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EPA Superfund
Record of Decision:

NORTH CAROLINA STATE UNIVERSITY (LOT 86, FARM UNIT #1)
EPA ID: NCD980557656
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RALEIGH, NC
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RECORD OF DECISION
NC STATE UNIVERSITY
LOT 86 SUPERFUND
SITE

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DECLARATION FOR THE RECORD OF DECISION

SITE NAME AND LOCATION

NC STATE UNIVERSITY LOT 86 SITE,
RALEIGH, WAKE COUNTY, NORTH CAROLINA

STATEMENT OF BASIS AND PURPOSE

This decision document presents the selected remedial action for the NC State University Lot 86 Site in Raleigh, Wake County, North Carolina, chosen in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA) and, to the extent practicable, the National Contingency Plan (NCP). This decision is based on the administrative record file for this Site.

The State of North Carolina 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.

DESCRIPTION OF THE SELECTED REMEDY

This remedy addresses the principle threat of contaminated groundwater emanating from beneath the Site.

The major components of the selected remedy include:

SOIL

The soil remedy is In-situ Mixing and Encapsulation. The soils will be mixed intially within the bore hole and the VOCs that are released as a result of the mixing will be captured via a specially designed bore hole shroud, and treated. The treatment may include but not be limited to liquid vapor separation, in-line prefiltration for dust and particulate removal, followed by parallel activated carbon filter banks. The remaining contaminants will be solidified in-situ
using various pozzolan-portland cement based formulations delivered to and dispersed within the soil column as a grout.

GROUNDWATER

Extraction of groundwater at the Site that is contaminated above Remediation Goals as provided in Table 11-1 of this document.

Onsite treatment of extracted groundwater via air stripping, and carbon adsorption; Discharge of treated groundwater to surface water or local publicly owned treatment works(POTW).

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 onsite 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.
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DECISION SUMMARY

I. SITE NAME, LOCATION AND DESCRIPTION

A. Introduction

The North Carolina State University Lot 86 Site (herinafter referred to as the "Lot 86 Site" or the "Site") is a 1.5-acre site located on the west side of Raleigh, North Carolina (Figure 1-1). The NCSU Lot 86 site served as a disposal site for chemical and low level radioactive wastes (LLRW) generated in the educational and research laboratories at NCSU from 1969 until 1980. The wastes were disposed in subsurface trenches and covered with native soils. The waste deposited in the trenches is responsible for the groundwater and soil contamination present on Site.

B. Site Description

The NCSU Lot 86 site is northeast of Carter-Finley Stadium and immediately south of the Wade Avenue Extension right-of-way and is surrounded by state-owned property (figure 1-2). The site is bound on the west by the stadium parking area and surround by trees on the three remaining sides.

The source of the contamination is attributed to solvents, pesticides, heavy metal, acids, and low-level radioactive waste buried in trenches which are 10' deep varying in lengths from 50 to 150 feet, totaling 2000 linear feet.

C. Demography and Land Use

The 1.5 acre site is located on and surrounded by state-owned property. The site is secured with a chain-link fence with a padlock on the gate. The site is covered with grass and weeds and no structures are present. A large grass-covered open area, adjacent to the west of the site and north of Carter-Finley Stadium, is used for parking during stadium events. The road leading into this area from Old Trinity Road is used as a jogging path by NCSU students, faculty and area residents. Trees along the fence north of the site screen the view from Wade Avenue. A pine forest borders the site to the east and south. The nearest water supply well is located approximately 2,000 feet southeast of the site at the Medlin residence.

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D. Geology

The region's crystalline bedrock weathers chemically and physically in-place to form a unconsolidated mantle of soils and partially weathered rock termed the regolith. The regolith consist of three distinct zones: residual soils at the surface, saprolite, and weathered rock. The surface soils of the study area included low compressibility silts, high compressibility silts, micaceous silts, and low to high compressibility clays. The saprolite is somewhat porous and granular due to the disintegration of feldspar crystals and solution removal of some internal rock mass and volume solids. Saprolite retains many aspects of the parent bedrock (banding, foliation, and structural features such as fractures) and its grain size ranges from clay to boulders. Silts and sands are common components, micas may be present in great quantity. The saprolite is directly underlain by a weathered rock zone. The weathered rock zone is of variable thickness and physical character; there is no sharp delineation between the regolith and the bedrock. The bedrock surface is uneven; the rock may be fractured or fissured for several hundred feet within its unaltered mass.

E. Hydrogeology

Groundwater occurs in the silty clay/granular soils (residual and saprolite) and in the underlying crystalline bedrock under generally water table (unconfined) conditions. The unconsolidated soils aquifer is chiefly replenished by the infiltration of precipitation where the unit is exposed. The shallow unconsolidated residual soil/saprolite water-bearing unit exist at depths ranging from 20 ft to 40 ft below land surface, and flows west northwest toward Wade Avenue.

F. Climate/Meteorology

The average annual precipitation is 46 inches, with July and August being the wettest months. Average monthly temperatures range from a low of 40.2 degrees Fahrenheit(5F) in January to a high or 78.85F in July. The warm summer temperatures combined with heavier precipitation in these months serve to maintain a typically humid environment.

II. Site History

The NCSU Lot 86 Site was used as a hazardous chemical and low level radioactive waste site beginning in 1969. The waste was generated in the University's educational and research laboratories. The site was divided into two separate areas as shown on Figures 2-1; the western area received the hazardous chemical waste, and the eastern area received low level radioactive waste (LLRW). Burial of waste was discontinued in November 1980, to comply with regulations promulgated under the Resource Conversation and Recovery Act (RCRA).

The chemical wastes were placed in trenches and back filled with approximately 2 feet of native soils. There are 22 trenches approximately 10 feet deep and varied from 50 to 150 feet in length. Types or chemical buried at the site include solvents, pesticides, inorganics, acids, and bases. NCSU reported that it had disposed of approximately 11,000 cubic yards of chemical waste at the site. Quantities reported included lightly contaminated soils and water as well as actual waste materials.

Radiological wastes were buried in trenches approximately 6 feet deep and 50 to 120 feet long. Nine trenches were reportedly excavated and used for LLRW disposal. The depth of wasted in the bottom of the trenches was reported to be 2 feet with 4 feet of native soil cover material. Records concerning waste disposal in this area are maintained by the NCSU Radiation Protection office in complete conformance with applicable AEC/NRC regulations. These records indicate that the wastes were properly disposed at the site. Most of the LLRW waste is in solid from, primarily animal carcasses, which range in size form rats to whole sheep. Radionuclides present in the waste include tritium, carbon-14, iron-59, phosphorus-32.

The site was placed on the National Priority List (NPL) in October 1984, based on results from an inspection completed earlier in June.

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III. HIGHLIGHTS OF COMMUNITY PARTICIPATION

Pursuant to CERCLA Section 113(K)(2)(B)(i-v) and Section 117, the RI/FS Report and the Proposed Plan for the NC State Lot 86 Site were released to the public for comment on June 26, 1996. These documents were made available to the public administrative record located in the information repository maintained at the EPA Docket Room in Region IV and at the Cameron Village Regional Public Library, 1930 Clark Avenue, and D. H. Hill library, North Carolina State University, Raleigh, North Carolina.

The notice of availability for these documents was published in the Raleigh News & Observer on June 26, 1996. A public comment period on the documents was held from June 26, 1996 to July 26, 1996. A copy of the notice was mailed to the individuals on the mailing list. In addition, a public meeting was held on July 9, 1996. At this meeting, representatives from EPA answered questions about problems at the Site and the remedial alternatives under consideration.

Other community relations activities included;

- Community Relations plan finalized in May of 1993 and a copy was placed in information repository.

- Issuance of a Fact Sheet on the RI/FS process in August 1993.

- Public meeting on September 7, 1993, to discuss the superfund process. The meeting was announced by a display ad that appeared in the newspaper on August 31, 1993.

- Issuance of a Fact Sheet on the Proposed Plan for the Lot 86 Site on June 26, 1996, in conjunction with the announcement that was displayed in the Raleigh News & Observer. The meeting was held on July 9, 1996.

IV. SCOPE AND ROLE OF RESPONSE ACTION WITHIN SITE STRATEGY

The Lot 86 Site will not be subdivided into phases or operable units. The remedial action described in this documents will address all medias of concern, including any and all principal threats.

Medias of concern include the contaminants contained in the on site trenches and the resulting groundwater plume migrating to the west, northwest. This final remedy is intended to address the entire Site with regard to the principal threats to human health and the environment posed by the site as indicated in the risk assessment. The findings of the risk assessment are included in the RI Report and are summarized in Section VI of this document.

V. SUMMARY OF SITE CHARACTERISTICS

The Remedial Investigation (RI) at the N.C. State Lot 86 Site included the characterization of routes of contaminant migration which included the soil and groundwater. The Site did not include any surface features.

A. Groundwater Investigation

The goal of the groundwater investigation was to verify the reliability of groundwater samples previously taken during previous investigations as well as supplement that sample data to fully assess the extent and level of contamination present in the aquifer system.

To accomplish that goal, eight new stainless steel monitoring wells were constructed during the investigation (Figure 5-1) to supplement the existing wells installed by the University during previous studies. Samples were collected from the 8 new stainless steel wells, 11 existing wells (4 stainless steel, 7 PVC), and one domestic well (Medlin residence).

