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REV. #1
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ENVIRONMENTAL PROTECTION AGENCY

ALTERNATIVE REMEDIAL CONTRACTING STRATEGY (ARCS)

REGION III

CONTRACT #68-W8-0092

WORK ASSIGNMENT #92-12-3L54

FEASIBILITY STUDY

JUNE 28, 1991

HAVERTOWN PCP SITE

HAVERTOWN, PENNSYLVANIA

TETRA TECH, INC.

AR301059

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1.0 INTRODUCTION

1.1 PURPOSE OF REPORT

The United States Environmental Protection Agency (USEPA), Region III, using the Alternative Remedial Contracting Strategy (ARCS), authorized Tetra Tech, Inc. (Tetra Tech) to perform a Remedial Investigation/Feasibility Study (RI/FS) at the Havertown PCP (HAVERTOWN) site, Havertown, Pennsylvania. The RI/FS activities were performed under Work Assignment 92-12-3L54.0, dated December 5, 1989. All work for this RI/FS was completed during the period January, 1990 to June, 1991. All RI/FS activities were based on regulations and procedures for implementing response actions set forth in the National Oil and Hazardous Substances Contingency Plan (NCP) as amended.

The two primary objectives of the Remedial Investigation as defined in the 1989 Record of Decision (ROD) for the HAVERTOWN site were to assess:

- the current magnitude and extent of ground water, surface water, and sediment contamination at the site; and

- the potential health risk due to the public's exposure to ground water from the site and surface water and sediments from Naylors Run.

A field effort was initiated to address the remedial objectives, and included: sampling of ground water from 28 monitoring wells; a closed circuit television surveillance and video taping of the storm sewers that discharges into Naylors Run; sampling of surface water and sediments from storm sewers that discharges into Naylors Run; sampling of surface water and sediments from Naylors Run and Cobbs Creek; and an ecological assessment of portions of Naylors Run and Cobbs Creek. Evaluation of contaminant transport pathways and potential risk to human health and the environment has been based collectively upon the data collected during the RI and previous field efforts.

This report summarizes the Feasibility Study phase of RI/FS only. The RI Report is submitted under separate cover. The information contained within this report

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includes: background information on the site, including a description of some of the previous investigations performed; a general description of the physical characteristics of the site; results of the RI; a general discussion of the risk to human health and the environment; a description of remedial action objectives, general response actions, and applicable remedial technologies; and the identification and screening of remedial alternatives, the detailed evaluation of applicable alternatives, and a comparative analysis.

1.2 SITE BACKGROUND

The HAVERTOWN site has an extensive regulatory history, which has been presented in detail in the Remedial Investigation Report completed in 1988 by R. E. Wright Associates, Inc., (REWAI). Much of the background information presented here has been excerpted or summarized from that document.

1.2.1 Site Description

The HAVERTOWN site is located in Havertown, Haverford Township, Delaware County, in southeastern Pennsylvania (Figure 1-1). The site is located approximately 10 miles west of Philadelphia and is surrounded by a mixture of commercial establishments, industries, parks, schools, and residential homes.

The HAVERTOWN site covers approximately 12 to 15 acres. It is roughly delineated by Lawrence Road and Rittenhouse Circle to the south, the former Penn Central Railroad (PCRR) tracks to the north, the fence on Continental Motors property to the west, and has no distinctive boundary to the east (Figure 1-2).

The site consists of a number of distinct properties including a former wood-treatment facility owned by National Wood Preservers (NWP), a bubble gum manufacturing plant owned by the Philadelphia Chewing Gum Company (PCG), and neighboring residential and commercial areas. The two-acre NWP property lies north of the intersection of Eagle Road and Lawrence Road, and is bordered by a chain-link fence. Structures on the NWP property consist of a sheet metal building with multiple above ground chemical storage tanks. The PCG facility

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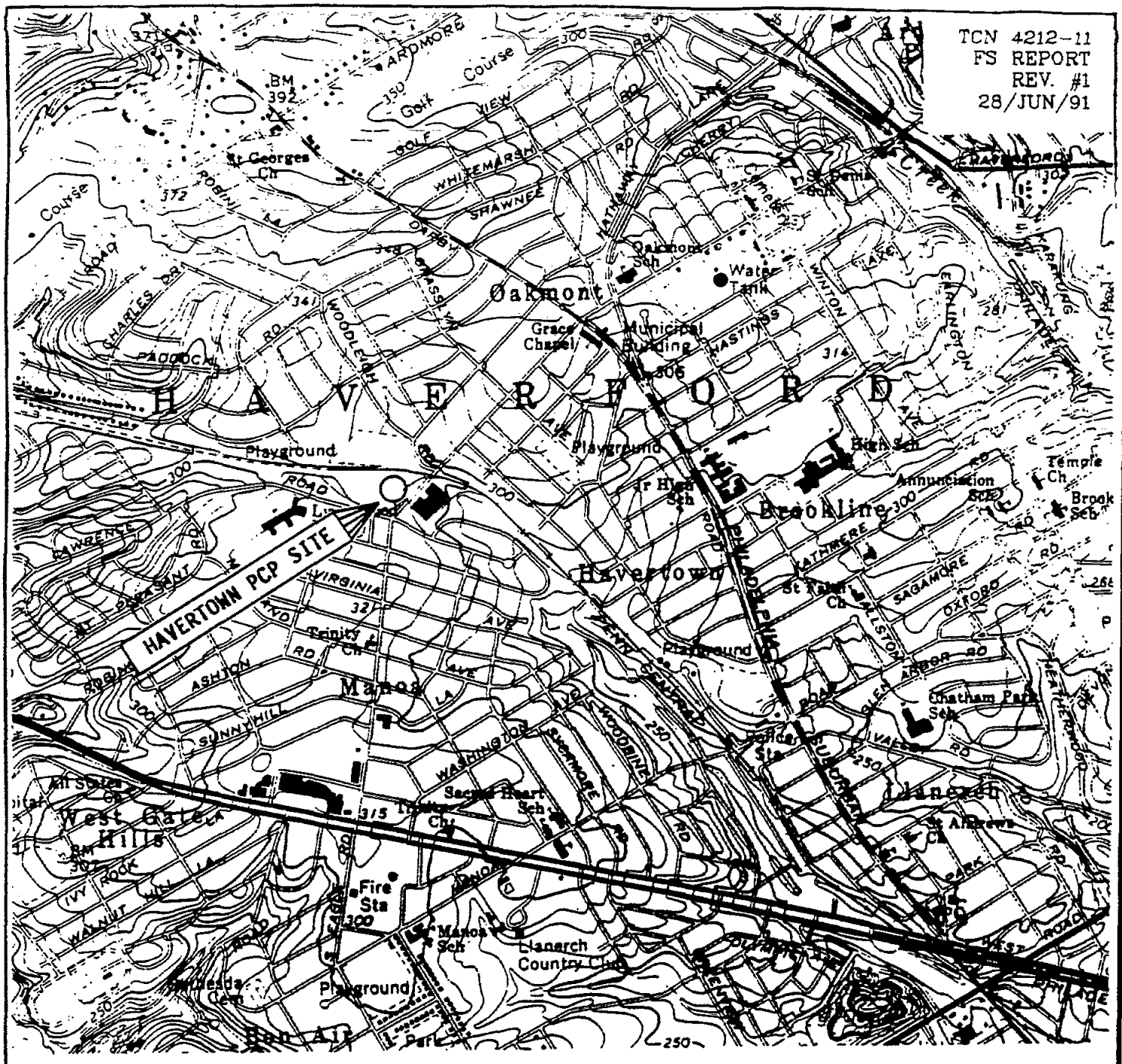

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FIGURE A1-1
HAVERTOWN PCP SITE
GENERAL LOCATION MAP

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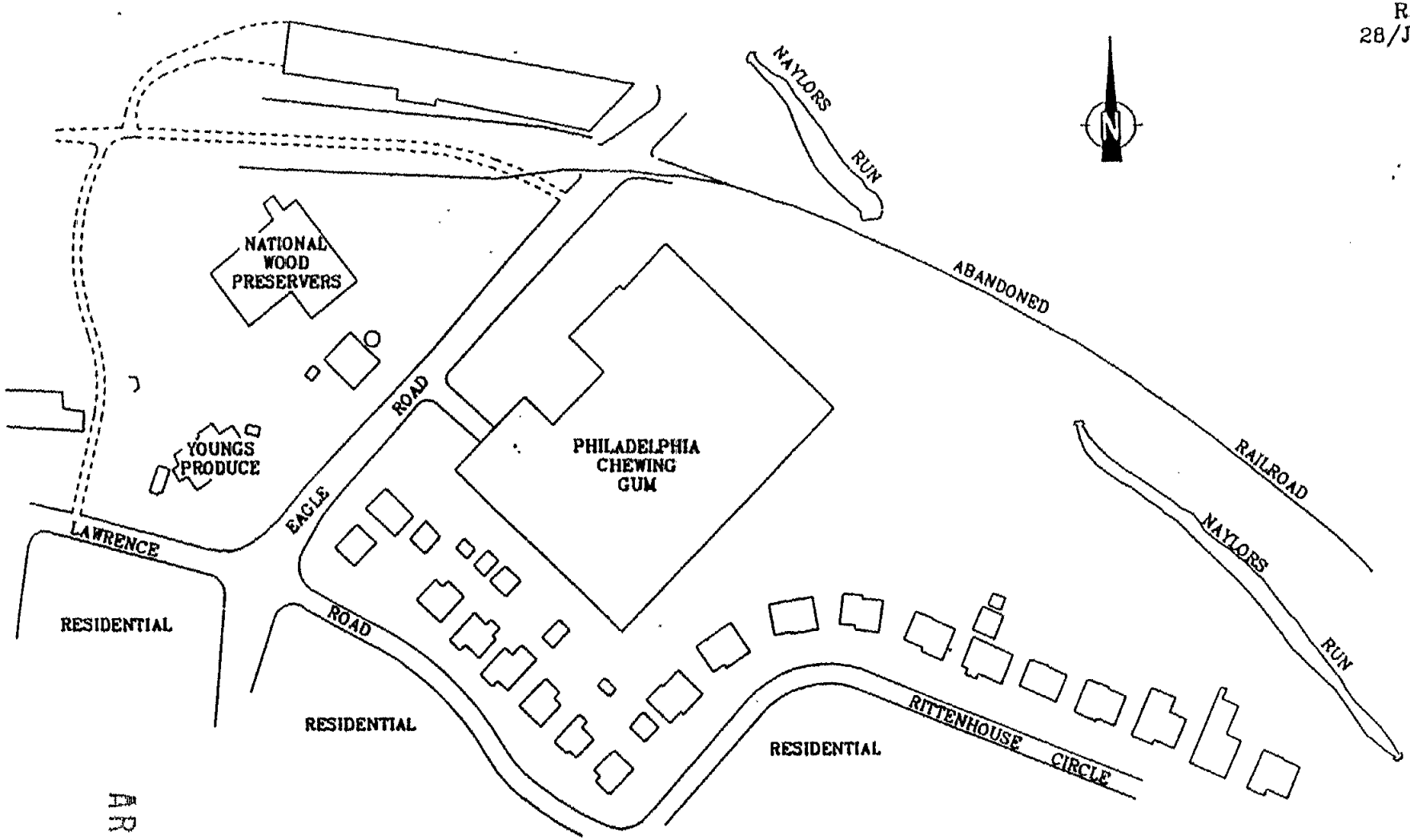

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FIGURE 1-2
HAVERTOWN PCP SITE
SITE MAP

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consists of a single large bubble gum production building located due east of NWP (northeast of the intersection of Eagle Road and Lawrence Road). The residential areas bordering Rittenhouse Circle and Naylors Run comprise the remainder of the study area.

1.2.2 Site History

A brief summary of the HAVERTOWN site history is presented below, and an expanded site chronology is included as Table 1-1 of the Remedial Investigation Report.

In 1947, Samuel T. Jacoby obtained a lease from the Clifford Rogers Estate and constructed National Wood Preservers. The facility has not changed significantly since its construction in 1947. The wood preservation practices at the NWP are summarized below.

NWP custom-treats wood as requested by its clients, who supply the materials to be treated. Historically, two wood-treating processes have been used at this facility, the empty cell pressure treatment process and a non-pressure dip treatment. The pressure treatment process was carried out in three pressure treatment cylinders on site. Wood has also been treated by a non-pressure dip method where wood is simply dipped in a tank of treatment solution. After treatment, the wood was allowed to air dry on drip tracks.

From 1947 to the present, NWP has used several wood-treating solutions in both their pressure and dip treatment operations. Known chemical solutions include:

- 5% pentachlorophenol (PCP) in a petroleum solvent (P-9 Type A oil, similar to diesel fuel) or a mineral spirits solution (P-9 Type C oil) (1947-1978);

- Tantalithe, also known as Fluoro Chrome Arsenate Phenol (1947- mid 1970's), was replaced by the CCA method;

There are presently eight above-ground storage tanks on site. According to Allen Goldstein, the tanks contain:

- Diluted Chromated Copper Arsenate (CCA) (in use mid 1970's - present);
- Diluted Chromated Zinc Chloride (CZC) (in use mid 1970's - present);
- Diluted Pentachlorophenol (PCP).

During the period 1947 to 1963, NWP allegedly disposed of wood-treatment waste materials into a 25 to 35 foot deep well, which was reportedly located in the present vicinity of Young's Produce Market (Figure 1-2). These wastes generally consisted of spent wood-treatment solutions containing pentachlorophenol (PCP) and diesel-type oil.

In 1962, the Pennsylvania Department of Health became aware of contamination in Naylors Run, a small watercourse located to the east of the site, and linked the source to waste disposal practices at the NWP site. In 1963, Harris Goldstein acquired the operations of the wood-treatment facility and continues to lease the property from the Rogers Estate.

In 1972, the Commonwealth of Pennsylvania Department of Environmental Resources (PADER) received complaints from local citizens concerning an oily substance being discharged into Naylors Run. PADER investigated and identified contaminated ground water discharging from a storm sewer into Naylors Run just east of PCG. PADER ordered NWP and Clifford A. Rogers to conduct a cleanup; however, the cleanup was never undertaken.

Since 1972, a number of interim cleanup measures were implemented by the USEPA. The HAVERTOWN site was placed on the National Priority List in 1982. An RI/FS was conducted by W.E. Wright Associates in 1988, resulting in a Remedial Investigation Report (September, 1988) and a Feasibility Study (August, 1989). A Record of Decision (ROD) was issued for the HAVERTOWN site by the USEPA on September 29, 1989, which addressed the cleanup of wastes currently staged on

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the site from previous investigative actions, and the interim remedial measure of designing and installing an oil/water separator at the storm drain outlet along Naylors Run.

The oil/water separator was designed in 1990 and emplaced in Naylors Run by March 1991. The design criteria were to reduce the oil in the discharge to a concentration of less than 5 mg/l, and to reduce the concentration of volatile organic compounds by 17%. Water from the 30-inch storm sewer discharges into the catch basin, then flows under gravity into the oil/water separator. Evaluation of initial performance testing is in progress.

1.2.3 Previous Investigations

Beginning in 1972, numerous sampling events, which included ground water, surface water, soil, air, and biota samples, have been conducted by the Pennsylvania Department of Environmental Resources (PADER), the Pennsylvania Department of Health (PDH), the USEPA, and private consultants (refer to Table 1-1 of the RI). The following discussion will focus on those investigations relevant to the objectives of the RI; ground water contamination and contamination of Naylors Run.

The initial sampling was performed in 1972, in response to citizen complaints concerning the discharge of an oily substance from the storm sewer into Naylors Run. PCP in fuel oil was detected in ground water samples collected from a well drilled on the NWP property by PADER and PennDOT in September of 1972.

PADER Division of Water Quality (Coyne and Sheaffer, 1975) conducted 24 hr. *in-situ* bioassay using Physa sp. snails. 100% mortality occurred in the snails introduced to the surface water of Naylors Run for 24 hours at all stations except the reference station, which had 0% mortality. The farthest downstream location averaged 0.78 mg/l (parts per million) PCP. Seven (7) taxa were found in Cobbs Creek above the confluence with Naylors Run. One (1) taxum was found below the confluence in Cobbs Creek. PCP was detected in Cobbs Creek at

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5 parts per billion (ppb), suggesting that Cobbs Creek does occasionally receive PCP in concentrations high enough to depress the aquatic community.

Three wells were drilled by the USEPA in 1976 to attempt to recover the PCP-oil product but this effort proved to be largely unsuccessful. Preliminary bioremediation pilot studies were conducted by Atlantic Research Corporation in 1978.

In May 1981, a geologic consultant (James Humphreville) was hired by NWP, at the direction of PADER, to determine the lateral extent and thickness of oil floating on the ground water surface. Eleven monitoring wells were drilled and installed on the Clifford A. Rogers Estate and the NWP property (Figure 1-3). Five wells (R-1 to R-5) were drilled on the Rogers estate and six wells (NW-1-81 to NW-6-81) were drilled on the NWP property. The major findings of this investigation were as follows (REWAI, 1988):

- An elongated oil plume trended in an easterly direction from the NWP property. The plume centered around monitoring wells NW-5-81 and R-2.

- Ground water flowed east-southeast from the NWP property towards the PCG property.

- The volume of free recoverable oil present in the ground water was calculated to be 157,600 gallons with an additional 143,400 gallons present in the unsaturated zone.

- Mr. Humphreville proposed that an oil recovery well be installed in the vicinity of monitoring well R-2.

EPA Environmental Response Team (ERT) conducted a nature and extent of contamination study (1981-82) at the Havertown PCP Site. A depressed aquatic community in Naylors Run was found, showing some recovery from the acute toxicity previously observed. Conservative mathematic modeling demonstrated the potential transport of PCP (3.9 µg/L concentration) to the Tinicum Marsh located

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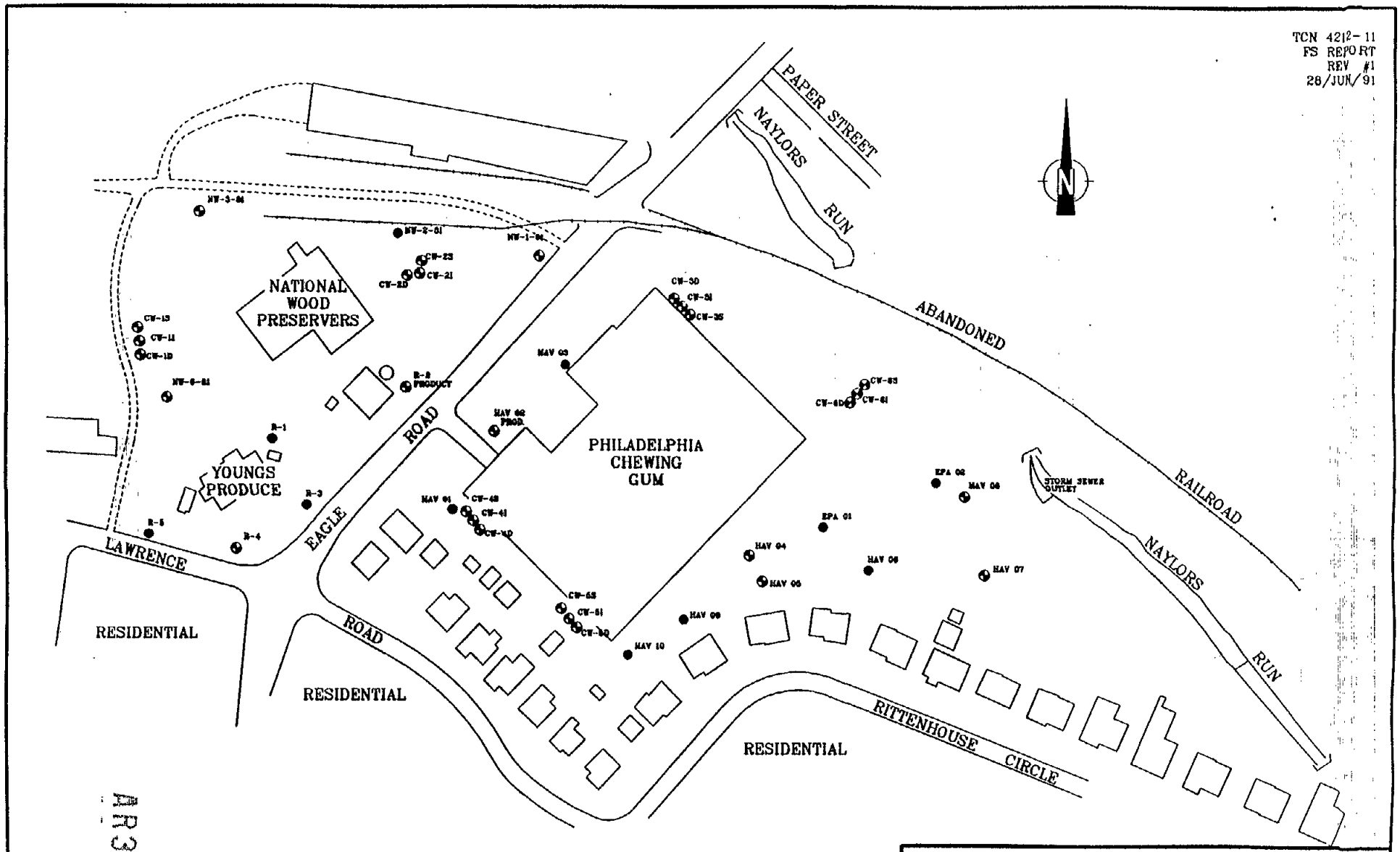

LEGEND:

- ◐ MONITORING WELL LOCATIONS SAMPLED
- ● OTHER MONITORING WELL LOCATIONS

0 100' 200'
SCALE

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FIGURE 1-9
HAVERTOWN PCP SITE
MONITORING WELL LOCATIONS

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approximately eight miles southeast of the site. However, at that time it was considered unlikely. Ninety percent (90%) of the PCP was thought to be bound in the sediment being transported down Naylors Run. Sediment deposited in pools over time could potentially act as a secondary source of contamination.

In 1982, SMC-was awarded an EPA contract to determine the extent of contamination and to perform a feasibility study for recovery of PCP-laden oil from Naylors Run. SMC-Martin designed a monitoring well network of ten wells (HAV-01 to HAV-10) which were installed on PCG property and on residential properties along Rittenhouse Circle. The major findings and conclusions of the investigation were as follows (REWAI, 1988):

- Most ground water occurs in the saprolite or weathered mantle of the Wissahickon Schist.

- The bedrock surface was presumed to be highly irregular due to varying degrees of weathering. Ground water flow and contaminant migration may be affected by this.

- Ground water flows primarily to the east and discharges into Naylors Run.

- The hydraulic gradient was relatively constant, except a for low gradient area just east of NWP which was attributed to the presence of fill material.

- Eight monitoring wells (HAV-01, HAV-02, HAV-04, NW-4-81, NW-5-81, NW-3-81, R-2 and R-3) contained measurable oil thickness, with well R-2 containing the greatest thickness (5.60 feet).

- The oil plume was projected as being elliptical in shape, and centered approximately around R-2, with its major axis parallel to the principal ground water flow direction (easterly).

- The area contaminated by measurable fee oil on the ground water surface was estimated to encompass 4.5 acres.

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- The estimated volume of free oil present on the water table surface was 400,000 to 650,000 gallons.

- Oil did not appear to migrate past the storm sewer trench behind PCG property; therefore, the storm sewer was believed to act as a conduit for oil migration.

In 1988, the Remedial Investigation for the Havertown PCP site was performed by R. E. Wright Associates, Inc. REWAI drilled 18 new monitoring wells (Figure 1-3), performed surface water and sediment sampling in Naylors Run, surface soil sampling on NWP property, and ground water sampling of 28 monitoring wells. The findings of this investigation included:

- From inspection of historical aerial photographs (1953-1958), the location of Naylors Run changed during the construction of the Rittenhouse Circle Subdivision. The pre-existing stream channel lies 100 to 130 feet south of its present location. A higher permeability likely exists along this buried stream channel.

- Air sampling results were highly variable and showed no distinct trends.

- Observations made during the drilling program indicated that the bedrock appears highly foliated under the NWP plant and seems less foliated eastward under the PCG plant.

- A significant change in hydraulic conductivity exists in the subsurface between NWP and PCG.

- The bedrock is completely saturated across the site and there were no apparent continuous confining layers.

- The horizontal hydraulic gradient under NWP and Rittenhouse Circle areas (0.021 and 0.030 respectively) is higher than the hydraulic gradient under the Swiss Farm Market and PCG building (.007). The overall vertical ground

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water gradients found at the site were small compared to the horizontal gradients.

- The highest concentrations of PCP, heavy metals oil and grease, dioxin and dibenzonfuran were located in the soil at the chemical storage tank area.

- Solvent/degreaser constituents detected in the ground water near the upgradient well clusters, may originate from a source area west of NWP, since these constituents were never reportedly in use at NWP.

- PCP is the most frequently found contaminant in ground water at the site.

- Dioxin in the ground water appears to be only present in shallow and in some intermediate depth cluster wells.

- The potential for free-floating immiscible oil, which may be present in the subsurface, is significantly less (estimated at 6,000 gallons) than the 350,000 to 600,000 gallons estimated from previous investigations.

- The migration of the subsurface fuel oil plume may be inhibited near Eagle Road, between NWP and PCG. The cause of this inhibition is not known; however, a stratigraphic oil trap, a structural oil trap, and/or a lithologic change affecting permeability may be responsible.

- Based upon the surface water parameters of dissolved oxygen, pH and specific conductance, water discharged from the storm sewer adversely affects the water quality of Naylors Run.

- Several Hazardous Substance List metals and Base Neutral Acid extractable compounds detected in the surface water of Naylors Run could be attributed to activities at NWP.

- Sediment samples contained comparatively greater concentrations of the selected dissolved metals than did the surface water samples.

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- Significantly greater numbers of semi-volatile compounds were detected in the sediments of Naylors Run than in the surface water.

On March 28 and 29, 1989, Appalachian Coal Surveys of Pittsburgh, Pennsylvania completed borehole geophysical logging in nine ground water monitoring wells at the Havertown PCP site under the supervision of REWAI. Natural gamma, high resolution density, formation (gamma-gamma) density, neutron density, and fluid conductivity logs were run on wells CW-4D, R1, R2, R3, R4, R5, NW-1, NW-2, and NW-3 (Figure 1-3). The purpose of these tests was to identify the lithology and relative hydraulic conductivities of the subsurface materials penetrated by the well bore and also to determine well construction features.

The results of the borehole testing indicated some divergences from the well construction logs with respect to the position of bentonite seals or thickness of sand pack in most wells. It was also found that wells CW-4, R-5, R-2, and NW-3 appear to be located in areas of relatively higher hydraulic conductivity, while wells NW-1, NW-2, and R-4 are located in areas of relatively lower hydraulic conductivity. Oil product thickness was found to be 10 feet in R-3, 6.5 feet in R-2, and zero in the other wells.

REWAI conducted a two month oil recovery test during the period April 20, 1989 to June 22, 1989 at the Havertown PCP site. The purpose of the test was to determine the potential effectiveness of oil recovery from the ground water surface. To perform this test an Auto-Skimmer (an automatic oil bailing device) was installed in monitoring wells R-2 and HAV-02. A top-filling bailer was mechanically lowered into the water surface and raised to the surface where the oil was removed from the bailer and stored. This cycle was controlled by preset electronic timers in the device.

In the first two weeks of the test, 56 gallons of oil were recovered from well R-2 and 0.16 gallons was recovered from well HAV-02. No further oil was recovered through the remainder of the test. REWAI attributed the relatively small volume of oil recovered to well construction characteristics such as bentonite plugging of the screen or gravel pack over time. It was also thought

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to be likely that the hydraulic conductivity of the aquifer was too low to allow free flow of oil to the well without pumping.

REWAI recommended that ground water pumping of the recovery well be performed in conjunction with the oil recovery test to create a depression of the water table into which oil flow could be induced. The test would require ground water containment and disposal. Relatively low ground water yield would be expected due to the low estimated hydraulic conductivity of the formation. Implementation of this recommendation was not performed.

In September, 1989 a ROD was written for the HAVERTOWN site, which included provisions for an interim remedial action for the installation of an oil-water separator to address the imminent and continued release of contaminants into Naylors Run.

Tetra Tech (1990) collected composite tissue samples of white suckers and black bullheads in Cobbs Creek approximately one mile down stream from the confluence with Naylors Run. Although the fish tissue was not tested for PCP, significant levels of pentachloroanisole (72.8 and 23.19 ppb) and other chlorinated phenols (ppb range), chlorinated dioxins, and chlorinated dibenzodioxins (parts per trillion range) were detected. These compounds are potential breakdown products of PCP.

1.2.4 Site Conditions

The following is a brief discussion of the site characteristics at the Havertown PCP Site. Included will be sections on the site demography, meteorology, geology, hydrogeology, surface features, surface hydrology, soils, and ecology.

1.2.4.1 Demography

The Havertown PCP site is predominately comprised of urban and suburban areas in Haverford Township, Delaware County, Pennsylvania. The Havertown PCP site is located in the borough of Havertown, which is centrally located in Haverford

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Township. Based on the 1990 United States Census Data, 18,210 housing units are occupied by 49,848 people located in Haverford Township.

Land use in Delaware County has been divided into four major categories: urban, agriculture, forest, and other uses. Of these four major categories, "urban" and "other uses" dominate the County, comprising 61% and 24% of the total area, respectively (USDA, 1963). The majority of the eastern half of Delaware County, including the vicinity of the HAVERTOWN site, is an "urban" land use, which consists of residential, commercial, and industrial developments.

1.2.4.2 Meteorology

The Havertown site is located in Delaware County, which is typified by a humid, temperate climate. Temperatures average 72°F in the summer months and 32°F in the winter months (USDA, 1963). The Delaware River Basin creates a "storm corridor" along which tropical disturbances and air masses move northward from the Gulf of Mexico or along the Atlantic coastline of the United States (REWAI, 1988). Generally, weather changes every few days in the winter and spring, and less frequently during summer and fall, due to slower atmospheric circulation. Mean annual rainfall is approximately 48 inches; the largest amount of rainfall generally occurs during the growing season, averaging 13.8 inches in summer months, and diminishes to 11 inches over the fall months. Occasional local periods of drought have been known to occur, but humid conditions are the norm. Because of the moderate, moist climate, physical and chemical weathering occur at a moderately rapid rate (USDA, 1963).

1.2.4.3 Geology

The HAVERTOWN PCP site is located in the Piedmont Uplands section of the Piedmont Physiographic Province, and is characterized by maturely dissected hills sloping gently to the southeast, underlain by a basement of crystalline igneous and metamorphic rocks. The Piedmont Uplands section is the most southerly section of the Piedmont Province in Pennsylvania.

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Bedrock in the vicinity of the site consists of metamorphic schist and gneiss of the Wissahickon Formation. This formation makes up the majority of the hard rock formation found in the area. The unconsolidated deposits that overlay the bedrock consist of saprolite (in-situ weathered bedrock), sand and gravel terrace deposits, and artificial fill.

1.2.4.4 Hydrology

Ground water at the HAVERTOWN site flows in an easterly direction and occurs in two major zones. The upper zone consists of surficial soils and weathered schist saprolite. The movement of water in the saprolite zone is influenced by the degree of saprolite weathering, relict bedrock structures, compositional variations, and the thickness of the weathered zone (REWAI, 1988). The lower zone consists of highly fractured and jointed schist bedrock, with water movement occurring along interconnected fractures. The bedrock aquifer receives some of its recharge from the downward flow through the overburden aquifer. Upward directed flow also occurs within the overburden aquifer and presumably provides base flow to Naylors Run. The depth to ground water below the site ranges from approximately 23 feet below ground surface in the vicinity of Young's Produce Store to approximately 0.5 feet below ground surface in the vicinity of Rittenhouse Circle. At present, neither aquifer is utilized as a source of water supply in the vicinity, as public water is supplied by Philadelphia Suburban Water Company. Records of the Haverford Township Public Works Department show no private wells within a four mile radius of the HAVERTOWN PCP site.

1.2.4.5 Surface Features

The HAVERTOWN site lies approximately 300 feet above mean sea level. It ranges in elevation from 280 feet above sea level (a.s.l.) in the residential areas along Rittenhouse Circle, to 320 feet a.s.l. northwest of Young's Produce. The present site topography is a result of major cut and fill alterations to the land. The NWP property is relatively flat, and drains northward toward a drainage ditch that borders the abandoned railroad bed north of the property.

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The PCG property is also flat, except for a 12-to-15 foot embankment along its southeastern border which separates the PCG property from residential backyards along Rittenhouse Circle. The PCG property drains to the southwest-southeast, towards the residential areas.

1.2.4.6 Surface Hydrology

The majority of surface runoff across the HAVERTOWN site enters artificial drainage channels, such as storm sewers, before discharging into Naylors Run. Surface ponding has been observed in selected locations on the NWP property, which either evaporates or infiltrates into the subsurface. During high precipitation events, significant sheet flow has been observed draining towards the main gate near Eagle Road before encountering a drainage ditch along the abandoned railroad, which conveys it to Naylors Run.

