United States
Environmental Protection
Agency

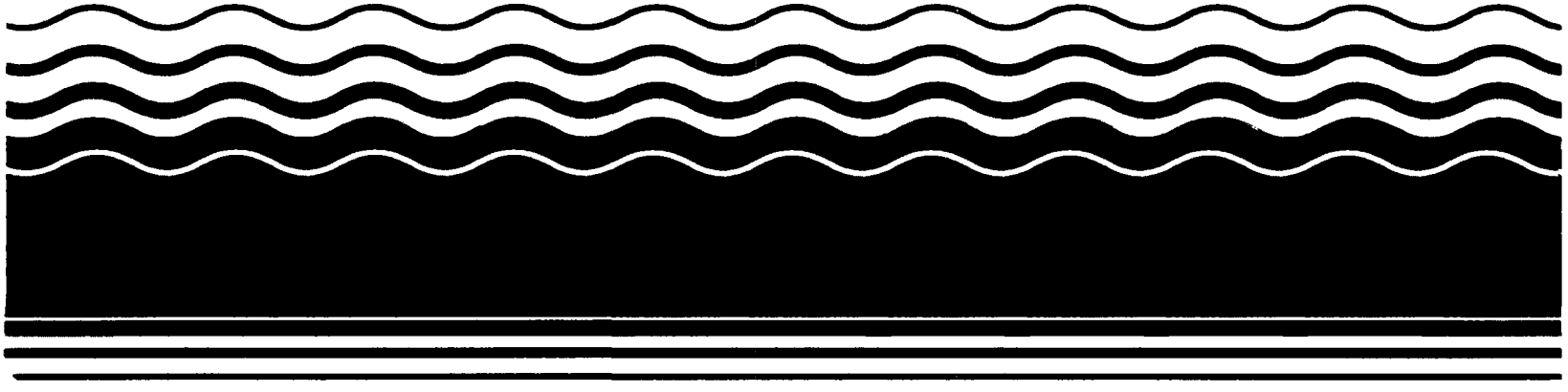
Office of
Emergency and
Remedial Response

EPA/ROD/R02-92/180
September 1992

EPA

Superfund Record of Decision:

Higgins Farm, NJ



50272-101

REPORT DOCUMENTATION PAGE	1. REPORT NO. EPA/ROD/R02-92/180	2.	3. Recipient's Accession No.
4. Title and Subtitle SUPERFUND RECORD OF DECISION Higgins Farm, NJ Second Remedial Action - Final			5. Report Date 09/30/92 6.
7. Author(s)			8. Performing Organization Rept. No.
9. Performing Organization 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
PB93-963813

16. Abstract (Limit: 200 words)

The 75-acre Higgins Farm site is a former cattle farm in Franklin Township, Somerset County, New Jersey. Land use in the area is predominantly agricultural, with two residences located onsite. The estimated 3,200 people who reside within 3 miles of the site use a municipal water supply well for their drinking water supply. During the 1960's, municipal sludge and penicillin waste were used as fertilizers on Higgins Farm. The site also contains three holding tanks and drums containing material removed from previous remedial investigations. In 1985, the city discovered and reported elevated levels of chlorobenzene in a potable well near the site. Additionally, the state investigated and discovered the presence of a drum burial dump site approximately 40 yards from the contaminated well. In 1986, the owner excavated 50 containers, including drums; however, during excavation activities, some of the containers were punctured and their contents spilled onto the ground. Later in 1986, the state sampled residential wells and discovered VOC contamination. The state also collected soil samples and analyses indicated the presence of VOCs, pesticides, metals, dioxins, and furans. In 1987, EPA responded to contamination in drinking water wells by providing bottled water to affected residents as an interim ground

(See Attached Page)

17. Document Analysis a. Descriptors
Record of Decision - Higgins Farm, NJ
Second Remedial Action - Final
Contaminated Medium: gw
Key Contaminants: VOCs (benzene, PCE, TCE, xylene)

b. Identifiers/Open-Ended Terms

c. COSATI Field/Group

18. Availability Statement	19. Security Class (This Report) None	21. No. of Pages 88
	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

Abstract (Continued)

and copper. In 1985, the state and C&D Recycling arranged for the excavation and offsite water remedy (OU1), and EPA assumed the lead in mitigating the site by constructing a barn of contaminated material; draining, lining, and backfilling the excavation pit; pumping treated and stored liquids into holding tanks; and fencing in the excavated pit area. In 1989, carbon filters were installed to limit ingestion of VOCs and mitigate the potential for human exposure. In 1992, EPA performed a removal action and completed the excavation of 94 drums and contaminated soil. This ROD addresses the final action for ground water to limit future migration of contaminated ground water to offsite areas, as OU2. The primary contaminants of concern affecting the ground water are VOCs, including benzene, PCE, TCE, and xylene.

The final remedial action for this site includes installing ground water extraction wells around the perimeter of the site; treating the contaminated ground water onsite by processes that are expected to include precipitation, flocculation, clarification, filtration, air stripping, intermediate pH adjustment, ion exchange, and final pH adjustment, however, the exact system will be developed during the RD phase; discharging the treated ground water to onsite surface water; monitoring ground water, surface water, and onsite and offsite wells including downgradient residential wells; and performing limited investigations to ensure all sources of contamination have been identified, with removal and offsite disposal of contaminated materials that were previously remediated and are currently stored onsite. The estimated present worth cost for this remedial action ranges from $5,990,000 to $8,447,600, which includes an annual O&M cost of $384,000.

PERFORMANCE STANDARDS OR GOALS: Chemical-specific goals for ground water clean-up, which are based on SDWA MCLs and state standards, include benzene 1 ug/l (state); chlorobenzene 4 ug/l (state); cis-1,2-dichloroethene 10 ug/l (state); vinyl chloride 2 ug/l (state); bis (2-ethyl hexyl) phthalate 6 ug/l (MCL); antimony 6 ug/l (MCL); chromium 100 ug/l; copper 1,300 ug/l (MCL); lead 15 ug/l; and nickel 100 ug/l (MCL).

DECLARATION STATEMENT

RECORD OF DECISION

HIGGINS FARM

SITE NAME AND LOCATION

Higgins Farm
Franklin Township, Somerset County, New Jersey

STATEMENT OF BASIS AND PURPOSE

This decision document presents the selected remedial action for the Higgins Farm site, which was chosen in accordance with the requirements of the Comprehensive Environmental Response, Compensation and Liability Act of 1980, as amended, and to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan. This decision document explains the factual and legal basis for selecting the remedy for the second operable unit at this site. The information supporting this remedial action decision is contained in the administrative record.

ASSESSMENT OF THE SITE

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

DESCRIPTION OF THE SELECTED REMEDY

The remedy described in this document represents the second operable unit for the Higgins Farm site. The first operable unit, which involved an interim ground water remedy, provided for the installation of a water line to supply area residents with an alternate water supply. The remedial action selected in this Record of Decision provides a permanent solution for contaminated ground water at the site. The soils on the site do not appear to pose an unacceptable health risk; therefore, no remedial action for site soils is anticipated.

The major components of the selected remedy include the following:

- Installation of ground water extraction wells around the perimeter of the site and the source areas;

ROD FACT SHEET

SITE

Site name: Higgins Farm

Site location: Franklin Township, Somerset County, New Jersey

HRS score: 32.08

ROD

Date Signed: September 30, 1992

Selected remedy: Ground water extraction and treatment with discharge of treated ground water to on-site surface water.

Capital cost: $2,544,800

O & M cost: $384,000

Present-worth cost (5-30 years): $5,990,000 - $8,447,600

LEAD

U.S. Environmental Protection Agency

Primary Contact: Joyce Harney, (212) 264-6313

Secondary Contact: Janet Feldstein, (212) 264-0613

Main PRPs: Fund lead

WASTE

Waste type: Volatile organics, metals

Waste origin: Illegal dumping

Estimated waste quantity: Unknown

Contaminated medium: Ground water

- Construction of an on-site treatment plant to treat the contaminated ground water;
- Discharge of the treated ground water to an on-site surface water body;
- Implementation of a sampling program involving monitoring wells and downgradient residential wells to evaluate off-site migration and the effectiveness of the ground water extraction system;
- Limited investigations to confirm that all sources of contamination have been identified; and
- Removal and proper disposal of contaminated materials which were generated during previous site stabilization and remedial investigation activities that are presently stored on the site.

STATUTORY DETERMINATIONS

The selected remedy is protective of human health and the environment, complies with Federal and State requirements that are applicable or relevant and appropriate to the extent practicable given the unpredictable nature of the fractured bedrock and stringent surface water discharge standards, and is cost effective. Requirements which cannot be achieved by the remedy may be waived pursuant to Section 121 of the Comprehensive Environmental Response, Compensation and Liability Act, as amended. The selected remedy utilizes permanent solutions and alternative treatment (or resource recovery) technologies to the maximum extent practicable and satisfies the statutory preference for remedies that employ treatment that reduces toxicity, mobility, or volume as a principal element.

Because this remedy may result in hazardous substances remaining at the site above health-based levels, a review will be conducted within five years after commencement of the remedial action to ensure that it continues to provide adequate protection of human health and the environment.

Constantine Sidamon-Eristoff
Regional Administrator
U.S. EPA Region II

9/30/92
Date

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RECORD OF DECISION

HIGGINS FARM

SITE LOCATION AND DESCRIPTION

The Higgins Farm site (the site) is located in a rural residential area on Route 518 in Franklin Township, Somerset County, New Jersey. The site, which is approximately 75 acres in size is owned by Mr. Clifford Higgins Sr., and is operated as a cattle farm (see Figure 1). It is primarily pasture land and is relatively flat and poorly drained. There are two residences located on the site, and other residences bordering the site to the northeast and northwest. Trap Rock Industries' Kingston Quarry borders the site to the south. Figure 2 shows the site boundaries and major features.

Two 3,000 gallon holding tanks containing contaminated water, two empty 10,000 gallon holding tanks, and drums containing material generated during removal and remedial investigation field activities are located in the northern portion of the site. A barn housing excavated containers, drums and roll-off containers of contaminated soils are also located in this area, which is referred to as the excavation pit area. A chain link fence surrounds the tanks, the barn and the area where the drums and containers were excavated. The tanks and the barn were installed during emergency response activities conducted by the U.S. Environmental Protection Agency (EPA). A berm was constructed to prevent runoff from this area onto the remainder of the site.

A small fenced area, which is referred to as the New Jersey Department of Environmental Protection and Energy (NJDEPE) fenced area, where buried drums were discovered during test pit excavation activities, is located in the southwest portion of the site. Demolition debris, including bricks, asphalt, metal scrap, and concrete, is also found near the drum burial area.

The topography of the site is generally flat, but slopes gently down to the southeast. A minor drainage area and pond exist in the southeastern corner of the site. Water from the pond discharges through an unnamed tributary to Carters Brook, approximately 2,000 feet to the east.

Approximately 545 residential and two municipal water supply wells are located within three miles of the site. Within this radius, approximately 3,200 people rely on ground water for their drinking water source. The nearest downgradient public supply wells are three wells operated by the Town of South Brunswick and are located approximately 3.5 miles southeast of the site.

SITE HISTORY AND ENFORCEMENT ACTIVITIES

The Higgins Farm site was used for the disposal of hazardous wastes, including hazardous substances, under the Comprehensive Environmental Response, Compensation and Liability Act, as amended (CERCLA). Aerial photographs covering the period from 1940 to 1983 show disturbed areas in the area of the NJDEPE fenced area and east of the excavation pit area (see Figure 2). During the 1960s, municipal sludge and penicillin wastes were used as fertilizers on Higgins Farm. In December 1985, the Franklin Township Health Department reported to NJDEPE that elevated levels of chlorobenzene existed in a potable well located at Route 518, Franklin Township, Somerset County, New Jersey. NJDEPE investigated and discovered the presence of a drum burial dump at the site approximately forty yards from the contaminated well.

On January 2, 1986, NJDEPE investigated drum excavation activities initiated at the site by Mr. Higgins. The excavation was halted by NJDEPE as the activity had not been approved. The NJDEPE issued a directive to Mr. Higgins on February 24, 1986 instructing him to implement a remedial action plan.

On April 7, 1986, O.H. Materials, a contractor employed by Mr. Higgins recommenced excavation of buried drums with NJDEPE approval. Approximately fifty containers, including drums, were excavated. During excavation activities, some containers were punctured and their contents spilled onto the ground as the drums were excavated. Liquids were pumped from the excavation pit to a holding tank and visibly contaminated soils were placed in roll-off containers. Due to payment disputes, Mr. Higgins terminated O.H. Materials' activities at the site after several days.

On April 26, 1986, NJDEPE sampled ten residential wells in the vicinity of the site and discovered that three wells were contaminated with volatile organic compounds (VOCs). Nine of the ten residential wells were resampled by NJDEPE in August 1986. The analysis confirmed the presence of volatile organic contamination in the ground water.

On May 8, 1986, NJDEPE personnel inspected Higgins Farm and collected soil samples from the site, including the excavation pit area. Analysis of these samples indicated the presence of volatile organic compounds, pesticides, metals, dioxins and furans in the soils at the site. On July 3, 1986, NJDEPE collected another sample from the vicinity of the drum excavation pit. Analysis confirmed the presence of dioxins and associated furans.

On August 27, 1986, NJDEPE personell collected 27 surface soil samples from the site. Samples were collected from an adjacent residence, the excavation pit area, and the two roll-off containers. Samples were analyzed for dioxins and furans. Analysis confirmed the presence of dioxins and associated furans.

In November 1986, NJDEPE established a "well impact area" near the Higgins Farm site, restricting installation of new wells within the affected area. Thirty-one residences were included within the well impact area at Higgins Farm. This well restriction has since been removed by the NJDEPE.

In March 1987, EPA responded to the presence of contamination in drinking water wells neighboring the site by providing bottled water to potentially impacted area residents. At that time, EPA explained that it would provide bottled water as an interim solution until an alternate water supply could be arranged by NJDEPE. Thereafter, NJDEPE determined that the most appropriate method to supply potable water was to install individual carbon units at the potentially impacted homes. NJDEPE installed the carbon filter units during the spring/summer of 1989, at which time bottled water delivery was discontinued. The carbon filter units were intended to limit ingestion of volatile organic compounds and mitigate the potential for human exposure via inhalation of volatile organic compounds through household use.

In March 1987, NJDEPE formally requested that EPA assume the lead role in mitigating the Higgins Farm site. On April 8, 1987, EPA initiated activities to stabilize the site and to control the release of hazardous substances into the environment. The following actions were undertaken:

a. the construction of a barn to house contaminated material, including but not limited to, overpacked drums and roll-off containers;

b. the excavation pit was drained, lined and backfilled;

c. the pumped liquids were treated and stored in holding tanks; and

d. the excavation pit area was fenced to prevent access by unauthorized persons.

In December 1989, NJDEPE advised EPA that it could not monitor and maintain the carbon units beyond the spring of 1990. On February 2, 1990, EPA authorized $625,320 to monitor and maintain the carbon filter units for approximately two years.

The site was proposed for inclusion on the National Priorities List (NPL) in June 1988. EPA began investigations to identify potentially responsible parties (PRPs) for the contamination at the site. In March 1989, the site was formally placed on the NPL, thus making it eligible for federal funds to investigate the extent of contamination and to clean up the site. In March 1989, EPA notified six PRPs of their potential liability. EPA offered these PRPs the opportunity to conduct or finance the Remedial Investigation and Feasibility Study (RI/FS) for the site; however, the PRPs declined to accept EPA's offer.

As a result, EPA allocated funds for the studies to be conducted under EPA supervision through its contractors. EPA has since identified one additional PRP, who also declined to conduct or finance the RI/FS.

On October 17, 1989, EPA offered the PRPs the opportunity to install a water line along Route 518 to service the residents impacted and potentially impacted by the Higgins Farm site to provide a permanent solution to the water supply problem. In February 1990, EPA informed the seven PRPs that the Agency had not received an acceptable offer to install the public water supply.

On March 20, 1990, EPA issued an Administrative Order to Mr. & Mrs. Clifford Higgins Sr. to install the water line. Mr. & Mrs. Higgins have failed to comply with the order.

In June 1990, EPA released the Focused Feasibility Study (FFS) report and EPA's Proposed Plan for the construction of a water line extension to provide the potentially affected residents with an alternate water supply. A public comment period was provided, beginning on June 28 and ending on July 30, 1990.

On September 24, 1990, EPA issued a first Record of Decision (ROD) which selected an interim remedy to connect the potentially affected residents to an existing water supply. The design of the water line has been completed and all necessary approvals from the Township of South Brunswick to connect to its water supply have been obtained. Construction of the water line is scheduled to begin in the near future.

Between March 1990 and July 1992, EPA conducted an RI/FS to define the nature and extent of contamination at the site.

In August 1992, EPA's removal program completed the excavation of 94 drums and contaminated soils which were discovered during test pit excavation activities in the NJDEPE fenced area. Arrangements are currently being made for the proper disposal of these drums and contaminated soils.

HIGHLIGHTS OF COMMUNITY PARTICIPATION

A Community Relations Plan (CRP) for the Higgins Farm site was finalized in March 1990. The CRP lists contacts and interested parties throughout government and the local community. It also establishes communication pathways to ensure timely dissemination of pertinent information.

The RI/FS reports and the Proposed Plan for the second operable unit ground-water remedy were released to the public for comment on July 15, 1992. These documents were made available to the public in the administrative record file at Information Repositories at the Mary Jacobs Memorial Library, the Franklin Township Library and at EPA's Region II Office in New York City. The notice of availability for these

documents was published in The Home News on July, 15, 1992. A public comment period was held from July 15 to September 18, 1992, due to a request to extend the comment period. In addition, a public meeting was held on August 3, 1992, to present the Proposed Plan for the site. At this meeting, representatives from EPA answered questions regarding remedial alternatives under consideration and problems at the site. All comments which were received by EPA prior to the end of the public comment period, including those expressed verbally at the public meeting, are addressed in the Responsiveness Summary which is attached as Appendix I to this Record of Decision.

SCOPE AND ROLE OF RESPONSE ACTION WITHIN SITE STRATEGY

This is the second of two operable units for the site. The first operable unit provided potentially affected residents located on Route 518 with an alternate water supply to prevent ingestion of contaminated ground water. The primary objectives of the second operable unit, as authorized by this ROD, are to capture and treat the bulk of ground-water contamination found on the site and limit future migration of contaminated ground water to off-site areas.

Many residents in the vicinity of the site depend on ground water as a potable water source. Although the first operable unit provided some area residents with an alternate water supply, there remains the potential for contaminated ground water to migrate from the site to other residential wells. As determined in the risk assessment, exposure to the contaminated ground water could pose a threat to residents who utilize ground water as their potable water supply. Therefore, this action is necessary to treat the contaminated ground water at the site, and restrict the off-site migration of contaminants.

In addition, as described below, the risk assessment concluded that exposure to site soils does not pose a significant risk, with the exception of the soils located in the NJDEPE fenced area which are being addressed as part of the removal action described above. No further action is considered necessary for soils although, as discussed below under **Description of Alternatives**, confirmatory sampling will be performed to ensure that all contaminant sources have been identified. Therefore, this second operable unit remedy focuses solely on ground-water remediation.

SUMMARY OF SITE CHARACTERISTICS

EPA contracted Malcolm Pirnie and CH2M Hill to conduct a Remedial Investigation in late Summer 1989. The purpose of the RI was to accomplish the following:

- identify the nature and extent of contaminant source areas;
- define contamination of ground water, soils, surface water and sediment;

- characterize site hydrogeology; and

- determine the risk to human health and the environment posed by the site.

The RI tasks conducted to accomplish each of these objectives are listed in Table 1.

RI field work was conducted in two phases: from March 1990 through January 1992, and from February 1992 through March 1992. Ground-water, surface and subsurface soil, surface-water, sediments and suspected source area (through test pit excavation) samples were collected and analyzed during Phase I of the RI. Phase II of the RI, which included the excavation of additional test pits and sampling, was conducted to investigate other potential sources of contamination. In addition, hydrogeologic studies were conducted using information obtained during the RI. The results of the RI are summarized as follows.

Site Hydrolgeology

The geology of the site is characterized as unconsolidated material underlain by fractured bedrock. Figure 3 shows a generalized geologic cross section of the site. Hydrogeologic testing of monitoring wells installed in both the overburden and bedrock zones were used to determine site hydrogeology, hydraulic conductivity, ground-water flow directions and velocity, and the vertical gradient between the two water-bearing zones. Results of the hydrogeologic studies indicate that ground water flows through poorly distributed fractures in the bedrock beneath the site, resulting in heterogeneous aquifer conditions. Aquifer anisotropy, which causes ground water to flow preferentially through these fractures, along with the heterogenous conditions, result in complex ground-water flow patterns which make it extremely difficult to ascertain the pattern of local ground-water flow. Detailed results of the hydrogeologic studies can be found in the Remedial Investigation report.

Ground-Water Investigation

Ground-water samples were collected from seven shallow and eight deep on-site monitoring wells. In addition, five residential wells in the vicinity of the site were sampled (see Figure 4). As shown in Table 2, analytical results indicate that numerous contaminants, including volatile organic compounds and metals, are present above federal and state Maximum Contaminant Levels (MCLs). VOCs were detected in 21 of 23 ground-water samples. Tetrachloroethene was the most frequently detected compound, at concentrations ranging from 0.17 to 270 parts per billion (ppb). The compound detected at the highest concentration was benzene at 1,200 ppb. Other VOCs which were detected above federal and state MCLs include: dichloroethane (320 ppb); trichloroethane (1,100 ppb); and vinyl chloride (86 ppb). No semi-volatile organic compounds (semi-VOCs) were detected above federal or state MCLs. The

most frequently detected semi-VOC was dichlorobenzene, at concentrations ranging from 20 to 48 ppb. Inorganic compounds appeared in all samples. The metal detected at the highest concentration was iron at 433,000 ppb. The following metals were detected above federal and state MCLs: beryllium (25.7 ppb); copper (8750 ppb); iron (433,000 ppb); and lead (81.4 ppb).

Source Area Investigation

Test pit excavations were conducted to identify sources of contamination. Thirteen test pits were excavated during Phase I of the RI (see Figure 5). The test pit locations were chosen based on the evaluation of the geophysical and soil gas surveys. A source of contamination was uncovered in the area which NJDEPE formerly designated as a suspected drum burial area. Buried 55-gallon drums, and other containers and refuse were uncovered during excavation. Table 3 summarizes the results of soil samples collected from test pits. The following contaminants were among those detected in soils in the NJDEPE fenced area: trichloroethane (4,400 ppb); tetrachlorethene (47,000 ppb); pentachlorophenol (2,100,000 ppb); arsenic (1,310,000 ppb); and dioxins (222 ppb). This source area is being addressed separately by EPA's removal program. The removal of drums and contaminated soil is expected to be completed in the Fall of 1992.

Six additional test pits were excavated and sampled during Phase II of the RI (see Figure 5). The follow-up test pit program was conducted in March 1992. These test pits were excavated to investigate potential sources of contamination as well as to delineate the extent of contamination in areas where buried drums or contaminated shallow monitoring wells are located. No drums or any other contaminant source material were found during the Phase II test pit excavation.

