2.0 STUDY AREA INVESTIGATION

2.1 SURFACE FEATURES

Surface features of the site were evaluated during an initial site reconnaissance conducted October 1995. During the site reconnaissance, the locations of buildings, utility lines, property lines, fencing, roadways, railways, drainage ditches, surface-water bodies, vegetation, topography, residences, and commercial buildings were identified and recorded. The site reconnaissance was conducted for a radius of a quarter of a mile from Ropers Shopping Center. In addition, aerial photographs obtained from the Gaston County Tax Office were reviewed, and interviews were conducted with local residences to obtain additional information concerning historical site features. Topographical Maps obtained from the United States Geologic Survey were also reviewed to reveal topographical relief and trends in the area. Specific site features were surveyed with Global Positioning System (GPS) equipment to determine the easting and northing coordinates; these included pertinent roadways, forty-three residential drinking water wells, twenty-two permanent ground-water monitoring wells, and nine converted residential monitoring wells. Vertical elevations of the monitoring wells were manually surveyed with transit and rod.

2.2 CONTAMINANT SOURCE INVESTIGATIONS

Four sites were investigated as potential source areas: the previous dry cleaning facility located at Ropers Shopping Center, the dry cleaning facility located in the northeastern quadrant of the Suggs Road and Acme Road intersection, the refrigerator repair shop located north of the intersection of Julia Court and Acme Road, and the machine shop located in the southern quadrant of the intersection of Acme and Centerview Road. Soil borings, temporary monitoring wells and permanent monitoring wells were used to search for the location of active sources such as contaminated subsurface soils since the original sources (the boiler distillation unit, or the septic tank) of contamination are no longer present on the Site. **Table 2-1** shows the soil borings or monitoring wells placed to investigate each suspect source area; **Figures 2-1** thru **2-3** indicate the respective locations. The installation and sampling activities are noted in Section 2.4 for the soil borings and Section 2.5 for the temporary and permanent ground water monitoring wells.

TABLE 2-1. CONTAMINANT SOURCE AREA INVESTIGATIONS FOR THE NORTH BELMONT PCE SITE.

SUSPECT SOURCE AREA	SAMPLE LOCATION
Dry Cleaning Facility at Ropers Shopping Center	SS-3 thru SS-7, HA-1, HA-2, SPT-1, MW-6
Dry Cleaning Facility at Suggs and Acme Roads	SS-1, MW-10
Refrigerator Repair Shop	SS-2, TW-14
Note: SS = Subsurface Soil Sample; HA = Hand Auger Sample; SPT = Standard Penetration Test (SPT) Subsurface Soil Sample; MW = Monitoring Well Soil Sample: TW = Temporary Well Soil Sample	

Figure 2-1, 2-2 and 2-3

2.3 SURFACE WATER AND SEDIMENT INVESTIGATIONS

Three surface water and co-located sediment samples were obtained at the locations shown on **Figure 2-4**. **Table 2-2** denotes the samples and the rationale for collection.

TABLE 2-2. SURFACE WATER AND SEDIMENT SAMPLE LOCATIONS FOR THE NORTH BELMONT PCE SITE.

SAMPLE LOCATION	SAMPLING RATIONALE
SW/SD-201	Confluence of “Unnamed Tributary - A” and “Unnamed Tributary - B” - to determine the impace ot the Jadco /Hughes Superfund Site
SW/SD-202	Downgradient of North Belmont PCE Site - to determine influence of site on stream
SW/SD-203	Upgradient of North Belmont PCE Site - control sample
NOTE: SW = Surface Water; SD = Sediment	

Samples were collected first from the downgradient portion of the stream and then proceeded in an upstream/upgradient direction. The surface water samples and the sediment volatile organic compounds (VOC) sample was collected directly into the sample container. The sample was collected facing upstream with minimal disturbance of the sediment. Surface water samples were collected prior to the sediment sample. The VOC sediment sample was collected beneath the water. The sediment was scooped in the jar utilizing the lid and sealed while staying submersed to minimize volatilization of the chemical constituents to the atmosphere. The extractable organic and inorganic samples were collected with a stainless steel spoon. The sample was collected by wading into the surface water body, and while facing upstream, the sample was scooped with the spoon along the bottom of the surface water body in an upstream direction. Aliquots of the sample were then placed in a glass pan and homogenized utilizing a quartering method prior to filling the individual sampling containers. Samples were placed on ice then transported to the command post where chain-of-custody for the samples completed using the FORMS (Field Operations Record Management System) computer program, preserved, tagged, sealed and placed in an ice cooled laboratory container. Samples were shipped to SESD’s laboratory for analysis. The surface water/sediment samples were submitted for full scan Target Compound (TCL) and Target Analyte Lists (TAL) constituents. All sampling activities were conducted by SESD personnel in general accordance to the *Environmental Investigations Standard Operating Procedures and Quality Assurance Manual (EISOPQAM)*, U.S. Environmental Protection Agency, Region 4, May 1996.

2.4 GEOLOGICAL INVESTIGATIONS

SESD’s investigation included installation of shallow soil borings and shallow temporary monitoring wells. WESTON's investigation included installing deep soil borings, top of rock temporary monitor wells, and permanent top of rock and bedrock monitoring wells. Other activities conducted by Weston included development of the new monitoring wells, slug testing and geophysical borehole logging of each well. All sampling activities were conducted by SESD personnel in general accordance to the *EISOPQAM.* These activities were conducted to

Figure 2-4

evaluate the extent of contamination in groundwater underneath the potential source areas, as well as the surrounding community. The methodologies employed to accomplish this objective are described in detail in the following subsections.