The HAVERTOWN PCP site is drained by Naylors Run creek, which flows in a southeasterly direction. Naylors Run receives storm water flow from NWP drainage channels, and storm water collection systems of PCG and Rittenhouse Circle, then flows through a series of natural and concrete lined channels and pipes before entering Cobbs Creek. Channelization and surface runoff subject Naylors Run to large volumes of water during storm events, resulting in severe stream scouring and erosion in the remaining unchannelized areas. The confluence of Naylors Run and Cobbs Creek is approximately four (4) miles southeast of the site. Cobbs Creek then joins Darby Creek, and flows through the Tinicum National Environmental Center before discharging into the Delaware River just east of Chester, Pennsylvania.

1.2.4.7 Soils

Based on United States Department of Agriculture (USDA) soil maps, the majority of the soils in the area are classified as Made Land, schist and gneiss materials. In this soil classification, the native pedogenic soil profile has been disturbed by earth moving equipment, resulting in a heterogeneous soil mixture of surface material, the subsurface soils, and fragmented partially

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weathered schist and gneiss rock. A band of Glenville silt loam (GnB2) borders NWP on the north and east. It consists of a moderately eroded soil on 3 to 8% slopes, and develops from weathering of schist and gneiss bedrock. The soil profile typically is 3 to 6 feet deep, and has a moderately slow permeability.

1.2.4.8 Ecology

The Havertown area is located on a major waterfowl migration route that is part of the Atlantic flyway. Locally, wetlands that serve as resting areas for migrating waterfowl are located in the Tinicum Wildlife Preserve, which lies approximately seven miles southeast of Havertown. Water from Naylors Run eventually enters this preserve via Cobbs Creek. Cobbs Creek and Darby Creek are listed as warm water fishing streams by the Pennsylvania Fish Commission.

The habitat quality within the study area is considered poor. Urbanization results in constant disturbance, poor natural food source (except for scavengers), and lack of quality cover on made-land soils. Extensive channelization of the run, due to urbanization, has resulted in the degradation of the stream habitat. The Glenville silt loam soils are considered moderate for supporting woodland habitat (USDA, 1963). There are no known undisturbed habitats within the study area.

Study Area Flora

Woodlands - According to the Soil Conservation Service, Delaware County originally consisted of seven forest types: red oak; yellow popular; sugar maple-beech-yellow birch; black ash-American elm-red maple; pitch pine-Virginia pine; and chestnut-oak. However, commercial cutting, clearing for farm lands, and to a greater extent, urbanization have eliminated any significant woodlands.

The upper section of Naylors Run bisects an area of Glenville silt loam soils. Yellow-poplar, red oak and white oak are native dominant species of this soil type. White pine, larch, Norway spruce and white spruce are typical introduced species found in this soil type. The middle and lower sections of Naylors Run,

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as well as the surrounding lands in the study area, consist of man-made soils, which vary in their capabilities to support woodlands.

Crop Lands and Pastures - As mentioned, the study area consists of urbanized lands. No crop lands or natural pastures are present. Small maintained parks are spread throughout the study area, consisting of domestic grasses and weeds interspersed with trees.

Study Area Fauna

Terrestrial Fauna - The terrestrial animal population is anticipated to be dominated by domesticated and opportunistic species. Expected mammalian species would include fox squirrel, chipmunk, eastern cottontail, striped skunk, raccoon, Norway rat, house mouse, and short-tail shrew. Homeless pets, such as cats and dogs, may also be present. Year round avian populations of rock dove, mourning dove, European starling, chickadee, cardinal, woodpeckers, sparrows, and finches would be considered common. Occasional migratory insectivores including warblers, flycatchers, and raptors may be seen during various times of the year.

Aquatic Fauna - The aquatic animal population within the majority of Naylors Run has been documented to be non-existent. The only exception noted was near the confluence with Cobbs Creek, where a stressed aquatic population was documented. Any surviving populations would be expected to consist of tolerant macroinvertebrates such Chironomids (Dipteran midges).

Cobbs Creek, below the confluence with Naylors Run, has also been documented as being impacted by the Havertown PCP Site, but to a lesser degree than Naylors Run. The extent and severity has not been clearly defined. Cobbs Creek has severe erosion and is expected to have a fair stream habitat. This is evident from previous data (Coyne and Sheaffer, 1975) where only seven (7) macroinvertebrate taxa were collected from above the confluence with Naylors Run. A low diversity of Ephemeroptera (mayflies), Trichoptera (caddisflies) and

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diptera are expected with in Cobbs Creek, as well as low populations of cool and warm water fish species such as suckers (Catostomidae) and minnows (Cyprinidae).

1.2.5 Nature and Extent of Contamination

The present nature and extent of contamination on the HAVERTOWN PCP site is summarized for ground water, surface water and sediments in Naylors Run, and water and sediment collected from several portions of the storm sewer feeding into Naylors Run.

Ground Water - Volatile organic compounds (VOCs), semi-volatile organic compounds (predominantly pentachlorophenol), and dioxin isomers constitute the majority of the contaminants present in the ground water on the HAVERTOWN site.

The volatile organic compounds trichloroethene and 1,2-dichloroethene are found in highest concentrations (630 and 270-µg/L, respectively) on the National Wood Preservers property and decrease from west to east across the site. Other prevalent VOCs, benzene and total xylenes, are found in highest concentration on Philadelphia Chewing Gum property (270 and 1,700 µg/L, respectively). In general, the concentration of all volatile organic compounds has decreased in most monitoring well locations since 1988. One exception is at well CW-6D, which is the furthest downgradient monitoring point in the deep hydrologic zone. There has been little change in the concentration of VOCs in this well since 1988.

Semi-volatile organic compounds have generally increased in concentration in the ground water since 1988. Pentachlorophenol and polycyclic aromatic hydrocarbons (PAHs) make up the majority of the semi-volatile organic compounds present in the ground water. Highest levels of PCP were present in wells R-2, HAV-04, and HAV-02 (80,000, 63,000, and 1,900 µg/L, respectively). Wells R-2 and HAV-02 presently contain floating free petroleum product. Well HAV-04 contained free product in the past. The increase in PCP concentration may be related to a decrease in the thickness of free product observed in the shallow hydrologic zone since 1988, suggesting dissolution of the free product into the ground

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water. PCP was found for the first time in the furthest downgradient shallow well, HAV-07. PCP is also present in the deep hydrologic zone, although generally in lower concentrations than those observed for the shallow hydrologic zone.

There are numerous dioxin isomers, all of which vary in their potential toxicity. The isomer 2,3,7,8-TCDD is considered to be the most toxic of the isomers. To evaluate dioxin, concentrations of all isomers are converted to a toxicity equivalent for 2,3,7,8-TCDD. Although 2,3,7,8-TCDD was only present in one monitoring well (HAV-04), almost all monitoring points exceeded a 2,3,7,8-TCDD toxicity equivalent of zero. The 2,3,7,8-TCDD toxicity equivalent of the ground water has apparently increased dramatically since 1988, especially in wells that still contain free floating product.

Naylors Run and Cobbs Creek - The surface water contained predominantly VOCs and PCP. Minor concentrations of pesticides and metals were also present. The surface water was generally absent of other semi-volatile organic compounds (besides PCP) and contained no dioxins.

VOCs and PCP are not the dominant contaminants in the sediments. Instead, the PAH subgroup of semi-volatile organic compounds dominates.

As with ground water, the primary VOCs in the surface water were benzene, total xylenes, trichloroethene, as well as toluene and ethylbenzene. All VOCs decreased in concentration downstream. No VOCs were present in the furthest downstream location in Naylors Run (NAY-01). The total VOC concentration was 205 µg/L, immediately outside the catch basin.

The concentration of PCP in the surface water ranged from a maximum of 1,200 µg/L, in water entering the catch basin (NAY-03), to 3 µg/L at the furthest downstream location sampled, Cobbs Creek station 01. The maximum concentrations of PCP and PAHs in the sediment were found at station 06 in concentrations of 3,000 (J) and 111,200 µg/kg, respectively. No PCP was found

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in the sediment downstream of station 08 (above quantitation limits of 1,000 µg/kg).

The pesticides gamma-BHC, 4,4'-DDD, heptachlor epoxide, and dieldrin were present in the surface water. At least one of these pesticides was present at every surface water station but no more than 2 pesticides were detected at any one station. The maximum concentration of any pesticide was 0.77 µg/L. Dieldrin, beta-BHC, heptachlor, aldrin, 4,4'-DDD, endosulfan sulfate, and endrin were all present in the sediment. Heptachlor represented the pesticide found in the highest concentration in the sediment at 160 µg/kg.

Aluminum, cobalt, lead, manganese, and thallium represented the metals of concern in the surface water. These metals, plus antimony, arsenic, barium, chromium, and vanadium were prevalent in the sediments. Only antimony, lead, and thallium were not found at every sample station.

All surface water samples located away from the immediate vicinity of the catch basin had a 2,3,7,8-TCDD toxicity equivalent of zero. All sediment samples collected in Naylors Run did contain dioxin isomers, although in low concentrations outside the immediate vicinity of the catch basin.

Storm Sewer - Volatile organic compounds, PCP and dioxin were found in a water sample collected from station 02A. The television surveillance of the storm sewer indicated numerous points of ground water inflow and what appeared to be oil stains at pipe joints. The presence and concentration of these compounds, mentioned above, reflect the ground water contribution to the water in the storm sewer.

A sediment sample collected from the drainage swale located adjacent to NWP indicated the presence of PCP in a concentration of 20,000 µg/kg. The location of this sample supports the assertion that some of the sediment contamination in Naylors Run is a direct result of surface soil erosion from NWP.

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1.2.6 Contaminant Fate and Transport

Several contaminant migration pathways have been documented in the remedial investigation. Contaminants were previously directly introduced into the ground water through an injection well. Evidence suggests that contaminated surface soil has been eroded from NWP and transported to Naylors Run via the storm sewer. Once contaminants have entered Naylors Run, they may be transported in the surface water, sediments, or through bioaccumulation processes. Additionally, contaminants are very likely being leached into the ground water from contaminated soil on NWP property.

Ground Water Pathway - In evaluating the contaminant fate and transport in the ground water at the HAVERTOWN site, flow conditions in two hydrologic zones must be considered. Additionally transport of free product versus transport of dissolved contaminants must be considered.

Ground water from the shallow hydrologic zone is discharging into the reach of Naylors Run below the catch basin. The calculated flow velocity in the shallow hydrologic zone is approximately 85 feet per year. Based on the length of time NWP has been in operation, contaminants in the shallow hydrologic zone could have migrated approximately 3,400 feet in the last 40 years. However, the remedial investigation indicates that PCP has just reached well HAV-07, located only 800 feet from NWP. It is believed that the storm sewer behind the PCG building is intercepting some shallow ground water and acting as a conduit for transport of ground water into Naylors Run. Factors such as dilution, biodegradation, and transformation could also be inhibiting further migration of contaminants in the ground water.

Ground water flows downward from the shallow hydrologic zone to the deep hydrologic zone on NWP but has an upward direction of flow in wells on PCG property. The deep hydrologic zone is therefore probably providing some recharge to the shallow hydrologic zone in the vicinity of Naylors Run. Some portion of the ground water in the deep hydrologic zone likely travels under Naylors Run and discharges further downgradient (to the southeast). Ground

water flow velocity in the deep hydrologic zone, within fractured bedrock, is estimated to be 25 feet per year. With no degradation, sorption, transformation, etc., dissolved contaminants could be presently be 1,000 feet downgradient of NWP.

Free petroleum product was observed in wells R-2 and HAV-02. The product is considered a Light Non-Aqueous Phase Liquid (LNAPL). The lateral extent of the free product plume has apparently decreased with time. Because the LNAPL is by definition less dense than water, it will not directly affect the deep hydrologic zone. The decrease in lateral extent and thickness of free product may however, be associated with a recent increase in the concentration of PCP in the shallow hydrologic zone.

Surface Water Runoff Pathway - Ground water is not providing any base flow to the reach of Naylors Run above the catch basin. Contaminants that are found in this section of Naylors Run have likely travelled in surface water runoff from NWP property. A comparison of contaminants in the surface soil on NWP and contaminants found in the sediments of Naylors Run indicates many of the contaminants found in the soil are present in the sediment. Additionally, the presence of PCP in a concentration of 20,000 µg/kg and dioxin isomers, with a 2,3,7,8-TCDD toxicity equivalent of 20.8 pptr, in the drainage swale adjacent to NWP which drains directly to Naylors Run, provides additional evidence for the viability of this pathway.

Transport in Naylors Run - The flow characteristics of Naylors Run, combined with grain size data indicate that the sediment is probably transported in a bedload regime only during high flow storm events. Dilution, diffusion, photolysis, and biodegradation may act on contaminants dissolved in the surface water. However, a close match between the predicted and observed downstream decrease in PCP concentrations can be accounted for by dilution alone. Bioaccumulation of contaminants may also play a role in transport of contaminants in Naylors Run; however, its role is difficult to quantify.

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Contaminant Leaching from Subsurface Soils - This pathway was not investigated as part of the RI. However, given the concentrations of PCP and other contaminants in the surface soil it is expected that the subsurface soils of NWP are also contaminated. These soils could be expected to leach contaminants into the shallow hydrologic zone.

1.2.7 Baseline Risk Assessment

Human Health - The total carcinogenic risk to children playing in Naylors Run is 9×10^{-7} from dermal absorption of chemicals of potential concern in surface water and 1×10^{-4} from dermal absorption and ingestion of chemicals of potential concern in sediment in Naylors Run. The estimated carcinogenic risk to children for contact with or ingestion of sediments is above the NCP point of departure (10^{-6}) and equal to the upper bound of the NCP acceptable risk range (10^{-4}). The majority of the risk was associated with the semi-volatile benzo(a)pyrene (Equivalent). The noncarcinogenic risk associated with these media have hazard quotients less than 1, indicating that noncarcinogenic effects will probably not be observed.

The total carcinogenic risk associated with ingestion of fish tissue (from Cobbs Creek) is 2×10^{-3} and is associated with the pesticide dieldrin. It is uncertain whether dieldrin is derived from the HAVERTOWN PCP site or derived from other sources. The carcinogenic risk associated with 2,3,7,8-TCDD (Equivalent) exposure for nursing infants, whose mothers ingest fish tissue, is 1×10^{-4}. A noncarcinogenic risk may also result from ingestion of fish due to the presence of dieldrin, heptachlor epoxide, and dioxin.

The total carcinogenic risk associated with exposure to all pathways under current land use is 2×10^{-3} while the hazard quotient exceeded unity (1) by a factor of 50.

There are currently no users of ground water in the vicinity of the HAVERTOWN site. However, the carcinogenic risk associated with ingestion of ground water with current concentrations of PCP, 2,3,7,8-TCDD (Equivalent), and PAHs is

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nearly 0.5, or one half a million times above the NCP point of departure. The noncarcinogenic risk, associated mainly with dioxin, exceeded unity by a factor of 5,000.

In summary, there are high carcinogenic and noncarcinogenic risks associated with the use of ground water due to polycyclic aromatic hydrocarbons, PCP, and dioxin contamination. The extent of primary contamination of these chemicals appears to be sufficiently characterized by data from existing monitoring wells.

Carcinogenic polycylic aromatic hydrocarbons (PAHs) in sediments may present a potential human health impact from direct contact. Pesticides and dioxin in surface water and sediments may contribute to the health risk associated with ingestion of fish (from further downstream) and subsequent indirect exposure to nursing infants. It is uncertain whether the chemicals present in the fish tissue are associated with chemical releases from the site.

Ecology - The benthic macroinvertebrate community is impaired due to the presence of semi-volatile organic compounds, along with the minor contribution of pesticides, aluminum, iron, lead, manganese, and dioxin in Naylors Run. Low EPT abundance, low diversity, poor community structure, and low number of organisms support this conclusion.

It was observed that the benthic community improves with distance downstream from the Havertown PCP Site. Additionally, it should be noted that the benthic community within Naylors Run and Cobbs Creek has improved compared to historic studies. Further characterization as to the point sources of the contamination in Naylors Run is needed. Channelization and receipt of urban storm water runoff is a continual source of stress to Naylors Run that will limit Naylors Run from becoming a high quality aquatic community.

Additionally, terrestrial birds and waterfowl may be exposed to levels of contaminants in the water and sediment that could cause chronic toxicity. However, the toxic levels are only present in the upper reach of Naylors Run, located closest to NWP. The terrestrial vegetation appears to be typical of stream bank vegetation found in the area.

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2.0 IDENTIFICATION AND SCREENING OF TECHNOLOGIES

2.1 INTRODUCTION

The Feasibility Study (FS) is performed to identify the optimal remedy for a given site through an iterative screening process accomplished in the following three general phases:

- development of remedial alternatives;
- screening of remedial alternatives; and
- the detailed analysis of the selected alternatives.

Section 2 addresses the first phase of alternative development as per USEPA Guidance for Conducting Remedial Investigation and Feasibility Studies Under CERCLA (USEPA, 1988). This section identifies the potentially applicable remedial technologies and constituent process options, screens the identified technologies as to their feasibility, and results in the subsequent assembly of remaining technologies into a variety of remedial alternatives (Section 3.0). Major steps in the evaluation include the following:

- development of remedial action objectives based upon the identified contaminants of concern (those which exceed ARARs or represent a risk to human health or the environment);
- determination of appropriate general remedial response actions for each contaminated medium by which the remedial action objectives may be attained;
- identification of quantities of media to which remedial actions may apply;
- identification and screening of technologies applicable to each general response action to eliminate those that are not technically feasible to implement based upon site-specific conditions;

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- evaluation of technology process options to select a process option for each technology type; and

- assembly of representative, feasible technologies into medium-specific remedial alternatives representing a range of treatment and containment combinations.

2.2 REMEDIAL ACTION OBJECTIVES

The following section presents the identified remedial action objectives for the site. These objectives consist of medium-specific environmental goals which direct the development of alternatives to those which will protect human health and the environment. Remedial efforts shall be directed to mitigate parameters which were identified in the site Remedial Investigation to exceed regulatory permitted levels (ARARs) or were identified in the Risk Assessment to pose an unacceptable level of risk to human health or the environment.

2.2.1 Identification of Remedial Action Objectives

2.2.1.1 Pathways of Exposure

Contaminants of concern identified in the Risk Assessment Section in the RI Report at the site during this operable unit include volatile and semi-volatile organic compounds, inorganics, and dioxins. Pathways of exposure to unacceptable levels of these compounds, defined as carcinogenic risk above the "acceptable range" of $1x10^{-6}$ to $1x10^{-4}$, and noncarcinogenic risk indicated by a hazard quotient above unity [one], under current land-use conditions were identified to consist of the ingestion of fish from Cobbs Creek, and nursing infant exposure by mother's ingestion of fish from Cobbs Creek. Exposure to children by playing in Naylors Run via pathways of ingestion of sediments and by dermal absorption from sediments and surface water were all within or below acceptable limits.

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Potential exposure pathways were evaluated for future hypothetical land-use scenarios based upon the domestic use of site ground water, all of which had risk levels which exceeded the NCP acceptable levels. This evaluation of hypothetical future exposure pathways included the ingestion of ground water, indirect infant exposure from nursing mothers ingesting ground water, and inhalation of VOCs while showering with ground water.

2.2.1.2 Contaminants of Potential Concern

Only a subset of the contaminants detected at the site were selected as chemicals of potential concern for evaluation in the Risk Assessment portion of the RI. Contaminants of concern were identified after an evaluation was conducted comparing chemicals detected and their concentrations to background (or in this case, assumed background levels), and an evaluation of risk factors. Not selected were TIC's, inorganics which are essential human macronutrients, and chemicals that were detected in less than 5% of the samples taken at concentrations below detection/quantitation limits (unless the risk factor was overriding or the maximum concentration detected exceeded ARARs). A more detailed explanation of the selection of chemicals of concern can be found in the Risk Assessment Section in the RI Report.

Those contaminants which were selected as chemicals of concern for each medium are indicated on Table 2-1 from the Risk Assessment. Note that 2,3,7,8-TCDD equivalent is not indicated for the Storm Sewer sediments; this is because dioxins were not analyzed at those stations. The RA concluded that dioxins and furans are likely to be present in the sediments at those locations, and that 2,3,7,8-TCDD equivalent is therefore likely to be the primary chemical of concern in the storm sewer sediments.

Forty-two compounds or elements were identified as contaminants of concern, in that they represented a potential risk to human health, including volatile organic compounds, PCP, PAH's, pesticides, dioxins and furans, and inorganics. Of these, PCP, PAH's, and dioxins and furans appear to be the primary chemicals of concern in all media at the HAVERTOWN site. The inorganics aluminum,

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Table 2-1
Summary of Chemicals of Potential Concern for the Havertown PCP Site

	Ground -Water	Naylors Run		Storm Sewer	
		Surface Water	Sedi- ment	Surface Water	Sedi- ment
Organics:					
acenaphthene	X		X		X
acenaphthylene	X				X
anthracene	X		X		X
benzene	X			X	
benzo(a)anthracene	X		X		X
benzo(a)pyrene			X		X
benzo(a)pyrene (Equivalent)	X	X	X		X
benzo(b)fluoranthene			X		X
benzo(g,h,i)perylene			X		X
benzo(k)fluoranthene			X		X
bis(2-ethylhexyl)phthalate	X				
chlordane(Total)			X		
chrysene	X		X		X
dibenzo(a,h)anthracene			X		X
dibenzofuran	X		X		X
1,2-dichloroethene	X				
dieldrin		X			
endosulfan sulfate			X		
fluoranthene	X		X		
heptachlor epoxide		X			
indeno(1,2,3-c,d)Pyrene			X		X
naphthalene	X				
2-methylnaphthalene	X			X	
pentachlorophenol	X	X	X	X	X
phenanthrene	X		X	X	X
pyrene	X	X	X		X
2,3,7,8-TCDD (Equivalent)	X	X	X	X	*
trichloroethene	X				
vinyl chloride	X				

* Not Analyzed

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Table 2-1 (Cont.)
Summary of Chemicals of Potential Concern for the Havertown PCP Site

	Ground -Water	Naylors Run		Storm Sewer	
		Surface Water	Sedi- ment	Surface Water	Sedi- ment
Inorganics:					
aluminum	X	X	X	X	X
antimony			X		
arsenic	X		X	X	X
barium			X	X	
chromium			X		X
cobalt	X	X	X	X	X
lead		X	X	X	X
manganese	X	X	X	X	X
mercury					X
nickel			X		
thallium		X	X		
vanadium			X		X
zinc					X

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arsenic, cobalt, and manganese also were selected as contaminants of concern for all media. Several volatiles were detected only in ground water, perhaps due to their high water solubility, low affinity for binding to sediment particles, and potential volatilization from surface water to the air. Pesticides were detected only in surface water, thus apparently do not leach from other media. Most PAH's were found only in sediments, probably due to their low water solubility and high affinity for binding to sediment particles. inorganics were only found at levels of concern in Naylors Run water and/or sediments; it is unknown whether these inorganics are actually associated with site activities.

2.2.1.3 Applicable or Relevant and Appropriate Requirements

Action - Specific ARARs

Air Emission Requirements: PADER 25 PA Code Section 127.1 requires that emissions from any new air contamination source be controlled to the maximum extent possible and be consistent with best available technology.

Waste Management: Pennsylvania regulations for the identification, listing, transportation, treatment, and storage of hazardous waste, are regulated per Subchapter D, PA Code 75, Sections 259 through 282.

Medium - and Chemical-Specific ARARs

Surface Water: 25 PA Code Chapter 92 sets forth water provisions for the administration of water quality National Pollutant Discharge Elimination System (NPDES) Permit program. Discharges to surface water will be in compliance with the chemical-specific criteria contained therein.

Ground Water: Hazardous substances in the ground water will be remediated per PADER ARARs to "background" as specified by 25 PA Code Section 75,264. In addition, chemical-specific ground water and surface water ARARs included in 25 PA Code Chapter 92, which describes the NPDES procedures, and 25 PA Code

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Chapter 93, which describes Pennsylvania water quality criteria, are also applicable.

Sediment: No action level Commonwealth of Pennsylvania chemical-specific ARARs exist for sediments. Sediments must be remediated to background levels if identified as a source of contaminated leachate to the ground or surface water.

2.2.1.4 Remedial Action Objectives

Remedial action objectives were developed for the HAVERTOWN site to mitigate the identified exceedances of ARARs and exposures to contaminants of concern which resulted in unacceptable levels of risk to human, aquatic, and terrestrial receptors.

Ground Water

- Contamination shall be mitigated to the maximum extent possible to meet Commonwealth of Pennsylvania ARARs for drinking water. Discharge of treated ground water to the surface water system (Naylors Run) shall meet NPDES regulations;

- If ARARs cannot be met, all unacceptable risk to human health or the environment by contaminated ground water shall be mitigated to the maximum extent possible.

Naylors Run Sediments

- Exposures to contaminated sediments shall not result in unacceptable levels of risk to human, aquatic, or terrestrial receptors; and

- Any contaminated sediments in Naylors Run which act as a secondary source of contamination due to erosion, sediment transport, etc. shall be remediated to protect the quality of downstream surface water and sediments as aquatic habitat.

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2.3 GENERAL RESPONSE ACTIONS

General response actions which may achieve the remedial objectives include a variety of categories ranging from no action to extensive remedial action. Response actions for the ground water medium include provisions for:

- No Action on ground water (and related elements);
- Limited Action scenarios which include elements such as monitoring of the ground water, institutional controls, and deed restrictions;
- Source Removal actions including ground water free product recovery (and related elements);
- Containment and Collection actions such as existing storm sewer replacement/rehabilitation;
- Treatment of the ground water; and
- Discharge of the treated water to surface water and/or public sanitary sewer.

Sediment response actions include:

- No Action and Limited Action scenarios as per ground water actions;
- Removal of sediment from Naylors Run;
- Containment by piping Naylors Run and/or capping the National Wood Preservers site;
- On-site and/or off-site disposal of contaminated sediment; and
- Treatment/Disposal by incineration.

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Remediation of the site will be achieved by the implementation of one or more response actions by one or more of the technologies identified to be applicable to the remediation of site conditions.

2.4 IDENTIFICATION AND SCREENING OF TECHNOLOGY TYPES AND PROCESS OPTIONS

2.4.1 Definition of Screening Criteria

In this section, technologies applicable to the remediation of the ground water and the sediments will be identified and briefly discussed. Those technologies not appropriate for implementation at the site will be screened out and removed from further consideration as remedial technologies.

The identification and evaluation of the potentially relevant technologies and their constituent process options is summarized in Table 2-2 for the ground water medium and Table 2-3 for the sediment medium. All options are discussed in relation to their effectiveness, implementability, and relative cost. The criteria are summarized as follows:

Effectiveness: Each technology process option is evaluated for effectiveness and its relation with other processes by focusing on the following categories: short-term and long-term effectiveness in the protection of human health and environment; reduction in the toxicity, mobility or volumes of hazardous substances; and the performance and reliability of the technology with respect to the contaminants and conditions at the site.

Implementability: This includes both the technical and administrative feasibility of implementing the technology process options, with the main concern focusing on the technical feasibility.

Cost: During this screening process, cost will be based on best engineering judgement. Focus will be on the relative costs of technologies or options, designated qualitatively as low, moderate or high. Both capital costs and operation and maintenance costs (O&M) are considered.

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TABLE 2-2
HAVERTOWN PCP SITE
SCREENING OF TECHNOLOGY TYPES AND PROCESS OPTIONS
GROUND WATER MEDIUM

General Response Action	Technology Type	Process Option	Description	Screening Comments
No Action	Not Applicable	Not Applicable	No remedial action	Potentially applicable
Institutional Controls	Access Restrictions	Governmental Restrictions	Limitations on water use	Potentially applicable
		Zoning/Deed Restrictions	Deed restrictions on future ground water use	Potentially applicable
	Monitoring	Ground Water Monitoring	Periodic sampling of selected wells	Potentially applicable
Source Removal	Free Product Recovery	Oil Skimming	Recovery of free product to prevent further dissolution of contaminants into ground water	Potentially applicable
	Residual free-product source removal	Excavation	Excavation of residually contaminated subsurface soils	Not applicable at this time
		Vacuum Extraction	The application of a vacuum to enhance volatilization of compounds from LNAPL's floating on the water table or in vadose zone	Limited applicability—Not optimal for recovery of semi-volatiles e.g. PCP
		Steam Extraction/Soil Flushing	Introduction of steam and/or surfactants to flush residual contaminants from soil to capture zone of extraction system	Potentially applicable in vicinity of source
Containment	Active Pumping	Extraction Wells	Employment of a series of conventional shallow aquifer ground water extraction wells to prevent the migration of contaminants	Limited applicability due to low transmissivity
	Migration Barriers	Vertical Barriers	Grout injected to prevent vertical migration of contaminants	Not applicable due to fractured bedrock

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TABLE 2-2 (continued)
HAVERTOWN PCP SITE
SCREENING OF TECHNOLOGY TYPES AND PROCESS OPTIONS
GROUND WATER MEDIUM

General Response Action	Technology Type	Process Option	Description	Screening Comments
Containment (continued)	Migration barriers (continued)	Horizontal Barriers	Grout injected to prevent horizontal migration of contaminants	Not applicable due to fractured bedrock
		Rehabilitate/Replace Storm Sewer	Prevent flow of contaminated ground water into existing storm sewer	Potentially applicable
	Containment of Residual Free Product	Impermeable Cap	Installation of impermeable cap to minimize transport of residual contaminants from soil to the water table	Not applicable at this time
Collection	Active	Extraction Wells	Employment of a series of conventional ground water extraction wells to recover contaminated ground water for treatment	Potentially applicable in bedrock aquifer Limited applicability in shallow aquifer due to low transmissivity
	Passive	Interceptor Trench	Installation of perforated pipe in excavated trenches and membrane walls, backfilled with porous media, to collect contaminated ground water for treatment	Potentially applicable
		Wick Drains	Placement of a material to provide a preferential path for ground water movement to a treatment system	Not applicable because operation is slow and incomplete

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TABLE 2-2 (continued)
HAVERTOWN PCP SITE
SCREENING OF TECHNOLOGY TYPES AND PROCESS OPTIONS
GROUND WATER MEDIUM

General Response Action	Technology Type	Process Option	Description	Screening Comments
Treatment	Biological	In-situ/Ex-situ	Aerobic/anaerobic degradation of organics by metabolic processes of microorganisms	In-situ: Potentially applicable to residual free-product in soils; not applicable to ground water due to low transmissivity upper zone and fractured bedrock Ex-situ: Potentially applicable to organics
	Physical/ Chemical	Chemical Precipitation	Alteration of chemical equilibrium of ground water to reduce the solubility of iron and other metals, promoting precipitation out of ground water	Potentially applicable for treating metals prior to organics
		Chemical Oxidation/ Advanced Oxidation	Mixing of ground water with agents such as hydrogen peroxide, and/or ozone, with ultraviolet light enhancement, to oxidize contaminants	Potentially applicable to treatment of organics and dioxins
		Oil/Water Separation	Skimming of oil as it rises to the surface of a separator chamber	In operation
		Granular Activated Carbon Adsorption	Adsorption of contaminants onto activated carbon by passing water through a carbon column	Potentially applicable to removing organics, dioxins, and some inorganics from water
		Powdered Activated Carbon Treatment (PACT®)	Adsorption of contaminants onto activated carbon and biological treatment	Potentially applicable to removing organics, dioxins, and some inorganics from water

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TABLE 2-2 (continued)
HAVERTOWN PCP SITE
SCREENING OF TECHNOLOGY TYPES AND PROCESS OPTIONS
GROUND WATER MEDIUM

General Response Action	Technology Type	Process Option	Description	Screening Comments
Treatment (continued)		Steam Stripping	Continuous fractional distillation (using steam) to remove contaminants	Potentially applicable to volatile and semi-volatile organics, not applicable to metals and dioxins
		Air Stripping (with or without off-gas treatment)	Passage of large volumes of air through water in a packed column to promote transfer of VOCs to off-gas, which may be treated by fume incineration or vapor phase carbon	Applicable to volatile organics but not applicable to semi-volatiles, dioxins, and metals
		Reverse Osmosis	Utilization of high pressure to force water through a membrane, leaving contaminants behind	Not applicable because oil concentrations will destroy membrane
Disposal	Off-Site	Local POTW	Discharge of untreated or treated ground water to a local POTW in accordance with pretreatment regulations	Potentially applicable for treated ground water only
		Off-site TSD	Off-site disposal of untreated or treated ground water to an approved treatment, storage, and disposal facility	Potentially applicable
		Stream Discharge	Discharge of untreated or treated ground water to Naylors Run	Potentially applicable for treated ground water only
	On-Site	Ground Water Recharge	Recharge of treated ground water through the use of injection wells, either on or off site	Not applicable due to low transmissivity of soil saprolite

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TABLE 2-3
HAVERTOWN PCP SITE
SCREENING OF TECHNOLOGY TYPES AND PROCESS OPTIONS
NAYLORS RUN CHANNEL SEDIMENTS MEDIUM

General Response Action	Technology Type	Process Option	Description	Screening Comments
No Action	Not Applicable	Not Applicable	No remedial action.	Potentially applicable
Institutional Controls	Access Restrictions	Zoning/Deed Restrictions	Deed or zoning restrictions associated with future land use	Not applicable-channel sediments not located in area prone to development
		Fencing	Fencing area of contamination to prevent exposure	Not applicable; exposure hazard within acceptable limits
Containment	Cap	Single Layer	Installation of a single layer of grassed topsoil, asphalt, or a concrete slab over NWP to prevent contaminant surface run-off into Naylors Run	Potentially applicable
		Synthetic Membrane	Installation of a synthetic membrane covered by soil over areas of contamination to prevent contaminant run-off into Naylors Run	Potentially applicable
Treatment	Physical/ Chemical	Soil Flushing	Treatment of excavated sediments by extraction with liquid solvents, with or without special additive chemicals, to remove contaminants	Not applicable to treatment of dioxins
	Thermal	On-Site Incineration	Thermal treatment of sediment in a mobile unit on site	Potentially applicable; however area is highly urbanized
		Off-Site Incineration	Thermal treatment of sediment at an approved facility off site	Potentially applicable
Removal	Complete Removal	None	Complete excavation/removal of channel sediments for treatment and/or disposal	Potentially applicable
	Partial Removal	None	Partial ("hot spots") excavation/removal of channel sediments for treatment and/or disposal	Potentially applicable
Disposal Sediment	On-Site	Replacement	Placing sediment at National Wood Preservers before capping area	Potentially applicable
		Disposal Facility	Disposal of untreated or partially treated soil in an on-site facility	Potentially applicable
	Off-Site	TSD Facility	Disposal of contaminated media at an approved off-site treatment, storage, and disposal facility	Potentially applicable

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The following subsections present the medium-specific evaluation of the feasible technologies and process options. The technologies and process options relevant to the ground water medium are presented first, followed by those for the sediment medium.