Surface and Subsurface Soil Investigation

Surface soil samples were collected at 59 locations, including 42 on site and 17 off site (see Figure 6). Sampling of on-site surface soils focused on suspect source areas. The majority of the off-site samples were collected from residential properties adjacent to the site. Results showed that VOCs and semi-VOCs, in both on- and off-site samples, were detected infrequently and at low concentrations. In addition, two pesticides were detected in the on-site samples, but have been determined to most likely have originated from insecticides applied at the site. The inorganics detected on and off the site include arsenic (12,400 ppb) and beryllium (2,000 ppb). Table 4 summarizes the analytical results of surface soils samples collected at the site.

Subsurface soil sampling included the installation of shallow borings, and collection of samples during installation of monitoring wells. VOCs were detected in 11 of the 13 borings. The VOC detected at the highest concentration was tetrachloroethene at 1,100 ppb, however, it was detected at only one location. Semi-VOCs and metals

were detected at low concentrations. Table 5 summarizes the analytical results of subsurface soil samples collected at the site.

As no promulgated federal or state standards exist for surface and subsurface soils, detected concentrations in test pits and soils were evaluated in a site-specific risk assessment. As discussed below in the Summary of Site Risk section, the levels of contamination present in soils do not pose a significant risk to human health or the environment, with the exception of the contaminated soil in the NJDEPE fenced area which is being addressed by EPA's removal program.

Surface-Water and Sediment Investigation

Three surface-water samples were collected from the intermittent on-site pond (see Figure 6). The only VOC detected above the Federal Ambient Water Quality Criteria (FAWQC) for the protection of aquatic life was carbon tetrachloride (1.4 ppb). No semi-VOC's were detected above the FAWQC. The inorganics results indicated that the following metals were detected above the FAWQC: copper (6.4 ppb); iron (4,950 ppb); lead (12 ppb); and zinc (292 ppb).

Seven sediment samples were collected from the pond and three drainage channels at the site. The following semi-VOCs were among those detected: benzo(a)pyrene (500 ppb); benzo(b)fluoranthene (830 ppb); and chrysene (750 ppb). These compounds, however, were detected infrequently. Inorganics detected include arsenic (5,700 ppb) and beryllium (2,000 ppb). Table 6 summarizes the analytical results of sediment samples collected at the site.

SUMMARY OF SITE RISK

EPA conducted a baseline Risk Assessment to evaluate the potential risks to human health and the environment associated with the Higgins Farm site in its current state. The Risk Assessment focused on contaminants in the ground water, soils and sediments. The selection of contaminants of concern (COC) is based on a number of parameters, including the frequency of detection and concentration in each environmental medium, environmental fate and transport characteristics, toxicity, and the likelihodd of exposure. The summary of COC in sampled matrices is listed in Table 7.

Human Health Risk Assessment

EPA's Risk Assessment identified several potential exposure pathways by which the public may be exposed to contaminant releases at the site under current and future land-use conditions. Ground-water, soils and sediment exposures were assessed for a potential present land-use scenario and sediment exposure was assessed for potential future land-use conditions. The baseline risk assessment evaluated the

health effects which could result from exposure to contamination as a result of six exposure pathways: 1) ingestion of chemicals in soil; 2) dermal contact with chemicals in soil; 3) dermal contact with chemicals in ground water; 4) ingestion of chemicals in ground water; 5) inhalation of chemicals in ground water volatilized to air; and 6) dermal contact with contaminants in sediment. For the purposes of this human health evaluation, potentially exposed populations include residents living on or adjacent to the site, farm workers, and site trespassers. These exposure pathways were evaluated separately for adult and child residents. Children are assumed to be under seven years old. All of the exposure pathways identified for the current land use can be expected to continue into the future. In addition, an on-site resident's exposure to sediments was evaluated for the future-use scenario. The exposure pathways considered under current and future-use scenarios are listed in Tables 8 and 9, respectively. The reasonable maximum exposure to COC was evaluated in all cases.

Under current EPA guidelines, the likelihood of carcinogenic (cancer causing) and non-carcinogenic effects due to exposure to COC are considered separately. It was assumed that the toxic effects of the site-related chemicals would be additive. Thus carcinogenic and non-carcinogenic risk associated exposures to individual compounds of concern were summed to indicate the potential risks associated with mixtures of potential carcinogens and non-carcinogens, respectively.

Non-carcinogenic 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 medium. The hazard index is obtained by adding the hazard quotients for all compounds across all media that impact a particular receptor population.

A hazard index greater than 1.0 indicates that the potential exists for non-carcinogenic 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. A summary of the non-carcinogenic risks associated with the chemicals of concern across the various exposure pathways is found in Table 10.

It can be seen from Table 10, that the HI for non-carcinogenic effects from the ingestion, dermal contact and inhalation of ground water is 6.50 for adult residents and 10.27 for child residents. Therefore, non-carcinogenic effects may occur from the exposure routes evaluated in the Risk Assessment. The non-carcinogenic risk

associated with exposure to contaminated ground water is attributable to several compounds including 1,1,2-trichloroethane and chlorobenzene.

As presented in Table 10, the HI for non-carcinogenic effects from ingestion and dermal contact with contaminants in soil is less than 1.0, indicating that the risk posed by the soils is below EPA's acceptable risk range.

Potential carcinogenic risks were evaluated using cancer slope factors (SFs) developed by EPA for the contaminants of concern. Cancer slope factors have been developed by EPA's Carcinogenic Risk Assessment Verification Endeavor for estimating excess lifetime cancer risks associated with exposure to potentially carcinogenic chemicals. SFs, 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 SF. 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 10^{-4} to 10^{-6} to be acceptable. This level indicates that an individual may have one in ten thousand to one in a million chance of developing cancer as a result of site-related exposure over a 70-year period under specific exposure conditions at the site. Under current land-use conditions, the risk characterization showed that cancer risks associated with each of the ground-water pathways (ingestion, inhalation and dermal contact) exceed Superfund acceptable risk levels for both adults and children. For example, the estimated cancer risk associated with ingestion of ground water is 2×10^{-3} (two in a thousand) for residential adults and 1×10^{-3} for residential children. The total cancer risk posed by contaminated ground water from all pathways considered is 3×10^{-3} for residential adults and 2×10^{-3} for residential children. The cancer risk analysis indicates that 1,1,2-trichloroethane, benzene, vinyl chloride and 1,2-dichloroethane are the main contributors to the estimated cancer risk (see Table 11).

As presented in Table 11, the cancer risks associated with the ingestion and dermal contact with contaminants in soil and sediments are below or within EPA's acceptable risk range, as described above.

The calculations were based on the concentrations of contaminants detected in on-site monitoring wells and residential wells. For many monitoring well locations, ground water from both shallow and deep monitoring wells was sampled and analyzed. Where data was available from both depths, the higher concentration was used to estimate exposure. For purposes of the Risk Assessment, the installation of the waterline, which will provide 30 residents located along route 518 with a safe potable water supply, was not taken into account as the waterline does not protect residents

located downgradient from the site who depend on ground water as their potable water source.

Ecological Risk Assessment

EPA also performed an Ecological risk assessment for the Higgins Farm site. The following were determined to be chemicals of concern in the environmental risk assessment: total polyaromatic hydrocarbons (PAHs); dioxins; and lead. The risk assessment qualitatively evaluated the exposure pathways through which these chemicals could migrate, potentially allowing for receptors to be at risk. For the variety of aquatic and terrestrial species, the most probable routes of exposure to the chemicals of concern were identified as ingestion or direct contact with surface water, sediments or soil containing these compounds.

Due to the intermittent nature of the on-site surface water, the long range impact from surface-water exposure to species that utilize the pond for habitat (e.g., amphibians), from surface-water exposure is deemed to be low. When the surface water is absent, however, these organisms would be exposed to the sediment and soil borne contamination and thus be potentially at risk to these media. Because of the small area of pond sediments, in conjunction with the low frequency of detection of the compounds, the risks due to exposure and ingestion of these media is also low.

The risk to the terrestrial wildlife (e.g., small mammals) was also found to be low for the following reasons. The PAHs were detected in residential areas which are unlikely to be used by wildlife. In addition, a review of the current literature did not indicate that the dioxins and lead detected in soils and sediments would pose any significant risks to these populations.

The site is operated as an active farm for cattle breeding. The cattle are bred and raised at the site and are subsequently sold for human consumption. In August 1987, NJDEPE collected seven milk and two beef tissue samples from the cattle. Dioxins and furans were not detected in the milk samples. As determined by the Food and Drug Administration (FDA), levels of dioxins detected in beef tissue samples were lower than those shown in routine market surveys and are not indicative of a problem. In addition, fencing restricts the cattle from the source areas, i.e., the excavation pit and NJDEPE fenced areas. Therefore, it has been determined that the cattle are not at risk.

As discussed below, the selected remedy will include discharge of treated ground water to on-site surface water. Such a discharge could potentially affect the water quality and increase the potential exposure of the aquatic community to contaminants, causing adverse impacts to the aquatic community. To ensure their continued protection, the selected remedy will include regular monitoring of the surface water. Field visits to the site have indicated that the wooded and wetland portion of the site

provide habitat for a variety of species. No signs of stressed conditions were observed at the site. No records exist showing the presence of rare plants, animals or natural communities on the Higgins Farm site.

Uncertainties

The procedures and inputs used to assess risks in this evaluation, as in all such assessments, are subject to a wide variety of uncertainties. In general, the main sources of uncertainties include:

- environmental chemistry sampling and analysis;
- environmental parameter measurement;
- fate and transport measurement;
- exposure parameter estimation; and
- toxicological data.

Uncertainty in environmental sampling arises in part from the potentially uneven distribution of chemicals in the media sampled. Consequently, there is significant uncertainty as to the actual levels present. Environmental chemistry analysis error can stem from several sources including the errors inherent in the analytical methods and characteristics of the matrix being sampled.

Uncertainties in the exposure assessment are related to estimates of how often an individual would actually come in contact with the chemicals of concern, the period of time over which such exposure would occur, and in the models used to estimate the concentrations of the chemicals of concern at the point of exposure.

Uncertainties in toxicological data occur in extrapolating both from animals to humans and from high to low doses of exposure, as well as from the difficulties in assessing the toxicity of a mixture of chemicals. These uncertainties are addressed by making conservative assumptions concerning risk and exposure parameters throughout the assessment. As a result, the Risk Assessment provides upper bound estimates of the risks to populations near the site, and is highly unlikely to underestimate actual risks related to the site.

More specific information concerning public health risks, including a quantitative evaluation of the degree of risk associated with various exposure pathways, is presented in the Risk Assessment report.

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

Remedial action objectives are specific goals to protect human health and the environment; they specify the contaminant(s) of concern, the exposure route(s), receptor(s), and acceptable contaminant level(s) for each exposure route. These objectives are based on available information and standards such as applicable, or relevant and appropriate requirements (ARARs) and risk-based levels established in the risk assessment.

The following remedial action objectives were established for the second operable unit of the Higgins Farm site:

- To capture and treat the contaminated ground water in an attempt to restore the aquifer to Federal and State drinking water standards;

- To control or limit the future off-site migration of the contaminated ground water; and

- To minimize the potential for direct exposure of the populace to the contaminated ground water.

The ground water flows through fractures in the bedrock such that contaminants may flow more quickly in one direction than in another. Defining the precise location of fractures conveying contaminants which have already migrated from the site and removing all contaminants from bedrock fractures would not be feasible. Therefore, the ground-water remediation goal is to capture and treat the bulk of the contamination on site and limit future off-site contamination to the extent practicable given the complicated nature of site geology.

DESCRIPTION OF ALTERNATIVES

CERCLA requires that each selected site remedy be protective of human health and the environment, be cost-effective, comply with other statutory laws, and utilize permanent solutions, alternative treatment technologies and resource recovery alternatives to the maximum extent practicable. In addition, the statute includes a preference for the use of treatment as a principal element for the reduction of toxicity, mobility, or volume of the hazardous substances.

This Record of Decision evaluates in detail, three remedial alternatives for addressing the contamination associated with the Higgins Farm site. The time to implement reflects only the time required to construct or implement the remedy and does not

include the time required to design the remedy, negotiate with the potentially responsible parties, or procure contracts for design and construction. Capital costs, operation and maintenance (O & M) costs, and present worth values are provided for the three alternatives.

These alternatives are:

Alternative 1: No Further Action

Estimated Capital Cost: $0
Estimated Annual O & M Cost: $71,500
Estimated Total Present Worth Value (5-30 years): $309,500 - $1,099,100
Estimated Implementation Period: None

CERCLA requires that the "no-action" alternative be evaluated at every site to establish a baseline for comparison to other alternatives. Under this alternative, EPA would take no further action at the site to prevent exposure to the ground-water contamination, thus the contamination would continue to migrate from the site and could impact downgradient wells in the future. Using existing monitoring wells to the extent possible, a long-term ground-water monitoring program would be implemented to monitor contaminant concentrations remaining at the site and migrating downgradient. For cost estimation purposes, it was assumed that sampling would occur on a semi-annual basis.

Because this alternative would result in contaminants remaining at the site, CERCLA requires that the site be reviewed every five years. If justified by the review, remedial actions may be implemented to remove or treat the contaminated ground water. The above cost estimate includes the cost to perform this review. Details of the costs associated with Alternative 1 are shown in Table 12.

Alternative 2: Source Area Ground-Water Extraction and Treatment

Estimated Capital Cost: $1,353,299
Estimated Annual O & M Cost: $262,100
Estimated Total Present Worth Value (5-30 years): $2,487,900 - $5,382,300
Estimated Implementation Period: 1 year

The ground-water capture zone of this alternative would attempt to remediate only the contaminated ground water in the vicinity of the two source areas; the excavation pit area and the NJDEPE fenced area. This alternative includes the installation of approximately six bedrock ground-water extraction wells around the source areas, treatment of the contaminated ground water and discharge of the treated effluent to the on-site surface water. Figure 7 provides a simulation of the anticipated source area capture zone for this alternative. For cost estimation purposes, the treatment

Details of the costs associated with Alternative 2 are shown in Table 14.

Alternative 3: Site-Wide Ground-Water Extraction and Treatment

Estimated Capital Cost: $2,544,800
Estimated Annual O & M Cost: $384,000
Estimated Total Present Worth Value (5-30 years): $5,990,000 - $8,447,600
Estimated Implementation Period: 1.2 years

In order to address site-wide ground-water contamination, this alternative includes a more encompassing, site-wide ground-water extraction system . This alternative is similar to Alternative 2 except that it includes the installation of approximately sixteen bedrock ground-water extraction wells around the perimeter of the site as well as around the two source areas. Figure 9 provides a simulation of the anticipated site-wide capture zone for this alternative. For cost purposes, the treatment system was assumed to include metals precipitation, flocculation, clarification, and filtration followed by aeration (air stripping), intermediate pH adjustment, ion exchange, and final pH adjustment. The actual number and placement of extraction wells and the exact nature of the treatment system would be determined during design of the system.

As in Alternative 2, a ground-water and surface-water monitoring program would be implemented to evaluate the performance of the remedial action. This program would include monitoring of on- and off-site monitoring wells (which may include the installation of additional off-site monitoring wells), and residential wells. Additional well surveys to identify existing potable wells in the vicinity of the site would also be included under this alternative.

As in Alternative 2, because the exact length of time the treatment system would be operated is unknown, it would be monitored regularly for effectiveness in containing and treating the contaminated ground water. Therefore, the cost of this alternative could range from $5,990,000 to $8,447,600 depending on the length of time the system is operated as shown in Table 13.

In addition, this alternative will include the previously described limited investigations to confirm that all sources have been identified and the removal of contaminated material presently stored at the site.

In order to increase the effectiveness of the extraction wells, artificial enhancement of fractures around extraction wells may be considered during the design of the remedial action.

A summary of the ARARs associated with Alternative 3 is provided under the **Summary of the Comparative Analysis of Alternatives** section.

system was assumed to include metals precipitation, flocculation, clarification, and filtration followed by aeration (air stripping), intermediate pH adjustment, ion exchange and final pH adjustment (see Figure 8). The actual number and placement of extraction wells and the exact nature of the treatment system would be determined during design of the system.

Alternative 2 includes a ground-water and surface-water monitoring program to evaluate the performance of the remedial action. This program would include monitoring of on- and off-site monitoring wells (which may include the installation of additional off-site monitoring wells), and residential wells. Additional well surveys to identify existing potable wells in the vicinity of the site would also be conducted under this alternative.

As the goal of this alternative is to restore the aquifer to drinking water standards, there is some uncertainty associated with the required time frame for achieving these goals. Thus, the cost estimate is based on an estimated treatment period of 5 to 30 years, as shown in the cost sensitivity analysis in Table 13. The cost of this alternative could range from $2,487,900 to 5,382,300 depending on the length of time required to remove contaminants. This ground-water treatment system would be monitored regularly for effectiveness in containing and treating the contaminated ground water.

This alternative would also include limited investigations of the following areas to confirm that all sources have been identified: the grain pile located in the feedstock area; an abandoned hand-dug well; the excavation pit area; and a small area located in the northwest portion of the site that could not previously be investigated due to the presence of livestock. EPA does not anticipate the discovery of additional sources of contamination.

Contaminated material presently stored at the site, including those materials generated during site stabilization and remedial investigation activities, would be removed from the site as part of this alternative. EPA suspects that some of these wastes may contain dioxin, which would limit disposal options. Therefore, the waste may be stored at the site until such time that proper disposal can be arranged.

In addition, in order to increase the effectiveness of the extraction wells, artificial enhancement of fractures around extraction wells may be considered during the design of the remedial action. This would be accomplished through controlled blasting or use of high pressure water to enlarge existing fractures, or create new fractures around individual wells.

A summary of the ARARs associated with Alternative 2 is provided in the **Summary of the Comparative Analysis of Alternatives** section.

including the availability of materials and services needed.

7. *Cost* includes estimated capital and operation and maintenance costs, and the present worth costs.

The following "modifying" criteria are considered fully after the formal public comment period on the Proposed Plan is complete:

8. *State acceptance* indicates whether, based on its review of the RI/FS and the Proposed Plan, the State supports, opposes, and/or has identified any reservations with the preferred alternative.

9. *Community acceptance* refers to the public's general response to the alternatives described in the Proposed Plan and the RI/FS reports. Factors of community acceptance to be discussed include support, reservation, and opposition by the community.

A comparative analysis of the remedial alternatives based upon the evaluation criteria noted above follows.

THRESHOLD CRITERIA

Overall Protection of Human Health and the Environment

As the no-action alternative does not include ground-water treatment or migration control, it provides no reduction in risk and is not considered to be protective of human health and the environment.

Alternative 2, source-area ground-water extraction and treatment, affords protection of human health and the environment through extraction and treatment of contaminants in ground water. By controlling contaminant migration within the source area capture zone, the extraction system aids in the prevention of exposure to contaminated ground water. However, as this alternative focuses on the source areas only, contamination would continue to migrate from other areas of the site. The monitoring of off-site residential and monitoring wells would provide additional protection by determining if contaminants are migrating from the site toward downgradient receptors. The effluent from the ground-water treatment system would be designed to meet the discharge requirements shown in Table 17, which are considered to be protective of human health and the environment.

Alternative 3, site-wide ground-water extraction and treatment, affords greater protection of human health and the environment than Alternative 2 since the capture zone for Alternative 3 encompasses the entire site. Therefore, Alternative 3 would allow less contaminated ground water to migrate from the site. In addition, as

Details of the costs associated with Alternative 3 are shown in Table 15.

SUMMARY OF THE COMPARATIVE ANALYSIS OF ALTERNATIVES

During the detailed evaluation of remedial alternatives, each alternative was assessed utilizing nine evaluation criteria as set forth in the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) and Office of Solid Waste and Emergency Response (OSWER) Directive 9355.3-01. These criteria were developed to address the requirements of Section 121 of CERCLA to ensure all important considerations are factored into remedy selection decisions.

The following "threshold" criteria are the most important, and must be satisfied by any alternative in order to be eligible for selection:

1. *Overall protection of human health and the environment* addresses whether or not a remedy provides adequate protection and describes how risks posed through each exposure pathway (based on a reasonable maximum exposure scenario) are eliminated, reduced, or controlled through treatment, engineering controls, or institutional controls.

2. *Compliance with ARARs* addresses whether or not a remedy would meet all of the applicable, or relevant and appropriate requirements of federal and state environmental statutes and requirements or provide grounds for invoking a waiver.

The following "primary balancing" criteria are used to make comparisons and to identify the major trade-offs between alternatives:

3. *Long-term effectiveness and permanence* refers to the ability of a remedy to maintain reliable protection of human health and the environment over time, once cleanup goals have been met. It also addresses the magnitude and effectiveness of the measures that may be required to manage the risk posed by treatment residuals and/or untreated wastes.

4. *Reduction of toxicity, mobility, or volume through treatment* is the anticipated performance of a remedial technology, with respect to these parameters, that a remedy may employ.

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

6. *Implementability* is the technical and administrative feasibility of a remedy,

Alternative 3 includes more extraction wells, it is expected that a greater volume of contaminated ground water will be extracted from the aquifer. However, as in Alternative 2, due to the complex nature of the site geology, some contamination may remain in the fractured bedrock at the end of the remediation time period. The monitoring of off-site residential and monitoring wells would provide additional protection in Alternative 3 as well. The effluent from this treatment system would meet discharge requirements considered to be protective of human health and the environment.

Compliance with Applicable Relevant and Appropriate Requirements

The technologies and methods proposed for use under the ground-water remedial alternatives would be designed and implemented to satisfy all corresponding ARARs, as described below.

Chemical-Specific ARARs

Chemical-specific ARARs are health- or environmentally-based numerical values limiting the amount of a contaminant that may be discharged to, or allowed to remain in environmental media.

GROUND WATER

It has been determined that the site is located within the boundaries of the 15 Basin Sole Source Aquifer, a ground-water protective designation authorized by the Safe Drinking Water Act. Standards which are considered ARARs for the site include: Federal Safe Drinking Water Act (SDWA) Maximum Contaminant Levels, Federal Resource Conservation and Recovery Act (RCRA) Maximum Concentration Limits, and State of New Jersey standards [New Jersey Safe Drinking Water Act A-280 Amendments and New Jersey Pollution Discharge Elimination System regulations (N.J.A.C. 7:14A-1.1 et seq.), N.J.A.C. 7:10-16 et seq. and 7:9-6 et seq.]. CERCLA requires remedies to comply with promulgated state requirements which are more stringent than federal requirements. Therefore, the most stringent standard is the cleanup goal for ground water at the site. Table 16 lists the chemicals found in the ground water at the site with their federal and state standards. The last column in the table provides the cleanup requirement for each chemical.

Alternative 1 does not involve active remediation and is not expected to meet chemical-specific ARARs in ground water. Natural flushing of ground water, in time, may eventually result in achievement of ARARs in ground water. The time frame is unknown, but would be expected to take many years.

Alternative 2 involves active remediation of ground water in the vicinity of the source areas. However, due to the difficulties in extracting contaminated ground water from

fractured bedrock, the time frame for achieving ARARs is difficult to estimate. Furthermore, since this alternative only addresses the source areas, ARARs will not be achieved outside the source area capture zone. Some decreases in contaminant levels can be expected over time. Alternative 3 will include more extraction wells than Alternative 2 and therefore is expected to remove and treat more contaminated ground water. Thus, Alternative 3 is more likely to achieve ARARs in the aquifer than Alternative 2. The time frame for Alternatives 2 and 3 to achieve compliance with chemical-specific ARARs in the underlying bedrock aquifer is difficult to estimate. Alternative 3 represents a more aggressive approach to attaining ARARs in the aquifer, and greater decreases in contaminant levels can be expected with this alternative.

