FOCUSED FEASIBILITY STUDY

IMPERIAL OIL COMPANY/CHAMPION CHEMICAL COMPANY SUPERFUND SITE

MARLBORO TOWNSHIP, MONMOUTH COUNTY

BIRCH SWAMP BROOK SEDIMENT

New Jersey Department of Environmental Protection
July 2000

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PURPOSE AND SCOPE

The purpose of this Focused Feasibility Study is to evaluate, in accordance with the Comprehensive Environmental Response, Compensation and Liability Act of 1980, as amended (CERCLA) and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), remedial action alternatives for addressing contaminated sediment related to the Imperial Oil Company/Champion Chemical Company (IOC/CC) Superfund site found in Birch Swamp Brook. Remedial investigations have confirmed that Birch Swamp Brook sediments (including sediments located in the Fire Pond) have been impacted by contaminants emanating from the IOC/CC Superfund site located in Marlboro Township, Monmouth County, New Jersey.

ENVIRONMENTAL SETTING

Site Background & History

The IOC/CC site is located in the Morganville section of Marlboro Township in northwest Monmouth County (see Figure 1). Champion Chemical Company is the owner of the real property located on Lot 29, Block 122, Orchard Place in Morganville. The premises are leased to the Imperial Oil Company, Inc. which has operated an oil blending facility at the site since 1969.

The IOC/CC property has been utilized as an industrial facility since approximately 1912. Initially ketchup and tomato paste was manufactured at the facility until approximately 1917, at which time it was converted to a chemical processing plant. The products of the chemical plant included arsenic acid and calcium arsenate, followed by manufactured flavors and essences. At the end of the 1950s the plant was purchased by Champion Chemicals and became an oil reclamation facility. This operation continued until the Imperial Oil Company leased the site from Champion Chemicals in 1969 and began conducting the oil blending operations at the site which continue today.

The Champion Chemical property is approximately 15 acres. Imperial Oil Company's operations occupy approximately 4.2 acres of the site. The plant consists of seven production, storage and maintenance buildings and numerous above-ground oil storage tanks. The western property line abuts the abandoned Central Railroad of New Jersey's Freehold and Atlantic Highlands Branch Main Line. A chain-link fence surrounds the active portion of the site. Imperial Oil's operations at the site consist of mixing and repackaging of "clean oils" delivered to Imperial Oil

by truck and stored in the above ground tanks. Imperial Oil blends the various grades of oil to meet their customer's specifications.

Three oil/water separators that were installed in the 1950s by Champion Chemical are still operational and they collect surface water runoff that accumulates in the northwest portion of the site during heavy rainfall events. The water from the oil/water separators discharges into an on-site arsenic treatment system and the treated water is discharged to Birch Swamp Brook under a New Jersey Pollutant Discharge and Elimination System (NJPDES) permit issued to Imperial Oil by the New Jersey Department of Environmental Protection (NJDEP).

The site also includes an recovery system installed by the Environmental Protection Agency (EPA) in 1991 to remove a petroleum-like product layer (floating product) from groundwater. This system is currently operated by NJDEP and consists of six (6) product recovery wells, a 500 gallon oil/water separator, and a 5,000 gallon product holding tank. To date, approximately 15,000 gallons of the floating product have been extracted and disposed of at a Toxic Substances Control Act (TSCA) regulated incinerator.

Downgradient from the main site are two areas known as Off-site Areas 1 & 2. These two areas are located approximately 220 feet and 700 feet northwest of the facility, respectively (see Figure 2). The Off-site Areas contain surface soils which are stained with a contaminated oily sludge residue. To the east of the plant is a Fire Pond, which discharges to Birch Swamp Brook. The Fire Pond has received contaminated runoff from the Imperial Oil property and the sediment in the Fire Pond exhibits elevated levels of contaminants. Birch Swamp Brook flows from the Fire Pond through Off-site Areas 1 & 2 and continues to Lake Lefferts approximately 1.3 miles downstream. Wetland vegetation in and around Off-site Areas 1 and 2 is visibly stressed in the vicinity of Birch Swamp Brook. Lake Lefferts is a swimming and recreational area, and has been identified as a potential potable water source for the area.

There are scattered residential properties in the vicinity of the Imperial Oil plant. A small commercial center (Morganville) is located approximately ½ mile southeast of the site at the junction of Route 3 and Route 79. Two automobile scrap yards are located just to the northeast and northwest of the site boundaries.

CONTAMINATION ASSESSMENT SUMMARY AND RESPONSE ACTIONS

On September 1, 1983, the site was included on the National Priorities List of Superfund sites. In 1987, NJDEP initiated a remedial investigation (RI) of the site to determine the nature and extent of the contamination. The analytical results of samples taken during the RI indicated that the soil, groundwater, and sediment were contaminated with organic and inorganic compounds, total petroleum hydrocarbons (TPHs), and polychlorinated biphenyls (PCBs). In 1990, a draft RI Report was prepared which summarizes the information and data collected during the investigations conducted between 1987 and 1990. Between 1990 and 1996, additional site investigation work was conducted which included the collection of additional samples and the revision of the public health and ecological risk assessments. In December 1996, the Final RI Report was issued. The RI Report identified the following contaminated media/areas:

- Off-site contaminated soils including upland and wetland soils (Off-site Areas 1 and 2);
- Site-related groundwater contamination;
- On-site soils contamination (including waste filter clay material and a floating product layer which underlies the waste filter clay material); and
- Birch Swamp Brook sediment contamination.

In September 1990, EPA issued a Record of Decision (ROD) to address the soil contamination found in Off-site Areas 1 and 2. The major components of the Operable Unit 1 ROD included:

- Installation of fencing to control access to the contaminated soil areas;
- Excavation and appropriate off-site disposal of approximately 3700 cubic yards of contaminated soil from within the wetlands; and
- Restoration of the affected wetlands

In September 1991, EPA installed a fence around Off-site Areas 1 and 2 to control access to the contaminated soil.

As part of RD activities for OU1, NJDEP conducted extensive sampling to fully delineate the extent of contamination related to Off-Site Areas 1 & 2. While PCB contamination was found to be in close proximity to the fenced portion of Off-Site Areas 1 & 2, elevated arsenic levels were found to be present throughout a widespread area of forested wetlands located north of the Off-Site Areas. In January 1996, EPA entered into an Interagency Agreement with the U. S. Geological Survey (USGS) to determine the sources of this arsenic contamination. The USGS completed the study in July 1996. The study concluded that the elevated arsenic concentrations in the soils on four adjacent residential properties were related to the IOC/CC site. Other areas of arsenic contamination were attributed to the widespread application of arsenic-based pesticides on properties, which were formerly orchards.

In September 1997, EPA issued an ESD to modify the OU1 ROD to include the remediation of four residential properties located adjacent to the Imperial Oil facility and the implementation of certain engineering controls in the vicinity of the Fire Pond and forested wetland areas of the site as a precautionary measure against potential recontamination of Off-site Areas 1 and 2, once remediated.

In March 1998, EPA initiated the excavation and disposal of the contaminated soil found on the four residential properties. EPA excavated and disposed of approximately 6,488 cubic yards of soil from the properties. By August 1998, EPA completed the work and restored the properties. The planned engineering controls were to include the diversion of Birch Swamp Brook around the Fire Pond, the construction of a sedimentation basin around the Fire Pond, and the construction of ditches and berms around portions of the forested wetland areas. Implementation of engineering controls has not been initiated.

Birch Swamp Brook

As part of the RI and RD activities for OU1, NJDEP conducted extensive sampling to fully delineate the extent of contamination related to Off-Site Areas 1 & 2 and Birch Swamp Brook.

In December 1994, as part of the RI, sediment samples were collected from Birch Swamp Brook and other areas downstream of the Brook. Twenty-eight (28) sediment samples were collected (24 in the stream and 4 in Lake Lefferts) and the sampling locations are depicted in Figure 2. Four of the samples were analyzed for Target Compound List (TCL) parameters, Target Analyte List (TAL)

Metals, TPHs and Total Organic Carbon (TOC). The remaining samples were analyzed for arsenic, chromium, copper, lead, PCBs, TPHs, and TOC (with 7 of the 24 samples also analyzed for phthalates).

The sampling results indicated that the sediment of Birch Swamp Brook is contaminated with various compounds including elevated levels of PCBs, TPHs, and arsenic. Elevated levels of PCBs and TPHs were detected at sampling locations SD-4, 5, 6, 7, 8, 14, 22, 23, 24 and 25 (see Figure 2). The results of the two primary contaminants of concern detected during the December 1994 sampling event (PCBs and TPHs) are summarized in Table 1. The highest concentration of arsenic detected in the sediment of Birch Swamp Brook was 46 parts per million (ppm) (SD-7).

In December 1994, NJDEP conducted toxicity testing to determine if the contaminants found in the sediment are biologically available to ecological receptors. The toxicity testing identified PCBs, TPHs, and Bis(2-ethylhexyl)phthalate (BEHP) as the contaminants of concern for ecological receptors in Birch Swamp Brook.

In April 1995, as part of the RI, NJDEP collected ten (10) surface water and eight (8) sediment samples from Lake Lefferts. Samples of fish tissue were also collected. All samples were analyzed for site-related contaminants, including lead, arsenic, PCBs, TPHs, and volatile and semi-volatile organic compounds. Contaminants such as arsenic, lead, and semi-volatile organic compounds were found at elevated levels only in sediments located in the area of the delta, where Birch Swamp Brook discharges into Lake Lefferts. The data revealed that the sediment, surface water, and fish in the lake have not been impacted by the IOC/CC site. In 1995, the Monmouth County Health Department reviewed the lake data, with the assistance of the N.J. Department of Health, and declared that the lake should remain open for recreational purposes. A summary of the data results for Lake Lefferts can be found in the Administrative Record for the site in the June 1998 report titled, Compilation of Previous Investigations: Birch Swamp Brook/Lake Lefferts Report.

