CDM
125 Maiden Lane, 5th Floor
New York, New York 10038
tel: 212 785-9123
fax: 212 785-6114

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Mr. Fernando Rosado
Project Officer
U.S. Environmental Protection Agency
290 Broadway
New York, NY 10278

Mr. Lorenzo Thantu
Remedial Project Manager
U.S. Environmental Protection Agency
290 Broadway, 20th Floor
New York, NY 10278

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| Project: | RAC II Contract No.: 68-W-98-210<br>Work Assignment: 164-RICO-02TK |
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| Subject: | Final Work Plan, Volume I<br>Hopewell Precision Site<br>Remedial Investigation/Feasibility Study<br>Hopewell Junction, New York |

Dear Mr. Rosado and Mr. Thantu:

CDM Federal Programs Corporation (CDM) is pleased to submit this Final Work Plan Volume I for the Remedial Investigation/Feasibility Study for the Hopewell Precision Site in Hopewell Junction, New York.

If you have any comments concerning this submittal, please contact me at (212) 785-9123 or Ms. Susan Schofield at (203) 262-6633.

Very truly yours,
CDM FEDERAL PROGRAMS CORPORATION

Robert Goltz

Robert D. Goltz, P.E.
RAC II Program Manager

cc: D. Butler, EPA Region II
J. Litwin, CDM
S. Kellogg, CDM
RAC II Document Control
S. Schofield, CDM
F. Gellati, CDM

# Contents

# Section 1
# Introduction

CDM Federal Programs Corporation (CDM) received Work Assignment 164-RICO-02TK under the Response Action Contract (RAC) II to perform a Remedial Investigation/ Feasibility Study (RI/FS) for the United States Environmental Protection Agency, Region II (EPA) at the Hopewell Precision Site (the site) located in Hopewell Junction, New York. The purpose of this work assignment is to evaluate the nature and extent of groundwater, soil, sediment, surface water, and vapor contamination and determine the appropriate remedial alternatives for the identified contamination.

For presentation purposes, work plan figures and tables are presented at the end of Volume I.

## 1.1 Overview of the Problem

The overview of the Hopewell Precision Site is summarized from the Hazard Ranking System (HRS) package prepared by Roy F. Weston (2004). Additional site history and background information are included in Section 2 of the Work Plan.

The Hopewell Precision Site is located in Hopewell Junction, New York. Operations at an active manufacturer of sheet metal parts and assemblies, Hopewell Precision, Inc., have resulted in a groundwater contamination plume beneath and downgradient of the current (19 Ryan Drive) and former (15 Ryan Drive) Hopewell Precision properties. The combined adjacent properties are 5.7 acres. The surrounding area consists mostly of residences, all of which are served by private wells and septic systems. Almost 27,000 people live within 4 miles of the Hopewell Precision Site.

The painting process at Hopewell Precision includes degreasing prior to application of wet spray paint. When the company operated at 15 Ryan Drive, liquid wastes were dumped directly onto the ground outside the building. Company records indicate that Hopewell Precision purchased 75 drums of trichloroethene (TCE) and 1,1,1-trichloroethane (1,1,1-TCA) from 1980 to 1997. These solvents were used in a vapor degreasing machine until 1998. The company generated 1,1,1-TCA waste for off-site disposal from 1986 to 1998, but has no hazardous waste manifests for off-site disposal of TCE. The New York State Department of Environmental Conservation (NYSDEC) performed hazardous waste compliance inspections of the company in May 1987 and October 2002. NYSDEC cited Hopewell Precision for violations of hazardous waste regulations, such as operating as a hazardous waste storage facility without a permit or interim status authorization. Hopewell Precision corrected the violations to NYSDEC's satisfaction.

Elevated concentrations of TCE and 1,1,1-TCA have been detected in the groundwater, in a drinking water well and several monitoring wells on the Hopewell Precision property, and in nearby private drinking water wells. TCE and 1,1,1-TCA have been detected as high as 144 micrograms per liter (ug/L) in private wells; EPA has installed treatment systems to remove volatile organic compounds (VOCs) at 37 homes. Groundwater contamination was detected in 46 wells in the area, at concentrations exceeding health-based benchmarks. As many as 152 individuals are potentially impacted by the contamination.

EPA conducted an investigation of indoor air quality at the Hopewell Precision Site. As a result, EPA has installed sub-slab ventilation systems at 50 homes. The systems are intended to reduce residents' exposure to contaminants that enter their homes from the subsurface environment.

In addition to groundwater contamination, TCE and 1,1,1-TCA have been detected in soil samples collected at the former Hopewell Precision property (15 Ryan Drive).

Contamination from the Hopewell Precision Site may have an impact on ponds located downgradient of the facility. EPA collected water and sediment samples from small ponds located about 300 feet south-southwest of the facility. TCA was detected in surface water samples (at 4 and 3.4 ug/L) and a sediment sample (at 88 micrograms per kilogram [ug/kg]). On July 6, 2004 the New York State Department of Health (NYSDOH) collected a surface water sample from Red Wing Lake. No VOCs were detected in the sample (detection limit 0.5 ug/L).

## 1.2 Approach to the Development of the Work Plan

CDM reviewed all available information on the Hopewell Precision Site prior to formulating the scope of work presented in this work plan. Section 8 provides a list of all documents reviewed and referenced during development of the work plan. The RI/FS for the site will include a remedial investigation (RI), risk assessments (RAs), and a feasibility study (FS).

The RI will focus on collecting adequate data from appropriate media to characterize the nature and extent of contamination. The sampling approach is discussed in Section 5. A Quality Assurance Project Plan (QAPP) detailing sample and analytical requirements for the field investigation and a health and safety plan (HSP) will be submitted separately. The RI report will provide a complete evaluation of sampling results.

The RAs for the Hopewell Precision Site will evaluate the risk from exposure to contaminated media, including groundwater, soil, surface water, deep water from two ponds, sediment, and vapors. The human health RA will be conducted according to EPA's *Risk Assessment Guidance for Superfund* (Part A 1989a and Part D 1998a) or according to the most recent EPA guidance and requirements. The ecological risk assessment will be conducted according to EPA's *Ecological Risk Assessment Guidance for Superfund, Process for Designing and Conducting Risk Assessments* (ERAGS) (EPA 1997a) or according to the most current EPA guidance and requirements. The risk assessments will include a list of contaminants of potential concern (COPCs); toxicology of COPCs; transport, degradation, and fate analysis of COPCs; comparison of COPCs to Applicable or Relevant and Appropriate Requirements (ARARs); and determination of potential risk.

An FS will be completed in accordance with EPA guidance under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) "Interim Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA" (EPA 1988), or the most recent EPA FS guidance document. The FS will develop and screen remedial alternatives and provide detailed analysis of selected alternatives, including the "No Action" alternative. The remedial alternatives will be evaluated against the nine criteria required by EPA guidance documents: (1) overall protection of human health and the environment; (2) compliance with ARARs; (3) long term effectiveness and permanence; (4) reduction of toxicity, mobility, or volume through treatment; (5) short-term effectiveness; (6) implementability; (7) cost; (8) state acceptance; and (9) community acceptance.

## 1.3 Work Plan Content

This work plan contains nine sections, as described below.

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| Section 1 | Introduction - The introductory section lays out the format of the work plan. |
| Section 2 | Site Background and Setting - This section describes the site background, including the current understanding of the location, history, and existing conditions at the site. |
| Section 3 | Initial Evaluation - This section presents the initial evaluation of existing data; it includes a description of previous sampling results, site geology and hydrogeology, the current conceptual site model (CSM), and a preliminary identification of ARARs. |
| Section 4 | Work Plan Rationale - This section includes the Data Quality Objectives (DQOs) for the RI sampling activities and the approach for preparing the work plan to satisfy the DQOs. |
| Section 5 | Task Plans - This section presents a discussion of each task of the RI/FS in accordance with the Hopewell Precision Site RAC II Statement of Work and discussions with EPA. |
| Section 6 | Schedule - The project schedule is presented in this section. |
| Section 7 | Project Management Approach - Project management considerations that define relationships and responsibilities for selected task and project management teams are described. |
| Section 8 | References - The references used to develop material presented in this work plan are listed in this section. |
| Section 9 | Glossary of Abbreviations - The acronyms and abbreviations used in the work plan are defined in this section. |

# Section 2
# Site Background and Setting

## 2.1 Site Location and Description

The Hopewell Precision Site is located in Hopewell Junction, Dutchess County, New York (Figure 2-1). The Hopewell Precision facility was located at 15 Ryan Drive from 1977 to 1980. The facility moved to the adjacent property at 19 Ryan Drive in 1980 and continues to operate at that location. The combined size of the adjacent properties is 5.7 acres. The surrounding area consists mostly of residential neighborhoods, all of which are served by private wells and septic systems. Almost 27,000 people live within 4 miles of the Hopewell Precision facility. Commercial development (e.g., strip malls, businesses, gas stations) in the area is primarily along New York State Route 82, which traverses the area in a northeast/ southwest direction. An area of farmland borders the eastern side of a section of Route 82, adjacent to the mapped groundwater plume (Figure 2-2). Whortlekill Creek flows in a southerly direction across the residential area and along the western border of the groundwater plume. Several ponds are present within the area, including a large gravel pit or quarry filled with groundwater.

## 2.2 Site History

The history of the Hopewell Precision Site is summarized from the HRS package prepared by Roy F. Weston (2004).

Hopewell Precision is an active manufacturer of sheet metal parts and assemblies. The company operated at its original location at 15 Ryan Drive from 1977 to 1980. It moved to its current location at the adjacent property at 19 Ryan Drive in 1980. The property at 19 Ryan Drive was vacant land prior to 1980 and Hopewell Precision has been the sole occupant of the building. The former facility at 15 Ryan Drive has been used by Nicholas Brothers Moving Company for equipment storage and office space since 1981.

Processes at Hopewell Precision include shearing, punching, bending, welding, and painting. The painting process includes degreasing prior to the wet spray paint application. Hopewell Precision currently uses a water-based degreaser, but the company used TCE and 1,1,1-TCA in a vapor degreasing machine until 1998. Hopewell Precision purchased 12 drums (7,020 pounds) of 1,1,1-TCA in 1980 and 15 drums (9,000 pounds) in 1994. The company generated 1,675 gallons (32 drums) of 1,1,1-TCA waste for off-site disposal from 1986 through 1998. The company purchased 48 drums (31,680 pounds) of TCE in 1996 and 1997, but does not have any hazardous waste manifests for off-site disposal of TCE. Hopewell Precision no longer uses TCE or 1,1,1-TCA for degreasing.

EPA was made aware of Hopewell Precision in October 1979 through a letter from a former Hopewell Precision employee. During an on-site inspection at the former facility (15 Ryan Drive) in November 1979, EPA observed solvent odors coming from an open disposal area. At the time of the inspection, Hopewell Precision was dumping one to five gallons per day of waste solvents, paint pigments, and sodium nitrate directly onto the ground. In August 2003, a former employee stated that the common practice for disposal of waste solvents at the former facility was to pour the material on the ground outside the building. Waste paints and thinners were dumped on a daily basis and waste solvents from the degreaser were dumped on a biweekly basis while he worked at Hopewell Precision in 1979 and 1980.

NYSDEC performed a Hazardous Waste Compliance Inspection of Hopewell Precision in May 1987. The inspector observed eleven 55-gallon drums of waste paint and thinners; six 55-gallon drums of waste 1,1,1-TCA; and one 55-gallon drum of unknown material at the facility. NYSDEC determined that Hopewell Precision was in violation of hazardous waste regulations because it was operating as a hazardous waste storage facility without a permit or interim status authorization. Hopewell Precision subsequently identified the drum of unknown material as paint thinner and performed corrective measures, including waste disposal, that NYSDEC found to be satisfactory. During another inspection in October 2002, NYSDEC observed four full or partially full 55-gallon drums of waste paint and solvent at the facility. The NYSDEC inspector reported that a spray booth/paint finishing operation generated waste paint and paint thinner. As a result of the inspection, NYSDEC cited the facility for 10 violations of hazardous waste regulations. Hopewell Precision subsequently corrected the violations to NYSDEC's satisfaction.

TCE and 1,1,1-TCA have been detected in soil samples collected recently at the Hopewell Precision Site. In July 2003, EPA collected on-site and off-site soil samples. TCE was detected in two on-site soil samples and 1,1,1-TCA was detected in one on-site sample, but neither contaminant was detected in any off-site samples. EPA completed test holes and collected additional soil samples in December 2003, concentrating the investigation between the current and former Hopewell Precision facilities. Background samples were collected from test holes near the northern property boundaries. TCE was detected in 5 soil samples, at depths ranging from 0 to 12 feet. The maximum detected concentration was 3.7 ug/kg; TCE was not detected in background samples from the same depth range. Location maps and results are provided in Appendix A.

The site also includes a groundwater contamination plume beneath and downgradient of the current and former Hopewell Precision facilities. The former facility was served by a 25-foot deep well that was sampled in March 1980 (sample collection point was a rest room faucet). The analytical results indicated the presence of 1,1,1-TCA at 3.6 ug/L and TCE at 0.6 ug/L. NYSDEC installed 3 monitoring wells, each 39 to 40 feet deep, at the former facility in May 1985 and sampled the wells in March 1986. The analytical results for monitoring well B-3, located between the current and former buildings, indicated the presence of 1,1,1-TCA at 23 ug/L and TCE at an estimated 4 ug/L. Samples collected from the on-site monitoring wells by Hopewell Precision in April 1993 showed the continuing presence of 1,1,1-TCA and TCE. In October and December 2003, EPA installed and sampled temporary shallow monitoring wells on both properties. The analytical results indicated TCE concentrations up to 144 ug/L in groundwater at depths ranging from 10 to 30 feet below the ground surface (bgs).

In 1985, the Dutchess County Department of Health sampled four private drinking water wells near the Hopewell Precision Site and no VOCs were detected in any of the samples. From February to November 2003, EPA collected groundwater samples from hundreds of private drinking water wells in the vicinity of Hopewell Precision. TCE and 1,1,1-TCA were both detected in numerous private well samples, at individual concentrations up to 250 ug/L for TCE and 11.7 ug/L for 1,1,1-TCA. In addition, 1,1-dichloroethene (1,1-DCE), a breakdown product of TCE, was detected in two samples. Several instances of TCE detection exceeded the compounds Maximum Contaminant Level (MCL) of 5 ug/L. EPA has installed treatment systems to remove VOCs at 37 homes where TCE exceeded or approached the MCL.

The site may have an impact on ponds located downgradient of the current/former Hopewell Precision properties. In April 2003, EPA collected water and sediment samples from small ponds located about 300 feet south-southwest (downgradient) of the Hopewell Precision facilities. TCE was detected at concentrations of 4 ug/L and 3.4 ug/L in the water samples and 88 ug/kg in one of the two sediment samples. EPA collected additional samples from two ponds located approximately 900 and 4,500 feet southwest of Hopewell Precision in May 2003. TCE was detected at an estimated concentration of 3.6 ug/kg in a sediment sample from the closer pond, but was not detected in a water sample from the same location or in sediment and water samples collected from the farther pond on Creamery Road. Results are provided in Appendix A.

The EPA Response and Prevention Branch has conducted indoor air testing at the Hopewell Precision Site. Since February 2004, EPA has collected sub-slab and/or indoor air samples from about 200 homes. EPA has installed sub-slab ventilation systems at 17 homes, to reduce the residents' exposure to indoor air contaminants associated with the site.

## 2.2.1 Previous Investigations

Several previous investigations have been conducted at the facility and in the downgradient groundwater flow area, including initial investigations conducted onsite, the discovery of onsite contamination, and the subsequent activities performed to delineate the contamination. Investigations and activities were performed by New York State and federal agencies.

### 2.2.1.1 NYSDEC 1984 Phase I Investigation

NYSDEC conducted a Phase I Investigation at the original Hopewell Precision property (15 Ryan Drive), in response to a complaint submitted by a former Hopewell Precision employee. Wastes generated during onsite manufacturing operations were identified as degreasers and paint thinners. Employees dumped wastes directly onto the ground.

#### 2.2.1.2 NYSDEC 1987 Phase II Investigation
Wehran Engineering (1987) conducted an engineering investigation of the site for NYSDEC. The following work was completed around the original Hopewell Precision facility at 15 Ryan Drive:

**Geophysical Survey**
An electromagnetic induction geophysical survey was conducted along seven survey lines (33 stations) to measure changes in the subsurface conductivity, to determine if contaminated groundwater (reflected by higher conductivity readings) was present. Conductivity readings showed little variation.

**Monitoring Wells**
Three monitoring wells were installed, with one in an upgradient position (B-1) and two in downgradient positions (B-2 and B-3). Each well was screened from approximately 25 to 40 feet bgs. None of the wells encountered bedrock; the water table ranges from 4 to 10 feet bgs. Sample results from the three wells showed chlorinated VOCs only in B-3 (1,1,1-TCA at 23 ug/L, TCE at 4 J ug/L, and 1,1-DCE at 1J ug/L).

#### 2.2.1.3 NYSDEC 1993 Groundwater Sampling Event
In April 1993 NYSDEC performed a groundwater sampling event at the three onsite monitoring wells. Groundwater analysis indicated that only a low level of TCE was detected in well B-3. Therefore, due to the absence of volatile organic compounds in the groundwater in the subsurface, the site was delisted from the NYSDEC Registry of Class 2 Inactive Hazardous Waste Disposal sites in 1994.

#### 2.2.1.4 EPA 2003 Groundwater Sampling Program
The EPA Region II Removal Support Team (RST) collected groundwater samples from approximately 450 residential wells. TCE contamination was detected in 44 wells. Subsequently, point of entry treatment (POET) systems were installed on 37 residential wells with TCE concentrations above the EPA MCL of 5 ug/L for TCE. Additionally, 1,1,1-TCA was detected in 75 wells; however, concentrations were below the EPA MCL of 200 ug/L. NYSDEC (at the request of NYSDOH) has installed POET systems on 14 residential wells with 1,1,1-TCA above the NYSDOH standard of 5 ug/L.

#### 2.2.1.5 EPA ERT Activities
From August to December 2003, the EPA Environmental Response Team Center/Response Engineering and Analytical Contract (ERTC/REAC) completed various field activities in the study area, to obtain additional information. Field activities included the following: 1) residential well survey; 2) installation and sampling of permanent wells in the overburden material; 3) installation and sampling of temporary wells in the overburden material; 4) geophysical logging; and 5) soil sample collection in the suspected source area. A summary of the activities is provided below.

**Residential Well Survey**
REAC personnel visited up to 200 residences in the vicinity to conduct a residential well survey. Measurements of water levels and well construction details were recorded for the residential wells. Additionally, well completion logs were obtained from the Dutchess County Health Department and NYSDEC records for wells in the site vicinity. Survey elevations for the top of well casings were not available; therefore, groundwater elevations could not be determined.

**Permanent Well Installation and Sampling**
Six overburden wells (EPA-1 through EPA-6) were installed in the lower portion of the water table aquifer, at depths ranging from 64 feet to 78 feet below grade. TCE was detected in the groundwater only in EPA-6. Bedrock was not encountered during field activities; therefore, depth to bedrock is greater than 78 feet.

**Temporary Well Installation and Sampling**
Twenty-four temporary wells (PZ-1 through PZ-24) were installed to examine the upper portion of the water table aquifer. Temporary wells were screened from 10-20 feet bgs with two exceptions. PZ-18 and PZ-24 were screened at 20-30 feet bgs and 10-16 feet bgs, respectively. TCE was detected in 17 temporary wells at concentrations ranging from 3 ug/L to 144 ug/L. TCE concentrations decreased with depth.

**Geophysical Logging**
Geophysical logging, using natural gamma ray and induction logging tools, of the six permanent EPA wells indicated that the water table was approximately 10 to 15 feet bgs and that consistent layering was not present in the shallow sediments. Logging could not differentiate lithographic changes between the sand and gravel unit and the underlying till material.

**Soil Samples**
Soil samples were collected from 16 boreholes (TH-1 through TH-16) located on the former and present Hopewell Precision properties. Soil samples consisted of poorly sorted, fine- to coarse-grained sand and gravel. TCE was detected in 5 of 26 soil samples collected from the boreholes; the maximum concentration was 3.7 ug/kg.

#### 2.2.1.6 NYSDOH Pond Samples
In June 2004, NYSDOH collected one surface water samples from Red Wing pond for VOC analysis. No VOCs were detected. Results are included in Appendix A.

## 2.3 Current Conditions
Currently the Hopewell Precision Site is comprised of the area with TCE and 1,1,1-TCA contamination in groundwater emanating from the former and present Hopewell Precision properties on Ryan Drive. Contamination migrated southwestward, intersecting residential water supply wells; it appears to be confined within the valley bordered by ridges located to the east and west. The plume extends from Ryan Drive in the north to Timothy Lane, located approximately 1.5 miles southwest of Ryan Drive. The plume is comprised of two segments: the northern two-thirds dominated

by detections of TCE and the southern one-third characterized by detections of 1,1,1-TCA. The currently mapped contaminant plume is shown on Figure 2-2.

The Hopewell Precision company continues to operate on Ryan Drive and the area remains predominantly residential, with each residence having a water supply well and a septic system. Commercial development is present along Route 82, including strip malls, gas stations, and businesses in individual buildings. Commercial facilities are also served by private water wells and individual septic systems.

# Section 3
# Initial Evaluation

This section presents an initial evaluation of site conditions, and is based on information obtained from previous and ongoing investigations, published geological research documents, local and regional geological data, and data publically available on the internet.

## 3.1 Review of Existing Data

This section summarizes the physical characteristics of the study area including the topography, drainage and surface water characteristics, regional and site-specific geology and hydrogeology, climate, population, and land use. Geological and hydrogeological data and publications pertaining to Dutchess County and Hopewell Junction, New York were reviewed. Documents were obtained from the United States Geological Survey (USGS), NYSDEC, town data, and internet sources.

### 3.1.1 Topography

The topography of Dutchess County is comprised of rolling hills and plains with valleys having narrow stream bottomlands and wetlands. The Hudson River is the major topographic feature in the county. The irregular topography has been shaped by glaciation and orogeny. Several major creeks are prevalent in the county and flow southward; the majority of the creeks flow toward the Hudson River. Dutchess County is located in the southeast region of New York State and is bordered by the State of Connecticut to the east and the Hudson River to the west.

The Hopewell Precision Site is located in the south-central region of Dutchess County. The Hopewell Precision property is situated in a flat, northeast-southwest trending valley between higher bedrock ridges to the east and west. These ridges slope upward to approximately 400 feet above mean sea level (msl). The site lies at a general elevation of 290 feet above msl, with the southern portion gradually sloping downward to approximately 240 feet above msl. A small hill is present in the central portion of the site; it slopes upward to approximately 320 feet above msl. The hamlet of Hopewell Junction occupies the southern region of the valley, at the southern end of the currently-mapped groundwater plume.

### 3.1.2 Drainage and Surface Water

The majority of Dutchess County is within the Hudson River drainage basin. The Hudson River basin is comprised of approximately 13,300 square miles and encompasses the region spanning eastern New York, Vermont, New Jersey, Massachusetts, and Connecticut. The Hudson River basin is divided into three subbasins: the upper Hudson, Mohawk, and lower Hudson. The Hopewell Precision Site lies within the Lower Hudson subbasin, which drains the southeastern portion of New York State and has an area of 5,230 square miles (Figure 3-1). Major tributaries in the county include Wappinger Creek and Fishkill Creek. Fishkill Creek drains most of the central and southern portions of Dutchess County, including the area occupied by the site.

Several freshwater creeks, marshes, and ponds are present in the vicinity of the site, affecting drainage. Whortlekill Creek is approximately 1,000 feet west of the Hopewell Precision property and flows southwestward following the base of the ridge along the western side of the valley. Whortlekill Creek discharges into Fishkill Creek, at a point approximately 3,000 feet south of the hamlet of Hopewell Junction. Sprout Creek is approximately two miles west of the site, flowing southwestward until it discharges into Fishkill Creek. Fishkill Creek flows southwestward and discharges into the Hudson River, located approximately 10.25 miles west of the site. The Hudson River flows in a southerly direction to New York City and ultimately discharges into the Atlantic Ocean.

Marshes are evident north and south of the site, with the northern marsh located approximately 1,000 feet to the northwest, traversed by Whortlekill Creek. The southern marsh borders the currently-mapped groundwater plume, approximately 8,500 feet south-southwest of the Hopewell Precision property.

Several ponds and lakes are present in the vicinity of the site, including a pond approximately 500 feet southwest of the Hopewell Precision property. An 8-acre spring-fed lake in Red Wing Park is used for recreational purposes and is situated approximately 7,500 feet south-southwest of Hopewell Precision property. Additionally, approximately 9,500 feet southwest of Hopewell Precision, a former sand and gravel mine has been reclaimed and is presently holding water for potential recreational use by the Whortlekill Rod & Gun Club.

Dutchess County is within the New York Bight watershed of the Hudson River. The Dutchess County Wetlands Complex is comprised of a network of five wetlands in the Hudson Valley: East Fishkill, La Grange, East Park, Milan Window, and Stissing Mountain. Hopewell Junction is adjacent to the East Fishkill wetlands area. The East Fishkill wetlands comprise portions of carbonate lowlands at elevations ranging from 250 feet to 650 feet above msl. The wetlands encompass large areas of farmland or former farmland, developed for residential and commercial purposes, woodlands, and wetlands drained by tributaries of Fishkill Creek. The wetlands range from highly calcareous fens to very acidic bogs and include wooded swamps, wet meadows, shrub pools, and marshes. A wetland area at Hopewell Junction has acidic bog mats and an acidic bog lake in addition to marshes.

The complex of wetlands in Dutchess County is the only known location in the Northeast for Blanding's turtle. Extant bog turtle populations are known to exist at two sites in the East Fishkill complex (U.S. Fish and Wildlife Service 1997).

### 3.1.3 Geological and Hydrogeological Characteristics

The geological and hydrogeological characteristics of Dutchess County and the area near the Hopewell Precision Site are described in the following sections. Dutchess County is within the Hudson River basin. Significant aquifers in the Hudson River basin occur in the unconsolidated deposits and in bedrock. The primary groundwater flow direction is south-southwest.

#### 3.1.3.1 Regional Geology

Two physiographic provinces are found in Dutchess County: the Ridge and Valley Province in the west and the New England Upland Province in the east. The Ridge and Valley Province is characterized by glacial sediments overlying sedimentary bedrock, while the New England Upland Province generally consists of glacial sediments overlying crystalline bedrock. The Hopewell Precision Site lies within the Ridge and Valley Province. The majority of the bedrock geology in Dutchess County is clastic with carbonates of the Ridge and Valley Province in the immediate vicinity of major creeks.

Dutchess County is underlain by four types of bedrock and four types of unconsolidated deposits, as shown on Figure 3-2. Consolidated rocks include: 1) Precambrian undifferentiated granite and gneiss, 2) Early Cambrian Cheshire quartzite, 3) Ordovician and Cambrian Stockbridge limestone, and 4) Late to Middle Ordovician Hudson River Formation. Consolidated rocks range in age from Precambrian to Ordovician and unconsolidated deposits range in age from Pleistocene to Recent.

During Precambrian time, the oldest strata were clayey and limy mud and sand laid down in a sea that covered the region. Subsequently, these strata were metamorphosed by granite intrusion. Following the granite intrusion, a long period of erosion occurred that created a low plain.

The sea advanced over the area again during the Cambrian age and sediments of sand and limy mud were deposited on the sea bottom. Additional deposition of limy mud, clay, and sandy clay continued into the Ordovician age. These sediments were consolidated into sandstone, limestone, and shale beds. These beds were folded, metamorphosed, and uplifted above sea level during the late-Ordovician Taconic orogeny. During this orogeny, the sandstone, limestone, and shale units were metamorphosed to quartzite, marble, phyllite, and schist. Following the Tactonic orogeny, a long period of erosion occurred.

During the Paleozoic era, crustal movements caused the rocks to be folded and faulted, resulting in fractures. The area was subsequently eroded to a lowland in the Mesozoic era.

Periods of erosion occurred again in the Cenozoic era. Continental glaciers advanced southward over New York State during the Pleistocene age. These glaciers laid down unconsolidated glacial till deposits of clay and boulders. Subsequently, gravel, sand, and silt were deposited in stream valleys during the melting and recession of the glaciers. Following the glacial period, the land was slightly elevated which rejuvenated streams in the area. Today, erosion of glacial debris and bedrock is occurring in some areas, while deposition takes place in lakes, swamps, and flood plains of streams. Sediments deposited during the last few thousand years are alluvium consisting of clay, silt, sand, and gravel.

**Unconsolidated Deposits**

Pleistocene and Recent unconsolidated deposits in Dutchess County result primarily from glacial activities, with minor unconsolidated deposits laid down by streams (Figure 3-2). The thickness of unconsolidated deposits ranges from a few feet to several hundred feet, with the greatest thickness occurring in lowland areas. Unconsolidated deposits overlying consolidated rock in Dutchess County, from oldest to youngest, include 1) unstratified till, 2) stratified lacustrine deposits, 3) stratified sand and gravel, and 4) recent alluvium.

**Unstratified Till**

Till laid down by glacial ice consists of a mixture of rock fragments derived from bedrock in the immediate vicinity. Therefore, the till is comprised mainly of clay in regions underlain by shale, slate, phyllite, or schist, and calcareous pebbles in regions underlain by limestone, dolomite, or marble. Thin sand lenses may be present in the till although their extent is limited. The till may be cemented or compacted to form a dense aggregate.

**Lacustrine Deposits**

Lacustrine deposits in the western region of the county contain layers of silt and clay. These deposits may also contain interbeds of silt and sand.

**Sand and Gravel**

Stratified sand and gravel deposits underlie extensive areas in major stream and tributary valleys. These sand and gravel units were stream-laid deposits from glacial melt water and are known as "outwash".

**Alluvium**

Alluvium deposits are clay, silt, sand, and gravel material deposited by streams into lakes, swamps, and flood plains. Alluvium deposits are not contiguous and have limited thickness.

Glacial till may be present underneath or in lieu of the sand and gravel deposits. Glacial till is comprised of clay, sandy clay, silty sand, gravel with clay, boulders, and rock fragments. Due to poor sorting, high clay content, and low permeability, glacial till is generally not a productive water-bearing unit. Although glacial till (where present) can retard movement between the glacial outwash and bedrock units, it does not prevent hydraulic connection from the glacial outwash unit to bedrock.

### 3.1.3.2 Site-Specific Geology

The Hudson River Formation is the most extensive bedrock unit in the county and underlies the Hopewell Precision Site. The Hudson River Formation is predominantly argillaceous and is generally comprised of black, gray, red, or green shale or slate. The formation also includes beds of sandstone, limestone, and conglomerate. Metamorphism of the Hudson River Formation within the county increases from the northwest to the southeast; and, phyllite is reportedly present in the vicinity of Hopewell Junction. The structure of the formation includes subparallel joints with spacing ranging from a fraction of an inch to several inches, depending upon the sand present in the formation. The thickness of the Hudson River Formation cannot be determined because beds cannot be traced over long distances; however, the apparent thickness ranges from a few feet to several thousand feet.

Within the residential neighborhood southwest of the Hopewell Precision facility, well completion reports noted the depth to bedrock ranges from 4 feet to 135 feet bgs. The depth to bedrock is shallower along the western ridge and deeper in the southern portion of the valley.

Unstratified till is the principle unit overlying bedrock in the region of the Hopewell Precision Site. An isolated pocket of stratified sand and gravel overlies bedrock in the south-central portion of the site. A cross-section through the central portion of the site shows that alluvial silt and sand, lacustrine silt and clay, and outwash sand and gravel comprise the unconsolidated deposits. The cross-section plan view is shown on Figure 3-3 and the cross-section is included as Figure 3-4.

#### 3.1.3.3 Regional Hydrogeology

Groundwater occurs in both unconsolidated deposits and consolidated rocks in Dutchess County, with precipitation as the primary source of groundwater recharge. Water moves in consolidated rock through joints and fractures, since the rocks have little primary porosity. In Dutchess County, porosity of unconsolidated deposits ranges from 10 to 20 percent for till and 15 to 35 percent for sand and gravel material. The porosity of bedrock is only 2 to 3 percent, but fractures can considerably enhance groundwater flow.

Water-bearing zones are present in the unconsolidated deposits in two distinct units: unstratified till and stratified sand and gravel. Water zones in till are generally found in upland areas while the water zones in stratified sand and gravel are found in valleys and lowlands. Generally, till is not a productive water-bearing unit because of its substantial clay content. Additionally, the permeability of till is low, generally resulting in slower water movement within or through the deposit.