AIR

Air emissions from the treatment systems associated with Alternatives 2 and 3 would be required to meet both Federal and State air quality standards and regulations including the following: National Ambient Air Quality Standards, 40 CFR Part 50; and New Jersey Air Pollution Control Regulations, N.J.A.C. 7:27 et seq.

SURFACE WATER

Pursuant to the Clean Water Act, EPA developed Federal Ambient Water Quality Criteria (FAWQC). EPA has determined that these criteria are relevant and appropriate requirements. The surface discharge requirements selected for the Higgins Farm site generally are the FAWQC for the protection of aquatic life. However, for those compounds for which the laboratory minimum detection level (MDL) is greater than the FAWQC (i.e., the concentration determined by the FAWQC cannot be detected), compliance with the FAWQC will be shown by meeting the lowest MDL available through the EPA contract laboratory program. In addition, for certain compounds, an anti-degradation limitation may be applicable. This is to minimize degradation of existing water quality (i.e., the discharge limit should not be higher than the ambient concentration in the surface water).

The treatment system conceptually developed in the FS for Alternatives 2 and 3 represents the best available technology for the constituents present in site ground water. The system includes metals precipitation, flocculation, clarification, and filtration, followed by aeration (air stripping), intermediate and final pH adjustments, as well as a polishing step for metals removal.

EPA determined that this treatment system would be the most appropriate for achievement of the FAWQC. In addition, it is anticipated that this system will achieve the anti-degradation limits. As shown in Table 17, the discharge from the treatment system should meet the FAWQC and the antidegradation limits. However, these requirements are rather stringent and may be difficult to achieve with the selected technology which, as stated above, represents the best available technology. If, upon

operation of the treatment system, it is determined that the selected discharge requirements cannot be achieved, these requirements may be waived based on the technical impracticability of achieving further contaminant reduction.

Action-Specific ARARs

Action-specific ARARs are either technology or activity based limitations which apply to remedial actions.

Since Alternative 1 does not involve active remediation, it has no associated action-specific ARARs.

The action-specific ARARs associated with both Alternatives 2 and 3 include the following: Clean Water Act, 33 U.S.C. 1251 et seq., for discharge to surface water; Resource Conservation and Recovery Act, 42 U.S.C. 6901 et seq., for operation of the ground-water treatment system; National Ambient Air Quality Standards, 40 CFR Part 50, for air emissions from the ground-water treatment system; DOT Rules for Hazardous Materials Transportation for The Transportation of Hazardous Materials, 49 CFR Parts 107, 171.1-172.558; Hazardous and Non-hazardous Waste Regulations, N.J.A.C., 7:26 et seq; Air Pollution Control Regulations, N.J.A.C. 7:27 et seq; Spill Notification requirements, N.J.A.C. 7:1(e); Notice of Release of Hazardous Substances to Atmosphere, N.J.S.A. 26:2c-19; Occupational Safety and Health Administration requirements, 29 U.S.C. 651 et seq.; General Requirements for Permitting Wells, N.J.A.C. 7:9-7; and Sealing of Wells Procedures, N.J.S.A.58:4A-5 et seq.

In addition, any sludge generated by the operation of the ground-water treatment plant would have to be disposed of in accordance with the requirements of the Resource Conservation and Recovery Act, including the Land Disposal Restrictions.

As treated ground water would be discharged to surface water, the requirements included in Table 17, as discussed above, would also be action-specific ARARs for the ground-water treatment system included in both Alternatives 2 and 3.

It is expected that both Alternatives 2 and 3 would address and comply with all action-specific ARARs listed above.

Location-Specific ARARs

Location-specific ARARs restrict activities or limit concentrations of contaminants in effluent because a site is in a special location such as a floodplain, wetland, or historical area.

Since Alternative 1 does not involve active remediation, it has no associated location-specific ARARs.

The location-specific ARARs associated with Alternatives 2 and 3 include the following: Fish and Wildlife Coordination Act, 16 U.S.C. 661 et seq.; Clean Water Act; National Historic Preservation Act of 1966, as amended, 16 U.S.C. 470 et seq.; New Jersey Flood Hazard Area Regulations, N.J.A.C. 7:13-1.1 et seq.; and New Jersey Freshwater Wetlands Protection Act Rules, N.J.A.C. 7:7A-1.1 et seq.

Alternatives 2 and 3 would comply with all the location-specific ARARs listed above. For the National Historic Preservation Act of 1966, as amended, a Stage 1A cultural resource survey was conducted at the site. The only portion of the site of historic interest is the nucleus of the Higgins Farmstead. Therefore, if the area of the farmstead nucleus will be affected by remedial actions, a Stage 1B-level archeological study will be performed in accordance with the National Historic Preservation Act of 1966, as amended, to determine whether potentially significant historic archeological resources exist that can be associated with the early history of this property.

A wetlands delineation and assessment will be performed during remedial design to determine whether any remedial actions will have an adverse impact on wetlands at the site. Treatment system design and construction for both Alternatives 2 and 3 would have to address and avoid any potential adverse impacts on wetlands that are identified.

PRIMARY BALANCING CRITERIA

Long-term Effectiveness and Permanence

Alternative 1 would not remove or control migration of contaminants in the ground water. Contaminants from the site would continue to migrate from the site which would increase the volume of contaminated ground water. The no-action alternative is not considered to be effective over the long term because contaminated ground water remains at the site and continues to migrate downgradient.

Alternative 2 is expected to be generally effective in providing cleanup of the aquifer in the source-area capture zone, although some contamination may remain in fractures at the end of the remediation time period. Due to the complex nature of the site geology, it is difficult to determine how effective pumping of the wells adjacent to the source areas will be in extracting contaminated ground water and controlling overall contaminant migration to downgradient receptors and the associated long-term risks due to the nature of fractured bedrock.

Alternative 3 is expected to be more effective than Alternative 2 in providing cleanup of the aquifer, because it involves a more encompassing site-wide capture zone. Although this alternative involves removal of a larger volume of contaminated ground water (i.e., less is likely to remain in the fractured bedrock) and more effectively prevents the off-site migration of contaminated ground water, it is possible that some

contamination may still remain in fractures at the end of the remediation time period.

Reduction of Toxicity, Mobility or Volume through Treatment

Alternative 1 would not involve any containment, removal, treatment, or disposal of contaminated ground water. Therefore, this alternative would not result in any immediate reduction in toxicity, mobility or volume. Contaminants would continue to migrate to off-site areas as well as into deeper fractures of the bedrock resulting in an increase in the volume of contaminated ground water.

Alternative 2 is expected to directly reduce the toxicity, mobility and volume of contaminants in ground water within the source-area capture zone through treatment. As previously stated, due to the complex nature of fractured bedrock, some contamination may remain in the interconnecting fractures of the bedrock and may continue to migrate from the site.

Alternative 3 is expected to further reduce the toxicity, mobility and volume of contaminants in ground water. Some contamination may still remain in the interconnecting fractures of the bedrock in this alternative as well, but to a lesser extent. The Alternative 3 capture zone is more encompassing than that of Alternative 2 and, therefore, would provide a greater reduction of contamination through extraction and treatment of greater volumes of contaminated ground water.

Short-term Effectiveness

Alternative 1 presents no significant short-term risk to residents adjacent to the site as their wells are connected to treatment units. There is no known contamination of residential wells within a one-mile radius of the site. However, under this alternative, ground water will continue to migrate from the site and present a risk to those downgradient residents.

Alternatives 2 and 3 do not pose any significant short-term risks to the community during construction and implementation of the remedy. Construction workers will follow applicable health and safety requirements during implementation of the remedy.

The time required to implement Alternative 2 is estimated to be two years for design and construction. Upon system startup, this alternative will immediately begin to control migration of ground-water contaminants from the source-area capture zone.

The time required to implement Alternative 3 is approximately two months longer than Alternative 2 due to the greater number of wells to be installed. Upon system startup, this alternative will also immediately begin to control ground-water contaminants from migrating from the more encompassing site-wide capture zone.

Implementability

Limited effort would be required to monitor and maintain the elements of Alternative 1. There are several monitoring wells at and near the site that can be used for ground-water monitoring.

Although Alternative 1 is the simplest to implement, the components of Alternatives 2 and 3 can be designed and installed relatively easily. The components of the treatment system are readily available and have proven effective in addressing similar ground-water contamination. The effectiveness of the ground-water pumping will depend on how well the extraction wells are located such that they intercept productive fractures. In general, it may not be possible to pump all of the contaminated ground water from the fractured bedrock within the respective capture zones. If appropriate, further remedial measures, such as installing additional wells, can be easily implemented.

Cost

There are no capital costs associated with Alternative 1. Annual operation and maintenance costs for long-term ground-water monitoring are estimated to be $71,500, for a present worth over five to thirty years of $309,500 - 1,099,100. Alternative 1 is the least costly of the three alternatives.

Capital costs for Alternative 2 are estimated to be $1,353,299. Annual operation and maintenance is estimated to be $262,100. Since it is difficult to predict how long the system would operate, the present worth costs are given in five-year increments, from 5 to 30 years, resulting in a cost range of $2,487,900 - $5,382,300 for Alternative 2.

The cost for Alternative 3 is approximately 50 percent higher than Alternative 2. Although this is the most costly alternative, it provides the greatest protection of human health and the environment. Capital costs for Alternative 3 are estimated to be $2,544,800. Annual operation and maintenance is estimated to be $384,000. The present worth cost range for this alternative is $5,990,000 - 8,447,600.

MODIFYING CRITERIA

State Acceptance

EPA has involved the New Jersey Department of Environmental Protection and Energy in the RI/FS and remedy selection process. The NJDEPE was provided the opportunity to comment on the draft RI/FS documents and the Proposed Plan, and was present at the public meeting held on August 3, 1992 to inform the public of the results of the RI/FS and the Proposed Plan. The NJDEPE has not yet indicated if it concurs with the selected remedy.

Community Acceptance

EPA solicited input from the community on the remedial alternatives proposed for the ground-water contamination at the Higgins Farm site. In general, the community has expressed agreement with EPA's selected remedy. The attached responsiveness summary addresses all comments received during the public comment period.

SELECTED REMEDY

EPA has selected Alternative 3 as the remedy for the Higgins Farm site. This remedy is comprised of the following components:

- Installation of ground-water extraction wells around the perimeter of the site and around the source areas. For cost estimation purposes, sixteen wells are proposed;

- Treatment of the contaminated ground water by processes which are expected to include metals precipitation, flocculation, clarification, and filtration, followed by aeration(air stripping), intermediate pH adjustment, ion exchange, and final pH adjustment;

- Discharge of treated ground water to the on-site surface water body;

- Implementation of a program for sampling of on-site and off-site monitoring wells and downgradient residential wells to evaluate the potential for off-site migration and the effectiveness of the extraction system;

- Limited investigations to confirm that all sources of contamination have been identified;

- Removal and proper disposal of contaminated materials generated during previous site stabilization and remedial investigation activities which are presently stored at the site.

The remedial design will specify the appropriate number and location of wells, and system parameters for the ground-water treatment system. Some modifications or refinements may be made to the remedy during remedial design, construction and operation.

The selection of this remedy is based upon the comparative analysis of the ground-water alternatives discussed above, and provides the best balance of tradeoffs with respect to the nine evaluation criteria. ARARs for the selected remedy are provided in the discussion Attainment of Applicable or Relevant and Appropriate Requirements of

Environmental Laws in the following section.

CONTINGENCY MEASURES

As previously discussed, the goal of this remedial action is to capture and treat the bulk of the ground-water contamination at the site and limit future off-site contamination to the extent practicable, as well as to restore the ground water to its beneficial use, which is, as stated above, a drinking water aquifer. Based on information obtained during the RI, EPA believes that the selected remedy may be able to achieve this goal. However, the ability to achieve cleanup standards (i.e., Federal and State MCLs) cannot be determined until the extraction and treatment system has been implemented and its efficiency and effectiveness are monitored over time.

During operation of the remedial action, if it becomes apparent that contaminant levels have ceased to decline and are remaining constant at levels higher than the remediation goals, treatment system operations may be discontinued or adjusted and the remedy reevaluated. If it is determined that the selected remedy is not effective in extracting or treating contaminated ground water at the site, contingency measures may be taken.

Those contingency measures may include discontinuing pumping at unproductive extraction wells, installing additional extraction wells to facilitate or accelerate cleanup of ground-water contamination, and alternating pumping wells to eliminate stagnation points. These contingency measures will be protective of human health and the environment.

If it is determined that in spite of any contingency measures that may be taken, the aquifer cannot be restored to its beneficial use, ARARs may be waived in accordance with the statutory waiver provisions of CERCLA based on the technical impracticability of achieving further contaminant reduction.

The decision to invoke a contingency measure may be made during the five year periodic review of the selected remedy.

The estimated cost range for the selected remedy is $5,990,000 - $8,447,600 over a time period of five to thirty years, depending on how long the treatment system is operated.

STATUTORY DETERMINATIONS

Under its legal authorities, EPA's primary responsibility at Superfund sites is to select remedial actions that are protective of human health and the environment. In addition, Section 121 of CERCLA also requires that when complete, the selected remedial action for the site will comply with applicable or relevant and appropriate environmental

standards established under Federal and State environmental laws, unless a waiver is granted. The selected remedy must also be cost-effective and utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. The statute also contains a preference for remedies that include treatment as a principal element. The following sections discuss how the selected remedy for contaminated ground water at the Higgins Farm site meets these statutory requirements.

Protection of Human Health and the Environment

The selected ground-water remedy protects human health and the environment by reducing levels of contaminants in the ground water through extraction and treatment as well as through containment of the plume. Of the three alternatives evaluated, the selected alternative provides greater protection of human health and the environment as its capture zone encompasses the entire site and, therefore, is able to extract and treat a greater volume of contaminated ground water over the remediation time period. However, due to the complex nature of the site geology, some contamination may still remain in the fractured bedrock at the end of the remediation time period. Monitoring of on- and off-site monitoring wells, as well as off-site residential wells would provide additional protection to human health and the environment. The treatment system will be designed such that the effluent will meet discharge requirements considered to be protective of human health and the environment, to the extent practicable.

Compliance with Applicable or Relevant and Appropriate Requirements

The selected remedy will be designed to meet all chemical-specific, action-specific, and location-specific ARARs discussed under **Summary of Comparative Analysis of Alternatives**, above.

However, due to the complex nature of the fractured bedrock, the selected remedy may not meet all chemical-specific ARARs for the remediation of ground water (see Table 16). Similarly, the selected remedy is conceptually designed to achieve compliance with ARARs for the discharge to surface water (see Table 17). These limitations are rather stringent and may be difficult to achieve with the available technology. The selected remedy, however, will comply with these ARARs to the extent practicable. If the treatment system cannot comply with these limitations, alternate limitations will be developed by EPA in conjunction with NJDEPE.

Cost Effectiveness

The selected remedy is cost-effective in mitigating risks posed by contaminated ground water. Although the selected remedy is the most costly of the three alternatives evaluated, it provides the greatest effectiveness in attaining the threshold criteria. The estimated cost for the selected ground-water remedy, over a five to thirty

year period, is $5,990,000 - $8,447,600, depending the length of time the system is operated.

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

The selected ground-water remedy represents the maximum extent to which permanent solutions and treatment technologies can be utilized in a cost-effective manner for the Higgins Farm site. The selected remedy for ground water provides the best balance of tradeoffs with respect to the nine evaluation criteria.

Preference for Treatment as a Principal Element

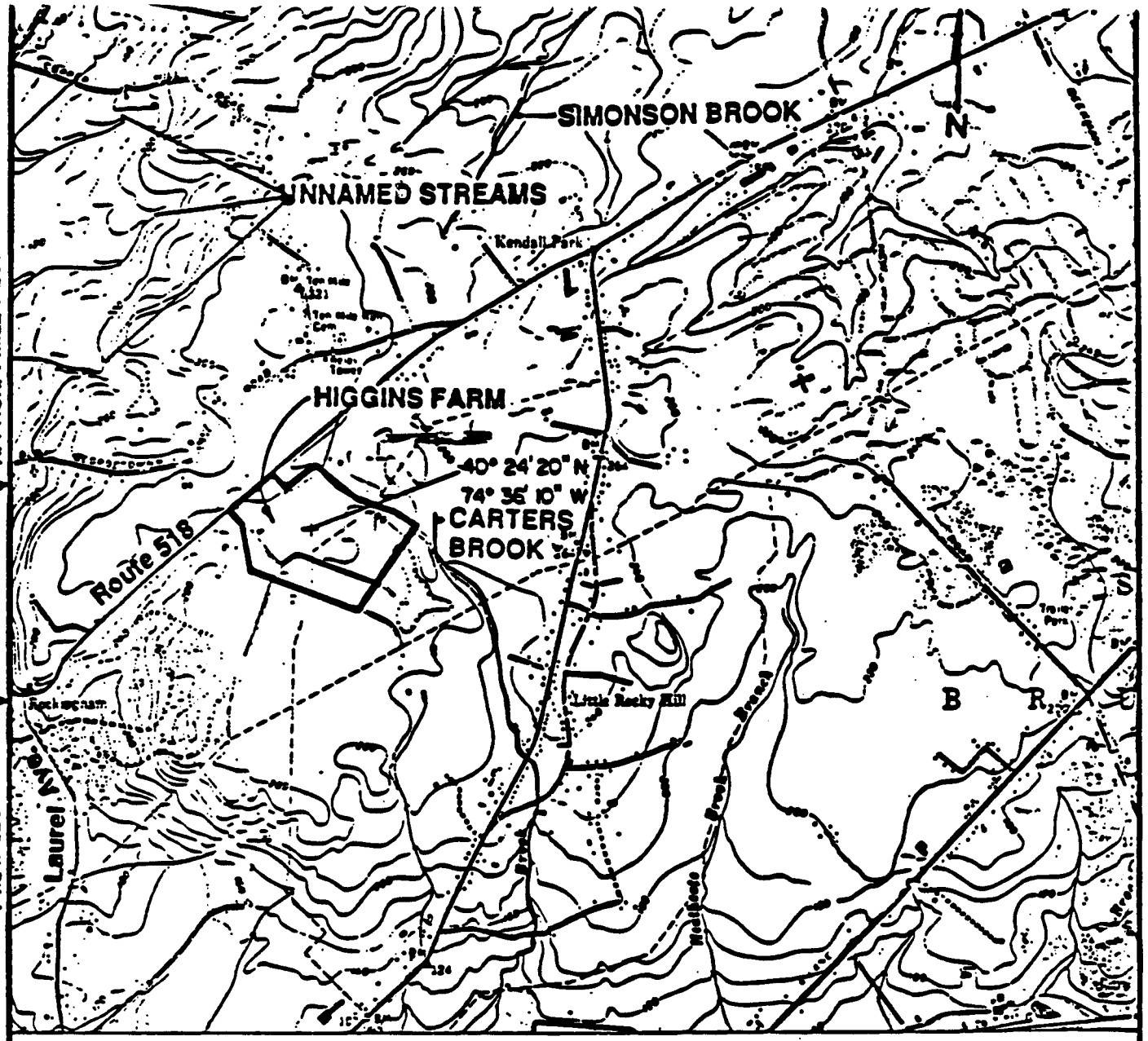
The selected remedy satisfies the statutory preference for treatment as a principal element. The selected remedy utilizes treatment to reduce levels of contamination in ground water to achieve applicable surface-water discharge limits, to the extent practicable.

Documentation of Significant Changes

The Proposed Plan for the site was released to the public in July 1992. This Plan identified Alternative 3 as the preferred alternative to remediate the ground-water contamination at the Higgins Farm site. Upon review of all comments submitted, EPA determined that no significant changes to the selected remedy, as it was presented in the Proposed Plan, were necessary.