In September 1997, after the RI Report was finalized, additional sediment samples were collected in Birch Swamp Brook from the area just downstream of Off-site Areas 1 & 2 (sample location SD-8 depicted in the RI Report) to Lake Lefferts to further define the nature and extent of the sediment contamination in the Brook. The sampling protocol divided the Brook into 100 foot sections and a minimum of four (4) samples were collected from each of 60

sections and analyzed for PCBs and TPH. The results of the September 1997 sampling revealed the presence of elevated levels of PCBs and TPHs in the sediment of the Brook. PCB and TPH were detected at concentrations up to 118.90 ppm and 83,300 ppm, respectively. The results of the September 1997 sediment samples are summarized in Table 2, and presented in the Field Sampling & Analysis Report, Birch Swamp Brook Sediment (Kimball, Revised 7/98).

In February 1999, a final round of sampling was conducted in the Fire Pond area to supplement the existing data collected during the original remedial investigation. A total of ten surface (0 to 6 inches) and subsurface (12 to 18 inches) soil samples were collected at five (5) locations between the berm at the northern boundary of the IOC/CC facility and the southern edge of the Fire Pond and analyzed for TPHs, PCBs, and arsenic. In addition, five (5) sediment samples each were collected from the Fire Pond and from the Brook between the Fire Pond and the railroad embankment and analyzed for the same parameters as the soil samples. Toxicity Characteristic Leaching Procedure (TCLP) analysis was performed on 5 samples to determine if this material were classified as hazardous waste under the Resource Conservation and Recovery Act (RCRA).

Results of the February 1999 sampling event indicate that seven (7) of the ten (10) soil samples collected between the berm and Birch Swamp Brook are contaminated with elevated levels of arsenic. Levels of arsenic detected in these soils ranged from estimated levels of 5.8 to 755 ppm. Levels of TPHs in the soils ranged from 12.5 ppm to an estimated level of 881 ppm. Levels of PCBs ranged from non-detect to an estimated level of 1.33 ppm. Of the five (5) Birch Swamp Brook sediment samples, arsenic levels ranged from estimated levels of 15.7 ppm to 232 ppm. TPHs in sediment ranged from an estimated level of 300 ppm to 22,500 ppm. PCB levels in sediment ranged from an estimated 0.1 ppm to 26.8 ppm. Of the five (5) Fire Pond sediment samples, all contained elevated levels of arsenic. Arsenic levels ranged from estimated levels of 66 ppm to 232 ppm. Levels of TPHs detected ranged from estimated levels of 271 ppm to 536 ppm. PCBs levels detected ranged from and estimated 0.093 ppm to 0.290 ppm. Results of TCLP analysis indicated that only one sample had an exceedance of criteria for one parameter, releaseable sulfide. All other samples and all parameters were within TCLP limits indicating that the material is not considered a hazardous waste under the Resource Conservation and Recovery Act. See Attachment C for a summary of the February 1999 sampling event.

ADDITIONAL OPERABLE UNITS/RESPONSE ACTIONS

In November 1991, EPA excavated the waste filter clay pile material down to the ground level. The waste filter clay pile was contaminated with high levels of PCBs and TPHs. The excavated material was disposed of at an approved RCRA landfill. Also, in 1991, EPA installed extraction wells to extract and store a petroleum-like product layer (floating product) from the groundwater beneath the waste filter clay pile material. In 1996, NJDEP assumed responsibility for the operation and maintenance of the floating product removal system. To date, approximately 15,000 gallons of the floating product have been extracted and disposed of at a TSCA-regulated incinerator.

In September 1992, EPA issued a ROD to address the contaminated groundwater plume found beneath the site. The components of the Operable Unit 2 ROD include:

- Extraction and treatment of contaminated ground water via precipitation of inorganic contaminants and carbon adsorption of organic contaminants;
- Discharge of the treated ground water to Birch Swamp Brook;
- Continuation of the floating product removal action originated by EPA; and
- Implementation of an environmental monitoring program to ensure the effectiveness of the remedy.

The groundwater remedy is currently in the design phase.

On September 30, 1999, EPA issued a ROD to address soil contamination found on and adjacent to the Imperial Oil facility. The major components of the selected remedy for Operable Unit 3 (OU3) include:

- Excavation of an estimated 83,000 cubic yards of soils containing contaminants above the selected remediation goals and disposal of this material at appropriate off-site facilities;

- Transportation of an estimated 27,000 cubic yards of the above soils which pose the principal threat (hot spots) to Resource Conservation and Recovery Act/Toxic Substances Control Act (RCRA/TSCA) hazardous waste disposal facilities. An estimated 19,000 cubic yards of this soil will be transported to a TSCA-permitted landfill and the other 8,000 cubic yards shipped to a RCRA-permitted landfill where the soil will receive appropriate treatment prior to disposal in accordance with RCRA requirements;

- Transportation of an estimated 56,000 cubic yards of the soils containing contaminants above the selected cleanup goals to an appropriate landfill. A portion of this soil will be recycled as asphalt base material;

- Removal of an estimated 5,000 gallons of floating product via vacuum truck and transportation of this material to a TSCA-licensed incinerator;

- Dismantling of site buildings and tank farms, as necessary, to complete the selected soil excavation and floating product removal activities;

- Backfilling of all excavated areas with clean fill; and

- Restoration of the wetlands affected by cleanup activities.

Remedial Design activities, during which detailed engineering plans for the OU3 remedy will be developed, are expected to start in late 2000.

SUMMARY OF SITE RISKS

Based upon the results of the off-site investigations and assuming a reasonable maximum exposure scenario (as described below), a baseline risk assessment was conducted during the RI to estimate the risks associated with current and future exposure to sediments in Birch Swamp Brook. The baseline risk assessment estimates the human health and ecological risk which could result from the contamination in these off-site areas if no remedial action were taken.

Human Health Risk Assessment

As part of the Human Health Risk Assessment, the reasonable maximum human exposure is evaluated by utilizing a four step process for assessing site-related human health risks. The four steps consist of:

Hazard Identification - identifies the contaminants of concern at the site based on several factors such as toxicity, frequency of occurrence, and concentration.

Exposure Assessment - estimates the magnitude of actual and/or potential human exposures, the frequency and duration of these exposures, and the exposure pathways by which humans are potentially exposed.

Toxicity Assessment - determines the types of adverse health effects associated with chemical exposures, and the relationship between magnitude of exposure (dose) and severity of adverse effects (response).

Risk Characterization - summarizes and combines outputs of the exposure and toxicity assessments to provide a quantitative assessment of site-related risks.

The human health risks posed by contaminated sediments in Birch Swamp Brook were assessed separately for the portion of the Brook located from the IOC/CC facility to Texas Road and the portion of the Brook located from Texas Road to Lake Lefferts. The human health risk assessments for each portion of the stream are presented below.

Birch Swamp Brook from the IOC/CC Site to Texas Road

The risk assessment contained in the December 1996 Remedial Investigation Report estimated the human health risks associated with the potential exposures to the Contaminants of Concerns (COC) in sediment. The COCs for Birch Swamp Brook include PCBs, TPHs, and BEHP. Risks were assessed by evaluating a total of 13 sediment samples collected throughout the length of Birch Swamp Brook from the IOC/CC site to Lake Lefferts, as well as two samples taken in the lake. However, the results of the risk assessment are presented here as representative of the portion of Birch Swamp Brook from the IOC/CC site to Texas Road because the primary contaminant of concern for the human health risk assessment was determined to be PCBs. No PCBs were detected in the data set used in the risk assessment between Texas Road and

Lake Lefferts. Therefore, the quantified human health risks for this portion of the stream are attributed to contamination between the IOC/CC site and Texas Road.

The potential exposure pathway evaluated for sediments was incidental ingestion and dermal contact with sediments by children wading in Birch Swamp Brook. Exposure assumptions were made for "average" and "reasonable maximum" exposure (RME) scenarios. Exposure intakes (doses) were calculated for each receptor for all pathways considered.

Under current EPA guidelines, the likelihood of carcinogenic and non-carcinogenic effects due to exposure to site-related chemicals are considered separately. Non-carcinogenic risks were assessed by calculation of a Hazard Index (HI), which is an expression of the sum of the chronic daily intake of a chemical divided by its Reference Dose (RfD). An HI that exceeds 1.0 indicates the potential for non-carcinogenic effects to occur. Carcinogenic risks were evaluated using a cancer Slope Factor (SF), which is a measure of the cancer-causing potential of a chemical. Slope Factors are multiplied by daily intake estimates to generate an upper-bound estimate of excess lifetime cancer risk. For known or suspected carcinogens, EPA has established an acceptable cancer risk range of 10^{-4} to 10^{-6} (one-in-ten thousand to one-in-one million). The State of New Jersey's acceptable risk standard is one-in-one million(10^{-6}).

The estimated cancer risk associated with the ingestion and dermal contact of the sediment of Birch Swamp Brook for children under a reasonable maximum exposure scenario is $2X10^{-4}$. The non-carcinogenic effects are above 1, with an HI of 7. The majority of the carcinogenic risk is attributable to PCBs, with Arochlor-1248 and Arochlor-1260 attributing more than 90% of the total cancer risk.

The results of the risk assessment indicate that the potential health risks associated with PCBs in the sediments of Birch Swamp Brook from the Fire Pond downstream to Texas Road are significantly outside the acceptable risk range and warrant remediation.

Birch Swamp Brook from Texas Road to Lake Lefferts

A risk assessment was conducted to estimate the human health risks associated with the potential exposures to PCBs in sediments in an approximately 4,000-foot section of Birch Swamp Brook downstream of the IOC/CC site between Texas Road and Lake

Lefferts. The risk assessment estimated the human health risk which would result from exposure to the contamination if no remediation occurred in the future. The risk assessment of Birch Swamp Brook from Texas Road to Lake Lefferts is shown in Appendix A of this document.

PCBs have been determined to be the primary contaminants of concern in this section of the Brook. Concentrations of PCBs in sediments ranged from non-detect to 40 ppm with an arithmetic mean of 2.01 ppm. The risk assessment used a conservative estimate called the upper confidence limit (UCL) of the mean of 3.52 ppm.

The risk assessment was conducted using all data collected in this portion of Birch Swamp Brook and addressing the reasonable maximum exposure (RME) scenario. Under current land use conditions, an adolescent (ages 7-18) wading and playing in the Brook was identified as the most sensitive receptor. Exposure was assumed to occur once a week throughout the year for 12 years. The primary pathways of concern would be incidental ingestion and dermal absorption of sediments contaminated with PCBs.