2.4.1 Subsurface Soil Investigations

In June and July 1996, a total of sixteen soil borings were installed within the study area. The locations of these soil borings are shown in **Figure 2-1**. The soil borings were installed to locate active sources since the original sources of contamination are no longer present on the sites, as well as, to determine the extent of contaminated subsurface soils. Soil borings SS-1 thru SS-10 were installed to approximately 10 feet below the groundwater surface; HA-1 and HA-2 were installed to hand auger refusal (these borings were drilled by SESD); and borings SPT-1, MW-6, MW-10 and TW-14 (installed by WESTON) were drilled to the top of bedrock, or to auger refusal depth, whichever was first encountered. **Table 2-3** lists the sampling location and rationale.

Each soil boring except HA-1, HA-2 and SS -1 was advanced using the solid stem auger method. HA-1 and HA-2 were advanced using 4-inch stainless steel hand augers, and SS-1 was advanced using the hollow stem auger method. Soil cuttings from the drilling were used to create a geologic log of each borehole. Geologic borehole logs of the soil borings may be found in Appendix A.

TABLE 2-3. SUBSURFACE SOIL SAMPLING FOR THE NORTH BELMONT PCE SITE.

SAMPLE LOCATION	SAMPLING RATIONALE
SS-1	Dry Cleaning Facility at Suggs and Acme Roads - Shallow Soils, Source Area
MW-10	Dry Cleaning Facility at Suggs and Acme Roads - Shallow /Deep Soils, Source Area
SS-3 thru SS-7	Dry Cleaning Facility at Ropers Shopping Center - Shallow Soils, Source Area
SPT-1	Dry Cleaning Facility at Ropers Shopping Center - Shallow/Deep Soil, Control
MW-6	Dry Cleaning Facility at Ropers Shopping Center - Shallow/Deep Soils, Source Area
HA-1	Dry Cleaning Facility at Ropers Shopping Center - Shallow Soils, Inside Building
HA-2	Dry Cleaning Facility at Ropers Shopping Center - Shallow Soils, Septic Field
SS-8 thru SS-10	Dry Cleaning Facility at Ropers Shopping Center - Shallow Soils, Extent of Contamination
SS-2	Refrigerator Repair Shop - Shallow Soils, Source Area
TW-14	Refrigerator Repair Shop - Shallow/Deep Soils, Source Area

Soil samples were collected for chemical analyses from borings SS-1 thru SS-5 at five foot intervals for the upper 20 feet and every ten feet thereafter until the termination depth of the borehole was reached. The samples were collected with a hand auger bucket for the upper 20 feet of samples and a slat auger for the 30 and 40 feet samples. The sampling procedure was modified for borings SS-6, SS-8 thru SS-10. At these locations soil samples for chemical analyses were collected using a slat auger at depths of 20, 30 and 40 feet for SS-6, and only 30 and 40 foot intervals for SS-8 thru SS-10. At each sampling interval, two 2-ounce VOC containers were collected with a stainless steel spoon directly from either the slat auger or the hand auger bucket. One of the VOC samples was submitted to the on-site analyst who used a portable gas chromatograph (GC); the other sample was logged into FORMS, tagged, sealed and transmitted to the SESD's analytical laboratory for verification. At the 5, 15, and 30 foot intervals, additional aliquots of the sample were then placed in a glass pan and homogenized utilizing a quartering method prior to filling the individual sampling containers. These samples were logged into FORMS, tagged, sealed and transmitted to SESD's analytical laboratory where they were submitted for extractable organic and inorganic TCL/TAL analyses.

Soil samples for chemical analysis were collected from borings SPT-1, TW-14, MW-6, and MW-10 at 10 foot intervals until auger refusal depth. These samples were collected using decontaminated, stainless steel split-spoon samplers. Portions of each sample were placed in a clean, 4-ounce glass jar for VOC analysis. The samples were tagged, sealed, and placed in an ice-cooled laboratory container. The samples from SPT-1 and MW-6 were transferred to SESD representatives for handling and analysis. The samples from locations TW-14 and MW-10 were shipped to laboratories under the EPA Contract Laboratory Program (CLP).

2.4.2 Bedrock Investigations

Information concerning the top of bedrock profile at the North Belmont PCE Site was obtained during the installation of the top of bedrock temporary wells and the permanent monitoring wells. During installation of four of the bedrock wells, the rock was cored with a 4-inch diameter bit in order to determine the fractures and rock quality designation (RQD) of the rock. WESTON, in conjunction with Geophex, Ltd., conducted geophysical borehole logging in monitor wells MW-14, MW-15, MW-17, MW-18, MW-20, and MW-21 (**Figure 2-3**). Due to an excessive amount of sediment in the open borehole portion of the well, geophysical borehole logs were not obtained in monitor well MW-17. The purpose of the borehole logging was to define fractured bedrock locations, the horizontal and vertical orientation of fractures, the depth to fractures, and the possible hydrologic activity associated with fractures in the bedrock. The data generated from the study did help determine potential transport paths of contaminated groundwater through subsurface materials. In order to complete the required logging, the following geophysical functions were used:

- Digital borehole acoustic televiewer
- Mechanical caliper
- Acoustic spectrum log, including transit time, signal amplitude, and variable density signature display
- Natural gamma ray
- Single point resistance
- Temperature with differential temperature curve

The functions were run consistently in the borehole until all logs were created. Decontamination of the logging tools followed the procedures described in the subsequent paragraphs. Each function of the geophysical tools is described in **Table 2-4.** Copies of recorded logs are located in the borehole data sections of the Geophysical Borehole Logging Report in Appendix A.

TABLE 2-4. GEOPHYSICAL BOREHOLE LOGGING TOOLS* UTILIZED AT THE NORTH BELMONT PCE SITE.