APPENDIX I

FIGURES



MONMOUTH JUNCTION QUADRANGLE

NEW JERSEY

7.5 MINUTE SERIES (TOPOGRAPHIC)

SCALE 1:24000

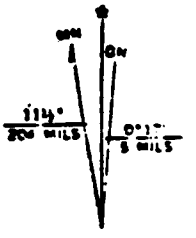
1 MILE

7000 FEET

1 KILOMETER

CONTOUR INTERVAL 20 FEET

NATIONAL GEODETIC VERTICAL DATUM OF 1929



UTM GRID AND 1981 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

FIGURE 1

FRANKLIN TOWNSHIP
SOMERSET COUNTY
LOCATION MAP
HIGGINS FARM

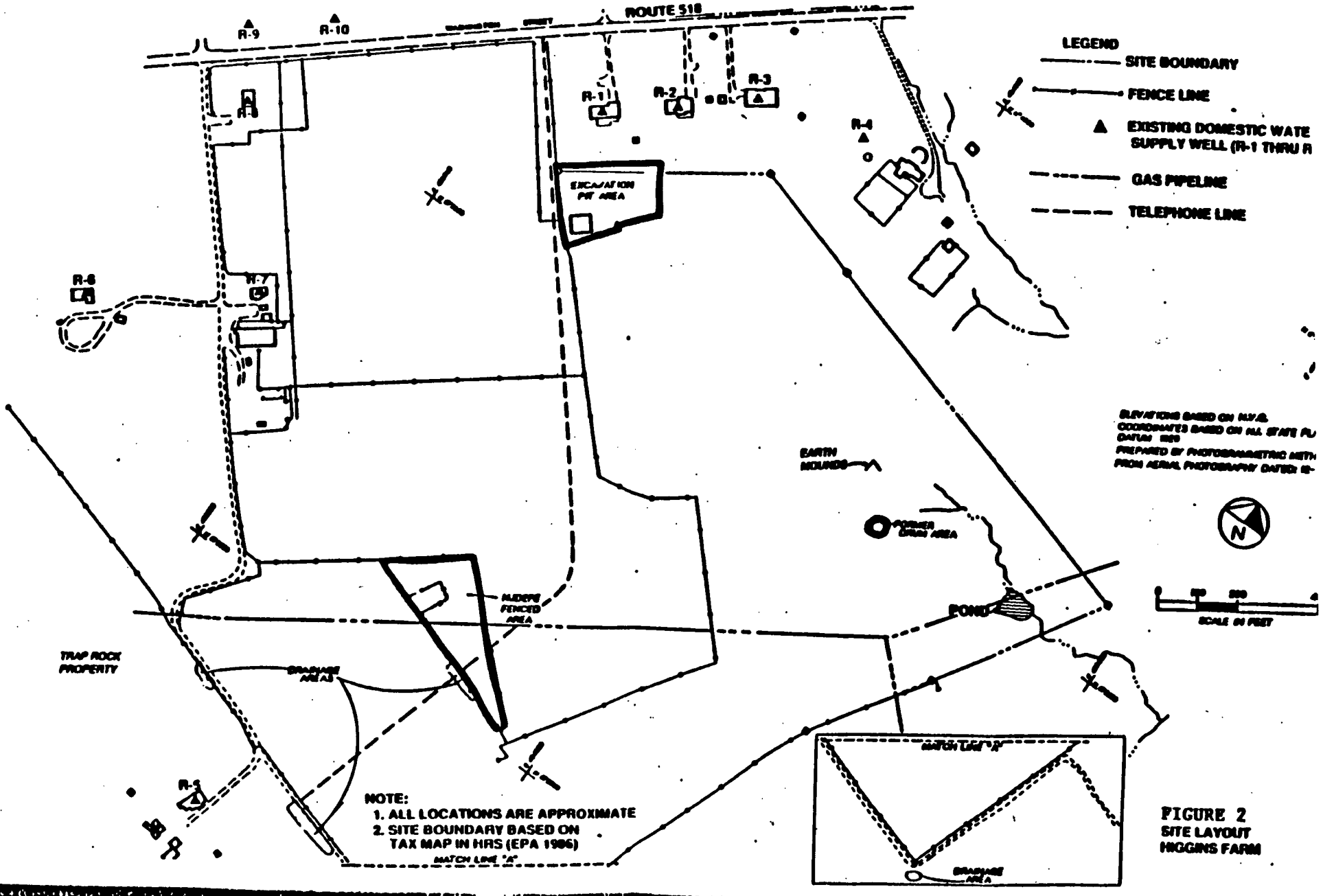
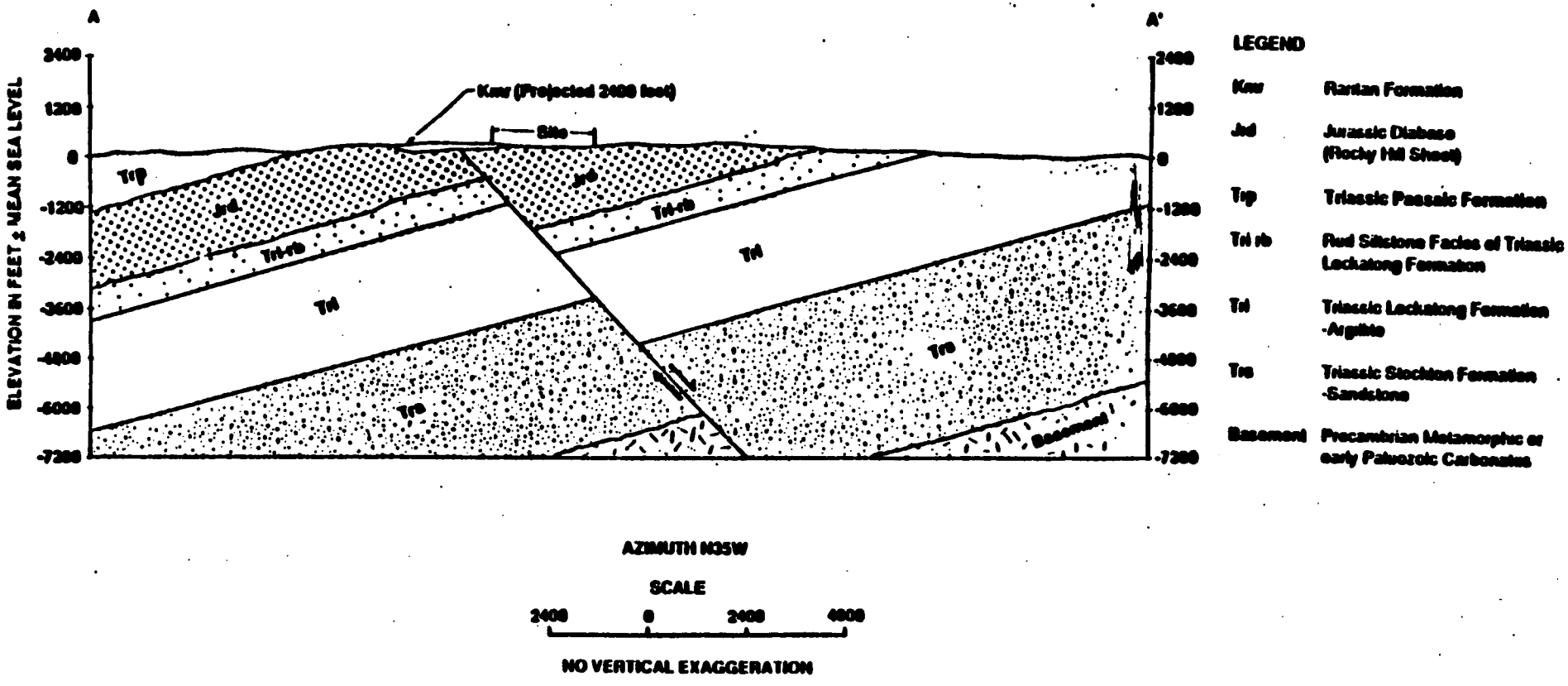


FIGURE 2
SITE LAYOUT
HIGGINS FARM



SOURCE: INTERPRETED FROM USEPA 1986a.

