (Benfield site or Site) was proposed for the National Priority List (NPL) in June 1988 and was finalized on the list in October 1989 with a Hazardous Ranking System (HRS) score of 31.67. As of March 1992, the Site is ranked/grouped 912 out of 1218 NPL sites across the country.

The Remedial Investigation (RI) and Feasibility Study (FS) at the Benfield site are complete. The RI, finalized on April 3, 1992, characterized the nature and probable extent of uncontrolled hazardous waste at the Site. The Risk Assessment Report, completed in May 1992, defined the risk posed by the hazardous waste described in the RI. The Proposed Plan Fact Sheet, based on the March 20, 1992 draft FS report, provided the public a summary of the detailed analysis of the seven (7) soil remediation alternatives and the six (6) groundwater remediation alternatives.

This Record of Decision (ROD) has been prepared to summarize the remedial selection process and to present the selected remedial alternative.

**2.0 SITE LOCATION AND DESCRIPTION**

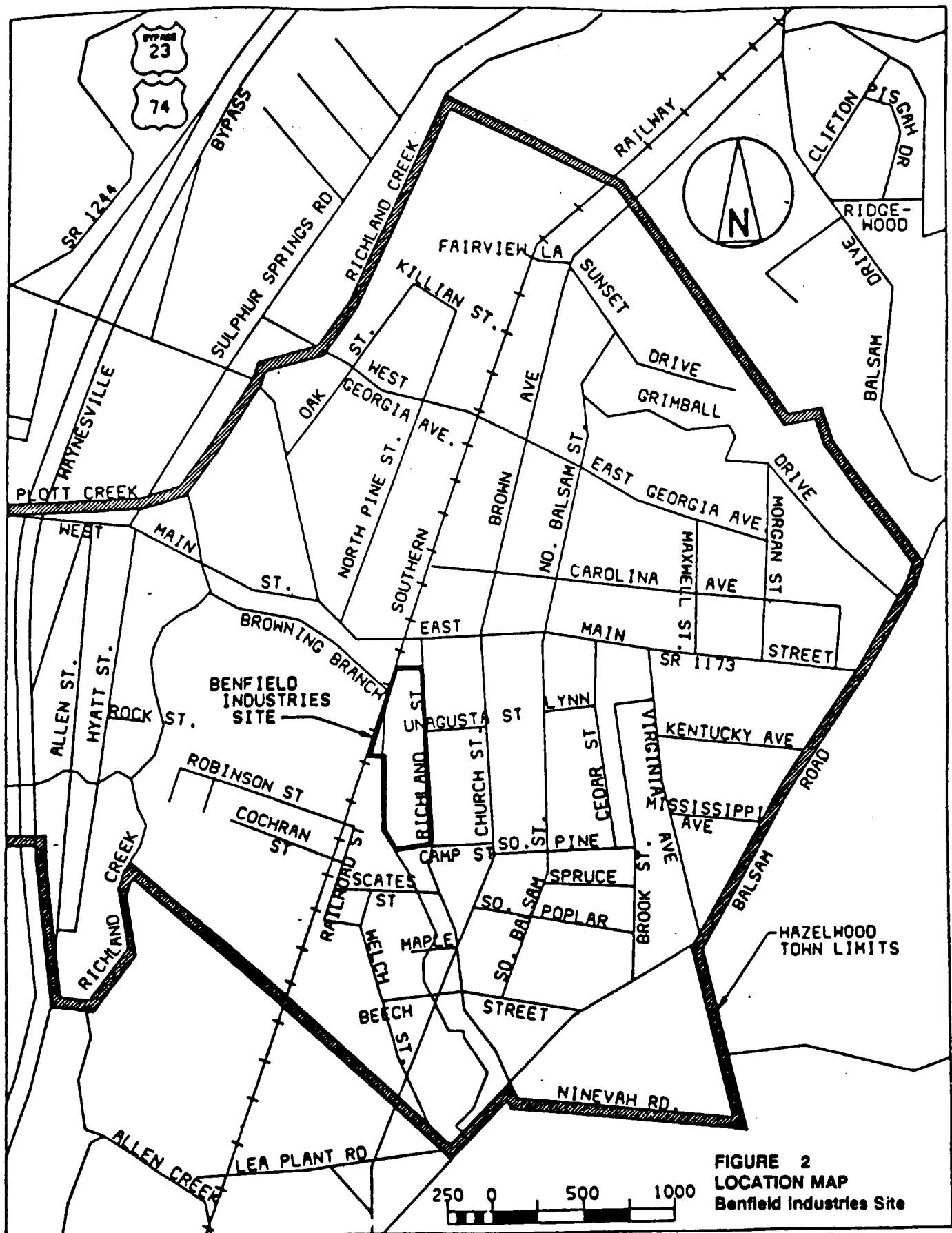
The Benfield site is located in Hazelwood, Haywood County, North Carolina, as shown in Figure 1 and occupies approximately 3½ acres of the 6 acre parcel at 112 to 124 Richland Street (Figure 2). The approximate latitude is 35°22'23" and longitude 83°00'15".

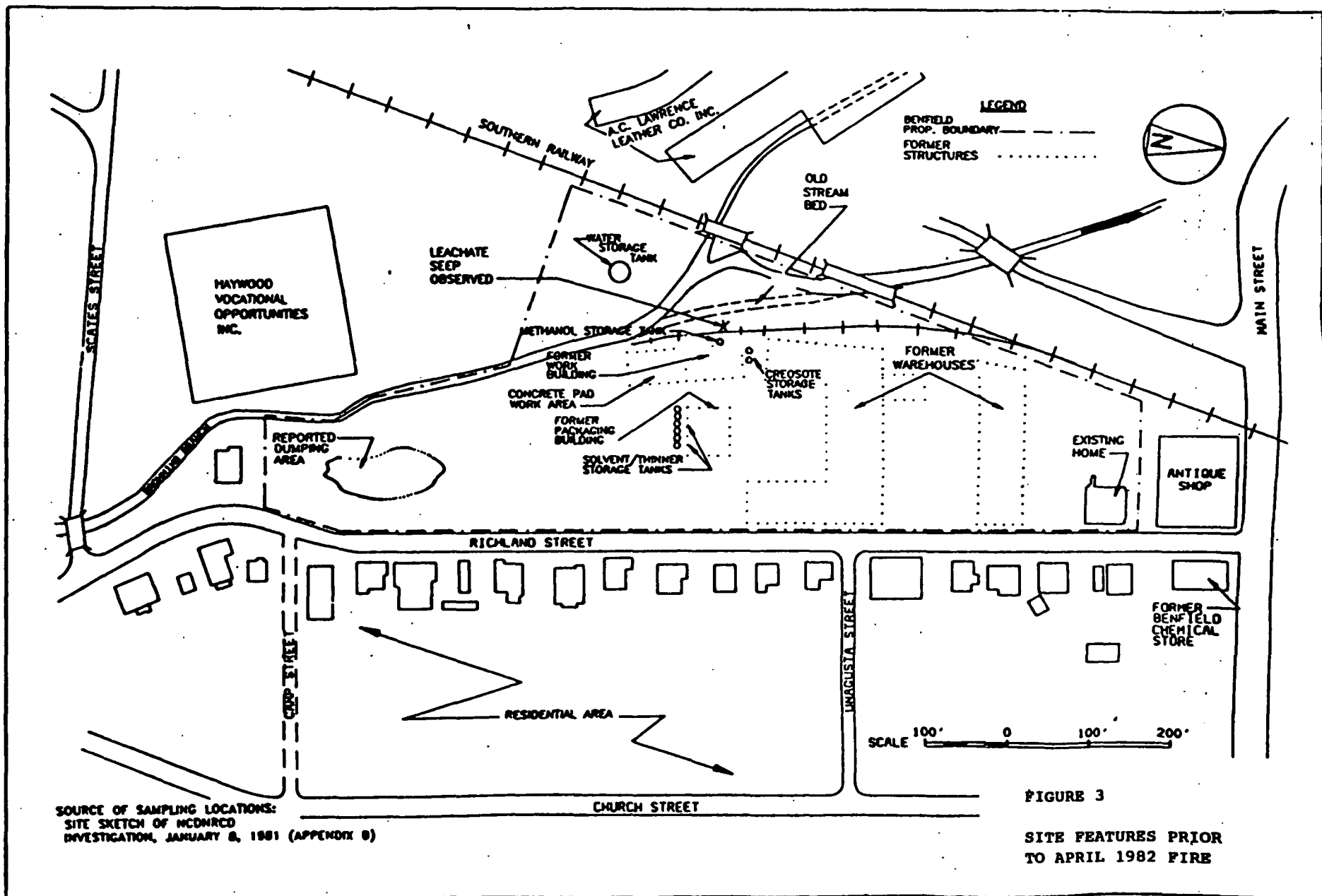
The Site is surrounded by light industrial, commercial, and residential areas. The Site is bordered to the north by an antique shop, by Richland Street to the east, a residence to the south, and the Southern Railway and Browning Branch to the west. Richland Street represents a divide between a predominantly residential area to the east and industrial/commercial area to the west, including the Benfield property (Figure 2). Other nearby features in the town of Hazelwood include the Hazelwood Elementary School, two blocks east and the Haywood County Prison approximately 1,000 feet southeast of the Site.

The Benfield site was an active facility until April 1982 at which time a fire destroyed the majority of the structures and the entire operations. Prior to April 1982, Benfield Industries, Inc. mixed and packaged bulk materials for resale. The facilities included two (2) storage buildings, a brick work building with a concrete storage area, a packaging building, and ten (10) above ground storage tanks, varying in capacity from 1,000 to 10,000 gallons. Figure 3 shows locations of these structures prior to the April 1982 fire.









Following the April 1982 fire, the North Carolina Department of Human Resources (NCDHR) ordered the owner of the facility to remove all debris from the Site. In addition to removing all usable chemicals, fire debris, recyclable materials, and storage tanks, the Site was to be covered with "clean" fill. The owner/operator complied with NCDHR order.

The terrain of the Site slopes gently toward the north-northwest at an average gradient of 0.013 foot/foot. The surface drops abruptly, approximately five (5) feet, at the banks of Browning Branch. A small berm consisting of soil, fill, and debris was created adjacent to Browning Branch along portions of the Site. The Site is currently covered with moderate uncontrolled vegetative growth (weeds, grasses, etc.). Along the banks of Browning Branch, vegetative growth is moderate to dense and includes trees, shrubs, etc.

According to the April 28, 1986 HRS package developed by North Carolina Department of Environment, Health & Natural Resources (NCDEHNR), approximately 3,258 residents within a three (3) mile radius of the Site use groundwater as their source of drinking water. However, no private potable wells are in use either in the vicinity of the Site or immediately downgradient of the Site. Approximately 2,056 people in the town of Hazelwood are connected to the local public water supply system. Of this number, approximately 425 of these people are served by the Hazelwood supply well, with the remainder obtaining water from the Allen Creek Reservoir. The Hazelwood supply well is approximately 1½ miles west of the Site and Allen Creek Reservoir is located about four miles south and upstream of the Site.

The Benfield site is located in the Browning Branch flood plain. Browning Branch flows north-northwest into Richland Creek about 1,600 feet downstream of the Site. Richland Creek flows northward into Lake Junaluska, about four (4) miles to the northeast. Richland Creek continues from Lake Junaluska until its confluence with the Pigeon River approximately 2½ miles downstream.

### 3.0 SITE HISTORY

The Site was owned and operated by Unagusta Furniture Company from about 1904 to 1961. Unagusta Furniture Company manufactured wooden bed frames. Waynewood, Inc. also operated at the Site during the same time. Waynewood, Inc. was a sewing operation which made mattresses for the bed frames built by Unagusta Furniture Company. Waynewood, Inc. went out of business sometime in the 1950's.

According to a 1975 deed, Waynewood, Inc., granted the Site to Guardian Investment Company on April 29, 1961. No information has been found regarding the operations of the Site during Guardian's ownership of the property. On February 14, 1975, Guardian Investment Company was "adjudicated a straight bankrupt by the Bankruptcy Judge for the Western District of North Carolina". The Bankruptcy Judge ordered that all of Guardian's real property be sold, and on August 4, 1975, the Site was sold to Clyde Savings and Loan

Association. Nine (9) days later, Clyde Savings and Loan Association sold the property to Thomas G. Benfield. Benfield Industries, Inc. began operating at the Site in 1976. Benfield Industries, Inc. was owned by Thomas G. Benfield and operated as a bulk chemical mixing and repackaging plant from 1976 until a fire destroyed the facility in April 1982.

Products handled and stored at the Benfield facility included paint thinners, solvents, sealants, cleaners, de-icing solutions, and wood preservatives including creosote. Most of the liquid products were packaged in one-pint to five gallon containers. Solid products were packaged in 8 to 100 pound bags or containers.

On April 21, 1982, a series of explosions at the Benfield site started a fire that eventually destroyed most of the on-site facilities and resulted in the permanent closing of the Benfield Industries plant. None of the tanks or gas cylinders on-site ruptured during or after the fire. Due to the dense toxic fumes emanating from the fire, law enforcement officials evacuated nearly 2,000 nearby residents for up to 48 hours. About 200 fireman used approximately 2.5 million gallons of water and several barrels of foam to bring the fire under control.

Mr. Benfield was ordered by the NCDHR to remove all debris from the Site by September 1, 1982. The first cleanup priority was to remove all remaining chemicals from the Site. By June 11, 1982, a number of chemicals had been removed. In addition to the removal of the usable chemicals, fire debris, recyclable materials, and the solvent and creosote storage tanks were also removed from the Site. Following this work, the majority of the Site was then covered with 6 to 18 inches of "clean" gravelly fill material.

The Site has been the focus of the following sampling investigations:

- Site Investigation, North Carolina Department of Natural Resources & Community Development, January 1981.
- Water Quality Investigation of the Chemical Plant Fire at Hazelwood, NC, North Carolina Water Resource Research Institute, April 1982.
- Site Investigation, North Carolina Department of Human Resources, Solid and Hazardous Waste Management Branch, September 1985.
- Follow-up Site Investigation, North Carolina Department of Environment, Health and Natural Resources, March 1990.

The January 1981 investigation was prompted by complaints from Hazelwood citizens of improper disposal of hazardous waste at the facility. Observations by North Carolina Department of Natural Resources & Community Development (NCDNRCD) personnel, in December 1980 confirmed complaints by nearby citizens that 55-gallon drums were being opened with an ax and their contents being allowed to empty onto the ground on the south end of the plant property.

On January 8, 1981, a total of eight soil samples, three surface water/sediment samples, and one leachate sample were collected and submitted for analyses. A wide range of organic and inorganic contaminants were qualitatively detected. The most frequently detected contaminants were phenanthrene and pyrene. Other polycyclic aromatic hydrocarbon (PAH) compounds frequently detected naphthalene compounds, fluorene, benzantracene, and dibenzofurans. Frequently detected organic compounds other than PAHs included benzenes, methanol, and phenolic compounds. Elevated levels of lead and chromium were also detected.

Several investigations were initiated in response to the fire on April 21, 1982, that destroyed the Benfield Industries plant. These investigations were conducted during and immediately after the fire by a combination of Federal, State and local agencies and academic institutions. These investigations focused on air and surface water quality in the vicinity of the fire. The following were the conclusions drawn from these various investigations:

- Drainage of the large quantities of water used to fight the fire carried hazardous substances that had spilled on the property before or during the fire into Browning Branch and Richland Creek. Reduced pH values were observed in direct runoff and surface water samples collected from Browning Branch. Richland Creek and other downstream watersheds also experienced decreased pH values as a result of the fire.
- The intensity of the fire consumed much of the potentially harmful chemicals being stored at the Site.
- The prevailing air patterns during the blaze were such that most of the gases and smoke released to the atmosphere was transported far from the fire Site and dispersed widely before the possibility of surface fallout.
- The negative biological impact to downstream aquatic communities observed could also be attributed to chronic exposures to hazardous substances migrating from the plant prior to the fire.

The State conducted a Site inspection on September 17, 1985. On-site soils, sediment, and surface water samples from Browning Branch were collected. A groundwater sample from the nearest private well, owned by Mr. Wayne Cable, located 1,900 feet northwest of the Site, was also collected. The results of the analyses indicated significant soil contamination by semi-volatile organics in proximity to the brick work building and the former creosote storage tank area. Lower concentrations of contaminants were detected on the south end of the Site and beneath the chemical storage warehouse. Problems were encountered in advancing the hand auger beyond a depth of 24 inches due to the gravelly nature of the soil. With the exception of trace levels of toluene, no organic contaminants were detected in the water or sediment of Browning Branch. No contamination was detected in the groundwater sample.

The results of the 1985 investigation were submitted to the Environmental Protection Agency (EPA or Agency) on May 8, 1986, and served as a basis for determining the HRS score for the Benfield facility. The resulting HRS scores were 54.29, 7.44 and 0.0 for the groundwater, surface water, and air routes, respectively, with a mean score of 31.67.

The State conducted a follow-up investigation to augment the Site's data base in March 1990. As in previous investigations, soil, sediment, and surface water samples were collected for analysis. These samples were collected in close proximity to the samples collected during the September 1985 investigation. This investigation confirmed the presence of PAH, phthalates, and chlorinated hydrocarbons in subsurface soils at the Site. No contamination was found in the surface water or sediment samples collected from Browning Branch. As with the 1985 investigation, hand auger refusal was frequently encountered which prevented sampling at depths greater than 15 inches below the land surface.

#### 4.0 ENFORCEMENT ACTIVITIES

Complaints by local citizens brought the Site to the attention of NCDNRCD in December 1980. Pursuant to 1981 and 1985 Site inspections by State environmental officials, high concentrations of PAH contaminants were discovered at the Site. The Site was proposed as a NPL candidate in update #7 which was published in the Federal Register on June 24, 1988. The Site was finalized on the NPL on October 4, 1989.

The following entities were identified as potentially responsible parties (PRPs) in the "Responsible Party Search" document, dated October 24, 1989: Mr. Thomas G. Benfield and Benfield Industries, Inc. Mr. Thomas G. Benfield was named a PRP as he is the current owner of the property and was the owner of Benfield Industries, Inc. The other PRP, Benfield Industries, Inc., was the operator of the facility. Benfield Industries, Inc. is no longer an active company.

On January 5, 1989, the Agency sent Mr. Benfield an Information Request letter under Section 104 of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA or Superfund) and Section 3007 of Resource Conservation and Recovery Act (RCRA). In March 1990, EPA issued a notice letter to Mr. Thomas Benfield informing him of EPA's intention to conduct CERCLA remedial activities at the Site unless the PRPs chose to conduct such activities themselves. A telephone conversation on April 4, 1990 between Mr. Payne, Mr. Benfield's lawyer, and EPA, Region IV Office of Regional Counsel, confirmed that Mr. Benfield is not financially capable of financing the RI/FS.

#### 5.0 HIGHLIGHTS OF COMMUNITY PARTICIPATION

Information Repositories/Administrative Records for this Site were established at the Hazelwood Town Hall in Hazelwood and in EPA, Region IV

Regional Information Center in Atlanta, Georgia. A Community Relations Plan (CRP) identifying a proactive public outreach strategy was developed and submitted to the information repositories prior to initiating RI field work. The following describes the community relations activities conducted by the Agency for this Site.

Three fact sheets and the Proposed Plan Fact Sheet were distributed to the public during the Benfield RI/FS. The first Fact Sheet, released in February 1990, provided the public with some background information and announced an upcoming public meeting. The first of these three public meetings was held on February 28, 1990. This meeting was held as a result of local financial lending institutions, collectively, requesting all potential real estate sellers/buyers within a one-mile radius of the Site to have an environmental assessment conducted on the prospective property prior to their approval of any loans. A one mile radius around the Site encompasses the entire town of Hazelwood.

At the meeting, the Mayor of Hazelwood stated the town was being held "hostage" by the Superfund program and was not being provided the information requested. The primary emphasis of the February 28, 1990 public meeting was to address the lending institution's reaction to the Site being placed on the NPL and other concerns of the Hazelwood community. Hazelwood is a lower socio-economic community of primarily residences, of which, a large portion of the population is retired and living on fixed-incomes.

The second fact sheet, disseminated in December 1990, provided the community a description of the Site, a brief history of the Site, a summary of previous investigations of the Site, a brief overview of the Superfund program, a list of RI and FS objectives, a time frame for activities, a list of contacts for more information and community relations activities, and a glossary of terms and acronyms commonly used in the Superfund program. This fact sheet preceded a second public meeting. This public meeting, the "Kick-Off Meeting", was held on January 7, 1991. The following topics were emphasized at this meeting: the Superfund process, community relations activities, field work as proposed in the RI/FS Work Plan, and a question and answer session.

A third Fact Sheet was distributed in January 1992. This fact sheet summarized the findings and conclusions of the RI, restated the objectives of the FS, and provided a revised time frame for future activities at the Benfield site.

The Proposed Plan Fact Sheet was mailed to the public on April 9, 1992. The basis of the information presented in the Proposed Plan was the draft FS document dated, March 20, 1992.

The public was informed through the Proposed Plan Fact Sheet and published ads in the Mountaineer Newspaper and Asheville Citizens Newspaper of the April 21, 1992 Proposed Plan Public Meeting. The Proposed Plan Fact Sheet was mailed on April 9, 1992 and the ads were printed on April 13, 1992. A press release was also issued on April 20, 1992. The goals of the Proposed Plan public meeting were to review the remedial alternatives developed,



identify the Agency's preferred alternative, present the Agency's rationale for the selection of this alternative, encourage the public to voice its own opinion with respect to the remedial alternative selected by the Agency, and inform the public that the public comment period on the Proposed Plan would run from April 13, 1992 to May 12, 1992. The public was also informed a 30 day extension to the public comment period could be requested and that all comments received during the public comment period would be incorporated into the Administrative Record and addressed in the Responsiveness Summary section of the ROD.

#### 6.0 SCOPE AND ROLE OF RESPONSE ACTION WITHIN SITE STRATEGY

The intent of the remedial action presented in this ROD is to eliminate future risks at this Site. This remedial action will remove the threat posed by contaminated groundwater at the Site and remediate residual soil contamination. Remediation of the residual soil contamination will prevent residual contamination from adversely impacting groundwater and decrease the future risk associated with Site soils. This is the only ROD contemplated for the Site and no other operable units are anticipated.

#### 7.0 SUMMARY OF SITE CHARACTERISTICS

The overall nature and extent of contamination at the Site is based upon analytical results of samples collected from surface and subsurface soils, groundwater, sediment, and surface water and the chemical/physical characteristics of the area. The environmental samples were analyzed for volatile and semi-volatile organic compounds on the target compound list (TCL), including pesticides and polychlorinated biphenyls (PCBs), and metals on the target analyte list (TAL) analytes including cyanide. TCL volatile and semi-volatile organic compounds, pesticides, and TAL metals were detected in the environmental media sampled during the RI. Neither PCBs nor cyanide were detected in any of the samples. Based on the history of the Site, no RCRA listed wastes are present at the Site.

Background samples were collected for surface and subsurface soils, groundwater, and surface water and sediment. Table 1 lists the contaminants detected in each environmental medium at the Site. The letter "J" placed next to some of the reported concentrations in the following Sections means "estimated value".

Air samples were not collected as part of the RI/FS effort. However, the quality of the immediate air was monitored during all field work as part of the health and safety effort to protect the individuals performing the RI field work. Based on this information, the quality of the air at and around the Site is not currently being adversely impacted by the Site.

The estimated total volume of contaminated soil present at the Site is 4,600 cubic yards. This volume is based on the area of the Site, as defined in Figure 4, and the depth down to groundwater which ranges from

**TABLE 1**  
**DETECTED TAL, TCL, AND PESTICIDE PARAMETERS**  
**IN**  
**MEDIA SAMPLED**

	SOIL	SEDIMENT	GROUND WATER	SURFACE WATER
<b>Inorganics</b>				
Aluminum	X	X	X	
Antimony	X		X	
Arsenic	X			
Barium	X	X	X	
Beryllium	X		X	
Calcium	X	X	X	X
Chromium	X	X	X	
Cobalt	X	X	X	
Copper	X	X	X	
Iron	X	X	X	X
Lead	X	X	X	
Magnesium	X	X	X	X
Manganese	X	X	X	X
Mercury			X	X
Nickel	X	X	X	
Potassium	X	X	X	X
Selenium	X			
Silver	X			
Sodium	X	X	X	X
Vanadium	X	X	X	
Zinc	X	X	X	
<b>Purgeable Organics</b>				
Vinyl Chloride			X	
Chloroethane			X	
1,1-Dichloroethane			X	
1,2-Dichloroethane	X		X	
Methyl Ethyl Ketone	X			
Chloroform			X	
1,1,1-Trichloroethane			X	
1,2-Dichloropropane			X	
Benzene	X		X	
Methyl isobutyl Ketone	X			
Tetrachloroethene (Tetrachloroethylene)	X			
Toluene	X		X	
Chlorobenzene			X	
Ethyl Benzene	X		X	
Total Xylenes	X		X	
<b>Extractable Organics</b>				
Phenol			X	
1,3-Dichlorobenzene			X	
1,4-Dichlorobenzene			X	
1,2-Dichlorobenzene	X		X	
2-Methylphenol			X	
(3-and/or 4-)Methylphenol	X		X	
2,4-Dichlorophenol	X			
1,2,4-Trichlorobenzene	X		X	
Naphthalene	X		X	
2-Methylnaphthalene	X		X	
2-Chloronaphthalene			X	
Acenaphthylene	X	X	X	
Acenaphthene	X		X	
Dibenzofuran	X		X	
Diethyl Phthalate	X			
Fluorene	X		X	
Hexachlorobenzene	X			
Pentachlorophenol	X		X	
Phenanthrene	X	X	X	
Anthracene	X	X	X	
Carbazole	X		X	
Di-N-Butylphthalate	X			
Fluoranthene	X	X	X	
Pyrene	X	X	X	
Benzyl Butyl Phthalate	X			

**TABLE 1**  
**DETECTED TAL, TCL, AND PESTICIDE PARAMETERS**  
**IN**  
**MEDIA SAMPLED**

	SOIL	SEDIMENT	GROUND WATER	SURFACE WATER
<b>Extractable Organics (cont.)</b>				
Benzo(A)Anthracene	X	X	X	
Chrysene	X	X	X	
Bis(2-Ethylhexyl) Phthalate	X			
Di-N-Octylphthalate	X			
Benzo(B and/or K) Fluoranthene	X	X	X	
Benzo-A-Pyrene	X	X	X	
Indeno (1,2,3-CD) Pyrene	X	X	X	
Dibenzo(A,H)Anthracene	X	X	X	
Benzo(GH)Perylene	X	X	X	
<b>Pesticides</b>				
Dieldrin	X			
4,4'-DDD(P,P'-DDD)				
Beta-BHC	X			
Heptachlor	X			
Aldrin	X			
4,4'-DDE(P,P'-DDE)	X			
Endrin	X			
Endosulfan I (Alpha)			X	
Endosulfan II (Beta)	X			
4,4'-DDT(P,P'-DDT)	X			
Gamma-Chlordane	X			
Alpha-Chlordane	X			

3½ to 6 feet below the surface. The volume of groundwater impacted by the Site is approximately 22 million gallons and the plume is delineated in Figure 5.

#### 7.1 SOILS

A total of 47 soil samples were collected from the soil borings including those borings used to install the monitoring wells. These soil samples included five (5) surface soil samples (0 to 12 inches below the surface), 22 soil samples collected from immediately below the surface soil/fill layer (shallow subsurface), and 20 soil samples from the water table interface (deep subsurface). In addition, two soil samples were collected from the test pits.

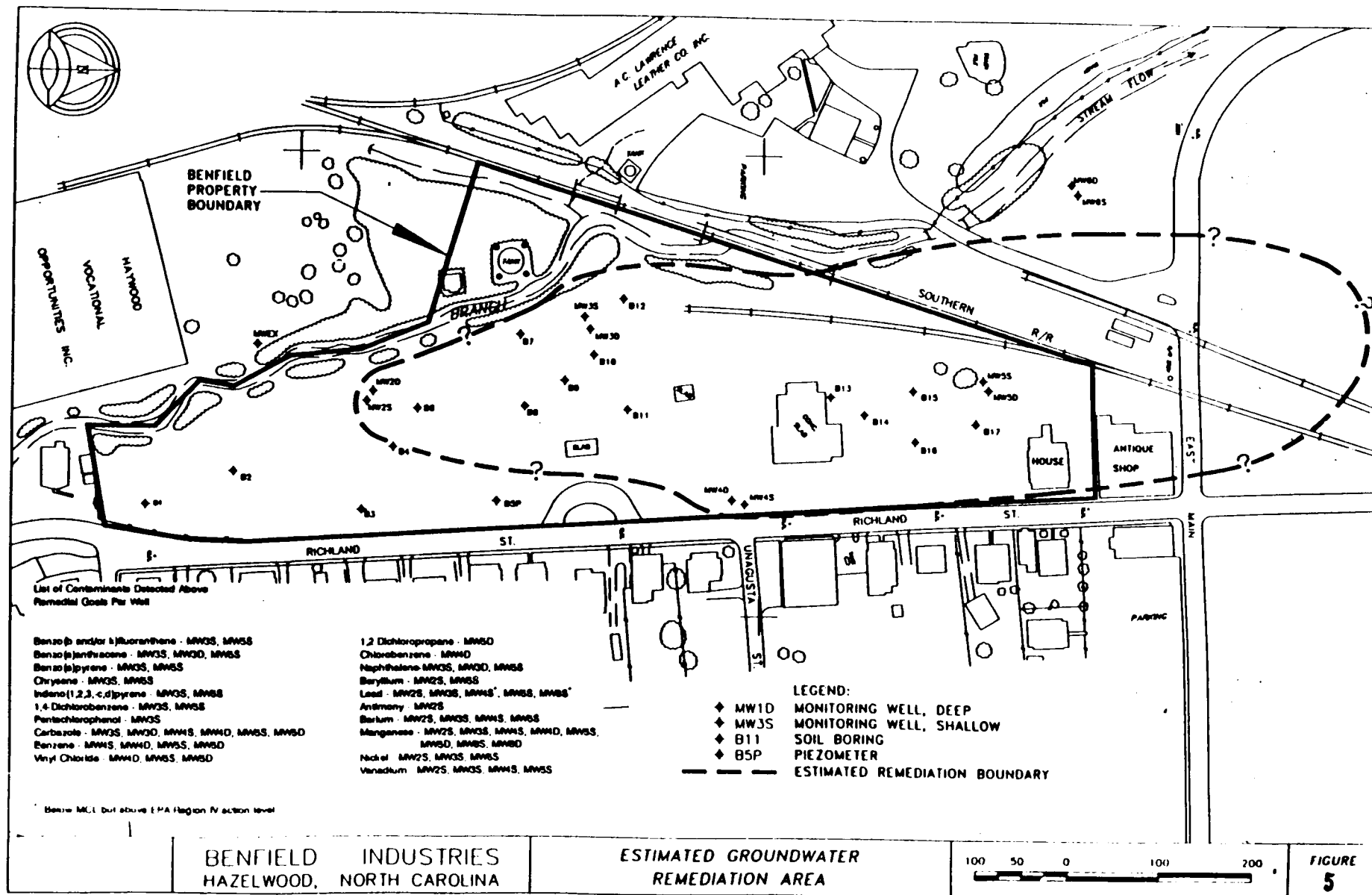
Volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), pesticides, and metals were detected in soils. A total of eight (8) different VOCs were detected. SVOCs were detected in each soil boring with the exception of soils from the background boring (monitoring well-1 deep or MW-1D) and one on-site boring (B-14). Twenty-nine (29) different SVOCs were detected of which 18 were PAH compounds. Other SVOCs included aromatics and phthalates. A total of 14 different pesticides were detected of which gamma-chlordane and alpha-chlordane were the most frequently detected. No pesticides were detected in two on-site borings (B-02 and B-14) and the background sample (MW-1D).

A variety of metals were detected in the soils during the RI. Although most of these metals occur naturally in the regional soils, elevated concentrations were detected in onsite soils throughout the Benfield site. The following metals were either detected in onsite soils but not in the background soil sample or detected onsite at concentrations at least two times greater than the background concentration: antimony, arsenic, beryllium, cobalt, lead, selenium, and zinc.

In general, the greatest concentrations of detected organic and inorganic constituents were found in three (3) areas. In the soils at the west-central portion of the Site in the vicinity of the former packaging building, brick work building, and the chemical storage tanks south of the terminus of the railroad spur. High concentrations of VOCs and SVOCs were found at the north/north-central portion of the Site in the vicinity of a former warehouse. This warehouse reportedly contained a sump. The third area of contaminated soils includes the south-central portion of the Site where dumping of chemicals was reported to have occurred. Organic compounds, particularly PAHs, were detected in nearly all of the on-site borings. Site constituents (PAHs and pesticides) were detected in low concentrations in the soils from the offsite, downgradient boring.

In addition to the TCL SVOCs, an extensive list of unidentified and tentatively identified miscellaneous SVOCs with significant estimated concentrations were reported for the soil samples. In some cases, the estimated total concentrations of unidentified and tentatively identified





compounds exceeded the concentrations of the TCL compounds. Generally, more miscellaneous compounds were reported at the locations in which significant quantities of TCL compounds were detected.

#### 7.1.1 SURFACE SOILS

Due to the fire that destroyed the facility in 1982 and the State ordered clean-up of the Site following the fire, the principal sources of potential contamination were either consumed (burned during the fire) or removed after the fire (above ground tanks and their contents and remaining chemicals). As part of the State ordered cleanup, the majority of the Site was covered with 6 to 18 inches of clean fill material. These events help explain why limited surface soil contamination was encountered during the RI.

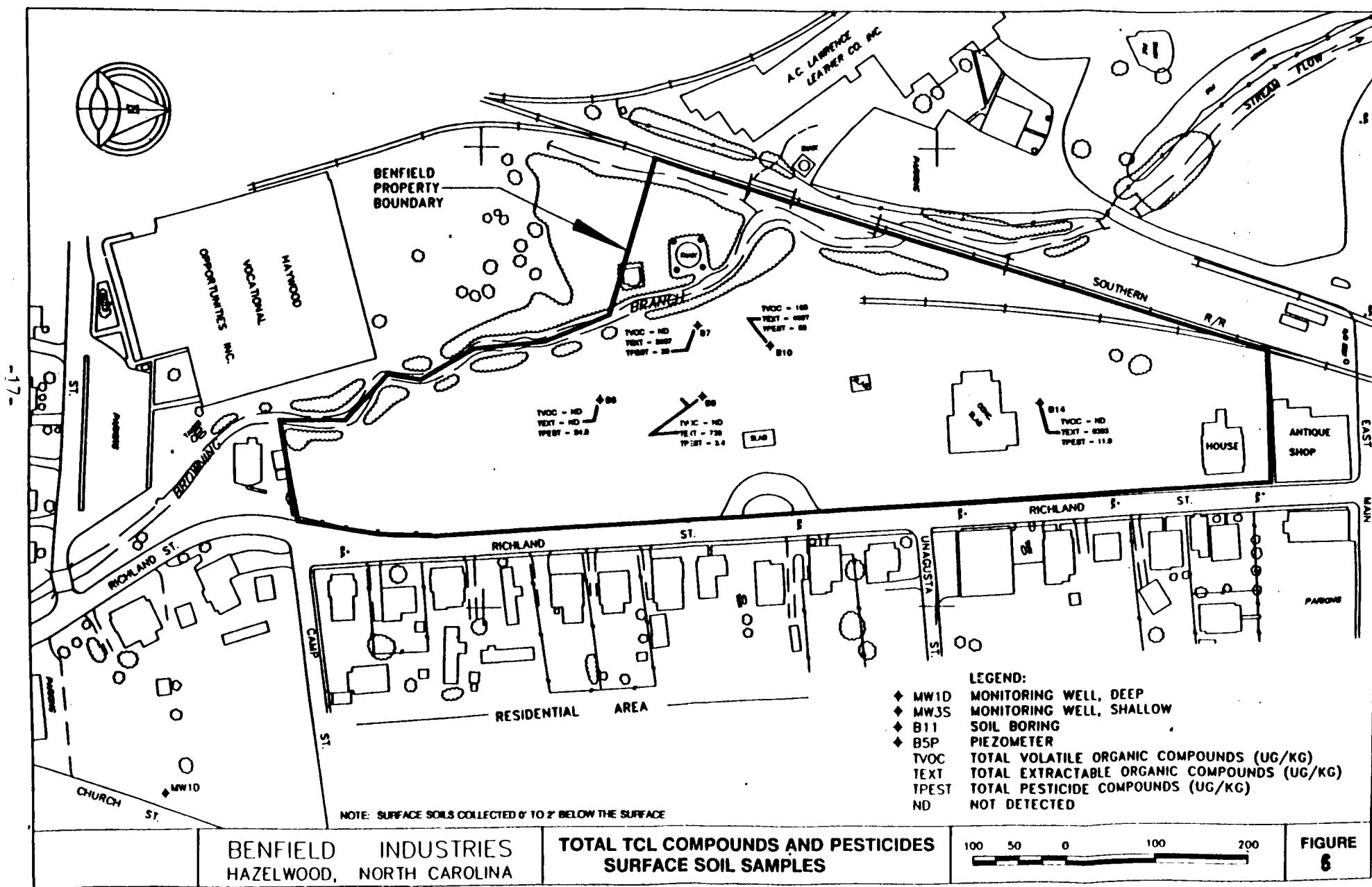
Figure 6 shows the surface soil sampling locations and what the total concentrations (in micrograms per kilogram or ug/kg) of VOCs, SVOCs and pesticides were at each sampling location. Table 2 lists the individual contaminants and their concentrations detected at each sampling point. Table 2 also lists the background levels for metals found in MW-1D. Table 3 provides the frequency of detection and the range of concentrations detected for contaminants found in the surficial soils at the Benfield site.

The only VOCs detected in surficial soils were total xylenes (0.18 milligrams per kilogram or 0.18 mg/kg) and tetrachloroethene (0.005 mg/kg). SVOCs were detected in 4 of the 5 surface soil samples. Specific compounds and detected concentrations include benzo (B and/or K) fluoranthene (1.1 mg/kg) in B-07, fluoranthene (1.4 mg/kg), pyrene (0.85 mg/kg), and chrysene (0.52 mg/kg) in B-10, and pentachlorophenol (3.1 mg/kg), fluoranthene (0.62 mg/kg), and pyrene (0.5 mg/kg) in B-14.

Pesticides were detected in each of the 5 surface soil samples. The predominant pesticide found in these soils was gamma chlordane with the highest concentration found in B-10 (0.055 mg/kg), B-07 (0.019 mg/kg), and B-06 (0.017 mg/kg). Alpha chlordane was detected in B-07 (0.020 mg/kg).

#### 7.1.2 SHALLOW SUBSURFACE SOILS

Figure 7 shows the shallow subsurface soil sampling locations and the total concentrations (in mg/kg) of VOCs, SVOCs and pesticides found at each sampling location. Shallow subsurface soil samples were collected at a depth of 2-3½ feet below the surface or just beneath the fill material. The intent of collecting these samples was to gain an understanding of the distribution of surface contamination prior to the Site being covered with clean fill material. Table 4 lists the individual contaminants and their concentrations detected at each sampling point. This table also contains the background levels for metals found in MW-1D. Table 5 provides the frequency of detection and the range of concentrations detected for contaminants found in the shallow subsurface soils at the Benfield site.