Potential carcinogenic risks were evaluated using the cancer slope factor developed by EPA for PCBs. EPA has classified PCBs as probable human carcinogens with a slope factor of $2(mg/kg-d)^{-1}$. Under current land use conditions, the excess cancer risk for an adolescent potentially exposed to PCBs via ingestion of Brook sediments, using the RME scenario and conservative exposure assumptions, is $4x10^{-07}$, which is below EPA's acceptable risk range of $1x10^{-04}$ to $1x10^{-06}$ and NJDEP's acceptable risk level of $1x10^{-06}$. The excess cancer risk for an adolescent wading scenario with potential exposure to PCBs via dermal absorption is $4.6x10^{-7}$ which does not exceed EPA's acceptable risk range of 10^{-4} to 10^{-6}. The risk is also less than NJDEP's acceptable risk level of $1.0x^{-06}$. This results in a Total Cancer Risk of $8.6x10^{-7}$ (dermal and ingestion). Thus the total cancer risk associated with the Brook sediments beyond Texas Road to Lake Lefferts does not exceed EPA's acceptable risk range and NJDEP's acceptable risk level of 10^{-6}.

Non-carcinogenic effects are assessed using a HI approach, based on the sum of the expected chronic daily intake divided by the RfD. The HI for the PCB-contaminated Brook sediment between Texas Road and Lake Lefferts is 0.013.

The results of the risk assessment indicate that the potential health risks associated with PCBs in the sediments of Birch Swamp Brook downstream of the IOC/CC site between Texas Road and Lake Lefferts, under current land use conditions, are within the Agencies' acceptable risk ranges and this portion of the stream does not require remediation.

Further, upon review of the April 1995 surface water and sediment sample data collected by NJDEP in Lake Lefferts, the Monmouth County Department of Health and the New Jersey Department of Health both determined that the Lake was safe for continued recreational uses. Based on data collected from the Brook, the agencies determined that any site-related contamination of the Lake and the Delta area, where Birch Swamp Brook and Matawan Creek flow into the Lake, is restricted to the upper reaches of the Brook, areas nearest to the site. Therefore, the IOC/CC site is not considered a significant source of contamination to the Lake.

Ecological Risk Assessment

The ecological assessment is a qualitative assessment of the actual or potential impacts associated with the site on plants and animals. The primary objectives of this assessment are to identify the ecosystems, habitats, and populations likely to be found at the site and to characterize the contaminants, exposure routes and potential impacts on the identified receptors.

The risk assessment completed during the Remedial Investigation for the site included an assessment of ecological risks associated with off-site surface soil, surface water, and sediment. The ecological risk assessment is presented in the 1996 Final RI Report for the site. Results of the baseline ecological risk assessment (also referred to as the Phase II Baseline Ecological Risk Assessment) indicated that potential acute and chronic risks to aquatic life exist as a result of exposure to chemicals in Birch Swamp Brook. The contaminants of potential concern in sediment identified in the baseline risk assessment included arsenic, copper, lead, phthalates, TPHs, and PCBs. Further, the baseline risk assessment concluded that additional sampling and bioassessment activities were necessary to further evaluate sediment contamination in Birch Swamp Brook.

As a result of the conclusions of the baseline ecological risk assessment, NJDEP performed additional studies, which are referred to as the Phase III Field Program and are fully described in the 1996 RI Report. These additional studies consisted of the collection of additional surface water and sediment samples and bio-assessment fieldwork. The bio-assessment fieldwork included a benthic community survey and toxicity tests. The purpose of this additional fieldwork was to evaluate potential impacts to aquatic life in Birch Swamp Brook, further define the specific contaminants of concern, and establish site-specific sediment cleanup goals for these contaminants of concern.

The results of the additional ecological studies indicated that the benthic community is adversely impacted by contaminated sediment in the Brook and the contaminants of concern are PCBs, TPHs, and BEHP. As part of the ecological risk assessment, EPA and NJDEP developed PRGs for these contaminates which are cleanup levels deemed ecologically protective. The PRGs for PCBs, TPHs and BEHP are 2.13 ppm, 4,148 ppm and 4.6 ppm, respectively. Upon examination of the data, it was determined that there were no sampling stations identified where BEHP was found independent of PCBs or TPHs. Therefore, remediating for PCBs and TPHs will eliminate all elevated levels of BEHP.

A total of 270 samples were collected at 193 locations in Birch Swamp Brook. Most of the contaminated sediment exceeding the ecological PRGs is present in the portion of Birch Swamp Brook located between the IOC/CC facility and Texas Road. Sampling results of Birch Swamp Brook surface sediments located north of Texas Road (between Texas Road and Lake Lefferts) exhibiting PCB concentrations exceeding the 2.13 ppm PRG are limited to only three (3) sample locations and TPHs markedly exceed the 4,148 ppm PRG in only four (4) samples spread out along approximately 4,000 feet of stream bed. Individual single-point exceedances of sediment PRGs represent only a fraction of the total habitat range utilized by a portion of the stream biota, exposing them to limited potential risk. Any "hot-spot" removal to address the limited PRG exceedances is not recommended due to access difficulty (absence of nearby roads, steep ravine slopes) and damage to the forested slopes/wetland borders via excavation, ingress and egress. In addition, excavated sediment volumes would be significantly greater due to wider Brook dimensions, and more significant sedimentation controls would be required to prevent any impacts to nearby Lake Lefferts.

Based on the above, EPA and NJDEP have concluded that since the ecological risk is minimal in the portion of Birch Swamp Brook located north of Texas Road, the marginal benefit of remediating limited and localized exceedances of PRGs does not justify the destruction of these sections of the Brook and the valuable wetlands. Therefore, no remedial action is recommended in this portion of the Brook. The remediation of contaminated sediment of Birch Swamp Brook from the IOC/CC facility to Texas Road would eliminate the majority of the threat posed to aquatic and terrestrial biota.

Actual or threatened releases of hazardous substances from contaminated sediment of Birch Swamp Brook, if not addressed by an appropriate remedial alternative, may present an imminent and substantial endangerment to the public health, welfare, or the environment.

REMEDIAL ACTION OBJECTIVES

Based on the site conditions, nature of contaminants, migration pathways and the unacceptable human health and ecological risks posed by the sediment contamination found in Birch Swamp Brook from the Fire Pond to Texas Road, the following specific remedial action objectives have been established:

- prevent human and ecological exposures to PCB and TPH contaminated sediment in the Birch Swamp Brook that represent significant health or ecological risks;

- prevent unnecessary destruction of valuable ecological resources exhibiting low level contamination or contamination that does not present significant adverse exposure threats; and

- restore ecological resources which will be impacted by the remediation (i.e. Birch Swamp Brook and associated wetlands) to allow these resources to function effectively.

From the results of ecological studies performed at the IOC/CC site, PRGs were developed for the primary contaminants of concern identified in Birch Swamp Brook sediment. These contaminants are PCBs, TPHs and BEHP. The PRGs established for PCBs, TPHs and BEHP are 2.13 ppm, 4,148 ppm and 4.6 ppm, respectively. Remediation of the Brook to meet these levels will be protective of ecological receptors. In addition, some limited areas of elevated arsenic were detected in Birch Swamp Brook sediments. However, these were generally located in areas where TPHs and

PCBs were also elevated. In general, it is believed that remediation of sediment to meet the PRGs for PCBs and TPHs will also address all arsenic levels of concern.

As stated above, several limited samples located in the portion of Birch Swamp Brook between Texas Road and Lake Lefferts contained levels of the contaminants of concern above the ecologically-based PRGs. As explained above, it has been determined that these areas will not be remediated. This decision is based on the fact that human health risks posed by these areas of contamination are within EPA's acceptable risk range and NJDEP's acceptable risk level and that although there were limited instances of exceedances of ecologically protective levels, the loss to the value of the wetlands to be disrupted or destroyed by any remediation is not warranted.

With respect to human health risks associated with Birch Swamp Brook sediments, PCBs and THPs were identified as the primary contaminants of concern. The cleanup level for PCBs established in the 1990 OU1 ROD for soils which is deemed protective of human health is 5 ppm. The use of 5 ppm as a remediation goal for PCBs in the wetlands sediments is protective of human health under a trespassing/recreational scenario. However, a human health-based remediation goal cannot be developed for TPHs due to the fact that the exact composition of the TPH mixture is not known. Due to the infrequent exposure under a trespassing/recreational scenario, the ecologically protective level of 4,148 for TPHs is believed to be adequately protective of human health.

Therefore, the remediation of Birch Swamp Brook sediments to meet the PRGs of 2.13 ppm for PCBs, 4,148 for TPHs, and 4.6 for BEHP will be protective of both human health and the environment.

Based on the 1997 sampling and delineation work, the total volume of contaminated sediment above PRGs in the stream from the Fire Pond to Texas Road is estimated to be 3,312 cubic yards. Approximately 1,720 cubic yards of contaminated sediment are located in the Fire Pond and the stretch of Birch Swamp Brook between the Fire Pond and the railroad embankment. The remainder (approximately 1,592 cubic yards) is located from the northern boundary of Off-site Area 1 and 2 down to Texas Road.

DEVELOPMENT AND SCREENING OF REMEDIAL 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 and 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.

EPA and NJDEP's ability to exercise a preference for alternative treatment technologies in identifying potential remedial alternatives for the contaminated sediment is limited. In-situ containment of the contaminated sediment was considered but this remedial option was screened out because the long term effectiveness of such an option cannot be guaranteed. The free-flowing nature of the stream provides an opportunity for future severe weather conditions to potentially compromise any containment system. There is also a potential for a myriad of unanticipated future disturbances because future access cannot be permanently limited. Accordingly, in-situ containment was eliminated from consideration.

A limited-action alternative in which site access would be restricted by fencing was also eliminated from consideration for similar reasons that eliminate in-situ containment as a viable alternative. A fence cannot restrict the potential for contaminant migration that results from a free-flowing stream.