FIGURE 3
GENERALIZED GEOLOGIC CROSS SECTION A- A'
HIGGINS FARM

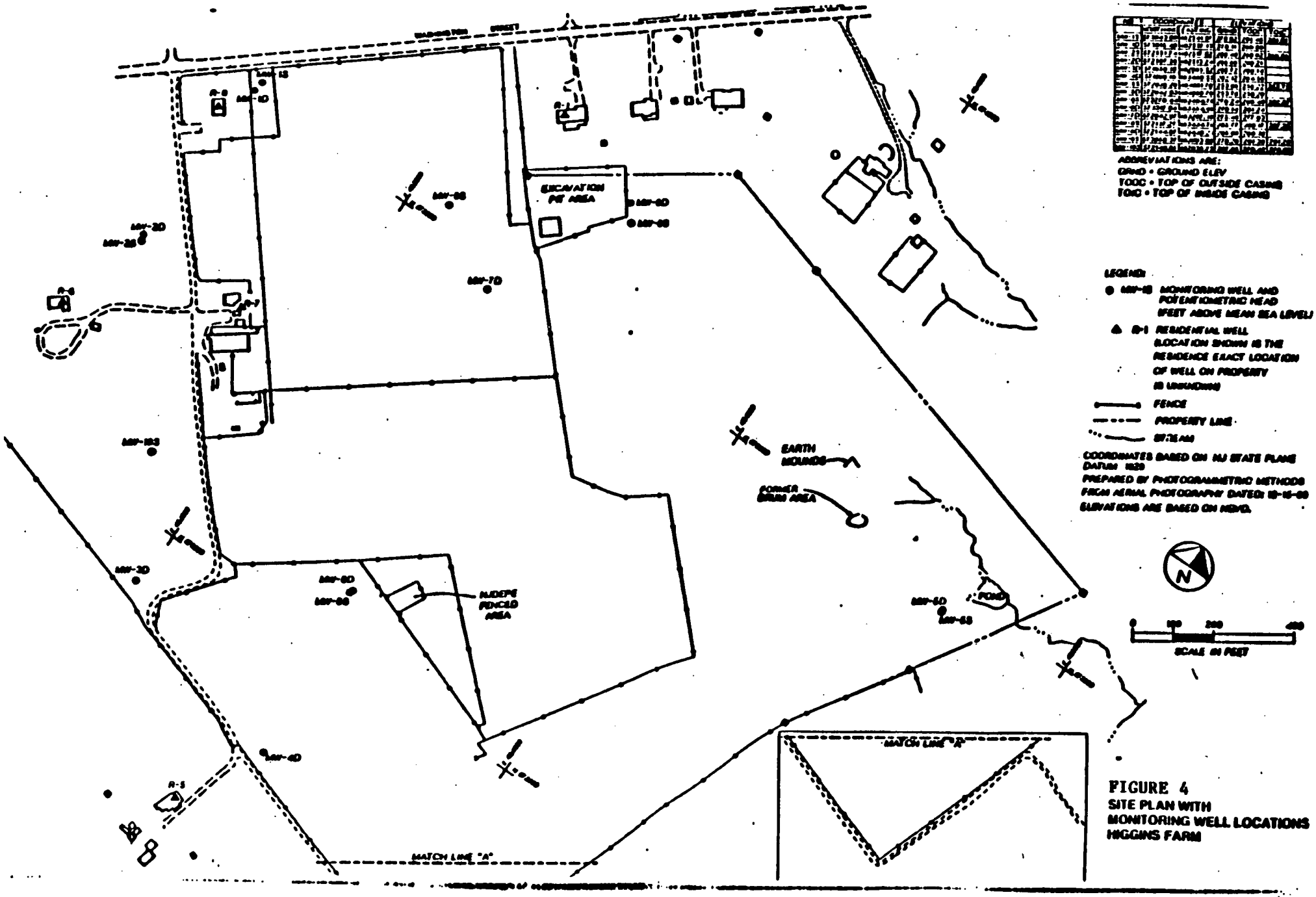


FIGURE 4
SITE PLAN WITH
MONITORING WELL LOCATIONS
HIGGINS FARM

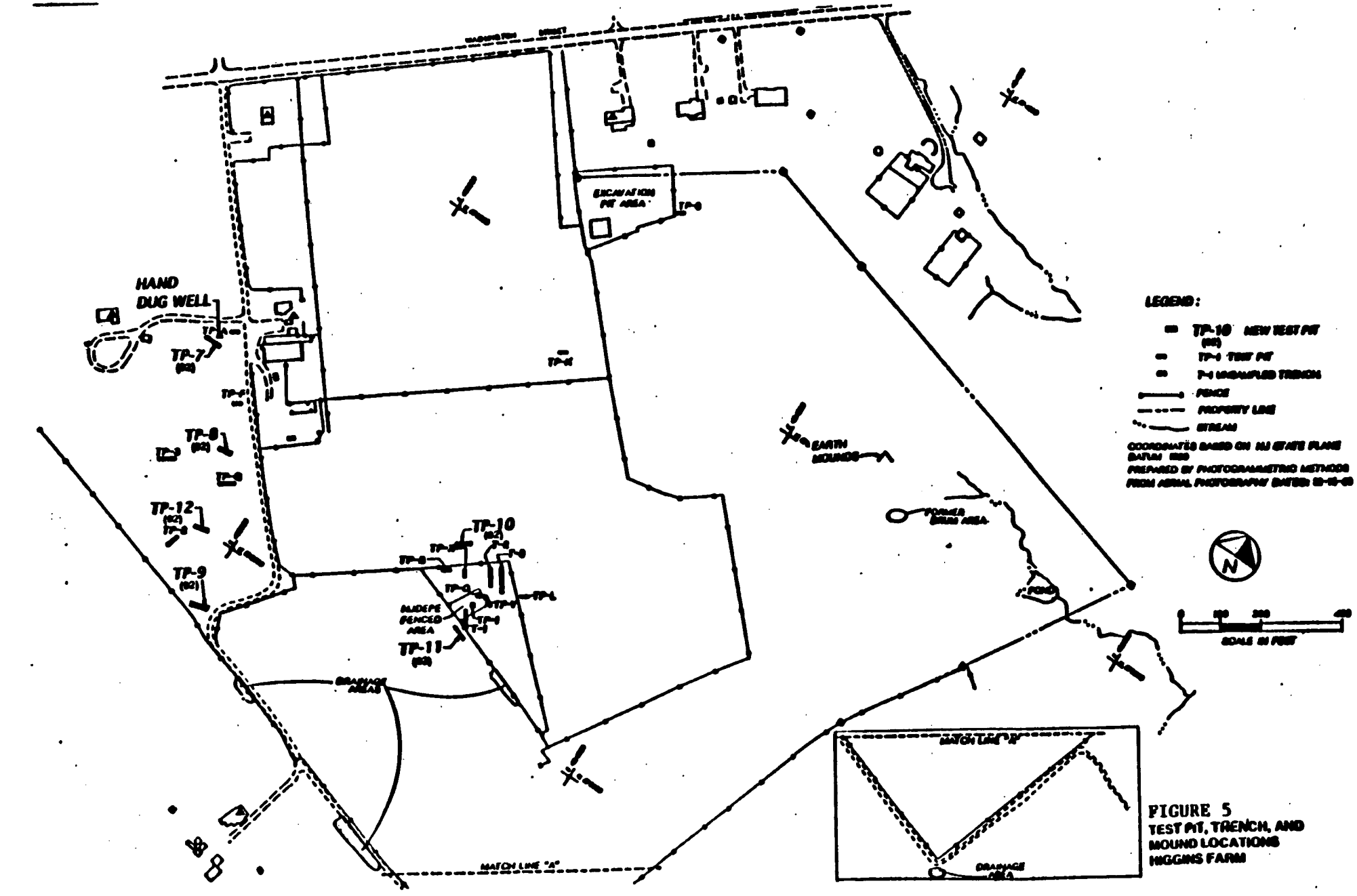


FIGURE 5
TEST PIT, TRENCH, AND MOUND LOCATIONS
HIGGINS FARM

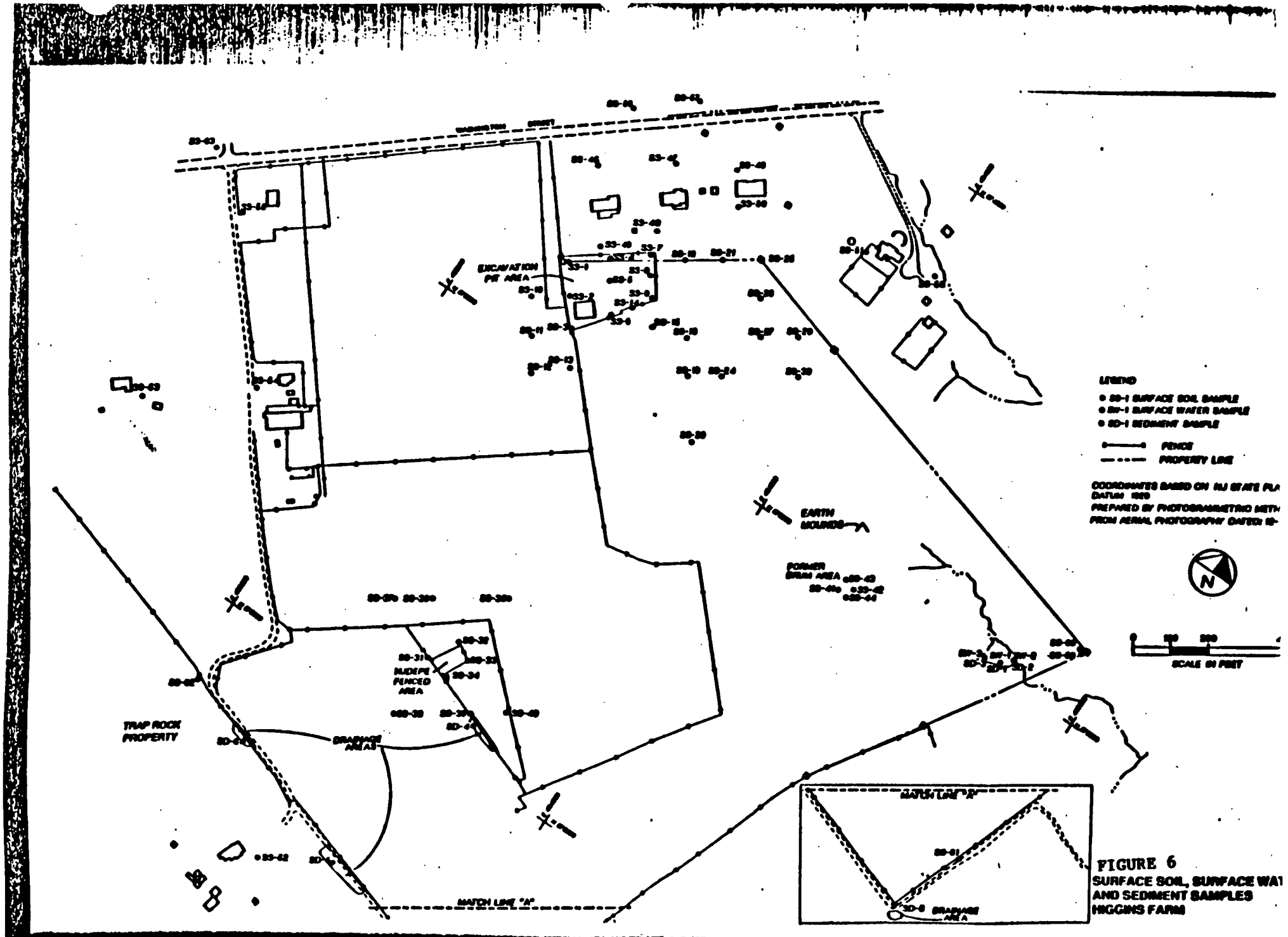


FIGURE 6
SURFACE SOIL, SURFACE WA
AND SEDIMENT SAMPLES
HIGGINS FARM

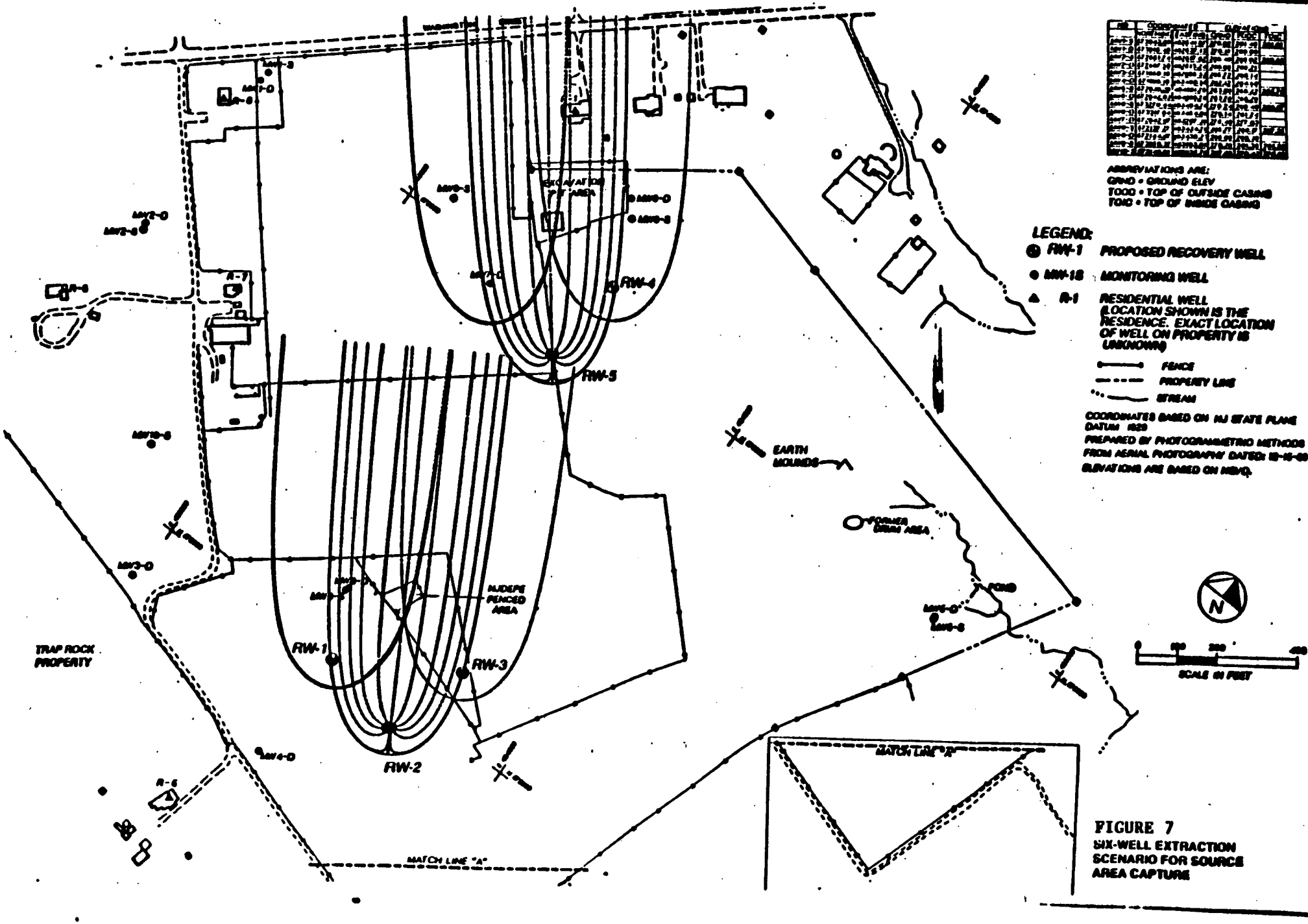


FIGURE 7
SIX-WELL EXTRACTION SCENARIO FOR SOURCE AREA CAPTURE

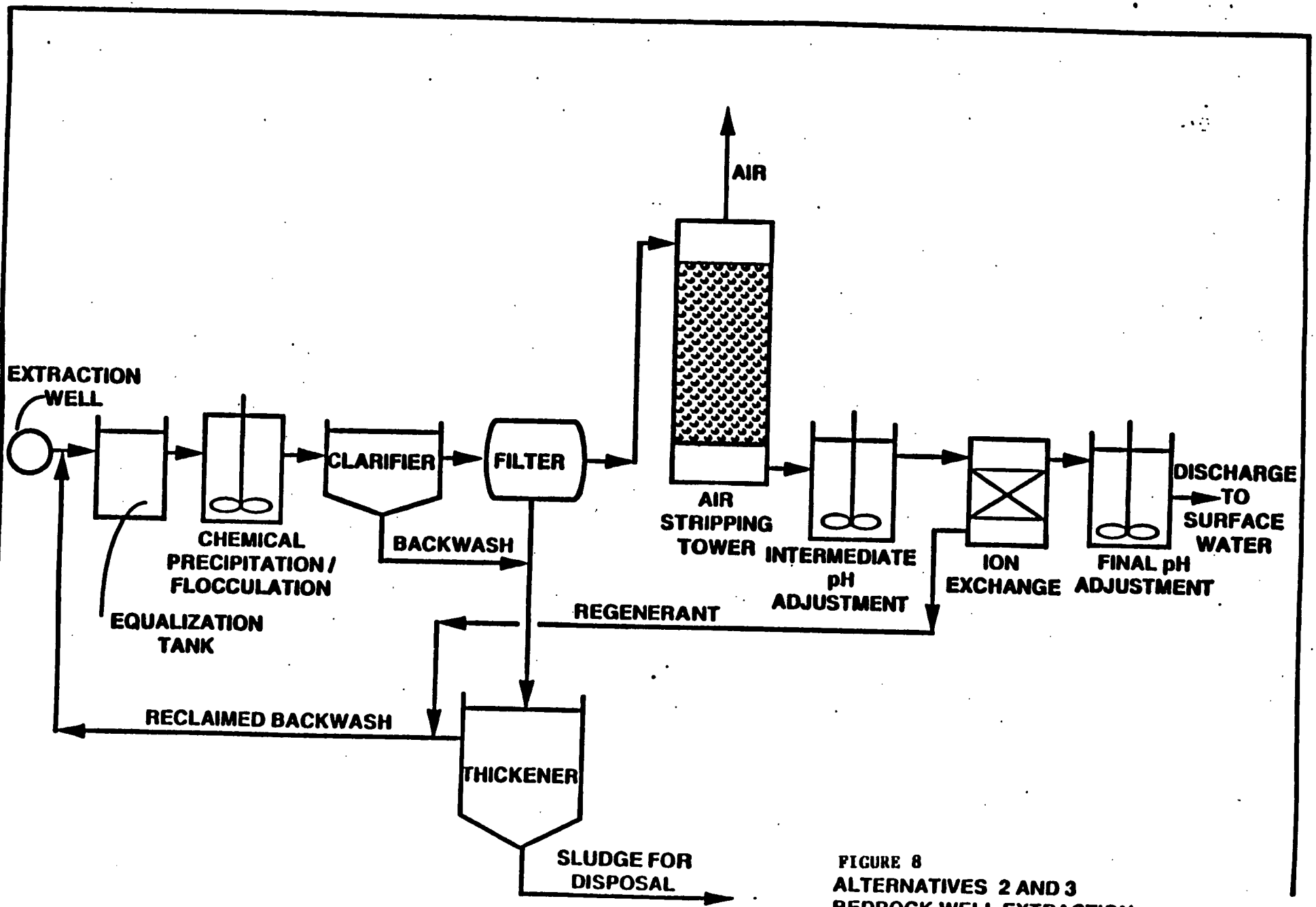


FIGURE 8
ALTERNATIVES 2 AND 3
BEDROCK WELL EXTRACTION,
METALS PRECIPITATION,
AERATION, AND ION EXCHANGE
HIGGINS FARM

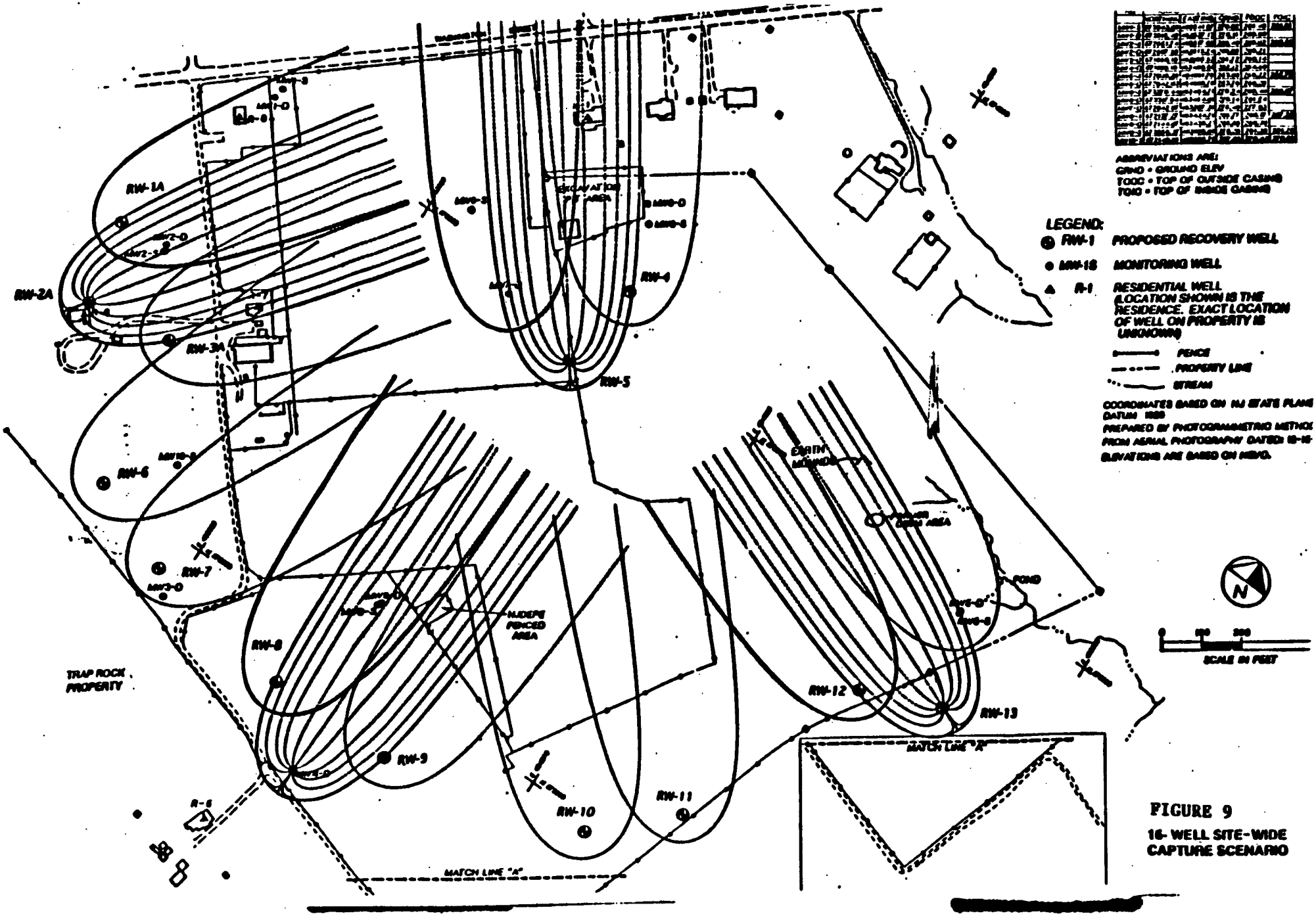


FIGURE 9

16- WELL SITE-WIDE CAPTURE SCENARIO

APPENDIX II

TABLES

TABLE 1

RI Objectives and Associated Tasks

Objective	RI Task
Identify source areas	• Surface geophysics • Soil gas survey • Test pits
Define contamination of soils, surface water, and sediment	• Topographic survey of site • Soil gas survey • Sample collection from surface soil, surface water, and sediment • Subsurface soil sample collection through soil borings and during well installation • Test pits
Characterize site hydrogeology and ground water contamination	• Fracture trace analysis • Soil borings • Borehole geophysics • Monitoring well installation • Packer testing • Sample collection from monitoring wells and residential wells
Identify cultural resources	• Stage 1-A historical survey
Determine risks to humans/ environment	• Human health and environmental assessment

TABLE 2
Comparison of Ground Water Results to State and Federal Requirements

Compound	Maximum Concentration Detected (µg/l)	NJ GWQ Criteria[a] (µg/l)		New Jersey MCL[b] (µg/l)	Federal MCL[c] (µg/l)	Federal MCLG[c] (µg/l)
		Existing[d]	Proposed[e]			
VOLATILE ORGANICS						
Acetone	5.2	—	700	—	—	—
Benzene	1,200.0	—	0.2	1	5	0
Bromobenzene	1.4	—	—	—	—	—
Carbon disulfide	[illegible]	—	—	—	—	—
Carbon tetrachloride	3.3	—	0.4	2	5	0
Chlorobenzene	[illegible] 1,200.0	—	5	[illegible]	—	—
Chloroform	33.0	—	6	—	100	—
2-Chlorotoluene	3.5	—	—	—	—	—
4-Chlorotoluene	2.9	—	—	—	—	—
cis-1,2-Dichloroethene	76.9	—	10	10	70	70
1,1-Dichloroethane	3.0	—	70	—	—	—
1,2-Dichloroethane	320.0	—	0.3	2	5	0
1,1-Dichloroethene	10.0	—	1	2	7	7
1,2-Dichloropropane	0.56	—	0.5	—	5	0
1,3-Dichloropropene	4.3	—	—	—	—	—
Ethylbenzene	1.0	—	700	—	700	700
Trans-1,2-Dichloroethene	13.0	—	100	10	100	100
1,1,2,2-Tetrachloroethane	7.5	—	2	—	—	—
Tetrachloroethene	270.0	—	0.4	1	5	0
Toluene	1.9	—	1,000	—	1,000	1,000
1,1,1,2-Tetracloroethane	1.4	—	10	—	—	—
1,1,1-Trichloroethane	4.2	—	30	26	200	200
1,1,2-Trichloroethane	1,100.0	—	3	—	5	3
Trichloroethene	220.0	—	1.0	1	5	0
Trichlorofluoromethane	3.8	—	—	—	—	—
Vinyl Chloride	86.0	—	0.083	2	2	0
Xylenes (total)	13.8	—	—	44	10,000	10,000

TABLE 2
Comparison of Ground Water Results to State and Federal Requirements

Compound	Maximum Concentration Detected (µg/l)	NJ GWQ Criteria[a] (µg/l)		New Jersey MCL[b] (µg/l)	Federal MCL[c] (µg/l)	Federal MCLG[c] (µg/l)
		Existing[d]	Proposed[e]			
SEMIVOLATILE ORGANICS						
Bis(2-chloroethyl)ether	2.0	—	0.03	—	—	—
Bis(2-ethylhexyl)phthalate	10.0	—	3	—	—	—
2-Chlorophenol	6.0	—	40	—	—	—
1,2-Dichlorobenzene	48.0	—	600	600	600	600
1,3-Dichlorobenzene	5.0	—	600	600	600	600
1,4-Dichlorobenzene	2.0	—	75	—	75	75
Di-n-butylphthalate	0.9	—	900	—	—	—
Diethyl phthalate	1.0	—	5,000	—	—	—
Hexachlorobutadiene	5.3	—	1	—	—	—
Isopropylbenzene	4.6	—	—	—	—	—
Naphthalene	0.38	—	—	—	—	—
N-Butylbenzene	5.0	—	—	—	—	—
N-Propylbenzene	4.5	—	—	—	—	—
P-Isopropyltoluene	5.0	—	—	—	—	—
Phenol	9.0	3,500	4,000	—	—	—
Sec-Butylbenzene	4.9	—	—	—	—	—
Tert-Butylbenzene	4.9	—	—	—	—	—
1,2,3-Trichlorobenzene	1.4	—	—	8	—	—
1,2,4-Trichlorobenzene	1.7	—	9	8	9	9
1,2,4-Trimethylbenzene	3.2	—	—	—	—	—
1,3,5-Trimethylbenzene	3.9	—	—	—	—	—
INORGANICS						
Aluminum	304,000.0	—	50-200	—	—	—
Antimony	28.5	—	2	—	5-10	3
Barium	1,890.0	—	2,000	—	2,000	2,000
Beryllium	25.7	—	0.008	—	4	0
Cadmium	4.1	10	4	—	5	5
Chromium	403.0	50	100	—	100	100
Cobalt	826.0	—	—	—	—	—
Copper	8,750.0	1,000	1,000	—	1,300	1,300

TABLE 2
Comparison of Ground Water Results to State and Federal Requirements

Compound	Maximum Concentration Detected (µg/l)	NJ GWQ Criteria[a] (µg/l)		New Jersey MCL[b] (µg/l)	Federal MCL[c] (µg/l)	Federal MCLG[c] (µg/l)
		Existing[d]	Proposed[e]			
Iron	433,000.0	300	300	—	—	—
Lead	81.4	50	5	—	15	0
Magnesium	27,200.0	—	—	—	—	—
Manganese	24,800.0	50	50	—	—	—
Nickel	224.0	—	100	—	100	100
Vanadium	1,490.0	—	—	—	—	—
Zinc	811.0	5,000	5,000	—	—	—

Notes:

Metals results are total, not dissolved, concentrations.

[a]New Jersey Ground Water Quality Standards. Class GW2.
[b]New Jersey Drinking Water Regulations NJAC 7:10.
[c]Environmental Protection Agency Primary Drinking Water Regulations 40 CFR 141. Maximum Contaminant Levels and Maximum Contaminant Level Goals.
[d]Existing New Jersey Ground Water Quality Standards NJAC 7:9-6.
[e]Proposed New Jersey Ground Water Quality Standards. Bureau of Water Supply Planning. January 1992. Class IIA.

— Value not available.

= Standards have been exceeded

TABLE 3
Comparison of Test Pit Results to Proposed NJDEPE Standards and EPA Risk-Based Standards

Station ID	Compound	Highest Detected Concentration	NJDEPE Proposed Soil Cleanup Standard (Residential Subsurface Soil)	EPA Risk-Based Standard[a]
VOLATILE ORGANICS				
TP-000X	1,2-Dichloroethane	30.00 ppb	6,000 ppb (1,000 ppb)	7,000 ppb
TP-002	1,1,2,2-Tetrachloroethane	56.00 ppb	1,000 ppb	3,145 ppb
TP-000X	1,1,2-Trichloroethane	4,400.00 ppb	1,000 ppb	11,100 ppb
TP-000YD	Acetone[b]	8,600.00 ppb	1,000,000 ppb (50,000 ppb)	26,988,000 ppb
TP-000X	Chloroform	15.00 ppb	19,000 ppb (1,000 ppb)	105,000 ppb
TP-000X	Tetrachloroethene	47,000.00 ppb	1,000 ppb	12,210 ppb
TP-000X	Carbon tetrachloride	2.00 ppb	2,000 ppb (1,000 ppb)	4,920 ppb
TP-000X	Trichloroethene	1,900.00 ppb	—	55,500 ppb
TP-000X	1,2-Dichloroethene (total)	55.00 ppb	79,000 ppb (50,000 ppb)	4,050,000 ppb
TP-000X	Toluene	63.00 ppb	1,000,000 ppb (500,000 ppb)	553,600,000 ppb
SEMIVOLATILE ORGANICS				
TP-001	1,2-Dichlorobenzene[c]	240.00 ppb	5,100,000 ppb	24,220,000 ppb
TP-000O	Benzoic acid[b]	6,700.00 ppb	— (—)	—
TP-000G	Bis(2-ethylhexyl)phthalate	490.00 ppb	100,000 ppb	44,400 ppb
TP-000A	Fluoranthene	170.00 ppb	500,000 ppb	10,726,000 ppb
TP-000O	Pentachlorophenol[b]	2,100,000.00 ppb	1,700,000 ppb (100,000) ppb	5,180 ppb
TP-000A	Phenanthrene	190.00 ppb	—	—
TP-000O	Phenol[b]	99.00 ppb	10,000,000 ppb	162,620,000 ppb
TP-000A	Pyrene	130.00 ppb	500,000 ppb	12,456 ppb
PESTICIDES/PCBs				
TP-000O	4,4'-DDT[b]	43.0 ppb	2,000 ppb (100,000 ppb)	1,850 ppb
TP-001	Heptachlor[c]	24.0 ppb	150 ppb	140.6 ppb
TP-001	Heptachlor epoxide[c]	11.0 ppb	—	—
DIOXINS/FURANS				
TP-000O	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	138.179 ppb	—	—
TP-000O	1,2,3,4,6,7,8-Heptachlorodibenzofuran	63.400 ppb	—	—
TP-000O	1,2,3,4,7,8,9-Heptachlorodibenzofuran	2.400 ppb	—	—
TP-000K	1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	0.558 ppb	—	—
TP-000YD	1,2,3,4,7,8-Hexachlorodibenzofuran	1.359 ppb	—	—

TABLE 3
Comparison of Test Pit Results to Proposed NJDEPE Standards and EPA Risk-Based Standards

Station ID	Compound	Highest Detected Concentration	NJDEPE Proposed Soil Cleanup Standard (Residential Subsurface Soil)	EPA Risk-Based Standard[a]
TP-000O	1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	5.371 ppb	—	—
TP-000Y	1,2,3,7,8-Pentachlorodibenzofuran	0.434 ppb	—	—
TP-000Y	2,3,4,6,7,8-Hexachlorodibenzofuran	0.422 ppb	—	—
TP-000O	Total-Heptachlorodibenzo-p-dioxin	208.643 ppb	—	—
TP-000O	Total-Heptachlorodibenzofuran	247.224 ppb	—	—
TP-000O	Total-Hexachlorodibenzo-p-dioxin	14.523 ppb	—	—
TP-000O	Total-Hexachlorodibenzofuran	121.069 ppb	—	—
TP-000O	Total-Octachlorodibenzo-p-dioxin	197.015 ppb	—	—
TP-000O	Total-Octachlorodibenzofuran	116.145 ppb	—	—
TP-000O	Total-Pentachlorodibenzofuran	5.354 ppb	—	—
INORGANICS				
TP-003	Aluminum	41,800.00 ppm	—	—
TP-000O	Antimony[b]	13.00 ppm	14 ppm (—)	107.26 ppm
TP-001	Arsenic[c]	1,310.00 ppm	20 ppm	0.3589 ppm
TP-000X	Barium[b]	212.00 ppm	500 ppm (—)	19,030 ppm
TP-000F	Beryllium	4.00 ppm	—	0.148 ppm
TP-000X	Cadmium[b]	0.79 ppm	1 ppm (—)	135 ppm
TP-000A	Calcium	2,150.00 ppm	—	—
TP-000O	Chromium[b,d]	3,700.00 ppm	— (—)	1,350 ppm(VI) 270,000 ppm(III)
TP-000F	Cobalt	210.00 ppm	—	—
TP-003	Copper	295.00 ppm	—	10,034 ppm
TP-001	Cyanide[c]	2.20 ppm	280 ppm	5,500 ppm
TP-003	Iron	102,000.00 ppm	—	—
TP-000A	Lead	32.90 ppm	—	500 ppm
TP-000X	Magnesium[b]	10,700.00 ppm	— (—)	—
TP-000F	Manganese	2,330.00 ppm	—	—
TP-003	Nickel	35.30 ppm	—	592 ppm
TP-000X	Potassium[b]	2,480.00 ppm	— (—)	—
TP-000Y	Silver[b]	2.60 ppm	40 ppm (—)	1,349.4 ppm

TABLE 3

Comparison of Test Pit Results to Proposed NJDEPE Standards and EPA Risk-Based Standards

Station ID	Compound	Highest Detected Concentration	NJDEPE Proposed Soil Cleanup Standard (Residential Subsurface Soil)	EPA Risk-Based Standard[a]
TP-000Y	Sodium[b]	3,890.00 ppm	— (—)	—
TP-002	Vanadium	742.00 ppm	—	1,903 ppm
TP-002	Zinc	106.00 ppm	—	55,360 ppm

[a]OSWER Directive 9285.7-01B, Human Health Evaluation Part B: Development of Risk-Based Preliminary Remediation Goals, December 13, 1991.

[b]These pit samples were obtained at a depth of 1-3 feet. The NJDEPE proposed surface soil cleanup standards are applicable from a depth of 0-2 feet, whereas the subsurface soil standards are applicable from a depth of 2-4 feet. Due to the depth range of 1-3 feet, which overlaps depth ranges, both the surface and subsurface standards are presented. The subsurface standards are in parentheses.

[c]The test pit was sampled at a depth between 0 and 2 feet and the existing surface soil standards were provided in these instances.

[d]Although test pit results are for total chromium, an exceedance is shown to be conservative. There are no results for the individual chromium species chromium VI and chromium III.

Note: "—" = Standard does not exist for this compound

▒▒ = Standards have been exceeded

Table 4
Comparison of Surface Soil Results to Proposed NJDEPE Standards and EPA Risk-Based Standards

Station ID	Compound	Highest Detected Concentration	NJDEPE Proposed Soil Cleanup Standard (Residential Surface Soil)	EPA Risk-Based Standard[a]
VOLATILE ORGANICS				
SS-061	Benzene	2.0 ppb	3,000 ppb	27,000 ppb
SS-061	Chlorobenzene	3.0 ppb	37,000 ppb	5,536,000 ppb
SS-061	Styrene	2.0 ppb	23,000 ppb	21,090 ppb
SS-032	Tetrachloroethene	100.0 ppb	9,000 ppb	12,210 ppb
SS-061	Toluene	2.0 ppb	1,000,000 ppb	553,600,000 ppb
SS-059	Trichloroethene	67.0 ppb	—	55,500 ppb
SS-061	Xylenes (Total)	5.0 ppb	360,000 ppb	553,600,000 ppb
SEMIVOLATILE ORGANICS				
SS-008	4-Methylphenol	41.0 ppb	—	—
SS-054	Anthracene	80.0 ppb	10,000,000 ppb	79,580,000 ppb
SS-052	Benzo(a)anthracene	290.0 ppb	660 ppb	740 ppb
SS-052	Benzo(a)pyrene	200.0 ppb	660 ppb	107.3 ppb
SS-052	Benzo(b)fluoranthene	260.0 ppb	660 ppb	777 ppb
SS-052	Benzo(ghi)perylene	160.0 ppb	660 ppb	4,810 ppb
SS-052	Benzo(k)fluoranthene	310.0 ppb	660 ppb	1,628 ppb
SS-005	Benzoic acid	240.0 ppb	—	—
SS-060	Bis(2-ethylhexyl)phthalate	3,800.0 ppb	49,000 ppb	44,400 ppb
SS-052	Chrysene	330.0 ppb	660 ppb	24,790 ppb
SS-054	Di-n-butyl phthalate	1,000.0 ppb	5,700,000 ppb	26,988,000 ppb
SS-059	Diethyl phthalate	300.0 ppb	10,000,000 ppb	217,980,000 ppb
SS-052	Fluoranthene	830.0 ppb	2,300,000 ppb	10,726,000 ppb
SS-052	Indeno(1,2,3-cd)pyrene	160.0 ppb	660 ppb	481 ppb
SS-002	Pentachlorophenol	210.0 ppb	1,700,000 ppb	5,180 ppb
SS-054	Phenanthrene	640.0 ppb	—	—
SS-052	Pyrene	690.0 ppb	1,700,000 ppb	12,456 ppb
PESTICIDES/PCBs				
SS-006	Dieldrin	170.0 ppb	42 ppb	40.7 ppb
SS-008	Endosulfan I	13.0 ppb	3,000 ppb	13,494 ppb
DIOXINS/FURANS				
SS-006	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	1.100 ppb	—	—
SS-006	1,2,3,4,6,7,8-Heptachlorodibenzofuran	0.110 ppb	—	—

Table 4
Comparison of Surface Soil Results to Proposed NJDEPE Standards and EPA Risk-Based Standards

Station ID	Compound	Highest Detected Concentration	NJDEPE Proposed Soil Cleanup Standard (Residential Surface Soil)	EPA Risk-Based Standard[a]
SS-006	1,2,3,4,7,8,9-Heptachlorodibenzofuran	0.030 ppb	—	—
SS-006	1,2,3,4,7,8-Hexachlorodibenzofuran	0.040 ppb	—	—
SS-006	1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	0.050 ppb	—	—
SS-049	2,3,7,8-Tetrachlorodibenzo-p-dioxin	0.100 ppb	—	—
SS-041B	Octachlorodibenzo-p-dioxin	25.200 ppb	—	—
SS-006	Octachlorodibenzofuran	0.720 ppb	—	—
SS-049	Tetrachlorodibenzo-p-dioxin (ITEF)	0.107 ppb	—	—
SS-006	Total-Heptachlorodibenzo-p-dioxin	1.600 ppb	—	—
SS-006	Total-Heptachlorodibenzofuran	0.510 ppb	—	—
SS-052	Total-Hexachlorodibenzo-p-dioxin	0.090 ppb	—	—
SS-006	Total-Hexachlorodibenzofuran	0.190 ppb	—	—
SS-054	Total-Pentachlorodibenzofuran	0.090 ppb	—	—
SS-045	Total-Tetrachlorodibenzo-p-dioxin	0.130 ppb	—	—
SS-043	Total-Tetrachlorodibenzofuran	0.040 ppb	—	—
INORGANICS				
SS-063	Aluminum	23,300.00 ppm	—	—
SS-063	Antimony	7.00 ppm	14 ppm	107.26 ppm
SS-063	Arsenic	12.40 ppm	20 ppm	0.3589 ppm
SS-040	Barium	397.00 ppm	600 ppm	19,030 ppm
SS-049	Beryllium	1.50 ppm	2 ppm	0.148 ppm
SS-002	Calcium	3,130.00 ppm	—	—
SS-063	Chromium	28.50 ppm	—	1,350 ppm (VI) 270,000 ppm (III)
SS-039	Cobalt	37.60 ppm	—	—
SS-059	Copper	193.00 ppm	600 ppm	10,034 ppm
SS-032	Cyanide	3.40 ppm	280 ppm	5,500 ppm
SS-058	Iron	48,200.00 ppm	—	—
SS-053	Lead	131.00 ppm	100 ppm	500 ppm
SS-063	Magnesium	3,220.00 ppm	—	—
SS-058	Manganese	1,270.00 ppm	—	—
SS-032	Mercury	0.62 ppm	14 ppm	79.58 ppm
SS-039	Nickel	21.90 ppm	250 ppm	592 ppm

Table 4
Comparison of Surface Soil Results to Proposed NJDEPE Standards and EPA Risk-Based Standards

Station ID	Compound	Highest Detected Concentration	NJDEPE Proposed Soil Cleanup Standard (Residential Surface Soil)	EPA Risk-Based Standard[a]
SS-063	Potassium	946.00 ppm	—	—
SS-050	Selenium	3.20 ppm	63 ppm	1,349.4 ppm
SS-032	Silver	15.50 ppm	40 ppm	1,349.4 ppm
SS-002	Sodium	362.00 ppm	—	—
SS-029	Thallium	0.46 ppm	2 ppm	19.03 ppm
SS-053	Vanadium	193.00 ppm	380 ppm	1,903 ppm
SS-051	Zinc	210.00 ppm	1,500 ppm	55,360 ppm

[a]OSWER Directive 9285.7-01B, Human Health Evaluation Part B: Development of Risk-Based Preliminary Remediation Goals, December 13, 1991.