Wells in the county are screened in both glacial outwash and bedrock formations. The glacial outwash and bedrock units may be hydraulically interconnected, forming a single aquifer. The most productive water-bearing zone in the county is the sand and gravel deposit. Deposits of sand and gravel are utilized as a source of water for domestic and agricultural needs. The yield in wells installed in the sand and gravel zone vary tremendously from 3 to 200 gallons per minute (gpm) for unscreened wells and from 20 to 800 gpm for screened wells.

Bedrock yields generally small to moderate quantities of water. Well yield in bedrock is determined by the type of bedrock, type of overlying unconsolidated deposits, and bedrock joints and fractures. Groundwater has been found in the bedrock of the Hudson River Formation, Stockbridge limestone, Cheshire quartz, and undifferentiated granite and gneiss. The predominant bedrock aquifer is the Hudson River Formation which has an average yield of 16 gpm. The highest well yield is found in the Stockbridge limestone with an average of 22 gpm. The yield of bedrock wells in Dutchess County is highest in wells located in valleys and the lowest in wells in the higher hills. The most productive wells in bedrock are located in valleys where joints, fractures, and other openings are numerous and recharge to bedrock is facilitated by topography and permeable overlying unconsolidated deposits.

### 3.1.3.4 Site-Specific Hydrogeology

The Hopewell Precision Site is situated in a valley and is underlain by glacial outwash consisting predominantly of sand and gravel. Glacial outwash is the most important source of groundwater supply in Dutchess County, especially in valleys. Sand and gravel deposits underlie the glacial outwash and overlie fractured bedrock. Bedrock consists of shale or slate of the Hudson River Formation.

**Glacial Outwash**

The surface geology at the site consists of highly permeable glacial outwash sand and gravel that was deposited by glacial melt-water streams. The thickness of the glacial outwash unit ranges from 0 to 100 feet. Hydraulic conductivity of the glacial outwash ranges from $2.39 \times 10^{-3}$ centimeters per second (cm/s) to $6.81 \times 10^{-5}$ cm/s (Weston 2004).

**Hudson River Formation**

The Hudson River Formation consists of shale and slate with interbeds of sandstone, limestone, limestone conglomerate, and chert. The Hudson River Formation underlying the site is slightly metamorphosed and is characterized by numerous, small, closely-spaced, subparallel joints and bedding-plane type openings. Groundwater occurs in these areas and bedrock wells yield small to moderate water supplies. The most productive bedrock wells are located in valley areas, such as the site location, where joints and other openings are abundant and recharge to bedrock is facilitated by favorable topographic position and overlying permeable deposits. There has been no actual measure of hydraulic conductivity of the bedrock; however, typical hydraulic conductivity for moderately permeable fracture rock is approximately $10^{-4}$ cm/s (Weston 2004).

**Glacial Outwash/Bedrock Hydrologic Unit**

The aquifer of concern at the site has been designated as the Glacial Outwash/Bedrock Hydrologic Unit (Weston 2004). Interconnection between the glacial outwash and bedrock occurs at the site; therefore, the aquifer of concern is considered as a single unit. Residential wells within the Hopewell Precision Site boundary are completed in both the glacial sediments and bedrock of the Hudson River Formation. Wells drilled in recent years are predominantly completed in the bedrock. Wells completed in the glacial materials are cased and screened. Wells tapping the bedrock portion of the aquifer are generally cased through the unconsolidated sediments, with the bedrock portion of the well uncased. Driller's logs of residential wells indicate that glacial sand and gravel units overlie fractured bedrock. Aquifer testing of residential wells completed in the glacial outwash unit revealed that pumping causes minimal drawdown, thereby suggesting a productive aquifer with high transmissivity. The sand and gravel unit transmits water to the underlying bedrock. Aquifer testing within the bedrock unit reveals that large drawdown may occur that could induce groundwater leakage from the glacial deposits.

Yield information for wells (from driller's logs) provides further evidence of aquifer interconnection. Bedrock wells overlain by sand and gravel have well yields exceeding 30 gpm. However, bedrock wells overlain by clay or glacial till have well yields of only 13 gpm. The higher yield is indicative of water transmission from the glacial deposits to bedrock.

Groundwater within the overburden material is encountered at depths ranging from 10 feet to 20 feet bgs. The static depth to water level for wells in the vicinity of the site installed in bedrock ranges from 20 feet to 60 feet below grade.

### 3.1.4 Climate

The Hopewell Junction region has a humid continental climate. The climate is characterized by long winters, short summers, and abundant precipitation. Average precipitation is 48.2 inches per year and the average snowfall is 26.6 inches per year (Hopewell Junction www.city-data.com). The average annual temperature is 51 degrees Fahrenheit (F). Historical maximum and minimum temperatures range from 105 degrees F to -22 degrees F, respectively (Snavely 1980). Precipitation is a source of freshwater for tributaries and groundwater in the region. Precipitation is distributed relatively evenly throughout the year. Months with the coldest temperatures are January and February and the warmest temperatures occur in July and August. Monthly average temperatures for January and July are 24.7 degrees F and 72.3 degrees F, respectively. Sunshine during the year ranges from 47 percent in November and December to 64 percent in July (Hopewell Junction www.city-data.com).

### 3.1.5 Population, Land Use and Hazardous Waste Sites

The Hopewell Precision facility is located approximately two miles north of Hopewell Junction, New York. Hopewell Junction is comprised of 2.8 square miles with a population of 2,610 (2000 Census). Hopewell Junction is a hamlet of the town of East Fishkill, New York. East Fishkill is approximately 2.5 miles south of Hopewell Junction. The population of East Fishkill is 25,589 (2000 Census).

Land use characteristics for the area of the lower Hudson subbasin in Dutchess County include forest (55%), agriculture (29%), and urban (13%). The land use in the vicinity of the site is primarily residential, commercial, manufacturing, and agricultural. Homes are supplied with water from individual residential wells installed in the unconsolidated glacial sediments or fractured bedrock. A recreational golf course is located east of the site.

The region includes landfills and several state and federal hazardous waste sites including the following:

- Hopewell Junction (NY0000108134)
- East Fishkill Landfill (NYD981560501)
- IBM on Route 52 (NYD000707901)

- Royal Carting Service (NYD002426757)
- Shenandoah Road Contamination Site (NYSFN204269)

### 3.1.6 Characteristics of Chemical Contaminants

The groundwater contamination is characterized by detections of TCE and 1,1,1-TCA, as discussed in previous sections of this work plan. Extensive sampling of residential wells downgradient of the source area suggest that 1,1,1-TCA was disposed to the ground for a period of time before TCE was disposed. Vapors of TCE and 1,1,1-TCA have also been identified under the slabs of numerous homes in the area and in indoor air at some locations.
In the suspected source area at 15 Ryan Drive, where Hopewell Precision personnel reported disposed of chlorinated solvents to the ground, limited residual soil contamination has been observed in recent soil and geoprobe groundwater investigations. It is currently uncertain if substantial amounts of source material remain in the Ryan Drive area.

### 3.1.7 Conceptual Site Model

The CSM is developed to integrate all the different types of information collected during a remedial investigation, including geology, hydrogeology, site background and setting, and the fate and transport of contamination associated with the site. The CSM will be updated as information is obtained during the RI. Figure 3-5 shows the conceptual site model for the Hopewell Precision Site.

**Physical Setting with Respect to Groundwater Movement**

The Hopewell Precision Site is located within the Ridge and Valley Physiographic Province and is part of the lower Hudson River drainage basin. The geology of the area is characterized by unconsolidated glacial sediments underlain by consolidated bedrock. The glacial sediments are a complex mixture of boulders, sand, silt and clay, which may form discontinuous beds. The predominant bedrock in the Hopewell area is the Hudson River Formation, which consists of fractured shale or slate. The bedrock has little primary porosity; secondary porosity such as fractures and bedding planes is common. The unconsolidated glacial sediments and bedrock generally form a single aquifer. Residential wells tap both zones of the aquifer; wells in the unconsolidated sediments are cased and screened, while bedrock wells are cased to the top of the bedrock with the bedrock portion completed as an open hole. The water table is generally between 5 and 15 feet bgs and groundwater flows toward the south/southwest. Groundwater may discharge to Whorlekill Creek, which traverses the northern area of the mapped groundwater plume and then forms the western contaminant boundary. Groundwater may also discharge into several ponds, including Red Wing pond and the gravel pit in the southern area of the mapped plume. However, surface water samples collected from Red Wing pond had no VOCs.

All of the groundwater in the Hopewell area is derived from precipitation. The volume of water that percolates down to the water table and recharges the groundwater is the residual of the total precipitation not returned to the atmosphere by evapotranspiration or lost by runoff to the surface water drainage systems. The area has no sanitary sewers; sanitary waste is stored in small, individual septic tanks with waste liquid returned to the glacial aquifer via leaching pools.

**Potential Contaminant Sources**

Hopewell Precision is an active manufacturer of sheet metal parts and assemblies. The company operated at its original location at 15 Ryan Drive from 1977 to 1980. It moved to its current location at the adjacent property at 19 Ryan Drive in 1980. Processes at Hopewell Precision include shearing, punching, bending, welding, and painting. The painting process includes degreasing prior to the wet spray paint application. The company used TCE and 1,1,1-TCA in a vapor degreasing machine until 1998. Hopewell Precision purchased 12 drums (7,020 pounds) of 1,1,1-TCA in 1980 and 15 drums (9,000 pounds) in 1994. The company generated 1,675 gallons (32 drums) of 1,1,1-TCA waste for off-site disposal from 1986 through 1998. The company purchased 48 drums (31,680 pounds) of TCE in 1996 and 1997, but does not have any hazardous waste manifests for off-site disposal of TCE.

Hopewell Precision employees or former employees reportedly dumped one to five gallons per day of waste solvents, paint pigments, and sodium nitrate directly onto the ground. The common practice for disposal of waste solvents at the former facility (15 Ryan Drive) was to pour the material on the ground outside the building. Waste paints and thinners were dumped on a daily basis and waste solvents from the degreaser were dumped on a biweekly basis. Areas of residual contamination in the unsaturated zone or below the water table are currently unknown.

**Expected Transport and Fate of Site Contaminants**

*Groundwater*

Liquid chlorinated solvents such as TCE and 1,1,1-TCA discharged to the ground surface would migrate downward through the unsaturated zone in a relatively linear pattern, with minimal dispersion from the discharge location. However, if glacial clays are present at the source area, migration of the liquid solvents could be complicated. Discharged solvents would migrate downward to the top of the clay unit, pool, then begin to migrate across the surface of the clay. The presence of clay layers is currently unknown. The unsaturated zone is approximately 5 to 10 feet thick in the Ryan Drive area.

Once the liquid chlorinated solvents (TCE and 1,1,1-TCA) encounter the water table, some of the solvent would dissolve into the groundwater and begin to move in the direction of groundwater flow. If the quantity of solvent reaching the water table is sufficient, some of the solvent may remain in an undissolved state as a dense non-aqueous phase liquid (DNAPL). Since TCE and 1,1,1-TCA are denser than water, the solvent would continue to move downward under the influence of gravity. DNAPL would sink until it encountered a lower permeability zone, which would slow or stop the downward migration. DNAPL could pool or accumulate on top of a lower permeability zone and remain stationary or move in the down-slope direction of the lower permeability zone. Movement of DNAPL in the saturated zone can be very complex, with movement controlled by the permeability of subsurface stratigraphic units, the shape and configuration of lower permeability zones, and/or the dip of bedding planes.

Chlorinated solvents such as TCE and 1,1,1-TCA in a dissolved phase move with the groundwater flow, but generally at a slower rate than groundwater. As the contaminants move downgradient toward the residential wells, shallow-screened wells are the most likely to intercept the contaminants. The observed pattern of groundwater contamination in the residential areas indicates contamination is generally in the shallow, glacial portion of the aquifer. However, the full extent of contamination in the aquifer is currently unknown.

Natural attenuation of chlorinated solvents is a documented process, with TCE breaking down through a known decay chain of compounds, with daughter products including cis-1,2-DCE and vinyl chloride. These latter two chemicals have not been detected in water samples from the site. Breakdown of chlorinated solvents occurs most prominently under anaerobic conditions. It is currently unknown if the glacial/bedrock aquifer is aerobic or anaerobic.

*Air*

TCE and 1,1,1-TCA are volatile organic chemicals. As such, they volatilize to the atmosphere and, in the unsaturated soil zone, to the pore spaces between soil particles. Volatile chemicals dissolved in groundwater also volatilize into the overlying unsaturated zone as a plume moves downgradient with the groundwater flow. Vapors move through the unsaturated zone pore spaces, often seeking preferential flow pathways such as sandier zones with more porosity and permeability, gravel commonly placed beneath concrete basements, or pipelines that may be backfilled with sandy material. As vapors move through the unsaturated zone, they can enter structures, such as homes, affecting air quality. Vapor movement may also be affected by differential pressure gradients, either natural (e.g., caused by weather changes) or man-made (e.g., pressure differences inside and outside structures).

*Surface Water/Sediment*

Groundwater may discharge into surface water bodies, including Whortlekill Creek and several ponds. Therefore, the potential exists for contamination from the groundwater to affect the quality of surface water and/or the sediments at (or downgradient from) the discharge points. Contaminated surface water and/or sediment could result in exposure to people utilizing the creek or ponds, or to ecological resources such as aquatic organisms or animals that frequent the habitat at the edge of water bodies. In addition, chemicals could enter the food chain, resulting in ecological exposure to higher levels of the food chain.

## 3.2 Preliminary Identification of Applicable or Relevant and Appropriate Requirements

This section provides a preliminary determination of the regulations that are applicable or relevant and appropriate to remediation of the groundwater, surface water, and sediment, indoor air media at the Hopewell Precision Site. Both federal and state environmental and public health requirements are considered. In addition, this section identifies federal and state criteria, advisories, and guidance that could be used for evaluating remedial alternatives. Only those regulations that are considered relevant to the site are presented.

### 3.2.1 Definition of ARARs

The legal requirements that are relevant to the remediation of the site are identified and discussed using the framework and terminology of CERCLA, as amended by the Superfund Amendments and Reauthorization Act (SARA). These acts specify that Superfund remedial actions must comply with the requirements and standards of both federal and state environmental laws.

The EPA defines applicable requirements as "those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site". An applicable requirement must directly and fully address the situation at the Site.

The EPA defines relevant and appropriate requirements as "those cleanup standards, standards of control, or other substantive requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility siting laws that, while not "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site".

Remedial actions must comply with state ARARs that are more stringent than federal ARARs. State ARARs are also used in the absence of a federal ARAR, or where a state ARAR is broader in scope than the federal ARAR. In order to qualify as an ARAR, state requirements must be promulgated and identified in a timely manner. Furthermore, for a state requirement to be a potential ARAR it must be applicable to all remedial situations described in the requirement, not just CERCLA sites.

ARARs are not currently available for every chemical, location, or action that may be encountered. For example, there are currently no ARARs which specify clean-up levels for sediments. When ARARs are not available, remediation goals may be based upon other federal or state criteria, advisories and guidance, or local ordinances. In the development of remedial action alternatives the information derived from these sources is termed "To Be Considered" (TBC) and the resulting requirements are referred to as TBCs. EPA guidance allows clean-up goals to be based upon non-promulgated criteria and advisories such as reference doses when ARARs do not exist, or when an ARAR alone would not be sufficiently protective in the given circumstance.

By contrast, there are six conditions under which compliance with ARARs may be waived. Remedial actions performed under Superfund authority must comply with ARARS except in the following circumstances: (1) the remedial action is an interim measure or a portion of the total remedy which will attain the standard upon completion; (2) compliance with the requirement could result in greater risk to human health and the environment than alternative options; (3) compliance is technically impractical from an engineering perspective; (4) the remedial action will attain an equivalent standard of performance; (5) the requirement has been promulgated by the state, but has not been consistently applied in similar circumstances; or (6) the remedial action would disrupt fund balancing.

ARARs and TBCs are classified as chemical, action, or location specific. Descriptions of these classifications are provided below:

- Chemical-specific ARARs or TBCs are usually health or risk-based numerical values, or methodologies which when applied to site specific conditions, result in the establishment of numerical values. These values establish the acceptable amount or concentration of a chemical that may be found in, or discharged to, the ambient environment.

- Location-specific ARARs or TBCs generally are restrictions imposed when remedial activities are performed in an environmentally sensitive area or special location. Some examples of special locations include flood plains, wetlands, historic places, and sensitive ecosystems or habitats.

- Action-specific ARARs or TBCs are restrictions placed on particular treatment or disposal technologies. Examples of action-specific ARARs are effluent discharge limits and hazardous waste manifest requirements.

## 3.2.2 Preliminary Identification of ARARs and TBCs

The identification of ARARs occurs at various points during the RI/FS and throughout the remedial process. ARARs are used to determine the extent of cleanup, to scope and formulate remedial action alternatives, and to govern the implementation of the selected alternative.

The following are preliminary ARARs that may impact the selection of remedial alternatives for various environmental media at the Site. This preliminary list of ARARs is based on current site knowledge and will be reviewed and updated during the RI/FS processes. Periodic review of the preliminary list of ARARs will assure that the ARARs remain applicable, as more site-specific information becomes available, and as new or revised ARARs are established.

### 3.2.2.1 Chemical-Specific ARARs

The determination of potential chemical-specific ARARs and TBCs for a site typically follows an examination of the nature and extent of contamination, potential migration pathways and release mechanisms for site contaminants, the presence of human receptor populations, and the likelihood that exposure to site contaminants will occur. The potential chemical-specific federal and state ARARs for the Site are as follows:

Federal:

- Resource Conservation and Recovery Act (RCRA) Groundwater Protection

Standards and Maximum Concentration Limits (40 Code of Federal Regulations (CFR) 264, Subpart F)
- Clean Water Act, Water Quality Criteria (Section 304) (May 1, 1987 - Gold Book)
- Safe Drinking Water Act, Maximum Contaminant Levels (40 CFR 141.11-.16)

New York:
- New York Ground Water Quality Regulations (6 NYCRR Part 703)
- New York State Department of Health, State Sanitary Code, Drinking Water Supply (10 NYCRR Part 5.1)
- New York Surface Water Quality Standards (6 NYCRR Part 702)
- New York Water Supply Sources (10 NYCRR Part 170)
- New York Pollution Discharge Elimination Systems (6 NYCRR Part 750-758)
- New York Technical and Operations Guidance Series (TOGS) Ambient Water Quality Standards and Guidance Values (June 2004)

#### 3.2.2.2 Location-Specific ARARs

The location of the Site is a fundamental determinant of its impact of human health and the environment. Location-specific ARARs are restrictions placed on the concentration of hazardous substances or the conduct of activities solely because they are in a specific location (EPA 1988). Some examples of these unique locations include: flood plains, wetlands, historic places, and sensitive ecosystems or habitats. The potentially applicable federal and state location-specific ARARs for the Site are as follows:

Federal:
(Generally, 50 CFR Parts and 402)
- Executive Order on Wetlands Protection (CERCLA Wetlands Assessments) No. 11990.
- National Historic Preservation Act (16 United States Code [USC] 470) Section 106 *et seq*. (36 CFR 800)
- RCRA Location Requirements for 100-year flood plains (40 CFR 264.18(b)).
- Fish and Wildlife Coordination Act (16 USC 661 *et seq*.)
- Wetlands Construction and Management Procedures (40 CFR 6, Appendix A)
- Executive Order 11988, "Floodplain Management"
- Executive Order 11990, "Protection of Wetlands"
- 1985 Statement of Policy on Floodplains/Wetlands Assessments for CERCLA Action

New York:
- New York Use and Protection of Waters (6 NYCRR Part 608)
- Freshwater Wetlands (6 NYCRR Part 662-665)
- Endangered and Threatened Species of Fish and Wildlife (6 NYCRR Part 182)
- Freshwater Wetlands Act (ECL article 24 and 71, Title 23)
- Flood Plain Management Regulations - development permits (6 NYCRR 500 ECL article 36)

#### 3.2.2.3 Action-Specific ARARs

Based on the identification of remedial response objectives and applicable general response actions, numerous federally promulgated action-specific ARARs and TBCs will affect the implementation of remedial measures and include administrative requirements related to treatment, storage and disposal actions.

The primary federal requirements which guide remediation are those established under CERCLA, as amended by SARA. The National Contingency Plan (NCP) incorporates the SARA Title III requirement that alternatives must satisfy ARARs and utilize technologies that will provide a permanent reduction in the toxicity, mobility or volume of wastes, to the extent practicable.

RCRA establishes both administrative (e.g., permitting, manifesting) requirements and substantive (i.e., design and operation) requirements for remedial actions. For all CERCLA actions conducted entirely onsite, only the substantive requirements apply. NYSDEC has promulgated several regulations relating to alternatives which involve the treatment, storage, disposal, or transportation of hazardous wastes including the NYSDEC Hazardous Waste Management and Facility Regulations. Portions of the NYSDEC hazardous waste regulations are more stringent than the federal counterparts. The potentially applicable federal and state action-specific ARARs are as follows:

Federal:

- RCRA Subtitle C Hazardous Waste Treatment Facility Design and Operating Standards for Treatment and Disposal Systems, (i.e., landfill, incinerators, tanks, containers, etc.)(40 CFR 264 and 265) (Minimum Technology Requirements)
- RCRA Ground Water Monitoring and Protection Standards (40 CFR 264, Subpart F)
- RCRA Manifesting, Transport and Record keeping Requirements (40 CFR 262)
- RCRA Wastewater Treatment System Standards (40 CFR 264, Subpart X)
- RCRA Storage Requirements (40 CFR 264; 40 CFR 265, Subparts I and J)
- RCRA Subtitle D Nonhazardous Waste Management Standards (40 CFR 257)
- Toxic Substances Control Act (TSCA)(40 CFR 761)
- Clean Water Act - NPDES Permitting Requirements for Discharge of Treatment System Effluent (40 CFR 122-125)
- Clean Water Act Discharge to Publicly Owned Treatment Works (POTW) (40 CFR 403)
- National Emission Standards for Hazardous Air Pollutants (NESHAPs) (40 CFR 61)
- Occupational Safety and Health Standards for Hazardous Responses and General Construction Activities (29 CFR 1904,1910,1926)
- Fish and Wildlife Coordination Act (16 UC 661 et seq.). (Requires actions to protect fish or wildlife when diverting, channeling or modifying a stream).
- National Primary and Secondary Ambient Air Quality Standards (40 CFR Part 50)
- The Endangered Species Act

New York:

- New York State Waste Transporter Permits (6 NYCRR Part 364)
- New York State Hazardous Waste Management System (6 NYCRR Part 370)
- New York State Identification and Listing of Hazardous Wastes (6 NYCRR Part 371)
- New York State Hazardous Waste Manifest System and related Standards for Generators, Transporters and Facilities (6 NYCRR Part 372)
- New York State Hazardous Waste Treatment, Storage and Disposal Facility Permitting Requirements (6 NYCRR Part 373-1)
- New York State Final Status Standard for Owners and Operators of Hazardous Waste TSD Facilities (6 NYCRR Part 373-2)
- New York State Interim Status Standards for Owners and Operators of Hazardous Waste Facilities (6 NYCRR Part 373-3)
- New York State Standards for the Management of Specific Hazardous Wastes and Specific Types of Hazardous Management Facilities (6 NYCRR Part 374)
- New York State Inactive Hazardous Waste Disposal Sites (6 NYCRR Part 375)
- New York State Uniform Procedures (6 NYCRR Part 621)
- Implementation of the National Pollution Discharge Elimination Systems (NPDES) Program in NYS (6 NYCRR Part 750-757)
- Division of Air, General Provisions (6 NYCRR Part 200)
- Air Permits and Certifications (6 NYCRR Part 201)
- General Prohibitions (6 NYCRR Part 211)
- General Process Emission Sources (6 NYCRR Part 212)
- New York Water Pollution Control Regulations (6 NYCRR Parts 608,610-614)

#### 3.2.2.4 To Be Considered

When ARARs do not exist for a particular chemical or remedial activity, other criteria, advisories and guidance (TBCs) may be useful in designing and selecting a remedial alternative. The following criteria, advisories and guidance were developed by EPA, other federal agencies and state agencies. The potentially applicable federal and state TBCs are as follows:

Federal TBCs (Action, Location, and Chemical-Specific):

- Safe Drinking Water Act National Primary Drinking Water Regulations, Maximum Contaminant Level Goals (MCLGs)
- National Recommended Water Quality Criteria, EPA 2003
- Guidelines for the Protection and Management of Aquatic Sediment Quality in Ontario (D. Persaud *et al.*, August 1993)
- Ontario Ministry of the Environment and Energy - Lowest Effect Level (LEL) and Severe Effects Level (SEL)
- EPA Region 9 Preliminary Remediation Goals (PRGs), (EPA 2002)
- EPA Drinking Water Health Advisories
- TSCA Health Data
- Policy for the Development of Water-Quality-Based Permit Limitations for Toxic Pollutants (49 Federal Register 8711)
- Ground Water Classification Guidelines
- Ground Water Protection Strategy

- Waste Load Allocation Procedures
- Fish and Wildlife Coordination Act Advisories.
- Control of Air Emissions from Superfund Air Stripper at Superfund Groundwater Sites (OSWER Directive 9355.0-28)
- Draft Guidance for Evaluation of the Vapor Intrusion to Indoor Air Pathway, EPA 2002

<u>New York TBCs (Action, Location, and Chemical-Specific):</u>

- NYSDEC Technical Guidance for Screening Contaminated Sediments, July 1999
- Technical and Operations Guidance Series
  - Analytical Detectability for Toxic Pollutants, July 12, 1985
  - Ambient Water Quality Standards and Guidance Values, June 2004
  - Toxicity Testing in the SPDES Permit Program, April 1, 1987
  - BPJ Methodologies, April 1, 1987
  - Regional Authorization for Temporary Discharges, April 1, 1987
  - Industrial SPDES Permit Drafting Strategy for Surface Waters, May 19, 1987.
- Guidelines for the Control of Toxic Ambient Air Contaminants (NYSDEC DAR-1)
- NYSDOH Tetrachloroethene Air Criteria Document
- NYSDOH Generic Community Air Monitoring Plan
- Draft Guidance for Evaluating Soil Vapor Intrusion in the State of New York (NYSDOH, February 2005).

# Section 4 Work Plan Rationale

## 4.1 Data Quality Objectives

DQOs are qualitative and quantitative statements which specify the quality of data required to support decisions regarding remedial response activities. DQOs are based on the end uses of the data collected. The data quality and level of analytical documentation necessary for a given set of samples will vary, depending on the intended use of the data.

As part of the work plan scoping effort, site-specific remedial action objectives were developed. Sampling data will be required to evaluate whether or not remedial alternatives can meet the objectives. The intended uses of these data dictate the data confidence levels. The guidance document *Guidance for the Data Quality Objectives Process* (EPA 2000) was used to determine the appropriate analytical levels necessary to obtain the required confidence levels. The three levels are screening data with definitive level data confirmation, definitive level data, and field measurement-specific DQO requirements (Table 4-1).

The applicability of these levels of data will be further specified in the QAPP. Sampling and analytical data quality indicators (DQIs) such as precision, accuracy, representativeness, comparability, completeness, and sensitivity will also be defined in the QAPP.

## 4.2 Work Plan Approach

CDM has developed investigations that will evaluate the nature and extent of contamination in several media, including groundwater, surface water, deep water in two ponds, sediments, soil, and air, both sub-slab and indoors. Sample results will generate data to support an RI report, an HHRA, a SLERA, an FS and a comprehensive Record of Decision (ROD). Both screening-level and definitive-level data will be used to support the objectives of this RI/FS.

The overall objectives of the RI/FS are to determine the nature and extent of contamination in the media to be sampled, in order to evaluate appropriate remedial alternatives. Specifically, the RI is designed to collect the following information:

**Groundwater**

- Determine the area, depth, and extent of groundwater contamination
- Determine the rate and direction of groundwater and contaminant movement

**Surface Water, Deep Water, Sediment**

- Determine if groundwater discharging to Whortlekill Creek and several ponds causes contamination of the surface water, deeper water in two ponds, and sediment

**Soil**

- Determine if contaminants are present in the unsaturated zone and bedrock around the former and present Hopewell Precision facilities on Ryan Drive
- Determine if DNAPL is present in the unsaturated zone or in the saturated zone (during drilling of the bedrock well)

**Air**

- Determine if VOCs are present in the unsaturated zone beneath building foundations and/or in indoor air in the area with 1,1,1-TCA groundwater contamination

RAC II field team personnel will collect environmental samples in accordance with the rationale described in Section 5.3 of this work plan. All standard EPA sample collection and handling techniques will be utilized. RAS samples will be analyzed in compliance with the Field and Analytical Services Teaming Advisory Committee (FASTAC) Policy. CDM will pursue the use of the CLP or DESA prior to engaging in a laboratory subcontract and alternatives to standard CLP analysis will be sought with the EPA Regional Sample Control Coordinator (RSCC), prior to any sample collection activities and analyses via a subcontracted laboratory. Under the "flexibility clause" of the Contract Laboratory Program (CLP), modifications are often made to CLP Statements of Work (SOWs), enabling achievement of method detection limits (MDL) that may meet the stated criteria.

CDM will implement the EPA Region 2 Policy as shown below.

| | |
|---|---|
| Tier 1: | DESA Laboratory (including Environmental Services Assistance Team (ESAT) support) |
| Tier 2: | EPA CLP |
| Tier 3: | Region specific analytical services contracts (use CLP flex clause) |
| Tier 4: | Obtaining analytical services using subcontractors via field contracts (such as RAC subcontractors) |

All fixed laboratory analytical needs will to be submitted to the EPA RSCC regardless of the EPA or CLP laboratories' ability to perform the required analyses. CDM will utilize the RAC II basic ordering agreement (BOA) laboratories only in the event that the first three tiers are not available.

The following samples are anticipated for the Hopewell Precision Site:

- <u>Groundwater Screening Samples</u>: Low detection limit VOCs, with 24-hour turnaround for faxed results

- <u>Surface Water and Deep Water Samples</u>: low detection limit VOCs, target compound list (TCL) SVOCs, pesticides/PCBs, target analyte list (TAL) metals, cyanide, hardness, alkalinity, ammonia, nitrate, nitrite, total Kjeldahl nitrogen (TKN), sulfate, sulfide, chloride, pH, total organic carbon (TOC), total dissolved solids (TDS), and total suspended solids (TSS)

- <u>Sediment Samples</u>: TCL VOCs, SVOCs, pesticides/PCBs, TAL metals, cyanide, pH, TOC, and grain size

- <u>Monitoring Well Samples</u>: Low detection limit VOCs, TCL SVOCs, pesticides/ PCBs, TAL metals, cyanide, chloride, methane, ethane, ethene, nitrate/nitrite, sulfate, sulfide, ferrous iron, TOC, TSS, TDS, ammonia, hardness, and TKN

- <u>Residential Well Samples</u>: Low detection limit VOCs

- <u>Soil Samples</u>: TCL VOCs, SVOCs, pesticides/PCBs, TAL metals, cyanide, 1,4-dioxane, pH, TOC, and grain size

- <u>Sub-Slab and Indoor Air Samples</u>: Dichlorodifluoromethane (Freon), chloromethane, carbon tetrachloride, 1,2-dichloroethane (total), methyl ethyl ketone (MEK), 1,1,1-TCA, 1,2-dichloroethane, chloroethane, 1,1 -dichloroethene, perchloroethene, TCE, cis-1,2-dichloroethane, trans-1,2-dichloroethane, methyl tert butyl ether (MTBE), and vinyl chloride

A summary of all analytical parameters is included on Table 5-1.

The RAS CLP and DESA analytical results will be validated by EPA Region II. CDM will validate all subcontract laboratory data using the protocols specified in the EPA-approved analytical methods. CDM will tabulate and evaluate the data and use it to characterize contamination at the site.

# Section 5
# Task Plans

The tasks identified in this section correspond to EPA's Statement of Work (SOW) for the Hopewell Precision Site, dated February 23, 2005. The tasks for the RI/FS presented below correspond to the applicable tasks presented in the *Interim Final Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA* (EPA 1988). In addition, EPA's SOW includes a task for project close-out. The order in which these tasks are presented and the task numbering scheme correspond to the work breakdown structure provided in EPA's SOW.

The scope of the field investigations for the RI/FS was discussed with EPA and other project stakeholders in a technical meeting on April 4, 2005. Field work will be conducted in two stages. A technical memorandum will be submitted to EPA at the conclusion of Stage I, recommending final monitoring well locations, construction materials and screen intervals. Two types of sampling events are seasonally dependent and are listed separately from the two stages. Major elements of the field investigation are shown in Section 5.3.