Site-specific treatability studies would be necessary to evaluate all other treatment technologies for Birch Swamp Brook sediment. Proper evaluation of various sediment treatment technologies is dependent upon site specific information (including grain size, moisture content, organic content, etc.) that is not available. This would require additional effort and expense as part of any treatability study. This requirement is not warranted based on the limited volume of contaminated sediment (approximately 3,312 cubic yards) requiring remediation. This is further supported by the fact that the waste characterization sampling completed in February 1999 for disposal purposes indicate the majority of the sediment will not be classified as a "hazardous waste". Even the least expensive treatment technology does not compare favorably on a cost-effective basis to the excavation and off-site disposal alternative unless a substantial portion of the material to be remediated is classified as hazardous.

Therefore, two (2) remedial alternatives for addressing contaminated sediment in Birch Swamp Brook have been selected for evaluation below: Alternative 1: No Action; and Alternative 2: Excavation and Off-Site Disposal/Re-use.

DETAILED DESCRIPTION OF REMEDIAL ALTERNATIVES

Detailed descriptions of each of these alternatives are provided below. The estimated capital and net present worth costs of each alternative are presented below for comparison. Cost summaries for Alternatives 1 and 2 are shown in Appendix B.

Alternative 1: NO ACTION

Estimated Capital Cost:	$0
Estimated Present Worth O & M Cost:	$100,000
Estimated Implementation Time:	None

The National Contingency Plan (NCP) and CERCLA require the evaluation of a No Action alternative as a basis for comparison with other remedial action alternatives. Under this alternative, EPA and NJDEP would not take any action to prevent or control exposure to contaminated sediment in Birch Swamp Brook that resulted from hazardous discharges from the IOC/CC site. Because this alternative would result in contaminants remaining in Birch Swamp Brook above health-based levels, CERCLA requires that a review of the Brook conditions be conducted every five (5) years. This 5-year review would include monitoring Birch Swamp Brook from the Fire Pond to Lake Lefferts. Monitoring under this alternative would include visual inspection and periodic sampling of the Brook. If justified by the review, remedial actions may be implemented to remove or treat the contaminants.

Alternative 2: EXCAVATION w/OFF-SITE DISPOSAL or RE-USE

Estimated Capital Cost:	$ 2,370,000
Estimated O & M Cost:	$ 30,000 (present worth)
Estimated Present Worth Cost:	$ 2,400,200
Estimated Implementation Time:	9 Months

This alternative consists of (1) excavating approximately 3,312 cubic yards of the contaminated sediment and off-site disposal of the contaminated material at either a hazardous waste or a non-hazardous waste facility or re-use of the material (if it is classified non-hazardous) as landfill cover or asphalt base material; (2) replacing the contaminated sediment with clean

fill and (3) restoring all disturbed areas along both banks of the stream. The stream sediment would be excavated from the vicinity of the Fire Pond to Texas Road to an estimated depth of two to three feet and the excavation would extend from the stream bed until PRGs are met for PCBs, TPHs and BEHP in sediment on both sides of the stream banks. Based on RI sample data, remediation of stream banks for most of the Brook between the Fire Pond and Texas Road would not extend beyond 10 feet on either side of the water's edge. Figure 2A provides a map of Birch Swamp Brook between the Fire Pond and Lake Lefferts with an identification of the approximate area to be remediated under this alternative. This alternative will also include a long term environmental monitoring program. The monitoring program would (1) monitor the effectiveness of the cleanup and the restoration of ecological resources of the remediated portion of the Brook, and (2) monitor the downstream portions of the Brook where low levels of contamination will be left. A floodplain assessment would be conducted during the Remedial Design phase of the clean-up. Although not a required part of the selected remedy, the NJDEP, pursuant to state law, plans to establish institutional controls. This alternative would eliminate significant threats to human health and the environment posed by contaminated sediments, to the maximum extent practicable.

EVALUATION OF ALTERNATIVES

NJDEP, together with EPA, is required to select the remedial alternative which offers the best balance of trade-offs among alternatives with respect to the evaluating criteria. At a minimum, the selected remedy must meet two (2) criteria: protection of human health and the environment and compliance with applicable or relevant and appropriate requirements (ARARs) (unless a waiver for an ARAR is granted).

Evaluation Criteria

In the detailed evaluation of remedial alternatives, each alternative is assessed against nine evaluation criteria pursuant to the NCP, namely, overall protection of human health and environment, compliance with ARARs, long-term effectiveness and permanence, reduction of toxicity, mobility, volume, short-term effectiveness, implementability, cost and state and community acceptance. The evaluation criteria are described below:

Overall protection of human health and the environment addresses whether a remedy provides adequate protection of human health and the environment and describes how risks posed through each exposure pathway are eliminated, reduced or controlled through treatment, engineering controls, or institutional controls.

Compliance with applicable or relevant and appropriate requirements addresses whether a remedy will meet all of the ARARs under Federal and State environmental laws and/or provides grounds for invoking a waiver.

Long-term effectiveness and permanence refers to expected residual risk and the ability of a remedy to maintain reliable protection of human health and the environment over time, once cleanup goals have been met.

Reduction of toxicity, mobility or volume addresses the statutory preference for selecting remedial actions that employ treatment technologies that permanently and significantly reduce toxicity, mobility or volume of the hazardous substances as a principal element.

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

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

Cost includes estimated capital costs, operation and maintenance costs, and net present worth costs.

Support agency acceptance indicates whether, based on review of the RI/FS reports and other appropriate documents, the support agency concurs with, opposes, or has no comment on the preferred alternative.

Community acceptance addresses the input of the affected community related to a proposed action.

COMPARATIVE ANALYSIS OF ALTERNATIVES

Described below is the detailed evaluation of alternatives against the criteria detailed above (except for State and community acceptance). Once an alternative is selected by EPA, State concurrence and appropriate community input will be sought.

Overall Protection of Human Health and the Environment

Alternative 1 (No Action) would not be protective of human health and the environment as there would not be any action taken to eliminate the potential for direct contact with or ingestion of contaminated sediment. Since no remedial activities would be implemented under this alternative, the risks posed to human health and the environment would be above EPA's and NJDEP's acceptable risk levels as described in the risk assessment. Alternative 1 is not consistent with remedial action objectives.

Alternative 2 provides protection of human health and the environment by removing the contaminated sediment in the upper reaches of the Brook (south of Texas Road), restoring the disturbed areas, and implementing a long-term monitoring program. By eliminating the potential human health and ecological risks posed by contaminated sediments in the upper reaches of the Brook, Alternative 2 would satisfy the remedial action objectives.

Compliance with ARARs

Alternative 1 would not attain the chemical-specific cleanup criteria for sediment as it does not involve remediation. Action- and location-specific ARARS are not applicable as Alternative 1 does not involve implementation of remedial activities.

Alternative 2 is expected to attain all chemical, location, and action specific ARARS for the upper reaches of the Brook. The chemical-specific cleanup goals for sediment (PRGs) would be achieved. All action and location specific ARARs for remedial activities and the restoration of wetlands, surface water bodies and floodplains would be achieved. All action-specific ARARs associated with the proper handling and transport of the contaminated material (either as hazardous or non-hazardous material) would be met.

Short-term Effectiveness

Since there are no remedial activities being implemented under Alternative 1, there would be no additional short-term risks posed to human health or the environment.

The time required to implement Alternative 2 is estimated to be 9 months. No additional risks to human health or the environment are expected as a result of the implementation of these activities. Due to the intrusive nature of the sediment removal, there may be potential risks posed to workers during the remedial activities. A Health and Safety Plan would be developed and implemented to protect the workers. Every effort will be made to minimize the disruption to areas in and around the Brook resulting from the excavation activities. Appropriate engineering controls would be implemented to control run-off and to safely re-route the stream flow during excavation and restoration activities. Upon completion of the excavation activities, the disturbed areas would be restored and stabilized by backfilling and revegetating.

Long-Term Effectiveness

Alternative 1 is not considered to be effective over the long term as it does not include remediation of any contamination within the Brook. This alternative would not provide an acceptable reduction in risk. Under this alternative, contaminated sediment would continue to present the potential threat of exposure to human and ecological receptors. In addition, the high levels of contamination in portions of the Brook will continue to act as a contaminant source and allow for contaminant migration downstream.

Alternative 2 provides long-term effectiveness and permanence by removing the contaminated sediment, thereby eliminating the potential for human exposure to the contaminants and the potential for adverse ecological effects. This alternative would result in a complete restoration of the stream and stream banks from the Fire Pond to Texas Road and would only require future monitoring of the restored Brook areas to insure that the Brook and disturbed portions of wetlands were functioning. Beyond Texas Road, the NJDEP will continue to monitor and insure that institutional controls for the portions of the Brook that exhibited limited areas of high levels of PCB and TPH contamination are maintained.

Reduction of Toxicity, Mobility, and Volume

Alternative 1 does not provide for treatment of contaminated sediment and, therefore, does not reduce the toxicity, mobility, or volume of the contamination in Birch Swamp Brook.

Alternative 2 would not be expected to provide for any treatment either and, therefore, there would be no reduction in the toxicity or volume of the contaminated sediment material. However, the contaminated sediment would be disposed off-site in a secure licensed landfill, which would limit the mobility of the contaminants by isolating them from environmental transport mechanisms. In the event certain material is determined during the remediation to exceed TSCA or Resource Conservation and Recovery Act (RCRA) characteristic hazardous waste criteria, it would be treated or stabilized as part of Alternative 2 in order to reduce the mobility of contaminants.

Implementability

There are no difficulties with respect to implementing the No Action Alternative since no remediation activities are involved.

Alternative 2 presents minor administrative and technical implementability issues associated with wetlands disturbance, disruption of an abandoned railroad property, working within an electrical transmission line right-of-way and overall ingress and egress issues to perform the remediation. There are no significant implementability concerns associated with the excavation, transportation, and off-site disposal of the contaminated sediment. There are readily available contractors in the region with the appropriate equipment and expertise to complete the remediation as well as disposal facilities with sufficient capacity to accept the material.

Cost

Since Alternative 1 does not include any remedial activities, there are no capital costs associated with this alternative. The present worth cost of a 30 year-long monitoring program is estimated to be approximately $100,000.

