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EPA Superfund
Record of Decision:

PETERSON/PURITAN, INC.
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LINCOLN/CUMBERLAND, RI
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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 1
J.F. KENNEDY FEDERAL BUILDING
BOSTON, MASSACHUSETTS 02203-2211

DECLARATION FOR THE RECORD OF DECISION

PETERSON/PURITAN, INC. SITE
OPERABLE UNIT 1
CUMBERLAND/LINCOLN, RHODE ISLAND

STATEMENT OF PURPOSE

This Decision Document presents the selected remedial action for the Peterson/Puritan, Inc. Superfund Site, Operable Unit 1, in Cumberland and Lincoln, Rhode Island, developed in accordance with the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA), as amended, 42 U.S.C. 9601 et seq. and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), as amended, 40 C.F.R. Part 300. The Region I Administrator has been delegated the authority to approve this Record of Decision (ROD).

The State of Rhode Island has concurred with the selected remedy.

STATEMENT OF BASIS

This decision is based on the Administrative Record which has been developed in accordance with Section 113(k) of CERCLA and which is available for public review at the Cumberland Public Library, 1464 Diamond Hill Road, Cumberland, and the Lincoln Public Library, Old River Road, Lincoln, Rhode Island, and at the Region I Waste Management Division Records Center in Boston, Massachusetts. The Administrative Record Index (Appendix E to the ROD) identifies each of the items comprising the Administrative Record upon which the selection of the remedial action is based.

ASSESSMENT OF THE SITE

Actual or threatened releases of hazardous substances from Operable Unit 1, if not addressed by implementing the response action selected in this ROD, may present an imminent and substantial endangerment to the public health or welfare or to the environment.

DESCRIPTION OF THE SELECTED REMEDY

This ROD sets forth the selected remedy for Operable Unit 1 which includes both source control and management of migration components to obtain a comprehensive remedy.

Major Components of the Selected Remedy

Operable Unit 1 contains two remediation areas. The CCL remediation area, a source of volatile organic contamination, includes the former Peterson/Puritan, Inc. facility, which is the Site's namesake (currently the CCL Custom Manufacturing facility, and referred to as CCL). Adjoining the CCL facility to the south is an undeveloped parcel known as the O'Toole property, which is included as part of the CCL remediation area. The PAC remediation area includes the Pacific Anchor Chemical Corporation (PAC) facility (formerly the Lonza and Universal Chemical Company facility), which is a source of arsenic and volatile organic contamination. Each remediation area is further split into source and downgradient area components, respectively. The components of the selected remedy include:

CCL remediation area:

- Excavation (manholes and catch basins),
- Capping,
- Soil venting of source area soils,
- Source area ground water extraction, treatment and discharge to POTW via the sewer,
- Downgradient area ground water extraction with the untreated ground water discharged to the POTW via the sewer,

- Natural attenuation of ground water at the Quinnville wellfield,
- Institutional controls throughout the CCL remediation area, and
- Environmental monitoring.

PAC remediation area:

- Excavation and disposal of contaminated leach fields and related soils,
- In-situ oxidation treatment of the soils in the PAC source area,
- Natural attenuation of the PAC downgradient ground water,
- Institutional controls throughout the PAC remediation area,
- Focused investigation of other potential sources of contamination in the PAC downgradient area, and
- Environmental monitoring.

Excavation: Excavation at the CCL area will consist of removing soils at manholes and catch basins. Excavation of these soils will remove a portion of the continuing source of ground water contamination. Excavation at the PAC remediation area includes removal of leachfields #1 and #2 and surrounding soils to a depth of approximately nine feet. Excavation will remove the source of contaminants to ground water in addition to removing organic material contributing to the mobilization of arsenic. The excavation soils which are contaminated with volatile organics and arsenic will be transported off-site for disposal at a RCRA-approved disposal facility.

Capping: Source area soils at the CCL remediation area will be capped to enhance the soil venting system operation (see below), limit infiltration through the soil and reduce the potential for direct contact of source area soils. An estimated 14,000 square foot area of the tank farm will be capped with concrete and an estimated 12,000 square feet of the O'Toole property will be paved.

Soil Venting and Vapor Treatment: A soil venting system (also known as Soil Vapor Extraction (SVE)), consisting of wells, blowers, and a Granular Activated Carbon (GAC) adsorption/regeneration off-gas treatment system, will be installed at the CCL source area. It is estimated that the SVE system will result in 99 percent removal of VOCs above the ground water table (vadose zone) in the vicinity of the CCL tank farm.

Source Area Ground Water Extraction: A multi-well recovery system in the CCL source area will capture and treat ground water within and immediately downgradient of the source to prevent migration of contaminated ground water from the source. Wells within the tank farm area will capture the grossly contaminated ground water and depress the ground water table in the source area. This depression will extend the vadose zone and allow further recovery of residual contamination at and below the static water table by the SVE system. Wells on the O'Toole property will cut off the source area from the downgradient plume.

A diffused air stripper will be used to treat the extracted ground water. Compared to other options considered in the FS, this process option will be less susceptible to fouling and reduced efficiencies from naturally occurring inorganics in the ground water, such as iron and manganese, due to the higher water velocity traveling through the system. The inorganics travel through the treatment system as suspended solids and will be discharged with the treated water to the POTW via the sewer. The VOC contaminated air passing through the stripping process will be treated by the GAC adsorption/regeneration system.

The GAC adsorption/regeneration off-gas treatment system will treat the contaminated air stream exiting the SVE system and the air stripper. The GAC system will regenerate the spent activated carbon on-site using steam. The concentrated chemical solutions from the steam stripping process will be temporarily stored on-site prior to off-site treatment and disposal.

In-situ Oxidation: In-situ (in place) oxidation, an innovative technology, has been selected to reduce the mobility of the arsenic in ground water migrating from the leachfields at the PAC remediation area. The leachfields will be replaced with perforated pipe and stone backfill to be used as an infiltration gallery. Clean water, amended with a chemical additive, will reduce the mobility of the arsenic by chemically changing the more soluble arsenite to arsenate, which will precipitate or sorb to soil particles.

Downgradient Ground Water Extraction and Discharge: Recovery of the ground water plume that has migrated from the CCL source area will be accomplished by installing a multi-well recovery system. This extracted ground water can be directly discharged to the POTW sewer without pretreatment. Monitoring of the influent to the sewer will ensure continued compliance with POTW requirements. Institutional Controls: Institutional controls will be required for all remediation areas, including the Quinnville wellfield and the PAC downgradient area. These controls will function to prevent the use or hydrologic alteration of ground water throughout OU 1, and prevent direct contact to, or exposure to, contaminated soils in areas where such soils exceed EPA's risk range.

Environmental Monitoring: Environmental monitoring is incorporated into the remedy to measure the rate of reduction of contaminants and evaluate the effectiveness of the components of the remedial action, including the natural attenuation processes acting on the contaminated media throughout OU 1.

Natural Attenuation: Natural attenuation is process of naturally occurring biodegradation, oxidation, adsorption and dilution which reduces contaminant concentrations. This process will be the sole means of remediation at two areas of OU 1: the Quinnville wellfield and the PAC downgradient area. A focused investigation will gather information on other potential sources impacting ground water at the PAC downgradient area.

DECLARATION

The selected remedy is protective of the human health and the environment, attains federal and state requirements that are applicable or relevant and appropriate for this remedial action, and is cost-effective. This remedy satisfies the statutory preference for remedies that utilize treatment as a principal element to reduce the toxicity, mobility, or volume of hazardous substances. In addition, this remedy utilizes permanent solutions and alternative treatment technologies to the maximum extent practicable.

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I. SITE NAME, LOCATION AND DESCRIPTION

The Peterson/Puritan, Inc. Superfund Site is located within the towns Lincoln and Cumberland, in Providence County, Rhode Island. The Site is situated within the Blackstone River Valley, south of the RI Route 116 overpass, extending approximately two miles down the Valley and as much as one-half mile to the northeast and to the southwest of the Blackstone River. The Site includes the extent of contamination that has impacted wellfields in the towns of Cumberland and Lincoln, Rhode Island. The Site, investigated by EPA under a Remedial Investigation (RI) in February 1990, includes the industrial facilities in the vicinity of Martin Street, the J.M. Mills Landfill, State and town recreational areas, interspersed woodlands and grass meadows, wetlands, the River and adjoining canal, and the affected municipal water supply wellfields in the towns of Cumberland and Lincoln; specifically, the Quinnville wellfield in Lincoln and the Martin Street and Lenox Street wells in Cumberland. These wells are now out of service; the Martin Street well house now functions as the town dog pound.

The Blackstone Valley is the most prominent geographic feature in the Site. The Blackstone River flows in a southeasterly direction through the valley on a comparatively flat floodplain between river terraces. The main channel of the river is approximately 150 feet wide and extremely variable in depth and flow. Through much of the Site, the River marks the boundary between the towns of Lincoln to the west and Cumberland to the east. The Blackstone Canal parallels the river on the Lincoln side. The canal originates where drainage is diverted from the Blackstone River north of the Site and rejoins the river south of the Site. The canal is no longer in use but remains hydraulically connected and historically significant to the area. The Blackstone River Heritage Park is being developed by the State along the canal and river route, through the Site, predominately on the Lincoln side of the river. All of the industrial facilities within the Site are located on the Cumberland side of the river. Figure 1 of Appendix A depicts the Site.

On September 9, 1983 the Site was listed on the National Priorities List (NPL) of hazardous waste sites to be investigated and remediated under the Federal Superfund program.

Because of the expansive Site area and the number of identified areas of concern, EPA, in 1990, divided the Site into operable units, allowing for resources and response actions to be focused in a phased approach. As a result, a second, more focused phase of study was commenced at Operable Unit 1 (OU 1). This study included a Feasibility Study which presented remedial alternatives for this operable unit. This Record of Decision (ROD) addresses the response actions to be taken at OU 1.

OU 1 contains two principal contaminant sources. The first source is the former Peterson/Puritan, Inc. facility, which is the Site's namesake (currently the CCL Custom Manufacturing facility, and referred to in this document as the CCL facility). Adjoining the facility to the south is an undeveloped parcel known as the O'Toole property. The second source is the Pacific Anchor Chemical Corporation (PAC) facility, formerly the Lonza and Universal Chemical Company facility. The PAC facility and the CCL facility are each located in Cumberland, off of Mendon Road and Martin Street, respectively. From these source areas OU 1 extends down the river valley to approximately 2,000 feet south of the CCL facility along the east bank of the river. The Blackstone River and the Quinnville wellfield are primary receptors of the contaminated ground water migrating from OU 1.

OU 1 is mainly comprised of industrial and commercial parcels with predominantly residential property to the west and mixed commercial and residential properties to the east. Recreational areas are noted by the presence of ball fields located on Martin Street and the Blackstone River Heritage Park along the river. EPA estimated that over 100 residences are located within a one mile radius of OU 1. Figure 2 depicts the boundaries of OU 1.

Within OU 1, the Blackstone Valley aquifer is classified by the State of Rhode Island as GAA Non-Attainment. This classification denotes that ground waters classified as GAA are those ground water resources designated to be suitable for public drinking water without treatment. Non-attainment areas are those areas that have pollutant concentrations greater than the ground water quality standards for the applicable classification. The goal for nonattainment areas is restoration to the ground water quality consistent with the standards of the applicable class (i.e. GAA). The Blackstone River is classified as Class C denoting a recreational, industrial process and cooling water use, and fish and wildlife habitat. According to Flood Insurance Rate Maps prepared by the Federal Emergency Management Agency (FEMA), the 100-year floodplain encompasses approximately two-thirds of OU 1. However, the principal source areas, the CCL and PAC facilities, are not located in the floodplain, but are elevated 15 to 20 feet above it.

A more complete description of OU 1 can be found in the Peterson/Puritan, Inc. Site, Lincoln and Cumberland, Rhode Island Revised Final Remedial Investigation Report, Primary Source Area (OU 1), June 1993, in Section 1 of Volume 1. Further information regarding the description of the Site can also be found in the following documents: Peterson/Puritan, Inc. Site, Cumberland, Rhode Island Draft Remedial Investigation Report, February 1990, in Section 1 of Volume 1, and the Lincoln/Cumberland Wellfield Contamination Study, March 1982, Sections 1 and 2.

II. SITE HISTORY AND ENFORCEMENT ACTIVITIES

A. History and Response

The Blackstone Valley was settled in the seventeenth century, and became one of the earliest sites of the Industrial Revolution in America. Regionally, the river provided power, supplied water, and served as a conduit for waste water discharge.

Ground water from the Blackstone Valley aquifer was first developed as a municipal water supply source in OU 1 in 1950 when the Town of Cumberland installed the Martin Street well. The Lenox Street well was added to the Cumberland system near the southern end of the Site in 1964. Until approximately 1967, these two wells supplied most of Cumberland's water needs. By 1967, the Martin Street well was no longer in service due to iron and manganese and by 1979 the Lenox Street well was the source of only 4 percent of the town's water supply. Most of Cumberland's water by that time came from surface sources and from the Manville wells located several miles up-valley from the site.

According to reports, in 1972, Peterson/Puritan pumped out its septic systems and was connected to the municipal sewer system. The facility eliminated its wastewater discharge to Brook A (see Figure 4) in 1975 and relocated its storage of hazardous materials to contained storage areas. In 1976, an explosion occurred at the plant which required new construction and modifications to the facility. It was reported that the incident did not affect the tank farm or cause any substantial releases. In 1983, Peterson/Puritan, Inc. installed engineering changes to plant chemical and wastewater piping systems. In response to contamination detected on its property, Peterson/Puritan implemented a contaminated ground water recovery well program in 1984 which operated for approximately eight years.

The Town of Lincoln installed its first supply well in the Quinnville wellfield in 1957. In 1970 and 1975 Lincoln installed two more wells at this location. By 1979, the Quinnville wellfield was supplying Lincoln with approximately 45 percent of its water.

During routine statewide sampling of wells in 1979, the Rhode Island Department of Health (RIDOH) discovered volatile organic compounds (VOCs), some at levels exceeding EPA drinking water guidelines, in three Quinnville wells and the Lenox Street well. The primary contaminants were 1,1,1-trichloroethane (TCA) and tetrachloroethylene (PCE) at concentrations ranging from 27 to 166 parts per billion (ppb) in all four wells tested. Trichloroethylene (TCE)was also detected at 14 ppb at Quinnville well #1. All wells were closed, and the Town of Lincoln constructed two new wells in the Blackstone Valley aquifer, one north and one south of the Quinnville wellfield beyond the area of the Site. The Town of Lincoln later took measures to connect to the Providence water system. Cumberland's water shortfall was offset by other town-owned water resources, including the Sneech Pond reservoir and municipal supply wells in the Abbott Run watershed and within the Blackstone Valley aquifer north of the Site. The Town also purchases water from Pawtucket.

Local industrial use of ground water began in the nineteenth century. Such uses included process water and fire protection. With the exception of the Okonite facility, the industrial use of ground water in OU 1 was discontinued by the early 1970's. The supply well at the Okonite facility was closed in 1981, when VOCs were detected during preliminary site investigations conducted by EPA.

There are no known residential wells currently operating as a drinking water supply in the Blackstone Valley Aquifer in the vicinity of OU 1.

In 1981, in response to the contamination detected in the Lenox Street and Quinnville wellfields, EPA undertook a hydrogeologic study of the portions of the Blackstone Valley aquifer underlying the river in Lincoln and Cumberland, Rhode Island. EPA reviewed available data, investigated a number of potential sources and developed a ground water flow model to ascertain the nature and extent of contamination at the Site.