## 5.1 Task 1 - Project Planning and Support

The project planning task generally involves several subtasks that must be performed in order to develop the plans and the corresponding schedule necessary to execute the RI. These subtasks include project administration, conducting a site visit, performing a review and detailed analysis of existing data, attending technical scoping meetings with EPA and other support agencies, preparing this RI/FS work plan, preparing the QAPP and HSP, and procuring and managing subcontractors.

### 5.1.1 Project Administration

The project administration activity involves regular duties performed by the CDM site manager (SM) and the Program Support Office throughout the duration of this work assignment. CDM will provide the following project administration support in the performance of this work assignment.

The SM will:

- Prepare the technical monthly report
- Review weekly financial reports
- Review and update the project schedule
- Attend quarterly internal RAC II meetings
- Communicate regularly with the EPA remedial project manager (RPM)
- Prepare staffing plans

The Program Support Office personnel will:

- Review the work assignment technical and financial status
- Review the monthly progress report
- Provide technical resource management
- Review the work assignment budget
- Respond to questions from the EPA project officer and contracting officer
- Prepare and submit invoices

### 5.1.2 Attend Scoping Meeting

Following the receipt of this work assignment on February 23, 2005, the CDM SM, the CDM RAC II technical operations manager, the CDM RI task manager attended an initial scoping meeting with the EPA contracting officer, the EPA project officers, the EPA RPM, the EPA risk assessor, the EPA Edison laboratory manager, and the EPA quality assurance specialist on March 2, 2005 in New York, to outline and discuss the project scope.

### 5.1.3 Conduct Site Visit

The CDM SM, RI task manager, and risk assessor conducted a site visit on March 9, 2005 to develop a better understanding of local and site-specific conditions. The CDM personnel were accompanied by the EPA RPM and EPA removal action on scene coordinator (OSC) during the site visit. The site visit consisted of visual observation of site conditions and current use and evaluating potential logistical and health and safety issues.

### 5.1.4 Develop Draft Work Plan and Associated Cost Estimate

CDM prepared the draft RI/FS work plan in accordance with the contract terms and conditions. CDM used existing site data and information, information from EPA guidance documents (as appropriate) and technical direction provided by the EPA RPM as the basis for preparing the work plan.

The work plan includes a comprehensive description of project tasks, the procedures to accomplish them, project documentation, and a project schedule. CDM uses internal QA/QC systems and procedures to insure that the work plan and other deliverables are of professional quality requiring only minor revisions (to the extent that the scope is defined and is not modified). Specifically, the work plan includes the following:

- Identification of RI project elements including planning and activity reporting documentation, field sampling, and analysis activities. A detailed work breakdown structure of the RI corresponds to the work breakdown structure provided in the EPA SOW (dated February 23, 2005) and discussions with EPA.

- CDM's technical approach for each task to be performed, including a detailed description of each task, the assumptions used, any information to be produced during and at the conclusion of each task, and a description of the work products that will be submitted to EPA. Issues relating to management responsibilities, site access, site security, contingency procedures and storage and disposal of investigation derived wastes are also addressed. Information is presented in a sequence consistent with the SOW.

- A schedule with dates for completion of each required activity, critical path milestones and submission of each deliverable required by the SOW and the anticipated review time for EPA.

- A list of key contractor personnel supporting the project (Section 7) and the subcontractor services required for the work assignment.

CDM prepared and submitted a draft work plan budget (as Volume II of the RI/FS work plan) that followed the work breakdown structure in the SOW. The draft work plan budget contained a detailed cost breakdown, by subtask, of the direct labor costs, subcontractor costs, other direct costs, projected base fee and award fee pool, and any other specific cost elements required for performance of each of the subtasks included in the SOW. Other direct costs were broken down into individual cost categories as required for this work assignment, based on the specific cost categories negotiated under CDM's contract. A detailed rationale describing the assumptions for estimating the professional level of effort (PLOE), professional and technical levels and skills mix, subcontract amounts, and other direct costs were provided for each subtask in the SOW.

### 5.1.5 Negotiate and Revise Draft Work Plan/Budget

CDM personnel will attend a work plan negotiation meeting at EPA's direction. EPA and CDM personnel will discuss and agree upon the final technical approach and costs required to accomplish the tasks detailed in the work plan. CDM will submit a negotiated work plan and budget incorporating the agreements made in the negotiation meeting. The negotiated work plan budget will include a summary of the negotiations. CDM will submit the negotiated work plan and budget in both hard copy and electronic formats.

### 5.1.6 Evaluate Existing Data and Documents

As part of the preparation of the work plan, CDM reviewed data collected during previous investigations at the site. Analytical data and other information from these background documents were incorporated, where applicable, into this planning document. Existing data are summarized in Section 3.

### 5.1.7 Quality Assurance Project Plan

**Quality Assurance Project Plan**

CDM prepared a draft and final site-specific vapor intrusion QAPP (CDM 2006), following EPA's QAPP for vapor intrusion sampling.

CDM will prepare a QAPP in accordance with EPA 505-B-04-900A, Uniform Federal Policy for Quality Assurance Project Plans. The QAPP will be submitted as a separate deliverable. The QAPP describes the project objectives and organization, functional activities, and QA/QC protocols that will be used to achieve the required DQOs. The DQOs will, at a minimum, reflect the use of analytical methods to identify and address contamination consistent with the levels for remedial action objectives identified in the NCP.

The QAPP includes sampling objectives; sample locations and frequency; sampling equipment and procedures; personnel and equipment decontamination procedures; sample handling and analysis; and a breakdown of samples to be analyzed through the CLP and through other sources, as well as the justification for those decisions. The QAPP is written so that a field sampling team unfamiliar with the site would be able to gather the samples and field measurements. Technical Standard Operating Procedures (SOPs) are included in the QAPP. Each SOP or QA/QC protocol has been prepared in accordance with EPA Region II guidelines and the site-specific HSP. The QAPP includes a project organization chart and delineates the responsibilities of key field and office team members. A schedule will be included that shows the proposed scheduling of each major field activity.

Any significant changes to the QAPP will be documented in a letter to the EPA RPM and EPA quality assurance officer.

**Other Quality Assurance/Quality Control Activities**
Quality assurance activities to be performed during the implementation of this work plan may also include internal office and field or laboratory technical systems audits, field planning meetings, and quality assurance reviews of all project plans, measurement reports, and subcontractor procurement packages. The quality assurance requirements are discussed further in Section 7.2 of this work plan.

### 5.1.8 Health and Safety Plan

CDM will prepare a HSP in accordance with 40 CFR 300.150 of the NCP and 29 CFR 1910.120 (1)(1) and (1)(2). The HSP includes the following site-specific information:

- Hazard assessment
- Training requirements
- Definition of exclusion, contaminant reduction, and other work zones
- Monitoring procedures for site operations
- Safety procedures
- Personal protective clothing and equipment requirements for various field operations
- Disposal and decontamination procedures
- Other sections required by EPA

The HSP also includes a contingency plan which addresses site specific conditions which may be encountered.

In addition to the preparation of the HSP, health and safety activities will be monitored throughout the field investigation. The HSP will specify air monitoring procedures in the exclusion zone established around the drilling rig or sampling locations. A qualified health and safety coordinator, or designated representative will attend the initial field planning meeting and may perform a site visit to ensure that all health and safety requirements are being adhered to. A member of the field team will be designated to serve as the onsite health and safety coordinator throughout the field program. This person will report directly to both the field team leader and the health and safety coordinator. The HSP will be subject to revision, as necessary, based on new information that is discovered during the field investigation.

<u>Community Air Monitoring Program</u>
CDM will establish air monitoring protocols in the site-specific HSP to comply with the NYSDOH air monitoring guidelines. Measurements will be taken continuously inside the exclusion zone around the drilling rig to maximize protection of on-site personnel.

The following actions will be taken, if necessary:

- If ambient air concentrations of total VOCs exceeds 5 parts per million (ppm) above background, work activities will be temporarily halted until VOC-levels drop below 5 ppm above background.
- If total VOCs persist at levels in excess of 5 ppm over background but less than 25 ppm, the source of vapors will be identified and corrective actions taken to abate emissions. After this step, work activities can resume if the total VOC vapor level 200 feet downwind of the exclusion zone (or half the distance to the nearest potential receptor) is below 5 ppm over background.
- If organic vapor levels exceed 25 ppm at the perimeter of the work area, activities will be shut down.

No air samples from this monitoring will be submitted for laboratory analysis. If ambient air concentrations of total VOCs exceed 5 ppm, an additional person will be added to the sampling crew to conduct the air monitoring. Protocols will be specified in the HSP and QAPP.

### 5.1.9 Non-RAS Analyses
This subtask is not required for this work assignment. Non-RAS analyses are described in Section 5.4.3.

### 5.1.10 Meetings
CDM will participate in various meetings with EPA during the course of the work assignment. As directed by EPA's SOW, CDM has assumed eight meetings, with two people in attendance, for four hours per meeting. CDM will prepare minutes which list the attendees and summarize the discussions in each meeting.

### 5.1.11 Subcontract Procurement
This subtask will include the procurement of all subcontractors required to complete the field investigation activities. Procurement activities include: preparing the technical statement of work; preparing Information for Bidders (IFB) or Request for Proposal (RFP) packages; conducting pre-bid site visits (when necessary); responding to technical and administrative questions from prospective bidders; performing technical and administrative evaluations of bid documents; performing the necessary background, reference, insurance, and financial checks; preparing consent packages for approval by the EPA contracting officer (when necessary); and awarding the subcontract.

To support the proposed field activities, the following subcontractors will be procured:

- A New York licensed driller to install groundwater screening locations, monitoring wells, and soil borings
- An analytical laboratory subcontractor to perform non-RAS analyses (if EPA's DESA laboratory does not have space) described in Section 5.4.3 and on Table 5-1

- A New York licensed surveyor to survey the location and elevation of all monitoring wells, groundwater screening locations, surface water and sediment locations and soil borings that will be sampled for the RI/FS
- A cultural resources subcontractor to conduct a Phase IA survey of the local area
- An aquatic survey subcontractor to provide a vessel, physical limnology/bathymetry measurement equipment and services, and sample collection support for surface water, deep water, and sediment sampling in lakes and ponds
- A subcontractor to haul and dispose of investigation derived waste (IDW), responsible for the removal and proper disposal of drums and storage tanks containing RI generated waste liquids and solids

All subcontractor procurement packages will be subject to CDM's technical and quality assurance reviews.

### 5.1.12 Perform Subcontract Management

The CDM SM and the CDM subcontracts managers will perform the necessary oversight of the subcontractors (identified under Section 5.1.11) needed to perform the RI/FS. CDM will institute procedures to monitor progress, and maintain systems and records to ensure that the work proceeds according to the subcontract and RAC II contract requirements. CDM will review and approve subcontractor invoices and issue any necessary subcontract modifications.

### 5.1.13 Pathway Analysis Report

In accordance with OSWER Directive 9285.7-01D-1 entitled *Risk Assessment Guidelines for Superfund - Part D* (1998a), CDM will provide EPA with standard tables, worksheets, and supporting information for the risk assessment as interim deliverables prior to preparation of the full baseline risk assessment report. CDM will prepare a pathways analysis report (PAR) that consists of Risk Assessment Guidance for Superfund (RAGS) Part D Standard Tables 1 through 6 and supporting text. The PAR will summarize the key assumptions regarding potential receptors, exposure pathways, exposure variables, chemical distribution, and chemical toxicity that will be used to estimate risk in the baseline risk assessment. Because RAGS Part D Tables 2 and 3 summarize site data, these tables of the PAR will be prepared once analytical data collected during the RI site investigation are available. Preparation of the PAR initiates the risk assessment process, whose components are described in greater detail in Section 5.7.1.

CDM will coordinate with EPA to define potential exposure pathways and human receptors. To accomplish this, CDM will review all available information obtained from EPA pertaining to the Hopewell Precision Site, including data generated during previous investigations. CDM will integrate this information with site data generated during the RI site investigation. Background information on the site will be summarized, and samples collected and the chemicals analyzed for in various media will be discussed. The treatment of data sets (e.g., duplicates, splits, blanks [trip, field, and laboratory], multiple rounds, and qualified and rejected data) will be discussed, and chemical-specific exposure point concentrations (EPCs) for each exposure scenario will be estimated. Based on current knowledge, potential receptors include any users of private water wells (assuming that treatment of the water is not in place) that draw on the contaminated portion of the aquifer. The receptors with the highest potential exposures are residents (adults and children) who use the groundwater as drinking water. Exposure variables to be used for the calculation of daily intakes will be presented. Carcinogenic and noncarcinogenic toxicity values for contaminants of concern and the sources of these values will be presented in the PAR. As noted above, the selection of chemicals of potential concern, exposure pathways and receptors, exposure concentrations, exposure variables, and toxicity values will be summarized in tabular form in accordance with the Standard Tables of RAGS Part D.

Upon EPA's approval of the PAR, CDM will estimate potential exposures and risks associated with the site and initiate preparation of the draft baseline risk assessment report as described in Section 5.7.

## 5.2 Task 2 - Community Relations

CDM will provide technical support to EPA during the performance of the following community relations activities throughout the RI/FS in accordance with *Community Relations in Superfund-A Handbook* (EPA 1992b).

### 5.2.1 Community Interviews

CDM will perform the following requirements:

- Preparation for Community Interviews - CDM will review background documents and provide technical support to EPA in conducting community interviews with government officials (federal, state, county, township, or city), environmental groups, local broadcast and print media, either in person or by telephone.
- Questions for Community Interviews - CDM will prepare draft interview questions for EPA's review. Final questions will reflect EPA's comments on the draft questions.

### 5.2.2 Community Relations Plan

CDM will prepare a draft Community Relations Plan (CRP) that presents an overview of community concerns. The CRP will include:

- Site background information including location, description, and history
- Community overview including a community profile, concerns, and involvement
- Community involvement objectives and planned activities, with a schedule for performance of activities
- Mailing list of contacts and interested parties
- Names and addresses of information repositories and public meeting facility locations
- List of acronyms
- Glossary

CDM will submit a Final CRP which reflects EPA's comments.

### 5.2.3 Public Meeting Support

CDM will perform the following activities in support of six public meetings, availability sessions, and open houses:

- Make reservation for meeting space, in accordance with EPA's direction
- Attend six public meetings or availability sessions, and prepare draft and final meeting summaries
- Reserve a court reporter for each public meeting
- Provide full-page and "four on one" page copy of meeting transcripts, both in hard copy and a 3.5-inch diskette in Word Perfect 8.0, or other format
- Prepare and maintain a sign-in sheet for each public meeting

CDM will develop draft visual aids (i.e., transparencies, slides, and handouts) as instructed by EPA. CDM will develop final visual aids incorporating all EPA comments. For budgeting purposes, CDM will assume 20 overhead transparencies, 10 slides, and 100 handouts for each public meeting.

### 5.2.4 Fact Sheet Preparation

CDM will prepare draft information letters/updates/fact sheets. CDM will research, write, edit, design, lay out, and photocopy the fact sheets. CDM will attach mailing labels to the fact sheets before delivering them to EPA from where they will be mailed. For budgeting purposes, CDM will assume six fact sheets (one for each public meeting), two to four pages in length, with three illustrations per fact sheet. CDM assumed 800 copies of each fact sheet will be provided to EPA. Final fact sheets will reflect EPA's comments.

### 5.2.5 Proposed Plan Support

CDM will provide administrative and technical support for the preparation of the draft and final Proposed Plan describing the preferred alternative and the alternatives evaluated in the FS. The Proposed Plan will be prepared in accordance with the NCP and the most recent version of *EPA Community Relations in Superfund - A Handbook* (EPA 1992b). The Proposed Plan will describe opportunities for public involvement in the ROD.

A draft and final Proposed Plan will be prepared. The final will reflect EPA comments.

### 5.2.6 Public Notices

CDM will prepare newspaper announcements/public notices for each public meeting, for inclusion in the most widely read local newspaper. Six public announcements/notices are assumed.

### 5.2.7 Information Repositories

In accordance with the SOW, this subtask is currently not applicable to this work assignment.

### 5.2.8 Site Mailing List

CDM will update the community relations mailing list six times for the Hopewell Precision Site. The mailing list will be developed under Subtask 5.2.2. and is estimated to consist of 1,000 names. CDM will provide EPA with a copy of the mailing list on diskette and mailing labels for each mailing. EPA will do the actual mailing of any information to the community.

### 5.2.9 Responsiveness Summary Support

CDM will provide administrative and technical support for the Hopewell Precision Site Responsiveness Summary. The draft document will be prepared, compiling and summarizing the public comments received during the public comment period on the Proposed Plan. CDM will prepare technical reviews of selected public comments, for EPA review and use in preparing formal responses. CDM assumes 300 separate comments will be received and that 150 responses will be necessary.

## 5.3 Task 3 - Field Investigation

This task includes all activities related to implementing field investigations for the RI/FS for the Hopewell Precision Site. The task descriptions have been developed after review and evaluation of site background data currently available to CDM.

The overall objective of the RI/FS is to collect sufficient information on the nature and extent of site-related contamination to evaluate remedial technologies and develop remedial alternatives that are protective of human health and the environment. The media to be sampled include groundwater, surface water, deep water, sediment, soil, and air (sub-slab vapor, indoor air, and ambient air). The data generated from the investigation will satisfy the DQOs and also be used to support an HHRA, SLERA, and FS. All activities performed during the field investigation will be conducted in accordance with the EPA-approved QAPP.

The field investigations will be conducted in two stages. A technical memorandum will be submitted to EPA at the conclusion of Stage I, recommending final monitoring well locations and screen intervals. Two types of sampling events are seasonally dependent and are listed separately from the two stages. Once the final field schedule is known, these sampling events will be combined with other field activities, if appropriate. Major elements of the field investigation are shown below.

**Stage I**

- Site reconnaissance and mobilization
- Groundwater screening survey
- Source area investigation
- Targeted residential well sampling (Round 1)

**Stage II**

- Monitoring well installation and sampling
- Aquifer testing
- Targeted residential well sampling (Round 2)

**Seasonal Sampling**

- Winter heating season - Residential vapor sampling (sub-slab sampling, followed by sub-slab, indoor air, and ambient air sampling at selected residences)
- Summer season - Surface water, deep water, and sediment sampling

## 5.3.1 Site Reconnaissance

To complete this RI/FS work plan, CDM conducted an initial site visit to become familiar with local and site-specific conditions. CDM's SM, RI task manager and risk assessor conducted a vehicular reconnaissance of the site and surrounding area to evaluate logistical problems relevant to installation of monitoring wells and implementation of the residential well, surface water, sediment, and air sampling. The site reconnaissance was led by EPA's Removal Branch On-Scene Coordinator and RPM.

Additional site reconnaissance activities will be performed to support mobilization and to prepare for drilling and sampling activities. During the site reconnaissance, sampling locations will be identified and marked; property boundaries and utility rights-of-way will be located; utility mark outs will be performed; and photographs will be taken. Site reconnaissance activities also include oversight of the cultural resources subcontractor and surveying subcontractor.

Individual reconnaissance activities are required to support implementation of specific sampling programs. Site reconnaissance activities are anticipated prior to conducting the following sampling activities:

- Mobilization and cultural resources survey
- Groundwater screening and source area investigation
- Surface water, deep water, and sediment sampling
- Monitoring well installation and aquifer testing
- Topographic survey oversight

Specific site reconnaissance activities are described below:

### 5.3.1.1 Mobilization and Cultural Resources Survey Oversight

Prior to initiating field activities, a subcontractor to CDM will conduct a cultural resources survey of the entire plume area. The Stage 1A Cultural Resources Survey will be prepared in order to determine the presence or absence of cultural resources which may be impacted by the implementation of any remedial actions. The Stage IA survey is the initial level of survey and requires comprehensive documentary research and an initial walk-over reconnaissance and surface inspection. CDM will oversee the on-site activities of the cultural resources subcontractor.

### 5.3.1.2 Groundwater Screening and Source Area Investigation Reconnaissance

Prior to conducting the groundwater screening and source area investigations CDM will visit the site to identify the exact sampling locations and any potential logistical or property access issues. Because many of the groundwater screening points are located along roadways, it is anticipated that close coordination will be required with local authorities and police on access and safety issues.

#### 5.3.1.3 Surface Water, Deep Water, and Sediment Sampling Reconnaissance

Prior to conducting surface water, deep water, and sediment sampling, the field team will visit the site to identify sampling locations, potential logistical issues, particularly those related to access to lake and pond sampling locations that will require use of a boat, and property access issues. The field team will also coordinate with local officials on property access issues.

#### 5.3.1.4 Monitoring Well Installation Reconnaissance

Monitoring well installation locations will be based on the results of the groundwater screening. Prior to installing the monitoring wells, the field team will visit proposed monitoring well locations to identify exact drilling locations and assess potential logistical issues and physical access constraints for the drill rig. Potential problem locations will be documented and photographed and locations may be adjusted to facilitate access.

It is currently anticipated that aquifer testing will consist of slug tests at selected monitoring wells. No special reconnaissance is needed to conduct slug tests.

#### 5.3.1.5 Topographic Survey Oversight

The existing geographic information system (GIS) database and maps will be used for this project. In addition, a topographic map of the site will be created that shows all relevant physical features of the area.

It is anticipated that survey activities will occur during both stages of the Hopewell Precision Site field investigation; at the conclusion of the Stage I activities and at the conclusion of the Stage II activities. At the conclusion of the Stage I activities, the location and elevation of all source area soil sampling locations and groundwater screening locations will be surveyed. At the conclusion of the Stage II activities the location and elevation of all monitoring wells, piezometers, and staff gauges will be surveyed. Three elevations will be determined at each monitoring well: the ground surface, top of the inner casing, and top of the outer casing. In addition, surface water and sediment sampling locations that are accessible from shore will be surveyed (if they were not surveyed following Stage I). The locations of surface water and sediment samples collected from ponds and lakes using a boat will be identified at the time of collection using on-board global positioning system (GPS) unit.

The locations of residential well samples and residential sub-slab and/or indoor air samples will not be surveyed. The residences will be located on tax maps and identified using the existing system previously established for the site by EPA's Removal Branch.

### 5.3.2 Mobilization and Demobilization

This subtask will consist of property and residential access assistance; field personnel orientation; field office and equipment mobilization and demobilization; and field supply ordering, staging, and transport to the site.

#### 5.3.2.1 Site Access Support

Access to public areas (roads, parks, etc.), private property, and residences will be needed to execute the field investigation. EPA will be responsible for obtaining site access. CDM will assist EPA with site access. Significant access support is anticipated for the following field sampling activities:

- Residential well sampling - CDM will develop a list of residential wells for sampling and provide EPA with a list of the property owners, residents, mailing addresses, and telephone numbers. Once EPA has established that access has been granted, CDM will contact each residence to arrange for a time to sample their well. Residential well sampling schedules will be coordinated to minimize gaps in sampling and maintain an efficient schedule.

- Residential vapor sampling (sub-slab and indoor air) - CDM developed a list of residences for sub-slab sampling and provided EPA with a list of property owners, residents, mailing addresses, and telephone numbers. Once EPA established that access had been granted, CDM arranged for a time to install a sub-slab sampling port and collect a sub-slab sample. Based on the results of the sub-slab sampling, a second list of residences identified for sub-slab and indoor air sampling was not needed. Residential vapor sampling schedules were coordinated to minimize gaps in sampling and to maintain an efficient schedule.

- Groundwater screening - Specific sampling locations will be identified during the on-site reconnaissance activities described in Section 5.3.1.2. CDM will provide a list of property owners (public and private) to be accessed during the groundwater screening program. The list will include the mailing address and telephone number of the property owners. Once EPA has established that access has been granted, sampling activities can begin. CDM will contact and coordinate with property owners and local officials (for work in public areas) to schedule sampling activities.

- Monitoring well installation and sampling - Specific monitoring well installation locations will be determined based on the results of the groundwater screening program and the site reconnaissance described in Section 5.3.1.4. CDM will provide a list of property owners (public and private) to be accessed for installation of monitoring wells. The list will include the mailing address and telephone number of the property owners. Once EPA has established that access has been granted, monitoring well installation activities can begin. CDM will contact and coordinate with property owners and local officials (for work in public areas) to schedule drilling activities.

#### 5.3.2.2 Field Planning Meetings

Prior to RI field activities, each field team member will review all project plans and participate in a field planning meeting conducted by the CDM SM and RI task manager to become familiar with the history of the site, health and safety requirements, field procedures, and related QC requirements. All new field personnel will receive a comparable briefing if they do not attend the initial field planning meeting and/or the tailgate kick-off meeting. Supplemental meetings may be conducted as required by any changes in site conditions or to review field operation procedures.

### 5.3.2.3 Field Equipment and Supplies

Equipment and field supply mobilization will entail the ordering, renting, and purchasing of all equipment needed for each part of the RI field investigation. This will also include the staging and transfer of all equipment and supplies to and from the site. Measurement and Test Equipment forms will be completed for rental or purchase of equipment (instruments) that will be utilized to collect field measurements. The field equipment will be inspected for acceptability, and instruments calibrated as required prior to use. This task also involves the construction of a decontamination area for sampling equipment and personnel. A separate decontamination pad will be constructed by the drilling subcontractor for drilling equipment.

It is anticipated that one major mobilization will be required at the beginning of the Stage I field activities and that a major demobilization will be required at the end of the Stage II field activities. Minor demobilization and mobilization activities will be required at the completion of Stage I and at the beginning Stage II, respectively.

**Field Trailer, Utilities, and Services**

EPA will assist with finding a suitable location for the command post area.

Arrangements for the lease of a field trailer and associated utilities, a secure storage area for investigation-derived waste, trash container, and portable sanitary facilities will be made. The command post area must be large enough to accommodate a 40-foot office trailer, at least two 20 cubic yard roll-off containers, two 21,000 gallon Baker tanks, portable sanitary facilities, a decontamination area, drilling equipment and supplies, drill rigs and subcontractor support vehicles, and CDM vehicles.

Health and safety work zones including personnel decontamination areas will be established. Local authorities such as the police and fire departments will be notified prior to the start of field activities. Equipment will be demobilized at the completion of each field event, as necessary. Demobilized equipment will include sampling equipment, drilling subcontractor equipment, health and safety equipment, and decontamination equipment.

### 5.3.2.4 Site Preparation and Restoration

**Site Preparation**

CDM will conduct ground truthing for overhead utilities and surface features around intrusive subsurface sampling locations. The drilling subcontractor will be responsible for contacting an appropriate utility location service to locate and mark out underground utilities.

CDM plans to use existing roadway rights-of-way, open space, and clearings to the maximum extent possible to access sampling locations. However, it may be necessary to clear some areas of vegetation and trees in order to access sampling locations. The drilling subcontractor will be responsible for clearing vegetation to provide access to sampling locations. CDM will direct and oversee any necessary clearing activities conducted by the drilling subcontractor.

**Site Restoration**

Some field activities are expected to occur on private and public properties. In the event that property damage occurs on and around these properties (e.g., landscaping and paving) as a result of the proper performance of field investigation activities, such damages will be repaired and restored, as near as practicable, to the conditions existing immediately prior to such activities. CDM will maintain photographic documentation of site conditions prior to commencement of and after completion of RI field activities.

At the completion of the field activities, decontamination pad materials will be decontaminated and removed from the command post area, unless otherwise instructed by EPA. The decontamination and command post area will be restored, as near as practicable, to its original condition.

CDM personnel will perform field oversight and health and safety monitoring during all site restoration field activities.

### 5.3.3 Hydrogeological Assessment

This section defines the primary objectives of the hydrogeological assessment and describes the hydrogeologic investigation activities that will be performed to evaluate the nature and extent of groundwater contamination at the Hopewell Precision Site.

Review of previously collected data indicates significant data gaps in the understanding of the nature and extent of groundwater contamination and the hydrogeologic framework at the site. CDM reviewed existing data provided by EPA's Removal Branch for approximately 450 residential wells. In addition, analytical data for soil and groundwater samples collected on and near the Hopewell Precision facility by NYSDEC (Wehran 1987) and EPA's ERT contractor (Lockheed Martin 2004) were reviewed. Based on these data, groundwater contaminated with VOCs is present primarily in the shallow, glacial outwash aquifer. Analytical data for 3 of the approximately 450 residential wells sampled indicate contamination in the deeper bedrock aquifer. Discussions with EPA suggest that contamination in these bedrock wells may be related to well construction methods and that the wells may be acting as conduits for migration of contaminants from the overlying unconsolidated sediments into the bedrock portion of the aquifer.

As part of the development of this work plan, CDM evaluated the residential well data to estimate the vertical and horizontal distribution of groundwater contamination with VOCs. Because most of the information on contaminant distribution is based on samples collected from residential wells, the data are not sufficient to adequately define the nature and extent of contamination, particularly the vertical aspects of contamination. The depths of many of the residential wells are unknown and some of the well depths are based on verbal information from residents (which is not supported by documentation). The screen interval (or open hole interval in bedrock wells) is often also unknown. EPA's contractor (Lockheed Martin 2004) obtained well construction logs and inspected some of the wells; however, well depths and construction details for most of the wells are unknown or uncertain. In addition, there are areas where residential wells are not present, resulting in data gaps for these areas.

There are significant gaps in information to support development of a detailed CSM, including groundwater flow direction, depth to bedrock, lithology and geometry of the unconsolidated sediments, aquifer properties, and interaction between groundwater and surface water.

The RI will collect data to supplement data gaps in the nature and extent of groundwater contamination and the hydrogeologic framework of the site. Preliminary information suggests that groundwater contamination may be restricted to the glacial portion of the aquifer. Therefore, the initial groundwater screening survey will focus on developing a profile of groundwater contamination above the bedrock. If the survey results indicate the presence of contamination directly above the bedrock, CDM will discuss with EPA the need for additional investigations into the bedrock portion of the aquifer.

The primary objectives of the hydrogeological assessment are to:

- Provide geologic, hydrogeologic, and contaminant distribution data to determine the nature and extent of groundwater contamination
- Refine the hydrogeologic aspects of the current CSM
- Obtain data on aquifer properties and groundwater flow
- Monitor contaminant levels in selected residential wells
- Provide data on the groundwater/surface water interaction

In support of the primary objectives, the following hydrogeologic investigation activities will be performed at the site:

- Groundwater screening survey
- Monitoring well drilling and installation
- Geophysical logging
- Synoptic water level measurements
- Groundwater/Surface Water Interaction Evaluation
- Aquifer testing

Based on discussions with EPA and NYSDEC, EPA's Removal Group will continue to maintain and monitor POET systems installed on residential wells by EPA. NYSDEC will continue to maintain and monitor POET systems installed by New York State. It is assumed that these two groups will continue their sampling efforts while the RI/FS is conducted and that their data will be available for evaluation with the rest of the sampling data for the site. Therefore, sampling of these wells is not described in this work plan.

### 5.3.3.1 Groundwater Screening Survey

Groundwater screening will be performed to fill the data gaps described in Section 5.3.3. This survey is a Stage I activity. The objectives of the groundwater screening survey include:

- Better define the vertical and lateral boundaries of groundwater contamination
- Fill data gaps in the residential well sampling data
- Provide a rational basis for selection of monitoring well locations, depths, and screen intervals
- Provide preliminary information on lithology of the glacial portion of the aquifer

Groundwater screening will be performed at a total of 49 locations along 9 transects using the direct push technology (DPT) sampling method. Proposed groundwater screening locations are shown on Figure 5-1. The transects are generally located perpendicular to the estimated groundwater flow direction but access issues were also considered. To the extent possible, transects are located along roadways and public property to minimize the need for access to residential properties. Actual sampling locations will be based on the results of the on-site reconnaissance and will be confirmed with EPA prior to conducting the sampling.

Based on review of geologic information, the bedrock surface across the site is variable, ranging from 40 to 50 feet bgs near the western edge of the contamination to approximately 80 to 90 feet bgs in the southern portion of the site. For costing purposes it is assumed the average depth of the groundwater screening points is 70 feet bgs. The groundwater table is generally shallow in the site area and, for costing purposes, is assumed to be 10 feet bgs. Based on these assumptions, a total 7 samples will be collected at each screening location for a total of 343 screening samples. Fewer samples may be collected, depending on the results of the sampling.

Sampling will begin at the center of the transect and proceed outward, toward the ends of each transect. Samples will be shipped on a daily basis to a laboratory for low-detection limit VOC analysis as shown on Table 5-1, with a 24-hour turnaround time. Thus, sample data from the previous day's sampling will be evaluated to aid in the determination of when to terminate sampling along the transect. Sampling along a given transect will be terminated when results for all parameters are below action levels. However, since the plume may bifurcate into two lobes, the clean area between the lobes of contamination will not be used to determine when to terminate sampling along transects T4, T5, and T6 (Figure 5-1).