Note: "—" = Standard does not exist for this compound

▒ = Standards have been exceeded

TABLE 5
Comparison of Soil Boring Results to Proposed NJDEPE Standards

Station ID	Compound	Highest Detected Concentration	NJDEPE Proposed Soil Cleanup Standard (Subsurface Soil)
VOLATILE ORGANICS			
SB-013	1,1,2-Trichloroethane	74.00 ppb	1,000 ppb
SB-006	1,2-Dichloroethane	0.50 ppb	1,000 ppb
SB-012	2-Butanone	2.00 ppb	50,000 ppb
SB-012	Acetone	49.00 ppb	50,000 ppb
SB-006	Benzene	69.00 ppb	1,000 ppb
SB-006	Chloroform	210.00 ppb	1,000 ppb
SB-004	Methylene chloride	9.00 ppb	10,000 ppb
SB-011	Tetrachloroethene	1,100.00 ppb	1,000 ppb
SB-005	Trichloroethene	4.00 ppb	—
SEMIVOLATILE ORGANICS			
SB-001	Benzyl butyl phthalate	1,100.00 ppb	100,000 ppb
SB-003	Bis(2-ethylhexyl)phthalate	1,400.00 ppb	100,000 ppb
PESTICIDES/PCBs			
SB-013	Aroclor-1260 (PCB)	5.20 ppb	100,000 ppb
DIOXINS/FURANS			
SB-003	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	0.230 ppb	—
SB-001	1,2,3,4,6,7,8-Heptachlorodibenzofuran	0.009 ppb	—
SB-001	1,2,3,4,7,8,9-Heptachlorodibenzofuran	0.008 ppb	—
SB-013	1,2,3,4,7,8-Hexachlorodibenzofuran	0.030 ppb	—
SB-013	1,2,3,6,7,8-Hexachlorodibenzofuran	0.030 ppb	—
SB-001	1,2,3,7,8,9-Hexachlorodibenzofuran	0.003 ppb	—
SB-001	1,2,3,7,8-Pentachlorodibenzofuran	0.005 ppb	—
SB-013	2,3,4,6,7,8-Hexachlorodibenzofuran	0.020 ppb	—
SB-013	2,3,7,8-Tetrachlorodibenzo-p-dioxin	0.030 ppb	—
SB-013	2,3,7,8-Tetrachlorodibenzofuran	0.020 ppb	—

TABLE 5
Comparison of Soil Boring Results to Proposed NJDEPE Standards

Station ID	Compound	Highest Detected Concentration	NJDEPE Proposed Soil Cleanup Standard (Subsurface Soil)
SB-003	Octachlorodibenzo-p-dioxin	76.00 ppb	—
SB-001	Octachlorodibenzofuran	0.009 ppb	—
SB-003	Total-Heptachlorodibenzo-p-dioxin	0.480 ppb	—
SB-001	Total-Heptachlorodibenzofuran	0.010 ppb	—
SB-006	Total-Hexachlorodibenzo-p-dioxin	0.070 ppb	—
SB-013	Total-Hexachlorodibenzofuran	0.080 ppb	—
SB-006	Total-Pentachlorodibenzofuran	0.006 ppb	—
SB-006	Total-Tetrachlorodibenzo-p-dioxin	0.550 ppb	—
SB-006	Total-Tetrachlorodibenzofuran	0.030 ppb	—
METALS			
SB-003	Aluminum	54,100.00 ppm	—
SB-008	Antimony	12.70 ppm	—
SB-006	Arsenic	21.10 ppm	—
SB-002	Barium	298.00 ppm	—
SB-008	Beryllium	11.60 ppm	—
SB-004	Cadmium	1.30 ppm	—
SB-006	Calcium	9,680.00 ppm	—
SB-001	Chromium	21.80 ppm	—
SB-013	Cobalt	97.00 ppm	—
SB-006	Copper	1,830.00 ppm	—
SB-013D	Iron	136,000.00 ppm	—
SB-010	Lead	17.10 ppm	—
SB-013	Magnesium	8,490.00 ppm	—
SB-004	Manganese	922.00 ppm	—
SB-004	Mercury	0.10 ppm	—
SB-002	Nickel	47.40 ppm	—

TABLE 5
Comparison of Soil Boring Results to Proposed NJDEPE Standards

Station ID	Compound	Highest Detected Concentration	NJDEPE Proposed Soil Cleanup Standard (Subsurface Soil)
SB-009	Potassium	2,760.00 ppm	—
SB-001	Selenium	0.48 ppm	—
SB-003	Silver	18.40 ppm	—
SB-002	Sodium	257.00 ppm	—
SB-011	Thallium	0.91 ppm	—
SB-003	Vanadium	551.00 ppm	—
SB-013	Zinc	251.00 ppm	—

Note: "—" = Standard does not exist for this compound

= Standards have been exceeded

TABLE 6
Comparison of Sediment Sample Results to Proposed NJDEPE Standards and EPA Risk-Based Standards

Station ID	Compound	Highest Detected Concentration	NJDEPE Proposed Soil Cleanup Standard (Residential Surface Soil)	EPA Risk-Based Standard*
SD-008	Total-Heptachlorodibenzo-p-dioxin	2.100 ppb	—	—
SD-008	Total-Hexachlorodibenzo-p-dioxin	0.180 ppb	—	—
SD-006	Total-Pentachlorodibenzo-p-dioxin	0.060 ppb	—	—
SD-006	Total-Tetrachlorodibenzo-p-dioxin	0.080 ppb	—	—
INORGANICS				
SD-003	Aluminum*	24,700.000 ppm	—	—
SD-003	Antimony*	11.80 ppm	14 ppm	107.26 ppm
SD-004	Arsenic	5.70 ppm	20 ppm	0.3589 ppm
SD-003	Barium*	129.00 ppm	500 ppm	19,030 ppm
SD-006	Beryllium	2.00 ppm	2 ppm	0.146 ppm
SD-006	Calcium	4,280.00 ppm	—	—
SD-002	Chromium*	14.70 ppm	—	—
SD-006	Cobalt	46.90 ppm	—	—
SD-003	Copper*	163.00 ppm	600 ppm	10,034 ppm
SD-003	Iron*	67,600.00 ppm	—	—
SD-004	Lead	74.50 ppm	100 ppm	500 ppm
SD-001	Magnesium*	1,330.00 ppm	—	—
SD-008	Manganese	518.00 ppm	—	—
SD-004	Mercury	0.22 ppm	14 ppm	79.58 ppm
SD-003	Nickel*	16.50 ppm	250 ppm	592 ppm
SD-004	Potassium	810.00 ppm	—	—
SD-008	Selenium	1.60 ppm	60 ppm	1,349.4 ppm
SD-002	Sodium*	137.00 ppm	—	—
SD-003	Vanadium*	224.00 ppm	380 ppm	1,903 ppm
SD-004	Zinc	94.70 ppm	1,500 ppm	55,360 ppm

*OSWER Directive 9285.7-01B, Human Health Evaluation Part B: Development of Risk-Based Preliminary Remediation Goals, December 13, 1991.

Note: "—" = Standard does not exist for this compound

= Standards have been exceeded

*** = Sediment sample taken from pond

TABLE 6
Comparison of Sediment Sample Results to Proposed NJDEPE Standards and EPA Risk-Based Standards

Station ID	Compound	Highest Detected Concentration	NJDEPE Proposed Soil Cleanup Standard (Residential Surface Soil)	EPA Risk-Based Standard*
VOLATILE ORGANICS				
SD-002	2-Butanone*	13.00 ppb	1,000,000 ppb	13,494,000 ppb
SD-006	Chloromethane	4.00 ppb	520,000 ppb	48,100 ppb
SD-006	Toluene	3.00 ppb	1,000,000 ppb	553,600,000 ppb
SEMIVOLATILE ORGANICS				
SD-004	2-Methylnaphthalene	80.00 ppb	—	—
SD-004	4-Methylphenol	660.00 ppb	—	—
SD-004	Acenaphthylene	57.00 ppb	3,400,000 ppb	16,500,000 ppb
SD-004	Anthracene	110.00 ppb	10,000,000 ppb	79,580,000 ppb
SD-004	Benzo(a)anthracene	580.00 ppb	660 ppb	740 ppb
SD-004	Benzo(a)pyrene	500.00 ppb	660 ppb	107.3 ppb
SD-004	Benzo(b)fluoranthene	830.00 ppb	660 ppb	777 ppb
SD-004	Benzo(ghi)perylene	320.00 ppb	660 ppb	4,810 ppb
SD-004	Benzo(k)fluoranthene	430.00 ppb	660 ppb	1,628 ppb
SD-003	Benzoic acid*	230.00 ppb	—	—
SD-004	Bis(2-ethylhexyl)phthalate	540.00 ppb	49,000 ppb	44,400 ppb
SD-004	Chrysene	750.00 ppb	660 ppb	24,790 ppb
SD-003	Di-n-butyl-phthalate*	25.00 ppb	5,700,000 ppb	26,988,000 ppb
SD-004	Dibenzofuran	84.00 ppb	—	—
SD-008	Diethyl phthalate	140.00 ppb	10,000,000 ppb	217,980,000 ppb
SD-004	Fluoranthene	900.00 ppb	2,300,000 ppb	10,726,000 ppb
SD-004	Indeno(1,2,3-CD)pyrene	390.00 ppb	660 ppb	481 ppb
SD-004	Naphthalene	79.00 ppb	230,000 ppb	11,000,000 ppb
SD-004	Phenanthrene	440.00 ppb	—	—
SD-004	Pyrene	950.00 ppb	1,700,000 ppb	12,456 ppb
DIOXINS/FURANS				
SD-008	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	0.740 ppb	—	—
SD-008	1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	0.120 ppb	—	—
SD-008	Octachlorodibenzo-p-dioxin	107.000 ppb	—	—
SD-008	Total-Heptachlorodibenzo-p-dioxin	2.100 ppb	—	—

TABLE 7

CHEMICALS OF POTENTIAL CONCERN: FINAL SELECTION LIST

HIGGINS FARM

CHEMICAL	GROUND WATER	SURFACE SOIL	SURFACE WATER	SEDIMENT
VOLATILES				
Benzene	X	•	ND	ND
Chlorobenzene	X	•	ND	ND
Chloroform	X	ND	ND	ND
1,2-Dichlorobenzene	X	ND	ND	ND
1,1-Dichloroethane	X	ND	ND	ND
1,2-Dichloroethane	X	ND	ND	ND
1,1-Dichloroethene	X	ND	ND	ND
1,2-Dichloroethene	X	ND	ND	ND
Isopropylbenzene	X	ND	ND	ND
1,1,2,2-Tetrachloroethane	X	ND	ND	ND
Tetrachloroethene	X	•	ND	ND
1,2,4-Trichlorobenzene	X	ND	ND	ND
1,1,2-Trichloroethane	X	ND	ND	ND
Trichloroethene	X	•	ND	ND
Vinyl Chloride	X	ND	ND	ND
Xylenes (total)	X	•	ND	ND
SEMI-VOLATILES				
Bis(2-chloroethyl)ether	X	ND	ND	ND
Bis(2-ethylhexyl)phthalate	•	X	•	X
Di-n-butylphthalate	•	X	•	X
Diethylphthalate	•	X	•	X
DIOXINS/FURANS				
PCDD/PCDFs	NA	X	NA	X
INORGANICS				
Arsenic	ND	X	ND	X
Beryllium	ND	X	ND	X

TABLE 7

CHEMICALS OF POTENTIAL CONCERN: FINAL SELECTION LIST

HIGGINS FARM

CHEMICAL	GROUND WATER	SURFACE SOIL	SURFACE WATER	SEDIMENT
Lead	•	X	•	X
Mercury	ND	X	ND	X

Notes:

X = selected as a chemical of potential concern.
ND = Not Detected.
• = Detected, but not selected as a chemical of potential concern.
NA = Not Analyzed.

TABLE 8

SUMMARY OF COMPLETE EXPOSURE PATHWAYS

HIGGINS FARM

Potentially Exposed Population	Exposure Route, Medium and Exposure Point	Pathway Selected for Evaluation?	Reason for Selection or Exclusion
Current Land Use			
Residents	Ingestion of and dermal contact with chemicals of potential concern in soil.	Yes	Contaminated soil is in an area potentially used by residents.
Residents	Ingestion of, dermal contact with, and inhalation of chemicals of potential concern in ground water.	Yes	Residents use ground water for drinking, bathing, cleaning and other home uses.
Workers	Ingestion of and dermal contact with chemicals of potential concern in soil.	Yes	Contaminated soil is in an area potentially used by workers.
Trespassers	Ingestion of and dermal contact with chemicals of potential concern in soil.	Yes	Contaminated soil may be encountered by trespassers.
Trespassers	Dermal contact with chemicals of potential concern in sediment.	Yes	Contaminated sediment may be encountered by trespassers.
Trespassers	Ingestion of and dermal contact with chemicals of potential concern in surface water.	No	No chemicals of potential concern have been identified in surface water.

TABLE 9

SUMMARY OF COMPLETE EXPOSURE PATHWAYS

HIGGINS FARM

Potentially Exposed Population	Exposure Route, Medium and Exposure Point	Pathway Selected for Evaluation?	Reason for Selection or Exclusion
Future Land Use			
Residents	Ingestion of and dermal contact with chemicals of potential concern in soil.	No	While the site could be developed in the future as a residential area, the estimated exposures would be unlikely to exceed those estimated in the current use scenario.
Residents	Dermal contact with chemicals of potential concern in sediment.	Yes	A resident my have opportunity to contact sediment during recreational activities for a longer duration than a trespasser if the site were developed in the future as a residential area.
Consumers	Ingestion of farm products and produce.	No	While its plausible that the site could be developed in the future for livestock and/or agricultural product production, it is unlikely that such development would occur.

TABLE 10

SUMMARY OF CHRONIC NONCARCINOGENIC HAZARD INDEX ESTIMATES

HIGGINS FARM

	Chemical	CDI (mg/kg-day)	RfD Adjusted for Absorption	RfD* (mg/kg-day)	Hazard Quotient	Pathway Hazard Index
CURRENT LAND USE						
ADOLESCENT TRESPASSERS: Ingestion of and dermal contact with chemicals in soil						
Ingestion	bis(2-ethylhexyl)phthalate	6.88E-08	NO	2.00E-02	3.44E-06	
	diethylphthalate	4.04E-08	—	—	—	
	di-n-butylphthalate	3.80E-08	NO	1.00E+00	3.80E-08	
	PCDDs/PCDFs	4.75E-12	—	—	—	
	arsenic	1.12E-06	NO	3.00E-04	3.73E-03	
	beryllium	3.32E-07	NO	5.00E-03	6.64E-05	
	lead	4.92E-06	—	—	—	
	mercury	1.80E-08	NO	3.00E-04	6.00E-05	3.86E-03
Dermal contact	bis(2-ethylhexyl)phthalate	4.11E-07	YES	2.00E-02	2.06E-05	
	diethylphthalate	2.41E-07	—	—	—	
	di-n-butylphthalate	2.27E-07	YES	1.00E+00	2.27E-07	
	PCDDs/PCDFs	2.84E-11	—	—	—	
	arsenic	1.33E-06	YES	2.40E-04	5.54E-03	
	beryllium	3.97E-07	YES	5.00E-05	7.94E-03	
	lead	5.96E-06	—	—	—	
	mercury	2.16E-08	YES	6.00E-06	3.60E-03	1.71E-02
ADOLESCENT TRESPASSERS: Dermal contact with chemicals in sediment						
	bis(2-ethylhexyl)phthalate	5.32E-07	YES	2.00E-02	2.66E-05	
	diethylphthalate	1.99E-07	—	—	—	
	di-n-butylphthalate	3.55E-08	YES	1.00E+00	3.55E-08	
	PCDDs/PCDFs	1.84E-10	—	—	—	
	arsenic	1.55E-06	YES	2.40E-04	6.46E-03	
	beryllium	5.19E-07	YES	5.00E-05	1.04E-02	
	lead	2.11E-05	—	—	—	
	mercury	6.24E-08	YES	6.00E-06	1.04E-02	2.73E-02
TOTAL EXPOSURE HAZARD INDEX FOR ADOLESCENT TRESPASSERS						4.82E-02

NOTE: *RfDs for dermal exposure pathways are adjusted for absorption as follows:

RfD x ABS = Adj RfD

Where ABS = 1.0 for organic chemicals (default value)
0.1 for arsenic (USEPA, 1984)
0.01 for beryllium (ATSDR, 1988)
0.02 for mercury (ATSDR, 1989)

TABLE 10

SUMMARY OF CHRONIC NONCARCINOGENIC HAZARD INDEX ESTIMATES

HIGGINS FARM

	Chemical	CDI (mg/kg-day)	RfD Adjusted for Absorption	RfD* (mg/kg-day)	Hazard Quotient	Pathway Hazard Index
CURRENT LAND USE						
RESIDENT ADULTS: Ingestion of and dermal contact with chemicals in soil						
Ingestion	bis(2-ethylhexyl)phthalate	4.79E-07	NO	2.00E-02	2.40E-05	
	di-n-butylphthalate	4.11E-07	NO	1.00E+00	4.11E-07	
	PCDDs/PCDFs	5.48E-11	—	—	—	
	arsenic	6.58E-06	NO	3.00E-04	2.19E-02	
	beryllium	1.51E-06	NO	5.00E-03	3.02E-04	
	lead	1.64E-04	—	—	—	
	mercury	5.21E-07	NO	3.00E-04	1.74E-03	2.40E-02
Dermal contact	bis(2-ethylhexyl)phthalate	2.85E-07	YES	2.00E-02	1.43E-05	
	di-n-butylphthalate	2.44E-07	YES	1.00E+00	2.44E-07	
	PCDDs/PCDFs	3.26E-11	—	—	—	
	arsenic	7.82E-07	YES	2.40E-04	3.26E-03	
	beryllium	1.79E-07	YES	5.00E-05	3.58E-03	
	lead	1.95E-05	—	—	—	
	mercury	6.19E-08	YES	6.00E-06	1.03E-02	1.72E-02
RESIDENT ADULTS: Ingestion, dermal contact and inhalation of chemicals in ground water						
Ingestion	bis(2-chloroethyl)ether	5.71E-05	—	—	—	
	benzene	3.43E-02	—	—	—	
	chlorobenzene	3.14E-02	NO	2.00E-02	1.57E+00	
	chloroform	2.84E-04	NO	1.00E-02	2.84E-02	
	1,2-dichlorobenzene	1.08E-03	NO	9.00E-02	1.20E-02	
	1,1-dichloroethane	4.43E-05	NO	1.00E-01	4.43E-04	
	1,2-dichloroethane	4.60E-03	—	—	—	
	1,1-dichloroethene	1.25E-04	NO	9.00E-03	1.39E-02	
	1,2-dichloroethene	1.88E-03	NO	2.00E-02	9.40E-02	
	isopropyl benzene	4.29E-05	NO	4.00E-02	1.07E-03	
	1,1,2,2-tetrachloroethane	4.23E-05	—	—	—	
	tetrachloroethene	7.71E-03	NO	1.00E-02	7.71E-01	
	1,2,4-trichlorobenzene	4.86E-05	NO	1.30E-03	3.74E-02	
	1,1,2-trichloroethane	3.14E-02	NO	4.00E-03	7.85E+00	
	trichloroethene	6.29E-03	—	—	—	
	vinyl chloride	4.29E-04	—	—	—	
	xylenes (total)	1.08E-04	NO	2.00E+00	5.40E-05	1.04E+01

NOTE *-RfDs for dermal exposure pathways are adjusted for absorption as follows:

RfD x ABS = AdjRfD

Where ABS = 1.0 for organic chemicals (default value)
0.8 for arsenic (USEPA, 1984)
0.01 for beryllium (ATSDR, 1988)
0.02 for mercury (ATSDR, 1989)

TABLE 10

SUMMARY OF CHRONIC NONCARCINOGENIC HAZARD INDEX ESTIMATES

HIGGINS FARM

	Chemical	CDI (mg/kg-day)	RfD Adjusted for Absorption	RfD* (mg/kg-day)	Hazard Quotient	Pathway Hazard Index
Dermal contact	bis(2-chloroethyl)ether	2.00E-06	—	—	—	
	benzene	4.46E-03	—	—	—	
	chlorobenzene	2.00E-02	YES	2.00E-02	1.00E+00	
	chloroform	2.44E-05	YES	1.00E-02	2.44E-03	
	1,2-dichlorobenzene	9.94E-05	YES	9.00E-02	1.10E-03	
	1,1-dichloroethane	2.51E-06	YES	1.00E-01	2.51E-05	
	1,2-dichloroethane	4.23E-03	—	—	—	
	1,1-dichloroethene	1.55E-05	YES	9.00E-03	1.72E-03	
	1,2-dichloroethene	5.22E-05	YES	2.00E-02	2.61E-03	
	isopropyl benzene	3.94E-05	YES	4.00E-02	9.85E-04	
	1,1,2,2-tetrachloroethane	9.55E-08	—	—	—	
	tetrachloroethene	5.39E-05	YES	1.00E-02	5.39E-03	
	1,2,4-trichlorobenzene	3.24E-06	YES	1.30E-03	2.49E-03	
	1,1,2-trichloroethane	7.61E-03	YES	4.00E-03	1.90E+00	
	trichloroethene	1.52E-03	—	—	—	
	vinyl chloride	9.03E-06	—	—	—	
	xylenes (total)	9.94E-05	YES	2.00E+00	4.97E-05	2.92E+00
Inhalation	bis(2-chloroethyl)ether	2.29E-05	—	—	—	
	benzene	1.37E-02	—	—	—	
	chlorobenzene	1.26E-02	NO	5.00E-03	2.52E+00	
	chloroform	1.14E-04	—	—	—	
	1,2-dichlorobenzene	4.32E-04	NO	4.00E-02	1.08E-02	
	1,1-dichloroethane	1.77E-05	NO	1.00E-01	1.77E-04	
	1,2-dichloroethane	1.84E-03	—	—	—	
	1,1-dichloroethene	5.01E-05	—	—	—	
	1,2-dichloroethene	7.51E-04	—	—	—	
	isopropyl benzene	1.71E-05	—	—	—	
	1,1,2,2-tetrachloroethane	1.69E-05	—	—	—	
	tetrachloroethene	3.09E-03	—	—	—	
	1,2,4-trichlorobenzene	1.94E-05	NO	3.00E-03	6.47E-03	
	1,1,2-trichloroethane	1.26E-02	—	—	—	
	trichloroethene	2.51E-03	—	—	—	
	vinyl chloride	1.71E-04	—	—	—	
	xylenes (total)	4.32E-05	NO	8.60E-02	5.02E-04	2.54E+00
TOTAL EXPOSURE HAZARD INDEX FOR RESIDENT ADULTS						1.59E+01

NOTE: *-RfDs for dermal exposure pathways are adjusted for absorption as follows:

RfD x ABS = AdjRfD

Where ABS = 1.0 for organic chemicals (default value)
0.8 for arsenic (USEPA, 1984)
0.01 for beryllium (ATSDR, 1988)
0.02 for mercury (ATSDR, 1989)

TABLE 10

SUMMARY OF CHRONIC NONCARCINOGENIC HAZARD INDEX ESTIMATES

HIGGINS FARM

	Chemical	CDI (mg/kg-day)	RfD Adjusted for Absorption	RfD* (mg/kg-day)	Hazard Quotient	Pathway Hazard Index
CURRENT LAND USE						
RESIDENT CHILDREN: Ingestion of and dermal contact with chemicals in soil						
Ingestion	bis(2-ethylhexyl)phthalate	4.54E-06	NO	2.00E-02	2.27E-04	
	di-n-butylphthalate	3.89E-06	NO	1.00E+00	3.89E-06	
	PCDDs/PCDFs	5.18E-10	—	—	—	
	arsenic	6.22E-05	NO	3.00E-04	2.07E-01	
	beryllium	1.43E-05	NO	5.00E-03	2.86E-03	
	lead	1.55E-03	—	—	—	
	mercury	4.92E-06	NO	3.00E-04	1.64E-02	2.27E-01
Dermal contact	bis(2-ethylhexyl)phthalate	5.24E-06	YES	2.00E-02	2.62E-04	
	di-n-butylphthalate	4.50E-06	YES	1.00E+00	4.50E-06	
	PCDDs/PCDFs	5.99E-10	—	—	—	
	arsenic	1.44E-05	YES	2.40E-04	6.00E-02	
	beryllium	3.30E-06	YES	5.00E-05	6.60E-02	
	lead	3.60E-04	—	—	—	
	mercury	1.14E-06	YES	6.00E-06	1.90E-01	3.16E-01
RESIDENT CHILDREN: Ingestion, dermal contact and inhalation of chemicals in ground water						
Ingestion	bis(2-chloroethyl)ether	1.35E-04	—	—	—	
	benzene	8.11E-02	—	—	—	
	chlorobenzene	7.43E-02	NO	2.00E-02	3.72E+00	
	chloroform	6.72E-04	NO	1.00E-02	6.72E-02	
	1,2-dichlorobenzene	2.55E-03	NO	9.00E-02	2.83E-02	
	1,1-dichloroethane	1.05E-04	NO	1.00E-01	1.05E-03	
	1,2-dichloroethane	1.09E-03	—	—	—	
	1,1-dichloroethene	2.96E-04	NO	9.00E-03	3.29E-02	
	1,2-dichloroethene	4.44E-03	NO	2.00E-02	2.22E-01	
	isopropyl benzene	1.01E-04	NO	4.00E-02	2.53E-03	
	1,1,2,2-tetrachloroethane	1.00E-04	—	—	—	
	tetrachloroethene	1.82E-02	NO	1.00E-02	1.82E+00	
	1,2,4-trichlorobenzene	1.15E-04	NO	1.30E-03	8.85E-02	
	1,1,2-trichloroethane	7.43E-02	NO	4.00E-03	1.86E+01	
	trichloroethene	1.49E-02	—	—	—	
	vinyl chloride	1.01E-03	—	—	—	
	xylenes (total)	2.55E-04	NO	2.00E+00	1.28E-04	2.46E+01

NOTE: *-RfDs for dermal exposure pathways are adjusted for absorption as follows:

RfD x ABS = Adj RfD

Where ABS = 1.0 for organic chemicals (default value)
0.8 for arsenic (USEPA, 1984)
0.01 for beryllium (ATSDR, 1988)
0.02 for mercury (ATSDR, 1989)

TABLE 10

SUMMARY OF CHRONIC NONCARCINOGENIC HAZARD INDEX ESTIMATES

HIGGINS FARM

	Chemical	CDI (mg/kg-day)	RfD Adjusted for Absorption	RfD* (mg/kg-day)	Hazard Quotient	Pathway Hazard Index
Dermal contact	bis(2-chloroethyl)ether	3.56E-06	—	—	—	
	benzene	7.94E-03	—	—	—	
	chlorobenzene	3.57E-02	YES	2.00E-02	1.79E+00	
	chloroform	4.35E-05	YES	1.00E-02	2.18E-03	
	1,2-dichlorobenzene	1.77E-04	YES	9.00E-02	1.97E-03	
	1,1-dichloroethane	4.48E-06	YES	1.00E-01	4.48E-05	
	1,2-dichloroethane	7.54E-03	—	—	—	
	1,1-dichloroethene	2.77E-05	YES	9.00E-03	3.08E-03	
	1,2-dichloroethene	9.30E-05	YES	2.00E-02	4.65E-03	
	isopropyl benzene	7.03E-05	YES	4.00E-02	1.76E-03	
	1,1,2,2-tetrachloroethane	1.07E-07	—	—	—	
	tetrachloroethene	9.60E-05	YES	1.00E-02	9.60E-03	
	1,2,4-trichlorobenzene	5.77E-06	YES	1.30E-03	4.44E-03	
	1,1,2-trichloroethane	1.36E-02	YES	4.00E-03	3.40E+00	
	trichloroethene	2.71E-03	—	—	—	
	vinyl chloride	1.61E-05	—	—	—	
	xylenes (total)	1.77E-04	YES	2.00E+00	8.85E-05	5.21E+00
Inhalation	bis(2-chloroethyl)ether	1.44E-04	—	—	—	
	benzene	8.65E-02	—	—	—	
	chlorobenzene	7.93E-02	NO	5.00E-03	1.59E+01	
	chloroform	7.16E-04	—	—	—	
	1,2-dichlorobenzene	2.72E-03	NO	4.00E-02	6.80E-02	
	1,1-dichloroethane	1.12E-04	NO	1.00E-01	1.12E-03	
	1,2-dichloroethane	1.16E-02	—	—	—	
	1,1-dichloroethene	3.16E-04	—	—	—	
	1,2-dichloroethene	4.74E-03	—	—	—	
	isopropyl benzene	1.08E-04	—	—	—	
	1,1,2,2-tetrachloroethane	1.07E-04	—	—	—	
	tetrachloroethene	1.95E-02	—	—	—	
	1,2,4-trichlorobenzene	1.23E-04	NO	3.00E-03	4.10E-02	
	1,1,2-trichloroethane	7.93E-02	—	—	—	
	trichloroethene	1.59E-02	—	—	—	
	vinyl chloride	1.08E-03	—	—	—	
	xylenes (total)	2.72E-04	NO	8.60E-02	3.16E-03	1.60E+01
TOTAL EXPOSURE HAZARD INDEX FOR RESIDENT CHILDREN						4.63E+01

NOTE: *-RfDs for dermal exposure pathways are adjusted for absorption as follows:

RfD x ABS = AdjRfD

Where ABS = 1.0 for organic chemicals (default value)
0.8 for arsenic (USEPA, 1984)
0.01 for beryllium (ATSDR, 1988)
0.02 for mercury (ATSDR, 1989)

TABLE 10

SUMMARY OF CHRONIC NONCARCINOGENIC HAZARD INDEX ESTIMATES

HIGGINS FARM

	Chemical	CDI (mg/kg-day)	RfD Adjusted for Absorption	RfD* (mg/kg-day)	Hazard Quotient	Pathway Hazard Index
CURRENT LAND USE						
ADULT WORKERS: Ingestion of and dermal contact with chemicals in soil						
Ingestion	bis(2-ethylhexyl)phthalate	2.84E-07	NO	2.00E-02	1.42E-05	
	diethylphthalate	1.66E-07	—	—	—	
	di-n-butylphthalate	1.57E-07	NO	1.00E+00	1.57E-07	
	PCDDs/PCDFs	1.96E-11	—	—	—	
	arsenic	4.60E-06	NO	3.00E-04	1.53E-02	
	beryllium	1.37E-06	NO	5.00E-03	2.74E-04	
	lead	2.05E-05	—	—	—	
	mercury	7.44E-08	NO	3.00E-04	2.48E-04	1.59E-02
Dermal contact	bis(2-ethylhexyl)phthalate	1.69E-07	YES	2.00E-02	8.45E-06	
	diethylphthalate	9.89E-07	—	—	—	
	di-n-butylphthalate	9.31E-08	YES	1.00E+00	9.31E-08	
	PCDDs/PCDFs	1.16E-11	—	—	—	
	arsenic	5.47E-07	YES	2.40E-04	2.28E-03	
	beryllium	1.63E-07	YES	5.00E-05	3.26E-03	
	lead	2.44E-06	—	—	—	
	mercury	8.84E-09	YES	6.00E-06	1.47E-03	7.02E-03
TOTAL EXPOSURE HAZARD INDEX FOR ADULT WORKERS						2.29E-02

NOTE: *-RfDs for dermal exposure pathways are adjusted for absorption as follows:

RfD x ABS = AdjRfD

Where ABS = 1.0 for organic chemicals (default value)
0.8 for arsenic (USEPA, 1984)
0.01 for beryllium (ATSDR, 1988)
0.02 for mercury (ATSDR, 1989)

TABLE 10

SUMMARY OF CHRONIC NONCARCINOGENIC HAZARD INDEX ESTIMATES

HIGGINS FARM

Chemical	CDI (mg/kg-day)	RfD Adjusted for Absorption	RfD* (mg/kg-day)	Hazard Quotient	Pathway Hazard Index
FUTURE LAND USE					
RESIDENT ADOLESCENTS: Dermal contact with chemicals in sediment					
bis(2-ethylhexyl)phthalate	5.32E-07	YES	2.00E-02	2.66E-05	
di-n-butylphthalate	[illegible]	YES	1.00E+00	3.55E-08	
PCDDs/PCDFs	1.84E-10	—	—	—	
arsenic	1.55E-06	YES	2.40E-04	6.46E-03	
beryllium	5.19E-07	YES	5.00E-05	1.04E-02	
lead	2.11E-05	—	—	—	
mercury	6.24E-08	YES	6.00E-06	1.04E-02	2.73E-02
TOTAL ADDITIONAL EXPOSURE HAZARD INDEX FOR RESIDENT ADOLESCENTS					2.73E-02

NOTE: *-RfDs for dermal exposure pathways are adjusted for absorption as follows:

RfD x ABS = AdjRfD

Where ABS = 1.0 for organic chemicals (default value)
0.8 for arsenic (USEPA. 1984)
0.01 for beryllium (ATSDR. 1988)
0.02 for mercury (ATSDR. 1989)

TABLE 11

SUMMARY OF CANCER RISK ESTIMATES

HIGGINS FARM

	Chemical	CDI (mg/kg-day)	CDI Adjusted for Absorption	SF* (mg/kg-day)-1	Chemical-specific Risk	Total Pathway Risk
CURRENT LAND USE						
RESIDENT ADULTS: Ingestion of and dermal contact with chemicals in soil						
Ingestion	bis(2-ethylhexyl)phthalate	2.05E-07	NO	1.40E-02	2.87E-09	
	PCDDs/PCDFs	2.35E-11	NO	1.50E+05	3.53E-06	
	arsenic	2.82E-06	NO	1.80E+00	5.08E-06	
	beryllium	6.46E-07	NO	4.30E+00	2.78E-06	1.14E-05
Dermal contact	bis(2-ethylhexyl)phthalate	1.22E-07	YES	1.40E-02	1.71E-09	
	PCDDs/PCDFs	1.40E-11	YES	1.50E+05	2.10E-06	
	arsenic	3.35E-07	YES	2.25E+00	7.54E-07	
	beryllium	7.68E-08	YES	4.30E-02	3.30E-05	3.59E-05
RESIDENT ADULTS: Ingestion, dermal contact and inhalation of chemicals in ground water						
Ingestion	benzene	1.47E-02	NO	2.90E-02	4.26E-04	
	bis(2-chloroethyl)ether	2.45E-05	NO	1.10E+00	2.70E-05	
	chloroform	1.22E-04	NO	6.10E-03	7.44E-07	
	1,1-dichloroethane	1.90E-05	—	—	—	
	1,2-dichloroethane	1.97E-03	NO	9.10E-02	1.79E-04	
	1,1-dichloroethene	5.36E-05	NO	6.00E-01	3.22E-05	
	1,1,2,2-tetrachloroethane	1.81E-05	NO	2.00E-01	3.62E-06	
	tetrachloroethene	3.31E-03	NO	5.10E-02	1.69E-04	
	1,1,2-trichloroethane	1.35E-02	NO	5.70E-02	7.70E-04	
	trichloroethene	2.69E-03	NO	1.10E-02	2.96E-05	
	vinyl chloride	1.84E-04	NO	1.90E+00	3.50E-04	1.99E-03

NOTE. *-RfDs for dermal exposure pathways are adjusted for absorption as follows:

RfD x ABS = AdjRfD

Where ABS = 1.0 for organic chemicals (default value)
0.8 for arsenic (USEPA, 1984)
0.01 for beryllium (ATSDR, 1988)
0.02 for mercury (ATSDR, 1989)

TABLE 11

SUMMARY OF CANCER RISK ESTIMATES

HIGGINS FARM

	Chemical	CDI (mg/kg-day)	CDI Adjusted for Absorption	SF* (mg/kg-day)-1	Chemical-specific Risk	Total Pathway Risk
Dermal contact	benzene	1.91E-03	YES	2.90E-02	5.54E-05	
	bis(2-chloroethyl)ether	8.57E-07	YES	1.10E+00	9.43E-07	
	chloroform	1.05E-05	YES	6.10E-03	6.41E-08	
	1,1-dichloroethane	1.08E-06	—	—	—	
	1,2-dichloroethane	1.81E-03	YES	9.10E-02	1.65E-04	
	1,1-dichloroethene	6.66E-06	YES	6.00E-01	4.00E-06	
	1,1,2,2-tetrachloroethane	4.09E-08	YES	2.00E-01	8.18E-09	
	tetrachloroethene	2.31E-05	YES	5.10E-02	1.18E-06	
	1,1,2-trichloroethane	3.26E-03	YES	5.70E-02	1.86E-04	
	trichloroethene	6.52E-04	YES	1.10E-02	7.17E-06	
	vinyl chloride	3.87E-06	YES	1.90E+00	7.35E-06	4.27E-04
Inhalation	benzene	5.88E-03	NO	2.90E-02	1.71E-04	
	bis(2-chloroethyl)ether	9.80E-06	NO	1.15E+00	1.13E-05	
	chloroform	4.87E-05	NO	8.50E-02	4.14E-06	
	1,1-dichloroethane	7.59E-06	—	—	—	
	1,2-dichloroethane	7.89E-04	NO	9.10E-02	7.18E-05	
	1,1-dichloroethene	2.15E-05	NO	1.20E+00	2.58E-05	
	1,1,2,2-tetrachloroethane	7.25E-06	NO	2.00E-01	1.45E-06	
	tetrachloroethene	1.32E-03	NO	1.80E-03	2.38E-06	
	1,1,2-trichloroethane	5.39E-03	NO	5.70E-02	3.07E-04	
	trichloroethene	1.08E-03	NO	1.70E-02	1.84E-05	
	vinyl chloride	7.35E-05	NO	2.90E-01	2.13E-05	6.34E-04
TOTAL EXPOSURE RISK RESIDENT ADULTS						3.09E-03

NOTE: *-RfDs for dermal exposure pathways are adjusted for absorption as follows:

RfD x ABS = AdjRfD

Where ABS = 1.0 for organic chemicals (default value)
0.8 for arsenic (USEPA, 1984)
0.01 for beryllium (ATSDR, 1988)
0.02 for mercury (ATSDR, 1989)

TABLE 11

SUMMARY OF CANCER RISK ESTIMATES

HIGGINS FARM

	Chemical	CDI (mg/kg-day)	CDI Adjusted for Absorption	SF* (mg/kg-day)-1	Chemical-specific Risk	Total Pathway Risk
CURRENT LAND USE						
RESIDENT CHILDREN: Ingestion of and dermal contact with chemicals in soil						
Ingestion	bis(2-ethylhexyl)phthalate	4.54E-07	NO	1.40E-02	6.36E-09	
	PCDDs/PCDFs	5.18E-11	NO	1.50E+05	7.77E-06	
	arsenic	6.22E-06	NO	1.80E+00	1.12E-05	
	beryllium	1.43E-06	NO	4.30E+00	6.15E-06	2.51E-05
Dermal contact	bis(2-ethylhexyl)phthalate	5.24E-07	YES	1.40E-02	7.34E-09	
	PCDDs/PCDFs	5.99E-11	YES	1.50E+05	8.99E-06	
	arsenic	1.44E-06	YES	2.25E+00	3.24E-06	
	beryllium	3.30E-07	YES	4.30E+02	1.42E-04	1.54E-04
RESIDENT CHILDREN: Ingestion, dermal contact and inhalation of chemicals in ground water.						
Ingestion	benzene	8.11E-03	NO	2.90E-02	2.35E-04	
	bis(2-chloroethyl)ether	1.35E-05	NO	1.10E+00	1.49E-05	
	chloroform	6.72E-05	NO	6.10E-03	4.10E-07	
	1,1-dichloroethane	1.05E-05	—	—	—	
	1,2-dichloroethane	1.09E-03	NO	9.10E-02	9.92E-05	
	1,1-dichloroethene	2.96E-05	NO	6.00E-01	1.78E-05	
	1,1,2,2-tetrachloroethane	1.00E-05	NO	2.00E-01	2.00E-06	
	tetrachloroethene	1.82E-03	NO	5.10E-02	9.28E-05	
	1,1,2-trichloroethane	7.43E-03	NO	5.70E-02	4.24E-04	
	trichloroethene	1.49E-03	NO	1.10E-02	1.64E-05	
	vinyl chloride	1.01E-04	NO	1.90E+00	1.92E-04	1.09E-03

NOTE: *-RfDs for dermal exposure pathways are adjusted for absorption as follows:

RfD x ABS = AdjRfD

Where ABS = 1.0 for organic chemicals (default value)
0.8 for arsenic (USEPA, 1984)
0.01 for beryllium (ATSDR, 1988)
0.02 for mercury (ATSDR, 1989)

TABLE 11

SUMMARY OF CANCER RISK ESTIMATES

HIGGINS FARM

	Chemical	CDI (mg/kg-day)	CDI Adjusted for Absorption	SF* (mg/kg-day)-1	Chemical-specific Risk	Total Pathway Risk
Dermal contact	benzene	7.94E-04	YES	2.90E-02	2.30E-05	
	bis(2-chloroethyl)ether	3.56E-07	YES	1.10E+00	3.92E-07	
	chloroform	4.35E-06	YES	6.10E-03	2.65E-08	
	1,1-dichloroethane	4.48E-07	—	—	—	
	1,2-dichloroethane	7.54E-04	YES	9.10E-02	6.86E-05	
	1,1-dichloroethene	2.77E-06	YES	6.00E-01	1.66E-06	
	1,1,2,2-tetrachloroethane	1.07E-08	YES	2.00E-01	2.14E-09	
	tetrachloroethene	9.60E-06	YES	5.10E-02	4.90E-07	
	1,1,2-trichloroethane	1.36E-03	YES	5.70E-02	7.75E-05	
	trichloroethene	2.71E-04	YES	1.10E-02	2.98E-06	
	vinyl chloride	1.61E-06	YES	1.90E+00	3.06E-06	1.78E-04
Inhalation	benzene	8.65E-03	NO	2.90E-02	2.51E-04	
	bis(2-chloroethyl)ether	1.44E-05	NO	1.15E+00	1.66E-05	
	chloroform	7.16E-05	NO	8.50E-02	6.09E-06	
	1,1-dichloroethane	1.12E-05	—	—	—	
	1,2-dichloroethane	1.16E-03	NO	9.10E-02	1.06E-04	
	1,1-dichloroethene	3.16E-05	NO	1.20E+00	3.79E-05	
	1,1,2,2-tetrachloroethane	1.07E-05	NO	2.00E-01	2.14E-06	
	tetrachloroethene	1.95E-03	NO	1.80E-03	3.51E-06	
	1,1,2-trichloroethane	7.93E-03	NO	5.70E-02	4.52E-04	
	trichloroethene	1.59E-03	NO	1.70E-02	2.70E-05	
	vinyl chloride	1.08E-04	NO	2.90E-01	3.13E-05	9.33E-04
TOTAL EXPOSURE RISK FOR RESIDENT CHILDREN						2.38E-03
FUTURE LAND USE						
RESIDENT ADOLESCENTS: Dermal contact with chemicals in sediment						
	bis(2-ethylhexyl)phthalate	4.56E-08	YES	1.40E-02	6.38E-10	
	PCDDs/PCDFs	1.58E-11	YES	1.50E+05	2.37E-06	
	arsenic	1.33E-07	YES	2.25E+00	2.99E-07	
	beryllium	4.45E-08	YES	4.30E+02	1.91E-05	2.18E-05
TOTAL ADDITIONAL EXPOSURE RISK FOR RESIDENT ADOLESCENTS						2.18E-05

NOTE: *RfDs for dermal exposure pathways are adjusted for absorption as follows:

RfD x ABS = AdjRfD

Where ABS = 1.0 for organic chemicals (default value)
0.8 for arsenic (USEPA, 1984)
0.01 for beryllium (ATSDR, 1988)
0.07 for mercury (ATSDR, 1989)

TABLE 11

SUMMARY OF CANCER RISK ESTIMATES

HIGGINS FARM

	Chemical	CDI (mg/kg-day)	CDI Adjusted for Absorption	SF* (mg/kg-day)-1	Chemical-specific Risk	Total Pathway Risk
CURRENT LAND USE						
ADULT WORKERS: Ingestion of and dermal contact with chemicals in soil						
Ingestion	bis(2-ethylhexyl)phthalate	1.01E-07	NO	1.40E-02	1.41E-09	
	PCDDs/PCDFs	6.99E-12	NO	1.50E+05	1.05E-06	
	arsenic	1.64E-06	NO	1.80E+00	2.95E-06	
	beryllium	4.89E-07	NO	4.30E+00	2.10E-06	6.10E-06
Dermal contact	bis(2-ethylhexyl)phthalate	6.02E-08	YES	1.40E-02	8.43E-10	
	PCDDs/PCDFs	4.16E-12	YES	1.50E+05	6.24E-07	
	arsenic	1.95E-07	YES	2.25E+00	4.39E-07	
	beryllium	5.82E-08	YES	4.30E+02	2.50E-05	2.61E-05
TOTAL EXPOSURE RISK FOR ADULT WORKERS						3.22E-05

NOTE. *-RfDs for dermal exposure pathways are adjusted for absorption as follows:

RfD x ABS = AdjRfD

Where ABS = 1.0 for organic chemicals (default value)
0.8 for arsenic (USEPA, 1984)
0.01 for beryllium (ATSDR, 1988)
0.02 for mercury (ATSDR, 1989)

TABLE 11

SUMMARY OF CANCER RISK ESTIMATES

HIGGINS FARM

	Chemical	CDI (mg/kg-day)	CDI Adjusted for Absorption	SF* (mg/kg-day)-1	Chemical-specific Risk	Total Pathway-Risk
CURRENT LAND USE						
ADOLESCENT TRESPASSERS: Ingestion of and dermal contact with chemicals in soil						
Ingestion	bis(2-ethylhexyl)phthalate	2.95E-09	NO	1.40E-02	4.13E-11	
	PCDDs/PCDFs	2.03E-13	NO	1.50E+05	3.05E-08	
	arsenic	4.78E-08	NO	1.80E+00	8.60E-08	
	beryllium	1.42E-08	NO	4.30E+00	6.11E-08	1.78E-07
Dermal contact	bis(2-ethylhexyl)phthalate	1.76E-08	YES	1.40E-02	2.46E-10	
	PCDDs/PCDFs	1.22E-12	YES	1.50E+05	1.83E-07	
	arsenic	5.71E-08	YES	2.25E+00	1.28E-07	
	beryllium	1.70E-08	YES	4.30E+02	7.31E-06	7.62E-06
ADOLESCENT TRESPASSERS: Dermal contact with chemicals in sediment						
	bis(2-ethylhexyl)phthalate	2.28E-08	YES	1.40E-02	3.19E-10	
	PCDDs/PCDFs	7.90E-12	YES	1.50E+05	1.19E-06	
	arsenic	6.64E-08	YES	2.25E+00	1.49E-07	
	beryllium	2.22E-08	YES	4.30E+02	9.55E-06	1.09E-05
TOTAL EXPOSURE RISK FOR ADOLESCENT TRESPASSERS						1.87E-05

NOTE: *RfDs for dermal exposure pathways are adjusted for absorption as follows:

RfD x ABS = AdjRfD

Where ABS = 1.0 for organic chemicals (default value)
0.8 for arsenic (USEPA, 1984)
0.01 for beryllium (ATSDR, 1988)
0.02 for mercury (ATSDR, 1989)

TABLE 12
ALTERNATIVE 1 COSTS

CAPITAL COSTS	$ 0
OPERATION AND MAINTENANCE (O&M) COSTS	
Labor @ $25/hr	2,000
Ground water monitoring: Analytical (32 samples @ $1,800/sample for TCL/TAL)	57,600
SUBTOTAL	59,600
CONTINGENCY (20%)	11,900
O&M SUBTOTAL	71,500
PRESENT WORTH O&M COSTS (30 YEARS AT 5%)	1,099,100
TOTAL PRESENT WORTH VALUE (Capital and O&M Costs)	$1,099,100

TABLE 13
SENSITIVITY ANALYSIS OF O & M COSTS FOR ALTERNATIVES 1-3

Treatment Time Frame	Present Worth O & M Costs		
	Alternative 1	Alternative 2	Alternative 3
Annual O & M Costs	$ 71,500	$ 262,100	$ 384,000
5 Years	$ 309,500	$ 1,134,600	$ 1,662,300
10 Years	$ 552,100	$ 2,023,900	$ 2,965,200
15 Years	$ 742,200	$ 2,720,600	$ 3,985,900
20 Years	$ 891,000	$ 3,266,300	$ 4,785,400
25 Years	$ 1,007,700	$ 3,694,000	$ 5,412,100
30 Years	$ 1,099,100	$ 4,029,000	$ 5,902,800

Note:
5% discount rate assumed for all present worth calculations.