LOGGING TOOL	DESCRIPTION OF USE
Digital Borehole Acoustic Televiewer	Primary investigative tool used for this investigation. The borehole televiewer is an acoustic imaging device that scans the interior of the borehole wall with acoustic energy. Reflected energy is received by the device and changes in signal amplitude and signal travel times are transmitted in digital format to the surface log recording computer. The borehole televiewer sonde (receiver) utilizes a rotating transducer, revolving at 10 rps, with a scan rate of 128 pulses per revolution. In open hole environments, the transducer rotation is synchronized to magnetic north allowing the data recorded to be correlated to compass directions. Surface processing of the digital data produces graphic images representing changes in the reflectivity of the materials exposed on the borehole wall and simultaneously variations of the signal travel times. Typically televiewer field data is presented as a depth oriented, magnetically keyed, gray scale graphic, displaying changes in signal amplitudes and travel times.
Acoustic Spectrum Log	This log suite includes data that is related to the acoustic properties of the materials exposed in the borehole. This log records several acoustic properties simultaneously. These include: • Relative Amplitude Curve recorded in track one • Transit Time Curve in track two • VDL or Signature Records in track three
Relative Amplitude Curve	This log is a measure of the amount of signal attenuation the acoustic signal has undergone as it passes through the material surrounding the borehole. Each time the acoustic energy traverses an interface between rock and borehole fluid, such as a fracture or other rock discontinuity, it loses a portion of its energy. The energy losses are evident on the relative amplitude curve. Relative amplitude records through a zone of rock fracturing typically indicate significant signal attenuation, or in some cases loss of sufficient signals to cause loss of signal tracking.
Transit Time Curve	This log is used to calculate the material velocity which also responds to borehole fractures. If the fracture is large enough to cause a significant reduction in the amplitude of the acoustic signal, the precision clock in the acoustic electronics will not be able to track the first signal arrivals and then "time out," causing a "cycle skip" on the transit time curve. These cycle skips are good indicators of fractures. In some cases, features or fracture zones will be indicated by an apparent decrease in the recorded acoustic velocity.
VDL Log	This log is a graphic record of the acoustic signal waveform as received by the downhole sonde. These records reflect the actual form of the acoustic signal following a "Z" axis type processing and are useful in identifying areas of reduced signal strength and relationships between the fracture effects on the compression and shear portions of the waveform.
Mechanical Caliper	Mechanical calipers provide direct indications of fractures present in the borehole. Should the fracture have sufficient dimensions, the caliper curve will indicate a distinct "kick out" when the caliper arm passes into the open fracture. The resolution of the caliper to indicate features is a function of the fracture opening, the size of the caliper and the vertical scale of the log data.
Electric Resistance	These logs have proven useful in identifying features in borings. Should the fracture be filled with borehole fluid, formation fluid, or possibly contaminated fluid, the point resistance curve may indicate a sharp excursion at the depth of the fracture.
Fluid Flow and Temperature	These logs are useful in identifying the movement of fluids into or out of a well. In many cases this fluid movement is directly related to features identified using the other logging functions.
Natural Gamma Ray	Useful in the qualitative borehole to borehole correlations necessary in the description of the site stratigraphy. The gamma log is also useful in evaluating the degree of weathered and/or clay content of the subsurface formations.
Note: (*) Information on logging tools and description of uses courtesy of Geophex, Ltd.	

2.5 GROUNDWATER INVESTIGATIONS

2.5.1 Residential Drinking Water Wells

During the period of March thru September 1996, forty-four(44) residential wells were sampled in the vicinity of the North Belmont PCE Site to determine the water quality of the residences drinking water. Six of the 44 wells were resampled due to the elevated levels of trichloroflouromethane detected in the initial sampling event; the quantitation limit for PCE, TCE and cis-1,2 DCE were above the Federal MCLs. Generally, the drinking water sample was collected at the spigot located at or near the well head or pump house and before the water supply is introduced into any storage tanks or treatment units. If the sample was collected at a point in the water line beyond a pressurization or holding tank, a sufficient volume of water was purged to provide a complete exchange of fresh water into the tank and at the location where the sample was collected. All wells were purged for 15 minutes prior to sample collection. All samples were collected for VOC analyses with approximately 25 percent submitted for full TCL/TAL scan. **Table 2-5** indicates the potable wells sampled as well as pertinent information concerning each well (**Figure 1-2** may be used as a cross-reference for lot/parcel numbers).

2.5.2 Temporary Monitoring Wells

Shallow Temporary Monitoring Wells. In June 1996, shallow temporary monitoring wells were installed at the Site to define the shallow groundwater plume and to investigate possible active source areas at the North Belmont PCE Site. Upon completion of the soil borings and after the augers were removed, 2 inch stainless steel casing tipped with a 5 foot screen were inserted into the borehole. Groundwater was collected using a decontaminated teflon bailer and poured into two preserved VOC containers and one unpreserved VOC container. The unpreserved VOC sample was submitted to the onsite laboratory for immediate analysis. The results from the portable GC provided information that was used by the project leader to place subsequent wells. The two preserved VOC samples were logged into FORMS, tagged, sealed and then transported to SESD's analytical laboratory for verification analysis.

Top of Bedrock Temporary Monitoring Wells. In July 1996, Weston drilled fifteen temporary monitoring wells to top of bedrock. Subsequent sampling of the temporary wells was used to design a permanent monitoring well system to monitor both the movement of the plume along the top of the bedrock interface and movement of the plume in the bedrock aquifer. After a top of bedrock (deep) boring was completed to auger refusal depth, a decontaminated teflon bailer was lowered to the bottom of the auger string within the inner annulus of the augers. A bailer was used to collect a sample of the groundwater, which when brought to the surface and slowly poured into two clean, 40 ml vials for VOC analysis. Groundwater samples were collected from all borings except TW-1. At this location, during the drilling phase, the formation backfilled the inner annulus of the augers a total of 50 feet preventing the collection of a groundwater sample. All groundwater samples were tagged, sealed, and placed in ice-cooled containers for transfer to SESD representatives for analysis. After transfer to SESD personnel, the samples were submitted for onsite VOC analysis with the portable GC.