The estimated capital cost associated with Alternative 2 is $2,370,000. This cost estimate assumes 10% of the contaminated sediment will require disposal as a "hazardous waste". The present worth of the future monitoring costs is estimated to be approximately $30,000 for approximately five (5) years of wetland

restoration monitoring and 30 years of stream sediment monitoring.

FIGURES

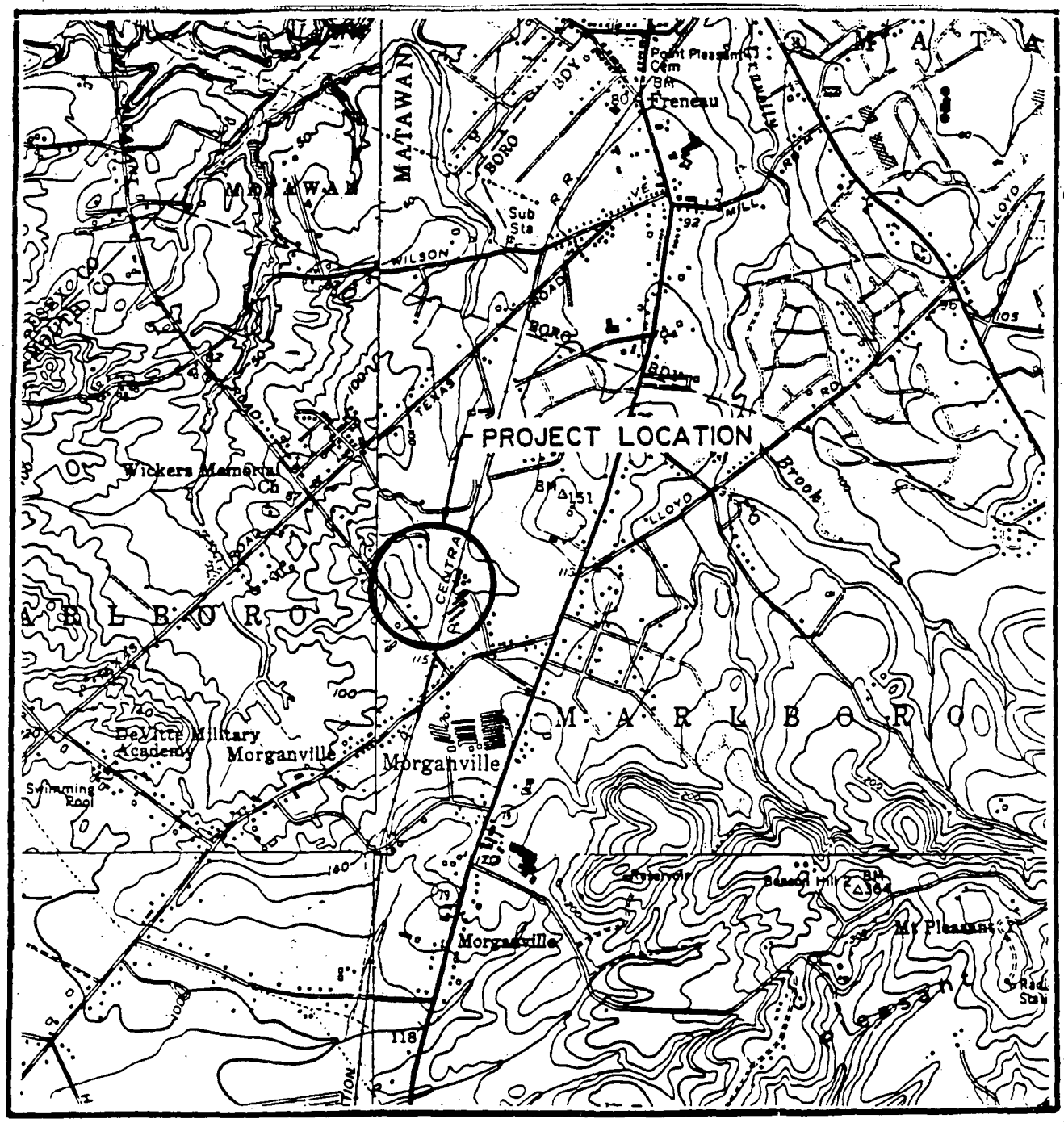


FIGURE 1

SITE LOCATION MAP

MORGANVILLE, NEW JERSEY

SCALE: 1" = 2000'

REFERENCE: U.S.G.S. 7.5 MIN. QUADRANGLE, SOUTH AMBOY PHOTOREVISED 1981, KEYPORT PHOTOREVISED 1970, MARLBORO PHOTOREVISED 1981, AND FREEHOLD PHOTOREVISED 1981.

CONTOUR INTERVAL 10'

L. ROBERT KIMBALL AND ASSOCIATES

FIGURE 2
Birch Swamp Brook Sediment Sample Locations
(12/94 Sampling Event)

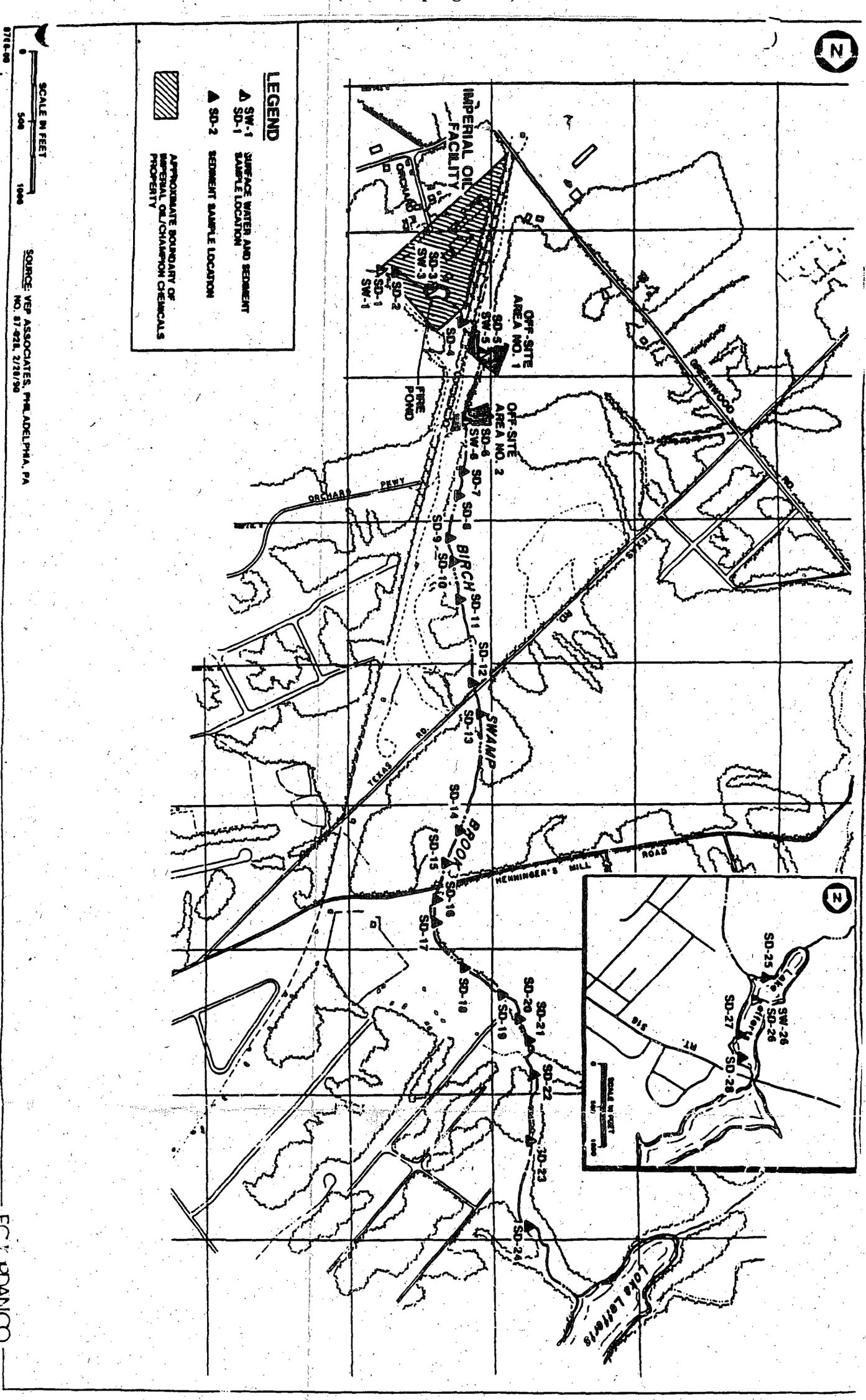
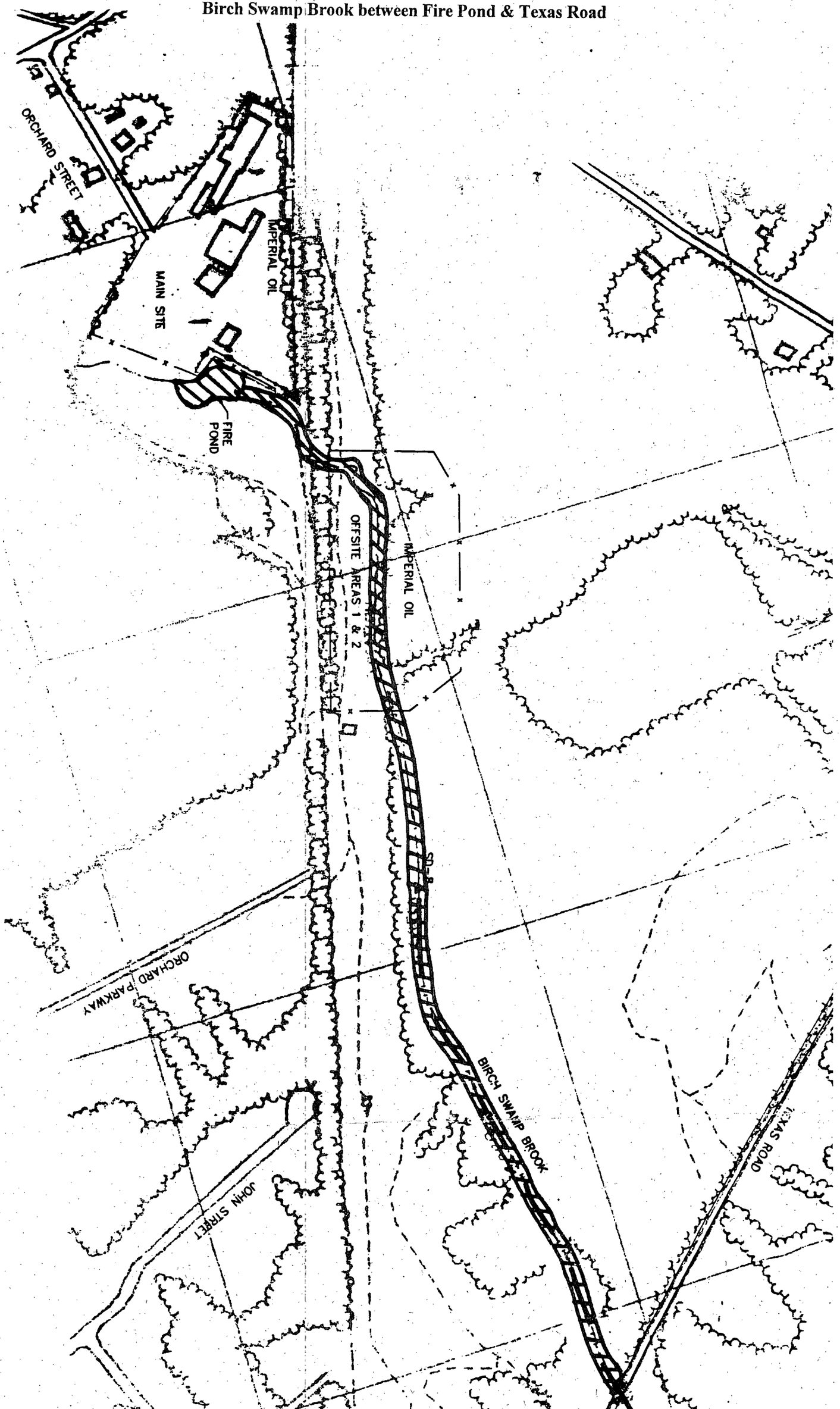


