United States
Environmental Protection
Agency

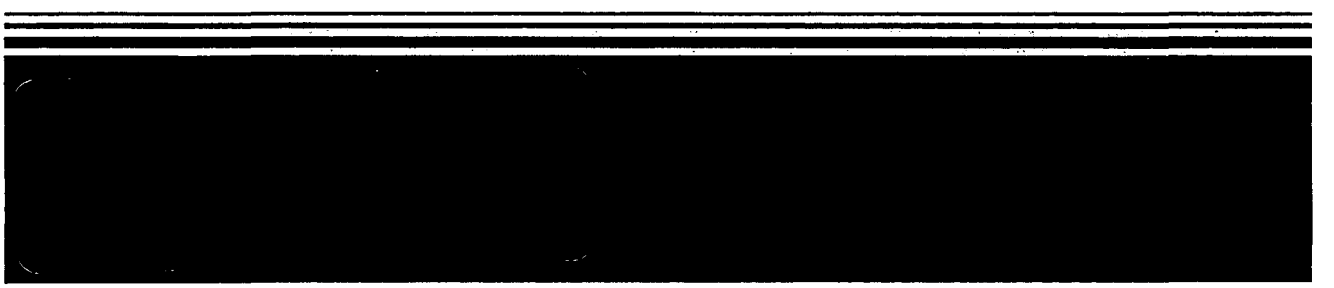
Office of
Emergency and
Remedial Response

EPA/ROD/R02-91/149
September 1991

EPA

Superfund Record of Decision:

Rockaway Borough Wellfield, NJ



50272-101

REPORT DOCUMENTATION PAGE	1. REPORT NO. EPA/ROD/R02-91/149	2.	3. Recipient's Accession No.

4. Title and Subtitle
SUPERFUND RECORD OF DECISION
Rockaway Borough Wellfield, NJ
Second Remedial Action

5. Report Date
09/30/91

6.

7. Author(s)

8. Performing Organization Rept. No.

9. Performing Orgainization Name and Address

10. Project/Task/Work Unit No.

11. Contract(C) or Grant(G) No.
(C)
(G)

12. Sponsoring Organization Name and Address
U.S. Environmental Protection Agency
401 M Street, S.W.
Washington, D.C. 20460

13. Type of Report & Period Covered
800/000

14.

15. Supplementary Notes

16. Abstract (Limit: 200 words)

The 2.1-square mile Rockaway Borough Wellfield site is a municipal well field in Rockaway Borough, Morris County, New Jersey. Land use in the area is predominantly residential. The estimated 10,000 people who reside in Rockaway Borough use the underlying glacial aquifer as their sole source of drinking water. Beginning in 1980, a number of State investigations revealed VOC-contaminated soil, sediment, and ground water, which had originated from several source areas within the Borough. In 1981, the Borough constructed a granular activated carbon adsorption treatment system that treated approximately 900,000 gallons per day of raw water pumped from the well field. Overall, the system has reduced VOC concentrations in the municipal water supply to levels meeting State and Federal drinking water standards. A 1986 Record of Decision (ROD) provided for the continued operation and maintenance of the existing ground water treatment system, for a continuation of the RI/FS to positively identify additional contaminant sources, and for further delineation of the full extent of contamination. The 1986 ROD did not, however, address ground water restoration. Recently, EPA also has approved a State-initiated modification to the current treatment system to include the installation of an air stripper as the first stage in

(See Attached Page)

17. Document Analysis a. Descriptors
Record of Decision - Rockaway Borough Wellfield, NJ
Second Remedial Action
Contaminated Medium: gw
Key Contaminants: VOCs (PCE, TCE), metals (chromium, lead)

b. Identifiers/Open-Ended Terms

c. COSATI Field/Group

18. Availability Statement	19. Security Class (This Report) None	21. No. of Pages 66
	20. Security Class (This Page) None	22. Price

(See ANSI-Z39.18) *See Instructions on Reverse* OPTIONAL FORM 272 (4-77) (Formerly NTIS-35) Department of Commerce

EPA/ROD/R02-91/149
Rockaway Borough Wellfield, NJ
Second Remedial Action

Abstract (Continued)

the treatment process. This ROD addresses final restoration of the contaminated onsite ground water to drinking water standards. A future ROD will address the need for remediation of the contaminant sources. The primary contaminants of concern affecting the ground water are VOCs including PCE and TCE; and metals including chromium and lead.

The selected remedial action for this site includes onsite pumping and treatment of ground water from two of three plumes of concern using chemical precipitation and air stripping, followed by reinjecting the treated ground water onsite into the glacial aquifer; and conducting environmental monitoring. Under this remedial action, a single treatment facility would be necessary for the two treatment areas, and no active remedial measures would be taken for the third plume. The estimated present worth cost for this remedial action is $17,818,000, which includes an annual O&M cost of $1,502,000 for 27 years.

PERFORMANCE STANDARDS OR GOALS: Chemical-specific ground water clean-up goals are based on the more stringent of Federal or State MCLs, and include PCE 1 ug/l (State MCL) and TCE 1 ug/l (State MCL).

ROD FACT SHEET

SITE

Name:	Rockaway Borough Well Field
Location/State:	Rockaway Borough, Morris Co., New Jersey
EPA Region:	II
HRS Score (date):	42.26 (August 1982)
NPL Rank (date):	377 (March 1990)

ROD

Date Signed: September 30, 1991

Selected Remedy

Groundwater:	Extraction of contaminated groundwater plume for treatment via chemical precipitation and air stripping. Reinjection of treated groundwater and appropriate environmental monitoring to ensure the effectiveness of the remedy.
Capital Cost:	$ 4,959,000
O & M:	$ 1,502,000
Present Worth:	$ 17,818,000

LEAD

Agency	Federal Remedial Lead
Primary Contact (phone):	Courtney McEnery (212) 264-1251
Secondary Contact (phone):	Robert McKnight (212) 264-7509

WASTE

Type:	Groundwater - Elevated levels of VOCs, primarily TCE and PCE.
Medium:	Groundwater.
Origin:	Pollution originated from three separate source areas within Rockaway Borough.

State of New Jersey
Department of Environmental Protection and Energy
Office of the Commissioner
CN 402
Trenton, NJ 08625-0402
Tel. # 609-292-2885
Fax. # 609-984-3962

Scott A. Weiner
Commissioner

September 30, 1991

Mr. Constantine Sidamon-Eristoff
Regional Administrator
U.S. Environmental Protection Agency
Region II
Jacob K. Javits Federal Building
New York, New York 10278

Dear Mr. Sidamon-Eristoff:

Subject: Rockaway Borough Municipal Wellfield
Record of Decision Concurrence Letter

After reviewing the selected remedy proposed by EPA and the information you supplied the Department in the Agency's Preliminary Evaluation memo dated September 16, 1991, the New Jersey Department of Environmental Protection and Energy (NJDEPE) conditionally concurs with the selected remedy for the above referenced site at this time.

"The remedy presented in this document addresses the current and future threats to human health and the environment associated with the contaminated groundwater at the Rockaway Borough Well Field site. A previous Record of Decision, signed on September 29, 1986, selected an initial remedy for the site which called for the continued operation and maintenance of the existing Borough water treatment system, but did not address groundwater restoration. This Record of Decision provides for the restoration of the contaminated groundwater to drinking water standards. A subsequent decision document is planned to evaluate the need for remediation of the contaminant sources.

The major components of the selected remedy include:

- Extraction of contaminated groundwater and restoration of the groundwater to drinking water standards;
- Treatment of extracted groundwater to levels attaining drinking water standards.;
- Reinjection of treated groundwater; and
- Appropriate environmental monitoring to ensure the effectiveness of the remedy."

DECLARATION STATEMENT

RECORD OF DECISION

ROCKAWAY BOROUGH WELL FIELD

Site Name and Location

Rockaway Borough Well Field
Rockaway Borough, Morris County, New Jersey

Statement of Basis and Purpose

This decision document presents the selected remedial action for groundwater contamination at the Rockaway Borough Well Field site, which was chosen in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended by the Superfund Amendments and Reauthorization Act of 1986 and, to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan. This decision is based on the administrative record for the site.

Assessment of the Site

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

Description of the Selected Remedy

The remedy presented in this document addresses the current and future threats to human health and the environment associated with the contaminated groundwater at the Rockaway Borough Well Field site. A previous Record of Decision, signed on September 29, 1986, selected an initial remedy for the site which called for the continued operation and maintenance of the existing Borough water treatment system, but did not address groundwater restoration. This Record of Decision provides for the restoration of the contaminated groundwater to drinking water standards. A subsequent decision document is planned to evaluate the need for remediation of the contaminant sources.

The major components of the selected remedy include:

- Extraction of contaminated groundwater and restoration of the groundwater to drinking water standards;
- Treatment of extracted groundwater to levels attaining drinking water standards;

DECISION SUMMARY

RECORD OF DECISION

ROCKAWAY BOROUGH WELL FIELD

SITE NAME, LOCATION, AND DESCRIPTION

The Rockaway Borough Well Field site is located in Rockaway Borough, Morris County, New Jersey. The Borough is approximately 2.1 square miles in size and is bordered to the north and west by Rockaway Township and to the east and south by Denville Township.

The Rockaway Borough Well Field site is a municipal well field serving approximately 10,000 people. Groundwater in the area is classified as Class II-A, a current source of drinking water. The Borough's three water supply wells (Numbers 1, 5, and 6) are in a glacial aquifer designated as a sole source aquifer since it is the only viable source of drinking water for Rockaway Borough and the surrounding communities. The three municipal wells are located off Union Street in the eastern section of the Borough. The municipal wells range in depth from 54 to 84 feet.

The Rockaway River is located approximately 750 feet south of the center of the well field, and Beaver Brook, a tributary to the Rockaway River, is located approximately 2,000 feet to the east. Both the Rockaway River and Beaver Brook are classified as FW2-NT surface water bodies, indicating that they are fresh water with no natural trout population. Prior to distribution, the groundwater is treated by a carbon adsorption treatment system which is housed near municipal well Number 5, along with the Rockaway Borough Department of Public Works garage.

Rockaway Borough is located in northwestern New Jersey in the broad, flat valley of the Rockaway River, between two prominent ridges. The easternmost boundary of the borough is near the confluence of the Rockaway River and Beaver Brook. Local relief is approximately 400 feet above mean sea level (MSL). Glacial processes have shaped the surrounding area. The local bedrock was scoured by glaciers into northeast- to southwest-trending ridges separated by broad valleys. Large cobble and boulder fields are present throughout the area as remnants of the Wisconsinan terminal moraine.

Bedrock is overlain by glacial deposits and fill material throughout most of the site area. These deposits vary in thickness and are typically thickest in the bedrock troughs. In addition, the thickness of these deposits varies depending on the proximity to the terminal moraine which generally parallels the Rockaway River.

An interpretation of available subsurface information shows five stratigraphic subunits within Rockaway Borough. These units, in

descending order, include: (1) undifferentiated fill; (2) a well-sorted sand and gravel unit with cobble-rich horizons; (3) a clay and silt unit; (4) a boulder and cobble unit with abundant sand and gravel; and (5) biotite gneiss, granite and/or diorite bedrock. During the field investigation, a clay unit was not observed at any of the newly installed soil borings or monitoring well locations, although other environmental investigations conducted under New Jersey's Environmental Cleanup Responsibility Act (ECRA) indicated that a clay/silt confining unit is present in the northeast portion of the site.

Regional groundwater flow within the glaciofluvial aquifer is in an easterly to southeasterly direction. The municipal production wells have a direct effect upon groundwater elevations, direction, and flow patterns within select portions of the Borough. Municipal pumping well Number 6 is the primary production well of the Borough, with additional quantities of water being pumped from Number 5 and Number 1. Groundwater within the area of influence of the municipal pumping wells will flow at various rates towards these wells. The rate of flow is proportional to the hydraulic conductivity, hydraulic gradient, porosity of the aquifer and the pumping rates of the municipal production wells.

SITE HISTORY AND ENFORCEMENT ACTIVITIES

Investigations, conducted by the New Jersey Department of Environmental Protection and Energy (NJDEPE) at the Rockaway Borough Well Field site since 1980, indicated the presence of volatile organic compounds (VOCs), primarily trichloroethylene (TCE) and tetrachloroethylene (PCE) in the groundwater. Other investigations that were conducted since 1985 at several industrial facilities in Rockaway Borough, under ECRA and other programs, have identified sediment, soil, and groundwater contamination. These facilities include the Roned Realty industrial area, the Klockner and Klockner property, the Pettit Paints facility, and the Stapling Machine Company. The primary contaminants of concern are TCE and PCE. Several inorganic compounds including chromium, lead, and nickel were also identified. This contamination, which has affected the well field, emanates from multiple source areas within Rockaway Borough.

The presence of VOC contamination caused the Borough of Rockaway to construct a three-bed granular activated carbon (GAC) adsorption treatment system. The system began operating in July 1981, treating approximately 900,000 gallons per day (gpd) of raw water pumped from the Borough's wells. Overall, the system has reduced the VOC contaminant concentrations in the municipal water supply to levels meeting the state and federal drinking water standards.

In December 1982, the site was placed on the U.S. Environmental Protection Agency's (EPA's) National Priorities List of Superfund sites. Under a cooperative agreement with EPA, NJDEPE initiated a Remedial Investigation and Feasibility Study (RI/FS) to determine the nature and extent of contamination. The first operable unit RI/FS, conducted by NJDEPE, confirmed the presence of the VOC contamination, but was unable to determine the overall extent or source(s) of the contamination. The RI/FS utilized a soil gas survey that identified three potential source areas within the Borough, although the horizontal and vertical extent of groundwater and soil contamination was not defined. As part of the study, remedial alternatives were developed and evaluated to address the known contamination.

Following a public meeting, at which the results of the RI/FS were presented, and a 30-day public comment period, EPA signed a Record of Decision (ROD) on September 29, 1986. This ROD selected a remedy for the Rockaway Borough Well Field site with the concurrence of the NJDEPE. The selected remedy called for the Borough to continue to operate and maintain the existing GAC filtration system, but noted that the carbon should be changed more frequently. The ROD also directed the continuation of the RI/FS in an attempt to positively identify the contaminant source(s) and further delineate the full extent of contamination.

In recent communications, Rockaway Borough has requested EPA approval of a modification of the current treatment system as approved of in the 1986 ROD. This modification would include the installation of an air stripper as the first stage in the treatment process to be followed by the GAC system. The Borough has determined that due to increases in drinking water standards and the cost of carbon replacement, the proposed upgrade of the treatment process would be cost-effective.

Since, with this modification, the treatment would continue to be protective of public health and the environment, continue to provide potable water which meets federal and state drinking water standards, and be more cost-effective for the Borough to operate and maintain, EPA has determined that it is consistent with the 1986 ROD and, therefore, EPA has no objection to it being implemented by the Borough. Further, EPA recognizes that continued operation of the Borough's water treatment system is an integral part of the remedy selected in this ROD and, therefore, supports any measures taken to reduce operational costs.

HIGHLIGHTS OF COMMUNITY PARTICIPATION

A Community Relations Plan (CRP) was developed to ensure the public opportunities for involvement in site-related decisions, including site analysis and characterization, alternatives analysis, and remedy selection. In addition, the CRP was used by EPA to determine, based on community interviews, activities to

ensure public involvement and to provide opportunities for the community to learn about the site.

EPA held a meeting in August 1986 to explain the initial RI/FS to the public and to report on the progress being made at the site. The results of the RI/FS were presented and groundwater remediation efforts planned for the near future were discussed.

Another meeting was held in November 1989. The purpose of the meeting was to provide residents and local officials with an update on past activities conducted by EPA and NJDEPE, and to discuss the activities of the supplemental RI/FS.

The supplemental RI and FS reports, which addressed the groundwater contamination, were released to the public in July 1991. A Proposed Plan, that identified EPA's preferred remedial alternative, was released on July 18, 1991. The documents were made available to the public at information repositories maintained at the Rockaway Free Public Library and the Rockaway Borough Municipal Complex. The administrative record for the site is located at the Rockaway Free Public Library. A public comment period was held from July 18 through September 16, 1991. A public meeting was held on August 12, 1991, to present the findings of the RI/FS and the Proposed Plan, and to solicit public input. The issues raised at the public meeting and during the public comment period are addressed in the Responsiveness Summary, which is part of this Record of Decision. This decision document presents the selected remedial action for the Rockaway Borough Well Field site, chosen in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act (SARA), and, to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). The decision for this site is based on the administrative record.

SCOPE AND ROLE OF ACTION

This document addresses the requirement of the 1986 ROD which called for the preparation of a supplemental RI/FS, and deals specifically with contamination in groundwater. The selected remedial action entails pumping and treating contaminated groundwater for restoration of the aquifer. This restoration will take an estimated 27 years to complete; however, actual aquifer conditions during remediation may affect this duration.

As noted above, this document deals specifically with remediation of the groundwater. Additional investigations to further delineate the extent of contamination within the immediate source areas will be necessary. While the purpose of the remedial action is to achieve the goal of aquifer restoration, it does not constitute a final action for the site. A subsequent operable

unit will be necessary to evaluate the need for remediation of contamination sources.

SUMMARY OF SITE CHARACTERISTICS

Although the 1986 ROD selected a remedy for the site, the data obtained during the initial RI/FS were insufficient to fully characterize the groundwater plume and positively identify source areas. Therefore, it was necessary for EPA to conduct a supplemental study.

The field investigation at the Rockaway Borough Well Field site consisted of a soil boring and groundwater monitoring well installation program, and the sampling of subsurface soils and groundwater.