Groundwater organic results indicated that VOCs were the most prevalent group with low levels of semivolatile organics and pesticides detected. VOC concentrations are notably higher in the shallow aquifer than in the bedrock aquifer, with the highest concentration near the landfill. Chloroform, methylene chloride, benzene, carbon tetrachloride, and trichloroethane (TCE) were identified as compounds detected most frequently and at the highest concentrations. VOCs were not present in background and upgradient wells. The highest VOC concentrations in groundwater occurred in wells MW-37, MW-36s, MW-5A, and MW-1B in the top 5 to 10 feet of the saturated zone, just off the west and northwest portions of the landfill, nearest the trenches. Low levels of VOCs were detected in some of the deep wells. Concentrations decrease significantly with depth and as you move away from the landfill to the north and west.

All of the semivolatile and pesticide detection in groundwater were low level concentrations. Within the semivolatile organic group, three parameters were detected at three different wells. Bis(2-ethlyhexyl)phthalate was detected at 41 milligrams per liter(mg/l) in the background well, MW-34D. Isophorone was detected at 570 mg/l in MW-37, and napthalene was detected at 30 mg/l in MW-36S. Pesticides (chlordane, dieldrin, and lindane) were detected in shallow wells MW-34S, MW-35S, and MW-37, respectively.

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Arsenic, barium, chromium, copper, lead, manganese, and zinc were identified in downgradient wells at concentrations above those present in the upgradient wells. Of those only Arsenic, was detected at 110 Ig/l in MW-36D, however arsenic was not found in MW-36S. Lead was detected at concentrations of 21 Ig/l and 31 Ig/l at MW-36S and MW-37 respectively. Concentration of manganese above MCL was detected in all of the shallow wells including the background well. Concentrations ranged from 370 Ig/l at MW-34S to 20,000 Ig/l at MW-36S. Maganese was also found at concentrations above MCL in the bedrock aquifer at several locations.

All groundwater samples were analyzed for carbon-14 and tritium. Carbon 14 was detected in one well just above the detection limit of 500 pCi/l at 522 pCi/l in MW-38. Tritium was detected at three wells at concentrations ranging from 711 pCi/l to 6000 pCi/l, which are well below the MCL of 20,000 pCi/l.

B. Soil Investigation

The purpose of the shallow soil samples was to determine if contaminants had migrated horizontally from the trenches and if surficial contamination was evident. Surface soil samples were collected from 0' to 1'-0" intervals. Shallow soil samples were collected from shallow soil borings at intervals of 4'0" to 6'-0" and 10'-0" to 12'-0" below existing ground surface. Surface and shallow soil samples were also taken from monitoring well borings at 2 foot intervals above the water table and at 5 foot intervals below the level at which groundwater was encountered. At MW-34S, MW-35D, and MW-36S two to five representative samples were collected. The 93 samples collected were subjected to gross volatile hydrocarbon and radiation field screening, as well as selected VOC screening using the GC. Based on the screening results, selected samples were shipped to th laboratory for TAL/TCL confirmational analysis. (See Figure 5-2 for depiction of sample locations.)

C. Surface Soil Results

In general, all detected volatile organics in surface soils were at low concentrations. The most frequently detected VOC was acetone (six detects), which included two detection at a background location. Other VOC detections included 1,2-dichloropropane, 1,1-dichloroethane, chloroform, methlyene chloride, tetrachloroethene, toluene, and trichloroethene.

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The most frequent detection within the semivolatile group was bis(2-ethlyhexyl)phthalate, with one of four detections occurring at a background location. All detected semivolatile concentrations were less than 5 mg/kg and average less than 1 mg/kg. All detection of pesticides were less than 8 Ig/kg. Aroclor 1260 was detected at SB-25-01 at 40.3 Ig/kg.

Concentrations of inorganic parameters in surface soil samples from the vicinity of the landfill are similar to those in background samples and those typical of soils in this part of North Carolina. Most of the highest metals concentrations were observed in the background samples.

Selected surface soil samples were analyzed for carbon-14 and tritium. There were no detectable levels of tritium (0.2 picocuries per gram(pCi/g)) or carbon-14 (0.5pCi/g).

D. Subsurface Soil Results

Subsurface organic results indicate that semivolatiles and pesticides are not of concern in the deeper soils. Volatile organic exhibited more of a presence in subsurface soils, primarily in well borings closest to the disposal trenches (MW-37 and MW-38). In the saturated soils chemicals detected were at low levels, and increased in concentration closer to the top of the groundwater table. All of the maximum VOC concentrations and the trace concentrations of semivolatile compounds were detected in the 35 to 37-foot depth interval in wells MW-37 and MW-38.

In the saturated soils, the highest volatile concentrations were observed in the top of the saturated zone. Acetone, 2-butanone, 4-methly-2-pentanone, and chloroform were the most frequently detected chemicals, with the maximum concentrations occuring at the 40 to 42 foot depth interval in boring MW-38. Subsurface inorganics are comparable with those in background samples and those typical of soils in this part of North Carolina. Of the radioactive constituents tritium was the only one detected, and those detection were very near the detection limits.

VI. SUMMARY OF SITE RISKS

The NC State Lot 86 Site is releasing contaminants into the environment. The Baseline Risk Assessment Report presents the results of a comprehensive risk assessment that addresses the potential threats to public health and the environment posed by the Site under current and future conditions, assuming that no remedial actions take place, and that no restrictions are placed on future use of the Site. The Baseline Risk Assessment being summarized in this section considered the Site risks associated with the soils, groundwater and the air pathways associated with those two medias.

The Baseline Risk Assessment Report consists of the following sections: identification of chemicals of potential concern; toxicity assessment; human exposure assessment, risk characterization; and environmental assessment. All sections are summarized below.

A. Contaminants of Concern

Data collected during the RI was reviewed and evaluated to determine the contaminants of concern at the Site which are most likely to pose risks to the public health. These contaminants were chosen for each environmental media sampled.

Once these contaminants of concern were identified, exposure concentrations in each media were estimated. Exposure point concentrations were calculated for groundwater and surface soils using the lesser of the 95 percent upper confidence limit concentration or the maximum detected value as the reasonable maximum exposure (RME) point concentration. Exposure point concentrations for groundwater are shown in Table 6-1. Exposure point concentration for the surficial soils are presented in Table 6-2

B. Exposure Assessment

The exposure assessment evaluates and identifies complete pathways of exposure to human population on or near the Site. Current and future exposure scenarios include potential surface soil exposure via incidental ingestion and dermal contact; ingestion of groundwater; and inhalation of volatiles evolved from groundwater during household water use. Further detail and mathematical calculations can be reviewed in the Baseline Risk Assessment (BRA). Table 6-3 provides the exposure assumptions that were used in the BRA.

Table 6-1

North Carolina State University Site
Chemicals of Potential Concern Detected in
Shallow Groundwater Exposure Point Concentrations

Groundwater Analyte	95% UCL of Mean Concentration (Ig/L)	Maximum Concentrations (Ig/L)	Exposure Point Concentrations (Ig/L)
	Site-Related Samples		
INORGANICS			
Barium	2,780	950	950
Chromium	919	17.0	17.0
Cobalt	4,936	88.0	88.0
Lead	1,440	31.0	31.0
Manganese	54,500	20,000	20,000
Nickel	5,051	73.0	73.0
VOLATILE ORGANICS			
Acetone	72,200	15,500	15,500
Benzene	45,300	14,000	14,000
Bromodichloromethane	209,800	280	280
Bromoform	22,715	35.5	35.5
Carbon Tetrachloride	17,100	6,400	6,400
Chlorobenzene	75,967	150	150
Chloroform	312,000	63,000	63,000
Dibromochloromethane	4,609	3.35	3.35

Ig/L = micrograms per liter
pCi/L = picoCuries per liter

Table 6-1 (Continued)

North Carolina State University Site
Chemicals of Potential Concern Detected in
Shallow Groundwater Exposure Point Concentrations

Groundwater Analyte	95% UCL of Mean Concentration (Ig/L)	Maximum Concentrations (Ig/L)	Exposure Point Concentrations (Ig/L)
	Site-Related Samples		
1,1-Dichloroethene	27,500	21.0	21.0
1,2-Dichloroethene (total)	9,191	31.0	31.0
1,2-Dichloropropane	41,800	865	865
2-Hexanone	4,952	5.45	5.45
Methylene Chloride	64,500	18,000	18,000
4-Methyl-2-pentanone	66,682	110	110
1,1,2,2-Tetrachloroethane	246,676	200	200
Tetrachloroethene	697,000	5,000	5,000
Toluene	455,000	1,500	1,500
1,1,2-Trichloroethane	74,091	135	135
Trichloroethene	904,000	1,250	1,250
Vinyl Chloride	4,774	3.7	3.7
SEMI-VOLATILE/ORGANICS			
Isophorone	2,880	570	570

Ig/L = micrograms per liter
pCi/L = picoCuries per liter

Table 6-1 (Continued)

North Carolina State University Site
Chemicals of Potential Concern Detected in
Shallow Groundwater Exposure Point Concentrations

Site-Related Samples

Groundwater Analyte	95% UCL of Mean Concentration (Ig/L)	Maximum Concentrations (Ig/L)	Exposure Point Concentrations (Ig/L)
PESTICIDES/PCBs			
gamma-BHC	0.05	0.016	0.016
Dieldrin	13.4	0.013	0.013
RADIONUCLIDES (concentrations in pCi/L)			
Tritium	1,200	6,000	1,200