2.4.2 Ground Water Technologies

2.4.2.1 No Action

Description: No Action means that no remedial actions are to be conducted on the ground water.

Effectiveness: A No Action evaluation is required by USEPA RI/FS Guidance as a baseline against which other remedial alternatives may be compared. Since there is no remedial action undertaken, there is no additional adverse impact on human health and the environment caused by implementation of No Action. The remedial action objectives for ground water would not be achieved except for possible long term dilution, biodegradation, and natural attenuation of contaminants that may occur.

Implementability: This criterion does not apply to the No Action alternative.

Cost: No cost is associated with this action.

2.4.2.2 Limited Action

Method 1 - Institutional Controls and Deed Restrictions

Description: Institutional actions are a class of controls that can be used to minimize the potential for exposure to the ground water. These controls would entail ground water use (well installation) restrictions for the area. Deed restrictions could be required as well.

Effectiveness: Restrictions on ground water use would protect human health and the environment even though contaminants would remain in the ground water. Protection would be provided by preventing the consumption, use, or release to the environment of contaminated ground water by area residents. Depending upon the enforceability of the actions taken, the remedial action objectives may or may not be met. There would be no additional adverse impacts to human health and the environment caused by implementation of this action as long as the contamination in the plume does not continue to migrate.

Implementability: The successful enforcement of institutional controls would require the cooperation of various public and private entities.

Cost: Long-term O&M costs for implementation of institutional controls are expected to be low.

Method 2 - Ground Water Monitoring

Description: Monitoring involves periodic sampling of the monitoring wells to determine changes in the magnitude and extent of contamination in the plume over time.

Effectiveness: Monitoring would have no additional adverse impact on the ground water. Monitoring alone would not meet remedial objectives for ground water.

Implementability: The equipment and labor required to monitor site ground water are readily available. No permits would be required unless additional monitoring wells were installed.

Cost: Ground water sampling and analysis of selected existing wells will result in moderate long-term O&M costs. No capital costs are associated with this action unless additional monitoring wells are installed.

2.4.2.3 Source Removal Technologies

Method 1 - Free Product Recovery

Description: Floating Non Aqueous Phase Liquid (NAPL) free product can be removed from the shallow aquifer water table surface by the action of one (or several) large diameter well(s) with a free product skimmer. Skimmers are available which can remove both free product and water or to remove only free product. An skimmer that removes only free product operates as follows. The skimmer head floats on the water surface such that the designed inlet level is always at the oil/water interface. A semipermeable screen inside the skimmer head allows free product to pass into the skimmer, but repels water. The free product is removed from the skimmer by use of a positive displacement transfer pump. The skimmer can be turned off automatically or manually when no free product is being recovered.

Effectiveness: Free product recovery by skimming is a proven technology. It has been demonstrated that this process will work at Havertown, but due to the indicated low transmissivity of the aquifer, free product does not recharge quickly enough to allow constant pumping. A pulsed or cyclic pumping schedule is therefore recommended. The recovery of free product may be enhanced by the use of ground water pumping to slightly lower water levels in the well vicinity, thus induce a gradient towards the pumping well. This procedure is not advocated at the HAVERTOWN site because of the indicated very low well yields (<1 gpm) in /the shallow zone and because of the potential for lowering of the water table to expose additional subsurface soils to the LNAPL contaminants.

Implementability: This process can be easily implemented. One or more 24-inch diameter recovery wells could be installed where free product has been observed (in the area of R-2 and HAV-02). A large diameter well would provide a greater surface area over which free product could be recovered and would also provide a larger collection area, optimizing the recovery system.

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Cost: Capital and O&M costs are expected to be low to moderate when compared to other remedial technologies. The long-term maintenance of vacuum ports is associated with this option.

Method 4 - Residual Source Removal by Steam Extraction or Soil Flushing

Description: This is an emerging technology which utilizes the application of steam, a solvent, or surfactant (depending upon the chemical behavior of the target contaminant) to facilitate the extraction of contaminants from the vadose zone. The mobilized contaminants and vehicle are then collected from the subsurface, e.g., drawn into a pumping extraction well, for treatment or disposal. The extractant used must be limited to those which exhibit low toxicity and will not otherwise harm the subsurface environment. This methodology is applicable to contaminants which are not recoverable by vacuum extraction, e.g., semi-volatiles, metals, and cyanides. USEPA Guidance (EPA, 1990) suggests that this method only be applied in situations where other less potentially intrusive remedial technologies cannot be utilized.

Effectiveness: Treatability studies would be needed to assess the effectiveness of this emerging technology to remediate the contaminants at the site. PAH's have a strong affinity for binding to soil particles, and may be difficult to extract from fine-grained residual soils.

Implementability: The uncertainties associated with this technology, as well as those associated with the magnitude, extent, and chemical nature of vadose zone contaminants, render it inapplicable on the basis of current knowledge. Therefore it is screened from further consideration for implementation at this time, but will be evaluated as a part of the subsurface soils operable unit.

Cost: Unable to assess at this time.

2.4.2.3 Source Removal Technologies

Method 1 - Free Product Recovery

Description: Floating Non Aqueous Phase Liquid (NAPL) free product can be removed from the shallow aquifer water table surface by the action of one (or several) large diameter well(s) with a free product skimmer. Skimmers are available which can remove both free product and water or to remove only free product. An skimmer that removes only free product operates as follows. The skimmer head floats on the water surface such that the designed inlet level is always at the oil/water interface. A semipermeable screen inside the skimmer head allows free product to pass into the skimmer, but repels water. The free product is removed from the skimmer by use of a positive displacement transfer pump. The skimmer can be turned off automatically or manually when no free product is being recovered.

Effectiveness: Free product recovery by skimming is a proven technology. It has been demonstrated that this process will work at Havertown, but due to the indicated low transmissivity of the aquifer, free product does not recharge quickly enough to allow constant pumping. A pulsed or cyclic pumping schedule is therefore recommended. The recovery of free product may be enhanced by the use of ground water pumping to slightly lower water levels in the well vicinity, thus induce a gradient towards the pumping well. This procedure is not advocated at the HAVERTOWN site because of the indicated very low well yields (<1 gpm) in /the shallow zone and because of the potential for lowering of the water table to expose additional subsurface soils to the LNAPL contaminants.

Implementability: This process can be easily implemented. One or more 24-inch diameter recovery wells could be installed where free product has been observed (in the area of R-2 and HAV-02). A large diameter well would provide a greater surface area over which free product could be recovered and would also provide a larger collection area, optimizing the recovery system.

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Costs: The capital costs of drilling shallow, large-diameter extraction wells and the purchasing and installing skimmers are expected to be low to moderate. Operations and Maintenance costs such as power and routine maintenance are also anticipated to be low. Costs for the disposal of the recovered free product are expected to be low, unless dioxin levels preclude standard disposal practices.

Method 2 - Residual Source Removal by Soils Excavation

Description: This technology involves the removal of residual free product which may act as a secondary source of contamination to the ground water by the excavation of subsurface soils in the vicinity of the source area.

Effectiveness: Because the areal and vertical extent of residual soil contamination remains unknown, the volume of soil to be excavated is undetermined. These considerations render soil excavation an infeasible technology to implement on the basis of current knowledge. Therefore soil excavation shall be screened from further consideration until additional data have been collected as a part of the soils operable unit.

Implementability: Unable to assess at this time.

Cost: Unable to assess at this time.

Method 3 - Residual Source Removal by Vacuum Extraction

Description: Vacuum extraction is effective at removing volatile contaminants from the vadose zone which may act as a source of ground water contamination. This technology is typically implemented in-situ; however, treatment of excavated soils on-site is also effective.

In-situ vacuum extraction consists of vacuum extraction ports which are connected to a vacuum pump system to provide continuous air flow through the soil, resulting in the stripping of volatile compounds from the soil or from

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LNAPLs floating on the water table. Some form of nearly impervious surface cover is used to ensure that airflow pathways are nearly horizontal. In some systems, air injection wells are used at the perimeter of the contaminated zone to increase air flow through the soil, thus aiding in both oxygenation of the subsurface to facilitate natural biodegradation and in contaminant stripping.

Effectiveness: Vacuum extraction has been found to be particularly applicable to the removal of relatively volatile organic compounds (those with Henry's Law Constant > 10^{-3} atm-m^3/mole) residing in the unsaturated zone. It can also be applied to remove volatile light non-aqueous phase liquids (LNAPLs) floating on the water table or bound in the capillary fringe. Generally, any compound with a low solubility in water and a vapor pressure of at least 1 mm Hg at ambient soil temperatures (55 to 60 degrees Fahrenheit) can potentially be removed by vacuum extraction. Vacuum extraction cannot remove metals (except mercury), heavy oils, or PCBs.

Because the areal and vertical extent of residual soil contamination remains unknown, the area and volume of soil to be treated is undetermined. These considerations render soil vacuum extraction an infeasible technology to evaluate and implement on the basis of current knowledge. Therefore vacuum extraction shall be screened from further consideration until additional data have been collected as a part of the soils operable unit.

Implementability: The equipment, materials, and labor required for the application of this technology are commercially available. Once the extent of soils to be remediated is determined, a pilot demonstration test would be required at the site in order to develop the system design and layout, as well as the expected performance. No off-site TSD facilities or permits would be required for processing, except that PADER air emissions limits would have to be met. In many vacuum extraction systems, air emissions treatment through vapor phase carbon adsorption is required.

Cost: Capital and O&M costs are expected to be low to moderate when compared to other remedial technologies. The long-term maintenance of vacuum ports is associated with this option.

Method 4 - Residual Source Removal by Steam Extraction or Soil Flushing

Description: This is an emerging technology which utilizes the application of steam, a solvent, or surfactant (depending upon the chemical behavior of the target contaminant) to facilitate the extraction of contaminants from the vadose zone. The mobilized contaminants and vehicle are then collected from the subsurface, e.g., drawn into a pumping extraction well, for treatment or disposal. The extractant used must be limited to those which exhibit low toxicity and will not otherwise harm the subsurface environment. This methodology is applicable to contaminants which are not recoverable by vacuum extraction, e.g., semi-volatiles, metals, and cyanides. USEPA Guidance (EPA, 1990) suggests that this method only be applied in situations where other less potentially intrusive remedial technologies cannot be utilized.

Effectiveness: Treatability studies would be needed to assess the effectiveness of this emerging technology to remediate the contaminants at the site. PAH's have a strong affinity for binding to soil particles, and may be difficult to extract from fine-grained residual soils.

Implementability: The uncertainties associated with this technology, as well as those associated with the magnitude, extent, and chemical nature of vadose zone contaminants, render it inapplicable on the basis of current knowledge. Therefore it is screened from further consideration for implementation at this time, but will be evaluated as a part of the subsurface soils operable unit.

Cost: Unable to assess at this time.

Method 5 - Residual Source Removal by In-Situ Bioremediation

This technology is described under Treatment Technologies in Section 2.4.2.7. as Method 6. As with the previous residual source removal technologies, it is found to be inapplicable to the site at this time, but will be evaluated as a part of the soils operable unit.

2.4.2.4 Ground Water Containment Technologies

Method 1 - Active Pumping

Description: Pumping wells utilized for ground water containment or collection technologies consist of a well screened over the desired interval of recovery, a sand filter pack around the screen, and solid casing, with the annular space cement-grouted to the land surface. This type of well is typically installed at lateral spacing intervals across a site such that the respective overlapping cones of depression permit the containment of the contaminant plume. These wells would be installed to the depths appropriate for the capture of contaminated ground water.

Effectiveness: Pumping is a widely used technique for the long-term containment, collection, and treatment of contaminated ground water.

The predominant chemicals of concern in the ground water at the HAVERTOWN site are pentachlorophenol (PCP) and dioxin. The ability of ground water pumping technologies to contain and/or remove the contaminants of concern depends upon both the characteristics of the compounds and the hydraulic characteristics of the aquifer(s). Since the major contaminant of concern, PCP, is hydrophobic and the shallow aquifer demonstrated very low (< 1 gpm) well yields during pumping, continuous ground water pumping of the shallow aquifer is believed to have limited potential for success. Because site-specific aquifer properties are largely unknown, it may be appropriate to conduct pumping tests to determine the characteristics of the shallow aquifer. The potential for increasing the vertical distribution of LNAPL contaminants has been identified to be a possible

consequence of lowering the ground-water table by pumping. Because of this potential and the indicated unfavorable subsurface conditions, shallow ground water pumping is screened as inappropriate to site conditions in the vicinity of the NWP Site.

In the fractured bedrock aquifer at the NWP Site, wells located along a fracture will sustain the highest yield, but no individual well will have a significant cone of influence. Due to the downward component of flow observed in the cluster wells on the NWP property (CW-1 and CW-2), there is the potential for the pumping of the bedrock aquifer to exacerbate the downward flow of ground water and introduce additional contaminants from the shallow aquifer into the deep aquifer. Deep aquifer pumping is therefore screened from further consideration as being inapplicable at this time. Once the shallow aquifer is remediated using free product recovery, pumping of the deep aquifer may be reconsidered as a means to address any residual contaminants as an additional operable unit.

Implementability: Pumping wells can be easily installed with minimal disruption at the site. Locations would be selected, where possible, to minimize disturbances to the residential neighborhood. The materials and labor for the construction of these wells are readily available. A well drillers' permit, and easements for the wells and pipe lines would be required. Treatment of the pumped ground water will probably be required prior to either discharge to Naylors Run or a POTW.

Cost: The capital cost for drilling and installing pumping wells is generally low. The overall O&M cost is low to moderate because of maintenance requirements and power consumption.

Method 2 - Ground Water Containment by Storm Sewer Rehabilitation/Replacement

Description: During the field investigation phase of the RI a closed circuit television surveillance was conducted of the existing 30-inch storm sewer system south of the Philadelphia Chewing Gum Company property. This storm sewer begins

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on Rittenhouse Circle and discharges to Naylors Run at the location of the new oil/water separator. The video tape that documented the investigation shows the locations of ground water inflow and infiltration. The video taping identifies the presence of a pipe discharging into the manhole at the south side of the Philadelphia Chewing Gum Company property. This is apparently an unpermitted connection to the storm sewer which unnecessarily increases the dry weather flow of the storm sewer. The source of inflow will be plugged, after USEPA notifies the affected property owners of the action to be taken.

Infiltration into the storm sewer system was observed during the television surveillance because the section of the storm sewer closest to Naylors Run is constructed below the water table. Contaminant migration due to infiltration of the contaminated ground water into the storm sewer is the remaining concern.

There are two basic options for correction of this condition. The first is the complete replacement of the storm sewer pipe, which would involve excavating the section of pipe, removing the pipe, disposing of the contaminated pipe and soils in the trench, and then replacing the pipe. The second option is to line the storm sewer pipe in-place.

Given the problem of disposal of the contaminated soil associated with the first option, the second option was selected for consideration. The storm sewer pipe could be lined in-place, using one of several possible vendors. The lining will virtually eliminate any infiltration of contaminated ground water into the storm sewer pipe. The contaminated water which is presently being collected by the storm sewer pipe will instead be collected in the shallow ground water collector trench, (if installed) with the advantage that the flows in the collector trench will not be subject to radical increases in flow during storm events.

Effectiveness: Lining the storm sewer pipe should be very effective in reducing storm sewer infiltration of contaminated ground water.

Implementability: A problem may arise in lining the storm sewer pipe if the work area encroaches on a resident's property. Prior to lining the storm sewer

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the contractor will probably clean the pipe. During the cleaning and/or lining of the pipe, it may be necessary to by-pass storm water flow. Otherwise there should be no technical difficulties.

Costs: The capital costs of this option are moderate but the O&M costs are very low.

Method 3 - Containment of Residual Free Product by Site Capping

Description: This technology involves the installation of an impermeable cap over the surface of the residual source area to inhibit the infiltration of precipitation and thereby to minimize the mobilization and transport of residual contaminants from the vadose zone into the ground water. Capping materials typically consist of clay, cement, asphalt, or a multimedia cap consisting of a combination of clay with synthetic liner materials.

Effectiveness: Capping technologies have been successfully utilized at numerous RCRA facilities and hazardous waste sites. The applicability of this remedial method at this site is hampered by the fact that approximately 40 years have elapsed since the alleged initiation of the waste disposal practices at the site. Since that time, contaminants have been migrating through the subsurface, and their current extent is undetermined. Therefore, the capping technology is not thought to be applicable to present conditions at the site in that the migration of subsurface contaminants has already occurred to an unknown extent.

Implementability: Because the location and areal extent of residual contamination is unknown, this technology cannot be implemented at the site on the basis of current knowledge. Therefore this technology is screened from further consideration at this time, and will be reevaluated as a part of the soils operable unit.

Cost: Unable to assess at this time.

2.4.2.5 Ground Water Collection Technologies

Method 1 - Active Ground Water Collection using Extraction Wells and Trenches, and Passive Ground Water Collection using Wick Drains and Membrane Walls

Description: Ground water collection systems are devices or a combination of devices installed to intercept and extract ground water from the saturated flow zone to contain the migration of a contamination plume and/or to remediate the ground water in the long term. Collection systems include both active and passive devices, as well as point and line (or area) devices. Pumped extraction wells and trenches, ground water galleries, and isolated collection systems are examples of active devices. The active extraction devices work by enhancing a gradient on the ground water system by withdrawing ground water, which induces an increased flow toward the collection location. Refer to Section 2.4.2.4 for a discussion of active pumping systems and to Section 2.4.3.5.

Extraction trenches, wick drains, and membrane walls are examples of passive collection systems. A passive system takes advantage of static conditions to collect contaminants, relying on the natural ground water gradient to carry the contaminants to the collection location and/or to a barrier impermeable to the passage of ground water. It is very common to use more than one collection system in a combined or supplemental role. Extracted ground water would be collected for transport to an off-site treatment plant or piped to an on-site treatment system.

Disposal of excavated soils, if not contaminated, may be removed from the site and transported to a landfill for disposal. Soils form the collector trench contaminated with site related organic compounds (e.g. pentachlorophenol) will be probably classified as K001 waste and therefore can not be disposed in a landfill. The contaminated soils will have to be transported off-site for incinerated or landfilled on-site at NWP. If dioxin concentrations in the soils exceed 1 µg/kg, the material may be classified as an F waste. At this time, no incinerators in the country are permitted to accept F classified waste. Refer to Section 2.4.3.5 for additional discussion on disposal of soils.

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Effectiveness: Active or passive extraction (collector) trenches are a proven, effective method for containing contamination plumes that exist at shallow depths (<40 feet). Trenches offer the advantage of capturing contaminants in a wide area with the maximization of the cross-section of the trench in the saturated zone. Favorable subsurface conditions exist on the southeastern portion of the site for the construction of a collector trench.

A ground water gallery is an effective method of intercepting ground water in a line, rather than a point, in areas where the access to the target zone is limited from the land surface. Since land surface access is not limited at the site, and the construction effort involved with building a gallery is much more complex than building a trench, this would not be the preferred collection system.

Wick drains have the disadvantage of slow operation and incomplete effect. Despite the slow movement of ground water at the site, a more effective device than wick drains, i.e., an collector trench, has been identified to be feasible.

A membrane wall would be best implemented as a secondary feature of an active system to limit the influence of the system and to reduce the volumes of ground water entering the system.

Recovered ground water would require treatment prior to on- or off-site disposal. Treatment options are discussed in Section 2.4.2.6 and 7. Minor volatilization of VOCs in ground water may occur in a trench system, and would be monitored to assess any violation of air quality ARARs or threats to human health.

Implementability: A ground water collection system is not complicated to install. The area at the site optimal for the location of the containment system is the backyards of the residential neighborhood, although this may not meet with community approval. Construction of the containment system will create a moderate to high degree of disruption. The materials and labor for the construction of the system are readily available. Permits will need to be

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obtained from PADER and easement agreements from neighboring property owners for construction of the containment system. If dioxin levels are above 1 µg/kg the excavated material can not be removed off site. During remedial design the subsurface soils will need to be sampled and analyzed for TCL/TAL and dioxin and dibenzofuran.

Cost: The capital cost for the construction of a collector trench ranges from moderate (if the trench is shallow) to high (if the trench is deep). The overall O&M cost is low to moderate because of maintenance requirements and power consumption associated with the pumping of the collected water to a treatment system. Refer to Section 2.4.3.5 for cost associated with the disposal of soils.

Method 2 - Collection of Residual Subsurface Soil Contaminants by Vacuum Extraction, Steam Extraction, and/or Soil Flushing

These technologies have been previously discussed under Source Removal Technologies in Section 2.4.2.3.

2.4.2.6 Ground Water Treatment Technologies for Inorganic Contaminants

Method 1 - Chemical Precipitation

Description: Chemical precipitation processes may be used to remove inorganic species such as iron, manganese and zinc from the water once it has been removed from the aquifer. A chemical precipitant is added to the water. The solution is mixed, and a flocculating agent (such as a synthetic polymer) is added to enhance floc formation and settling. Chemical precipitation can be applied as an initial treatment step for organics-contaminated ground water, as a "roughing" process to protect against unwanted accumulation or interference of solids in organics-treatment units. Because the process results in the formation of insoluble metal salts, a solids fraction is generated that may require dewatering prior to disposal. Possible disposal options will depend on the character of the solids fraction, which can be determined using the TCLP

(Toxicity Characteristic Leaching Procedure). Chemical coagulants and polymers are available in liquid or solid form to improve the settleability of the raw water to be treated.

Effectiveness: Chemical precipitation is an effective and reliable conventional technology for metals/solids removal, as long as the metals are present in sufficient quantity and oxidation state to permit precipitation. Chemical precipitation has been successfully used for removing heavy metals and other inorganics from water but is not suitable for organics removal. The process is limited by the fact that not all metals have a common optimal pH at which they precipitate. Laboratory-scale testing will be necessary to optimize the full-scale process. Unless treatment vessels are covered to prevent volatile emissions, there may be potential adverse impacts to human health and the environment during implementation. At the site, the overall low levels (<10 ppm) of volatiles in the water may eliminate the need for closed tanks. Chemical precipitation alone would not attain remedial action objectives for contaminated ground water. Chemical precipitation would be used as a first step process prior to treatment processes for organics.

Implementability: The materials and labor needed for proper installation of this process option are readily available. A mixing tank and a settling tank are usually required for chemical precipitation. Chemical precipitation at the site would be used as an aluminum, iron, manganese, and zinc pretreatment step prior to further treatment of the ground water for organics removal. Sludge disposal facilities, depending on the size of the treatment plant, may be required.

Cost: The capital cost for implementing this process option is generally low. However, the costs for chemicals, solids fraction disposal, supervision, and maintenance lead to moderate O&M costs.

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Method 2 - Reverse Osmosis

Description: In normal osmotic processes, the solvent (e.g., water) will flow across a semi-permeable membrane from a dilute concentration (e.g., a solution of contaminants in water) to a more concentrated solution (e.g., water with no solute) until equilibrium is reached. The application of high pressure to the concentrated side will cause this process to reverse. This results in solvent (water) flow towards the concentrated solution (purer water), leaving an even higher concentration of solute. The semi-permeable membrane can be flat or tubular, and acts as a filter due to the pressure driving force. In application the waste stream flows past the membrane while the solvent, such as water, is pulled through the membrane's pores and the remaining solutes such as organic or inorganic components do not pass through, but become more and more concentrated on the influent side of the membrane.

Effectiveness: As a contaminant collection method, reverse osmosis is very effective. Some membranes may be dissolved by some wastes. Low-solubility salts may precipitate onto the membrane surface. Suspended solids, some organics, and oil will clog the membrane material. The oil concentration exiting the existing oil/water separator, although reduced from its initial concentration, would remain very detrimental to the membrane. Even if an additional oil/water separator unit were installed to remove the residual oil from the water, the process may not be sufficient to remove emulsified oils which would clog the reverse osmosis membrane. The properties of the contaminated ground water at this site are not amenable to remediation by a reverse osmosis system, thus it is screened from further consideration.

Implementability: The equipment, materials, and labor required for the application of this technology are commercially available.

Costs: The capital costs are low but the O&M cost would be unreasonably high.

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Method 3 - Granular Activated Carbon

Some types of inorganic elements and compounds will adsorb to activated carbon. Because this methodology is typically implemented as an organic treatment process, it is described in the Organic Treatment Technologies as Method 3 in Section 2.4.2.7.

2.4.2.7 Ground Water Treatment for Organic Contaminants

Method 1 - Air Stripping

Description: Air stripping to remove organics from water is performed by passing air through the water to facilitate transfer of volatile organics from the liquid phase to the gas (e.g, air) phase. These volatiles are then removed with the stripper off-gas. The degree to which stripping is successful for removing volatiles from a liquid stream depends on the volatility of the compounds present, the volumetric ratio of air to water flow, the surface area of the air/liquid interface, and the temperature at which stripping is conducted. Three principal methods of air stripping are employed: diffused aeration, mechanical aeration, and packed or spray tower stripping. Packed-tower stripping is most widely used for stripping volatiles in waste streams the size of this site.

Effectiveness: The packed-tower stripping efficiency for a given compound is primarily a function of the air-to-water ratio, the packing configuration and depth, and the stripping temperature. Air stripping is not suitable for highly water-soluble organic compounds, metals, non-volatile organics, or dioxin. This technology is expected to be effective on the volatile compounds detected in the ground water at the site. Off-gas treatment may be needed based on the levels of contaminants in ground water and the flow rate through the stripper. The remedial action objectives for recovered ground water would not be met with this technology alone, as site-related compounds such as the phenolics, dioxin and metals are not strippable. However, air stripping can be used as a pretreatment step to reduce the loading of organics on polishing processes.

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Implementability: The materials and labor needed to install an air stripper are readily available. An air discharge permit could be required.

Cost: The cost for installing an air stripping system is low to moderate. The O&M is generally low and depends on power consumption and the frequency of packing replacement.

Method 2 - Steam Stripping

Description: Steam stripping operates essentially as a continuous fractional distillation process carried out in a packed or tray tower. Steam is used to evaporate volatile organics from aqueous wastes. Clean steam provides direct heat to the column in which gas flows from the bottom to the top of the tower. The resulting residuals are contaminated steam condensate, recovered solvent and stripped effluent. The organic vapors and the raffinate are sent through a condenser in preparation for further treatment. Carbon adsorption may be used as a post-treatment.

Effectiveness: Steam stripping is effective on chlorinated hydrocarbons, aromatics such as xylenes, ketones such as acetone or MEK, alcohols such as methanol and high boiling point chlorinated aromatics such as pentachlorophenol. Dioxin will be left untreated. Steam stripping can handle a wide concentration range (less than 100 ppm to about 10 percent organics). Some type of air pollution control mechanism will be needed.

Because dioxins are not treated and various post-treatments would be needed, this process appears to not be feasible as a stand-alone technology.

Implementability: The equipment, materials, and labor required for the this technology are commercially available. Off-site TSD facilities or permits would be required and PADER emission standards would have to be met.

Costs: The capital and O&M costs are moderate for this process.

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Method 3 - Granular Activated Carbon Adsorption

Description: Carbon adsorption involves contacting a waste stream with activated carbon, usually by flow through a series of packed bed reactors. Most organic compounds, many inorganics, and dioxins will readily attach to the carbon. The carbon is said to be activated because the carbon has been treated to increase its surface-to-volume ratio. This allows more adsorption to occur. The strength of the attachment of a compound to carbon depends on the specific compound being adsorbed. The stronger this attachment, the more difficult the subsequent desorption will be.

When the activated carbon has adsorbed so much that its adsorptive capacity is severely depleted, the "spent" carbon must either be regenerated or replaced. Carbon regeneration can be accomplished on-site or off-site. If steam is used to regenerate the carbon, a condensate requiring treatment or disposal will result. If the carbon is directly heated instead, the adsorbed organics can be destroyed and converted to primarily carbon dioxide and water. Simple carbon replacement may be more cost effective than regeneration for strongly adsorbed compounds.

Effectiveness: GAC is an effective and reliable means of removing aqueous wastes with high molecular weight, high boiling point, and low solubility and polarity: aromatics such as phenol, chlorinated hydrocarbons such as tetrachloroethylene, and dioxin. GAC may also provide some metals removal. The GAC process is, however, sensitive to iron and suspended solids concentrations. This process effects a permanent removal of contaminants from the water and has the advantage that no off-gas is generated. There would be minimal impacts to human health and the environment associated with carbon replacement.

The carbon-packed beds range in size from disposable 55-gallon drums to sizes appropriate for wastewater treatment plants. Depending upon the concentrations and type of chemicals that need to be treated, GAC can be used as either a primary treatment process or a secondary (polishing) process. A pilot test

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would be required to determine the effectiveness of the GAC process for the recovered ground water.

Implementability: The equipment and labor for installing this process option are readily available, and the operation and maintenance requirements of the system are not complex. Mechanical equipment failure should be infrequent and minor for a GAC system. Spent carbon must either be disposed of, regenerated, or incinerated depending on the quantity of carbon used and the relative costs of each option. Off-site carbon regeneration or disposal facilities would be appropriate at HAVERTOWN. Presently, waste from the site is classified for disposal (incineration) as K001 waste. If GAC is used as the primary organic treatment process, the dioxin concentrations in the spent carbon could increase above 1 µg/kg. Spent carbon, if dioxin concentrations exceed 1 µg/kg, could be classified as a F series waste instead of a K series waste. Currently, no disposal facilities are permitted to accept dioxin F series waste. Because the disposal of the dioxin-contaminated carbon is currently unresolved, this technology is screened from further consideration as a primary organic treatment process and retained for use as a secondary (polishing) organic treatment process. A pilot test during the treatability will verify if GAC is appropriate and cost effective as a polishing process.

Cost: The capital and O&M costs for a GAC system are moderate. Carbon regeneration and replacement are the primary factors determining the O&M costs.

Method 4 - Powdered Activated Carbon Treatment with On-Site Carbon Regeneration

Description: A Powdered Activated Carbon Treatment (PACT™) system uses powdered activated carbon which can have a greater adsorptive capacity than granular carbon, and combines it with activated sludge. The powdered activated carbon adsorbs compounds similar to those adsorbed by granular carbon, but has a greater unit surface area.

A Batch-Operated PACT™ is designed for small flow rates. The batch operation allows aeration, settling, and decanting - all in the same tank. In the first

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step, the water is pumped from a flow equalization tank into the aeration tank where it comes in contact with a mixture of biological solids and powdered activated carbon. In the second step, the contents are aerated. During aeration, the biodegradable portion of the waste is treated biologically, while the non-biodegradable contaminants are adsorbed in the carbon particles. In step three, aeration ceases and the tank contents are allowed to settle. The solids are retained in the tank for use with the next batch of water, unless some disposal or regeneration is needed. Ordinarily, 150-200 mg/l of Chemical Oxygen Demand (COD) is needed to support the biomass. If necessary, a supplemental carbon source (e.g., molasses) can be metered into the treatment system.

When the powdered activated carbon has adsorbed so much that its adsorptive capacity is severely depleted, the "spent" carbon must either be regenerated or replaced. If the spent carbon is replaced instead of being regenerated, it is possible, if the carbon is contaminated with high concentrations of dioxins, that no options are available for off-site disposal or incineration. The method for remediation of the spent carbon is regeneration. The preferred method of carbon regeneration is on-site Wet Air Oxidation.