**TABLE 2 DETECTED CONTAMINANTS IN SURFACE SOIL SAMPLES**

Station Location	Frequency of Detection	BO06-S-0 (mg/kg)	BO07-S-0 (mg/kg)	BO08-S-0 (mg/kg)	BO10-S-0 (mg/kg)	BO14-S-0 (mg/kg)	
<b><u>VOLATILE ORGANICS</u></b>							
Tetrachloroethene	5/47				0.005J		
(Tetrachloroethylene)							
Total Xylenes	7/47				0.18		
<b><u>SEMI-VOLATILE ORGANICS</u></b>							
Naphthalene	25/47				0.087J	0.13J	
2-Methylnaphthalene	23/47				0.11J	0.12J	
Dibenzofuran	17/47				0.12J	0.16J	
Phenanthrene	27/47		0.097J				
Hexachlorobenzene	3/47					0.16J	
Pentachlorophenol	8/47					3.1J	
Phenanthrene	27/47					0.46J	
Anthracene	21/47				0.12J	0.063J	
Fluoranthene	28/47		0.54J		1.4	0.62J	
Pyrene	27/47				0.85	0.5J	
Benzo(A)Anthracene	23/47		0.34J		0.36J	0.21J	
Pentachlorophenol	8/47			0.28J			
Chrysene	28/47		0.47J	0.14J	0.52	0.19J	
Benzo(B and/or K)	25/47		1.1J	0.20J		0.46J	
Fluoranthene							
Benzo-A-Pyrene	24/47		0.31J	0.11J	0.39J	0.13J	
<b><u>PESTICIDES</u></b>							
Dieldrin	3/47					0.0034J	
4,4'-DDD(P,P'-DDD)	2/47	0.0039J					
4,4'-DDT(P,P'-DDT)	9/47	0.0039J					
Gamma-Chlordane	20/47	0.017	0.019	0.0014J	0.055	0.0082	
Alpha-Chlordane	10/47		0.02				
<b><u>INORGANICS</u></b>							
Antimony	5/44						<b>Background</b>
Arsenic	6/44						
Beryllium	1/44						
Cobalt	43/44	10.0	20.0	23.0	28.0	15.0	8.2
Lead	44/44	20.0J	18.0J	14.0J	16.0	36.0J	1.7J
Selenium	9/44						
Zinc	44/44	73.0J	88.0J	140.0J	120.0	150.0J	53.0

**TABLE 3**  
**SURFACE SOIL**  
**ANALYTICAL DATA SUMMARY**

	Frequency of Detection	Range of Detection	Mean Value
<b>Inorganics</b>		mg/kg	mg/kg
Aluminum	5/5	27,000-54,000	35,600
Barium	5/5	110-310	240
Calcium	4/5	440-23,000	7,235
Chromium	5/5	43-96	59
Cobalt	5/5	10-28	19
Copper	4/5	28-70	41
Iron	5/5	36,000-41,000	40,400
Lead	5/5	14-38	21
Magnesium	5/5	3,000-10,000	6960
Manganese	5/5	360-830	646
Nickel	5/5	17-31	23
Potassium	5/5	2,200-12,000	6,540
Sodium	4/5	39-270	114
Vanadium	5/5	54-130	84
Zinc	5/5	73-150	114
<b>Purgeable Organics</b>		ug/kg	ug/kg
Tetrachloroethene (Tetrachloroethylene)	1/5	5	5
Total Xylenes	1/5	180	180
<b>Extractable Organics</b>		ug/kg	ug/kg
Naphthalene	2/5	87-130	109
2-Methylnaphthalene	2/5	110-120	115
Dibenzofuran	2/5	120-160	140
Flourene	1/5	140	140
Hexachlorobenzene	1/5	160	160
Pentachlorophenol	2/5	280-3,100	1,690
Phenanthrene	1/5	480	480
Anthracene	3/5	63-120	93
Fluoranthene	3/5	540-1,400	853
Pyrene	2/5	500-850	675
Benzo(A)Anthracene	3/5	210-360	303
Chrysene	4/5	140-520	330
Benzo(B and/or K) Fluoranthene	3/5	200-1,100	586
Benzo-A-Pyrene	4/5	110-390	235
<b>Pesticides</b>		ug/kg	ug/kg
Dieldrin	1/5	3.4	3.4
4,4'-DDD (P,P-DDD)	1/5	3.9	3.9
4,4'-DDT (P,P-DDT)	1/5	3.9	3.9
Gamma-Chlordane	5/5	1.4-55	20.1
Alpha-Chlordane	2/5	2-20	11

**NOTES:**

1. Mean value is averaged for actual hits.
2. The Range of Detection includes all concentrations reported for each parameter.  
The lower value may be a concentration detected below the quantitation limit.

mg/Kg - milligrams per Kilogram (parts per million)  
ug/Kg - micrograms per Kilogram (parts per billion)



**TABLE 4 DETECTED CONTAMINANTS IN SHALLOW SUBSURFACE SOIL SAMPLES  
COLLECTED DURING THE INSTALLATION OF THE MONITORING WELLS**

Station Location	Frequency of Detection	MW2S-S-1 (mg/kg)	MW3S-S-1 (mg/kg)	MW4S-S-1 (mg/kg)	MW5S-S-1 (mg/kg)	MW6S-S-1 (mg/kg)	
<b><u>VOLATILE ORGANICS</u></b>							
1,2-Dichloroethane	1/47		0.006J				
Methyl Ethyl Ketone	1/47		0.013				
Benzene	1/47		0.003J				
Methy Isobutyl Ketone	1/47		0.022				
Tetrachloroethane	5/47		0.002J				
Toluene	7/47		0.41J				
Ethylbenzene	8/47		0.11				
Total Xylenes	7/47		7.0				
<b><u>SEMI-VOLATILE ORGANICS</u></b>							
(3-and/or 4-)Methyphenol	4/47		1.0J				
Naphthalene	25/47	0.047J	35.0			0.15J	
2-Methylnaphthalene	23/47	0.082J	35.0			0.22J	
Acenaphthylene	7/47		2.3J				
Acenaphthene	11/47		52.0				
Dibenzofuran	17/47		38.0				
Fluorene	17/47		55.0				
Phenanthrene	27/47		110.0		0.097J		
Anthracene	21/47		74.0				
Carbazole	15/47		34.0				
Fluoranthene	28/47		75.0				
Pyrene	27/47		48.0				
Benzo(A)Anthracene	23/47		19.0				
Chrysene	28/47	0.043J	19.0				
Benzo(B and/orK) Fluoranthene	25/47		19.0	0.082J	0.042J		
Benzo-A-Pyrene	24/47		8.0				
Indeno (1,2,3-CD)Pyrene	8/47		3.6J				
Benzo(GHI)Perylene	5/47		3.2J				
<b><u>PESTICIDES</u></b>							
Beta-BHC	1/47		0.011				
4,4'-DDE(P,P'-DDE)	10/47	0.0038		0.0028J		0.0051	
Endrin	3/47		0.08				
4,4'-DDT(P,P'-DDT)	9/47					0.0038J	
Gamma-Chlordane	20/47	0.0009J		0.011	0.0005J	0.0009J	
Alpha-Chlordane	10/47			0.012			
<b><u>INORGANICS</u></b>							
Antimony	5/44			3.8J			N/D
Arsenic	6/44						N/D
Beryllium	1/44						N/D
Cobalt	43/44			15.0	7.0	23.0	8.2
Lead	44/44			15.0J	6.8J	23.0J	1.7J
Selenium	9/44						N/D
Zinc	44/44			85.0J	49.0J	95.0J	53.0
							<b><u>Background</u></b>

**TABLE 4 DETECTED CONTAMINANTS IN SHALLOW SUBSURFACE SOIL  
SAMPLES COLLECTED DURING SOILING BORINGS**

Station Location	Frequency of Detection	B01-S-1 (mg/kg)	B02-S-1 (mg/kg)	B03-S-1 (mg/kg)	B04-S-1 (mg/kg)	B05-S-1 (mg/kg)	B06-S-1 (mg/kg)	B07-S-1 (mg/kg)	B08-S-1 (mg/kg)	B09-S-1 (mg/kg)	
<b><u>VOLATILE ORGANICS</u></b>											
Ethylbenzene	8/47									0.008J	
<b><u>SEMI-VOLATILE ORGANICS</u></b>											
(3-and/or 4-)Methyphenol	4/47		0.15J			0.19J					
1,2,4-Trichlorobenzene	3/47				0.065J						
Naphthalene	25/47	0.043J	2.0J			0.11J		0.063J		45.0J	
2-Methylnaphthalene	23/47	0.061J	0.79J					0.093J		17.0J	
Acenaphthylene	7/47		0.058J							35.0J	
Acenaphthene	11/47			1.3J							
Dibenzofuran	17/47			1.2J			0.054J			23.0J	
Fluorene	17/47			1.3J			0.091J			27.0J	
Pentachlorophenol	8/47				0.71J						
Phenanthrene	27/47		5.5J		0.17J	0.43J	0.056J			120.0J	
Anthracene	21/47		1.8J		0.047J	0.066J		0.055J		14.0J	
Carbazole	15/47			1.6J					0.083J	3.2J	
Di-N-Butylphthalate	2/47				1.8J						
Fluoranthene	28/47		4.5J		0.059J	0.44	0.059J	1.3		66.0J	
Pyrene	27/47			3.7J		0.42J	0.36J	0.049J	0.81	48.0J	
Benzo(A)Anthracene	23/47		2.4J		0.120J		0.723J		0.35J	12.0J	
Chrysene	28/47			2.0J		0.22J	0.12J	0.57	0.055J	12.0J	
Bis(2-Ethylhexyl) Phthalate	2/47				11.0J						
Di-N-Octylphthalate	2/47				0.42J						
Benzo(B and/or K) Fluoranthene	25/47		3.8J		0.39J	0.35J			0.082J	12.0J	
Benzo-A-Pyrene	24/47			1.7J	0.07J	0.35J	0.46		0.041J	4.0J	
Indeno (1,2,3-CD)Pyrene	8/47		0.87J								
Dibenzo(A,B)Anthracene	3/47		0.24J								
Benzo(GHI)Perylene	5/47			0.94J							
<b><u>PESTICIDES</u></b>											
Heptachlor	5/47				0.01						
Aldrin	3/47							0.0014J			
4,4'-DDE(P,P'-DDE)	10/47						0.0017				
Endrin	3/47	0.0005J									
Gamma-Chlordane	20/47		0.0004J	0.0004J		0.0011J	0.0023				
Alpha-Chlordane	10/47							0.0043			
<b><u>INORGANICS</u></b>											<b><u>Background</u></b>
Antimony	5/44							4.9J	4.1		N/D
Arsenic	6/44						1.0	5.8			N/D
Beryllium	1/44										N/D
Cobalt	43/44	9.7	16.0	8.8	13.0	6.9		18.0	14.0	12.0	8.2
Lead	44/44	13.0J	9.4J	5.5J	18.0	5.1J	42.0	13.0J	15.0J	50.0J	1.7J
Selenium	9/44		3.8J					3.1J	1.7	1.8	N/D
Zinc	44/44	67.0J	89.0J	59.0J	60.0J	58.0J	86.0	34.0J	110.0J	77.0J	53.0

**TABLE 4 DETECTED CONTAMINANTS IN SHALLOW SUBSURFACE SOIL  
SAMPLES COLLECTED DURING SOILING BORINGS**

Station Location	Frequency of Detection	B10-S-1 (mg/kg)	B11-S-1 (mg/kg)	B12-S-1 (mg/kg)	B13-S-1 (mg/kg)	B14-S-1 (mg/kg)	B15-S-1 (mg/kg)	B16-S-1 (mg/kg)	B17-S-1 (mg/kg)	
<b><u>VOLATILE ORGANICS</u></b>										
Tetrachloroethene	5/47	0.12J								
Toluene	7/47	0.19J		0.004J	0.002J					
Ethylbenzene	8/47	0.66J			0.003J					
Total Xylenes	7/47	9.6J								
<b><u>SEMI-VOLATILE ORGANICS</u></b>										
1,2-Dichlorobenzene	1/47				0.28J					
2,4-Dichlorophenol	1/47				0.34J					
1,2,4-Trichlorobenzene	3/47				0.18J					
Naphthalene	25/47	120.0	0.12J		0.67		0.13J			
2-Methylnaphthalene	23/47	65.0	0.087J		1.0		0.18J			
Acenaphthylene	7/47	84.0			0.3J					
Acenaphthene	11/47				1.6					
Dibenzofuran	17/47	61.0			1.6		0.081J			
Diethyl Phthalate	1/47				0.072J					
Fluorene	17/47	74.0			1.1		0.042J			
Hexachlorobenzene	3/47				0.08J				0.055J	
Pentachlorophenol	8/47				19.0J			0.074J	0.15J	
Phenanthrene	27/47	160.0	0.11J		5.1J		0.55J	0.084J	0.073J	
Anthracene	21/47	53.0			1.1		0.069J			
Carbazole	15/47	25.0J			0.6					
Di-N-Butylphthalate	2/47								0.87J	
Fluoranthene	28/47	100.0	7.9		7.1		0.56	0.075J	0.45J	
Pyrene	27/47	70.0	5.7		5.8J		0.47J	0.056J	0.3J	
Benzyl Butyl Phthalate	6/47				0.14J					
Benzo(A)Anthracene	23/47	27.0J			2.6		0.17J		0.13J	
Chrysene	28/47	23.0	0.04J	1.3J	2.4J		0.3J		0.15J	
Benzo(B and/or K)	25/47	31.0J		5.7J	4.4				0.17J	
Fluoranthene										
Benzo-A-Pyrene	24/47	14.0J		2.0J	1.6		0.16J			
Indeno (1,2,3-CD)Pyrene	8/47	1.6								
Dibenzo(A,H)Anthracene	3/47	0.68								
Benzo(GHI)Perylene	5/47	1.3								
<b><u>PESTICIDES</u></b>										
4,4'-DDE(P,P'-DDE)	10/47			0.016				0.0004J		
Endosulfan II (Beta)	6/47								0.0004J	
Endosulfan Sulfate	1/47						0.0011			
4,4'-DDT(P,P'-DDT)	9/47	0.014						0.001J		
Gamma-Chlordane	20/47		0.0071		0.018		0.0023			
Alpha-Chlordane	10/47			0.076	0.0069					
<b><u>INORGANICS</u></b>										<b><u>Background</u></b>
Antimony	5/44									N/D
Arsenic	6/44	4.4		29.0						N/D
Beryllium	1/44									N/D
Cobalt	43/44	13.0	8.7	13.0	15.0	7.6	12.0	13.0	15.0	8.2
Lead	44/44	76.0J	30.0J	380.0J	110.0J	4.3J	130.0J	39.0J	13.0J	1.7J
Selenium	9/44	2.3J								N/D
Zinc	44/44	300.0J	72.0J	42.0J	270.0J	77.0J	140.0J	150.0J	110.0J	53.0

**TABLE 5**  
**SHALLOW SOIL SAMPLES**  
**ANALYTICAL DATA SUMMARY**

	Frequency of Detection	Range of Detection mg/kg	Mean Value mg/kg
<b>Inorganics</b>			
Aluminum	20/20	12,000-33,000	29,904
Antimony	4/20	3.6-4.9	4.2
Arsenic	4/20	4.4-29	13
Barium	20/20	130-1,700	301
Calcium	20/20	560-31,000	3,237
Chromium	20/20	18-55	35
Cobalt	20/20	7-23	12
Copper	12/20	15-100	50
Iron	20/20	16,000-47,000	30,333
Lead	20/20	4.3-380	60
Magnesium	20/20	3,900-9,000	5,762
Manganese	20/20	230-750	467
Nickel	20/20	9.6-27	18
Potassium	20/20	2,200-6,400	3,552
Selenium	5/20	1.7-3.8	2.5
Silver	1/20	29	29
Sodium	14/20	30-340	119
Vanadium	20/20	27-74	48.6
Zinc	20/20	49-420	146.5
<b>Purgeable Organics</b>		ug/kg	ug/kg
1,2-Dichloroethene	1/22	6	6
Methyl Ethyl Ketone	1/22	13	13
Benzene	1/22	3	3
Methyl Isobutyl Ketone	1/22	22	22
Tetrachloroethene (Tetrachloroethylene)	2/22	2-120	62
Toluene	4/22	2-410	151.5
Ethyl Benzene	4/22	3-660	195
Total Xylenes	2/22	7,000-9,600	8,300
<b>Extractable Organics</b>		ug/kg	ug/kg
1,2-Dichlorobenzene	1/22	280	280
(3-and/or 4-)Methylphenol	3/22	150-1,000	447
2,4-Dichlorophenol	1/22	340	340
1,2,4-Trichlorobenzene	3/22	65-360	212
Naphthalene	11/22	43-120,000	18,473
2-Methylnaphthalene	11/22	61-65,000	9,103
Acenaphthylene	3/22	58-2,300	886
Acenaphthene	5/22	1,300-84,000	34,620
Dibenzofuran	7/22	54-61,000	17,848
Diethyl Phthalate	1/22	72	72
Fluorene	7/22	42-74,000	15,576
Hexachlorobenzene	2/22	55-80	68
Pentachlorophenol	4/22	74-19,000	4,984
Phenanthrene	13/22	58-160,000	30,936
Anthracene	9/22	47-74,000	16,024
Carbazole	7/22	69-34,000	9,222
Di-N-Butylphthalate	2/22	870-1,800	1,335
Fluoranthene	13/22	59-75,000	19,705
Pyrene	13/22	49-70,000	13,697
Benzyl Butyl Phthalate	1/22	140	140
Benzo(A)Anthracene	10/22	72-27,000	6,384
Chrysene	13/22	40-23,000	4,704
Bis(2-Ethylhexyl) Phthalate	1/22	11,000	11,000
Di-N-Octylphthalate	1/22	420	420
Benzo(B and/or K) Fluoranthene	13/22	42-31,000	6,047
Benzo-A-Pyrene	11/22	41-14,000	2944
Indeno (1,2,3-CD) Pyrene	3/22	870-3,600	2,023
Dibenzo(A,H)Anthracene	2/22	240-680	460
Benzo(GH)Perylene	3/22	940-3,200	1,813

**TABLE 5**  
**SHALLOW SOIL SAMPLES**  
**ANALYTICAL DATA SUMMARY**

	Frequency of Detection	Range of Detection	Mean Value
Pesticides		ug/kg	ug/kg
Beta-BHC	1/22	11	11
Heptachlor	1/22	10	10
Aldrin	1/22	1.4	1.4
4,4'-DDE (P,P'-DDE)	6/22	0.4-16	5
Endrin	3/22	0.5-80	27.2
Endosulfan II (Beta)	1/22	0.4	0.4
4,4'-DDT (P,P'-DDT)	3/22	1-14	6.3
Gamma-Chlordane	10/22	0.4-11	4.5
Alpha-Chlordane	4/22	4.3-76	25

**NOTES:**

1. Mean Value is averaged for actual hits.
2. The Range of Detection includes all concentrations reported for each parameter.  
The lower value may be a concentration detected below the quantitation limit.  
Quantitation limits are presented in Appendix D.  
mg/kg - milligrams per Kilogram (parts per million)  
ug/Kg - micrograms per Kilogram (parts per billion)



The highest concentration of VOCs detected in the shallow subsurface soils occurred in boring B-10. The predominant contaminants include total xylenes (9.6 mg/kg), ethylbenzene (0.66 mg/kg), toluene (0.19 mg/kg), and tetrachloroethene (0.12 mg/kg).

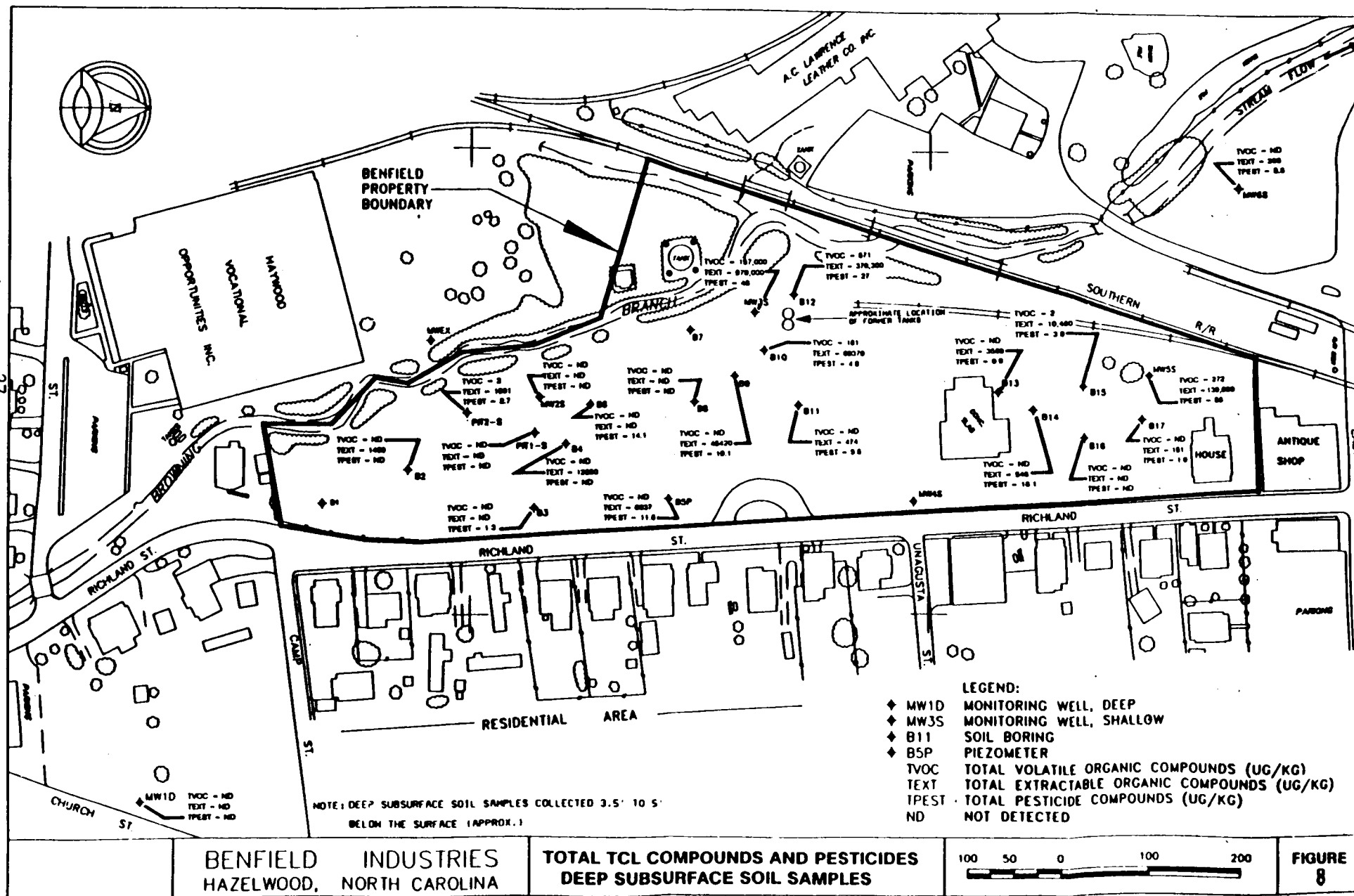
SVOCs are widespread in the shallow soils and, with the exception of the background boring (MW-1D), were detected in nearly every shallow subsurface soil sample, including the soil sample collected from the offsite downgradient boring for monitoring well MW-6S. The highest concentrations of SVOCs detected in the shallow subsurface soils were found in borings B-09, B-10, and MW-3S. The total concentration of SVOCs in these borings ranged from 438.2 mg/kg (B-09) to 910.58 mg/kg (B-10). The predominant SVOCs detected were PAH compounds including: naphthalene, acenaphthene, dibenzofuran, fluorene, phenanthrene, anthracene, carbazol, fluoranthene, pyrene, benzo-A-pyrene, chrysene, and benzo (b and/or k) fluoranthene. Most of these compounds were detected well above concentrations of 10.0 mg/kg. Concentrations of phenanthrene exceeded 120.0 mg/kg in the shallow soils in each of these borings.

The highest concentrations of pesticides in the shallow subsurface soils were found in borings B-12 and MW-3S. Alpha chlordane was detected at 0.076 mg/kg in B-12 along with 0.016 mg/kg 4,4'-DDE. The pesticides detected in the shallow soils from MW-3S were endosulfar II (beta) (0.080 mg/kg) and the only occurrence of beta-BHC (0.011 mg/kg).

### 7.1.3 DEEP SUBSURFACE SOIL

Figure 8 shows the deep subsurface soil sampling locations and the total concentrations (in mg/kg) of VOCs, SVOCs and pesticides found at each sampling location. Deep subsurface soil samples were generally collected at a depth of 3½-5 feet below the surface or at the water table interface. The intent of collecting these samples was to gain an understanding of the depth of contamination to help determine the volume of soils that may need to be remediated. Table 6 lists the individual contaminants and their concentrations detected at each sampling point. Also included in this table are the background levels for metals found in MW-1D. Table 7 provides the frequency of detection and the range of concentrations detected for contaminants found in the deep subsurface soils at the Benfield site.

The highest concentration of VOCs in the deep subsurface soils occurred in boring MW-3S in which toluene, ethylbenzene, and total xylenes were detected at concentrations of 18.0 mg/kg, 19.0 mg/kg, and 12.0 mg/kg, respectively. With the exception of B-03, B-06, B-08, B-16, and MW-2S, SVOCs were detected in each deep subsurface soil sample. The greatest concentrations of SVOCs in the deep subsurface soils were detected in borings B-12, MW-3S, and MW-5S with total concentrations ranging from 0.139 mg/kg (MW-5S) to 987.0 mg/kg (MW-3S). The predominant compounds detected were the PAH compounds identified in the shallow soils.



**TABLE 6 DETECTED CONTAMINANTS IN DEEP SUBSURFACE SOIL SAMPLES  
COLLECTED DURING THE INSTALLATION OF THE MONITORING WELLS**

Station Location	Frequency of Detection	MW2S-S-2 (mg/kg)	MW3S-S-2 (mg/kg)	MW5S-S-2 (mg/kg)	MW6S-S-2 (mg/kg)	
<b><u>VOLATILE ORGANICS</u></b>						
Toluene	7/47		18.0			
Ethylbenzene	8/47		19.0	0.041J		
Total Xylenes	7/47		120.0	0.23J		
<b><u>SEMI-VOLATILE ORGANICS</u></b>						
Naphthalene	25/47		120.0	4.2J	0.096J	
2-Methylnaphthalene	23/47		110.0	5.0J	0.140J	
Acenaphthylene	7/47		13.0	0.79J		
Acenaphthene	11/47		80.0	10.0		
Dibenzofuran	17/47		73.0	7.8		
Fluorene	17/47		70.0	11.0		
Phenanthrene	27/47		160.0	34.0	0.07J	
Anthracene	21/47			47.0	6.7	
Carbazole	15/47		32.0	0.84J		
Fluoranthene	28/47		97.0	24.0		
Pyrene	27/47		77.0	16.0		
Benzyl Butyl Phthalate	6/47			5.5J	0.61J	
Benzo(A)Anthracene	23/47		33.0	6.0		
Chrysene	28/47		26.0	4.2J		
Benzo(B and/or K) Fluoranthene	25/47		26.0	5.4J		
Benzo-A-Pyrene	24/47		13.0	2.4J		
Indeno (1,2,3-CD)Pyrene	8/47		5.1J	0.75J		
<b><u>PESTICIDES</u></b>						
4,4'-DDE(P,P'-DDE)	10/47		0.019		0.0026J	
Endosulfan II (Beta)	6/47				0.0008J	
4,4'-DDT(P,P-DDT)	9/47				0.0021J	
Methoxychlor	1/47			0.058		
Endrin Aldehyde	1/47		0.029			
Alpha-Chlordane	10/47					
<b><u>INORGANICS</u></b>						<b><u>Background</u></b>
Antimony	5/44					N/D
Arsenic	6/44					N/D
Beryllium	1/44					N/D
Cobalt	43/44	10.0		9.9	13.0	8.2
Lead	44/44	11.0J		4.6J	36.0J	1.7J
Selenium	9/44	3.4J				N/D
Zinc	44/44	72.0J		63.0J	13.0	53.0

**TABLE 6 DETECTED CONTAMINANTS IN DEEP SUBSURFACE SOIL  
SAMPLES COLLECTED DURING SOILING BORING**

Station Location	Frequency of Detection	B02-S-2 (mg/kg)	B03-S-2 (mg/kg)	B04-S-2 (mg/kg)	B05-S-2 (mg/kg)	B06-S-2 (mg/kg)	B08-S-2 (mg/kg)	B09-S-2 (mg/kg)	
<b><u>SEMI-VOLATILE ORGANICS</u></b>									
(3-and/or 4-)Methylphenol	4/47				0.51J				
Naphthalene	25/47	0.044J			0.73			6.3	
2-Methylnaphthalene	23/47					0.083J		1.9	
Acenaphthene	7/47							3.7	
Dibenzofuran	17/47					0.15J		2.3	
Fluorene	17/47	0.045J			0.25J			2.8	
Pentachlorophenol	8/47			0.17J					
Phenanthrene	27/47				0.084J	1.2J		9.9	
Anthracene	21/47	0.12J			0.23J			1.6J	
Carbazole	15/47	0.1J			0.064J			0.28J	
Fluoranthene	28/47				1.2J	1.5		8.2	
Pyrene	27/47				0.79J	1.3J		4.7	
Benzyl Butyl Phthalate	6/47			0.046J					
Benzo(A)Anthracene	23/47	0.24J		0.19J	0.25J			1.2J	
Chrysene	28/47	0.18J		0.37J	0.41J			1.2J	
Bis(2-Ethylhexyl) Phthalate	2/47			8.7J					
Di-N-Octylphthalate	2/47			0.35J					
Benzo(B and/or K) Fluoranthene	25/47	0.34J		0.8J				1.1J	
Benzo-A-Pyrene	24/47	0.17J		0.13J	0.21J			0.26J	
Indeno (1,2,3-CD)Pyrene	8/47	0.11J		0.12J					
Benzo(GHI)Perylene	5/47	0.12J							
<b><u>PESTICIDES</u></b>									
Heptachlor	5/47			0.0005J					
Dieldrin	3/47				0.0025J			0.0031J	
4,4'-DDE(P,P'-DDE)	10/47			0.0018J		0.0068			
Endosulfan II (Beta)	6/47				0.0015J			0.001J	
4,4'-DDD(P,P'-DDD)	2/47					0.0025J			
4,4'-DDT(P,P'-DDT)	9/47			0.0008J	0.0004J	0.0048			
Gamma-Chlordane	20/47				0.0072			0.011	
Alpha-Chlordane	10/47							0.004	
<b><u>INORGANICS</u></b>									<b><u>Background</u></b>
Antimony	5/44	4.3J							N/D
Arsenic	6/44					4.0J			N/D
Beryllium	1/44		1.4						N/D
Cobalt	43/44	21.0	29.0	15.0	8.7	7.8	7.2	7.3	8.2
Lead	44/44	9.0J	15.0J	14.0J	7.1J	41.0J	4.1J	12.0J	1.7J
Selenium	9/44						2.1J	1.4J	N/D
Zinc	44/44	140.0J	110.0J	68.0J	80.0J	57.0J	53.0J	77.0J	53.0

**TABLE 6 DETECTED CONTAMINANTS IN DEEP SUBSURFACE SOIL  
SAMPLES COLLECTED DURING SOILING BORINGS**

Station Location	Frequency of Detection	B10-S-2 (mg/kg)	B11-S-2 (mg/kg)	B12-S-2 (mg/kg)	B13-S-2 (mg/kg)	B14-S-2 (mg/kg)	B15-S-2 (mg/kg)	B16-S-2 (mg/kg)	B17-S-2 (mg/kg)	
<b><u>VOLATILE ORGANICS</u></b>										
Tetrachloroethene (Tetrachloroethylene)	5/47	0.002J								
Toluene	7/47	0.003J		0.009J						
Ethylbenzene	8/47	0.016		0.042J						
Total Xylenes	7/47	0.14		0.52J						
<b><u>SEMI-VOLATILE ORGANICS</u></b>										
1,2,4-Trichlorobenzene	3/47	0.28J								
Naphthalene	25/47	5.3	0.17J	6.8J	0.081J		0.57			
2-Methylnaphthalene	23/47	3.2	0.077J	18.0	0.11J		0.73			
Acenaphthylene	7/47				0.2J		0.094J			
Acenaphthene	7/47	5.3		29.0			0.67			
Dibenzofuran	17/47	4.0		26.0	0.14J		0.65			
Fluorene	17/47	4.7		32.0	0.097J		0.64			
Pentachlorophenol	8/47					0.23J				
Phenanthrene	27/47	11.0	0.095J	32.0	0.42J	0.1J	2.3J		0.055J	
Anthracene	21/47	3.3		13.0	0.25J		0.21J			
Carbazole	15/47	1.8			0.14J		0.089J			
Fluoranthene	28/47	7.9	0.064J	65.0	0.48J	0.120J	1.4		0.044J	
Pyrene	27/47	5.7	0.068J	30.0	0.42J	0.098J	1.2J		0.052J	
Benzyl Butyl Phthalate	6/47				0.071J		0.097J			
Benzo(A)Anthracene	23/47	2.1J		12.0J	0.22J		0.48			
Chrysene	28/47	2.0J		8.50J	0.35J		0.43J			
Benzo(B and/or K) Fluoranthene	25/47	6.9		10.0J	0.44J		0.69			
Benzo-A-Pyrene	24/47	3.2			0.17J		0.23J			
Indeno (1,2,3-CD)Pyrene	8/47	1.2								
Dibenzo(A,H)Anthracene	3/47	0.49								
Benzo(GHI)Perylene	5/47	1.0								
<b><u>PESTICIDES</u></b>										
Heptachlor	5/47				0.0009J	0.0009J			0.0002J	
Endrin	3/47					0.0019J				
Endosulfan II (Beta)	6/47					0.0045			0.0008J	
4,4'-DDT(P,P'-DDT)	9/47			0.014						
Gamma-Chlordane	20/47		0.0058			0.006	0.0039			
Alpha-Chlordane	10/47	0.0049		0.013		0.0048				
<b><u>INORGANICS</u></b>										<b>Background</b>
Antimony	5/44			3.8J						N/D
Arsenic	6/44			7.7						N/D
Beryllium	1/44									N/D
Cobalt	43/44	15.0	10.0	7.8	18.0	8.5J	14.0	14.0	15.0	8.2
Lead	44/44	46.0J	17.0J	110.0J	17.0J	18.0J	150.0J	16.0J	11.0J	1.7J
Selenium	9/44	4.5J								N/D
Zinc	44/44	310.0J	59.0J	180.0J	110.0J	91.0J	210.0J	76.0J	82.0J	53.0

**TABLE 7**  
**DEEP SOIL SAMPLES**  
**ANALYTICAL DATA SUMMARY**

	Frequency of Detection	Range of Detection	Mean Value
<b>Inorganics</b>		mg/kg	mg/kg
Aluminum	19/19	11,000-37,000	19,388
Antimony	2/19	3.8-4.3	4
Arsenic	2/19	4-7.7	5.9
Barium	19/19	120-370	219
Beryllium	1/19	1.4	1.4
Calcium	18/19	720-26,000	3,199
Chromium	19/19	18-110	36.8
Cobalt	19/19	7.2-29	12.5
Copper	10/19	15-44	29.7
Iron	19/19	17,000-45,000	29,222
Lead	19/19	4.1-48	21.8
Magnesium	19/19	3.1-10	5.7
Manganese	19/19	130-800	439
Nickel	19/19	11-34	18.8
Potassium	19/19	2,100-7,800	4,294
Selenium	4/19	1.4-5.4	3.1
Silver	1/19	9.3	9.3
Sodium	10/19	72-150	103
Vanadium	19/19	28-110	52
Zinc	19/19	53-310	101
<b>Purgeable Organics</b>		ug/kg	ug/kg
Tetrachloroethene (Tetrachloroethylene)	2/20	2	2
Toluene	3/20	3-1,800	604
Ethyl Benzene	4/20	18-19,000	4,775
Total Xylenes	4/20	1,400-120,000	30,323
<b>Extractable Organics</b>		ug/kg	ug/kg
(3-and/or 4-)Methylphenol	1/20	510	510
1,2,4-Trichlorobenzene	1/20	280	280
Naphthalene	10/20	44-120,000	14,372
2-Methylnaphthalene	10/20	170-120,000	15,984
Acenaphthylene	4/20	77-110,000	15,390
Acenaphthene	8/20	3,700-80,000	25,600
Dibenzofuran	8/20	140-73,000	16,199
Fluorene	9/20	45-70,000	15,112
Pentachlorophenol	2/20	170-230	200
Phenanthrene	13/20	55-180,000	28,077
Anthracene	9/20	120-47,000	9,025
Carbazole	8/20	100-32,000	5,857
Fluoranthene	12/20	44-97,000	19,884
Pyrene	12/20	52-77,000	13,102
Benzyl Butyl Phthalate	5/20	46-5,500	1,557
Benzo(A)Anthracene	10/20	190-33,000	6,134
Chrysene	10/20	180-8,500	4,801
Bis(2-Ethylhexyl) Phthalate	1/20	8,700	8,700
Di-N-Octylphthalate	1/20	350	350
Benzo(B and/or K) Fluoranthene	9/20	340-28,000	6,373
Benzo-A-Pyrene	9/20	130-13,000	2,443
Indeno (1,2,3-CD) Pyrene	5/20	750-5,100	1,458
Dibenzo(A,H)Anthracene	1/20	480	480
Benzo(G,H)Perylene	2/20	120-1,000	580
<b>Pesticides</b>		ug/kg	ug/kg
Heptachlor	4/20	0.2-0.9	0.63
Dieldrin	2/20	2.5-3.1	2.8
4,4'-DDE (P,P'-DDE)	4/20	1.8-18	7.5
Endrin	1/20	1.9	1.9
Endosulfan II (Beta)	4/20	0.8-1.5	1
Endosulfan Sulfate	1/20	4.5	4.5
4,4'-DDT (P,P'-DDT)	5/20	0.4-14	4.4
Methoxychlor	1/20	58	58
Endrin Aldehyde	1/20	29	29
Gamma-Chlordane	4/20	5.6-11	7.5
Alpha-Chlordane	4/20	4-13	6.6

**NOTES:**

1. Mean value is averaged for actual hits.
2. The Range of Detection includes all concentrations reported for each parameter.  
The lower value may be a concentration below the quantitation limit.

mg/Kg - milligrams per Kilogram (parts per million)  
ug/Kg - micrograms per Kilogram (parts per billion)

The highest concentration of pesticides in the deep subsurface soils were found in the boring for MW-5S, in addition to borings B-12 and MW-3S. The only occurrence of methoxychlor, which was the only pesticide detected in MW-5S, was detected at 0.058 mg/kg. The only occurrence of endrin aldehyde (0.029 mg/kg) was detected in MW-3S along with 0.019 mg/kg 4,4'-DDE. Alpha chlordane was detected in B-09, B-12, and B-14. Gamma chlordane was detected in B-05, B-09, B-11, and B-14.

## 7.2 GROUNDWATER

Contaminants detected in groundwater also include VOCs, SVOCs, and metals. Only one pesticide, endosulfan I (Alpha) at 0.3 micrograms per liter (ug/l), was detected in the groundwater (MW-3S). Contaminants were found in the shallow and deep monitoring wells. The greatest concentrations of organic contaminants in the groundwater were found in the well nest in the west-central portion of the Site (MW-3S and MW-3D), the well nest installed immediately north (downgradient) of the former Benfield facility (MW-5S and MW-5D), and to a lesser extent in the well nest adjacent to the eastern site boundary (MW-4S and MW-4D). Concentrations of organic parameters are significantly greater in the shallow wells, compared to the deep wells at each well nest location. Well nests MW-3, MW-4, and MW-5 are situated along the western, eastern, and northern perimeter of the former facility.

Groundwater samples were collected from the five (5) shallow monitoring wells (designated "S") and six (6) deep monitoring wells (designated "D"). The shallow wells were screened at the water table interface and the deep wells were screened at the based on saprolite (on top bedrock). Groundwater was typically encountered at a depth of 3½ to 6 feet below surface and the depth of the deep wells ranged from 34 to 52 feet below surface.

A total of 12 different VOCs were detected in seven (7) monitoring wells. VOCs detected in groundwater from on-site wells in concentrations that exceed Federal MCLs include vinyl chloride (MW-4D, MW-5S, and MW-5D), benzene (MW-5S and MW-5D), and 1,2-dichloropropane (MW-5D). A total of 27 different SVOCs were detected in 7 of the monitoring wells of which 19 were PAH compounds. Eighteen (18) of these PAH compounds were also found in soils. A variety of metals were detected in the groundwater. Concentrations above background were detected in the onsite monitoring wells. In general, higher concentrations were observed in the shallow wells. The highest concentrations were generally found in MW-2S and in MW-5S which are situated at the southern portion of the Site in the vicinity of the reported dumping area. Metals that were detected at concentrations exceeding two time the background groundwater sample include: antimony, barium, beryllium, chromium, cobalt, lead, vanadium, and zinc.

Although Figure 5 attempts to define the plume, the RI did not generate sufficient data to completely define the extent of groundwater contamination. One organic site constituent was detected in the deep well (MW-6D) in the downgradient off-site well nest and insufficient data was collected to evaluate the adverse impact, if any, the Site has had on the

bedrock zone of the aquifer. Additional information to address this data gap will be collected during the remedial design (RD).

#### 7.2.1 SHALLOW GROUNDWATER

Figure 9 shows the locations of the shallow monitoring wells and the total concentrations of VOCs, SVOCs and pesticides detected at each well. Table 8 lists the individual contaminants and their concentrations detected at each

well. This table also lists the background levels for metals in groundwater as determined by the groundwater sample collected from MW-1D. Table 9 provides the frequency of detection and the range of concentrations detected for contaminants found in the shallow monitoring wells at the Benfield site.

The highest total concentration of volatiles were found in MW-3S while the greatest variety of volatiles were found in MW-5S. VOCs detected in MW-3S included total xylenes (1,800 ug/l), toluene (830 ug/l), ethylbenzene (380 ug/l), and 1,2-dichloroethene (22J ug/l). These compounds were also detected in MW-5S but generally in lower concentrations as well as vinyl chloride (33J ug/l), 1,1-dichloroethane (60 ug/l), 1,1,1-trichloroethane (22J ug/l), and benzene (20J ug/l). Chlorobenzene (50 ug/l) was the only VOC detected in MW-4S. The greatest total concentrations of miscellaneous VOCs were found in MW-3S and MW-4S.

SVOCs were also detected in MW-3S, MW-4S, and MW-5S. The greatest total concentration of SVOCs was found in MW-3S. Nineteen PAH compounds were detected in MW-3S including: naphthalene (2500J ug/l), 2-methylnaphthalene (1000J ug/l), acenaphthene (840 ug/l), dibenzofuran (620 ug/l), fluorene (580 ug/l), and phenanthrene (1100 ug/l). Eighteen of the 19 PAH compounds detected in MW-3S were detected in MW-5S but generally in lower concentrations. Only 6 PAH compounds were detected in MW-4S.

The highest level of metals were found in monitoring wells MW-2S and MW-5S. The metals detected in MW-2S included antimony (83 ug/l), barium (8100 ug/l), beryllium (15 ug/l), chromium (600 ug/l), lead (380 ug/l), and vanadium (1100 ug/l). MW-5S contained barium (2800 ug/l), beryllium (7 ug/l), chromium (740 ug/l), lead (48 ug/l), and vanadium (940 ug/l).

#### 7.2.2 DEEP GROUNDWATER

Figure 10 shows the locations of the deep monitoring wells and the total concentrations of VOCs and SVOCs detected in each well. Table 10 lists the individual contaminants and their concentrations detected at each well. This table also lists the background levels for metals in groundwater as determined by the groundwater sample collected from MW-1D. Table 11 provides the frequency of detection and the range of concentrations detected for contaminants found in the deep monitoring wells at the Benfield site.



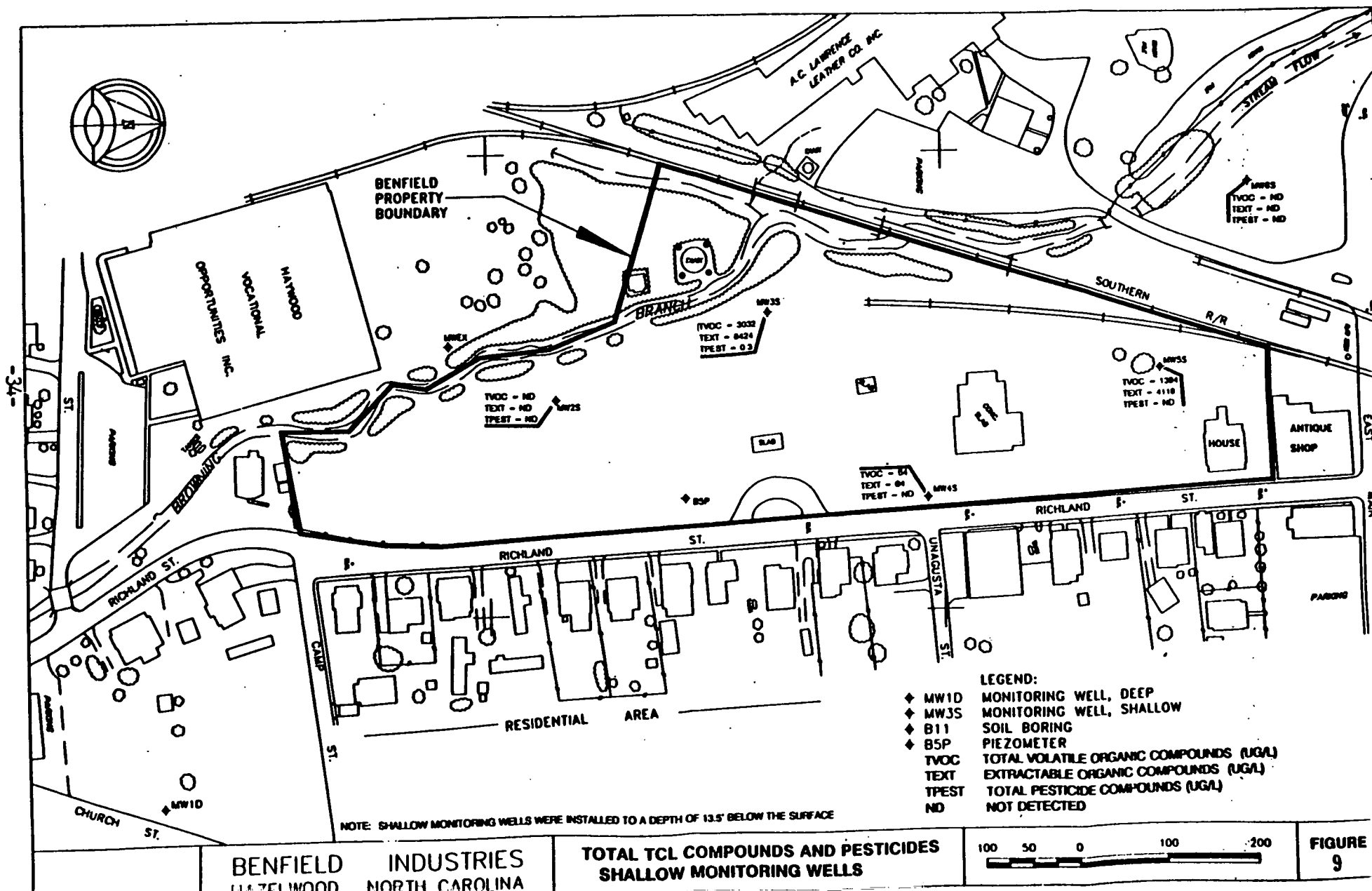


TABLE 8 CONTAMINANTS DETECTED IN SHALLOW ZONE OF THE AQUIFER

Station Location	Frequency of Detection	MW2S-GW (ug/l)	MW3S-GW (ug/l)	MW4S-GW (ug/l)	MW5S-GW (ug/l)	MW6S-GW	
<b><u>VOLATILE ORGANICS</u></b>							
Vinyl Chloride	1/5				33.0 J		
Chloroethane	1/5			2.0 J			
1,1-Dichloroethane	1/5				60.0		
1,2-Dichloroethane	2/5		22.0 J		29.0 J		
Chloroform	1/5			1.0 J			
1,1,1-Trichloroethane	1/5				22.0 J		
Benzene	2/5			1.0 J	2.0 J		
Toluene	2/5		830.0		190.0		
Chlorobenzene	1/5			50.0			
Ethyl Benzene	2/5		380.0	41.0 J	440.0		
Total Xylenes	2/5		1800.0	230.0 J	600.0		
<b><u>SEMI-VOLATILE ORGANICS</u></b>							
1,3-Dichlorobenzene	1/5				3.0 J		
1,4-Dichlorobenzene	2/5		4.0 J		6.0 J		
1,2-Dichlorobenzene	1/5				51.0		
2-Methylphenol	2/5		13.0		8.0 J		
(3-and/or 4-)Methylphenol	1/5		28.0				
Naphthalene	3/5		2500.0 J	34.0	2400.0 J		
2-Methylnaphthalene	3/5		1000.0	4.0 J	390.0 J		
2-Chloronaphthalene	1/5				4.0		
Acenaphthylene	2/5		100.0 J		38.0		
Acenaphthene	2/5		840.0		220.0 J		
Dibenzofuran	3/5		620.0	8.0 J	200.0 J		
Fluorene	3/5		580.0	8.0 J	160.0 J		
Pentachlorophenol	1/5		89.0 J				
Phenanthrene	3/5		1100.0	4.0 J	250.0 J		
Anthracene	2/5		160.0 J		26.0		
Carbazole	3/5		380.0 J	6.0 J	210.0 J		
Fluoranthene	2/5		440.0 J		64.0		
Pyrene	2/5		320.0 J	16000.0	41.0		
Benzo(A)Anthracene	2/5		77.0	6000.0	14.0		
Chrysene	2/5		56.0 J	4200.0 J	12.0 J		
Benzo(B and/or K)	2/5		63.0	5400.0 J	11.0 J		
Fluoranthene							
Benzo-A-Pyrene	2/5		31.0	2400.0 J	5.0		
Indeno (1,2,3-CD)Pyrene	2/5		12.0	750.0 J	2.0 J		
Dibenzo(A,B)Anthracene	1/5		3.0 J				
Benzo(GHI)Perylene	2/5		8.0 J		1.0 J		

TABLE 6 (continued) CONTAMINANTS DETECTED IN SHALLOW ZONE OF THE AQUIFER

Station Location	Frequency of Detection	MW2B-GW (ug/l)	MW3B-GW (ug/l)	MW4B-GW (ug/l)	MW5B-GW (ug/l)	MW6B-GW	
<b>PESTICIDES</b>							
Endosulfan II (Alpha)	1/5		0.3				
<b>INORGANICS</b>							
Antimony	1/5	83.0					<u>Background</u> 120.0
Barium	5/5	8100.0	1400.0	1400.0	2800.0	1000.0	
Beryllium	2/5	15.0			7.0		
Chromium	5/5	600.0	240.0	64.0	740.0	75.0	
Cobalt	5/5	240.0	96.0	98.0	220.0	51.0	
Lead	5/5	380.0	170000.0 J	47.0	87.0	48.0	69.0 J
Manganese	5/5	8200.0 J	3400.0 J	18000.0 J	13000.0 J	2600.0 J	
Mercury	2/5	0.88		0.52			
Nickel	4/5	250.0	130.0	65.0	380.0		
Vanadium	5/5	1100.0	330.0	200.0	940.0	52.0	