The study identified the Peterson/Puritan (P/P), Inc. facility as a major source of the ground water contamination found in the Quinnville wells. Similar contamination found in the Lenox Street well also suggested a potential link to the Peterson/Puritan source.

Information obtained at that time indicated that the Peterson/Puritan, Inc. facility was the only facility known to use, store and dispose of halogenated volatile organic compounds. Plant operations involved the packaging of a variety of aerosol products such as perfumes, oven cleaners, pesticides, hair sprays, deodorants, and window cleaners. Before 1976, chlorofluorocarbons and methylene chloride propellants were used in many products. On August 4, 1981, a sample of runoff discharging from pipes located in the northwest corner of the Peterson/Puritan building into a culvert known as Brook A was found to contain methylene chloride and 1,1,1-trichloroethane. Tabulated data showed that six of the seven contaminants found at the Lincoln wellfield were typical components of products packaged by the Peterson/Puritan facility. Three compounds were identified by Peterson/Puritan as used at its facility; 1,1,1-TCA, PCE, and trichlorofluoromethane.

Through later investigations conducted in November, 1990, during the RI, EPA learned that in July, 1974, a release of PCE occurred from a railcar which was off-loading product to the Peterson/Puritan tankfarm. An estimated 6200 gallons of PCE spilled onto the ground along the rail spur in close proximity to the tank farm at the Peterson/Puritan facility. This spill, along with historical releases of volatile organic compounds into manholes and catch basins associated with the facility's sewer system, is the primary source of contamination at the CCL facility. Figure 3 depicts the CCL facility and associated tankfarm (formerly Peterson/Puritan, Inc.).

A July 24, 1981 RCRA inspection of the PAC facility revealed no halogenated volatile organic compounds. However, the inspection revealed the existence of on-site septic tanks and a leach field. A portion of the facility's wastewater and non-contact cooling water, while not containing halogenated compounds, did discharge to a culvert known as Brook A (Figure 4). Samples taken from the facility indicated the presence of acetone, 2-propanol, toluene, ethylbenzene and methyl isobutyl ketone (MIBK). Samples of the facility's wastewater taken in 1981 (reported to the Blackstone Valley Sewer District) and in 1984 (collected by RIDEM) contained high concentrations of arsenic, associated with chromium and nickel, and tetrachloroethylene and xylene, respectively.

The facility continues to discharge non-contact cooling water to Brook A under a Rhode Island Pollution Discharge Elimination System (RIPDES) permit. The facility manufactures general industrial chemicals and specialty chemical materials for use in detergents, cosmetics, agriculture and food.

Information obtained from PAC indicates that there are three leachfields located on the PAC facility which were in use at various times. The two main leachfields, designated as Leachfield #1 and #2, were installed in approximately 1973 and were shut down in 1985. The third field, designated as Leachfield #3, is known to have been in use in 1972, and may have been installed as early as 1962. Although the exact use of this third leachfield is not known, it is still in use today as a sole sanitary system. Figure 5 shows the locations of each of the PAC leachfields.

An important source of contamination at the PAC facility is the discharge of VOCs, primarily acetone and isopropanol, to on-site septic systems and leachfields. Arsenic, another important source of contamination in ground water at the PAC facility, has been detected in PAC facility wastewaters. Furthermore, naturally occurring arsenic, normally bound to subsurface soils, can be liberated to ground water due to the biological activity which occurs in a reducing (non-oxidized) environment. A reducing environment in ground water at the PAC facility may be contributing to arsenic contamination at the PAC source area.

A more detailed description of the Site history can be found in the Revised Final Remedial Investigation Report, June 1993, Sections 1 and 5 of Volume 1.

B. Enforcement Activity

From 1981 through 1986, EPA negotiated with Peterson/Puritan, Inc. to enter into an Administrative Order By Consent under which it would agree to conduct a Remedial Investigation/Feasibility Study (RI/FS). During this period of time, Peterson/Puritan further investigated the contamination at the Site and submitted its findings to the Agency in two technical reports. The Agency did not formally accept these reports as an RI/FS performed pursuant to the NCP since Peterson/Puritan had declined to enter into an Administrative Order By Consent and the Agency had been unable to confirm the veracity of information contained in those reports. However, the technical reports were used as supporting data in the development of subsequent studies.

By 1986, EPA had decided to conduct the RI/FS itself and in January, 1987, EPA initiated its RI. Shortly thereafter, EPA received a request from Peterson/Puritan to take over the RI/FS.

In May 1987, Peterson/Puritan signed a Administrative Order on Consent (AOC) requiring it to perform an RI/FS for the entire Site area and reimburse EPA's oversight costs during this process. Also in 1987, Peterson/Puritan was sold to Hi-Port Industries, Inc. Its former parent, CPC International, Inc., (CPC) assumed, Peterson/Puritan's responsibilities under the AOC. This RI/FS work has to date included the takeover (with EPA oversight) of investigations which commenced in 1987 and ended February, 1990 and a second phase of the RI, initiated in March, 1992, to better define the nature and extent of contamination within OU 1. The second phase led to the development of the OU 1 Feasibility Study. CPC has been active in the study of OU 1.

EPA conducted a Baseline Risk Assessment and Ecological Assessment under a federal lead contract and maintained oversight of the PRP-lead RI/FS. The final Ecological Assessment and Baseline Risk Assessment were submitted on May 21, 1993 and June 2, 1993, respectively.

CPC International, Inc. (CPC) submitted a Revised Final RI for OU 1 on June 8, 1993 and an FS report for OU 1 on June 28, 1993. These documents are part of the Administrative Record which forms the basis for this Record of Decision.

On March 10, 1992, in response to PRP concerns, EPA amended the 1987 Administrative Order to clarify the language concerning the PRP reimbursement of oversight costs and cost documentation.

In June, 1992 EPA notified approximately seven (7) parties of their potential liability with respect to the Site. This group of potentially responsible parties (PRPs) includes CPC. Several of these PRPs have been active in the remedy selection process for OU 1. EPA mailed a copy of the proposed plan for OU 1 to the PRPs in July 1993. Technical comments presented by PRPs during the public comment period are included in the Administrative Record. A summary of these comments as well as EPA's responses, which describe how these comments affected the remedy selection, are included in the Responsiveness Summary, Appendix C of this document.

To date, EPA remains in contact with these parties in preparation for negotiations concerning the implementation of the selected remedy and future response actions to be conducted at other portions of the Site.

III. COMMUNITY PARTICIPATION

Throughout the Site's history, community concern and involvement has been minimal. EPA has kept the community and other interested parties apprised of Site activities through informational meetings, fact sheets, press releases and public meetings.

In January, 1987, EPA released a community relations plan which outlined a program to address community concerns and keep citizens informed about and involved in activities during remedial activities. On January 15, 1987, EPA held an informational meeting at the Ashton elementary school in Cumberland, Rhode Island to describe the plans for the Remedial Investigation and Feasibility Study.

A fact sheet was issued in June, 1993 which discussed the findings of the Remedial Investigation, Risk Assessment, Ecological Assessment and opportunities for public involvement.

EPA issued a public notice and brief analysis of the Proposed Plan in the Pawtucket times and Woonsocket Call on July 1, 1993 and made the plan available to the public at the Lincoln and Cumberland town libraries. On July 6, 1993, EPA made the administrative record available for public review at EPA's offices in Boston and at the above referenced local information repositories.

On July 15, 1993, EPA held an informational meeting to discuss the results of the Remedial Investigation and the cleanup alternatives presented in the Feasibility Study and to present the Agency's Proposed Plan. Also during this meeting, the Agency answered questions from the public.

From July 6, 1993 to August 5, 1993, the Agency held a 30 day public comment period to accept public comment on the alternatives presented in the Feasibility Study and the Proposed Plan and on any other documents previously released to the public.

On July 29, 1993, the Agency held a public hearing to discuss the Proposed Plan and to accept any oral comments. A transcript of this meeting with the comments received and the Agency's response to comments are included in the attached responsiveness summary.

All supporting documentation for the decision regarding OU 1 is placed in the Administrative Record for review. The Administrative Record is a collection of all the documents considered by EPA in choosing the remedy for OU 1. It was made available at the EPA Records Center, at 90 Canal Street, in Boston, MA, and at the Cumberland and Lincoln public libraries. The Cumberland public library is located on Diamond Hill Road in Cumberland, Rhode Island. The Lincoln public library is located on Old River Road, in Lincoln, Rhode Island. An index to the Administrative Record for OU 1 is provided as Appendix E.

IV. SCOPE AND ROLE OF THE OPERABLE UNIT RESPONSE ACTION

Response activities at the Site have been divided into operable units. OU 1 addresses contamination emanating from the CCL and PAC facilities. A second operable unit will address contamination at the J.M. Mills landfill as necessary.

The OU 1 remedy will reduce the VOCs in soil and arsenic in ground water at the source areas, prevent continued release and further migration of hazardous substances to the ground water (and surface water at the Blackstone River which is a receptor of OU 1 contamination), restore contaminated ground water to drinking water standards, and provide for continued environmental monitoring at OU 1. The remediation of OU 1 is not expected to adversely impact any future response actions at other operable units at the Site. The remedy will provide for active restoration of all portions of OU 1 that are outside of EPA's acceptable risk range and will employ permanent treatment technologies to reduce contaminants while undertaking a cost effective approach to meeting EPA's remedial response objectives.

This remedial action will address the following principal threats to human health and the environment posed by OU 1: 1) the threat of future potential ingestion of ground water contaminated from OU 1; and 2) the threat of ingestion or contact with contaminated soils.

V. SUMMARY OF SITE CHARACTERISTICS

Section 1.0 of the Feasibility Study contains an overview of the Remedial Investigation. The Remedial Investigation consists of a February, 1990 Draft Remedial Investigation Report for the entire Site (referred to in that report as the Site Study Area). Subsequently, a June, 1993 Revised Final Remedial Investigation Report presented data focused on a portion of the Site identified herein as OU 1 (referred as the Primary Source Area in that report.) The Feasibility Study further subdivides OU 1 into two remediation areas: the CCL remediation area and the PAC remediation area. This division was based on the two principal contaminant source areas identified in the RI/FS; the CCL and PAC source areas and their respective downgradient areas. Figure 6 depicts OU 1 and the principal source areas within it. The significant finding of the Remedial Investigation relating to OU 1 and the two remediation areas are summarized below.

The Blackstone River is the most prominent water feature in the Site and borders OU 1 to the west. The main channel of the river is approximately 150 feet wide, highly variable in depth, and meanders slightly. The Blackstone River canal parallels the river to the west throughout the Site. Under normal flow conditions, the river is recharged by ground water with an average discharge rate of 729 cubic feet per second. Upstream, the river flow is hydraulically controlled by dams as it passes through Woonsocket, RI. According to Flood Insurance Rate Maps prepared by FEMA, the 100-year floodplain encompasses approximately two-thirds of OU 1. However, the principal source areas, the CCL and PAC facilities, are not located in the floodplain, but are elevated 15 to 20 feet above it.

A small drainage channel, referred to in the RI as Brook A, originates at Mendon Road and is sustained by periodic runoff from Mendon Road and the PAC and CCL properties, and on a more regular basis, by industrial non-contact cooling water discharge from the PAC facility. Average daily discharge from the PAC facility is approximately 200,000 gallons per day. Brook A follows an almost entirely artificial channel between the PAC and CCL facilities to the Providence & Worcester (P&W) railroad tracks where it is diverted south along the tracks to Martin Street. Brook A is predominantly 10 to 25 feet above the water table along its course to Martin Street. Here the flow enters a storm sewer and is piped to its discharge point at a headwall south of the Martin Street Bridge at the Blackstone River.

The Blackstone River valley occupies a bedrock trough filled with glacial kame terrace deposits and post-glacial alluvium. Kame terrace deposits are composed of homogeneous, well-sorted fine to coarse sand and gravel. The alluvial sediments are reworked glacial sand and gravel, and exhibit little to no variation in composition or structure from the kame terrace deposits. These unconsolidated deposits are relatively thin (10 to 20 feet) in the northwestern portion of OU 1 where the bedrock valley narrows. Deposits thicken to greater than 130 feet to the southeast as the trough widens. Deposits pinch out along the steep bedrock valley walls to the east and west. An esker deposit was mapped by the USGS in the vicinity of the PAC facility. This deposit may account for a higher percentage of gravel in this area. However, surface expression of the esker deposit is no longer visible due to land development and construction. Till is found in the base of the bedrock trough and is primarily dense with a high silt content and more sandy in some locations. The till also contains boulders up to five feet in diameter. The bedrock is composed primarily of a very hard quartzite and to a lesser extent, a softer schist. The quartzite varies from highly fractured to little fracturing and water bearing fractures are known to exist. The schist is generally more fractured and weathered with water bearing fractures also occurring.

Comparison of rock core logs indicates that there is a high variation of fracture density and orientation within the Site and that only localized preferential fracture patterns appear to be exhibited.

The majority of the ground water flow in the Blackstone River valley occurs in highly transmissive outwash sand and gravel deposits. This flow is minimally augmented by till and bedrock seepage, all of which eventually discharges to the river.

A. Soil

1. CCL Source Area

The CCL facility is situated on a kame terrace along the eastern valley wall of the Blackstone River, in close proximity to bedrock outcrops. Grain-size analysis indicative of the majority of soils encountered during the drilling program at CCL was 71% sand, 29% fines (silts and clay), and 0% gravel.

Events and activities at the CCL facility constitute a significant source of VOCs in OU 1. Soils in the vadose zone (i.e. above the permanent ground water level) of the CCL tank farm have retained a substantial quantity of VOCs associated with solvent releases. Monitoring wells installed in the tank farm confirm the presence of residual contamination in the tank farm soils. Soil gas samples were obtained from 49 stations at a depth five feet or less in 1988. Concentrations in soil vapor ranged up to 6,070 ug/l trans-1,2-DCE; up to 336 ug/l TCE; and non-detect to 898 ug/l PCE/acetone. The highest concentrations of soil gas (PCE/acetone) from the upper five feet of soil were in the tank farm area on the southwest perimeter of the plant. Significantly lower concentrations were found along the southeast, northeast, and northwest sides of the building.

In 1990, boring locations were chosen to intercept a reported railroad tank car spill area within the tank farm and to determine background soil conditions. Table B-1 of Appendix B summarizes the VOCs detected. Findings from the 1990 investigation indicated that residual contamination of the vadose zone was more widespread than previously believed.

In May and June of 1992, ten additional borings and four additional wells were installed in and immediately downgradient of the tank farm to better define the extent and distribution of CCL soil contamination. (The area immediately downgradient of the tank farm is also identified in the RI/FS and this document as the O'Toole property. See Figure 4.) The results of this investigation are presented in Tables B-2 and B-3 which summarize the distribution of total, selected VOCs within the vadose zone in and adjacent to the tank farm. Selected VOCs include PCE, TCA, TCE, 1,2-DCE (total) and 1,1-DCE. PCE is the predominant compound detected in the vadose zone.

In summary, soil samples (Photo-ionization Detector (PID) screening and laboratory analyses) from borings advanced into the unsaturated zone in the vicinity of the tank farm revealed significantly elevated levels of chlorinated solvents. The nature and extent of these chemicals in the soils suggests that they are largely derived from a common source. Their location underlying the railroad spur indicates that the reported tank car spill is a significant cause of CCL source area contamination. The vertical distribution of the contaminants in the tank farm shows that the highest concentrations are at a depth of about 20 feet. (See Figure 7.)