Soil

The soil sampling program included five soil borings taken in an area that may have been once used as a municipal landfill located near John and Barnett Streets in the northeast section of Rockaway Borough. VOC contamination was detected in one soil boring, but did not exceed the NJDEPE soil action level. Eight additional soil borings were located throughout Rockaway Borough at suspected contaminant source areas. Figure 1 shows the locations of the soil borings. These soil borings were eventually converted to monitoring wells during the RI. Inorganic contamination was detected in soil boring samples in the former Morris Canal, near the Wall Street/East Main Street area, and the Dye Pit area, near the current location of the Saints Peter & Paul Orthodox Church. Of the 18 inorganic compounds identified in the subsurface soil, beryllium was detected at levels slightly above NJDEPE Interim Soil Action Levels. Arsenic and chromium were also detected above NJDEPE soil action levels. Tables 1 and 2 show the concentrations of contamination found through the soil sampling program.

Groundwater

Two rounds of groundwater samples were collected during the supplemental, or Phase II RI. The first sampling round occurred in October 1989 and consisted of sampling 23 existing monitoring wells. The second round of sampling occurred in September 1990 and consisted of sampling groundwater in 11 newly installed Phase II monitoring wells in addition to 44 other monitoring wells located throughout Rockaway Borough. Figure 1 shows the locations of the monitoring wells. Groundwater samples obtained from shallow, intermediate, and deep wells were analyzed and the results demonstrated that the groundwater is contaminated with VOCs and metals. Tables 3 through 5 show the concentration of the contaminants found in the groundwater.

A total of 12 organic compounds were detected in the groundwater in Rockaway Borough. VOCs were the most frequently detected organic chemicals and of these, PCE and TCE were the most common. TCE was found in significantly higher concentrations than PCE. Concentrations of both contaminants exceeded the Maximum Contaminant Levels (MCLs) which have been developed to protect drinking water. TCE was detected at concentrations as high as 5,900 parts per billion (ppb) in an intermediate depth groundwater monitoring well, and PCE was detected at concentrations as high as 570 ppb in a shallow well. The New Jersey Safe Drinking Water Act MCL for both of these contaminants is 1 ppb. The other organic chemicals were detected infrequently in the groundwater at generally low (<5 ppb) concentrations.

The extent of groundwater contamination by inorganic compounds was evaluated based on the results of samples collected from the 11 newly installed monitoring wells. Chromium, beryllium, and nickel were detected at levels above the primary MCLs. The highest level of chromium was detected in a Wall Street/East Main Street monitoring well at a level of 1,170 ppb. The MCL for chromium is 50 ppb.

Based on the sampling program conducted in the RI, groundwater is contaminated in the Klockner and Klockner, Roned Realty, and the Wall Street/East Main Street areas, with the most extensive contamination present near the Klockner and Klockner property. Figure 2 shows the conceptual location of the three areas of organic groundwater contamination. The extent of organic contamination in the groundwater is generally described as follows:

Klockner & Klockner area - The plume is approximately 1,125 feet wide by 1,375 feet long, and 100 feet deep. The contaminated groundwater volume is estimated to be approximately 290 million gallons. Organic contaminant levels range from 0.5 to 570 ppb for PCE and from 0.3 to 5,900 ppb for TCE.

Roned Realty industrial area - The plume is approximately 500 feet in diameter. The contaminated groundwater volume is approximately 11 million gallons. Organic contamination is primarily TCE, which ranges from 1.1 to 4.3 ppb.

Wall Street/East Main Street area - The plume is approximately 500 feet wide by 1,750 feet long, and 85 feet deep. The contaminated groundwater volume is estimated to be approximately 139 million gallons. Organic contamination is primarily PCE, which ranges from 3.3 to 120 ppb.

SUMMARY OF SITE RISKS

Human Health Risks

EPA conducted a Public Health Evaluation (PHE) of the "no action" alternative to evaluate the potential risks to human health and the environment associated with the Rockaway Borough Well Field site in its current state. This risk assessment only addressed those potential human health impacts associated with domestic use of untreated groundwater from the Rockaway Borough Well Field site. Because a groundwater treatment system is currently in place in the Borough, domestic use of untreated groundwater is considered unlikely. However, the human health risks associated with such use were evaluated to provide a risk-based measure of the extent of contamination associated with the various source areas within Rockaway Borough. This assessment was not intended to provide a complete or exhaustive characterization of all risks potentially associated with groundwater or other contamination in the Rockaway Borough area.

The risk assessment focused on the contaminants which are likely to pose the most significant risks to human health and the environment (chemicals of potential concern). These "chemicals of potential concern" and their concentrations in groundwater are shown in Table 6, and include volatile organic compounds (primarily TCE and PCE) and heavy metals.

Groundwater monitoring data obtained during the RI indicate that chemicals have been released to and are being transported in groundwater. However, because there is currently no use of untreated groundwater by residents or other persons in Rockaway Borough, no complete exposure pathways exist under current land-use conditions. Potential risks associated with in-home use of groundwater were evaluated to provide a risk-based measure of the extent of contamination resulting from the various source areas within the Borough.

EPA's PHE identified several potential exposure pathways by which the public could be exposed to contaminant releases from the Rockaway Borough Well Field site. Persons using untreated groundwater as a domestic water supply could be exposed to chemicals in groundwater through the ingestion of drinking water, inhalation of chemicals that have volatilized from groundwater during use (while showering, cooking, watering the lawn), and dermal contact with groundwater during in-home use (while bathing, swimming in pools, washing dishes).

Under current EPA guidelines, the likelihood of carcinogenic (cancer causing) and noncarcinogenic effects due to exposure to site chemicals are considered separately. It was assumed that the toxic effects of the site-related chemicals would be additive. Thus, carcinogenic and noncarcinogenic risks

associated with exposures to individual indicator compounds were summed to indicate the potential risks associated with mixtures of potential carcinogens and noncarcinogens, respectively. The Health Effects Criteria for the chemicals of potential concern are presented in Table 7.

Noncarcinogenic risks were assessed using a hazard index (HI) approach, based on a comparison of expected contaminant intakes and safe levels of intake (Reference Doses). Reference doses (RfDs) have been developed by EPA for indicating the potential for adverse health effects. RfDs, which are expressed in units of milligrams per kilogram per day (mg/kg-day), are estimates of daily exposure levels for humans which are thought to be safe over a lifetime (including sensitive individuals). Estimated intakes of chemicals from environmental media (e.g., the amount of a chemical ingested from contaminated drinking water) are compared with the RfD to derive the hazard quotient for the contaminant in the particular media. The hazard index is obtained by adding the hazard quotients for all compounds across all media. A hazard index greater than 1 indicates that the potential exists for noncarcinogenic health effects to occur as a result of site-related exposures. The HI provides a useful reference point for gauging the potential significance of multiple contaminant exposures within a single medium or across media.

Potential carcinogenic risks were evaluated using the cancer potency factors developed by EPA for the indicator compounds. Cancer potency factors (CPFs) have been developed by EPA's Carcinogenic Risk Assessment Verification Endeavor for estimating excess lifetime cancer risks associated with exposure to potentially carcinogenic chemicals. CPFs, which are expressed in units of $(mg/kg\text{-}day)^{-1}$, are multiplied by the estimated intake of a potential carcinogen, in mg/kg-day, to generate an upper-bound estimate of the excess lifetime cancer risk associated with exposure to the compound at that intake level. The term "upper bound" reflects the conservative estimate of the risks calculated from the CPF. Use of this approach makes the underestimation of the risk highly unlikely.

For known or suspected carcinogens, EPA considers excess upper-bound individual lifetime cancer risks of between 1×10^{-4} to 1×10^{-6} to be acceptable. This level indicates that an individual has no greater than a one in ten thousand to one in a million chance of developing cancer as a result of exposure to site conditions over a 30-year period.

The Hazard Indices and cancer risks associated with the potential exposure pathways at the Rockaway Borough Well Field site are presented in Table 8. The dominant health risk is posed by the potential future use of groundwater for drinking and showering. Based on the contaminant concentrations identified in the upper

portion of the aquifer in Rockaway Borough, ingestion of groundwater from the Klockner and Klockner region would pose the greatest carcinogenic and noncarcinogenic risk to residents. For adults, the excess lifetime cancer risks is $1x10^{-3}$ (one in a thousand) and the Hazard Index is 30. For persons exposed from birth to age 30, the excess lifetime cancer risk is $2x10^{-3}$ and the Hazard Index is 40. This is primarily due to the liver toxicants, PCE and TCE. In the Roned Realty industrial area, the excess lifetime cancer risk for adults is $4x10^{-4}$ (four in ten thousand) and the Hazard Index is 6. For persons exposed from birth to age 30, the excess lifetime cancer risk is $6x10^{-4}$ and the Hazard Index is 8. The excess lifetime cancer risks for adults in the Wall Street/East Main Street area is $3x10^{-4}$ and the Hazard Index is 8. For persons exposed from birth to age 30, the excess lifetime cancer risk is $4x10^{-4}$ and the Hazard Index is 10. Similarities of risks between the Roned Realty industrial area and the Wall Street/East Main Street area are primarily due to varying levels of potential contaminants of concern other than TCE and PCE.

As in any risk assessment, the estimates of risk for the Rockaway Borough Well Field site have many uncertainties. As a result of the uncertainties, the risk assessment should not be construed as presenting an absolute estimate of risks to human or environmental populations. Rather, it is a conservative analysis intended to indicate the potential for adverse impacts to occur.

Environmental Evaluation

This risk assessment only addressed those potential human health impacts associated with domestic use of untreated groundwater. Environmental impacts were not addressed in this risk assessment.

Conclusion

Actual or threatened releases of hazardous substances from this site, 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.

REMEDIAL ACTION OBJECTIVES

The goal for the cleanup of the groundwater contamination at the Rockaway Borough Well Field site is to restore the groundwater to the MCLs which have been developed to protect drinking water. MCLs are enforceable standards based on health risks associated with an individual's consumption of two liters of water per day over a 70-year period. Therefore, health risks associated with the groundwater contamination resulting from the site will be reduced to within the acceptable range of between 1×10^{-4} to 1×10^{-6} for carcinogens, and the Hazard Indices for noncarcinogens will be less than one. The MCLs for the contaminants of concern

at the site are shown on Table 9. The area of attainment is the contaminated groundwater plume.

DESCRIPTION OF REMEDIAL ALTERNATIVES

The Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended, requires that each selected site remedy be protective of human health and the environment, comply with applicable or relevant and appropriate requirements (ARARs), utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable, and be cost effective.

The RI identified the groundwater itself as the principal environmental medium affected by contamination. The sources of this groundwater contamination are not addressed by this ROD.

The FS evaluated, in detail, three main alternatives for remediating the groundwater. Alternatives 2 and 3 have been further broken down into separate components. A brief description of each of the alternatives, as well as an estimate of their cost and implementation time frame, follows.

Alternative 1: No Further Action

Estimated Capital Cost:	$ 0
Estimated Five-Year Review Cost:	$ 44,000
Estimated Present Worth:	$ 27,000

The Superfund program requires that a "no action" alternative be developed and evaluated at every site to establish a baseline for comparison of other remedial alternatives. Under this alternative, EPA would take no further action to address contamination at the site. This alternative relies entirely on natural attenuation and the existing water supply treatment scheme for achieving cleanup levels. A five-year review would be conducted to determine whether or not the contamination has spread. If necessary, appropriate actions would be considered at that time.

Alternative 2: Separate Remediation of Plumes

Option 2A - Extraction, Air Stripping with Treated Water Discharge

	Reinjection to groundwater	Discharge to surface water
Estimated Capital Cost:	$ 6,386,000	$ 6,217,000
Estimated Annual Operation and Maintenance (O&M) Costs:	$ 3,001,000	$ 2,942,000
Estimated Present Worth:	$20,439,000	$19,899,000
Implementation Time Frame:	27 years	27 years

The major features of this remedial alternative include groundwater extraction (pumping and collection) from all three contaminant plumes, construction and operation of three separate facilities for groundwater treatment, discharge of the treated water from the three separate treatment facilities, and a performance monitoring program.

Groundwater would be extracted at an estimated total rate of 1,450,000 gallons per day (gpd) from the aquifer using a series of approximately 12 extraction wells. The groundwater extraction strategy for the individual plumes would be designed to capture the bulk of the contaminants from the respective plumes. It is estimated that three extraction wells would extract groundwater at a rate of 130,000 gpd (total 390,000 gpd) from the Roned Realty industrial area. It is estimated that five extraction wells would extract groundwater at 100,000 gpd (total 500,000 gpd) from the Wall Street/East Main Street plume and four extraction wells would extract groundwater at 140,000 gpd (total 560,000 gpd) from the Klockner and Klockner plume. The exact number and location of the extraction wells would be determined during remedial design.

Treatment of the extracted groundwater would include chemical precipitation to remove inorganic contaminants. The resultant sludge would require appropriate off-site disposal. Chemical precipitation would then be followed by air stripping to remove VOCs from the contaminated groundwater.

It is estimated that VOCs would be emitted from the air stripper at levels below allowable discharge rates without any air pollution controls. However, the need for provisions to destroy them by catalytic incineration or adsorption using vapor-phase activated carbon will be evaluated during remedial design.

Discharge options include either reinjection into the aquifer or discharge to the surface waters of Rockaway River and/or Beaver Brook.

For the reinjection options, groundwater would be treated to MCLs and reinjected into to the aquifer using approximately 12 injection wells. The conceptual layout of the system includes three injection wells located upgradient of the plume. These wells would reinject into the aquifer all of the treated groundwater from the Wall Street/East Main Street plume. At the Roned Realty industrial area, three injection wells would be located along the circular boundary of the plume in order to redirect the groundwater flow away from the river. For the Klockner and Klockner plume, three injection wells would be located at the upgradient plume boundary. The other three injection wells would be located near the northeastern corner of the plume, where the groundwater divide is located at present. An option of using infiltration galleries would also be explored.

The exact number and location of the injection wells would be determined during remedial design.

For surface water discharge options, the groundwater would be treated to levels which attain New Jersey surface water discharge limitation requirements and discharged to on-site surface water bodies. Treated water from the Roned Realty industrial area and the Wall Street/East Main Street area would be discharged to the Rockaway River and the treated groundwater from the Klockner and Klockner area would be discharged to Beaver Brook.

Option 2B - Extraction, Chemical Oxidation enhanced by Ultra-Violet (UV) Photolysis with Treated Water Discharge

	Reinjection to groundwater	Discharge to surface water
Estimated Capital Cost:	$ 6,369,000	$ 6,304,000
Estimated Annual O&M Cost:	$ 3,063,000	$ 3,004,000
Estimated Present Worth:	$ 20,888,000	$ 20,349,000
Implementation period:	27 years	27 years

This option is basically the same as Option 2A, with the exception that chemical precipitation would be followed by chemical oxidation enhanced by UV photolysis. In addition, UV photolysis options may require treatability studies to establish operating parameters for site-specific conditions. These treatability studies would be conducted during the remedial design for the site.

Option 2C - Extraction, Carbon Adsorption with Treated Water Discharge

	Reinjection to groundwater	Discharge to surface water
Estimated Capital Cost:	$ 6,041,000	$ 5,871,000
Estimated Annual O&M Cost:	$ 2,998,000	$ 2,939,000
Estimated Present Worth:	$ 20,086,000	$ 19,546,000
Implementation period:	27 years	27 years

This option is basically the same as Option 2A, with the exception that chemical precipitation would be followed by carbon adsorption to remove VOCs from the contaminated groundwater. Carbon adsorption treatment would require off-site regeneration or disposal of the spent carbon.

Alternative 3A: Combined Remediation of the Klockner and Klockner and Wall Street/East Main Street Plumes and No Further Action at Roned Realty Industrial Area

Option 3A(1) - Extraction, Air Stripping with Treated Water Discharge

	Reinjection to groundwater	Discharge to surface water
Estimated Capital Costs:	$ 4,959,000	$ 4,369,000
Estimated Annual O&M:	$ 1,502,000	$ 1,446,000
Estimated Present Worth:	$ 17,818,000	$ 16,794,000
Implementation period:	27 years	27 years

The major features of this remedial alternative include groundwater extraction (pumping and collection) from the Klockner and Klockner and Wall Street/East Main Street plumes, the construction and operation of a single treatment facility for groundwater treatment, discharge of treated water from this combined treatment facility, and a performance monitoring program. No active remedial measures would be taken for the Roned Realty industrial area plume. The residual risks associated with the Roned Realty industrial area are not considered significant, since flushing and attenuation processes are expected to restore the aquifer quality in that area prior to the completion of the remediation efforts at the Klockner and Klockner and Wall Street/East Main Street plumes.

Conceptually, groundwater would be extracted at a total rate of approximately 1,060,000 gpd from the aquifer using an estimated nine extraction wells. It is anticipated that five extraction wells pumping at approximately 100,000 gpd each for the Wall Street/East Main Street plume, and four extraction wells pumping at approximately 140,000 gpd each for the Klockner and Klockner plume would be required. The exact number and location of the injection wells would be determined during remedial design.

Treatment and discharge options for this option are the same as those for Alternative 2, Option A. However, one single treatment facility would be constructed, instead of three separate facilities discussed in Alternative 2.

It is expected that the amount of groundwater treated would vary in time. Initially, groundwater would be treated at a total rate of approximately 1,060,000 gpd, but would decrease to approximately 560,000 gpd as the Wall Street/East Main Street plume attained remediation goals (estimated at approximately 11 years). At that point in time, only the wells extracting groundwater from the Klockner and Klockner plume would continue to operate (estimated at approximately 16 more years).