**GROUNDWATER - SHALLOW WELLS  
ANALYTICAL DATA SUMMARY**

	Frequency of Detection	Range of Detection	Mean Value
<b>Inorganics</b>		ug/l	ug/l
Aluminum	5/5	22000 - 430000	167000
Antimony	1/5	83	83
Barium	5/5	1000 - 8100	2940
Beryllium	2/5	7 - 15	11
Calcium	5/5	12000 - 51000	29200
Chromium	5/5	64 - 740	344
Cobalt	5/5	51 - 220	141
Copper	5/5	55 - 490	219
Iron	5/5	24000 - 640000	253000
Lead	5/5	47 - 380	134
Magnesium	5/5	69000 - 110000	42380
Manganese	5/5	2800 - 18000	9040
Mercury	2/5	0.52 - 0.88	0.70
Nickel	4/5	65 - 380	208
Potassium	5/5	5600 - 140000	44820
Sodium	5/5	3500 - 23000	9380
Vanadium	5/5	52 - 1100	524
Zinc	5/5	130 - 1300	516
<b>Purgeable Organics</b>		ug/l	ug/l
Vinyl Chloride	1/5	33	33
Chloroethane	1/5	2	2
1,1-Dichloroethane	1/5	60	60
1,2-Dichloroethane	2/5	22 - 29	26
Chloroform	1/5	1	1
1,1,1-Trichloroethane	1/5	22	22
1,2-Dichloropropane	0/5	-	-
Benzene	2/5	1 - 20	11
Toluene	2/5	190 - 830	510
Chlorobenzene	1/5	50	50
Ethyl Benzene	2/5	380 - 440	410
Total Xylenes	2/5	600 - 1800	1200
<b>Extractable Organics</b>		ug/l	ug/l
Phenol	0/5	-	-
1,3-Dichlorobenzene	1/5	3	3
1,4-Dichlorobenzene	2/5	4 - 6	5
1,2-Dichlorobenzene	1/5	51	51
2-Methylphenol	2/5	8 - 13	11
(3-and/or 4-)Methylphenol	1/5	28	28
1,2,4-Trichlorobenzene	0/5	-	-
Naphthalene	3/5	34 - 2500	1645
2-Methylnaphthalene	3/5	4 - 1000	465
2-Chloronaphthalene	1/5	4	4
Acenaphthylene	2/5	36 - 100	66
Acenaphthene	2/5	220 - 840	530
Dibenzofuran	3/5	8 - 620	276
Fluorene	3/5	8 - 580	250
Pentachlorophenol	1/5	86	86
Phenanthrene	3/5	4 - 1100	451
Anthracene	2/5	26 - 180	93
Carbazole	3/5	6 - 380	198
Fluoranthene	2/5	64 - 440	252
Pyrene	2/5	41 - 320	181
Benzo(A)Anthracene	2/5	14 - 77	46
Chrysene	2/5	12 - 56	34
Benzo(B and/or K) Fluoranthene	2/5	11 - 63	37
Benzo-A-Pyrene	2/5	5 - 31	18
Indeno (1,2,3-CD) Pyrene	2/5	2 - 12	7
Dibenzo(A,H)Anthracene	1/5	3	3
Benzo(GH)Perylene	2/5	1 - 8	5
<b>Pesticides</b>		ug/l	ug/l
Endosulfan II (Alpha)	1/5	0.3	0.3

**NOTES:**

1. Mean value is averaged for actual hits.
2. The Range of Detection includes all concentrations reported for each parameter.  
The lower value may be a concentration detected below the quantitation limit.

ug/l - micrograms per liter (parts per billion)

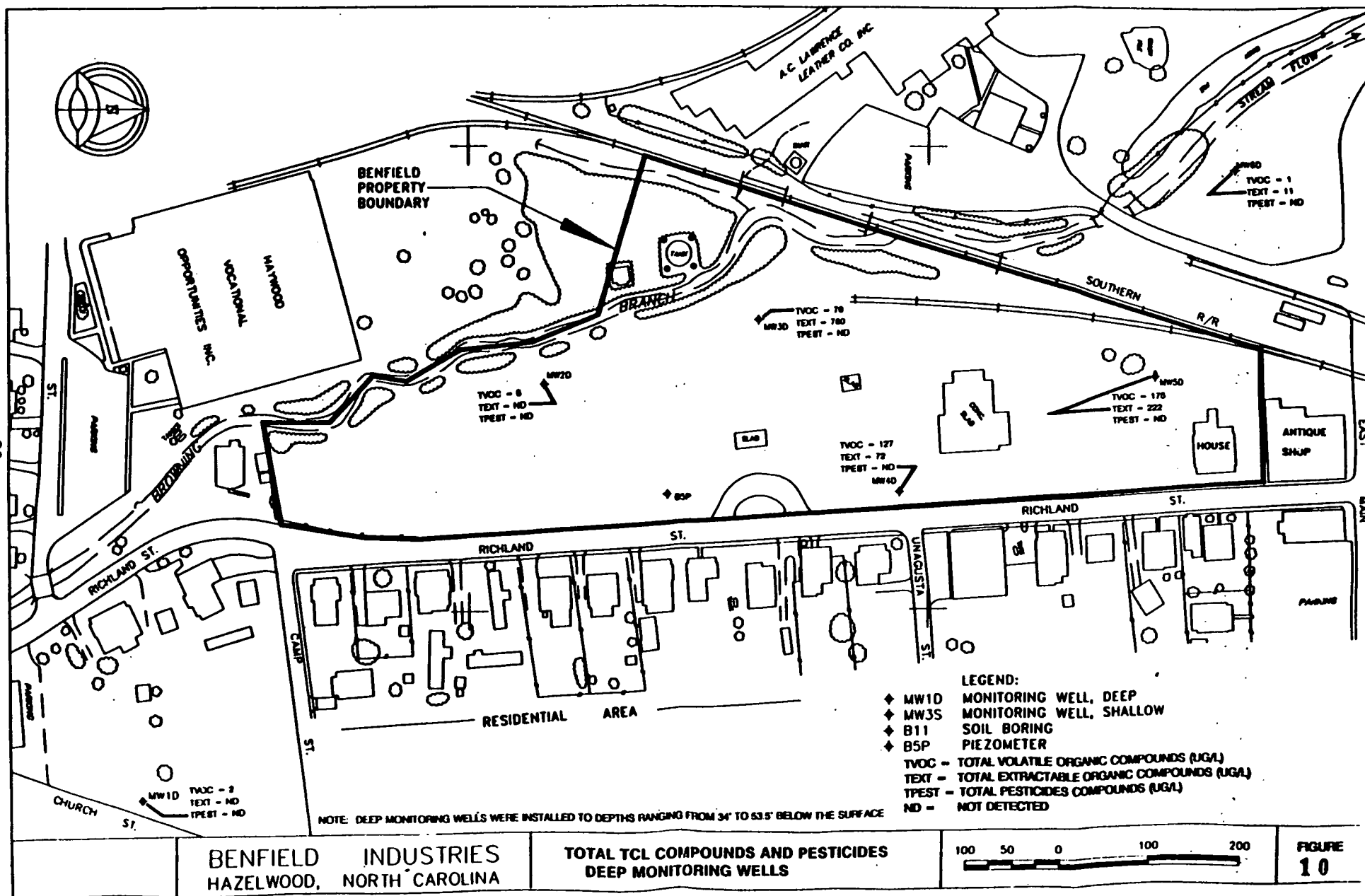


TABLE 10 CONTAMINANTS DETECTED IN DEEP ZONE OF THE AQUIFER

Station Location	Frequency of Detection	MW2D-GW (ug/l)	MW3D-GW (ug/l)	MW4D-GW (ug/l)	MW5D-GW (ug/l)	MW6D-GW (ug/l)	Background MW1D-GW (ug/l)
<b><u>VOLATILE ORGANICS</u></b>							
Vinyl Chloride	2/6			9.0J	53.0		
Chloroethane	1/6			12.0J			
1,1-Dichloroethane	1/6				48.0		
1,2-Dichloroethane	2/6			3.0J	44.0		
Chloroform	6/6	2.0J	2.0J	1.0J	2.0J		1.0J
1,1,1-Trichloroethane	1/6				5.0J		
1,2-Dichloropropane	1/6				6.0J		
Benzene	2/6			2.0J	11.0		
Toluene	3/6	3.0J	9.0J		6.0J		
Chlorobenzene	1/6			100.0			
Total Xylenes	1/6		65.0		600.0		
<b><u>SEMI-VOLATILE ORGANICS</u></b>							
Phenol	3/6			7.0J	28.0		
1,4-Dichlorobenzene	1/6				2.0J		
1,2-Dichlorobenzene	1/6				33.0		
1,2,4-Trichlorobenzene	3/6		4.0J	10.0	2.0J		
Naphthalene	2/6		130.0		39.0J		
2-Methylnaphthalene	2/6		110.0		7.0J		
Acenaphthylene	1/6		11.0				
Acenaphthene	1/6		120.0				
Dibenzofuran	3/6		96.0	28.0	28.0		
Fluorene	3/6		79.0	6.0J	7.0J		
Phenanthrene	3/6		150.0	9.0J	16.0		
Anthracene	2/6		13.0		1.0J		
Carbazole	3/6		24.0	12.0	48.0J		
Fluoranthene	2/6		27.0		7.0J		
Pyrene	2/6		13.0		4.0J		
Benzo(A)Anthracene	1/6		1.0J				
<b><u>INORGANICS</u></b>							
Antimony	0/6						
Barium	6/6	30.0	18.0	70.0	160.0	360.0	120.0
Beryllium	0/6						
Chromium	4/6	19.0		10.0J	43.0	40.0	
Cobalt	0/6						
Lead	5/6	4.0	5.0	5.0	3.0	5.0	
Manganese	5/6	19.0J		140.0J	140.0J	200.0J	69.0J
Mercury	0/6						
Nickel	0/6						
Vanadium	0/6						

**TABLE 11**  
**GROUNDWATER - DEEP WELLS**  
**ANALYTICAL DATA SUMMARY**

	Frequency of Detection	Range of Detection	Mean Value
<b>Inorganics</b>		ug/l	ug/l
Aluminum	6/6	670-7300	3258
Antimony	0/6	-	-
Barium	6/6	18-360	128
Beryllium	0/6	-	-
Calcium	6/6	19000-69000	38333
Chromium	4/6	10-43	28
Cobalt	0/6	-	-
Copper	0/6	-	-
Iron	5/6	470-9300	3968
Lead	5/6	3-8	4
Magnesium	5/6	420-25000	8264
Manganese	5/6	19-200	114
Mercury	0/6	-	-
Nickel	0/6	-	-
Potassium	6/6	2300-8600	5700
Sodium	6/6	8500-17000	11087
Vanadium	0/6	-	-
Zinc	0/6	-	-
<b>Purgeable Organics</b>		ug/l	ug/l
Vinyl Chloride	2/6	9-53	31
Chloroethane	1/6	12	12
1,1-Dichloroethane	1/6	48	48
1,2-Dichloroethane	2/6	3-44	24
Chloroform	6/6	1-2	2
1,1,1-Trichloroethane	1/6	5	5
1,2-Dichloropropane	1/6	6	6
Benzene	2/6	2-11	7
Toluene	3/6	3-9	6
Chlorobenzene	1/6	100	100
Ethyl Benzene	0/6	-	-
Total Xylenes	1/6	65	65
<b>Extractable Organics</b>		ug/l	ug/l
Phenol	3/6	7-28	16
1,3-Dichlorobenzene	0/6	-	-
1,4-Dichlorobenzene	1/6	2	2
1,2-Dichlorobenzene	1/6	33	33
2-Methylphenol	0/6	-	-
(3-and/or 4-)Methylphenol	0/6	-	-
1,2,4-Trichlorobenzene	3/6	2-10	8
Naphthalene	2/6	39-130	85
2-Methylnaphthalene	2/6	7-110	59
2-Chloronaphthalene	0/6	-	-
Acenaphthylene	1/6	11	11
Acenaphthene	1/6	120	120
Dibenzofuran	3/6	28-98	51
Fluorene	3/6	6-78	31
Pentachlorophenol	0/6	-	-
Phenanthrene	3/6	9-150	58
Anthracene	2/6	1-13	7
Carbazole	3/6	12-48	28
Fluoranthene	2/6	7-27	17
Pyrene	2/6	4-13	9
Benzo(A)Anthracene	1/6	1	1
Chrysene	0/6	-	-
Benzo(B and/or K) Fluoranthene	0/6	-	-
Benzo-A-Pyrene	0/6	-	-
Indeno (1,2,3-CD) Pyrene	0/6	-	-
Dibenzo(A,H)Anthracene	0/6	-	-
Benzo(GH)Perylene	0/6	-	-
<b>Pesticides</b>		ug/l	ug/l
Endosulfan II (Alpha)	0/6	-	-

**NOTES:**

1. Mean value is averaged for actual hits.
2. The Range of Detection includes all concentrations reported for each parameter.  
The lower value may be a concentration detected below the quantitation limit

ug/l - micrograms per liter (parts per billion)

VOCs were detected in each of the deep monitoring wells. Chloroform was the only VOC detected in both of off-site deep wells, MW-1D and MW-6D. However, since chloroform was also found in the trip blanks for these samples, chloroform is not considered to be a groundwater constituent. Toluene (3J ug/l) was the only VOC detected in MW-2D. Toluene (9J ug/l) and total xylenes (6J ug/l) were found in MW-3D. VOCs detected in MW-4D included vinyl chloride (9J ug/l), chlorobenzene (100 ug/l), and chloroethane (12 ug/l). MW-5D was contaminated with the following VOCs: vinyl chloride (53 ug/l), 1,1-dichloroethane (48 ug/l), 1,2-dichloroethane (44 ug/l), and benzene (11 ug/l).

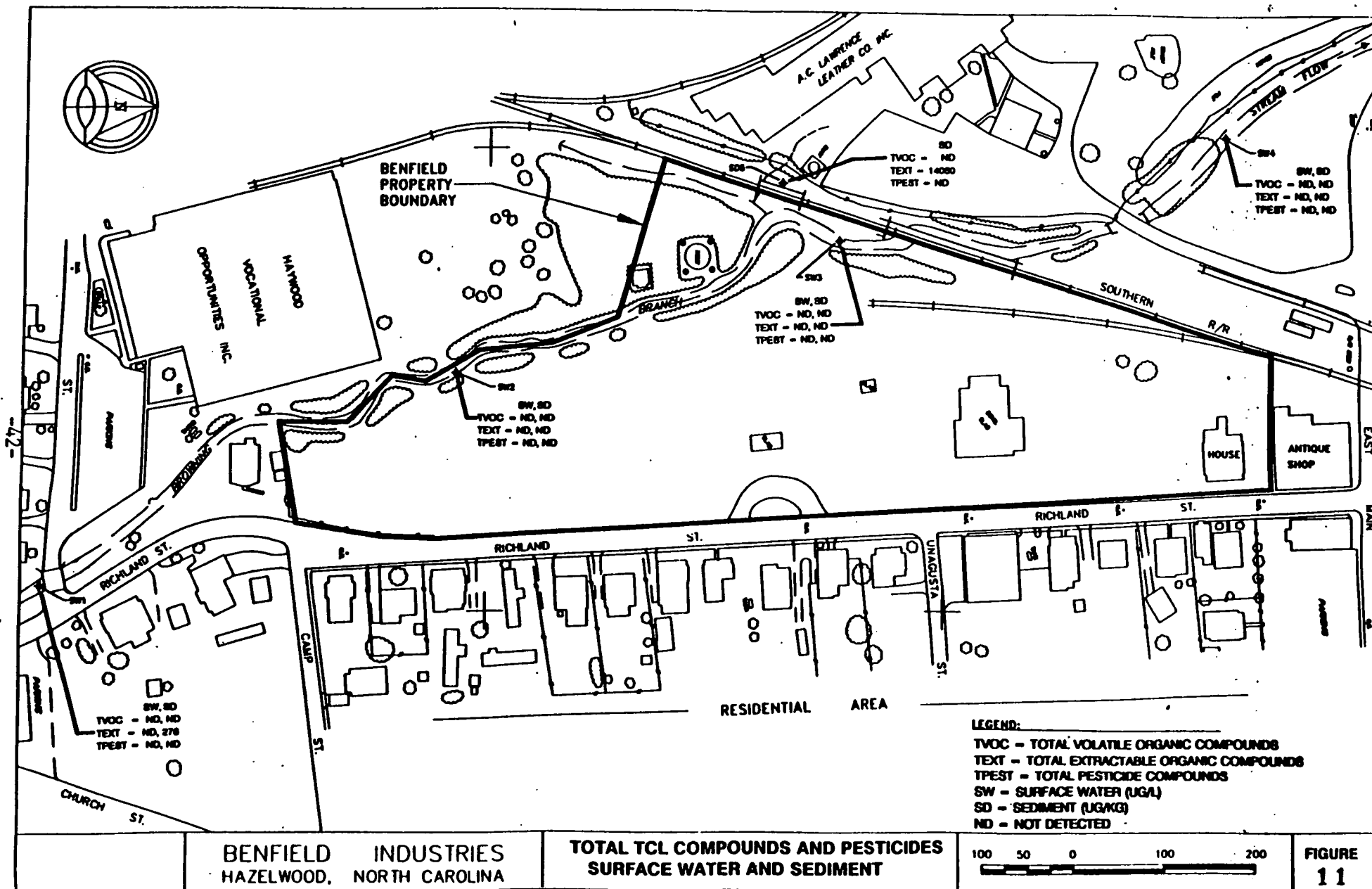
SVOCs were detected in MW-3D, MW-4D, MW-5D, and MW-6D with the greatest concentrations being found in MW-3D and MW-5D. Twelve PAH compounds and 1,2,4-trichlorobenzene (4J ug/l) were detected in MW-3D. The PAH compounds detected in the greatest concentration include: naphthalene (130 ug/l), 2-methylnaphthalene (110 ug/l), acenaphthene (120 ug/l), and phenanthrene (150 ug/l). In general, the concentrations of the PAH compounds detected in the deep well (MW-3D) are approximately one order of magnitude lower than the concentrations of PAH compounds detected in the shallow well (MW-3S). Nine PAH compounds were detected in MW-5D. The PAH compounds detected in the greatest concentrations include naphthalene (39J ug/l), dibenzofuran (28J ug/l), phenanthrene (16 ug/l), and carbazole (48J ug/l). In addition, phenol (28 ug/l) and 1,2-dichlorobenzene (33 ug/l) were also detected in MW-5D. The concentrations of PAH compounds in MW-5D are much lower than those found in MW-5S. Dibenzofuran (28 ug/l), carbazole (12 ug/l), phenol (7J ug/l), and 1,2,4-trichlorobenzene (10 ug/l) were the SVOCs detected in MW-4D. The only SVOC detected in MW-6D was phenol (11 ug/l). MW-6D is downgradient of MW-5D and phenol was also detected in MW-5D.

The only metal detected above its clean up goal in the deep monitoring wells was magnesium; however, the concentration of magnesium observed in the background well was also above the cleanup goal (50 ug/l).

### 7.3 SURFACE WATER AND SEDIMENT


Currently, Browning Branch is not being adversely impacted by the Benfield site. Neither residual soil contamination nor contaminated groundwater are entering into this stream. Figure 11 shows the locations of the surface water and sediment sampling locations and the total concentrations of contaminants detected at each sampling location. Table 12 lists the individual metals and their concentrations detected in the surface water at each sampling location. This table only contains metals as neither VOCs nor SVOCs were detected in the surface water of Browning Branch. This table also lists the background levels for metals in the surface water as determined by the surface water sample collected at SW-1. Table 13 lists the individual contaminants and their concentrations detected in the sediment collected at each sampling location. This table also lists the background levels for contaminants in the sediment at sampling location SD-1 which is upgradient of the Site.





**TABLE 1 2**  
**DATA SUMMARY - DETECTED PARAMETERS**  
**SURFACE WATER SAMPLES BENFIELD INDUSTRIES**


Sample No. Station Location Sample Date	Frequency of Detection	Background			
		59000 SW-1 060491	59002 SW-2 060491	59004 SW-3 060491	59006 SW-4 060491
Inorganics		ug/l	ug/l	ug/l	ug/l
Calcium	4/4	3100.0	3000.0	3100.0	2800.0
Iron	3/4	340.0	320.0	300.0	42.0 U
Magnesium	1/4	1100.0	1100.0 U	1100.0 U	37.0 U
Manganese	2/4	28.0 U	23.0	23.0	1.0 U
Mercury	1/4	0.20 U	0.20 U	0.20 U	0.58
Potassium	4/4	1800.0	1700.0	1800.0	1400.0
Sodium	2/4	2600.0 U	2700.0 U	2600.0	820000.0

U - Analyzed for but not detected. The number is the minimum quantitation limit.  
 - Concentration of detected parameters are highlighted by shading  
 ug/l - micrograms per liter (parts per billion)

**TABLE 1 3**  
**DATA SUMMARY - DETECTED PARAMETERS**  
**SEDIMENT SAMPLES BENFIELD INDUSTRIES**

Sample No. Station Location Sample Date	Frequency of Detection	59001 SD-1 060491	59003 SD-2 060491	59005 SD-3 060491	59007 SD-4 060491	59010 SD-5 060491
		mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Inorganics		mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Aluminum	4/5	9900.0	11000.0	12000.0	8700.0 UJ	45000.0
Barium	5/5	91.0	100.0	110.0	270.0	360.0
Calcium	2/5	440.0	480.0 U	670.0 U	430.0 U	3400.0
Chromium	5/5	22.0	25.0	29.0	31.0	65.0
Cobalt	5/5	7.3	7.5	8.6	5.6	24.0
Copper	5/5	18.0	12.0	14.0	77.0	43.0
Iron	5/5	18000.0	19000.0	21000.0	32000.0	46000.0
Lead	5/5	10.0 J	6.6 J	9.2 J	5.2 J	56.0 J
Magnesium	5/5	4100.0	3600.0	4400.0	2700.0	11000.0
Manganese	5/5	210.0 J	250.0 J	250.0 J	210.0 J	780.0 J
Nickel	5/5	8.2	8.9	11.0	15.0	33.0
Potassium	5/5	2700.0	2900.0	3700.0	1700.0	8200.0
Sodium	5/5	120.0	110.0	130.0	100.0	220.0
Vanadium	5/5	24.0	29.0	36.0	26.0	81.0
Zinc	5/5	71.0	59.0	68.0	120.0	170.0
Extractable Organics		ug/kg	ug/kg	ug/kg	ug/kg	ug/kg
Acenaphthylene	1/5	400.0 UJ	430.0 UJ	440.0 UJ	390.0 UJ	230.0 J
Phenanthrene	2/5	44.0 J	430.0 U	440.0 U	390.0 U	590.0
Anthracene	1/5	400.0 U	430.0 U	440.0 U	390.0 U	380.0 J
Fluoranthene	2/5	95.0 J	430.0 U	440.0 U	390.0 U	2000.0
Pyrene	2/5	88.0 J	430.0 U	440.0 U	390.0 U	1700.0
Benzo(A)Anthracene	1/5	400.0 U	430.0 U	440.0 U	390.0 U	1200.0
Chrysene	2/5	49.0 J	430.0 UJ	440.0 UJ	390.0 UJ	1800.0 J
Benzo(B and/or K) Fluoranthene	1/5	400.0 U	430.0 U	440.0 U	390.0 U	3300.0
Benzo-A-Pyrene	1/5	400.0 U	430.0 U	440.0 U	390.0 U	1300.0
Indeno (1,2,3-CD) Pyrene	1/5	400.0 U	430.0 U	440.0 U	390.0 U	750.0
Dibenzo(A,H)Anthracene	1/5	400.0 U	430.0 U	440.0 U	390.0 U	190.0 J
Benzo(GH)Perylene	1/5	400.0 UJ	430.0 UJ	440.0 UJ	390.0 UJ	620.0 J

NOTES:

U - Analyzed for but not detected. The number is the minimum quantitation limit.  
 J - Estimated value  
 - Concentrations of detected parameters are highlighted by shading.  
 mg/Kg - milligrams per Kilogram (parts per million)  
 ug/Kg - micrograms per Kilogram (parts per billion)

Contaminants were found in the sediments collected at location SD-1 and SD-5. The contamination found at SD-1, fluoranthene (0.095J mg/kg), pyrene (0.088 mg/kg), chrysene (0.049 mg/kg), and phenanthrene (0.044J mg/kg), are not attributable to the Site as this sampling location is located both topographically and hydraulically upgradient of the Site. However, it is conceivable that the elevated levels of PAHs and metals detected in sediment (SD-5) may have originated from the Site. Sampling location SD-5 was in an abandoned channel west of Browning Branch. No surface water sample was collected at this location as a two foot high berm has been constructed between Browning Branch and this point. In the 1960's and 1970's this channel provided process water to the Lawrence Leather Company.

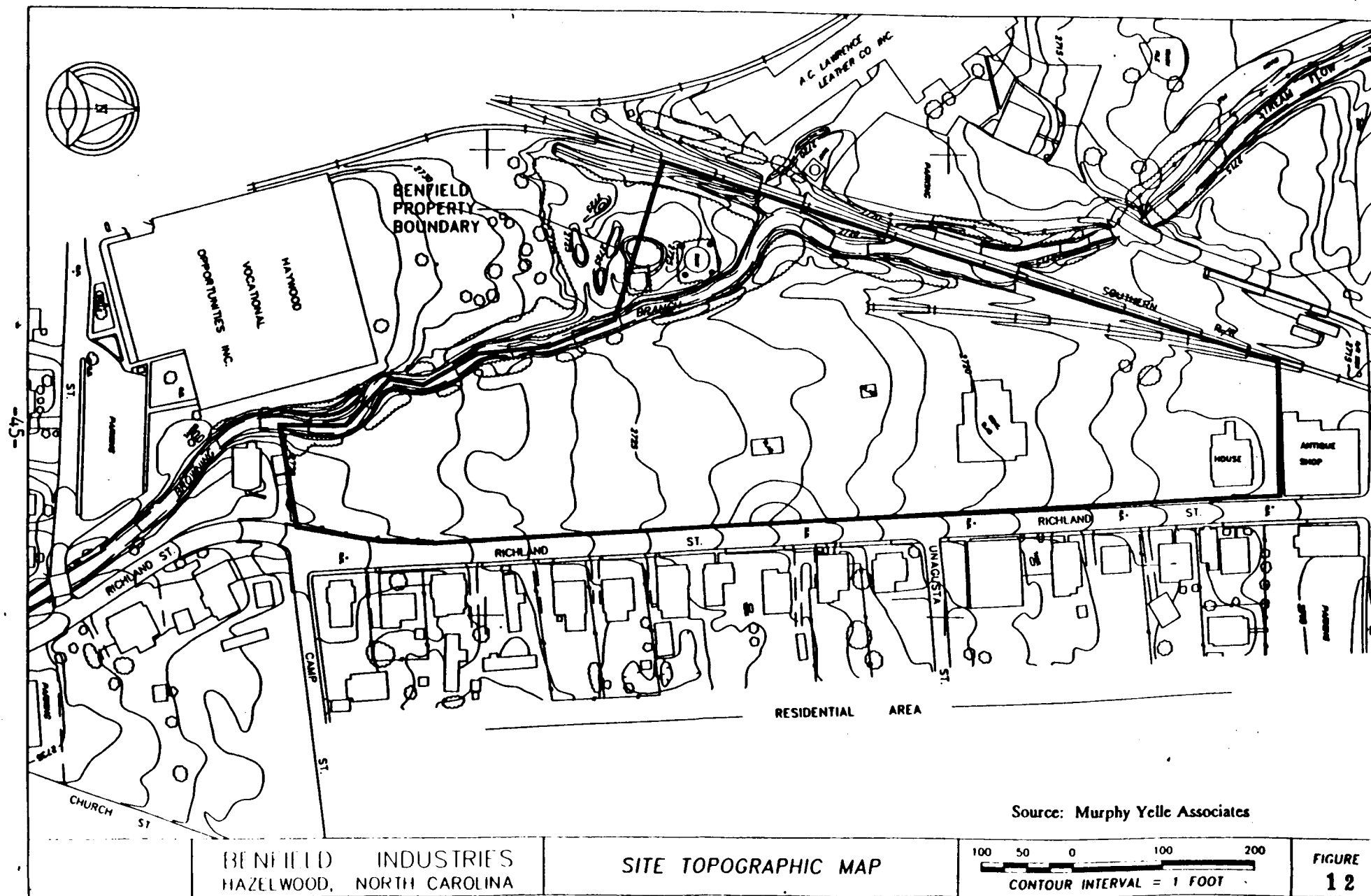
The source of the PAHs and elevated levels of metals found at sampling point SD-5 is presently not known. This sampling point is on the opposite side of Browning Branch and is adjacent to and underneath an active railroad line and railroad bridge both of which use creosote treated wood. The two foot high berm between Browning Branch and this point insures that this sediment, even under flood conditions, will not enter Browning Branch. This fact is confirmed by the absence of any contamination at the downstream sampling points 3 and 4.

The surface water in Browning Branch is classified as Class C under North Carolina Administrative Code, Title 15A, Subchapter 2B (NCAC 15A:02B). being suitable for secondary recreation and the "propagation of natural trout and maintenance of trout". Neither sport nor commercial fish species were observed in the shallow surface waters during the RI field work.

#### 7.4 HYDROGEOLOGICAL SETTING

The Site is located in the floodplain of Browning Branch which flows north-northwest into Richland Creek about 1,600 feet downstream of the Site. The topography of the Site and of the surrounding area is illustrated on Figure 12.

Groundwater in the region occurs in alluvial deposits, saprolite, and fractured metamorphic bedrock. These units are typically hydraulically connected and together comprise the Blue Ridge-Inner Piedmont Hydrogeologic Unit. This groundwater is designated as Class GA in accordance with North Carolina's water classification system and Class IIB under USEPA Groundwater Classification Guidelines (December 1986). The Class GA classifications means that the groundwater is an existing or potential source of drinking water supply for humans North Carolina Administrative Code, Title 15, Subchapter 2L (NCAC 15:02L). EPA classifies the groundwater as Class IIB since the aquifer is of drinking quality but is not currently being used as a source of drinking water. Therefore, the groundwater needs to be remediated to a level protective of public health and the environment as specified in Federal and State regulations governing the quality and use of drinking water. The primary source of groundwater in Haywood County is fractured bedrock.



The water table is typically coincident with topography although at greater depths beneath hills than beneath valleys. Depths to the water table in the region range from less than three feet below the surface to as much as 60 feet below the surface and seasonal fluctuations of the water table are generally on the order of 10 feet or less.

Site-specific hydrogeologic information was obtained during the RI. In general, the materials encountered in the on-site borings include, from the surface to the total depth drilled, fill material or native silty soils, alluvium, saprolite, and weathered bedrock. The orientation of two geologic cross sections are shown in Figure 13 with the actual geologic cross sections shown in Figures 14 and 15.

For the most part, the Site is covered with a veneer of fill material 6 inches to more than 3 feet in thickness. The fill material observed includes soils that were reportedly hauled to the Site and soils that were apparently disturbed or moved during the removal of debris from the site and regrading of the Site after the fire. The fill is described as orange-brown, clayey silt with broken brick, rock, glass and other debris.

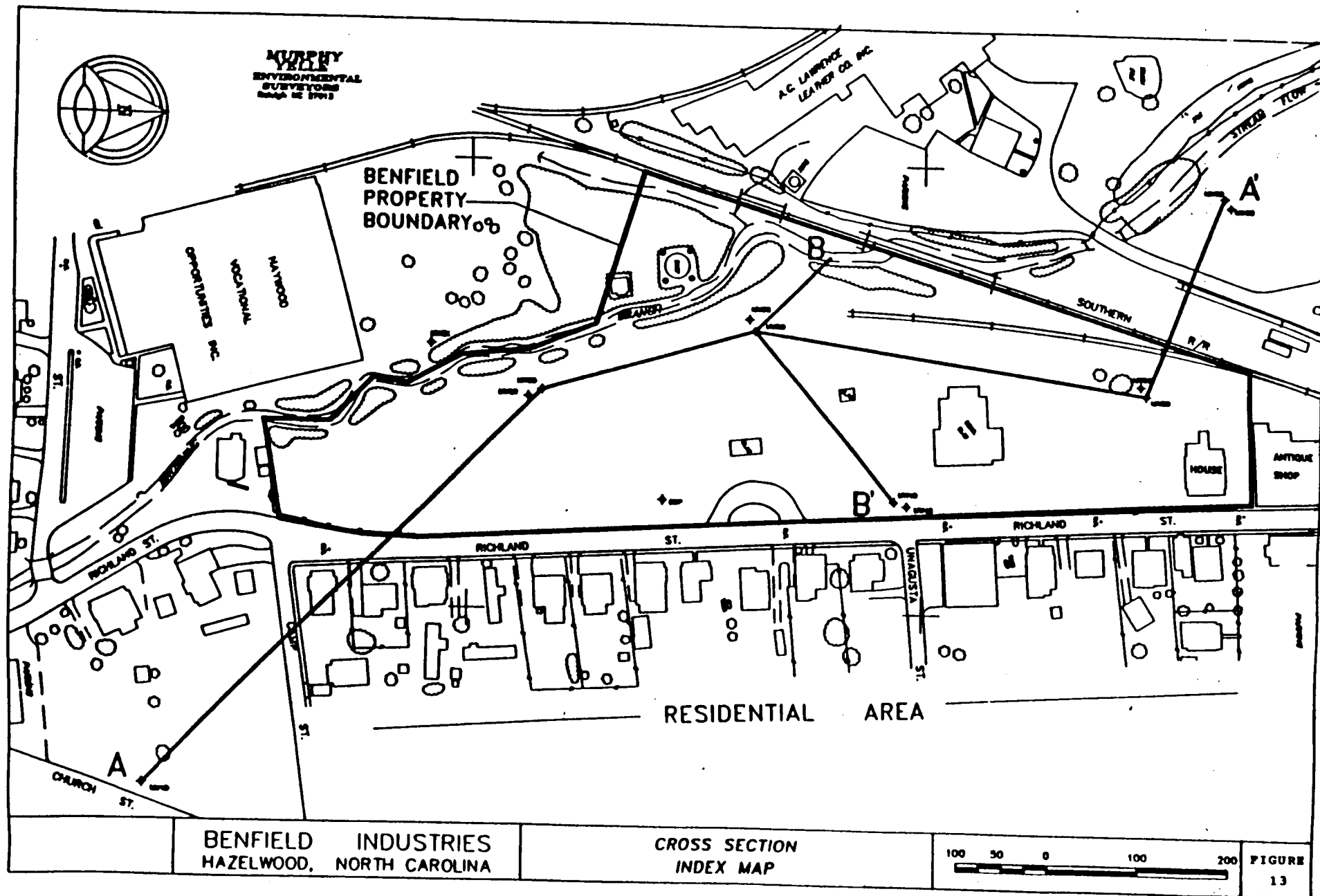
Beneath the fill, alluvial materials were encountered. The alluvium was encountered in each soil boring but was only completely penetrated in the monitoring well borings. Thickness of the alluvium ranged from 6½ to 9 feet. The alluvium is generally comprised of poorly sorted sand, gravel, cobbles, and rock fragments in a dark brown silty/clayey to sandy matrix. Cobbles observed in test pits excavated on site were 3 to 6 inches in diameter.

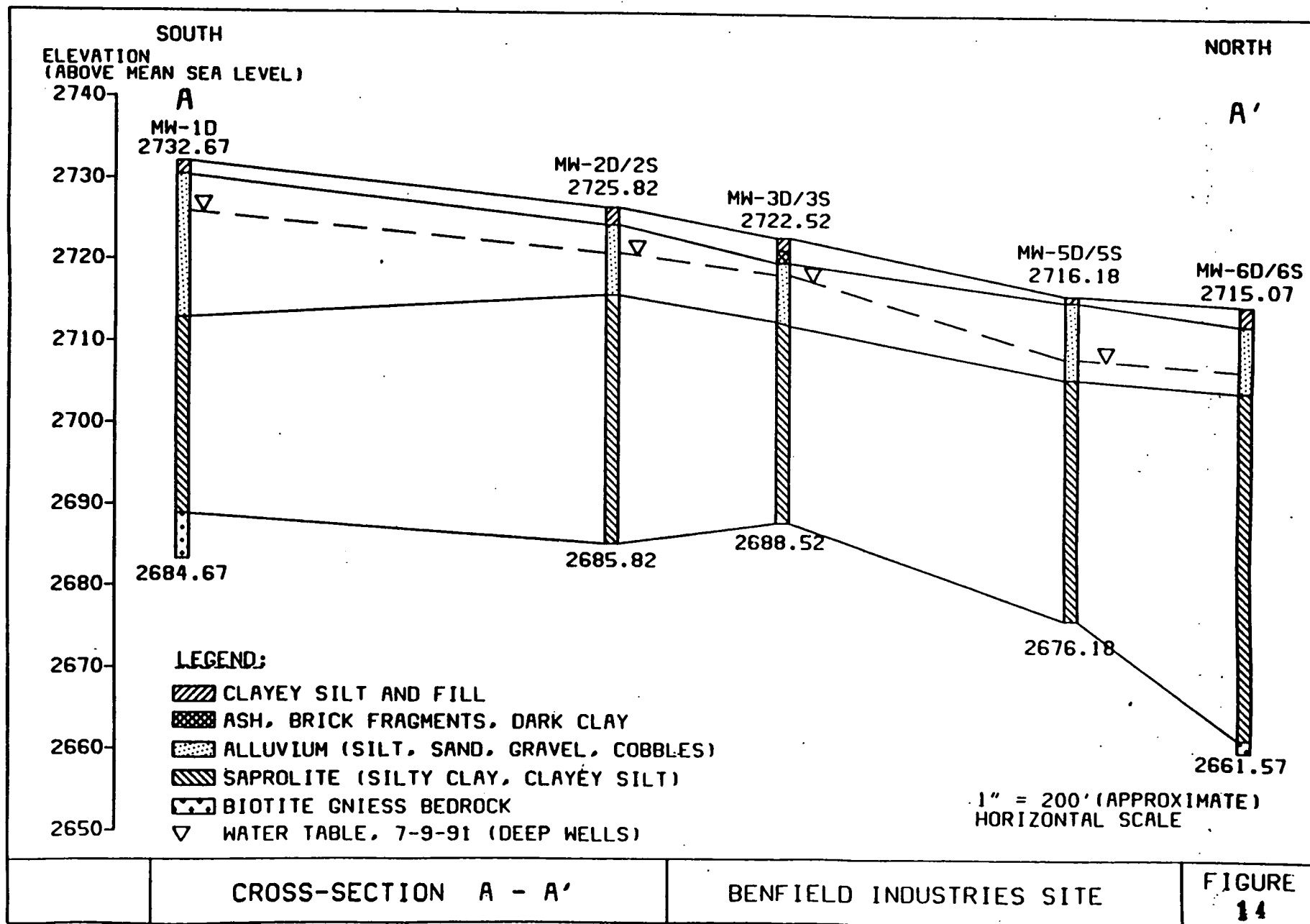
The alluvial materials overlie saprolite throughout the area. The thickness of the saprolite ranges from 25 feet to 42 feet. The saprolite is the product of highly weathered biotite gneiss bedrock. Clayey bands of quartz and feldspar alternating with biotite are characteristic. The saprolite varies from clayey to granular. Iron staining was observed throughout.

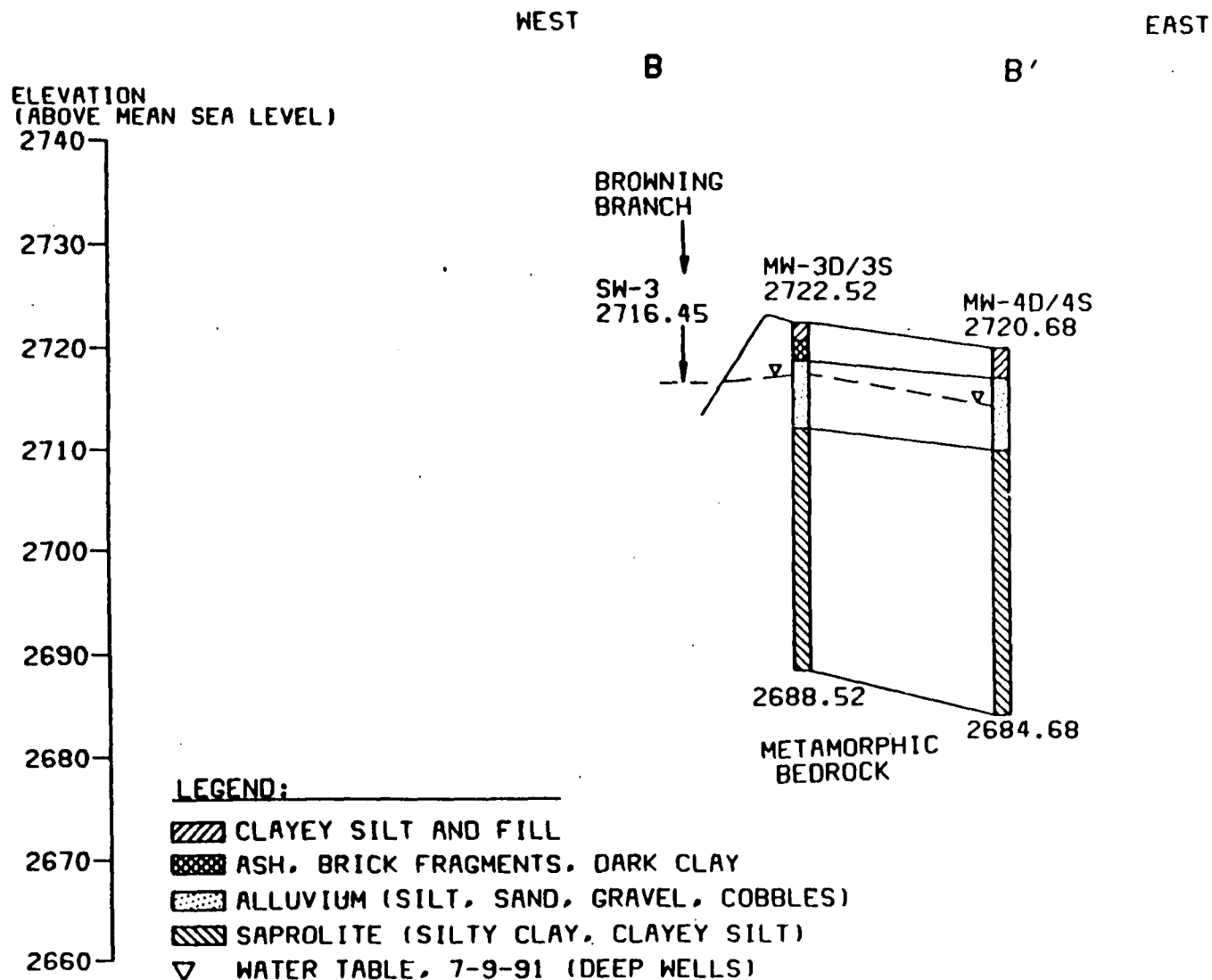
Lying below the saprolite is fractured metaphoric bedrock. This zone of the underlying aquifer was not study as part of the RI as it was not anticipated that contamination had reached this depth.

Groundwater flow in both the shallow portion of the aquifer (alluvium) and the deeper portion of the aquifer (saprolite) is to the north. Figures 16 and 17 show the groundwater contours and direction of groundwater flow. Groundwater flow parallels the direction of stream flow in Browning Branch and follow surface topography. Estimated hydraulic gradients for the shallow and deep wells are 0.017 and 0.015, respectively. The average hydraulic conductivity estimated from the shallow/alluvium wells is  $9.3 \times 10^{-3}$  centimeters/second (cm/sec) and  $6.8 \times 10^{-4}$  cm/sec in the deep/saprolite wells. This equates to horizontal velocities of 558 feet/year in the alluvium zone and 43 feet/year in the saprolite zone.