However, soil data indicates that other sources of VOCs have released contaminants to soils between the facility building and the tank farm. The sources of these VOCs are a manhole and catch basins associated with sanitary and storm sewers. The VOCs detected in this vicinity include PCE, ICA, and methylene chloride.

Semivolatile organic compounds (SVOCs), pesticides, and PCBs were detected in soils at the CCL source area. The majority of the SVOCs detected were polyaromatic hydrocarbons (PAHs) detected in surface soils. A total of eight pesticides were detected at low concentrations. A single PCB (aroclor -1254) was detected in a subsurface sample at a concentration of approximately 0.093 mg/kg.

Regarding inorganics in soil at the CCL source, analytes most notably detected were lead at 262 mg/kg and vanadium at a concentration of 236 mg/kg. Analytes such as aluminum, chromium, iron, lead and manganese were detected at each subsurface sampling location while vanadium was detected at a single location.

2. PAC Source Area

The PAC facility is located in close proximity to an esker deposit comprised of fine to course silty sands and gravel. Grain-size analysis of samples taken at the PAC facility indicate 32-98% sand, 2-14% fines, and 0-54% gravel. In the area of the PAC facility, bedrock outcrops to the east along Mendon Road.

Acetone, Isopropyl Alcohol (IPA), nickel, chromium and arsenic were historically detected in Lonza facility wastewater discharges. Specifically, high concentrations of arsenic were reportedly discharged to the subsurface via the leachfield(s). Prior to hookup to the municipal sewer system, facility wastewater was discharged to on-site leachfields which the RI identifies as potential sources of subsurface contamination.

In June of 1992, a comprehensive Site investigation of the PAC facility was completed. The program consisted of a soil gas survey, a soil boring and sampling program, and the installation of monitoring wells for the sampling of ground water at the facility. Soil borings were focused on leachfield #1 as a potential source identified with the soil gas survey. VOCs detected in PAC soils during the June 1992 soil gas and boring investigations were acetone ranging from 0.022 to 4.4 mg/kg, IPA at 30 mg/kg, MIBK ranging from 0.029 to 0.044 mg/kg, toluene ranging from 0.013 to 1.6 mg/kg, ethylbenzene ranging from 0.032 to 1.5 mg/kg, styrene at 0.075 to 0.079 mg/kg, xylene at0.026 to 5.5 mg/kg, and chlorobenzene being detected only once at a single location at 0.011 mg/kg.

Acetone and IPA were not detected in surface soils (0 to 1 ft. below ground surface). Acetone was detected in three borings located at leachfield #1, and detected in soil (16 to 18 ft. below ground surface) between the leachfield and well = AW-2, where the highest concentration of acetone was recorded in ground water. In addition to acetone and IPA, the list of compounds found in the three leachfield borings includes toluene, ethylbenzene, styrene, and xylene. These same six compounds were also detected in ground water from leachfield #1 at well AW-01R.

Acetone is the primary contaminant detected in PAC soils, with a peak concentration occurring below grade (>2 ft. below ground surface) in borings advanced through leachfield #1. Acetone is a miscible compound and will not likely remain in the permeable, unsaturated soils underlying the PAC facility. IPA is likely a parent compound responsible in part for the presence of acetone.

The limited distribution of acetone in soils suggests that leachfield #1 and the immediate subsurface area is the source of acetone detected in ground water. Acetone readily degrades in both aerobic and anaerobic environments. Its persistence in ground water at the PAC facility suggests residual acetone or IPA is present in leachfield piping or soils. Furthermore, the leachfield(s) may be a source of other previously detected VOCs.

Eleven SVOCs were detected within the PAC source area. The highest concentrations of SVOCs were detected in borings B-02 and B-301 at the ground surface, each containing eight compounds, with no single contaminant concentration exceeding 2.2 mg/kg.

Eleven pesticides were detected in soils on the PAC property in relatively low concentrations. Samples from borings B-04 and B-301 revealed at least seven pesticides, with no single contaminant concentration exceeding 0.08 mg/kg. No PCBs were detected.

Inorganics including arsenic, chromium, lead, and occasionally nickel were found throughout the PAC vadose zone and background surface soils. It is uncertain to what extent these inorganic detections in soil are indicative of PAC facility contamination or of mineral composition of native deposits.

B. Ground Water

1. CCL Source and Downgradient Areas

Ground water flows southwesterly from the CCL facility to the Blackstone River. In the direction of flow, the saturated deposits increase in thickness from less than 30 feet at the facility to approximately 100 feet south and west to the boundary of OU 1. The aquifer is highly transmissive, ranging from 75,000 to 300,000 gpd/ft. with an average hydraulic conductivity of 1,000 gpd/ft., or 134 ft/day. A recovery well located downgradient of the tank farm indicates a hydraulic conductivity of approximately 97 ft/day.

Chlorinated solvents have consistently been identified in ground water samples from wells immediately downgradient of the CCL property. Ground water data collected for the RI from directly below the CCL tank farm clearly indicate that the sources of VOC contamination lie within the tank farm area. Both PCE and TCA were detected in ground water in 1992 from overburden well MW201A at concentrations of 110,000 ug/l and 120,000 ug/l respectively. The concentration of PCE detected in ground water at this location is very close to the compound's solubility of 150 mg/l. Likewise, the concentration of TCA approaches 10 percent of the compound's solubility of 1,400 ug/l. While dense non-aqueous phase liquids (DNAPLs) were not identified at OU 1 during any investigation phase, DNAPLs may exist at the CCL source area, based on the solubility values for the contaminants as presented above. If pockets of DNAPLs are present at the CCL source area, they may continue to be a long-term source of contamination in the aquifer.

Upgradient of the tank farm, TCE was detected at 120 ug/l in ground water from a single well location (MP-7), and is considered to be residual contamination from a former leachfield located in that vicinity. Upgradient of both PAC and CCL facilities, background conditions have been established at well MW301 in that no VOCs were detected in ground water at this location.

Figure 8 presents a cross-sectional view of the 1992 select VOC data along a representative flowline from the CCL tank farm downgradient to the Blackstone River. RI data indicate that both the plume and ground water flowlines have a distinct southwest orientation. Flowlines at the valley wall initially move downward and then generally flow along the base of the aquifer. Under natural aquifer (non-pumping) conditions, the plume discharges to the Blackstone River in the vicinity of wells MP-10 and -11, across from the Quinnville wellfield. In a southerly direction from the CCL source area, concentrations of VOCs diminish in both shallow and deep portions of the aquifer. At well MW-106B, benzene was detected at concentrations of 9 and 5 ug/l in June and August of 1989, respectively. Nonetheless, well MW-106 may mark a boundary for the southeasterly distribution of the OU 1 plume since (with benzene in June and August, 1989 as the sole exception) no VOCs were detected within the well triplet in four separate sampling events.

Degradation compounds of PCE and TCA have been detected at near source, transitional, and downgradient wells. In immediate proximity to the tank farm, degradation compounds were detected in ground water, primarily 1,2DCE (total) and to a lesser extent TCE; but combined, the degradation products comprise a small percentage of the total VOCs detected. Ground water from transitional wells contains a higher percentage (50 percent or more) of degradation compounds, primarily 1,2-DCE followed by TCE. Downgradient of the transitional zone, PCE and TCA are not detected; the primary component of the plume is 1,2-DCE followed by TCE, 1,1-DCA and 1,1-DCE. Chloroethane is detected furthest from the source, deep in the aquifer, and is considered to be a near-complete degradation compound of PCA at greater distances from the source. During the June 1992 sampling round, vinyl chloride, another degradation compound, was only detected in two transitional wells (GZ-2-1 and MW-103) at 830 and 9 ug/l, respectively. Historically, vinyl chloride has been detected at the transitional zone and points farther downgradient.

Bedrock contamination was found at two well locations (MW-103, west of the CCL tank farm at the corner of Martin Street and the railroad tracks, and MW 105C, south of the CCL tank farm and across Martin Street). Each well displays characteristic contaminants from the CCL source containing total VOCs at MW-103 and MW-105 at approximately 96 ug/l and 633 ug/l, respectively.

Ground water monitoring wells, located south of Martin Street (near the Health-Tex facility) reported detectable levels of inorganics during the 1992 field investigation. Cadmium, chromium, and lead were detected in well 442 (installed by USGS) at concentrations above their respective MCLs reported as total (unfiltered) results. Copper and mercury were also detected, but at concentrations below MCLs. The results of well 442 are suspect, due to the construction of this well, which includes a steel casing. None of the five metals were detected during the corresponding analyses for dissolved (filtered) metals. These metals were not detected in upgradient wells located on the Health-Tex or Okonite properties or in well 102A, B & C located on the north side of Martin Street.

Copper and cadmium were detected in well MP-10B at concentrations of 2,550 and 7.6 ug/l, respectively. The corresponding MCLs for these metals are 1,300 and 5 ug/l. The detected copper is anomalously high since copper was not detected in any other downgradient well at concentrations above 208 ug/l during 1992 sampling. The detected cadmium concentration is less than two times the cadmium MCL. No metals were detected in the corresponding dissolved metals analysis for this well.

Cadmium was detected in well MP-11C at 6.1 ug/l (total), which is slightly above the MCL of 5 ug/l. Arsenic was detected in well MP-11B at 71 ug/l (total) which exceeds the corresponding 50 ug/l MCL. During both the June and August 1989 sampling events, dissolved (filtered) arsenic was reported for the same well at 72 ug/l. The occurrence of total and dissolved arsenic detected at well MP-11B appears to be an isolated case. MP-11C showed a marked decrease in total arsenic (below the MCL) deeper in the aquifer at the same location while other wells upgradient of MP-11 location detect no arsenic in either filtered or unfiltered samples. While the cause of elevated arsenic levels at well MP-11B is unclear, this result is believed to be limited in extent.

It is believed that the aquifer downgradient of the CCL facility is primarily an oxidized environment, and therefore does not produce detectable quantities of dissolved metals. The difference between the total and the dissolved metals noted above, with the exception of dissolved arsenic at well MP11B, is most likely related to entrainment of suspended solids during sampling. It is not likely that water pumped from an extraction well or public supply well would entrain suspended solids to the extent experienced during monitoring well sampling.

2. PAC Source and Downgradient Areas

Three types of VOCs have been detected in ground water at the PAC remediation area: ketones, chlorinated solvents, and aromatic compounds.

Of the Ketones detected in the ground water at the PAC source, acetone is most prevalent. In 1987, acetone was detected at very high concentrations approx. 1,700,000 ug/l in June 1987). Low concentrations of other ketones such as methyl ethyl ketone (MEK), 2-hexanone, and MIBK were reported in ground water from well AW-2 in 1989.

In 1992, additional monitoring wells were installed to further delineate the acetone plume previously identified in wells AW-1 and AW-2. Acetone was detected in AW-1 at 51,000 ug/l and also downgradient from this well at MW 304 (49 ug/l). However, acetone was not detected in wells downgradient of AW-2 and the concentration of acetone in AW-2 dropped significantly since its initial detection (1,700,000 ug/l in 1987 to 150 ug/l in June 1992).

IPA is a likely parent compound responsible, in part, for acetone. IPA was detected on the PAC property at wells AW-1 (78 to 96 mg/l) and MW 304 (33 J ug/l).

Acetone will degrade aerobically to carbon dioxide and water. It will also degrade anaerobically to carbon dioxide and water and possibly methane. Either or both mechanisms is likely occurring in the former leachfield soils and in aquifer material below the water table. These reactions explain the marked decrease of acetone detected in ground water from well AW-2.

The former leachfield #1 at the PAC facility acts as a continuing source of IPA and acetone. Given that acetone is miscible in water, the concentrations detected in ground water in proximity to this leachfield are relatively small, and not necessarily indicative of a significant mass of contaminant. However, since the concentration of acetone remained relatively constant at this location from 1987 to 1992, it appears that acetone continues to be released from the former leachfield by some mechanism.

The chlorinated solvents PCE and TCA were detected in concentrations of 17 to 73 ug/l, and 10 ug/l, respectively in five of nine wells located on the PAC facility in June 1992.

Aromatic compounds such as toluene, ethylbenzene, styrene, and xylene were identified in the soil gas survey and were detected in ground water below the PAC facility. Benzene was not detected in any media on the PAC property. Ethylbenzene was detected in five wells on the PAC property and downgradient at well 308 at concentrations ranging from 23 to 830 ug/l. Xylene and toluene were detected less frequently at lower concentrations, and styrene was detected once at 13 ug/l in ground water at AW-2.

Additional sampling data concerning the PAC remediation area, was submitted to EPA by Lonza in June, 1993. In this report, the detection of chlorinated solvents was limited to MW 302B with 1,2-DCE, trichloroethene, estimated at 1, and 4 ug/l, respectively and carbon disulfide at approximately 2 ug/l. Well MW-307 was found to have significant concentrations of VOCs where in 1992 there were none detected.

The Lonza report also states that acetone concentrations remain relatively consistent with that of the RI findings with two exceptions: acetone was not detected above the detection limit at well AW-2 and was detected in two PAC downgradient wells (MW 305B and 305C) at a concentration of 9 (estimated) and 57 ug/l, respectively. Aromatic compounds such as toluene, ethylbenzene, and xylene were also detected in four of nine PAC facility wells. Ethylbenzene was the most prominent compound detected with the highest concentration found at well AW-1R (1200 ug/l).

Based upon the sampling conducted in June, 1992 for the RI, it is unlikely that the VOCs detected in PAC source area ground water are presently migrating in significant concentrations to downgradient areas. Compared with the PAC source area, PAC downgradient wells MW 305 and 306 show a marked increase in chlorinated solvents, such as TCA ranging from 15 to 23 ug/l, TCE ranging from 18 to 150 ug/l and 1,2-DCE ranging from 16 to 130 ug/l. Aromatic hydrocarbons such as benzene, ethylbenzene, and xylene are also present. Chlorinated solvents were not detected in PAC soils or soil vapor during the RI investigations. However, TCA was detected in PAC ground water during the August 1988 sampling event. Historic wastewater and ground water sampling at PAC does indicate the release of these compounds including PCE, which degrades to TCE and 1,2-DCE. With the exception of benzene, aromatic hydrocarbons have consistently been detected at the PAC source area. Furthermore, acetone, a PAC source contaminant detected at the PAC leachfield, was recently detected in the PAC downgradient area at the MW 305 well location in June 1993. Taken as a whole, this data indicates that historic waste disposal practices at the PAC source area have contributed to the contamination presently detected in the PAC downgradient area, although the PAC source area is now diminished as a source of VOCs for the PAC downgradient area.

Based on June, 1992 RI data for the PAC remediation area, arsenic, nickel, and lead concentrations (total/unfiltered) in ground water exceeded Rhode Island and/or federal Maximum Contaminant Levels (MCLs) is monitoring wells at the PAC source and downgradient areas. Total chromium also exceeded the Rhode Island MCL in ground water immediately downgradient of the PAC facility, on CCL property. Total chromium was detected elsewhere on the PAC property, below state and federal standards. Arsenic, chromium and nickel were reported as being detected historically in facility wastewaters disposed onsite.

As previously stated, the difference between the total and the dissolved metals analyses, with the exception of arsenic, is most likely related to entrainment of suspended solids during sampling. Therefore, the total metal concentrations for nickel, lead and chromium may not accurately indicate an exceedance of MCLs at these groundwater locations since water pumped from an extraction well or public supply well is not expected to entrain suspended solids to the extent experienced during monitoring well sampling.