Effectiveness: The PACT™ system is very reliable and effective in removing volatile organic compounds from ground water. Acid extractables (e.g., pentachlorophenol) and aromatic compounds are generally well removed. Dioxins are also adsorbed. Phenolics removability decreases with increased ring chlorination. Supplementing the PACT™ system with the Wet Air Oxidation process on-site for regeneration of the carbon is an effective approach for the final destruction of dioxins.

Implementability: The Batch PACT™ plant and the Wet Air Oxidation Process arrives on-site, ready to hook up and operate. This option has the advantage of possibly destroying the dioxins by carbon regeneration. A disposal facility may not take the spent solids (carbon plus biomass) if they contain dioxin waste greater than 1 µg/kg. PACT™ can only be implemented by use of on-site regeneration of the spent carbon.

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Cost: The capital costs for a Batch PACT™ with Wet Air Oxidation plant are moderate to high. O&M costs for a Batch PACT™ is also moderate to high.

Method 5 - Advanced Oxygen Process

Description: The advanced oxygen process consists of adding an oxidizing agent, such as hydrogen peroxide, Fenton's reagent, ozone, or hypochlorite in conjunction with ultraviolet radiation, to a waste stream to convert organics to more highly oxidized intermediates or ultimately to carbon dioxide and water, depending on the oxidant used. The ultraviolet light greatly enhances the oxidation process by transforming O_3 and/or H_2O_2 into highly reactive (OH) radicals. Partially oxidized intermediates may be readily treatable.

Effectiveness: Advanced oxygen process has been successfully used to treat water contaminated with a variety of organic compounds, but it is not effective for metals removal. Advanced oxygen process is most effective on aromatics, alkenes, and halogenated compounds and least effective on alkanes. This process is reported to also destroys dioxins. The toxicity of the water is generally reduced following chemical oxidation, although in some cases partially oxidized intermediate compounds are formed, which tend to increase overall toxicity. The degree of intermediate degradation product formation depends on the oxidant, dosage, and reaction time.

In an oxidation process using ozone, hydrogen peroxide and ultraviolet light, the organics are oxidized to form carbon dioxide and water. Any halogens are converted to inorganic halides. Chemical oxidation is thermodynamically irreversible, since once the organics are converted to less complex, stable substances, they do not revert to their original forms. A pilot test would be required for most process applications to determine the effectiveness and reliability of the process on the specific contaminants at the site, as well as to define appropriate reaction time and dosage rates. There would be no expected impacts on human health or the environment during remediation, because the process does not generate air emissions or sludge. This process option

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could meet the remedial action objectives of organics removal in the ground water recovered from the aquifer.

Implementability: The equipment, chemicals, and services needed to implement this process are readily available. The operation and maintenance requirements for a ground water treatment system would include maintaining the inventory of chemical feedstocks and checking pumps, mixers, metering pumps, and power supplies for proper operation. Long-term management would be required for any chemical oxidation system until such time as ground water treatment was discontinued.

Cost: The capital cost for installing and operation chemical oxidation is moderate to high. O&M costs are moderate.

Method 6 - In-situ Bioremediation

Description: Bioremediation; (1) is a process in which bacteria degrade contaminants by using the contaminant as food, and (2) can occur aerobically or anaerobically. In general, aerobic degradation processes are more often used because the degradation process is more rapid and more complete, and problematic end products (methane, hydrogen sulfide) are not produced. However, anaerobic degradation is important for dehalogenation.

Some compounds are not degradated by naturally occurring microbial populations because of the lack of solubility, absence of required enzymes, nutrients or other factors. Organic microorganisms require adequate levels of inorganics and organics nutrients, water, oxygen, carbon dioxide and sufficient biological space for survival and growth. One or more of these factors are usually in limited supply. In addition, various microbial competitors adversely affect each other through the struggle for these limiting factors. Other factors which can influence microbial biodegradation rates include microbial inhibition by chemicals in the waste to be treated, the seasonal state of microbial development, predators, pH and temperature. Interactions between these and other potential factors can cause wide variation in degradation kinetics.

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Naturally occurring aerobic bacteria can decompose organic materials of both natural and synthetic origin to harmless or stable forms or both by mineralizing them to CO_2 and water. For the reasons mentioned above, aerobic biodegradation is usually carried out in processes in which all or many of the requisite environmental conditions can be controlled.

Effectiveness: Biodegradation may be able to remove the volatile and semi-volatile compounds but would not degrade the dioxin. Anaerobic treatment can be used in-situ, but the soils at the site are not conducive to in-situ biodegradation because the low porosity of the soil at the site does not leave sufficient space for the survival and growth of microbes. Also, the low transmissivity of the aquifer may hinder the ability of the microbes to travel with the ground water.

Implementability: The equipment, materials and labor required for application of the technology are available although this process is not yet a standardized engineering method. Treatability testing would be required to confirm the effectiveness of the process on remediating the contaminants at the site.

Costs: Capital costs are expected to be moderate, although site conditions may raise the cost.

2.4.2.8 Ground Water Disposal Technologies

Method 1 - On Site Disposal in Injection Wells

Description: Ground water recharge involves the replacement of treated ground water back into the aquifer by use of injection wells or infiltration galleries. The primary purpose of re-injection is to ensure the recharge of an aquifer.

Effectiveness: Although recharge has been successfully used at a number of sites for ground water disposal, it will not be effective at the HAVERTOWN site due to the indicated low hydraulic conductivity of the subsurface soils and saprolite. This option would also be difficult to implement because of the

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problems related to situating the wells or galleries in the highly urbanized area. Once the contaminants have been remediated, other discharge options are found to be more applicable to site conditions, thus more cost effective.

Implementability: The materials and equipment for the construction and operation of a recharge system are readily available. Permission from USEPA and PADER to discharge to ground water would be required.

Cost: The capital cost of a recharge system is expected to be moderate, as a limited number of wells would be required. The cost to operate and maintain the wells would be low to moderate.

Method 2 - Discharge of Treated Water to Naylors Run

Description: In this disposal option, treated ground water would be directly discharged to Naylors Run. This could require the installation of a pipeline from the treatment plant site to the discharge point.

Effectiveness: Direct discharge is a proven, effective means of disposing of treated ground water from a site. There would be no adverse impacts on human health or the environment since the water would meet PADER NPDES discharge standards. Direct discharge, in conjunction with appropriate ground water treatment measures, would attain remedial objectives for ground water.

Implementability: The materials and labor are readily available to install a direct discharge line from the site to either of the streams. A NPDES permit to discharge would be required. In addition, a right-of-way to the receiving stream selected may be required. Periodic inspection and maintenance of the pipeline would also be required.

Cost: The capital cost to install the discharge line is low to moderate, and O&M costs for inspection and maintenance are low.

2.4.3 Remedial Technologies for the Sediments in Naylors Run

2.4.3.1 No Action

Description: No Action means that no action will be implemented for the remediation of the sediments in Naylors Run.

Effectiveness: The No Action alternative is required as a baseline against which other remedial alternatives may be compared. Since there is no remedial action undertaken, there is no impact on human health or the environment caused by implementation. The remedial action objectives will not be met, except to the degree allowed by long-term natural transport of contaminated sediments out of Naylors Run.

Implementability: Not applicable for a No Action alternative.

Cost: No costs are associated with this action.

2.4.3.2 Limited Action

Description: This option includes provisions for institutional actions such as zoning or deed restrictions to prohibit future development of the contaminated area, and access restrictions to prevent against accidental exposure to surface contaminants.

Effectiveness: Both of these options are considered to be inapplicable to the site, because the stream channel is an unlikely site for development and because the dermal contact or ingestion risks associated with the channel sediments have been identified by the Risk Assessment to lie within the acceptable NCP range.

Implementability: Neither institutional controls or access restrictions would be difficult to implement, however they are screened as inapplicable to site conditions.

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Cost: Either of the limited actions would be inexpensive to implement, with very low capital costs and no O&M costs.

2.4.3.3 Sediment Containment Technologies

Method 1- Capping National Wood Preservers Site

Description: Capping of the NWP site may be appropriate to minimize the future migration of chemicals of concern from site soils into Naylors Run via surface run-off. Single layer cap designs are the simplest types of caps. The capping layer can consist of either soil, clay, asphalt, concrete, or a synthetic membrane.

Effectiveness: Since the concern is the mitigation of contaminant run off, not the elimination of infiltration, the soil cap may be the best option. The soil cap can only be successful if vehicular traffic is restricted and vegetative cover (e.g., lawn grass) is established. If NWP remains in operation as a wood preserving company, an asphalt cap with proper site grading may also be appropriate.

Insufficient data have been collected to verify or establish quantitatively whether or not the NWP site soils act as a current source of sediment to Naylors Run channel, or if the contaminants in the upper stretch of Naylors Run were from historical releases and are no longer being supplied. Until this relationship can be clarified, the placement of a cap at the NWP site is not supported. Additionally, the evaluation of the subsurface soils operable unit at NWP may result in soils remediation which would destroy any cap on the site. The evaluation of the cap is deferred until the soils operable unit (OU3), at which time both the NWP soils and the source of the sediment contamination in Naylors Run can be evaluated.

Implementability: The equipment, labor, and materials required for installation and maintenance of a single layer cap are readily available. The type of cap will depend on the operational status of NWP.

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Cost: The capital expenditures required to install a cap of compacted topsoil and to establish vegetative cover are low to moderate. Utilization of this technology would require monitoring and maintenance of the vegetative cover (lawn) and to control erosion, settling, cracking; these O&M costs are also low.

Method 2 - Piping of Naylors Run

Description: An alternative containment technology for the sediments in Naylors Run is to isolate the sediments from transport or leaching by water by piping Naylors Run. This would involve the construction of a pipeline to collect the surface water of the stream, the installation of anti-seep collars to minimize flow along the outside of the pipe, and then backfilling with soil, topsoil and grass. Contaminated sediment disturbed during excavation, if any, could be disposed at NWP prior to capping or taken off-site.

Effectiveness: Although the sediments would remain in-place, no unacceptable level of risk to human receptors has been identified with any sediment exposure pathway. The potential risk associated with the leaching of contaminants from the sediments into the surface water of Naylors Run would be addressed by isolating the sediments from the water. Leaching to the ground water table is not likely because the majority of Naylors Run is above the water table, and the majority of sediment contaminants are PAH's which are strongly hydrophobic. The leaching behavior of the dioxin isomers in the sediment is unknown.

The soils at NWP may represent an ongoing source of contamination to the sediments in Naylors Run. Any remediation of channel sediment is deferred until implementation of additional sampling and or computer modelling of fate and transport in the soils operable unit.

Implementability: The equipment, material, and labor required to pipe Naylors Run and restore the installation are readily available. Storm flow and contaminant transport during construction represent minor health and safety and implementability concerns related to the pipe/backfill option.

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Cost: Capital costs for piping Naylors Run is moderate assuming that no off-site transport or disposal of the excavated soil or sediment is needed. Operation and maintenance costs are considered low for this alternative.

2.4.3.4 Sediment Removal by Excavation

Description: Complete removal of the sediments would require the physical removal or excavation of all contaminated sediments in excess of cleanup levels from Naylors Run for disposal either at NWP or off-site. This may require temporary bypassing of water in Naylors Run to complete the excavation. Excavation is generally accomplished with conventional heavy construction equipment, such as backhoes, bulldozers, loaders, and cranes. Following excavation, the stream bed would be lined with stone rip-rap.

Effectiveness: No exposure pathway was identified to pose an unacceptable level of risk to human receptors. No ARARs specify target contaminant levels for sediments, only that leaching of contaminants should not pose a human health or environmental risk. Removal of all contaminated sediments is therefore seen as excessive, given the minimal risks associated with exposure pathways. Sediment excavation, in combination with treatment and/or disposal options, could likely meet the goals identified in the remedial action objectives. Potential adverse impacts to human health and the environment could result, however, due to the extensive handling of sediments during implementation. Releases of contaminants into Naylors Run stream flow could occur during sediment excavation. An additional concern involves controlling contaminant transport during rain events.

The soils at NWP may represent an ongoing source of contamination to the sediments in Naylors Run. Any remediation of channel sediment is deferred until implementation of additional sampling and or computer modelling of fate and transport in the soils operable unit.

Implementability: The equipment, material, and labor required for complete removal and restoration are readily available. Locating an incinerator to

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dispose of dioxin-contaminated sediments may be a problem. Placing the contaminated sediments on NWP property prior to capping would address the disposal problem. The major problem will be with construction in the stream and construction activity in the residential community.

Cost: Capital costs for removal are moderate to high, assuming that no off-site transport or disposal of the removed sediments is contemplated. There are low O&M costs associated with removal.

2.4.3.5 Disposal of Sediments/Soils

Method 1 - On-Site Disposal

Description: Disposal of contaminated materials at NWP facility would consist of placement of untreated sediments (and perhaps residually contaminated soils) in a secured landfill cell. Because the contaminated sediments from Naylors Run may be classified as hazardous, it has been assumed for costing purposes that any on-site landfill would be constructed to RCRA requirements (40 CFR 264.300) and PADER regulations. These requirements include the use of a double liner system and a leachate detection/collection system. The side slopes and base landfill would consist of compacted earth. The top and bottom of the landfill would have an impermeable liner and a collection system to remove any leachate.

If an impermeable flexible liner was used to cap the landfill, it could be necessary to construct a layered cover system similar to that required under RCRA for hazardous waste landfills. A typical cover system consists of a synthetic liner, bedding layers of sand to protect the liner, a drainage layer above the liner to divert percolating rainwater, and a vegetated surface layer to minimize erosion.

The soils at NWP may represent an ongoing source of contamination to the sediments in Naylors Run. Any remediation of channel sediment is deferred until implementation of additional sampling and or computer modelling of fate and transport in the soils operable unit (OU3).

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Effectiveness: If the targeted excavation area of Naylors Run is limited to the section from Eagle Road down to the area below the catch basin and from the construction of the collector trench, an on-site disposal facility could be feasible. There could be potential short-term adverse impacts on human health and the environment if the wastes are not treated or temporarily covered to reduce emissions during removal and placement in the landfill. Construction of a RCRA-equivalent disposal facility would minimize contaminant mobility, and the goals identified in the remedial action objectives would be met.

Implementability: The equipment, materials, labor, and area required to construct an on-site disposal facility are readily available. The PADER landfill siting criteria could restrict implementation of this alternative because of the nature of the material to be landfilled. This technology is not likely to meet with community approval.

Cost: Construction of an on-site disposal facility is expected to be high in cost, and low to moderate in O&M costs (associated with the initial construction of the facility and subsequent required maintenance of the cap and leachate collection/treatment system).

Method 2 - Off-Site Disposal

Description: As part of the first operable unit (OU1) for the HAVERTOWN site, contaminated materials that were generated and disposed were classified as K001 wood preservation (PCP) hazardous waste. Because of the November 1990 land disposal restrictions, the only disposal option for K001 wood preservation waste is incineration. To dispose of contaminated sediments from Naylors Run, excavated soils generated during construction, spent carbon and other materials that may be site related, they must be incinerated. If dioxin concentrations increase above 1 µg/kg, the waste may be reclassified to be a F waste. Presently, F classified wastes can neither be landfilled or incinerated.

The soils at NWP may represent an ongoing source of contamination to the sediments in Naylors Run. Any remediation of channel sediment is deferred until

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implementation of additional sampling and or computer modelling of fate and transport in the soils operable unit (OU3).

Effectiveness: If the targeted excavation area of Naylors Run is limited to the section from Eagle Road down to the area below the catch basin and from the construction of the collector trench, off-site disposal may be feasible if dioxin levels are less than 1 µg/kg. There could be potential short-term adverse impacts on human health and the environment if the wastes are not treated. Removal of the sediments would minimize contaminant mobility, and the goals identified in the remedial action objectives would be met.

Implementability: Equipment, material, transportation vehicles, and labor are available to remove the contaminated soils. Levels of contamination must be determined by soil testing prior to excavation. Presently, incineration space is at limited. Excavation, transportation and incineration must be closely coordinated to minimize the requirement to of temporarily stock-pile material on-site. Off-Site disposal of contaminated waste will most likely meet with community approval.

Cost: Off-Site disposal (incineration) of sediments from Naylors Run or contaminated material is expected to be moderate to high in capital cost. No O&M cost are associated with this method.

2.4.4 Summary of Relevant Response Actions and Technology Types

A range of remedial technologies and response actions have been identified to be applicable to the conditions present at the HAVERTOWN site, as summarized in Tables 2-3 and 2-4, and discussed below for the media of ground water and channel sediments, respectively.

2.4.4.1 Ground Water Response Actions and Technologies

The remedial response actions of No Action and Limited Action (both institutional and access actions) were found to be applicable. Source removal actions identified to be applicable include both free product recovery of residual sources of contaminants in the subsurface residual soil/ saprolite horizons. Treatability studies would be required to ascertain the areal and vertical extent of residual contamination, and to assess the properties of the Wissihickon Formation saprolite which are relevant to evaluating the implementability of remedial technologies, as this was not a part of the scope of work performed for the RI/FS.

Containment technologies were found to be largely inapplicable, due to the interpreted low transmissivity indicated by low well yields observed during sampling. The rehabilitation (lining) of the storm sewer was found to be applicable to the containment of contaminated ground water. The containment of residual contaminants in the saprolite by placing an impermeable cap on the NWP site was found to be not applicable due to the uncertainties regarding the extent of possible residual contamination, as discussed above. Relevant collection technologies include the passive down-gradient collector trench; the active systems were considered not optimal based upon the observed well yields.

Many treatment technologies were found to be applicable to the remediation of inorganic and organic contaminants found at the site, while only Powdered Activated Carbon Treatment (PACT™) with Wet Air Oxidation (WAO) and the Advanced Oxygen Process (AOP) were applicable and appropriate for the remediation of dioxin isomers. Granular Activated Carbon (GAC) adsorption systems will be retained for use as a polishing step in the treatment of PACT™ or AOP effluent. Due to the presence of oils in the ground water which could clog the membrane, reverse osmosis treatment was screened out.

Applicable disposal technologies may include offsite POTW or TSD facilities, or on-site discharge of treated water to Naylors Run if NPDES criteria can be attained.

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2.4.4.2 Sediment Response Actions and Technologies

The No Action response action was found to be applicable, while limited institutional and access restriction scenarios were found to be not applicable to stream channel sediments. Containment of residual surficial sources of contaminated channel sediments by a pervious grassed soil cap on the NWP site was found to be applicable, as was the isolation of contaminated sediments from surface water transport or leaching by piping a length of Naylors Run. Response actions involving technologies for excavation, treatment, and disposal of channel sediments were also found to be implementable at the site.

The soils at NWP may represent an ongoing source of contamination to the sediments in Naylors Run. Any remediation of channel sediment is deferred until implementation of additional sampling and or computer modelling of fate and transport in the soils operable unit.

3.0 DEVELOPMENT AND SCREENING OF REMEDIAL ALTERNATIVES

3.1 INTRODUCTION

In Section 2 of the FS, available remedial technologies were identified and evaluated for effectiveness, implementability, and cost. These remedial technologies were combined to identify medium specific remedial alternatives for the shallow ground water and the Naylors Run sediments, including disposal options.

In Section 3 of the FS, these remedial alternatives will be evaluated in greater detail for the same three categories. The results of this screening process will identify the most promising alternatives for remedial action.

The evaluation will focus on technologies which will be effective in mitigating contamination in or related to the shallow aquifer.

The evaluation of sediments/soils alternatives will be considered preliminary, pending completion of additional study to determine the feasibility of soils excavation at the NWP site. The alternative developed to control erosion includes installation of a cap at the NWP site, which would significantly complicate any future soils excavation at the NWP site.

3.2 DISCUSSION OF ALTERNATIVE SELECTION

Four alternatives for remediation of the ground water in the shallow aquifer will follow this screening process. The first required alternative is No Action (GW-1), which includes limited monitoring.

The second alternative (GW-2) is a Limited Action that includes institutional controls, deed restrictions, and monitoring.

The third alternative (GW-3) includes features from GW-2 plus Source Removal in

the form of free product recovery from the shallow aquifer near NWP, Treatment of the discharge from the existing oil/water separator, and Disposal via discharge of treated water to Naylors Run.

The fourth alternative (GW-4) to be evaluated includes features from GW-3, with the addition of Collection via installation of a new collector trench, and Containment using rehabilitation and lining of the existing storm sewer pipe.

The goal of any remedial action will be to mitigate the levels of contaminants to below ARARs and to eliminate health and environmental risk associated with the site. Pre-design activities will include performing a treatability study to evaluate two primary options for treatment of the shallow ground water.

Relatively low levels of contamination have been detected in the deep bedrock aquifer underlying the site. However, there is a concern that any attempt to pump the deep bedrock aquifer might draw additional contaminants from the shallow aquifer into the deeper aquifer. As a precaution, possible installation of deep aquifer recovery wells will be deferred while the ground water in the shallow aquifer is being remediated.

For the sediments, four alternatives will be discussed, based on available information. These alternatives are presented *for information only*, since the screening of alternatives in Section 2 indicated that there are data gaps which preclude a definitive analysis of alternatives.

Prior to selection of an alternative, further studies are needed to determine whether Soils Excavation might prove to be more effective. Site-specific analysis of the adsorption and desorption of free product and contaminants using the native soils would be performed. This information would be used to computer model the fate and transport of contaminants, and to identify potential remedial alternatives for the contaminated soils.

The first alternative (S-1) is the required analysis of a No Action response.

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The limited action (S-2) as well as the complete removal action (S-3 and S-4) all include placement of a cap on NWP. Alternative S-3 further includes removal of contaminated sediments in Naylors Run and disposal of the sediments in an on-site landfill cell. The landfill cell will be sized to accommodate the soils excavated from installation of the collector trench, described in GW-4.

Alternative S-4 would mitigate the presence of contaminated sediments in Naylors Run by the installation of a pipeline in Naylors Run instead of landfilling the sediments.

3.3 SCREENING CRITERIA

Screening criteria used to evaluate the medium developed alternatives will be effectiveness, implementability, and cost. Because the purpose of the screening evaluation is to reduce the number of alternatives that will undergo a more thorough analysis, this evaluation will be sufficiently detailed to distinguish among the alternatives in each medium category.

3.3.1 Effectiveness Evaluation

Each alternative will be evaluated on the basis of its protectiveness of human health and the environment and the reductions in toxicity, mobility, or volume that it achieves. Both the short-term (construction and implementation period) and long-term (after the remedial action is complete) components of effectiveness will be evaluated.

The attainment of ARARs or other cleanup objectives is a key component of effectiveness. ARARs/TBCs for chemicals of concern have been developed and discussed in Section 2.2.

3.3.2 Implementability Evaluation

Each alternative will be evaluated as to its short- and long-term

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implementability, measuring both the technical and administrative feasibility of constructing, operating, and maintaining a remedial action alternative.

Technical feasibility refers to the ability to construct, operate, and maintain the remedial alternative.

Administrative feasibility refers to the activity's ability to obtain approval from other offices and agencies and to obtain the necessary equipment, services, and materials to implement the alternative.

3.3.3 Cost Evaluation

Each alternative will be evaluated on both its capital and operation and maintenance (O&M) costs during the screening. Capital costs include both direct (construction) and indirect (nonconstruction and overhead) costs. Present worth analyses will be used to discount all costs to a common base year (1991) so cost for each alternative can be compared on the basis of a single figure. For the present worth cost comparison, the USEPA recommended discount rate of eight and three-quarters percent (8.75%) and a thirty (30) year period of performance will be used.

Cost estimates for screening alternatives will be based on readily available sources, including vendor information, conventional cost-estimating guides, and previous experience at other sites. Absolute accuracy of cost estimates during this phase is not essential; rather, the primary objective of the cost-estimating process is to develop costs whose relative accuracy will be maintained when more detailed costs are prepared.

3.4 DISCUSSION AND EVALUATION OF GROUND WATER ALTERNATIVES

3.4.1 Alternative GW-1: No Action

Description: The No Action alternative is the baseline against which all other

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ground water remediation alternatives will be compared. The No Action alternative for ground water would not include any new remedial action, but would include limited monitoring activities.

Limited monitoring of the levels of contaminants in the ground water would continue for a thirty year period, with an anticipated sampling frequency of two times per year for the first five years, and yearly sampling for the next twenty-five years. The sampling would include sampling three well clusters (nine wells) and two stream locations. The samples would be analyzed for the Target Analyte List (TAL), Target Compound List (TCL), and Dioxins.

Effectiveness: The overall extent and levels of contaminants of concern observed during this Remedial Investigation (RI) have increased in the ground water since the 1988 RI was conducted for the site. This observation would indicate that conditions could be expected to deteriorate with implementation of the No Action alternative.

An oil/water separator (OWS) recently was installed on the storm sewer discharge as part of the 1989 ROD. The OWS went on-line after completion of the sampling for this Remedial Investigation. Since some of the contaminants would be dissolved in the free product removed by OWS, installation of the OWS would be expected to lower the concentration or mass loadings of contaminants entering Naylors Run. This observation would indicate that conditions might be expected to improve in Naylors Run.

The net effect of these two opposing trends is unknown. No accurate prediction can be made concerning whether the levels of contaminants in Naylors Run will increase, remain the same, or decrease under a No Action alternative. The stream sampling and monitoring will provide an indication of the actual trends.

It is conceivable that when all of the free product source has been eliminated "naturally," and after a flushing and dilution period, the ground water will be remediated. Given the current levels of contamination, this process could take many decades or perhaps centuries. If releases of free product continue, no

significant reduction of contaminants in the ground water would be expected in the foreseeable future.

Implementability: This alternative could be implemented as soon as the Record of Decision is published by USEPA. Necessary sampling resources and laboratory support are readily available.

Cost: There is no capital cost associated with the No Action alternative. There would be O & M costs for the limited monitoring program. The cost of monitoring the discharge from the existing OWS is included in the O & M costs for the Remedial Action initiated by the 1989 ROD.

A description of the estimated costs for this alternative are provided in Appendix A, summarized as follows:

Capital Cost:	$ 0	
O & M per Year:	$ 80,000	(first five years)
	$ 40,000	(next twenty-five years)
Present Worth:	$ 715,000	(thirty year period)

3.4.2 Alternative GW-2: Limited Remedial Action

Description: This alternative includes the elements listed in the No Action alternative (previous remedial activities and limited long term monitoring) as well as additional monitoring activities and institutional controls and deed restrictions. A total of five well clusters and two stream locations would be sampled. The samples would be analyzed for TAL, TCL, and Dioxins. Two new monitoring well clusters would be installed to the east of Naylors Run.

Effectiveness: Institutional controls are potentially able to limit exposure to contaminants at this site, by restricting use of the ground water (e.g. deed restrictions), or limiting access to the contaminated surface water (e.g. fencing). Since it is possible to circumvent or ignore institutional controls,

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there is no assurance that the institutional controls would be effective.

The additional well clusters would be used to better define the levels of contamination in the deep bedrock aquifer.

Implementability: This alternative could be implemented in a relatively short time frame. Various affected residents would be contacted by USEPA to initiate Deed changes. The local governmental agency and community would be involved in implementing the necessary zoning changes. Deed and Zoning changes are normally straightforward to implement, and this activity may provide the opportunity to increase community awareness and interest in the site. Additional resources will need to be committed to install the new wells and for the increased monitoring activities.

Cost: There is a capital cost associated with installing the two new well clusters, and processing the paperwork necessary for the deed and zoning changes for the Limited Action alternative. The O & M cost for limited monitoring of the levels of contaminants in the ground water would continue for a thirty year period, with an anticipated sampling frequency of two times per year.

A description of the estimated costs for this alternative are provided in Appendix A, summarized as follows:

Capital Cost:	$ 198,000
O & M per Year:	$ 162,000
Present Worth:	$1,900,000

3.4.3 Alternative GW-3: Source Removal, Treatment, and Disposal

Description: This alternative includes features which will actively treat the contaminated ground water presently infiltrating into the storm sewer at the site. This includes free-product recovery from the shallow aquifer in the vicinity of NWP; treatment by the existing oil/water separator; chemical

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precipitation; either of two treatment systems (Powdered Activated Carbon Treatment, PACT™, or an Advanced Oxidation Process, AOP); granular activated carbon (GAC, as a polishing step); stream discharge; improved access to the OWS using the existing railroad right-of-way next to the Philadelphia Chewing Gum property; and disposal of treatment residuals at appropriate waste receiving facilities.

A Site Plan for GW-3, giving the locations of system components is shown in Figure 3-1. A Flow Diagram for GW-3 is shown in Figure 3-2, as described below:

Source Removal

Free Product Recovery from the Shallow Aquifer

Two free product recovery wells will be installed on or adjacent to NWP property in the vicinity of the "hot spot" at well R-2. Each of the free product recovery wells will include a free product skimmer.

A floating skimmer will be provided to remove any free product which accumulates in the well. The skimmer will operate whenever there is a significant accumulation of free product. The contaminated oil from the skimmer pump will discharge to a 3,000 gallon Free Product Storage tank at the NWP site. The accumulated oil in the Free Product Storage Tank should be removed at least two times per year, unless there is economic justification and regulatory approval for a longer interval. The Free Product Storage tank vent will be fitted with a disposable vapor phase carbon unit to control odors and air emissions from the tank.

Treatment

Treatment by the Existing Oil/Water Separator (OWS)

The existing oil/water separator was sized to treat flows in the range of 0 to 100 gallons per minute. The flow from the storm sewer (in the shallow aquifer)

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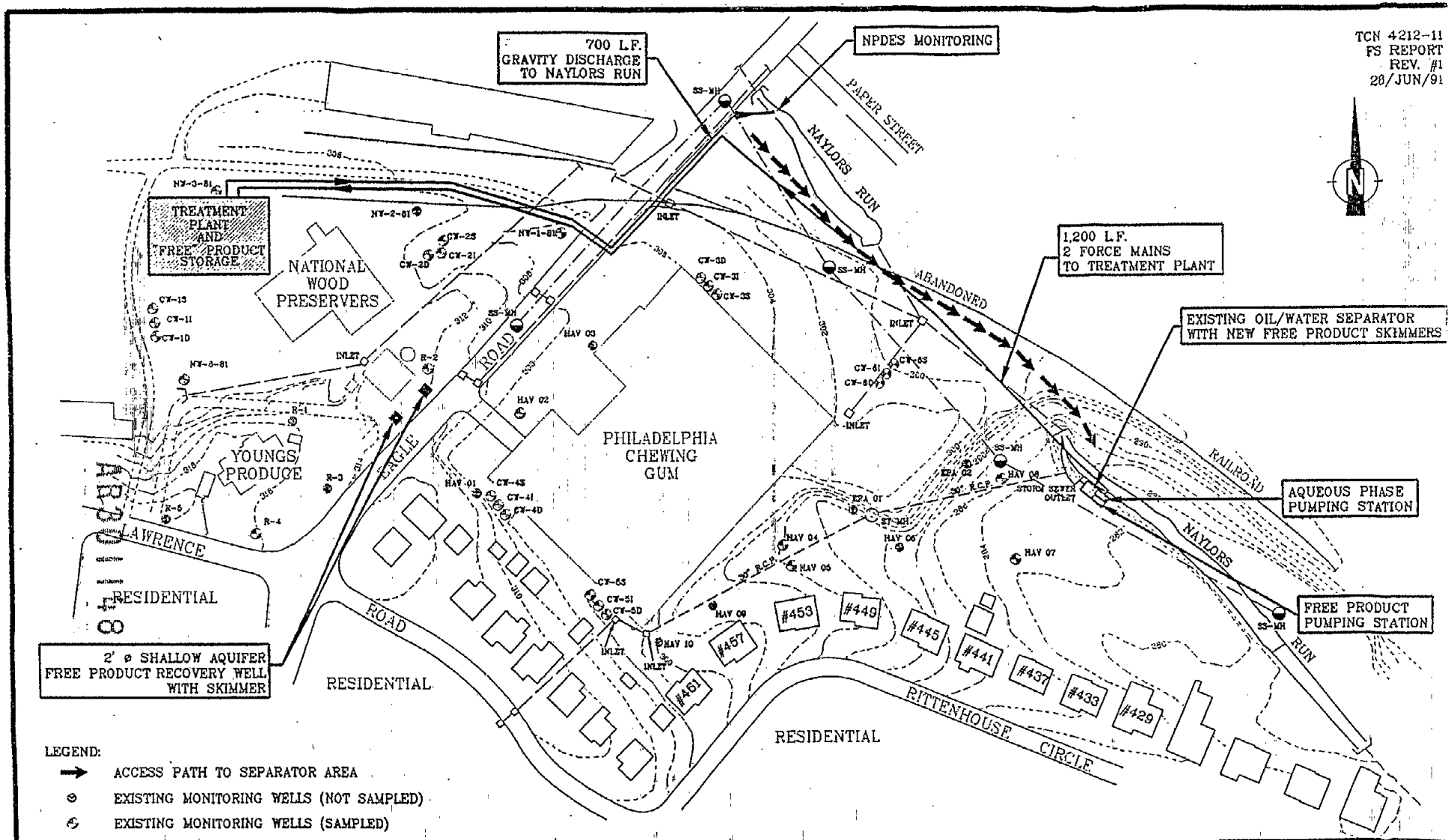
TCN 4212-11
FS REPORT
REV. #1
28/JUN/91
700 L.F.
GRAVITY DISCHARGE
TO NAYLORS RUN
NPDES MONITORING
PAPER STREET
NAYLORS RUN
ABANDONED
1,200 L.F.
2 FORCE MAINS
TO TREATMENT PLANT
EXISTING OIL/WATER SEPARATOR
WITH NEW FREE PRODUCT SKIMMERS
AQUEOUS PHASE
PUMPING STATION
FREE PRODUCT
PUMPING STATION
TREATMENT
PLANT
AND
FREE PRODUCT
STORAGE
NATIONAL
WOOD
PRESERVERS
YOUNGS
PRODUCE
PHILADELPHIA
CHEWING
GUM
EAGLE ROAD
LAWRENCE ROAD
RESIDENTIAL
RESIDENTIAL
RESIDENTIAL
RITTENHOUSE CIRCLE
RAILROAD
NAYLORS RUN
2' ø SHALLOW AQUIFER
FREE PRODUCT RECOVERY WELL
WITH SKIMMER
#451
#457
#453
#449
#445
#441
#437
#433
#429
LEGEND:
ACCESS PATH TO SEPARATOR AREA
EXISTING MONITORING WELLS (NOT SAMPLED)
EXISTING MONITORING WELLS (SAMPLED)
EXISTING STORM SEWER
EXISTING SANITARY SEWER
EXISTING GRADE
0 100' 200'
SCALE
TETRA TECH, INC.
FIGURE 3-1
HAVERTOWN PCP SITE
SITE PLAN (GW-3)
TOPOGRAPHIC INFORMATION TAKEN FROM R.E.WRIGHT ASSOC. PROJECT BASE MAP, HAVERTOWN PCP SITE.