FIGURE 2A
Birch Swamp Brook between Fire Pond & Texas Road



Not To Scale
(see Figure 7 for scale)

TABLES

TABLE 1
Birch Swamp Brook Sediment Sampling Results
(12/94 Sampling Event)

Sample ID	Total PCBs	TPH
SD-1 S/D	ND/ND	140/ND
SD-2 S/D	ND/ND	63/54
SD-3 S/D	0.095/0.030	361/950
SD-4 S/D	21.5*/37.0*	66,300*/13,300*
SD-5 S/D	23.1*/19.8*	260,000*/94,500*
SD-6 S/D	25.0*/9.0*	302,000*/150,000*
SD-7 S/D	15.6*/8.3*	64,300*/49,300*
SD-8 S/D	4.25*/ND	8,295*/ND
SD-9 S/D	0.520/1.17	1290/2130
SD-10 S/D	0.680/0.028	3310/ND
SD-11 S/D	0.230/0.127	552/332
SD-12 S/D	0.06/ND	714/ND
SD-13 S/D	0.206/0.139	314/330
SD-14 S/D	9.9*/0.082	478/240
SD-15 S/D	0.199/0.068	278/ND
SD-16 S/D	0.493/ND	204/ND
SD-17 S/D	ND/ND	120/ND
SD-18 S/D	ND/ND	ND/ND
SD-19 S/D	0.134/ND	250/ND
SD-20 S/D	0.063/ND	74/ND
SD-21 S/D	0.148/0.043	182/143
SD-22 S/D	0.128/4.3*	110/2860
SD-23 S/D	0.088/3.7*	176/4870*
SD-24 S/D	0.241/18.8*	761/20,600*
SD-25 S/D	5.7*/15.6*	766/3940
SD-26 S/D	ND/0.070	ND/478
SD-27 S/D	0.27/2.8*	514/509
SD-28 S/D	0.130/0.170	ND/ND

Results are in parts per million (ppm).
S - Shallow sample (0 - 6")
D - Deep sample (18 - 24")
ND - Not Detected
* - Above Proposed Remediation Goals:
Total PCB's - 2.130 ppm
TPH - 4148 ppm

TABLE 2
Sediment Sample Results Exceeding PRGs
(9/97 Sampling Event)

Sample	Sample Date	Sample Depth (inches)	Parameter	Result (ppm)	PRG (ppm)
BSS-1A	9/12/97	0 - 6	Total PCB	5.76	2.13
BSS-2A	9/11/97	0 - 6	Total PCB	6.38	2.13
BSS-3A	9/11/97	0 - 6	Total PCB	21.94	2.13
BSS-4A	9/11/97	0 - 6	Total PCB	2.91	2.13
BSS-4X	9/11/97	0 - 6	Total PCB	3.41	2.13
BSS-6A	9/11/97	0 - 6	Total PCB	2.53	2.13
BSS-6X	9/11/97	0 - 6	Total PCB	118.9	2.13
BSS-17Z	9/9/97	24 - 30	Total PCB	5.12	2.13
BSS-43A	9/23/97	0 - 6	Total PCB	28	2.13
BSS-45Z	9/23/97	40 - 46	Total PCB	33.5	2.13
BSS-48B	10/10/97	42 - 48	Total PCB	2.7	2.13
BSS-52C	10/9/97	60 - 66	Total PCB	4.9	2.13
BSS-53X	10/9/97	0 - 6	Total PCB	7.9	2.13
BSS-55D	10/9/97	108 - 114	Total PCB	5.4	2.13
BSS-57A	10/8/97	0 - 6	Total PCB	3.6	2.13
BSS-58A	10/8/97	0 - 6	Total PCB	3.22	2.13
BSS-59A	10/8/97	0 - 6	Total PCB	17	2.13
BSS-60X	10/8/97	0 - 6	Total PCB	40	2.13
D-1B	10/14/97	18 - 24	Total PCB	2.24	2.13
Class-3	9/11/97	0 - 6	Total PCB	44.1	2.13
Class-8	10/8/97	0 - 6	Total PCB	2.19	2.13
BSS-1A	9/11/97	0 - 6	TPH	83300	4148
BSS-2A	9/11/97	0 - 6	TPH	27200	4148
BSS-3A	9/11/97	0 - 6	TPH	20500	4148
BSS-4A	9/11/97	0 - 6	TPH	5490	4148
BSS-5A	9/11/97	0 - 6	TPH	22800	4148
BSS-6A	9/11/97	0 - 6	TPH	26000	4148
BSS-6X	9/11/97	0 - 6	TPH	23800	4148
BSS-11D	9/10/97	0 - 6	TPH	5680	4148
BSS-19D	9/18/97	35 - 41	TPH	5720	4148
BSS-45Z	9/23/97	40 - 46	TPH	8740	4148
BSS-53X	10/9/97	0 - 6	TPH	18500	4148
BSS-54A	10/9/97	0 - 6	TPH	13900	4148
BSS-55D	10/9/97	108 - 114	TPH	9890	4148
BSS-59A	10/8/97	0 - 6	TPH	8600	4148
BSS-60A	10/8/97	0 - 6	TPH	8130	4148
BSS-60X	10/8/97	0 - 6	TPH	12000	4148
Class-3	9/11/97	0 - 6	TPH	84400	4148
Class-10	10/14/97	0 - 6	TPH	4370	4148

APPENDIX A

Human Health Risk Assessment
Birch Swamp Brook Sediments from Texas Road to Lake Lefferts

HUMAN HEALTH RISK ASSESSMENT SUMMARY FOR IMPERIAL OIL

SUMMARY OF SITE RISKS

A risk assessment was conducted to estimate the human health risks associated with the potential exposures to PCBs in sediments in an approximately 4,000-feet section of Birch Swamp Brook downstream of the IOC/CC site between Texas Road and Lake Lefferts. The risk assessment estimated the human health risks which would result from exposure to the contamination if no remediation occurred in the future.

HUMAN HEALTH RISK ASSESSMENT

Studies in Birch Swamp Brook have determined that PCBs are the primary contaminants of concern to human health in the Brook sediments. Detected concentrations of PCBs in sediments ranged from non-detect to 40 ppm with an arithmetic mean of 2.01 parts per million (ppm). The risk assessment used a conservative estimate (UCL) of the mean of 3.52 ppm.

The risk assessment was conducted using the reasonable maximum exposure (RME) scenario. Under current land use conditions, an adolescent (age 7-18) wading and playing in the Brook was identified as the most sensitive receptor. Exposure was assumed to occur once a week throughout the 12 years. The primary pathways of concern would be incidental ingestion and dermal absorption of sediments contaminated with PCBs.

Potential carcinogenic risks were evaluated using the cancer slope factor developed by EPA for PCBs. EPA has classified PCBs as a probable human carcinogen with a slope factor of 2 $(mg/kg\text{-}d)^{-1}$. Under current land use conditions, the excess cancer risks for the incidental ingestion and the dermal absorption of the PCBs in Birch Swamp Brook sediments by an adolescent, using the RME scenario and conservative exposure assumptions, are 4.0×10^{-7} and 4.6×10^{-7}, respectively. The cumulative cancer risk is 8.6×10^{-7}, which is below EPA's acceptable risk range of 10^{-4} to 10^{-6} and NJDEP's acceptable risk level of 10^{-6}.

Non-carcinogenic effects are assessed using a Hazard Quotient (HQ) approach, based on the ratio of the expected chronic daily intake divide by the Reference Dose (RfD). The sum of the HQ for a given chemical is called the Hazard Index (HI). An HI that exceeds 1.0 indicates the potential for non-carcinogenic effects to occur. Since Reference Doses for the PCBs (Arochlors 1248 and 1260) detected in Birch Swamp Brook are not available, the Reference Dose for Arochlor 1254 was used to calculate the HQ. The HI for the PCB-contaminated sediment. A HQ of 0.06 for incidental ingestion and a HQ of 0.07 for dermal contact were derived. Therefore the cumulative HI is 0.13. This value is within EPA's acceptable risk range for a HI of less than 1.