However, total arsenic was detected in ground water within the PAC source area at concentrations that approach tenfold background levels detected at MW 301. Historically, total arsenic has been detected in PAC wells, with peak concentrations ranging from 290 ug/l (AW-2; August 1989) to 921 ug/l (AW-l; August 1988). Concentrations of both total and dissolved arsenic are similar to and above the MCL of 50 ug/l historically for AW-2. In 1992, MW303 and MP-2 reported total and dissolved concentrations of arsenic at 83 and 73 ug/l, and 136 and 110 ug/l, respectively.

The distribution of arsenic, particularly dissolved arsenic, is consistent with reported historic handling of wastewater containing arsenic. The concentrations of arsenic in wastewater were on occasion much greater than that recently been detected in ground water (10,000 ug/l; Lonza wastewater analysis, 1981). Records indicate that from 1981 to 1985 wastewaters were discharged to the leachfields.

Although arsenic was discharged to the leachfields at PAC, the presence of dissolved arsenic detected in wells downgradient of the former leachfields may also be due to the presence of organic material (acetone, IPA, fatty acids and other available organic carbon) derived from the leachfields. Under strongly reducing conditions, arsenic will desorb from mineral soils into solution. The biodegradation of organic materials creates a reducing environment which tends to liberate and mobilize arsenic from native soils as well as from the arsenic enriched deposits derived from the leachfields. In the presence of chelating agents, such as organic molecules, arsenic forms soluble organic complexes even in a mildly reducing environment where iron is abundant.

Total arsenic exceeds the MCL at nine locations sampled. At six of nine locations, dissolved arsenic also exceeds the MCL. In general, the highest concentration of arsenic was found in the vicinity of the leachfields. The difference between total and dissolved arsenic is significant at wells MW-301 and MW-101C positioned upgradient of the former leachfields. Total arsenic concentrations at these two locations were 115 ug/l (estimated) and 580 ug/l (estimated), respectively, whereas dissolved arsenic was not detected. The total arsenic may likely be a reflection of concentrations indicative of native soils. The absence of dissolved arsenic reflects the absence of reducing conditions and chelating agents in the background environment upgradient of the PAC facility.

C. Surface Water and Sediments

Two VOCs, chloroform and acetone, were detected in Brock A surface water samples in OU 1. Chloroform was detected most frequently at concentrations ranging from 12 to 37 ug/l from three locations along Brook A in the October 1987 sampling event and from a single location in the June 1992 sampling event. Acetone was detected at three locations during the October, 1987 sampling round with a peak concentration of 4020 ug/l at location SW-06. SW -06 is the only surface water station located on the Blackstone River within OU-1 to detect a VOC (i.e. trichlorofluoromethane at 2.9 ug/l).

No semivolatile organic compounds, pesticides or PCBs were detected in surface water.

Copper was detected in surface water in 1987 at a concentration of 0.2 mg/l in Brook A at station SW-007 (SW-04). Zinc was detected in 1988 at 38, 45, and 43 ug/l at stations SW- 006, -005, -007 (SW-03, 3A, and 04), respectively. Six inorganic analytes were reported in the June 1992 surface water samples. Zinc was reported at concentrations ranging from 142 to 290 ug/l with the highest concentration at SW-007. All other inorganics were found at concentration ranges typically found in the natural environment.

Sediment samples collected along Brook A were analyzed for VOCs, SVOCs, pesticides/PCBs and inorganics. SVOCs and inorganics were the most prevalent analytes detected. The only VOC detected in sediment along Brook A was 1,1,2,2-tetrachloroethane at trace levels from SD-006 (SW-03) during the August 1988 sampling round. SVOCs and pesticides/PCBs were detected more frequently in the sediment samples as compared with the number of these compounds detected in corresponding surface water samples. SD-001, -003, and -006 each had at least six SVOCs during the June 1992 sampling round while SD-002, -003, and -006 were the stations detecting pesticides and PCBs. No pesticides were detected in the October 1987 and August 1988 sampling rounds. Still, the identification of these compounds along the Brook were sporadic and did not indicate and presence of a significant source.

A complete discussion of OU 1 characteristics can be found in the Revised Final Remedial Investigation Report, June, 1993, in Sections 3, 4, 5 and 6 of Volume 1. A complete discussion of Site characteristics is contained in the Draft Remedial Investigation Report, February, 1990.

VI. SUMMARY OF SITE RISKS

A Risk Assessment (RA) and Ecological Assessment (EA) were performed under a Federal-lead contract to estimate the probability and magnitude of potential adverse human health and environmental effects from exposure to contaminants associated with OU 1. The results of the human health risk assessment for OU 1 are discussed below followed by the conclusions of the ecological assessment.

A. Baseline Risk Assessment

The risk assessment followed a four step process: 1) contaminant identification, which identified those hazardous substances which, given the specifics of OU 1 were of significant concern; 2) exposure assessment, which identified actual or potential exposure pathways, characterized the potentially exposed populations, and determined the extent of possible exposure; 3) toxicity assessment, which considered the types and magnitude of adverse health effects associated with exposure to hazardous substances, and 4) risk characterization, which integrated the three earlier steps to summarize the potential and actual risks posed by hazardous substances at OU 1, including carcinogenic and non-carcinogenic risks.

Forty-four contaminants of concern, listed in Table B-4 were selected for evaluation in the RA. These contaminants constitute a representative subset of the more than 75 contaminants identified at OU 1 during the Remedial Investigation. The 44 contaminants of concern were selected to represent potential OU 1 related hazards based on toxicity, concentration, frequency of detection, and mobility and persistence in the environment. (See Tables B-5 through B-10). A summary of the health effects of each of the contaminants of concern can be found in the risk assessment at Appendix A.

Potential human health effects associated with exposure to the contaminants of concern were estimated quantitatively through the development of the following hypothetical exposure pathways:

- Future potential use of ground water as drinking water,
- Ingestion of and dermal contact with the Blackstone River during recreational use,
- Ingestion of and dermal contact with sediments in Brook A by trespassers,
- Ingestion of and dermal contact with soils by workers during construction and by future residents.

For each pathway evaluated, an average and a reasonable maximum exposure estimate was generated corresponding to exposure to the average and the maximum concentration detected and estimated exposure in that particular medium.

1. Ground Water

Ground water is currently not being used as a drinking water source. Therefore, only a future residential use scenario was evaluated. Ingestion of 2 liters per day over 30 years lifetime was assumed for both average and maximum exposure estimates. Separate risk evaluations were performed for the following four areas of the contaminated ground water:

- CCL source area,
- PAC source area,
- CCL downgradient area,
- PAC downgradient area.

These four areas are depicted in Figure 6.

2. Surface Water - Blackstone River

Ingestion and dermal contact with surface water while swimming or wading in the Blackstone River were evaluated as potential current and future exposure scenarios. The current and future use exposure scenarios were considered to be equivalent. Exposure frequency was estimated at 5 times per year for an adult residing in the area for 30 years and 10 times per year for a child (aged 6 to 17 years) over 12 years.

3. Sediments - Brook A

Ingestion and dermal contact with sediment while wading in Brook A were evaluated as potential current and future use exposure scenarios. Exposure was based on the assumption that children aged 6 to 17 would wade 10 times per year over 12 years.

4. Soils

Ingestion and dermal contact with soil were evaluated under two potential future exposure scenarios. One scenario was based on the assumption that residences would be built within each source area. Exposure to children aged 0 to 6 years and adults residing on the site for 30 years was evaluated. The other scenario evaluated exposure to subsurface soils by construction workers over one year. These scenarios were evaluated separately for the following two areas:

- CCL source area (including tank farm and O'Toole property),
- PAC source area,

Excess lifetime cancer risks were determined for each exposure pathway by multiplying the exposure level with the chemical specific cancer factor. Cancer potency factors have been developed by EPA from epidemiological or animal studies to reflect a conservative "upper bound" of the risk posed by potentially carcinogenic compounds. That is, the true risk is unlikely to be greater than the risk predicted. The resulting risk estimates are expressed in scientific notation as a probability (e.g. 1 x 10[-6] for 1/1,000,000) and indicate (using this example), that an average individual is not likely to have greater than a one in a million chance of developing cancer over 70 years as a result of site-related exposure as defined to the compound at the stated concentration. Current EPA practice considers carcinogenic risks to be additive when assessing exposure to a mixture of hazardous substances.

The hazard index was also calculated for each pathway as EPA's measure of the potential for non-carcinogenic health effects. A hazard quotient is calculated by dividing the exposure level by the reference dose (RfD) or other suitable benchmark for non-carcinogenic health effects for an individual compound. Reference doses have been developed by EPA to protect sensitive individuals over the course of a lifetime and they reflect a daily exposure level that is likely to be without an appreciable risk of an adverse health effect. RfDs are derived from epidemiological or animal studies and incorporate uncertainty factors to help ensure that adverse health effects will not occur. The hazard quotient is often expressed as a single value (e.g. 0.3) indicating the ratio of the stated exposure as defined to the reference dose value (in this example, the exposure as characterized is approximately one third of an acceptable exposure level for the given compound). The hazard quotient is only considered additive for compounds that have the same or similar toxic endpoint and the sum is referred to as the hazard index (HI). (For example: the hazard quotient for a compound known to produce liver damage should not be added to a second whose toxic endpoint is kidney damage).

B. Summary of Baseline Risk Assessment

Tables B-11 through B-27 depict the carcinogenic and noncarcinogenic risk summary for the contaminants of concern in each exposure pathway described above.

1. Ground Water

CCL source area

The average and reasonable maximum exposure case carcinogenic risks associated with the potential future ingestion of ground water were approximately 2 x 10[-2] and 2 x 10[-1], respectively. 1,1, Dichloroethene, tetrachloroethene and vinyl chloride comprise the majority of the risk for both the average and reasonable worst case scenarios. Other chemicals which contributed a risk of greater than one in one million (1 x 10[-6]) were benzene; 1,1 dichloroethane; methylene chloride; 1,2 dichloroethane; methylene chloride; 1,1,2 trichloroethane, trichloroethene, bis (2-ethylhexyl)phthalate, chlordane and arsenic.

For noncarcinogenic effects, the average and reasonable maximum exposure case Hazard Indices exceeded one for the toxic endpoints of liver, skin and kidney. 1,2 Dichloroethene, methylene chloride, tetrachlorethene, 1,1,1 trichloroethane and chlordane were major contaminants for the liver. Acetone and cadmium were the major contaminants for the kidney. Arsenic was the major contaminant for the skin.

PAC source area

The average and reasonable maximum exposure case carcinogenic risks associated with the potential future ingestion of groundwater were approximately 6 x 10[-3] and 1 x 10[-2], respectively. Arsenic was the major contributor to the risks. One other contaminant, tetrachloroethene, contributed a risk greater than one in one million.

For noncarcinogenic effects, the average and reasonable maximum exposure case Hazard Indices exceeded one for the toxic endpoints of liver and skin. Acetone and arsenic were the major contributors to the liver and skin Hazard Indices, respectively.

CCL downgradient area

The average and reasonable maximum exposure case carcinogenic risks were approximately 4 x 10[-4] and 2 x 10[-3], respectively. Tetrachloroethene, vinyl chloride and arsenic contributed to the majority of the risks. Benzene, 1,2 dichloroethane, trichloroethene and bis(2-ethylhexyl) phthalate each contributed a risk greater than one in one million.

For noncarcinogenic effects, the average Hazard Index exceeded one for the toxic endpoint of skin based on the presence of arsenic. The maximum Hazard Indices were exceeded for the toxic endpoints of liver, skin and gastrointestinal tract. 1,1 Dichloroethene and tetrachloroethene were the major contributors to the liver Hazard Index, and arsenic and copper to the skin and gastrointestinal endpoints, respectively.

PAC downgradient area

The average and reasonable maximum exposure case carcinogenic risk were approximately 1 x 10[-4] and 4 x 10[-4], respectively. Arsenic contributed to the majority of the risk. Benzene and trichloroethene each contributed a risk greater than one in one million.

For noncarcinogenic effects, the average Hazard Index did not exceed one. For the reasonable maximum exposure case, the Hazard Index exceeded one for the toxic endpoint of skin based on the presence of arsenic.

2. Surface Water - Blackstone River

The reasonable maximum exposure case carcinogenic risks associated with the potential current and future recreational use were approximately 1 x 10[-7] and 1 x 10[-6], respectively.

For noncarcinogenic effects, the Hazard Index was well below one.

3. Sediment - Brook A

The average and reasonable maximum exposure case carcinogenic risks associated with exposure to Brook A were approximately 1 x 10[-6] and 3 x 10[6], respectively.

For noncarcinogenic effects, the Hazard Index was well below one.

4. Soil

CCL source area - tank farm

The average and reasonable maximum exposure case carcinogenic risks associated with exposure to the soils for future residents was approximately 3 x 10[-3] and 3 x 10[-2], respectively. Tetrachloroethene in subsurface soils was the major contributor to the risk.

For noncarcinogenic effects the Hazard Indices for the average and reasonable maximum exposure scenario for future residents were 35 and 382, respectively. Tetrachloroethene was the major contributor to the Hazard Index.

The average and maximum carcinogenic risks associated with the adult worker were approximately 3 x 10[-5] and 3 x 10[-4] respectively. The average and maximum Hazard Indices were 4.7 and .43, respectively.

CCL source area - O'Toole Property

The average and reasonable maximum exposure case carcinogenic risks associated with exposure to the soils for future residents were 8 x 10[-5], and 6 x 10[-5], respectively. The risks to workers was approximately 3 x 10[-7] for both the average and maximum cases.

For noncarcinogenic effects, the Hazard Indices for the average and reasonable maximum exposure were well below one for all potentially exposed populations.

PAC facility

The average and reasonable maximum exposure case carcinogenic risks associated with exposure to soils for future residents were approximately 1 x 10[-4] and 4 x 10[-5], respectively.

For noncarcinogenic effects, the Hazard Indices for the average and reasonable maximum exposure for future residents were well below one for all potentially exposed populations.

In summary, predicted carcinogenic health risks assuming the future use of ground water, fell outside EPA's risk range at three of the four areas evaluated: CCL Source, PAC Source and CCL Downgradient. Unacceptable Hazard Indices were also estimated at these three areas.

The maximum predicted carcinogenic risk and Hazard Index for the Blackstone River are within EPA's acceptable range.

The maximum predicted carcinogenic risk and Hazard Index for Brook A are within EPA's acceptable range.

The predicted carcinogenic risks and Hazard Index for contact with soils fell outside EPA's risk range at the CCL Facility. The maximum predicted carcinogenic risk and Hazard Index for the other two soils areas evaluated (PAC Facility and O'Toole Property) are within EPA's acceptable range.

Actual or threatened releases of hazardous substances from OU 1, 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. Specifically, the potential future use of contaminated ground water throughout OU 1, including the Quinnville wellfield, and exposure to soils at the CCL source area pose threats to public health.

C. Ecological Assessment

Measured concentrations of compounds in ground water, surface water and sediments were compared to benchmark criteria (i.e. protective guidelines). Due to the limited number of surface water samples collected from the Blackstone River within the OU, this comparison for the river was evaluated using contaminant concentrations in ground water wells adjacent to the river. Ground water concentrations for several volatile organic compounds (VOCs) and inorganics exceeded the respective benchmark criteria. However, dilution by the river water is likely to decrease actual surface water concentrations to levels below benchmark criteria. The results of the Ecological Assessment (EA) are listed in Tables B-28 through B-31.

The primary objective of the EA was to characterize, qualify and quantify the current and potential environmental risks associated with exposure to OU 1 derived contamination of soil, sediment and surface water, if no remedial action is taken within OU 1.