Ig/L = micrograms per liter
pCi/L = picoCuries per liter

Table 6-1

North Carolina State University Site
Chemicals of Potential Concern Detected in
Deep Groundwater Exposure Point Concentrations

Site-Related Samples

Groundwater Analyte	95% UCL of Mean Concentration (Ig/L)	Maximum Concentrations (Ig/L)	Exposure Point Concentrations (Ig/L)
INORGANICS			
Arsenic	2,350	110	110
Chromium	4,003	20.0	20.0
Copper	11,403	48.0	48.0
Manganese	3,130	460	460
Zinc	8,600	67.0	67.0
VOLATILE ORGANICS			
Acetone	959	190	190
Benzene	549	7.3	7.3
Bromodichloromethane	541	44.0	44.0
Carbon Tetrachloride	199	39.0	39.0
Chlorobenzene	2.8	1.0	1.0
Chloroform	640	510	510
1,2-Dichloroethane	2,947	2.5	2.5
1,2-Dichloropropane	699	28.0	28.0
Methylene Chloride	155	59.0	59.0

Ig/L = micrograms per liter
pCi/L = picoCuries per liter

Table 6-1 (Continued)

North Carolina State University Site
Chemicals of Potential Concern Detected in
Deep Groundwater Exposure Point Concentrations

Site-Related Samples

Groundwater Analyte	95% UCL of Mean Concentration (Ig/L)	Maximum Concentrations (Ig/L)	Exposure Point Concentrations (Ig/L)
4-Methyl-2-pentanone	3.3	3.0	3.0
1,1,2,2-Tetrachloroethane	101	5.8	5.8
Tetrachloroethene	5,546	5.7	5.7
Toluene	16.8	1.3	1.3
Trichloroethene	88,159	20.0	20.0
RADIONUCLIDES (concentrations in pCi/L)			
Carbon-14	1,679	522	522
Tritium	7,560	3,890	3,890

Ig/L = micrograms per liter
pCi/L = picoCuries per liter

Table 6-2

North Carolina State University Site
Chemicals of Potential Concern Detected in
Soil Exposure Point Concentrations

	Site-Related Samples		
Surface Soil Analyte	95% UCL of Mean Concentration (mg/kg)	Maximum Concentrations (mg/kg)	Exposure Point Concentrations (mg/kg)
INORGANICS			
Chromium	65.3	89.0	65.3
Nickel	7.2	13.0	7.2
SEMI-VOLATILE ORGANICS			
Bis(2-ethylhexyl)phthalate	1.32	1.5	1.32
PESTICIDES/PCBs			
Aroclor 1260	0.03	0.04	0.03
alpha-Chlordane	0.006	0.005	0.005
gamma-Chlordane	0.004	0.003	0.003
P,P'-DDE	0.008	0.007	0.007
P,P'-DDT	0.007	0.006	0.006
Dieldrin	0.006	0.005	0.005
VOLATILE ORGANICS			
Chloroform	0.01	0.006	0.006
1,2-Dichloroethane	0.01	0.003	0.003
1,2-Dichloropropane	0.01	0.013	0.01
Methylene Chloride	0.01	0.003	0.003

mg/kg = milligrams per kilogram

Table 6-3

Potential Exposure Pathways/Routes

Exposure Media	Scenario	Receptor	Exposure Pathways
Groundwater	Future	Resident (Child, Youth 7-16, and Adult)	1. Ingestion of drinking water 2. Inhalation of VOCs released to indoor air
Surficial Soils	Current	Visitor (Child, Youth 7-16, and Adult) Recreational Person (Child, Youth 7-16, and Adult) Student (Adult)	1. Incidental ingestion 2. Dermal contact
	Future	Resident (Child, Youth 7-16, and Adult)	1. Dermal contact 2. Incidental ingestion

C. Toxicity Assessment

Under current EPA guidelines, the likelihood of adverse effects occurring in humans from carcinogens and noncarcinogens are considered separately. These are discussed below. Table 6-4 summarizes the carcinogenic and noncarcinogenic toxicity criteria for the contaminants of concern.

Cancer slope factors (CSFs) have been developed by EPA for estimating excess lifetime cancer risk associated with exposure to potentially carcinogenic chemicals. CSFs, which are expressed in units of (mg/kg-day) -1, are multiplied by the estimated intake dose of a potential carcinogen, in mg/kg-day, to provide an upperbound estimate of the excess lifetime cancer risk associated with exposure at that intake level. The term "upperbound" reflects the conservative estimate of the risks calculated from the slope factor. Use of this approach makes underestimation of the actual cancer risk highly unlikely. Cancer potency factors 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 indication of the potential for adverse health effects from exposure to chemicals exhibiting noncarcinogenic effects. RfDs, which are expressed in units of mg/kg-day, are estimates of acceptable lifetime daily exposure levels for humans, including sensitive individuals. Estimated intake dose of chemicals from environmental media can be compared to the RfD. RfDs are derived from human epidemiological studies or animal studies to which uncertainty factors have been applied. These uncertainty factors help ensure that the RfDs will not underestimate the potential for adverse noncarcinogenic effects to occur.

In the case of lead, EPA recommends the use of the Agency's Uptake Biokinetic model which predicts blood-lead levels for children ages 0.5-7 years under various exposure scenarios and lead concentrations.

D. Risk Characterization

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

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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. Calculation of a HI in excess of unity indicates the potential for adverse health effects. Indices greater than one will be generated anytime intake for any of the chemicals of concern exceeds its Reference Dose (RfD). However, given a sufficient number of chemicals under consideration, it is also possible to generate a HI greater than one even if none of the individual chemical intakes exceeds their respective RfDs.

Carcinogenic risk is expressed as a probability of developing cancer as a result of lifetime exposure to a contaminant concentration in a given medium. Excess lifetime cancer risks are determined by multiplying the intake level with the cancer potency factor. EPA's acceptable target range for carcinogenic risk is one-in-ten-thousand (1E-4) to one-in-one-million (1E-6).

Table 6-5

Lifetime Cancer Risk - Current and Future Scenarios
Reasonable Maximum Exposure Concentrations

Exposure Medium	Current Student	Current Visitor	Current Recreational Person	Future Resident
Surface Soil	3x10 -8	7x10 -9	3x10 -7	7x10 -7
Groundwater - Shallow	NE	NE	NE	1x10 -1
Groundwator - Deep	NE	NE	NE	4x10 -3
Total	3x10 -8	7x10 -9	3x10 -7	1x10 -1

NE = Not evaluated in this pathway

Neither a cancer slope factor nor a reference dose is available for lead. Instead, blood lead concentrations have been accepted as the best measure of exposure to lead. The EPA has developed a biokinetic/uptake model to assess chronic and nonchronic exposure of children to lead. The uptake/biokinetic model estimates total lead uptake resulting from diet, inhalation, and ingestion of soil/dust, water, paint, and placental transport to the fetus. The uptake/biokinetic model calculates the uptake and blood lead levels for the most sensitive population, children ages 0 to 6 years old. EPA uses a blood lead level of 10 micrograms per deciliter (ug/dl) as the benchmark to evaluate lead exposure.

Current use

The current visitor, student, and recreational person at the NC state site were assumed to be potentially exposed to chemicals in the surface soil only. There are no current exposures to groundwater, therefore groundwater risks were not evaluated under a current use scenario. Table 6-5 presents the current carcinogenic risk, Table 6-6 presents the current Hazard Index.

Future use

The future use scenario considers the possibility that future on-site or nearby residents are exposed to chemicals in the groundwater and surface soils. Consumption of the water from the contaminated plume would result in an unacceptable risk to human health and the environment. Table 6-5 lists the lifetime cancer risk, and Table 6-6 provides the total hazardous index for future senario.

Contaminant Risk

The quantified carcinogenic risk and non-carcinogenic hazard indices by contaminant are provided in Table 6-7 and 6-8 respectively.

Potential Risk Associated with Radionuclides

The radionuclides associated with the NC State site, carbon-14 and tritium, were found at concentrations above their natural background concentrations. However, the levels of carbon-14 and tritium at the Site fall below the limits for release to the environment (800,000 pCi/L for carbon-14 and 3,000,000 pCi/L for tritium) and the concentration limits in public drinking water supplies which are 3,200pCi/L for carbon-14 and 60,000 pCi/L for tritium. The beta particle activity is also below the MCL of 4 mrem/yr.

Radionuclide	Shallow Aquifer	Deep Aquifer
Tritium	0.0614 mrem/yr	0.199 mrem/yr
Carbon-14	0.877 mrem/yr	0.877 mrem/yr

The calculated lifetime risk associated radionuclides at the Site which EPA calculates by integrating intakes over a 30 year time period to account for the length of time people live in one residence, is provided below.

Radionuclide	Shallow Aquifer	Deep Aquifer
Tritium	2x10 -6	5x10 -6
Carbon-14		1x10 -5

Total hazard indices for the hypothetical future exposure scenario exceeded 1.0 for the ingestion of groundwater, however hazard indices for soils fall below benchmark level of 1.0.