The results of the risk assessment indicate the potential health risks associated with PCBs in the sediments of Birch Swamp Brook downstream of the IOC/CC site, between Texas Road and Lake Lefferts, under current land use, are below EPA's acceptable risk range and NJDEP's acceptable risk level for carcinogenic and non-carcinogenic health effects.

EXPOSURE PATHWAY

INCIDENTAL INGESTION AND DERMAL ABSORPTION OF SEDIMENTS

EXPOSURE VARIABLES:

C_S = concentration of PCBs in sediments (UCL of Mean)	3.52 ppm
IR = ingestion rate	100 mg/day
CF = conversion factor	10^{-6} kg/mg
FI = fraction ingested	1
EF = exposure frequency	52 days/year(d/yr)
ED = exposure duration	12 years (7-18 years)
BW = body weight	42 kg
AT = averaging time	70 years
CSF = cancer slope factor	2 mg/kg/day^{-1}
AF = adherence factor	0.2 mg/cm^2
ABS_d = dermal absorption factor	14%(0.14)
SA = surface area exposed	4,070 cm^2

LAND USE - CURRENT USE ADOLESCENT WADING SCENARIO

CANCER CALCULATION

Cancer Risk=Intake(mg/kg/day) x Cancer Slope Factor(mg/kg/day)$^{-1}$

$$\text{Intake (ingestion)} = \frac{CS \times IR \times FI \times CF \times EF \times ED}{BW \times AT \times 365 \text{ days/year}}$$

$$\text{Intake} = \frac{3.52 \text{ mg/kg} \times 100 \text{ mg/day} \times 1 \times 10^{-6} \times 52 \text{ d/yr} \times 12 \text{ years}}{42 \text{ kg} \times 70 \text{ years} \times 365 \text{ days/years}}$$

Intake = 2.0×10^{-7} mg/kg/day

RISK (ingestion) = Intake x $CSF_{(PCBs)}$

RISK (ingestion) = 2.0×10^{-7} mg/kg/day x 2 mg/kg/day^{-1}

CANCER RISK (incidental ingestion) = 4.0×10^{-7}

$$\text{Intake (dermal absorption)} = \frac{CS \times AF \times ABS_D \times CF \times SA \times EF \times ED}{BW \times AT \times 365 \text{ days/year}}$$

$$\text{Intake} = \frac{3.52 \text{ mg/kg} \times 0.2 \text{ mg/cm}^2 \times 0.14 \times 10^{-6} \text{ kg/mg} \times 4{,}070 \text{ cm}^2 \times 52 \text{ d/yr} \times 12 \text{ years}}{42 \text{ kg} \times 70 \text{ years} \times 365 \text{ days/year}}$$

Intake (dermal absorption) = 2.3×10^{-7} mg/kg/day

RISK (dermal absorption) = Intake x $CSF_{(PCBs)}$

RISK (dermal absorption) = 2.3 x 10-7 mg/kg/day x 2 $mg/kg/day^{-1}$

CANCER RISK (dermal absorption) = 4.6×10^{-7}

CANCER RISK (incidental ingestion) = 4.0×10^{-7}

TOTAL CANCER RISK = 8.6×10^{-7}

NONCARCINOGENIC RISK CALCULATION

Noncarcinogenic Risk = Intake (mg/kg-day) ÷ Reference Dose (mg/kg-day)

$$\text{Intake (ingestion)} = \frac{CS \times IR \times FI \times CF \times EF \times ED}{BW \times AT \times 365 \text{ days/year}}$$

$$\text{Intake} = \frac{3.52 \text{ mg/kg} \times 100 \text{ mg/day} \times 1 \times 1x^{-6} \text{ kg/mg} \times 52 \text{ dy/yr} \times 12 \text{ years}}{42 \text{ kg} \times 12 \text{ years} \times 365 \text{ days/year}}$$

Intake (Ingestion) = 1.2×10^{-6} mg/kg-day

HAZARD QUOTIENT = Intake ÷ $RfD_{(PCBs)}$

HAZARD QUOTIENT (ingestion) = 1.2×10^{-6}mg/kg-day ÷ 2×10^{-5}mg/kg-day

HAZARD QUOTIENT (incidental ingestion) = 6.0×10^{-2}

$$\text{Intake (dermal contact)} = \frac{CS \times AF \times ABS_d \times CF \times SA \times EF \times ED}{BW \times AT \times 365 \text{ days/year}}$$

$$\text{Intake} = \frac{3.52 \text{ mg/kg} \times 0.2 \text{ mg/cm}^2 \times 0.14 \times 1x^{-6} \text{ kg/mg} \times 4070 \text{ cm}^2 \times 52 \text{ d/y} \times 12 \text{ years}}{42 \text{ kg} \times 12 \text{ year} \times 365 \text{ day/year}}$$

Intake (dermal contact) = 1.4×10^{-6} mg/kg-day

HAZARD QUOTIENT = Intake ÷ $RfD_{(PCBs)}$

HAZARD QUOTIENT(dermal contact) = 1.4×10^{-6} mg/kg-day ÷ 2×10^{-5} mg/kg-day

HAZARD QUOTIENT (dermal contact) = 7×10^{-2}

HAZARD QUOTIENT (ingestion) = 6×10^{-2}

HAZARD INDEX = 1.3×10^{-1}

Uncertainties in the Risk Estimate

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 uncertainty include:

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

Uncertainty in environmental sampling arises in part from the potentially uneven distribution of chemicals in the media sampled. Consequently, there is significant uncertainties to the

actual levels present. Environmental chemistry-analysis errors 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.

APPENDIX B
Cost Estimates

BIRCH SWAMP BROOK SEDIMENT

ALTERNATIVE 1: NO ACTION

Under the No Action alternative, a monitoring program would be conducted for 30 years. The monitoring program would consist of (1) an annual inspection to evaluate physical changes to Birch Swamp Brook which could potentially alter exposure pathways and/or contaminant migration pathways; (2) stream sediment sampling to evaluate changes in contaminant concentrations and distribution.

On average, 32 hours of direct labor per year would be required to perform the inspection, obtain the samples as necessary, compile the data, evaluate the results, and draft a written report with conclusions. The estimated cost for this effort would be approximately $1,600 (32 hours @ $50/hour).

On average, approximately 18 sediment samples would be analyzed per year for PCBs, TPH, and BEHP at an estimated cost of $5,400 (18 samples @ $300/sample). The locations of the samples would be determined each successive year based on changes in site conditions, but would be targeted to depositional and scoured areas of the Brook.

In Year 1, the monitoring program would be conducted every 4 months to obtain a good baseline data set covering any seasonal variations in stream conditions.

The estimated present worth cost (at an annualized interest rate of 7%) to perform this monitoring, at an annual cost of $7,000 ($21,000 - Year 1), is $100,000 (rounded to the nearest $100).

ALTERNATIVE 2: EXCAVATION W/OFF-SITE DISPOSAL OR RE-USE

Cleanup Volume: 3,312 Cubic Yards

1. CAPITAL COSTS

	Unit	Quantity	Unit Price	Amount
Direct Costs:				
Engineering Management Mob/Demob	LS	1	$ 15,000.00	$ 15,000.00
Runon/Runoff Controls	LS	1	$ 10,000.00	$ 10,000.00
Air Monitoring	LS	1	$ 60,000.00	$ 60,000.00
Site Security	LS	1	$ 40,000.00	$ 40,000.00
Stream Diversion	LS	1	$ 75,000.00	$ 75,000.00
Decontamination	LS	1	$ 120,000.00	$ 120,000.00
Dust Control	LS	1	$ 30,000.00	$ 30,000.00
Temporary Road Construction	LS	1	$ 20,000.00	$ 20,000.00
Classification Samples	Each	35	$ 800.00	$ 28,000.00
Excavation/Stockpiling	yd3	3312	$ 15.00	$ 49,680.00
Post Excavation Samples (PCBs/Metals)	Each	70	$ 500.00	$ 35,000.00
Soil Transport/Disposal (Non Haz)	Ton	4518	$ 125.00	$ 564,750.00
Soil Transport/Disposal (Haz)	Ton	450	$ 300.00	$ 135,000.00
Site Restoration (Backfill/Wetlands)	LS	1	$ 400,000.00	$ 400,000.00
			Total Direct Costs:	$ 1,582,430.00
Indirect Costs:				
Prime Contractor Markup @ 15%				$ 237,364.50
Engineering and Design @ 12%				$ 189,891.60
Legal and Administrative @ 3%				$ 47,472.90
			Total Indirect Costs:	$ 474,729.00
			TOTAL CAPITAL COSTS:	$ 2,057,159.00

2. ANNUAL O&M COST (Present Value)

$ 30,000.00

TOTAL COSTS:	$ 2,087,159.00
15% Contingency:	$ 313,073.85
PROJECT TOTAL:	$ 2,400,232.85

NOTE: 1 yd^3 = 1.5 tons

APPENDIX C

Imperial Oil/Champion Chemicals Superfund Site
Marlboro Township, New Jersey

Birch Swamp Brook and Fire Pond Sediment Sample Results

Summary:

(Note: All samples were analyzed for arsenic, PCBs and TPHC. Four sediment samples were also analyzed for TCLP and RCRA characteristics.)