The EA is comprised of five major components: 1) Hazard Identification (Problem Formulation), 2) Exposure Assessment, 3) Toxicity Assessment, 4) Risk Characterization, and 5) Uncertainties and Limitations. EPA selected 39 contaminants, detected throughout OU 1, which either occurred in ground water discharging to the Blackstone River, Brook A surface water and sediments or surficial soils. These contaminants were of concern in addressing environmental risk at OU 1. Indicator species were selected based upon previous reports, literature searches, and field observations. A qualitative evaluation of risks to indicator species was completed based on the integration of OU 1 sampling data, habitat, feeding and behavioral characteristics of indicator species, potential relationships between these species, the exposure assessment, and toxicity information.

Concentrations of a number of contaminants of concern detected in Brook A sediments exceeded the benchmark criteria. However, Brook A does not provide likely or valuable habitat for ecological receptors based on its location and ephemeral nature.

A qualitative risk description for upland soils was completed. While potential upland habitat is located within OU 1, it is comprised of a few small separated parcels located in an industrial setting, thus reducing the habitat potential and value. In addition, the locations of these small parcels do not overlap known or suspected soil contaminated areas. Home ranges for receptors inhabiting these parcels may minimally overlap for small mammals or would be used infrequently by larger species.

In conclusion, based on this assessment, it is not likely that the contaminants found within OU 1 will cause significant impacts to terrestrial or aquatic populations.

VII. DEVELOPMENT AND SCREENING OF ALTERNATIVES

A. Statutory Requirements/Response Objectives

Under its legal authorities, EPA's primary responsibility at Superfund sites is to undertake remedial actions that are protective of human health and the environment. In addition, Section 121 of CERCLA establishes several other statutory requirements and preferences, including: a requirement that EPA's remedial action, when complete, must comply with all federal and more stringent state environmental standards, requirements, criteria or limitations, unless a waiver is invoked; a requirement that EPA select a remedial action that is cost-effective and that utilizes permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable; and a preference for remedies in which treatment which permanently and significantly reduces the volume, toxicity or mobility of the hazardous substances is a principal element over remedies not involving such treatment. Response alternatives were developed to be consistent with these Congressional mandates.

Based on preliminary information relating to types of contaminants, environmental media of concern, and potential exposure pathways, remedial action objectives were developed to aid in the development and screening of alternatives. These remedial action objectives were developed to mitigate existing and future potential threats to public health and the environment. These response objectives were:

1. Minimize/mitigate the mass of contaminants at the source,
2. Prevent further migration of contaminants from the sources to potential receptors and downgradient areas, including the Blackstone River,
3. Prevent ingestion/contact of ground water contaminated with carcinogens at levels in excess of Maximum Contaminant Levels (MCLs) and a total excess cancer risk of greater than 1 x 10[-4] to 1 x 10[-6],
4. Prevent ingestion of/contact with ground water contaminated with noncarcinogens at levels greater than MCLs, health-based Applicable or Relevant and Appropriate Requirements (ARARs) and a total hazard index greater than 1,
5. Restore the contaminated ground water in the aquifer, from the source to the outer boundary of the contaminant plumes, to a level protective of human health and the environment as soon as practicable,
6. Prevent the leaching of contaminants from the soil that would result in ground water contamination in excess of health and risk-based ARARs, and
7. Ensure a coordinated remediation between all points of source contamination, such that restoration of OU 1 is achieved as soon as practicable.

In response to the remedial action objectives, general response actions were identified. These actions for ground water and soil at OU 1 included the following: No Action, Limited Action, Containment, In-situ Treatment, Collection/Removal, Treatment, and Discharge/Disposal.

Although the river is a receptor of OU 1 contamination, remediation of the Blackstone River itself is not a remedial action objective under this Superfund action. Historically, the river has been subjected to contamination from various non-site related sources, as evidenced by its current Class C designation. Such contamination is beyond the scope of any OU 1 remedial action. However, low levels of OU 1 contaminants currently discharge into the river. The evaluation of alternatives in the FS considered technologies for OU 1 which will mitigate, to the extent practicable, this discharge by extracting CCL downgradient ground water contaminated with VOCs, thereby reducing the discharge of OU 1 contaminants to the river.

Similarly, the Quinnville wellfield is a receptor of OU 1 related contamination. However, no active restoration/remedial action is contemplated at the Quinnville wellfield. Prior to closure in 1979, pumping of the wellfield drew OU 1 contaminants under the Blackstone River. Since its closure, residual contamination at the wellfield has been naturally attenuating to health-based standards, based on the 1988 ground water quality data. Active restoration at the wellfield may draw contaminants from the nearby J. M. Mills Landfill (designated as OU 2). Therefore, the evaluation of alternatives for OU 1 included a monitoring program to ensure that the observed natural attenuation continues, and institutional controls to ensure that there is no use or hydrologic alteration of ground water at the wellfield until risks at the nearby J.M. Mills Landfill are identified and addressed.

B. Technology and Alternative Development and Screening

CERCLA and the NCP set forth the process by which remedial actions are evaluated and selected. In accordance with these requirements, a range of alternatives were developed for OU 1.

With respect to source control response actions, the RI/FS developed a range of alternatives in which treatment that reduces the toxicity, mobility, or volume of the hazardous substances is a principal element. These alternatives included options that remove or destroy hazardous substances to the maximum extent feasible, thereby eliminating or minimizing, to the degree possible, the need for long term management. These alternatives also included options that, while treating the principal threats posed by OU 1, vary in the degree of treatment employed and the quantities and characteristics of the treatment residuals and untreated waste that must be managed. These alternatives also included those that involve little or no treatment but provided protection through engineering and institutional controls, and a no action alternative.

With respect to groundwater response actions, the RI/FS developed a limited number of remedial alternatives that attain OU 1 specific remediation levels within different timeframes using different technologies, and a no action alternative.

As discussed in sections 3, 4 and 5 of the FS, the FS identified, assessed and screened technologies based on implementability, effectiveness and cost. Approximately 60 technologies were determined to be potentially applicable to the remedial response objectives. This assessment retained certain technologies and led to the development of a number of process options which were further evaluated in the FS.

In order to assemble alternatives, section 6.1 of the FS assembled remedial technologies and process options into remedial alternative elements for both the CCL and PAC remediation areas. Seven remedial alternative elements were developed for each of the remediation areas. These remedial alternative elements were screened based on implementability, effectiveness and cost, as described in Section 300.430(e)(4) of the NCP. The remedial alternative elements for each remediation area that were retained from the screening process were then combined to form remedial alternatives for the entire operable unit, addressing source control and management of migration considerations.

From this screening and combination process, six alternatives were retained for detailed analysis. Table B-32 identifies these alternatives, which are also discussed in section VIII., below.

VIII. DESCRIPTION OF ALTERNATIVES

This Section provides a narrative summary of each alternative evaluated. A detailed tabular assessment of each alternative can be found in Table 8-1 of the Feasibility Study.

A. Alternative 1: No-Action

- Environmental monitoring.

This alternative was evaluated in detail in the FS as required by CERCLA, to serve as a baseline for comparison with the other remedial alternatives under consideration. Under this alternative, there would be no remedial action of any of the contaminated media found at OU 1; however, the no-action alternative would include long-term monitoring of existing ground water monitoring wells located within the CCL and PAC remediation areas and the Quinnville wellfield.

The objectives of the environmental monitoring program are to evaluate whether the natural attenuation processes of biodegradation, oxidation, and dilution within the aquifer are reducing contaminant concentrations and to monitor the migration of contamination from the source areas.

This alternative would rely solely on natural attenuation to reduce contaminant concentrations at OU 1. While natural attenuation is occurring to some extent at OU 1, it is not known if these natural processes will reduce the concentrations of OU 1 contaminants to levels that are protective of human health and the environment throughout OU 1. The alternative could be implemented easily at a relatively low cost, but would maximize the amount of time needed to achieve remedial action objectives for ground water because contaminant leaching from soil would act as a continuing source of contamination.

Estimated Time for Design and Construction: 0 years
Estimated Time for Restoration: 30+ years for entire OU 1
Estimated Capital Costs: $0
Estimated Operation and Maintenance:$980,000 (net present Worth)
Estimated Total Costs: $980,000 (net present worth, assuming 7% discount rate)

B. Alternative 2: Limited Action

- Environmental monitoring,
- Institutional controls, and
- Focused investigation.

This alternative would include the long-term environmental monitoring of ground water as described in Alternative 1, and would establish institutional controls to prevent its future use, as well as prevent direct contact or exposure to contaminated soils, and provide a focused investigation to further characterize the extent and source of VOC contaminants detected in the PAC downgradient area.

Institutional controls would be required to prevent the use or hydrologic alteration of ground water throughout OU 1, including the Quinnville wellfield, and prevent direct contact to or exposure to contaminated soils in areas where such soils exceed EPA's risk range.

The focused field investigation of the PAC downgradient area would include installation of new monitoring well clusters, sampling and analysis of ground water, and investigation of potential contaminant sources impacting the PAC downgradient area. Based on the findings of the investigation, further response actions may be required.

Estimated Time for Design and Construction:	1 years
Estimated Time for Restoration:	30+ years for entire OU 1

Estimated Capital Costs: $119,000
Estimated Operation and Maintenance Costs: $1,154,000 (net present worth)
Estimated Total Costs: $1,273,000 (net present worth, assuming 7% discount rate)

C. Alternative 3: Source Control

CCL remediation area:

- Excavation (manholes and catch basins),
- Capping,
- Soil venting of source soils and treatment,
- Source area ground water extraction,
- Ground water treatment and discharge,
- Institutional controls throughout the CCL remediation area, and
- Environmental monitoring.

PAC remediation area:

- Excavation and disposal of leachfields soils,
- Institutional controls throughout the PAC remediation area, and
- Focused investigation.

This alternative involves source control actions to limit the migration of contaminants. Source control at the CCL remediation area would include excavating contaminated soils in two catch basins and one manhole, capping source soils, venting vadose zone soils, and extracting and treating source area ground water via an air stripping process with discharge of the treated ground water to the Narragansett Bay Commission (NBC) Privately-Owned Treatment Works (POTW) via the local sewer interceptor located on-site.

Source control at the PAC remediation area would consist of excavating the two leachfields and conducting a focused investigation of the PAC downgradient area.

Like Alternative 2, this alternative would include the long-term environmental monitoring of ground water and institutional controls to prevent the future use of ground water, as well as prevent direct contact or exposure to contaminated soils, and provide a focused investigation of VOC contaminants detected in the PAC downgradient area. Remediation of ground water downgradient of the CCL and PAC source areas would rely on natural attenuation of the contaminants.

Estimated Time for Design and Construction: 2 years
Estimated Time for Restoration: 4 years at PAC source,
6 years at PAC downgradient, 12 years at CCL source, 12 years at CCL downgradient
Estimated Capital Costs: $1,614,000
Estimated Operation and Maintenance Costs: $4,638,000 (net present worth)
Estimated Total Costs:$6,252,000 (net present worth, assuming 7% discount rate)

D. Alternative 4: Enhanced Source Control

CCL remediation area:

- Excavation (manholes and catch basins),
- Capping,
- Soil venting of source soils and treatment,
- Source area ground water extraction,
- Ground water treatment and discharge,
- Institutional controls throughout the CCL remediation area, and
- Environmental monitoring.

PAC remediation area:

- Soil excavation, disposal and leachfield reconstruction,
- In-situ oxidation treatment of ground water,
- Environmental monitoring,
- Institutional controls throughout the PAC remediation area, and
- Focused investigation.

The enhanced source control alternative would include all the remedial actions described in Alternative 3 for the CCL remediation area; however, at the PAC remediation area, this alternative would combine the source control remedial actions described in Alternative 3 with in-situ treatment of ground water. In-situ oxidation would be used to reduce the mobility of arsenic in ground water migrating from the PAC leachfields. Institutional controls, environmental monitoring, and a focused investigation would be conducted as described in Alternative 3.

Estimated Time for Design and Construction: 3 years
Estimated Time for Restoration:
1 year at PAC source, 6 years at PAC downgradient
12 years at CCL source, 12 years at CCL downgradient
Estimated Capital Costs: $1,676,000
Estimated Operation and Maintenance Costs: $4,859,000 (net present worth)
Estimated Total Cost: $6,535,000 (net present worth, assuming 7% discount rate)

E. Alternative 5: Enhanced Source Control and CCL Area Management of Migration

CCL remediation area:

- Excavation (manholes and catch basins),
- Capping,
- Soil venting of source area soils,
- Source area ground water extraction, treatment and discharge to POTW,

- Downgradient area ground water extraction with direct POTW discharge,
- Natural attenuation of the Quinnville wellfield,
- Institutional controls throughout the CCL remediation area, and
- Environmental monitoring.

PAC remediation area:

- Excavation, disposal and reconstruction of the leachfields,
- In-situ oxidation treatment of the PAC source,
- Natural attenuation of the PAC downgradient ground water,
- Institutional controls throughout the PAC remediation area,
- Focused investigation of the PAC downgradient area, and
- Environmental monitoring.

Alternative 5 includes the remedial elements described in Alternative 4 for the PAC and CCL remediation areas. Alternative 5 also includes extraction and treatment of the CCL downgradient ground water. Recovery of the ground water plume that has migrated from the CCL source area toward the Blackstone River would be accomplished by a multi-well recovery system south of Martin Street. Because ground water monitoring of downgradient wells has indicated that downgradient concentrations of total VOCs are below levels required for discharge to the POTW, this recovered ground water would be directly discharged without pretreatment to the POTW via the sewer.

Estimated Time for Design and Construction: 3 years
Estimated Time for Restoration:
    1 year at PAC source, 6 years at PAC downgradient
    12 years at CCL source, 6 years at CCL downgradient
Estimated Capital Costs: $1,901,000
Estimated Operation and Maintenance Costs: $5,350,000 (net present worth)
Estimated Total Cost: $7,251,000 (net present worth, assuming 7% discount rate)

F. Alternative 6: Enhanced Source Control and CCL/PAC Area Management of Migration

CCL remediation area:

- Excavation (manholes and catch basins),
- Capping,
- Soil venting of source area soils,
- Source area ground water extraction and treatment
- Downgradient area ground water extraction with direct POTW discharge,
- Natural attenuation of the Quinnville wellfield,
- Institutional controls throughout the CCL remediation area, and
- Environmental monitoring.

PAC remediation area:

- Excavation, disposal and reconstruction of the leachfields,
- In-situ oxidation treatment of the PAC source,
- PAC downgradient ground water extraction and direct POTW discharge,

- Institutional controls throughout the PAC remediation area,
- Focused investigation, and
- Environmental monitoring.

This alternative would combine the remedial action elements of Alternative 5, with additional extract ion and direct discharge of PAC downgradient ground water to the POTW via the sewer. A multi-well system would be used to pump contaminated ground water in the PAC downgradient area pending the results of the focused investigation. Based on previous monitoring results, this extracted ground water could be discharged directly to the POTW via the sewer without pretreatment. Cleanup timeframes for the PAC downgradient area would be reduced to three years, as opposed to six years under natural attenuation.

Estimated Time for Design and Construction: 3 years
Estimated Time for Restoration:
    1 year at PAC source, 3 years at PAC downgradient
    12 years at CCL source, 6 years at CCL downgradient
Estimated Capital Costs: $1,969,000
Estimated Operation and Maintenance Costs: $5,465,000 (net present worth)
Estimated Total Cost: $7,434,000 (net present worth, assuming 7% discount rate)

IX. SUMMARY OF THE COMPARATIVE ANALYSIS OF ALTERNATIVES

Section 121(b)(1) of CERCLA presents several factors that at a minimum EPA is required to consider in its assessment of alternatives. Building upon these specific statutory mandates, the National Contingency Plan articulates nine evaluation criteria to be used in assessing the individual remedial alternatives.