Table 6-6

Total Hazard Index Using Reasonable Maximum Exposure Concentrations
Current and Future Scenarios

		Current Visitor			Current Recreational Person			Future Resident		
Exposure Medium	Current Student	Child 1-6	Youth 7-16	Adult	Child 1-6	Youth 7-16	Adult	Child 1-6	Youth 7-16	Adult
Surface soil	0.02	0.002	0.001	0.001	0.1	0.03	0.02	0.2	0.04	0.02
Groundwater - Shallow	NE	NE	NE	NE	NE	NE	NE	2022	1358	853
Groundwater - Deep	NE	NE	NE	NE	NE	NE	NE	42	28	18
Total	0.02	0.002	0.001	0.001	0.1	0.03	0.02	2064	1386	871

NE = Not evaluated in this scenario.

Table 6-7

Carcinogenic Risks for Substances of Concern
(Reasonable Maximum Concentration)
That Pose a Carcinogenic Risk
Exceeding One in One Million (10 -6)

Exposure Medium	Current Student	Current Recreational Person	Current Visitor	Future Resident
Surface Soil	NC	NC	NC	NC
Groundwater - Shallow	NE	NE	NE	Benzene (7 x 10 -3) Bromodichloromethane (3 x 10 -4) Bromoform (5 x 10 -4) Carbon Tetrachloride (1 x 10 -2) Chloroform (9 x 10 -2) Dibromochloramethane (5 x 10 -6) 1,1-Dichloroethene, (3 x 10 -4) Methylene Chloride (2 x 10 -3) 1,1,2,2-Tetrachloroethane (7 x 10 -4) Tetrachloroethene (5 x 10 -3) 1,1,2-Trichloroethene (1 x 10 -1) Trichloroethene (4 x 10 -4) Vinyl Chloride (1 x 10 -4) Isophorone (9 x 10 -6) Dieldrin (7 x 10 -6)
Groundwater - Deep	NE	NE	NE	Arsenic (3 x 10 -3) Benzene (4 x 10 -6) Bromodichloromethane (5 x 10 -5) Carbon Tetrachloride (9 x 10 -5) Chloroform (8 x 10 -4) 1,2-Dichloroethane (4 x 10 -6) Methylene Chloride (8 x 10 -6) 1,1,2,2-Tetrachloroethane (2 x 10 -5) Tetrachloroethene (5 x 10 -6) Trichloroethene (6 x 10 -6)

NC = Not of concern; did not exceed 1 x 10 -6 risk.
NE = Not evaluated.

Table 6-8

Noncarcinogenic Risks for Substances of Concern
(Reasonable Maximum Concentration)
Where Pathway Hazard Index Exceeds One

Exposure Medium	Current Student	Current Recreational Person	Current Visitor	Future Resident Child 1-6	Future Resident Youth 7-16	Future Resident Adult
Surface Soil	NC	NC	NC	NC	NC	NC
Groundwater - Shallow	NE	NE	NE	Barium (0.9) Chromium (0.2) Manganese (256) Nickel (0.2) Acetone(15) Bromodichloromethane (2) Bromoform (0.2) Carbon Tetrachloride (790) Chlorobenzene (2) Chloroform (806) 1,1-Dichloroethene (0.2) 1,2-Dichloroethene (0.4) 1,2-Dichloropropane (14) Methylene Chloride (38) Tetrachloroethene (64) Toluene (0.7) 1,1,2-Trichloroethane (4) Trichloroethene (27) Isophorone (0.2)	Barium (0.6) Chromium (0.1) Manganese (172) Nickel (0.2) Acetone (10) Bromodichloromethane (1) Bromoform (0.2) Carbon Tetrachloride (531) Chlorobenzene (2) Chloroform (542) 1,1-Dichloroethene (0.1) 1,2-Dichloroethene (0.3) 1,2-Dichloropropane (9) Methylene Chloride (26) Tetrachloroethene (43) Toluene (0.5) 1,1,2-Trichloroethane (3) Trichloroethene (18) Isophorone (0.1)	Barium (0.4) Manganese (108) Nickel (0.1) Acetone (6) Bromodichloromethane (0.8) Bromoform (0.1) Carbon Tetrachloride (333) Chlorobenzene (1) Chloroform (340) 1,2-Dichloroethene (0.2) 1,2-Dithloropropane (6) Methylene Chloride (16) Tetrachloroethene (27) Toluene (0.3) 1,1,2-Trichloroethane (2) Trichloroethene (11)

Table 6- 8

Noncarcinogenic Risks for Substances of Concern
(Reasonable Maximum Concentration)
Where Pathway Hazard Index Exceeds One

Exposure Medium	Current Student	Current Recreational Person	Current Visitor	Future Resident: Child 1-6	Future Resident: Youth 7-16	Future Resident: Adult
Groundwater - Deep	NE	NE	NE	Arsenic (2 3) Chromium (0.3) Manganese (6) Acetone (0.2) Bromodichloromethane (0.3) Carbon Tetrachloride (5) Chloroform (7) 1,2-Dichloropropane (0.4) Methylene Chloride (0.1) Trichloroethene (0.2)	Arsenic (16) Chromium (0.2) Manganese (4) Acetone (0.1) Bromodichloromethane (0.2) Carbon Tetrachloride (3) Chloroform (4) 1,2-Dichloropropane (0.3) Trichloroethene (0.1)	Arsenic (10) Chromium (0.1) Manganese (2) Bromodichloromethane (0.1) Carbon Tetrachloride (2) Chloroform (3) 1,2-Dichloropropane (0.2)

NC = Not of concern; did not exceed a hazard index of 1 in this pathway
NE = Not evaluated

E. Environmental Assessment

Risk to terrestrial wildlife was evaluated qualitatively based on the potential for exposure and on the available toxicity information for the chemicals of potential concern. There is a potential for several of the chemicals of potential concern to be toxic to numerous terrestrial species, as well as a potential for several of these chemical to bioaccumulate and to biomagnify though the terrestrial food chain, however the risks to terrestrial receptors are expected to be low based on the low potential for exposure.

No contaminants in groundwater (presuming groundwater discharges to surface water) exceeded federal and regional WQC. The results show that acute or chronic adverse effects are not expected for aquatic life inhabiting Richland Creek.

F. Conclusions

The NC State Site has one primary media of concern, which is groundwater. The surface soils were evaluated and the resulting determination was that the surface soils posed no substantial risk to human health or the environment. The sub-surface soils on the other hand were found to be a continuing source of contamination to the groundwater and should be addressed.

Actual or threatened releases of hazardous substances from this Site via the groundwater if not addressed by implementing the response action selected in this ROD, may present an imminent and substantial endangerment to public health, welfare, or the environment.

VII. APPLICABLE RELEVANT AND APPROPRIATE REQUIREMENTS (ARARs)

Section 121(d) of CERCLA, as amended by SARA, requires that remedial actions comply with requirements or standards set forth under Federal and State environmental laws. The requirements that must be complied with are those that are applicable or relevant and appropriate to the (1) potential remedial actions, (2) location, and (3) media-specific chemicals at the Site.

Applicable requirements are those requirements specific to the hazardous substance, location, and/or contemplated remedial action, that are, or will be, related to the Site. These requirements would have to be met under any circumstance. Relevant and appropriate requirements are those requirements that address problems or situations sufficiently similar to those encountered at the Site, so that their use is well suited to the Site, but for which the jurisdictional prerequisites have not been met.

This Section examines the cleanup criteria associated with the contaminants found and the environmental media contaminated.

A. Action-Specific ARARs

Action-specific ARARs are technology-based, establishing performance, design, or other similar action-specific controls or regulations on activities related to the management of hazardous substances or pollutants. Potential action-specific ARARs/are presented in Table 7-1.

B. Location-Specific ARARs

Location-specific ARARs are design requirements or activity restrictions based on the geographical or physical positions of the Site and its surrounding area. Potential location-specific ARARs are presented in Table 7-2.

Table 7-1
POTENTIAL ACTION-SPECIFIC ARARs
NC STATE LOT 86 SITE

Standard, Requirements, Criteria, or Limitations	Citation	Description	Applicable or Relevant & Appropriate
Federal Disposal - Discharge to Surface Water/POTW			
Clean Water Act	33 USC 1351-1376		
Requires use of Best Available Treatment Technology (BATT)	40 CFR 122	Use of best available technology economically achievable is required to control discharge of toxic Pollutants to POTW	Relevant & Appropriate
National Pollutant Discharge Elimination System Permit Regulations	40 CFR 122 (Subpart C)	Use of best available technology economically achievable is required to control discharge of toxic pollutants discharged to surface waiers	Applicable
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	Relevant & Appropriate
STATE			
North Carolina Groundwater Standards	NCAC 15A-2L	Groundwater quality standards, regulates injection wells	Applicable
Wastewater Discharge to Surface Waters	NCAC 15A-2H	Regulates surface water discharge	Applicable
North Carolina Air Pollution Control Requirements	NCAC 15A-2D, 2H & 2Q	Air pollution control air quality and emissions standards	Applicable
North Carolina Water Quality Standards	15A NCAC 2B	Surface water quality standards.	Relevant and Appropriate
North Carolina Sedimentation Control Rules	15A NCAC 4	Requirements for prevention of sedimentation pollution.	Relevant and Appropriate
North Carolina Solid Waste Management Rules	15A NCAC 13 B	Siting and design requirements for hazardous waste TSDs	Relevant and Appropriate