Considering this variation in treatment requirements, a modular approach could be used in estimating the size of the treatment facility. The facility could have two modules, essentially one for each of the two plumes being treated. As soon as the remediation of the Wall Street/East Main Street area is completed, one module could be shut off, achieving a significant reduction in O&M costs for the duration of remediation. The overall cleanup time frame is estimated to be 27 years.

Option 3A(2) - Extraction, Chemical Oxidation enhanced by UV Photolysis with Treated Water Discharge

	Reinjection to groundwater	Discharge to surface water
Estimated Capital Costs:	$ 5,040,000	$ 4,450,000
Estimated Annual O&M:	$ 1,547,000	$ 1,491,000
Estimated Present Worth:	$ 17,448,000	$ 16,424,000
Implementation period:	27 years	27 years

This option is basically the same as Option 3A(1), with the exception that chemical precipitation would be followed by chemical oxidation enhanced by UV photolysis.

Option 3A(3) - Extraction, Carbon Adsorption with Treated Water Discharge

	Reinjection to groundwater	Discharge to surface water
Estimated Capital Costs:	$ 4,882,000	$ 4,292,000
Estimated Annual O&M:	$ 1,501,000	$ 1,444,000
Estimated Present Worth:	$ 16,922,000	$ 15,898,000
Implementation period:	27 years	27 years

This option is basically the same as Option 3A(1), with the exception that chemical precipitation would be followed by carbon adsorption.

Alternative 3B: Combined Remediation of the Klockner and Klockner and Wall Street/East Main Street Plumes and Separate Remediation of the Roned Realty Plume

The major features of this remedial alternative include the groundwater extraction (pumping and collection) from all of the three contaminant plumes, construction and operation of two separate facilities for groundwater treatment, discharge of the treated water from the two separate treatment facilities, and a performance monitoring program.

This alternative includes the combined remediation of the Klockner and Klockner and Wall Street/East Main Street plumes as in Alternative 3A, with the addition of a separate extraction and treatment system for the Roned Realty plume. Treatment and discharge options for this alternative are the same as those for Alternatives 2 and 3A. However, one treatment facility would be constructed for the Klockner and Klockner and Wall Street/East Main Street plumes with a separate treatment facility constructed for the Roned Realty industrial area plume.

Under this alternative, the estimated present worth for treatment by air stripping with treated water discharge is $19,441,000; by UV photolysis, $19,008,000; and by carbon adsorption, $18,177,000.

SUMMARY OF COMPARATIVE ANALYSIS OF ALTERNATIVES

Evaluation Criteria

The alternatives noted above were evaluated using criteria derived from the NCP and SARA. These criteria relate directly to factors mandated by SARA in Section 121, including Section 121(b)(1)(A-G). The criteria are as follows:

- Overall protection of human health and the environment
- Compliance with applicable or relevant and appropriate requirements
- Long-term effectiveness and permanence
- Reduction of toxicity, mobility, or volume via treatment
- Short-term effectiveness
- Implementability
- Cost
- State acceptance
- Community acceptance

Comparisons

A comparative discussion of the major components of the alternatives, using the evaluation criteria, follows.

Overall Protection

Overall protection of human health and the environment is the central mandate of CERCLA, as amended. Protection is achieved by

reducing health and environmental threats and by taking appropriate action to ensure that, in the future, there would be no unacceptable risks to human health and the environment through any exposure pathway.

The "No Further Action" alternative would not provide any additional protection of human health and the environment than has been provided by the remedy initiated by the Borough of Rockaway and later endorsed in the 1986 ROD. No further treatment would be provided, and only natural and pumping-induced processes would attenuate groundwater contamination.

The "No Further Action" alternative is not considered protective and, therefore, will not be considered further in the analysis of options for this site.

Alternatives 2 and 3 are responsive to the remedial action objectives and provide adequate protection of human health and the environment.

The major difference among Alternatives 2 and 3 is the manner in which groundwater is treated and discharged. Since all the groundwater extraction and treatment options would meet the cleanup goals effectively, the degree of protection is not much different.

An important difference between the two treatment alternatives is the construction of the treatment facilities. Alternative 2 includes the use of three separate facilities (one for each plume) while Alternative 3 treats contaminated groundwater in one combined facility. For Alternative 3A, there is no provision of control measures for the Roned Realty industrial area plume. However, the residual risks associated with that area are not considered significant since flushing and attenuation processes would alleviate groundwater contamination.

Compliance with ARARs

Section 121(d) of CERCLA requires that remedies for Superfund sites comply with federal and state laws that are applicable and legally enforceable. Remedies must also comply with the requirements of laws and regulations that are not applicable, but are relevant and appropriate. Applicable requirements are defined as cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that specifically address a hazardous substance, pollutant, remedial action, location, or other circumstance at a Superfund site. Relevant and appropriate requirements are defined as substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that, while not "applicable" to a hazardous substance, pollutant, contaminant,

remedial action, location or circumstance at a Superfund site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site. EPA has also developed another category of requirements, known as "to be considered" (TBCs), that includes nonpromulgated criteria, advisories, guidance, and proposed standards issued by federal or state governments. TBCs are not potential ARARs because they are neither promulgated nor enforceable. It may be necessary to consult TBCs to interpret ARARs, or to determine preliminary remediation goals when ARARs do not exist for particular contaminants. However, identification and compliance with TBCs is not mandatory in the same way that it is for ARARs.

ARARs for the Rockaway Borough Well Field site include the more stringent of the federal or state MCLs, which are shown in Tables 9 and 11, New Jersey Surface Water Quality Standards, Clean Water Act Ambient Water Quality Criteria, Occupational Safety and Health Administration Standards, the Resource Conservation and Recovery Act, and the Clean Air Act.

EPA has divided ARARs into three categories to facilitate their identification:

> Action-Specific ARARs are usually technology- or activity-based requirements or limitations on actions or conditions involving specific substances.
>
> Chemical-specific ARARs are usually health- or risk-based numerical values or methodologies used to determine acceptable concentrations of chemicals that may be found in or discharged to the environment.
>
> Location-specific ARARs restrict actions or contaminant concentrations in certain environmentally sensitive areas. Examples of areas regulated under various federal laws include floodplains, wetlands, and locations where endangered species or historically significant cultural resources are present.

The goal for the cleanup of groundwater contamination at the Rockaway Borough Well Field site is to restore the groundwater to the more stringent of the federal or state MCLs which have been devised to protect drinking water. For groundwater reinjection options, extracted water would be treated to MCLs, and for surface water discharge options, it would be treated to attain New Jersey surface water discharge limitation requirements.

The treatment plant and associated facilities for both Alternatives 2 and 3 would be operated in accordance with federal and state hazardous waste treatment facility requirements. Both alternatives would comply with all pertinent chemical-specific,

action-specific, and location-specific ARARs as referenced earlier.

To ensure compliance with the National Historic Preservation Act, a cultural resources survey will be prepared during the remedial design phase.

Long-term Effectiveness and Permanence

This evaluation criterion refers to the ability of the remedy to maintain reliable protection of human health and the environment over time once cleanup goals have been met.

The major benefits associated with Alternatives 2 and 3 include minimization of migration of contaminated groundwater and removal of contaminants. The bulk of contaminated groundwater would be treated to meet ARARs resulting in significant reductions of risks to human health and the environment. The extracted groundwater will be treated to achieve the more stringent of the federal or state MCLs prior to its reinjection into the ground in order to bring the aquifer to its intended beneficial use without treatment. For discharge to surface water options, groundwater would be treated to attain New Jersey surface water discharge limitation requirements. The long-term performance monitoring program would confirm the effectiveness of the remedy.

For Alternative 3A, there is no provision of control measures for the Roned Realty industrial area plume. However, the residual risks associated with that area are not considered significant, since flushing and attenuation processes are expected to restore the aquifer quality in that area prior to the completion of the remediation efforts at the Klockner and Klockner and the Wall Street/East Main Street plumes.

The remedy would be designed to prevent adverse impacts to the Borough's wells. An assessment would be made during the design of the remedy to ensure that any adverse impacts to wetland areas would also be mitigated. If appropriate, some of the treated groundwater could be discharged to wetland areas to help offset any dewatering effects created by groundwater extraction. It is believed that reinjecting the treated water will minimize adverse impacts.

Reduction of Toxicity, Mobility, or Volume through Treatment

This evaluation criterion relates to the performance of a technology or remedial alternative in terms of eliminating or controlling risks posed by the toxicity, mobility, or volume of hazardous substances.

Alternatives 2 and 3 would reduce the toxicity, mobility, and volume of the contaminants present in the groundwater through the

use of extraction and treatment methods. Sludge resulting from the treatment for metals removal would be disposed of off site, and spent carbon from the removal of VOCs would be regenerated or disposed of off site. It is anticipated that, at the conclusion of the remedial action, the groundwater quality will be within MCLs. The treatment provided under both of these alternatives would be irreversible.

The toxicity of contaminants for Alternative 3A, at the Roned Realty industrial area plume, would be reduced by flushing and natural attenuation processes.

Short-term Effectiveness

This criterion considers 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.

The major risk associated with the contaminated groundwater is the use of it for potable purposes. A GAC filtration system was installed on the Borough's municipal water supply system in July 1981. Therefore, that risk has already been significantly reduced.

Neither Alternative 2 or 3 would create any significant short-term, health-related concerns for the public beyond those associated with normal construction activities. Increased traffic during construction and transportation of treatment residuals is expected.

The remedy does present a slight risk increase resulting from emissions; however, these can be minimized through careful management of the treatment unit.

The remedy would be designed to prevent adverse impacts to the Borough's wells. An assessment would be made during the design of the remedy to ensure that any adverse impacts to wetland areas would also be mitigated. If appropriate, some of the treated groundwater could be discharged to wetland areas to help offset any dewatering effects created by groundwater extraction. It is believed that reinjecting the treated water will minimize adverse impacts.

Implementability

This criterion examines the technical and administrative feasibility of a remedy, including availability of materials and services needed to implement the chosen solution.

Alternatives 2 and 3 both rely on technically feasible and reliable treatment processes to actively restore groundwater

quality. Extraction and treatment systems are relatively easily designed and constructed. The treatment units described in Alternatives 2 and 3 are readily available, and can be easily operated and maintained. A pilot-scale treatability study would be required to establish operating parameters for UV photolysis as a treatment option. The reinjection of treated groundwater should be relatively easily implemented, and would aid in the flushing of contamination from the aquifer. Surface water discharge should also be relatively easily implemented, however, it would not influence the movement of groundwater and enhance the flushing of contaminants from the aquifer.

Alternatives 2 and 3 have few associated administrative difficulties which could delay implementation. The technologies have been used successfully to address similar contaminants at other Superfund sites, and skilled workers needed to implement the remedies are readily available in the area.

Sufficient land is available to build the treatment plants required for any of the alternatives within the existing boundaries of the Rockaway Borough Well Field site. Installation of the extraction and injection wells and their associated piping may have to take place on private properties and may be expected to require some administrative and legal efforts.

Cost

Costs are evaluated in terms of remedial action capital costs, operation and maintenance costs, and present worth.

The major cost differences between the alternatives depends on their classification. The No Further Action alternative is the least expensive with an estimated present worth of $27,000. The estimated present worth for the Separate Remediation of Plumes ranges from $19,546,000 to $20,888,000, whereas, for the Combined Remediation of the Klockner and Klockner and Wall Street/East Main Street plumes with No Further Action at the Roned Realty industrial area, it varies between $15,898,000 and $17,818,000. If remediation of the Roned Realty industrial area plume is included as in Alternative 3B, the estimated present worth ranges from $18,177,000 to $19,441,000. The preferred alternative, 3A(1), has an estimated present worth of $17,818,000. Table 10 shows the summary of costs.

State Acceptance

The State Acceptance factor addresses whether the State of New Jersey supports, opposes, or has no comment on the preferred alternative.

The New Jersey Department of Environmental Protection and Energy has conditionally concurred with the selected remedy. The

Department has raised some issues relative to the attainment of MCL goals and the consideration of other alternatives. It has also questioned the effectiveness of moving ahead with a groundwater remedy without addressing the sources.

The Record of Decision clearly indicates that subsequent source investigations will be necessary to better characterize any continuing sources of contamination as well as to determine the need for remediation of such contamination. It also indicates that the MCL goal may be reevaluated based on operating experience with the remedial system. In addition, the ROD commits to evaluating reasonable approaches to ensure that the Borough's water supply system and our extraction and treatment system operate in a complimentary and efficient manner.

Contrary to the State's position, EPA considered appropriate remedial alternatives to address the groundwater contamination and firmly believes that the selected remedy will be successful in achieving cleanup goals and can be performed in a cost-effective manner. Therefore, EPA is not making a commitment to amend the ROD at a later date.

Community Acceptance

This evaluation factor addresses public reaction to the remedial alternatives which were considered, and the preferred alternative.

Issues raised during the public comment period and at the public meeting held on August 12, 1991, are addressed in the Responsiveness Summary section of this ROD. Upon review of these comments, EPA has determined that no significant changes to the remedy, as it was originally identified in the Proposed Plan, were necessary.

SELECTED REMEDY

Section 121(b) of CERCLA, as amended, requires EPA to select remedial actions which utilize permanent solutions and alternative treatment technologies or resource recovery options to the maximum extent practicable. In addition, EPA prefers remedial actions that permanently and significantly reduce the mobility, toxicity, or volume of site wastes.

After careful review and evaluation of the alternatives evaluated in detail in the feasibility study, and consideration of all evaluation criteria, EPA presented Alternative 3, Option A(1), Combined Remediation at the Klockner and Klockner and Wall Street/East Main Street Plumes with No Further Action at the Roned Realty Industrial Area. This alternative includes groundwater extraction, treatment by chemical precipitation and

air stripping, reinjection of treated groundwater, and a performance monitoring program.

The input received during the public comment period, consisting primarily of questions and statements submitted at the public meeting held on August 12, 1991, and written comments, is presented in the attached Responsiveness Summary. Public comments encompassed a range of issues, but did not necessitate any major changes in the preferred alternative for the site. Accordingly, the preferred alternative has been selected by EPA as the remedial solution for the site.

The selected remedy addresses only the contaminated groundwater. Additional investigations to further delineate the extent of the sources of the groundwater contamination will be necessary.

The goal of the remedial action at the Rockaway Borough Well Field site is to restore the groundwater to MCLs. Based on information obtained during the remedial investigation and on a careful analysis of the remedial alternatives, it is anticipated that the selected remedy will achieve this goal. However, studies suggest that groundwater extraction and treatment remedies are not always completely successful in reducing contaminants to health-based levels in an aquifer. Actual operation of the remedial system may indicate the technical impracticability of reaching health-based water quality standards using this approach. If, during the implementation of the remedy, it becomes apparent that contaminant levels have ceased to decline and are remaining relatively constant at levels higher than the remedial goal, or that it is no longer cost-beneficial to operate the remedial system, than the remedial goal and the remedy itself may be reevaluated.

Under the above scenario, it is likely that operation of the remedial extraction wells and treatment system would be suspended. The Borough would then need to continue operating its system to treat the levels of contamination remaining in the groundwater prior to distribution for potable use.

Since the Borough's water supply system is extracting a portion of the contaminated groundwater, continued operation of the system has a beneficial effect on groundwater quality. Therefore, during design of the selected remedy, EPA will explore ways to integrate the water supply and remedial systems to maximize their combined effectiveness.

The selected remedy will include groundwater extraction for an estimated period of 27 years, during which the remedial 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, but not be limited to:

a) alternating pumping at wells to eliminate stagnation points; and

b) pulse-pumping to allow aquifer equilibration and to encourage adsorbed contaminants to partition into the groundwater.

Some additional activities will be performed during the remedial design and remedial action phases for the site. These activities are described below.

The aquifers will be periodically monitored during the remedial design and remedial action phases, as well as following the completion of the remedial action. During the remedial design, studies will be undertaken to further delineate the extent of contamination and groundwater flow patterns, and to determine if the remediation of the groundwater contamination can be accelerated by optimizing the extraction system.

An assessment will be made during the remedial design to ensure that any adverse impacts to any wetland areas will be mitigated. If appropriate, some of the treated groundwater could be discharged to wetland areas to help offset any dewatering effects created by the groundwater extraction.

A cultural resources survey will be prepared to ensure compliance with the National Historic Preservation Act.

STATUTORY DETERMINATIONS

Superfund remedy selection is based on CERCLA, as amended, and the regulations contained in the NCP. EPA's primary responsibility at Superfund sites is to undertake remedial actions that achieve adequate protection of human health and the environment. Additionally, several other statutory requirements and preferences have been established. These specify that, when complete, the selected remedy must comply with ARARs, unless a statutory waiver is justified. The remedy must also be cost effective and utilize permanent solutions and alternative treatment or resource recovery technologies to the maximum extent practicable. Finally, there is a preference for remedies which employ treatment that permanently and significantly reduce the toxicity, mobility, or volume of hazardous wastes as their principal element. The following sections discuss how the remedy

selected for the Rockaway Borough Well Field site meets these requirements and preferences.

Protection of Human Health and the Environment

The selected remedy protects human health and the environment through the extraction and treatment of contaminated groundwater.

The extraction and treatment of the contaminated groundwater will significantly reduce the threat of potential exposure to contaminated groundwater. The potential risk, estimated under a future use scenario in the PHE, is 2 $x10^{-3}$. The remedy, upon completion, will restore the aquifer to the MCLs. Therefore, health risks associated with the groundwater contamination resulting from the site will be reduced to within the acceptable range of between 1 x 10^{-4} to 1 x 10^{-6} for carcinogens, and the Hazard Indices for noncarcinogens will be less than one.