A detailed analysis was performed on the alternatives using the nine evaluation criteria in order to select an OU 1 remedy. The following is a summary of the comparison of each alternative's strength and weakness with respect to the nine evaluation criteria. These criteria are summarized as follows:

Threshold Criteria

The two threshold criteria described below must be met in order for the alternatives to be eligible for selection in accordance with the NCP.

1. Overall protection of human health and the environment addresses whether or not a remedy provides adequate protection and describes how risks posed through each pathway are eliminated, reduced or controlled through treatment, engineering controls, or institutional controls.

2. Compliance with applicable or relevant and appropriate requirements (ARARS) addresses whether or not a remedy will meet all of the ARARs of other Federal and State environmental laws and/or provide grounds for invoking a waiver.

Primary Balancing Criteria

The following five criteria are utilized to compare and evaluate the elements of one alternative to another that meet the threshold criteria.

3. Long-term effectiveness and permanence addresses the criteria that are utilized to assess alternatives for the long-term effectiveness and permanence they afford, along with the degree of certainty that they will prove successful.

4. Reduction of toxicity, mobility, or volume through treatment addresses the degree to which alternatives employ recycling or treatment that reduces toxicity, mobility, or volume, including how treatment is used to address the principal threats posed by the site.

5. Short term effectiveness addresses the period of time needed to achieve protection and any adverse impacts on human health and the environment that may be posed during the construction and implementation period, until cleanup goals are achieved.

6. Implementability addresses the technical and administrative feasibility of a remedy, including the availability of materials and services needed to implement a particular option.

7. Cost includes estimated capital and Operation Maintenance (O&M) costs, as well as present-worth costs.

Modifying Criteria

The modifying criteria are used on the final evaluation of remedial alternatives generally after EPA has received public comment on the RI/FS and Proposed Plan.

8. State acceptance addresses the State's position and key concerns related to the preferred alternative and other alternatives, and the State's comments on ARARs or the proposed use of waivers.

9. Community acceptance addresses the public's general response to the alternatives described in the Proposed Plan and RI/FS report.

A detailed tabular assessment of each alternative according to the nine criteria can be found in Table 7-2, 7-5, 7-8, 7-11, 7-14, and 7-17 of the Feasibility Study.

Following the detailed analysis of each individual alternative, a comparative analysis, focusing on the relative performance of each alternative against the nine criteria, was conducted. This comparative analysis can be found in Table 8-1 of the Feasibility Study.

The section below presents the nine criteria and a brief narrative summary of the alternatives and the strengths and weaknesses according to the detailed and comparative analysis.

1. Overall Protection of Human Health and the Environment

Alternative 1 is not protective, in that it provides for no remedial action, and does not impose institutional controls throughout OU 1 to prevent potential future exposures to contaminants. The remaining alternatives all include institutional controls. Each of these remedies is more protective than Alternative 1 to the extent that the necessary institutional controls are acquired and maintained for the time necessary to restore the soils and ground water under each alternative. Institutional controls will not prevent the further migration of contaminants throughout OU 1 or beyond its boundaries. The typical institutional controls, such as deed restrictions on excavation and use of ground water, must be readily enforceable by both private parties and governmental agencies to be effective. Such controls also depend on cooperation of adjacent property owners, which make their acquisition and maintenance questionable at OU 1. Considering the magnitude of risk at the PAC and CCL source areas, and the geographic extent of the CCL downgradient area, institutional controls, by themselves, are questionable in their ability to provide adequate protectiveness at OU 1. Therefore, alternatives 2, 3, and 4, which rely solely on institutional controls and natural attenuation in areas where risk is demonstrated to be outside EPA's acceptable risk range, are less protective than Alternative 5 and Alternative 6, which actively restore the soils and ground water in all areas where these media are outside the risk range. The active response measures in these two alternatives greatly reduce the amount of time for which institutional controls must be relied upon at OU 1.

Alternative 6 also calls for active restoration at the PAC downgradient area. The risk at the PAC downgradient area is currently within EPA's acceptable risk range, when EPA's risk management factor for arsenic is incorporated (see notation on Table I). As such, the additional measures proposed at the PAC downgradient area under Alternative 6 do not provide for quicker attainment of EPA's remedial response objectives at OU 1. Therefore, Alternative 5 and Alternative 6 are equally protective under this criterion.

2. Compliance with ARARs

Alternatives 1 and 2 would not meet ARARs because they would allow contamination throughout OU 1 to continue to spread to downgradient areas, resulting in further exceedances of chemical-specific ARARs. Alternative 3 allows exceedances of chemical-specific ARARs to continue and spread at the PAC remediation area and the CCL downgradient area until such time as natural attenuation restores the soils and ground water in these areas. In Alternative 4, such exceedances are limited to the CCL downgradient area and the PAC downgradient area.

Alternative 5 and Alternative 6 both attain all Federal and State ARARs. Alternative 6 provides that ground water at the PAC downgradient area would be restored to MCLs in three years, as opposed to six years under Alternative 5; however, the risk at the PAC downgradient area is currently within EPA's acceptable risk range, considering the Agency's risk management factor for arsenic. Therefore, the required timeframe for Alternative 5 to attain ARARs at the PAC downgradient area is acceptable to EPA.

3. Long-term Effectiveness and Permanence

Each alternative provides for reduction of risks at OU 1 at the completion of the remedial action;

however, under Alternative 1, the risks at OU 1 are present until such time as natural attenuation restores soils and ground water within OU 1. Alternative 2 mitigates these risks solely through institutional controls. Alternatives 3 and 4 further reduce risks through active restoration of the CCL and/or PAC source areas; however, the CCL downgradient risks are not addressed, except through institutional controls. Alternative 5 reduces contaminants as soon as practicable in all areas of contamination within OU 1 that are currently known to be exceeding EPA's risk range. While Alternative 6 provides for faster cleanup in the PAC downgradient area, it does not restore this portion of OU 1 to EPA's acceptable risk range any faster than Alternative 5, since the risk at the PAC downgradient area is within EPA's acceptable risk range, considering the Agency's risk management factor for arsenic.

4. Reduction of Toxicity, Mobility, or Volume through Treatment

With the exception of Alternatives 1 and 2, all the alternatives evaluated in the FS would provide for the reduction of toxicity, mobility or volume of site contaminants through treatment since all would employ some degree of treatment prior to discharge or disposal. Alternative 3 includes treatment only at the CCL source area. Alternative 4 provides for treatment at both the CCL and PAC source areas. Alternative 5 and Alternative 6 provide for no further treatment than Alternative 4. Alternative 5 and Alternative 6 provide for further recovery of contaminated ground water in the CCL or CCL and PAC downgradient areas, respectively; however, such ground water would not require pretreatment prior to POTW discharge.

5. Short-term Effectiveness

Alternative 1, which consists solely of natural attenuation, provides for no protection of the community until cleanup levels are achieved. Alternative 2 provides for more protection of the community only to the extent that institutional controls are effectively implemented and maintained. Alternatives 3 and 4 are more protective of the community during remedial actions, because their active restoration processes at the source areas provide for a shorter time period when risks are unacceptable; however, both these remedies continue to rely solely on institutional controls to reduce risks for portions of OU 1 where risks are outside EPA's acceptable risk range. Alternative 5 and Alternative 6 provide for maximum reduction of risks to the community, by implementing institutional controls and providing for the quickest practicable restoration of those contaminated areas that are outside of EPA's acceptable risk range. Since the risk presented at the PAC downgradient area is within EPA's acceptable risk range, considering the Agency's risk management factor for arsenic, any additional risk reduction provided by Alternative 6 is not required to achieve levels that are protective of human health and the environment. Because of the potential for release of contaminants during the excavation activities, engineering precautions would be taken to minimize the potential for contaminant releases to ensure short-term protection of site workers, nearby industries' workers, and area residents during cleanup related activities.

6. Implementability

All aspects of Alternative 5's source control and management of migration are implementable and have been used successfully at other hazardous waste sites. In-situ oxidation is innovative in environmental cleanups, and pilot testing will ensure optimal treatment. The technologies required for Alternative 5 and alternatives 3, 4 and 6, which involve on-site air stripping, soil vapor extraction, carbon adsorption, and pumping of ground water, are readily implementable, and have been successfully used at other Superfund sites.

Alternatives 3, 4, and 6, and Alternative 5, all involve discharge to the local POTW via the sewer located on-site. Discharge to the POTW will involve connecting to the Narragansett Bay Commission (NBC) sewer interceptor, located in the immediate vicinity of the CCL remediation area, and will be treated at Bucklin Point Wastewater Treatment Facility in East Providence, Rhode Island. Based on current information obtained from RIDEM, the Narragansett Bay Commission treatment facility is in compliance with state regulations. Based on information presented in the FS, NBC indicated that the discharge rates would likely be acceptable and would not exceed the design capacity of the interceptor or the treatment facility, pending submittal of design specifications. Therefore, discharge to the POTW is considered to be fully implementable.

7. Cost

A comparison of the estimated total present worth costs (based on a 7 percent discount) for each alternative is as follows:

Alternative	Total Capital	Total Operation & Maintenance	Total Costs
#1	$ 0	$ 901,000	$ 980,000
#2	$ 119,000	$ 1,154,000	$ 1,273,000
#3	$ 1,614,000	$ 4,638,000	$ 6,252,000
#4	$ 1,676,000	$ 4,859,000	$ 6,535,000
#5	$ 1,901,000	$ 5,350,000	$ 7,251,000
#6	$ 1,969,000	$ 5,465,000	$ 7,434,000

8. State Acceptance

The Rhode Island Department of Environmental Management (RIDEM) has been actively involved with the Site, and particularly OU 1, during the development of the RI/FS and this Record of Decision.

RIDEM submitted comments on EPA's Preferred Alternative during the public comment period. In summary, RIDEM generally supports the alternative selected by EPA. RIDEM expressed concern that the focused investigation in the PAC downgradient area should not foreclose the possibility of any future RIDEM action in this portion of OU 1. RIDEM also favors "triggering" mechanisms that would describe the circumstances under which active restoration may be required at the PAC downgradient area.

A summary of these and other RIDEM comments, and EPA's responses, are included in the Responsiveness Summary, attached as Appendix C to this ROD.

RIDEM has reviewed this document and concurs with the alternative selected for the remedy as documented in the attached Declaration of State Concurrence (Appendix D).

9. Community Acceptance

The comments received by the community, potentially responsible parties, and local governments, are summarized and responded to in the Responsiveness Summary attached to the ROD as Appendix C.

The Town of Cumberland, a citizen, two citizen organizations, and three potentially responsible parties submitted comments. Major comments are summarized below:

- The Town of Cumberland expressed concerns about the reconstruction of the Martin Street well field and requested further studies on contamination impacting the Lenox Street well.
- One citizen was concerned about worker safety issues at the CCL plant.
- The Blackstone Valley Tourist Council stated a preference for Alternative 6.
- Save the Bay supported Alternative 5, while expressing a preference for Alternative 6, if, after the results of the focused investigation are understood, the PAC downgradient area is found to be outside of EPA's acceptable risk range.
- CPC, International stated a preference for Alternative 3 (source control), and stated that the preferred alternative would be unable to achieve cleanup levels. CPC further stated that the EPA risk assessment was flawed.
- Lonza Inc. believes that the in-situ oxidation at the PAC facility should be attempted on a pilot basis before EPA commits to full scale implementation. Lonza further stated that the PAC downgradient area should be treated as a separate source and also took issue with EPA risk assessment assumptions.
- PAC, while concerned about business impacts of remedial actions on its property, generally favored the preferred alternative.

X. THE SELECTED REMEDY

The remedy selected to address the contamination identified in Operable Unit 1, of the Peterson/Puritan, Inc. Site is Alternative 5, Enhanced Source Control and CCL Area Management of Migration. The remedy includes the following components: the excavation and off-site disposal of source area soils, venting with treatment of source area soils, extraction and treatment of the contaminated ground water, natural attenuation of the PAC downgradient area and the Quinnville well field, institutional controls for ground water use/hydrologic alteration and contact with contaminated soils, environmental monitoring and focused investigation of contamination at the PAC downgradient area.

The selected remedy is comprehensive in that it provides for both source control and management of migration components to be implemented at OU 1. The approximate cleanup timeframes for the selected remedy are as follows: 12 years in the CCL source area, six years for the CCL downgradient area, six years to naturally attenuate contaminants at PAC downgradient area, and one year for source control measures at the PAC source. The Quinnville wellfield ground water, currently estimated to be within acceptable contaminant levels under non-pumping conditions, is expected to continue to attenuate throughout the duration of the cleanup.

A. Interim Ground Water Cleanup Levels

Interim cleanup levels have been established in ground water for all contaminants of concern identified in the Baseline Risk Assessment found to pose an unacceptable risk to either public health or the environment. Interim cleanup levels have been set based on the ARARs (e.g., Drinking Water Maximum Contaminant Level Goals (MCLGs) and MCLs) as available, or other suitable criteria described below. Periodic assessments of the protection afforded by remedial actions will be made as the remedy is being implemented and at the completion of the remedial action. At the time that Interim Ground Water Cleanup Levels identified in the ROD and newly promulgated ARARs and modified ARARs which call into question the protectiveness of the remedy have been achieved and have not been exceeded for a period of three consecutive years, a risk assessment shall be performed on the residual ground water contamination to determine whether the remedial action is protective. This risk assessment of the residual ground water contamination shall follow EPA procedures and will assess the cumulative carcinogenic and non-carcinogenic risks posed by the ingestion of ground water and exposure to soils at OU 1. If, after review of the risk assessment, the remedial action is not determined to be protective by EPA, the remedial action shall continue until either protective levels are achieved, and are not exceeded for a period of three consecutive years, or until the remedy is otherwise deemed protective. These protective residual levels shall constitute the final cleanup levels for this Record of Decision and shall be considered performance standards for any remedial action.

Because the aquifer under OU 1 is a Class IIB aquifer, which is a potential source of drinking water, MCLs and non-zero MCLGs established under the Safe Drinking Water Act are ARARs.

Interim cleanup levels for known, probable, and possible carcinogenic compounds (Classes A, B, and C) have been established to protect against potential carcinogenic effects and to conform with ARARs. Because the MCLGs for Class A & B compounds are set at zero and are thus not suitable for use as interim cleanup levels, MCLs and proposed MCLs have been selected as the interim cleanup levels for these Classes of compounds. Because the MCLGs for the Class C compounds are greater than zero, and can readily be confirmed, MCLGs and proposed MCLGs have been selected as the interim cleanup levels for Class C compounds. When neither a MCL or a non-zero MCLG exists, EPA has considered proposed MCLS or proposed non-zero MCLGs in setting the interim cleanup level.

Interim cleanup levels for Class D and E compounds (not classified, and no evidence of carcinogenicity) have been established to protect against potential non-carcinogenic effects and to conform with ARARs. Because the MCLGs for these Classes are greater than zero and can readily be confirmed, MCLGs and proposed MCLGs have been selected as the interim cleanup levels for these classes of compounds.