Table 7 - 2
POTENTIAL LOCATION-SPECIFIC ARARs
NC STATE LOT 86 SITE

Standard, Requirements, Criteria, or Limitations	Citation	Description	Applicable or Relevant & Appropriate
Federal			
Resource Conservation and Recovay Act (RCRA) as amended	42 USC 6901		
RCRA Location Standards	40CFR 264.18(b)	A treatment/storage/disposal/(TSD) facility must be designed, constructed, operated, and maintained to avoid washout on a 100 year floodplain.	May be relevant and appropriate if an onsite TSD facility is required as part of overall remediation and it exists within the 100 year floodplain.
Fish and Wildlife Conservation Act	16USC 2901 et seq.	Requires states to identify significant habitats and develop conservation plans for these areas.	Confirmation with the responsible state agency regarding the site being located in one of these significant habitats ins required.
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	Remedial actions are to prevent incursion of contaminated groundwater onto forested floodplain
Endangered Species Act	16 USC 1531	Requires action to conserve endangered species or threatened species, including consultation with the Department of Interior.	
Wetlands Management Executive Order	Executive Order 11990; 40CFR 6.302	Action to minimize the destruction, loss or degradation of wellands	Potential remedial alternatives within wetlands. Requirement is relevant and appropriate.
STATE			
North Carolina Hazardous Wasted Management Rules	15A NCAC 13A.0009 & .0012	Location requirements for hazardous waste treatment/storage/disposal facilities.	May be applicable to hazardous waste excavated, stored, and treated onsite.
North Carolina Solid Waste Management Rules	15A NCAC 13B.0500	Siting requirements for solid waste disposal units.	May be relevant and appropriate to nonhazardous waste disposed onsite.

Table 7-3

POTENTIAL CHEMICAL-SPECIFIC ARARS
NC STATE UNIVERSITY LOT 86 SITE

Standard, Requirements Criteria, or Limitations	Criteria	Description	Applicable or relevant & appropriate	Comment
Federal				
Safe Drinking Water Act	40 USC 300 et. Seq.			
National Primary Drinking Water Standards	40 CFR 141	Establishes health-based standards for public water systems (Maximum contaminant levels)	Relevant & Appropriate	The MCLs for organic & inorganic contaminants are relevant and appropriate for groundwater at the site since it is it potential water source
Primary Maximum Contaminant Levels	40 CFR 142	Primary MCLs are adopted for the protection of human health but include an analysis of feasibility & cost of attainment	Relevant & Appropriate	
Maximum Contaminant Level Goals	40 CFR 142 50 CFR 46936 (November 13, 1985)	EPA has also established Maximum Contaminant level Goals (MCGLs). The nonenforceable standards are based on health criteria. The MCGLs are goals for the nation's water supply	Relevant & Appropriate	
National Secondary Drinking Water Standards	40 CFR 143	Establishes welfare-based standards for public water systems (secondary maximum contaminated levels)	Not an ARAR	The secondary Mcls for inorganic contaminants in groundwater are "to be considered" guidelines
Maximum Contaminant Level Goals (MCLGs)	Publications L. N2 99-399, 100 Stat. 642 (1986)	Establishes drinking water quality goals so at levels of no known or anticipated adverse health effects	Relevant & Appropriate	Proposed MCGLs for organic & inorganic contaminants are relevant & appropriate for groundwater at the site since it is a potential drinking water source
North Carolina Drinking Water Act	130A NCAC 311-327	Regulates water systems within the state that supply drinking water that many affect the public health.	Relevant & Appropriate	Provides the State with the authority needed to assume primary enforcement responsibility under the federal act.
North Carolina Drinking Water and Groundwater Standards	15A NCAC 2L	Establishes groundwater classification and water quality standards.	Applicable	Guidelines for allowable levels of toxic organic and inorganic compounds in groundwater used for drinking water.
North Carolina Water Quality Standards	15A NCAC 2B.0100 & 0200	Establishes a series of classifications and water quality standards for surface water.	applicable	May be applicable if treated groundwater is discharged to surface waters.
North Carolina Surface Water Effluent Limitations	15A NCAC 2B.0400	Establishes limits and guidelines for effluent discharged to waters of the state.	applicable	May be applicable if treated groundwater is discharged to surface waters.
North Carolina Air Pollution Control Regulations	15A NCAC 2D, 2H, & 2Q	Regulates ambient air quality and establishes air quality standards for hazardous air pollutants.		May be applicable if onsite treatment or excavation is part of remedial action.
North Carolina Hazardous Waste Management Rules	15A NCAC 13A.0009 & .0012	Establishes standards for hazardous waste treatment facilities		May be applicable if hazardous waste is excavated and stored or treated as part of the remedial action

Standard, Requirements Criteria, or Limitations	Criteria	Description	Applicable or relevant & appropriate	Comment
Surface Water				
Clean Water Act	33 USC 1351-1376			
Water Quality Criteria	40 CFR 131	Sets criteria for water quality based on toxicity to aquatic organisms and human health	Relevant & Appropriate	Criteria available for water & fish ingestion, and fish consumption for human health
Air				
Clean Air Act	40 USC 1857	Sets primary and secondary air standards at levels to protect public health & welfare	Relevant & Appropriate	Will be relevant & appropriate if on-site treatment units are part of remedial action
National Primary & Secondary Ambient Air Quality Standards	40 CFR 50			
National Emission & Standards for Hazardous Air Pollutants	40 CFR 61	Provides emission standards for hazardous air pollutants for which no ambient air quality standard exists	Relevant & Appropriate	Will be relevant & Appropriate if on-site treatment units are put of remedial action

Federal classification guidelines for groundwater are as follows:

- Class I: Groundwater that is irreplaceable with no alternative source or is ecologically vital;

- Class II: A - Groundwater currently used for drinking water;

  B - Groundwater potentially available for drinking water;

- Class III: Groundwater not considered Class IIA.

State classification guidelines are based on best usage (NCAC 2L.0201). Under the State system the aquifer is considered Class GA groundwater, existing or potential source of drinking water supply for humans under the state system.

C. Chemical-Specific ARARs

Chemical-specific ARARs include those laws and regulations governing the release of materials possessing certain chemical or physical characteristics, or containing specified chemical compounds. These requirements generally set health or risk-based concentration limits or discharge limitations in various environmental media for specific hazardous substances, contaminants, and pollutants. Potential chemical-specific ARARs are listed in Table 7-3.

VIII. REMEDIAL ACTION OBJECTIVES

The NC State Site has one primary media of concern, which is groundwater. The surface soils were evaluated and the resulting determination was that the surface soils posed no substantial risk to human health or the environment. The sub-surface soils on the other hand were found to be a continuing source of contamination to the groundwater and should be addressed.

A. Groundwater

Based on the results of the RI, the baseline risk assessment and considering the requirements for risk reduction, risk-based remediation levels, and the ARARs, the remedial action objectives specifically developed for groundwater at the Site are presented in Table 8-1. The objectives in establishing the remediation levels were:

- Prevent migration of contaminants to surface water that would result in contamination to levels greater that the Ambient Water Quality Criteria (AWQC).

- Control future releases of contaminants to ensure protection of human health and the environment (SARA Section 121 [d]).

- Permanently and significantly reduce mobility, toxicity, or volume of characteristic hazardous-waste with treatment (SARA Section-121(d])

The final remediation levels were selected as the most conservative of the federal and state chemical-specific ARARs, and if a standard did not exist, the risk-based goals were applied. However, the average background concentration was selected as the remediation level if it exceeded the most conservative level.

B. Extent of contamination Above Remediation Levels

The chemical groups found above the remediation levels in groundwater are volatile organics and metals. The approximate locations of the contaminant plumes are shown in Figures 8-1, 8-2, 8-3, and 8-4. The estimated volume of groundwater contamination 300,000 gallon. The extent of soil contamination is primarily below surface in northwest corner of the landfill in the vicinity of the disposal trenches with an estimated volume 12,000 cubic yards. The most prevalent chemicals present were VOCs.

TABLE 8-1
REMEDIAL ACTION OBJECTIVES FOR GROUNDWATER
NC STATE UNIVERSITY LOT 86 SITE
RALEIGH, NORTH CAROLINA

Contaminant	Remediation Level (Ig/1)	Basis
Benzene	1	NC Groundwater Quality Standard (15NANC 02L)
Carbon Tetrachloride	1	Contract Quantitation limit (CRQL)
Chloroform	1	Contract Quantitation limit (CRQL)
Methylene Chloride	5	NC Groundwater Quality Standard (15NANC 02L)
Tetrachloroethene	1	Contract Quantitation limit (CRQL)
Acetone	700	NC Groundwater Quality Standard (15NANC 02L)
Bromodichloromethane	1	Contract Quantitation limit (CRQL)
1,2-Dichloropropane	1	Contract Quantitation limit (CRQL)
1,1,2-Trichloroethane	1	Contract Quantitation limit (CRQL)
Trichloroethene	2.8	NC Groundwater Quality Standard (15NANC 02L)
Manganese	370	Background Concentration
Arsenic	10	Contract Quantitation limit (CRQL)

<IMG SRC 04277K>
<IMG SRC 04277L>
<IMG SRC 04277M>
<IMG SRC 04277N>

IX. DESCRIPTION OF ALTERNATIVES

Figure 9-1 summarizes the technologies considered for remediating the contamination, at the Site. The table also provides the rationale as to why certain technologies were not retained for further consideration after the initial screening.