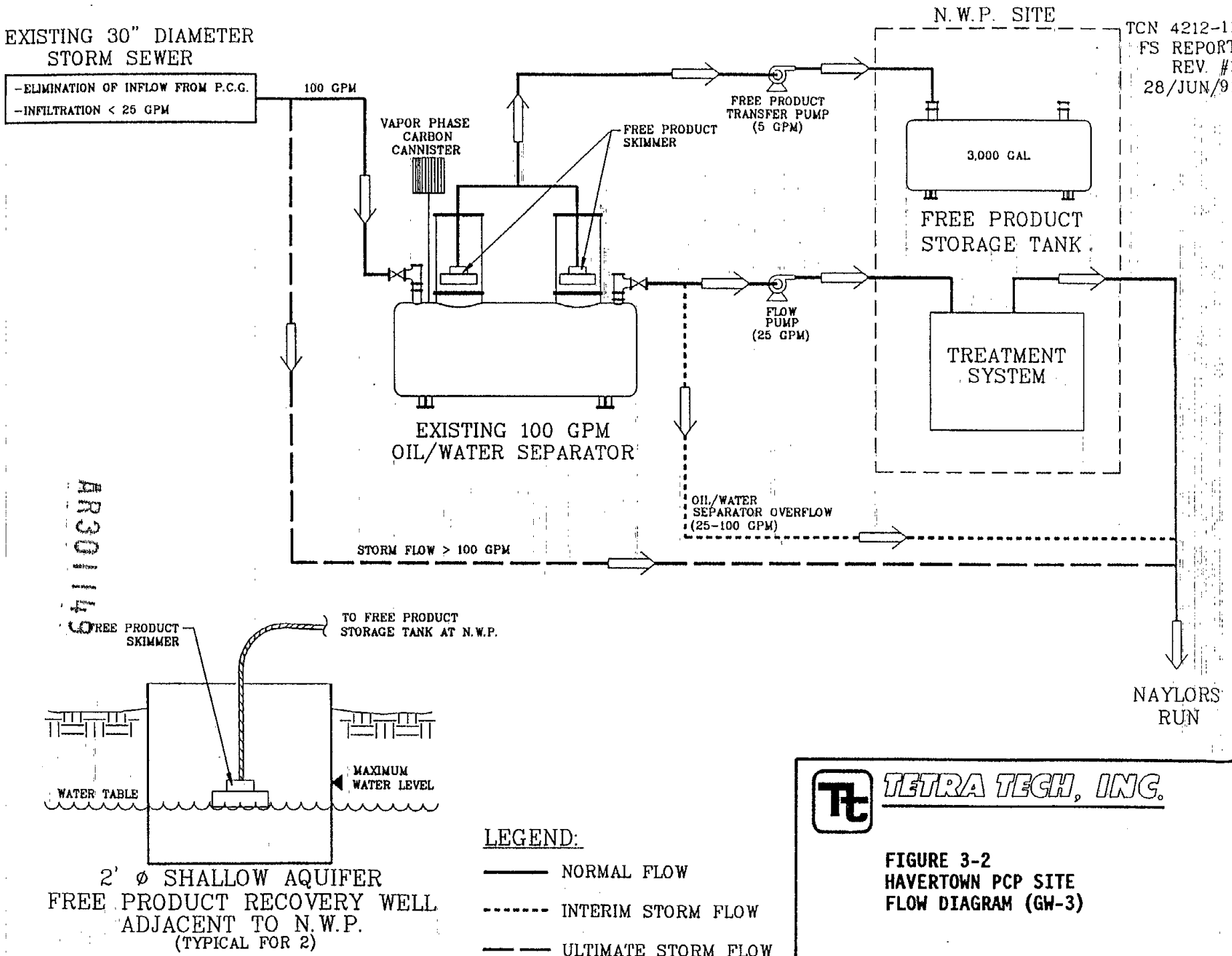

FIGURE 3-2
HAVERTOWN PCP SITE
FLOW DIAGRAM (GW-3)

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will continue to be directed to the existing oil/water separator (OWS), prior to further treatment. The normal dry weather flow from the storm sewer has been determined to be less than approximately twenty-five gallons per minute (25 gpm).

The aqueous flow discharging from the OWS will then be pumped (using the 25 gpm aqueous phase pumping station) to a new treatment system, located on NWP property. Access to the OWS will be improved by obtaining access agreements and grading the railroad right-of-way adjacent to PCG to permit vehicular traffic. A gate would be provided at the entrance to the right-of-way to restrict use of the access road to authorized persons.

Free Product Recovery from the Existing Oil/Water Separator

Two free product skimmers will be installed in the OWS to remove free product from the OWS. The skimmer will operate whenever there is a significant accumulation of free product in the OWS. The skimmers will discharge to a small day tank located near the OWS.

A 5 gpm free product transfer pump will pump the recovered oil to the 3,000 gallon Free Product Storage tank located at the NWP site. This approach will eliminate the need to move drums of recovered free product from the existing OWS through the residential neighborhood.

If necessary, appropriate chemicals (e.g. NaCl) can be metered into the day tank to break any emulsion in the free product. This may be necessary to allow pumping the recovered free product the 1,200 feet to the Free Product Storage tank.

The piping from the free product transfer pump to the Free Product Storage Tank will be double walled with provision for leak detection and periodic leak testing/monitoring.

Disposal of the recovered free product is addressed under the heading DISPOSAL.

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Aqueous Phase Pumping Station

A submersible pumping station will be provided at the existing OWS to convey the collected ground water to a suitable treatment system. Installation of the pumping station will require extending an electrical service to power the pumps, system controls, and any desired alarm systems. Design pumping capacity depends on the actual dry weather flow of water in the storm sewer, and the instantaneous flow capacity of the selected treatment system. Each pump will have a capacity of approximately 25 gpm. Only one pump will be able to run at a time, i.e. the second pump will serve as a back-up. The system shall be provided with necessary features for explosion-proof operation.

Chemical Precipitation

The water treated by the OWS will be pumped to the chemical precipitation treatment system at the NWP site for removal of metals. The estimated chemical concentration for the treatment plant influent is given in Table 3-1. Several inorganic compounds, at concentrations in excess of the allowable discharge criteria, have been observed in the shallow aquifer monitoring wells at the site. This includes Cr, Cd, and Zn.

The chemical precipitation system will treat the inorganics and will remove the settleable solids which will be present in the ground water. The system will effectively remove Fe, Ca, Mn, as well as Cr, Cd, and Zn from the waste stream. Removal of the Fe, Ca, and Mn is necessary for optimum performance of subsequent treatment processes. The system will have provision to add polymer to enhance removal of solids, and a gravity settling tank where the metals and solids will accumulate. This solids fraction will be collected in drums for disposal at a suitable facility.

Depending on the rate of formation of the solids, it is possible that a dewatering device will be installed to reduce the volume of waste solids, and to possibly allow the waste to be considered as a solid (rather than a liquid) waste. This solids fraction will primarily be Fe and Mn precipitants but may

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TABLE 3-1
HAVERTOWN PCP SITE
ESTIMATED CHEMICAL CONCENTRATION
EXISTING OIL/WATER SEPARATOR EFFLUENT
µg/L

ALLOCATED FLOW (gpm)	20
1,2 Dichloroethene	7
Vinyl Chloride	BDL
Trichloroethene	13
Benzene	35
Toluene	4
Ethyl Benzene	24
Xylenes	110
Naphthalene	BDL
2-Methylnapthalene	1
Pentachlorophenol	3,600
Total BNA	3,663

BDL = Below Detection Limits

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require special handling for disposal, since the solids could include adsorbed dioxin or other significant contaminant concentrations.

Treatability studies will be performed during the remedial design phase of the project to adequately characterize the necessary size, features, and disposal options of the chemical precipitation system.

Removal of Organics

Following removal of metals using chemical precipitation, a system will be provided for removal of organic compounds. Two treatment alternatives for organic compounds have been selected for evaluation as part of this feasibility study. The two options are Powdered Activated Carbon Treatment (PACT™) as shown in Figure 3-3, or an Advanced Oxidation Process (AOP), as shown in Figure 3-4. Either process would be followed by a Granular Activated Carbon (GAC) polishing step.

Since it was decided that the remedial investigation would focus on characterizing the risk at the site, rather than assuming that a treatment system would automatically be needed, there will be additional work needed to properly select a treatment alternative.

The actual treatment system selection will be determined during pilot scale treatability tests for a few representative treatment technologies. The treatment systems to be evaluated are described as follows:

Powdered Activated Carbon Treatment with On-Site Carbon Regeneration

A proprietary powdered activated carbon treatment system (PACT™) is capable of effectively removing the organic compounds in the ground water at this site. The combination of the powdered carbon and activated sludge in a continuously stirred tank reactor (CSTR) effectively captures the volatile and semi-volatile organic compounds onto the carbon/biomass solids matrix.

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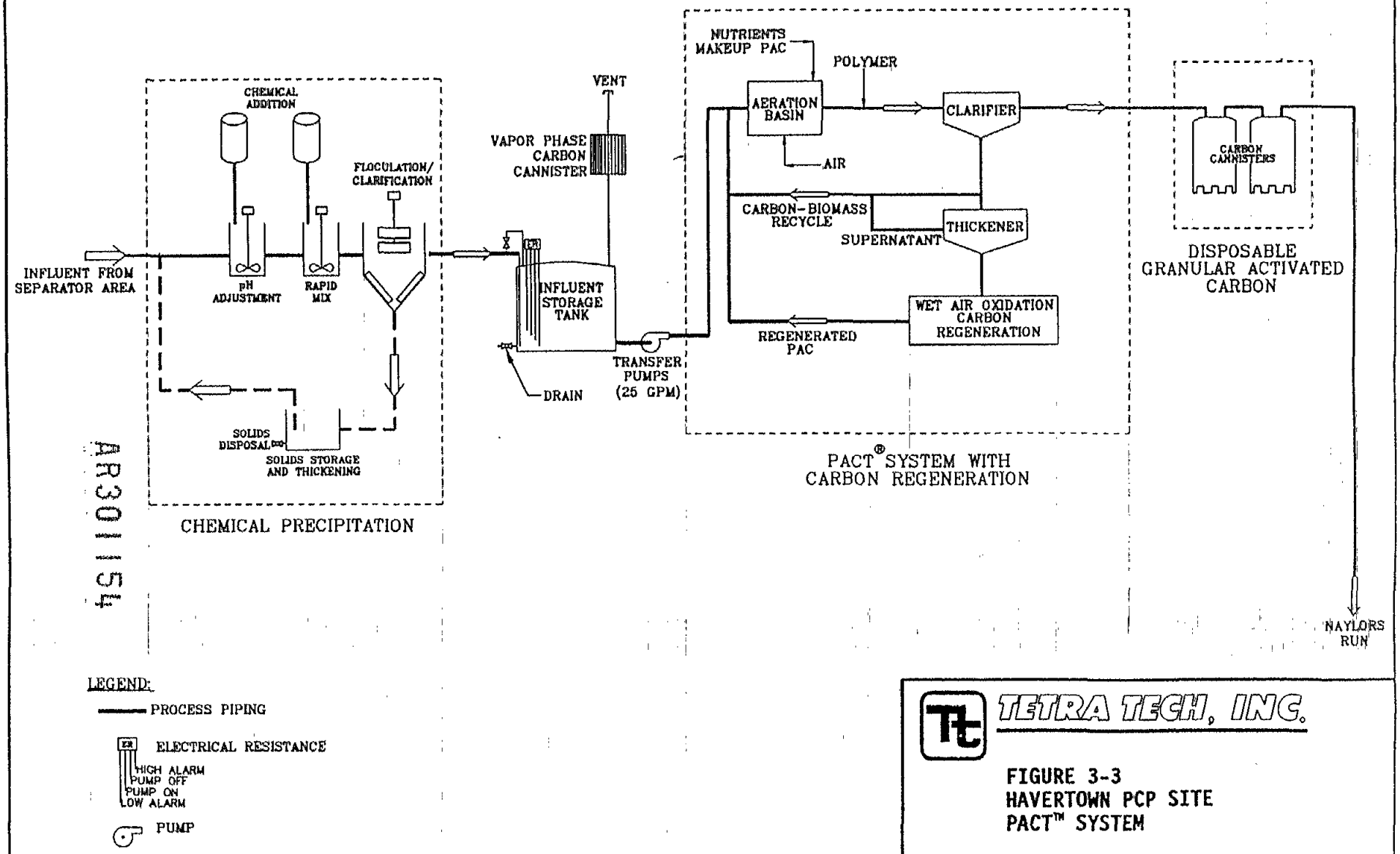

LEGEND:

PROCESS PIPING

ER ELECTRICAL RESISTANCE
HIGH ALARM
PUMP OFF
PUMP ON
LOW ALARM

PUMP

TETRA TECH, INC.

FIGURE 3-3
HAVERTOWN PCP SITE
PACT™ SYSTEM

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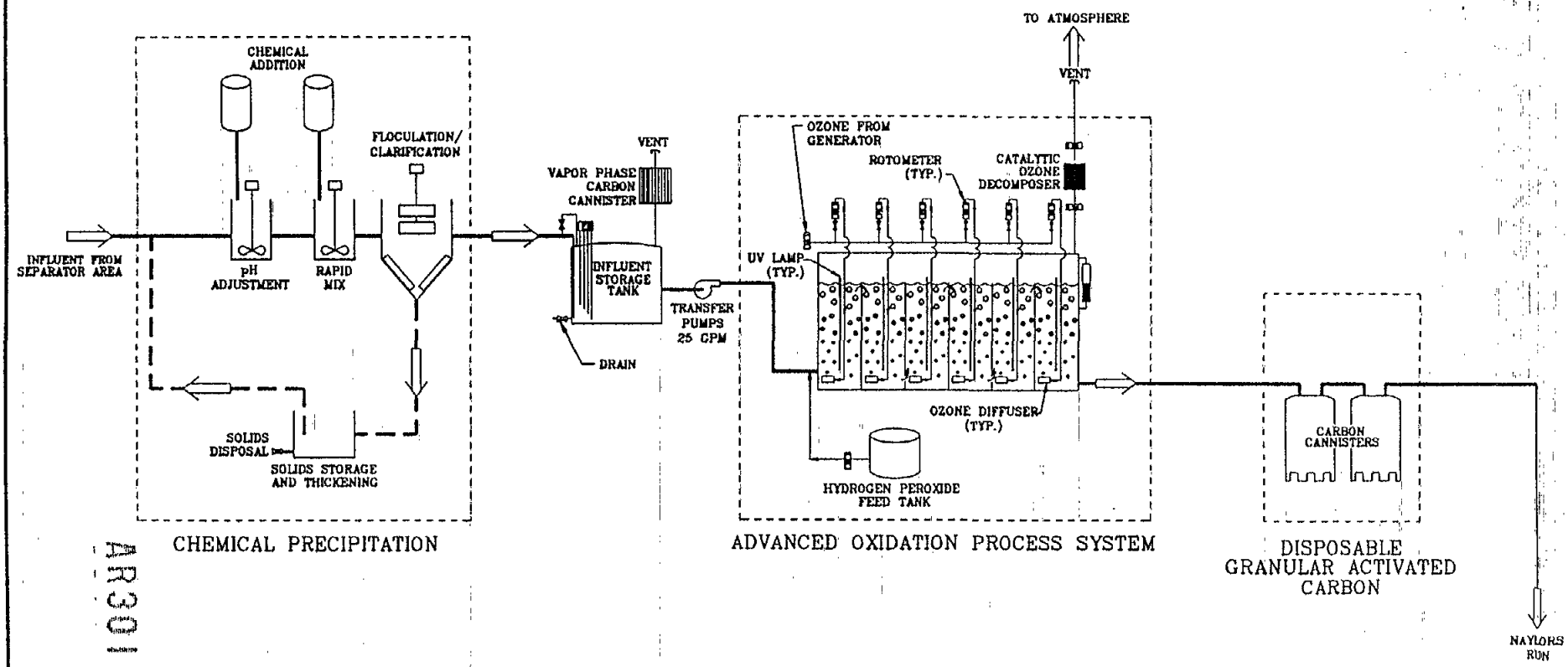
FS REPORT
REV. #1
28/JUN/91



LEGEND:

PROCESS PIPING

ER ELECTRICAL RESISTANCE
HIGH ALARM
PUMP OFF
PUMP ON
LOW ALARM

PUMP

ABBREVATIONS:

UV ULTRAVIOLET

TETRA TECH, INC.

FIGURE 3-4
HAVERTOWN PCP SITE
AOP SYSTEM

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The combined effect of the powdered carbon and activated sludge provides tolerance of shock-loads of any toxic organics. This will provide enhanced system performance with potential biodegradation of numerous organic compounds, after a period of acclimation to the influent organic compounds.

The PACT™ system will be tolerant of significant organics loadings, such as from any free product which is not captured by the oil/water separator. It is possible that a supplemental carbon source will be needed to provide an influent chemical oxygen demand of approximately 150 mgCOD/l. Inexpensive molasses is a commonly used carbon source for the activated sludge, which permits co-metabolism of recalcitrant organics.

A single batch-mode PACT™ unit will be provided to treat the flow. A 10,000 gallon flow equalization tank will be provided for the batch unit, to permit continuous operation of the collection system. Transfer pumps will be provided to fill the process tank in approximately 45 minutes.

The effluent from the PACT™ system will be directed to granular activated carbon polishing units, as described below.

If needed, on-site carbon regeneration can be provided by a wet air oxidation (WAO) system. On-site regeneration would be justified only if off-site disposal was not possible. The smallest WAO unit would be capable of treating a 5 gpm residual waste solids stream, and requires a thirty foot by forty foot utility building to house the unit.

The smallest WAO unit would have enough capacity to oxidize residuals from the PACT™ system, the GAC units, and the free product from the skimmers. The WAO process uses high pressure (2000 psi) and elevated temperature (540 °F) in a 316L or titanium reactor to regenerate the carbon, and can be operated to effectively destroy organic compounds such as PCP and dioxins. Treatability tests would determine whether the WAO system was needed at the NWP site.

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Advanced Oxidation Process (AOP)

Advanced oxidation systems are a relatively new technology which have been shown to be capable of treating the volatile and semi-volatile compounds which are present in the ground water at the site. For instance, a system using UV light, combined with hydrogen peroxide (H_2O_2) and ozone (O_3) will be able to destroy the compounds found in the ground water.

Ultraviolet oxidation is an advanced oxidation process that uses ultraviolet light with the addition of ozone and/or hydrogen peroxide. The resulting oxidative environment is significantly more destructive than the environment created with O_3 or H_2O_2 by themselves or in combination.

Ultraviolet light enhances the oxidation process by transforming O_3 or H_2O_2 into highly reactive $(OH)^-$ radicals, exciting the target organic solute to a higher, less stable energy level, and cleaving of chemical bonds to destroy the target compound.

ULTROX™ is an example of a UV oxidation process. The system consists of a stainless steel reactor with several stages, several UV lamps, an ozone generator, and a hydrogen peroxide feed system. The UV lamps are mounted vertically in the reactor and are enclosed in quartz tubes. Ozone enters each stage through a stainless steel diffuser. Hydrogen peroxide is metered into the reactor influent.

When the system is operated in the continuous mode, the contaminants in the water are oxidized to form carbon dioxide, and water. Any halogens are converted to inorganic halides (e.g. Cl^-). A fixed-bed catalytic ozone destroying unit is part of the UV oxidation process, producing oxygen and limiting ozone emissions to an instantaneous concentration of 0.1 ppm in air. Ozone emission rates would be negligible. Any volatilized organic compounds are also destroyed in the off-gas. The offgas is then vented to the atmosphere.

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ULTROX™ was consulted for cost information concerning an appropriate AOP system. The concentrations of the contaminants in the ground water at the site were estimated to determine and select an appropriate unit and to develop an approximate cost. Chemical feed rates and O & M costs were determined to ensure oxidation of the observed PCP and dioxin concentrations. Pilot scale tests would be needed to verify assumed performance.

At a flow rate of 25 GPM, Model F1300 would be appropriate. The unit is skid-mounted and packaged for ease of installation. The unit would be installed in a utility building, which would be located on the NWP property.

A consideration of any ultraviolet oxidation system is the amount of heat generated by the UV lamps used in the treatment process. This can cause scale formation on the quartz tubes. This scaling can reduce the effectiveness of UV radiation and the overall process. Some fouling would be stripped off by the ozone bubbles, but a problem may develop every 1 to 1 1/2 years unless a citric acid wash is used approximately every six months.

The discharge from the AOP system would be directed to Granular Activated Carbon units.

Granular Activated Carbon (GAC)

Disposable granular activated carbon (GAC) units (e.g. Calgon Disposorb units) will be installed in series to polish the waste water prior to discharge to Naylors Run. These units are relatively inexpensive and can also provide effective back-up treatment (redundancy) at low cost, for when there is an upset in the PACT unit or AOP unit.

Each disposable carbon unit contains approximately 1,000 pounds of carbon, and can treat up to 30 gpm. For the anticipated flow of 25 gpm, there would be a minimum of two units installed in series. Periodic samples would be collected from the influent and effluent of the GAC units, to predict breakthrough times and to indicate how often the units would need to be replaced. Samples of the

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spent carbon would be taken to determine disposal options for the carbon.

The piping for the two units would permit any combination or sequence of flow. Operation of the units would be staggered so that the carbon units would not both reach breakthrough at the same time. Treatability studies will be performed during the remedial design phase of the project to adequately characterize the necessary size and features of the granular activated carbon treatment system.

Disposal of spent GAC is discussed under the heading DISPOSAL.

Disposal

Stream Discharge

The effluent from the treatment plant would be conveyed to Naylors Run in the vicinity of Eagle Road for discharge. Periodic samples would be collected in accordance with any discharge permit for the facility. Discharge monitoring reports would be submitted per any regulatory requirements.

Waste Disposal or Discharge to Hazardous Waste Facilities

It is anticipated that the recovered free product from the oil/water separator and free product recovery wells, as well as the solids collected from the chemical precipitation, PACT™ process, and GAC units may contain hazardous compounds which will require special handling for disposal at an off-site facility. A secure storage area will be provided, located on the NWP site, to store the residuals until they can be removed or treated.

For instance, the residuals could be listed as K001 wastes. There are several off-site facilities which can accept the K001 wastes, subject to analysis and verification of the waste characteristics. A waste disposal firm was contacted to explore actual disposal alternatives. It was determined that K001 wastes could be incinerated at two of its facilities - one in New Jersey (drummed

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waste), or a facility in Texas (bulk roll-off trailers). On-site incineration of the solids is unlikely given the suburban location.

On-site treatment and destruction of organic residuals could be provided by the wet air oxidation (WAO) system, particularly with respect to residuals produced by the PACT™ process. Treatability studies would evaluate operational conditions and equipment sizes necessary to oxidize the spent carbon, recovered free product, and other similar materials to the required destruction and removal efficiency.

Effectiveness: The ground water contamination which originated from the NWP facility has slowly migrated to the southeast in the shallow aquifer, and to directly under the NWP facility in the deep aquifer. Although use of PCP was discontinued several years ago, very significant concentrations of PCP and other deleterious compounds ("hot spots") remain in the ground water in several areas. Natural flushing and attenuation of the contamination has been ineffective in removing the contaminants to low residual levels.

Localized hot spots provide a potential source of continued contamination of the ground water by a process of slow desorption of PCP and other contaminants into the ground water. In effect, the PCP is desorbed from the soils in order to reach its quasi-equilibrium solubility in water in the immediate vicinity of the hot spot. The aqueous concentration will decline through diffusion to areas of lower concentration, coupled with advective transport as the slug of water moves downgradient.

At one time, there was a considerable layer of contaminated free product underlying the NWP property. This layer apparently originated from the unfortunate disposal practice for spent preservative solution (PCP in oil) at NWP, which amounted to dumping the preservative down a shallow well at the property. Some of the initial clean-up efforts at the site included removal of the readily recoverable free-product. Recent sampling efforts have indicated the presence of measurable free-product in the vicinity of well R-2.

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Removal of any significant free-product is an important component in eliminating the source of the contaminant plume. Recent recovery efforts have been of a relatively short duration. Given the low permeability of the soils at the site, it is important to provide time for the free-product to flow to the withdrawal point. Thus, a long-term skimming program will be needed to recover the remaining residual free-product.

Two free-product recovery well points will be located near a known "hot spot" (the vicinity of well R2). The free-product recovery skimmer pumps will be operated periodically over an extended period of time (years), until the pumps are no longer effective.

Once the free-product source of contamination is removed, the gradual flow under the site should serve to attenuate concentration of contamination in the ground water. This process will be complicated by the poor solubility of PCP in water, and the tendency for the PCP to remain bound to the soils. The site-specific solute transport modelling which is needed to sufficiently define this process was not performed as part of this RI/FS. If requested by USEPA, this modelling could be performed to determine the number of years needed to attain ground water clean-up levels.

Well sampling has identified a second hot spot of contamination, near HAV-04 and the storm sewer. The storm sewer may be collecting at least a portion of this contaminated shallow ground water. The low permeability of the soils underlying the site precludes installation of a reasonable number of ground water recovery wells.

Depending on the concentration of PCP in the soils underlying the site, it could take many decades for the soils to reach background concentrations. It appears that the contaminated plume in the shallow aquifer at the site is approximately bounded by the NWP site to the north, and a the vicinity of the storm sewer pipe to the south. The eastern edge of the plume roughly coincides with Naylors Run. The western boundary roughly parallels Lawrence Road and Rittenhouse Circle.

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Implementability: The primary constraint affecting implementation of this alternative is the suburban location of the site, which may hinder obtaining access for construction. Improved access using the railroad right-of-way would be provided in response to this concern. Another potential difficulty relates to disposal of residuals from the treatment systems, particularly if they are contaminated with PCP or dioxins. On-site oxidation (to completion) of residuals would be possible with the WAO unit.

The necessary equipment, construction methods, and labor are all readily available. Access agreements and easements for construction of an access road and installation of skimmers, pumps, and treatment systems will be needed from several property owners. A significant public relations effort may be needed to assure local property owners of the justification for the construction.

Construction of the treatment systems could be completed within a thirty-six month period from issuance of the ROD.

Cost: The capital cost for this alternative would include installation of the Shallow Aquifer Free Product Recovery Wells, the Skimmer systems, the Pumping Stations, the Chemical Precipitation system, and purchase and installation of the selected treatment system for organics. The cost of the PACT™ system would be significantly reduced if the WAO system was not needed for on-site residuals management. The capital and O & M costs for monitoring would be repeated from option GW-2.

The philosophy taken to establish costs for this alternative has been to keep the systems as simple as possible. If a higher level of sophistication is provided in the ultimate design, this could affect the ultimate cost of the system. Yearly operation and maintenance (O & M) costs have also been estimated.

A description of the estimated costs for this alternative are provided in Appendix A, summarized as follows:

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	Using PACT™ System	Using AOP System
Capital Cost:	$ 5,018,000	2,577,000
O & M per Year:	$ 445,000	479,500 (first year)
Present Worth:	$ 9,684,000	7,553,000

3.4.4 Alternative GW-4 Source Removal, Containment, Collection, Treatment, and Disposal

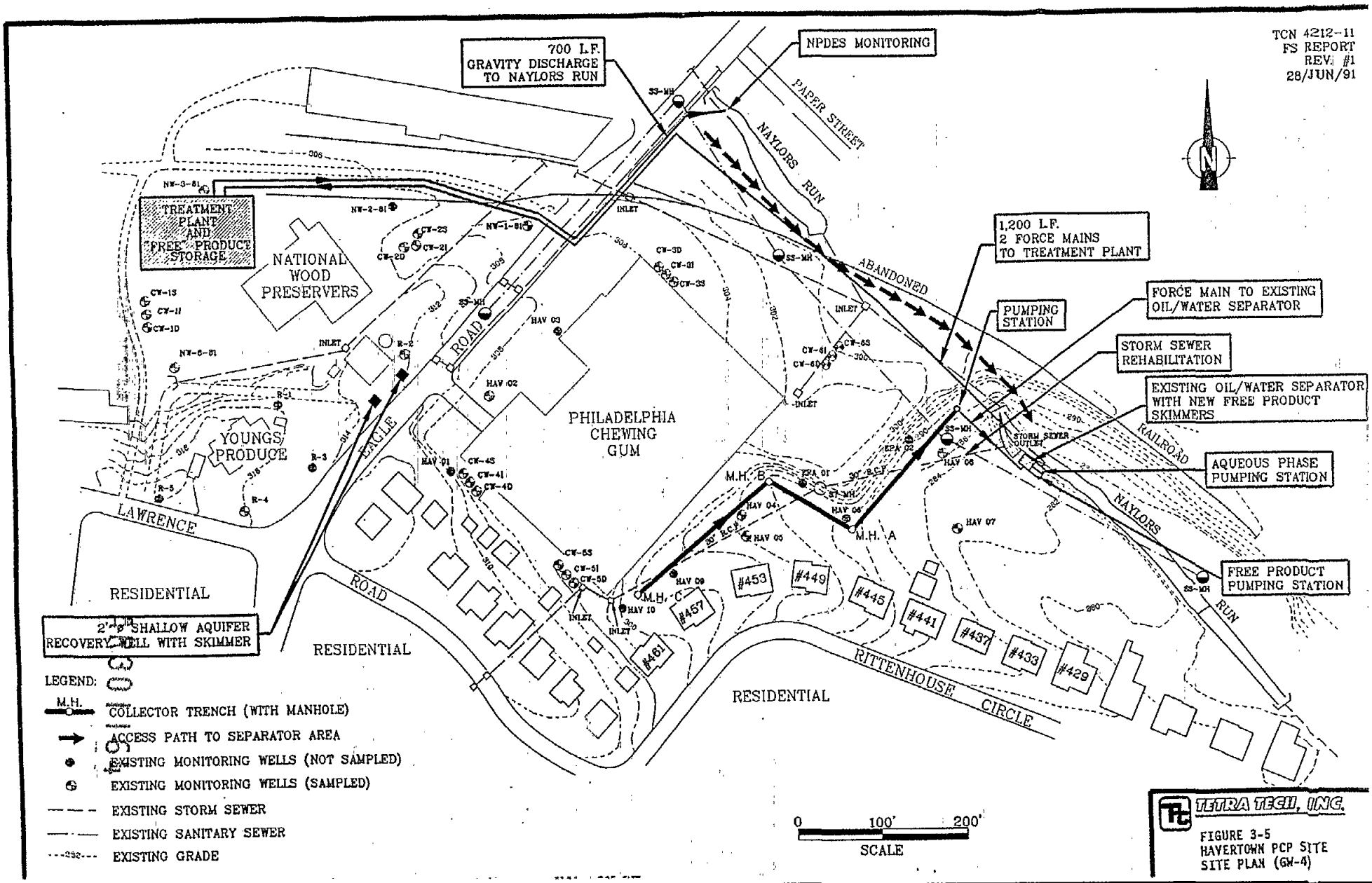
Description: This multi-faceted alternative includes features provided in GW-3, as well as a Collection system (shallow ground water collector trench and pumping station), and Containment (rehabilitation and in-place lining of the existing storm sewer).