There are no short-term adverse impacts associated with the selected remedy which cannot be readily controlled. While no cross-media impacts are expected from the remedy, any environmental impacts associated with site related contaminants or remedial activities will be addressed in the remedial design.

Compliance with Applicable or Relevant and Appropriate Requirements

The selected remedy will comply with all applicable or relevant and appropriate action-, contaminant-, and location-specific requirements. The ARARs are presented below.

Action-Specific

The selected remedy will be in compliance with all federal and state ARARs. The cleanup goals for the remediation of the groundwater are the more stringent of the state and federal MCLs which are standards for drinking water.

Emissions from the treatment unit would conform with the provisions of the Clean Air Act. This will be accomplished through the installation of appropriate air pollution control equipment if necessary. Sludge from chemical precipitation would be disposed of according to RCRA requirements. Occupational Safety and Health Administration requirements would be complied with during the implementation of the remedy.

With respect to state action-specific ARARs, the air stripper and any other regulated equipment will be designed, constructed, and operated to meet the Air Pollution Control and the Noise Pollution Control Act requirements and regulations.

Chemical-Specific

The more stringent of the state and federal MCLs will be used as cleanup goals for the groundwater remediation.

Location-Specific

The site is not within the coastal zone as defined by the State of New Jersey. Additionally, there are no federally designated wild and scenic rivers and there are no significant agricultural lands in the vicinity of the site. The project area may be sensitive for the discovery of cultural resources. Therefore, as discussed earlier, a cultural resources survey will be prepared during remedial design. Additionally, a wetlands assessment will be performed at that time to determine the presence of and potential impacts on wetland areas. If the remedial action takes place in a floodplain, or will result in changes to flooding levels, a floodplains assessment will be conducted during the design phase.

Utilization of Permanent Solutions and Alternative Treatment or Resource Recovery Technologies to the Maximum Extent Practicable

EPA has determined that the selected remedy represents the maximum extent to which permanent solutions and treatment technologies can be utilized in a cost-effective manner for the Rockaway Borough Well Field site. Of the alternatives that are protective of human health and the environment, and comply with ARARs, EPA has determined that the selected remedy provides the best balance of tradeoffs in terms of long-term effectiveness and permanence, reduction in toxicity, mobility, or volume achieved through treatment, short-term effectiveness, implementability, cost, and community acceptance.

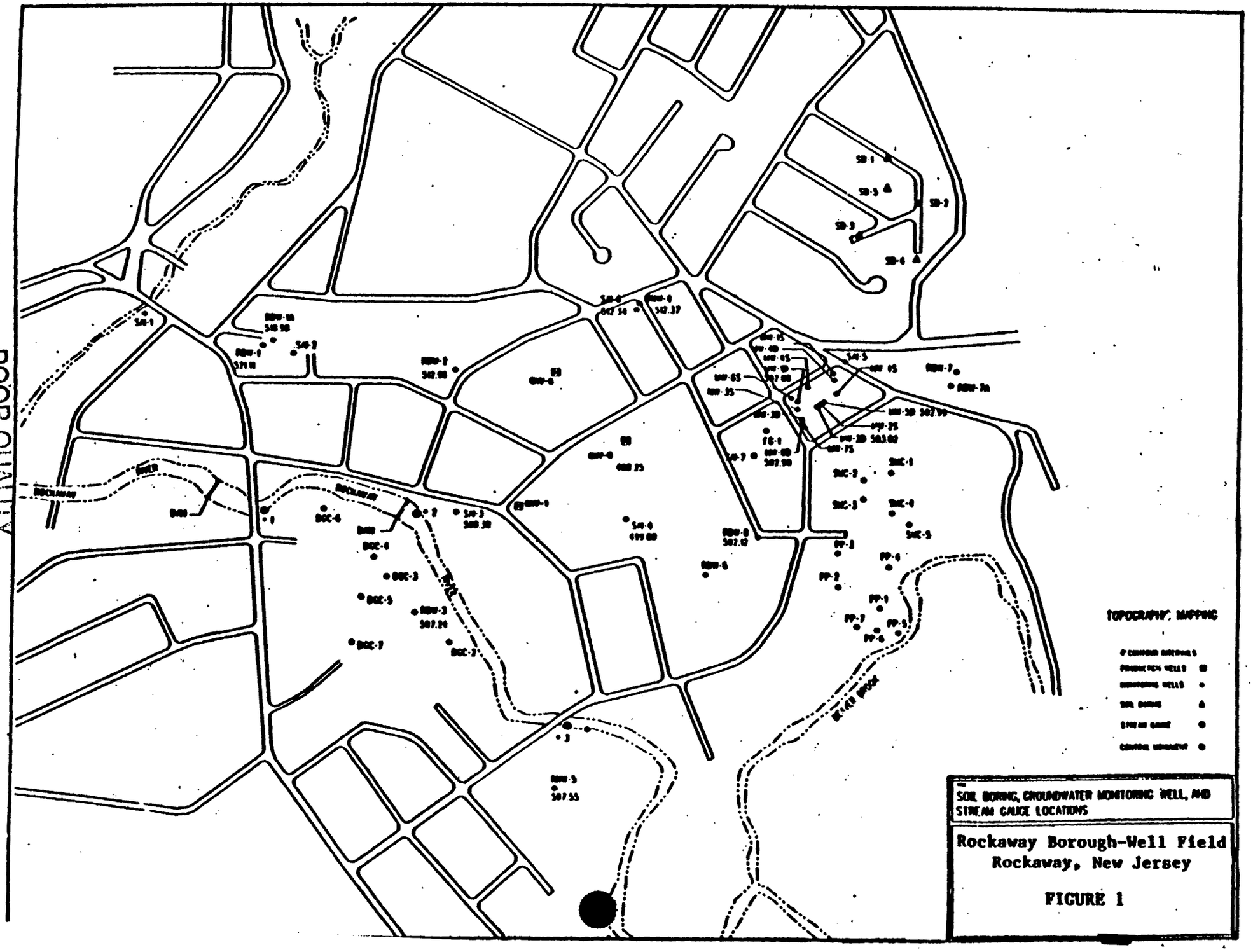
Alternative 2 reduces the toxicity, mobility, and volume of the contaminants in the groundwater; complies with ARARs; provides both short-term and long-term effectiveness; and protects human health and the environment equally as well as Alternative 3. The costs for both of the alternatives are also relatively close. However, Alternative 3 may be more easily implemented than Alternative 2. Therefore, the selected remedy is determined to be the most appropriate solution for the contaminated groundwater at the Rockaway Borough Well Field site.

Cost Effectiveness

The selected alternative is determined to be cost effective because it provides the highest degree of protectiveness among the alternatives evaluated at reasonable cost.

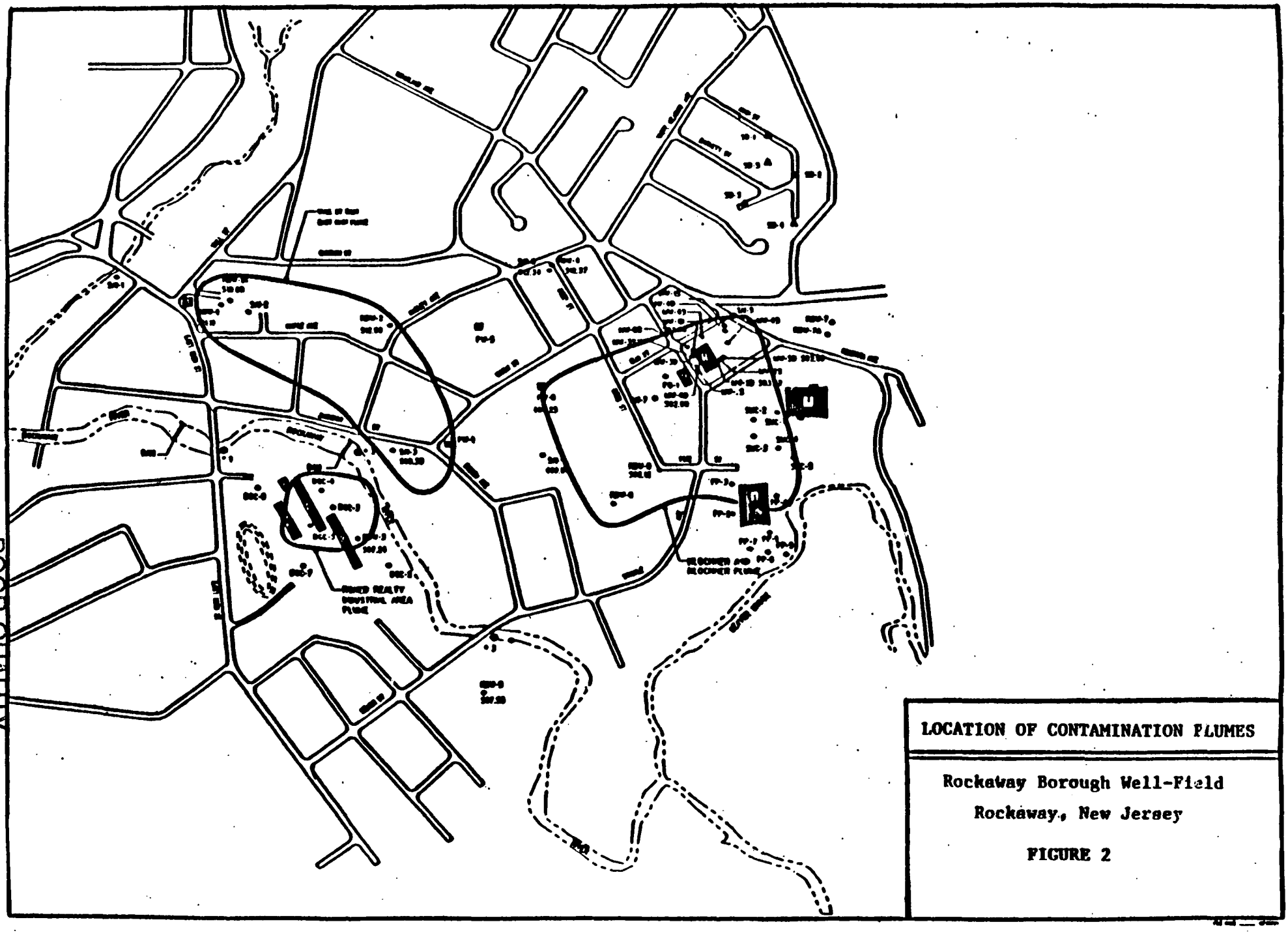
Preference for Treatment as a Principal Element

By extracting and treating the contaminated groundwater, the selected remedy addresses the threats posed by the site through the use of treatment technologies. Therefore, the statutory preference for remedies that employ treatment as a principal element is satisfied by the selected remedy.



Rockaway Borough-Well Field
Rockaway, New Jersey

FIGURE 1



LOCATION OF CONTAMINATION PLUMES

Rockaway Borough Well-Field

Rockaway, New Jersey

FIGURE 2

TABLE 1

ROCKAWAY BOROUGH WELL FIELD SITE
SURSURFACE SOIL
SEMI-VOLATILE ORGANIC ANALYTICAL RESULTS

SAMPLE LOCATION	SB-05	RBW-1	RBW-3	RBW-4	RBW-5	RBW-7
SAMPLE NUMBER	RB-SS-05	RB-SS-01	RB-SS-03	RB-SS-04	RB-SS-05	RB-SS-07
SAMPLE DEPTH	0ft: 12-14 Ft.	0ft: 0-2 Ft.	0ft: 0-2 Ft.	0ft: 0-2 Ft.	0ft: 10-12 Ft.	0ft: 12-14 Ft.
CONCENTRATION	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg
DATE COLLECTED	6/16/99	6/11/99	6/16/99	6/9/99	6/1/99	6/4/99
Acenaphthene			49 J			
Fluoranthene		78 J	630 J			
Anthracene			110 J			
Di-n-Butylphthalate	6300 B					
Fluorenthene		120 J	1000 J			62 J
Pyrene		150 J	900 J			61 J
Benzo(a)Anthracene		67 J	400 J			
Chrysene		130 J	830 J			
Bis(2-Ethylhexyl)Phthalate	1600 B		470 J	1300	2400 B	400
Benzo(b)Fluoranthene		160 J	830 J			
Benzo(k)Fluoranthene		67 J	280 J			
Benzo(a)Pyrene		120 J	410 J			
Indeno(1,2,3-cd)Pyrene		110 J	340 J			
Dibenz(a,h)Anthracene		100 J	84 J			
Benzo(g,h,i)Perylene		420 J	340 J			
Total	7900 B	1632 J	6484 J	1300	2400 B	563 J

*Note: Only compounds detected are listed in this table.
U - Analyte was not detected at the instrument detection limit given.
[redacted] - Determined by method of standard addition.
J - Reported value is between the instrument detection limit and the contract-required detection limit.
[redacted] digestion spike was not within control limits.

R - Rejected due to QA/QC review.
r - Correlation coefficient less than 0.995.
N - Spiked sample recovery was not within control limits.

J - Estimated.
B - Determined by standard addition.
* - Duplicate was not within control limits.

TABLE 2

ROCKAWAY ROROUGH WELL FIELD SITE
SUBSURFACE SOIL
INORGANIC ANALYTICAL RESULTS*
(Page 1 of 4)

SAMPLE LOCATION	SB-01	SB-02	SB-03	SB-04	SB-04	SB-05	RSW-1	RSW-2
SAMPLE NUMBER	RB-SB-01	RB-SB-02	RB-SB-03	RB-SB-04	RB-SB-04	RB-SB-05	RB-SB-01	RB-SB-02
SAMPLE DEPTH	SOIL: 4-6 FT.	SOIL: 10-12 FT.	SOIL: 6-8 FT.	SOIL: 4-6 FT.	SOIL: 12-14 FT.	SOIL: 12-14 FT.	SOIL: 6-8 FT.	SOIL: 14-16 FT.
UNITS	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG	MG/KG
DATE COLLECTED	6/14/00	6/11/00	6/14/00	6/14/00	6/14/00	6/14/00	6/11/00	6/20/00
Aluminum	10,000	7,000	10,000	7,170	6,380	14,300	30,000	2,000*
Arsenic	0.63 B	0.44 B	0.55 BW	0.32 B	0.27 B	0.72 B	0.80 J0*B	0.66 B
Barium	26.40 B	20.2 B	31.2 B	16.6 B	24.6 B	34.6 B	64.00	16.30 BJ
Beryllium	0.66 B	0.61 B	0.76 B	0.52 B	0.72 B	0.60 B	1.00	0.23 B
Calcium	674 B	508 B	1460	1060	1500	1000 B	1000	1200
Chromium	26.0	12.9	14.7 B	14.3 J	17.6 J	16.20	50.00 J	6.00
Cobalt	6.0 B	6.6 BJ	7.6 BJ	7.6 BJ	12.6 J	8.60 B	0 B	4.00 B
Copper	16.20	14.4	R	R	R	16.60	32.60	6.70
Iron	21,700	13,700	16,100	16,000	16,000	23,100	30,000	6,000*
Lead	4.60 B*J	1.6 J	2.0 B	1.0	1.2	2.2 *J	53.20*	2.10
Magnesium	1000	1720	1000	2000	2120	2040	2610	1300*J
Manganese	160	171	170	120	137	230	700	120 N*J
Mercury	U	U	U	U	U	U	0.52	50*
Nickel	7.0 B	7.3	8.0 B	6.7 B	8.2	10.70	10.30	7.60 B
Potassium	672.0 BJ	573 B	1,110	640 B	1,100	824 BJ	1,400	376 B
Sodium	160 B	201 B	200 B	232 B	262 B	62.60 B	U	60.50 B
Vanadium	30.60	23.2 J	26.2	20.0	20.0	34.60	62.10	11.0
Zinc	14.60 J	14.6	22.2 NJ	10.2 NJ	12.0 J6	10.10 J	137 J	12.40 *J

*Note: Only compounds detected are listed in this table.
U - Analyte was not detected at the instrument detection limit given.
B - Determined by method of standard addition.
B - Reported value is between the instrument detection limit and the contract-required detection limit.
W - Post digestion spike was not within control limits.
R - Rejected due to QA/QC review.
Y - Correlation coefficient less than 0.995.
N - Spiked sample recovery was not within control limits.
J - Estimated.
S - Determined by standard addition.
* - Duplicate was not within control limits.