The CDM SM and RI task manager will hold daily discussions with the EPA RPM to evaluate sample analytical data and to determine when to terminate sampling. Based on review of the VOC data and discussions with EPA, sample locations and/or sample depths may be modified or sample locations may be deleted. Any such modifications will be approved by the EPA RPM.

To establish a profile of groundwater contamination, at each groundwater screening location a DPT probe fitted with a screen will be driven to specific sampling depths. The first sample will be collected two feet below the groundwater surface and then at 10-foot intervals proceeding to the bedrock surface (or refusal). For example, if the groundwater is at 24 feet bgs, samples will be collected at 26 feet bgs, 36 feet bgs, 46 feet bgs, 56 feet bgs, until bedrock (or refusal) is reached.

Samples will be collected using a bladder or submersible pump, if one can be located that will fit within the Geoprobe® pipe. If one is not available, a peristaltic pump and polyethylene tubing will be used to collect the samples. The DPT rods will be purged to clear the screen of fines and produce as clear a sample as possible. Purge water will be monitored for pH, conductivity, temperature, dissolved oxygen, and turbidity. Once the parameters have stabilized the sample will be collected. Samples will be collected using polyethylene tubing fitted with a check valve.

Samples will be analyzed by EPA's mobile laboratory for low-detection limit VOCs on a 24-hour turnaround basis. If EPA's mobile laboratory is not available, CDM will use the FASTAC strategy described in Section 4.2 to obtain a laboratory to analyze the groundwater screening samples.

#### 5.3.3.2 Lithologic Sampling and Logging

In conjunction with groundwater screening, subsurface soil samples will be collected at groundwater screening locations T1C, T2C, T3B, T4C, T5B, T5E, T6C, T6H, T7C, T8C, and T9C to provide preliminary lithological information to enhance the CSM and to provide additional information to support selection of permanent monitoring well locations and construction materials. These soil samples will not be submitted for chemical analysis. The proposed subsurface soil locations are shown on Figure 5-1.

At each location, 4-foot samples will be collected at 10-foot intervals using DPT, starting at the ground surface and terminating at the bedrock surface. For costing purposes it is assumed that 8 samples will be collected at each location, for a total of 80 samples. Lithologic logging will be performed by the on-site geologist and evaluated in the technical memorandum prepared at the conclusion of the Stage I activities.

#### 5.3.3.3 Monitoring Well Drilling and Installation

This section describes the monitoring well drilling and installation activities that will be performed to support the RI/FS. Monitoring wells will be installed during Stage II of the RI, after the groundwater screening survey, source area investigations, and residential well sampling are complete.

The primary objectives of the monitoring well installation and sampling are to:

- Define the nature and extent of groundwater contamination
- Collect lithologic and stratigraphic data to refine the CSM
- Provide wells for aquifer testing
- Provide a means to monitor temporal changes in contaminant distribution

A total of 38 monitoring wells at 19 locations are proposed, including one background well location. Figure 5-2 shows the locations of monitoring wells. However, monitoring well locations and depths may be modified based on evaluation of the groundwater screening survey, residential well sampling, and source area investigations in the technical memorandum that will be prepared at the conclusion of the Stage I activities. The technical memorandum will provide the rationale for the location, depth and screen interval of each well.

For cost estimation purposes, it is assumed wells will be installed in pairs consisting of a deep and a shallow well. This will provide a means to define the vertical extent of groundwater contamination. It is estimated that shallow wells will be drilled to a depth of 30 feet bgs and that deep wells will be drilled to a depth of 80 feet bgs. Based on current understanding of the vertical aspects of groundwater contamination, it is anticipated that all wells except one will be installed in the unconsolidated glacial sediments. One bedrock well will be installed 20 feet into the bedrock at the source area on Ryan Drive. The bedrock section of this well will be cored. If the results of the Stage I field investigation indicate the need for additional bedrock wells, CDM will provide a recommendation and rationale for installation of bedrock wells in the technical memorandum that will be prepared at the conclusion of the Stage I activities.

It is anticipated that monitoring wells will be installed using the hollow stem auger (HSA) drilling method. However, if the HSA method is unsuccessful because of boulders or other obstructions to advancement of the augers, air rotary drilling will be used. Eight-inch diameter boreholes will be drilled to the target depth. Monitoring wells will be constructed of 4-inch diameter schedule 40 polyvinyl chloride (PVC) casing and 10 foot lengths of slotted PVC screen. It is assumed that the glacial wells will be single-cased. The bedrock well will be double cased. The annulus around the well screen will be backfilled with sand which will extend 2-feet above the well screen. A 2-foot bentonite seal will be placed above the sand pack and the remaining annulus will be grouted to the surface. An 8-inch steel protective casing with a locking cap will be installed and a concrete collar will be poured around the well. The well screen slot size and the grade of filter sand will be determined based on the results of the lithologic sampling of the groundwater screening locations. Well drilling and construction details will be specified in the site-specific QAPP.

Split-spoon samples will be collected at 5-foot intervals from the surface to total depth in the deep well of the each well pair. The split spoon samples will be logged by the on site geologist. The lithologic information will be used to support development of the hydrogeologic framework and CSM for the site. It is important to identify the presence of significant clay layers, sand and gravel layers, and other geologic materials that may control or limit groundwater flow and contaminant transport in the aquifer. Split-spoon samples will be screened with a photoionization detector (PID) to identify contaminated zones within the borehole. The PID screening data will be used to refine placement of the well screen.

Monitoring well installation will not be considered complete until the wells have been fully developed. Monitoring well development will be performed to remove silt and well construction materials from the well screen and sand pack and to provide a good hydraulic connection between the well and the aquifer materials. Turbidity, pH, temperature, conductivity, and dissolved oxygen will be monitored during development. Development will continue until all parameters have stabilized (within 10 percent for successive measurements) and the water is clear. Well development procedures will be detailed in the site-specific QAPP.

Drill cuttings and water from drilling operations will be containerized at the drilling location and transported by the drilling subcontractor to a central waste storage area. Liquid wastes will be transferred to a 21,000 gallon Baker tank and drill cuttings will be transferred to 20 cubic yard roll-off containers for subsequent sampling, characterization, and disposal by CDM's IDW subcontractor.

#### 5.3.3.4 Synoptic Water Level Measurements

Two rounds of synoptic water level elevation measurements will be taken in the 38 newly installed wells to define groundwater flow in at the site. The synoptic groundwater level measurements will be taken in conjunction with the two rounds of groundwater sampling. Groundwater contour maps will be constructed for each of the shallow and deep groundwater monitoring zones, and will be included in the RI/FS reports.

Before taking water level measurements, a survey of the location and elevation for each completed monitoring well will be made by a New York licensed land surveyor. Elevation measurements will be made at marked water level measuring points on the inner casing, the top of outer protective casing, and the adjacent ground surface. The wells will be allowed to equilibrate after development for a minimum of two weeks before water level measurements are taken.

#### 5.3.3.5 Natural Gamma Logging

Once well construction is complete, natural gamma logs will be run in the deep well of each monitoring well pair. Gamma logs will assist with identification of clay layers. Geophysical logging will be performed by CDM personnel. Results of the gamma logging will be correlated with lithologic logs. Geophysical logging procedures will be fully detailed in the QAPP.

#### 5.3.3.6 Groundwater/Surface Water Interaction Investigation

Groundwater/surface water interaction will be evaluated at Red Wing Lake and the gravel pit. Staff gauges and piezometers will be installed in both water bodies. Piezometers will be installed at locations as close as practicable to the staff gauges. To account for seasonal fluctuation in the groundwater table, piezometer screens will straddle the groundwater table. The staff gauge will consist of a calibrated scale affixed to a steel rod driven into the lake bottom. Staff gauges will be installed at locations that are accessible by wading. The top of the staff gauge will be surveyed so that water level measurements can be referenced to a known datum. The top of the piezometers and adjacent ground surface will also be surveyed and referenced to the same datum.

Two rounds of staff gauge readings and piezometer readings will be taken in conjunction with the two rounds of synoptic water level measurements in the monitoring wells. A detailed description of the groundwater/surface water interaction investigation will be provided in the site-specific QAPP.

#### 5.3.3.7 Aquifer Testing

Several types of aquifer tests could be performed at the site, including long-term (e.g., 24-hour to 72-hour) pumping at a selected monitoring well or specially installed well, limited pumping (e.g., 4 hours) at one or more selected monitoring wells, or slug tests in the screen intervals of selected monitoring wells. After discussions with EPA on the advantages and disadvantages of each type of test, EPA determined that slug tests should be performed, with a contingency to perform a limited (i.e., 24-hour) pump test if slug test results prove to be inadequate.

Slug tests will be conducted at selected monitoring wells that cover a range of depths, lithology types, and locations across the site. For cost estimation purposes, it is assumed that half of the 38 wells will be slug tested. Slug tests are a rapid and easy means to estimate hydraulic conductivity of an aquifer. Advantages of slug tests over pump tests include the fact that little or no contaminated water is produced, which then requires containment, sampling, and disposal as IDW or treatment at the pump test site prior to disposal. Disadvantages include that the hydraulic conductivity estimates are limited to a small volume of the aquifer around the borehole; slug tests may only measure the hydraulic conductivity of the sand pack around the well screen; or extrapolating the results from one well to other areas or intervals of the aquifer may be questionable.

Slug tests are conducted by adding (or removing/displacing) a known volume to (or from) the monitoring well to create a rapid rise (or fall) in water level. Water levels are measured as the water in the well returns to static (pre-test) conditions. Water is displaced with a weighted cylinder of known volume. The rate of water recovery is measured with a pressure transducer and data recorder. Both rising and falling head slug tests will be conducted. Slug test procedures will be fully detailed in the QAPP.

### 5.3.4 Soil Boring, Drilling, and Testing

This section describes soil boring, drilling, and testing activities that will be performed as part of the RI investigation. Activities under this task are limited to the subsurface soil investigation at the former and current locations of the Hopewell Precision facility.

**Subsurface Soil Sampling**

The overall objective of the subsurface soil sampling is to characterize the subsurface soils at the former and current Hopewell Precision Facilities. The data will supplement previous source area soil sampling conducted by EPA's ERT contractor (Lockheed Martin 2004). Subsurface soil sampling will be conducted during Stage I of the field investigation. The data will also be used to support placement of the on-site bedrock monitoring well that will be installed at the facility on Ryan Drive and will be evaluated in the technical memorandum prepared at the conclusion of the Stage I investigation.

Subsurface soil sampling will be conducted at a total of 25 locations over the Hopewell Precision facilities, including one background location (up to 3 samples). Figure 5-3 shows the proposed subsurface soil sampling locations. Soil cores will be collected continuously, using a DPT rig, from the ground surface to the top of the water table, with samples collected at 4-foot intervals. Based on an estimated depth to groundwater of 10 feet bgs, a total of 75 soil samples will be collected. Upon retrieval from the drill rod each 4-foot core will be screened for VOCs using a PID. The onsite geologist will select the interval for VOC analysis using the PID readings together with visual observations of any potential source materials. The lithology of the each sample will be characterized and logged by the field geologist. Depth to groundwater and PID readings also will be recorded in the log.

To prevent cross-contamination, drill rods will be decontaminated between successive locations and new, polyethylene sleeves will be used for each sample.

Subsurface soil samples will be analyzed for TCL VOCs, SVOCs, pesticides/PCBs, and TAL metals through the EPA CLP and for 1,4-dioxane, pH, TOC, and grain size distribution through EPA's DESA laboratory or by a CDM subcontract laboratory.

Detailed sample collection and decontamination procedures will be provided in the site-specific QAPP.

## 5.3.5 Environmental Sampling

Table 5-1 summarizes the number of samples and associated analytical parameters for the various environmental media that will be sampled during the RI. The FASTAC procedures will be followed. Unless otherwise specified, analysis for TCL/TAL parameters through the CLP will be performed in accordance with the most current EPA CLP statements of work for multi-media, multi-concentration analyses for organics and inorganics. Non-RAS parameters will be analyzed by EPA's DESA laboratory or CDM's analytical laboratory subcontractor. Quality control samples will be collected in addition to the environmental samples discussed below. The number and type of quality control samples will be in accordance with the EPA Region II CERCLA QA Manual.

### 5.3.5.1 Limited Residential Well Sampling

EPA's Removal Branch has sampled over 450 residential wells within the site area and will continue to sample and monitor residential wells fitted with POET systems. As part of the RI investigation, CDM, will sample residential wells to update sampling results for selected wells in contaminated areas, to supplement groundwater screening data described in Section 5.3.3.

CDM will develop a preliminary list of residential wells for sampling prior to completion of the Draft QAPP. Wells selected for sampling will be based on the depth of the well, location relative to other contaminated wells, and known contaminated areas. For example, wells that are known to be completed in the deep bedrock aquifer may not be sampled if previous sample results indicated no contamination was present. Consideration will be given to sampling wells with unknown completion depths, especially if the well is located within the plume boundary or adjacent to contaminated wells.

A list of residential wells to be sampled during the RI will be developed and submitted to EPA with the Draft QAPP. The list will include the rationale for sampling a well. Based on a preliminary review of the existing residential well data, it is estimated that 60 residential wells will be sampled during each of two rounds of residential well sampling during the course of the RI field investigation. It is assumed that one round of sampling will occur during Stage I and one round will occur during Stage II.

Residential well samples will be collected as near as possible to the wellhead and before any treatment systems. The tap will be run for sufficient time to ensure that a representative sample is collected. Detailed procedures for collecting residential well samples will be provided in the site-specific QAPP.

Residential well samples will be analyzed for low detection limit VOCs through the EPA CLP.

### 5.3.5.2 Monitoring Well Sampling

Groundwater samples will be collected at the Hopewell Precision Site to characterize the nature and extent of contamination in groundwater from contaminants associated with the site. Analytical data from groundwater sampling will be used to support preparation of the RI, HHRA, and FS reports.

Two rounds of groundwater samples will be collected from the 38 monitoring wells installed during the RI. A minimum of two weeks will elapse between well development and groundwater sample collection. Synoptic water level measurements will be collected from all monitoring wells prior to sampling, as described in Section 5.3.3.4. Monitoring wells will be purged with a Grundfos Rediflow 2 submersible pump and sampled following the site-specific low-flow, minimal drawdown sampling procedure which follow the EPA SOP "Ground Water Sampling Procedure, Low Stress (Low Flow) Purging and Sampling (EPA 1998c). Groundwater sampling procedures will be fully detailed in the site-specific QAPP.

Groundwater samples will be analyzed for low detection limit VOCs, TCL SVOCs, pesticides/PCBs, and TAL inorganics by an EPA CLP laboratory. To support evaluation of natural attenuation of VOCs in groundwater, samples will be analyzed for the following parameters: chloride, methane, ethane, ethene, nitrate/nitrite, sulfate, sulfide, ferrous iron, and TOC. Samples will also be analyzed for water quality parameters including TSS, TDS, ammonia, hardness, and TKN. Dissolved oxygen (DO), oxidation reduction potential (as Eh), turbidity, temperature, and conductivity will be measured in the field.

### 5.3.5.3 Surface Water, Deep Water, and Sediment Sampling

The water/sediment sampling program includes one round of surface water/sediment sampling at Whortlekill Creek, a wet area, and the five ponds in the area, and one round of deep water sampling at the two largest ponds. Deep water is defined as water that is deep enough to cause thermoclines in the water body.

The wet area was noted to exist just south of Ryan Drive, in the wooded area. The five ponds are: an unnamed pond located south of Ryan Drive and west of Route 82; another unnamed pond located north of Creamery Road; Red Wing Lake, a recreational pond located in the park; the gravel pit located south of the Timothy Lane; and a man-made pond at the residence located at 100 Clove Branch Road. The two largest ponds are Red Wing Lake and the gravel pit. For easy tracking in the Work Plan, the unnamed pond by Ryan Drive will be called Unnamed Pond No. 1, while the unnamed pond by Creamery Road will be called Unnamed Pond No. 2.

As part of the RI, samples will be collected from Whortlekill Creek and ponds in the area to characterize the nature and extent of contamination in order to support RI and ecological and human health risk assessments. Since the site is currently defined as a groundwater contamination site, the major pathway for contamination of water and sediment may be via discharge of contaminated groundwater to the water bodies. Accordingly, the water and sediment program focuses on those areas where contaminated groundwater may discharge.

**Surface Water/Sediment Sampling**

In April 2003, two surface water and two sediment samples were collected from the wet area located south of Ryan Drive. Analytical results showed that TCE concentrations in surface water samples were 4.0 and 3.4 $\mu$g/L. In sediments, TCE was detected at 88 ug/kg in one sample and was non-detect in the other sample. In May 2003, sediment samples collected from two unnamed ponds contained TCE at 3.6 ug/kg from Unnamed Pond No. 1 and no contaminants were detected from Unnamed Pond No. 2. No contaminants were detected in the surface water samples from either pond. NYSDOH collected surface water samples from Red Wing pond in June 2004; no VOCs were detected. No samples were collected from the other ponds or from Whortlekill Creek (Weston 2005).

The direction of the groundwater flow from the site is south-southwest toward the gravel pit. Whortlekill Creek runs along the west boundary of the identified groundwater plume from Creamery Road to Timothy Lane. The potential exists for contaminated groundwater to discharge to surface water in Whortlekill Creek and the ponds, especially the gravel pit.

Surface water and sediment samples will be collected from the following proposed 39 sample locations:

- Wet area south of Ryan Drive - one surface water and one sediment sample
- Unnamed Pond No. 1 - two surface water and two sediment samples
- Unnamed Pond No. 2 - three surface water and three sediment samples
- Whortlekill Creek
  - Section between Creamery Road and Timothy Lane - 10 surface water and 10 sediment samples
  - Upstream - two surface water and two sediment samples, serving as background samples

- 100 Clove Branch Road - one surface water and one sediment sample
- Red Wing Lake - 10 surface water and 10 sediment samples, evenly distributed over the lake with at least 4 locations close to the swimming area
- Gravel Pit - 10 surface water and 10 sediment samples

Surface water samples collected from the above locations will be analyzed through the CLP for low detection limit VOCs, TCL SVOCs, pesticides/PCBs, TAL metals, and cyanide. Surface water samples also will be analyzed for hardness, alkalinity, ammonia, nitrate, nitrite, TKN, sulfate, sulfide, chloride, pH, TOC, TDS, and TSS by the DESA laboratory or the CDM analytical laboratory subcontractor. All samples will be analyzed using the most current EPA-approved methods. In addition, CDM will collect field measurements including conductivity, pH, turbidity, DO, and redox potential (as Eh) at each of surface water sampling location.

Sediment samples will be analyzed through the CLP for TCL VOCs, SVOCs, pesticides/PCBs, TAL metals, and cyanide, and by the DESA laboratory or the CDM analytical laboratory subcontractor for grain size, pH, and TOC.

Figure 5-4 shows the proposed sampling locations for surface water and sediment samples. Specific locations of the surface water and sediment samples in the field will be based on actual field conditions (such as amount of sediment available in the creek and ponds) and biased towards sedimentation locations (such as the slower flowing portions or the inside of the creek bend where lower stream flow velocities promote sediment fall out from suspension).

Sediment samples will be collected from a depth of 0 to 6 inches. Both surface water and sediment samples will be collected during the summer, using EPA approved methodologies which will be fully detailed in the QAPP.

**Surface Water/Sediment Sampling - Round 2 (Optional)**
The need for a second round of surface water/sediment sampling will be determined if the groundwater screening activity and the first round of surface water/sediment sampling does not provide an understanding of the groundwater system and its relationship to the surface water streams and water bodies. The number of samples and sample locations for the second round of sampling will be determined based on the results from the previous sampling activities in order to focus on areas identified as groundwater discharge points.

**Deep Water Sampling**
Ten deep water samples will be collected from the gravel pit and from Red Wing Lake. The deep water samples are needed if a thermocline occurs in these two large ponds in the summer. A thermocline is an area of water within the water body in which the warmer upper waters (epilimnion) are prevented from mixing with the deeper level (hypolimnion). If contaminated groundwater discharges to these two large water bodies, and if a thermocline is established in these two ponds, then collection of water samples at the surface may not detect the contamination of the ponds. Thus, collection of water samples at deeper depths in these two ponds is warranted.

The Red Wing Lake is estimated to be less than 20 feet deep. Sampling will be conducted during high summer (mid-July to early-August) when the lake is the most likely to be stratified and contaminants could accumulate in the hypolimnion, if groundwater contaminants are discharged to the lake.

The 10 deep water samples will be collected toward the center of the lake, presumably where the water is the deepest, because stratification usually does not occur near the edges of the lake. Before sampling, a thermal profile of the lake will be made to determine the depth of the bottom on the thermocline (i.e., top of the hypolimnion). The lake bottom will be established by a sounding with a weighted, calibrated line.

Water samples will be collected at the midpoint of the distance between the bottom of the thermocline and the lake bottom using a Kemmerer sampler with a calibrated line. In the event that there is no clear thermal stratification, the samples will be collected approximately two feet above the lake bottom. Sampling locations will be determined using GPS.

The gravel pit is reportedly up to 50 feet deep and is likely to have strong thermal stratification in the summer months. Ten deep water samples will be collected from the center of the lake during high summer (mid-July to early August). Because it is a large lake and the structure of the bottom of the gravel pit may be very variable, bathymetry of the lake will be determined. Thus, the physical structure of the lake, especially if the lake intercepts certain geologic layers, will be determined for a better selection of sampling locations.

Before sampling at each location, a thermal profile of the gravel pit will be made to determine the depth of the bottom of the thermocline. The lake bottom will also be established by a sounding with a weighted, calibrated line. Water samples will be collected at the midpoint of the distance between the bottom of the thermocline and the lake bottom using a Kemmerer sampler with a calibrated line. Sample locations will be determined using GPS.

These 20 deep lake water samples will be analyzed for the same parameters as the surface water samples.

In summary, a total of 39 surface water and 39 sediment samples will be collected from Whortlekill Creek and the five ponds in the area. Twenty deep water samples will be collected from the two large ponds (Red Wing Lake and the gravel pit).

#### 5.3.5.4 Sub-slab and Indoor Air Sampling

The objective of the sub-slab and indoor air sampling is to fill the identified data gap. EPA has conducted sub-slab and indoor air sampling at more than 206 residences in the area where contaminated groundwater is suspected to be under the slab foundations. However, there were approximately 100 residences where EPA did not conduct sub-slab and indoor air investigations because TCE and 1,1,1-TCA did not exceed their Federal MCLs. These residences are in the area bordered by Clove Branch Road and Timothy Lane (Figure 5-5).

EPA, with support from CDM, identified 96 residences and businesses for sampling and attempted to obtain access from the property owners. Of the 96 properties identified for sampling, 64 were sampled, 15 declined sampling, 6 locations were not suitable for sampling, and 11 residents could not be contacted.

The sub-slab and indoor air sampling program was detailed in a site-specific QAPP (CDM 2006). In January and February 2006, CDM collected sub-slab samples at 64 residences in the identified area. Prior to sample collection, ports were installed through concrete slabs in the residences, to facilitate sampling beneath the slab. All preliminary results were below the EPA-established action levels, except one sample location. A second set of sub-slab samples was collected from this residence in March 2006. Round 2 sampling (consisting of sub-slab, indoor, and ambient vapor samples) was not conducted.

The sampling event took place during the winter heating season, because soil vapor intrusion is more likely to occur when a building's heating system is in operation and air is being drawn into the building.

Sub-slab and indoor air samples were analyzed by EPA utilizing Method TO-15 for the following VOCs: dichlorodifluoromethane (Freon), chloromethane, carbon tetrachloride, MEK, 1,1,1-TCA, 1,2-dichloroethane, chloroethane, 1,1-dichloroethene, PCE, TCE, cis-1,2-dichloroethene, trans-1,2-dichloroethene, MTBE, and vinyl chloride.

## 5.3.6 Ecological Characterization

An ecological characterization of the site will be conducted to describe existing conditions relative to vegetation community structure, wildlife utilization, and sensitive resources such as surface waters and wetlands. Based on the current understanding of the site contamination and the existing CSM, much of the contamination occurs in groundwater and is not available to ecological receptors. Potential impact to ecological receptors occurs only in areas where groundwater discharges to water bodies, such as Whortlekill Creek along the western plume boundary, Unnamed Pond No. 1, Unnamed Pond No. 2, Red Wing Lake and the gravel pit.

The ecological characterization will be limited to these areas where potential groundwater discharge may occur and will also consist of a review of existing information, an ecological field investigation, and identification of threatened/endangered species and critical habitats as defined in the Endangered Species Act.

### 5.3.6.1 Ecological Field Investigation

The ecological field investigation will be conducted to characterize the terrestrial and aquatic communities associated with groundwater discharge areas along Whortlekill Creek and in the vicinity of the four ponds. Prior to the field investigation, CDM will contact a fisheries biologist from NYSDEC Region 3 regarding fish usage in Whortlekill Creek. Habitat conditions will be visually inspected by walking the site and recording observations of species composition and relative diversity and abundance, habitat association, and surface water conditions. Field observations will be recorded in logbooks and photographs will be taken to record both representative and unusual site conditions that would influence conclusions regarding potential contamination pathways, food chain effects, receptor identification, and risks to floral and faunal communities. The following information will be gathered during the field survey:

- General aquatic habitat conditions (e.g., water velocity, bottom substrate, channel width, channel depth, and extent of bank vegetation over) along Whortlekill Creek and the ponds. The Physical Characterization/Water Quality Field Data Sheet and the Habitat Assessment Field Data Sheet included in EPA's *Rapid Bioassessment Protocols for Use in Streams and Rivers* (EPA 1989b) may be used as tools to complete the characterization of the aquatic habitats.

- Vegetation community/cover types and observed vegetative species makeup of each community, including dominant species and general observation of abundance and diversity within each cover type, at and in areas related to the site.

- Wildlife (including aquatic receptors in the water column) use observations including wildlife habitats, species, wildlife concentrations areas, and habitat use activities.

- General surficial soil conditions.

- Indications of environmental stress that could be related to site contaminants.

An ecological description will be prepared for the RI report and/or SLERA that discusses the vegetative communities, wildlife habitats, suspected surface water drainage pathways, and observed areas of environmental stress or disturbance. A desktop delineation of wetlands, using available GIS layers, will be performed. The following information will also be prepared and presented: observed potential surficial migration pathways; vegetation communities and composition; observed terrestrial and aquatic wildlife habitats; observed and expected wildlife utilization of the site; potential occurrence of state and federal threatened, endangered, or rare species and critical habitats; and observed ecological impairments.

### 5.3.6.2 Identification of Endangered and Special Concern Species

The Endangered Species Act endeavors to conserve ecosystems inhabited by endangered or threatened species, and to protect the species themselves. The presence of any State or federal threatened or endangered wildlife or plant species, or significant habitats at the site or surrounding area will be determined. The Natural Heritage Program of NYSDEC and U. S. Fish and Wildlife Service will be consulted to aid in this

determination. Written communication from these agencies will be presented in the ecological risk assessment report.

Habitats essential to the growth and survival of rare plants and animals are considered critical habitats. Site walks conducted during the ecological characterization will identify critical habitats and the presence of these habitats will be noted in field logbooks. In addition, impairment (stressed vegetation, single species habitat) of critical habitats, as defined by the Endangered Species Act, will be noted in field logbooks.

### 5.3.7 Geotechnical Survey

This subtask will not be utilized for this work assignment.

### 5.3.8 Disposal of Field Generated Waste

A subcontractor will be procured that will be responsible for the removal and proper disposal of all IDW, including drilling cuttings, waste soils, liquids, solids, and personal protective equipment. Representative waste samples will be collected and analyzed by a laboratory to characterize the waste. A technical statement of work will be prepared for the procurement of the waste hauling and disposal subcontractor under Subtask 5.1.11. Field oversight and health and safety monitoring will be conducted during all waste disposal field activities.

## 5.4 Task 4 - Sample Analysis

Section 5.3 and Table 5-1 specify the analyses for each type of samples. Details are summarized below.

- Groundwater Screening Samples: Low detection limit VOCs, with 24-hour turnaround for faxed results

- Surface Water and Deep Water Samples: Surface water and deep water samples will be analyzed by a CLP laboratory for low detection limit VOCs, TCL SVOCs, pesticides/PCBs, TAL metals, cyanide, and by EPA's DESA laboratory for hardness, alkalinity, ammonia, nitrate, nitrite, TKN, sulfate, sulfide, chloride, pH, TOC, TDS, and TSS

- Sediment Samples: Sediment samples will be analyzed by a CLP lab for TCL VOCs, SVOCs, pesticides/PCBs, TAL metals, and cyanide and by EPA's DESA laboratory or CDM's analytical laboratory subcontractor for pH, TOC, and grain size

- Monitoring Well Samples: Monitoring well samples will be analyzed by a CLP lab for low detection limit VOCs, TCL SVOCs, pesticides/ PCBs, TAL metals, and cyanide and by EPA's DESA laboratory or CDM's subcontract laboratory for chloride, methane, ethane, ethene, nitrate/nitrite, sulfate, sulfide, TOC, TSS, TDS, ammonia, hardness, and TKN. Ferrous iron analysis will be conducted onsite.
- Residential Well Samples: Residential well samples will be analyzed for low detection limit VOCs.

- Soil Samples: Soil samples will be analyzed for TCL VOCs, SVOCs, pesticides/PCBs, TAL metals, cyanide, 1,4-dioxane, pH, TOC, and grain size
- Sub-Slab and Indoor Air Samples: Sub-slab and indoor air samples will be analyzed for selected VOCs (dichlorodifluoromethane (Freon), chloromethane, carbon tetrachloride, MEK, 1,1,1-TCA, 1,2-dichloroethane, chloroethane, 1,1-dichloroethene, PCE, TCE, cis-1,2-dichloroethene, trans-1,2-dichloroethene, MTBE, and vinyl chloride) by the TO-15 method by an EPA laboratory through the Flexibility Clause.

## 5.4.1 Innovative Methods/Field Screening Sample Analysis
This subtask is not applicable to the remedial investigation.

## 5.4.2 Analytical Services Provided via CLP or DESA
RAS samples will be analyzed in compliance with the FASTAC Policy. CDM will pursue the use of the CLP or DESA prior to engaging in a laboratory subcontract and alternatives to standard CLP analysis will be sought with the EPA RSCC, prior to any sample collection activities and analyses via a subcontracted laboratory. Under the CLP "flexibility clause", modifications are often made to CLP SOWs, enabling achievement of MDLs that may meet the stated criteria.

CDM will implement the EPA Region 2 Policy as shown below:

| | |
|---|---|
| Tier 1: | DESA Laboratory (including ESAT support) |
| Tier 2: | EPA CLP |
| Tier 3: | Region specific analytical services contracts (use CLP flex clause) |
| Tier 4: | Obtaining analytical services using subcontractors via field contracts (such as RAC subcontractors) |

All fixed laboratory analytical needs will to be submitted to the EPA RSCC regardless of the EPA or CLP laboratories' ability to perform. CDM will utilize the RAC II BOA laboratories only in the event that the first three tiers are not available.

## 5.4.3 Subcontractor Laboratory for Non-RAS Analyses
CDM follow the FASTAC strategy as described in Section 4.2. If the first three laboratory tiers cannot provide the required laboratory services, CDM will procure a subcontract laboratory for analysis of non-RAS samples, including fast turnaround (24 hour) low detection limit VOCs from the groundwater screening program. If DESA does not have capacity to analyze the non-RAS parameters listed in Section 5.4, the samples will be analyzed by the subcontract laboratory.

CDM has selected laboratory subcontractors for a BOA based on their ability to meet analytical QA and QC requirements specified in the BOA technical statements of work for non-RAS analytical services. The BOA laboratory subcontractors were selected by EPA-approved criteria and follow the most current EPA protocols and Region II QA requirements. The CDM RQAC ensures that the laboratories meet all EPA requirements for laboratory services. A project-specific SOW will govern the analytical work performed by the BOA laboratory subcontractors. CDM provided EPA with copies of the QA manuals and/or QA plans of the BOA subcontract laboratories. CDM will monitor the subcontractor laboratory's analytical performance.

The number of samples and analytical parameters are defined on Table 5-1. The analytical test methods, levels of detection, holding times, parameters, field sample preservation and QC samples will be provided in the QAPP.

## 5.5 Task 5 - Analytical Support and Data Validation

CDM will validate the non-RAS environmental samples analyzed by the subcontract laboratory. EPA will validate all RAS analytical data for the RI investigation.

### 5.5.1 Collect, Prepare and Ship Samples

Sample preparation and shipment is included under Task 3.

### 5.5.2 Sample Management

The CDM ASC will be responsible for all RAS CLP laboratory bookings and coordination with the Sample Management Office (SMO), the RSCC, DESA, and/or other EPA sample management offices for sample tracking prior to and after sampling events.