A Site Plan for GW-4, giving the locations of system components is shown in Figure 3-5. A Flow Diagram for GW-4 is shown in Figure 3-6, as described below:

Collection

Groundwater Collector Trench

Installation of a collector trench near the existing storm sewer will provide controlled collection of the contaminated ground water. The estimated chemical concentration of shallow ground water collected by the trench is given in Table 3-2. The storm sewer in the vicinity of HAV-04 shows no evidence of infiltration, using closed circuit television surveillance of the pipe. This may indicate that a portion of the plume is escaping capture by the storm sewer pipe.


TCN 4212-11
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REV. #1
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700 L.F.
GRAVITY DISCHARGE
TO NAYLORS RUN
NPDES MONITORING
PAPER STREET
NAYLORS RUN
ABANDONED
1,200 L.F.
2 FORCE MAINS
TO TREATMENT PLANT
PUMPING STATION
FORCE MAIN TO EXISTING OIL/WATER SEPARATOR
STORM SEWER REHABILITATION
EXISTING OIL/WATER SEPARATOR WITH NEW FREE PRODUCT SKIMMERS
AQUEOUS PHASE PUMPING STATION
FREE PRODUCT PUMPING STATION
TREATMENT PLANT AND FREE PRODUCT STORAGE
NATIONAL WOOD PRESERVERS
YOUNGS PRODUCE
PHILADELPHIA CHEWING GUM
EAGLE ROAD
LAWRENCE ROAD
RAILROAD
NAYLORS RUN
RITTENHOUSE CIRCLE
RESIDENTIAL
RESIDENTIAL
RESIDENTIAL
2'-6" SHALLOW AQUIFER RECOVERY WELL WITH SKIMMER
M.H. A
M.H. B
M.H. C
#453
#449
#445
#441
#437
#433
#429
#457
#461
LEGEND:
M.H. COLLECTOR TRENCH (WITH MANHOLE)
ACCESS PATH TO SEPARATOR AREA
EXISTING MONITORING WELLS (NOT SAMPLED)
EXISTING MONITORING WELLS (SAMPLED)
EXISTING STORM SEWER
EXISTING SANITARY SEWER
EXISTING GRADE
0 100' 200'
SCALE
TETRA TECH, INC.
FIGURE 3-5
HAVERTOWN PCP SITE
SITE PLAN (GW-4)

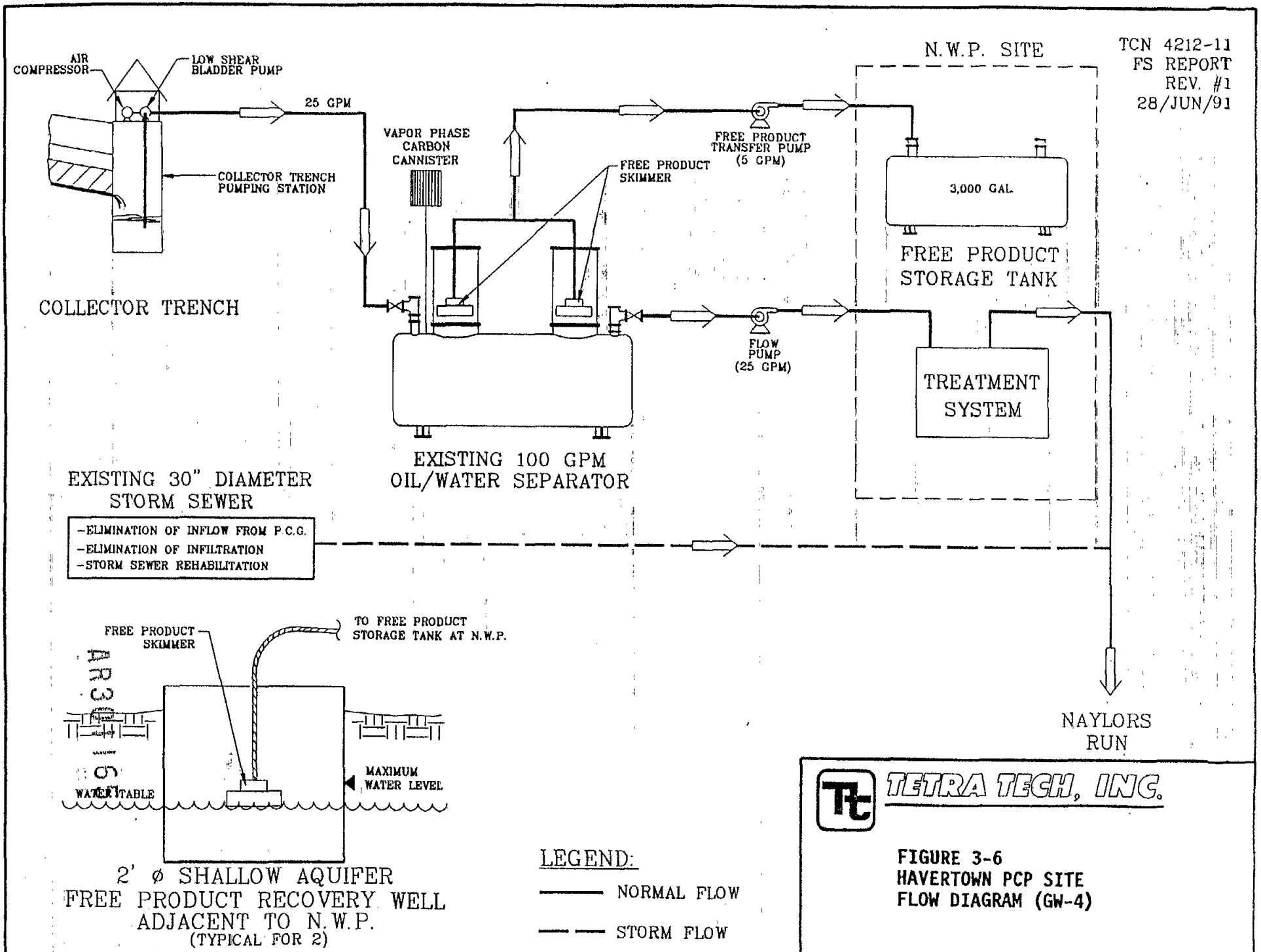

FIGURE 3-6
HAVERTOWN PCP SITE
FLOW DIAGRAM (GW-4)

TABLE 3-2
HAVERTOWN PCP SITE
ESTIMATED CHEMICAL CONCENTRATION
COLLECTOR TRENCH
µg/L

	COLLECTOR TRENCH
FLOW (gpm)	20
1,2 Dichloroethene	22
Vinyl Chloride	2
Trichloroethene	23
Benzene	160
Toluene	40
Ethyl Benzene	27.2
Xylene	910
Naphthalene	400
2-Methylnaphthalene	5,300
Pentachlorophenol	42,000
Total BNA	61,000
Calcium	23,600
Iron	3,390
Magnesium	14,900
Manganese	16,600
Zinc	130
Dioxin (2,3,7,8-TCDD) TE	115 ppTr

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A collector trench will be installed, roughly in parallel with the existing storm sewer pipe, to address this condition. Unlike the storm sewer, however, the collector trench will be designed and installed to efficiently intercept the flow of contaminated ground water. One possible alignment for the collector trench is shown in Figure 3-5. Details of the collector trench installation are shown in Figure 3-7. The following factors have been identified concerning construction and placement of the trench:

Trench Excavation

The trench excavation should be extended to the approximate elevation of the fractured bedrock for maximum effect. This will require excavation to a depth of approximately fifteen to twenty feet. The base of the trench should be a minimum of two feet wide in section. Shoring of the trench will be needed during construction to minimize the quantity and cost of disposal of excavated material. Shoring is also necessary to prevent possible cave-ins and personal injury or property damage.

Interceptor Pipe

An eight inch (8") perforated pipe will be placed at the bottom of the trench, which will serve to convey the ground water to a pumping station. The perforations will be oriented so that they are above the normal depth of water flowing in the pipe to minimize accumulation of debris.

The slope of the interceptor pipe will be designed so that a constantly descending gradient is maintained to the pumping station. Test pits will be excavated along the route of the interceptor pipe during the Remedial Design and Remedial Action (RD/RA) phase of the project, so that the interceptor pipe design invert elevations can be determined.

Samples would be collected at various depths in the test pits to determine the levels of contaminants and disposal options for the excavated materials. Depending on the contaminant levels, the soils could be used as clean fill.

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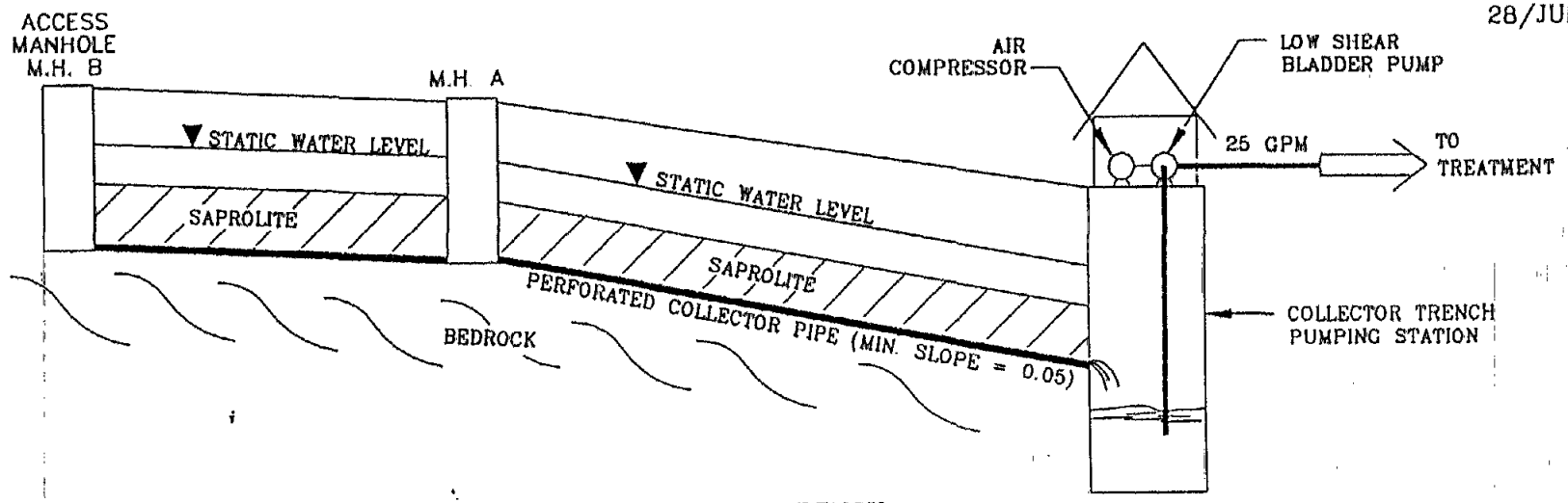
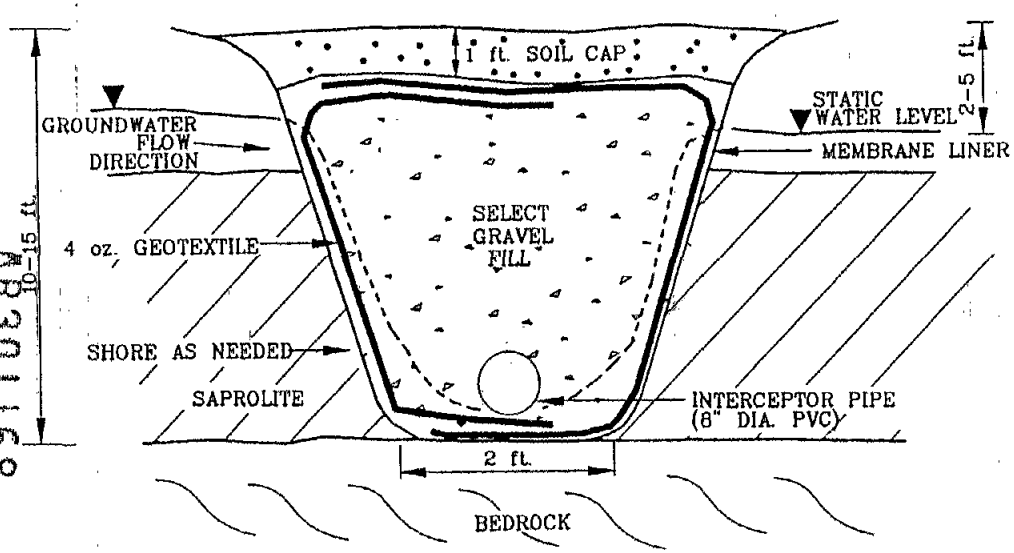


GROUND WATER COLLECTOR TRENCH



COLLECTOR TRENCH SECTION

NOT TO SCALE

TETRA TECH, INC.

FIGURE 3-7
HAVERTOWN PCP SITE
COLLECTOR TRENCH

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or if contamination is present, could be landfilled, incinerated, or other possible alternatives.

During installation, irregularities in the elevation of the fractured bedrock between test pits may require excavation of fractured bedrock where it extends above the interpolated bedrock elevations.

Access Manholes

Manholes are provided every few hundred feet for access, and at any changes in pipe alignment. The manholes are minimum four foot diameter precast concrete sections, with heavy duty cast iron manhole covers. This will facilitate any necessary cleaning or inspection of the collector pipe. The access manholes should be vented to ensure free drainage of the interceptor pipe. The Remedial Design should evaluate the possible provision for retrofitting disposable vapor phase carbon units, if odors become a problem.

Selection of Materials of Construction

In many cases, there will be a choice of different possible materials of construction for a given system component. For instance, the interceptor pipe could be made of PVC or some other appropriate material. Equipment vendors should be contacted during the design phase of the project, for information concerning the chemical compatibility of the waste with the products and equipment to be specified. For the purposes of this Feasibility Study, costs have been estimated assuming that the major pieces of equipment will not require significant use of exotic materials of construction.

Trench Backfill Material

The trench will be appropriately graded and backfilled with a highly porous select gravel. The gravel will drain freely to the perforated interceptor pipe at the bottom of the trench.

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Trench Liners

The trench will be lined with a permeable geotextile fabric on the face of the trench which is upgradient to the collector pipe, to permit unimpeded flow while minimizing gradual plugging of the gravel with fine particles (fines).

To minimize entry of surface drainage and run-off into the collector trench, an impermeable membrane liner will be placed above the gravel layer. This membrane liner will be extended along the face of the trench which is downgradient to the collector pipe. Without this feature, where the collector trench crosses the existing sanitary sewer pipe or other buried utilities, there would be the undesirable possibility of contaminated ground water flow entering the select backfill present in other utility trenches.

The impermeable membrane will minimize such flows wherever the collector trench encounters such potential conduits for the ground water to escape the collector trench. This key feature will minimize any communication between the ground water in the collector trench with permeable soil formations which are present.

The seams where two rolls of membrane adjoin will be sealed to be water tight. The liner thickness (and any necessary reinforcing) will be selected to withstand any hydraulic forces acting on the membrane due to the differential head across the membrane.

Collector Trench Pumping Station

A pumping station will be provided to convey the collected ground water to a suitable treatment system. Installation of the pumping station will require extending an electrical service to power the pumps, system controls, and any desired alarm systems. Pumping capacity will depend on the actual flow of water in the collector trench, and the instantaneous flow capacity of the treatment system. Each pump will have a capacity of approximately

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25 gpm. The pumps would be located above grade in a small utility building (or in a suitable water tight utility vault). The pump system shall be provided with necessary features for explosion-proof operation. Low shear diaphragm pumps will be provided to minimize emulsification of the oily water.

Monitoring Wells

Installation of the interceptor trench could potentially affect the performance of existing monitoring wells which are located in the vicinity of the trench. This will require careful attention to the design and installation of the trench, or possibly installation of new wells outside the trench area, so that representative samples can be collected.

Containment

Rehabilitation of the Existing 30-inch Storm Sewer

A recent closed circuit television surveillance of the storm sewer pipe indicates the presence of a small pipe discharging into a manhole located on the south side of the Philadelphia Chewing Gum property. This source of inflow is apparently an unpermitted connection to the storm sewer, which unnecessarily increases the dry weather flow of the storm sewer. It is anticipated that this source of inflow will be plugged, after USEPA notifies the affected property owners of the action to be taken.

The last section of storm sewer pipe (extending approximately 200 feet from the manhole south of PCG to the discharge point into Naylors Run) was observed to contribute noticeable infiltration into the storm sewer pipe during dry weather.

There are two basic alternatives for correction of this condition. The first alternative is total replacement of the pipe. This would involve excavating the section of pipe, removing the pipe, disposal of the contaminated pipe and soils in the trench, and then replacing the pipe. The second alternative is to line

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the storm sewer pipe in-place.

Given the cost of disposal of the contaminated soil, the second alternative was selected for consideration. The storm sewer pipe will be lined in-place, using one of several possible vendors (e.g Insituform).

Effectiveness: The purpose of a collector trench is to effectively capture the plume of contaminated water in the shallow aquifer at the southern edge of the site. The contaminated water can then be sent to a treatment system for removal of the contaminants. System components are selected to be compatible with any free product which may be collected.

Although not designed to act as an collector trench, the existing 30" storm sewer pipe has intercepted a portion of the flow of contaminated ground water. The storm sewer pipe is subject to periodic high storm water flows, which significantly restrict the utility of using the storm sewer to collect water for further treatment. Also, the storm sewer does not appear to be effective in capturing the plume along its entire length. This significantly limits the effectiveness of the storm sewer for capturing the plume of contaminants in the shallow ground water.

Installation of the collector trench will significantly improve capture of the plume, in comparison to the performance of the existing storm sewer. The collector trench will be installed to the depth of the fractured bedrock (significantly deeper than the storm sewer), to improve collection throughout the shallow aquifer. Also, the collector pipe will not be subject to periodic flow excursions and flooding during storm events. The periodic high flows in the storm sewer make continuous treatment unrealistic for the storm sewer effluent.

Unless this action is taken, there is a significant concern that the plume of contaminated ground water will migrate beyond the storm sewer, and possibly into seeps in the back yards and basements of residences along Rittenhouse Circle.

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Rehabilitation of the existing storm sewer pipe will also be performed. The lining will virtually eliminate any infiltration into the storm sewer pipe. The contaminated water which is presently being collected by the storm sewer pipe will instead be collected in the interceptor trench, with the advantage that the flows in the interceptor trench will not be subject to radical increases in flow during storm events.

Implementability: Placement of the collector trench will be complicated by the location of numerous residences, commercial buildings, and a large manufacturing building in the immediate area. The necessary equipment, construction methods, and labor are all readily available.

There are several vendors who specialize in lining concrete sewer pipes in-place. Since the workers do not normally enter the pipe during the lining process, the installation can proceed relatively quickly.

Cost: The capital cost for this alternative would include installation of the items included in alternative GW-3, as well as the collector trench and pumping station, and rehabilitation (lining) of the existing storm sewer pipe. The capital and O & M costs for monitoring would be repeated from option GW-2.

A description of the estimated costs for this alternative are provided in Appendix A, summarized as follows:

	Using PACT™ System	Using AOP System
Capital Cost:	$ 7,437,000	4,997,000
O & M per Year:	$ 595,000	485,500 (first year)
Present Worth:	$12,177,000	10,036,000

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3.5 DISCUSSION AND EVALUATION OF SEDIMENT ALTERNATIVES

3.5.1 Alternative S-1: No Action

Description: The No Action alternative is the base line against which all other Naylors Run sediment remediation alternatives will be compared. The No Action alternative for sediment would not include any remedial action.

Effectiveness: The extent and levels of contaminants of concern have increased in the Naylors Run sediments since the 1988 Remedial Investigation conducted for the site. A No Action alternative will not effectively reduce the contaminants in the sediments until the source stops transporting chemicals of concern into Naylors Run.

Another source of sediment contamination is adsorption of contaminants from the storm sewer discharge onto the sediments in the stream bed. Elimination or control of this source of contamination is addressed in the discussion of ground water remedial alternatives.

Implementability: This alternative could be implemented as soon as the Record of Decision is published by USEPA.

Cost: There is no capital cost or O&M cost associated with the No Action alternative.

Capital Cost:	$	0
O & M per Year:	$	0
Present Worth:	$	0

3.5.2 Alternative S-2: Limited Remedial Action - Capping National Wood Preservers

Description: An investigation of the levels of contamination in Naylors Run and Cobbs Creek has identified significant levels of contamination in the associated

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sediments. Samples taken from above the catch basin outfall (near Eagle Road), which were intended to serve as background samples, in fact showed the presence of significant levels of contamination.

One of the apparent sources of this contamination is sediment transport from the surface run-off from the NWP property. Currently, much of the site (with the exception of the NWP building) is covered with soil with a variable amount of gravel incorporated into the soil.

One alternative for mitigating further erosion of contaminated soils from the NWP property will be to place a vegetative soils cap over the exposed soils at the site, with the cap located as shown in Figure 3-8.

A vegetative cap will be used to isolate the contaminated soils from further erosion. This will involve initially cleaning the site of any debris which will interfere with placement of the cap. The next step will involve scarifying the existing soils (during dry weather) to impart adequate connection to the cap, for cap stability and drainage. Dust control measures will be needed during all construction activities. Also, this operation will require appropriate personnel protection measures, to avoid contact exposure, and exposures to dust and vapors.

Then a minimum six inch layer of clay will be placed as a barrier between the existing soils and the new cap. A six inch layer of topsoil will be placed as a final cap. The cap will be tapered so that it meets existing grade at the fenceline of the NWP property. The site will be graded to promote effective run-off of any rainwater, and to prevent significant ponding.

The topsoil will be seeded with a suitable seed mix which will include an annual rye grass to provide quick cover, and perennial grasses to establish a durable cover with minimum potential surface erosion. Sediment and erosion controls will be utilized during construction, and until the site vegetative cover is fully stabilized.

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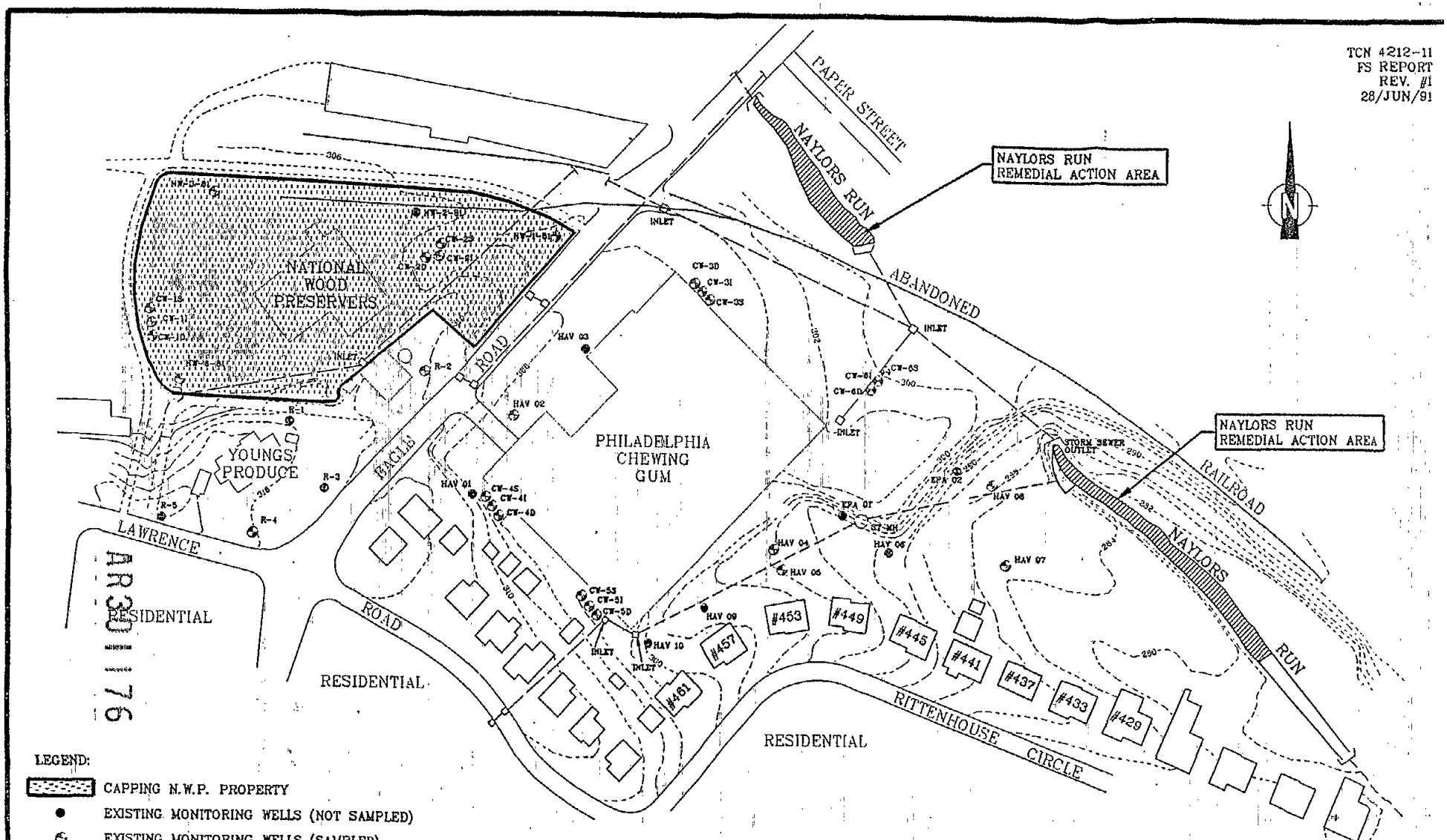

LEGEND:

- CAPPING N.W.P. PROPERTY
- EXISTING MONITORING WELLS (NOT SAMPLED)
- EXISTING MONITORING WELLS (SAMPLED)
- EXISTING STORM SEWER
- EXISTING GRADE

TOPOGRAPHIC INFORMATION TAKEN FROM R.E.WRIGHT ASSOC. PROJECT BASE MAP, HAVERTOWN PCP SITE

TETRA TECH, INC.

FIGURE 3-8
HAVERTOWN PCP SITE
SITE PLAN (S-2, S-3, & S-4)

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Effectiveness: This option will isolate the contaminated surface soils from direct contact with rainfall, which will limit erosion and runoff of contaminated soils. The cap will have a run-off coefficient which is similar to the existing cover. This will not significantly interfere with the downward flow of rainwater into the underlying aquifer. It is possible that the grasses planted will exhibit a minor amount of uptake (through the root zone) from the contaminated soils under the cap. Mowing operations could possibly result in very minor quantities of contaminants being released to the environment through any transport of the small pieces of leaves.

Implementability: Installation of a vegetative cover will be easily implemented, and will be effective to control erosion of contaminated soils at the NWP property. The required equipment is available through numerous landscaping or general construction contractors. Rigorous decontamination of equipment will be needed during the period of construction.

It is unlikely that there will be local landscaping contractors with the necessary health and safety training. Contractors with the necessary skills and equipment could receive the necessary health and safety training, or alternatively, a local general contractor with health and safety training could perform the work. The major capital expense will be the clay and topsoil needed to cap the site. Topsoil is readily available in the Philadelphia metropolitan area.

Cost: The major cost for implementation of this alternative will be purchase and installation of the soil and clay layers. The estimated cost is summarized as follows:

Capital Cost:	$ 290,000
O & M per Year:	$ 10,000
Present Worth:	$ 395,000

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3.5.3 Alternative S-3: Complete Remedial Action - Sediment Removal

Description: This alternative includes features which will effectively control further sediment exposures, and which will isolate the existing contaminated soils in a secure storage cell constructed on NWP property. The remedial action includes capping the NWP property, sediment removal from a section of Naylors Run, and proper disposal of contaminated materials on-site at the NWP property, as shown in Figure 3-8.

Removal of the contaminated sediments in the affected section of Naylors Run will be included in this alternative.

Naylors Run will be dewatered by diverting flow around the section where work is underway. Excavation will begin at the catch basin end of Naylors Run, using a temporary bypass pumping arrangement, so that heavy equipment can remove the contaminated soils.

It is anticipated that backhoes, front end loaders, and large industrial vacuum trucks will be used to remove the soils. The old railroad right-of-way east of Naylors Run will be used for access and as a staging area for the necessary dump trucks. The excavated soils will be hauled to a newly constructed secure area at the NWP property.

The stream bed will be stabilized with a twelve-inch thick layer of compacted gravel and rip-rap, or other appropriate material, underlain by a geotextile mat, which will limit any further contact or erosion.

A landfill cell will be constructed to hold the contaminated soils and sediments which are generated as a result of the construction activities needed for the project. The landfill cell will include features suitable for a hazardous waste landfill, such as a leachate collection system, a double liner, and an impermeable cap. The height of the landfill cell will be selected to blend in to the extent possible.

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Effectiveness: This alternative will effectively isolate the contaminated surface soils at the NWP property from direct contact with rainfall, which will limit erosion and runoff of contaminated soils. The cap will have a run-off coefficient which is similar to the existing cover. This will not significantly interfere with the downward flow of rainwater into the underlying aquifer.

It is possible that the grasses planted will exhibit a minor amount of uptake (through the root zone) from the contaminated soils under the cap. Mowing operations could possibly result in very minor quantities of contaminants being released to the environment through any transport of the small pieces of leaves.

This alternative will remove the top twelve inches of sediments from the affected section of Naylors Run, which will effectively remove the majority of sediments deposited during operation of the NWP facility. The stream bed will be restored using a twelve inch layer of compacted gravel and rip-rap, to control further erosion and to minimize any contact with remaining soils and sediments. Construction methods will be selected to minimize any adverse impact on the local residents and down stream water quality.

On-site disposal of the contaminated soils will effectively limit any further possible exposures. Availability of on-site disposal will provide greater cost control in the event that additional soils are excavated, since the cap depth can be increased marginally without a significant increase in the cost of the landfill cell.

Implementability: Installation of a vegetative cover and secure landfill will be easily implemented, and will be effective to control erosion of contaminated soils and for long term storage of contaminated soils at the NWP property. The required equipment is available through numerous landscaping or general construction contractors. Rigorous decontamination of equipment will be needed during the period of construction.

Contractors with the necessary skills and equipment could receive the necessary health and safety training, or alternatively, a local general contractor with

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health and safety training could perform the work. The major capital expense will be for the clay and membrane liners to construct the landfill, and the clay and topsoil needed to cap the site. Topsoil and clay are readily available in the Philadelphia metropolitan area.

Cost: Major cost items for this alternative include the capital and installation costs for the clay material, liners, leachate collection system, and vegetative cover. Operation and Maintenance (O & M) costs would include groundskeeping and minor repairs to the surface of the cap. The costs are summarized as follows:

Capital Cost:	$ 1,139,000
O & M per Year:	$ 13,000
Present Worth:	$ 1,276,000

3.5.4 Alternative S-4: Complete Remedial Action - Piping Naylors Run

Description: This alternative includes features which will effectively control further sediment exposures in a section of Naylors Run, and which will isolate the existing contaminated soils at the NWP property. The remedial action includes capping the NWP property, and installation of a new buried corrugated metal storm sewer pipe in a section of Naylors Run, as shown in Figure 3-8.

The new storm sewer pipe will effectively isolate the contaminated soils from the flow of water in Naylors Run. An anti-seep collar would be provided so that water would not flow along the outside of the pipe. The construction activity would include bypassing any flow around the construction area, to minimize transport of sediment down stream during construction.

Naylors Run will be dewatered by diverting flow around the section where work is underway. Excavation will begin at the catch basin end of Naylors Run, using a temporary bypass pumping arrangement, so that heavy equipment can remove the soils during placement of the storm sewer pipe. It is estimated that a 72" to 84" corrugated metal pipe should suffice, based on the sizes of the existing

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storm sewer pipes. This estimate would be checked rigorously during the remedial design phase of the project.

It is anticipated that backhoes and front end loaders will be used to install the new storm sewer pipe. The old railroad right-of-way east of Naylors Run will be used for access and as a staging area for the necessary construction materials. The excavated soils will be replaced in the vicinity of the new storm sewer pipe. The entire area would receive a 6" layer of clean topsoil, graded to promote run-off, to mitigate any contact with potentially contaminated soils.

Effectiveness: This alternative will effectively isolate the contaminated surface soils at the NWP property from direct contact with rainfall, which will limit erosion and runoff of contaminated soils. The cap will have a run-off coefficient which is similar to the existing cover. This will not significantly interfere with the downward flow of rainwater into the underlying aquifer.

This alternative will isolate the sediments in the affected section of Naylors Run, which will effectively remove the potential for contact with the sediments. The former stream bed will become a relatively level surface, and it will be difficult to outwardly determine that there had been a small stream at the location. Construction methods will be selected to minimize any adverse impact on the local residents and down stream water quality.

In-place disposal of the contaminated soils and sediment will effectively limit any further possible exposures.

Implementability: Installation of a vegetative cover and secure landfill will be easily implemented, and will be effective to control erosion of contaminated soils and for long term storage of contaminated soils at the NWP property. The required equipment is available through numerous landscaping or general construction contractors. Rigorous decontamination of equipment will be needed during the period of construction.