TABLE 2

ROCKAWAY BOROUGH WELL FIELD SITE
SURFACE SOIL
INORGANIC ANALYTICAL RESULTS*
(Page 2 of 4)

SAMPLE LOCATION	RSW-3	RSW-4	RSW-5	RSW-6	RSW-6	RSW-7A	RSW-7	RSW-7
SAMPLE NUMBER	RS-00-00	RS-00-04	RS-00-05	RS-00-06	RS-00-06	RS-00-7A	RS-00-07	RS-00-07
SAMPLE DEPTH	000: 4-6 FT.	000: 0-0 FT.	000: 10-12 FT.	000: 10-12 FT.	012: 22-24 FT.	000: 0-10 FT.	000: 10-12 FT.	007: 12-14 FT.
UNITS	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG
DATE COLLECTED	6/16/00	6/0/00	6/1/00	6/21/00	6/21/00	6/24/00	6/0/00	6/0/00
Aluminum	10,000	11,000 J	8,330 *	9,230 *	2,430 *	8,330 *	3,700	6,030 J
Antimony	UJ	U	U	0.00 BJ	4.00 BJ	U	0.0 BNJ	U
Arsenic	0.03 B	2.10	121 *J	0.40 B	2.40 J	1.20 B	0.00 B	0.00 B
Barium	20.40 B	41.00 BJ	40.0 N*J	47.00	11.00 B	13.10 BJ	12.00 BJ	40.10 J
Beryllium	0.00 B	R	0.02 B	U	U	0.23 B	R	R
Cadmium	U	1.0 J	U*	1.10 J	0.41 BJ	U	1.20 NJ	1.40 J
Calcium	674 B	032 BJ	1,000	0,300	001 B	1,320	1,700	1,000 J
Chromium	20.0	10.30 J	1,070 *J	10.30	3.00*	0.00	0.00	10.10 J
Cobalt	0.0 B	10.10 BJ	7.3 B	0.00 B	2.00 B	0 B	4.20 B	0.00 J
Copper	10.20	14.30 J	27.0 EN*J	20.00	7.00	12.30 J	10.00 J	10.40 J
Iron	21,700	10,000 J	10,000 *	10,000 *	0,070 *	14,100 *	0,100 EJ	10,000 J
Lead	4.00 E*J	0.10 J	30.3 J	20.00 BJ	R	1.20 J	2.40	4.00 J
Magnesium	1,000	2,030 J	2,010	0,720	1,100	4,010 *J	1,200	2,000 J
Manganese	100	217 J	174	402 N	01.00 NJ	103 N*J	00.20 NJ	217 J
Nickel	7.0 B	14 J	0.0	17.00	4.00 B	0.10	4.10 B	12.10 J
Potassium	072.0 BJ	010 B	720 B	1,000	240 B	000 B	200 B	020 BJ
Silver	U	U	1.0 B	0.00 BJ	U	U	0NJ	U
Sodium	100 B	404 BJ	R	200 B	00.70 B	00.00 B	240 BJ	020 BJ
Vanadium	20.00	20.00 J	23.1	22.00	0.20 B	11.30	14.10	20.00 J
Zinc	14.00 J	30.00 J	40.0 EN*J	30.00 *	15.00 *	24.70 *J	14.10 J	30.00 J

*Note: Only compounds detected are listed in this table.
U - [redacted] was not detected at the instrument detection limit given.
B - [redacted] mined by method of standard addition.
B - [redacted] ted value is between the instrument detection limit and the contract-required detection limit.
W - [redacted] digestion spike was not within control limits.

[redacted] Rejected due to QA/QC review.
[redacted] correlation coefficient less than 0.995.
[redacted] Spiked sample recovery was not within control limits.

J - Estimated.
B - Determined by standard addition.
* - Duplicate was not within control limits.

TABLE 2

ROCKAWAY BOROUGH WELL FIELD SITE
SURFACE SOIL
INORGANIC ANALYTICAL RESULTS*
(Page 3 of 4)

SAMPLE LOCATION	RSW-6							
SAMPLE NUMBER	RS-06-00							
SAMPLE DEPTH	0&4: 0-6 FT.							
UNITS	MG/KG							
DATE COLLECTED	6/30/00							
Aluminum	10,100							
Antimony	6.10 B							
Arsenic	3.10							
Barium	48.60 B							
Beryllium	0.73 B							
Cadmium	0.07 BJ							
Calcium	2,100							
Chromium	16.30 *J							
Cobalt	11.50 B							
Copper	16.40							
Iron	20,700 *							
Lead	4.60							
Magnesium	3,490							
Manganese	480 NJ							
Nickel	16.30							
Potassium	1,040							
Sodium	249 B							

*Note: Only compounds detected are listed in this table.
U - Analyte was not detected at the instrument detection limit given.
B - Determined by method of standard addition.
B - Reported value is between the instrument detection limit and the contract-required detection limit.
W - Post digestion spike was not within control limits.
R - Rejected due to QA/QC review.
T - Correlation coefficient less than 0.995.
N - Spiked sample recovery was not within control limits.
J - Estimated.
B - Determined by standard addition.
* - Duplicate was not within control limits.

TABLE 2

ROCKAWAY BOROUGH WELL FIELD SITE
SURFACE SOIL
INORGANIC ANALYTICAL RESULTS*
(Page 4 of 4)

SAMPLE LOCATION	RSW-6							
SAMPLE NUMBER	RB-00-00							
Vanadium	33							
Zinc	28.70 *							

*Note: Only compounds detected are listed in this table.
U - Analyte was not detected at the instrument detection limit given.
B - Determined by method of standard addition.
B - [illegible] value is between the instrument detection limit and the contract-required detection limit.
! digestion spike was not within control limits.

R - Rejected due to QA/QC review.
T - Correlation coefficient less than 0.995.
N - Spiked sample recovery was not within control limits.

J - Estimated.
B - Determined by standard addition.
* - Duplicate was not within control [illegible]

TABLE 3

ROCKAWAY BOROUGH WELL FIELD SITE
GROUNDWATER VOLATILE ORGANICS ANALYTICAL RESULTS
(Page 1 of 13)

Compound	MW-1S 6/30/87 (ppb)	MW-1S 8/7/87 (ppb)	MW-1S Round #1 (ppb)	MW-1S Round #2 (ppb)	MW-1D 6/30/87 (ppb)	MW-1D 8/10/87 (ppb)	MW-1D Round #1 (ppb)	MW-1D Round #2 (ppb)
KLOCKNER AND KLOCKNER								
Trans 1-2 Dichloroethylene	130	43	0.2	—	—	—	—	—
Trichloroethylene (TCE)	230	78	130	110	23	14	20	24
Tetrachloroethylene (PCE)	22	—	2.0	2.1	—	6	0.2	1.8 J
Cis-1,2 Dichloroethane	—	—	68	20	—	—	2.0	—
Chloroform	—	—	0.1	—	—	—	—	
Benzene	—	—	0.6	—	—	—	—	—
1,1-Dichloroethylene	—	—	—	—	—	—	—	—
1,1,2-Trichloroethane	—	—	—	—	—	—	—	—
Carbon Disulfide	—	—	—	—	—	—	—	—
1,1-Dichloroethane	—	—	—	—	—	—	—	—
1,1,1-Trichloroethane	—	—	—	—	—	—	—	—
1,2-Dichloroethane	—	—	—	—	—	—	—	—
Xylene	—	—	—	—	—	—	—	—
TOTAL VOLATILE ORGANICS	382	121	201.1	141.1	23	20	22.2	25.8

Compound	MW-2S 6/30/87 (ppb)	MW-2S 8/7/87 (ppb)	MW-2S Round #1 (ppb)	MW-2S Round #2 (ppb)	MW-2D 6/30/87 (ppb)	MW-2D 8/7/87 (ppb)	MW-2D Round #1 (ppb)	MW-2D Round #2 (ppb)
KLOCKNER AND KLOCKNER								
Trans 1-2 Dichloroethylene	91	97	2.0	4.4	20	150	2.0	8.2
Trichloroethylene (TCE)	100	280	470	680	120	730	1200	5800
Tetrachloroethylene (PCE)	—	20	40	40	—	—	8	17
Cis-1,2 Dichloroethane	—	—	170	100	—	—	220	270
Chloroform	—	—	0.3	—	—	—	0.4	—
Benzene	—	—	—	—	—	—	0.1	—
1,1-Dichloroethylene	—	—	—	—	—	—	3.0	2.4
1,1,2-Trichloroethane	—	—	0.3	—	—	—	0.3	—
Carbon Disulfide	—	—	0.1	—	—	—	0.2	—
1,1-Dichloroethane	—	—	—	—	—	—	—	—
1,1,1-Trichloroethane	—	—	—	—	—	—	—	—
1,2-Dichloroethane	—	—	—	—	—	—	—	—
Xylene	—	—	—	—	—	—	—	—
TOTAL VOLATILE ORGANICS	191	400	680.7	868.0	140	880	1,430	6,102.2

TABLE 3

ROCKAWAY BOROUGH WELL FIELD SITE
GROUNDWATER VOLATILE ORGANICS ANALYTICAL RESULTS
(Page 2 of 13)

Compound	MW-3S 7/02/87 (ppb)	MW-3S 9/7/87 (ppb)	MW-3S Round #1 (ppb)	MW-3S Round #2 (ppb)	MW-3D 7/01/87 (ppb)	MW-3D 9/10/87 (ppb)	MW-3D Round #1 (ppb)	MW-3D Round #2 (ppb)
KLOCKNER AND KLOCKNER								
Trans 1-2 Dichloroethylene	--	--	--	0.6 M	--	--	0.6	0.4 M
Trichloroethylene (TCE)	18	18	17	16.6	180	41	2100	800
Tetrachloroethylene (PCE)	50	62	100	100	--	--	5.6	0.2 J
Cis-1,2 Dichloroethene	--	--	14.0	13.0	--	--	220	30
Chloroform	--	--	0.4	--	--	--	0.2	--
Benzene	--	--	--	--	--	--	--	--
1,1-Dichloroethylene	--	--	--	--	--	--	0.7	--
1,1,2-Trichloroethane	--	--	--	--	--	--	--	--
1,1-Dichloroethane	--	--	--	--	--	--	0.1	--
1,1,1-Trichloroethane	--	--	0.2	--	--	--	0.2	--
1,2-Dichloroethane	--	--	0.3	--	--	--	0.4	--
Xylene	--	--	--	--	--	--	0.2	--
Carbon Disulfide	--	--	0.2	--	--	--	0.2	--
TOTAL VOLATILE ORGANICS	**68**	**97**	**312.1**	**311.6**	**180**	**41**	**2,327.6**	**870.6**

Compound	MW-4S Round #1 (ppb)	MW-4S Round #2 (ppb)	MW-4D Round #1 (ppb)	MW-4D Round #2 (ppb)	MW-5S Round #1 (ppb)	MW-5S Round #2 (ppb)	MW-5D Round #1 (ppb)	MW-5D Round #2 (ppb)
KLOCKNER AND KLOCKNER								
Trans 1-2 Dichloroethylene	Not Sampled	2.2	Not Sampled	4.7	Not Sampled	--	Not Sampled	0.6 M
Trichloroethylene (TCE)	--	660	--	38	--	88	--	1300 J
Tetrachloroethylene (PCE)	--	7.6 J	--	--	--	23 J	--	--
Cis-1,2 Dichloroethene	--	160	--	--	--	3	--	25
Chloroform	--	--	--	--	--	--	--	--
Benzene	--	--	--	--	--	--	--	--
1,1-Dichloroethylene	--	--	--	--	--	--	--	--
1,1,2-Trichloroethane	--	--	--	--	--	--	--	--
Carbon Disulfide	--	--	--	--	--	--	--	--
1,1-Dichloroethane	--	--	--	--	--	--	--	--
1,1,1-Trichloroethane	--	--	--	--	--	--	--	--
1,2-Dichloroethane	--	--	--	--	--	--	--	--
Xylene	--	--	--	--	--	--	--	--
TOTAL VOLATILE ORGANICS	**--**	**769.7**	**--**	**34.7**	**--**	**92**	**--**	**1,325.6**

TABLE 3

ROCKAWAY BOROUGH WELL FIELD RITE
GROUNDWATER VOLATILE ORGANICS ANALYTICAL RESULTS
(Page 3 of 13)

Compound	MW-6S Round #1 (ppb)	MW-6S Round #2 (ppb)	MW-6D Round #1 (ppb)	MW-6D Round #2 (ppb)	MW-7S Round #1 (ppb)	MW-7S Round #2 (ppb)
KLOCKNER AND KLOCKNER						
Trans 1-2 Dichloroethylene	Not Sampled	--	--	--	Not Sampled	--
Trichloroethylene (TCE)	--	79	18	12	--	48
Tetrachloroethylene (PCE)	--	170	0.4	12	--	810
Cis-1,2 Dichloroethene	--	27	0.4	--	--	--
Chloroform	--	--	0.1	--	--	--
Benzene	--	--	0.1	--	--	--
1,1-Dichloroethylene	--	--	--	--	--	--
1,1,2-Trichloroethane	--	--	--	--	--	--
Carbon Disulfide	--	--	0.2	--	--	--
1,1-Dichloroethane	--	--	0.2	--	--	--
1,1,1-Trichloroethane	--	--	0.4	--	--	--
1,2-Dichloroethane	--	--	--	--	--	--
Xylene	--	--	0.2	--	--	--
Carbon Tetrachloride	--	--	0.2	--	--	--
Ethylbenzene	--	--	0.4	--	--	--
TOTAL VOLATILE ORGANICS	--	276	20.7	24	--	858

TABLE 3

ROCKAWAY ROFOUGH WELL FIELD SITE
GROUNDWATER VOLATILE ORGANICS ANALYTICAL RESULTS
(Page 4 of 13)

Compound	DOC-2 8/87 (ppb)	DOC-2 Round #1 (ppb)	DOC-2 Round #2 (ppb)	DOC-3 8/87 (ppb)	DOC-3 Round #1 (ppb)	DOC-3 Round #2 (ppb)	DOC-4 Round #1 (ppb)	DOC-4 Round #2 (ppb)
ROWED REALTY								
Trans 1-2 Dichloroethylene	–	–	ND	ND	–	ND	–	–
Trichloroethylene (TCE)	–	0.2	ND	ND	0.2	ND	1.1	1.1
Tetrachloroethylene (PCE)	–	0.2	ND	ND	–	ND	–	–
Cis-1,2 Dichloroethene	–	0.2	ND	ND	0.1	ND	–	–
Chloroform	–	0.1	ND	ND	–	ND	–	–
Benzene	–	–	ND	ND	–	ND	–	–
1,1-Dichloroethylene	–	–	ND	ND	0.2	ND	–	–
1,1,2-Trichloroethane	–	–	ND	ND	–	ND	–	–
Carbon Disulfide	–	–	ND	ND	–	ND	–	–
1,1-Dichloroethene	–	0.2	ND	ND	–	ND	0.1	–
1,1,1-Trichloroethane	–	0.1	ND	ND	0.1	ND	–	–
1,2-Dichloroethane	–	0.8	ND	ND	–	ND	0.5	–
Xylene	–	–	ND	ND	–	ND	–	–
Toluene	2	–	ND	ND	–	ND	–	–
Chloromethane	–	0.2	ND	ND	–	ND	–	–
Bromomethane	–	0.1	ND	ND	–	ND	–	–
Trichlorofluoromethane	–	0.1	ND	ND	–	ND	–	–
2,2-Dichloropropane	–	0.1	ND	ND	–	ND	–	–
1,2-Dichloropropane	–	0.1	ND	ND	–	ND	–	–
Bromodichloromethane	–	0.1	ND	ND	–	ND	–	–
1,2-Dibromoethane	–	0.1	ND	ND	–	ND	–	–
Chlorobenzene	–	0.1	ND	ND	–	ND	–	–
Bromobenzene	–	0.1	ND	ND	–	ND	–	–
Vinyl Chloride	–	–	ND	ND	–	ND	–	–
TOTAL VOLATILE ORGANICS	**2**	**2.0**	**ND**	**ND**	**0.3**	**ND**	**1.7**	**1.1**

TABLE 3

ROCKAWAY BOROUGH WELL FIELD SITE
GROUNDWATER VOLATILE ORGANICS ANALYTICAL RESULTS
(Page 5 of 13)

Compound	DOC-6 8/87 (ppb)	DOC-5 Round #1 (ppb)	DOC-5 Round #2 (ppb)	DOC-8 8/87 (ppb)	DOC-8 Round #1 (ppb)	DOC-8 Round #2 (ppb)	DOC-7 8/87 (ppb)	DOC-7 Round #1 (ppb)	DOC-7 Round #2 (ppb)
ROWED REALTY									
Trans 1-2 Dichloroethylene	4	0.1	–	ND	–	ND	ND	ND	ND
Trichloroethylene (TCE)	10	0.7	4.3	ND	–	ND	ND	ND	ND
Tetrachloroethylene (PCE)	3	1.0	1.0	ND	–	ND	ND	ND	ND
Cis-1,2 Dichloroethene	–	0.6	4.6	ND	–	ND	ND	ND	ND
Chloroform	–	0.5	–	ND	–	ND	ND	ND	ND
Benzene	–	–	–	ND	–	ND	ND	ND	ND
1,1-Dichloroethylene	–	0.2	–	ND	–	ND	ND	ND	ND
1,1,2-Trichloroethane	–	–	–	ND	–	ND	ND	ND	ND
Carbon Disulfide	–	–	–	ND	–	ND	ND	ND	ND
1,1-Dichloroethane	6	0.6	2.0	ND	–	ND	ND	ND	ND
1,1,1-Trichloroethane	–	2.0	–	ND	–	ND	ND	ND	ND
1,2-Dichloroethane	–	0.5	–	ND	–	ND	ND	ND	ND
Xylene	–	–	–	ND	0.4	ND	ND	ND	ND
Toluene	–	–	–	ND	–	ND	ND	ND	ND
Chloromethane	–	–	–	ND	–	ND	ND	ND	ND
Bromomethane	–	–	–	ND	–	ND	ND	ND	ND
Trichlorofluoromethane	–	–	–	ND	–	ND	ND	ND	ND
2,2-Dichloropropane	–	–	–	ND	–	ND	ND	ND	ND
1,2-Dichloropropane	–	–	–	ND	–	ND	ND	ND	ND
Bromodichloromethane	–	–	–	ND	–	ND	ND	ND	ND
1,2-Dibromoethane	–	–	–	ND	–	ND	ND	ND	ND
Chlorobenzene	–	–	–	ND	–	ND	ND	ND	ND
Ethylbenzene	–	–	–	ND	–	ND	ND	ND	ND
Vinyl Chloride	–	2.3	1.5 J	ND	–	ND	ND	ND	ND
TOTAL VOLATILE ORGANICS	**23**	**21.7**	**14.0**	**ND**	**0.4**	**ND**	**ND**	**ND**	**ND**