After collection of the groundwater samples, the boreholes were then backfilled to land surface with the soil cuttings. All remaining soil cuttings from borings/shallow temporary wells installed by SESD were analyzed on site by the portable GC. No detectable volatile organics were noted. Soils from the installation of TW-1, TW-2, TW-7 thru TW-10 were transported and disposed of on the Parkdale Mills property. Soils from TW-3 through TW-6 were spread around the borehole behind Ropers Shopping Center. All remaining soil cuttings from the soil

TABLE 2-5. RESIDENTIAL DRINKING WATER WELLS FOR THE NORTH BELMONT PCE SITE.

STATION	EASTING	NORTHING	LOT	PARCEL	OWNER	ADDRESS	DATE
NB-309-PW	1387006.48	560862.62	15-18	2.01	ROPER, WILLIAM	601 Woodlawn	Jun-96
NB-003-PW	1387006.48	560862.62	15-18	2.01	ROPER, WILLIAM J., SR.	601 Woodlawn	Mar-96
NB-004-PW	1387376.98	560723.1	15-18	3.05	WALLS, HAROLD	505 Woodlawn	Mar-96
NB-350-PW	1386970.00	560665.00	15-18	4.06	WALTERS, ETHEL	2519 Boundary	Sept-96
NB-351-PW	1386790.00	560698.00	15-18	4.08	PENLEY, DELORES	2513 Boundary	Sept-96
NB-312-PWS	1390270.18	561512.61	15-18	12	POPE, RONALD	126 Cody Ln	Jun-96
NB-312-PW	1390270.18	561512.61	15-18	12	POPE, RONALD	126 Cody Ln	Jun-96
NB-305-PW	1389304.72	561823.34	15-18A	21	STEVENS, A.M.	2312 Acme	Jun-96
NB-011-PW	1388437.14	560161.29	15-18A	29	WHITE, STEVE	114 Roper	Mar-96
NB-046-PW	1388639.93	560329.31	15-18A	31	HOFFMAN, ALICE	104 Roper	Mar-96
NB-012-PW	1389068.98	560397.63	15-18A	39	CONTINENTAL CABINET	2115 Acme	Mar-96
NB-355-DPW	1389010.00	560410.00	15-18A	40	SMITH, ANGIE	2203 Acme	Sept-96
NB-355-PW	1389010.00	560410.00	15-18A	40	SMITH, ANGIE	2203 Acme	Sept-96
NB-047-PW	1389050.01	560621.57	15-18A	42	GRIFFITH, JOHN	2209 Acme	Mar-96
NB-013-PW	1389122.04	560497.41	15-18A	43	OLIVER, RAY	2205 Acme	Mar-96
NB-001-PW	1389122.04	560497.41	15-18A	43	OLIVER, RAY	2205 Acme	Apr-96
NB-014-PW	1389127.12	560620.78	15-18A	44	LEATHERMAN, JD	2207 Acme	Mar-96
NB-002-PW	1389127.12	560620.78	15-18A	44	LEATHERMAN, JD	2207 Acme	Apr-96
NB-356-PW	1389090.00	560764.00	15-18A	46	HEFTNER, JIMMIE	2223 Acme	Sept-96
NB-310-PW	1388871.48	560604.12	15-18A	52	WARE	2207 Acme	Jun-96
NB-017D-PW	1388643.92	560585.52	15-18A	58	BROOME, HESSIE	101 Roper	Mar-96
NB-017-PW	1388643.92	560585.52	15-18A	58	BROOME, HESSIE	101 Roper	Mar-96
NB-018-PW	1388536.41	560706.88	15-18A	61	FULL GOSPEL CHURCH	116 School	Mar-96
NB-019S-PW	1388639.41	560694.38	15-18A	62	FUJIKO, DAVID	114 School	Mar-96
NB-019-PW	1388639.41	560694.38	15-18A	62	FUJIKO, DAVID	114 School	Mar-96
NB-021-PW	1388588.97	560855.55	15-18A	65	CONNER,FLETCHER	104 Apricot	Mar-96
NB-001-PW	1386678.11	560867.36	15-10A	78	BARNES, JD	2507 Boundary	Mar-96
NB-033-PW	1388876.24	561247.18	15-18A	96.01	COLLETTE, JAMES	2309 Acme	Mar-96
NB-033S-PW	1388876.24	561247.18	15-18A	96.01	COLLETTE, JAMES	2309 Acme	Mar-96
NB-034-PW	1388921.71	560982.15	15-18A	99	CONNER, LYNN & BO	104 School	Mar-96
NB-352-PW	1389140.00	561062.00	15-18A	106	CENTERVIEW BAPTIST CH	2300 Acme	Sept-96
NB-307-PW	1389351.19	561272.42	15-18A	108	GRINDSTAFF, BOBBY	105 O'Daniel	Jun-96
NB-048-PW	1389351.19	561272.42	15-18A	108	GRINDSTAFF, BOBBY	105 Odaniel	Mar-96
NB-049-PW	1389141.13	561498.67	15-18A	109.03	MCMILLANS, SHIRLEY	2304 Acme	Mar-96
NB-308-PW	1389404.15	561460.99	15-18A	110	CAGLE, THOMAS	115 O'Daniel	Jun-96
NB-306-PW	1389552.31	561390.22	15-18A	112	O'DANIEL, NELL	106 O'Daniel	Jun-96
NB-311-PW	1389827.15	561521.92	15-18A	112.01	SPAGGS, HAZEL	119 Cody Ln	Jun-96
NB-353-PW	1389900.00	561355.00	15-18A	112.02	UNDERWOOD, KATHY	123 Thomas Fite	Sept-96
NB-003-PW	1389668.24	561195.33	15-18A	112.03	BROOME, LARRY	Dumont Ave	Apr-96
NB-037-PW	1389405.25	561037.02	15-18A	114	MARLOWE, JOANN	102 Odaniel	Mar-96
NB-038-PW	1389371.12	560865.28	15-18A	116	AMIS, INC	2232 Acme	Mar-96
NB-302-PW	1389371.12	560865.28	15-18A	116	GORE, AL	2232 Acme	Jun-96
NB-301-PW	1389346.34	560828.74	15-18A	118	LYNCH, KATHY	2228 Acme	Jun-96
NB-039-PW	1389346.34	560828.74	15-18A	118	LYNCH, KATHY	2228 Acme	Mar-96
NB-357-PW	1389200.00	560636.00	15-18A	119	PADGETT, LUCILLE	2224 Acme	Sept-96
NB-040-PW	1389237.46	560658.26	15-18A	121	COBB, DIANNE	2216 Acme	Mar-96
NB-042-PW	1389245.22	560540.31	15-18A	123	OLIVER, RAY WELL B	2208 Acme	Mar-96
NB-041-PW	1389245.99	560536.1	15-18A	123	OLIVER, RAY WELL A	2208 Acme	Mar-96
NB-303-PW	1389447.76	560525.7	15-18A	125	KALE, TRISHA	201 Centerview	Jun-96
NB-045-PW	1390173.48	561210.05	15-18A	142	WATERS, MARY	118 Thomas Fite	Mar-96
NB-304-PW	1389442.27	560709.43	15-18A	127	MORGAN, FOREST	205 Centerview	Jun-96
NB-044-PW	1389567.15	560727.35	15-18A	128	OLIVER, MARY FRANCIS	202 Centerview	Mar-96
NB-359-PW	1389770.00	560825.00	15-18A	132	DUDLEY	113 Thomas Fite	Sept-96
NB-354-PW	1389880.00	561213.00	15-18A	138	SUTTON, DAVID	121 Thomas Fite	Sept-96
NB-045-PW	1390173.48	561210.05	15-18A	142	WATERS, MARY	118 Thomas Fite	Mar-96