Installation of the new storm sewer pipe could be performed by the same general category of contractors. The desired invert elevation might require removal of a portion of the existing stream bed, but this material could be relocated in the trench for the new storm sewer pipe.

A significant public relations effort may be needed to assure the local affected residents that this action is necessary and justified. For example, some of the affected residents would lose the aesthetic benefit of having the Naylors Run stream in their back yards. Also, a properly graded and maintained cap would be potentially more attractive than the existing NWP property.

Cost: The major cost items for implementation of this alternative include the capital cost and installation cost for the new storm water pipe, the cost of disposal of soils form the excavation at a secure landfill on the NWP site, and the cost of clay and soil materials for the cover at the site. Yearly operation and maintenance (O & M) includes groundskeeping on the NWP property. These costs are summarized as follows:

Capital Cost:	$ 1,561,000
O & M per Year:	$ 13,000
Present Worth:	$ 1,698,000

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4.0 DETAILED ANALYSIS OF ALTERNATIVES

4.1 INTRODUCTION

The detailed evaluation of the proposed remedial alternatives is conducted in Section 4 to provide the decision-making body (USEPA) with sufficient information to allow for the selection of the optimal site remedy. The statutory requirements of a remedial action under CERCLA/SARA are that it:

- be protective of human health and the environment;
- attain ARARs if possible;
- be cost-effective;
- utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the extent practicable; and
- satisfy the preference for treatment that reduces the toxicity, mobility, and/or volume of contaminants.

CERCLA also emphasizes that long-term protectiveness and effectiveness of remedial actions be evaluated.

It is proposed that the planned remedial action for ground water and sediments at this site be undertaken as two or more new operable units. The alternatives presented in this Feasibility Study are based on the best available information concerning the fate and transport of site-related contaminants.

A previous Operable Unit (OU1) addressed requirements provided in the 1989 ROD for the HAVERTOWN Site.

Operable Unit Two (OU2) will address treatment of the shallow ground water at the HAVERTOWN Site, with selection of the optimum treatment technology deferred pending completion of treatability studies. Treatment of the deep bedrock aquifer will be deferred until contamination in the shallow aquifer is remediated.

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A focused remedial investigation and feasibility study will be performed as part of Operable Unit Three (OU3), to better define the extent of sediment and soils contamination. OU3 will be initiated following issuance of the OU2 ROD.

In this section, the four identified alternatives for OU2 will be screened according to the nine criteria established by the USEPA to address the statutory requirements of CERCLA. These criteria are:

- overall protection of human health and the environment;
- compliance with ARARs;
- reduction of toxicity, mobility, or volume through treatment;
- short-term effectiveness;
- long-term effectiveness and permanence;
- implementability;
- cost;
- state acceptance; and
- community acceptance.

A brief description, as given in USEPA (1988), of each criteria follows:

Overall protection of human health and the environment - This criteria is used to assess how the alternative achieves and maintains protection of human health and the environment.

Compliance with ARARs - This criteria is used to assess how the alternative complies with ARARs, specifically chemical-, location-, and action-specific federal, state and local ARARs.

Reduction of toxicity, mobility, or volume through treatment - This criteria is used to assess the anticipated performance of the technologies to be employed by the alternative with respect to the reduction of toxicity, mobility, and volume.

Short-term effectiveness - This criteria is used to assess the effectiveness of

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the alternative in protecting human health and the environment during implementation of the alternative.

Long-term effectiveness and permanence - This criteria is used to assess the long-term effectiveness of the alternative in maintaining protection of human health and the environment once response objectives have been met.

Implementability - This criteria is used to assess the technical, operational, and administrative feasibility of the alternative.

Cost - This criteria is used to assess the capital and operational and maintenance costs of the alternative.

State acceptance - This criteria is used to assess the state's technical and administrative preferences or concerns about the alternative.

Community acceptance - This criteria is used to assess the community's preference or concerns about the alternative.

4.2 INDIVIDUAL ANALYSIS OF ALTERNATIVES

4.2.1 Alternative GW-1 - No Action

4.2.1.1 Description

RI/FS Guidance requires that the No Action alternative be considered as a baseline against which all other alternatives may be compared. The No Action alternative will include limited monitoring of the ground water and surface water at the site.

Limited monitoring of the levels of contaminants in the ground water and surface water would continue for a thirty year period, with an anticipated sampling frequency of two times per year for the first five years, and yearly sampling for the next twenty-five years. The sampling would include nine wells and two

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stream locations. The samples would be analyzed for the Target Analyte List (TAL), Target Compound List (TCL), and Dioxins.

The No Action alternative also indirectly incorporates measures performed under the 1989 ROD (first operable unit) for the HAVERTOWN site, which included removal of containerized (drummed) waste at the NWP site and installation of an oil/water separator (OWS) at the discharge point of the existing storm sewer into Naylors Run.

Details of the feasibility evaluation (which was the basis for the 1989 ROD) and a description of the chosen remedial measures is given in the Pennsylvania Department of Environmental Resources Final Focused Feasibility Study, August 1989, prepared by R.E. Wright Associates, Inc. and Lawler, Matusky & Skelly Engineers.

The OWS was a refinement of the treatment provided by a temporary catch basin installed as an interim response action. The interim action included placement and periodic removal of oil sorbent booms in the catch basin.

This No Action option will indirectly include continued monitoring of OWS performance as part of OU1. O & M cost elements associated with the OWS, including effluent sampling for compliance with NPDES regulations, have been funded for a ten year period under the 1989 ROD.

The No Action alternative includes no further actions for the ground water and surface water at the HAVERTOWN site.

4.2.1.2 Assessment

Overall Protection of Human Health and the Environment

The No Action alternative would indirectly provide a limited degree of mitigation of the identified potential risks to human receptors and the environment, as a result of the recent installation of the OWS.

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Installation of the OWS was completed after the surface water sampling effort was concluded in this Remedial Investigation. A portion of the contaminants in the storm sewer discharge would be dissolved in the oil which has been captured by the OWS. The contaminants dissolved in the aqueous phase would not be remediated by the OWS.

The first round of sampling of the aqueous fraction being discharged from the OWS to Naylors Run has shown that the OWS effluent contains significant concentrations of PCP.

The No Action alternative would not remediate the risks associated with possible future ground water use, and risks related to the ingestion of fish and consumption pathways identified in the risk assessment.

Compliance With ARARs

The implementation of the No Action alternative will have no direct effect on reducing the levels of site contaminants in the surface water at the site. The existing OWS, installed under the 1989 ROD, was not designed to address full compliance with ARARs. The OWS discharge will continue to contribute significant loadings of organics and inorganics from the site to the surface water. For example, the risk assessment indicated that the level of dioxin compounds should be reduced to a toxicity equivalent of 1×10^{-8}, relative to the 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) isomer. The OWS has no provision for the necessary treatment or destruction of dioxins.

With regard to ARARs concerning aquifer restoration, the ground water in the bedrock aquifer at the HAVERTOWN site may be classified as Class IIA, and as such, might need to be remediated to drinking water standards. Also, since the shallow ground water is being discharged to surface water, the surface water cleanup standards would apply.

With regard to the soils at the NWP site, there is insufficient information to

AR301187

evaluate the contribution of contaminants from this pathway. The No Action alternative would provide no remedial measures regarding these contaminants. A decision concerning remediation of the soils will be deferred to OU3.

Possible remediation of the sediments in Naylors Run will also be deferred until the soils at NWP are further characterized under OU3, and the potential of the soils to act as a continuing source of contamination has been evaluated.

Long-Term Effectiveness and Permanence

Under the No Action alternative, the magnitude of any future risk at the HAVERTOWN site is nearly equivalent to the identified current and future risk. The effectiveness of the OWS to reduce the levels of contaminants in the surface water has not been fully characterized. The contaminated ground water at the site represents a major source of ongoing contaminant release from the shallow aquifer into the surface water via the storm sewer. However, a likely result of continued operation of the OWS will be a limited reduction of the amount of contaminated oil reaching the surface water (and related sediment).

Monitoring requirements included with the No Action alternative will include limited ground water and surface water sampling for a period of 30 years. Performance of the oil/water separator with respect to the NPDES program will be monitored for a ten year period as part of the 1989 ROD. The monitoring will document any possible reduction in risk which may arise as a result of the OWS and dilution/natural attenuation/biodegradation processes. Sample collection and analysis are the only O&M functions which will be performed as part of this No Action alternative.

No problems or technical difficulties are anticipated in relation to the No Action alternative. The discharge from the OWS will apparently not come into compliance with surface water ARARs and NPDES criteria in the near future, since the ground water contaminant concentrations (e.g. PCP and dioxin) appear to be increasing with respect to the previous round of sampling. Also, since there will be no free product recovery adjacent to NWP, the attainment of ARARs solely

AR301108

by natural attenuation of contaminants in the aquifer may require an extremely long period of time.

Reduction in Toxicity, Mobility or Volume

The toxicity, mobility, and volume of contaminants at the HAVERTOWN site have been reduced as a result of previous remedial activities, including past effort to remove free product underlying the NWP property, and installation of the catch basin. The recent completion of the OWS installation will reduce the quantity of contaminants being discharged to the surface waters by an unknown amount.

This No Action alternative does not result in any further reduction of toxicity, mobility, or volume of contaminants related to free product source removal and ground water cleanup beyond those already realized or expected.

Short-Term Effectiveness

The implementation of the No Action alternative will not further impact community or environmental quality. The potential for exposure of site workers during monitoring will be minimized by the use of conventional health and safety protocols. The rate of site related contaminant reduction in the ground water is anticipated to be very slow as a result of natural attenuation, and will be documented by the limited monitoring effort.

Recent ground water sampling results actually have shown a slight increase in the levels of PCP and dioxin in the ground water at certain locations, perhaps resulting from loss of the free product carrier which acted to partition the PCP from the ground water.

The contribution of contaminants from the site to the surface water will decrease by an unknown amount after operation of the OWS. The rate and amount of contaminant reduction will be documented by an evaluation of the monitoring data.

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The remedial objective of attaining surface water discharge ARARs (e.g. NPDES standards) with respect to site related organics will not likely be accomplished. Attaining ARARs with respect to organics and inorganics present in the aqueous fraction also will not be accomplished, as the OWS is ineffective in the removal of such compounds.

Implementability

Technical and administrative implementability is simplified for the No Action alternative. No further permits or facilities for collection, rehabilitation, treatment, storage, or disposal are required. The existing oil/water separator may be subject to permitting restrictions and disposal requirements for the captured free product. Standard sampling methodologies are applicable to the monitoring effort, and conventional sampling equipment and trained personnel are readily available.

Other than the remedial measures already completed, the No Action alternative includes no other actions, and consequently, evaluation of implementability is not applicable.

Cost

The cost associated with the No Action alternative is summarized as follows:

Capital Cost:	$ 0
O & M per Year:	$ 58,000 (average)
Present Worth:	$ 715,000 (30 year period)

State Acceptance

The acceptability of this No Action alternative to concerned Commonwealth of Pennsylvania agencies is unknown at this time.

Community Acceptance

The acceptability of the No Action alternative to the community is unknown at this time. Community acceptance will be determined after the public comment period.

Current maintenance for the oil/water separator requires periodic trips through a residential community to remove oil captured by the unit and to check for accumulation of debris on the screen. It is unknown whether continuation of this drum removal and cleaning activity will continue to be supported by the local community.

4.2.2 Alternative GW-2 - Limited Remedial Action

4.2.2.1 Description

The limited remedial action alternative includes all of the elements included in the No Action alternative (previous or planned remedial activities and long-term monitoring) and the following additional elements:

- Ground Water Monitoring - The frequency and number of locations of the proposed long-term ground water and surface water monitoring would be modified in the Limited Remedial Action alternative beyond those described under the No Action alternative. Changes in the frequency and location of monitoring would allow for a more comprehensive evaluation of long-term ground water and surface water quality.

  A total of fifteen wells and two stream locations would be sampled. The samples would be analyzed for TAL, TCL, and Dioxins. Two new monitoring well clusters would be installed to the east of Naylors Run to better characterize the extent of plume migration in the bedrock aquifer.

- Institutional Controls and Deed Restrictions - Institutional actions including deed/zoning restrictions and other administrative actions are part of the Limited Remedial Action alternative.

  Deed/zoning restrictions will be enacted for the HAVERTOWN site to limit the potential for future ground water consumption, and to permit any ongoing monitoring activities.

  Other possible administrative actions are related to the notification and announcement of any future fishing controls, advisories or bans. This could include advertisement of fishing controls via the media, posted signs, public meetings, and so forth.

4.2.2.2 Assessment

Overall Protection of Human Health and the Environment

Institutional actions are identified to eliminate future potential exposure pathways for contaminated ground water and fish. Although complete compliance with institutional actions is not guaranteed, the chances of direct exposures to ground water contamination occurring by those pathways in the vicinity of the NWP site is thought to be sufficiently unlikely so as to render the institutional restriction alternative a possible alternative for adequately protecting human health. Drinking water in the area is currently supplied by a central water system.

The Limited Action alternative does not provide any means of limiting the migration of the contaminated ground water in the shallow or deep aquifer, creating a potential consumption hazard beyond the bounds of the restricted area.

As with the No Action alternative, the Limited Remedial Action alternative does not address the risks to terrestrial/aquatic receptors posed by the elevated levels of PCP and other organic compounds and inorganics being discharged into

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the surface water.

Additional site monitoring is intended to evaluate the effectiveness of the implemented remedial actions in meeting the objective of providing overall protection of human health and the environment.

Compliance With ARARs

The discussion of compliance with ARARs issues under the Limited Remedial Action alternative is the same as that presented previously under the No Action alternative.

Long-Term Effectiveness and Permanence

As stated previously, institutional actions are identified to address future potential exposure pathways (such as domestic use of ground water), but insuring complete compliance with institutional actions is not guaranteed. Therefore, there is a long-term management need to ensure that future land use at the HAVERTOWN site is in compliance with zoning/deed restrictions developed.

Given the observed levels of contaminants in the ground water at the site, should the institutional actions be circumvented or ignored, there would be a potential risk associated with activities such as fishing or using ground water. Because the Limited Action alternative does not provide for containment or removal of the contaminated ground water, a potential exposure hazard exists at locations beyond the deed- or zoning- restricted area.

The remainder of the discussion of long-term effectiveness and permanence issues as related to past or future remedial actions under the Limited Remedial Action alternative is the same as that presented previously under the No Action alternative.

Reduction in Toxicity, Mobility, or Volume

Through institutional controls, the mobility of contaminants (as related to exposure pathways) in the ground water at the HAVERTOWN site will be potentially reduced by limiting use of the ground water. By limiting ingestion of fish, the increase in toxicity associated with bioaccumulation is removed as a route of exposure. The levels of contaminants in the surface water and sediments would not be further reduced. No other additional reduction in toxicity or volume is provided under this alternative.

The remainder of the discussion of reduction in toxicity, mobility, or volume issues as related to past or future remedial actions under the Limited Remedial Action alternative is the same as that presented previously under the No Action alternative.

Short-Term Effectiveness

The implementation of institutional controls, deed restrictions, or additional monitoring would not result in any short-term effects on human health or the environment. Further, as soon as institutional controls are in place, the remedial response objective of controlling exposure to residual contamination in the ground water will be met. Since the shallow ground water would continue to be discharged to surface waters, there would be no further improvement in surface water quality.

The remainder of the discussion of short-term effectiveness issues as related to past and future remedial actions under the Limited Remedial Action alternative is the same as that presented previously under the No Action alternative.

Implementability

Institutional actions and additional monitoring would not be difficult to implement. With regard to institutional actions, deed and zoning changes are

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not difficult to implement (with the cooperation of the local community), although the changes may require extensive paperwork and require a reasonable amount of time (several weeks to several months) to complete. With regard to additional monitoring, only additional time, supplies, and funding would be needed beyond those already committed for the limited monitoring program.

The remainder of the discussion of implementability issues as related to past and future remedial actions under the Limited Remedial Action alternative is the same as that presented previously under the No Action alternative.

Cost

Estimated capital costs for implementation of institutional controls and additional monitoring costs are as follows, based on a project life of 30 years:

Capital Cost:	$	198,000
Yearly O & M:	$	162,000
Present Worth:	$	1,900,000

State Acceptance

The acceptability of this Limited Remedial Action alternative to concerned Commonwealth of Pennsylvania agencies is unknown.

Community Acceptance

The acceptability of this Limited Remedial Action alternative to the community is unknown. Community acceptance will be determined during the public comment period.

4.2.3 Alternative GW-3 - Source Removal, Treatment, and Disposal

4.2.3.1 Description

The Source Removal, Treatment, and Disposal alternative includes all of the elements included in the Limited Remedial Action alternative and the following additional elements:

- Two (2) 2-Foot diameter Shallow Aquifer Free Product Recovery Wells
- Use of Existing Oil/Water Separator (OWS) with Two New Free Product Skimmers
- Aqueous Phase Pumping Station at Existing OWS - Pumped to NWP Site
- Free Product Pumping Station at Existing OWS - Pumped to NWP Site
- Access for OWS Maintenance Through PCG/Existing Railroad Right-of-Way
- Chemical Precipitation for Removal of Inorganics
- Advanced Oxidation Process (AOP) or Powdered Activated Carbon Treatment (PACT™) System for treatment of organics, located at NWP Site
- Disposable Granular Activated Carbon (GAC) Units at NWP Site
- Free Product Storage Tank at NWP Site
- Discharge to Naylors Run

The two alternatives for treatment of the organics have been identified for further analysis as part of a treatability study. The AOP has the advantage of reportedly being able to destroy PCP and dioxin compounds, subject to verification during the treatability study. The AOP system has the potential to emit small quantities of ozone, which will be evaluated during the study.

AR301486

The PACT™ system has the advantage of being more tolerant of elevated organics or solids loadings, and may also be capable of destroying dioxin compounds using the wet-air oxidation system for on-site regeneration of the PAC. The capabilities of both systems will be evaluated as part of the treatability study.

Remediation of any contaminated ground water in the deep bedrock aquifer will be deferred until after the contaminants in the shallow aquifer have been remediated.

4.2.3.2 Assessment

Overall Protection of Human Health and the Environment

The current method of evaluating human exposure and risk for potentially dioxin-contaminated waters requires effective treatment to reduce contamination levels to extremely low values.

Sophisticated treatment systems are provided to remove the contaminants of concern prior to discharging the treated water to Naylors Run.

Given the importance of removing these compounds, granular activated carbon units will be provided as a justifiable level of redundancy. The GAC units will normally act to polish the effluent prior to discharge, but will also provide treatment if there is an upset in the primary treatment system. The GAC units are expected to require replacement approximately every few months.

This alternative will rely on continued use of the storm sewer for collection of the plume of contaminants at the southern end of the site. The overall effectiveness of the storm sewer in capturing the plume is unknown.

There is a concern that the plume of contaminated ground water could potentially migrate beyond the storm sewer, and possibly into seeps in the back yards and basements of residences along Rittenhouse Circle.

AR301197

Free product recovery in the vicinity of the NWP site will partially mitigate the source of contaminants, and will contribute to an ultimate reduction in the levels of contaminants.

The remainder of the discussion of compliance with overall protection of human health and the environment issues as related to past or future remedial actions under the Source Control alternative is the same as that presented previously under the Limited Remedial Action alternative.

Compliance With ARARs

The current discharge is not in compliance with ARARs for several organic and inorganic compounds. The very low levels of dioxin which are allowed by the risk assessment require implementation of the best available treatment technology.

The Source Removal, Treatment, and Disposal remedy will remove inorganics and organic compounds, and will attain NPDES ARARs (to the extent that is technically feasible) for the ground water being discharged to the Naylors Run. The attainment of drinking water ARARs related to the ground water in the deep aquifer will be evaluated after the shallow aquifer has been remediated.

The remainder of the discussion of compliance with ARARs issues as related to past or future remedial actions under the Source Control alternative is the same as that presented previously under the Limited Remedial Action alternative.

Long-Term Effectiveness and Permanence

Given the low transmissivity of the ground water in the soils at the site, it is reasonable to assume that the shallow ground water will be treated for a very long period of time before it will be possible to consider treatment of the deep bedrock aquifer.

The ability of the soils at the site to retain the PCB and other contaminants

AR301198

was not evaluated in the remedial investigation. It is probable that the advective transport of the PCP is retarded by the slow desorption of PCP and other contaminants from concentrated hot spots associated with the NWP site. By removing the free product near the NWP site, there will be a reduction in the available source of the contaminants.

The steps in the Source Removal, Treatment, and Disposal alternative provide a reasonable balance between cost and effectiveness of collection and treatment.

The remainder of the discussion of long-term effectiveness and permanence issues as related to past or future remedial actions under the Source Control alternative is the same as that presented previously under the Limited Remedial Action alternative.

Reduction in Toxicity, Mobility, or Volume

Treatment of the shallow ground water will provide the best possible reduction in the treatment system effluent toxicity. Since there will be significant capture of contaminated residual materials, the effective volume of wastes being discharged to Naylors Run will be reduced. By reducing the concentration of contaminants in the shallow aquifer, there will be a possible reduction in the level of contaminants reaching the deep bedrock aquifer.

Installation of Granular Activated Carbon (GAC) is provided to polish the effluent to help ensure reaching the desired level of treatment for dioxin compounds. The GAC units also provide redundancy in the event the primary treatment system fails or is taken off-line temporarily. Given the lengthy turn-around time for analysis of dioxin compounds, it would not be cost-effective to store the effluent for analysis prior to discharge.

Treatability tests would be performed to determine the anticipated levels of PCP and dioxin in the GAC polishing units, in order to determine disposal options (i.e. whether the waste extract PCP concentration in the spent carbon is less than 0.01 ppm, and the waste extract concentration of various dioxin categories

AR301199

in the spent carbon is less than 1 ppb).

Removal of free product would effectively reduce the volume of the original source of contamination. It is unknown whether removal of the free product might produce an effect on the mobility of the contaminants.

The remainder of the discussion of reduction in toxicity, mobility, or volume issues as related to past or future remedial actions under the Source Removal, Treatment, and Disposal alternative is the same as that presented previously under the Limited Remedial Action alternative.

Short-Term Effectiveness

The selected alternative can be constructed in a relatively short time. Including the time needed for the treatability studies, it is possible that the selected alternative can be expedited and implemented in an eighteen to twenty-four month period, following completion of the applicable Record of Decision (ROD).

The remainder of the discussion of short-term effectiveness issues as related to past and future remedial actions under the Source Removal, Treatment, and Disposal alternative is the same as that presented previously under the Limited Remedial Action alternative.

Implementability

The selected alternative is straightforward with respect to the technical aspects of its implementation. Various innovative technologies have been eliminated from consideration due to concerns with implementability and the treatment of dioxin wastes. Several potentially attractive technologies, such as *in-situ* bioremediation, and steam stripping have been eliminated as a result of the poor soil conditions in the shallow aquifer.

Effective project management will be critical to minimize potential

AR301200

environmental exposures and to maintain positive public relations. One of the more challenging aspects of this site is its location relative to an attractive suburban community.

Any construction activities will have a short-term impact on the daily lives of the local residents, which will include inconvenience and the general disruption associated with earth work in a well established and populated area. It is judged that the local residents will favor a long term environmental clean-up of the site over the short-term inconvenience associated with implementing the selected remedial actions.

The remainder of the discussion of implementability issues as related to past and future remedial actions under the Source Removal, Treatment, and Disposal alternative is the same as that presented previously under the Limited Remedial Action alternative.

Cost

To an extent, the cost associated with cleaning-up the site is driven by the presence of dioxin in the ground water, which is currently being discharged to Naylors Run. Treatability studies will be performed to determine the waste classification of any residuals generated by the process. The cost and availability of disposal for any residuals could be a factor in selecting the optimum treatment alternative. Disposal options for the process residuals can be better characterized as part of the treatability study.

The residual material generated in prior cleanup activities at the site apparently have been classified as a K001 waste, which is listed as "Bottom sediment sludge from the treatment of wastewaters from wood preserving processes that use creosote and/or pentachlorophenol" (40CFR Part 261, Subpart D).

The construction cost of implementing the Source Removal, Treatment, and Disposal ground water collection and treatment option is as follows:

AR301201

Advanced Oxidation Process (AOP)

Capital Cost:	$ 2,577,000	
Yearly O & M:	$ 479,500	(first year)
Present Worth:	$ 7,553,000	

PACT™ Process

Capital Cost:	$ 5,018,000	
Yearly O & M:	$ 445,000	(first year)
Present Worth:	$ 9,684,000	

State Acceptance

The acceptability of this Source Removal, Treatment, and Disposal alternative to concerned Commonwealth of Pennsylvania agencies is unknown at this time.

Community Acceptance

The acceptability of this Source Removal, Treatment, and Disposal alternative to the community is unknown. Community acceptance will be determined during the public comment period.

4.2.4 Alternative GW-4 - Source Control, Containment, Collection, Treatment, and Disposal

4.2.4.1 Description

The Source Control, Containment, Collection, Treatment, and Disposal alternative includes all of the elements included in the Source Control, Treatment, and Disposal alternative and the following additional elements:

- Storm Sewer Lining

AR301202

- Collector Trench and Pumping Station

Remediation of any contaminated ground water in the deep bedrock aquifer will be deferred until after the contaminants in the shallow aquifer have been remediated.

4.2.4.2 Assessment

Overall Protection of Human Health and the Environment

Continued reliance on the storm sewer pipe to collect the contaminated ground water at the site may not be justified given the presence of high levels of PCP and significant levels of dioxins in the ground water. These compounds are being discharged to Naylors Run, where elevated levels of contamination have been documented in the remedial investigation and risk assessment.

The effectiveness of the existing storm sewer pipe as a collector for contaminated ground water is compromised by the effect of periodic high flows during storm events and other conditions. The storm sewer pipe was not designed to act as a collector, an therefore possibly could allow a portion of the contaminated shallow plume to flow under or around the storm sewer pipe.

During the closed circuit television surveillance of the storm sewer pipe, it appeared that some sections of the pipe exhibited relatively insignificant infiltration.

To address these concerns, a new 500 foot collector trench would be installed as part of this option. The details of construction for the collector trench would be designed to provide collection along the length of the collector. The collector would be installed deeper than the existing storm sewer pipe, to provide a greater capture cross sectional area.

The existing storm sewer pipe would then be lined in place, to eliminate the amount of ground water infiltrating into the pipe. The storm sewer would

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continue to function as a storm sewer.

By providing a favorable hydraulic gradient to the collector trench, and by lining the storm sewer pipe, this alternative will provide enhanced capture of the shallow ground water and will limit the flow of contaminated shallow ground water from reaching Naylors Run.

The remainder of the discussion of compliance with overall protection of human health and the environment issues as related to past or future remedial actions under the Source Control, Containment, Collection, Treatment, and Disposal alternative is the same as that presented previously under the Source Removal, Treatment, and Disposal alternative.

Compliance With ARARs

Installation of the collector trench would effectively capture the plume of contaminated ground water extending from the NWP site in the shallow aquifer. Lining the storm sewer pipe would eliminate the observed flow of contaminated ground water from the storm sewer pipe into Naylors Run. This would provide the most technically feasible method of complying with site ARARs.

The remainder of the discussion of compliance with ARARs issues as related to past or future remedial actions under the Source Control, Containment, Collection, Treatment, and Disposal alternative is the same as that presented previously under the Source Removal, Treatment, and Disposal alternative.

Long-Term Effectiveness and Permanence

In order to provide maximum assurance of long-term effectiveness and permanence of the remedy, it will be necessary to take steps to eliminate the direct discharge of contaminated ground water to Naylors Run. Installation of a collector trench and treatment system will virtually eliminate the direct discharge of untreated ground water, and will provide the greatest long-term effectiveness and permanence from among the available ground water remediation

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alternatives.

The steps in the Source Control, Containment, Collection, Treatment, and Disposal alternative provide a reasonable balance between cost and effectiveness of collection and treatment.

The remainder of the discussion of long-term effectiveness and permanence issues as related to past or future remedial actions under the Source Control, Containment, Collection, Treatment, and Disposal alternative is the same as that presented previously under the Source Removal, Treatment, and Disposal alternative.

Reduction in Toxicity, Mobility, or Volume

Collection and treatment of the shallow ground water will provide the best possible reduction in effluent toxicity. Since there will be no dilution from storm sewer flows, there will be significant capture of contaminated residual materials in the shallow ground water, and the effective volume of wastes being discharged to Naylors Run will be reduced.

The remainder of the discussion of reduction in toxicity, mobility, or volume issues as related to past or future remedial actions under the Source Control, Containment, Collection, Treatment, and Disposal alternative is the same as that presented previously under the Source Removal, Treatment, and Disposal alternative.

Short-Term Effectiveness

The treatment system would be expected to produce a high quality effluent for discharge to Naylors Run. The selected alternative can be constructed in a thirty-six month period from the date of issuance of the ROD for OU2. Including the time needed for the treatability studies, it is possible that the selected alternative can be expedited and implemented in a twenty-four month period.

AR301205

The remainder of the discussion of short-term effectiveness issues as related to past and future remedial actions under the Source Control, Containment, Collection, Treatment, and Disposal alternative is the same as that presented previously under the Source Removal, Treatment, and Disposal alternative.

Implementability

The selected alternative is straightforward with respect to the technical aspects of its implementation. Treatability tests will be performed to evaluate the performance of selected treatment methods. Various innovative technologies have been eliminated from consideration due to concerns with implementability and the treatment of dioxin wastes. Several potentially attractive technologies, such as *in-situ* bioremediation, have been eliminated as a result of the poor soil conditions in the shallow aquifer.

Effective project management will be critical to minimize potential environmental exposures and to maintain positive public relations. One of the more challenging aspects of this site is its location relative to an attractive suburban community.

Any construction activities will have a short-term impact on the daily lives of the local residents, which will include inconvenience and the general disruption associated with earth work in a well established community. Given the levels of contaminants at the site, the local residents may favor the benefit of an effective long-term environmental clean-up of the site above the short-term inconvenience associated with implementing the selected remedial actions.

The remainder of the discussion of implementability issues as related to past and future remedial actions under the Source Control, Containment, Collection, Treatment, and Disposal alternative is the same as that presented previously under the Source Removal, Treatment, and Disposal alternative.

AR301206

Cost

Estimated capital costs for implementation of the Source Control, Containment, Collection, Treatment, and Disposal alternative(s) are shown as follows:

Advanced Oxidation Process (AOP)

Capital Cost:	$ 4,997,000
Yearly O & M:	$ 485,500 (first year)
Present Worth:	$ 10,036,000

PACT™ Process

Capital Cost:	$ 7,437,000
Yearly O & M:	$ 595,000 (first year)
Present Worth:	$ 12,177,000

To an extent, the cost associated with cleaning-up the site is driven by the presence of dioxin in the ground water, which is currently being discharged to Naylors Run. The above treatment methods include provision for on-site treatment and destruction of dioxins.

It is assumed that the residuals generated by the various treatment alternatives may not be classified as listed PCP wastes (K-001). Disposal options for the process residuals can be better characterized as part of the treatability study. The cost estimates for this feasibility study assume that the residuals generated by the treatment process may require the additional special handling for dioxin wastes.

State Acceptance

The acceptability of this Source Control, Containment, Collection, Treatment, and Disposal alternative to concerned Commonwealth of Pennsylvania agencies is unknown.

Community Acceptance

The acceptability of this Source Control, Containment, Collection, Treatment, and Disposal alternative to the community is unknown. Community acceptance will be determined during the public comment period.

4.3 COMPARATIVE ANALYSIS

A summary of the evaluation of alternatives is given in Table 4-1. A comparison of alternatives show that the Source Control, Containment, Collection, Treatment, and Disposal alternative is somewhat more effective than the Source Removal, Treatment, and Disposal alternative in terms of meeting the objectives of the FS.

The implementation of the Source Control, Containment, Collection, Treatment, and Disposal alternative will result in a positive impact and reduction of human health or environment risk at the HAVERTOWN site, whereas the No Action or Limited Action alternatives will not result in any appreciable further reduction of the risk.

However, it should be noted that none of the ground water alternatives address the removal of contaminated soil at the NWP site, or remediation of contaminated sediments, which will be addressed as part of OU3.

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TABLE 4-1

SUMMARY OF DETAILED EVALUATION OF REMEDIAL ALTERNATIVES
HAVERTOWN SITE

REMEDIAL ALTERNATIVE	PROTECTION OF HUMAN HEALTH AND ENVIRONMENT	COMPLIANCE WITH ARARs	REDUCTION OF TOXICITY, MOBILITY, AND VOLUME	SHORT-TERM EFFECTIVENESS	LONG-TERM EFFECTIVENESS AND PERMANENCE	IMPLEMENTABILITY	COST	STATE ACCEPTANCE	COMMUNITY ACCEPTANCE
GW-1 NO ACTION (Includes limited monitoring of the ground water and surface water.)	• Will not address further mitigation of the risks to human health and the environment. • Will not provide for protection to human health for future ground water use and for ingestion of fish and consumption pathways identified through nursing mother.	• No chemical-specific ARARs are applicable to sediment. • Will not meet potentially applicable ARARs for Class IIa ground water at the site. • Will likely not meet organic and inorganic surface water quality ARARs.	• No further reduction beyond those realized and expected associated with previous actions.	• No further impact on community or environmental quality. • The rate of site related contaminant reduction in the ground water will be slow as a result of natural attenuation.	• No further impact on community or environmental quality. • The rate of site related contaminant reduction in the ground water will be slow as a result of natural attenuation. • Limited reduction of the amount of contaminants reaching the surface water will be realized. • Migration of contaminants through ground water is possible.	• Technical and administrative implementability of previous remedial action is demonstrated. • No implementation issues other than determination of the locations of sampling are anticipated.	• Costs of additional monitoring of ground water are provided in the text of the FS Report.	• To be determined.	• To be determined.