TABLE 3

ROCKAWAY BOROUGH WELL FIELD SITE
GROUNDWATER VOLATILE ORGANICS ANALYTICAL RESULTS
(Page 6 of 13)

Compound	BAI-01 3/88 (ppb)	BAI-01 Round #1 (ppb)	BAI-01 Round #2 (ppb)	BAI-02 3/88 (ppb)	BAI-02 Round #2 (ppb)	BAI-03 3/88 (ppb)	BAI-03 Round #1 (ppb)	BAI-03 Round #2 (ppb)
NJDEP MONITORING WELLS								
1,1-Dichloroethane	—	—	ND	—	ND	—	0.4	ND
Chloroform	—	—	ND	—	ND	—	—	ND
1,1,1-Trichloroethane	—	—	ND	—	ND	—	—	ND
Carbon Tetrachloride	—	—	ND	—	ND	—	—	ND
Trichloroethylene (TCE)	—	—	ND	—	ND	—	—	ND
Tetrachloroethylene (PCE)	—	—	16*	366	ND	4.69	8	3.3 [illegible]
Ethylbenzene	—	—	ND	—	ND	—	0.1	ND
p&m-Xylene	—	0.3	ND	—	ND	—	—	ND
o-Xylene	—	0.1	ND	—	ND	—	—	ND
Methylene Chloride	34.9	—	ND	19.7	ND	13.7	—	ND
TOTAL VOLATILE ORGANICS	34.9	0.4	ND	384.7	ND	18.39	8.5	3.3 ND

Compound	BAI-04 3/88 (ppb)	BAI-04 Round #1 (ppb)	BAI-04 Round #2 (ppb)	BAI-05 3/88 (ppb)	BAI-05 Round #1 (ppb)	BAI-05 Round #2 (ppb)
NJDEP MONITORING WELLS						
1,1-Dichloroethane	ND	—	ND	ND	—	—
Chloroform	ND	0.2	ND	ND	0.3	0.2 ND
1,1,1-Trichloroethane	ND	0.3	ND	ND	0.2	—
Carbon Tetrachloride	ND	—	ND	ND	0.2	—
Trichloroethylene (TCE)	ND	0.6	ND	ND	—	—
Tetrachloroethylene (PCE)	ND	0.5	ND	ND	—	—
Ethylbenzene	ND	—	ND	ND	—	—
p&m-Xylene	ND	0.3	ND	ND	—	—
o-Xylene	ND	—	ND	ND	—	—
Methylene Chloride	ND	—	ND	ND	—	—
TOTAL VOLATILE ORGANICS	ND	2.1	ND	ND	0.7	0.2 ND

TABLE 3

ROCKAWAY BOROUGH WELL FIELD SITE
GROUNDWATER VOLATILE ORGANICS ANALYTICAL RESULTS
(Page 7 of 13)

Compound	BAI-08 3/89 (ppb)	BAI-08 Round #1 (ppb)	BAI-08 Round #2 (ppb)	BAI-07 3/89 (ppb)	BAI-07 6/07/07 (ppb)	BAI-07 Round #1 (ppb)	BAI-07 Round #2 (ppb)
SUDEP MONITORING WELLS							
1,1-Dichloroethane	ND	–	ND	–	–	–	–
Chloroform	ND	0.3	ND	–	–	0.6	–
1,1,1-Trichloroethane	ND	0.3	ND	–	–	0.2	–
Carbon Tetrachloride	ND	–	ND	–	–	–	–
Trichloroethylene (TCE)	ND	–	ND	253	170	19	19.4
Tetrachloroethylene (PCE)	ND	–	ND	–	–	2	–
Ethylbenzene	ND	–	ND	–	–	–	–
p&m-Xylene	ND	–	ND	–	–	0.1	–
o-Xylene	ND	–	ND	–	–	–	–
Methylene Chloride	ND	–	ND	–	–	–	1.0 J
TOTAL VOLATILE ORGANICS	ND	0.6	ND	253	170	19.1	11.4

Compound	SMC-1 3/03/89 (ppb)	SMC-1 Round #2 (ppb)	SMC-2 Round #2 (ppb)	SMC-3 6/23/89 (ppb)	SMC-3 Round #2 (ppb)	SMC-4 3/03/89 (ppb)	SMC-4 6/23/89 (ppb)	SMC-4 Round #2 (ppb)
STAPLING MACHINE COMPANY								
Trans 1,2 Dichloroethylene	–	–	–	–	–	–	ND	ND
Trichloroethylene (TCE)	–	0.6 M	0.3 M	10	–	–	ND	ND
Tetrachloroethylene (PCE)	–	0.6 M	2.0 M	25	1.2	–	ND	ND
Cis-1,2 Dichloroethene	–	–	–	–	–	–	ND	ND
Chloroform	–	–	–	–	–	–	ND	ND
Benzene	–	–	–	10	–	–	ND	ND
1,1-Dichloroethylene	–	–	–	22	–	–	ND	ND
1,1,2-Trichloroethane	–	–	–	–	–	–	ND	ND
Carbon Disulfide	–	–	–	–	–	–	ND	ND
1,1-Dichloroethane	–	–	–	–	–	–	ND	ND
1,1,1-Trichloroethane	–	–	–	–	–	–	ND	ND
1,2-Dichloroethane	–	–	–	–	–	–	ND	ND
Xylene	–	–	–	–	–	–	ND	ND
Toluene	0.6	–	–	10	–	0.6	ND	ND
Chlorobenzene	–	–	–	13	–	–	ND	ND
TOTAL VOLATILE ORGANICS	0.6	1.0 M	2.3 M	110.0	1.2	0.6	ND	ND

TABLE 3

ROCKAWAY BOROUGH WELL FIELD SITE
GROUNDWATER VOLATILE ORGANICS ANALYTICAL RESULTS
(Page 8 of 13)

Compound	SMC-5 3/03/88 (ppb)	SMC-5 6/23/88 (ppb)	SMC-5 Round #2 (ppb)
STAPLING MACHINE COMPANY			
Trans 1-2 Dichloroethylene	--	ND	ND
Trichloroethylene (TCE)	--	ND	ND
Tetrachloroethylene (PCE)	--	ND	ND
Cis-1,2 Dichloroethene	--	ND	ND
Chloroform	--	ND	ND
Benzene	--	ND	ND
1,1-Dichloroethylene	--	ND	ND
1,1,2-Trichloroethane	--	ND	ND
Carbon Disulfide	--	ND	ND
1,1-Dichloroethane	--	ND	ND
1,1,1-Trichloroethane	--	ND	ND
1,2-Dichloroethane	--	ND	ND
Xylene	--	ND	ND
Toluene	11 B	ND	ND
Chlorobenzene	--	ND	ND
TOTAL VOLATILE ORGANICS	**11 B**	**ND**	**ND**

TABLE 3

ROCKAWAY BOROUGH WELL FIELD SITE
GROUNDWATER VOLATILE ORGANICS ANALYTICAL RESULTS
(Page 9 of 13)

Compound	PP-1 Round #2 (ppb)	PP-2 Round #2 (ppb)	PP-3 Round #2 (ppb)	PP-4 Round #2 (ppb)	PP-5 Round #2 (ppb)	PP-6 Round #2 (ppb)
PETTIT PAINTS						
Trans 1-2 Dichloroethylene	—	ND	ND	—	ND	—
Trichloroethylene (TCE)	0.6 M	ND	ND	—	ND	0.49 M
Tetrachloroethylene (PCE)	—	ND	ND	1.0 M	ND	0.10 M
Cis-1,2 Dichloroethene	—	ND	ND	—	ND	—
Chloroform	—	ND	ND	—	ND	—
Benzene	—	ND	ND	—	ND	—
1,1-Dichloroethylene	—	ND	ND	—	ND	—
1,1,2-Trichloroethane	—	ND	ND	—	ND	—
Carbon Disulfide	—	ND	ND	—	ND	—
1,1-Dichloroethane	—	ND	ND	—	ND	—
1,1,1-Trichloroethane	—	ND	ND	—	ND	—
1,2-Dichloroethane	—	ND	ND	—	ND	—
Xylene	4400	ND	ND	—	ND	—
Toluene	40	ND	ND	—	ND	—
Ethylbenzene	7000	ND	ND	—	ND	—
Propylbenzene	32.2 J	ND	ND	—	ND	—
TOTAL VOLATILE ORGANICS	11,472.8 J	ND	ND	1.0 M	ND	0.59 M

TABLE 3

ROCKAWAY BOROUGH WELL FIELD SITE
GROUNDWATER VOLATILE ORGANICS ANALYTICAL RESULTS
(Page 10 of 13)

Compound	RBW-1 Round #2 (ppb)	RBW-1A Round #2 (ppb)	RBW-2 Round #2 (ppb)	RBW-3 Round #2 (ppb)	RBW-4 Round #1 (ppb)
EPA WELLS					
Trans 1-2 Dichloroethylene	--	--	--	ND	ND
Trichloroethylene (TCE)	--	--	--	ND	ND
Tetrachloroethylene (PCE)	29.3 J	14.1 J	130.0 J	ND	ND
Cis-1,2 Dichloroethene	--	--	--	ND	ND
Chloroform	--	--	--	ND	ND
Benzene	--	--	--	ND	ND
1,1-Dichloroethylene	--	--	--	ND	ND
1,1,2-Trichloroethane	--	--	--	ND	ND
Carbon Disulfide	--	--	--	ND	ND
1,1-Dichloroethane	--	--	--	ND	ND
1,1,1-Trichloroethane	--	--	--	ND	ND
1,2-Dichloroethane	--	--	--	ND	ND
Xylene	--	--	--	ND	ND
TOTAL VOLATILE ORGANICS	29.3	14.1	130.0	ND	ND

Compound	RBW-5 Round #2 (ppb)	RBW-6 Round #2 (ppb)	RBW-7 Round #2 (ppb)	RBW-7A Round #2 (ppb)	RBW-8 Round #2 (ppb)	RBW-8A Round #2 (ppb)
EPA WELLS						
Trans 1-2 Dichloroethylene	ND	--	--	ND	--	ND
Trichloroethylene (TCE)	ND	58.0 J	4.2	ND	58.3 J	ND
Tetrachloroethylene (PCE)	ND	--	--	ND	--	ND
Cis-1,2 Dichloroethene	ND	--	--	ND	--	ND
Chloroform	ND	--	--	ND	--	ND
Benzene	ND	--	--	ND	--	ND
1,1-Dichloroethylene	ND	--	--	ND	--	ND
1,1,2-Trichloroethane	ND	--	--	ND	--	ND
Carbon Disulfide	ND	--	--	ND	--	ND
1,1-Dichloroethane	ND	--	--	ND	--	ND
1,1,1-Trichloroethane	ND	--	--	ND	--	ND
1,2-Dichloroethane	ND	--	--	ND	--	ND
Xylene	ND	--	--	ND	--	ND
TOTAL VOLATILE ORGANICS	--	58.0	4.2	--	58.3	--

TABLE 3

ROCKAWAY BOROUGH WELL FIELD SITE
GROUNDWATER VOLATILE ORGANICS ANALYTICAL RESULTS
(Page 11 of 13)

Compound	FG-1 Round #2 (ppb)
F.G. CLOVER	
Trans 1-2 Dichloroethylene	—
Trichloroethylene (TCE)	81.0 J
Tetrachloroethylene (PCE)	160.0 J
Cis-1,2 Dichloroethene	—
Chloroform	—
Benzene	—
1,1-Dichloroethylene	—
1,1,2-Trichloroethane	—
Carbon Disulfide	—
1,1-Dichloroethane	—
1,1,1-Trichloroethane	—
1,2-Dichloroethane	—
Xylene	—
TOTAL VOLATILE ORGANICS	**241.0**

TABLE 3

ROCKAWAY BOROUGH WELL FIELD SITE
GROUNDWATER VOLATILE ORGANIC ANALYTICAL RESULTS
(Page 12 of 13)

Compound	GW-01 Round #1 (ppb)	GW-01 Round #2 (ppb)	GW-05 Round #1 (ppb)	GW-05 Round #2 (ppb)	GW-08 Round #1 (ppb)	GW-08 Round #2 (ppb)
MUNICIPAL WELLS						
Chloromethane	—	—	—	ND	0.7	—
Trichlorofluoromethane	—	—	—	ND	0.7	—
1,1-Dichloroethane	0.2	—	—	ND	—	—
Cis 1-2-Dichloroethene	0.6	—	—	ND	0.7	0.6 M
Chloroform	—	—	—	ND	0.1	—
1,1,1-Trichloroethane	0.2	—	0.1	ND	0.3	—
1,2-Dichloroethane	0.2	—	—	ND	0.5	—
Trichloroethylene (TCE)	0.3	—	—	ND	10.3	10.0 J
Tetrachloroethylene (PCE)	40.0	10.0 J	0.2	ND	82.0	120.0 J
Carbon Disulfide	0.1	—	—	ND	—	—
TOTAL VOLATILE ORGANICS	41.0	10.0	0.3	ND	105.3	130.6

Compound	GW-CAR Round #1 (Post Treatment) (ppb)	GW-CAR Round #2 (Post Treatment) (ppb)	GW-INF Round #1 (Pre Treatment) (ppb)	GW-INF Round #2 (Pre Treatment) (ppb)
MUNICIPAL WELLS (Carbon Treatment System)				
Chloromethane	—	—	0.6	—
Trichlorofluoromethane	0.2	—	0.3	—
1,1-Dichloroethane	0.1	—	—	—
Cis 1-2-Dichloroethene	0.3	—	0.6	—
Chloroform	0.1	—	0.1	—
1,1,1-Trichloroethane	0.2	—	0.2	—
1,2-Dichloroethane	—	—	0.7	—
Trichloroethylene (TCE)	0.9	2.0 J	7.0	6.6
Tetrachloroethylene (PCE)	1.9	0.6	80.0	72.0
Carbon Disulfide	—	—	—	—
TOTAL VOLATILE ORGANICS	3.7	0.4	88.4	81.6

TABLE 3

ROCKAWAY BOROUGH WELL FIELD SITE
GROUNDWATER VOLATILE ORGANIC ANALYTICAL RESULTS
(Page 13 of 13)

Compound	GW-08 Round #1 (ppb)	GW-08 Round #2 (ppb)
RESIDENTIAL WELLS		
Chloromethane	—	ND
Trichlorofluoromethane	—	ND
1,1-Dichloroethane	—	ND
Cis 1,2-Dichloroethene	—	ND
Chloroform	—	ND
1,1,1-Trichloroethane	—	ND
1,2-Dichloroethane	—	ND
Trichloroethylene (TCE)	—	ND
Tetrachloroethylene (PCE)	0.2	ND
Carbon Disulfide	—	ND
TOTAL VOLATILE ORGANICS	**0.2**	**ND**

J - Estimated Value

M - Presence of material verified but not quantified.

TABLE 4

ROCKAWAY BOROUGH WELL FIELD SITE
GROUNDWATER EXTRACTABLE ORGANICS ANALYTICAL RESULTS
EPA WELLS

Parameter (ug/l)	Well No. RBW-01	RBW-1A	RBW-02	RBW-03	RBW-04	RBW-05	RBW-06	RBW-07	RBW-07A	RBW-08	RB 2-08A
Semi-Volatiles											
Bis(2-Ethylhexyl) phthalate	ND	44.0 J	ND	ND	70	10.0 J	37.0 J	7.0 J	6.0 J	ND	13.0 J
Pesticides	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
PCB	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

J - Concentration estimated due to QA/QC reasons.

TABLE 5

ROCKAWAY BOROUGH WELL FIELD SITE
GROUNDWATER
METALS ANALYTICAL RESULTS ABOVE ARARs
(Page 1 of 2)

Analyte	RBW-1 (ug/l)	RBW-1A (ug/l)	RBW-2 (ug/l)	RBW-3 (ug/l)	RBW-4 (ug/l)	RBW-5 (ug/l)
Aluminum (a)	27,300	214	267	49,900	439	4,350
Beryllium (c)	2.0 B	—	—	3.7 B	—	—
Chromium (b)	1,170	—	52.1	598	155	—
Iron (a)	69,000	1,730	1,180	144,000	1,010	7,620
Manganese (a)	643	735	—	2,660	—	1,010
Nickel (c, d)	382	—	—	239	—	—

(a) Found at levels above Secondary Drinking Water Standards.

(b) Found at levels above Federal MCLs and NJDEP Guidelines.

(c) Found at levels above Federal MCLs, no NJDEP Guidelines are set for these analytes.

(d) Federal MCL for this analyte is proposed.

B - Analyte detected in a blank sample.

TABLE 5

ROCKAWAY BOROUGH WELL FIELD SITE
GROUNDWATER
METALS ANALYTICAL RESULTS ABOVE ARARs
(Page 2 of 2)

Analyte	RBW-6 (ug/l)	RBW-7 (ug/l)	RBW-7A (ug/l)	RBW-8 (ug/l)	RBW-8A (ug/l)
Aluminum (c)	1,480	720	381	300	382
Chromium (b)	—	340	132	—	124
Iron (c)	4,810	4,160	1,740	841	1,030
Manganese (c)	60	220	88.3	—	84.8
Nickel (b, d)	—	483	198	—	194

(a) Found at levels above Secondary Drinking Water Standards.