For all RAS activities, CDM will notify the Contract Laboratory Analytical Support Services (CLASS) to enable them to track the shipment of samples from the field to the laboratories and to ensure timely laboratory receipt of samples. Sample trip reports will be sent directly to the RSCC and the EPA RPM within 10 working days of final sample shipment, with a copy sent to the CDM ASC.

The CLP laboratories will be responsible for providing organic and inorganic analytical data packages to the Region II shipping coordinator for data validation by EPA.

Samples analyzed by the DESA laboratory and/or the subcontract laboratory will be coordinated by the ASC. All analytical data packages from the subcontract laboratory will be sent directly to CDM for data validation. If requested, CDM will send these validated data packages to EPA for QA review purposes. The data will be delivered in a format conducive for database input. CDM will provide the subcontract laboratory with a format for the electronic data deliverable.

### 5.5.3 Data Validation

All RAS samples will be analyzed by a laboratory participating in the CLP and all analytical data will be validated by EPA. The non-RAS data will be validated by CDM validators, who will use the requirements and the quality control procedures outlined in the associated methods and as per the analytical statement of work for the laboratory subcontractor. The validation will determine the usability of the data. All validated data results will be presented in an appendix to the RI report. A data validation report summarizing the results of data validation will be submitted to EPA after all data have been validated.

Data validation will verify that the analytical results were obtained following the protocols specified in the CLP SOW, and are of sufficient quality to be relied upon to prepare a human health risk assessment, to prepare an RI report, and to support a ROD.

The groundwater screening samples will not be validated.

## 5.6 Task 6 - Data Evaluation

This task includes efforts related to the compilation of analytical and field data. All validated and unvalidated data will be entered into a relational database that will serve as a repository for data analysis, risk assessment, GIS, and data visualization. Environmental Quality Information Systems (EQuIS) will be used as the database. Tables, figures, and maps will be generated from the data to support preparation of the data evaluation report, the RI report, the human health RA report, the SLERA report, and the FS report. The data from this investigation will be reviewed and carefully evaluated to identify the nature and extent of site-related contamination.

### 5.6.1 Data Usability Evaluation

CDM will evaluate the usability of the data, including any uncertainties associated with the data. The data will be checked against the DQOs identified in the QAPP. Any qualifications to the data usability will be discussed in the quality assurance section of any reports presenting data.

### 5.6.2 Data Reduction, Tabulation and Evaluation

CDM will evaluate, interpret, and tabulate data in an appropriate presentation format for final data tables. The following will be used as general guidelines in the preparation of data for use in the various reports.

**Data Reduction**

- Tables of analytical results will be organized in a logical manner such as by sample location number, sampling zone, or some other logical format.
- Analytical results will not be organized by laboratory identification numbers because these numbers do not correspond to those used on sample location maps. The sample location/well identification number will always be used as the primary reference for the analytical results. The sample location number will also be indicated if the laboratory sample identification number is used.
- Analytical tables will indicate the sample collection dates.
- The detection limit will be indicated in instances where a parameter was not detected.
- Analytical results will be reported in the text, tables and figures using a consistent and conventional unit of measurement such as $\mu$g/L for groundwater analyses and milligrams/kilogram (mg/kg) for soil analyses.

- EPA's protocol for eliminating field sample analytical results based on laboratory/field blank contamination results will be clearly explained.
- If the reported result has passed established data validation procedures, it will be considered valid.

- Field equipment rinsate blank analytical results will be discussed in detail if decontamination solvents are believed to have contaminated field samples.

Detailed information concerning the hydrogeological and physical characteristics of the site and the surrounding area will be gathered, reviewed, and evaluated for inclusion in the data evaluation report, the RI report, the RA reports, and the FS report. The purpose of these activities will be to provide a detailed understanding of the site physical features and to assess how these features may affect contaminant source areas, potential migration pathways, and potential remedial alternatives.

**Data from Others**
CDM will enter residential sampling data collected by EPA's removal group (37 wells) and NYSDEC (14 wells) into the database. A total of 204 samples (51 wells sampled quarterly) will require entry into the site database.

**GIS Mapping**
Figures will be generated in plan view and cross section to show the extent of groundwater contamination. Graphic illustrations in the data evaluation report and/or the RI report will include geological profiles, cross-sections, contaminant isoconcentration maps, and longitudinal and cross-sectional profiles of groundwater contamination. Plan view maps and figures will be generated using GIS to facilitate plan-view spatial data analysis. Figures will be generated to illustrate site features, historical sample locations, historical sampling results, current sample locations, current sampling results, locations where groundwater quality exceeds regulatory standards and criteria, and monitored natural attenuation (MNA) parameter concentrations (e.g., chloride, methane/ethane/ethene, ferrous iron, sulfate) relative to contaminant concentrations. The presence and/or absence of the MNA parameters can indicate whether MNA is occurring in the aquifer.

**Letters to Residents**
CDM will prepare letters to residents, transmitting the results of residential well samples and sub-slab/indoor air samples. A total of 120 well samples and 263 sub-slab/indoor air samples will be collected and, at EPA's direction, sent to the residents.

**Database Management**
CDM will use a relational environmental database and standard industry spreadsheet software programs for managing all data related to the sampling program. The system will provide data storage, retrieval, and analysis capabilities, and be able to interface with a variety of spreadsheet, word processing, statistical, GIS, and graphics software packages to meet the full range of site and media sampling requirements necessary for this work assignment.

Data collected during the RI will be organized, formatted, and input into the database for use in the data evaluation phase. All data entry will be checked for quality control throughout the multiple phases of the project. Data tables comparing the results of the various sampling efforts will be prepared and evaluated. Data tables will also be prepared that compare analytical results with both state and federal ARARs.

### 5.6.3 Modeling

Per direction from EPA, CDM will evaluate existing data and make an assessment of the need for groundwater modeling, in conjunction with the groundwater data, to complete an accurate characterization of the nature, extent, distribution and movement of site contamination. Modeling may be used to help to predict contaminant movement in the aquifers. The evaluation of existing data and an approach for the modeling will be summarized in a technical memorandum.

Groundwater models are generally used to evaluate groundwater flow, groundwater quality problems, and/or groundwater remediation alternatives. Prior to full scale modeling, CDM will provide EPA with the following information about the groundwater model before the model is run:

- The objectives and scope of the model
- Basic documentation for the model to be used
- A list of assumptions to be used in generating the model
- A list of the model variables and the units in which they are expressed
- A list of approximate preliminary input values to be used for the model variables, together with the calculations used to determine the input values
- A map showing the areal extent of the model and the major topographic features to be included
- A cross section illustrating the hydrogeologic framework to be used in the development of the model
- The rationale for lateral and vertical boundary conditions such as "no flow" or "constant head" boundaries
- Calibration targets for piezometric heads and mass balance
- All input assumptions regarding type of contaminants, level of contaminants at the source area at time zero, and mobility factors (for contaminant transport models)
- A description of the types of sensitivity analyses that will be considered and carried out
- References for all sources of data and assumptions used to develop the model
- A list of all significant rivers, streams, lakes, pumping wells and recharge basins in the vicinity of the site that may have an impact on groundwater flow patterns and an explanation of how the model will address these factors

All of the items listed above and related supporting data will be included in an appendix in both the RI report and the FS report, as appropriate. The computer model will be calibrated following the American Society of Testing and Materials (ASTM) standard D5981-96 (2002) (ASTM 2002a) and a sensitivity analysis will be preformed following ASTM standard D5611-94 (2002) (ASTM 2002b). Results and problems encountered with computer model sensitivity analyses for specific parameters during development and testing as well as calibration will be discussed in the text of the modeling appendix. The text will also discuss the following items:

- The initial conditions calibration model will be thoroughly reviewed before remedial alternatives are modeled as part of the FS.

- Modeled groundwater extraction systems will include capture zone analysis in order to determine the effectiveness of extraction wells to prevent further migration of groundwater contamination. An accurate determination of extraction well capture zones will not be based solely on visual analysis of a predicted potentiometric surface map.
- Computer model input/output value printouts for each "run" discussed in the modeling appendix text will be provided, with an explanation of all numerical units and the type of display.
- Maps such as predicted groundwater flow or contaminant concentration maps will show the site boundary, surface water features, pumping wells, and any other features that are required to interpret the information.
- The computer model code will be available for review by EPA.
- A discussion of uncertainties and limitations of the computer model will be provided in the text of the modeling appendix.

### 5.6.4 Data Evaluation Report

Upon completion of data evaluation, CDM will prepare a data evaluation report for review and approval by EPA. The data evaluation report will establish site characteristics such as the media contaminated, the extent of contamination, and the physical boundaries of the contamination. If additional data are needed to determine the extent of contamination, CDM will provide recommendations to EPA for supplemental work at the Hopewell Precision Site. The data evaluation report will include data results but will not include a full evaluation or interpretation of the analytical data. Full data evaluation will be performed in the RI Report as outlined in Task 10. The data evaluation report will require technical and QA review prior to submittal to EPA.

## 5.7 Task 7 - Assessment of Risk

CDM will conduct an HHRA and a SLERA for the Hopewell Precision Site. The objective of the risk assessments is to provide an evaluation of the potential threat to human health and the environment that could occur from contaminants originating from the Hopewell Precision Site in the absence of any remedial action. The risk assessment also provides the basis for determining whether or not remedial action is necessary and the justification for performing remedial actions.

### 5.7.1 Human Health Risk Assessment

The human health risk assessment will determine the potential adverse human health effects that could occur from contaminants originating from the site, in the absence of any actions to control or mitigate the releases. If the HHRA determines that potential adverse health effects exist and remediation is warranted, the HHRA will be used to focus remediation on the contaminated media and exposure pathways posing the greatest risk. Furthermore, the HHRA can be utilized to compare the potential health impacts of various remedial alternatives.

The HHRA will be performed in accordance with EPA guidance set forth in the following documents:

- *Risk Assessment Guidance for Superfund: Human Health Evaluation Manual, Part A* (EPA 1989a)
- *Risk Assessment Guidance for Superfund: Human Health Evaluation Manual, Part B, Development of Risk Based Preliminary Remediation Goals* (EPA 1991)
- *Risk Assessment Guidance for Superfund: Human Health Evaluation Manual, Part D, Standardized Planning, Reporting, and Review of Superfund Risk Assessments* (EPA 1998a)
- *Risk Assessment Guidance for Superfund: Volume I: Human Health Evaluation Manual, Part E, Supplemental Guidance for Dermal Risk Assessment Interim Final* (EPA 1999)
- *Exposure Factors Handbook, Vol I, II and III* (EPA 1997a)
- *Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors* (EPA 1991)
- *Final Guidance for Data Usability in Risk Assessment* (EPA 1992a)
- *Health Effects Assessment Summary Tables FY-1997 Annual* (EPA 1997b)
- *Integrated Risk Information System (on-line data base of toxicity measures)* (most current version)
- *EPA Region IX Preliminary Remediation Goals* (EPA 2004b or most current version)

Additional guidance which addresses site-specific issues and chemical contaminants will also be consulted.

CDM will evaluate key contaminants identified in the HHRA for receptor exposure and perform an estimate of the level of key contaminants reaching human receptors. CDM will use EPA's standardized planning and reporting methods as outlined in EPA's Risk Assessment Guidance for Superfund (RAGS Part D).

The following activities under this subtask will form the basis for the HHRA.

#### 5.7.1.1 Draft Human Health Risk Assessment Report

The draft risk assessment report will be submitted after EPA has approved the PAR, described in Section 5.1.13. The draft HHRA report will cover the following:

**Hazard Identification**

CDM will review available information on the hazardous substances present at the site, and identify the major COPC. The COPCs to be used in the risk assessment will be selected in accordance with EPA Region II procedures as presented in RAGS Part A. Additional selection criteria that will be used to identify the COPCs at the site include the following:

- Frequency of detection in analyzed environmental medium (e.g., groundwater)
- Historical site information/activities (i.e., site-related)
- Chemical concentration relative to upgradient and background concentrations
- Chemical toxicity (potential carcinogenic and noncarcinogenic effects, weight of evidence for potential carcinogenicity)
- Chemical properties (e.g., mobility, persistence and bioaccumulation)

- Significant exposure routes
- Risk-based concentration screen using EPA Region IX Risk Based Concentrations and media specific chemical concentrations (i.e., maximum detected concentrations)

In general, nutrients such as calcium, magnesium, potassium, and sodium are not quantitatively evaluated in the risk assessment as the potential toxicities of these minerals is significantly lower than other inorganics detected at the site and more data are available for identifying dietary intake rather than for toxicity.

Statistical analysis of the data will be performed (i.e., tests for normal distribution, calculation of upper confidence levels [UCLs]).

**Toxicity Assessment**
The toxicological properties of the selected COPCs using the most current toxicological human health effects data will be presented. Chemicals that cannot be quantitatively evaluated due to a lack of toxicity values will not be eliminated as COPCs on this basis. These chemicals will instead be qualitatively addressed for consideration in risk management decisions for the site.

Toxicity values and toxicological information regarding the potential for carcinogens and non-carcinogens to cause adverse health effects in humans will be obtained from the hierarchy of EPA sources in accordance with EPA OSWER Directive 9285.7-53 (EPA 2003). The primary source will be EPA's Integrated Risk Information System (IRIS) on-line database (EPA 2005b). IRIS, which is updated regularly, provides chemical-specific toxicity values and toxicological information that have undergone peer review and represent an EPA scientific consensus. If toxicity values are not available from IRIS, the EPA's Provisional Peer Reviewed Toxicity Values (PPRTVs) will be consulted. PPRTVs are developed by EPA's Office of Research and Development/National Center for Environmental Assessment/Superfund Health Risk Technical Support Center (STSC) on a chemical specific basis when requested by EPA's Superfund program. If no toxicity values are available from PPRTVs, then other sources such as the most recent Health Effects Assessment Summary Tables (HEAST) will be used to select toxicity values.

Toxicity values include slope factors for carcinogens and reference doses (RfDs) and reference concentrations (RfCs) for non-carcinogens. In HHRA, a slope factor, expressed in the unit of $(mg/kg/day)^{-1}$, is used to estimate an upper-bound probability of an individual developing cancer as a result of a lifetime of exposure to a particular level of a potential carcinogen.

For the evaluation of non-carcinogenic health effects in the risk assessment, chronic and subchronic RfDs or RfCs are used. A chronic RfD or RfC is an estimate of a daily exposure level for the human population, including sensitive subpopulations, that is likely to be without appreciable risk of deleterious effects during a lifetime. Chronic RfDs or RfCs are generally used to evaluate the potential non-cancinogenic effects associated with exposure periods between six years and a lifetime. Subchronic RfDs or

RfCs aid in the characterization of potential non-cancer effects associated with shorter-term exposure (i.e., less than six years).

Toxicity endpoints/target organs for non-carcinogenic COPCs will be presented for those chemicals showing hazard quotients greater than one. If the hazard index is greater than one due to the summing of hazard quotients, segregation of the hazard index by critical effect and mechanism of action will be performed as appropriate.

**Exposure Assessment**
Exposure assessment involves the identification of the potential human exposure pathways at the site for present and potential future land-use scenarios. Potential release and transport mechanisms will be identified for contaminated source media. Exposure pathways will also be identified that link the sources, locations, types of environmental releases, and environmental fate with receptor locations and activity patterns. An exposure pathway is considered complete if it consists of the following elements:

- A source and mechanism of release
- A transport medium
- An exposure point (i.e., point of potential contact with a contaminated medium)
- An exposure route (e.g., ingestion) at the exposure point

All exposure pathways under the current and future land-use scenarios will be presented; however, only some may be selected for quantitative analysis. Justifications will be provided for those exposure pathways retained and for those eliminated.

Based on the initial site visit at the Hopewell Precision Site and information regarding current and future land use, the potentially complete exposure pathways include:

**Current and Future Land Use**
- Residents *(Adults and Children)*
  - Groundwater
    - Ingestion
    - Dermal contact
    - Inhalation of volatiles while showering
  - Indoor Air vapors
    - Inhalation of volatiles
- Workers *(Adults)*
  - Surface soil
    - Incidental Ingestion
    - Incidental Dermal contact
    - Inhalation of fugitive dust
  - Groundwater
    - Ingestion
    - Dermal contact
  - Indoor Air vapors
    - Inhalation of volatiles

- Recreational Users *(Adults and Children)*
  - Water
    - Incidental ingestion
    - Dermal contact
  - Sediment
    - Incidental ingestion
    - Dermal contact

**Future Land-Use Scenario**
Construction Workers *(Adults)*

- Surface/subsurface soil
  - Incidental ingestion
  - Incidental dermal contact
  - Inhalation of fugitive dust
- Groundwater
  - Ingestion
  - Dermal contact

Three separate areas of concern for the water and sediment will be considered in this HHRA. These areas of concern are Whortlekill Creek including two unnamed ponds, Red Wing Lake, and the gravel pit, because Red Wing Lake and the gravel pit are two isolated water bodies, and Red Wing Lake is mainly used for recreation such as swimming during the summer months. Thus, exposure parameters, such as exposure duration and frequency, and body surface of receptors, for these three areas of concern will be different, consequently, separate human health risk assessments will be conducted for these three separate water bodies.

Exposure point concentrations will be developed for each COPC in the risk assessment, for use in the calculation of daily intakes. The concentration is the 95 percent UCL on the arithmetic mean, or the maximum detected value (whichever is lower).

Chronic daily intakes, expressed as mg/kg-day, will be calculated and used in conjunction with toxicity values to provide quantitative estimates of carcinogenic risk and non-carcinogenic health effects.

Exposure assumptions used in chronic daily intake calculations will be based on information contained in EPA guidance, site-specific information, and professional judgement. These assumptions are generally 90th and 95th percentile parameters, which represent the reasonable maximum exposure (RME). The RME is the highest exposure that is reasonably expected to occur at a site. If potential risks and hazards exceed EPA target levels, then Central Tendency Exposures (CTE) will be evaluated using 50th percentile exposure variables.

The exposure assessment will identify the magnitude of actual or potential human exposures, the frequency and duration of these exposures, and the routes by which receptors are exposed. The assumptions will include information from the Standard Default Assumptions Guidance and the Exposure Factors Handbook (EPA 1997a). Site specific information will be used where appropriate to verify or refine these assumptions. In developing the exposure assessment, CDM will develop reasonable maximum estimates of exposure for both current land-use conditions and potential future land-use conditions at the site.

**Risk Characterization**

In this section on the risk assessment, toxicity and exposure assessments will be integrated into quantitative and qualitative expressions of carcinogenic risk and non-carcinogenic hazards.

Carcinogenic risks are estimated as the incremental probability of an individual developing cancer over a life time as a result of exposure to a potential carcinogen. Per RAGS, the slope factor directly converts estimated daily intakes averaged over a lifetime to incremental risk of an individual developing cancer. This carcinogenic risk estimate is generally an upper-bound value since the slope factor is often an upper 95th percentile confidence limit of probability of response based on experimental animal data used in the multistage model.

The potential for non-cancer effects will be evaluated by comparing an exposure level over a specified time period with a reference dose derived for a similar exposure period. This ratio of exposure to toxicity is referred to as a hazard quotient. This hazard quotient assumes that there is a level of exposure below which it is unlikely even for sensitive populations to experience adverse health effects; however, this value should not be interpreted as a probability. Generally, the greater the hazard quotient is above unity, the greater the level of concern.

Carcinogenic risks and non-carcinogenic hazard index (HI) values will be combined across chemicals and exposure pathways as appropriate. EPA recommends a target value or risk range (i.e., HI = 1 for non-carcinogenic effects or carcinogenic risk = $1\times10^{-4}$ to $1\times10^{-6}$) as threshold values for potential human health impacts. The results presented in the spreadsheet calculations will be compared to these target levels and discussed. Characterization of the potential risks associated with the site provides the EPA risk manager with a basis for determining whether additional response action is necessary at the site and a basis for determining residual chemical levels that are adequately protective of human health.

**Identification of Limitations/Uncertainties**

In any risk assessment, estimates of potential carcinogenic risk and non-carcinogenic health effects have numerous associated uncertainties. The primary areas of uncertainty and limitations will be qualitatively discussed. Quantitative measures of uncertainty will involve the calculation of central tendencies. Central tendency evaluation involves the use of $50^{th}$ percentile input parameters in risk and hazard estimates as opposed to $90^{th}$ or $95^{th}$ percentile parameters used in the RME calculations. The $50^{th}$ percentile parameters are considered representative of the general receptor population, but may underestimate the health risk to sensitive receptors. The chemicals driving the risk assessment will be evaluated using these average exposure assumptions and the 95 percent UCL concentrations. The central tendency risks will be discussed in relation to RME risks. Central tendency analyses will only be calculated for pathways in which RME risks are considered above *de minimus* levels (carcinogenic risk above $1 \times 10^{-6}$ and/or HI above 1.0).

The CDM SM will coordinate with the EPA RPM and submit draft/interim deliverables as outlined in the Risk Assessment Guidance for Superfund - Part D. All data will be presented in RAGS Part D Format. The draft HHRA report will provide adequate details of the activities and be presented so that individuals not familiar with risk assessment can easily follow the procedures.

#### 5.7.1.2 Final Human Health Risk Assessment Report

CDM will submit the final human health risk assessment report, incorporating EPA review comments.

### 5.7.2 Screening Level Ecological Risk Assessment

CDM will conduct a qualitative ecological risk assessment. This SLERA will be conducted utilizing the data generated from the RI and previous investigations at the site, as applicable. The SLERA will address the potential risks to sensitive ecological receptors from site contaminants in sediments, soils, and/or surface water at the site, especially in areas identified as likely to receive discharge from site groundwater.

This assessment will be prepared in accordance with the *Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments (Interim Final)* (EPA 1997c) and *Guidelines for Ecological Risk Assessment* (EPA 1998b).

#### 5.7.2.1 Draft Screening Level Ecological Risk Assessment

The draft screening level ecological risk assessment report will be composed of the following
four components to assess site-related potential ecological risks for a reasonable maximum exposure scenario:

- Problem Formulation
- Ecological Effects Evaluation
- Exposure Estimates
- Risk Calculation

These four components are discussed in details below.

**Problem Formulation**

The problem formulation will include descriptions of site history, environmental setting, nature and extent of contamination, habitat characterization, identification of contaminants of potential ecological concern (COPECs), contaminant fate and transport mechanisms, and ecotoxicity and potential receptors. In addition, assessment and measurement endpoints for the SLERA will also be included.

COPECs will be identified in order to narrow the focus of the SLERA and to identify dominant site risk. In each environmental medium the maximum detected concentrations will be compared to the regulatory screening levels. When the maximum detected concentration of a contaminant exceeds its regulatory screening level, the contaminant will be selected as a COPEC. Maximum detection limits of non-detected contaminants will be compared to the screening levels. Non-detected contaminants with detection limits exceeding regulatory screening levels will be added to the list of COPECs. Contaminants lacking screening levels will be retained as COPECs for further evaluation.

The following regulatory screening levels will be utilized for the COPEC selection:

- Surface Soil
  - EPA Ecological Soil Screening Level (EPA 2000, 2003)
  - Oak Ridge National Laboratory Soil Screening Level (Efroymson et al. 1997)
  - NOAA Screening Quick Reference Tables (1999)
  - EPA Ecological soil screening levels (2005b)
  - CCME Guidelines for Agricultural Land Uses (2003)

- Surface Water
  - NYSDEC Technical Operational Guidance 6NYCRR Chapter X part 703 Surface Water and Groundwater Quality Standards and Groundwater Effluent Limitations
  - National Recommended Water Quality Criteria (EPA 2002)
  - NOAA Screening Quick Reference Tables (1999)

- Sediment
  - NYSDEC Technical Guidance for Screening Contaminated Sediment - Sediment Criteria for Benthic Aquatic Life Chronic Toxicity and for Wildlife Bioaccumulation
  - NOAA Screening Quick Reference Tables (1999)
  - Washington State DOE Freshwater Sediment Quality Values (1997)
  - Ingersoll *et al.* (1996)
  - Smith *et al.* (1996)

The NYSDEC sediment criteria for organic compounds are calculated on the basis of TOC content of the sediment. For conservative purposes, these criteria will be converted using the lowest site-specific TOC.

Chemicals will not be eliminated as COPECs due to the chemical's frequency of detection or by comparison to background concentrations. Therefore, frequency of detection and background concentrations are not factors in the selection of COPECs for the SLERA.

Site-related receptor species or surrogates will be chosen as potential ecological representatives of the trophic levels and habitats at and surrounding the site. Selection will be based on an integration of the types and distribution of COPECs, habitats, range and feeding habits of the potential ecological receptors, and relationships between the observed/expected species in the areas of concern. Other considerations include species that are Trustee or regulatory concerns.

The assessment endpoint for the ecological risk assessment is the disruption of ecological community structures via reduction of ecological populations. It will be assumed that a reduction of an ecological population may occur through the loss of normally-functioning individuals of the population. Assessment endpoints will be evaluated through measurement endpoints. Measurement endpoints to evaluate potential ecological impacts will be the benchmark toxicity endpoints from the literature. Individual toxicity endpoints such as survival, reproductive effects, and growth impacts will be considered.

**Effects Assessment**
The effects assessment will determine the ecological toxic effects of COPECs on the potential ecological receptors. A database and literature search will be performed to identify COPECs benchmark toxicity values to estimate the potential ecological risks.

Chronic no-observed-adverse-effect levels (NOAELs) for COPECs will be selected to represent the benchmark toxicity values in the SLERA as they ensure that risk is not underestimated (EPA 1997c). If chronic NOAELs are not available, acute or chronic lowest-observed-adverse-effect levels (LOAELs) or median lethal doses ($LD_{50}$) will be used with a uncertainty factor to reflect the level of uncertainty. The following scheme (Calabrese and Baldwin 1993) will be used to obtain a chronic NOAEL for the adjusted benchmark toxicity values:

- Acute $LD_{50}$ be multiplied by a uncertainty factor of 0.02
- Chronic LOAEL or chronic $LD_{50}$ be multiplied by a uncertainty factor of 0.1
- Acute LOAEL be multiplied by a uncertainty of 0.04

When toxicity values are not available for the selected receptor species, the use of toxicity values from other animal studies will be necessary. No additional uncertainty factor will be applied to the available toxicity value if the value is for an animal within the same taxonomic class as the target receptor. Values for taxonomic classes other than the receptor species will not be used. If more than one toxicity value is available, the most conservative toxicity value for the most closely-related species to the target receptor will be used. CDM will also obtain benchmark toxicity values from open literature sources.

**Exposure Estimates**
The purpose of this section is to evaluate the potential for receptor exposure to COPECs. This evaluation involves identification of contaminant exposure pathways that may be of concern for ecological receptors and determination of the magnitude of exposure to the selected ecological receptors. A conceptual site model will be included to identify complete exposure pathways.

The potential ecological receptors for the SLERA may have the potential to be exposed to COPECs in surface water and sediment in Whortlekill Creek and the ponds. Aquatic invertebrates, fish, and frog species will have considerable exposure to surface water and sediments throughout their life spans. Due to lack of established ecotoxicity values for fish and amphibians exposed to chemicals in sediment, the evaluation of sediment exposure to fish and frogs will not be made. Only the surface water pathway will be evaluated for the fish and frog receptors.

Contaminant exposures for other receptors such as mink or duck, occur through direct contact with the contaminated media will be evaluated.

**Risk Calculation**
The risk calculation will evaluate the evidence linking site contamination with potential adverse ecological effects. Risk calculation to site ecological receptors will be determined on the basis of comparison of ecotoxicity values from the literature with exposure doses (hazard index approach). Hazard quotients (HQs) for all COPECs in an environmental medium will be summed and expressed as HIs for that medium. An HI less than one (unity) indicates that the COPECs in that environmental medium is unlikely to cause adverse effects.

**Identification of Uncertainties and Limitations**
To produce any risk assessment, it is necessary to make assumptions. Assumptions carry with them associated uncertainties which must be identified so that risk estimates can be put into perspective. CDM will discuss uncertainties and limitations associated with the SLERA.

**SLERA Recommendations**
If results of the SLERA indicate that potential for ecological adverse effects exists at the site, a recommendation for further ecological investigation will be made to EPA. Subsequently, EPA will determine whether a baseline ecological risk assessment is warranted.

### 5.7.2.2 Final Screening Level Ecological Risk Assessment Report
CDM will submit the final screening level ecological risk assessment report to EPA, incorporating EPA's review and comments.

If the SLERA indicates the need for additional BERA work, a BERA work plan letter will be prepared under Subtask 5.7.2.2. The work plan letter will outline the technical requirements to conduct a BERA at the site and the associated costs for the work.

## 5.8 Task 8 - Treatability Studies/Pilot Testing
Applicable treatment technologies that may be suitable for the Hopewell Precision Site will be identified to determine if there is a need to conduct treatability studies.

### 5.8.1 Literature Search
CDM will research viable technologies that may be applicable to the contaminants of concern and the site conditions encountered. Upon completion of the literature search, CDM will provide a technical memorandum to the EPA RPM that summarizes the results. As part of this document, CDM will submit a plan that recommends

performance of a treatability study and identifies the types and specific goals of the study. The treatability study will be designed to determine the suitability of remedial technologies to site conditions and addressing the type of contamination that exists at the site. If directed by EPA, CDM will prepare an addendum to the RI/FS work plan for the treatability study. However, an addendum for a treatability study is not included in the current work plan.

### 5.8.2 Treatability Study Work Plan

As directed by EPA, this subtask is not included in the work plan at this time.

### 5.8.3 Conduct Treatability Studies

As directed by EPA, this subtask is not included in the work plan at this time.

### 5.8.4 Treatability Study Report

As directed by EPA, this subtask is not included in the work plan at this time.

## 5.9 Task 9 - Remedial Investigation Report

CDM will develop and submit a remedial investigation report that accurately establishes site characteristics including the identification of contaminated media, definition of the extent of contamination in soil, groundwater, surface water, deep water, sediments, and sub-slab/indoor air, and delineation of the physical boundaries of contamination. CDM will obtain detailed sampling data to identify key contaminants and determine the movement and extent of contamination in the environment. Key contaminants will be identified in the report and will be selected based on toxicity, persistence, and mobility in the environment.

### 5.9.1 Draft Remedial Investigation Report

A draft RI report will be prepared in accordance with the format described in EPA guidance documents such as the *"Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA"*. A draft outline of the report, adapted from the 1988 guidance, is shown in Table 5-2. This outline should be considered a draft and subject to revision, based on the data obtained. EPA's SOW for this work assignment has provided a detailed description of the types of information, maps, and figures to be included in the RI report. CDM will incorporate such information to the fullest extent practicable.

Upon completion, the draft RI report will be submitted for review by a CDM Technical Review Committee (TRC), followed by a quality assurance review. It will then be submitted to EPA for formal review and comment.

### 5.9.2 Final Remedial Investigation Report

Upon receipt of all EPA, other federal and state agency written comments, CDM will revise the report and submit the amended report to EPA. When EPA determines that the report is acceptable, the report will be deemed the final RI report.

## 5.10 Task 10 - Remedial Alternatives Screening

This task covers activities for the development of appropriate remedial alternatives that will undergo full evaluation. A range of alternatives will be considered, including innovative treatment technologies, consistent with the regulations outlined in the National Contingency Plan (NCP), 40 CFR Part 300, the *"Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA" (OSWER Directive 9355.3-01 October 1988)* or latest version, and other OSWER directives including 9355.4-03, October 18, 1989, and 9283.1-06, May 27, 1992, *"Considerations in Ground Water Remediation at Superfund Sites"*, as well as other applicable and more recent policies or guidance. CDM will also use EPA's 1996 final guidance *Presumptive Response Strategy and Ex-Situ Treatment Technologies for Contaminated Groundwater at CERCLA Sites*, which describes strategies and technologies for groundwater contaminated with chlorinated solvents.

CDM will investigate alternatives that will remediate or control contaminated media related to the site, as defined in the RI, to provide adequate protection of human health and the environment. The potential alternatives will encompass, as appropriate, a range of alternatives in which treatment is used to reduce the toxicity, mobility, or volume of wastes but vary in the degree to which long-term management of residuals or untreated waste is required, and will include one or more alternatives involving containment with little or no treatment, as well as a no-action alternative.

Based on EPA's presumptive remedy for groundwater at CERCLA sites guidance for groundwater at CERCLA sites (EPA 1996), the following alternatives, composed of treatment technologies for potentially affected media at the site, may be selected as representative technologies in the FS alternatives if they are deemed appropriate for chlorinated VOCs.