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TABLE 4-1 (continued)

SUMMARY OF DETAILED EVALUATION OF REMEDIAL ALTERNATIVES
HAVERTOWN SITE

REMEDIAL ALTERNATIVE	PROTECTION OF HUMAN HEALTH AND ENVIRONMENT	COMPLIANCE WITH ARARs	REDUCTION OF TOXICITY, MOBILITY, AND VOLUME	SHORT-TERM EFFECTIVENESS	LONG-TERM EFFECTIVENESS AND PERMANENCE	IMPLEMENTABILITY	COST	STATE ACCEPTANCE	COMMUNITY ACCEPTANCE
GW-2 LIMITED REMEDIAL ACTION (Includes all No Action elements, plus expanded ground water monitoring, Institutional Control, and Deed Restriction)	• Will provide a limited degree of mitigation of the risks to human health and environment. • Will not provide protection for ingestion of fish and consumption pathways identified through nursing mother. • Complete protection of human health is not guaranteed through institutional control.	• No chemical-specific ARARs are applicable to sediment. • Will not meet potentially applicable ARARs for class IIa ground water at the site. • Will likely not meet organic and inorganic surface water quality ARARs.	• No further reduction beyond those realized and expected associated with previous actions.	• No further impact on community or environmental quality. • The rate of site related contaminant reduction in the ground water will be slow as a result of natural attenuation.	• No further impact on community or environmental quality. • The rate of site related contaminant reduction in the ground water will be slow as a result of natural attenuation. • Limited reduction of the amount of contaminants reaching the surface water will be realized. • Migration of contaminants through ground water is possible. • Institutional control will restrict future ground water use and therefore limits the exposure pathways.	• Technical and administrative implementability of previous remedial action is demonstrated. • No implementation issues other than determination of the locations of sampling are anticipated. • Potential difficulty in enforcing the institutional control on a long-term basis.	• Costs of implementing are provided in the text of the FS Report.	• To be determined.	• To be determined.

TABLE 4-1 (continued)

SUMMARY OF DETAILED EVALUATION OF REMEDIAL ALTERNATIVES
HAVERTOWN SITE

REMEDIAL ALTERNATIVE	PROTECTION OF HUMAN HEALTH AND ENVIRONMENT	COMPLIANCE WITH ARARs	REDUCTION OF TOXICITY, MOBILITY, AND VOLUME	SHORT-TERM EFFECTIVENESS	LONG-TERM EFFECTIVENESS AND PERMANENCE	IMPLEMENTABILITY	COST	STATE ACCEPTANCE	COMMUNITY ACCEPTANCE
GW-3 SOURCE REMOVAL, TREATMENT, AND DISPOSAL (Includes all GW-2 plus free product recovery wells, pumping from oil water separator to treatment plant at NWP site.)	• Will greatly reduce the risk to human health and environment due to surface water discharge. • Complete protection of human health is not guaranteed but much reduced through institutional controls and active treatment.	• No chemical-specific ARARs are applicable to sediment. • May aid in attainment of potentially applicable ARARs for class IIa ground water at the site. • Will likely meet surface water quality ARARs.	• Significantly reduce the toxicity, mobility, and volume of contaminants discharged to Naylors Run. • Some reduction of the toxicity, viability, and volume of contaminants through removal of free products is anticipated.	• Short-term effectiveness on reduction of toxicity in surface water is excellent. • Limited site related contaminant reduction in the ground water will be realized as a result of natural attenuation and free product removal.	• Long-term effectiveness on reduction of toxicity in surface water is excellent. • Limited site related contaminant reduction in the ground water will be realized as a result of natural attenuation and free product removal. • Migration of contaminants through groundwater is possible.	• Technical and administrative implementability of previous remedial action is demonstrated. • No implementation issues other than determination of the locations of sampling are anticipated. • Potential difficulty in enforcing the institutional control on a long-term basis. • The selected treatment alternatives are straight forward technically, However, treatability study prior to FS is required. • Construction activities will have short-term impact on local residents.	• The costs of this alternative provided in the text of the FS Report.	• To be determined.	• To be determined.

AR300122

TABLE 4-1 (continued)

SUMMARY OF DETAILED EVALUATION OF REMEDIAL ALTERNATIVES
HAVERTOWN SITE

REMEDIAL ALTERNATIVE	PROTECTION OF HUMAN HEALTH AND ENVIRONMENT	COMPLIANCE WITH ARARs	REDUCTION OF TOXICITY, MOBILITY, AND VOLUME	SHORT-TERM EFFECTIVENESS	LONG-TERM EFFECTIVENESS AND PERMANENCE	IMPLEMENTABILITY	COST	STATE ACCEPTANCE	COMMUNITY ACCEPTANCE
GW-4 SOURCE CONTROL, CONTAINMENT, COLLECTION, TREATMENT, AND DISPOSAL (Includes GW-3 alternative plus lining of storm sewer, and construction of collector trench and pumping station)	• Will greatly reduce the risk to human health and environment due to surface water discharge. • Complete protection of human health is not guaranteed but much reduced through institutional controls and treatment.	• No chemical-specific ARARs are applicable to sediment. • May aid attainment of ARARs applicable to class IIa ground water at the site. • Will likely meet surface water quality ARARs.	• Significantly reduce the toxicity, mobility, and volume of contaminants discharged to Naylors Run. • Significantly reduce the toxicity and mobility of the contaminants in shallow ground water.	• Short-term effective-ness on reduction of toxicity in surface water is excellent. • Site related contaminant reduction in the ground water will be realized as a result of natural attenuation, free product removal, and through the collection trench.	• Short-term effectiveness on reduction of toxicity in surface water is excellent. • Site related contaminant reduction in the ground water will be slow as a result of natural attenuation, free products removed, and through the collection trench. • Migration of contaminants through deep aquifer is possible.	• Technical and administrative implementability of previous remedial action is demonstrated. • No implementation issues other than determination of the locations of sampling. • Potential difficulty in enforcing the institutional control on a long-term basis. • The selected treatment alternatives are straight forward technically, However, treatability study prior to RD is required. • Construction activities will have short-term impact on local residents.	• The costs of this alternative are provided in the text of the FS Report.	• To be determined.	• To be determined.

AR301212

APPENDIX A

COST SUMMARY

GW-1
NO ACTION

ITEM		PRESENT WORTH
Ground Water Monitoring		
Direct Capital		
none		
Annual O&M (first five years-biannually)		
lab fees (3 cluster wells of 3 @ 4,000/well)	72,000	
sampling and travel (2,000/day for three people)	8,000	
	80,000	
Present worth (8 ¾ % for years 1-5)		$ 313,000
Annual O&M (the following 25 years-annually)		
lab fees (3 cluster wells of 3 @ 4,000/well)	36,000	
sampling and travel (2,000/day for three people)	4,000	
	40,000	
Present worth (8 ¾ % for years 6-30)		$ 265,000
Stream Monitoring		
Direct Capital		
none		
Annual O&M (first five years-biannually)		
lab fees (2 locations @ $4,500 ea.)	18,000	
sampling labor	1,000	
	19,000	
Present worth (8 ¾ % for years 1-5)		$ 74,000
Annual O&M (the following 25 years-annually)		
lab fees (2 locations @ $4,500 ea.)	9,000	
sampling labor	500	
	9,500	
Present worth (8 ¾ % for years 6-30)		$ 63,000

AR301214

GW-1 cont'd

Subtotal of Direct Capital Costs	$ -0-
Indirect Capital Costs	
Remedial Design and Remedial Action Consulting Services	$ -0-
Legal and Administrative (10%)	$ -0-
Contingency (25%)	$ -0-
Total Capital Costs	$ -0-
Total of O&M Present Worth Costs	$ 715,000
TOTAL PRESENT WORTH	$ 715,000

GW-2
LIMITED REMEDIAL ACTION

ITEM		PRESENT WORTH
Institutional Controls & Deed Restrictions		$ 20,000
Ground Water Monitoring (bi-annually)		
Direct Capital		
2 new cluster monitoring wells	100,000	$ 100,000
Annual O&M		
lab fees (15 wells @ 4,000/well)	120,000	
sampling and travelling (2,000/day for three people)	24,000	
	144,000	
Present worth (8 ¾% for 30 years)		$ 1,513,000
Stream Monitoring		
Direct Capital		
none		
Annual O&M		
lab fees & sampling (2 locations @ $4,500 ea.)	18,000	
Present worth (8 ¾% for 30 years)		$ 189,000
Subtotal of Direct Capital Costs		$ 120,000
Indirect Capital Costs		
Remedial Design and Remedial Action Consulting Services (30%)		$ 36,000
Legal and Administrative (10%)		$ 12,000
Contingency (25%)		$ 30,000
Total of Capital Costs		$ 198,000
Total of O&M Present Worth Costs		$ 1,702,000
TOTAL PRESENT WORTH		$ 1,900,000

AR301216

GW-3a
SOURCE REMOVAL, TREATMENT & DISPOSAL

ITEM		PRESENT WORTH
Institutional Controls & Deed Restrictions		$ 20,000
Ground Water Monitoring (bi-annually)		
Direct Capital		
2 new cluster monitoring wells	100,000	$ 100,000
Annual O&M		
lab fees (15 wells @ 4,000/well)	120,000	
sampling and travelling (2,000/day for three people)	24,000	
	144,000	
Present worth (8 ¾% for 30 years)		$ 1,513,000
Free-Product Recovery (2 - 2' diameter shallow aquifer wells)		
Direct Capital		
excavation; stone; backfill (2 @ $16,000)	32,000	
locking cover (2 @ $500)	1,000	
skimmer w/oil sensor (2 @ $10,000)	20,000	
piping (250' double walled w/ leak detection to storage tank)	5,000	
fencing area & restoration	4,000	
electrical & controls	5,000	
		$ 67,000
Annual O&M		
oil disposal (see "3,000 gallon Free Product Storage Tank")		
power cost	500	
Present worth (8 ¾ % for 30 years)		$ 5,000

AR301217

GW-3a cont'd

Existing Oil/Water Separator Modifications		
Direct Capital		
access road (stone @ 550 LF)	5,500	
oil skimmers (2 @ $10,000)	20,000	
ventsorb (odor control)	2,000	
aqueous phase pumping station 25 gpm, double containment	30,000	
free product pumping station w/ 5 gpm transfer pump, double containment	30,000	
piping to free product storage tank (2 x 1200' double containment)	72,000	
electrical power	15,000	
electrical controls	5,000	
		$ 180,000
Annual O&M		
oil disposal (see "3,000 gallon Free Product Storage Tank")		
electricity	15,000	
Present worth (8 ¾ % for 30 years)		$ 158,000
3,000 gallon Free Product Storage Tank at NWP		
Direct Capital		
tank with double containment	20,000	
ventsorb (odor control)	2,000	
		$ 22,000
Annual O&M		
oil disposal	18,000	
Present worth (8 ¾ % for 30 years)		$ 189,000
Treatment Plant Site		
Direct Capital		
utilities (elec., water, telephone)	30,000	
utility building	50,000	
road, parking in non-contaminated area	10,000	
		$ 90,000
Annual O&M		
contract options & maintenance	75,000	
Present worth (8 ¾ % for 30 years)		$ 788,000

AR301218

GW-3a cont'd

Chemical Precipitation		
Direct Capital		
unit and installation	300,000	
electrical controls	4,000	
		$ 304,000
Annual O&M		
waste disposal	11,000	
power	25,000	
lime, sulfuric acid, polymer	1,000	
	$ 37,000	
Present worth (8 ¾ % for 30 years)		$ 389,000
Advanced Oxidation Process		
Direct Capital		
system including: air preparation system; ozone generator; H_2O_2 feed system; UV reactor; ozone destruction unit; semi-automatic control unit; installation	500,000	
heated shelter	80,000	
influent tank (10,000 gal)	20,000	
vapor phase carbon	2,000	
electrical controls	10,000	
		$ 612,000
Annual O&M		
power; H_2O_2 costs; annual UV lamp replacement ($8.00/1000 gal water)	105,000	
Present worth (8 ¾ % for 30 years)		$ 1,040,000

AR301219

GW-3a cont'd

Disposable Granular Activated Carbon (GAC) Units, 25 gpm		
Direct Capital		
2 - 1000 gal units installed in series	40,000	$ 40,000
O&M		
disposal, replacement	25,000	
Present worth (8 ¾ % for 30 years)		$ 263,000
Discharge to Naylors Run		
Direct Capital		
piping (700' @ $20/ft); outlet structure; road crossing	30,000	$ 30,000
Annual O&M		
stream monitoring (lab fees & sampling)	60,000	
Present worth (8 ¾ % for 30 years)		$ 631,000
Subtotal of Direct Capital Costs		$ 1,465,000
Indirect Capital Costs		
Remedial Design and Remedial Action Consulting Services		$ 600,000
Legal and Administrative (10%)		$ 146,000
Contingency (25%)		$ 366,000
Total of Capital Costs		$ 2,577,000
Total of O&M Present Worth Costs		$ 4,976,000
TOTAL PRESENT WORTH		$ 7,553,000

AR301220

GW-3b
SOURCE REMOVAL, TREATMENT & DISPOSAL

ITEM		PRESENT WORTH
Institutional Controls & Deed Restrictions		$ 20,000
Ground Water Monitoring (bi-annually)		
Direct Capital		
2 new cluster monitoring wells	100,000	$ 100,000
Annual O&M		
lab fees (15 wells @ 4,000/well)	120,000	
sampling and travelling (2,000/day for three people)	24,000	
	144,000	
Present worth (8 ¾% for 30 years)		$ 1,513,000
Free-Product Recovery (2 - 2' diameter shallow aquifer wells)		
Direct Capital		
excavation; stone; backfill (2 @ $16,000)	32,000	
locking cover (2 @ $500)	1,000	
skimmer w/oil sensor (2 @ $10,000)	20,000	
piping (250' double walled w/ leak detection to storage tank)	5,000	
fencing area & restoration	4,000	
electrical & controls	5,000	
		$ 67,000
Annual O&M		
oil disposal (see "3,000 gallon Free Product Storage Tank")		
power cost	500	
Present worth (8 ¾ % for 30 years)		$ 5,000

AR301221

GW-3b cont'd

Existing Oil/Water Separator Modifications		
Direct Capital		
access road (stone @ 550 LF)	5,500	
oil skimmers (2 @ $10,000)	20,000	
ventsorb (odor control)	2,000	
aqueous phase pumping station 25 gpm, double containment	30,000	
free product pumping station w/ 5 gpm transfer pump, double containment	30,000	
piping to free product storage tank (2 x 1200' double containment)	72,000	
electrical power	15,000	
electrical controls	5,000	
		$ 180,000
Annual O&M		
oil disposal (see "3,000 gallon Free Product Storage Tank")		
electricity	15,000	
Present worth (8 ¾ % for 30 years)		$ 158,000
3,000 gallon Free Product Storage Tank at NWP		
Direct Capital		
tank with double containment	20,000	
ventsorb (odor control)	2,000	
		$ 22,000
Annual O&M		
oil disposal	18,000	
Present worth (8 ¾ % for 30 years)		$ 189,000
Treatment Plant Site		
Direct Capital		
utilities (elec., water, telephone)	30,000	
utility building	50,000	
road, parking in non-contaminated area	10,000	
		$ 90,000
Annual O&M		
contract options & maintenance	100,000	
Present worth (8 ¾ % for 30 years)		$ 1,051,000

AR301222

GW-3b cont'd

Chemical Precipitation		
Direct Capital		
unit and installation	300,000	
electrical controls	4,000	
		$ 304,000
Annual O&M		
waste disposal	11,000	
power	25,000	
lime, sulfuric acid, polymer	1,000	
	$ 37,000	
Present worth (8 ¾ % for 30 years)		$ 389,000
Powdered Activated Carbon Treatment System (PACT™), 25 gpm		
Direct Capital		
pre-assembled unit; delivery start-up; operator training; O&M manuals; installation	300,000	
influent tank (10,000 gal)	20,000	
wet air oxidation (smallest unit)	2,100,000	
		$ 2,420,000
Annual O&M		
powdered carbon (100 lb/d @ $0.50/lb)	22,000	
electricity (225 kwh @ $0.10/kwh)	8,500	
wet air oxidation	15,000	
	$ 45,500	
Present worth (8 ¾ % for 30 years)		$ 478,000
Disposable Granular Activated Carbon (GAC) Units, 25 gpm		
Direct Capital		
2 - 1000 gal units installed in series	40,000	$ 40,000
Annual O&M		
disposal, replacement	25,000	
Present worth (8 ¾ % for 30 years)		$ 263,000

AR301223

GW-3b cont'd

Discharge to Naylors Run		
Direct Capital		
piping (700' @ $20/ft); outlet structure; road crossing	30,000	$ 30,000
Annual O&M		
stream monitoring (lab fees & sampling)	60,000	
Present worth (8 ¾ % for 30 years)		$ 631,000
Subtotal of Direct Capital Costs		$ 3,273,000
Indirect Capital Costs		
Remedial Design and Remedial Action Consulting Services		$ 600,000
Legal and Administrative (10%)		$ 327,000
Contingency (25%)		$ 818,000
Total of Capital Costs		$ 5,018,000
Total of O&M Present Worth Costs		$ 4,666,000
TOTAL PRESENT WORTH		$ 9,684,000

AR301224

GW-4a
SOURCE REMOVAL, CONTAINMENT, COLLECTION, TREATMENT & DISPOSAL

ITEM		PRESENT WORTH
Institutional Controls & Deed Restrictions		$ 20,000
Ground Water Monitoring (bi-annually)		
Direct Capital		
2 new cluster monitoring wells	100,000	$ 100,000
Annual O&M		
lab fees (15 wells @ 4,000/well)	120,000	
sampling and travelling (2,000/day for three people)	24,000	
	144,000	
Present worth (8 ¾% for 30 years)		$ 1,513,000
Collector Trench (500 Linear Feet to OWS)		
Direct Capital		
excavation (1800 cy)	18,000	
stone (1700 cy)	6,500	
select backfill (1000 cy)	6,000	
geotextile	6,500	
lining	6,500	
piping (2 x 500')	5,000	
manholes (2 @ $5000)	10,000	
excavated material disposal including trucking (1200 cy @ $1100/cy)	1,330,000	
dewatering of trench & water disposal (6 weeks @ $10,000/week)	60,000	
restoration (1000 sy)	10,000	
pumping station (double containment; with duplex 25 gpm low shear diaphragm pumps; and 10 CFM, 5 hp air compressors; small building)	60,000	
		$ 1,518,000
Annual O&M		
power cost	2,000	
labor, general maintenance	4,000	
	6,000	
Present worth (8 ¾ % for 30 yrs)		$ 63,000

AR301225

GW-4a cont'd

Free-Product Recovery (2 - 2' diameter shallow aquifer wells)		
Direct Capital		
excavation; stone; backfill (2 @ $16,000)	32,000	
locking cover (2 @ $500)	1,000	
skimmer w/oil sensor (2 @ $10,000)	20,000	
piping (250' double walled w/ leak detection to storage tank)	5,000	
fencing area & restoration	4,000	
electrical & controls	5,000	
		$ 67,000
Annual O&M		
oil disposal (see "3,000 gallon Free Product Storage Tank")		
power cost	500	
Present worth (8 ¾ % for 30 years)		$ 5,000
Rehabilitation of Existing 30" diam. Storm Sewer		
Direct Capital		
500 LF @ $ 400/ft	200,000	
		$ 200,000
Annual O&M		
negligible		
Existing Oil/Water Separator Modifications		
Direct Capital		
access road (stone @ 550 LF)	5,500	
oil skimmers (2 @ $10,000)	20,000	
ventsorb (odor control)	2,000	
aqueous phase pumping station 25 gpm, double containment	30,000	
free product pumping station w/ 5 gpm transfer pump, double containment	30,000	
piping to free product storage tank (2 x 1200' double containment)	72,000	
electrical power	15,000	
electrical controls	5,000	
		$ 180,000

GW-4a cont'd

AR301226

Annual O&M
oil disposal (see "3,000 gallon Free

Product Storage Tank")		
electricity	15,000	
Present worth (8 ¾ % for 30 years)		$ 158,000
3,000 gallon Free Product Storage Tank at NWP		
Direct Capital		
tank with double containment	20,000	
ventsorb (odor control)	2,000	
		$ 22,000
Annual O&M		
oil disposal	18,000	
Present worth (8 ¾ % for 30 years)		$ 189,000
Treatment Plant Site		
Direct Capital		
utilities (elec., water, telephone)	30,000	
utility building	50,000	
road, parking in non-contaminated area	10,000	
		$ 90,000
Annual O&M		
contract options & maintenance	75,000	
Present worth (8 ¾ % for 30 years)		$ 788,000
Chemical Precipitation		
Direct Capital		
unit and installation	300,000	
electrical controls	4,000	
		$ 304,000
Annual O&M		
waste disposal	11,000	
power	25,000	
lime, sulfuric acid, polymer	1,000	
	$ 37,000	
Present worth (8 ¾ % for 30 years)		$ 389,000

AR301227

GW-4a cont'd

Advanced Oxidation Process		
Direct Capital		
system including: air preparation system; ozone generator; H_2O_2 feed system; UV reactor; ozone destruction unit; semi-automatic control unit; installation	500,000	
heated shelter	80,000	
influent tank (10,000 gal)	20,000	
vapor phase carbon	2,000	
electrical controls	10,000	
		$ 612,000
Annual O&M		
power; H_2O_2 costs; annual UV lamp replacement ($8.00/1000 gal water)	105,000	
Present worth (8 ¾ % for 30 years)		$ 1,040,000
Disposable Granular Activated Carbon (GAC) Units, 25 gpm		
Direct Capital		
2 - 1000 gal units installed in series	40,000	$ 40,000
O&M		
disposal, replacement (1 unit/week)	25,000	
Present worth (8 ¾ % for 30 years)		$ 263,000
Discharge to Naylors Run		
Direct Capital		
piping (700' @ $20/ft); outlet structure; road crossing	30,000	$ 30,000
Annual O&M		
stream monitoring (lab fees & sampling)	60,000	
Present worth (8 ¾ % for 30 years)		$ 631,000

AR301228

GW-4a cont'd

Subtotal of Direct Capital Costs	$ 3,183,000
Indirect Capital Costs	
Remedial Design and Remedial Action Consulting Services	$ 700,000
Legal and Administrative (10%)	$ 318,000
Contingency (25%)	$ 796,000
Total of Capital Costs	$ 4,997,000
Total of O&M Present Worth Costs	$ 5,039,000
TOTAL PRESENT WORTH	$ 10,036,000

AR301229

GW-4b
SOURCE REMOVAL, CONTAINMENT, COLLECTION, TREATMENT & DISPOSAL

ITEM		PRESENT WORTH
Institutional Controls & Deed Restrictions		$ 20,000
Ground Water Monitoring (bi-annually)		
Direct Capital		
2 new cluster monitoring wells	100,000	$ 100,000
Annual O&M		
lab fees (15 wells @ 4,000/well)	120,000	
sampling and travelling (2,000/day for three people)	24,000	
	144,000	
Present worth (8 ¾% for 30 years)		$ 1,513,000
Collector Trench (500 Linear Feet to OWS)		
Direct Capital		
excavation (1800 cy)	18,000	
stone (1700 cy)	6,500	
select backfill (1000 cy)	6,000	
geotextile	6,500	
lining	6,500	
piping (2 x 500')	5,000	
manholes (2 @ $5000)	10,000	
excavated material disposal including trucking (1200 cy @ $1100/cy)	1,330,000	
dewatering of trench & disposal (6 weeks @ $10,000/week)	60,000	
restoration (1000 sy)	10,000	
pumping station (double containment; with duplex 25 gpm low shear diaphragm pumps; and 10 CFM, 5 hp air compressors; small building)	60,000	
		$ 1,518,000
Annual O&M		
power cost	2,000	
labor, general maintenance	4,000	
	6,000	
Present worth (8 ¾ % for 30 yrs)		$ 63,000

AR301230

GW-4b cont'd

Free-Product Recovery (2 - 2' diameter shallow aquifer wells)

Direct Capital		
excavation; stone; backfill (2 @ $16,000)	32,000	
locking cover (2 @ $500)	1,000	
skimmer w/oil sensor (2 @ $10,000)	20,000	
piping (250' double walled w/ leak detection to storage tank)	5,000	
fencing area & restoration	4,000	
electrical & controls	5,000	
		$ 67,000
Annual O&M		
oil disposal (see "3,000 gallon Free Product Storage Tank")		
power cost	500	
Present worth (8 ¾ % for 30 years)		$ 5,000

Rehabilitation of Existing 30" diam. Storm Sewer

Direct Capital		
500 LF @ $ 400/ft	200,000	
		$ 200,000
Annual O&M		
negligible		

Existing Oil/Water Separator Modifications

Direct Capital		
access road (stone @ 550 LF)	5,500	
oil skimmers (2 @ $10,000)	20,000	
ventsorb (odor control)	2,000	
aqueous phase pumping station 25 gpm, double containment	30,000	
free product pumping station w/ 5 gpm transfer pump, double containment	30,000	
piping to free product storage tank (2 x 1200' double containment)	72,000	
electrical power	15,000	
electrical controls	5,000	
		$ 180,000
Annual O&M		
oil disposal (see "3,000 gallon Free Product Storage Tank")		
electricity	15,000	

AR301231

Present worth (8 ¾ % for 30 years)		$ 158,000
3,000 gallon Free Product Storage Tank at NWP		
Direct Capital		
tank with double containment	20,000	
ventsorb (odor control)	2,000	
		$ 22,000
Annual O&M		
oil disposal	18,000	
Present worth (8 ¾ % for 30 years)		$ 189,000
Treatment Plant Site		
Direct Capital		
utilities (elec., water, telephone)	30,000	
utility building	50,000	
road, parking in non-contaminated area	10,000	
		$ 90,000
Annual O&M		
contract options & maintenance	100,000	
Present worth (8 ¾ % for 30 years)		$ 1,051,000
Chemical Precipitation		
Direct Capital		
unit and installation	300,000	
electrical controls	4,000	
		$ 304,000
Annual O&M		
waste disposal	11,000	
power	25,000	
lime, sulfuric acid, polymer	1,000	
	$ 37,000	
Present worth (8 ¾ % for 30 years)		$ 389,000

AR301232

GW-4b cont'd

Powdered Activated Carbon Treatment System (PACT™), 25 gpm		
Direct Capital		
pre-assembled unit; delivery start-up; operator training; O&M manuals; installation	300,000	
influent tank (10,000 gal)	20,000	
wet air oxidation (smallest unit)	2,100,000	
		$ 2,420,000
Annual O&M		
powdered carbon (100 lb/d @ $0.50/lb)	22,000	
electricity (225 kwh @ $0.10/kwh)	8,500	
wet air oxidation	15,000	
	$ 45,500	
Present worth (8 ¾ % for 30 years)		$ 478,000
Disposable Granular Activated Carbon (GAC) Units, 25 gpm		
Direct Capital		
2 - 1000 gal units installed in series	40,000	$ 40,000
O&M		
disposal, replacement (1 unit/week)	25,000	
Present worth (8 ¾ % for 30 years)		$ 263,000
Discharge to Naylors Run		
Direct Capital		
piping (700' @ $20/ft); outlet structure; road crossing	30,000	$ 30,000
Annual O&M		
stream monitoring (lab fees & sampling)	60,000	
Present worth (8 ¾ % for 30 years)		$ 631,000

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GW-4b cont'd

Subtotal of Direct Capital Costs	$ 4,991,000
Indirect Capital Costs	
Remedial Design and Remedial Action Consulting Services	$ 700,000
Legal and Administrative (10%)	$ 499,000
Contingency (25%)	$ 1,247,000
Total of Capital Costs	$ 7,437,000
Total of O&M Present Worth Costs	$ 4,740,000
TOTAL PRESENT WORTH	$ 12,177,000

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S-2
LIMITED REMEDIAL ACTION - CAPPING NWP

ITEM		PRESENT WORTH
Vegetative Soils Cap		
Direct Capital		
grade area & scarify (10000 sy @ $1.2/sy)	12,000	
purchase & deliver clay (3300 cy @ $27.50/cy)	91,700	
spread & compact clay (3300 cy @ $2/cy)	6,600	
purchase & deliver topsoil (1650 cy @ $20/cy)	33,000	
seed; mulch; fertilizer (86,000 sf @ $0.12/sf)	10,000	
		$ 153,000
Annual O&M		
seed; mulch; fertilizer	10,000	
Present worth (8 ¾ % for 30 years)		$ 105,000
Subtotal of Direct Capital Costs		$ 153,000
Indirect Capital Costs		
Remedial Design and Remedial Action Consulting Services (40%)		$ 61,000
Legal and Administrative (25%)		$ 38,000
Contingency (25%)		$ 38,000
Total of Capital Costs		$ 290,000
Total of O&M Present Worth Costs		$ 105,000
TOTAL PRESENT WORTH		$ 395,000

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S-3
COMPLETE REMEDIAL ACTION - SEDIMENT REMOVAL

ITEM		PRESENT WORTH
Vegetative Soils Cap		
Capital		
grade area & scarify (10000 sy @ $1.2/sy)	12,000	
purchase & deliver clay (3300 cy @ $27.50/cy)	91,700	
spread & compact clay (3300 cy @ $2/cy)	6,600	
purchase & deliver topsoil (1650 cy @ $20/cy)	33,000	
seed; mulch; fertilizer (86,000 sf @ $0.12/sf)	10,000	
		$ 153,000
Annual O&M		
seed; mulch; fertilizer	10,000	
Present worth (8 ¾ % for 30 years)		$ 105,000
Landfill (above ground)		
Capital		
purchase, deliver, compact sand; clay; gravel; topsoil	208,000	
flexible membrane liners & geotextiles	131,000	
leachate collection system	67,000	
excavation & hauling of sediment & trench soil	20,000	
monitoring wells (4)	20,000	
		$ 446,000
Annual O&M		
seed; mulch; fertilizer	3,000	
Present worth (8 ¾ % for 30 years)		$ 32,000

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S-3 cont'd

Subtotal of Direct Capital Costs	$ 599,000
Indirect Capital Costs	
Remedial Design and Remedial Action Consulting Services (40%)	$ 240,000
Legal and Administrative (25%)	$ 150,000
Contingency (25%)	$ 150,000
Total of Capital Costs	$ 1,139,000
Total of O&M Present Worth Costs	$ 137,000
TOTAL PRESENT WORTH	$ 395,000

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S-4
COMPLETE REMEDIAL ACTION - PIPING NAYLORS RUN

ITEM		PRESENT WORTH
Vegetative Soils Cap		
Capital		
grade area & scarify (10000 sy @ $1.2/sy)	12,000	
purchase & deliver clay (3300 cy @ $27.50/cy)	91,700	
spread & compact clay (3300 cy @ $2/cy)	6,600	
purchase & deliver topsoil (1650 cy @ $20/cy)	33,000	
seed; mulch; fertilizer (86,000 sf @ $0.12/sf)	10,000	
		$ 153,000
Annual O&M		
seed; mulch; fertilizer	10,000	
Present worth (8 ¾ % for 30 years)		$ 105,000
Piping Naylors Run		
Capital		
sand; gravel; clean fill; topsoil; seed; mulch; fertilizer	59,000	
corrugated metal pipe	112,000	
geotextile	4,000	
miscellaneous restoration	6,000	
compaction of soils & fill	3,000	
clean channel	3,000	
charge for limited access to lower pipe (25% of lower pipe cost)	36,000	
		$ 223,000
Annual O&M		
negligible		

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S-4 cont'd

Landfill (above ground)		
Capital		
purchase, deliver, compact sand; clay; gravel; topsoil	208,000	
flexible membrane liners & geotextiles	131,000	
leachate collection system	67,000	
excavation & hauling of sediment & trench soil	20,000	
monitoring wells (4)	20,000	
		$ 446,000
Annual O&M		
seed; mulch; fertilizer	3,000	
Present worth (8 ¾ % for 30 years)		$ 32,000
Subtotal of Direct Capital Costs		$ 822,000
Indirect Capital Costs		
Remedial Design and Remedial Action Consulting Services (40%)		$ 329,000
Legal and Administrative (25%)		$ 205,000
Contingency (25%)		$ 205,000
Total of Capital Costs		$ 1,561,000
Total of O&M Present Worth Costs		$ 137,000
TOTAL PRESENT WORTH		$ 1,698,000

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