(b) Found at levels above Federal MCLs and NJDEP Guidelines.

(c) Found at levels above Federal MCLs, no NJDEP Guidelines are set for these analytes.

(d) Federal MCL for this analyte is proposed.

TABLE 6

SUMMARY OF CHEMICALS DETECTED IN GROUNDWATER
AT ROCKAWAY BOROUGH WELL FIELD

(Concentrations reported in ug/L)

Source Area/ Chemical	Frequency of Detection (a)	Range of Detected Concentrations	Background Concentration (b)
KLOCKNER & KLOCKNER (c)			
Organic Chemicals:			
*Carbon disulfide (d)	2/25	0.7 - 12	ND
1,1-Dichloroethene	1/25	2.4	ND
cis-1,2-Dichloroethene	10/25	0.8 - 270	ND
trans-1,2-Dichloroethene	7/25	0.6 - 5.2	ND
*bis(2-Ethylhexyl)phthalate	2/3	7 - 37	19 - 70
Methylene chloride	1/25	1	ND
Tetrachloroethene (e)	16/25	0.5 - 510	ND
Trichloroethene	21/25	0.3 - 5900	ND
Inorganic Chemicals:			
*Aluminum	3/3	300 - 1660	439 - 4350
*Barium	2/3	33.7 - 39.2	40.4
*Calcium	3/3	37100 - 53000	29600 - 54400
Chromium	3/3	22.2 - 340	17.9 - 155
Cobalt	1/3	5.7	4.6
Copper	3/3	11.4 - 23.9	14.4 - 20
*Iron	3/3	841 - 4810	1610 - 7620
*Lead	3/3	3.5 - 6.3	1.8 - 9
Magnesium	3/3	13900 - 23300	13300 - 20800
*Manganese	3/3	30.1 - 255	33 - 1010
Nickel	3/3	38.8 - 403	24.5 - 72.4
Potassium	3/3	1940 - 7180	2990 - 5990
Sodium	3/3	10500 - 104000	19100 - 27700
Vanadium	2/3	15.2 - 73.9	18.6 - 26.8
*Zinc	3/3	20.9 - 28.1	28.2 - 69.6
PETITT PAINT (f)			
Organic Chemicals:			
Ethylbenzene (e)	1/6	5850	ND
*i-Propylbenzene (d)	1/6	32	ND
Tetrachloroethene	2/6	0.1 - 1.6	ND
Toluene (e)	1/6	41	ND
Trichloroethene	2/6	0.4 - 0.7	ND
Xylenes (total) (e)	1/6	17200	ND
RONED REALTY (g)			
Organic Chemicals:			
1,1-Dichloroethane	1/7	2.9	ND
cis-1,2-Dichloroethene	1/7	4.5	ND
Tetrachloroethene	1/7	1.6	ND
Trichloroethene	2/7	1.1 - 4.3	ND
Vinyl chloride	1/7	1.5	ND

(a) The number of samples in which the chemical was detected divided by the total number of samples analyzed for that chemical.
(b) Range of background concentrations reported from wells RBW-4 and RBW-5.
(c) Samples: FG-1, MW-1 through MW-7, PW-6, RBW-6 through RBW-8, SAI-04, SAI-07, and SMC-1 through SMC-5.
(d) Tentatively identified compound.
(e) One of the samples was analyzed twice, therefore the arithmetic mean of the two concentrations is reported.
(f) Samples: PP-1 through PP-6; samples not analyzed for inorganic chemicals.
(g) Samples: DGC-2 through DGC-7, and RBW-3.
(h) Samples: PW-1, PW-5, RBW-1, RBW-1A, RBW-2, SAI-02, and SAI-03.

* = Compound not selected as a chemical of potential concern; see text.

TABLE 6

SUMMARY OF CHEMICALS DETECTED IN GROUNDWATER
AT ROCKAWAY BOROUGH WELL FIELD

(Concentrations reported in ug/L)

Source Area/ Chemical	Frequency of Detection (a)	Range of Detected Concentrations	Background Concentration (b)
ROMED REALTY (g) (cont.)			
Inorganic Chemicals:			
Aluminum	1/1	49800	439 - 4350
Arsenic	1/1	9.4	ND
Barium	1/1	323	40.4
Beryllium	1/1	3.7	ND
*Cadmium	1/1	3.5	3.4
Calcium	1/1	124000	29600 - 54400
Chromium	1/1	568	17.9 - 155
Cobalt	1/1	55.1	4.6
Copper	1/1	129	14.4 - 20
Iron	1/1	144000	1610 - 7620
Lead	1/1	37.2	1.8 - 9
Magnesium	1/1	66800	13300 - 20800
Manganese	1/1	2060	33 - 1010
Nickel	1/1	259	24.5 - 72.4
Potassium	1/1	11300	2990 - 5990
Sodium	1/1	29000	19100 - 27700
Vanadium	1/1	207	18.6 - 26.8
Zinc	1/1	196	28.2 - 69.6
WALL ST. AND E. MAIN ST. (h)			
Organic Chemicals:			
*bis(2-Ethylhexyl)phthalate	1/3	44	19 - 70
Tetrachloroethene (e)	5/7	3.3 - 120	ND
Inorganic Chemicals:			
Aluminum	3/3	214 - 27300	439 - 4350
Arsenic	1/3	3.5	ND
Barium	3/3	20.5 - 195	40.4
Beryllium	1/3	2.9	ND
*Calcium	3/3	35700 - 53300	29600 - 54400
Chromium	3/3	38.1 - 1170	17.9 - 155
Cobalt	1/3	31.6	4.6
Copper	3/3	6.6 - 94	14.4 - 20
Iron	3/3	1125 - 68000	1610 - 7620
Lead	3/3	2.6 - 11.7	1.8 - 9
Magnesium	3/3	10800 - 23000	13300 - 20800
*Manganese	3/3	36.2 - 943	33 - 1010
Nickel	3/3	30.8 - 362	24.5 - 72.4
Potassium	3/3	1975 - 9770	2990 - 5990
Selenium	3/3	2.1 - 4.5	ND
Sodium	3/3	47450 - 60900	19100 - 27700
Vanadium	3/3	33.6 - 122	18.6 - 26.8
Zinc	3/3	23.1 - 131	28.2 - 69.6

(a) The number of samples in which the chemical was detected divided by the total number of samples analyzed for that chemical.
(b) Range of background concentrations reported from wells RBW-4 and RBW-5.
(c) Samples: FG-1, MW-1 through MW-7, PW-6, RBW-6 through RBW-8, SAI-04, SAI-07, and SMC-1 through SMC-5.
(d) Tentatively identified compound.
(e) One of the samples was analyzed twice, therefore the arithmetic mean of the two concentrations is reported.
(f) Samples: PP-1 through PP-6; samples not analyzed for inorganic chemicals.
(g) Samples: DGC-2 through DGC-7, and RBW-3.
(h) Samples: PW-1, PW-5, RBW-1, RBW-1A, RBW-2, SAI-02, and SAI-03.

* = Compound not selected as a chemical of potential concern; see text.

TABLE 7

CHRONIC ORAL TOXICITY VALUES FOR CHEMICALS OF POTENTIAL CONCERN

Chemical	Chronic Reference Dose (mg/kg-day) (Uncertainty Factor) (a)	Target Organ (b)	Reference Dose Source	Cancer Slope Factor (mg/kg-day)-1	USEPA Weight of Evidence Classification (c)	Slope Factor Source
Organic Chemicals:						
cis-1,2-Dichloroethene	1E-02 [3000]	Blood	HEAST	--	D	IRIS
trans-1,2-Dichloroethene	2E-02 [1000]	Blood Serum	IRIS	--	D	IRIS
1,1-Dichloroethane	1E-01 [1000]	Kidney	HEAST	(d)	C	HEAST
1,1-Dichloroethene	9E-03 [1000]	Liver	IRIS	6E-01	C	IRIS
Ethylbenzene	1E-01 [1000]	Liver/Kidney	IRIS	--	D	IRIS
Methylene chloride	6E-02 [100]	Liver	IRIS	7.5E-03	B2	IRIS
Tetrachloroethene	1E-02 [1000]	Liver	IRIS	5.1E-02 (e)	B2	HEAST
Toluene	2E-01 [1000]	Liver/Kidney	IRIS	--	D	IRIS
Trichloroethene	7.4E-03 [1000]	Liver	HA 1987	1.1E-02	B2	HEAST
Vinyl chloride	--	--	--	1.9E+00	A	HEAST
Xylenes (total)	2E+00 [100]	CNS/Mortality	IRIS	--	D	IRIS
Inorganic Chemicals:						
Aluminum	--	--	--	--	D	--
Arsenic	1E-03 [1]	Skin	HEAST	2E+00 (h)	A	IRIS
Barium	7E-02 [3]	Blood pressure	IRIS	--	D	--
Beryllium	5E-03 [100]	Total tumors	IRIS	4.3E+00	B2	IRIS
Calcium	--	--	--	--	D	--
Chromium (f)	5E-03 [500]	Nervous system	IRIS	--	D	IRIS
Cobalt	--	--	--	--	D	--
Copper	3.7E-02 [1] (g)	GI Tract	HEAST	--	D	--
Iron	--	--	--	--	D	--
Lead	--	CNS	IRIS	--	B2	IRIS
Magnesium	--	--	--	--	D	--
Manganese	1E-01 [1]	CNS	HEAST	--	D	IRIS
Nickel	2E-02 [300]	Body weight	IRIS	--	D	IRIS
Potassium	--	--	--	--	D	--
Selenium	3E-03 [15]	Dermatitis	IRIS	--	D	IRIS
Sodium	--	--	--	--	D	--
Vanadium	7E-03 [100]	Liver, Kidney	HEAST	--	D	--
Zinc	2E-01 [10]	Anemia	HEAST	--	D	--

(a) Uncertainty factors used to develop reference doses generally consist of multiples of 10, with each factor representing a specific area of uncertainty in the data available. The standard uncertainty factors include the following:
- A 10-fold factor to account for the variation in sensitivity among the members of the human population;
- A 10-fold factor to account for the uncertainty in extrapolation animal data to the case of humans;
- A 10-fold factor to account for uncertainty in extrapolating from subchronic to chronic exposure durations;
- A 10-fold factor to account for the uncertainty in extrapolating from LOAELs to NOAELs.

(b) A target organ is the organ most sensitive to a chemical's toxic effect. RfDs are based on toxic effects in the target organ. If an RfD was based on a study in which a target organ was not identified, an organ or system known to be affected by the chemical is listed.

(c) EPA Weight of Evidence for Carcinogenic Effects: [A] = Human carcinogen based on adequate evidence from human studies; [B2] = Probable human carcinogen based on inadequate evidence from human studies and adequate evidence from animal studies; [C] = Possible human carcinogen based on limited evidence from animal studies in the absence of human studies; and [D] = Not classified as to human carcinogenicity.

(d) Withdrawn by EPA.

(e) Under review by CRAVE workgroup.

(f) Toxicity criteria reported is for chromium VI, as all chromium is conservatively assumed to be in the form of chromium VI.

(g) Drinking water standard reported in mg/l is converted to mg/kg-day by assuming a 70 kg adult consumes 2 liters of water per day.

(h) EPA 1988. Special report on ingested inorganic arsenic skin cancer; nutritional essentiality. Risk assessment forum. EPA, Washington, D.C. EPA 625/3-87/013F. July 1988.

NOTE: CNS = Central nervous system
GI = Gastrointestinal
IRIS = Integrated Risk Information System - February 1, 1991
HEAST = Health Effects Assessment Summary Tables - September 1, 1990
HA = Drinking Water Health Advisory
EPA = Environmental Protection Agency
-- = No information available

TABLE 7

CHRONIC INHALATION TOXICITY VALUES FOR CHEMICALS OF POTENTIAL CONCERN

Chemical	Chronic Reference Dose (mg/kg-day) [Uncertainty Factor] (a)	Target Organ (b)	Reference Dose Source	Cancer Slope Factor (mg/kg-day)-1	USEPA Weight of Evidence Classification (c)	Slope Factor Source
Organic Chemicals:						
cis-1,2-Dichloroethene	--	--	HEAST	--	D	IRIS
trans-1,2-Dichloroethene	--	--	IRIS	--	D	IRIS
1,1-Dichloroethane	1E-01 [1000]	Kidney	HEAST	(d)	C	IRIS
1,1-Dichloroethene	--	--	IRIS	1.8E-01 (f)	C	IRIS
Ethylbenzene	2.9E-01 [300] (e)	Developmental tox.	IRIS	--	D	IRIS
Methylene chloride	8.6E-01 [100] (e)	Liver	HEAST	1.6E-03 (f)	B2	IRIS
Tetrachloroethene	--	--	IRIS	1.8E-03 (f,g)	B2	HEAST
Toluene	5.7E-01 [100] (e)	CNS/irritation	HEAST	--	D	IRIS
Trichloroethene	--	--	IRIS	1.7E-02	B2	HEAST
Vinyl chloride	--	--	--	2.9E-01 (f)	A	HEAST
Xylenes (total)	8.6E-02 [100] (e)	CNS/Respiratory	HEAST	--	D	IRIS

(a) Uncertainty factors used to develop reference doses generally consist of multiples of 10, with each factor representing a specific area of uncertainty in the data available. The standard uncertainty factors include the following:
- A 10-fold factor to account for the variation in sensitivity among the members of the human population;
- A 10-fold factor to account for the uncertainty in extrapolation animal data to the case of humans;
- A 10-fold factor to account for uncertainty in extrapolating from subchronic to chronic exposure durations;
- A 10-fold factor to account for the uncertainty in extrapolating from LOAELs to NOAELs.

(b) A target organ is the organ most sensitive to a chemical's toxic effect. RfD's are based on toxic effects in the target organ. If an RfD was based on a study in which a target organ was not identified, an organ or system known to be affected by the chemical is listed.

(c) EPA Weight of Evidence for Carcinogenic Effects: [A] = Human carcinogen based on adequate evidence from human studies; [B2] = Probable human carcinogen based on inadequate evidence from human studies and adequate evidence from animal studies; [C] = Possible human carcinogen based on limited evidence from animal studies in the absence of human studies; and [D] = Not classified as to human carcinogenicity.

(d) Withdrawn by EPA.

(e) Criterion reported in mg/m3 is converted to mg/kg-day by assuming a 70 kg adult inhales 20 cubic meters of air per day.

(f) standard reported in (ug/m3)-1 is converted to (mg/kg-day)-1 by assuming a 70 kg adult inhales 20 cubic meters of air per day.

(g) Tetrachloroethene is under review by CRAVE workgroup.

NOTE: CNS = Central Nervous System
IRIS = Integrated Risk Information System - March 1, 1991
HEAST = Health Effects Assessment Summary Tables - September 1, 1990
-- = No information available

TABLE 8

CUMULATIVE RISKS TO 0-30 YEAR OLD RESIDENTS USING UNTREATED GROUNDWATER FROM THE ROCKAWAY BOROUGH WELL FIELD SITE (INGESTION AND BATHING EXPOSURES)

	Upper Bound Excess Lifetime Cancer Risk	Hazard Index
KLOCKNER & KLOCKNER		
Ingestion	2E-03	>1 (4E+01)
Bath *	3E-06	<1 (7E-02)
Total	2E-03	>1 (4E+01)
PETITT PAINT		
Ingestion	2E-06	>1 (3E+00)
Bath *	3E-09	<1 (5E-03)
Total	2E-06	>1 (3E+00)
ROWED REALTY		
Ingestion	6E-04	>1 (8E+00)
Bath *	6E-08	<1 (6E-04)
Total	6E-04	>1 (8E+00)
MALL ST. & E. MAIN ST.		
Ingestion	4E-04	>1 (1E+01)
Bath *	2E-07	<1 (9E-04)
Total	4E-04	>1 (1E+01)

* - Inhalation and dermal

TABLE 8

CUMULATIVE RISKS TO ADULT RESIDENTS USING UNTREATED GROUNDWATER FROM THE ROCKAWAY BOROUGH WELL FIELD SITE (INGESTION AND SHOWERING EXPOSURES)

Source Area/ Exposure Pathway	Upper Bound Excess Lifetime Cancer Risk	Hazard Index
KLOCKNER & KLOCKNER		
Ingestion	1E-03	>1 (3E+01)
Shower *	1E-03	<1 (6E-06)
Total	2E-03	>1 (3E+01)
PETITT PAINT		
Ingestion	1E-06	>1 (2E+00)
Shower *	2E-07	>1 (3E+00)
Total	1E-06	>1 (5E+00)
ROWED REALTY		
Ingestion	4E-04	>1 (6E+00)
Shower *	5E-06	<1 (5E-04)
Total	4E-04	>1 (6E+00)
WALL ST. & E. MAIN ST.		
Ingestion	3E-04	>1 (8E+00)
Shower *	2E-06	Not applicable
Total	3E-04	>1 (8E+00)

* - Inhalation and dermal

TABLE 9

MAXIMUM CONTAMINANT LEVELS AND GROUNDWATER QUALITY STANDARDS FOR CHEMICALS DETECTED AT THE ROCKAWAY BOROUGH SITE (ug/l)

Chemical	New Jersey A-280 Maximum Contaminant Levels (a)	New Jersey Groundwater Standards (b)	Federal Maximum Contaminant Levels	NJDEP Groundwater Cleanup Level
Benzene	1	1 (P)	5 (d)	
Bromochloromethane	—	100 (P,c)	100 (c,d)	
Carbon Tetrachloride	2	2 (P)	5 (d)	
Chlorobenzene	4	4 (P)	100 (e)	
Chloroform	—	100 (P,c)	100 (c,d)	
1,2-Dichloroethane	2	2 (P)	5 (d)	
1,1-Dichloroethene	2	2 (P)	7 (d)	
cis-1,2-Dichloroethene	10	10 (P)	70 (e)	
trans-1,2-Dichloroethene	10	10 (P)	100 (e)	
1,2-Dichloropropane	—	—	5 (e)	
Ethylbenzene	—	—	700 (e)	
Tetrachloroethene	1	1 (P)	5 (e)	
1,1,1-Trichloroethane	26	26 (P)	200 (d)	
Trichloroethene	1	1 (P)	5 (d)	
Vinyl Chloride	2	2 (P)	2 (d)	
Xylenes (Total)	44	44 (P)	10,000 (e)	

— Standard not developed for this chemical.