A. Remedial Alternatives to Address Soil Contamination

The following alternatives were developed to address subsurface soil contamination at the Site:

Alternative 1: No Action

Alternative 2: Institutional Action

Alternative 3: Containment/Capping

Alternative 4: Soil Vapor Extraction

Alternative 5: On-Site incineration

Alternative 6: Low Temperature Thermal Desorption

Alternative 7: In-situ Mixing and Encapsulation

The remedial alternatives to address soil contamination are discussed below.

Alternative 1: No Action

The no action alternative for soils provides a baseline for comparing other alternatives. No remedial activities would be implemented, long-term human health and environmental risks for the site would essentially be the same as those that currently exist.

Total Capital Costs	$ 0
Present Worth O & M Costs	$475,000
Total Present Worth Costs	$475,000

Alternative 2: Institutional Controls

This alternative is similar to Alternative No. 1 except that deed restrictions plus physical barriers would be used to restrict access to the site. Deed restriction would include zoning ordinances that prohibit construction on, or use of, the site during the time that the soil remains contaminated above cleanup goals. Physical barriers would include fencing, signs, etc. to prevent access the site.

Total Capital Costs	$ 59,100
Present Worth O & M Costs	$641,820
Total Present Worth Costs	$700,920

Alternative 3: Containment/Capping

Containment by capping, would involve the installation of an impervious layer over the area of contaminated soil (considered to be an area of approximately 40,000 square feet) and development of a stormwater management system to route stormwater off the cap in an acceptable manner.

Total Capital Costs	$ 550,000
Present Worth O & M Costs	$ 641,820
Total Present Worth Costs	$1,191,820

Alternative 4: Soil Vapor Extraction

This technology involves creating a movement of air through the soil via series of injection wells. The movement of air would then vaporize the VOCs and would also assist in oxidizing any metals present. The vaporized gas would then be removed from the ground by a series of vacuum wells. This alternative would remediate the soils in the unsaturated zone vertically between the landfill trenches and the groundwater table. The effectiveness of the system will be dependent on the soil permeability allowing air to move through soils. The precise layout and extent of the system would have to be determined by further investigation and pilot test.

Total Capital Costs	$ 500,000
Present Worth O & M Costs	$1,842,677
Total Present Worth Costs	$2,342,677

Alternative 5: On-site Incineration

On-site incineration involves excavation and stockpiling of the contaminated material. The excavated material would then be conditioned prior to being incinerated on-site. Properly prepared material when incinerated results in a clean ash residue. The excavated area would be backfilled with the ash supplemented with clean imported soil. The incineration would take place with a mobile incinerater which would be brought to the site and set up, together with a soil conditioning plant, to receive the contaminated soil. It would be operating as a continuous process with a through put of about 50 cubic yards per day. The incineration would take about 1 year to complete, not including the test burn, mobilization, and start-up.

Total Capital Costs	$ 500,000
Present Worth O & M Costs	$10,300,000
Total Present Worth Costs	$10,800,000

Alternative 6: Low Temperature Thermal Desorption

The process consists of a heated chamber with temperatures of 700 to 900 degrees Fahrenheit. Contaminated soil are excavated, preconditioned, broken up, and then fed into the chamber in a continuous operation. Contaminants are driven off the soil by the heat and are captured in the next stage (bag house, GAC, or other equivalent system). The treated soil is placed back in the ground and the capture contaminants are sent off-site for disposal to an authorized incinerator or for regeneration.

Total Capital Costs	$ 800,000
Present Worth O & M Costs	$ 4,950,000
Total Present Worth Costs	$ 5,750,000

Alternative 7: In-situ Mixing and Encapsulation

The soils will be mixed initially within the bore hole and the VOCs that are released as a result of the mixing will be captured via a specially designed bore hole shroud, and treated. The treatment may include but not be limited to liquid vapor separation, in-line prefiltration for dust and particulate removal, followed by parallel activated carbon filter banks. The remaining contaminants will be solidified in-situ using various pozzolan-portland cement based formulations delivered to and dispersed within the soil column as a grout.

Total Capital Costs	$ 931,000
Present Worth O & M Costs	$ 0
Total Present Worth Costs	$ 931,000

B. Remedial Alternatives to Address Groundwater Contamination

The following alternatives were developed to address groundwater contamination at the Site:

Alternative 1: No Action

Alternative 2: Institutional

Alternative 3: Groundwater Extraction, Treatment, and Discharge

Alternative 4: Biotreatment

Alternative 5: Intrinsic Degradation

The remedial response actions to address groundwater contamination are discussed below.

Alternative 1: No Action

This alternative provides the baseline case for comparing remedial actions for groundwater and the level of improvement achieved. The groundwater will be monitored and recorded semiannually and a status report issued every 5 years for 30 years. All samples would be collected and analyzed for the contaminants of concern.

There are no capital costs associated with this alternative. Operating costs are based on the review of Site conditions every five years for a period of thirty years. There would be no maintenance costs.

Total Capital Costs	$ 0
Present Worth O & M Costs	$ 300,000
Total Present Worth Costs	$ 300,000

Alternative 2: Limited Action

This alternative is identical to the no-action alternative described above except that it includes implementation of institutional controls. Those institutional controls would include deed restrictions to restrict access to contaminated groundwater on the site. Deed restrictions could included zoning ordinances that prohibit use of groundwater at the site and in areas downgradient to Richland Creek, during the time that the groundwater is not usable.

Total Capital Costs	$ 0
Present Worth O & M Costs	$ 500,000
Total Present Worth Costs	$ 500,000

Alternative 3: Groundwater Extraction, Treatment, Discharge

This alternative includes extraction of the contaminated groundwater, VOC removal using air stripping, followed by carbon adsorption for the removal of organics, and discharge of the treated effluent. Groundwater monitoring is required to evaluate remediation as it progresses. A period of 30 years is assumed for complete remediation. If an offsite discharge option is selected the treated effluent would meet the surface water discharge criteria of the NPDES permit that would be obtained during the remedial design phase. The groundwater system will be designed to operate 24 hours per day. System controls would allow for complete automatic operation with minimal operator attention. Alarms and switches would be furnished for fail-safe operation.

Total Capital Costs	$ 343,500
Present Worth O & M Costs	$ 1,762,190
Total Present Worth Costs	$ 2,100,000

Alternative 4: Biotreatment of Groundwater

Biotreatment of the groundwater is a closed-loop system consisting of nutrients and possibly a carbon source addition into the upgradient groundwater through and an infilltration trench to facilitate bioremediation of the groundwater contaminants. The groundwater will be pump from a down gradient location using three extraction wells to control flow and enable groundwater sampling, and recirculation of the extracted water. This alternative would also include long term monitoring.

Total Capital Costs	$ 209,000
Present Worth O & M Costs	$ 1,356,830
Total Present Worth Costs	$ 1,600,000

Alternative 5: Intrinsic Degradation

Intrinsic degradation involves the transformation of site contaminants into a innocuous state naturally, without any external aids or treatments. Simply stated, chemicals present would transform chemically into a harmless state. To quantify the viability of this option an evaluation of contaminant transformation under environmental conditions has to be conducted.

Total Capital Costs	$	100,000
Present Worth O & M Costs	$	500,000
Total Present Worth Costs	$	600,000

X. SUMMARY OF COMPARATIVE ANALYSIS OF ALTERNATIVES

The remedial alternatives to address contamination were evaluated using the nine evaluation criteria as set forth in the NCP, 40 CFR º300.430(e)(9). A brief description of each of the nine evaluation criteria is provided below.

THRESHOLD CRITERIA

1. Overall Protection of Human Health and the Environment addresses how an alternative as a whole will protect human health and the environment. This includes an assessment of how the public health and the environmental risks are properly eliminated, reduced, or controlled through treatment, engineering controls, or controls placed on the property to restrict access and (future) development. Deed restrictions are examples of controls to restrict development.

2. Compliance with Applicable or Relevant and Appropriate Requirements (ARARs) addresses whether or not a remedy complies with all state and federal environmental and public health laws and requirements that apply or are relevant and appropriate to the conditions and cleanup options at a specific site. If an ARAR cannot be met, the analysis of the alternative must provide the grounds for invoking a statutory waiver.

PRIMARY BALANCING CRITERIA

3. Long-term Effectiveness and Permanence refers to the ability of an alternative to maintain reliable protection of human health and the environment over time once the cleanup levels have been met.

4. Reduction of Toxicity, Mobility, and Volume are the three principal measures of the overall performance of an alternative. The 1986 amendments to the Superfund statute emphasize that, whenever possible, EPA should select a remedy that uses a treatment process to permanently reduce the level of toxicity of contaminants at the site; the spread of contaminants away from the source of contaminants; and the volume, or amount, of contamination at the Site.

5. Short-term Effectiveness refers to the likelihood of adverse impacts on human health or the environment that may be posed during the construction and implementation of an alternative until cleanup levels are achieved.

6. Implementability refers to the technical and administrative feasibility of an alternative, including the availability of materials and services needed to implement the alternative.

7. Cost includes the capital (up-front) cost of implementing an alternative, as well as the cost of operating and maintaining the alternative over the long-term, and the net present worth of both the capital and operation and maintenance costs.

MODIFYING CRITERIA

8. State Acceptance addresses whether, based on its review of the RI/FS and Proposed Plan, the State concurs with, opposes, or has no comments on the alternative EPA is proposing as the remedy for the Site.