borings installed by WESTON were containerized on-site and handled as described in the Section 2.7 of the *Field Investigation Report for the North Belmont PCE Site*, Roy F. Weston, Inc. February 1997.

2.5.3 Permanent Ground Water Monitoring Wells

Eight top of bedrock (MW-6 through MW-13) and nine bedrock monitoring wells (MW-14 through MW-22) were installed during the remedial investigation to determine the extent of contamination associated with releases from the former Untz Dry Cleaners location. Nine of the original sixteen residential wells which were converted to monitoring wells in 1991 were modified to have concrete pads and locking well covers; the other seven were no longer accessible due to vandalism of the wells. **Figure 2-3** presents the location of all the monitoring wells and **Table 2-6** provides a summary of the location and purpose of each monitoring well installed by WESTON in 1996. Well construction details for the top of bedrock and bedrock monitoring wells are presented in **Tables 2-7** and **2-8**, respectively, and monitoring well construction specification diagrams and boring logs are presented in Appendix A.

Installation of Top-of-Bedrock Monitor Wells (MW-6 through MW-13). In July 1996, top-of-bedrock monitoring wells MW-6 through MW-13 were installed using a CME-75 drilling rig equipped with 8.75-inch outer diameter hollow stem augers. Soil cuttings from the drilling were used to create a geologic log of each borehole. Upon auger refusal at each of the well locations, the drilling was stopped and the monitoring well was constructed inside the augers using 2-inch outer diameter flush threaded stainless steel casing and well screen (0.010-inch slot size). The bottom of the screen was sealed with a stainless steel sediment sump. A washed, graded sand was then tremied using potable water in the borehole annulus (the tremied method is a positive displacement method where a 1" diameter pipe is used to direct the flow of materials into the well to prevent bridging of the material in the borehole annulus). As the level of the filter pack rose, the auger and tremie pipe were gradually removed, and the filter pack was emplaced to a level of 2 feet above the top of the screen. With the filter pack in place, bentonite pellets were placed directly onto the sand using the tremie pipe to a thickness of approximately 2 feet. Potable water and groundwater present in the borehole during the placement of the sand was allowed to hydrate the pellets for approximately eight hours.

A cement/bentonite slurry used as a grout seal was then tremied on top of the bentonite seal to a level of 1 foot below the ground surface. A flush-mounted manhole or protective cover (depending upon the location of the well) was placed over the top of the well casing and grouted into place within a three foot by three foot concrete pad. A lockable cap was then placed on top of the well casing and secured with a padlock, and the manhole cover was secured. For locations with a protective casing (MW-6, -8, -11, -12, and -13), the padlock was placed on the outside of the cover and three protective barriers were placed around the concrete pad in a roughly triangular shape. All top-of-bedrock wells are identified by a small identification tag on either the inside of the manhole or on the outside of the protective casing.

TABLE 2-6. LOCATION AND PURPOSE OF MONITOR WELLS FOR THE NORTH BELMONT PCE SITE.