**Groundwater**

- No Action
- Groundwater treatment with air stripping, granular activated carbon, chemical/ultraviolet oxidation, permeable reactive barriers (PRB), and/or anaerobic biological reactors
- Connect residents to public water supplies
- Installation of deep residential wells at residences with shallow wells
- Monitored natural attenuation

Additional technologies may be evaluated if extremely high levels of contamination (e.g., DNAPL) are identified. Groundwater remedial alternatives will also include several disposal options for treated groundwater (e.g., recharge basins, discharge to a surface water body).

**Soil**

- No Action
- Soil vapor extraction
- Excavation and off-site disposal
- Excavation, stabilization, and on-site disposal

**Deep Water, Surface Water, and Sediment**
- No Action
- Excavation and off-site disposal

**Indoor Air**
- No Action
- Installation of sub-slab extraction systems

Based on the established remedial response objectives and the results of the risk assessment (Task 7), the initial screening of remedial alternatives will be performed according to the procedures recommended in "*Interim Final Guidance for Conducting RI/FS under CERCLA*" (EPA 1988).

The alternatives will be screened qualitatively against three criteria: effectiveness, implementability, and relative cost. A brief description of the application of these criteria is as follows:

- Effectiveness - The evaluation focuses on the potential effectiveness of technologies in meeting the remedial action goals; the potential impacts to human health and the environment during construction and implementation; and how proven and reliable the process is with respect to the contaminants and conditions at the site.

- Implementability - This evaluation encompasses both the technical and administrative feasibility of the technology. It includes an evaluation of treatment requirements, waste management, and relative ease or difficulty in achieving the operation and maintenance requirements. Technologies that are clearly unworkable at the site are eliminated.

- Relative Cost - Both capital cost and operation and maintenance cost are considered. The cost analysis is based upon engineering judgement, and each technology is evaluated as to whether costs are high, moderate, or low relative to other options within the same category.

The screening evaluation will generally focus upon the effectiveness criterion, with less emphasis on the implementability and relative cost criteria. Technologies surviving the screening process are those that are expected to achieve the remedial action objectives for the site, either alone or in combination with others.

## 5.10.1 Technical Memorandum

CDM will prepare a draft remedial alternatives screening memorandum that will document all of the analyses and evaluations described above. This draft memorandum will be submitted to EPA for formal review and comment and will:

- Establish Remedial Action Objectives - Based on existing information, CDM will identify site-specific remedial action objectives that should be developed to protect human health and the environment. The objectives will specify the contaminant(s) and media of concern, the exposure route(s) and receptor(s), and an acceptable contaminant level or range of levels for each exposure route (i.e., preliminary remediation goals).

- Establish General Response Actions - CDM will develop general response actions for each medium of interest by defining contaminant, treatment, excavation, pumping, or other actions, singly or in combination to satisfy remedial action objectives. The response actions will take into account requirements for protectiveness as identified in the remedial action objectives and the chemical and physical characteristics of the site.

- Identify and Screen Applicable Remedial Technologies - CDM will identify and screen technologies based on the general response actions. Hazardous waste treatment technologies will be identified and screened to ensure that only those technologies applicable to the contaminants present, their physical matrix, and other site characteristics will be considered. This screening will be based primarily on a technology's ability to address the contaminants at the site effectively, but will also take into account that technology's implementability and cost. CDM will select representative process options, as appropriate, to carry forward into alternative development and will identify the need for treatability testing for those technologies that are probable candidates for consideration during the detailed analysis.

- Develop Remedial Alternatives in accordance with the NCP.

- Screen Remedial Alternatives for Effectiveness, Implementability, and Cost - CDM will screen alternatives to identify the potential technologies or process options that will be combined into media-specific or site-wide alternatives. The developed alternatives will be defined with respect to size and configuration of the representative process options, time for remediation, rates of flow or treatment, spatial requirements, distances for disposal, required permits, imposed limitations, and other factors necessary to evaluate the alternatives. If many distinct viable options are available and developed, CDM will screen the alternatives undergoing detailed analysis to provide the most promising process options.

### 5.10.2 Final Technical Memorandum

As directed by EPA, this subtask is not applicable.

## 5.11 Task 11 - Remedial Alternatives Evaluation

Remedial technologies passing the initial screening process will be grouped into remedial alternatives. This task covers efforts associated with the assessment of individual alternatives against each of the nine current evaluation criteria and a comparative analysis of all options against the evaluation criteria. The analysis will be consistent with the NCP, 40 CFR Part 300, and will consider the *"Guidance for Conducting Remedial Investigation and Feasibility Studies under CERCLA"* (OSWER Directive 9355.3-01) and other pertinent OSWER guidance. The detailed evaluation criteria for remedial alternatives are listed on Table 5-3 and a brief description of each criterion is provided:

- Overall Protection of Human Health and the Environment - This criterion provides a final check to assess whether each alternative meets the requirement that it is protective of human health and the environment. The overall assessment of protection is based on a composite of factors assessed under the evaluation criteria, especially long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs.

- Compliance with ARARs - This criterion is used to determine how each alternative complies with applicable or relevant and appropriate Federal and State requirements, as defined in Section 121 of CERCLA 42 USC Section 9621.

- Long-Term Effectiveness - This criterion addresses the results of a remedial action in terms of the risk remaining at the Site after the response objectives have been met. The primary focus of this evaluation is to determine the extent and effectiveness of the controls that may be required to manage the risk posed by treatment residuals and/or untreated wastes. The factors to be evaluated include the magnitude of remaining risk (measured by numerical standards such as cancer risk levels), and the adequacy, suitability and long-term reliability of management controls for providing continued protection from residuals (i.e., assessment of potential failure of the technical components).

- Reduction of Toxicity, Mobility, or Volume - This criterion addresses the statutory preference for selecting remedial actions that employ treatment technologies that permanently and significantly reduce toxicity, mobility or volume of the contaminants. The factors to be evaluated include the treatment process employed, the amount of hazardous material destroyed or treated, the degree of reduction expected in toxicity, mobility or volume, and the type and quantity of treatment residuals.

- Short-Term Effectiveness - This criterion addresses the effects of the alternative during the construction and implementation phase until the remedial actions have been completed and the selected level of protection has been achieved. Each alternative is evaluated with respect to its effects on the community and onsite workers during the remedial action, environmental impacts resulting from implementation, and the amount of time until protection is achieved.

- Implementability - This criterion addresses the technical and administrative feasibility of implementing an alternative and the availability of various services and materials required during its implementation. Technical feasibility considers construction and operational difficulties, reliability, ease of undertaking additional remedial action (if required), and the ability to monitor its effectiveness. Administrative feasibility considers activities needed to coordinate with other agencies (e.g., state and local) in regard to obtaining permits or approvals for implementing remedial actions.

- Cost - This criterion addresses the capital costs, annual operation and maintenance costs, and present worth analysis. Capital costs consist of direct (construction) and indirect (non-construction and overhead) costs. Direct costs include expenditures for the equipment, labor and material necessary to perform remedial actions. Indirect costs include expenditures for engineering, financial and other services that are not part of actual installation activities but are required to complete the installation of remedial alternatives. Annual operation and maintenance costs are post-construction costs necessary to ensure the continued effectiveness of a remedial action. These costs will be estimated to provide an accuracy of +50 percent to -30 percent. A present worth analysis is used to evaluate expenditures that occur over different time periods by discounting all future costs to a common base year, usually the current year. This allows the cost of remedial action alternatives to be compared on the basis of a single figure representing the amount of money that would be sufficient to cover all costs associated with the remedial action over its planned life.

- State Acceptance - This criterion evaluates the technical and administrative issues and concerns the State may have regarding each of the alternatives. The factors to be evaluated include those features of alternatives that the State supports, reservations of the State, and opposition of the State.

- Community Acceptance - This criterion incorporates public concerns into the evaluation of the remedial alternatives. Often, community (and also state) acceptance cannot be determined during development of the RI/FS. Evaluation of these criteria is postponed until the RI/FS report has been released for state and public review. These criteria are then addressed in the ROD and the responsiveness summary.

Each remedial alternative will be subject to a detailed analysis according to the above evaluation criteria. A comparative analysis of all alternatives will then be performed to evaluate the relative benefits and drawbacks of each according to the same criteria. A preferred remedial alternative will be recommended based upon the results of the comparative analysis.

### 5.11.1 Technical Memorandum

CDM will prepare a draft technical memorandum that addresses the following:

- A technical description of each alternative that outlines the waste management strategy involved and identifies the key ARARs associated with each alternative.

- A discussion that describes the performance of that alternative with respect to each of the evaluation criteria. A table will be provided summarizing the results of this analysis. Once the individual analysis is completed, a comparison and contrast of the alternatives to one another, with respect to each of the evaluation criteria, will be performed.

This draft memorandum will be submitted to EPA for formal review and comment.

### 5.11.2 Final Technical Memorandum
As directed by EPA, this subtask is not applicable.

## 5.12 Task 12 - Feasibility Study Report
CDM will develop a feasibility study report consisting of a detailed analysis of alternatives and a cost-effectiveness analysis, in accordance with the NCP, 40 CFR Part 300, as well as the most recent guidance.

### 5.12.1 Draft Feasibility Study Report
CDM will submit a draft feasibility study report to the EPA. The FS report will contain the following:

- Summary of feasibility study objectives
- Summary of remedial objectives
- Identification of general response actions
- Identification and screening of remedial technologies
- Remedial alternatives description
- Detailed analysis of remedial alternatives
- Summary and conclusions

The technical feasibility considerations will include the careful study of any problems that may prevent a remedial alternative from mitigating site problems. Therefore, the site characteristics from the RI will be kept in mind as the technical feasibility of the alternative is studied. Specific items to be addressed will be reliability (operation over time), safety, operation and maintenance, ease with which the alternative can be implemented, and time needed for implementation.

The draft FS report will be prepared to: 1) summarize the activities performed and 2) present the results and associated conclusions for Tasks 1 through 11. The report will include a summary of a description of the initial screening study process and the detailed evaluations of the remedial action alternatives studied. The FS report format is shown on Table 5-4 and will consist of an executive summary and five sections. The executive summary will be a brief overview of the FS and the analysis underlying the remedial actions that were evaluated. The five sections will be as follows:

- Introduction and Site Background
- Identification and Screening of Remedial Technologies
- Development and Initial Screening of Remedial Alternatives
- Description and Detailed Analysis of Alternatives
- Comparative Analysis of Alternatives

The FS report will be reviewed by a CDM TRC. TRC comments will be addressed prior to submittal to EPA for review.

### 5.12.2 Final Feasibility Study Report

Upon receipt of all EPA and other federal and state agency written comments, CDM will revise the FS report and submit the amended document to EPA. When EPA determines that the document is acceptable, the FS report will be deemed the final FS report.

## 5.13 Task 13 - Post RI/FS Support

### 5.13.1 FS Addendum

CDM will prepare an FS addendum (if required), based on the final ROD adopted for the site, covering issues arising after finalization of the basic RI/FS documents.

### 5.13.2 Technical Support

CDM will provide several types of technical support to EPA, including: technical meetings; review of presentation materials; technical support on the draft and final Responsiveness Summary, Proposed Plan, and ROD; attendance by project staff at briefings; additional PRP searches; and general technical support during the ROD period.

## 5.14 Task 14 - Negotiation Support

In accordance with the SOW, this task is currently not applicable to this work assignment.

## 5.15 Task 15 - Administrative Record

In accordance with the SOW, this task is currently not applicable to this work assignment.

## 5.16 Task 16 - Work Assignment Closeout

Project closeout includes work efforts related to the project completion and closeout phase. Project records will be transferred to EPA. A Work Assignment Closeout Report (WACR) will be completed.

### 5.16.1 Work Assignment Closeout Report (WACR)

CDM will prepare a WACR that will include all level-of-effort hours, by professional level, and costs in accordance with the project work breakdown structure.

### 5.16.2 Document Indexing

CDM will organize the work assignment files in its possession in accordance with the currently approved file index structure.

### 5.16.3 Document Retention/Conversion

CDM will convert all pertinent paper files into an appropriate long-term storage format. EPA will define the specific long-term storage format prior to closeout of this work assignment.

# Section 6
# Schedule

A project schedule for the RI/FS is included as Figure 6-1. The project schedule is based on assumptions for durations and conditions of key events occurring on the critical and non-critical path. These assumptions are as follows:

- The schedule for the field activities is dependent on access to all properties being obtained by EPA without difficulty.
- Field activities will not be significantly delayed due to severe weather conditions (snow and icing conditions, hurricanes).
- The schedule for the field activities is dependent on timely review and approval of the work plan and QAPP and the provision of adequate funding by EPA.
- The schedule for the field investigation is dependent on all field activities being performed in Level D or Level C health and safety protection.
- CDM will receive validated data for analyses performed by EPA's Contract Laboratory Program 8 weeks after sample collection.

# Section 7
# Project Management Approach

## 7.1 Organization and Approach

The proposed project organization is shown in Figure 7-1.

The SM, Ms. Susan Schofield, P.G., has primary responsibility for plan development and implementation of the RI, including coordination with the task leader and support staff, development of bid packages for subcontractor services, acquisition of engineering or specialized technical support, and all other aspects of the day-to-day activities associated with the project. The SM identifies staff requirements, directs and monitors site progress, ensures implementation of quality procedures and adherence to applicable codes and regulations, and is responsible for performance within the established budget and schedule.

The RI task manager, Ms. Seth Kellogg, reports to, and will work directly with the SM to develop and coordinate the work plan, QAPP, staffing and physical resource requirements, and technical statements of work for professional subcontractor services. She will be responsible for the implementation of the field investigation, performance tracking of the CDM subcontractor laboratory, the analysis, interpretation and presentation of data acquired relative to the site, preparation of the data evaluation summary report, and the RI report.

The FS task manager, Mr. Frank Tsang, P.E., will work closely with the RI task manager to ensure that the field investigation generates the proper type and quantity of data for use in the initial screening of remedial technologies/alternatives, detailed evaluation of remedial alternatives, development of requirements for and evaluation of treatability study/pilot testing, if required, and associated cost analysis. The FS report will be developed by the FS technical group.

The field team leader (FTL), Mr. Tom Horn, is responsible for on-site management for the duration of all site operations including the activities conducted by CDM such as equipment mobilization, sampling, and the work performed by subcontractors such as surveying.

The regional quality assurance coordinator (RQAC) is Ms. Jeniffer Oxford. The RQAC is responsible for overall project quality including development of the QAPP, review of specific task QA/QC procedures, and auditing of specific tasks. The RQAC reports to the CDM QAD.

The RAC II QAD, Mr. Steven Martz, is responsible for overall quality for the RAC contract, and will have approved quality assurance coordinators (QACs) perform the required elements of the RAC II QA program of specific task QA/QC procedures, and auditing of specific tasks at established intervals. These QACs report to CDM's corporate QA director and are independent of the SM's reporting structure.

The ASC, Mr. Scott Kirchner, will ensure that the subcontract analytical laboratory will perform analyses as described in the QAPP. The ASC provides assistance with meeting EPA sample management and paperwork requirements.

The task numbering system for the RI/FS effort is described in Section 5 of this work plan. Each of these tasks has been scheduled and will be tracked separately during the course of the RI/FS work. For the RAC II contract, the key elements of the monthly progress report will be submitted within 20 calendar days after the end of each reporting period and will consist of a summary of work completed during that period and associated costs.

Project progress meetings will be held, as needed, to evaluate project status, discuss current items of interest, and review major deliverables such as the work plan, QAPP, the data evaluation summary report, the RI report, the human health risk assessment, the SLERA report, and the FS report.

## 7.2 Quality Assurance and Document Control

All work by CDM on this work assignment will be performed in accordance with the CDM RAC II Quality Management Plan (QMP) (December 2005).

The RAC II RQAC will maintain QA oversight for the duration of the work assignment. A CDM QAC has reviewed this work plan for QA requirements. A QAPP governing field sampling and analysis is required and will be prepared in accordance with EPA R-5 and EPA Region II requirements. It will be submitted to an approved QAC for review and approval before submittal to EPA. Any reports for this work assignment which present measurement data generated during the work assignment will include a QA section addressing the quality of the data and its limitations. Such reports are subject to QA review following technical review. Statements of work for subcontractor services and subcontractor bids and proposals will receive technical and QA review.

The CDM SM is responsible for implementing appropriate QC measures on this work assignment. Such QC responsibilities include:

- Implementing the QC requirements referenced or defined in this work plan and in the QAPP
- Adhering to the CDM RAC Management Information System (RACMIS) document control system
- Organizing and maintaining work assignment files
- Conducting field planning meetings, as needed, in accordance with the RAC II QMP
- Completing measurement and test equipment forms that specify equipment requirements

Technical and QA review requirements as stated in the QMP will be followed on this work assignment.

Document control aspects of the program pertain to controlling and filing documents. CDM has developed a program filing system that conforms to EPA's requirements to ensure that the documents are properly stored and filed. This guideline will be implemented to control and file all documents associated with this work assignment. The system includes document receipt control procedures, a file review, an inspection system, and file security measures.

The RAC II QA program (QMP, Table 9-1) includes both self-assessments and independent assessments as checks on quality of data generated on this work assessment. Self assessments include management system audits, trend analyses, calculation checking, data validation, and technical reviews. Independent assessments include office, field and laboratory audits and the submittal of performance evaluation samples to laboratories.

One QA internal system audit and one field technical system audit are required. A laboratory technical system audit may be conducted by the CDM QA staff. Performance audits (i.e., performance evaluation samples) may be administered by CDM as required for any analytical parameters. An audit report will be prepared and distributed to the audited group, to CDM management, and to EPA. EPA may conduct or arrange a system or performance audit.

## 7.3 Project Coordination

The SM will coordinate all project activities with the EPA RPM. Regular telephone contact will be maintained to provide updates on project status. Field activities at the site will require coordination among federal, state, and local agencies and coordination with involved private organizations. Coordination of activities with these stakeholders is described below.

EPA is responsible for overall direction and approval of all activities for the Hopewell Precision Site. EPA may designate technical advisors and experts from academia or its technical support branches to assist on the site. Agency advisors could provide important sources of technical information and review, which the CDM team will use from initiation of RI/FS activities through final reporting.

Sources of technical information include EPA, NYSDEC, USGS, Dutchess County Health Department, and sampling conducted during previous investigations. These sources can be used for background information on the site and surrounding areas.

The state, through NYSDEC, may provide review, direction, and input during the RI/FS. EPA's RPM will coordinate contact with NYSDEC personnel.

Local agencies that may be involved include the Dutchess County Department of Health, the local water districts, and local departments such as planning boards, zoning and building commissions, police, fire, health departments, and utilities (water and sewer). Contacts with these local agencies will be coordinated through EPA.

Private organizations requiring coordination during the RI/FS include residents in the area and public interest groups such as environmental organizations and the press. Coordination with these interested parties will be performed through EPA.

# Section 8
# References

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# Section 9
# Glossary of Abbreviations

| | |
|---|---|
| ARARs | Applicable or Relevant and Appropriate Requirements |
| ASC | Analytical Services Coordinator |
| ASTM | American Society of Testing and Materials |
| bgs | Below the ground surface |
| CDM | CDM Federal Programs Corporation |
| CERCLA | Comprehensive Environmental Response, Compensation and Liability Act of 1980 |
| CFR | Code of Federal Regulations |
| CLASS | Contract Laboratory Analytical Support Services |
| CLP | Contract Laboratory Program |
| COPC | Chemical of Potential Concern |
| COPEC | Contaminant of Potential Ecological Concern |
| CRP | Community Relations Plan |
| CSM | Conceptual Site Model |
| CTE | Central Tendency Exposure |
| DESA | Division of Environmental Science and Assessment |
| DNAPL | Dense Non-Aqueous Phase Liquid |
| DO | Dissolved oxygen |
| DPT | Direct push technology |
| DQI | Data Quality Indicator |
| DQO | Data Quality Objective |
| Eh | Oxidation-Reduction Potential |
| EPA | United States Environmental Protection Agency |
| EPC | Exposure point concentration |
| EQuIS | Environmental Quality Information Systems |
| ERAGS | Ecological Risk Assessment Guidance for Superfund |
| ERTC | Environmental Response Team Contractor |
| F | Fahrenheit |
| FACTAC | Field and Analytical Services Teaming Advisory Committee |
| FS | Feasibility Study |
| FTL | Field Team Leader |
| GIS | Geographic Information System |
| gpm | Gallons per minute |
| GPS | Global Positioning System |
| HEAs | Health Effects Assessment |
| HEAST | Health Effects Assessment Summary Tables |
| HHRA | Human Health Risk Assessment |
| HI | Hazard Index |
| HQ | Hazard Quotient |
| HRS | Hazard Ranking System |
| HSP | Health and Safety Plan |
| IDW | Investigation Derived Waste |
| IFB | Invitation For Bid |
| IRIS | Integrated Risk Information System |
| kg | Kilogram |
| L | Liter |

| | |
|---|---|
| $LD_{50}$ | Median lethal dose |
| LOAEL | Lowest observed adverse effect level |
| LOE | Level of Effort |
| $m^3$ | Cubic meter |
| MCL | Maximum Contaminant Level |
| MCLG | Maximum Contaminant Level Goal |
| MEK | Methyl ethyl ketone |
| mg | Milligram |
| mg/kg | Milligrams per kilogram |
| MNA | Monitored natural attenuation |
| msl | Mean Sea Level |
| MTBE | Methyl tert butyl ether |
| NCEA | National Center for Environmental Assessment |
| NCP | National Contingency Plan |
| NESHAPs | National Emission Standards for Hazardous Air Pollutants |
| NOAEL | No observed adverse effect level |
| NPDES | National Pollution Discharge Elimination System |
| NYCRR | New York Code of Requirements and Regulations |
| NYSDEC | New York State Department of Environmental Conservation |
| NYSDOH | New York State Department of Health |
| OSC | On scene coordinator |
| OSWER | Office of Solid Waste and Emergency Response |
| PAR | Pathway Analysis Report |
| PCB | Polychlorinated Biphenyl |
| PID | Photoionization detector |
| PLOE | Professional level of effort |
| POET | Point of entry treatment |
| POTW | Publically Owned Treatment Works |
| ppb | Parts per billion |
| PPRTV | Provisional Peer Reviewed Toxicity Values |
| PRGs | Preliminary Remediation Goals |
| PVC | Polyvinyl chloride |
| QA/QC | Quality Assurance/Quality Control |
| QAC | Quality Assurance Coordinator |
| QAD | Quality Assurance Director |
| QAPP | Quality Assurance Project Plan |
| QMP | Quality Management Plan |
| RA | Risk Assessment |
| RAC | Response Action Contract |
| RACMIS | RAC Management Information System |
| RAGS | Risk Assessment Guidance for Superfund |
| RAS | Routine Analytical Services |
| RCRA | Resource Conservation and Recovery Act |
| REAC | Response Engineering and Analytical Contract |
| RfC | Reference concentration |
| RfD | Reference dose |
| RFP | Request for Proposal |

| | |
|---|---|
| RI | Remedial Investigation |
| RI/FS | Remedial Investigation/Feasibility Study |
| RME | Reasonable maximum exposure |
| ROD | Record of Decision |
| RPM | Remedial Project Manager |
| RQAC | Regional Quality Assurance Coordinator |
| RSCC | Regional Sample Control Center |
| RST | Removal Support Team |
| RTECS | Registry of Toxic Effects of Chemical Substances |
| SARA | Superfund Amendments and Reauthorization Act of 1986 |
| SCST | Superfund Contract Support Team |
| SEL | Sever effects limit |
| SF | Slope factor |
| SLERA | Screening Level Ecological Risk Assessment |
| SM | Site Manager |
| SMO | Sample Management Office |
| SOP | Standard Operating Procedures |
| SOW | Statement of Work |
| STSC | Superfund Health Risk Technical Support Center |
| SVOC | Semi-volatile organic compound |
| TAL | Target Analyte List |
| TBC | "To Be Considered" Material |
| 1,1,1-TCA | 1,1,1-trichloroethane |
| TCE | Trichloroethene |
| TCL | Target Compound List |
| TDS | Total dissolved solids |
| the site | Hopewell Precision Site |
| TKN | Total Kjehldahl nitrogen |
| TOC | Total organic carbon |
| TOG | Technical Operations Guidance series |
| TRC | Technical Review Committee |
| TSCA | Toxic Substances Control Act |
| TSS | Total suspended solids |
| UCL | Upper Confidence Limit |
| ug/L | Micrograms/liter |
| USC | United States Code |
| USGS | United States Geological Survey |
| VOC | Volatile Organic Compound |
| WACR | Work Assignment Close-Out Report |
| 1,2-DCE | 1,2-dichloroethene |

## Table 4-1
## Summary of Data Quality Levels
## Hopewell Precision Site
## Hopewell Junction, New York

| Data Uses | Analytical Level (1) | Types of Analysis |
|---|---|---|
| Site characterization monitoring during implementation | Screening level with definitive level confirmation | - Total organic vapor using instruments<br>- Water quality field measurements using portable instruments |
| Risk assessment<br>Site Characterization<br>Monitoring during implementation | Definitive level | - Organics/Inorganics using EPA-approved methods<br>- CLP SOWs<br>- Standard water analyses<br>- Analyses performed by laboratory |
| Site characterization | DQO level<br>Field instrument (2) | - Measurements from field equipment<br>- Qualitative measurements |

(1) Definitions of analytical levels: Screening data are generated by rapid, less precise methods of analysis with less rigorous sample preparation. Screening data provide analyte (or at least chemical class) identification and quantification, although the quantification may be relatively imprecise. For definitive confirmation, approximately 10 percent of the screening data are confirmed using analytical methods and quality control procedures and criteria associated with definitive data. Screening data without associated confirmation data are generally not considered to be data of known quality.

Definitive data are generated using rigorous analytical methods, such as EPA reference methods. Data are analyte-specific, with confirmation of analyte identity and concentration. Methods generating definitive data produce tangible raw data (e.g., chromatograms, spectra, digital values) in the form of paper printouts or computer-generated electronic files. Data may be generated at the site or at an off-site location, as long as the quality control requirements are satisfied. For the data to be definitive, either analytical or total measurement error must be determined.

(2) DQO = Measurement-specific Data Quality Objective requirements will be defined in the QAPP.

**Table 5-1**
**Summary of Sampling Activities**
**Stage I, Stage II, and Seasonal Sampling Events**
**Hopewell Precision Site**
**Hopewell Junction, New York**

| SAMPLE TYPE/ LOCATION | SAMPLE MEDIA | CLP ANALYTICAL PARAMETERS | NO. OF SAMPLES | NON-RAS ANALYTICAL PARAMETERS | NO. OF SAMPLES | SAMPLING FREQUENCY |
|---|---|---|---|---|---|---|
| **Stage I** | | | | | | |
| **Groundwater Screening Sampling**<br>1 event, 49 locations | Groundwater (1) | None | NA | LDL VOCs - 24 hr TAT | 343 | Seven per location |
| **Residential Well Sampling**<br>2 Rounds, 60 locations | Groundwater | LDL VOCs | 120 | None | 0 | NA |
| **Source Area Soil Sampling**<br>1 event, 25 location | Soil | TCL VOCs<br>TCL SVOCs<br>TCL Pest/PCBs<br>TAL Inorganics (2) | 75 | 1,4-dioxane, pH, Grain Size, TOC | 75 | Five per location |
| **Stage II** | | | | | | |
| **Monitoring Well Sampling** (1)<br>2 Rounds; 38 locations | Groundwater | TCL LDL VOCs<br>TCL SVOCs<br>TCL Pest/PCBs<br>TAL Inorganics (2) | 76 | MNA Parameters: Chloride, methane, ethane, ethene, nitrate/nitrite, sulfate, sulfide, TOC, Ferrous Iron ($Fe^{2+}$)<br>Water Quality Parameters: TSS, TDS, Ammonia, Hardness, TKN | 76 | Two Rounds at 38 wells |

**Table 5-1**
**Summary of Sampling Activities**
**Stage I, Stage II, and Seasonal Sampling Events**
**Hopewell Precision Site**
**Hopewell Junction, New York**

| SAMPLE TYPE/ LOCATION | SAMPLE MEDIA | CLP ANALYTICAL PARAMETERS | NO. OF SAMPLES | NON-RAS ANALYTICAL PARAMETERS | NO. OF SAMPLES | SAMPLING FREQUENCY |
|---|---|---|---|---|---|---|
| **Seasonal Sampling Events** | | | | | | |
| **Lake and Stream Sediment**<br>1 event, 39 locations<br>Collected in mid-Summer | Sediment | TCL VOCs<br>TCL SVOCs<br>TCL Pest/PCBs<br>TAL Inorganics (2) | 39 | pH, Grain Size, TOC | 39 | One sample per location |
| **Lake and Stream Surface Water**<br>1 event, 39 locations<br>Collected in mid-Summer | Surface Water | TCL LDL VOCs<br>TCL SVOCs<br>TCL Pest/PCBs<br>TAL Inorganics (2) | 39 | Alkalinity, Ammonia, Chloride, Hardness, Nitrate/Nitrite, Sulfide, Sulfate, pH TKN, TOC, TSS, TDS, | 39 | One sample per location |
| **Deep Water Lake Samples**<br>1 event, 20 locations<br>Collected in mid-Summer | Deep Water | TCL LDL VOCs<br>TCL SVOCs<br>TCL Pest/PCBs<br>TAL Inorganics (2) | 20 | Alkalinity, Ammonia, Chloride, Hardness, Nitrate/Nitrite, Sulfide, Sulfate, pH TKN, TOC, TSS, TDS | 20 | One sample per location |
| **Sub-Slab Vapor - Initial Event**<br>1 event, 100 locations<br>Collected in Winter | Air (Sub-Slab) | None | NA | Selected VOCs by TO-15 (3) | 100 | One sample per residence |

## Table 5-1
## Summary of Sampling Activities
## Stage I, Stage II, and Seasonal Sampling Events
## Hopewell Precision Site
## Hopewell Junction, New York

| SAMPLE TYPE/ LOCATION | SAMPLE MEDIA | CLP ANALYTICAL PARAMETERS | NO. OF SAMPLES | NON-RAS ANALYTICAL PARAMETERS | NO. OF SAMPLES | SAMPLING FREQUENCY |
|---|---|---|---|---|---|---|
| **Sub-Slab Vapor**<br>(sub-slab conc. > 2.7 ug/$m^3$)<br>1 event, 50 locations<br>Collected in Winter | Air (Sub-Slab) | None | NA | Selected VOCs by TO-15 (3) | 50 | One sample per residence |
| **Indoor Air**<br>(sub-slab conc. > 2.7 ug/$m^3$)<br>1 event, 50 locations<br>Collected in Winter | Air (Indoor) | None | NA | Selected VOCs by TO-15 (3) | 100 | Two samples per residence |
| **Ambient Air**<br>1 event, 17 locations<br>Collected in Winter | Air (Ambient) | None | NA | Selected VOCs by TO-15 (3) | 13 | One sample per four residences |

Notes:
(1) Groundwater samples also will be measured for field parameters: dissolved oxygen, oxidation-reduction potential, turbidity, temperature, and conductivity.
(2) TAL Inorganics includes TAL metals and cyanide
(3) Selected VOCs by TO-15 include: Dichlorodifluoromethane (freon), chloromethane, carbon tetrachloride, 1,2-dichloroethane (total), methyl ethyl ketone (MEK), 1,1,1-TCA, 1,2-dichloroethane, chloroethane, 1,1 - dichloroethene, perchloroethene, TCE, cis-1,2-dichloroethane, trans-1,2-dichloroethane, methyl tert butyl ether (MTBE), and vinyl chloride

Abbreviations: CLP = Contract Laboratory Program; No. = number; RAS = routine analytical services; LDL VOC = low detection limit volatile organic compounds; TAT = turnaround time; TCL = Target Compound List; SVOCs = semivolatile organic compounds; Pest/PCBs = pesticides/polychlorinated biphenols; TAL = Target Analyte List; TOC = total organic carbon; MNA = monitored natural attenuation; TKN =

**Table 5-1**
**Summary of Sampling Activities**
**Stage I, Stage II, and Seasonal Sampling Events**
**Hopewell Precision Site**
**Hopewell Junction, New York**

Total Kjehldahl nitrogen; TSS = total suspended solids; TDS = total dissolved solids; ug/$m^3$ = micrograms per cubic meter

**Table 5-2**
**Proposed RI Report Format**
**Hopewell Precision Site**
**Hopewell Junction, New York**

1.0 Introduction
- 1.1 Purpose of Report
- 1.2 Site Background
  - 1.2.1 Site Description
  - 1.2.2 Site History
  - 1.2.3 Previous Investigations
- 1.3 Report Organization