9. Community Acceptance addresses whether the public concurs with EPA's proposed plan. Community acceptance of this proposed plan will be evaluated based on comments received at the public meetings and during the public comment period.

These evaluation criteria relate directly to requirements in Section 121 of CERCLA, 42 USC Section 9621, which determine the overall feasibility and acceptability of the remedy.

Threshold criteria must be satisfied in order for a remedy to be eligible for selection. Primary balancing criteria are used to weigh major trade-offs between remedies. State and community acceptance are modifying criteria formally taken into account after public comment is received on the proposed plan. Table 10-1 provides a summary of all the alternatives. The comparative analysis of the potential remedial alternatives to address Site contamination are discussed below.

TABLE 10-1
Remedial Action Alternatives
NC State University Lot 86 Superfund Site

Alternative	Description	Cost
1S	No Action	$ 475,000
2S	Institutional Control	$ 700,920
3S	Containment/Capping	$ 1,191,820
4S	Soil Vapor Extraction	$ 2,342,677
5S	On-Site Incineration	$ 10,800,000
6S	Low Temperature Thermal Desorption	$ 5,750,000
7S	Sub-Surface: in-situ Mixing & Encapsulation	$ 931,000
1G	No Action	$ 300,000
2G	Limited Action	$ 500,000
3G	Groundwater Extraction Treatment and Discharge	$ 2,100,000
4G	Biotreatment of Groundwater	$ 1,600,000
5G	Intrinsic Degradation	$ 600,000

A. Comparative Analysis of Soil Alternatives

The following alternatives were subjected to detailed analysis for soil remediation:

- Alternative 1: No Action
- Alternative 2: Insitutional Control
- Alternative 3: Containment /Capping
- Alternative 4: Soil Vapor Extraction
- Alternative 5: On-Site Incineration
- Alternative 6: Low Temperature Thermal Desorption
- Alternative 7: In-situ Mixing and Encapsulation

Overall Protection of Human Health and the Environment

Each alternative was evaluated to determine whether it is likely to effectively mitigate and minimize the long-term risk of harm to public health and the environment currently presented at the Site. Alternative 1 does not provide any additional protection from site contaminants. Alternative 2 would provide a greater degree of protection than No Action, however the protection provided would not be much better than what currently exists at the Site. Alternatives 3 and 7 would prohibit the infiltration of site runoff which could potentially add to the groundwater contamination, thereby providing good overall protection of human health and the environment. Alternative 7 provides a slightly better degree of protection than Alternative 3 because in addition to reduced permeablity this alternative will also reduce the concentration of the VOCs present in the trenches. The greatest degree of overall protection that could be provided, would only be achieved by the removal of contamination from the soils. Alternatives 4, 5, and 6 seek to remove contaminants from the soils providing the best overall protection.

Compliance With ARARs

The no action and the Institutional Controls alternatives would not comply with ARARs, and would continue to allow contaminants to leach into the groundwater. Alternative 3 does not involve treatment that would achieve ARARs either; however, this alternative by preventing further migration of contamination from the disposal trenches, is consider to be protective of groundwater. Alternative 7 provides treatment of VOCs and may provide some ARAR compliance in-relation to VOCs. Alternatives 4, 5, and 6 included treatment options that will reduce the level of contamination in the soils to meet ARARs. Alternative 4 would require a treatibility study to determine if the level of contamination would be reduced to meet ARARs.

Long-term Effectiveness and Permanence

In Alternatives 1 and 2, will continue to allow contaminants to allow contaminants to migrate off-site; therefore they are not considered to be permanent or provide reliable protection to public health and the environment. Alternatives 3 and 7 prohibit further leaching from the disposal trenches, thereby providing reliable protection and long term effectiveness. Alternatives 5 and 6 will meet the remediation goals, providing the best degree of protectiveness and permanence. The long term effectiveness and permanence of Alternative 4 is uncertain.

Reduction of Toxicity, Mobility, and Volume

Alternatives 1 and 2 would not reduce the toxicity, mobility, or volume (T/M/V) of the contaminants. Alternative 3 provides no reduction in toxicity or volume, however it does provide some degree of reduction in the mobility of site contaminants. Alternatives 5 and 6 provide the maximum reduction of T/M/V. It is uncertain what degree of T/M/V Alternative 4 will provide, however at this point it's expected results would fall between that of Alternatives 1 and 2 which provides no reduction in TMV and Alternatives 5 and 6. Alternative 7 will reduce toxicity and volume of VOCs, and the mobility of the other contaminants present in the trenches along with the VOCs.

Short-term Effectiveness

Alternatives 1, 2 and 3 do not disturb the buried contaminants, thereby avoiding any increased short term health and environmental risk to workers or nearby residents. Alternatives 4 and 7 involves an increased risk to on-site workers during installation, however the risk could be easily controlled by the use of normal heath and safety practices.

Alternatives 5 and 6 provide the greatest degree of increased short term risk, because both alternatives involve the excavation and storage of contaminated materials until the actual treatment is completed.

Implementability

Alternative 1 requires no further action and is readily implemented. Administrative and legal actions required by Alternative 2 are easily implemented, particularly because the Site is owned by the State of North Carolina. The cap required by Alternative 3 is easily constructed over the area of contamination utilizing standard construction techniques. Alternative 4 will require a Site specific treatability study, and the implementabilty of this alternative would depend totally on the results of the treatabilty study. As a result of the number of unknowns associated with the implemetability of this Alternative it is considered to be the most difficult to implement. Alternatives 5 and 6 are very implementable, however they required a large area to implement because of materials pre-processing and storage. Alternative 7 is very implementable and has been used successfully at much larger sites.

Cost

Total present worth costs for the alternatives are presented in Table 10-1.

State Acceptance:

The State Recommends In-situ Mixing and Encapsulation as the soil remedy.

Community Acceptance:

The community is in favor of the soil remediation option of in-situ mixing and encapsulation.

B. Comparative Analysis of Groundwater Alternatives

The following alternatives were subjected to detailed analysis for groundwater remediation:

- Alternative 1: No Action
- Alternative 2: Limited Action
- Alternative 3: Groundwater Extraction, Treatment, and Discharge
- Alternative 4: Biotreatment of Groundwater
- Alternative 5: Intrinsic Degradation

Overall Protection of Human Health and the Environment

Each alternative was evaluated to determine whether it is likely to effectively mitigate and minimize the long-term risk of harm to public health and the environment currently presented at the Site. Alternative 1 does not eliminate any exposure pathways or reduce the level of risk. Alternative 2 eliminates some exposure pathways, with a reduction in the potential risk of groundwater ingestion and inhalation, however the potential for exposure still remains under a future residential scenario. Alternatives 3 and 4 are active treatment technologies that seek to remove contaminants from the groundwater, thereby being protective of human health and the environment. Alternative 5 is a passive treatment technology which theorizes that the contaminants will attenuate naturally overtime. To date this treatment technology has not been proven to be effective at the Lot 86 Site, however if proven effective, this alternative initially would not provide any greater protection than Alternative 1, but over time contaminant levels would attenuate providing adequate overall protection.

Compliance With ARARs

The no action and the limited action alternatives would not comply with ARARs. Alternative 3 would attain ARARs on the extracted groundwater, however there are some uncertainties about this treatment technologies ability to extract all the contaminated groundwater from the aquifer. Alternative 4 is expected to achieve a 80 to 90 percent reduction in level of contamination. It is expected that residual levels of contamination will remain that may require waivers from ARARs. Alternative 5 has not been shown to attain ARARS.

Long-term Effectiveness and Permanence

In Alternatives 1 and 2, contaminant migration through groundwater water discharge would continue. In Alternative 3, there would be a maximum reduction in pathway exposure risk, and further migration would be eliminated. Alternatives 4 as with Alternative 3 is expected to reduce pathway exposure, however the reduction is expected to be less than that provided by Alternative 3. Alternative 5 if proven to be effective at the Lot 86 Site, would provide long term effectiveness and permanence. In the absence of that conclusive evidence Alternative 5 is considered to provide the same level of effectiveness and permanence as Alternatives 1 and 2.

Reduction of Toxicity, Mobility, and Volume

Alternatives 1 and 2 would not reduce the toxicity, mobility, or volume (T/M/V) of the contaminants. Alternative 3 provides the maximum reduction of T/M/V. In is uncertain what degree of T/M/V Alternatives 4 and 5 will provide, however at this point their expected results would fall between that of Alternatives 1 and 2 which provides no reduction in TMV and Alternative 3.

Short-term Effectiveness

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

Implementability

Alternative 2, requiring deed restrictions presents no implementability problems. Alternative 3 could potentially require a NPDES permit or substantive compliance if the treated effluent is discharged to surface water. Alternative 4 would require a site specific treatability study to verify the viability or this alternative as well as a more tedious regulatory process because of the closed loop system. Alternative 5 will require further modeling along with additional monitoring, before this Alternative could be successfully implemented.

Cost

Total present worth costs for the groundwater alternatives are presented in Table 10-1.

Community Acceptance:

The community has expressed it's concern over the expenditure of additional funds associated with the pump and treat option for groundwater when intrinsic degradation may be a cheaper viable option.

XI. THE SELECTED REMEDY

Based upon consideration of the requirements of CERCLA, the NCP, the detailed analysis of the alternatives and public and state comments, EPA has selected Alternatives 3G (groundwater pump and treat) and 7S (In-situ Mixing and Encapsulation), as the remedy for this Site. At the completion of this remedy, the risk associated with this Site has been calculated to be within the accepted risk range determined to be protective of human health and the environment. The total present worth of the selected remedy is $ 3,031,000.00.