WELL NUMBER	LOCATION	PURPOSE
MW-6	Top-of-bedrock well located immediately adjacent to east side of Roper Building.	Provide top-of-bedrock aquifer monitoring data adjacent to source location.
MW-7	Lot 115; corner of Centerview and O'Daniel Streets.	Provide top-of-bedrock aquifer monitoring data near potential source area of groundwater contamination.
MW-8	Lot 18; Parkdale Mills property; north of Goshen Road.	Provide downgradient top-of-bedrock aquifer monitoring data from position northeast of Roper Building.
MW-9	Lot 112; near corner of O'Daniel and Dumont Streets.	Location at outer edge of potential groundwater plume originating from Roper Building. Monitor top-of-bedrock aquifer.
MW-10	Lot 11; east of Acme Road; southeast of Roper Building — 0.3 miles.	Monitor groundwater from top-of-bedrock aquifer near source area A.
MW-11	Lot 10; on North Belmont Elementary School property; northwestern edge of property.	Monitor top-of-bedrock aquifer groundwater at a lateral gradient position to Roper Building.
MW-12	Lot 1.02; northeast of Austin International and Roper Building location.	Monitor top-of-bedrock aquifer in a downgradient location from Roper Building.
MW-13	Lot 20; immediately west of Acme Road at northern edge of site.	Monitor northern edge of potential top-of-bedrock aquifer groundwater contaminant plume.
MW-14	Immediately adjacent to eastern edge of Roper Building.	Monitor bedrock aquifer at location adjacent to source area A.
MW-15	Lot 115; at corner of O'Daniel and Centerview Streets.	Monitor bedrock aquifer adjacent to potential groundwater contamination source area.
MW-16	Lot 18; Parkdale Mills property; north of Goshen Road.	Location provides bedrock aquifer data northeast of source area A.
MW-17	Parkdale Mills property; extreme northeast edge of site.	Provide bedrock aquifer data at furthest downgradient point to site.
MW-18	Lot 40; west of Acme Road.	Provide bedrock aquifer data from position adjacent to source area B.
MW-19	Lot 10; in northwest corner of North Belmont Elementary School property.	Provide monitoring data on bedrock aquifer from lateral gradient position to Roper Building.
MW-20	Lot 2; east of Woodlawn Road and west of Roper Building.	Monitor bedrock aquifer in potential upgradient location to source area A.
MW-21	Lot 20; west of Acme Road; northern edge of site.	Provide bedrock aquifer monitoring data from potential downgradient position and at northern edge of contaminant plume.
MW-22	Lot 112; corner of O'Daniel and Dumont Streets.	Monitor bedrock aquifer in downgradient position.

TABLE 2-7. SPECIFICATIONS FOR TOP-OF-BEDROCK MONITOR WELLS FOR NORTH BELMONT PCE SITE.

MONITOR WELL NO.	BOREHOLE DIAMETER (inches)	TOTAL DEPTH (ft. bgs)	SCREEN LENGTH (ft)	SCREEN INTERVAL (ft. bgs)	FILTER PACK INTERVAL (ft. bgs)	BENTONITE SEAL (ft. bgs)	WATER DEPTH (10/96) (ft. btoc)
MW-6	8.25	127	10	117-127	115-127	112-115	34.58
MW-7		118		106-116	104-116	102-104	27.33
MW-8		45		34-44	32-44	30-32	25.30
MW-9		74.5		64-74	62-74	60-62	31.95
MW-10		67		57-67	55-67	53.55	32.55
MW-11		73		63-73	61-73	59-61	31.93
MW-12		69		59-69	57-69	55-57	23.51
MW-13		41		31-41	29-41	27-29	3.05

Notes: All top-of-bedrock monitor wells utilized stainless steel riser pipe and screen.
ft. bgs = feet below ground surface
ft. btoc = feet below top-of-casing

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TABLE 2-8. SPECIFICATIONS FOR BEDROCK MONITOR WELLS FOR THE NORTH BELMONT PCE SITE.

MONITOR WELL NO.	BOREHOLE DIAMETER (inches)	DEPTH TO BOTTOM OF SURFACE CASING (ft. bgs)	OUTER DIAMETER OF SURFACE CASING (inches)	TOTAL BORING DEPTH (ft. bgs)	DEPTH TO WATER 10/96 (ft. btoc)
MW-14	8	128	4	144	31.58
MW-15		118		133	27.20
MW-16		69		83	21.41
MW-17		28.4		50	8.56
MW-18	10	139	6	161	27.51
MW-19		77		181	30.21
MW-20		105.5		122	34.35
MW-21		46		80	2.65
MW-22		75		92	30.77

Notes: All bedrock monitor wells are open borehole from the bottom of the casing to the total drilled depth.
ft. bgs = feet below ground surface.
ft. btoc = feet below top-of-casing

Well development methods are described in subsequent paragraphs. All soil cuttings were containerized on-site and handled as described in Section 2.7 of the *Field Investigation Report for the North Belmont PCE Site*, Roy F. Weston, Inc. February 1997.

Installation of Bedrock Monitoring Wells (MW-14 through MW-22). In August and September 1996, bedrock monitoring wells MW-14 through MW-22 were installed. The proposed installation procedures for these wells instructed that each bedrock monitoring well would be installed as a single cased well, where a carbon steel surface casing would be installed but the remainder of the borehole would be left as an open borehole. The surface casings would be installed through the saprolite and partially weathered rock zones and into the top of bedrock to inhibit the migration of any overlying groundwater contamination into the bedrock aquifer. The preferred methods of drilling the overburden were, in order, water rotary, followed by air and then mud rotary techniques. Air rotary drilling techniques were attempted on the first bedrock monitoring well location to be drilled; however, due to the rapid collapse of the saprolite aquifer material into the borehole after the drill rods were removed, all surface casings for bedrock wells would have to be installed using mud rotary techniques.