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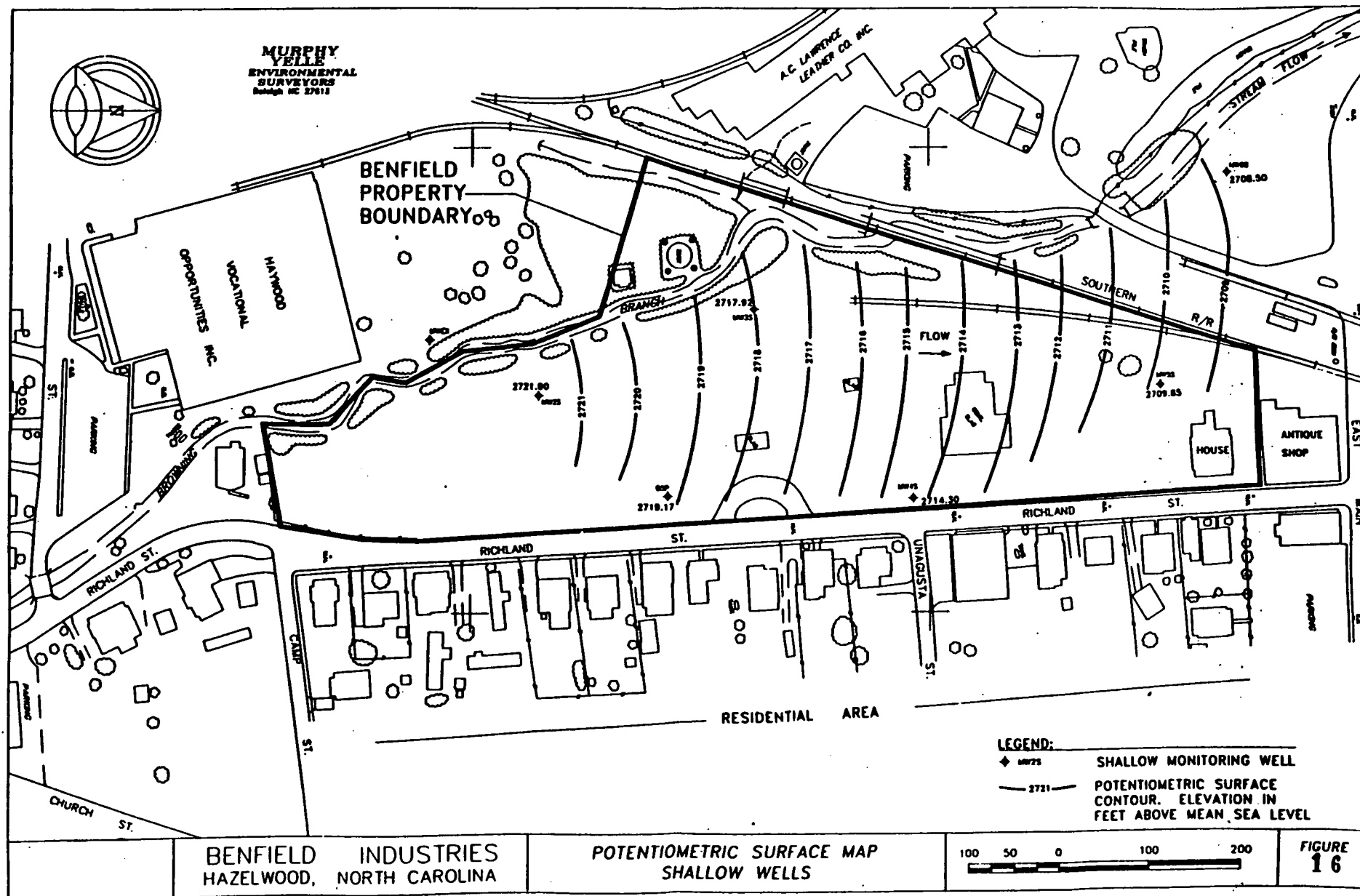


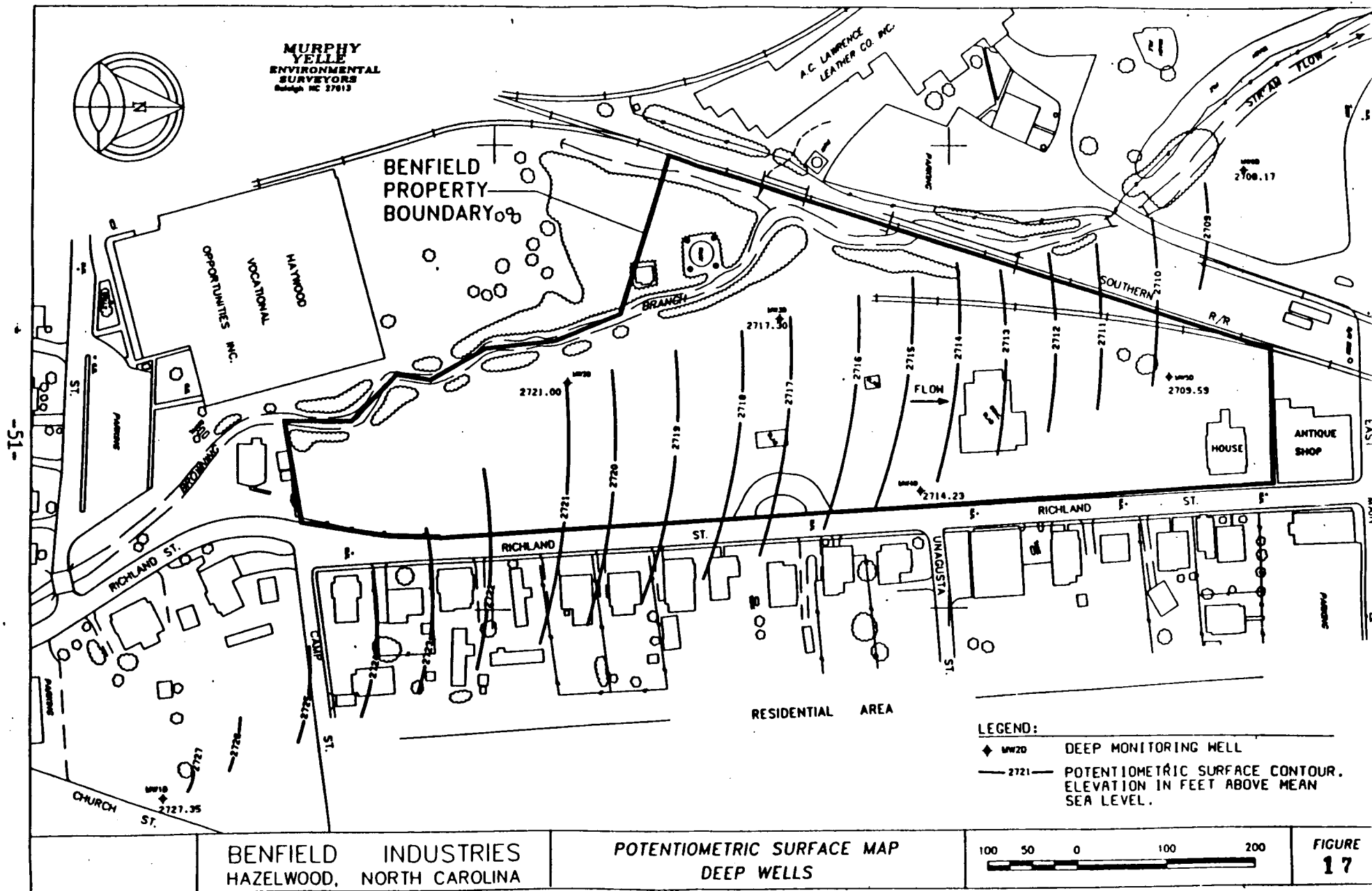
CROSS-SECTION B - B'

BENFIELD INDUSTRIES SITE

FIGURE  
15







## 7.5 PATHWAYS AND ROUTES OF EXPOSURE

The chemicals of potential concern include VOCs, SVOCs, and metals. An exposure pathway is the route or mechanism by which a chemical agent goes from a source to an individual or population. Each exposure pathway includes the following:

- A source and mechanism of chemical release to the environment
- A transport medium (e.g., soil or groundwater)
- An exposure point (where a receptor will contact the medium)
- An exposure route (i.e., ingestion, inhalation, or dermal contact).

A pathway is considered complete when all of the above elements are present.

The five transport mechanisms most likely to occur at the Benfield site are:

- 1) wind and mechanical erosion of contaminated surface soil,
- 2) volatilization from contaminated soil,
- 3) surface water runoff,
- 4) leaching of contaminants from the soil into the groundwater, and
- 5) migration with groundwater flow.

Based on the information collected during the RI, only the last two transport mechanisms are presently occurring.

Potential exposure pathways under current conditions are summarized in Table 14. This table presents potential routes of exposure, potential receptors, an evaluation of pathway completeness, and an assessment of exposure potential. As can be seen, there are no current complete exposure pathways that pose an unacceptable risk to human health or the environment.

The air pathway was qualitatively evaluated but not quantitatively evaluated as an exposure pathway for volatilized chemicals and particulate emissions from surface soils for the following reasons:

- 1) Much of the Site has been covered with 6 to 18 inches of fill material;
- 2) Only two VOCs were detected in surface soil; and
- 3) Each of the VOCs detected were at low concentrations (less than 0.2 parts per million or ppm).

In order for wind erosion to occur, the surface must be dry and exposed to the wind. Particulate emissions rates from nonhomogenous surfaces impregnated

**TABLE 1 4**  
**Summary of Exposure Pathways – Current Land Use**

Potentially Exposed Population	Exposure Route and Point	Medium	Pathway Quantitatively Evaluated	Reason for Selection or Exclusion
Residents (offsite)	Ingestion of, direct contact with, and inhalation of contaminants from downgradient wells.	Alluvial/Saprolite Aquifer	No	There is no documented current use of the surficial zones of the aquifer for potable water use.
	Ingestion of, direct contact with, and inhalation of contaminants from downgradient wells	Bedrock Aquifer	No	No data obtained from this depth in the aquifer during the RI.
	Direct contact with contaminants.	Surface Water	Yes	Potential exists for exposure to contaminated surface water.
	Incidental ingestion of and direct contact with contaminants.	Sediment	Yes	Potential exists for exposure to contaminated sediment.
	Inhalation of volatilized or particulate contaminants	Air	No	The site is covered by vegetation, much of the site has been covered with 6 to 18 inches of fill, and the surface of the site is not being disturbed.
Workers (offsite)	Ingestion of, direct contact with, and inhalation of contaminants from downgradient industrial wells	Alluvial/Saprolite Aquifer	No	No documented use of the surficial aquifer for industrial or potable use. However, if contaminants migrated to the underlying bedrock section of the aquifer, exposure would be similar to the offsite residents but with shorter durations and exposure frequencies.
	Direct contact with contaminants	Surface Water/ Sediment	No	Exposure would be similar to offsite residents but with shorter durations and exposure frequencies.
Trespassers (onsite)	Incidental ingestion of and direct contact with contaminants.	Surface Soil	Yes	Potential exists for exposure to contaminated soil.
	Direct contact with contaminants.	Surface Water/ Sediment	Yes	Potential exists for exposure to contaminated surface water and sediment.
	Inhalation of volatilized or particulate contaminants	Air	No	The site is covered by vegetation, much of the site has been covered with 6 to 18 inches of fill, and volatile organics were detected at only one surface soil sampling location at low concentrations.

with non-erodible elements (such as the surfaces present at the Site) tend to decay rapidly during wind erosion event. Wind speeds of about 22 miles per hour (mph) would be required to cause wind erosion from such surfaces, however, the average annual wind speed in the Hazelwood area is only 8 mph.

The future, potential exposure pathways are summarized in Table 15. This table presents potential routes of exposure, potential receptors, an evaluation of pathway completeness, and an assessment of exposure potential. Since the surrounding land use is a mixture of residential and commercial, it is possible that the Site may be used as a residential or commercial area in the future, therefore both scenarios are included in Table 15.

In summary, the following pathways were evaluated in the risk assessment:

- Current exposure of onsite trespassers to contaminants in surface soil through incidental ingestion and dermal contact, and in surface water and sediment through direct contact.
- Current exposure of offsite residents to contaminants in groundwater through ingestion, inhalation, and direct contact; to contaminants in sediment through incidental ingestion and direct contact; and to contaminants in surface water through direct contact.
- Future exposure of onsite residents in groundwater through ingestion, inhalation, and direct contact; to contaminants in soil (surface and shallow subsurface) through incidental ingestion and direct contact; and to contaminants in surface water and sediment through direct contact.
- Future exposure of potential onsite construction workers to contaminants in soil (surface and subsurface) through incidental ingestion and direct contact; and to contaminants in groundwater, surface water, and sediment through direct contact.

#### 8.0 SUMMARY OF SITE RISKS

CERCLA directs that the Agency must protect human health and the environment from current and future exposure to hazardous substances at Superfund sites. In order to assess the current and future risks from the Benfield Industries site, a baseline risk assessment was conducted as part of the RI. This section of the ROD summarizes the Agency's findings concerning the impact to human health and the environment if contaminated media (i.e., soils, groundwater) at the Site were not remediated. The baseline risk assessment for this Site is presented as a stand alone document in the Benfield Administrative Record.

**TABLE 1 5**  
**Summary of Exposure Pathways -- Future Land Use**

Potentially Exposed Population	Exposure Route and Point	Medium	Pathway Quantitatively Evaluated	Reason for Selection or Exclusion
Residents (onsite)	Ingestion of, direct contact with, and inhalation of contaminants.	Alluvial/Saprolite Aquifer	Yes	Potential exists for the site to be developed for residential use.
	Ingestion of, direct contact with, and inhalation of contaminants.	Bedrock Aquifer	No	No data obtained from this depth in the aquifer during the RI.
	Incidental ingestion and direct contact with contaminants.	Soil (surface and shallow subsurface)	Yes	Potential exists for the site to be developed for residential use.
	Direct contact with contaminants.	Surface Water/Sediment	Yes	Potential exists for the site to be developed for residential use.
	Inhalation of volatilized or particulate contaminants.	Air	No	The site is covered by vegetation, much of the site has been covered with 6 to 18 inches of fill, and volatile organics were detected at only one surface soil sampling location at low concentrations.
Residents (offsite)	Ingestion of, direct contact with, and inhalation of contaminants.	Alluvial/Saprolite Aquifer	Yes	Potential exists for future use of area groundwater.
	Direct contact with contaminants	Surface Water	No	Pathway was evaluated under current use (Table 3-1).
	Incidental ingestion of and direct contact with contaminants.	Sediment	No	Pathway was evaluated under current use (Table 3-1).
Workers (onsite)	Incidental ingestion of, direct contact with, and inhalation of contaminants.	All	No	Exposure would be the same as for onsite residents but with shorter exposure durations and frequencies. A qualitative evaluation will be discussed.
Construction Workers (onsite)	Direct Contact with contaminants.	Alluvial/Saprolite Aquifer Sediment	Yes	Potential exists for future development of the site and exposure to contaminated media.
	Incidental ingestion and dermal contact with contaminants.	Soil (surface, shallow and deep subsurface)	Yes	Potential exists for future development of the site and exposure to contaminated media.
	Inhalation of volatilized or particulate contaminants.	Air	No	Exposure would be dependent on a variety of possible work conditions (i.e., type of equipment used, job type, depth of work) and scenarios (i.e., weather conditions). Therefore, it is impossible to calculate a reasonable exposure.
Workers (offsite)	Incidental ingestion of, direct contact with, and inhalation of contaminants.	All	No	Exposure conditions the same as under current land use.
	Incidental ingestion of and direct contact with contaminants.	All	No	Exposure would be the same as under current land use.

### 8.1 CONTAMINANTS OF CONCERN

Table 16 provides a comprehensive list of the contaminants identified as chemicals of potential concern at the Site in their various media. The contaminants of concern consist of 15 purgeable organics, 34 extractable organics, 15 pesticides, and 16 inorganic chemicals.

Table 17 provides the reasonable maximum exposure concentrations which were used in calculating the carcinogenic and noncarcinogenic risks associated with each chemical of concern.

### 8.2 EXPOSURE ASSESSMENT

The objective of the exposure assessment is to estimate the type and magnitude of potential exposures to the chemicals of concern that are present at the Site. The results of the exposure assessment are combined with chemical-specific toxicity information to characterize potential risks.

The primary current human receptors at the Site are onsite trespassers and offsite residents (adults and children). The trespassers may currently be exposed to site-related contaminants in surface soil, surface water, and sediment. The offsite residents may currently be exposed to offsite sediments and surface water.

The primary future human receptors at the Site may be onsite residents (adult and children) and/or onsite construction workers. Potential future exposures would include surface soils, shallow sub-surface soils, sediments, and groundwater (shallow and deep). Although, all of the groundwater is not currently being used as a drinking water source, EPA and the State of North Carolina have classified the aquifer as a Class II-B aquifer. A resource which should be maintained at drinking water quality.

The current exposure pathways considered were dermal contact and incidental ingestion of surface soils and sediments and dermal contact with surface water. The future pathways considered were these mentioned above plus ingestion, dermal contact, and inhalation of contaminants from groundwater and ingestion and dermal contact with shallow sub-surface soils.

Tables 14 and 15 provide a summary of current and future exposure pathways, respectively. Tables 18 and 19 provides a summary of the exposure and intake assumptions which were used in the baseline risk assessment. Refer to Table 20 for the specific dermal permeability constant for each contaminant.

### 8.3 TOXICITY ASSESSMENT

The toxicity assessment was conducted to further determine the potential hazard posed by the chemicals of concern for which exposure pathways have been identified. Available evidence is weighed in regards to the potential

**TABLE 16**  
**Chemicals of Potential Concern – Benfield Industries**

Analyte (Contaminant of Concern)	Test Pits	Shallow Subsurface Soil (2'-3.5')	Deep Subsurface Soil (3.5'-5')	Surface Soil (0-2')	Groundwater	Surface Water	Sediment
<b>PURGEABLE ORGANICS</b>							
Vinyl Chloride					S,D		
1,2-Dichloropropane					D		
Chloroform					S,D		
Cis-1,2-Dichloroethene		X			S,D		
Benzene		X			S,D		
Toluene	X	X	X		S,D		
Tetrachloroethene		X	X	X			
Chlorobenzene					S,D		
Ethyl Benzene		X	X		S,D		
Total Xylenes		X	X	X	S,D		
Methyl Ethyl Ketone		X					
Methyl Isobutyl Ketone		X					
1,1,1-Trichloroethane					S,D		
Chloroethane					S,D		
1,1-Dichloroethane					S,D		
<b>EXTRACTABLE ORGANICS</b>							
Phenol					D		
1,3-Dichlorobenzene					S		
1,4-Dichlorobenzene					S,D		
1,2-Dichlorobenzene		X			S,D		
Naphthalene	X	X	X	X	S,D		
2-Methylnaphthalene	X	X	X	X	S,D		
Bis(2-ethylhexyl)phthalate		X	X				
Dibenzofuran		X	X	X	S,D		
Fluorene		X	X	X	S,D		
Fluoranthene	X	X	X	X	S,D		
Phenanthrene	X	X	X	X	S,D		X
Pyrene	X	X	X	X	S,D		X
Benzo(a)Pyrene	X	X	X	X	S		X
Benzo(b and/or k)Fluoranthene	X	X	X	X	S		X
Benzo(a)Anthracene		X	X	X	S,D		X
Chrysene	X	X	X	X	S		X
Indeno(1,2,3-c,d)Pyrene		X	X		S		X
Dibenzo(a,h)Anthracene		X	X		S		X
Anthracene		X	X	X	S,D		X
Acenaphthylene		X	X		S,D		X
Acenaphthene		X	X		S,D		
Benzo(g,h,i)Perylene	X	X	X		S		X
2-Chloronaphthalene					S		
2-Methylphenol					S		
(3-and/or 4)-Methylphenol		X	X		S		
2,4-Dichlorophenol		X					
Pentachlorophenol		X	X	X	S		
1,2,4-Trichlorobenzene		X	X		D		
Carbazole		X	X		S,D		
Diethyl Phthalate		X					
Di-N-Butylphthalate		X					
Benzyl Butyl Phthalate		X	X				
Di-N-Octylphthalate		X	X				
Hexachlorobenzene		X		X			
<b>PESTICIDES</b>							
Aldrin		X					
Beta-BHC		X					
Alpha-Chlordane		X	X	X			
Gamma-Chlordane		X	X	X			
4,4'-DDD				X			
4,4'-DOE		X	X				
4,4'-DDT		X	X	X			



**TABLE 16**  
**Chemicals of Potential Concern – Benfield Industries**

<b>Analyte (Contaminant of Concern)</b>	<b>Test Pits</b>	<b>Shallow Subsurface Soil (2'-3.5')</b>	<b>Deep Subsurface Soil (3.5'-5')</b>	<b>Surface Soil (0-2')</b>	<b>Groundwater</b>	<b>Surface Water</b>	<b>Sediment</b>
<b>PESTICIDES</b>							
Dieldrin			X	X			
Endrin		X	X				
Endrin Aldehyde			X				
Endosulfan I (Alpha)					S		
Endosulfan II (Beta)	X	X	X				
Endosulfan Sulfate			X				
Heptachlor		X	X				
Methoxychlor			X				
<b>INORGANICS</b>							
Aluminum				X	S,D		X
Antimony		X	X		S		
Arsenic		X	X				
Barium		X	X	X	S,D		X
Chromium (III)				X	S,D		X
Copper		X	X	X	S		X
Lead		X	X	X	S,D		X
Manganese				X	S,D	X	X
Mercury					S	X	
Nickel				X	S		X
Vanadium		X	X	X	S		X
Zinc		X	X	X	S		X
Beryllium			X		S		
Cobalt		X	X	X	S		X
Selenium		X	X				
Silver		X	X				

S = Shallow Groundwater

D = Deep Groundwater

**TABLE 17**  
**SUMMARY OF EXPOSURE POINT CONCENTRATIONS OF**  
**CHEMICALS OF POTENTIAL CONCERN**

<u>EXPOSED POPULATION</u>	<u>EXPOSURE MEDIUM</u>	<u>CHEMICAL</u>	<u>EXPOSURE POINT CONCENTRATION</u>		
			<u>WATER CONC. (mg/l)</u>	<u>DATA REFERENCE</u>	<u>SAMPLE DEPTH</u>
Future Onsite Adult and Child Residents	Onsite	Aluminum	4.3E+02	A	5'-12'
	Shallow	Antimony	8.3E-02	A	5'-12'
Future Construction Workers	Groundwater	Barium	8.1E+00	A	5'-12'
		Beryllium	1.5E-02	A	5'-12'
		Chromium	7.4E-01	A	5'-12'
		Cobalt	2.4E-01	A	5'-12'
		Copper	4.9E-01	A	5'-12'
		Lead	3.8E-01	A	5'-12'
		Manganese	1.8E+01	A	5'-12'
		Mercury	8.8E-04	A	5'-12'
		Nickel	3.8E-01	A	5'-12'
		Vanadium	1.1E+00	A	5'-12'
		Zinc	1.3E+00	A	5'-12'
		Vinyl Chloride	3.3E-02	A	5'-12'
		Chloroethane	2.0E-03	A	5'-12'
		1,1-Dichloroethane	6.0E-02	A	5'-12'
		1,2-Dichloroethane	2.9E-02	A	5'-12'
		Chloroform	1.0E-03	A	5'-12'
		1,1,1-Trichloroethane	2.2E-02	A	5'-12'
		Benzene	2.0E-02	A	5'-12'
		Toluene	8.3E-01	A	5'-12'
		Chlorobenzene	5.0E-02	A	5'-12'
		Ethyl Benzene	4.4E-01	A	5'-12'
		Total Xylenes	1.8E+00	A	5'-12'
		1,3-Dichlorobenzene	3.0E-03	A	5'-12'
		1,4-Dichlorobenzene	6.0E-03	A	5'-12'
		1,2-Dichlorobenzene	5.1E-02	A	5'-12'
		2-Methylphenol	1.3E-02	A	5'-12'
		(3-and/or 4-)Methylphenol	2.8E-02	A	5'-12'
		Naphthalene	2.5E+00	A	5'-12'
		2-Methylnaphthalene	1.0E+00	A	5'-12'
		2-Chloronaphthalene	4.0E-03	A	5'-12'
		Acenaphthylene	1.0E-01	A	5'-12'
		Acenaphthene	8.4E-01	A	5'-12'

\* - Exposure Point concentrations assumed to be identical for current and future exposures.

A - Max hits, lower than Confidence Limit (CL) or Quantitation Limit (QL).

B - CL, lower than max hits.

**TABLE 17**  
**SUMMARY OF EXPOSURE POINT CONCENTRATIONS OF**  
**CHEMICALS OF POTENTIAL CONCERN**

<u>EXPOSED POPULATION</u>	<u>EXPOSURE MEDIUM</u>	<u>CHEMICAL</u>	<u>EXPOSURE POINT CONCENTRATION</u>		
			<u>WATER CONC. (mg/l)</u>	<u>DATA REFERENCE</u>	<u>SAMPLE DEPTH</u>
Future Onsite	Onsite	Dibenzofuran	6.2E-01	A	5'-12'
Adult and	Shallow	Fluorene	5.8E-01	A	5'-12'
Child Residents	Groundwater	Pentachlorophenol	8.9E-02	A	5'-12'
Future Construction		Phenanthrene	1.1E+00	A	5'-12'
Workers		Anthracene	1.6E-01	A	5'-12'
		Carbazole	3.8E-01	A	5'-12'
		Fluoranthene	4.4E-01	A	5'-12'
		Pyrene	3.2E-01	A	5'-12'
		Benzo(A)Anthracene <sup>**</sup>	7.7E-03	A	5'-12'
		Chrysene <sup>**</sup>	5.8E-04	A	5'-12'
		Benzo(B and/or K) Fluoranthene <sup>**</sup>	6.3E-03	A	5'-12'
		Benzo(A)Pyrene <sup>**</sup>	3.1E-02	A	5'-12'
		Indeno(1,2,3-CD)pyrene <sup>**</sup>	1.2E-03	A	5'-12'
		Dibenzo(A,H)Anthracene <sup>**</sup>	3.0E-03	A	5'-12'
		Benzo(GHI)Perylene	8.0E-03	A	5'-12'
		Endosulfan 1 Alpha	3.0E-04	A	5'-12'

\* - Exposure Point concentrations assumed to be identical for current and future exposures.

\*\* - Carcinogenic PAH exposure point concentration adjusted by multiplying by its toxicity equivalency factor relative to benzo(a)pyrene.

A - Max hits, lower than Confidence Limit (CL) or Quantitation Limit (QL).

B - CL, lower than max hits.

**TABLE 17**  
**SUMMARY OF EXPOSURE POINT CONCENTRATIONS OF**  
**CHEMICALS OF POTENTIAL CONCERN**

<u>EXPOSED POPULATION</u>	<u>EXPOSURE MEDIUM</u>	<u>CHEMICAL</u>	<u>EXPOSURE POINT CONCENTRATION</u>		
			<u>WATER CONC. (mg/l)</u>	<u>DATA REFERENCE</u>	<u>SAMPLE DEPTH</u>
Future Onsite Adult and Child Residents	Onsite	Aluminum	7.2E+00	A	30'-60'
	Deep	Barium	1.6E-01	A	30'-60'
	Groundwater	Chromium	4.3E-02	A	30'-60'
		Lead	5.0E-03	A	30'-60'
		Manganese	1.4E-01	A	30'-60'
		Vinyl Chloride	5.3E-02	A	30'-60'
		Chloroethane	1.2E-02	B	30'-60'
		1,1-Dichloroethane	4.8E-02	A	30'-60'
		1,2-Dichloroethane	4.4E-02	A	30'-60'
		Chloroform	2.0E-03	A	30'-60'
		1,1,1-Trichloroethane	5.0E-03	A	30'-60'
		1,2-Dichloropropane	5.8E-03	B	30'-60'
		Benzene	1.1E-02	A	30'-60'
		Toluene	9.0E-03	A	30'-60'
		Chlorobenzene	1.0E-01	A	30'-60'
		Total Xylenes	6.5E-02	A	30'-60'
		Phenol	2.8E-02	A	30'-60'
		1,4-Dichlorobenzene	2.0E-03	A	30'-60'
		1,2-Dichlorobenzene	3.3E-02	A	30'-60'
		1,2,4-Trichlorobenzene	1.0E-02	A	30'-60'
		Naphthalene	1.3E-01	A	30'-60'
		2-Methylnaphthalene	1.1E-01	A	30'-60'
		Acenaphthylene	1.1E-02	B	30'-60'
		Acenaphthene	1.2E-01	A	30'-60'
		Dibenzofuran	9.8E-02	A	30'-60'
		Fluorene	7.9E-02	A	30'-60'
		Phenanthrene	1.5E-01	A	30'-60'
		Anthracene	1.3E-02	A	30'-60'
		Carbazole	4.8E-02	A	30'-60'
		Fluoranthene	2.7E-02	A	30'-60'
		Pyrene	1.3E-02	A	30'-60'
		Benzo(A)Anthracene**	1.0E-04	A	30'-60'

\* - Exposure Point concentrations assumed to be identical for current and future exposures.

\*\* - Carcinogenic PAH exposure point concentration adjusted by multiplying by its toxicity equivalency factor relative to benzo(a)pyrene.

A - Max hits, lower than Confidence Limit (CL) or Quantitation Limit (QL).

B - CL, lower than max hits.

**TABLE 17**  
**SUMMARY OF EXPOSURE POINT CONCENTRATIONS OF**  
**CHEMICALS OF POTENTIAL CONCERN**

<u>EXPOSED POPULATION</u>	<u>EXPOSURE MEDIUM</u>	<u>CHEMICAL</u>	<u>EXPOSURE POINT CONCENTRATION</u>		
			<u>WATER CONC. (mg/l)</u>	<u>DATA REFERENCE</u>	<u>SAMPLE DEPTH</u>
Future Offsite Adult and Child Residents	Offsite	Aluminum	2.2E+01	A	5'-12'
	Shallow	Barium	1.0E+00	A	5'-12'
	Groundwater	Chromium	7.5E-02	A	5'-12'
		Cobalt	5.1E-02	A	5'-12'
		Copper	5.5E-02	A	5'-12'
		Lead	4.8E-02	A	5'-12'
		Manganese	2.6E+00	A	5'-12'
		Vanadium	5.2E-02	A	5'-12'
		Zinc	1.9E-01	A	5'-12'
Future Offsite Adult and Child Residents	Offsite	Aluminum	7.3E+00	A	30'-60'
	Deep	Barium	3.6E-01	A	30'-60'
	Groundwater	Chromium	4.0E-02	A	30'-60'
		Lead	5.0E-03	A	30'-60'
		Manganese	2.0E-01	A	30'-60'
		Chloroform	1.0E-03	A	30'-60'
		Phenol	1.1E-02	A	30'-60'

\*- Exposure Point concentrations assumed to be identical for current and future exposures.

A - Max hits, lower than Confidence Limit (CL) or Quantitation Limit (QL).

B - CL, lower than max hits.

**TABLE 17**  
**SUMMARY OF EXPOSURE POINT CONCENTRATIONS OF**  
**CHEMICALS OF POTENTIAL CONCERN**

<u>EXPOSED POPULATION</u>	<u>EXPOSURE MEDIUM</u>	<u>CHEMICAL</u>	<u>EXPOSURE POINT CONCENTRATION</u>		
			<u>WATER CONC. (mg/l)</u>	<u>DATA REFERENCE</u>	<u>SAMPLE DEPTH</u>
Current Trespasser	Onsite	Manganese	2.3E-02	A	
Future Adult and Child Residents	Surface Water	Mercury	1.0E-04	C	
Future Construction Worker					
Current	Offsite	Manganese	5.0E-04	C	
Offsite Adult and Child Residents	Surface Water	Mercury	5.8E-04	A	

**TABLE 17**  
**SUMMARY OF EXPOSURE POINT CONCENTRATIONS OF**  
**CHEMICALS OF POTENTIAL CONCERN**

<u>EXPOSED</u> <u>POPULATION*</u>	<u>EXPOSURE</u> <u>MEDIUM</u>	<u>CHEMICAL</u>	<u>EXPOSURE POINT CONCENTRATION</u>		
			<u>SOIL</u> <u>CONC. (mg/kg)</u>	<u>DATA</u> <u>REFERENCE</u>	<u>SAMPLE</u> <u>DEPTH</u>
Current	Onsite	Aluminum	4.7E+04	B	0'-2'
Onsite Trespasser	Surface Soil	Barium	3.1E+02	A	0'-2'
Future		Chromium	8.3E+01	B	0'-2'
Adult and Child		Cobalt	2.8E+01	A	0'-2'
Residents		Copper	6.7E+01	B	0'-2'
Future Construction		Lead	3.2E+01	B	0'-2'
Worker		Manganese	8.6E+02	A	0'-2'
		Nickel	3.0E+01	B	0'-2'
		Vanadium	1.2E+02	B	0'-2'
		Zinc	1.5E+02	A	0'-2'
		Tetrachloroethene	5.0E-03	A	0'-2'
		Total Xylenes	1.8E-01	A	0'-2'
		Naphthalene	1.3E-01	A	0'-2'
		2-Methylnaphthalene	1.2E-01	A	0'-2'
		Dibenzofuran	1.6E-01	A	0'-2'
		Fluorene	1.4E-01	A	0'-2'
		Hexachlorobenzene	1.6E-01	A	0'-2'
		Pentachlorophenol	3.1E+00	A	0'-2'
		Phenanthrene	4.6E-01	A	0'-2'
		Anthracene	1.2E-01	A	0'-2'
		Fluoranthene	1.4E+00	A	0'-2'
		Pyrene	8.5E-01	A	0'-2'
		Benzo(A)anthracene**	2.9E-02	B	0'-2'
		Chrysene**	4.7E-03	A	0'-2'
		Benzo(B and/or K)Fluoranthene**	1.1E-01	A	0'-2'
		Benzo(A)pyrene**	3.9E-01	A	0'-2'
		Dieldrin	3.2E-03	A	0'-2'
		4,4'-DDD (P,P'-DDD)	3.3E-03	A	0'-2'
		4,4'-DDT (P,P'-DDT)	3.9E-03	A	0'-2'
		Gamma-Chlordane	5.5E-02	A	0'-2'
		Alpha-Chlordane	2.0E-02	A	0'-2'

\* - Exposure Point concentrations assumed to be identical for current and future exposures.

\*\* - Carcinogenic PAH exposure point concentration adjusted by multiplying by its toxicity equivalency factor relative to benzo(a)pyrene.

A - Max hits, lower than Confidence Limit (CL) or Quantitation Limit (QL).

B - CL, lower than max hits.

**TABLE 17**  
**SUMMARY OF EXPOSURE POINT CONCENTRATIONS OF**  
**CHEMICALS OF POTENTIAL CONCERN**

<u>EXPOSED</u> <u>POPULATION*</u>	<u>EXPOSURE</u> <u>MEDIUM</u>	<u>CHEMICAL</u>	<u>EXPOSURE POINT CONCENTRATION</u>		
			<u>SOIL</u> <u>CONC. (mg/kg)</u>	<u>DATA</u> <u>REFERENCE</u>	<u>SAMPLE</u> <u>DEPTH</u>
Current Onsite	Onsite	Aluminum	1.2E+04	A	Upper 6'
Trespasser	Sediment	Barium	1.1E+02	A	Upper 6'
Future Onsite		Chromium	2.9E+01	A	Upper 6'
Adult and Child		Cobalt	8.6E+00	A	Upper 6'
Resident		Copper	1.4E+01	A	Upper 6'
Future		Lead	9.2E+00	A	Upper 6'
Construction		Manganese	2.5E+02	B	Upper 6'
Worker		Nickel	1.1E+01	A	Upper 6'
		Vanadium	3.6E+01	A	Upper 6'
		Zinc	6.8E+01	A	Upper 6'
		Acenaphthylene	2.2E-01	C	Upper 6'
		Phenanthrene	2.2E-01	C	Upper 6'
		Anthracene	2.2E-01	C	Upper 6'
		Fluoranthene	2.2E-01	C	Upper 6'
		Pyrene	2.2E-01	C	Upper 6'
		Benzo(A)anthracene**	2.2E-02	C	Upper 6'
		Chrysene**	2.2E-03	C	Upper 6'
		Benzo(B and/or K)Fluoranthene**	2.2E-02	C	Upper 6'
		Benzo(A)pyrene**	2.2E-01	C	Upper 6'
		Indeno(1,2,3-CD)pyrene**	2.2E-02	C	Upper 6'
		Dibenzo(A,H)anthracene**	2.2E-01	C	Upper 6'
		Benzo(G,H,I)Perylene	2.2E-01	C	Upper 6'

\* - Exposure Point concentrations assumed to be identical for current and future exposures.

\*\* - Carcinogenic PAH exposure point concentration adjusted by multiplying by its toxicity equivalency factor relative to benzo(a)pyrene.

A - Max hits, lower than Confidence Limit (CL) or Quantitation Limit (QL).

C - QL, lower than CL with no detects.



**TABLE 1.7**  
**SUMMARY OF EXPOSURE POINT CONCENTRATIONS OF**  
**CHEMICALS OF POTENTIAL CONCERN**

<u>EXPOSED</u> <u>POPULATION*</u>	<u>EXPOSURE</u> <u>MEDIUM</u>	<u>CHEMICAL</u>	<u>EXPOSURE POINT CONCENTRATION</u>		
			<u>SOIL</u> <u>CONC. (mg/kg)</u>	<u>DATA</u> <u>REFERENCE</u>	<u>SAMPLE</u> <u>DEPTH</u>
Adult and Child Offsite Residents	Offsite	Aluminum	4.5E+04	A	Upper 6"
	Sediment	Barium	3.6E+02	A	Upper 6"
	SDS	Chromium	6.5E+01	A	Upper 6"
		Cobalt	2.4E+01	A	Upper 6"
		Copper	4.3E+01	A	Upper 6"
		Lead	5.6E+01	A	Upper 6"
		Manganese	7.8E+02	A	Upper 6"
		Nickel	3.3E+01	A	Upper 6"
		Vanadium	9.1E+01	A	Upper 6"
		Zinc	1.7E+02	A	Upper 6"
		Acenaphthylene	2.3E-01	A	Upper 6"
		Phenanthrene	5.9E-01	A	Upper 6"
		Anthracene	3.8E-01	A	Upper 6"
		Fluoranthene	2.0E+00	A	Upper 6"
		Pyrene	1.7E+00	A	Upper 6"
		Benzo(A)anthracene <sup>**</sup>	1.2E-01	A	Upper 6"
		Chrysene <sup>**</sup>	1.8E-02	A	Upper 6"
		Benzo(B and/or K) Fluoranthene <sup>**</sup>	3.3E-01	A	Upper 6"
		Benzo(A)pyrene <sup>**</sup>	1.3E+00	A	Upper 6"
		Indeno(1,2,3-CD)pyrene <sup>**</sup>	7.5E-02	A	Upper 6"
		Dibenzo(A,H)anthracene <sup>**</sup>	1.9E-01	A	Upper 6"
		Benzo(G,H,I)Perylene	6.2E-01	A	Upper 6"

\* - Exposure Point concentrations assumed to be identical for current and future exposures.

\*\* - Carcinogenic PAH exposure point concentration adjusted by multiplying by its toxicity equivalency factor relative to benzo(a)pyrene.

A - Max hits, lower than Confidence Limit (CL) or Quantitation Limit (QL).

B - CL, lower than max hits.

**TABLE 17**  
**SUMMARY OF EXPOSURE POINT CONCENTRATIONS OF**  
**CHEMICALS OF POTENTIAL CONCERN**

<u>EXPOSED</u> <u>POPULATION*</u>	<u>EXPOSURE</u> <u>MEDIUM</u>	<u>CHEMICAL</u>	<u>EXPOSURE POINT CONCENTRATION</u>		
			<u>SOIL</u> <u>CONC. (mg/kg)</u>	<u>DATA</u> <u>REFERENCE</u>	<u>SAMPLE</u> <u>DEPTH</u>
Adult and Child Offsite Residents	Offsite	Aluminum	4.4E+03	C	Upper 6'
	Sediment	Barium	2.7E+02	A	Upper 6'
	SD4	Chromium	3.1E+01	A	Upper 6'
		Cobalt	5.6E+00	A	Upper 6'
		Copper	7.7E+01	A	Upper 6'
		Lead	5.2E+00	A	Upper 6'
		Manganese	2.1E+02	A	Upper 6'
		Nickel	1.5E+01	A	Upper 6'
		Vanadium	2.8E+01	A	Upper 6'
		Zinc	1.2E+02	A	Upper 6'
		Acenaphthylene	2.0E-01	C	Upper 6'
		Phenanthrene	2.0E-01	C	Upper 6'
		Anthracene	2.0E-01	C	Upper 6'
		Fluoranthene	2.0E-01	C	Upper 6'
		Pyrene	2.0E-01	C	Upper 6'
		Benzo(A)anthracene**	2.0E-02	C	Upper 6'
		Chrysene**	2.0E-03	C	Upper 6'
		Benzo(B and/or K)Fluoranthene**	2.0E-02	C	Upper 6'
		Benzo(A)pyrene**	2.0E-01	C	Upper 6'
		Indeno(1,2,3-CD)pyrene**	2.0E-02	C	Upper 6'
		Dibenzo(A,H)anthracene**	2.0E-01	C	Upper 6'
		Benzo(G,H,I)Perylene	2.0E-01	C	Upper 6'

\* - Exposure Point concentrations assumed to be identical for current and future exposures.

\*\* - Carcinogenic PAH exposure point concentration adjusted by multiplying by its toxicity equivalency factor relative to benzo(a)pyrene.

A - Max hits, lower than Confidence Limit (CL) or Quantitation Limit (QL).

B - CL, lower than max hits.

**TABLE 17**  
**SUMMARY OF EXPOSURE POINT CONCENTRATIONS OF**  
**CHEMICALS OF POTENTIAL CONCERN**

<u>EXPOSED</u> <u>POPULATION*</u>	<u>EXPOSURE</u> <u>MEDIUM</u>	<u>CHEMICAL</u>	<u>EXPOSURE POINT CONCENTRATION</u>		
			<u>SOIL</u> <u>CONC. (mg/kg)</u>	<u>DATA</u> <u>REFERENCE</u>	<u>SAMPLE</u> <u>DEPTH</u>
Future Onsite	Onsite	Antimony	3.2E+00	B	2'-3.5
Adult and Child	Shallow	Arsenic	4.3E+00	B	2'-3.5
Residents	Subsurface Soil	Barium	4.0E+02	B	2'-3.5
Future		Cobalt	1.4E+01	B	2'-3.5
Construction		Copper	4.6E+01	B	2'-3.5
Workers		Lead	1.2E+02	B	2'-3.5
		Selenium	2.1E+00	B	2'-3.5
		Silver	2.9E+01	A	2'-3.5
		Vanadium	5.6E+01	B	2'-3.5
		Zinc	1.9E+02	B	2'-3.5
		1,2-Dichloroethene	6.0E-03	A	2'-3.5
		Methyl Ethyl Ketone	1.3E-02	A	2'-3.5
		Benzene	3.0E-03	A	2'-3.5
		Methyl Isobutyl Ketone	2.2E-02	A	2'-3.5
		Tetrachloroethene	1.2E-01	A	2'-3.5
		Toluene	2.5E-01	B	2'-3.5
		Ethyl Benzene	2.4E-01	B	2'-3.5
		Total Xylenes	4.2E+00	B	2'-3.5
		1,2-Dichlorobenzene	2.8E-01	A	2'-3.5
		(3-and/or 4-)Methylphenol	1.0E+00	A	2'-3.5
		2,4-Dichlorophenol	3.4E-01	A	2'-3.5
		1,2,4-Trichlorobenzene	3.9E-01	A	2'-3.5
		Naphthalene	5.2E+01	B	2'-3.5
		2-Methylnaphthalene	1.6E+01	B	2'-3.5
		Acenaphthylene	2.3E+00	B	2'-3.5
		Acenaphthene	2.3E+01	B	2'-3.5
		Dibenzofuran	1.8E+01	B	2'-3.5
		Diethyl Phthalate	7.2E-02	A	2'-3.5
		Fluorene	9.8E+00	B	2'-3.5
		Hexachlorobenzene	8.0E-02	A	2'-3.5
		Pentachlorophenol	1.9E+01	A	2'-3.5
		Phenanthrene	1.6E+02	A	2'-3.5
		Anthracene	8.1E+00	B	2'-3.5
		Carbazole	6.3E+00	B	2'-3.5

\* - Exposure Point concentrations assumed to be identical for current and future exposures.

A - Max hits, lower than Confidence Limit (CL) or Quantitation Limit (QL).

B - CL, lower than max hits.

**TABLE 17**  
**SUMMARY OF EXPOSURE POINT CONCENTRATIONS OF**  
**CHEMICALS OF POTENTIAL CONCERN**

<u>EXPOSED</u> <u>POPULATION*</u>	<u>EXPOSURE</u> <u>MEDIUM</u>	<u>CHEMICAL</u>	<u>EXPOSURE POINT CONCENTRATION</u>		
			<u>SOIL</u> <u>CONC. (mg/kg)</u>	<u>DATA</u> <u>REFERENCE</u>	<u>SAMPLE</u> <u>DEPTH</u>
Future Onsite	Onsite	Di-N-Butylphthalate	1.0E+00	B	2'-3.5
Adult and Child	Shallow	Fluoranthene	9.9E+01	B	2'-3.5
Residents	Subsurface Soil	Pyrene	6.3E+01	B	2'-3.5
Future		Benzyl Butyl Phthalate	1.4E-01	A	2'-3.5
Construction		Benzo(A)Anthracene**	8.9E-01	B	2'-3.5
Workers		Chrysene**	8.4E-02	B	2'-3.5
		Bis(2-Ethylhexyl) Phthalate	3.9E+00	B	2'-3.5
		Di-N-Octylphthalate	4.2E-01	A	2'-3.5
		Benzo(B and/or K) Fluoranthene**	1.8E+00	B	2'-3.5
		Benzo(A)pyrene**	1.4E+00	A	2'-3.5
		Indeno(1,2,3-CD)pyrene**	1.1E-01	B	2'-3.5
		Dibenzo(A,H)anthracene**	6.8E-01	A	2'-3.5
		Benzo(G,H,I)Perylene	1.1E+00	B	2'-3.5
		Beta-BHC	1.0E-03	B	2'-3.5
		Heptachlor	2.2E-03	B	2'-3.5
		Aldrin	1.3E-03	B	2'-3.5
		4,4'-DDE (P,P'-DDE)	4.5E-03	B	2'-3.5
		Endrin	4.9E-03	B	2'-3.5
		Endosulfan II (Beta)	4.0E-04	A	2'-3.5
		4,4'-DDT (P,P'-DDT)	3.9E-03	B	2'-3.5
		Gamma-Chlordane	1.8E-02	A	2'-3.5
		Alpha-Chlordane	1.6E-02	A	2'-3.5

\* - Exposure Point concentrations assumed to be identical for current and future exposures.

\*\* - Carcinogenic PAH exposure point concentration adjusted by multiplying by its toxicity equivalency factor relative to benzo(a)pyrene.

A - Max hits, lower than Confidence Limit (CL) or Quantitation Limit (QL).

B - CL, lower than max hits.

**TABLE 17**  
**SUMMARY OF EXPOSURE POINT CONCENTRATIONS OF**  
**CHEMICALS OF POTENTIAL CONCERN**

<u>EXPOSED POPULATION*</u>	<u>EXPOSURE MEDIUM</u>	<u>CHEMICAL</u>	<u>EXPOSURE POINT CONCENTRATION</u>		
			<u>SOIL CONC. (mg/kg)</u>	<u>DATA REFERENCE</u>	<u>SAMPLE DEPTH</u>
Future Onsite Adult and Child Residents Future Construction Workers	Onsite	Antimony	2.9E+00	B	3.5'-5'
	Deep	Arsenic	2.3E+00	B	3.5'-5'
	Subsurface Soil	Barium	2.7E+02	B	3.5'-5'
		Beryllium	7.3E-01	B	3.5'-5'
		Cobalt	1.6E+01	B	3.5'-5'
		Copper	3.3E+01	B	3.5'-5'
		Lead	5.0E+01	B	3.5'-5'
		Selenium	1.9E+00	B	3.5'-5'
		Silver	4.6E+00	B	3.5'-5'
		Vanadium	6.7E+01	B	3.5'-5'
		Zinc	1.4E+02	B	3.5'-5'
		Tetrachloroethene	2.0E-03	A	3.5'-5'
		Toluene	9.6E-02	B	3.5'-5'
		Ethyl Benzene	1.1E-01	B	3.5'-5'
		Total Xylenes	4.6E-01	B	3.5'-5'
		(3-and/or 4-)Methylphenol	5.1E-01	A	3.5'-5'
		1,2,4-Trichlorobenzene	2.8E-01	A	3.5'-5'
		Naphthalene	5.3E+00	B	3.5'-5'
		2-Methylnaphthalene	4.6E+00	B	3.5'-5'
		Acenaphthylene	4.3E+00	B	3.5'-5'
		Acenaphthene	4.3E+00	B	3.5'-5'
		Dibenzofuran	3.7E+00	B	3.5'-5'
		Fluorene	5.3E+00	B	3.5'-5'
		Pentachlorophenol	2.3E-01	A	3.5'-5'
		Phenanthrene	4.5E+01	B	3.5'-5'
		Anthracene	2.3E+00	B	3.5'-5'
		Carbazole	1.5E+00	B	3.5'-5'
		Fluoranthene	3.1E+01	B	3.5'-5'
		Pyrene	8.6E+00	B	3.5'-5'
		Benzyl Butyl Phthalate	1.9E+00	B	3.5'-5'
		Benzo(A)Anthracene**	1.8E-01	B	3.5'-5'
		Chrysene**	2.5E-02	B	3.5'-5'

\* - Exposure Point concentrations assumed to be identical for current and future exposures.