Table 14 ALTERNATIVE 2 COSTS	Page 1 of 1
CAPITAL COSTS	
Ground Water Extraction	$137,000
Extraction System Monitoring Wells (3)	45,000
Treatment System Building	50,000
Equalization	7,000
Aeration	49,000
Chemical Precipitation, Flocculation, Clarification, and Filtration (includes chemical feed systems)	98,000
Intermediate/Final pH Adjustment	16,000
Ion Exchange	72,000
Discharge to Surface Water	50,000
SUBTOTAL	524,000
SITE WORK (20%)	104,800
ELECTRICAL, I&C, AND MECHANICAL (30%)	157,200
SUBTOTAL	786,000
Transporation and disposal of RI and past removal wastes	87,200
SUBTOTAL	873,200
CONTINGENCY (20%)	174,600
SUBTOTAL	1,047,800
ENGINEERING AND ADMINISTRATION (20%)	209,600
OVERHEAD & PROFITS (15%)	157,200
TOTAL CAPITAL COSTS	1,414,600
OPERATION AND MAINTENANCE (O&M) COSTS	
Labor (@ $25/hour)	52,000
System influent/effluent monitoring (24 samples @ $1,800/sample for TCL/TAL)	43,200
Extraction System Monitoring (12 samples @ $1,800/sample for TCL/TAL)	21,600
Power (@ $0.10/k W-hr)	40,000
Chemicals	13,000
Resin disposal and replacement	25,000
Metal hydroxide sludge disposal	23,600
SUBTOTAL	218,400
CONTINGENCY (20%)	43,700
TOTAL ANNUAL O&M	262,100
PRESENT WORTH O&M COSTS (30 YEARS AT 5%)	4,029,000
TOTAL PRESENT WORTH VALUE (Capital and O&M Costs)	$5,443,600

Table 15
ALTERNATIVE 3 COSTS

CAPITAL COSTS	
Ground Water Extraction	$365,300
Extraction System Monitoring Wells (3)	45,000
Treatment System Building	50,000
Equalization	14,000
Aeration	58,000
Chemical Precipitation, Flocculation, Clarification, and Filtration (includes chemical feed systems)	150,000
Intermediate/Final pH Adjustment	25,000
Ion Exchange	175,000
Discharge to Surface Water	133,000
SUBTOTAL	1,015,300
SITE WORK (20%)	203,100
ELECTRICAL, I&C, AND MECHANICAL (30%)	304,600
SUBTOTAL	1,523,000
Transportation and disposal of RI and past removal wastes	87,200
SUBTOTAL	1,610,200
CONTINGENCY (20%)	322,000
SUBTOTAL	1,932,200
ENGINEERING AND ADMINISTRATION (20%)	386,400
OVERHEAD & PROFITS (15%)	289,800
TOTAL CAPITAL COSTS	2,608,400
OPERATION AND MAINTENANCE (O&M) COSTS	
Labor (@ $25/hour)	52,000
System influent/effluent monitoring (24 samples @ $1,800/sample for TCL/TAL)	43,200
Extraction System Monitoring (12 samples @ $1,800/sample for TCL/TAL)	21,600
Power (@ $0.10/k W-hr)	80,000
Chemicals	26,000
Resin disposal and replacement	50,000
Metal hydroxide sludge disposal	47,200
SUBTOTAL	320,000
CONTINGENCY (20%)	64,000
TOTAL ANNUAL O&M	384,000
PRESENT WORTH O&M COSTS (30 YEARS AT 5%)	5,902,800
TOTAL PRESENT WORTH VALUE (Capital and O&M Costs)	$8,511,200

Table 16
CHEMICAL-SPECIFIC ARARs & TBCs
FOR REMEDIATION OF GROUND WATER

Compound	Maximum Concentration Detected (µg/l)	Frequency of Detection	NJ GWQ Criteria[a] (µg/l) (ARAR)	NJ Proposed Cleanup Standards[b] (µg/l) (TBC)	New Jersey MCL[c] (µg/l) (ARAR)	Federal MCL[d] (µg/l) (ARAR)	Federal MCLG[d] (µg/l) (ARAR/ TBC)[e]	Selected Remedial Requirement (µg/l)
Volatile Organics								
Acetone	5.2	2/2	—	700	—	—	—	—
Benzene	1,200.0	12/22	—	1	1	5	0	1
Bromobenzene	1.4	4/22	—	—	—	—	—	—
Carbon Disulfide	2.1	1/1	—	—	—	—	—	—
Carbon Tetrachloride	3.3	1/22	—	2	2	5	0	2
Chlorobenzene	1,100.0	14/22	—	5	4	100	100	4
Chloroform	33.0	3/22	—	6	—	100	—	100
2-Chlorotoluene	3.5	1/22	—	—	—	—	—	—
4-Chlorotoluene	2.9	2/22	—	—	—	—	—	—
cis-1,2-Dichloroethene	76.0	10/22	—	10	10	70	70	10
1,1-Dichloroethane	3.0	8/22	—	70	—	—	—	—
1,2-Dichloroethane	320.0	8/22	—	2	2	5	0	2
1,1-Dichloroethene	10.0	7/22	—	2	2	7	7	2
1,2-Dichloropropane	0.56	1/22	—	1	—	5	0	5
1,1-Dichloropropene	4.3	1/22	—	—	—	—	—	—
Ethylbenzene	1.0	2/22	—	700	—	700	700	700
Trans-1,2-Dichloroethene	13.0	6/22	—	100	10	100	100	10
1,1,2,2-Tetrachloroethane	7.5	7/22	—	2	—	—	—	—
Tetrachloroethene	270.0	18/22	—	1	1	5	0	1
Toluene	1.9	2/22	—	1,000	—	1,000	1,000	1,000
1,1,1,2-Tetracloroethane	1.4	1/22	—	10	—	—	—	—
1,1,1-Trichloroethane	4.2	4/22	—	30	26	200	200	26
1,1,2-Trichloroethane	1,100.0	8/22	—	3	—	5	3	3
Trichloroethene	220.0	16/22	—	1	1	5	0	1
Trichlorofluoromethane	3.8	1/22	—	—	—	—	—	—
Vinyl Chloride	86.0	3/22	—	2	2	2	0	2
Xylenes (total)	13.8	9/22	—	40	44	10,000	10,000	44

Table 16
CHEMICAL-SPECIFIC ARARs & TBCs
FOR REMEDIATION OF GROUND WATER

Compound	Maximum Concentration Detected (µg/l)	Frequency of Detection	NJ GWQ Criteria[a] (µg/l) (ARAR)	NJ Proposed Cleanup Standards[b] (µg/l) (TBC)	New Jersey MCL[c] (µg/l) (ARAR)	Federal MCL[d] (µg/l) (ARAR)	Federal MCLG[d] (µg/l) (ARAR/ TBC)[e]	Selected Remedial Requirement (µg/l)
Semivolatile Organics								
Bis(2-chloroethyl)ether	2.0	2/22	—	10	—	—	—	—
Bis(2-ethylhexyl)phthalate	10.0	1/22	—	30	—	6	0	6
2-Chlorophenol	6.0	2/22	—	40	—	—	—	—
1,2-Dichlorobenzene	48.0	3/22	—	600	600	600	600	600
1,3-Dichlorobenzene	5.0	5/22	—	600	600	600	600	600
1,4-Dichlorobenzene	2.0	1/22	—	70	—	75	75	75
Di-n-butylphthalate	0.9	2/22	—	900	—	—	—	—
Diethyl phthalate	1.0	1/22	—	5,000	—	—	—	—
Hexachlorobutadiene	5.3	1/22	—	1	—	—	—	—
Isopropylbenzene	4.6	6/22	—	—	—	—	—	—
Naphthalene	0.38	2/22	—	30	—	—	—	—
N-Butylbenzene	5.0	2/22	—	—	—	—	—	—
N-Propylbenzene	4.5	2/22	—	—	—	—	—	—
P-Isopropyltoluene	5.0	2/22	—	—	—	—	—	—
Phenol	9.0	3/22	3,500	4,000	—	—	—	—
Sec-Butylbenzene	4.9	2/22	—	—	—	—	—	—
Tert-Butylbenzene	4.9	4/22	—	—	—	—	—	—
1,2,3-Trichlorobenzene	1.4	2/22	—	—	8	—	—	8
1,2,4-Trichlorobenzene	1.7	5/22	—	9	8	9	9	8
1,2,4-Trimethylbenzene	3.2	4/22	—	—	—	—	—	—
1,3,5-Trimethylbenzene	3.9	3/22	—	—	—	—	—	—
Inorganic Compounds								
Aluminum	304,000.0	27/42	—	—	—	—	—	—
Antimony	28.5	4/44	—	20	—	6	6	6
Barium	1,890.0	38/42	1,000	2,000	—	2,000	2,000	2,000
Beryllium	25.7	7/44	—	20	—	4	4	4
Cadmium	4.1	3/44	10	4	—	5	5	5
Chromium	403.0	20/44	50	100	—	100	100	100
Cobalt	826.0	25/42	—	—	—	—	—	—
Copper	8,750.0	29/39	1,000[f]	—	—	1,300	1,300	1,300
Iron	433,000.0	41/44	300[f]	—	—	—	—	—

Table 16
CHEMICAL-SPECIFIC ARARs & TBCs
FOR REMEDIATION OF GROUND WATER

Compound	Maximum Concentration Detected (µg/l)	Frequency of Detection	NJ GWQ Criteria[a] (µg/l) (ARAR)	NJ Proposed Cleanup Standards[b] (µg/l) (TBC)	New Jersey MCL[c] (µg/l) (ARAR)	Federal MCL[d] (µg/l) (ARAR)	Federal MCLG[d] (µg/l) (ARAR/ TBC)[e]	Selected Remedial Requirement (µg/l)
Lead	81.4	20/31	50	10	—	15	0	15
Magnesium	27,200.0	44/44	—	—	—	—	—	—
Manganese	24,800.0	42/42	50[f]	—	—	—	—	—
Nickel	224.0	18/43	—	100	—	100	100	100
Vanadium	1,490.0	14/44	—	—	—	—	—	—
Zinc	811.0	32/32	5,000[f]	5,000	—	—	—	—

Notes:

[a]New Jersey Ground Water Quality Standards for Class GW2, NJAC 7:9-6, adopted effective March 4, 1981; readopted June 3, 1988.
[b]New Jersey Proposed Cleanup Standards, NJAC 7:26D-4 for Class IIA Ground Water.
[c]New Jersey Drinking Water Regulations NJAC 7:10.
[d]Environmental Protection Agency Primary Drinking Water Regulations 40 CFR 141. Maximum Contaminant Levels (MCL) and Maximum Contaminant Level Goals (MCLG), April 1992 and May 1992 (Phave V Rule).
[e]MCLGs that are set above zero are ARARs. Zero values are TBCs. (Federal Register, Vol. 55, No. 46, March 8, 1990).
[f]New Jersey Ground Water Quality Secondary Standards, NJAC 7:9-6.

— Value not available.

Source of selected remedial requirement

Table 17
CHEMICAL-SPECIFIC ARARs & TBCs
FOR DISCHARGE TO SURFACE WATER

Compound	Maximum Concentration Detected in Ground Water (µg/l)	Maximum Concentration Detected in Surface Water (µg/l)	NJ SWQ[a] (µg/l) (TBC)	NJPDES[b] (µg/l)		FAWQC[c] (µg/l) (ARAR)	Method Detection Limit[d] (µg/l) (MDL)	Anti-Degradation Goal[e] (µg/l)
				Aquatic[f] (ARAR)	Potable[g] (ARAR)			
Volatile Organics								
Acetone	5.2	—	—	—	—	—	1.0	ND (1.0)
Benzene	1,200.0	—	—	5,300	—	1.2	1.0	ND (1.0)
Bromobenzene	1.4	—	—	—	—	—	1.0	ND (1.0)
Carbon Disulfide	2.1	5.0	—	—	—	—	1.0	5.0
Carbon Tetrachloride	3.3	1.4	—	35,200	—	0.25	1.0	1.4
Chlorobenzene	1,100.0	—	—	250	488	680.0	1.0	ND (1.0)
Chloroform	33.0	—	—	28,900	—	5.7	1.0	ND (1.0)
2-Chlorotoluene	3.5	—	—	—	—	—	1.0	ND (1.0)
4-Chlorotoluene	2.5	—	—	—	—	—	1.0	ND (1.0)
Cis-1,2-Dichloroethene	76.0	—	—	11,600	—	—	1.0	ND (1.0)
1,1-Dichloroethane	3.0	—	—	—	—	—	1.0	ND (1.0)
1,2-Dichloroethane	320.0	—	—	20,000	—	0.38	1.0	ND (1.0)
1,1-Dichloroethene	10.0	—	—	11,600	—	0.057	1.0	ND (1.0)
1,2-Dichloropropane	0.56	—	—	5,700	—	0.52	1.0	ND (1.0)
1,1-Dichloropropene	4.3	—	—	244	87	—	1.0	ND (1.0)
Ethylbenzene	1.0	—	—	32,000	1,400	3,100.0	1.0	ND (1.0)
Trans-1,2-Dichloroethene	13.0	—	—	11,600	—	700.0	1.0	ND (1.0)
1,1,2,2-Tetrachloroethane	7.5	—	—	2,400	—	0.17	1.0	ND (1.0)
Tetrachloroethene	270.0	—	—	840	—	0.8	1.0	ND (1.0)
Toluene	1.9	1.3	—	17,500	14,300	6,800.0	1.0	1.3
1,1,1,2-Tetrachloroethane	1.4	—	—	9,320	—	—	1.0	ND (1.0)
1,1,1-Trichloroethane	4.2	—	—	18,000	18,400	3,100.0	1.0	ND (1.0)
1,1,2-Trichloroethane	1,100.0	—	—	9,400	—	0.6	1.0	ND (1.0)
Trichloroethene	220.0	—	—	45,000	—	2.7	1.0	ND (1.0)
Trichlorofluoromethane	3.8	—	—	11,000	—	—	1.0	ND (1.0)
Vinyl chloride	86.0	—	—	—	—	2.0	1.0	ND (1.0)
Xylenes (total)	13.8	—	—	—	—	—	1.0	ND (1.0)
Semivolatile Organics								
Bis(2-chloroethyl)ether	2.0	—	—	—	—	0.031	5.0	ND (5.0)
Bis(2-ethylhexyl)phthalate	10.0	—	—	3	—	1.8	5.0	ND (5.0)
2-Chlorophenol	6.0	—	—	4,380	—	—	5.0	ND (5.0)

Table 17
CHEMICAL-SPECIFIC ARARs & TBCs
FOR DISCHARGE TO SURFACE WATER

Compound	Maximum Concentration Detected in Ground Water (µg/l)	Maximum Concentration Detected in Surface Water (µg/l)	NJ SWQ[a] (µg/l) (TBC)	NJPDES[b] (µg/l)		FAWQC[c] (µg/l) (ARAR)	Method Detection Limit[d] (µg/l) (MDL)	Anti-Degradation Goal[e] (µg/l)
				Aquatic[f] (ARAR)	Potable[g] (ARAR)			
1,2-Dichlorobenzene	48.0	—	—	763	400	2,700.0	10.0	ND (10.0)
1,3-Dichlorobenzene	5.0	—	—	763	400	400.0	10.0	ND (10.0)
1,4-Dichlorobenzene	20.0	—	—	763	400	400.0	10.0	ND (10.0)
Di-n-butylphthalate	0.9	—	—	3	34,000	—	5.0	ND (5.0)
Di-n-octylphthalate	ND	1.0	—	3	—	—	5.0	ND (5.0)
Diethyl phthalate	1.0	42.0	—	3	350,000	23,000.0	5.0	42.0
Hexachlorobutadiene	5.3	—	—	9.3	—	0.44	1.0	ND (1.0)
Isopropylbenzene	4.6	—	—	—	—	—	1.0	ND (1.0)
Naphthalene	0.38	—	—	620	—	—	1.0	ND (1.0)
N-Butylbenzene	5.0	—	—	—	—	—	1.0	ND (1.0)
N-Propylbenzene	4.5	—	—	—	—	—	1.0	ND (1.0)
P-Isopropyltoluene	5.0	—	—	—	—	—	1.0	ND (1.0)
Phenol	9.0	—	—	2,560	3,500	—	5.0	ND (5.0)
Sec-Butylbenzene	4.9	—	—	—	—	—	1.0	ND (1.0)
Tert-Butylbenzene	4.9	—	—	—	—	—	1.0	ND (1.0)
1,2,3-Trichlorobenzene	1.4	—	—	250	—	—	1.0	ND (1.0)
1,2,4-Trichlorobenzene	1.7	—	—	250	—	—	10.0	ND (10.0)
1,2,4-Timethylbenzene	3.2	—	—	—	—	—	1.0	ND (1.0)
1,3,5-Trimethylbenzene	3.9	—	—	—	—	—	1.0	ND (1.0)
Inorganic Compounds								
Aluminum	304,000.0	2,310.0	—	—	—	87.0[h,i]	100.0	2,310.0
Antimony	28.5	—	—	1,600	146	14.0	5.0	ND (5.0)
Barium	1,890.0	27.5	1,000	—	—	—	20.0	27.5
Beryllium	25.7	—	—	5.3	—	0.0077	1.0	ND (1.0)
Cadmium	4.1	—	10	0.012	10	0.25[i]	1.0	ND (1.0)
Chromium	403.0	—	50	0.29	50	11.0	10.0	ND (10.0)
Cobalt	826.0	5.2	—	—	—	—	10.0	ND (10.0)
Copper	8,750.0	6.4	—	5.6	—	2.32[i]	10.0	ND (10.0)
Iron	433,000.0	4,950	—	—	—	300.0[h]	100.0	4,950
Lead	81.4	12.0	50	.75	50	0.28[i]	0.3	12.0
Magnesium	27,200.0	3,780	—	—	—	—	5,000.0	ND (5,000.0)
Manganese	24,800.0	325	—	—	—	50.0[h]	10.0	325

Table 17
CHEMICAL-SPECIFIC ARARs & TBCs
FOR DISCHARGE TO SURFACE WATER

Compound	Maximum Concentration Detected in Ground Water (µg/l)	Maximum Concentration Detected in Surface Water (µg/l)	NJ SWQ[a] (µg/l) (TBC)	NJPDES[b] (µg/l)		FAWQC[c] (µg/l) (ARAR)	Method Detection Limit[d] (µg/l) (MDL)	Anti-Degradation Goal[e] (µg/l)
				Aquatic[f] (ARAR)	Potable[g] (ARAR)			
Nickel	224.0	—	—	56	13.4	31.45[j]	20.0	ND (20.0)
Vanadium	1,490.0	14.4	—	—	—	—	10.0	14.4
Zinc	811.0	292	—	47	—	—	20.0	292

Note:

The following conventional parameter limits must also be considered:

Parameter	Maximum Detected In Ground Water	Maximum Detected In Surface Water	Limit	Rationale
BOD	—	2.1 ppm	25 ppm	NJAC 7:9-5.1.
COD	—	15 ppm	31 ppm	Assume BOD:COD ratio is 0.8.
TDS	—	74 ppm	95 ppm	133% of natural background concentration. NJAC 7:9-4.
pH	8.4	6.9	6.5-8.5	NJAC 7:9-4.
TSS	25,900 ppm	—	40 ppm	NJAC 7:9-4.
Whole effluent toxicity	—	—	L_c = 100	No observed effects using 100% effluent. NJAC 7:9-4.

Treatability testing will determine the ability of a treatment system to meet these limits.

[a]New Jersey Surface Water Quality Standards NJAC 7:9-4 for FW2-NT Waters.
[b]New Jersey Pollutant Discharge Elimination System Regulations NJAC 7:14A, Appendix F, Values for Determination of NJPDES Permit Toxic Effluent Limitations.
[c]Federal Ambient Water Quality Criteria. Quality Criteria for Water. May 1, 1987. EPA 440/5-86-001. From "Toxics Rule".
[d]MDLs are best available Contract Laboratory Program analytical method detection limit. [From Superfund Analytical Methods for Low Concentration Water for Organics Analysis (6/91) and Superfund Analytical Methods for Low Concentration Water for Inorganics Analysis (10/91)].
[e]Anti-degradation goal is based on the maximum concentration detected in surface water. If contaminant was not detected in surface water or if detected below the method detection limit, the MDL is the anti-degradation goal.
[f]Maximum Values for Protection of Aquatic Life.
[g]Maximum Values for Protection of Potable Water Supplies.
[h]Federal Ambient Water Quality Criteria; non-priority pollutants.
[i]pH dependent criterion. Value given based on a pH of 6.5 to 9.0.
[j]Hardness dependent criterion. Value given based on an assumed total hardness of 15 mg/l.

— Value not available.
ND = Not Detected

APPENDIX IV

STATE LETTER OF CONCURRENCE

The State did not concur.

Therefore, there is no letter of concurrence.