In situations where a promulgated State standard is more stringent than values established under the Safe Drinking Water Act, the State standard was used as the interim cleanup level. In the absence of an MCLG, an MCL, a proposed MCLG, proposed MCL, State standard, or other suitable criteria to be considered (i.e., health advisory, state guideline) an interim cleanup level was derived for each compound having carcinogenic potential (Classes A, B, and C compounds) based on a 10[-6] excess cancer risk level per compound considering the ingestion of contaminated ground water at OU 1. In the absence of the above standards and criteria, interim cleanup levels for all other compounds (Classes D and E) were established based on a level that represents an acceptable exposure level to which the human population including sensitive subgroups may be exposed without adverse affect during a lifetime or part of a lifetime, incorporating an adequate margin of safety (hazard quotient = 1) considering the ingestion of contaminated ground water at OU 1. If a value described by any of the above methods was not capable of being detected with good precision and accuracy or was below what was deemed to be the background value, then the practical quantification limit or background value was used as appropriate for the Interim Ground Water Cleanup Level.

Table I below summarizes the Interim Cleanup Levels for carcinogenic and non-carcinogenic contaminants of concern identified in ground water.

While these interim cleanup levels are consistent with ARARs or suitable TBC criteria for ground water, a cumulative risk that could be posed by these compounds may exceed EPA's goals for remedial action. Consequently, these levels are considered to be interim cleanup levels for ground water. At the time that these Interim Groundwater Cleanup Levels identified in the ROD and newly promulgated ARARs and modified ARARs which call into question the protectiveness of the remedy have been achieved and have not been exceeded for a period of three consecutive years, a risk assessment shall be performed on the residual ground water contamination to determine whether the remedial action is protective. This risk assessment of the residual ground water contamination shall follow EPA procedures and will assess the cumulative carcinogenic and non-carcinogenic risks posed by the ingestion of contaminated ground water. If, after review of the risk assessment the remedial action is not determined to be protective by EPA, the remedial action shall continue until either protective levels are achieved and are not exceeded for a period of three consecutive years, or until the remedy is otherwise deemed protective. These protective residual levels shall constitute the final cleanup levels for this Record of Decision and shall be considered performance standards for any remedial action.

All Interim Groundwater Cleanup Levels identified in the ROD and newly promulgated ARARs and modified ARARs which call into question the protectiveness of the remedy and the protective levels determined as a consequence of the risk assessment of residual contamination, must be met at the completion of the remedial action in all ground water within OU 1, including the Quinnville well field. EPA has estimated that these ground water cleanup levels will be obtained within twelve years throughout all of OU 1.

B. Soil Cleanup Levels

Based upon data developed in the RI and the Baseline Risk Assessment, remedial measures to address risk associated with possible exposure to source soils are not warranted because present and future risks are within or below EPA's acceptable carcinogenic risk range or for the non-carcinogens generally below a Hazard Index of one. However, available data suggest that area soils are a primary source of release of VOCs to ground water. This phenomenon may result in an unacceptable risk to those who consume contaminated ground water. Therefore, cleanup levels for soils were established to protect the aquifer from potential soil leachate. The Summers Model, described in Section 1.4.2.3 of the Feasibility Study was used to estimate residual soil levels that are not expected to impair future ground water quality. The interim cleanup levels for ground water were used as input into the leaching model. If the predicted protective soil level was not capable of being detected with good precision and accuracy, then the practical quantification limit was selected as the cleanup level for soils. The table below summarizes the soil cleanup levels required to protect public health and the environment through restoration of the aquifer and were developed for the ground water contaminants of concern detected above the interim ground water cleanup levels.

These cleanup levels in soils are consistent with ARARs for ground water, attain EPA's risk management goal for remedial actions, and have been determined by EPA to be protective. These cleanup levels must be met at the completion of the remedial action at the CCL source area (tank farm and O’Toole property) and the PAC source area.

C. Description of Remedial Components

The following is a description of the remedial components of the selected remedy for OU 1. As previously described, OU 1 is comprised of the CCL and PAC remediation areas; these are further broken into the CCL source and downgradient, and PAC source and downgradient areas, respectively.

The components of the CCL remediation area include:

- Excavation (manholes and catch basins),
- Capping,
- Soil venting of source area soils,
- Source area ground water extraction, treatment and discharge to POTW via the sewer,

- Downgradient area ground water extraction with direct POTW discharge via the sewer,
- Natural attenuation of ground water at the Quinnville wellfield,
- Institutional controls throughout the CCL remediation area, and
- Environmental monitoring.

The components of the PAC remediation area include:

- Excavation and disposal of the leachfields and related soils,
- In-situ oxidation treatment of the PAC source area,
- Natural attenuation of the PAC downgradient ground water,
- Institutional controls throughout the PAC remediation area,
- Focused investigation of the PAC downgradient area, and
- Environmental monitoring.

Excavation: Excavation at the CCL area will consist of removing soils at manholes and catch basins. These soils are contaminated with solvents and will be transported off-site for disposal at a RCRA-approved disposal facility. Excavation of these soils will remove a portion of the continuing source of ground water contamination.

Excavation at the PAC remediation area includes removal of leachfields #1 and #2 and surrounding soils to a depth of approximately nine feet. Excavation will remove the source of contaminants to ground water in addition to removing other organic material contributing to the conditions which cause arsenic to become more soluble. Excavated soils will be sampled and analyzed to determine the most appropriate off-site disposal option. It is estimated that approximately 1,000 cubic yards of soil will be excavated and disposed of at a RCRA-approved disposal facility.

The excavation of soils and associated debris from the PAC leachfields and the CCL manholes and catch basins will be performed in accordance with established performance specifications to be determined during remedial design.

Capping: Source area soils at the CCL remediation area will be capped to enhance the soil venting system operation (see below) by: 1) eliminating the potential inflow of clean air through the ground surface and from around the vent well casing in the immediate vicinity of operation, thereby increasing the area affected by each vent well, 2) limiting the infiltration through the soil, and 3) reducing the potential for direct contact of source area soils. An estimated 14,000 square foot area of the tank farm will be capped with concrete and an estimated 12,000 square feet of the O'Toole property will be paved. The steep slope between the two areas will not be capped because minimal precipitation could infiltrate into the sloped surface. In addition, the influx of clean air through the side slope is expected to assist in flushing VOCs from the vadose zone soils in the CCL tank farm by encouraging lateral air movement through the zone where soils are heavily contaminated.

Soil Venting and Vapor Treatment: A soil venting system (also known as Soil Vapor Extraction (SVE)) consisting of an estimated 12 wells, blowers, and a Granular Activated Carbon (GAC) adsorption/ regeneration off-gas treatment system will be installed at the CCL source area. It is presently estimated that the system will operate for a period of two years. It is estimated that the SVE system will result in 99 percent removal of VOCs above the ground water table (vadose zone) in the vicinity of the CCL tank farm. Due to the persistence of chlorinated solvents in the soil medium, residual contamination may remain after maximum soil venting has occurred. This residual contamination could continue to leach into the ground water by infiltration; however, EPA believes that an effective soil venting program, combined with an effective surface cap (described above) will minimize leaching, and ground water extraction (described below) will minimize contaminant migration so that cleanup levels in ground water will be achieved in approximately 12 years.

The GAC adsorption/regeneration off-gas treatment system will treat the contaminated air stream exiting the SVE system. The system will consist of an estimated two GAC vessels, an automated air stream switching device, and steam boiler. The contaminated air stream collected from the SVE system will be cycled through one of two vessels such that while one vessel was in operation, the second will be regenerated (cleansed) using steam. The unit will automatically direct the air stream influent to a new GAC vessel when the first vessel reached a pre-determined VOC adsorption capacity, triggering the steam regeneration of the spent vessel. The VOCs in the steam will be decanted and the recovered water reused in the regeneration process. The concentrated chemical solutions from the steam stripping process will be temporarily stored on-site prior to off-site treatment and disposal.

Source Area Ground Water Extraction: A multi-well recovery system in the CCL source area will capture and treat ground water within and immediately downgradient of the source to prevent migration of contaminated ground water from the source. Wells within the tank farm area will capture the grossly contaminated ground water and depress the ground water table in the source area. This depression will extend the vadose zone and allow further recovery of residual contamination at and below the static water table by the SVE system. Wells on the O'Toole property will cut off the source area from the downgradient plume. The total pumping rate will be about 90 gpm.

A diffused air stripper will be used to treat the extracted ground water. Air stripping is a process that induces the mass transfer of VOCs from water to air by applying a forced air stream through the water column. Estimating a 100-gpm influent flow rate from CCL source area recovery wells, the diffused aeration system will consist of four tanks in series. Compared to other options considered in the FS, this process option will be less susceptible to fouling and reduced efficiencies from naturally occurring inorganics in the ground water, such as iron and manganese, due to the higher water velocity traveling through the system. The inorganics will travel through the treatment system as suspended solids and will be discharged with the treated water to the POTW via the sewer. The VOC-contaminated air passing through the stripping process will be treated by the GAC adsorption/regeneration system as described above.

In-situ Oxidation: In-situ (in place) oxidation will be used to reduce the mobility of the arsenic in ground water migrating from the leachfields at the PAC remediation area. The leachfields will be replaced with perforated pipe and stone backfill to be used as an infiltration gallery. Clean water, amended with a chemical additive, will infiltrate the soils at about four gallons per minute (gpm) through the infiltration gallery. As this water moves through the aquifer, it will reduce the mobility of the arsenic by chemically changing the more soluble arsenite to arsenate, which will precipitate or sorb to soil particles. In-situ oxidation is considered to be an innovative technology which will require pilot testing to ensure optimum treatment. Removal of the organic material in the old leachfields (as described above) is expected to enhance the effectiveness of the in-situ oxidation technology.

Downgradient Ground Water Extraction and Discharge: Recovery of the ground water plume that has migrated from the CCL source area toward the Blackstone River and Quinnville wellfield will be accomplished by installing a multi-well recovery system. The system will include approximately six to nine wells south of Martin Street, which will be about 100 to 120 feet deep and pump a total of approximately 100 gpm, and will be sufficient to capture the deep ground water plume. Because ground water monitoring of downgradient wells has indicated that downgradient concentrations of total VOCs are below levels requiring treatment prior to discharge to the POTW, this ground water can be directly discharged to the POTW via the sewer without pretreatment. Monitoring of the influent to the sewer will ensure continued compliance with POTW requirements.

Institutional Controls: Institutional controls will be required for all remediation areas, including the Quinnville wellfield and the PAC downgradient area. These controls will function to prevent the use or hydrologic alteration of ground water throughout OU 1, including the Quinnville wellfield. These controls will also function to prevent direct contact to, or exposure to, contaminated soils in areas where such soils exceed EPA's risk range (i.e. CCL source Area). These controls may include the registration of deed restrictions prohibiting 1) excavation of source area soils, and 2) use of ground water throughout the remediation areas and the Quinnville wellfield. These restrictions would not apply to excavation and use that is within the scope of any authorized response action. Deed restrictions shall function, in part, to inform future purchasers that those properties within OU 1 are within a Superfund site. While in themselves institutional controls are not a permanent solution by which to solely manage exposure risks to contaminants, the controls, when applied with other components of the remedy, do provide an additional measure of protection. Institutional controls will be implemented at the CCL remediation area to prevent the future use or hydrologic alteration of contaminated ground water throughout the entire CCL remediation area (source area and downgradient area) and to prevent the direct contact or exposure to contaminated soil at the CCL source area. Similarly, institutional controls will be implemented at the PAC remediation area to prevent the future use or hydrologic alteration of contaminated ground water throughout the entire PAC remediation area (source area and downgradient area). Institutional controls will be implemented at the Quinnville wellfield to prevent the future use or hydrologic alteration of contaminated ground water. The restrictions will be maintained until OU 1 is determined not to pose a threat to human health and the environment, and at the Quinnville wellfield will be maintained until risks at the nearby J.M. Mills Landfill are identified and addressed.

Environmental Monitoring: The objectives of the environmental monitoring program will be to evaluate the rate and measure the success of the components of the remedial action, including natural processes acting on the contaminated media, and to monitor the migration and reduction of contamination at the PAC and CCL remediation areas and at the wellfield. The program will include the sampling of environmental media, including monitoring of a) ground water; b) treated and direct discharges from the ground water remediation systems to the POTW interceptor (i.e. sewerline); and c) the injection of chemically amended waters as a component of the PAC remedy. The reporting of such results for periodic evaluation shall continue until cleanup levels are met or OU 1 is determined not to pose a threat to human health and the environment. Long-term monitoring of the treated and direct discharge to the POTW via the sewer intercepter shall ensure that the discharge is not adversely affecting the POTW and that ARARs are being met.

The environmental monitoring program will also include a) a soil monitoring program to demonstrate compliance with soil cleanup levels; and b) a performance monitoring program for the soil vapor extraction (SVE) system to determine if the SVE system is working effectively to remove the VOCs from the CCL source area soils.

Natural Attenuation: Natural attenuation is a process of naturally occurring biodegradation, oxidation, adsorption and dilution which reduces contaminant concentrations. This process is occurring within portions of the remediation areas and the Quinnville wellfield. This process will be the sole means of remediation at two areas of OU 1: the Quinnville wellfield and the PAC downgradient area. Natural attenuation, coupled with monitoring and institutional controls (as discussed above) will be implemented at the Quinnville wellfield. Natural attenuation with a focused investigation, monitoring, and institutional controls, will be implemented at the PAC downgradient area. The focused investigation will be required because VOCs were detected in monitoring wells in the PAC downgradient area. The investigation will include the installation of new monitoring well clusters, sampling and analyses of ground water, and investigation of potential contaminant sources impacting this area. Based on the findings of the investigation, further response actions may be required.

The goal of this remedial action is to restore the ground water to its beneficial use, which is, at OU 1, a potential drinking water source. Based on information obtained during the remedial investigation, and the analysis of all remedial alternatives, EPA believes that the selected remedy may be able to achieve this goal. Although not detected during the RI, Dense Nonaqueous Phase Liquids (DNAPLs), i.e., undissolved chemicals, may be present at OU 1. If present, DNAPL could serve as a long-term source of contamination to ground water at the CCL source area. This could impact the ability of the remedial action to achieve cleanup levels at all points throughout the CCL source area in a reasonable time period.

Based on current data, EPA estimates that the ground water will be restored to its beneficial use in approximately 12 years after implementation of the ground water component of this ROD. During operation, 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 interim ground water cleanup levels have been attained for a period of three years, pumping may be discontinued,

b) alternating pumping at wells to eliminate stagnation points;

c) pulse pumping to allow aquifer equilibration and encourage absorbed contaminants to partition into ground water,

d) installation of additional extraction wells to facilitate or accelerate cleanup of the contaminant plume; and

e) periodic revaluation of remedial technologies for ground water restoration.

If, following a reasonable period of system operation, EPA determines that the selected remedy cannot meet cleanup levels, EPA may consider contingency measures as a modification to the selected remedy. Such contingency measures may include the following:

a) engineering controls such as physical barriers, including enhancements to cap impermeability or long-term gradient control provided by pumping, as containment measures;

b) ARARs may be waived for the cleanup of the relevant portions of the aquifer based on the technical impracticability of achieving further contaminant reductions and revised cleanup levels may be established for the relevant portions of the aquifer,

c) institutional controls may be maintained until such time as the remedy is determined to be protective by EPA to 1) prevent hydrologic alteration or use of ground water that remains above health-based levels; and 2) ensure the impermeability and integrity of the cap at the CCL source area;

d) continued monitoring of specified wells;

e) periodic reevaluation of remedial technologies for ground water restoration; or

f) such other measures as EPA determines are necessary to further reduce the mass of contaminants and to ensure that the remedy remains protective of human health and the environment.