\*\* - Carcinogenic PAH exposure point concentration adjusted by multiplying by its toxicity equivalency factor relative to benzo(a)pyrene.

A - Max hits, lower than Confidence Limit (CL) or Quantitation Limit (QL).

B - CL, lower than max hits.

**TABLE 17**  
**SUMMARY OF EXPOSURE POINT CONCENTRATIONS OF**  
**CHEMICALS OF POTENTIAL CONCERN**

<u>EXPOSED POPULATION*</u>	<u>EXPOSURE MEDIUM</u>	<u>CHEMICAL</u>	<u>EXPOSURE POINT CONCENTRATION</u>		
			<u>SOIL CONC. (mg/kg)</u>	<u>DATA REFERENCE</u>	<u>SAMPLE DEPTH</u>
Future Onsite	Onsite	Bis(2-Ethylhexyl) Phthalate	5.9E+00	B	3.5'-6'
Adult and Child	Deep	Di-N-Octylphthalate	3.5E-01	A	3.5'-6'
Residents	Subsurface Soil	Benzo(B and/or K)fluoranthene**	3.8E-01	B	3.5'-6'
Future		Benzo(A) Pyrene**	2.0E+00	B	3.5'-6'
Construction		Indeno(1,2,3-CD)pyrene**	1.8E-01	B	3.5'-6'
Workers		Dibenzo(A,H)Anthracene**	4.9E-01	A	3.5'-6'
		Benzo(GHI)Perylene	1.0E+00	A	3.5'-6'
		Heptachlor	9.0E-04	A	3.5'-6'
		Dieldrin	3.1E-03	A	3.5'-6'
		4,4'-DDE (P,P'-DDE)	3.4E-03	B	3.5'-6'
		Endrin	1.9E-03	A	3.5'-6'
		Endosulfan II (Beta)	2.7E-03	A	3.5'-6'
		Endosulfan Sulfate	4.5E-03	A	3.5'-6'
		4,4'-DDT (P,P'-DDT)	5.8E-03	B	3.5'-6'
		Methoxychlor	1.7E-02	B	3.5'-6'
		Endrin Aldehyde	2.5E-03	B	3.5'-6'
		Gamma-Chlordane	1.1E-02	A	3.5'-6'
		Alpha-Chlordane	7.3E-03	B	3.5'-6'

\* - Exposure Point concentrations assumed to be identical for current and future exposures.

\*\* - Carcinogenic PAH exposure point concentration adjusted by multiplying by its toxicity equivalency factor relative to benzo(a)pyrene

A - Max hits, lower than Confidence Limit (CL) or Quantitation Limit (QL).

B - CL, lower than max hits.

**Table 18**  
**Current Exposure Assumptions for**  
**Soil, Sediment, and Surface Water**

	Ingestion and/or Dermal Exposure		
	Trespasser On-Site	Adult Resident Off-Site	Child Resident Off-Site
IR	100	100	200
FI	100%	100%	100%
EF	52	52	52
ED	6	24	6
BW	35	70	16
AT	2190 chronic 25,550 lifetime	4380 chronic 25,550 lifetime	2190 chronic 25,550 lifetime
SA	7000	4985	3160
AF	0.2	0.2	0.2
AB	1% organics 0.1% inorganics	1% organics 0.1% inorganics	1% organics 0.1% inorganics
SA <sub>sw</sub>	4020	4985	6150
PC	See Table 20	See Table 20	See Table 20
ET <sub>sw</sub>	1	1	1

IR = Ingestion Rate (mg soil/day)  
 FI = Fraction Ingested from Contaminated Source (unitless)  
 EF = Exposure Frequency (days/years)  
 ED = Exposure Duration (years)  
 BW = Body Weight (kg)  
 AT = Averaging Time (period over which exposure is averaged - days)  
 SA = Surface Area Exposed (cm<sup>2</sup>)  
 AF = Soil Adherence Factor (mg/cm<sup>2</sup>)  
 AB = Absorption Factor (unitless)  
 SA<sub>sw</sub> = Surface Area Exposed to Surface Water (cm<sup>2</sup>)  
 PC = Chemical Specific Dermal Permeability Constant (cm/hr)  
 ET<sub>sw</sub> = Exposure Time to Surface Water (hours/day)

Table 19  
Future Exposure Assumptions to Soil

	Ingestion & Dermal Exposure		
	Adult Resident On-Site	Child Resident On-Site	Construction Worker On-Site
IR	100	200	480
FI	100%	100%	100%
EF	350	350	260
ED	24	6	1
BW	70	16	70
AT	4380 chronic 25,550 lifetime	2190 chronic 25,550 lifetime	365 chronic 25,550 lifetime
SA	4985	3160	4985
AF	0.2	0.2	0.2
AB	1% organics 0.1% inorganics	1% organics 0.1% inorganics	1% organics 0.1% inorganics

IR = Ingestion Rate (mg soil/day)  
 EF = Exposure Frequency (days/years)  
 ED = Exposure Duration (years)  
 BW = Body Weight (kg)  
 AT = Averaging Time (period over which exposure is averaged - days)  
 SA = Surface Area Exposed (cm<sup>2</sup>)  
 PC = Chemical specific dermal permeability constant (cm/hr)  
 ET = Exposure time (hours/day)

- Future exposure assumptions for sediments are the same as current off-site residents.



Table 19  
Future Exposure Assumption to Groundwater

	Ingestion, Dermal, & Inhalation Exposures		
	Adult Resident On-Site & Off-Site	Child Resident On-site & Off-Site	Construction Worker
IR	2	1.4	NA
EF	350	350	260
ED	24	6	1
BW	70	16	70
AT	4380 chronic 25,550 lifetime	2190 chronic 25,550 lifetime	365 chronic 25,550 lifetime
SA	18,150	7195	4985
PC	See Table 20	See Table 20	See Table 20
ET	0.2	0.2	8
IR air	0.6	0.6	NA

IR = Ingestion Rate (l/day)  
 FI = Fraction Ingested from Contaminated Source (unitless)  
 EF = Exposure Frequency (days/years)  
 ED = Exposure Duration (years)  
 BW = Body Weight (kg)  
 AT = Averaging Time (period over which exposure is averaged - days)  
 SA = Surface Area Exposed (cm<sup>2</sup>)  
 PC = Chemical Specific Permeability (cm/hr)  
 ET = Exposure Time (hour/day)  
 IR air = Inhalation rate (m<sup>3</sup>/hour)  
 NA = Not Applicable

**TABLE 2 0**  
**Summary of Dermal Permeability Constants (PC)**  
**For Chemicals of Potential Concern<sup>1</sup>**

Chemical	Permeability Constants (cm/hr)
<u>ORGANICS</u>	
2-Methylnaphthalene	1.5E-3(A)
Naphthalene	1.5E-3(A)
Acenaphthene	1.5E-3(A)
Dibenzofuran	1.5E-3(A)
Fluorene	1.5E-3(A)
Phenanthrene	1.5E-3(A)
Anthracene	1.5E-3(A)
Fluoranthene	1.5E-3(A)
Pyrene	1.5E-3(A)
Benzo(b and/or k)Fluoranthene	1.5E-3(A)
Benzo(a)Anthracene	1.5E-3(A)
Dibenzo(a,h)Anthracene	1.5E-3(A)
Chrysene	1.5E-3(A)
2-Chloronaphthalene	1.5E-3(A)
Benzo(g,h,i)Perylene	1.5E-3(A)
Indeno(1, 2, 3-c,d)Pyrene	1.5E-3(A)
2-Methylphenol	1.5E-3(A)
(3-and/or 4-)Methylphenol	1.5E-3(A)
Phenol	8.2E-3
Pentachlorophenol	1.5E-3(A)
1, 2, 4-Trichlorobenzene	1.5E-3(A)
Carbazole	1.5E-3(A)
Benzene	1.5E-3(A)
1,2-Dichloroethene(Total)	1.5E-3(A)
Ethyl Benzene	1.5E-3(A)
1,4-Dichlorobenzene	1.5E-3(A)
1,2-Dichlorobenzene	1.5E-3(A)
1,3-Dichlorobenzene	1.5E-3(A)
Chlorobenzene	1.5E-3(A)
Diethyl Phthalate	1.5E-3(A)
Toluene	1.0E+0
1,1-Dichloroethane	1.5E-3(A)
Vinyl Chloride	1.5E-3(A)
Chloroethane	1.5E-3(A)
Benzo(a)Pyrene	1.5E-3(A)
1,2-Dichloropropane	1.5E-3(A)
Chloroform	1.5E-3(A)
1,1,1-Trichloroethane	1.5E-3(A)
Total Xylenes	1.5E-3(A)
Acenaphthylene	1.5E-3(A)
<u>INORGANICS</u>	
Aluminum	1.5E-3(A)
Antimony	1.5E-3(A)
Barium	1.5E-3(A)
Beryllium	1.5E-3(A)
Chromium	1.5E-3(A)
Cobalt	1.5E-3(A)
Copper	1.5E-3(A)
Lead	1.5E-3(A)
Manganese	1.5E-3(A)
Mercury	1.5E-3(A)
Nickel	1.5E-3(A)
Vanadium	1.5E-3(A)
Zinc	1.5E-3(A)

<sup>1</sup> PC values represent EPA Interim values (personal communication with EPA, Region IV personnel)  
(A) PC for Water

of particular contaminants to cause adverse effects in exposed individuals and to provide, where possible, an estimate of the relationship between the extent of exposure to a contaminant and the increased likelihood and/or severity of adverse effects.

Cancer slope factors (CSFs) have been developed by EPA's Carcinogenic Assessment Group for estimating excess lifetime cancer risks associated with exposure to potentially carcinogenic chemicals. CSFs, which are expressed in units of  $(\text{mg/kg/day})^{-1}$ , are multiplied by the estimated intake of a potential carcinogen, in  $(\text{mg/kg/day})$ , to provide an upper-bound estimate of the excess lifetime cancer risk associated with exposure at that intake level. The term "upper-bound" reflects the conservative estimate of the risks calculated from the CSF. Use of this approach makes underestimation of the actual cancer risk highly unlikely. CSFs are derived from the results of human epidemiological studies or chronic animal bioassays to which animal-to-human extrapolation and uncertainty factors have been applied.

Reference doses (RfDs) have been developed by EPA for indicating the potential for adverse health effects from exposure to chemicals exhibiting noncarcinogenic (systemic) effects. RfDs, which are expressed in units of  $\text{mg/kg/day}$ , are estimates of lifetime daily exposure levels for humans, including sensitive individuals, which will result in no adverse health effects. Estimated intakes of chemicals from environmental media (i.e., the amount of chemical ingested from contaminated drinking water) can be compared to the RfD. RfDs are derived from human epidemiological studies or animal studies to which uncertainty factors have been applied (i.e., to account for the use of animal data to predict effects on humans). These uncertainty factors help ensure that the RfDs will not underestimate the potential for adverse noncarcinogenic effects to occur.

The Agency has derived CSFs and RfDs for the contaminants of concern at the Site for use in determining the upper-bound level of cancer risk and non-cancer hazard from exposure to a given level of contamination. These values are provided in Tables 21 and 22, respectively.

#### B.4 RISK CHARACTERIZATION

The risk characterization step of the baseline risk assessment process integrates the toxicity and exposure assessments into quantitative and qualitative expressions of risk. The output of this process is a characterization of the site-related potential noncarcinogenic and carcinogenic health effects.

Potential concern for noncarcinogenic effects of a single contaminant in a single medium is expressed as the hazard quotient (HQ) (or the ratio of the estimated intake derived from the contaminant concentration in a given medium to the contaminant's reference dose). By adding the HQs for all contaminants within a medium or across all media to which a given population may be reasonably exposed, the Hazard Index (HI) can be generated. The HI provides a useful reference point for gauging the potential significance of multiple

**TABLE 2 1.**  
**Toxicity Values**

Analyte (Contaminant of Concern)	Carcinogenicity	Oral		Inhalation		Reference
		Slope (mg/kg/day) <sup>-1</sup>	RfD Chronic (mg/kg/day)	Slope (mg/kg/day) <sup>-1</sup>	RfC Chronic (mg/kg/day)	
PURGEABLE ORGANICS						
Vinyl Chloride	A	1.9E+00	-	-	-	HEAST
1,2-Dichloropropane	B2	6.8E-02	-	ND	-	HEAST
Chloroform	B2	6.1E-03	1E-02	8.1E-02	ND	IRIS
Cis-1,2-Dichloroethene	-	-	1E-02	-	ND	HEAST
Benzene	A	2.9E-02	-	2.9E-02	-	HEAST
Toluene	-	-	2E-01	-	5E-01	HEAST
Tetrachloroethene	B2	5.1E-02	1E-02	1E-03	ND	HEAST
Chlorobenzene	-	-	2E-02	-	5E-03	HEAST
Ethyl Benzene	-	-	1E-01	-	2E-01	HEAST
Total Xylenes	-	-	2E+00	-	8E-02	HEAST
Methyl Ethyl Ketone	D	-	5E-02	-	9E-02	HEAST
Methyl Isobutyl Ketone	-	-	5E-02	-	2E-02	HEAST
1,1,1-Trichloroethane	-	-	9E-02	-	3E-01	HEAST
Chloroethane	-	-	-	-	-	HEAST
1,1-Dichloroethane	C	ND	1E-01	-	1E-01	HEAST
EXTRACTABLE ORGANICS						
1,3-Dichlorobenzene	-	-	-	-	-	HEAST
1,4-Dichlorobenzene	C	2.4E-02	ND	ND	2E-01	HEAST
1,2-Dichlorobenzene	-	-	9E-02	-	4E-02	HEAST
Phenol	-	-	6E-01	-	ND	HEAST
Naphthalene	-	-	4E-03	-	ND	HEAST
2-Methylnaphthalene	-	-	-	-	-	HEAST
Bis(2-ethylhexyl)phthalate	B2	1.4E-02	2E-02	ND	ND	HEAST
Dibenzofuran	-	-	-	-	-	HEAST
Fluorene	-	-	4E-02	-	ND	HEAST
Fluoranthene	-	-	4E-02	-	ND	HEAST
Phenanthrene	-	-	3E-02	-	-	HEAST
Pyrene	-	-	3E-02	-	-	IRIS
Benzo(a)Pyrene	B2	5.8E+00	-	6.1E+00	-	HEAST
Benzo(b and/or k)Fluoranthene	B2	5.8E+00	-	6.1E+00	-	.
Benzo(a)Anthracene	B2	5.8E+00	-	6.1E+00	-	.
Chrysene	B2	5.8E+00	-	6.1E+00	-	.
Indeno(1,2,3-c,d)Pyrene	B2	5.8E+00	-	6.1E+00	-	.
Dibenzo(a,h)Anthracene	B2	5.8E+00	-	6.1E+00	-	.
Anthracene	-	-	3E-01	-	-	IRIS
Acenaphthylene	-	-	3E-02	-	-	HEAST
Acenaphthene	-	-	6E-02	-	-	HEAST
Benzo(g,h,i)Perylene	-	-	3E-02	-	-	HEAST
2-Chloronaphthalene	-	-	-	-	-	HEAST
2-Methylphenol	-	-	-	-	-	HEAST
(3-and/or 4)-Methylphenol	-	-	-	-	-	HEAST
2,4-Dichlorophenol	-	-	3E-03	-	-	HEAST
Pentachlorophenol	B2	1.2E-01	3E-02	-	-	HEAST
1,2,4-Trichlorobenzene	-	-	1E-03	-	3E-3	HEAST
Carbazole	B2	2.0E-02	-	-	-	HEAST
Diethyl Phthalate	-	-	8E-01	-	-	HEAST
Di-N-Butylphthalate	-	-	1E-01	-	-	HEAST
Benzyl Butyl Phthalate	C	ND	2E-01	-	-	HEAST
Di-N-Octylphthalate	-	-	2E-02	-	-	HEAST
Hexachlorobenzene	B2	1.6E+00	8E-04	1.6E+00	-	HEAST
PESTICIDES						
Aldrin	B2	1.7E+01	3E-05	1.7E+01	-	HEAST
Beta-BHC	C	1.8E+00	-	1.8E+00	-	HEAST
Alpha-Chlordane	B2	1.3E+00	6E-05	1.3E+00	-	HEAST
Gamma-Chlordane	B2	1.3E+00	6E-05	1.3E+00	-	HEAST
4,4'-DDD	B2	2.4E-01	5E-04 <sup>***</sup>	-	-	HEAST
4,4'-DDE	B2	3.4E-01	5E-04 <sup>***</sup>	-	-	HEAST
4,4'-DDT	B2	3.4E-01	5E-04	3.4E-01	-	HEAST
Dieldrin	B2	1.6E+01	5E-05	1.6E+01	-	HEAST

**TABLE 2 1**  
**Toxicity Values**

Analyte (Contaminant of Concern)	Carcinogenicity	Oral		Inhalation		Reference
		Slope (mg/kg/day) <sup>-1</sup>	RfD Chronic (mg/kg/day)	Slope (mg/kg/day) <sup>-1</sup>	RfC Chronic (mg/kg/day)	
PESTICIDES						
Endrin	-	-	3E-04	-	-	HEAST
Endrin Aldehyde	-	-	-	-	-	HEAST
Endosulfan I (Alpha)	-	-	5E-05	-	-	HEAST
Endosulfan II (Beta)	-	-	5E-05	-	-	HEAST
Endosulfan Sulfate	-	-	-	-	-	HEAST
Heptachlor	B2	4.5E+00	5E-04	4.5E+00	-	HEAST
Methoxychlor	-	-	5E-03	-	-	HEAST
INORGANICS						
Aluminum	-	-	-	-	-	HEAST
Antimony	-	-	4E-04	-	ND	HEAST
Arsenic	A	-	1E-03	5.0E+01	ND	HEAST
Barium	-	-	5E-02	-	1E-04	HEAST
Chromium (VI)	-	-	5E-03	4.1E+01	5E-07	IRIS/HEAST
Copper	-	-	3E-02	-	ND	HEAST
Lead	B2	ND	ND	ND	ND	HEAST
Manganese	-	-	1E-01	-	1E-04	HEAST
Mercury	-	-	3E-04	-	8E-05	HEAST
Nickel (Soluble Salts)	-	ND	2E-02	ND	ND	IRIS
Vanadium	-	-	7E-03	-	ND	HEAST
Zinc	-	-	2E-01	-	ND	HEAST
Beryllium	B2	4.3E+00	5E-03	8.4E+00	-	HEAST
Cobalt	-	-	-	-	-	HEAST
Selenium	-	-	-	-	-	HEAST
Silver	-	-	3E-03	-	-	HEAST

ND Not Determined

- Not Listed

\* A slope factor has not been established for this compound; therefore, the EPA interim slope factor for benzo(a)pyrene was assigned since this compound is also a carcinogenic PAH.

\*\* A reference dose has not been established for this compound. Based on this compound's structural similarity to 4,4-DDT, the oral reference dose for 4,4-DDT was substituted.

**TABLE 2 2**  
**Derivation of Dermal Critical Toxicity Values**

Analyte (Contaminant of Concern)	Oral		Absorption Factor (a)	Dermal	
	Slope (mg/kg/day) <sup>-1</sup>	RfD Chronic (mg/kg/day)		Slope (mg/kg/day) <sup>-1</sup>	RfD Chronic (mg/kg/day)
PURGEABLE ORGANICS					
Vinyl Chloride	1.9E+00	-	0.8	2.4E+00	-
1,2-Dichloropropane	6.8E-02	-	0.8	8.5E-02	-
Chloroform	6.1E-03	1E-02	0.8	7.6E-03	8E-03
Cis-1,2-Dichloroethene	-	1E-02	0.8	-	8E-03
Benzene	2.9E-02	-	0.8	3.6E-02	-
Toluene	-	2E-01	0.8	-	2E-01
Tetrachloroethene	5.1E-02	1E-02	0.8	6.4E-02	8E-03
Chlorobenzene	-	2E-02	0.8	-	2E-02
Ethyl Benzene	-	1E-01	0.8	-	8E-02
Total Xylenes	-	2E+00	0.8	-	2E+00
Methyl Ethyl Ketone	-	5E-02	0.8	-	4E-02
Methyl Isobutyl Ketone	-	5E-02	0.8	-	4E-02
1,1,1-Trichloroethane	-	9E-02	0.8	-	7E-02
Chloroethane	-	-	0.8	-	-
1,1-Dichloroethane	ND	1E-01	0.8	-	8E-02
EXTRACTABLE ORGANICS					
Phenol	-	6E-01	0.5	-	3E-01
1,3-Dichlorobenzene	-	-	0.5	-	-
1,4-Dichlorobenzene	2.4E-02	ND	0.5	4.6E-02	-
1,2-Dichlorobenzene	-	9E-02	0.5	-	5E-02
Naphthalene	-	4E-03	0.5	-	2E-03
2-Methylnaphthalene	-	-	0.5	-	-
Bis(2-ethylhexyl)phthalate	1.4E-02	2E-02	0.5	2.8E-02	1E-02
Dibenzofuran	-	-	0.5	-	-
Fluorene	-	4E-02	0.5	-	2E-02
Fluoranthene	-	4E-02	0.5	-	2E-02
Phenanthrene	-	3E-02	0.5	-	2E-02
Pyrene	-	3E-02	0.5	-	2E-02
Benzo(a)Pyrene	5.8E+00	-	0.5	1.2E+01	-
Benzo(b and or k)Fluoranthene	5.8E+00	-	0.5	1.2E+01	-
Benzo(a)Anthracene	5.8E+00	-	0.5	1.2E+01	-
Chrysene	5.8E+00	-	0.5	1.2E+01	-
Indeno(1,2,3-c,d)Pyrene	5.8E+00	-	0.5	1.2E+01	-
Dibenzo(a,h)Anthracene	5.8E+00	-	0.5	1.2E+01	-
Anthracene	-	3E-01	0.5	-	2E-01
Acenaphthylene	-	3E-02	0.5	-	2E-02
Acenaphthene	-	6E-02	0.5	-	3E-02
Benzo(g,h,i)Perylene	-	3E-02	0.5	-	2E-02
2-Chloronaphthalene	-	-	0.5	-	-
2-Methylphenol	-	-	0.5	-	-
(3-and/or 4)-Methylphenol	-	-	0.5	-	-
2,4-Dichlorophenol	-	3E-03	0.5	-	2E-03
Pentachlorophenol	1.2E-01	3E-02	0.5	2.4E-01	2E-02
1,2,4-Trichlorobenzene	-	1E-03	0.5	-	5E-04
Carbazole	2.0E-02	-	0.5	4.0E-02	-
Diethyl Phthalate	-	8E-01	0.5	-	4E-01
Di-N-Butylphthalate	-	1E-01	0.5	-	5E-02
Benzyl Butyl Phthalate	ND	2E-01	0.5	-	1E-01
Di-N-Octylphthalate	-	2E-02	0.5	-	1E-02
Hexachlorobenzene	1.6E+00	8E-04	0.5	3.2E+00	4E-04
PESTICIDES					
Aldrin	1.7E+01	3E-05	0.5	3.4E+01	2E-05
Beta-BHC	1.8E-00	-	0.5	3.6E+00	-
Alpha-Chlordane	1.3E+00	6E-05	0.5	2.6E+00	3E-05
Gamma-Chlordane	1.3E+00	6E-05	0.5	2.6E+00	3E-05
4,4'-DDD	2.4E-01	5E-04	0.5	4.8E-01	3E-04
4,4'-DDE	3.4E-01	5E-04	0.5	6.8E-01	3E-04
4,4'-DDT	3.4E-01	5E-04	0.5	6.8E-01	3E-04
Dieldrin	1.6E+01	5E-05	0.5	3.2E+01	3E-05

**TABLE 2 2**  
**Derivation of Dermal Critical Toxicity Values**

Analyte (Contaminant of Concern)	Oral		Absorption Factor (a)	Dermal	
	Slope (mg/kg/day) <sup>-1</sup>	RfD Chronic (mg/kg/day)		Slope (mg/kg/day) <sup>-1</sup>	RfD Chronic (mg/kg/day)
PESTICIDES					
Endrin	-	3E-04	0.5	-	2E-04
Endrin Aldehyde	-	-	0.5	-	-
Endosulfan I (Alpha)	-	5E-05	0.5	-	3E-05
Endosulfan II (Beta)	-	5E-05	0.5	-	3E-05
Endosulfan Sulfate	-	-	0.5	-	-
Heptachlor	4.5E+00	5E-04	0.5	9.0E+00	3E-04
Methoxychlor	-	5E-03	0.5	-	3E-03
INORGANICS					
Aluminum	-	-	0.2	-	-
Antimony	-	4E-04	0.2	-	8E-05
Arsenic	-	1E-03	0.2	-	2E-04
Barium	-	5E-02	0.2	-	1E-02
Chromium (VI)	-	5E-03	0.2	-	1E-03
Copper	-	3E-02	0.2	-	6E-03
Lead	ND	ND	0.2	-	-
Manganese	-	1E-01	0.2	-	2E-02
Mercury	-	3E-04	0.2	-	6E-05
Nickel (Soluble Salts)	ND	2E-02	0.2	-	4E-03
Vanadium	-	7E-03	0.2	-	1E-03
Zinc	-	2E-01	0.2	-	4E-02
Beryllium	4.3E+00	5E-03	0.2	2.2E+01	1E-03
Cobalt	-	-	0.2	-	-
Selenium	-	-	0.2	-	-
Silver	-	3E-03	0.2	-	6E-04

(a) Based on USEPA HEAs and ATSDR Documents

(b) Slope/Absorption Factor

(c) ORAL RfD x Absorption Factor

ND Not Determined

- Not Listed

contaminant exposures within a single medium or across media. The HQs and HIs for the exposure pathways (current and future) identified at the Site are summarized in Table 23. The only hazard indices which exceed unity result from the potential of future exposure to contaminated groundwater.

Excess lifetime cancer risks are determined by multiplying the intake level with the cancer potency factor. These risks are probabilities that are generally expressed in scientific notation (i.e.,  $1 \times 10^{-6}$  or  $1\text{E-6}$ ). An excess lifetime cancer risk of  $1\text{E-6}$  indicates that, as a plausible upper-bound, an individual has a one in one million chance of developing cancer as a result of site-related exposure to a carcinogen over a 70-year lifetime under the specific exposure conditions at a site.

EPA has set an acceptable carcinogenic risk range of  $1\text{E-4}$  to  $1\text{E-6}$ , but prefers that remediation of Superfund sites achieve a residual cancer risk no greater than  $1\text{E-6}$ . However, depending upon site factors, a risk of  $1\text{E-4}$  may be considered protective.

The carcinogenic upper-bound risk for each of the exposure pathways (current and future) identified at the Site are summarized in Table 24. The only carcinogenic risks which exceed EPA's acceptable risk range result from the potential of future exposure to contaminated groundwater.

#### 8.5 RISK UNCERTAINTY

There is a generally recognized uncertainty in human risk values developed from experimental data. This is primarily due to the uncertainty of extrapolation in the areas of (1) high to low dose exposure and (2) animal data to values that are protective of human health. The Site specific uncertainty is mainly in the degree of accuracy of the exposure assumptions.

Most of the exposure assumptions used in this and any risk assessment have not been fully verified. For example, the degree of chemical absorption from the gut or through the skin or the amount of soil contact that may occur is not known with certainty. Generally accepted default values provided in Agency guidance were used when available.

In the presence of such uncertainty, the Agency and the risk assessor have the obligation to make conservative assumptions such that the chance is very small, approaching zero, for the actual health risk to be greater than that determined through the risk assessment process. On the other hand, the process is not intended to yield absurdly conservative risks values that have no basis in reality. That balance was kept in mind in the development of exposure assumptions and pathways and in the interpretation of data and guidance for this baseline risk assessment.



**TABLE 2.3**  
**TOTAL HAZARD QUOTIENT**

POPULATION	EXPOSURE PATHWAY	PATHWAY HAZARD INDEX
Onsite Trespasser Current Use	Ingestion (onsite surface soil)	2E-02
	Dermal contact (onsite surface soil)	2E-03
	Dermal contact (onsite sediment)	6E-04
	Dermal contact (onsite surface water)	7E-05
	Total Hazard Index	2E-02
Offsite Adult Resident Current Use	Ingestion (sediment, SD5)	9E-03
	Dermal contact (sediment, SD4)	2E-04
	Dermal contact (sediment, SD5)	5E-04
	Dermal contact (offsite surface water)	1E-04
	Total Hazard Index	1E-02
Offsite Child Resident Current Use	Ingestion (sediment, SD5)	8E-02
	Dermal contact (sediment, SD4)	7E-04
	Dermal contact (sediment, SD5)	1E-03
	Dermal contact (offsite surface water)	8E-04
	Total Hazard Index	8E-02

**TABLE 2 3**  
**TOTAL HAZARD QUOTIENT**

POPULATION	EXPOSURE PATHWAY	PATHWAY HAZARD INDEX
Offsite Child Resident Future Use	Ingestion (offsite shallow groundwater)	6E+00
	Dermal contact (offsite shallow groundwater)	5E-02
	<b>Total Hazard Index</b>	<b>6E+00</b>
Offsite Child Resident Future Use	Ingestion (offsite deep groundwater)	1E+00
	Dermal contact (offsite deep groundwater)	1E-02
	Inhalation (offsite deep groundwater)	0E+00
	<b>Total Hazard Index</b>	<b>1E+00</b>
Onsite Child Resident Future Use	Ingestion (onsite shallow groundwater)	1E+02
	Dermal contact (onsite shallow groundwater)	1E+00
	Inhalation (onsite shallow groundwater)	5E+00
	Ingestion (onsite surface soil)	7E-01
	Ingestion (onsite shallow subsurface soil)	0E+00
	Dermal contact (onsite surface soil)	1E-02
	Dermal contact (onsite sediment)	5E-04
	Dermal contact (onsite surface water)	2E-04
	<b>Total Hazard Index</b>	<b>1E+02</b>
	Ingestion (onsite deep groundwater)	6E+00
	Dermal contact (onsite deep groundwater)	3E-02
	Inhalation (onsite deep groundwater)	3E+00
	Ingestion (onsite surface soil)	7E-01
	Ingestion (onsite shallow subsurface soil)	0E+00
	Dermal contact (onsite surface soil)	9E-03
	Dermal contact (onsite sediment)	5E-04
	Dermal contact (onsite surface water)	2E-04
	<b>Total Hazard Index</b>	<b>1E+01</b>

**TABLE 2 3**  
**TOTAL HAZARD QUOTIENT**

POPULATION	EXPOSURE PATHWAY	PATHWAY HAZARD INDEX
Offsite Adult Resident Future Use	Ingestion (offsite shallow groundwater)	2E+00
	Dermal contact (offsite shallow groundwater)	3E-02
	<b>Total Hazard Index</b>	<b>2E+00</b>
Offsite Adult Resident Future Use	Ingestion (offsite deep groundwater)	5E-01
	Dermal contact (offsite deep groundwater)	6E-03
	Inhalation (offsite deep groundwater)	0E+00
	<b>Total Hazard Index</b>	<b>5E-01</b>
Onsite Adult Resident Future Use	Ingestion (onsite shallow groundwater)	4E+01
	Dermal contact (onsite shallow groundwater)	7E-01
	Inhalation (onsite shallow groundwater)	1E+00
	Ingestion (onsite surface soil)	8E-02
	Dermal contact (onsite surface soil)	5E-03
	Ingestion (onsite shallow subsurface soil)	3E-03
	Dermal contact (onsite shallow subsurface soil)	3E-04
	Dermal contact (onsite sediment)	2E-04
	Dermal contact (onsite surface water)	4E-05
	<b>Total Hazard Index</b>	<b>4E+01</b>
	Ingestion (onsite deep groundwater)	2E+00
	Dermal contact (onsite deep groundwater)	1E-02
	Inhalation (onsite deep groundwater)	7E-01
	Ingestion (onsite surface soil)	8E-02
	Dermal contact (onsite surface soil)	5E-03
	Ingestion (onsite shallow subsurface soil)	3E-03
	Dermal contact (onsite shallow subsurface soil)	3E-04
	Dermal contact (onsite sediment)	2E-04
	Dermal contact (onsite surface water)	4E-05
	<b>Total Hazard Index</b>	<b>3E+00</b>

**TABLE 2 3**  
**TOTAL HAZARD QUOTIENT**

POPULATION	EXPOSURE PATHWAY	PATHWAY HAZARD INDEX
Onsite Construction Worker Future Use	Dermal contact (onsite shallow groundwater)	4E+00
	Dermal contact (onsite surface soil)	3E-03
	Dermal contact (onsite shallow subsurface soil)	7E-03
	Dermal contact (onsite deep subsurface soil)	3E-03
	Dermal contact (onsite sediment)	1E-03
	Dermal contact (onsite surface water)	2E-03
	Ingestion (onsite surface soil)	3E-01
	Ingestion (onsite shallow subsurface soil)	4E-01
	Ingestion (onsite deep subsurface soil)	2E-01
	Total Hazard Index	5E+00

**TABLE 2 4**  
**TOTAL CARCINOGENIC RISKS**

POPULATION	EXPOSURE PATHWAY	PATHWAY CANCER RISK
Onsite Trespasser Current Use	Ingestion (onsite surface soil)	5.4E-07
	Dermal contact (onsite surface soil)	1.5E-07
	Dermal contact (onsite sediment)	1.2E-07
	Dermal contact (onsite surface water)	0.0E+00
	<b>Total Cancer Risk</b>	<b>8.1E-07</b>
Offsite Adult Resident Current Use	Ingestion (sediment, SD5)	3.8E-06
	Dermal contact (sediment, SD4)	3.9E-08
	Dermal contact (sediment, SD5)	8.3E-08
	Dermal contact (onsite surface water)	0.0E+00
	<b>Total Cancer Risk</b>	<b>3.9E-06</b>
Offsite Child Resident Current Use	Ingestion (sediment, SD5)	3.7E-06
	Dermal contact (sediment, SD4)	2.7E-08
	Dermal contact (sediment, SD5)	1.2E-07
	Dermal contact (onsite surface water)	0.0E+00
	<b>Total Cancer Risk</b>	<b>3.8E-06</b>

**TABLE 2 4**  
**TOTAL CARCINOGENIC RISKS**

POPULATION	EXPOSURE PATHWAY -	PATHWAY CANCER RISK
Offsite Adult Resident Future Use	Ingestion (offsite shallow groundwater)	0.0E+00
	Dermal contact (offsite shallow groundwater)	0.0E+00
	<b>Total Cancer Risk</b>	<b>0.0E+00</b>
Offsite Adult Resident Future Use	Ingestion (offsite deep groundwater)	5.7E-08
	Dermal contact (offsite deep groundwater)	2.0E-10
	Inhalation (offsite deep groundwater)	7.6E-07
	<b>Total Cancer Risk</b>	<b>8.2E-07</b>
Onsite Adult Resident Future Use	Ingestion (onsite shallow groundwater)	4.1E-03
	Dermal contact (onsite shallow groundwater)	2.7E-05
	Inhalation (onsite shallow groundwater)	6.3E-06
	Ingestion (onsite surface soil)	1.8E-06
	Dermal contact (onsite surface soil)	3.0E-07
	Ingestion (onsite shallow subsurface soil)	5.0E-07
	Dermal contact (onsite shallow subsurface soil)	1.0E-07
	Dermal contact (onsite sediment)	4.2E-08
	Dermal contact (onsite surface water)	0.0E+00
	<b>Total Cancer Risk</b>	<b>4.1E-03</b>
	Ingestion (onsite deep groundwater)	9.7E-04
	Dermal contact (onsite deep groundwater)	3.5E-06
	Inhalation (onsite deep groundwater)	4.4E-06
	Ingestion (onsite surface soil)	1.8E-06
	Dermal contact (onsite surface soil)	3.0E-07
	Ingestion (onsite shallow subsurface soil)	5.0E-07
	Dermal contact (onsite shallow subsurface soil)	1.0E-07
	Dermal contact (onsite sediment)	4.2E-08
	Dermal contact (onsite surface water)	0.0E+00
	<b>Total Cancer Risk</b>	<b>9.8E-04</b>

**TABLE 2 4**  
**TOTAL CARCINOGENIC RISKS**

POPULATION	EXPOSURE PATHWAY	PATHWAY CANCER RISK
Offsite Child Resident Future Use	Ingestion (offsite shallow groundwater)	0.0E+00
	Dermal contact (offsite shallow groundwater)	0.0E+00
	<b>Total Cancer Risk</b>	<b>0.0E+00</b>
Offsite Child Resident Future Use	Ingestion (offsite deep groundwater)	4.4E-08
	Dermal contact (offsite deep groundwater)	8.4E-11
	Inhalation (offsite deep groundwater)	8.1E-07
	<b>Total Cancer Risk</b>	<b>8.5E-07</b>
Onsite Child Resident Future Use	Ingestion (onsite shallow groundwater)	3.1E-03
	Dermal contact (onsite shallow groundwater)	1.2E-05
	Inhalation (onsite shallow groundwater)	6.6E-06
	Ingestion (onsite surface soil)	3.9E-06
	Dermal contact (onsite surface soil)	2.1E-07
	Dermal contact (onsite sediment)	3.0E-08
	Dermal contact (onsite surface water)	0.0E+00
	<b>Total Cancer Risk</b>	<b>3.1E-03</b>
	Ingestion (onsite deep groundwater)	7.4E-04
	Dermal contact (onsite deep groundwater)	1.5E-06
	Inhalation (onsite deep groundwater)	4.8E-06
	Ingestion (onsite surface soil)	3.9E-06
	Dermal contact (onsite surface soil)	2.1E-07
	Dermal contact (onsite sediment)	3.0E-08
	Dermal contact (onsite surface water)	0.0E+00
	<b>Total Cancer Risk</b>	<b>7.5E-04</b>
Onsite Resident (shallow groundwater exposure)		
	Lifetime Cancer Risk =	7.3E-03
Onsite Resident (deep groundwater exposure)		
	Lifetime Cancer Risk =	1.7E-03

**TABLE 2 4**  
**TOTAL CARCINOGENIC RISKS**

POPULATION	EXPOSURE PATHWAY	PATHWAY CANCER RISK
Onsite Construction Worker Future Use	Dermal contact (onsite shallow groundwater)	9.1E-06
	Dermal contact (onsite surface soil)	9.1E-09
	Dermal contact (onsite shallow subsurface soil)	9.1E-08
	Dermal contact (onsite deep subsurface soil)	5.7E-08
	Dermal contact (onsite sediment)	8.5E-10
	Dermal contact (onsite surface water)	0.0E+00
	Ingestion (onsite surface soil)	2.7E-07
	Ingestion (onsite shallow subsurface soil)	2.2E-06
	Ingestion (onsite deep subsurface soil)	1.6E-06
	Total Cancer Risk	1.3E-05



## 8.6 ECOLOGICAL RISK

A qualitative ecological risk assessment was conducted as part of the Benfield Risk Assessment Report. The surface and subsurface soils appear pose the greatest risk to flora and fauna of all the contaminated media at the Site. This is especially true for vegetation which has roots in the contaminated areas as well as borrowing mammals and insects which may inhabit these soils. Groundwater contamination is not expected to pose any environmental risk as it does not discharge to Browning Branch. Surface water samples collected in Browning Branch confirm this fact as no organic contaminants were detected adjacent to or downgradient of the Site. Only one of the five sediment samples collected from Browning Branch (SD5) contained elevated levels of PAHs and metals. However, this sediment cannot adversely impact Browning Branch, even under flood conditions due to the 2-foot berm between this sampling point and the stream and the topography of the surrounding area. It is unlikely there are any airborne contaminants from the soils due to the fact of the vegetation and that the soil has been undisturbed for over ten years.

## 8.7 SUMMARY

The health risk posed by this National Priority List site is primarily from the future use of the groundwater as a potable source. This is due to the presence of contaminants at concentrations above EPA's Maximum Contaminant Levels for drinking water. These contaminants will be remediated during the remedial action phase.

Presently, there is no known adverse impact on the eco-system resulting from the Site. However, the surface water and sediments of Browning Branch will be monitored during the remedial design/remedial action phase.

## 9.0 DESCRIPTION OF ALTERNATIVES

Tables 25 and 26 inventory those technologies that passed the initial screening for remediating the contaminated soils and the groundwater, respectively. In the initial screening, process options and entire technology types were eliminated from consideration if they are difficult to implement due to Site constraints or contaminant characteristics, or if the technology has not been proven to effectively control the contaminants of concern. Tables 27 and 28 summarize the results of the final screening for soil and groundwater remediation technologies, respectively. Effectiveness, implementability, and relative capital and operation and maintenance costs are the criteria used for evaluating the technologies and process options in the final screening. Tables 27 and 28 also provide the rationale as to why certain technologies were not retained for the detailed comparison. The retained seven (7) soil remediation alternatives and eight (8) groundwater remediation alternatives to address the estimated 4,600 cubic yards of contaminated soil and the 22 million gallons of contaminated groundwater are described below.

**TABLE 2 5**  
**CONTAMINATED SOIL TECHNOLOGIES AND**  
**PROCESS OPTIONS PASSING INITIAL SCREENING**

<u>TECHNOLOGY</u>	<u>PROCESS OPTION</u>
No Action	None
Site Access and Use Restrictions	Land Use Restrictions Fencing
Environmental Monitoring	Air, Soil, and Surface Water Monitoring
Capping	Gravel- or Soil-Clay Soil-Synthetic Membrane RCRA Multilayer
Surface Controls	Surface Water Diversion/Collection System Revegetation
Dust/Vapor Suppression	Water Organic Agents/Polymers/Foams Membranes/Tarps Hydroscopic Agents
Excavation	Contaminated Soils
Onsite Biological Treatment	Land Farming Composting Slurry Bioremediation
Onsite Chemical Treatment	Solvent Extraction Soil Washing
Onsite Thermal Treatment	Rotary Kiln Incinerator Fluidized Bed Incinerator Circulating Bed Incinerator Infrared Incinerator Pyrolysis
Onsite Physical Treatment	Solids Separation/Sizing Decontamination
Offsite Thermal Treatment	RCRA-Approved Offsite Incinerator

**TABLE 2 5 (Continued)**  
**CONTAMINATED SOIL TECHNOLOGIES**  
**AND PROCESS OPTIONS PASSING INITIAL SCREENING**

**TECHNOLOGY**

**PROCESS OPTION**

In Situ Biological Treatment

Bioremediation

Onsite Disposal

Onsite RCRA Landfill  
Temporary Storage

Offsite Disposal

RCRA Solid Waste Landfill  
RCRA Hazardous Waste Landfill

TABLE 2 6

**GROUNDWATER TECHNOLOGIES AND  
PROCESS OPTIONS PASSING INITIAL SCREENING**

<u>TECHNOLOGY</u>	<u>PROCESS OPTION</u>
No Action	None
Groundwater Use Restrictions	State Imposed Permit Restrictions
Alternative Water Supplies	Surface Water New Wells Bottled Water Home Treatment Units Public Water System Hook-up
Environmental Monitoring	Groundwater Monitoring
Gradient Control	Extraction Wells Injection Wells
Surface Control	Surface Water Diversion/ Collection System Revegetation
Extraction	Extraction Wells Extraction-Injection Wells
Onsite Biological Treatment	Submerged Fixed Film Reactor
Onsite Physical Treatment	Phase Separation Filtration Carbon Absorption Ion Exchange
Onsite Chemical Treatment	Neutrailization Oxidation Chemical Reduction Aeration Chemical Precipitation Oxidation/UV Photolysis
In Situ Biological Treatment	Bioremediation
Onsite Discharge	Surface Water Injection Wells Recharge Trench
Offsite Discharge	Surface Water Publicly Owned Treatment Works

**TABLE 2.7**  
**FINAL SCREENING OF REMEDIAL TECHNOLOGIES FOR THE**  
**CONTAMINATED SOILS**

GENERAL RESPONSE ACTION	REMEDIAL TECHNOLOGY	PROCESS OPTION	SCREENING CRITERIA		
			EFFECTIVENESS	IMPLEMENTABILITY	RELATIVE COST
No Action	No Action	None	Would not meet remedial action objectives.	Not applicable.	None.
Institutional Controls	Site Access and Use Restrictions	Land Use Restrictions	Would be effective in conjunction with other remedial technologies, such as capping.	Difficult to implement onsite: Personnel and administrative procedures are available. Implementation at the existing Benfield site property would be routine and required.	Low Capital. Low Operations & Maintenance.
		Fencing	Would be effective in conjunction with other remedial technologies, such as capping.	Implementation is easy and has already begun. Would require long-term security and maintenance activities.	Low Capital. Low Operations & Maintenance
	Environmental Monitoring	Air, Soil, and Surface Water Monitoring	Would be effective in evaluating the effectiveness of remedial actions, such as capping or onsite incineration.	Implementation is easy and was begun during the PI. Conventional technology. Equipment, personnel, and services readily available.	Low Capital. Low Operations & Maintenance.
Containment	Capping	Gravel - or Soil - Clay	Would effectively minimize the potential for direct contact with contaminated material, if properly maintained. Moderately effective in reducing infiltration. Subject to erosion.	Easily implementable. Conventional technology. Equipment, personnel, and services readily available. Requires restrictions on future land use and long-term maintenance.	Low Capital. Moderate Operations & Maintenance.
		Soil - Synthetic Membrane*	Would effectively minimize the potential for direct contact with contaminated material, if properly maintained. More effective than gravel - or soil - clay caps at reducing infiltration. The membrane is susceptible to tearing or puncture. Long-term reliability of the membrane is uncertain.	Implementable. Conventional technology. Equipment, personnel, and services are readily available. Requires restrictions on future land use and long-term maintenance. The membrane must be protected during the installation of the soil layer.	Moderate Capital. Moderate Operations & Maintenance.
		RCRA Multilayer	Would effectively minimize the potential for direct contact with contaminated material, if properly maintained. Most effective cap for reducing infiltration.	Implementable. Conventional technology. Equipment, personnel, and services are readily available. Requires restrictions on future land use and long-term maintenance. Difficult to fit into existing structures. Each layer must be protected during the installation of all higher layers.	High Capital. Moderate Operations & Maintenance.
	Surface Controls	Surface Water Diversion/ Collection System	Effective in reducing infiltration of surface water run-on and run-off. Proven, reliable technology. Would be used in conjunction with onsite containment, storage, or disposal process options.	Easily implementable. Conventional technology. Equipment, personnel, and services are readily available. Requires restrictions on future land use and long-term maintenance.	Low Capital. Moderate Operations & Maintenance.
		Revegetation	Effective in reducing surface water infiltration to the aquifer. Proven, reliable technology. Would be used in conjunction with other remedial technologies.	Easily implementable. Requires long-term maintenance. Equipment, personnel, and services are readily available.	Low Capital. Moderate Operations & Maintenance.