2.0 Study Area Investigation
- 2.1 Surface Features (topographic mapping, etc.) (natural and manmade features)
- 2.2 Contaminant Source Investigations
- 2.3 Meteorological Investigations
- 2.4 Geological Investigations
- 2.5 Groundwater Investigation
- 2.6 Human Population Surveys
- 2.7 Ecological Investigation

3.0 Physical Characteristics of Site
- 3.1 Topography
- 3.2 Meteorology
- 3.3 Geology
- 3.5 Hydrogeology
- 3.6 Air Quality
- 3.7 Demographics and Land Use

4.0 Nature and Extent of Contamination
- 4.1 Sources of Contamination
- 4.2 Groundwater
- 4.3 Soil
- 4.4 Surface Water/Sediment
- 4.5 Residential Wells
- 4.6 Indoor Air Vapors

5.0 Contaminant Fate and Transport
- 5.1 Routes of Migration
- 5.2 Contaminant Persistence
- 5.3 Contaminant Migration

**Table 5-2**
**Proposed RI Report Format**
**Hopewell Precision Site**
**Hopewell Junction, New York**

6.0 Baseline Risk Assessment
- 6.1 Human Health Evaluation
  - 6.1.1 Summary of Data Collection and Evaluation
  - 6.1.2 Exposure Assessment
  - 6.1.3 Toxicity Assessment
  - 6.1.4 Risk Characterization
  - 6.1.5 Uncertainty Assessment
- 6.2 Ecological Evaluation
  - 6.2.1 Screening Level Ecological Risk Assessment
  - 6.2.2 Ecological Risk Assessment

7.0 Summary and Conclusions
- 7.1 Source(s) of Contamination
- 7.2 Nature and Extent of Contamination
- 7.3 Fate and Transport
- 7.4 Risk Assessments
- 7.5 Data Limitations and Recommendations for Future Work
- 7.6 Recommended Remedial Action Objectives

Appendices
Analytical Data/QA/QC Evaluation Results
Boring Logs
Data

**Table 5-3**
**Detailed Evaluation Criteria for Remedial Alternatives**
**Hopewell Precision Site**
**Hopewell Junction, New York**

- SHORT-TERM EFFECTIVENESS
  - Protection of community during remedial action
  - Protection of workers during remedial actions
  - Time until remedial response objectives are achieved
  - Environmental impacts

- LONG-TERM EFFECTIVENESS
  - Magnitude of risk remaining at the site after the response objectives have been met
  - Adequacy of controls
  - Reliability of controls

- REDUCTION OF TOXICITY, MOBILITY OR VOLUME THROUGH TREATMENT
  - Treatment process and remedy
  - Amount of hazardous material destroyed or treated
  - Reduction in toxicity, mobility or volume of the contaminants
  - Irreversibility of the treatment
  - Type and quantity of treatment residuals

- IMPLEMENTABILITY
  - Ability to construct technology
  - Reliability of technology
  - Ease of undertaking additional remedial action, if necessary
  - Monitoring considerations
  - Coordination with other agencies
  - Availability of treatment, storage capacity, and disposal services
  - Availability of necessary equipment and specialists
  - Availability of prospective technologies

- COST
  - Capital costs
  - Annual operating and maintenance costs
  - Present worth
  - Sensitivity Analysis

**Table 5-3**
**Detailed Evaluation Criteria for Remedial Alternatives**
**Hopewell Precision Site**
**Hopewell Junction, New York**

- COMPLIANCE WITH ARARs
  - Compliance with chemical-specific ARARs
  - Compliance with action-specific ARARs
  - Compliance with location-specific ARARs
  - Compliance with appropriate criteria, advisories and guidance
- OVERALL PROTECTION OF HUMAN HEALTH AND ENVIRONMENT
- STATE ACCEPTANCE
- COMMUNITY ACCEPTANCE

**Table 5-4**
**Proposed FS Report Format**
**Hopewell Precision Site**
**Hopewell Junction, New York**

1.0 Introduction and Site Background
- 1.1 Purpose and Organization of Report
- 1.2 Site Description and History
- 1.3 Site
- 1.4 Source(s) of Contamination
- 1.5 Nature and Extent of Contamination
- 1.6 Contaminant Fate and Transport
- 1.7 Risk Assessment Summaries

2.0 Identification and Screening of Remedial Technologies
- 2.1 Remedial Action Objectives
  - Contaminants of Interest
  - Allowable Exposure Based on Risk Assessment
  - Allowable Exposure Based on ARARs
  - Development of Remedial Action Objectives
- 2.2 General Response Actions
  - Volumes
  - Containment
  - Technologies
- 2.3 Screening of Technology and Process Options
  - 2.3.1 Description of Technologies
  - 2.3.2 Evaluation of Technologies
  - 2.3.3 Screening of Alternatives
  - Effectiveness
  - Implementability
  - Cost

3.0 Development and Initial Screening of Alternatives
- 3.1 Development of Alternatives
- 3.2 Screening of Alternatives
  - 3.2.1 Alternative 1
  - 3.2.2 Alternative 2
  - 3.2.3 Alternative 3

4.0 Description and Detailed Analysis of Alternatives
- 4.1 Description of Evaluation Criteria
  - Short-Term Effectiveness
  - Long-Term Effectiveness and Permanence
  - Implementability
  - Reduction of Mobility, Toxicity, or Volume Through Treatment
  - Compliance with ARARs
  - Overall Protection
  - Cost
  - State Acceptance

**Table 5-4**
**Proposed FS Report Format**
**Hopewell Precision Site**
**Hopewell Junction, New York**

4.2 Individual Analysis of Alternatives
  4.2.1 Alternative 1
  4.2.2 Alternative 2
  4.2.3 Alternative 3
4.3 Summary

5.0 Comparative Analysis of Alternatives
  5.1 Comparison Among Alternatives

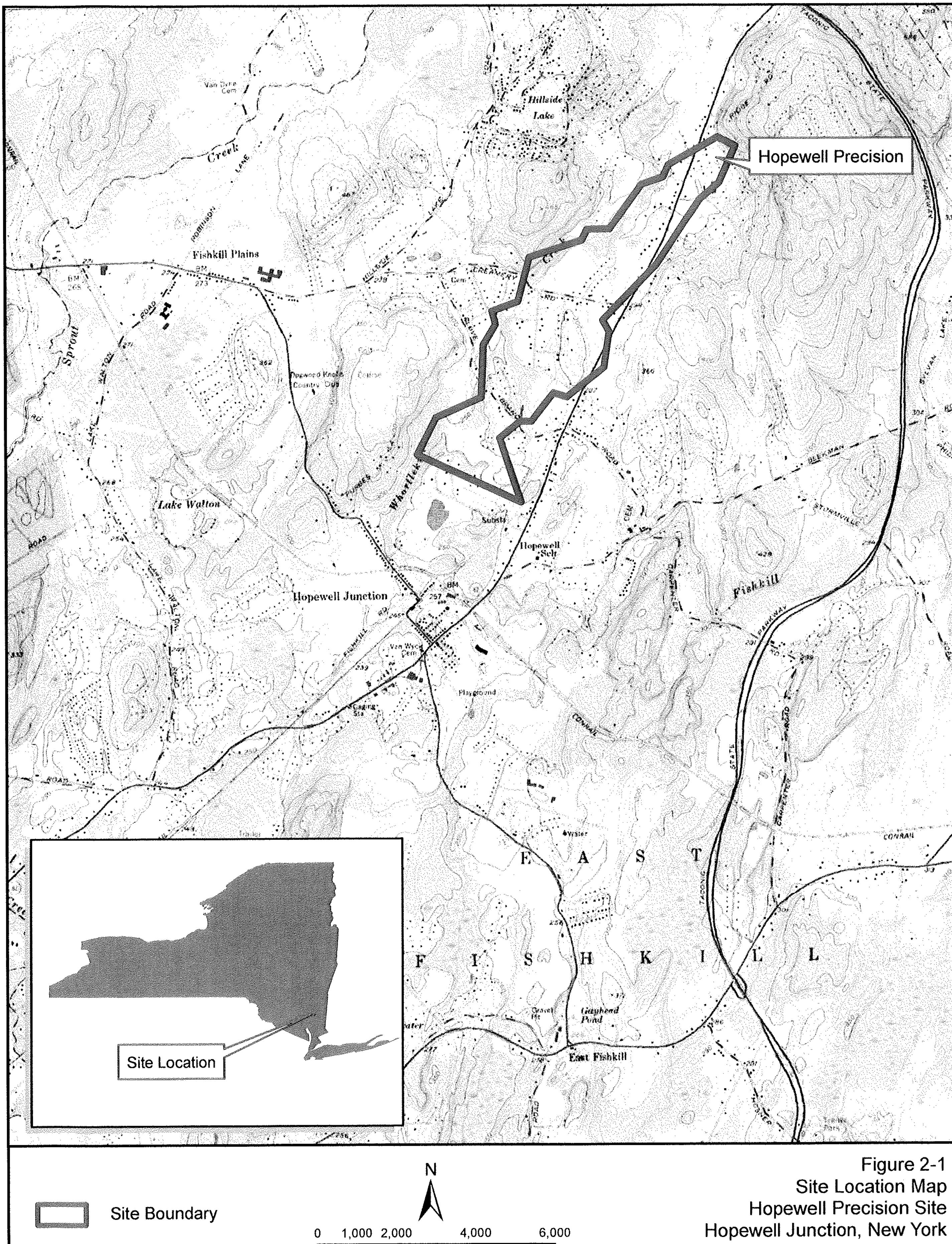
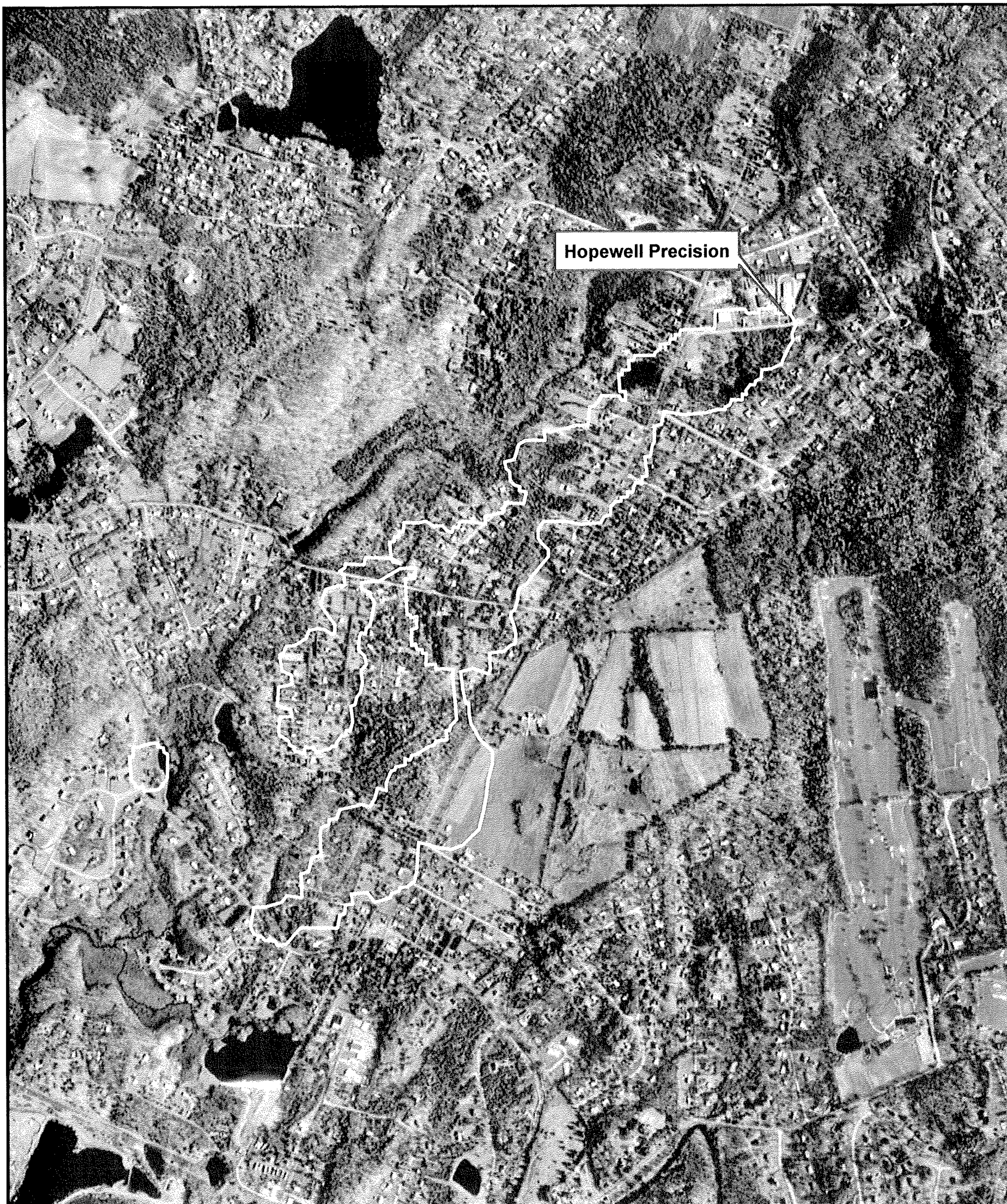



Figure 2-1
Site Location Map
Hopewell Precision Site
Hopewell Junction, New York

CDM



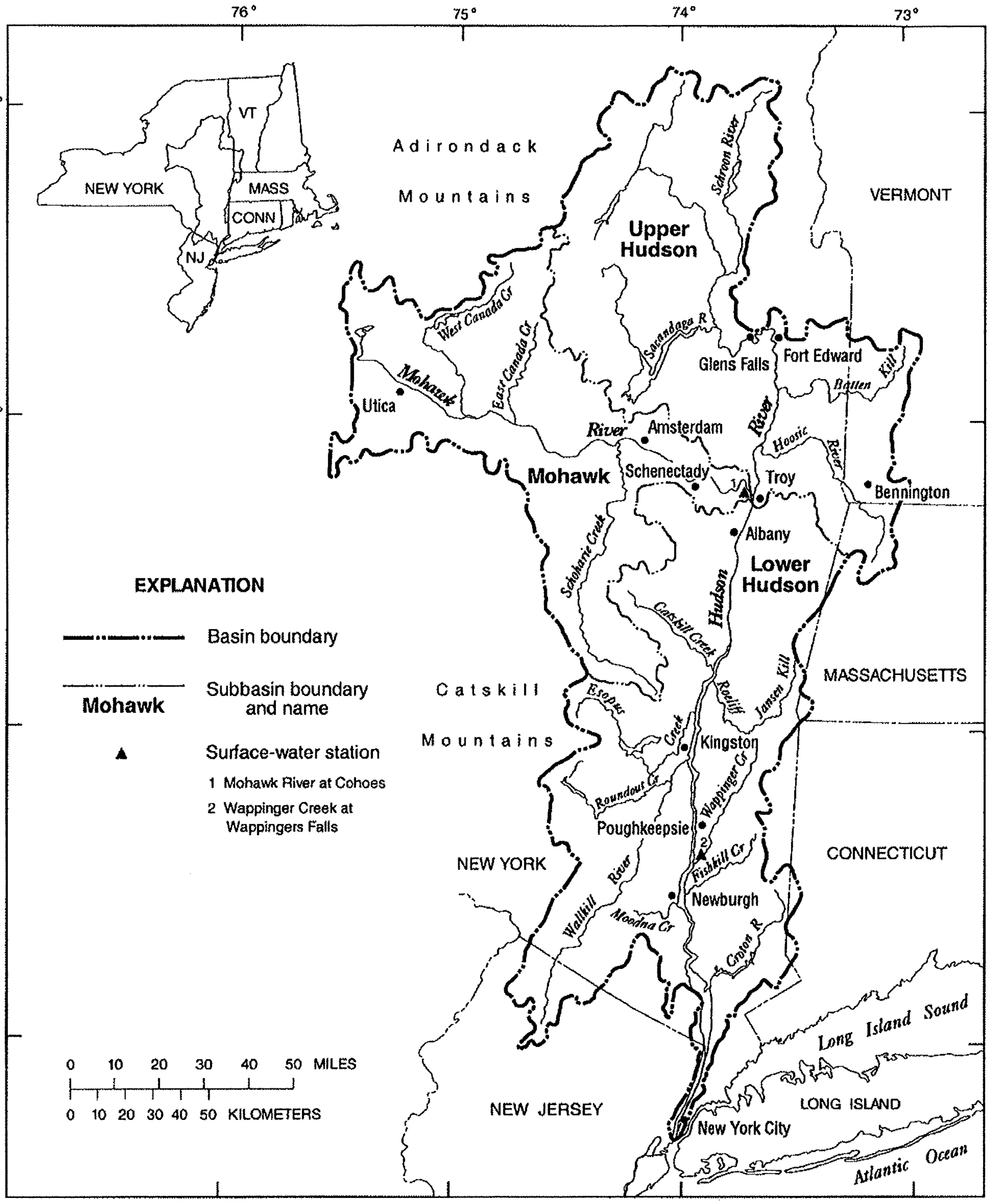

Groundwater TCE Plume

N

0 250 500 1,000 1,500 2,000 Feet

Figure 2-2
Site Map With TCE Plume
Hopewell Precision Site
Hopewell Junction, New York

CDM




Base from U.S. Geological Survey digital data 1:2,000,000, 1972
Albers Equal-Area Conic projection
Standard parallels 29° 30' and 45° 30', central meridian -74°

Figure 3-1
Surface Water Drainage
Hopewell Precision Site
Hopewell Junction, New York

CDM

Geologic units in Dutchess County and their water-bearing properties

| Class | Age | Geologic Unit | | Maximum thickness (feet) | Character of material | Water-bearing properties |
|---|---|---|---|---|---|---|
| Unconsolidated deposits | Recent | | Alluvium | 30± | Clay, silt sand, and gravel deposited by present-day streams in lakes, swamps, and on flood plains. | Not important as source of water because of limited thickness and restriction to discontinuous areas adjacent to streams. Potentially important, however, in larger valleys where coarse-grained material permits induced infiltration from nearby streams. |
| | Pleistocene | Stratified drift | Sand and gravel | 200 | Irregularly interbedded and interlensing sand and gravel formed by glacial melt-water streams. | Most productive source of ground water in county, though restricted in areal extent to portions of main stream valleys. Yields moderate to large supplies from properly constructed wells. Water moderately hard in parts of the valleys underlain by Stockbridge limestone. |
| | | | Lacustrine deposits | 200 | Clay and silt deposited in glacial lakes. | Yields little water. Generally acts as a confining bed where underlain by permeable deposits. |
| | | Unstratified drift | Till | 150 | Heterogeneous mixture of boulders and clay deposited by glacial ice. In places, contains small lenses of sand and gravel. Locally called "hardpan." | Generally thin and impermeable but yields small supplies to wells of large diameter. |
| Consolidated rocks | Late (?) and Middle Ordovician | | Hudson River formation | 3,000+ | Shale or slate, chiefly gray or black but locally red, purple, and green. Contains beds of grit, limestone, limestone conglomerate, and black chert. Metamorphosed to phyllite and in east to schist. | Most extensive bedrock formation in county. Yields average 16 gpm. Water moderately soft and fairly low in dissolved solids, but hydrogen sulfide reported in some wells. |
| | Ordovician and Cambrian | | Stockbridge limestone | 1,000± | White, blue, and gray limestone and dolomite metamorphosed to marble in east. Veins of calcite and quartz common. | Chiefly restricted to valley areas. Most productive bedrock formation; yields average 22 gpm and range widely from 0 to 220 gpm. Water moderately hard and relatively high in dissolved solids. |
| | Early Cambrian | | Cheshire quartzite | 600± | Strong, compact rock composed almost entirely of quartz. Generally white except locally, where impurities result in buff or pink color. | Unimportant as a source of ground water because of small areal extent. Yields of five wells in southern part of county average 10 gpm. |
| | Precambrian | | Undifferentiated granite and gneiss | Unknown | Banded black and white gneiss and gray or pink granite. Chief minerals feldspar and quartz. Locally contains basic dikes, quartz veins, and minor amounts of schist and marble. | Principally restricted to southern part of county. Yields of wells average 11 gpm. Water generally soft and low in dissolved solids. |

Figure 3-2
Stratigraphic Formations
Hopewell Precision Site
Hopewell Junction, New York

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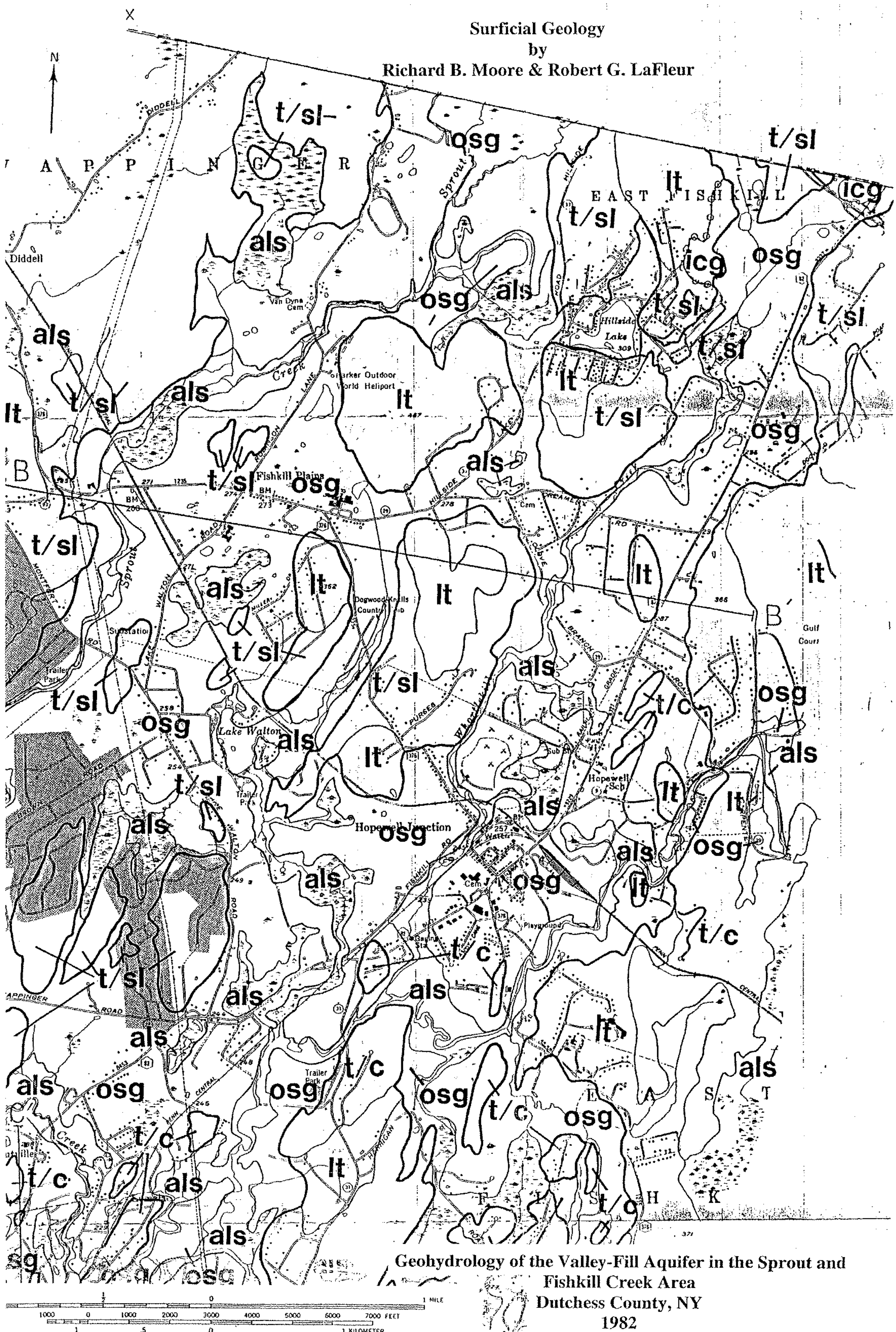



| | |
|---|---|
| B——B' | Location of Figure 3-4 cross-section |
| **als** | Geology abbreviations defined in Figure 3-4 |

Figure 3-3
Surface Geology and Location of Cross-Section
Hopewell Precision Site
Hopewell Junction, New York

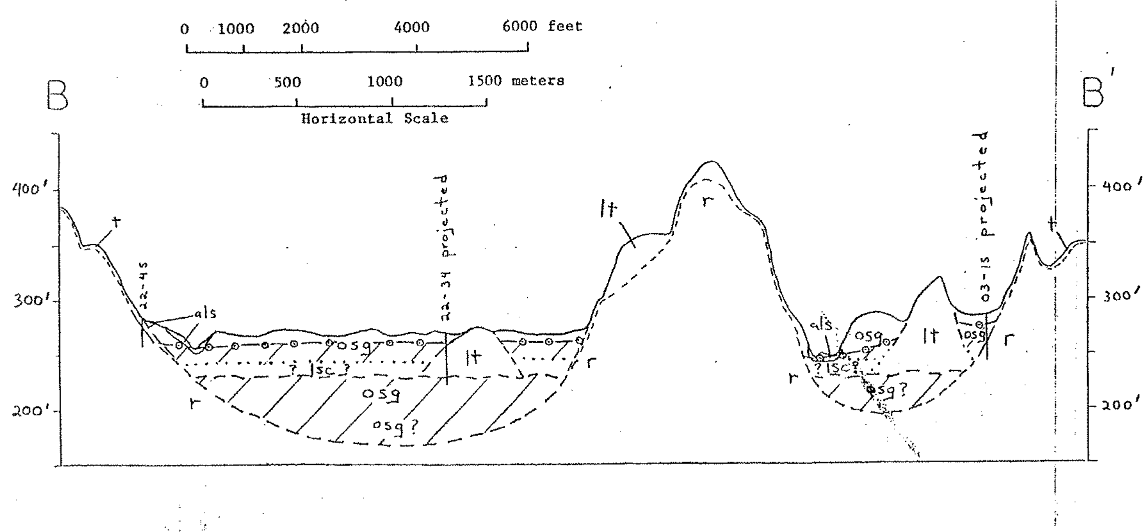
CDM

**Geohydrology of the Valley-Fill Aquifer in the Sprout and Fishkill Creek Area**
**Dutchess County, NY**
**1982**

**Geologic Sections**
**by**
**Richard B. Moore & Robert G. LaFleur**

Datum is sea level

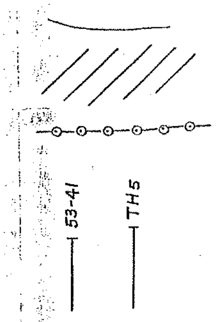
Vertical exaggeration X 20




EXPLANATION

QUARTERNARY

| | |
|---|---|
| als | Alluvial silt and sand; flood plain, swamp, and bog deposits; low permeability where silty, moderate permeability where sandy |
| alg | Alluvial sand and gravel; alluvial-fan deposits; high permeability |
| lsc | Lacustrine silt and some clay; glacial-lake deposits; low permeability |
| osg | Outwash sand and gravel; coarse outwash in the north, grading to fine to the south; high permeability |
| icg | Ice-contact sand and gravel, some silt; kames, kame terraces, eskers and kame deltas; high permeability |
| lt | Lodgement till; thick deposits of lodgement till; low permeability |
| t | Till, undifferentiated; generally thinner than 10 feet with occasional bedrock exposures; low permeability where clayey, moderate permeability where sandy |
| r | Bedrock, undifferentiated; generally low permeability (fractured bedrock can be more permeable, especially carbonate bedrock where permeability is highly variable, depending upon extent of fracturing) |




GEOLOGIC CONTACT--dashed where approximately located - dotted where the existence of a geologic unit is inferred

PRINCIPAL AQUIFER

WATER TABLE--approximately coincides with contact between geologic units als and osg in section D-D'

WELL--with seconds of latitude - longitude (example, 53-41) or local test hole number (example, TH5)

Figure 3-4
Cross-Section
Hopewell Precision Site
Hopewell Junction, New York

CDM

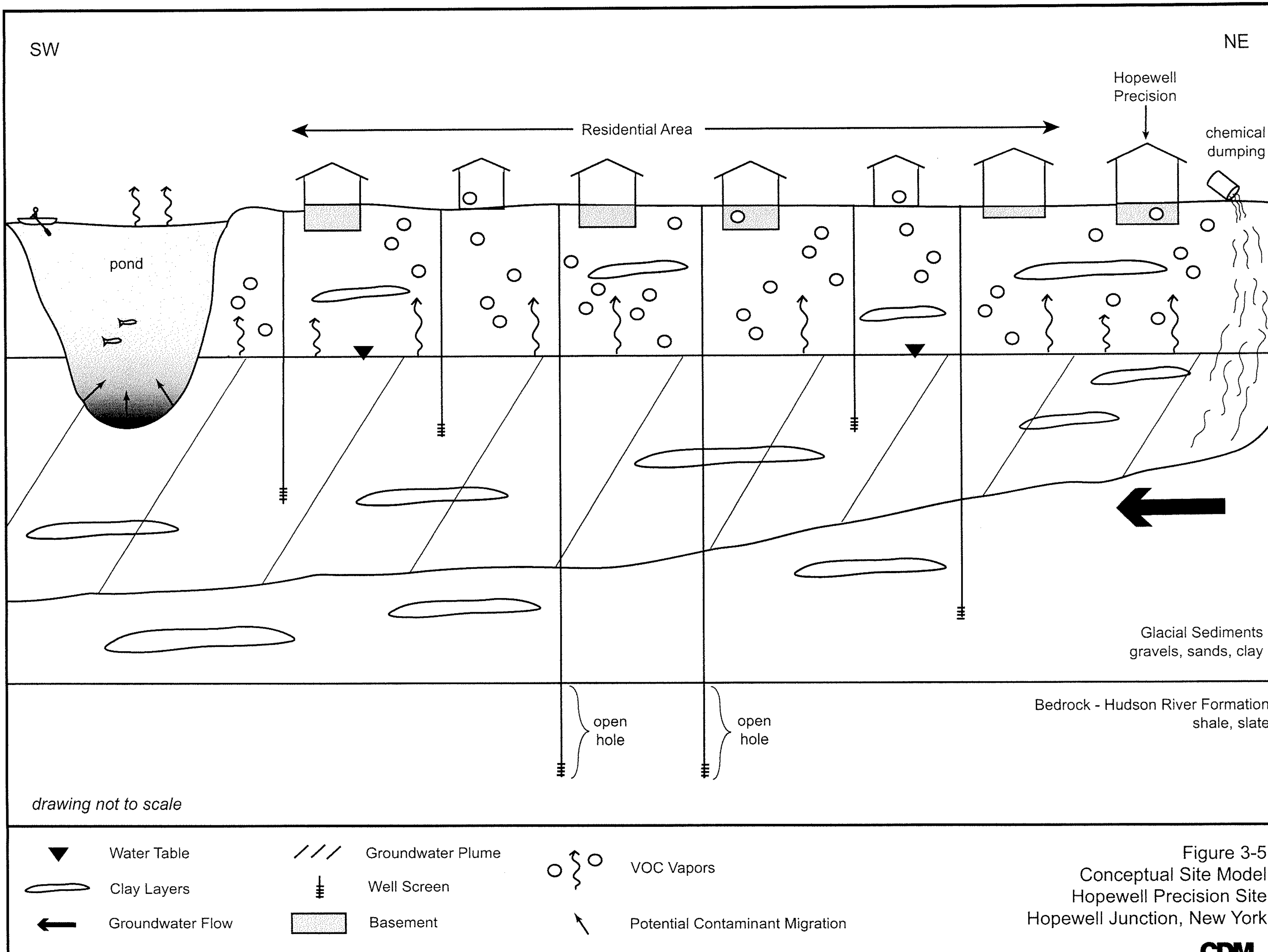
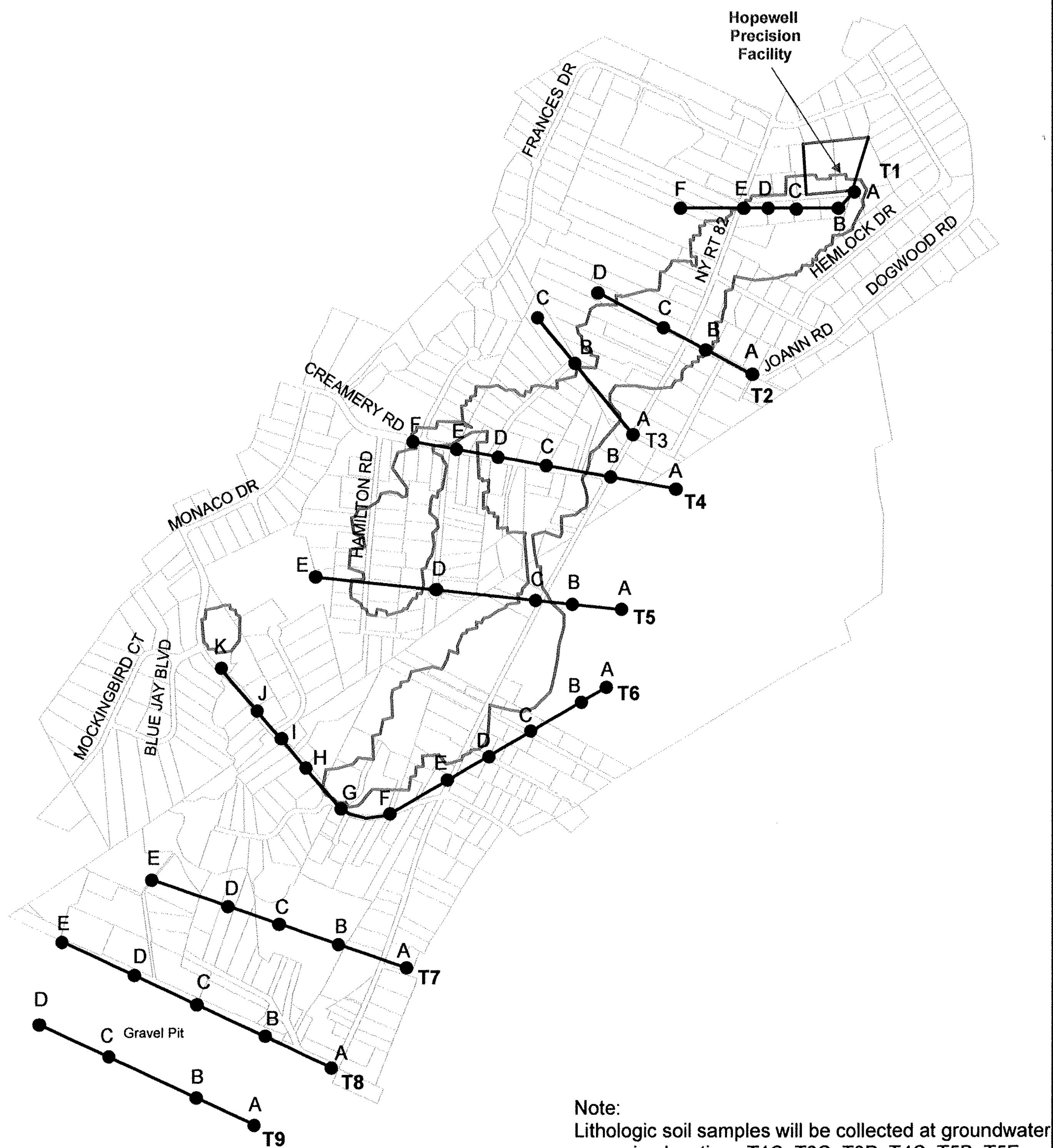



Figure 3-5
Conceptual Site Model
Hopewell Precision Site
Hopewell Junction, New York




Note:
Lithologic soil samples will be collected at groundwater screening locations T1C, T2C, T3B, T4C, T5B, T5E, T6C,T6H, T7C, T8C and T9C.