The decision to invoke any or all of these measures may be made by EPA during a future review, following a reasonable period of operation of the selected remedy. If EPA determines that such contingency measures are necessary, and are significant or fundamental modifications to the remedy, such changes will be documented in a future decision document.

D. Other Components of the Selected Remedy

To the extent required by law, EPA will review OU 1 at least once every five years after the initiation of remedial action at OU 1, if any hazardous substances, pollutants or contaminants remain at OU 1, to assure that the remedial action continues to protect human health and the environment. EPA will also review the Site before the Site is proposed for deletion from the National Priorities List.

XI. STATUTORY DETERMINATIONS

The remedial action selected for implementation at the first operable unit of the Peterson/Puritan Site is consistent with CERCLA and, the NCP. The selected remedy is protective of human health and the environment, attains ARARs and is cost effective. The selected remedy also satisfies the statutory preference for treatment which permanently and significantly reduces the mobility, toxicity or volume of hazardous substances as a principal element. Additionally, the selected remedy utilizes alternate treatment technologies or resource recovery technologies to the maximum extent practicable.

A. The Selected Remedy is Protective of Human Health and the Environment

The remedy at OU 1 will permanently reduce the risks posed to human health and the environment by eliminating, reducing or controlling exposures to human and environmental receptors through treatment, engineering controls, and institutional controls. Specifically, the risk presented by OU 1 is the future ingestion of contaminated ground water. Therefore, the selected remedy uses a SVE system to treat soils that are contaminated with VOCs and thereby eliminate the migration of VOCs from soils to ground water. The selected remedy also uses in-situ oxidation, excavation, and pumping and treatment of ground water to contain and reduce the levels of contamination throughout the ground water plume. Engineering controls, such as adding enhancements to the SVE, or modifying the ground water pump and treat system, will be implemented as warranted to ensure the effectiveness of the remedial action technologies. Institutional controls will be required for all remediation areas, including the Quinnville wellfield and the PAC downgradient area. These controls will function to prevent the use or hydrologic alteration of ground water throughout OU 1, including the Quinnville wellfield, until cleanup levels have been met.

Moreover, the selected remedy will achieve potential human health risk levels that attain the 10[-4] to 10[-6] incremental cancer risk range and a level protective of noncarcinogenic endpoints, and will comply with ARARs and "to be considered" criteria. At the time that the Interim Ground Water Cleanup Levels identified in the ROD and newly promulgated ARARs and modified ARARs which call into question the protectiveness of the remedy have been achieved and have not been exceeded for a period of three consecutive years, a risk assessment shall be performed on the residual ground water contamination to determine whether the remedial action is protective. This risk assessment of the residual ground water contamination shall follow EPA procedures and will assess the cumulative carcinogenic and non-carcinogenic risks posed by ingestion of ground water. If, after review of the risk assessment, the remedial action is not determined to be protective by EPA, the remedial action shall continue until protective levels are achieved and have not been exceeded for a period of three consecutive years, or until the remedy is otherwise deemed protective. These protective residual levels shall constitute the final cleanup levels for this Record of Decision and shall be considered performance standards for any remedial action.

B. The Selected Remedy Attains ARARs

This remedy will attain all applicable or relevant and appropriate federal and state requirements that apply to OU 1. Environmental laws from which ARARs for the selected remedial action are derived, and the specific ARARs include:

Chemical Specific

Federal Standards

- Resource Conservation and Recovery Act (RCRA), Identification and Listing of Hazardous Waste; [40 CFR Part 261]
- Safe Drinking Water Act (SDWA), Maximum Contaminant Level Goals (MCLGs); [40 CFR Part 141]
- Safe Drinking Water Act (SDWA), National Primary Drinking Water Standards, Maximum Contaminant Levels (MCLs); [40 CFR Part 141]

State Standards

- Rhode Island Rules and Regulations Pertaining to Public Drinking Water; July, 1991
- Rhode Island Rules and Regulations for Groundwater Quality; July, 1993

Location Specific

Federal Standards

- Protection of Wetlands Executive Order No. 11990; [40 CFR Part 6]
- Floodplain Management Executive Order No. 11988; [40 CFR Part 6]

State Standards

- Rhode Island Rules and Regulations Governing the Enforcement of the Freshwater Wetlands Act - August, 1990

Action Specific

Federal Standards

- Clean Air Act (CAA), National Emission Standards for Hazardous Air Pollutants (NESHAP); [40 CFR Part 61]
- RCRA Air Emissions Standards [40 CFR Part 264, Subparts AA and BB
- CWA, National Pretreatment Standards; [40 CFR Part 403]
- RCRA, Standards Applicable to Generators of Hazardous Waste; [40 CFR Part 262]
- RCRA, General Facility Standards; [40 CFR Subpart B, 264.10264.18]
- RCRA, Preparedness and Prevention; [40 CFR Part 264, Subpart C]
- RCRA, Contingency Plan and Emergency Procedures; [40 CFR Part 264, Subpart D]
- RCRA, Releases from Solid Waste Management Units; [40 CFR Part 264, Subpart F]
- RCRA, Closure and Post-Closure; [40 CFR Part 264, Subpart G]
- RCRA, Use and Management of Container; [40 CFR Part 264, Subpart I]
- RCRA, Tanks; [40 CFR Part 264, Subpart J]
- RCRA, Miscellaneous Units [40 CFR Part 264, Subpart X, 264.600264.999]
- RCRA, Interim Status TSDF Standards; Chemical, Physical, and Biological Treatment [40 CFR 265, Subpart Q, 265.400-265.406]
- RCRA, Land Disposal Restrictions; [40 CFR Part 268]

State Standards

- Rhode Island Pretreatment Regulations - June, 1984
- Rhode Island Underground Injection Control Regulations - June, 1984
- Rhode Island Air Pollution Control Regulations, Air Pollution Control Regulation No. 1 - Amended 1977
- Rhode Island Air Pollution Control Regulations, Air Pollution Control Regulation No. 7 - July, 1990
- Rhode Island Air Pollution Control Regulations, Air Pollution Control Regulation No. 9 - March, 1993
- Rhode Island Air Pollution Control Regulations, Air Pollution Control Regulation No. 13 - October, 1982
- Rhode Island Air Pollution Control Regulations, Air Pollution Control Regulation No. 15 - January, 1993
- Rhode Island Air Pollution Control Regulations, Air Pollution Control Regulation No. 17 - February, 1977
- Rhode Island Air Pollution Control Regulations, Air Pollution Control Regulation No. 22 - October, 1992
- Rhode Island Rules and Regulations for Solid Waste Management Facilities - June, 1992
- Rhode Island Hazardous Waste Rules and Regulations - Section 8
- Rhode Island Hazardous Waste Rules and Regulations - Section 9

The following policies, criteria, and guidances will also be considered (TBCs) during the implementation of the remedial action:

<u>Chemical Specific</u>

- USEPA Health Assessment Documents, Acceptable Intake, Chronic (AIC) and Subchronic (AIS)
- USEPA Human Health Assessment Cancer Slope Factors (CSFs)
- USEPA Office of Drinking Water, Health Advisories
- USEPA Reference Doses (RfDs)

<u>Location Specific</u>

- (None Identified)

<u>Action Specific</u>

- Control of Air Emissions from Superfund Air Strippers at Superfund Groundwater Sites; [OSWER Directive #9355 0-28}
- USEPA Region I Memo from Louis Gitto to Merrill Hohman-July 12, 1989
- RCRA Air Emissions Standards [40 CFR Part 264, Subpart CC

A full description of each ARAR or TBC, its application to the selected remedy, and actions necessary to attain each ARAR or TBC, can be found at Table B-33.

C. The Selected Remedial Action is Cost-Effective

In the Agency's judgment, the selected remedy is cost effective, i.e., the remedy affords overall effectiveness proportional to its costs. In selecting this remedy, once EPA identified alternatives that are protective of human health and the environment and that attain, or, as appropriate, waive ARARs, EPA evaluated the overall effectiveness of each alternative by assessing the relevant three criteria--long term effectiveness and permanence; reduction in toxicity, mobility, and volume through treatment; and short term effectiveness, in combination. The relationship of the overall effectiveness of this remedial alternative was determined to be proportional to its costs. The costs of this remedial alternative are specified in Table B-34.

Of all the alternatives evaluated in the FS, the selected remedy is the most cost effective approach to ensuring the necessary level of protectiveness. EPA evaluates cost-effectiveness only in selecting a remedy from among protective alternatives. Alternatives 1, 2, 3, and 4, in the FS are all less costly than the selected remedy. However, each of those alternatives allows some portion of OU 1 to continue to pose an unacceptable risk for an excessive time period in the Agency's view. This is because each of these alternatives relies solely on institutional controls and natural attenuation in areas where risk is demonstrated to be outside EPA's acceptable risk range. Since these alternatives are not sufficiently protective, their cost effectiveness cannot be analyzed.

Alternative 6 in the FS is more costly than the selected remedy. Alternative 6 is not cost effective. Any enhanced protectiveness provided by Alternative 6 is not proportional to its additional costs, since Alternative 6 would require immediate active restoration in the PAC downgradient area, where risks are currently within EPA's acceptable risk range, considering the Agency's risk management factor for arsenic. The Agency believes it is more cost effective to conduct a focused investigation, with monitoring and institutional controls, in the PAC downgradient area. Further response actions may be required based on these activities. This approach is incorporated into the selected remedy. Thus, the Agency believes that, when comparing Alternative 6 and the selected remedy, the selected remedy is more cost effective since it provides for protectiveness throughout OU 1 and does not require the expenditure of an estimated $183,000 on active restoration in the PAC downgradient area unless deemed necessary by EPA based on results of the focused investigation. The actual costs of any active restoration at the PAC downgradient area will not be known until the results of the focused investigation are analyzed.

D. The Selected Remedy Utilizes Permanent Solutions and Alternative Treatment or Resource Recovery Technologies to the Maximum Extent Practicable

Once the Agency identified those alternatives that attain or, as appropriate, waive ARARs and that are protective of human health and the environment, EPA identified which alternative utilizes permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. This determination was made by deciding which one of the identified alternatives provides the best balance of trade-offs among alternatives in terms of: 1) long-term effectiveness and permanence; 2) reduction of toxicity, mobility or volume through treatment; 3) short-term effectiveness; 4) implementability; and 5) cost. The balancing test emphasized long-term effectiveness and permanence and the reduction of toxicity, mobility and volume through treatment; and considered the preference for treatment as a principal element, the bias against off-site land disposal of untreated waste and community and state acceptance. The selected remedy provides the best balance of trade-offs among the alternatives. This analysis was performed with respect to Alternative 6 and the selected remedy, the only two alternatives that comply with ARARs and are fully protective of human health and the environment.

The Agency believes that the selected remedy and Alternative 6 compare similarly in terms of long term effectiveness and permanence, and reduction of toxicity, mobility, or volume through treatment. Both alternatives would effectively maintain reliable protection of human health and the environment over time once cleanup levels have been met. Under either alternative, residual risks remaining at OU 1 after the completion of the remedial action would be within EPA's acceptable risk range.

The selected remedy and Alternative 6 both provide for identical reduction of contaminants through treatment. While Alternative 6 would immediately extract contaminants from the groundwater in the PAC downgradient area, such contaminants would not require treatment prior to discharge to the POTW.

Both the selected remedy and Alternative 6 are fully implementable. Neither option involves off-site land disposal of untreated waste. Since the risk presented at the PAC downgradient area is within EPA's acceptable risk range, considering the Agency's risk management factor for arsenic, any additional risk reduction provided by Alternative 6 is not required to achieve levels that are protective of human health and the environment. However, Alternative 6 would require the added expenditure of approximately $183,000 for immediate active restoration at the PAC downgradient area. The actual costs of any active restoration at the PAC downgradient area will not be known until the results of the focused investigation are understood. This added cost is significant, considering that Alternative 6 does not provide any appreciable advantage in terms of utilizing permanent solutions and alternate technologies.

As described in more detail in the Responsiveness Summary, State and community comments generally support EPA's choice of the selected remedy, especially as it compares to Alternative 6. Considering such support, and based on the above analysis of statutory criteria, the Agency believes that the selected remedy utilizes permanent solutions and alternative treatment or resource recovery technologies to the maximum extent practicable.

E. The Selected Remedy Satisfies the Preference for Treatment Which Permanently and Significantly reduces the Toxicity, Mobility or Volume of the Hazardous Substances as a Principal Element

The principal elements of the selected remedy are source control and management of migration. The primary threats at the OU 1 are the threat of future potential ingestion of ground water contaminated from OU 1 and the threat of ingestion or contact with contaminated soils. The selected remedy addresses these threats by treating contaminants in both the CCL and PAC source areas, thereby providing significant reduction in the toxicity, mobility and volume of contaminants at OU 1 through treatment. Therefore, the selected remedy satisfies the statutory preference for treatment as a principal element.

XII. DOCUMENTATION OF SIGNIFICANT CHANGES

EPA presented a Proposed Plan for OU 1 of the Peterson/Puritan Superfund Site on July 6, 1993.

The components of the preferred alternative included:

<u>CCL remediation area</u>:

- Excavation (manholes and catch basins),
- Capping,
- Soil venting of source area soils,
- Source area ground water extraction, treatment and discharge to POTW,
- Downgradient area ground water extraction with direct POTW discharge,
- Natural attenuation of the Quinnville wellfield,
- Institutional controls, and
- Environmental monitoring.

<u>PAC remediation area</u>:

- Excavation, disposal and reconstruction of the leachfields,
- In-situ oxidation treatment of the PAC source,
- Natural attenuation of the PAC downgradient ground water,
- Institutional controls,
- Focused investigation of the PAC downgradient area, and
- Environmental monitoring.

The Proposed Plan describes that soil venting, also described herein as soil vapor extraction (SVE), will be employed to remove contaminants from the soils at the CCL source area. The selected remedy described in this document also contains this technology. Additionally, the selected remedy provides that during operation, the system's performance will be carefully monitored on a regular basis and adjusted as warranted by the performance data collected during operation. These adjustments are described in detail in Section X, above.

The selected remedy also provides that if, following a reasonable period of system operation, EPA determines that the selected remedy cannot meet cleanup levels, EPA may consider contingency measures as a modification to the selected remedy. Such contingency measures are also described in detail in Section X, above. EPA believes that these enhancing and modifying technologies provide that the CCL source area systems will be implemented most effectively based on actual data received during operation.

These changes regarding EPA's possible enhancement of soil vapor extraction, and modifications and contingency measures with respect to ground water extraction at the CCL source area, are logical outgrowths of the technologies presented in the Proposed Plan. The overall waste management approach presented in the selected remedy remains the same as that presented in the Proposed Plan. While EPA believes that these changes are significant, they do not radically alter the remedy from the form in which it was presented in the Proposed Plan. Thus, these changes are of such a nature that they could have been reasonably anticipated, considering the inherent uncertainties associated with waste management technologies. Therefore, EPA does not believe that these changes require a revised Proposed Plan and new public comment period.

XIII. STATE ROLE

The Rhode Island Department of Environmental Management has reviewed the various alternatives and has indicated its support for the selected remedy. The State has also reviewed the Remedial Investigation, Risk Assessment and Feasibility Study to determine if the selected remedy is in compliance with applicable or relevant and appropriate State Environmental laws and regulations. The State of Rhode Island concurs with the selected remedy for the first operable unit at the Peterson/Puritan Site. A copy of the declaration of concurrence is attached as Appendix D.

APPENDIX A

FIGURES

APPENDIX B

TABLES