-- Process selected for alternative development  
 -- Process rejected for alternative development

\* -- If the remedial design calls for the use of this technology, this process option should also be considered.

**POOR QUALITY ORIGINAL**

**TABLE 27 (continued)**  
**FINAL SCREENING OF REMEDIAL TECHNOLOGIES FOR THE**  
**CONTAMINATED SOILS**

GENERAL RESPONSE ACTION	REMEDIAL TECHNOLOGY	PROCESS OPTION	SCREENING CRITERIA		
			EFFECTIVENESS	IMPLEMENTABILITY	RELATIVE COST
Containment (Continued)	Dust/Vapor Suppression	Water	Not effective in reducing volatile organic emissions or preventing surface water infiltration into excavated material. Effective in reducing dust generation.	Easily implementable. Conventional technology. Equipment, personnel, and services are readily available.	Low Capital. Low Operations & Maintenance.
		Organic Agents/ Polymers/Foams*	Not effective in preventing surface water infiltration into excavated material. Effective in reducing dust and volatile organic vapor emissions.	Implementable. Conventional technology. Equipment, personnel, and services are available.	Moderate Capital. Moderate Operations & Maintenance.
		Membranes/Traps	Effective in preventing surface water infiltration into excavated material and in reducing dust and volatile organic vapor emissions.	Implementable. Conventional technology. Equipment, personnel, and services are available.	High Capital. High Operations & Maintenance.
		Hydroscopic Agents	Not effective in reducing volatile organic emissions or preventing surface water infiltration into excavated material. Effective in reducing dust generation.	Easily implementable. Conventional technology. Equipment, personnel, and services are readily available.	Low Capital. Low Operations & Maintenance.
Removal	Excavation	Contaminated Soils	Proven, reliable technology. Would effectively reduce the potential threat to human health and the environment. Short-term effects include noise and fugitive dust emissions. Would be used in conjunction with temporary storage.	Easily implementable. Conventional technology. Equipment, personnel, and services are readily available.	Low to Moderate Capital. Low Operations & Maintenance.
On-site Treatment	Biological	Land Farming*	Less effective than slurry biotreatment and composting. Requires bench and pilot testing. Biological degradation may not be completely effective in treating the carcinogenic PAHs unless seeded with appropriate microbes. Might not be able to meet the PAH action levels.	More easily implemented than slurry biotreatment or composting. Would require materials handling to prepare the excavated soils for treatment. Might not be acceptable in a residential area. Equipment, personnel, and services are available.	Low Capital. Moderate Operations & Maintenance.
		Composting*	Less effective than slurry biotreatment but more effective than land farming. Requires bench and pilot testing. Biological degradation may not be completely effective in treating the carcinogenic PAHs unless seeded with appropriate microbes. Might not be able to meet the PAH action levels.	More easily implemented than slurry biotreatment but more difficult than land farming. Would require materials handling to prepare the excavated soils for treatment. Might not be acceptable in a residential area. Equipment, personnel, and services are available.	Moderate Capital. Moderate Operations & Maintenance.
		Slurry Biotreatment	More effective than land farming or composting. Requires bench and pilot testing. Biological degradation may not be completely effective in treating the carcinogenic PAHs unless seeded with appropriate microbes. Might not be able to meet the PAH action levels. Could be used after soil washing.	More difficult to implement than land farming or composting. Would require extensive materials handling and pretreatment to prepare the excavated soils for treatment. Might not be acceptable in a residential area. Equipment, personnel, and services are available.	High Capital. High Operations & Maintenance.

POOR QUALITY  
ORIGINAL

TABLE 27 (continued)  
FINAL SCREENING OF REMEDIAL TECHNOLOGIES FOR THE  
CONTAMINATED SOILS

GENERAL RESPONSE ACTION	REMEDIAL TECHNOLOGY	PROCESS OPTION	SCREENING CRITERIA		
			EFFECTIVENESS	IMPLEMENTABILITY	RELATIVE COST
Onsite Treatment (Continued)	Physical (Continued)	Solvent Extraction	Effective and proven method for removing organic contaminants from soils. Short-term effects would include potential fugitive dust and solvent emissions. Will require bench and pilot testing. Might not be able to meet the PAH and hexachlorobenzene action levels.	Implementable. Equipment, personnel, and services are available. Would require materials handling to prepare the excavated soils for treatment. Contaminated solvent will require treatment or disposal.	Moderate Capital. Moderate Operations & Maintenance.
		Rotary Kiln Incinerator	Effective and proven method for the destruction of organic contaminants. Short-term effects would include noise and potential air emissions. Relatively low thermal efficiency.	Implementable. Extensive performance and permitting requirements must be met. Materials handling would be required to prepare the soils for incineration. Might not be acceptable in a residential area. Most readily available onsite thermal technology.	Moderate Capital. Moderate Operations & Maintenance.
	Thermal	Fluidized Bed Incinerator	Effective and proven method for the destruction of organic contaminants. Short-term effects would include noise and potential air emissions. Low operational temperature.	Implementable. Extensive performance and permitting requirements must be met. Extensive materials handling required to prepare the soils for incineration. Might not be acceptable in a residential area. Requires a very uniform waste feed to avoid liquification of the bed.	Moderate Capital. Moderate Operations & Maintenance.
		Circulating Bed Incinerator	Effective and proven method for the destruction of organic contaminants. Short-term effects would include noise and potential air emissions. Efficient heat recovery.	Implementable. Extensive performance and permitting requirements must be met. Materials handling required to prepare the soil for incineration. Might not be acceptable in a residential area. Can treat a more varied waste stream than the fluidized bed incinerator.	Moderate Capital. Moderate Operations & Maintenance.
		Fixed-bed Incinerator	Effective and proven method for the destruction of organic contaminants. Short-term effects would include noise and potential air emissions. Low particulate emissions.	Implementable. Extensive performance and permitting requirements must be met, especially for the dioxin contaminants. Materials handling required to prepare the soils for incineration. Might not be acceptable in a residential area.	Moderate Capital. Moderate Operations & Maintenance.
		Pyrolysis	Effective and proven method for the destruction of organic contaminants. Short-term effects would include noise and potentially high air emissions.	Implementable. Extensive performance and permitting requirements must be met. Materials handling required to prepare the soils for incineration. Might not be acceptable in a residential area. Char may be hazardous and require further treatment before disposal.	Moderate Capital. Moderate Operations & Maintenance.
	Physical	Solids Separation/Sizing	Effective when used to provide a more homogeneous waste stream. Does not decrease toxicity, mobility, or volume of the wastes. Would be used in conjunction with other technologies, such as incineration or biotreatment.	Easily implementable. Services, personnel, and equipment readily available.	Low Capital. Low Operations & Maintenance.

POOR QUALITY  
REPRODUCED

TABLE 2 7 (continued)  
FINAL SCREENING OF REMEDIAL TECHNOLOGIES FOR THE  
CONTAMINATED SOILS

GENERAL RESPONSE ACTION	REMEDIAL TECHNOLOGY	PROCESS OPTION	SCREENING CRITERIA		
			EFFECTIVENESS	IMPLEMENTABILITY	RELATIVE COST
Onsite Treatment (Continued)	Physical (Continued)	Decontamination	Effective and proven method of cleaning treatment equipment and cobbles. Would be used in conjunction with other treatment and disposal technologies to prevent migration of contaminants offsite.	Easily implementable. Services, personnel, and equipment readily available. Decontamination wash waters would require treatment or disposal.	Low Capital. Low Operations & Maintenance.
Offsite Treatment	Thermal	RCRA Approved Offsite Incinerator	Effective and proven method for destruction of organic contaminants. Transportation to offsite facility required. Short-term effects include dust and noise associated with waste excavation.	Implementable. Permitting may be required for transport. Facility must be in compliance with RCRA and state regulations.	Very High Capital. Very Low Operations & Maintenance.
	Biological	Land Farming	Not fully demonstrated for PAHs, particularly four- and five-ring PAHs, which include most of the carcinogenic PAHs. Transportation to offsite facility required. Short-term effects include dust and noise associated with waste excavation.	Implementable. Permitting may be required for transport. Facility must be in compliance with RCRA and state regulations. Only practical as a separate option for the contaminated soils if contaminated soil volume is much larger than estimated in this FS.	Moderate Capital. Low Operations & Maintenance.
In Situ Treatment	Biological	Bioremediation	Not proven. Would require bench and pilot testing. Biological degradation may not be completely effective in treating the carcinogenic PAHs unless appropriate microbes are injected. May not be able to meet the carcinogenic PAH and hexachlorobenzene action levels. Short-term effects include dust and noise associated with installation of recharge trenches.	Implementable. More easily implemented than composting or slurry biotreatment.	Moderate Capital. Moderate Operations & Maintenance.
Onsite Disposal	Disposal	Onsite RCRA Landfill	Proven, effective method of disposing of contaminated soils. Would be used in conjunction with excavation.	Very difficult to implement. Several North Carolina landfill siting requirements would have to be waived. Would not be acceptable in a residential area.	Moderate Capital. Moderate Operations & Maintenance.
		Temporary Storage	Proven, effective method of temporarily storing contaminated soil. Would be used in conjunction with other remedial technologies.	Implementable. Storage area must comply with RCRA and North Carolina State regulations.	Low Capital. Low Operations & Maintenance.
Offsite Disposal	Disposal	RCRA Solid Waste Landfill	Proven, effective method of disposing of treated soils and decontaminated cobbles. Transportation offsite required.	Implementable. Treatment or decontamination certification of material required before transport and disposal.	Low Capital. Very Low Operations & Maintenance.
		RCRA Hazardous Waste Landfill	Proven, effective method of disposing of contaminated soils. Would be used in conjunction with other technologies. Transportation offsite required. Soils must be treated to land-ban levels before disposal.	Implementable. Permitting may be required for transport. Facility must be in compliance with RCRA and resolving state regulations.	High Capital. Very Low Operations & Maintenance.



**TABLE 28**  
**FINAL SCREENING OF REMEDIAL TECHNOLOGIES FOR THE**  
**CONTAMINATED GROUNDWATER**

GENERAL RESPONSE ACTION	REMEDIAL TECHNOLOGY	PROCESS OPTION	SCREENING CRITERIA		
			EFFECTIVENESS	IMPLEMENTABILITY	RELATIVE COST
No Action	No Action	None	Would not meet remedial action objectives.	Not applicable.	None
Institutional Controls	Ground Water Use Restrictions	State-Imposed Permit Restrictions	Would be effective in preventing ingestion of contaminated groundwater. Would be used in conjunction with other remedial actions, such as gradient control.	More easily implemented efforts than use restrictions. Personnel and administrative procedures are available. Implementation at the existing Benfield property would be routine and required.	Low Capital. Low Operations & Maintenance.
	Alternative Water Handling	Boiling Water*	Would be protective of human health as long as contaminant plume is clearly identified. Would not be protective of environment since contamination would remain.	Would be easy to implement. Treatment would be required.	Low Capital. Low Operations & Maintenance.
		Hot Water*	Would be protective of human health as long as extent of contaminant plume was clearly identified. Would not be protective of environment because contamination would remain.	Would be easily implemented and installed.	Low Capital. Low Operations & Maintenance.
		Bottled Water*	Would be protective of human health. Would not be protective of environment because contamination would remain.	Would be easily implemented. Would require coordination with residents and local, state, and federal governments.	Low Capital. Operations & Maintenance.
		Home Treatment Units	Would be protective of human health. Would not be protective of environment because contamination would remain.	Would be easy to implement. Would require installation of licensed plumber. Monitoring would be needed to ensure removal. Would require coordination with residents and local, state, and federal governments.	Low Capital. Moderate Operations & Maintenance.
		Public Water System Hook-Up	Would be protective of human health. Would not be protective of environment because contamination would remain.	Would be easy to implement. Would require coordination with residents and local, state, and federal governments.	Low Capital. Low Operations & Maintenance.
	Environmental Monitoring	Ground Water Monitoring	Would be effective in evaluating the effectiveness of other remedial actions, such as containment.	Implementation would be easy. Requires long-term maintenance. Equipment, personnel, and services are readily available.	Low Capital. Moderate Operations & Maintenance.
Containment	Gradient Control	Extraction Wells	Effective in reducing horizontal infiltration of contaminants. Proven, reliable technology. Would be used in conjunction with in situ bioremediation, groundwater treatment, or ground water containment.	Easily implementable. Would eventually allow unrestricted ground water use. Requires long-term maintenance. Equipment, personnel, and services are readily available.	Low Capital. Moderate Operations & Maintenance.
		Injection Wells	Effective in reducing horizontal infiltration of contaminants. Proven, reliable technology. Would be used in conjunction with in situ bioremediation, groundwater treatment, or ground water containment.	Implementable. Requires long-term maintenance. Equipment, personnel, and services are available.	Moderate Capital. Moderate Operations & Maintenance.

▬ Process selected for alternative development

▬ Process rejected for alternative development

\* -- If the remedial design calls for the use of this technology, this process option should also be considered.

\*\* -- If the remedial design calls for the use of in situ bioremediation, this process option must be used.

--- Aeration has been specified in Section 3.2 as the pretreatment that will be used to remove iron and manganese from the groundwater.

POOR QUALITY

TABLE 2.8 (continued)  
FINAL SCREENING OF REMEDIAL TECHNOLOGIES FOR THE  
CONTAMINATED GROUNDWATER

GENERAL RESPONSE ACTION	REMEDIAL TECHNOLOGY	PROCESS OPTION	SCREENING CRITERIA		
			EFFECTIVENESS	IMPLEMENTABILITY	RELATIVE COST
Containment (Continued)	Surface Controls	Surface Water Diversion/Collection Systems	Would not be effective as a means of remedialing existing groundwater contamination. Would be effective in conjunction with source control measures.	Would be easy to implement because it would involve conventional construction techniques.	Low Capital. Low Operations & Maintenance.
		Vegetation	Would not be effective as a means of remedialing existing groundwater contamination. Would be effective in conjunction with source control measures.	Would be easy to implement because it would involve conventional construction techniques.	Low Capital. Low Operations & Maintenance.
Removal	Extraction	Extraction Wells	Effective option for removal of contaminated groundwater from an aquifer. Proven, reliable technology. Would be used in conjunction with in situ bioremediation or groundwater treatment.	Easily implementable. Would eventually allow unrestricted groundwater use. Requires long-term maintenance. Equipment, personnel, and services are readily available.	Low Capital. Moderate Operations & Maintenance.
		Extraction - Injection Wells	Effective option for removal of contaminated groundwater from an aquifer. Proven, reliable technology. Would be used in conjunction with in situ bioremediation or groundwater treatment.	Implementable. Would eventually allow unrestricted groundwater use. Requires long-term maintenance. Equipment, personnel, and services are available.	Moderate Capital. Moderate Operations & Maintenance.
Onsite Treatment	Biological	Submerged Fixed Film Reactor	Most effective process for removing hydrocarbons from weakly contaminated water, such as groundwater. Large, complex PAHs are more difficult to metabolize. May require the use of polishing process option, such as carbon adsorption.	Implementable. Requires long-term maintenance. Equipment, personnel, and services are readily available. Growth of biofilm required. Proven process for treatment of water contaminated with low levels of organic contaminants. Resistant to shock loadings.	Moderate Capital. Moderate to High Operations & Maintenance.
	Physical	Phase Separation (Skimming, Decanting, Coagulation, Flocculation, or Sedimentation)	Conventional technologies. May be used as pretreatment for other process options, such as carbon adsorption or biological treatment.	Implementable. The separated materials may contain concentrations of contaminants that would require further treatment before disposal. Further treatment may also be required to improve the handling characteristics of the separated materials. Equipment, personnel, and services are readily available.	Low Capital. Moderate Operations & Maintenance.
		Filtration	Conventional technology. May be used as a pretreatment for other process options, such as carbon adsorption or biological treatment.	Implementable. The filtered materials may contain concentrations of contaminants that would require further treatment before disposal. Equipment, personnel, and services are readily available.	Low Capital. Moderate Operations & Maintenance.
		Carbon Adsorption	Effective treatment for all organic site contaminants except vinyl chloride. Reliable, proven process.	Implementable. Requires long-term maintenance. Equipment, personnel, and services are readily available. Spent carbon would require disposal or regeneration.	Moderate Capital. Moderate Operations & Maintenance.
		Ion Exchange	Would be effective for removal of heavy metals. However, this process is not as effective when a large variety of metals is present in the waste stream. Therefore, would require pretreatment to remove manganese and iron.	Would be readily implementable. Sludge produced might require disposal as a hazardous waste. Bench-scale testing would probably be required.	High Capital. High Operations & Maintenance.

DO NOT WRITE IN THESE SPACES

TABLE 28 (continued)  
FINAL SCREENING OF REMEDIAL TECHNOLOGIES FOR THE  
CONTAMINATED GROUNDWATER

GENERAL RESPONSE ACTION	REMEDIAL TECHNOLOGY	PROCESS OPTION	SCREENING CRITERIA		
			EFFECTIVENESS	IMPLEMENTABILITY	RELATIVE COST
Onsite Treatment (Continued)	Chemical	Neutralization, Reduction, Aeration, and Precipitation	Effective processes for treating certain metals. Might be used as pretreatments for other process options, such as carbon adsorption or oxidation/UV photolysis.	Implementable. Equipment, personnel, and services are readily available. Treated water may require further treatment before it can be discharged.	Low to Moderate Capital. Moderate Operations & Maintenance.
		Oxidation/UV Photolysis	Effective process for treating most site contaminants. Not a proven technology for treating four- and five-ring PAHs or PCP, but generally more effective than either oxidation or UV photolysis alone.	Implementable. Equipment, personnel, and services are readily available. Treated water may require further treatment before it can be discharged.	Moderate to High Capital. Moderate to High Operations & Maintenance.
		Oxidation	Not as effective as oxidation/UV photolysis in removing the carcinogenic PAHs.	Would be implementable. Bench-scale studies would be required to determine effectiveness.	Moderate Capital. High Operations & Maintenance.
In Situ Treatment	Biological	Bioremediation	Would be used in conjunction with gradient control or extraction technologies. Can effectively remove the small, simple PAHs. Large, complex PAHs are more difficult to metabolize.	Implementable. Equipment, personnel, and services are available. Extracted water would require treatment before it could be discharged or rejected.	Low Capital. Moderate Operations & Maintenance.
		Surface Water	Effectiveness would depend upon volume of water to be discharged and available capacity of the creek.	Easy implementation using conventional methods and material. NPDES compliance required. Permits may be necessary.	Low Capital. Low Operations & Maintenance.
Onsite Discharge	Discharge	Injection Wells	Effective, proven method for discharging water. Might be used with gradient control, extraction, or in situ biological treatment.	Implementable. Equipment, personnel, and services are available.	Moderate Capital. Moderate Operations & Maintenance.
		Discharge Trench	Effective, proven method for discharging water. Might be used with gradient control or extraction. The trench may have to be lengthened to effectively discharge all the water, because of the high local water table.	Easily implementable. Equipment, personnel, and services are available.	Moderate Capital. Moderate Operations & Maintenance.
Offsite Discharge	Discharge	Surface Water	Effective, proven method of disposing of treated groundwater.	Might be difficult to implement, because an NPDES permit is required for offsite discharge to surface water.	Low Capital. Low Operations & Maintenance.
		Publicly Owned Treatment Works	Effective, proven method of disposing of treated groundwater.	Treated water would be required to meet City of Hazelwood POTW pretreatment standards.	Moderate-High Capital. Low Operations & Maintenance.

DO NOT REPRODUCE

Surface water/sediment remediation technologies were not evaluated as the this environmental medium does not pose an unacceptable risk to either human health or the environment. Even though the air pathway does not currently present an unacceptable exposure pathway, it may pose an unacceptable risk during the actual implementation of the Site remedy. Therefore, any potential adverse impact on air quality will be considered along with the description of each individual remedial alternative in Section 10.0. Presently, the need to control air emissions from the Site during remediation is not anticipated, however, additional information will be generated as part of the remedial design (RD) to either confirm or rebut this perception.

## 9.1 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARs)

The environmental setting and the extent and characterization of the contamination at the Benfield site were defined in Section 7.0. Section 8.0 highlighted the human health and environmental risks posed by the Site. Table 16 lists the contaminants of concern present in the soil and groundwater at the Site. This Section examines and specifies the cleanup goals for each environmental medium adversely impacted by the contaminants found in association with the Benfield site.

### 9.1.1 Action-Specific ARARs

Action-specific requirements are technology-based and establish performance, design, or other similar action-specific controls or regulations on activities related to the management of hazardous substances or pollutants. Table 29 lists all potential action-specific applicable or relevant and appropriate requirements (ARARs). Those marked with "RA" are relevant and appropriate for that particular alternative.

### 9.1.2 Chemical-Specific ARARs

Chemical-specific ARARs are concentration limits established by government agencies for a number of contaminants in the environment. Chemical-specific ARARs can also be derived in the Risk Assessment. Table 30 lists all of the potential chemical-specific ARARs which may be pertinent at the Benfield site. Discussed below is each environmental medium investigated at the Benfield site as part of the RI and the associated chemical-specific ARARs.

#### 9.1.2.1 Soils

The soils are considered as two zones. The top 12 inches are considered surface soils and the subsurface soils lie below the surface soils down to the groundwater interface which ranges in depth below surface from 3-6 feet.

The risk assessment considered both present day conditions as well as two future use scenarios. The two future use scenarios involve construction

**TABLE 2 9**  
**ACTION-SPECIFIC ARARs**  
**GROUNDWATER**

STANDARD, REQUIREMENT CRITERIA, OR LIMITATION	CITATION	DESCRIPTION	ALTERNATIVE					
			GW1	GW2	GW3	GW4	GW5	GW6
FEDERAL GROUNDWATER TREATMENT								
RESOURCE CONSERVATION AND RECOVERY ACT, as amended (RCRA)	40 U.S.C. Sect 1609 et seq							
Identification of Hazardous Waste	40 CFR 261	Federal requirements for classification and identification of hazardous wastes	-	-	-	RA	RA	RA
Treatment of Hazardous Wastes in a Unit	40 CFR 264.601 40 CFR 265.400	Rules and requirements for the treatment of hazardous wastes.	-	-	-	RA	RA	RA
Requirements for Generation, Storage, Transportation, and Disposal of Hazardous Waste	40 CFR 263 40 CFR 264	Regulates storage, transportation, and operation of hazardous waste generators.	-	-	-	RA	RA	RA
SAFE DRINKING WATER ACT (SDWA)								
Primary Maximum Contaminant Levels	40 CFR 142	Primary MCL are adopted for the protection of human health but include an analysis of feasibility and cost of attainment.	-	-	-	RA	RA	RA

**TABLE 2 9**  
**ACTION-SPECIFIC ARARs**  
**GROUNDWATER**  
**(continued)**

STANDARD, REQUIREMENT CRITERIA, OR LIMITATION	CITATION	DESCRIPTION	ALTERNATIVE					
			GW1	GW2	GW3	GW4	GW5	GW6
Maximum Contaminant Level Goals	40 CFR 142 60 FR 48936 (November 13, 1995)	EPA has also established Maximum Contaminant Level Goals (MCLGs). The nonenforceable standards are based on health criteria. The MCLGs are goals for the nation's water supply.	-	-	-	RA	RA	RA
<b>DISPOSAL - DISCHARGE TO SURFACE WATER/POTW</b>								
CLEAN WATER ACT (CWA)	33 U.S.C. Sect 1251-1376							
Requires Use of Best Available Treatment Technology (BACT)	40 CFR 122	Use of best available technology economically achievable is required to control discharge of toxic pollutants to POTW	-	-	RA	RA	RA	RA
National Pollutant Discharge Elimination System Permit Regulations	40 CFR 122 Subpart C.	Use of best available technology economically achievable for toxic pollutants discharged to a POTW.	-	-	RA	RA	RA	RA
Discharge must be Consistent with the Requirements of a Water Quality Management Plan Approved by EPA	40 CFR 122	Discharge must comply with EPA-approved Water Quality Management Plan	-	-	RA	RA	RA	RA
Superfund Amendments and Reauthorization Act (SARA)	42 U.S.C. Sect 9601 et seq	Discharge must comply with Federal Water Quality Criteria.						
Discharge must not increase contaminant concentrations in offsite surface water	Section 121 (d)(2)(B)(i)	Selected remedial action must establish a standard of control to maintain surface water quality.	-	-	RA	RA	RA	RA

**TABLE 2.9**  
**ACTION-SPECIFIC ARARs**  
**GROUNDWATER**  
**(continued)**

STANDARD, REQUIREMENT CRITERIA, OR LIMITATION	CITATION	DESCRIPTION	ALTERNATIVE					
			GW1	GW2	GW3	GW4	GW5	GW6
STATE								
North Carolina Water Quality Standards	NCAC-15A-2B	Surface Water quality standards	-	-	RA	RA	RA	RA
North Carolina Groundwater Standards	NCAC-15A-2L	Groundwater quality standards, regulates injection wells	-	-	RA	RA	RA	RA
Wastewater Discharge to Surface Waters	NCAC-15A-2H	Regulates surface water discharge and discharges to POTW.	-	-	RA	RA	RA	RA
North Carolina Air Pollution Control Requirements	NCAC-15A-2D	Air pollution control air quality and emissions standards	-	-	-	RA	RA	RA

RA - Relevant and Appropriate

**TABLE 2 9**  
**ACTION-SPECIFIC ARARs**  
**SOILS**

STANDARD, REQUIREMENT CRITERIA, OR LIMITATION	CITATION	DESCRIPTION	ALTERNATIVE						
			SS1	SS2	SS3	SS4	SS5	SS6	SS7
FEDERAL									
DISPOSAL - TREATED RESIDUE									
REPLACED ONSITE									
RESOURCE CONSERVATION AND RECOVERY ACT, as amended (RCRA)	42 U.S.C. Sect 6901 et seq								
Classification of Hazardous Waste	40 CFR 261	Federal requirements for classification and identification of hazardous wastes	-	-	RA	RA	RA	RA	RA
Land Disposal Ban	40 CFR 268.10-12 40 CFR 268 (Subpart D)	Disposal of contaminated soil and debris resulting from CERCLA response actions are subject to federal and disposal prohibitions.	-	-	RA	RA	RA	RA	RA
SOIL TREATMENT									
RESOURCE CONSERVATION AND RECOVERY ACT, as amended (RCRA)	40 U.S.C. Sect 1609 et seq								
Identification of Hazardous Waste	40 CFR 261	Federal requirements for classification and identification of hazardous wastes.	-	-	RA	RA	RA	RA	RA
Treatment of Hazardous Wastes in a Unit	40 CFR 264.601	Rules and requirements for the treatment of hazardous wastes.	-	-	RA	RA	RA	RA	RA
Requirements for Generation, Storage, Transportation, and Disposal of Hazardous Waste	40 CFR 264	Regulates storage, transportation, and operation of hazardous waste generators.	-	-	RA	RA	RA	-	RA
Land Disposal Restrictions	40 CFR 268.10-12 40 CFR 268 (Subpart D)	Establishes treatment standards for hazardous wastes.	-	-	RA	RA	RA	-	RA



**TABLE 2.9**  
**ACTION-SPECIFIC ARARs**  
**SOILS**  
**(continued)**

STANDARD, REQUIREMENT CRITERIA, OR LIMITATION	CITATION	DESCRIPTION	ALTERNATIVE						
			SS1	SS2	SS3	SS4	SS5	SS6	SS7
<u>CLEAN AIR ACT</u>									
Air Use Approval	40 CFR 60 (Subpart A)	Requires notification and performance testing by owner or operator.	-	-	RA	RA	RA	-	RA
Particulate Discharge Limitations and Performance Testing	40 CFR 60 (Subpart B)	Defines limitations for particulate emissions, test methods, and monitoring requirements for incinerators.	-	-	-	-	RA	-	RA
<u>State</u>									
North Carolina Hazardous Waste Management Rules	NCAC - 15A-13A	Siting and design requirements for hazardous waste TSDs.	-	RA	RA	RA	RA	-	RA
North Carolina Air Pollution Control Requirements	NCAC-15A-2D	Air pollution control, air quality, & emissions control standards.	-	-	-	RA	RA	-	RA
North Carolina Sedimentation Control Rules	NCAC-15A-4	Requirements for prevention of sedimentation pollution.	-	-	RA	RA	RA	-	RA

RA - Relevant and Appropriate

**Table 3 0**  
**Potential Chemical-Specific ARARs**

<u>Standard, Requirement Criteria or Limitation</u>	<u>Citation</u>	<u>Description</u>	<u>Applicable/ Relevant and Appropriate</u>	<u>Comment</u>
<u>Federal</u> Safe Drinking Water	40 USC Sect. 300			
National Primary Drinking Water Standards	40 CFR Part 141	Established health-based standards for public water systems (maximum contaminant levels).	No/Yes	The MCLs for organic and inorganic contaminants are relevant and appropriate for groundwater at the site since it is a potential drinking water source.
National Secondary Drinking Water Standards	40 CFR Part 143	Establishes welfare-based standards for public water systems (secondary maximum contaminant levels).	No/No	The secondary MCLs for inorganic contaminants in groundwater are "to be considered" guidelines.
Maximum Contaminant Level Goals	Pub. L. No 99-399, 100 Stat. 642 (1986)	Establishes drinking water quality goals set at levels of no known or anticipated adverse health effect.	No/Yes	Proposed MCLGs for organic and inorganic contaminants are relevant and appropriate for groundwater potentially used for drinking water.

**Table 3 0 (continued)**  
**Potential Chemical-Specific ARARs**

<u>Standard, Requirement Criteria or Limitation</u>	<u>Citation</u>	<u>Description</u>	<u>Applicable/ Relevant and Appropriate</u>	<u>Comment</u>
<u>Federal (continued)</u> <u>Clean Water Act</u>	33 USC Sect. 1251-1376			
Water Quality Criteria	40 CFR Part 131	Sets criteria for water quality based on toxicity to aquatic organisms and human health.	No/Yes	The AWQC for organic and inorganic contaminants are relevant and appropriate
Resource Conservation and Recovery Act (RCRA), as amended	42 USC 6905, 6912, 6924, 6925			
RCRA Groundwater Protection	40 CFR Part 264	Provides for groundwater protection standards, general monitoring requirements and technical requirements.	No/Yes	The RCRA MCLs are relevant and appropriate for groundwater at the site.
RCRA SWMU Requirements	40 CFR Part 254.3-4	Provides for protection of groundwater at solid waste management unit.	Yes/No	May be applicable if remedial action includes provisions for an on-site landfill.
Solid Waste Disposal Act	42 U.S.C. 6901 et seq.			
Land Disposal	40 CFR Part 268	Established a timetable for restriction of land disposal of hazardous materials	No/Yes	May be applicable if hazardous materials are disposed of.
Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA)	42 U.S.C. 9601 et seq.	Provides for response to hazardous substances released into the environment and the cleanup of inactive hazardous waste disposal sites.	Yes/Yes	

**Table 3 0 (continued)**  
**Potential Chemical-Specific ARARs**

<u>Standard, Requirement Criteria or Limitation</u>	<u>Citation</u>	<u>Description</u>	<u>Applicable/ Relevant and Appropriate</u>	<u>Comment</u>
<u>Federal (continued)</u>				
Clean Air Act	40 USC 1857			
National Primary and Secondary Ambient Air Quality Standards	40 CFR Part 50	Sets primary and secondary air standards at levels to protect public health and public welfare.	No/Yes	May be relevant or appropriate if on-site treatment units are part of remedial actions.
National Emissions Standards for Hazardous Air Pollutants (NESHAPs)	40 CFR Part 61	Provides emissions standard for hazardous air pollutants for which no ambient air quality standard exists.	No/Yes	May be relevant or appropriate if on-site treatment units are part of remedial actions.
Occupational Safety and Health Administration	29 CFR 1910 Part 120	Provides safety rules for handling specific chemicals for site workers during remedial activities.	Yes/No	Health and Safety requirements are applicable to all potential remedial actions.

**Table 3 0 (continued)**  
**Potential Chemical-Specific ARARs**

<u>Standard, Requirement Criteria or Limitation</u>	<u>Citation</u>	<u>Description</u>	<u>Applicable/ Relevant and Appropriate</u>	<u>Comment</u>
<u>Federal (continued)</u>				
Department of Transportation (DOT) Hazardous Materials Transportation Act	49 USC 1801	Regulates off-site transportation of specific hazardous chemicals and wastes.	Yes/No	Regulations for transport of contaminated media off-site are applicable to potential activities at the site.
<u>State</u> North Carolina Water Quality Control Standards	15A NCAC 2B	Establishes water quality requirements applicable to all surface waters of North Carolina which protect public health and the environment.	Yes/Yes	Guidelines for allowable levels of toxic organic and inorganic compounds in surface water after a discharge is mixed with a receiving stream.
North Carolina Drinking Water Act	130A NCAC 311-327	Regulates water systems within the State which supply drinking water that may affect the public health.	No/Yes	Provides the State with the authority needed to assume primary enforcement responsibility under the federal act.

Table 3 0 (continued)  
Potential Chemical-Specific ARARs

<u>Standard, Requirement Criteria or Limitation</u>	<u>Citation</u>	<u>Description</u>	<u>Applicable/ Relevant and Appropriate</u>	<u>Comment</u>
<u>State (continued)</u>				
North Carolina Drinking Water and Groundwater Standards	15A NCAC Chapter 2L	Establishes groundwater classification and water quality standards.	Yes/No	Guidelines for allowable levels of toxic organic and inorganic compounds in groundwater after a discharge.
North Carolina Solid and Hazardous Waste Management Act	130 A NCAC			
North Carolina Comprehensive Environmental Response Act	130A 310.1-310.23			

activities and inhabitation of residential dwellings on the Site. Based on the risk assessment findings, neither surficial nor subsurface soils pose an unacceptable risk to human health. Under current conditions, the greatest cumulative risk to the exposure to contaminated surficial soils is for a trespasser at  $6.9 \times 10^{-7}$ . Under future conditions, the greatest cumulative risk to the exposure to surficial soil is  $4.1 \times 10^{-6}$  for a child living on the Site. There is no current cumulative risk associated with the subsurface soils as there are no complete exposure pathways. Under future conditions, the greatest cumulative risk to the exposure to contaminated subsurface soils is  $3.9 \times 10^{-6}$  for a construction worker. The cumulative Hazard Index to the exposure to either surficial or subsurface soils is less than one (1).

As specified in the Administrative Record, the levels of contaminants in the unsaturated soils will continue to adversely impact the quality of the groundwater above ARARs for an estimated 200 years. Therefore, soil remediation goals, based on the ability of these contaminants to migrate through the soils and leach into the underlying groundwater, were developed. The remediation levels were generated by the "Multimedia Leaching" model. In comparing the remediation goals based on leachability to the remediation goals to protect human health to a risk level of  $1 \times 10^{-6}$ , the health based cleanup goal for benzo-A-pyrene was more protective than the leachability remediation goal and was therefore included in Table 31. Table 31 presents the remediation goals for contaminants in the unsaturated soils.

#### 9.1.2.2 Groundwater

As stated earlier, the groundwater at the Benfield site is designated as Class GA by the State and Class IIB by EPA. Since this groundwater is a potential source of drinking water, it needs to be remediated to a level protective of public health and the environment.

The Safe Drinking Water Act and North Carolina Administrative Code, Title 15, Subchapter 2L (NCAC 15:02L.0202) establish maximum concentration levels (MCLs) and non-zero maximum contaminant level goals (MCLGs) for numerous organic and inorganic constituents. For contaminants that do not have either a Federal or State cleanup goal, risk based remediation goals numbers were calculated. The cleanup goals to be obtained at the Benfield site along with the source for the stated goals are shown in Table 32. The most stringent State or Federal requirements were included in this table.

#### 9.1.2.3 Surface Waters

The RI determined that Browning Branch is not currently being adversely impacted by the Site. Therefore surface waters are not in violation of the Federal Ambient Water Quality Criteria (AWQC, EPA, 1986) or the State of North Carolina Water Quality Standards. These ARARs protect human health and aquatic organisms. However, because there is a potential for contaminated groundwater to naturally discharge to Browning Branch, additional surface water samples will be collected from Browning Branch and analyzed during the

TABLE 31 SOIL REMEDIATION LEVELS

Contaminant	Maximum Soil Concentration (mg/kg)	Soil Remediation Level (mg/kg)	Source for Remediation Level
<u>SEMI-VOLATILE ORGANICS</u>			
<u>Carcinogenic PAHs</u>			
Benzo(A)Anthracene	33.0	0.8	L
Benzo-A-Pyrene	14.0	0.3	H
Benzo(B and/or K)Fluoranthene	31.0	1.6	L
Chrysene	23.0	1.6	L
Indeno (1,2,3-CD)Pyrene	5.1	2.8	L
Naphthalene	120.0	10.0	L
Pentachlorophenol	19.0	1.0	L
<p>H -- Remediation Goal to Achieve a Cancer Risk of <math>1 \times 10^{-6}</math></p> <p>L -- Remediation Goal to Protect Groundwater from Concentrations Above Groundwater ARARs</p>			

RD and if warranted, during the Remedial Action (RA) phase. This additional data will allow the quality of this stretch of Browning Branch to be monitored. If levels of contaminants detected exceed those provided Table 33, then additional investigation of Browning Branch will be warranted (refer to Section 11.3)

If determined to be necessary in the RD, any discharge of water to Browning Branch will meet the substantive requirements of a National Pollution Discharge Elimination System (NPDES) discharge permit.

#### 9.1.2.4 Sediment

There are no promulgated Federal or State quality standards for sediments; however, guidelines developed by the National Oceanic and Atmospheric Administration (NOAA) are deemed "To Be Considered" (TBC) are listed in Table 34. No Site related contaminants were detected in the sediment downstream of the Site in Browning Branch, but as discussed in Section 7.3, elevated levels of PAHs were detected in a sediment sample collected beneath a railroad bridge crossing Browning Branch. The railroad bridge is constructed of creosote treated railroad ties. The Hazard Indices under



**TABLE 32 GROUNDWATER REMEDIATION LEVELS**

Contaminant	Maximum Concentration Detected (ug/l)	Remediation Level (ug/l)	Source
<b><u>VOLATILE ORGANICS</u></b>			
Benzene	20	5	A
Chlorobenzene	100	100	A
1,2-Dichloropropane	6	0.56	C
Vinyl Chloride	53	0.015	C
Total Xylenes	1,800	400	C
<b><u>SEMI-VOLATILE ORGANICS</u></b>			
Carbazole	380	5	D
Carcinogenic PAHs:			
Benzo(B and/or K)Fluoranthene	63	0.2	B
Benzo(A)Anthracene	77	0.1	B
Benzo-A-Pyrene	31	0.2	A
Chrysene	56	0.2	B
Indeno (1,2,3-CD)Pyrene	12	0.4	B
1,4-Dichlorobenzene	6	1.8	C
Naphthalene	2,500	100	D
Pentachlorophenol	89	1	A
<b><u>INORGANICS</u></b>			
Antimony	83	6	A
Barium	8,100	1,000	C
Beryllium	15	4	A
Chromium	740	50	C
Lead	380	15	E
Manganese	18,000	50	C
Nickel	380	100	A
Vanadium	1,100	200	D
<b>SOURCES OF SPECIFIED REMEDIATION GOAL</b> A - MCL B - Proposed MCL, Phase V Rule C - State Groundwater Quality Standards (NCAC 15-2L.0202) D - Health-Based Remediation Goal (Protective to 10 <sup>-6</sup> ) E - EPA, Region IV Established Action Level			

current and future exposure scenarios is less than or equal to  $8.1 \times 10^{-2}$ . The greatest carcinogenic cumulative risk under current conditions is  $3.8 \times 10^{-6}$  and  $4.2 \times 10^{-6}$  under future conditions. This risk is within the Agency's acceptable risk range of  $10^{-4}$  to  $10^{-6}$ , therefore the sediment in this area will not be remediated.

Additional sediment samples will be collected in association with the surface water samples discussed above. If the concentration of contaminants detected in the sediment exceed the levels listed in Table 34, then additional investigation of Browning Branch will be warranted (refer to Section 11.3)

TABLE 33 SCREENING CRITERIA FOR SURFACE WATER	
Chemical	Permissible Level*
<u>ORGANICS</u>	
Benzene	71.4 ug/l
PAHs	0.0311 ug/l
Vinyl Chloride	525 ug/l
<u>INORGANICS</u>	
Barium	1,000 ug/l
Beryllium	6.5 ug/l
Chromium (total)	50 ug/l
Lead	25 ug/l
Manganese	50 ug/l
Nickel	88 ug/l
* - Freshwater Quality Standards Obtained from North Carolina Administrative Code, Title 15A, Subchapter 2B (NCAC 15A:02B)	

### 9.1.3 Location-Specific ARARs

Location-specific ARARs are design requirements or activity restrictions based on the geographical and/or physical positions of the Site and its surrounding area. These requirements and/or restrictions can be stipulated by Federal, State, or local governments. Table 35 lists the location-specific ARARs that apply at the Benfield site.

**TABLE 34 SCREENING CRITERIA FOR SEDIMENT**

Chemical	Permissible Level* (NOAA ER-L/ER-M)
<b><u>ORGANICS</u></b>	
Phenanthrene	0.225/1.38 mg/kg
Anthracene	0.085/0.96 mg/kg
Fluoranthene	0.6/3.6 mg/kg
Pyrene	0.35/2.2 mg/kg
Benzo(A)Anthracene	0.23/1.6 mg/kg
Chrysene	0.4/2.8 mg/kg
Benzo(A)Pyrene	0.4/2.5 mg/kg
Dibenzo(A,H)Anthracene	0.06/0.26 mg/kg
<b><u>INORGANICS</u></b>	
Copper	70/390 mg/kg
Lead	35/110 mg/kg
Nickel	30/50 mg/kg
Zinc	120/270 mg/kg
<p>* - Guidelines developed by National Oceanic and Atmospheric Administration (NOAA) to protect aquatic life</p> <p>ER-L (Effects Range-Low)</p> <p>ER-M (Effects Range-Median)</p>	

## **9.2 REMEDIAL ALTERNATIVES TO ADDRESS SOIL CONTAMINATION**

Seven (7) alternatives were developed to address soil contamination at the Site. They are list below:

Alternative SS1:	No Action
Alternative SS2:	RCRA Cap
Alternative SS3:	Soil Washing/Slurry Biotreatment
Alternative SS4:	Solvent Extraction
Alternative SS5:	On-site Incineration
Alternative SS6:	In-situ Bioremediation
Alternative SS7:	Off-site Incineration

**Table 3 5**  
**Potential Location - Specific ARARs**

<u>Standard, Requirement Criteria or Limitation</u>	<u>Citation</u>	<u>Description</u>	<u>Applicable/ Relevant and Appropriate</u>	<u>Comment</u>
<u>Federal</u> Resource Conservation and Recovery Act (as amended)	42 USC 6901			
Location Standards	40 CFR 264.18(b)	A TSD facility must be designed, constructed, operated, and maintained to avoid washout.	No/Yes	Potential remedial alternatives within the 100-year floodplain. Requirement is relevant and appropriate.
Fish and Wildlife Coordination Act	16 USC 661-666			
Floodplain Management Executive Order	Executive Order 11988; 40 CFR 6.302	Actions that are to occur in floodplain should avoid adverse effects, minimize potential harm, restore and preserve natural and beneficial value.	Yes/No	Remedial actions are to prevent incursion of contaminated groundwater onto forested floodplain.