1. Soils between the berm and Birch Swamp Brook

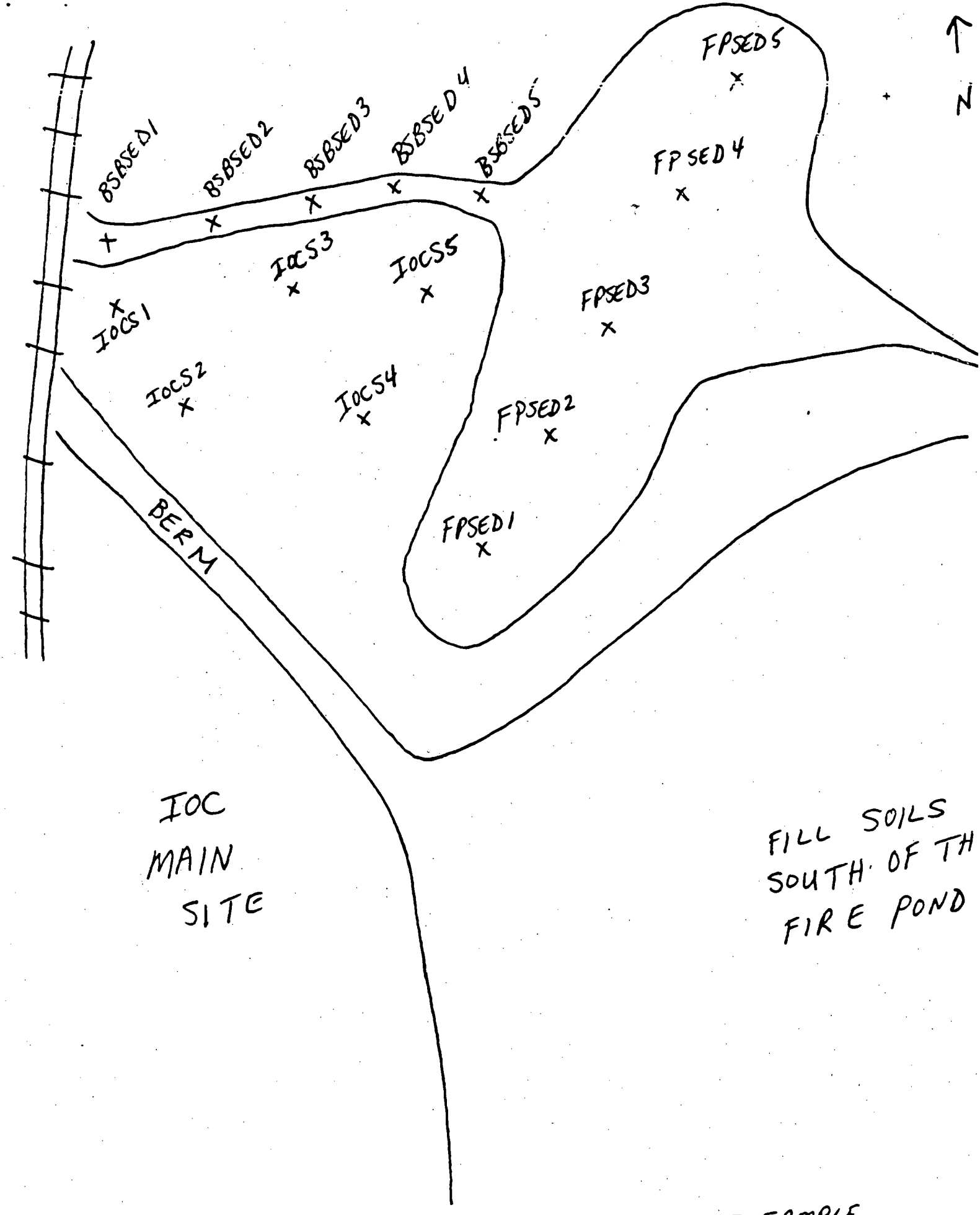
Virtually all of the soil samples collected between the berm and Birch Swamp Brook are contaminated with arsenic above the RDCSCC of 20 ppm. This applies to both the 0-6" and the 12-18" depth samples. With the exception of sample IOCS-3A, which showed 1.33 ppm PCBs at 0-6", no PCBs or TPHC were detected in these soils above 0.49 ppm and 10,000 ppm, respectively. These soils were not tested for TCLP or RCRA characteristics.

2. Birch Swamp Brook

Four of five sediment samples contained arsenic above 20 ppm and all were above the Ontario LEL of 6 ppm. (The SEL is 33 ppm.) One sample (BSBSED1 located next to railroad track culvert) exceeded the 4,138 ppm preliminary remediation goal (PRG) for TPHC. BSBSED1 and BSBSED2 were above the PCBs PRG of 2.13 ppm. BSBSED1 tested RCRA hazardous for releasable sulfide, exceeding the 500 ppm standard by 190 ppm.

3. Fire Pond

All five sediment samples exceeded the NJDEP SCC (20 ppm), the Ontario LEL (6 ppm) and the Ontario SEL (33 ppm) for arsenic. None of the samples exceeded the PRGs for PCBs or TPHC. None of the fire pond samples tested hazardous.



IOC BIRCH SWAMP BROOK / FIRE POND SEDIMENT SAMPLE

BIRCH SWAMP BROOK AND FIRE POND SEDIMENT SAMPLING RESULTS
IMPERIAL OIL/CHAMPION CHEMICALS SUPERFUND SITE
MARLBORO TOWNSHIP, NEW JERSEY

ARSENIC RESULTS

Sample	(depth)	Concentration (ppm)	SCC (ppm)
IOCS-1A	0-6"	6.8 J	20
IOCS-1B	12-18"	37.0 J	20
IOCS-2A	0-6"	26.0 J	20
IOCS-2B	12-18"	755 J	20
IOCS-3A	0-6"	157 J	20
IOCS-3B	12-18"	29.7 J	20
IOCS-4A	0-6"	5.8 J	20
IOCS-4B	12-18"	113 J	20
IOCS-5A	0-6"	42.6 J	20
IOCS-5B	12-18"	17.9 J	20
FPSED-1	0-6"	252 J	20
FPSED-2	0-6"	101 J	20
FPSED-3	0-6"	134 J	20
FPSED-4	0-6"	79.9 J	20
FPSED-5	0-6"	66.0 J	20
BSBSED1	0-6"	172 J	20
BSBSED2	0-6"	114 J	20
BSBSED3	0-6"	15.7 J	20
BSBSED4	0-6"	70.9 J	20
BSBSED5	0-6"	232 J	20

PPM = Parts per Million (mg/kg or mg/l)
PRG = Preliminary Remediation Goal
SCC = Soil Cleanup Criterion
Values above PRG/SCC shaded in gray

BIRCH SWAMP BROOK AND FIRE POND SEDIMENT SAMPLING RESULTS
IMPERIAL OIL/CHAMPION CHEMICALS SUPERFUND SITE
MARLBORO TOWNSHIP, NEW JERSEY

TPHC RESULTS (diesel organics)

Sample	(depth)	Concentration (ppm)	PRG/SCC (ppm)
IOCS-1A	0-6"	24.2	10,000
IOCS-1B	12-18"	144 J	10,000
IOCS-2A	0-6"	23.6	10,000
IOCS-2B	12-18"	37	10,000
IOCS-3A	0-6"	187 J	10,000
IOCS-3B	12-18"	13.2	10,000
IOCS-4A	0-6"	55.4	10,000
IOCS-4B	12-18"	881 J	10,000
IOCS-5A	0-6"	74.6	10,000
IOCS-5B	12-18"	12.5	10,000
FPSED-1	0-6"	277	4,138
FPSED-2	0-6"	271 J	4,138
FPSED-3	0-6"	536 J	4,138
FPSED-4	0-6"	285 J	4,138
FPSED-5	0-6"	527 J	4,138
BSBSED1	0-6"	[redacted]	4,138
BSBSED2	0-6"	3,800	4,138
BSBSED3	0-6"	351 J	4,138
BSBSED4	0-6"	300 J	4,138
BSBSED5	0-6"	334 J	4,138

PPM = Parts per Million (mg/kg or mg/l)
PRG = Preliminary Remediation Goal
SCC = Soil Cleanup Criterion
Values above PRG/SCC shaded in gray

BIRCH SWAMP BROOK AND FIRE POND SEDIMENT SAMPLING RESULTS
IMPERIAL OIL/CHAMPION CHEMICALS SUPERFUND SITE
MARLBORO TOWNSHIP, NEW JERSEY

PESTICIDE/PCBs RESULTS

Sample	(depth)	Analyte	Concentration (ppm)	PRG/SCC (ppm)
IOCS-1A	0-6"	PCBs	0.038 J	0.49
IOCS-1B	12-18"	PCBs	0.218 J	0.49
IOCS-2A	0-6"	PCBs	0.027 J	0.49
IOCS-2B	12-18"	PCBs	0.065	0.49
IOCS-3A	0-6"	PCBs	1.33 J	0.49
IOCS-3B	12-18"	PCBs	0.096 J	0.49
IOCS-4A	0-6"	PCBs	0.054	0.49
IOCS-4B	12-18"	PCBs	0.460	0.49
IOCS-5A	0-6"	PCBs	0.018 J	0.49
IOCS-5B	12-18"	PCBs	ND	0.49
FPSED-1	0-6"	PCBs	0.290 J	2.13
FPSED-2	0-6"	PCBs	0.120	2.13
FPSED-3	0-6"	PCBs	0.130	2.13
FPSED-4	0-6"	PCBs	0.093 J	2.13
FPSED-5	0-6"	PCBs	0.140	2.13
BSBSED1	0-6"	PCBs	26.8 J	2.13
BSBSED2	0-6"	PCBs	6.0 J	2.13
BSBSED3	0-6"	PCBs	0.720 J	2.13
BSBSED4	0-6"	PCBs	0.21	2.13
BSBSED5	0-6"	PCBs	0.100 J	2.13

PPM = Parts per Million (mg/kg or mg/l)
PRG = Preliminary Remediation Goal
SCC = Soil Cleanup Criterion
Values above PRG/SCC shaded in gray

BIRCH SWAMP BROOK AND FIRE POND SEDIMENT SAMPLING RESULTS
IMPERIAL OIL/CHAMPION CHEMICALS SUPERFUND SITE
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TCLP RESULTS

Sample	Analyte	Concentration (ppm)	Standard (ppm)
BSBWC-1	Arsenic	0.073 J	5
	Barium	0.031 J	100
	Cadmium	0.0027 J	1
	Lead	0.0038 J	5
	Selenium	0.0053 J	1
	Releasable Sulfide	690 J	500
BSBWC-2	Arsenic	0.020 J	5
	Barium	0.019 J	100
	Cadmium	0.0025 J	1
	Lead	0.0034 J	5
FPWC-1	Arsenic	0.011 J	5
	Barium	0.0095 J	100
	Cadmium	0.00032 J	1
	Chromium	0.00055 J	5
	Lead	0.0065 J	5
FPWC-2	Arsenic	0.0065 J	5
	Barium	0.037 J	100
	Cadmium	0.00032 J	1
	Lead	0.046 J	5