Each of the bedrock monitoring well borings was initiated using a 10-inch-diameter tricone roller bit. This bit was used for installing a borehole through saprolite and partially weathered rock and into bedrock for the purpose of setting the surface casing. Drilling mud was mixed fresh for each drilling location. The mud was composed of a bentonite powder and potable water mixture and the drill rig operator controlled the viscosity of the drilling mud. Potable water was provided from the City of Belmont Public Water Supply. The surface casing, composed of either 4-inch or 6-inch-diameter carbon steel, was then lowered into the borehole. Four-inch-diameter casing was used in all borehole locations where the bedrock was cored while 6-inch-diameter casing was used in all boreholes completed with standard air hammer drilling techniques. Once a surface casing had been set, a cement and bentonite grout slurry was pumped under pressure through galvanized tremie pipe set within the inner annulus of the casing and to the bottom of the casing. All cuttings and drilling fluids were pumped into a mobile holding tank for subsequent discharge into an on-site fractionalization (frac) tank. Residual handling is discussed in Section 2.7 of the *Field Investigation Report for the North Belmont PCE Site*, Roy F. Weston, Inc. February 1997. After the grout had set for a minimum of 24 hours, either a 6-inch-diameter (for wells completed by air hammer drilling) or a 4-inch-diameter (for wells completed by coring) bit was used to complete the boring into bedrock. Drilling of the borehole was halted when a significant water bearing fracture was encountered.

To complete the surface portion of each well, a flush-mounted manhole was placed over the top of the well casing and grouted into place. For monitoring wells MW-14, MW-16, MW-17, and MW-21, an aboveground protective cover was used for surface completion. A lockable cap was placed on top of the well casings and secured with a padlock and the manhole covers secured. The padlock (in the case of wells MW-14, MW-16, MW-17, and MW-21) was placed on the outside of the protective cover. All bedrock monitoring wells are identified by a number on a faceplate which is either set within the manhole cover or on the protective cover. All bedrock wells have a three foot by three foot concrete pad surrounding the manhole or the protective cover. All wells with the protective cover are also completed with three steel pipe barriers arranged in a roughly triangular shape around the pad.

Well Development. All permanent monitoring wells were developed using a submersible pump. The development process continued until: 1) a minimum of five standing well borehole volumes were removed/computed at an estimated 30% porosity for the annular volume occupied by the saturated filter pack plus the full standing water volume inside the well casing; 2) the effluent was free of visible suspended solids as was practical; and 3) pH, temperature, and specific conductance parameters had stabilized. Parameters were considered stable when three successive readings agreed to within 0.1 standard pH units, 0.5 degrees Centigrade, and within 5% micromhos/cm conductivity, with at least 5% of a single development volume passing between each successive measurement. Development was considered complete when the water parameters had stabilized and/or five volumes of water had been completely removed. All well development water was containerized on-site and disposed as described in the Section 2.7 of the *Field Investigation Report for the North Belmont PCE Site*, Roy F. Weston, Inc. February 1997.

Monitoring Well Purging and Sampling Operations. During October and November 1996, the 21 permanent monitoring wells (MW-1 was unable to be sampled due to blockage from the plumbing of a bladder pump), and nine residential wells converted to monitoring wells were sampled; locations are shown on **Figure 2-3**. All permanent monitoring well purging and sampling was conducted in accordance to the *EISOPQAM.* Generally, three to five well volumes of water were purged from the monitoring well with either a submersible pump, peristaltic pump (if water depth less than 25 feet) or bailer. The purge waters were monitored for stabilization of pH, temperature, specific conductivity, and turbidity. Stabilization criteria are noted in **Table 2-9**. Field instruments utilized to measure these parameters were calibrated at the beginning and end of each sampling day as per the *EISOPQAM.* Upon stabilization of parameters, the ground water sample was collected. The same device utilized for purging was generally used for sampling; except for the submersible pumps which were not adapted for sampling, in which case, the sample was collected either with a bailer or peristaltic pump. Prior to using the submersible pumps which were adapted for sampling, equipment rinseate blanks were collected to verify decontamination procedures. All samples except for six locations were submitted for a full TCL/TAL chemical analyses to SESD's laboratory; the six wells sampled in November were submitted for full TCL/TAL analysis by a CLP approved laboratory.

TABLE 2-9. WELL STABILIZATION CRITERIA FOR NORTH BELMONT PCE SITE.

FIELD INDICATOR PARAMETER	ACCEPTABLE MEASUREMENT DEVIATION RANGE FOR DETERMINING MONITORING WELL STABILIZATION
Turbidity	+/- 10% (where turbidity > 10 NTU)
Temperature	+/- 1^{o}C
pH	+/- 0.1
Conductivity	+/- 3%
DO	+/- 10%

Slug Tests. In January 1997, slug tests were conducted in all newly-installed monitoring wells for the purpose of determining the hydraulic conductivity of the aquifer. The rising head slug test method was used in each well to maintain consistency of method. This method reduces the chances of compression of air within the screened zone. Equipment utilized during the test included a bailer for removing a slug of water and an electronic data logger for recording of the water level changes in the well. Depth to water measurements were collected within each well prior to initiation of the slug test.

2.6 DECONTAMINATION PROCEDURES

During the soil boring/temporary well, monitoring well installation program, geophysical logging and sampling activities, all down-hole drilling equipment (including augers, bits, rod, split-spoons, etc.), stainless steel well casings, well screens, end caps, tremie pipes and sampling equipment were decontaminated using the subsequent procedures:

1. A thorough potable water rinse and a wash and scrub with a solution of potable water and phosphate-free detergent (Alconox);
2. Rinse with a high pressure, hot water sprayer delivering potable water, followed by a thorough rinse with organic-free water;
3. Spray with reagent grade isopropanol and air dry. If the equipment was to be used immediately after decontamination or if atmospheric conditions did not permit air-drying, the equipment was thoroughly rinsed a second time with organic-free water;
4. Depending upon size, the equipment was wrapped in aluminum foil, placed inside a plastic bag, or wrapped in clear plastic sheeting.

Organic-free water was produced from potable water from the City of Belmont Public Water Supply, which was processed through an on-site water treatment unit. All residuals from the decontamination process, including water and sediment, were contained on-site, and disposed of as described in Section 2.7 of the *Field Investigation Report for the North Belmont PCE Site*, Roy F. Weston, Inc. February 1997. All pumps, hoses, tubing, well sounders, and other measuring instruments were also decontaminated without the use of isopropanol. Instead, each instrument, tubing, hose, or pump was rinsed twice with organic-free water.