**Table 3 5 (continued)**  
**Potential Location-Specific ARARs**

<u>Standard, Requirement Criteria or Limitation</u>	<u>Citation</u>	<u>Description</u>	<u>Applicable/ Relevant and Appropriate</u>	<u>Comment</u>
<b><u>Federal (continued)</u></b>				
<b>Endangered Species Act</b>	<b>16 USC 1531</b>	<b>Requires action to conserve endangered species or threatened species, including consultation with the Department of Interior.</b>	<b>No/No</b>	<b>No threatened or endangered species or critical habitats were identified in or near the site.</b>
<b>Clean Water Act</b>	<b>33 USC Sect. 1251</b>			
<b>Dredge or Fill Requirements (Section 404)</b>	<b>40 CFR 230</b>	<b>Requires permit for discharge of dredged or fill material into aquatic environment.</b>	<b>No/No</b>	<b>No alternative will be developed which will discharge dredge or fill material into an aquatic environment.</b>
<b>Rivers and Harbors Act of 1889 Section 10 permit</b>	<b>33 USC Sect. 403</b>	<b>Requires permit for structures or work in or affecting navigable waters.</b>	<b>No/No</b>	<b>No alternative involves work that would affect a navigable waterway.</b>

**Table 3 5 (continued)**  
**Potential Location-Specific ARARs**

<u>Standard, Requirement Criteria or Limitation</u>	<u>Citation</u>	<u>Description</u>	<u>Applicable/ Relevant and Appropriate</u>	<u>Comment</u>
<b><u>Federal (continued)</u></b>				
<b>Wilderness Act</b>	<b>16 USC 1311</b>	<b>Area must be administered in such a way as will leave it unimpaired as wilderness and will preserve it as a wilderness.</b>	<b>No/No</b>	<b>No wilderness areas exist onsite or adjacent to the site.</b>
<b>National Wildlife Refuge System</b>	<b>16 USC 668 50 CFR 27</b>	<b>Restricts activities within National Wildlife Refuge.</b>	<b>No/No</b>	<b>No wildlife refuge areas exist onsite or adjacent to the site.</b>
<b><u>State</u> North Carolina Sedimentation Pollution Control Act</b>	<b>General Statistics of North Carolina, Chapter 113A, Article 4</b>	<b>Establishes mandatory standards for control of sedimentation and erosion in streams and lakes.</b>	<b>No/No</b>	<b>No alternative will be developed which discharges sediment into stream.</b>

#### 9.2.1 SS1: No Action

The No Action alternative is included, as required by CERCLA and the National Contingency Plan (NCP), to serve as a baseline for comparing the benefits achieved through the other source control measures. Under the no action alternative, the Site would be left "as is" and no monitoring, control, treatment, or any other type remedial activity would occur at the Site.

A slight reduction in the levels of contamination may occur over time through natural process; however, the contaminants in the soil would continue to contribute contamination of the groundwater above groundwater cleanup goals for up to 200 years. Short-term effectiveness presents no additional risks to public health or the environment. This alternative would not significantly reduce the toxicity, mobility, or volume (TMV) of the contaminants.

Contaminated Site soils do not pose an unacceptable risk to either human health or the environment under current or potential future conditions; however, unless the levels of contamination are not reduced to those specified in Table 31, groundwater will be adversely impacted above groundwater cleanup goals for the next 200 years.

The No Action alternative could be readily implemented, and would not hinder any future remedial actions. There are no construction or operation and maintenance (O&M) costs associated with this alternative; therefore, the total present worth (PW) costs is zero.

Capital Costs:	\$ 0
PW O&M Costs:	<u>\$ 0</u>
Total PW Costs:	\$ 0

Time to Implement:	None
Estimated Period of Operation:	30 years

#### 9.2.2 Alternative SS2: RCRA Cap

This alternative requires the construction of a RCRA multi-layer cap over the contaminated soils and the installation of surface drainage controls. This alternative also involves the implementation of institutional controls to help prevent direct contact and incidental ingestion of contaminated soil by the general public. The institutional controls consist of maintaining the 6-foot chain-linked security fence installed around the Site during the RI and displaying warning signs in obvious locations to alert the public of potential hazards. Future use of the property would also be limited by the application of deed restrictions. State and local agencies would be responsible for the implementation and enforcement of these restrictions.

The RCRA multi-layer cap would consist of the following layers in ascending order: a densely compacted 2 foot-thick clay layer placed over the contaminated soils, a synthetic polyethylene liner of at least 30 mils in

thickness on top of the clay layer, a synthetic drainage layer over the synthetic liner along with a geotextile fabric to prevent clogging of the drainage layer, and finally, 18 inches of native soil and 6 inches of top-soil on top of the geotextile fabric. A vegetative cover of native grass would be established to minimize cap erosion. Figure 18 provides a plan and cross-sectional view of the cap.

Since heavy earth moving and grading equipment would be used, dust control measures would be needed to minimize short-term potential release of airborne particulates and fugitive dust. Surface drainage channels would be constructed around the perimeter of the cap to collect surface runoff and water from the drainage layer. The collected water would be drained into Browning Branch. This alternative would only reduce the mobility of the contaminants and would not reduce either the toxicity or volume of the hazardous substances present at the Site. And since hazardous materials will be left on-site, the long-term effectiveness and permanence of this alternative would be reviewed every five years as required by Section 121(c) of CERCLA.

The risks associated with this Site will be reduced by eliminating the potential for the public to come into direct contact with contaminated soil. However, due to the seasonal fluctuations in the groundwater level, this alternative would not be protective of groundwater due to this "flushing" action. No special implementation requirements or treatability studies are anticipated in order to implement this alternative.

Capital Costs:	\$867,700
PW O&M Costs:	<u>\$ 45,200</u>
Total PW Costs:	\$912,900

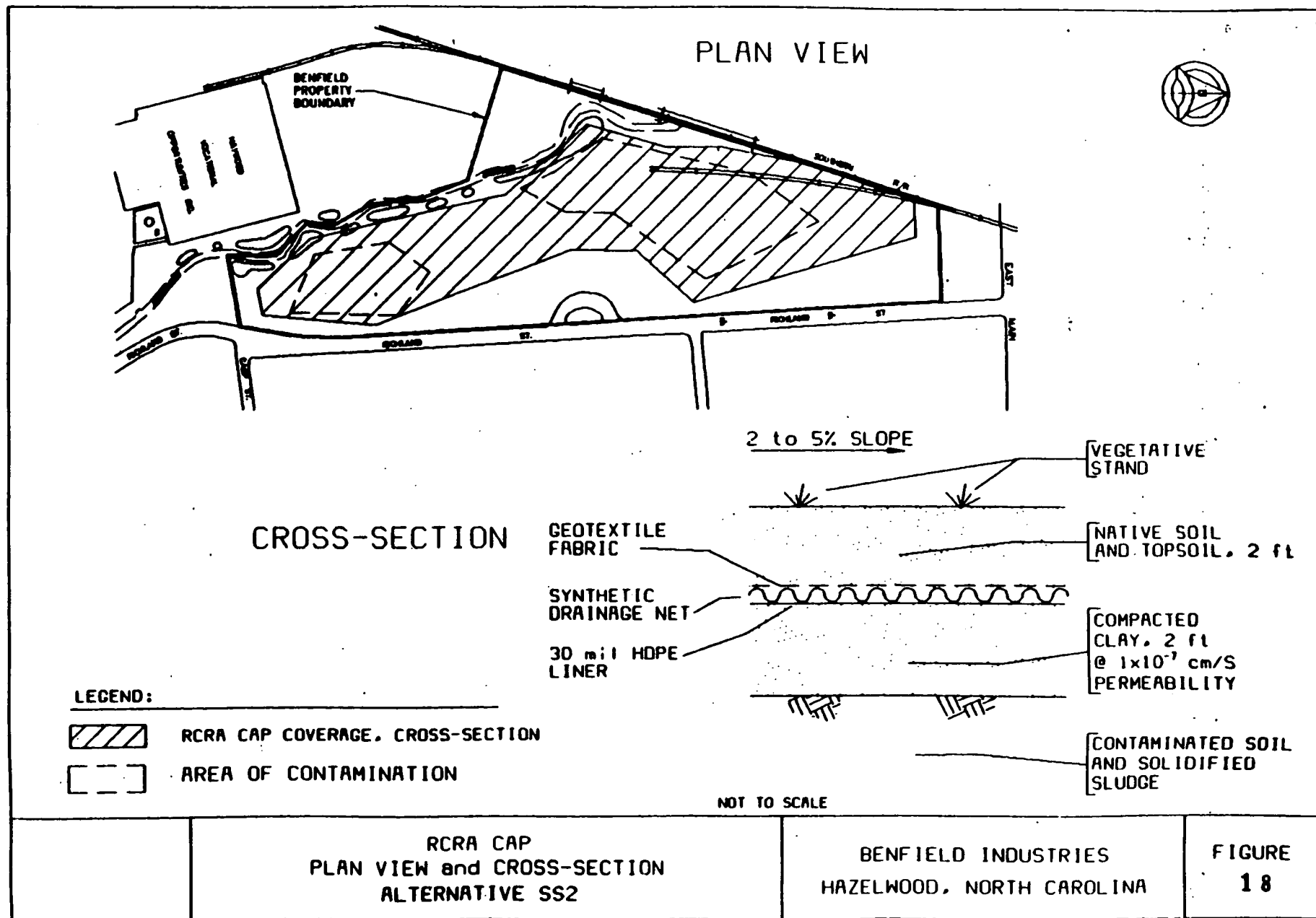
Time to Implement:	4 months
Estimated Period of Operation:	30 years

#### 9.2.3 Alternative SS3: Soil Washing/Slurry Biotreatment

This alternative involves the microbial degradation to destroy the contaminants in the soil. Prior to biotreatment, the contaminated soil will be excavated, separated and sized, and washed. The washing process will reduce the volume of contaminated soil to be remediated through the bioreactor.

Soil washing will generate two primary effluents: clean coarse fraction of soils (sand, gravel and cobbles) and a slurry containing the soil fines (silt, clay, and organic matter). As the majority of the contamination in the soil is associated with the smaller soil particles, the slurry will be transferred to a biological treatment system where bacteria will destroy the contaminants. Following confirmation sampling, coarse soil fraction and the treated soil fines will be replaced in the on-site excavations, graded, and revegetated. Any remaining hazardous waste residual will be disposed of at





an off-site, RCRA-permitted hazardous waste facility. The facility will need to be in compliance. The Water contaminated by the washing system will be treated through the groundwater treatment system.

This alternative will reduce the current risk presented by the contaminated soils by reducing the TMV of the contaminants in the soils. By obtaining the soil cleanup goals specified in Table 31, the underlying groundwater will also be protected so that MCLs for these contaminants are not exceeded.

In addition to the need for confirmation sampling, surface water runoff and fugitive dust emissions would need to be monitored and potentially controlled during implementation of this alternative. Confirmation sampling will include TCL/TAL analyses and Toxicity Characteristic Leaching Procedure (TCLP).

Treatability studies are needed to determine if additives will enhance the desorptive ability of the washing solution as well to define the optimal operationing conditions for the slurry bioreactor.

Capital Costs:	\$1,775,340
PW O&M Costs:	\$ 45,260
Total PW Costs:	\$1,820,600

Time to Implement:	12 months
Estimated Period of Operation:	4 months

#### 9.2.4 Alternative SS4: Solvent Extraction

This alternative treats the contaminated soil using a solvent or solvents to extract the contaminants of concern. Prior to solvent extraction, the contaminated soil will be excavated and separated by size. In the mixing tank, the contaminated soil is blended with the solvent. Following mixing, the cleaned soil and solvent are separated with the solvent being reused. Following confirmation sampling, the cleaned soil will be backfilled into the excavated areas, graded and revegetated.

This alternative will achieve the same benefits and degree of protection as Alternative SS3 as well as remediate the same volume of soil. In addition to the need for confirmation sampling, surface water runoff, fugitive dust emissions, and solvent emissions would need to be monitored and controlled. Confirmation sampling will include TCL/TAL analyses and TCLP.

Issues to be resolved in the RD include: determining the type(s) and volume of solvents needed, if air emissions control apparatus are needed, and determine the most cost efficient manner to dispose of the spent solvents following completion of the soil remediation process.

Capital Costs:	\$2,308,000
PW O&M Costs:	\$ 45,200
Total PW Costs:	\$2,353,200

Time to Implement:	12 months
Estimated Period of Operation:	6 months

#### 9.2.5 Alternative SS5: On-site Incineration

This alternative involves excavation and incineration of the contaminated soils in an on-site mobile incinerator and will achieve the same of level protection of public health and the environment as Alternatives SS3 and SS4. The incinerator destroys the organic contaminants in the soil. If concentrations of metals in the treated soils become too high, then these soils will be stabilized/fixated/solidified prior to replacing the soil back into the excavation areas. TCLP tests will be conducted on the ash prior to placement back in the excavated areas.

Initially, two treatability studies will be conducted during the RD. First, a trail test burn and secondly, a study to determine if contaminated cobbles can be decontaminated to the appropriate cleanup goals. A third treatability study will be needed if ash from the incinerator fails the TCLP test. If this occurs, a treatability study will be needed to optimize the chemicals to stabilized/fixated/solidified the ash prior to placement. The need to control surface water runoff and fugitive emissions during excavation would also be evaluated in the RD.

Capital Costs:	\$6,450,300
PW O&M Costs:	\$ 45,200
Total PW Costs:	\$6,495,500

Time to Implement:	8 months
Estimated Period of Operation:	4 months

#### 9.2.6 Alternative SS6: In-situ Bioremediation

This alternative employs the use of microorganisms to bioremediate the contaminated soil in place. The contact between hazardous compounds and the microbes would be enhanced by periodically flooding the soil with a nutrient/oxygen rich solution. This solution will help create the appropriate environmental conditions for the microbiological destruction of the targeted contaminants. By alternately flooding and draining the soil, the indigenous microbial population is supplied with the water and atmospheric oxygen needed to degrade the contaminants. Treated groundwater will be used to supply the flood water.

Given sufficient time, this alternative will achieve similar levels of TMV reduction as do Alternatives SS3, SS4, and SS5, however, this alternative will take an estimated 3 years to achieve these goals.

Issues to be resolved in the RD include a treatability study to optimize the watering and nutrient schedule as well as the nutrients to be added and the necessity to control surface water runoff.

Capital Costs:	\$1,020,100
PW O&M Costs:	\$ 45,200
Total PW Costs:	\$1,065,300

Time to Implement:	4 months
Estimated Period of Operation:	3 years

#### 9.2.7 Alternative SS7: Off-site Incineration

This alternative will achieve the same degree of protection as SS5 but there is an added short-term risk associated with this alternative as contaminated soils will need to be transported to the RCRA-permitted off-site incineration facility. The final disposal of the incinerated soil ash will be the responsibility of the incineration facility. The excavated areas will be backfilled with clean soil, graded, and revegetated.

A trail burn will need to be conducted during the RD. Surface water runoff and fugitive dust emissions would also need to be monitored and potentially controlled.

Capital Costs:	\$14,096,800
PW O&M Costs:	\$ 45,200
Total PW Costs:	\$14,142,000

Time to Implement:	4 months
Estimated Period of Operation:	6 months

#### 9.3 REMEDIAL ALTERNATIVES TO ADDRESS GROUNDWATER CONTAMINATION

Eight (8) alternatives were developed to address groundwater contamination at the Site. They are listed below:

Alternative GW1:	No action
Alternative GW2:	Restrict Groundwater Use and Monitor
Alternative GW3:	Groundwater Containment/Surface Water Discharge
Alternative GW4A:	Extraction, Above-ground Bioremediation, Surface Water Discharge
Alternative GW4B:	Extraction, Above-ground Bioremediation, POTW Discharge
Alternative GW5A:	Extraction, UV/OX, Surface Water Discharge
Alternative GW5B:	Extraction, UV/OX, POTW Discharge
Alternative GW6:	Extraction, Above-ground Treatment/In-Situ Bioremediation

#### 9.3.1 Alternative GW1: No action

The No Action alternative is included, as required, to serve as a baseline for comparing the benefits achieved by the other groundwater remediation alternatives. No cleanup activities are implemented to remediate the groundwater adversely impacted by past Site activities. The implementation of this remedy could begin immediately and would have no negative impact on future remedial actions.

A slight reduction in the levels of contamination may occur over time through natural processes; however, the levels in the groundwater would remain above the groundwater cleanup goals for up to 70 years. Although there is no current unacceptable risk associated with the contaminated groundwater, this situation would change immediately if a potable well was installed near the Site. The reason there is no current risk is because nobody in the vicinity of the Site is using the groundwater as a source of drinking water. However, if a potable well was installed in or near the plume, the risk would increase to  $3.1 \times 10^{-3}$ . Since this alternative does not involve any treatment or other remedial action, the reduction in the TMV of the contaminated groundwater at the Site would result from natural processes.

There are no capital costs associated with this alternative; however, O&M costs would be incurred since hazardous materials would be left on-site and Section 121(c) of CERCLA requires long-term effectiveness and permanence reviews every five years when hazardous materials are left at a site.

Capital Costs:	\$ 0
PW O&M Costs:	\$ 70,000
Total PW Costs:	\$ 70,000

Time to Implement:	None
Estimated Period of Operation:	30 years

#### 9.3.2 Alternative GW2: Restrict Groundwater Use and Monitor

Under this alternative, institutional controls will be implemented, restricting the use of the groundwater in the vicinity of the Site. The institutional controls include deed restrictions and not issuing any well drilling permits for new wells on properties which may be impacted by the contaminated groundwater plume. This would prevent future use of the aquifer for such purposes as potable and industrial water supplies, irrigation, washing, etc. State and local governments would be responsible for imposing and enforcing these restrictions.

Periodic sampling of the groundwater would take place in order to monitor changes in both contaminant concentrations as well as defining the migration of the plume. The need for additional monitoring and the frequency of the sample monitoring would be resolved in the RD.

Capital Costs:	\$120,800
PW O&M Costs:	<u>\$115,000</u>
Total PW Costs:	\$235,800

Time to Implement:	12 months
Estimated Period of Operation:	30 years

### 9.3.3 Alternative GW3: Groundwater Containment/Surface Water Discharge

This alternative involves installing extraction wells downgradient of the contaminant plume in addition to the activities included under Alternative GW2. Two (2) extraction wells pumping at a rate 3 gallons per minute (gpm) each should be able to produce a hydraulic barrier to control contaminant migration as well as capture the contaminants. The extracted groundwater would be discharged to Browning Branch following treatment. The discharged effluent would meet the substantive requirements of a NPDES permit. The point of compliance for this alternative would be the extent the plume as traveled in the aquifer.

The treatment train for the extracted groundwater would consist of a pre-treatment step to remove iron and manganese, an ion exchange unit to remove heavy metals, and a polishing step to remove any organic contaminants. A granular activated carbon (GAC) adsorption unit would be used as the organic contaminant polishing step.

The following work/information will need to be performed/generated in the RD: additional groundwater modeling and aquifer testing, a treatability study to size the groundwater treatment equipment, and a determination of how to dispose of waste streams generated by the RA. Additional hydrogeological information is needed to insure the extraction wells will accomplish their goals. Sludge generated by the aeration step is typically non-hazardous. The waste stream created by the regeneration of the ion-exchange resin and the spent GAC are both typically considered hazardous.

Capital Costs:	\$ 465,000
PW O&M Costs:	<u>\$ 877,700</u>
Total PW Costs:	\$1,342,700

Time to Implement:	6 months
Estimated Period of Operation:	30 years

### 9.3.4 Alternative GW4A: Extraction, Above-ground Bioremediation, Surface Water Discharge

This alternative involves installing extraction wells throughout the contaminant plume to actively extract groundwater for treatment as well as the activities discussed in Alternative GW2. Five (5) extraction wells pumping at a rate 3 gpm are anticipated to obtain the remedial action objective of this alternative. The extracted groundwater would be discharged

to Browning Branch following treatment. The discharged effluent would meet the substantive requirements of a NPDES permit. The point of compliance for this alternative is the entire Site.

The treatment train for the extracted groundwater would consist of a pre-treatment step to remove iron and manganese, an ion exchange unit to remove heavy metals, submerged fixed film reactors (SFFRs) to provide primary organic removal, and a polishing step to remove any residual organic contaminants. A GAC adsorption unit would be used as the organic contaminant polishing step.

Effluent will be discharged to Browning Branch and monitored to insure compliance with NPDES discharge requirements.

The following information will be generated in the RD: additional groundwater modeling and aquifer testing to insure the extraction wells will accomplish their goals, evaluate adequacy of existing groundwater monitoring system and install additional monitoring wells if necessary, a treatability study to size the equipment to treat the extracted groundwater, and decide on what to do with the typically non-hazardous sludge generated by the aeration step, the typically hazardous waste stream created by the regeneration of the ion-exchange resin, the generally non-hazardous organic sludge from the SFFRs, and the spent GAC.

Capital Costs:	\$ 819,300
PW O&M Costs:	<u>\$1,172,700</u>
Total PW Costs:	\$1,992,000

Time to Implement:	6 months
Estimated Period of Operation:	30 years

#### 9.3.5 Alternative GW4B: Extraction, Above-ground Bioremediation, Publicly Owned Treatment Works (POTW) Discharge

Alternative GW4B is identical to Alternative GW4A, except for the discharge option and the need for the polishing step. Under this alternative, treated groundwater will be discharged to the City of Waynesville POTW, instead of Browning Branch. Because the water will be further treated by the POTW, the need for the organic polishing step may be deleted. The actual on-site treatment requirements will be dictated by the pretreatment standards established by the Waynesville POTW. User fees, based on the discharge rate, will be required to discharge to the POTW. The effluent will be monitored to assure compliance with the pretreatment standards established by the POTW.

Capital Costs:	\$ 667,400
PW O&M Costs:	<u>\$1,166,100</u>
Total PW Costs:	\$1,833,500

Time to Implement:	6 months
Estimated Period of Operation:	30 years

#### 9.3.6 Alternative GW5A: Extraction, UV/OX, Surface Water Discharge

The only difference between this alternative and Alternative GW4A is the technology to provide the primary treatment for the organics in the extracted groundwater. Under this alternative, an ultra-violet/oxidation (UV/OX) process will provide the permanent destruction of the organic contaminants of concern. To assure compliance with NPDES discharge requirements, the effluent will be monitored. The point of compliance, the need for treatability studies, and level of protection obtained by this alternative is the same as for Alternative GW4A.

Capital Costs:	\$ 699,600
PW O&M Costs:	<u>\$1,486,600</u>
Total PW Costs:	\$2,186,200

Time to Implement:	6 months
Estimated Period of Operation:	30 years

#### 9.3.7 Alternative GW5B: Extraction, UV/OX, POTW Discharge

The only difference between this alternative and Alternative GW4B is the technology to provide the primary treatment for the organics in the extracted groundwater. Under this alternative, an UV/OX process will provide the permanent destruction of the organic contaminants of concern. To assure compliance with the pretreatment discharge requirements established by the POTW, the effluent will be monitored. The point of compliance, the need for treatability studies, and level of protection obtained by this alternative is the same as for Alternative GW4B.

Capital Costs:	\$ 646,200
PW O&M Costs:	<u>\$1,547,900</u>
Total PW Costs:	\$2,194,100

Time to Implement:	6 months
Estimated Period of Operation:	30 years

#### 9.3.8 Alternative GW6: Extraction, Above-ground Treatment/In-Situ Bioremediation

Alternative GW6 combines in-situ bioremediation with above-ground treatment. The process involves extracting contaminated groundwater (identical to Alternatives GW4A, GW4B, GW5A, and GW5B) and pumping the contaminated groundwater to an on-site treatment facility (as described in Alternative GW4A). The treatment consists of pretreatment (aeration), heavy metals removal (ion exchanged), biotreatment (SFFR), and granular activated carbon adsorption for polishing. The treated effluent then flows to a holding tank where hydrogen peroxide and nutrients are added prior to reintroducing the water back into the aquifer in the upgradient portion of the Site. The nutrient enriched water reintroduced into the underlying aquifer will promote and enhance indigenous microorganisms to degrade contaminants in-situ.



This alternative provides three additional benefits that none of the previous groundwater alternatives provide: destruction of the contaminant fraction, that is uncoverable using standard pumping methods (in-situ bioremediation), creation of a flushing action by reintroducing the extracted groundwater back into the aquifer upgradient of the Site, and achievement of the groundwater cleanup goals in a more timely fashion.

Several additional treatability studies will need to be conducted in addition to the treatability studies called for under Alternative GW4A. They include identifying and optimizing the necessary concentrations of nutrients to be added and determining what percentage of the treated groundwater can be re-introduced back into the aquifer. It is anticipated that 100 percent of the extracted groundwater will be reintroduced back into the aquifer; however, it may be necessary to discharge up to 25 percent to either Browning Branch (meeting the substantiative requirements of a NPDES permit), or to the Waynesville POTW meeting their pretreatment requirements.

Capital Costs:	\$ 880,200
PW O&M Costs:	<u>\$ 379,100</u>
Total PW Costs:	\$1,259,300

Time to Implement:	6 months
Estimated Period of Operation:	5 years

## 10.0 SUMMARY OF COMPARATIVE ANALYSIS OF ALTERNATIVES

Section 9.0 describes the remedial alternatives that were considered in the detailed analysis of alternatives. This section summarizes the detailed evaluation of these remedial alternatives in accordance to the nine (9) criteria specified in the NCP. Table 36 quantitatively summarizes the comparative analysis.

### 10.1 THRESHOLD CRITERIA

In order for an alternative to be eligible for selection, it must be protective of both human health and the environment and comply with ARARs, unless either one or both of these requirements are waived. If an alternative fails to protect human health or the environment, or does not comply with ARARs, then this alternative cannot be selected. Below is a discussion of the screened alternatives in comparison with these two threshold criteria.

#### 10.1.1 Overall Protection of Human Health and the Environment

This criterion assesses the alternatives to determine whether they can adequately protect human health and the environment from unacceptable risks posed by the contamination at the Site. This assessment considers both the short-term and long-term time frames.

**TABLE 3 6**  
**COMPARATIVE ANALYSIS SUMMARY**  
**REMEDIAL ALTERNATIVES FOR CONTAMINATED SOILS**

Alternative	Criteria Rating (a)						Present Worth		
	Protection of Human Health and the Environment	Compliance with ARAR's	Long Term Effectiveness and Permanence	Reduction in Toxicity, Mobility, and Volume	Short-Term Effectiveness	Implementability	Baseline	Cost Sensitivity	
								(b) Minimum	(c) Maximum
SS1 No Action	0	0	0	0	n/a	n/a	\$0	—	—
SS2 RCRA Cap	2	2	2	1	4	5	\$912,900	\$314,300	—
SS3 Slurry Bioremediation	5	5	5	5	5	5	\$1,820,600	\$996,400	—
SS4 Solvent Extraction	5	5	5	5	5	5	\$2,353,200	\$935,800	\$3,073,500
SS5 Onsite Incineration	5	5	5	5	5	5	\$6,495,500	\$2,267,600	—
SS6 In Situ Bioremediation	3	4	4	4	3	4	\$1,065,300	\$864,400	\$1,608,800
SS7 Offsite Incineration	5	5	5	5	5	5	\$14,142,000	\$4,743,800	—

(a) A ranking of '0' indicates complete noncompliance with criteria while a ranking of '5' indicates complete compliance.

(b) Estimate assumes a reduced volume and area of contamination due to reduced remedial goals of exp -6 cancer risk factor.

(c) Estimate assumes treatment requirements in addition to those originally estimated.

**TABLE 3 6**  
**COMPARATIVE ANALYSIS SUMMARY**  
**REMEDIAL ALTERNATIVES FOR CONTAMINATED GROUNDWATER**

Alternative	Criteria Rating (a)						Present Worth		
	Protection of Human Health and the Environment	Compliance with ARAR's	Long Term Effectiveness and Permanence	Reduction in Toxicity, Mobility, and Volume	Short-Term Effectiveness	Implementability	Baseline	Cost Sensitivity	
								(b) Minimum	(c) Maximum
GW1 No Action	0	0	0	0	n/a	n/a	\$0	—	—
GW2 Use Restrictions	2	1	2	0	2	2	\$235,800	—	\$353,700
GW3 Containment	3	2	2	2	3	5	\$1,342,700	\$633,100	\$1,882,000
GW4A Bioreat SW Discharge	4	5	4	4	4	4	\$1,992,000	\$659,800	\$2,849,300
GW4B Bioreat POTW Disch.	4	5	4	4	4	5	\$1,883,500	\$659,800	\$2,575,400
GW5A UV/OX SW Discharge	4	5	4	4	4	4	\$2,186,200	\$659,800	\$2,654,000
GW5B UV/OX POTW Discharge	4	5	4	4	4	5	\$2,194,100	\$659,800	\$2,911,200
GW6 In-Situ Bioremediation	5	5	5	5	5	3	\$1,259,300	—	\$1,930,400

(a) A ranking of '0' indicates complete noncompliance with criteria while a ranking of '5' indicates complete compliance.

(b) Estimate assumes that local POTW will accept untreated discharge from site.

(c) Estimate assumes that plume volume is twice as large as that predicted by computer model.

Number of extraction wells were doubled to insure containment of plume.

As documented in the risk assessment, Site soils and the sediment in Browning Branch do not pose an unacceptable risk to human health under either current or future conditions at the Site. However, Site soils will continually adversely impact the quality of the underlying groundwater above MCLs for the next 200 years. Therefore, the potential risk due to Site soils is to the groundwater through the leaching of contaminants from the soil into the groundwater.

Alternative SS1 (no action) is protective of human health and the environment under current conditions; however this alternative may not be protective under future conditions. Upon implementation, Alternative SS2 would prevent precipitation from leaching contaminants from the soil into the groundwater, but the cap would not prevent the groundwater from coming into contact with contaminated soil due to seasonal fluctuations in groundwater elevation. Alternatives SS-3 through SS5 and SS7 would eliminate any risks associated with the soil contamination as well as mitigate any further degradation of the groundwater. Alternative SS6 does not immediately mitigate the migration potential to groundwater of contaminants above health-based risk levels, but over time, this alternative would obtain this goal.

Groundwater poses no unacceptable risks to human health or the environment under current conditions; however, under the future use scenarios developed for the Site in the Risk Assessment, groundwater could pose significant risks to future residents living on the Site. The no action Alternative GW1 and Alternative GW2 would not address contaminant levels in groundwater and therefore would not be protective of human health under potential future conditions. Alternative GW3 would prevent the further migration of contaminated groundwater and given sufficient time would remediate the contaminant plume. Alternatives GW4 through GW6 actively address the plume in the aquifer, the only difference between these alternatives is the type of treatment and the discharge option for the treated groundwater. Alternative GW6 not only remediates the contaminated groundwater above-ground but also encourages in-situ biodegradation. Alternatives GW3 through GW6 would be protective of human health and the environment.

#### 10.1.2 Compliance with Applicable or Relevant and Appropriate Requirements

This criterion assesses the alternatives to determine whether they attain ARARs under federal and state environmental laws, or provide justification for waiving an ARAR. Section 9.1 defines the three types of ARARs: action-specific, chemical-specific, and location-specific. Site-specific ARARs are identified below.

There are no federal or state chemical-specific ARARs for the contaminants detected in the soils as there are no action-specific ARARs for Alternative SS1. RCRA requirements for Alternative SS2 (capping) may be relative and appropriate. All alternatives will have to meet location-specific ARARs since the Site lies in a 100-year flood plain. Alternatives SS3 through SS7 will comply with all applicable ARARs, including Land Disposal Requirements

(LDRs) by complying with and meeting Treatability Variance standards/levels. Because the LDR treatment (cleanup levels) are based on treating less complex matrices of industrial process wastes than what is present at the Benfield Site, the selected remedy will comply with the LDRs through a Treatability Variance for the contaminated soil/debris. The Treatability Variance does not remove the requirement to treat restricted soil/debris wastes: it allows the establishment of LDR standards on actual data collected from Site. LDR treatment levels will be met for the soil/debris and for any sludge or used activated carbon generated by the treatment processes. Table 37 provides the alternate treatment variance levels under LDR.

MCLs are ARARs for Site groundwater. Neither Alternatives GW1 nor GW2 would comply with this ARAR. Alternative GW3 would obtain ARARs downgradient of the Site and with time, may eventually achieve ARARs underneath the Site. Alternatives GW4 through GW6 would attain ARARs throughout the entire Site. Construction of the groundwater recovery, treatment, and discharge system for Alternatives GW3 through GW6 would satisfy action-specific ARARs. The only location-specific ARAR pertaining to these alternatives is the construction of the groundwater treatment system within a 100-year flood plain. The disposal of any sludge or spent activated carbon generated by the groundwater treatment system will also comply with ARARs.

## 10.2 PRIMARY BALANCING CRITERIA

These criteria are used to evaluate the overall effectiveness of a particular remedial alternative.

### 10.2.1 Long-Term Effectiveness and Permanence

This criterion assesses the long-term effectiveness and permanence an alternative will afford as well as the degree of certainty to which the alternative will prove successful.

Alternative SS1 would not be effective in reducing contaminant levels in the groundwater. Alternative SS2 could be effective in the long term through regular maintenance of the cap, but a review of the remedy would be required every five years since a cap is not considered to be a permanent remedy and leaves wastes in place that would adversely impact the groundwater above health protective levels. Alternatives SS3 through SS7 call for treatment of the contaminated soil and therefore, results in the highest degree of long-term effectiveness by permanently reducing the Site risks.

Under Alternatives GW1 and GW2, groundwater contamination would continue to migrate off-site; therefore these are not considered to be permanent or effective remedial solutions. The long-term effectiveness of Alternative GW3 is questionable, because of the time it would require for "Nature" to clean "Itself". This remedy relies on the naturally flowing groundwater to eventually remove all the contaminants that have entered the groundwater at

TABLE 37 ALTERNATE TREATABILITY VARIANCE LEVEL

Chemical	Concentration Range (ppm)	Threshold Concentration (ppm)	Percent Reduction Range
<b><u>ORGANICS</u></b>			
Halogenated Non-Polar Aromatics	0.5 - 10	100	90 - 99.9
Halogenated Phenols	0.5 - 40	400	90 - 99
Halogenated Aliphatics	0.5 - 2	40	95 - 99.9
Halogenated Cyclics	0.5 - 20	200	90 - 99.9
Polynuclear Aromatics	0.5 - 20	400	95 - 99
<b><u>INORGANICS</u></b>	<b><u>TCLP</u></b>	<b><u>TCLP</u></b>	
Antimony	0.1 - 0.2	2	90 - 99
Barium	0.1 - 40	400	90 - 99
Chromium	0.5 - 6	120	95 - 99.9
Lead	0.1 - 3	300	99 - 99.9
Nickel	0.5 - 1	20	95 - 99.9
Vanadium	0.2 - 20	200	90 - 99.9

Select the appropriate concentration level or percent reduction range by comparing concentrations of each constituent with the threshold concentration. If the concentration of the restricted constituent is less than the threshold concentration, the waste should be treated to within the concentration range. If the waste concentration is above the threshold, the waste should be treated to reduce the concentration of the waste to within the specified percent reduction range.

the Site. Contaminant concentrations in the groundwater will be permanently reduced through the groundwater extraction and treatment systems specified in Alternatives GW4 through GW6.

#### 10.2.2 Reduction of Toxicity, Mobility or Volume

This criterion assesses the degree to which the alternative employs recycling or treatment to reduce TMV of the contaminants present at the Site.

Contaminant levels in the soil would remain essentially unchanged under Alternatives SS1 and SS2. Alternatives SS1 and SS2 would not reduce the volume, but would reduce the mobility and effective toxicity of the contaminants. Alternative SS3 through SS7 would reduce the toxicity, mobility, and volume of contaminants in the soils through treatment.

Neither Alternatives GW1 nor GW2 would significantly reduce the toxicity, mobility, or volume of contaminants in groundwater. Alternative GW3 would slowly reduce the toxicity, mobility, or volume of contaminants in groundwater as the natural flow of groundwater beneath the Site moves the contaminants towards the containment extraction wells. Alternatives GW4 through GW6 would effectively reduce the mobility and volume of contaminants in the aquifer through groundwater recovery. The groundwater treatment systems will comply with the statutory preference for alternatives that reduce toxicity of contaminants.

#### 10.2.3 Short-Term Effectiveness

This criterion assesses the short-term impact of an alternative to human health and the environment. The impact during the actual implementation of the remedial action is usually centered under this criterion.

Both Alternative SS1 and SS2 can be implemented without significant risks to the community or on-site workers and without adverse environmental impacts. The principal short term impacts of implementing Alternatives SS3 through SS7 is the possible exposure of the community and more potentially, the on-site workers to fugitive dust and contaminant vapors during excavation and the handling of contaminated soils. Onsite workers have an added risk (dermal contact) through coming into direct contact with the contaminants in the soil. In the event of a malfunction of the incinerator (Alternatives SS5 and SS7), short term exposure to the surrounding community is possible.

All of the groundwater remediation alternatives can be implemented without significant risk to the community or on-site workers and without adverse environmental impacts.

#### 10.2.4 Implementability

This criterion assesses the ease or difficulty of implementing the alternative in terms of technical and administrative feasibility and the availability of services and materials.

No implementation is needed for the no action alternatives. Construction of the cap (Alternative SS2) would pose no significant difficulties. Alternatives SS3, SS4, and SS6 will require treatability studies to assure achievement of Site specific remedial goals and ARARs. Treatment units are available and Site conditions are suitable for on-site treatment. The literature review for these technologies indicate that they will work. Implementation of Alternatives SS5 and SS7 will require test burns.

None of the groundwater remediation alternatives pose significant concerns regarding implementation. Design of the treatment systems for Alternatives GW3 through GW6 cannot be completed until the discharge requirements are defined. This determination is dependent on where the treated groundwater will be discharged to. This decision will be finalized in the RD.

#### 10.2.5 Cost

This criterion assesses the cost of an alternative in terms of total present worth cost. Total PW was calculated by combining the capital cost plus the PW of the annual O&M costs. Capital cost includes engineering and design, mobilization, site development, equipment, construction, demobilization, utilities, and sampling/analyses. Operating costs were calculated for activities that continue after completion of construction, such as routine operation and maintenance of treatment equipment, and groundwater monitoring. The PW of an alternative is the amount of capital required to be deposited at the present time at a given interest rate to yield the total amount necessary to pay for initial construction costs and future expenditures, including O&M and future replacement of capital equipment.

Total present worth costs for the soil alternatives are:

Alternative SS1 - No Action:	\$ 0
Alternative SS2 - RCRA Cap:	\$ 912,900
Alternative SS3 - Soil Washing/Slurry Biotreatment:	\$ 1,820,700
Alternative SS4 - Solvent Extraction:	\$ 2,353,200
Alternative SS5 - On-site Incineration:	\$ 6,495,500
Alternative SS6 - In-situ Bioremediation:	\$ 1,065,300
Alternative SS7 - Off-site Incineration:	\$14,142,000

Total present worth costs for the groundwater remediation alternatives are:

Alternative GW1 - No action:	\$ 70,000
Alternative GW2 - Restrict Groundwater Use and Monitor:	\$ 235,800
Alternative GW3 - Groundwater Containment/Surface Water Discharge:	\$1,342,700
Alternative GW4A - Extraction, Above-ground Bioremediation, Surface Water Discharge:	\$1,992,000
Alternative GW4B - Extraction, Above-ground Bioremediation, POTW Discharge:	\$1,833,500
Alternative GW5A - Extraction, UV/OX, Surface Water Discharge:	\$2,186,200
Alternative GW5B - Extraction, UV/OX, POTW Discharge:	\$2,194,100
Alternative GW6 - In-Situ Bioremediation/Above-ground Treatment:	\$1,259,300



TABLE 38 REMEDIATION GOALS AND CORRESPONDING RISKS

Remediation Levels				Corresponding Risk Levels	
Chemical	Remediation Level	Point of Compliance	Basis of Goal	Chemical-Specific RME Risk	
				Cancer	Non-Cancer
<b>SOIL</b>					
Benzo(A)Anthracene	0.8 mg/kg	All	++	N/A	N/A
Benzo-A-Pyrene	0.3 mg/kg	Property	--	1 x 10 <sup>-6</sup>	N/A
Benzo(B and/or K) Fluoranthene	1.6 mg/kg	Soils	++	N/A	N/A
Chrysene	1.6 mg/kg	Except			
Indeno(1,2,3-CD)	2.8 mg/kg	for Benzo-	++	N/A	N/A
Pyrene		A-pyrene	++	N/A	N/A
Naphthalene	10.0 mg/kg	which is			
Pentachlorophenol	1.0 mg/kg	only for	++	N/A	N/A
		the top	++	N/A	N/A
		12 inches			
<b>GROUNDWATER</b>					
Benzene	5 ug/l	The	MCL	4.2 x 10 <sup>-5</sup>	N/A
Benzo(A)Anthracene	0.1 ug/l	Entire	pMCL	1.7 x 10 <sup>-6</sup>	N/A
Benzo-A-Pyrene	0.2 ug/l	Plume	MCL	3.4 x 10 <sup>-5</sup>	N/A
Benzo(B and/or K) Fluoranthene	0.2 ug/l	of	pMCL	3.4 x 10 <sup>-6</sup>	N/A
Chlorobenzene	100 ug/l	Contamin-			N/A
1,4-Dichlorobenzene	1.8 ug/l	ated	MCL	N/A	0.1
1,2-Dichloropropane	0.56 ug/l	Groundwater	State	1.2 x 10 <sup>-6</sup>	N/A
Carbazole	5 ug/l	"	State	1.0 x 10 <sup>-6</sup>	N/A
Chrysene	0.2 ug/l	"	Risk	1.4 x 10 <sup>-6</sup>	N/A
Ethylbenzene	29 ug/l	"	pMCL	3.4 x 10 <sup>-7</sup>	N/A
Indeno(1,2,3-CD)	0.4 ug/l	"	State	N/A	0.008
Pyrene		"	pMCL	6.8 x 10 <sup>-6</sup>	N/A
Naphthalene	100 ug/l	"			
Pentachlorophenol	1 ug/l	"	Risk	N/A	0.07
Total Xylenes	400 ug/l	"	MCL	3.0 x 10 <sup>-6</sup>	N/A
Vinyl Chloride	0.015 ug/l	"	State	N/A	0.0055
Antimony	6 ug/l	"	State	8.1 x 10 <sup>-6</sup>	N/A
Barium	1,000 ug/l	"	MCL	N/A	0.4
Beryllium	4 ug/l	"	State	N/A	0.5
Chromium	50 ug/l	"	MCL	1.2 x 10 <sup>-4</sup>	N/A
Lead	15 ug/l	"	State	N/A	N/A
Manganese	50 ug/l	"	Action Level	N/A	N/A
Nickel	100 ug/l	"	State	N/A	0.01
Vanadium	200 ug/l	"	MCL	N/A	0.1
			Risk	N/A	0.8

MCL/pMCL - Maximum Concentration Level/Proposed MCL, Phase V Rule

Action Level - EPA, Region IV Established Action Level

State - State Groundwater Quality Standard (NCAC 15-2L.0202)

Risk - Health-Based Remediation Goal (Protective to  $10^{-6}$ )

N/A - Not Applicable

-- - Health Based Soil Remediation Goal Protective to  $1 \times 10^{-6}$ 

++ - Soil Remediation Goal to Protect Aquifer from having Concentrations Above MCLs

a slurry containing the soil fines (silt, clay, and organic matter) and the washing solution. The optimal aqueous washing solution will be determined in a treatability study to be conducted during the RD.

Prior to placing the cleaned coarse fraction of soil back into the excavated areas, TCL, TAL, and TCLP analyses will be conducted on this fraction to insure that the performance standards have been achieved. If these soils fail, they will be rewashed until the goals are obtained.

Since contaminants are typically associated with the smaller soil particles, the contaminants will be concentrated in the slurry. The slurry will be dewatered to obtain the optimal solid/water ratio for biodegradation of the contaminants in a bioreactor. Water generated from the dewatering step will either be reused to wash additional soil or piped to the groundwater treatment system for treatment and ultimate disposal.

Water needed for the soil washing process will be obtained from the groundwater treatment system, as well as any additional make-up water needed during the operation of the soil washing process.

The optimal operating conditions for the slurry bioreactor will be determined in a treatability study to be conducted during the RD. TCL, TAL, and TCLP analyses/tests will be conducted on the bioremediated soil fines in the slurry to insure that the performance standards have been met prior to placing this portion of the remediated soil back into the excavated areas. Following completion of the soil remediation process, the Site will be graded and revegetated with native grasses.

The TCL, TAL, and TCLP data will also be used to demonstrate that the cleaned soils and soil fines meet LDRs and the alternate treatment variance levels. This data will establish that the waste remediation has rendered the soil clean to protective health based levels.

### 11.3 GROUNDWATER REMEDIATION

The groundwater remediation alternative selected for the Benfield site is Alternative GW6 - In-Situ Bioremediation/Above-ground Treatment. A description of this portion of the selected remedial alternative follows.

The contaminated aquifer will be remediated until the performance standards (Table 38) are achieved. Figure 5 delineates the estimated periphery of the plume emanating from the Benfield site. Following treatment of the extracted groundwater, the groundwater will be reintroduced back into the underlying aquifer in an upgradient portion of the Site in order to promote in-situ biodegradation of the contaminants in the aquifer.

It is anticipated that five (5) extracting wells, each pumping at a rate of three (3) gpm will be necessary to achieve and maintain a sufficient drawdown in the the underlying geology to contain and remove the plume of contamination. The extraction wells will be located within and near the

### 10.3 MODIFYING CRITERIA

State and community acceptance are modifying criteria that shall be considered in selecting the remedial action.

#### 10.3.1 State of North Carolina Acceptance

The State of North Carolina has reviewed and provided EPA with comments on the reports and data from the RI and the FS. NCDEHNR has also reviewed the Proposed Plan and EPA's preferred alternative and conditionally concurs with the selected remedy as described in Section 11.0.

#### 10.3.2 Community Acceptance

The Proposed Plan Fact Sheet was distributed to interested residents, to local newspapers and radio and TV stations, and to local, State, and Federal officials on April 9, 1992. The Proposed Plan public meeting was held in the evening of April 21, 1992. The public comment period on the Proposed Plan began April 13, 1992 and closed on May 12, 1992.

No written comments were received during the public comment period. The questions asked during the April 21, 1992 public meeting are summarized in the Responsiveness Summary, Appendix A. The community appears to be in favor of the selected remedy specified in Section 11.0

### 11.0 DESCRIPTION OF THE SELECTED REMEDY

Briefly, the selected remedy for this Site is:

- soil washing and biotreatment of the resulting slurry;
- extraction and on-site treatment and discharge of contaminated groundwater. Treatment will consist of pretreatment through aeration, ion exchange to remove heavy metals, primary organic treatment using submerged fixed film bioreactors, and polishing through GAC filters;
- addition of nutrients to the treated groundwater prior to reintroducing the water back into aquifer through infiltration galleries to promote in-situ biodegradation;
- review of existing groundwater monitoring system to insure proper monitoring of groundwater; additional monitoring wells will be added to mitigate any deficiencies; and
- monitoring of groundwater and Browning Branch.