(P) Proposed

(a) Amendment 280 to the New Jersey Safe Drinking Water Act. New Jersey Drinking Water Institute recommended MCLs. In the absence of a NJ State promulgated MCL for a specific compo nd, NJDEP adopts the Federal MCLs as stated in Section 7:10-5.1 of the NJ SDWA .

(b) New Jersey Water Pollution Control Act Ground Water Quality Standards (NJAC 7:9-6).

(c) The value of 100 ug/liter is for total trihalomethanes (i.e., the sum of chloroform, bromochloromethan and bromoform).

(d) 40 CFR, Part 141-National Primary Drinking Water Regulations. 526-533, 585-587.

(e) Environmental Protection Agency (EPA). 1991. National Primary and Secondary Drinking Water Regulations; Final Rule. Federal Register. Vol. 56, No. 20, January 30, 1991.

TABLE 10

Cost Estimates for Alternative 2 : Option A: Reinjection/ Air Stripping/ Chemical Precipitation

ITEM	CAPITAL COSTS	ANNUAL O&M COSTS 1st month	month 2-60	years 6-11	years 12-16	years 17-27	years 28-32	PRESENT WORTH OF O&M @10%
(1) LONG-TERM MONITORING & REVIEW	$110,000	$85,000	$85,000	$66,000	$66,000	$33,000	$33,000	$641,295
(2) GROUND WATER EXTRACTION SYSTEM	$718,000	$394,300	$276,200	$276,200	$138,100	$138,100	$0	$2,182,472
(3) TREATMENT SYSTEM	$1,741,000	$1,816,200	$1,007,500	$1,007,500	$440,500	$440,500	$0	$7,819,100
(4) TREATED WATER DISPOSAL	$688,000	$105,000	$75,000	$75,000	$40,000	$40,000	$0	$599,317
CONSTRUCTION SUBTOTAL	$3,257,000	$2,400,500	$1,443,700	$1,424,700	$684,600	$651,600	$33,000	$11,242,184
Health and Safety, 10%	$325,700	$240,050	$144,370	$142,470	$68,460	$65,160	$3,300	$1,124,218
Bid Contingency, 15%	$488,550	$360,075	$216,555	$213,705	$102,690	$97,740	$4,950	$1,686,328
Scope Contingency, 30%	$977,100							
CONSTRUCTION TOTAL	$5,048,350	$3,000,625	$1,804,625	$1,780,875	$855,750	$814,500	$41,250	$14,052,730
Administrative & Legal, 5%	$252,418							
Services During Construction, 10%	$504,835							
TOTAL IMPLEMENTATION COSTS	$5,805,603	$3,000,625	$1,804,625	$1,780,875	$855,750	$814,500	$41,250	$14,052,730
Engineering & Design, 10%	$580,560							
TOTAL ESTIMATED COSTS	$6,386,163	$3,000,625	$1,804,625	$1,780,875	$855,750	$814,500	$41,250	$14,052,730

NET PRESENT WORTH OF COSTS OF ALTERNATIVE: $20,438,892

TABLE 10

Cost Estimates for Alternative 2 : Option B: Reinjection Chemical Oxidation Enhanced with UV Photolysis/ Chemical Precipitation

ITEM	CAPITAL COSTS	ANNUAL O&M COSTS 1st month	month 2-60	years 6-11	years 12-16	years 17-27	years 28-32	PRESENT WORTH OF O&M @10%
(1) LONG-TERM MONITORING & REVIEW	$110,000	$85,000	$85,000	$66,000	$66,000	$33,000	$33,000	$641,295
(2) GROUND WATER EXTRACTION SYSTEM	>718,000	$394,300	$276,200	$276,200	$138,100	$138,100	$0	$2,182,472
(3) TREATMENT SYSTEM	$1,785,500	$1,866,000	$1,043,500	$1,043,500	$460,500	$460,500	$0	$8,108,916
(4) TREATED WATER DISPOSAL	$688,000	$105,000	$75,000	$75,000	$40,000	$40,000	$0	$599,317
CONSTRUCTION SUBTOTAL	$3,301,500	$2,450,300	$1,479,700	$1,460,700	$704,600	$671,600	$33,000	$11,531,999
Health and Safety, 10%	$330,150	$245,030	$147,970	$146,070	$70,460	$67,160	$3,300	$1,153,200
Bid Contingency, 15%	$495,225	$367,545	$221,955	$219,105	$105,690	$100,740	$4,950	$1,729,800
Scope Contingency, 30%	$990,450							
CONSTRUCTION TOTAL	$5,117,325	$3,062,875	$1,849,625	$1,825,875	$880,750	$839,500	$41,250	$14,414,999
Administrative & Legal, 5%	$255,866							
Services During Construction, 10%	$511,733							
TOTAL IMPLEMENTATION COSTS	$5,884,924	$3,062,875	$1,849,625	$1,825,875	$880,750	$839,500	$41,250	$14,414,999
Engineering & Design, 10%	$588,492							
TOTAL ESTIMATED COSTS	$6,473,416	$3,062,875	$1,849,625	$1,825,875	$880,750	$839,500	$41,250	$14,414,999

NET PRESENT WORTH OF COSTS OF ALTERNATIVE: $20,888,415

TABLE 10

Cost Estimates for Alternative 2 : Option C: Reinjection/ Carbon Adsorption/ Chemical Precipitation

ITEM	CAPITAL COSTS	ANNUAL O&M COSTS 1st month	month 2-60	years 6-11	years 12-16	years 17-27	years 28-32	PRESENT WORTH OF O&M @10%
(1) LONG-TERM MONITORING & REVIEW	$110,000	$85,000	$85,000	$66,000	$66,000	$33,000	$33,000	$641,295
(2) GROUND WATER EXTRACTION SYSTEM	$718,000	$394,300	$276,200	$276,200	$138,100	$138,100	$0	$2,182,472
(3) TREATMENT SYSTEM	$1,565,000	$1,814,000	$1,006,500	$1,006,500	$440,500	$440,500	$0	$7,812,505
(4) TREATED WATER DISPOSAL	$688,000	$105,000	$75,000	$75,000	$40,000	$40,000	$0	$599,317
CONSTRUCTION SUBTOTAL	$3,081,000	$2,398,300	$1,442,700	$1,423,700	$684,600	$651,600	$33,000	$11,235,589
Health and Safety, 10%	$308,100	$239,830	$144,270	$142,370	$68,460	$65,160	$3,300	$1,123,559
Bid Contingency, 15%	$462,150	$359,745	$216,405	$213,555	$102,690	$97,740	$4,950	$1,685,338
Scope Contingency, 30%	$924,300							
CONSTRUCTION TOTAL	$4,775,550	$2,997,875	$1,803,375	$1,779,625	$855,750	$814,500	$41,250	$14,044,486
Administrative & Legal, 5%	$238,778							
Services During Construction, 10%	$477,555							
TOTAL IMPLEMENTATION COSTS	$5,491,883	$2,997,875	$1,803,375	$1,779,625	$855,750	$814,500	$41,250	$14,044,486
Engineering & Design, 10%	$549,188							
TOTAL ESTIMATED COSTS	$6,041,071	$2,997,875	$1,803,375	$1,779,625	$855,750	$814,500	$41,250	$14,044,486

NET PRESENT WORTH OF COSTS OF ALTERNATIVE: $20,085,557

TABLE 10

Cost Estimates for Alternative 2 : Option D: Surface Water Discharge/
Air Stripping/ Chemical Precipitation

ITEM	CAPITAL COSTS	ANNUAL O&M COSTS 1st month	month 2-60	years 6-11	years 12-16	years 17-27	years 28-32	PRESENT WORTH OF O&M @10%
(1) LONG-TERM MONITORING & REVIEW	$110,000	$85,000	$85,000	$66,000	$66,000	$33,000	$33,000	$641,295
(2) GROUND WATER EXTRACTION SYSTEM	$713,000	$394,300	$276,200	$276,200	$138,100	$138,100	$0	$2,182,472
(3) TREATMENT SYSTEM	$1,741,000	$1,816,200	$1,007,500	$1,007,500	$440,500	$440,500	$0	$7,819,100
(4) TREATED WATER DISPOSAL	$601,500	$58,000	$38,000	$38,000	$20,000	$20,000	$0	$303,322
CONSTRUCTION SUBTOTAL	$3,170,500	$2,353,500	$1,406,700	$1,387,700	$664,600	$631,600	$33,000	$10,946,190
Health and Safety, 10%	$317,050	$235,350	$140,670	$138,770	$66,460	$63,160	$3,300	$1,094,619
Bid Contingency, 15%	$475,575	$353,025	$211,005	$208,155	$99,690	$94,740	$4,950	$1,641,928
Scope Contingency, 30%	$951,150							
CONSTRUCTION TOTAL	$4,914,275	$2,941,875	$1,758,375	$1,734,625	$830,750	$789,500	$41,250	$13,682,737
Administrative & Legal, 5%	$245,714							
Services During Construction, 10%	$491,428							
TOTAL IMPLEMENTATION COSTS	$5,651,416	$2,941,875	$1,758,375	$1,734,625	$830,750	$789,500	$41,250	$13,682,737
Engineering & Design, 10%	$565,142							
TOTAL ESTIMATED COSTS	$6,216,558	$2,941,875	$1,758,375	$1,734,625	$830,750	$789,500	$41,250	$13,682,737

NET PRESENT WORTH OF COSTS OF ALTERNATIVE: $19,899,295

TABLE 10

Cost Estimates for Alternative 2 : Option E: Surface Water Discharge/ Chemical Oxidation Enhanced with UV Photolysis/ Chemcial Precipitation

ITEM	CAPITAL COSTS	ANNUAL O&M COSTS 1st month	month 2-60	years 6-11	years 12-16	years 17-27	years 28-32	PRESENT WORTH OF O&M @10%
(1) LONG-TERM MONITORING & REVIEW	$110,000	$85,000	$85,000	$66,000	$66,000	$33,000	$33,000	$641,295
(2) GROUND WATER EXTRACTION SYSTEM	$718,000	$394,300	$276,200	$276,200	$138,100	$138,100	$0	$2,182,472
(3) TREATMENT SYSTEM	$1,785,500	$1,866,000	$1,043,500	$1,043,500	$460,500	$460,500	$0	$8,108,916
(4) TREATED WATER DISPOSAL	$601,500	$58,000	$38,000	$38,000	$20,000	$20,000	$0	$303,322
CONSTRUCTION SUBTOTAL	$3,215,000	$2,403,300	$1,442,700	$1,423,700	$684,600	$651,600	$33,000	$11,236,005
Health and Safety, 10%	$321,500	$240,330	$144,270	$142,370	$68,460	$65,160	$3,300	$1,123,601
Bid Contingency, 15%	$482,250	$360,495	$216,405	$213,555	$102,690	$97,740	$4,950	$1,685,401
Scope Contingency, 30%	$964,500							
CONSTRUCTION TOTAL	$4,983,250	$3,004,125	$1,803,375	$1,779,625	$855,750	$814,500	$41,250	$14,045,007
Administrative & Legal, 5%	$249,163							
Services During Construction, 10%	$498,325							
TOTAL IMPLEMENTATION COSTS	$5,730,738	$3,004,125	$1,803,375	$1,779,625	$855,750	$814,500	$41,250	$14,045,007
Engineering & Design, 10%	$573,074							
TOTAL ESTIMATED COSTS	$6,303,811	$3,004,125	$1,803,375	$1,779,625	$855,750	$814,500	$41,250	$14,045,007

NET PRESENT WORTH OF COSTS OF ALTERNATIVE: $20,348,818

TABLE 10

Cost Estimates for Alternative 2 : Option F: Surface Water Discharge/ Carbon Adsorption/ Chemical Precipitation

ITEM	CAPITAL COSTS	ANNUAL O&M COSTS 1st month	month 2-60	years 6-11	years 12-16	years 17-27	years 28-32	PRESENT WORTH OF O&M @10%
(1) LONG-TERM MONITORING & REVIEW	$110,000	$85,000	$85,000	$66,000	$66,000	$33,000	$33,000	$641,295
(2) GROUND WATER EXTRACTION SYSTEM	$718,000	$394,300	$276,200	$276,200	$138,100	$138,100	$0	$2,182,472
(3) TREATMENT SYSTEM	$1,565,000	$1,814,000	$1,006,500	$1,006,500	$440,500	$440,500	$0	$7,812,505
(4) TREATED WATER DISPOSAL	$601,500	$58,000	$38,000	$38,000	$20,000	$20,000	$0	$303,322
CONSTRUCTION SUBTOTAL	$2,994,500	$2,351,300	$1,405,700	$1,386,700	$664,600	$631,600	$33,000	$10,939,595
Health and Safety, 10%	$299,450	$235,130	$140,570	$138,670	$66,460	$63,160	$3,300	$1,093,959
Bid Contingency, 15%	$449,175	$352,695	$210,855	$208,005	$99,690	$94,740	$4,950	$1,640,939
Scope Contingency, 30%	$898,350							
CONSTRUCTION TOTAL	$4,641,475	$2,939,125	$1,757,125	$1,733,375	$830,750	$789,500	$41,250	$13,674,493
Administrative & Legal, 5%	$232,074							
Services During Construction, 10%	$464,148							
TOTAL IMPLEMENTATION COSTS	$5,337,696	$2,939,125	$1,757,125	$1,733,375	$830,750	$789,500	$41,250	$13,674,493
Engineering & Design, 10%	$533,770							
TOTAL ESTIMATED COSTS	$5,871,466	$2,939,125	$1,757,125	$1,733,375	$830,750	$789,500	$41,250	$13,674,493

NET PRESENT WORTH OF COSTS OF ALTERNATIVE: $19,545,959

TABLE 11

ROCKAWAY BOROUGH WELL FIELD SITE
APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARS)
AND OTHER GUIDANCE FOR CHEMICALS OF POTENTIAL CONCERN:
GROUNDWATER (ug/l)

		Other Federal Guidance		
Chemical	Federal Maximum Contaminant Levels	Maximum Contaminant Level Goals	Drinking Water Health Advisory for Lifetime Exposure	Secondary Maximum Contaminant Levels
Aluminum	–	–	–	50 (P,h)
Antimony	10; 5 (P,ac,ab)	3 (P,ac)	–	–
Arsenic	50 (a)	50 (P,a)	–	–
Barium	1,000 (a) 5,000 (P,h)	5,000 (P,h)	1,000 (e)	–
Beryllium	1 (P,ac)	0 (P,ac)	–	–
Cadmium	10 (a) 5 (P,h)	5 (P,h)	5 (e)	–
Chromium	50 (a) 100 (P,h)	100 (P,h)	120 (e)	–
Copper	1,300 (P,h)	1,300 (P,h)	–	1,000 (i)
Iron	–	–	–	300 (i)
Lead	50 (a) 5 (P,h)	0 (P,h)	–	–
Manganese	–	–	–	50 (i)
Mercury	2 (a)	2 (P,h)	1.1 (e)	–
Nickel	100 (P,ac)	100 (P,ac)	100 (e)	–
Selenium	10 (a) 50 (P,h)	50 (P,h)	–	–
Silver	50 (a)	–	–	50 (P,h)
Thallium	≥ 1 (P,ac,ad)	0.5 (P,ac)	–	–

(P) = Proposed.

(a) 40 CFR, Part 141-National Primary Drinking Water Regulations. 559-560, 580-621.

(b) Environmental Protection Agency (EPA). 1988. National Primary and Secondary Drinking Water Regulations; Proposed Rule. Federal Register. Vol. 54, No. 97, Monday, May 22, 1989. 22062-22160.

(e) Environmental Protection Agency (EPA). 1987. Health Advisories. Office of Drinking Water. Washington, D.C. March 31, 1987.

(h) Environmental Protection Agency (EPA). 1984. Drinking Water Regulations; Maximum Contaminant Level Goals and National Primary Drinking Water Regulations for Lead and Copper; Proposed Rule. Federal Register. Vol. 53, No. 160, 31516-31578, Thursday, August 18, 1988.

(i) 40 CFR, Part 143-National Secondary Drinking Water Regulations. 674.

(ac) Environmental Protection Agency (EPA). 1990. National Primary and Secondary Drinking Water Regulations.; Synthetic Organic Chemicals and Inorganic Chemicals. Proposed Rule. Federal Register. Vol. 55, No. 143 Wed. July 25, 1990.

(ab) EPA proposes MCLs of 10 ug/l and 5 ug/l for antimony based on proposed practical quantitation levels (PQLs).

(ad) EPA proposes MCLs of 2 ug/l and 1 ug/l for thallium based on proposed practical quantitation levels (PQLs).