A. Soil Remediation

The soil component of the selected remedy will be in-situ mixing and encapsulation. The technology involves a two stage process. The volatiles will be driven off and captured via a specially designed bore hole shroud, and then treated in the first stage. The treatment may include but not be limited to liquid vapor separation, in-line prefiltration for dust and particulate removal followed by parallel activated carbon filter banks. The remaining contaminants in the trenches will then be solidified in-situ, using various pozzolan-portland cement based formulations delivered to and dispersed within the soil column as a grout. The extent of encapsulation will be better defined during, the remedial design process, however at a minimum the encapsulation shall extend to encompass a two foot radius around the confines of the trenches. The Toxicity Characteristic Leaching Procedure (TCLP) (55 FR 11798, 1990) is to be considered in the design of the soils encapsulation alternative.

B. Groundwater Remediation

Groundwater remediation will involve the extraction of the contaminated groundwater via extraction wells. The extracted groundwater will be treated and discharged to either surface water or the local POTW.

The treatment will consist of air stripping to remove volatile organics, and carbon adsorption to remove organics. The groundwater system will operate 24 hours per day. System controls will allow complete automatic operation with minimal operator attention. Long-term monitoring for cleanup verification purposes and to track contaminant plume migration will be required. The system is expected to operate 30 years; samples will be collected from existing wells on a semi-annually basis for the first 5 years, and on an annual basis for the following 25 years.

The groundwater treatment system will also require monitoring and maintenance. Monitoring of the treatment system will include periodic sampling of the influent and effluent from the treatment system and analysis in accordance with the permit requirements.

C. Retraction and Performance Standards

Location of extraction wells, pumping rates and method of discharge will be determined during the remedial design.

Groundwater shall be treated until the Remediation objectives listed in Table 11-1 are attained throughout the contaminant plume.

The goal of this remedial action is to restore the groundwater to its beneficial use. 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 will 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 remediation levels 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 30 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 following:

a) at individual wells where remediation levels 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 at least 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 levels;

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). The remedial actions shall comply with all ARARs (See Sections VII).

The implementation of the remedial action portion of the groundwater remedy will be delayed two years from the date of this Record of Decision. During that time, EPA will consider any new evidence submitted by interested parties that the reduction of groundwater contamination is occurring at the site by means of natural processes. If analytical results such as but not limited to a decrease of groundwater contamination or the existence of breakdown products of the original contaminants is presented, EPA will consider a change in remedy.

TABLE 11-1
REMEDIAL ACTION OBJECTIVES FOR GROUNDWATER
NC STATE UNIVERSITY LOT 86 SITE
RALEIGH, NORTH CAROLINA

Contaminant	Remediation Level (Ig/1)	Basis
Benzene	1	NC Groundwater Quality Standard (15NANC 02L)
Carbon Tetrachloride	1	Contract Quantitation limit (CRQL)
Chloroform,	1	Contract Quantitation limit (CRQL)
Methylene Chloride	5	NC Groundwater Quality Standard (15NANC 02L)
Tetrachloroethene	1	Contract Quantitation limit (CRQL)
Acetone	700	NC Groundwater Quality Standard (15NANC 02L)
Bromodichloromethane	1	Contract Quantitation limit (CRQL)
1,2-Dichloropropane	1	Contract Quantitation limit (CRQL)
1,1,2-Trichloroethane	1	Contract Quantitation limit (CRQL)
Trichloroethene	2.8	NC Groundwater Quality Standard (15NANC 02L)
Manganese	370	Background Concentration
Arsenic	10	Contract Quantitation limit (CRQL)

Appendix I
RESPONSIVENESS SUMMARY

Responsiveness Summary Overview

The Responsiveness Summary is the official record of how the Agency responded to public comments as a part of the decision making process. The responsiveness summary also provides the decision makers of the lead Agency with the public's views, so that they are considered in the final decision.

This document is segregated into three components; summary of the community's involvement, the Agency's response to comments received at the proposed plan public meeting and the Agency's response to written comments received form concern parties during the process.

Background of Community involvement and Concerns

The public concerns regarding this Site have been minimal. This is probably the result of the Agency's rather extensive community relations efforts, and the fact that the contamination at the Site has remained on State land and has not effected any of the neighboring communities.

Two public meetings were held. The first meeting was held on September 7, 1993 to discuss the superfund process, and the second meeting was the proposed plan meeting on July 9, 1996. Several fact sheets were prepared and distributed through out the process. The Remedial Investigation (RI) and Feasibility Study (FS) reports along with the Proposed Plan were released to the public in June of 1996. All of these documents as well as the Administrative Record were made available to the public. Announcements of each meeting were advertised in the local newspaper and press releases prepared.

Public Meeting Comments

These are the community concerns that were expressed as a result of the July 9, 1996 proposed plan public meeting are as follows:

Comment: A gentleman stood, and expressed his concern over the amount of time the process has taken to this point. He has been aware and following the progress of the Site for over ten years, and wanted to know if were at an impasse over what was to be done next.

Response: A decision as to what remedy will be selected will occur within the next 60 days, and that the ongoing debate is a part of the formal comment period where all comments are heard and factored into the final decision.

Comment: The gentleman first expressed his disagreement with the estimated cost of the alternatives, and further went on to ask why the Agency would not consider the cheaper remedy of intrinsic degradation if it had a potential of working. Especially since the site contaminants aren't posing a threat the human health or the environment at this time.

Response: In the Agency's evaluation of the alternatives, we are required to consider all of the nine criteria not cost alone.

Comment: The gentleman further stated that as a member of the community that he wanted to cast his vote for intrinsic degradation and if it was deem ineffective at a later date another remedy could be selected.

Response: It is the Agency's intent at this time to gather the opinion of the affected community and factor those concerns and opinions into the final remedy selection.

Comment: Another citizen cast a dissenting vote for pump and treat and a favorable one for natural attenuation. He further stated that he has managed two natural attenuation sites in North Carolina and one was successfully remediated and one wap underway.

Comment: A gentleman wanted to know what was the origin of the cost documentation.

Response: The cost figures come from the University's contractor and that is what the contractor represented to the University as the cost of implementing these alternatives.

Comment: When were these cost provided to the University?

Response: The cost estimates are about a year and a half old.

Comment: Could the cost be twice that much or three times that much?

Response: I am unable to answer that question.

Comment: Another citizen expressed concern over the potential escalation of the cost and the impact that would have on the taxpayers.

Comment: A gentleman expressing his concern over the amount of time it has taken to get to this point wanted to know how much more time is the State requesting to demonstrate that natural attenuation will work.

Response: Dave Lown of the State responded to the question. Dave stated without providing a specific time frame that the State was experienced in this area and would be looking for specific criteria and that it would not turn into a 20 year research project.

Comments: A gentleman stated that he was aware that the State had experience with petroleum sites or sites with hydrocarbon not chlorinated or halloginated solvents, and that he has seen less evidence where chlorinated solvents break down.

Response: Dave Lown responded by stating that a report was submitted to USEPA pertaining specifically to situation at the Lot 86 Site, and that included a fairly extensive literature review of the degradation pathways and mechanisms to the contaminants specific to our situation.

Comment: Concern was expressed over the effect the delay in action would have on the migration of the plume, especially as the potential for the spread of the plume into the bedrock aquifer. The citizen referenced a Camp Dresser & Mckee document prepare for the Agency stating that the potential to cleanup the site is good considering the limited exposure to the bedrock aquifer.

Comment: It was asked if the introduction of natural attenuation was a delay tactic.

Response: Dave Lown responded stating that everyone is in agreement on the soils remediation and that would proceed in a expeditious manner. The debate is over pump and treat which is a long term process and that a one to two year delay will have minimal effect on the overall process.

Comment: A gentleman asked what is the status of the radioactive portion of the site.

Response: Our investigation of the radioactive portion of the Site revealed that the low level radioactive waste did not pose a threat. The risk fell within the acceptable risk range.

Comment: Does the site have any affect on the Wade Avenue road projects or the Centennial Coliseum.

Response: From a risk scenario standpoint the only scenario that would present a problem would be a residential scenario which included the ingestion of the groundwater. The currently proposed projects are not threatened or affected by the Site.

Response: Duane Knudson of N.C. State University stated that they task it's hydrogeologist to determine if there was an impact on those projects by site, and he felt the that site would not effect the proposed projects.

Response to Written Comments

There were no written comments received during the comment period.

General Response to Comments

Comments were received indicating the belief that natural attenuation is occurring or may occur in the groundwater at the site. Even though there is no conclusive evidence of the reduction of contaminants by natural processes occurring at this time, EPA believes that a delay giving time for interested parties to gather additional evidence is warranted. Therefore, the implementation of the remedial action section of the groundwater remedy will be delayed two years from the date of this Record of Decision. During that time, EPA will consider any new evidence submitted by interested parties that the reduction of groundwater contamination is occurring by means of natural processes at the site. If analytical results such as a decrease in groundwater contamination or the existence of breakdown products of the original contaminants is presented, EPA will consider a change in remedy to this Record of Decision. EPA believes that during this time, the remedial design and subsequent cleanup of the soils can continue; and that the two year delay in the groundwater remedial action will not impact the overall speed of the cleanup.