This remedy will reduce the total cancer risk posed by the Site to a risk level that is within EPA's acceptable risk range of  $10^{-4}$  to  $10^{-6}$ . To

obtain this level, this remedial action alternative requires the extraction and treatment of groundwater above Federal MCLs and State water quality standards as well as the removal of residual soil contamination that would continue to adversely impact groundwater above these ARARs.

#### 11.1 PERFORMANCE STANDARDS TO BE ATTAINED

Performance standards are defined as any applicable or relevant and appropriate standards/requirements, cleanup goals and/or levels, or remediation goals and/or levels to be achieved by the remedial action. The performance levels to be met/attained by the Benfield remedial action are specified in the following tables and summarized in Table 38:

- groundwater remediation levels are specified in Table 32,
- surface water screening criteria are listed in Table 33
- sediment screening criteria are listed in Table 34
- action-specific ARARs are inventoried in Table 29,
- chemical-specific ARARs are inventoried in Table 30, and
- location-specific ARARs are inventoried in Table 35.

Table 38 provides the remediation goals to be achieved at this Site. This table also lists the risk level associated with each remediation goal.

#### 11.2 SOIL/SOURCE REMEDIATION

The soil/source control alternative selected for the Benfield site is Alternative SS3 - Soil Washing/Slurry Biotreatment. Below is a description of this alternative as it is envisioned to be implemented at the Benfield site.

Soils contaminated above the remediation levels (Table 38) will be excavated and stockpiled in order to be processed through the soil washing process. Figure 4 shows the estimated areas where the levels of contaminants in Site soils are above these remediation goals. The excavation is expected to extend down to the groundwater interface which ranges 3-6 feet below the surface. Soil washing is anticipated to reduce the estimated 4,600 cubic yards of contaminated soil down to 460 cubic yards, a 90 percent reduction.

Following excavation, the contaminated soil will be washed with an aqueous washing solution. The soil washing process generates two primary effluent streams, the cleaned coarse fraction of soil (sand, gravel, and cobbles) and

periphery of the plume. The extracted groundwater will be treated onsite in an above-ground treatment process which includes the following steps: pretreatment utilizing aeration to remove iron and manganese, ion exchange to remove the heavy metals, bioremediation employing SFFRs as the primary process to destroy the organic contaminants, and a polishing step using GAC filters. The actual number and location of the extraction wells and their pumping rate will be determined in the RD.

In a holding tank, necessary nutrients including hydrogen peroxide will be added to the treated groundwater. This nutrient enriched groundwater will then be reintroduced back into the aquifer through infiltration galleries upgradient of the contamination. This nutrient enriched groundwater will stimulate and promote indigenous microorganisms to degrade contaminants in-situ. The type and quantities of nutrients to be added to the treated groundwater will be determined in a RD treatability study.

It is anticipated that 100 percent of the extracted groundwater will be reintroduced back into the aquifer. However, it may be necessary to discharge up to 25 percent of the extracted, treated groundwater to either the Waynesville POTW via a pretreatment discharge permit issued by the POTW or into Browning Branch meeting the substantive requirements of a NPDES permit. Discharging to the POTW is preferred over discharging into Browning Branch.

The groundwater treatment process described above will generate a number of by-products that will need to be dealt with in an appropriate manner. The RD will evaluate the disposal options for each by-product and select the most cost efficient option.

The pretreatment aeration step and the SFFRs both are anticipated to generate a non-hazardous sludge. Prior to disposal, the sludge will be analyzed to confirm it is non-hazardous. If the sludges are found to be hazardous, they will be disposed of at a hazardous waste, RCRA-permitted landfill which is in compliance with RCRA regulations.

The regeneration solutions for the ion exchange resin are generally hazardous wastes because they are corrosive and contaminated with heavy metals. The RD will evaluate the degree and type of contamination in these solutions to determine if they can be treated or disposed of offsite, discharged to the POTW for treatment, or pretreated onsite and discharged to the POTW for final treatment.

The spent GAC will be shipped offsite for destruction, disposal, or reactivation. The most cost efficient option will be identified and selected.

The goal of this remedial action is to restore the groundwater to its beneficial use, as defined in Section 7.4. Based on information obtained during the RI, and the analysis of all remedial alternatives, EPA and the State of North Carolina believe that the selected remedy may be able to achieve this goal. Groundwater contamination may be especially persistent in

the immediate vicinity of the contaminants' source, where concentrations are relatively high. The ability to achieve cleanup goals at all points throughout the area of attainment, or plume, cannot be determined until the extraction system has been implemented, modified as necessary, and plume response monitored over time. If the selected remedy cannot meet the specified performance standards, at any or all of the monitoring points during implementation, the contingency measures and goals described in this section may replace the selected remedy and goals for these portions of the plume. Such contingency measures will, at a minimum, prevent further migration of the plume and include a combination of containment technologies and institutional controls. These measures are considered to be protective of human health and the environment, and are technically practicable under the corresponding circumstances.

The selected remedy will include groundwater extraction for an estimated period of 5 years, during which time the system's performance will be carefully monitored on a regular basis and adjusted as warranted by the performance data collected during operation. Modifications may include any or all of the followings:

- a) at individual wells where cleanup goals have been attained, pumping may be discontinued;
- b) alternating pumping at wells to eliminate stagnation points
- c) pulse pumping to allow aquifer equilibration and encourage adsorbed contaminants to partition into groundwater;
- d) installation of additional extraction wells to facilitate or accelerate cleanup of the contaminant plume.

To ensure that cleanup continues to be maintained, the aquifer will be monitored at those wells where pumping has ceased on an occurrence of every 2 years following discontinuation of groundwater extraction.

If it is determined, on the basis of the preceding criteria and the system performance data, that certain portions of the aquifer cannot be restored to their beneficial use, all of the following measures involving long-term management may occur, for an indefinite period of time, as a modification of the existing system:

- a) engineering controls such as physical barriers, or long-term gradient control provided by low level pumping, as contaminant measure;
- b) chemical-specific ARARs may be waived for the cleanup of those portions of the aquifer based on the technical impracticability of achieving further contaminant reduction;
- c) institutional controls may be provided/maintained to restrict access to those portions of the aquifer which remain above remediation goals;

- d) continued monitoring of specified wells; and
- e) periodic reevaluation of remedial technologies for groundwater restoration.

The decision to invoke any or all of these measures may be made during a periodic review of the remedial action, which will occur at 5 year intervals in accordance with CERCLA Section 121 (c).

#### 11.4 ADDITIONAL DATA REQUIREMENTS/MONITOR EXISTING CONDITIONS

In addition to delineating the work specified above, the RD will also have to address a number of additional information/data requirements.

Since the RI was not able to completely define the extent of the groundwater contamination, especially in the bedrock zone of the aquifer, additional monitoring wells will need to be installed during the RD. At a minimum, this effort will include the installation of at least three (3) bedrock monitoring wells, two (2) deep saprolite monitoring wells, and (2) shallow saprolite monitoring wells. The placement of these and any additional monitoring wells will be made after a review and evaluation of the existing groundwater monitoring system. This review is to insure the groundwater monitoring system will provide adequate information to assess the long-term quality of the groundwater and to demonstrate the effectiveness of the groundwater extraction system. This review effort may also include additional groundwater modeling and aquifer testing.

In order to help establish a broader data base on groundwater quality, additional groundwater samples will be collected and analyzed for VOCs, SVOCs and metals. Sampling will occur every four (4) months, for a year, during the RD.

In addition to monitoring the groundwater, semi-annual surface water and sediment samples shall be collected from Browning Branch, for a minimum of two (2) years to confirm and verify that this stream is not being adversely impacted by the Site. If it is determined that the Site is adversely impacting either the surface water or the sediment in Browning Branch, then toxicity testing using methods specified in U.S. EPA, Region IV, Standard Operating Procedure for Toxicity Testing Hazardous Waste Assessment, dated 1991, as amended, will be implemented. Table 33 provides the surface water criteria and Table 34 lists the screening levels for sediment. If contaminants in either the surface water or sediment exceed these values, then a bio-survey will be conducted in conjunction with chemically analyzing appropriate organisms tissues for contamination. Based on this data, it may be necessary to either issue an Explanation of Significant Difference (ESD) or amend this ROD to incorporate the appropriate clean up technology for either the surface water or the sediment or both.

Two subsurface soil samples will be collected and analyzed in the old stream bed identified in Figure 3. This sampling will confirm that contaminated debris/soil was not used to backfill this stream bed when the course of Browning Branch was altered by the owner/operator of the facility in the mid-1970's. As can be seen by comparing Figures 3 and 4, part of these soils are already slated to be remediated. These two (2) samples will be collected outside the area highlighted on Figure 4.

#### 11.5 COST

The total present worth costs for the selected alternative is \$3,080,000. The break down of this cost is specified below.

The present worth cost components of the soil washing/slurry biotreatment are:

	<u>Capital Cost</u>	<u>Annual Cost</u>
Soil Excavation and Stockpile	\$ 32,100	
Soil Washing	\$ 979,000	
Slurry Biodegradation	\$ 117,790	
Site Restoration	\$ 42,050	
Maintenance and Mowing		\$ 3,600
Security		\$ 1,200
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Subtotal	\$1,170,940	
Contingencies	\$ 351,200	
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Construction Total	\$1,522,140	
Permitting/Legal/Construction Services	\$ 121,800	
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Total Implementation	\$1,643,940	
Engineering Design	\$ 131,500	
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Total Capital	\$1,775,440	
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Total Annual		\$ 4,800
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Present Worth (30 years of operation)		\$1,820,700



The present worth cost components of the extraction, above-ground/in-situ bioremediation are:

	<u>Capital Cost</u>	<u>Annual Cost</u>
Groundwater Containment/Extraction System	\$ 72,500	\$ 3,100
Groundwater Treatment	\$ 112,200	\$ 300
Biotreatment/Infiltration	\$ 167,000	\$ 19,100
Sludge Dewatering	\$ 12,100	\$ 7,500
Power, Maintenance & Operations	\$	\$ 70,000
Groundwater Use Restriction & Monitoring	\$ 216,700	
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Subtotal	\$ 580,500	\$ 100,000
Contingencies	\$ 174,200	
<hr/>		
Construction Total	\$ 754,700	
Permitting/Legal/Construction Services	\$ 60,300	
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Total Implementation	\$ 815,000	
Engineering Design	\$ 65,200	
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Total Capital	\$ 880,200	
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Total Annual		\$ 100,000
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Present Worth (5 years of operation)		\$1,259,300

## 12.0 STATUTORY DETERMINATION

The selected remedy satisfies the requirements of Section 121 of CERCLA.

## 12.1 PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

The selected remedy will permanently treat the soil and groundwater and removes or minimizes the potential risk associated with the wastes. Dermal, ingestion, and inhalation contact with Site contaminants will be eliminated and risks posed by continued groundwater contamination will be abated.

## 12.2 COMPLIANCE WITH ARARS

The selected remedy will be designed to meet all Federal or more stringent State environmental laws. A complete discussion of the ARARS which are to be attained is included in Sections 9.1. These sections also describe the TBC requirements.

### 12.3 COST-EFFECTIVENESS

The selected soil remediation and groundwater remediation technologies are more cost-effective than the other acceptable alternatives considered primarily because they provide greater benefit for the cost.

### 12.4 UTILIZATION OF PERMANENT SOLUTIONS AND ALTERNATIVE TREATMENT TECHNOLOGIES OR RESOURCE TECHNOLOGIES TO THE MAXIMUM EXTENT PRACTICABLE

The selected remedy represents the maximum extent to which permanent solutions and treatment can be practicably utilized for this action. Of the alternatives that are protective of human health and the environment and comply with ARARs, EPA and the State have determined that the selected remedy provides the best balance of trade-offs in terms of long-term effectiveness and permanence; reduction in toxicity, mobility or volume achieved through treatment; short-term effectiveness, implementability, and cost; and State and community acceptance; and the statutory preference for treatment as a principal element.

### 12.5 PREFERENCE FOR TREATMENT AS A PRINCIPAL ELEMENT

The preference for treatment is satisfied by the use of the soil washing and slurry biotreatment system to remove contamination from the soil at the Site and the use of the treatment train and in-situ bioremediation to mitigate the contamination in the groundwater at the Site. The principal threats at the Site will be eliminated by use of these treatment technologies.

### 13.0 SIGNIFICANT CHANGES

CERCLA section 117(b) requires an explanation of any significant changes from the preferred alternative originally presented in the Proposed Plan. Below are the specific changes made in the ROD as well as the supporting rationale for making those changes. The Proposed Plan was disseminated to the public on April 9, 1992. Table 4 of the Proposed Plan, lists the maximum concentration detected, the remediation goal, and the source for the remediation goal for each of the chemicals of concern detected in the groundwater at the Benfield site. Since issuance of the Proposed Plan, the remediation goals for the following contaminants have been changed: benzene, antimony, and beryllium. The remediation goal for benzo-A-pyrene was also finalized since the Proposed Plan was issued.

The remediation goal for benzene in the ROD has been changed from 1 ug/l in the Proposed Plan, the State groundwater standard as specified in 15 A NCAC 2L.0202 (g)(4), to 5 ug/l in the ROD, the MCL specified in the Safe Drinking Water Act (42 U.S.C.A. §300f to 300j-26). The state water quality standard for benzene adopted pursuant to G.S. 143-214.1 and 143B-282(2) can be deviated from "where the maximum allowable concentration of a substance is less than the limit of detectability" (15 A NCAC 2L.0202(b)(1)). Presently,

5 ug/l is the lowest concentration current analytical technology can consistently detect with accuracy. Consequently, EPA and NCDEHNR concur that 5 ug/l should be the groundwater ARAR for benzene at the Site.

The MCLs for antimony and beryllium have been revised since the Proposed Plan was published. The revision to these MCLs was published in the Federal Register on July 17, 1992 (Fed. Reg. 31,776 1992). The MCL for antimony was changed from 10 ug/l to 6 ug/l and the MCL for beryllium was changed from 1 ug/l to 4 ug/l. The proposed MCL for benzo-A-pyrene, 0.2 ug/l, was also finalized at that concentration in the July 17, 1992 Federal Register.



# SUPERFUND PROPOSED PLAN FACT SHEET

## BENFIELD INDUSTRIES

Hazelwood, Haywood County,  
North Carolina

April 1992

### INTRODUCTION

The U.S. Environmental Protection Agency (EPA) is proposing a cleanup plan, referred to as the preferred alternative, to address contaminated soil and groundwater at the Benfield Industries Superfund Site ("the Site") located in Hazelwood, North Carolina. This document is being issued by EPA, the lead agency for Site activities, and the North Carolina Department of Environment, Health and Natural Resources (NCDEHNR), the support agency. NCDEHNR has reviewed this alternative and concurs with EPA's recommendation. This Proposed Plan summarizes the cleanup methods/technologies evaluated in the Feasibility Study (FS). In accordance with Section 117(a) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), EPA is publishing this Proposed Plan to provide an opportunity for public review and comment on all the cleanup options, known as remedial alternatives, under consideration for the Site and to initiate the 30-day public comment period on the cleanup option the Agency as identified as its preferred alternative. EPA, in consultation with NCDEHNR, will select a remedy for the Benfield Site only after the public comment period has ended and all information submitted to EPA during that time has been reviewed and considered.

This fact sheet summarizes information that is explained in greater detail in the Remedial Investiga-

tion (RI) Report, dated March 6, 1992, the revised Risk Assessment document, dated March 13, 1992, and the draft FS, dated March 20, 1992. These documents and all other records utilized by the Agency to make the proposal specified below are contained in the information repository/administrative record for this Site. EPA and the State encourage the public to review this information, especially during the public comment period, to better understand the Site, the Superfund process, and the intent of this Proposed Plan. The information repository/administrative record is available for public review locally at the Hazelwood Town Hall at 121 West Georgia Avenue in Hazelwood, North Carolina or in the Record Center at EPA, Region IV's office in Atlanta, Georgia.

This is the third fact sheet distributed by the Agency for the Benfield Site. The January 1992 fact sheet summarized the findings of the RI. The RI provided the information for use in the FS and the selection of the proposed remedy. Briefly, the preferred remedy includes the following cleanup methods/technologies:

#### For Contaminated Soils:

The contaminated soil would be washed with water followed by biotreatment of the resulting slurry generated by the soil washing process. All cleaned soil would be replaced back in the excavated areas

### PUBLIC MEETING NOTICE

**DATE:** April 21, 1992  
**TIME:** 7:00 pm - 9:00 pm  
**WHERE:** Hazelwood Town Hall  
121 West Georgia Avenue  
Hazelwood, North Carolina

-(Some words highlighted in bold print are defined in the glossary.)

#### **For Contaminated Groundwater:**

Contaminated groundwater would be pumped from the aquifer and treated to remove contaminants. Following treatment, the water would be reintroduced back into the aquifer after hydrogen peroxide and nutrients have been added. These ingredients would promote a natural breakdown of contaminants in the aquifer.

### **THIS PROPOSED PLAN:**

1. Includes a brief history of the Site, the principal findings of the RI and a summary of the Risk Assessment;
2. Presents the cleanup alternatives for the Site considered by EPA;
3. Outlines the criteria used by EPA to recommend an alternative for use at the Site;
4. Provides a summary of the analysis of alternatives;
5. Presents EPA's rationale for its preliminary selection of the preferred alternatives; and
6. Explains the opportunities for the public to comment on the remedial alternatives, and hence the cleanup of the Benfield Industries Superfund Site.

### **SITE BACKGROUND**

The Benfield Site comprises approximately 3.5 acres of the Benfield property, which is approximately 6 acres in size, at 112 to 124 Richland Street in Hazelwood, Haywood County, North Carolina (Figure 1). The Site is surrounded by light industrial, commercial, and residential areas. The Site is bordered to the north by an antique shop, by Richland Street to the east, a residence to the south, and the Southern Railway and Browning Branch to the west. Richland Street represents a divide between a predominantly residential area to the east and industrial/commercial areas to the west, including the Benfield property. Other nearby features in the town of Hazelwood include the Hazelwood Elementary School, two blocks east and the Haywood County Prison approximately 1,000 feet southeast of the Site.

The Benfield property was an active facility until April 1982 at which time a fire destroyed the entire operations. Prior to April 1982, Benfield Industries, Inc. mixed and packaged bulk materials for resale. Products handled and stored at the Benfield facility included paint thinners, solvents, sealants, cleaners, de-icing solutions, and wood preservatives including creosote. Unagusta Furniture Company owned and operated the facility prior to Benfield Industries, from about 1904 to 1961, but no records have been found stating the use or storage of hazardous chemicals at the facility during their tenure. Unagusta Furniture Company reportedly manufactured wooden bed frames.

Following April 1982, the North Carolina Department of Human Resources (NCDHR) ordered the owner of the facility to remove all debris from the Site by September 1, 1982 which the owner/operator complied with. In addition to removing all usable chemicals, fire debris, recyclable materials, and storage tanks, much of the Site was covered with "clean" fill material.

The structures at the Site prior to the fire included two (2) storage buildings, a brick work building with a concrete storage area, a packaging building, and ten (10) above ground storage tanks, varying in capacity from 1,000 to 10,000 gallons. Figure 2 shows locations of these structures prior to the April 1982 fire.

The Benfield Industries Superfund Site (Benfield Site) was proposed for the National Priority List (NPL) in June 1988 and was finalized on the list in October 1989 with a Hazardous Ranking System (HRS) score of 31.67. As of March 1992, the Site is ranked/grouped 912 out of 1218 NPL sites across the country. Only sites scoring over 28.5 are eligible to be placed on the National Priority List.

### **SCOPE AND ROLE OF RESPONSE ACTION**

#### **Results of the Remedial Investigation (RI)**

The RI, which was initiated in August 1990 and finalized in March 1992, was summarized in a fact sheet disseminated to the public in January 1992. Below is a synopsis of the RI findings:

For the most part, the Benfield Site is covered with fill material put in place after the 1982 fire destroyed the structures at the Site. This fill material ranges

from 6 to 36 inches in thickness. Beneath the fill material are alluvial materials. The thickness of the alluvium ranges from 6 to 9 feet. Alluvium is generally comprised of poorly sorted sand, gravel, cobbles, and rock fragments in a dark brown silty/clayey to sandy matrix. The alluvial materials overlie saprolite throughout the area. The thickness of the saprolite on-site ranges from 28 to 30 feet. Saprolite is the clay, silt, or rock fragments that is created from bedrock weathering over thousands of years. Fractured bedrock lies beneath the saprolite.

Groundwater flows in a northerly direction, parallel to the direction of stream flow in Browning Branch and appears to follow the lay of the land. Depth of groundwater ranges from 3 to 6 feet below the surface. Groundwater travels 558 feet per year in the alluvium and 43 feet per year in saprolite.

The following paragraphs discuss the nature and extent of contamination at the Site.

A wide range of chemicals were detected in two of the three environmental medium sampled as part of the RI. These chemicals include volatile organics, semi-volatile organics, pesticides and inorganics (metals). Neither cyanide nor polychlorinated biphenyls (PCBs) were detected at the Site. The three environmental media sampled were soils, both surface and subsurface, groundwater, both shallow and deep zones of the aquifer, and surface water and sediment in Browning Branch.

Air samples were not collected for chemical analysis as part of the RI. However, air quality was monitored during all field work as part of the health and safety effort. Based on this information, the quality of the air at and around the Site is not currently being adversely impacted by contaminants at the Site.

Volatile organic and semi-volatile organic compounds, pesticides, and metals were detected in the soil and groundwater. A total of eight volatiles, 29 semi-volatile organics, 14 pesticides, and elevated levels of metals were detected in the soils at the Site. Twelve volatile organics, 27 semi-volatile organics, one pesticide, and elevated concentrations of metals were detected in the groundwater beneath the Site. Only one sediment sample contained contaminants of concern. Based on the surface water and sediment data, the Agency has concluded that Browning Branch is not currently being adversely impacted by the contamination at the Site.

Tables 1 and 2 summarize those contaminants detected in sufficient concentrations in the soils and groundwater that require these areas to be cleaned up. These tables also present the frequency and range of concentrations detected for each of these contaminants.

## SUMMARY OF SITE RISKS

A task of the RI/FS is to analyze and estimate the human health and environmental problems that could result if the soil and groundwater contamination at the Benfield Site is not cleaned up. This analysis is called a baseline risk assessment. In conducting this assessment, EPA focuses on the adverse human health effects that could result from long-term (30 years) daily, direct exposure as a result of ingestion, inhalation, or dermal contact to carcinogenic chemicals (cancer causing) and non-carcinogenic chemicals present at the Site.

A goal of the Agency is to reduce the risk posed by a Superfund Site to below one person out of 10,000 being at risk. This is the minimum risk the Agency will allow, typically the Agency aspires to be even more protective and strives to lower the risk so that at a minimum, only one person out of one million may be adversely impacted by the contamination found at the Site. This is the goal the Agency has set for the Benfield Site.

EPA has concluded that there are no major current risks to human health at the Site. Exposure pathways evaluated in the Risk Assessment were ingestion, inhalation, and direct contact to contaminants in the soil and groundwater, including the elevated levels of contaminants found in the sediment at sampling location SD-5, near Browning Branch. The only reason groundwater does not pose a current risk is because everyone living near the Site is on the public water supply system and not obtaining drinking water from a private well installed near the Site.

However, there is a future risk for residents living in homes built on or near the Site due to contaminants in the groundwater. This scenario includes the exposure to off-site residents to contaminants in the groundwater through ingestion, inhalation, and direct contact.

A qualitative assessment of the possible hazards to environmental receptors was also included in the Risk Assessment. Based on this environmental as-

assessment, the on-site contaminated soils may have adverse effects on the environment. Surface water, air, and groundwater will not adversely impact the environment or the fauna/flora found in these ecological niches.

For more information about the risks posed by the contamination at the Benfield Site, please refer to the Risk Assessment Report and other documents available for review at the information repository.

## REMEDIAL RESPONSE OBJECTIVES

Remedial response objectives (RAOs) were developed based on the results of the Risk Assessment and examination of potential Applicable or Relevant and Appropriate Requirements (ARARs). Action-, location-, and chemical-specific ARARs were examined. In summary, the (RAOs) are:

### For Soils

- Prevent migration of contaminants in the soil that could result in groundwater contamination.

### For Groundwater

- Prevent ingestion of water having carcinogen concentrations that exceed established Federal and State limits.
- Prevent ingestion of water having non-carcinogen(s) that exceed established Federal and State limits.
- Restore the groundwater system to stated cleanup goals and prevent the migration of the pollutants beyond the known contaminant plume.

The remediation goal for both soil and groundwater is to obtain a stringent health risk level. There are no Federal or State cleanup ARARs for contaminants in soil, therefore, the soil cleanup goals (Table 3) are based on the ability of the contaminants to leach from the soil into the groundwater. These soil cleanup levels will prevent any further degradation of the groundwater above maximum concentration levels (MCLs) from contaminants found in the soil. For groundwater, all chemical-specific ARARs, which include MCLs and the North Carolina

Groundwater Standards, will be met (Table 4). Based on the cleanup goals specified in Tables 3 and 4, it is estimated that the volumes of contaminated soil and groundwater requiring remediation are 4,600 cubic yards and 22 million gallons, respectively.

For more information about the RAOs for the Benfield site, please refer to the draft Feasibility Study document and other documents available for review at the information repository.

## SUMMARY OF REMEDIAL ALTERNATIVES

The following section provides a summary of the alternatives developed in the FS Report. The primary objective of the FS was to determine and evaluate alternatives for cleaning up the Site. Descriptions of the clean-up alternatives are summarized below.

The cost information provided below for each alternative represents estimated total present worth (PW) of each alternative. Total PW was calculated by combining the capital cost plus the PW of the annual operating and maintenance (O&M) costs. Capital cost includes construction, engineering and design, equipment, and site development. Operating costs were calculated for activities that continue after completion of construction, such as routine operation and maintenance of treatment equipment, and groundwater monitoring. The PW of an alternative is the amount of capital required to be deposited at the present time at a given interest rate to yield the total amount necessary to pay for initial construction costs and future expenditures, including O&M and future replacement of capital equipment.

## REMEDIAL ALTERNATIVES TO ADDRESS SOIL CONTAMINATION

The soil alternatives are:

### ALTERNATIVE SS1: NO ACTION

Capital Costs:	\$ 0
PW O&M Costs:	\$ 0
Total PW Costs:	\$ 0
Time to Implement:	None

CERCLA requires that the "No Action" alternative be evaluated at every Superfund Site to establish a

**ALTERNATIVE SS7: OFF-SITE INCINERATION**

Capital Costs:	\$14,096,800
PW O&M Costs:	\$ <u>45,200</u>
Total PW Costs:	\$14,142,000
Time to Implement:	4 months

This alternative involves excavating the contaminated soils and transporting the contaminated soil to a RCRA-permitted off-site incineration facility. The final disposal of the incinerated soil ash will be the responsibility of the incineration facility. The excavated areas will be backfilled with clean soil, graded, and revegetated.

**REMEDIAL ALTERNATIVES TO ADDRESS GROUNDWATER CONTAMINATION**

The groundwater alternatives are:

**ALTERNATIVE GW1: NO ACTION**

Capital Costs:	\$ 0
PW O&M Costs:	\$ <u>0</u>
Total PW Costs:	\$ 0
Time to Implement:	None

This alternative for groundwater contamination is the same as Alternative SS1 for soil contamination. No further activities are conducted for on-site groundwater.

**ALTERNATIVE GW2: RESTRICT GROUNDWATER USE AND MONITOR**

Capital Costs:	\$120,800
PW O&M Costs:	\$ <u>115,000</u>
Total PW Costs:	\$235,800
Time to Implement:	12 months

Under this alternative, institutional controls will be implemented, restricting the use of the groundwater from the contaminated plume. The State of North Carolina will impose the restrictions that would include deed restrictions preventing future use of the aquifer for such purposes as potable and industrial water supplies, irrigation, washing, etc. NCDEHNR will not issue any well drilling permits for new wells on properties which may be impacted by the contaminated groundwater plume.

**ALTERNATIVE GW3: GROUNDWATER CONTAINMENT/SURFACE WATER DISCHARGE**

Capital Costs:	\$ 465,000
PW O&M Costs:	\$ <u>877,700</u>
Total PW Costs:	\$1,342,700
Time to Implement:	6 months

This alternative involves installing extraction wells downgradient of the contaminant plume in order to capture contaminants and produce a hydraulic barrier to control contaminant migration. The extracted groundwater will be discharged to Browning Branch after treatment. The treatment consists of a pre-treatment step to remove iron and manganese, an ion exchange unit to remove heavy metals followed by an organic contaminant polishing step.

**ALTERNATIVE GW4A: EXTRACTION, ABOVE-GROUND BIOREMEDIATION, SURFACE WATER DISCHARGE**

Capital Costs:	\$ 819,300
PW O&M Costs:	\$ <u>1,172,700</u>
Total PW Costs:	\$1,992,000
Time to Implement:	6 months

This alternative involves installing extraction wells throughout the contaminant plume to actively extract groundwater for treatment. The steps in the treatment system will consist of pre-treatment, heavy metals treatment, primary organic treatment, and an organic contaminant polishing step. The primary organic treatment consists of a submerged fixed film bioreactor to permanently remove and destroy the organic contaminants. Effluent will be discharged to Browning Branch and monitored to insure compliance with National Pollution Discharge Elimination System (NPDES) discharge requirements.

**ALTERNATIVE GW4B: EXTRACTION, ABOVE-GROUND BIOREMEDIATION, DISCHARGE TO A PUBLICLY OWNED TREATMENT WORKS**

Capital Costs:	\$ 667,400
PW O&M Costs:	\$ <u>1,166,100</u>
Total PW Costs:	\$1,833,500
Time to Implement:	6 months

Alternative GW4B is identical to Alternative GW4A, except treated groundwater will be discharged to the City of Waynesville publicly owned treatment works (POTW), instead of Browning Branch and no granular activated carbon polishing step will be in-



## EVALUATING CRITERIA

3. **Cost:** The benefits of implementing a particular remedial alternative are weighed against the cost of implementation. Costs include the capital (up-front) cost of implementing an alternative over the long term, and the net present worth of both capital and operation and maintenance costs.

4. **Implementability:** EPA considers the technical feasibility (e.g., how difficult the alternative is to construct and operate) and administrative ease (e.g., the amount of coordination with other government agencies that is needed) of a remedy, including the availability of necessary materials and services.

5. **Short-term effectiveness:** The length of time needed to implement each alternative is considered, and EPA assesses the risks that may be posed to workers and nearby residents during construction and implementation.

6. **Long-term effectiveness:** The alternatives are evaluated based on their ability to maintain reliable protection of public health and the environment over time once the cleanup goals have been met.

7. **Reduction of contaminant toxicity, mobility, and volume:** EPA evaluates each alternative based on how it reduces (1) the harmful nature of the contaminants, (2) their ability to move through the environment, and (3) the volume or amount of contamination at the site.

## MODIFYING CRITERIA

8. **State acceptance:** EPA requests state comments on the Remedial Investigation and Feasibility Study reports, as well as the Proposed Plan, and must take into consideration whether the state concurs with, opposes, or has no comment on EPA's preferred alternative.

9. **Community acceptance:** To ensure that the public has an adequate opportunity to provide input, EPA holds a public comment period and considers and responds to all comments received from the community prior to the final selection of a remedial action.

## EVALUATION OF ALTERNATIVES

The following summary profiles the performance of the preferred alternatives in terms of the nine evaluation criteria noting how it compares to the other alternatives under consideration. The comparative analysis for the soil remediation alternatives is as follows:

### Soil Remediation

The following alternatives were subjected to detailed analysis for source control:

**Alternative SS1:** No Action

**Alternative SS2:** RCRA Cap

**Alternative SS3:** Soil Washing/Slurry Biotreatment

**Alternative SS4:** Solvent Extraction

**Alternative SS5:** On-site Incineration

**Alternative SS6:** In-situ Bioremediation

**Alternative SS7:** Off-site Incineration

**Overall Protection.** The potential risk due to Site soils under potential future conditions is to the groundwater through the leaching of contaminants from the soil into the groundwater. Alternative SS1 (no action) would not be protective of human health or the environment. Upon implementation, Alternative SS2 would prevent precipitation from leaching contaminants from the soil into the groundwater, however, would not be protective of the groundwater due to seasonal fluctuations in the elevation of groundwater coming into contact with contaminated soil. Alternatives SS-3 through SS5 and SS7 would eliminate any risks associated with the soil contamination as well as mitigate any further degradation of the groundwater. Alternative SS6 does not immediately mitigate the migration potential to groundwater of contaminants above health-based risk levels, but over time, this alternative would obtain this goal.

**Compliance with ARARs.** There are no federal or state chemical-specific ARARs for the contaminants detected in the soils. There are no action-specific ARARs for Alternative SS1. RCRA requirements for

**Alternative GW4A:**  
Extraction, Above-ground Bioremediation,  
Surface Water Discharge

**Alternative GW4B:**  
Extraction, Above-ground Bioremediation,  
POTW Discharge

**Alternative GW5A:**  
Extraction, UV/OX, Surface Water Discharge

**Alternative GW5B:**  
Extraction, UV/OX, POTW Discharge

**Alternative GW6:**  
In-Situ Bioremediation/Above-ground  
Treatment

**Overall Protection.** Groundwater poses no risks to human health and the environment under current conditions. The no action Alternative GW1 and Alternative GW2 would not address contaminant levels in groundwater and therefore would not be protective of human health under potential future conditions. Alternative GW3 would prevent the further migration of contaminated groundwater and given sufficient time would remediate the contaminant plume. Alternatives GW4 through GW6 actively address the plume in the aquifer, the only difference between these alternatives is the type of treatment to be used on the extracted groundwater and the discharge option for the treated groundwater. Alternative GW6 remediates the contaminants in the groundwater in place along with treating extracted groundwater above-ground. Therefore, Alternatives GW3 through GW6 would be protective of human health and the environment.

**Compliance With ARARs.** MCLs are ARARs for Site groundwater. Neither Alternatives GW1 nor GW2 would comply with ARARs. Alternative GW3 would obtain ARARs downgradient of the Site and given time, may eventually achieve ARARs underneath the Site. Alternatives GW4 through GW6 would attain ARARs throughout the entire Site. Construction of the groundwater recovery, treatment, and discharge system for Alternatives GW3 through GW6 would satisfy action-specific ARARs. The only location-specific ARAR pertaining to these alternatives is construction within a 100-year flood plain. The disposal of any sludge or spent activated carbon generated by the groundwater treatment system will also comply with ARARs.

#### **Long-term Effectiveness and Permanence.**

Under Alternatives GW1 and GW2, groundwater contamination would continue to migrate off-site; therefore these are not considered to be permanent or effective remedial solutions. The long-term effectiveness of Alternative GW3 is questionable, because of the time it would require for "Nature" to clean "itself". This remedy relies on the natural flow of groundwater to eventually remove all the contaminants that have entered the groundwater at the Site. Contaminant concentrations in the groundwater will be permanently reduced through groundwater extraction and treatment specified in Alternatives GW4 through GW6.

#### **Reduction of Toxicity, Mobility or Volume.**

Neither Alternatives GW1 nor GW2 would significantly reduce the toxicity, mobility, or volume of contaminants in groundwater. Alternative GW3 would slowly reduce the toxicity, mobility, or volume of contaminants in groundwater as the natural flow of groundwater beneath the Site moves the contaminants towards the containment extraction wells. Alternatives GW4 through GW6 would reduce the volume of contaminants in the aquifer through recovery. The groundwater treatment systems will comply with the statutory preference for alternatives that reduce toxicity of contaminants.

**Short-term Effectiveness.** All of the alternatives can be implemented without significant risk to the community or on-site workers and without adverse environmental impacts.

**Implementability.** None of the alternatives pose significant concerns regarding implementation. Design of the treatment systems for Alternatives GW3 through GW6 could not be conducted until discharge requirements were defined.

**Cost.** Total present worth costs for the groundwater remediation alternatives are presented below:

**Alternative GW1**  
No action: \$ 0

**Alternative GW2**  
Restrict Groundwater Use and Monitor:  
\$ 235,800

**Alternative GW3**  
Groundwater Containment/Surface Water  
Discharge: \$1,342,700

to carbon dioxide and water. It is anticipated that all of the extracted, treated groundwater will be reintroduced to the aquifer, however, it may be necessary to discharge up to 25% of the water either to Browning Creek, meeting NPDES requirements, or to the City of Waynesville POTW, meeting the POTW's pretreatment requirements.

Based on current information, this alternative appears to provide the best balance of trade-offs with respect to the nine criteria that EPA uses to evaluate

alternatives. EPA believes the preferred alternative will satisfy the statutory requirements of Section 121(b) of CERCLA, 42 U.S.C. 9621(b), which provides that the selected alternative be protective of human health and the environment, comply with ARARs, be cost effective, and utilize permanent solutions and treatments to the maximum extent practicable. The selection of the above alternative is preliminary and could change in response to public comments.



## COMMUNITY PARTICIPATION

EPA has developed a community relations program as mandated by Congress under Superfund to respond to citizen's concerns and needs for information, and to enable residents and public officials to participate in the decision-making process. Public involvement activities undertaken at Superfund sites are interviews with local residents and elected officials, a community relations plan for each site, fact sheets, availability sessions, public meetings, public comment periods, newspaper advertisements, site visits, and Technical Assistance Grants, and any other actions needed to keep the community informed and involved.

EPA is conducting a 30-day public comment period from April 13, 1992 to May 12, 1992, to provide an opportunity for public involvement in selecting the final cleanup method for this Site. Public input on all alternatives, and on the information that supports the alternatives is an important contribution to the remedy selection process. During this comment period, the public is invited to attend a public meeting on April 21, 1992, at the Hazelwood Town Hall in Hazelwood, North Carolina beginning at 7:00 p.m. at which EPA will present the Remedial Investigation/ Feasibility Study and Proposed Plan describing the preferred alternative for treatment of the contamination at the Benfield Industries Site and to answer any questions. Because this Proposed Plan Fact Sheet provides only a summary description of the cleanup alternatives being considered, the public is encouraged to consult the information repository for a more detailed explanation.

During this 30-day period, the public is invited to review all site-related documents housed at the information repository located at the Hazelwood Town Hall, 121 West Georgia Avenue, Hazelwood, and offer comments to EPA either orally at the public meeting which will be recorded by a court reporter or in written form during this time period. The actual remedial action could be different from the preferred alternative, depending upon new information or arguments EPA may receive as a result of public comments. If you prefer to submit written comments, please mail them postmarked no later than midnight May 12, 1992 to:

Diane Barrett  
NC Community Relations Coordinator  
U.S.E.P.A., Region 4  
North Remedial Superfund Branch  
345 Courtland Street, NE  
Atlanta, GA 30365

All comments will be reviewed and a response prepared in making the final determination of the most appropriate alternative for cleanup/treatment of the Site. EPA's final choice of a remedy will be issued in a Record of Decision (ROD). A document called a Responsiveness Summary summarizing EPA's response to all public comments

## GLOSSARY OF TERMS USED IN THIS FACT SHEET

**Aquifer:** An underground geological formation, or group of formations, containing useable amounts of groundwater that can supply wells and springs.

**Administrative Record:** A file which is maintained and contains all information used by the lead agency to make its decision on the selection of a method to be utilized to clean up/treat contamination at a Superfund site. This file is located in the information repository for public review.

**Applicable or Relevant and Appropriate Requirements (ARARs):** The federal and state requirements that a selected remedy must attain. These requirements may vary among sites and various alternatives.

**Baseline Risk Assessment:** A means of estimating the amount of damage a Superfund site could cause to human health and the environment. Objectives of a risk assessment are to: help determine the need for action; help determine the levels of chemicals that can remain on the site after cleanup and still protect health and the environment; and provide a basis for comparing different cleanup methods.

**Cap:** A layer of clay and/or other highly impermeable material, such as a thick polyethylene liner, installed over the top of a closed landfill or land area to prevent entry of rainwater and minimize production of leachate.

**Carcinogenic:** Any substance that can cause or contribute to the production of cancer; cancer-producing.

**Comprehensive Environmental Response, Compensation and Liability Act (CERCLA):** A federal law passed in 1980 and modified in 1986 by the Superfund Amendments and Reauthorization Act (SARA). The Acts created a special tax paid by producers of various chemicals and oil products that goes into a Trust Fund, commonly known as Superfund. These Acts give EPA the authority to investigate and clean up abandoned or uncontrolled hazardous waste sites utilizing money from the Superfund Trust or by taking legal action to force parties responsible for the contamination to pay for and clean up the site.

**Groundwater:** Water found beneath the earth's surface that fills pores between materials such as sand, soil, or gravel (usually in aquifers) which is often used for supplying wells and springs. Because groundwater is a major source of drinking water there is growing concern over areas where agricultural and industrial pollutants or substances are getting into groundwater.

**Information Repository:** A file containing accurate up-to-date information, technical reports, reference documents, information about the Technical Assistance Grant, and any other materials pertinent to the site. This file is usually located in a public building such as a library, city hall or school, that is accessible for local residents.

**Land Disposal Restriction (LDRs):** Any placement of hazardous waste in a landfill, surface impoundment, waste pile, injection well, land treatment facility, salt dome formation, underground mine, cave and concrete bunker or vault.

**Leachate:** A contaminated liquid resulting when water percolates or trickles through waste materials and collects components of those wastes. Leaching may occur at landfills and may result in hazardous substances entering soil, surface water or groundwater.

**Maximum Contaminant Levels (MCLs):** The maximum permissible level of a contaminant in water delivered to any user of a public water system. MCLs are enforceable standards.

**National Oil and Hazardous Substances Contingency Plan (NCP):** The federal regulation that guides determination of the sites to be corrected under the Superfund program and the program to prevent or control spills into surface waters or other portions of the environment.

**National Pollutant Discharge Elimination System (NPDES):** A provision of the Clean Water Act which prohibits the discharge of pollutants into waters of the United States unless a special permit is issued by EPA, a state or (where delegated) a tribal government on an Indian reservation allowing a controlled discharge of liquid after it has undergone treatment.



State of North Carolina  
Department of Environment, Health, and Natural Resources  
Division of Solid Waste Management  
P.O. Box 27687 · Raleigh, North Carolina 27611-7687

James G. Martin, Governor  
William W. Cobey, Jr., Secretary

July 27, 1992

William L. Meyer  
Director

Mr. Greer C. Tidwell  
Regional Administrator  
U.S. EPA Region IV  
345 Courtland Street, N.E.  
Atlanta, GA 30365

Subj: Conditional Concurrence with the Record of Decision  
Benfield Industries NPL Site  
Hazelwood, Haywood County, NC

Dear Mr. Tidwell:

The State of North Carolina has completed review of the attached Revised Draft Record of Decision and concurs with the selected remedy subject to the following conditions.

1. Because State comments regarding additivity of risk have not been fully incorporated into the cleanup goals, the total additive residual risk after site cleanup will exceed  $10^{-6}$ . If, after remediation is complete, the total residual risk level exceeds  $10^{-6}$ , the site will require deed recordation/restriction to document the presence of residual contamination and possibly limit the future use of the property as specified in NCGS 130A-310.8.
2. State concurrence on this Record of Decision and the selected remedy for the site is based solely on the information contained in the attached Record of Decision. Should the State receive new or additional information which significantly affects the conclusions or remedy selection contained in the Record of Decision, it may modify or withdraw this concurrence with written notice to EPA Region IV.
3. State concurrence on this Record of Decision in no way binds the State to concur in future decisions or commits the State to participate, financially or otherwise, in the clean up of the site. The State reserves the right to review, comment, and make independent assessments of all future work relating to this site.

Mr. Greer C. Tidwell  
27 July 1992  
Page 2

The State of North Carolina appreciates the opportunity to comment on the Revised Draft Record of Decision for the subject site, and we look forward to working with EPA on the final remedy.

Sincerely,



Jack Butler, PE  
Environmental Engineering Supervisor  
Superfund Section

bin\berodcon

cc: Michael Kelly  
Bruce Nicholson  
Curt Fehn  
Jon Bornholm

Attachment



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION IV

345 COURTLAND STREET, N.E.  
ATLANTA, GEORGIA 30365

JUL 29 1992

4WD-NCRS

Mr. Jack Butler  
North Carolina Department of Environment,  
Health, and Natural Resources  
401 Oberlin Road, Suite 150  
Raleigh, North Carolina 27605

RE: Response to Conditions Included in North Carolina's  
Conditional Concurrence for the Benfield Industries  
Superfund Site Record of Decision

Dear Mr. Butler:

EPA-Region IV appreciates the State's conditional concurrence on the Record of Decision (ROD) for the Benfield Industries Superfund site located in Hazelwood, North Carolina. For the record, EPA would like to respond to the conditions formulated by North Carolina Department of Environment, Health, and Natural Resources (NCDEHNR) - Superfund Section and specified in your July 27, 1992 correspondence to Mr. Greer Tidwell. Your July 27, 1992 letter, along with this response, will be included in Appendix C of the ROD. These letters should stand as official documentation that EPA-Region IV and NCDEHNR-Superfund Section have agreed on the preferred alternatives at this point in time.

Of the three conditions expressed, only the first condition requires a response from the Agency. In response to NCDEHNR-Superfund Section first condition, the State may in the future put in place, pursuant to State law (G.S. 130A-310.8), a deed recordation/restriction to document the presence of residual contamination which may limit the future use of the property. And, as stated, this would be done after the completion of the Site's remediation.

Please contact me at (404) 347-7791 if you have any questions or comments regarding this matter.

Sincerely yours,

Jon K. Bornholm  
Remedial Project Manager

cc: Curt Fehn, EPA  
Bruce Nicholson, NCDEHNR