2.7 QUALITY ASSURANCE/QUALITY CONTROL

All samples collected during the investigation were in accordance to the *EISOPQAM* and the *Remedial Investigation/Feasibility Study Work Plan,* North Belmont, Gaston County, North Carolina, June 1996. The quality assurance and quality control (QA/QC) procedures described in these manuals insured collection of representative samples from the various media at the Site. The various QA/QC samples collected at the Site are noted in **Table 2-10**.

TABLE 2-10. QUALITY CONTROL/QUALITY ASSURANCE SAMPLES COLLECTED AT THE NORTH BELMONT PCE SITE.

QA/QC SAMPLE	DESCRIPTION
Field	a sample that is prepared in the field to evaluate the potential for contamination of a sample by site contaminants from a source not associated with the sample collected. Field blanks should be collected in dusty environments and/or from areas where volatile organic contamination is present in the atmosphere and originating from a source other than the source being sampled.
Trip	a sample which is prepared prior to the sampling event in the actual container and is stored with the investigative samples throughout the sampling event. Trip blanks are used to determine if samples were contaminated during storage and/or transportation back to the laboratory (a measure of sample handling variability resulting in positive bias in contaminant concentration).
Water Source	sample of water from local water supplies used for decontamination procedures and collected to measure any positive bias from sample handling variability.
Organic Free System	sample collected from a field organic/analyte free water generating system. The purpose of the organic/analyte free water blank is to measure positive bias from sample handling variability due to possible localized contamination of the organic/analyte free water generating system or contamination introduced to the sample containers during storage at the site.
Equipment Rinseate	a sample collected using organic-free water which has been run over/through sample collection equipment. These samples are used to determine if contaminants have been introduced by contact of the sample medium with sampling equipment. Equipment field blanks are often associated with collecting rinse blanks of equipment that has been field cleaned
Preservative	a sample that is prepared in the field and used to determine if the preservative used during field operations was contaminated, thereby causing a positive bias in the contaminant concentration.
Split	a sample which has been portioned into two or more containers from a single sample container or sample mixing container. The primary purpose of a split sample is to measure sample handling variability.
Duplicate or Co-located	two or more samples collected from a common source. The purpose of a duplicate sample is to estimate the variability of a given characteristic or contaminant associated with a population.

2.8 DEMOGRAPHICS, LAND AND WATER USE

A residential well survey was performed by Weston during September and October, 1995. A door to door survey and records search was conducted for the study area shown on **Figure 1-2.** Information gathered by the door to door survey included existing wells, well use, well depth, age and access for potential well sampling activities. The records research included reviewing the city water bills for areas supplied with municipal water.

2.9 ECOLOGICAL SURVEY

A bioassessment was conducted during July 1996 of the “unnamed tributary-A” adjacent to the Site. Study objectives were to (1) characterize the benthic macroinvertebrate community of the tributary and an established reference stream (Dutchmans Creek) near Mount Holly, N.C., (2) evaluate the quality of the stream habitat at all sites using the Rapid Bioassessment Methodology (EPA, 1989), and (3) conduct in-situ physicochemical measurements at all sites. Completion of these study objectives showed that the stream was not affected by the Site.

The headwaters of the unnamed tributary adjacent to the Site are located less than 1000' northwest of the railroad crossing at Goshen Grove (see **Figure 2-5**). The unnamed tributary flows through an urbanized area for approximately one mile and then joins another unnamed tributary prior to its confluence with Fites Creek (**Figure 2-5**). Due to their proximity to urban areas, both unnamed tributaries and their floodplains have been subjected to environmental degradation. Past studies by the North Carolina Department of Environment, Health, and Natural Resources (NCDEHNR;1974-75 & 1986) found poor water quality due to urban runoff in the unnamed tributary that joins Fites Creek northeast of North Belmont.

Sampling stations in the unnamed tributary adjacent to the Site were located near the headwaters at the railroad crossing (UT-1), proximal to the Site (UT-1A), and downstream of the Site at the railroad crossing and just before the confluence with the unnamed tributary to Fites Creek (**Figure 2-5**). Discussions with NCDEHNR indicated a suitable reference site, Dutchmans Creek, existed near Mount Holly, N.C. Reference sites are minimally impacted sites and serve to provide insight into biological potential for an area and allow comparison to other sites to determine if impacts exist and the severity of those impacts. Dutchmans Creek (DC-1) was sampled at SR 1918 (Sandy Ford Road) north of Mount Holly (See **Figure 2-6**).

<u>Rapid Bioassessment III- Methods</u>. Benthic macroinvertebrates provide an indication to water quality and detect environmental perturbations due to introduced pollutants. Due to their limited mobility and relatively long life span, the benthic macroinvertebrate community is a reflection of water quality conditions over time. The Rapid Bioassessment Protocols (EPA, 1989) were followed for benthic macroinvertebrate collection, habitat evaluation, and in-situ physicochemical measurements at all sampling sites. Benthic macroinvertebrate collection involved a multi-habitat sampling effort (rocks, snags, root bank, and stream bottom). Habitat parameters, relating to substrate and instream cover, channel morphology, and riparian and bank cover, are evaluated or scored. Habitat, as affected by instream and surrounding topography, is a major factor in the development of a stream biological community. In conjunction with the benthic macroinvertebrate sampling and habitat evaluations, in-situ physicochemical measurements of water temperature, pH, conductivity, and dissolved oxygen were recorded at each station. Field instruments utilized to measure these parameters were calibrated at the beginning and end of each sampling day as per the *EISOPQAM.*

Figures 2-5 and 2-6