The TCE plume outline was provided by the EPA Removal Branch and is based on 2003 data

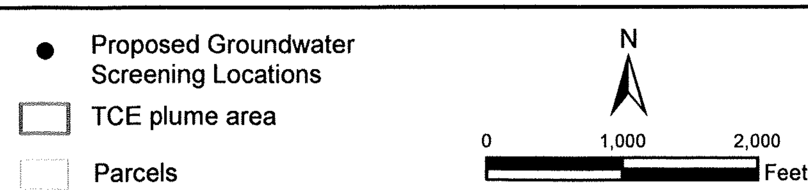



Figure 5-1
Proposed Groundwater Screening Locations
Hopewell Precision Site
Hopewell Junction, New York

CDM


Note:
The TCE plume outline was provided by the EPA Removal Branch and is based on 2003 data

● Proposed Monitoring Well Cluster Location (final depths and locations to be determined based on ground water screening results)

TCE plume area

Parcels

N

0 1,000 2,000 Feet

Figure 5-2
Proposed Monitoring Well Locations
Hopewell Precision Site
Hopewell Junction, New York

CDM

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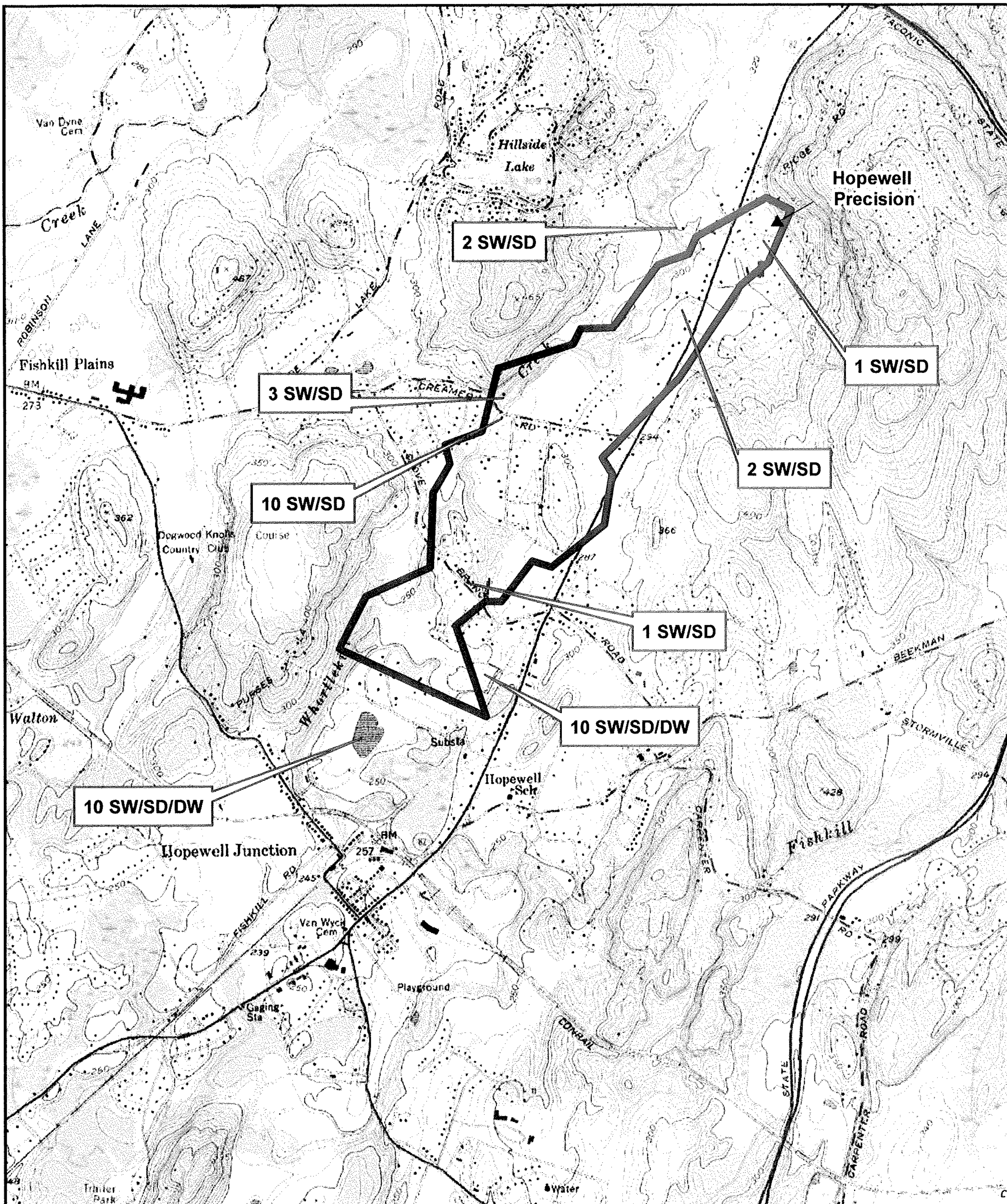
△ Proposed Source Area Soil Sampling Locations

N

0 25 50 100 150 200 Feet

Figure 5-3
Proposed Source Area Soil Sampling Locations
Hopewell Precision Site
Hopewell Junction, New York

CDM




SW - Surface Water
SD - Sediment
DW - Deep Water

Site Boundary

N

0 750 1,500 3,000 4,500 Feet

Figure 5-4
Proposed Surface Water/ Sediment Sample Locations
Hopewell Precision Site
Hopewell Junction, New York

CDM


Round 1 and 2 Sub-Slab Air Sampling Locations

Round 1 Sub-Slab Air Sampling Locations

Parcels

Figure 5-5
Sub-Slab Air Sampling Locations
Hopewell Precision Site
Hopewell Junction, New York

CDM

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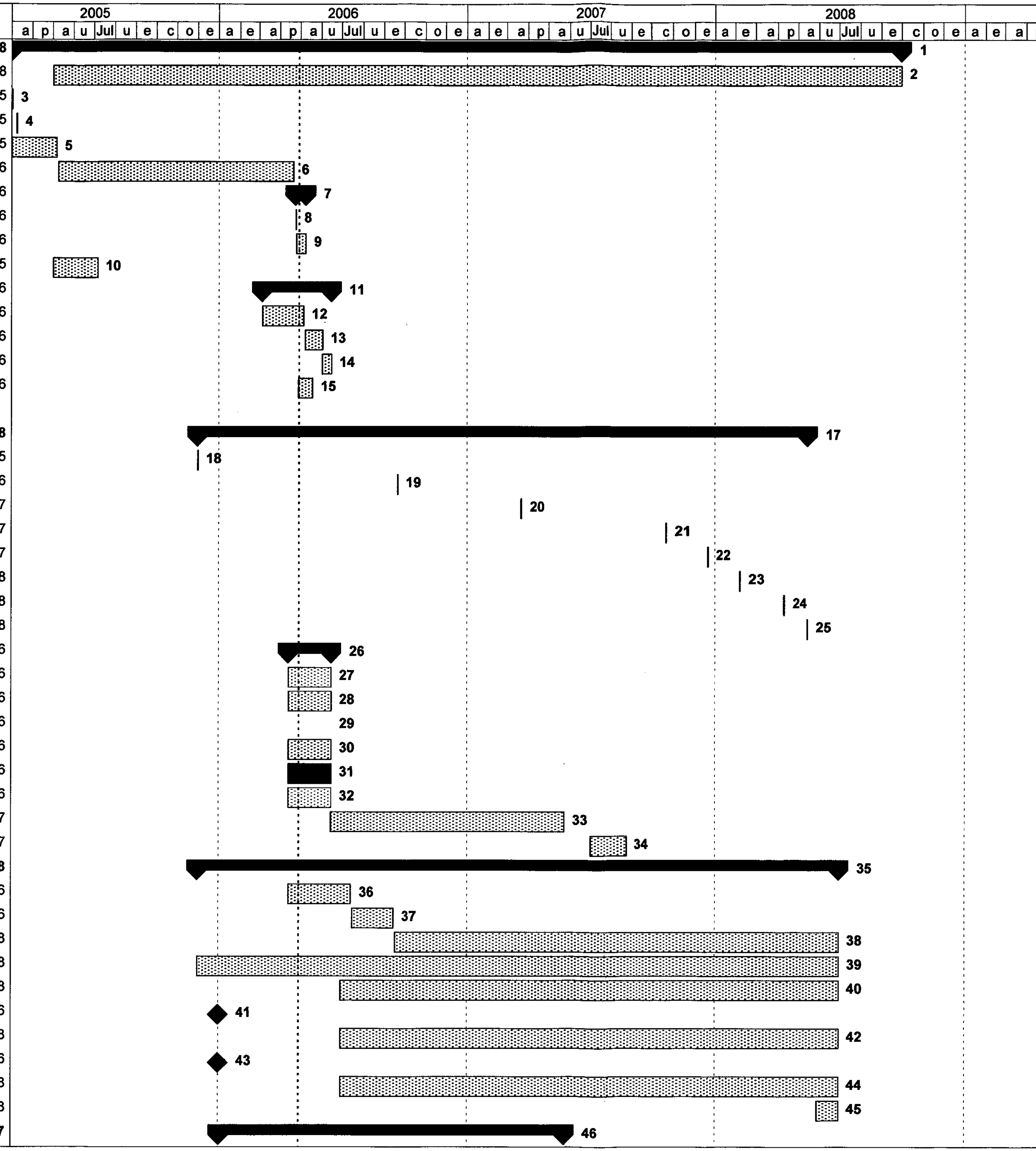
Hopewell Precision Site

| ID | | Task Name | Duration | Start | Finish |
|---|---|---|---|---|---|
| 1 | | **TASK 1 Project Planning & Support** | **935 days** | **Wed 3/2/05** | **Tue 9/30/08** |
| 2 | | 1.1 Project Administation | 892 days | Mon 5/2/05 | Tue 9/30/08 |
| 3 | | 1.2 Attend Scoping Meeting | 1 day | Wed 3/2/05 | Wed 3/2/05 |
| 4 | | 1.3 Conduct Site Visit | 1 day | Wed 3/9/05 | Wed 3/9/05 |
| 5 | | 1.4 Develop Draft Work Plan and Associated Cost Estimate | 48 days | Wed 3/2/05 | Fri 5/6/05 |
| 6 | | EPA Review of Draft Work Plan | 249 days | Mon 5/9/05 | Thu 4/20/06 |
| 7 | | 1.5 Negotiate and Revise Draft Work Plan/Budget | 11 days | Mon 4/24/06 | Mon 5/8/06 |
| 8 | | Negotiate Budget | 1 day | Mon 4/24/06 | Mon 4/24/06 |
| 9 | | Prepare/Submit Final Work Plan | 10 days | Tue 4/25/06 | Mon 5/8/06 |
| 10 | | 1.6 Evaluate Existing Data and Documents | 48 days | Mon 5/2/05 | Wed 7/6/05 |
| 11 | | 1.7 Quality Assurance Project Plan | 74 days | Mon 3/6/06 | Thu 6/15/06 |
| 12 | | Prepare/Submit Draft QAPP | 45 days | Mon 3/6/06 | Fri 5/5/06 |
| 13 | | EPA Review | 20 days | Mon 5/8/06 | Fri 6/2/06 |
| 14 | | Prepare/Submit Final QAPP | 10 days | Fri 6/2/06 | Thu 6/15/06 |
| 15 | | 1.8 Health & Safety Plan | 15 days | Fri 4/28/06 | Thu 5/18/06 |
| 16 | | 1.9 Non-RAS Analyses (Not Applicable) | | | |
| 17 | | **1.10 Meetings** | **641 days** | **Thu 12/1/05** | **Thu 5/15/08** |
| 18 | | First Meeting | 1 day | Thu 12/1/05 | Thu 12/1/05 |
| 19 | | Second Meeting | 1 day | Thu 9/21/06 | Thu 9/21/06 |
| 20 | | Third Meeting | 1 day | Thu 3/22/07 | Thu 3/22/07 |
| 21 | | Fourth Meeting | 1 day | Mon 10/22/07 | Mon 10/22/07 |
| 22 | | Fifth Meeting | 1 day | Fri 12/21/07 | Fri 12/21/07 |
| 23 | | Sixth Meeting | 1 day | Fri 2/8/08 | Fri 2/8/08 |
| 24 | | Seventh Meeting | 1 day | Thu 4/10/08 | Thu 4/10/08 |
| 25 | | Eighth Meeting | 1 day | Thu 5/15/08 | Thu 5/15/08 |
| 26 | | 1.11 Subcontract Procurement | 45 days | Fri 4/14/06 | Thu 6/15/06 |
| 27 | | Topographic Survey | 45 days | Fri 4/14/06 | Thu 6/15/06 |
| 28 | | Drilling Services | 45 days | Fri 4/14/06 | Thu 6/15/06 |
| 29 | | Cultural Resources | 45 days | Fri 4/14/06 | Thu 6/15/06 |
| 30 | | Analytical Laboratory | 45 days | Fri 4/14/06 | Thu 6/15/06 |
| 31 | | Waste Hauling and Disposal | 45 days | Fri 4/14/06 | Thu 6/15/06 |
| 32 | | Aquatic Survey Services | 45 days | Fri 4/14/06 | Thu 6/15/06 |
| 33 | | 1.12 Perform Subcontract Management | 246 days | Thu 6/15/06 | Thu 5/24/07 |
| 34 | | 1.13 Pathway Anaysis Report (PAR) | 40 days | Mon 7/2/07 | Fri 8/24/07 |
| 35 | | **TASK 2 Community Relations** | **673 days** | **Thu 12/1/05** | **Mon 6/30/08** |
| 36 | | 2.1 Community Interviews | 66 days | Fri 4/14/06 | Fri 7/14/06 |
| 37 | | 2.2 Community Relations Plan | 45 days | Mon 7/17/06 | Fri 9/15/06 |
| 38 | | 2.3 Public Meeting Support | 466 days | Mon 9/18/06 | Mon 6/30/08 |
| 39 | | Public Meetings # 1 through #6 | 673 days | Thu 12/1/05 | Mon 6/30/08 |
| 40 | | 2.4 Fact Sheet Preparation | 522 days | Fri 6/30/06 | Mon 6/30/08 |
| 41 | | 2.5 Proposed Plan Support (Not Applicable) | 0 days | Sun 1/1/06 | Sun 1/1/06 |
| 42 | | 2.6 Public Notices | 522 days | Fri 6/30/06 | Mon 6/30/08 |
| 43 | | 2.7 Information Repositories (Not Applicable) | 0 days | Sun 1/1/06 | Sun 1/1/06 |
| 44 | | 2.8 Site Mailing List | 522 days | Fri 6/30/06 | Mon 6/30/08 |
| 45 | | 2.9 Responsiveness Summary Support | 22 days | Fri 5/30/08 | Mon 6/30/08 |
| 46 | | **TASK 3 Field Investigation** | **364 days** | **Mon 1/2/06** | **Thu 5/24/07** |

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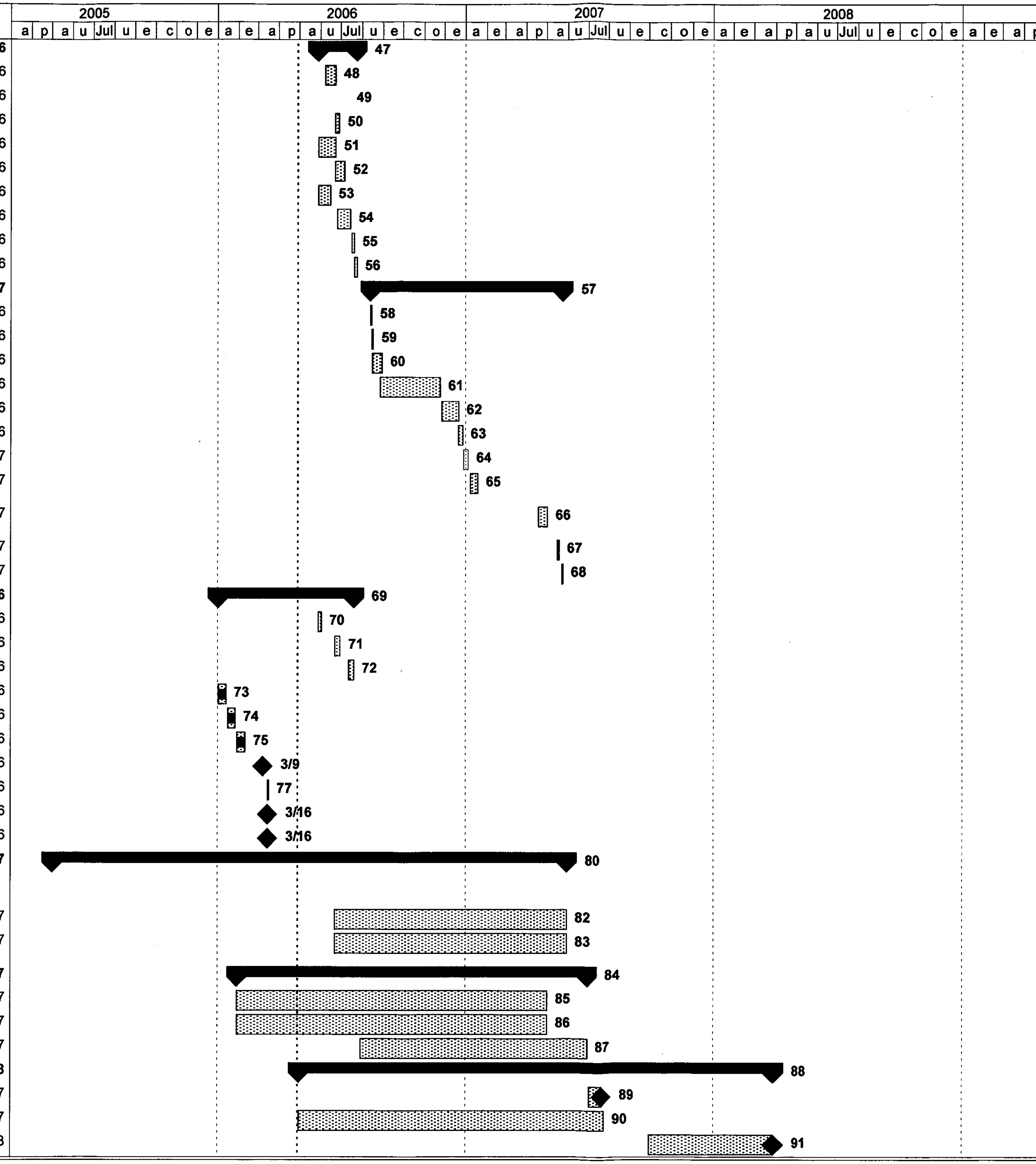
Project: Figure 6-1_Schedule_SS-yes
Date: Fri 4/28/06

Task | Split | Progress | Milestone | Summary | Project Summary



Figure 6-1
Project Schedule Hopewell Precision Site
Hopewell Junction, New York

| ID | | Task Name | Duration | Start | Finish |
|---|---|---|---|---|---|
| 47 | | **Stage I** | **41 days** | **Mon 5/29/06** | **Mon 7/24/06** |
| 48 | | Mobilization | 12 days | Thu 6/8/06 | Fri 6/23/06 |
| 49 | | Cultural Resources Survey | 1 day | Tue 7/11/06 | Tue 7/11/06 |
| 50 | | Site Preparation | 4 days | Fri 6/23/06 | Wed 6/28/06 |
| 51 | | Site Access Support (for Round 1 Residential Well Sampling) | 20 days | Mon 5/29/06 | Fri 6/23/06 |
| 52 | | Residential Well Sampling (Round 1) | 10 days | Fri 6/23/06 | Thu 7/6/06 |
| 53 | | Site Access Support (Groundwater Screening) | 14 days | Mon 5/29/06 | Thu 6/15/06 |
| 54 | | Groundwater Screening | 15 days | Mon 6/26/06 | Fri 7/14/06 |
| 55 | | Source Area Subsurface Soil Sampling | 4 days | Mon 7/17/06 | Thu 7/20/06 |
| 56 | | Demobilization (Interim) | 2 days | Fri 7/21/06 | Mon 7/24/06 |
| 57 | | **Stage II** | **204 days** | **Mon 8/14/06** | **Thu 5/24/07** |
| 58 | | Mobilization | 2 days | Mon 8/14/06 | Tue 8/15/06 |
| 59 | | Site access Support (MW Installation) | 2 days | Wed 8/16/06 | Thu 8/17/06 |
| 60 | | Site Preparation | 10 days | Thu 8/17/06 | Wed 8/30/06 |
| 61 | | Monitoring Well Installation | 65 days | Mon 8/28/06 | Fri 11/24/06 |
| 62 | | Well Development | 19 days | Mon 11/27/06 | Thu 12/21/06 |
| 63 | | Aquifer Testing | 5 days | Thu 12/21/06 | Wed 12/27/06 |
| 64 | | Survey of Sample and well locations | 5 days | Fri 12/29/06 | Thu 1/4/07 |
| 65 | | Groundwater Sampling (all wells - Round 1) and Water Level Measurements | 9 days | Mon 1/8/07 | Thu 1/18/07 |
| 66 | | Groundwater Sampling (all wells - Round 2) and Water Level Measurements | 9 days | Thu 4/19/07 | Tue 5/1/07 |
| 67 | | Disposal of Field Generated Waste | 3 days | Wed 5/16/07 | Fri 5/18/07 |
| 68 | | Demobilization (Final) | 2 days | Wed 5/23/07 | Thu 5/24/07 |
| 69 | | **Season-Dependent Activities** | **144 days** | **Mon 1/2/06** | **Thu 7/20/06** |
| 70 | | Site Access Support (Surface Water/Sediment Sampling) | 5 days | Mon 5/29/06 | Fri 6/2/06 |
| 71 | | Surface Water/Sediment Sampling | 6 days | Fri 6/23/06 | Fri 6/30/06 |
| 72 | | Ecological Characterization | 6 days | Thu 7/13/06 | Thu 7/20/06 |
| 73 | ✓ | Site Access Support (for Sub-slab Sampling) | 10 days | Mon 1/2/06 | Fri 1/13/06 |
| 74 | ✓ | Installation of Sub-Slab Sampling Ports | 10 days | Mon 1/16/06 | Fri 1/27/06 |
| 75 | ✓ | Sub-Slab Vapor Sampling (Initial Sampling) | 10 days | Mon 1/30/06 | Fri 2/10/06 |
| 76 | ✓ | Site Access Support (for sub-slab and indoor air) - R2 | 0 days | Thu 3/9/06 | Thu 3/9/06 |
| 77 | ✓ | Sub-Slab Vapor Sampling - R2 | 2 days | Thu 3/16/06 | Fri 3/17/06 |
| 78 | | Indoor Air Sampling | 0 days | Thu 3/16/06 | Thu 3/16/06 |
| 79 | | Ambient Air Sampling | 0 days | Thu 3/16/06 | Thu 3/16/06 |
| 80 | | **TASK 4 Sample Analysis** | **543 days** | **Mon 5/2/05** | **Wed 5/30/07** |
| 81 | | 4.1 Innovative Methods/Field Screening Sample Analysis (Not Applicable) | | | |
| 82 | | 4.2 Analytical Services Provided Via CLP, DESA or ERTC | 244 days | Fri 6/23/06 | Wed 5/30/07 |
| 83 | | 4.3 Non-Routine Analytical Services (Subcontracted Analytical Services) | 244 days | Fri 6/23/06 | Wed 5/30/07 |
| 84 | | **TASK 5 Analytical Support & Data Validation** | **370 days** | **Mon 1/30/06** | **Fri 6/29/07** |
| 85 | | 5.1 Collect, Prepare and Ship Samples (Under Task 3.5) | 327 days | Mon 1/30/06 | Tue 5/1/07 |
| 86 | | 5.2 Sample Management | 327 days | Mon 1/30/06 | Tue 5/1/07 |
| 87 | | 5.3 Data Validation | 240 days | Mon 7/31/06 | Fri 6/29/07 |
| 88 | | **TASK 6 Data Evaluation** | **500 days** | **Mon 5/1/06** | **Fri 3/28/08** |
| 89 | | 6.1 Data Usability Evaluation | 15 days | Mon 7/2/07 | Fri 7/20/07 |
| 90 | | 6.2 Data Reduction, Tabulation, and Evaluation | 322 days | Mon 5/1/06 | Tue 7/24/07 |
| 91 | | 6.3 Modeling | 130 days | Mon 10/1/07 | Fri 3/28/08 |

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Date: Fri 4/28/06

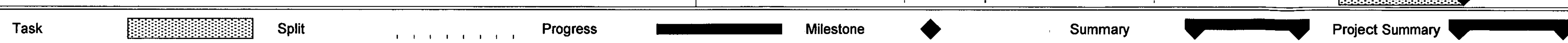
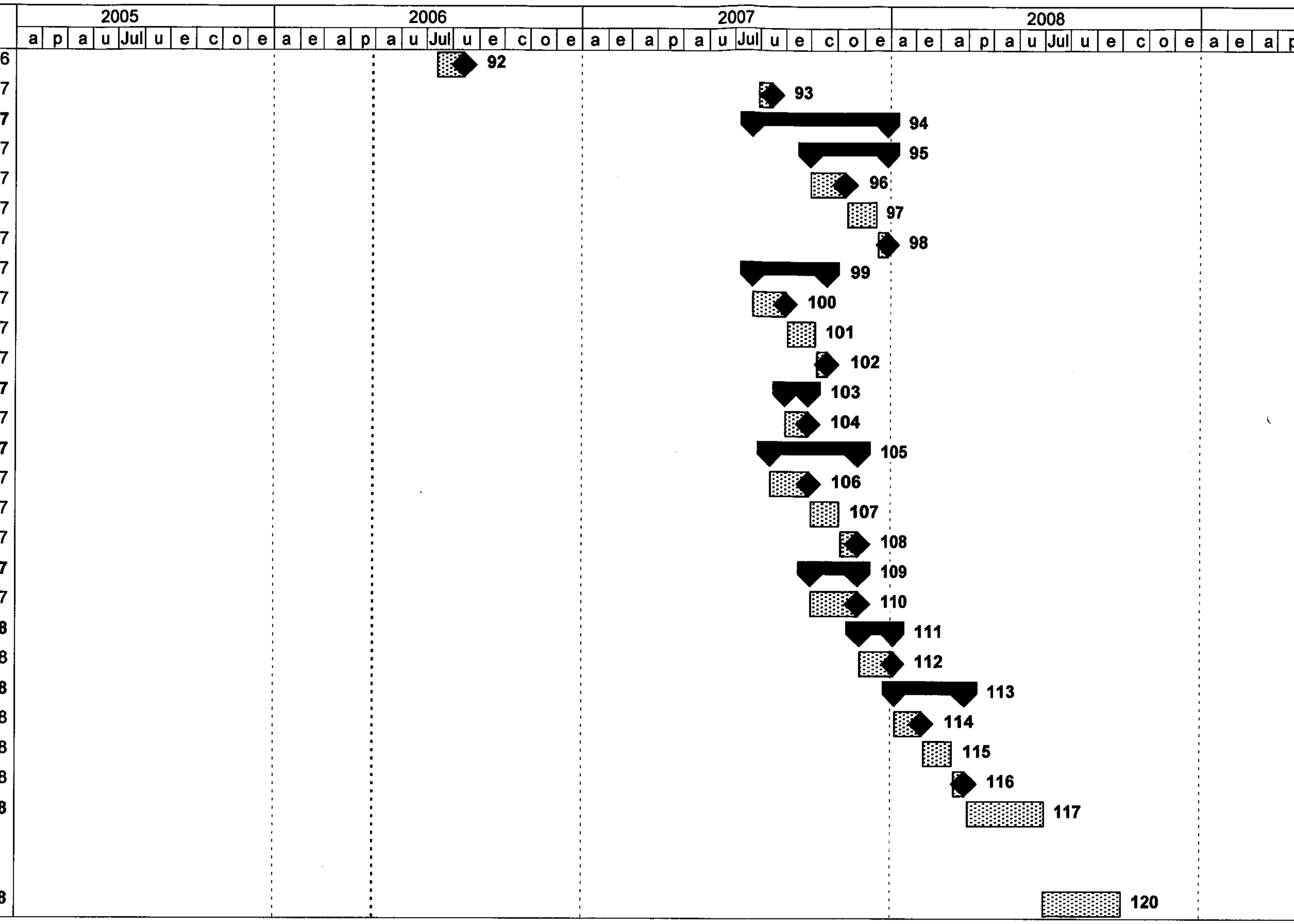





Figure 6-1
Project Schedule Hopewell Precision Site
Hopewell Junction, New York

| ID | Task Name | Duration | Start | Finish |
|---|---|---|---|---|
| 92 | 6.4 Technical Memorandum | 22 days | Fri 7/14/06 | Mon 8/14/06 |
| 93 | 6.4 Technical Memorandum | 12 days | Tue 7/31/07 | Wed 8/15/07 |
| 94 | **TASK 7 Assessment of Risk** | **115 days** | **Mon 7/23/07** | **Fri 12/28/07** |
| 95 | 7.1 Baseline Risk Assessment (Human Health) | 65 days | Mon 10/1/07 | Fri 12/28/07 |
| 96 | Prepare Draft Risk Assessment (HH) | 30 days | Mon 10/1/07 | Fri 11/9/07 |
| 97 | EPA Review of Draft Risk Assessment (HH) | 25 days | Mon 11/12/07 | Fri 12/14/07 |
| 98 | Prepare Final Risk Assessment (HH) | 10 days | Mon 12/17/07 | Fri 12/28/07 |
| 99 | 7.2 Ecological Risk Assessment (Screening Level) | 65 days | Mon 7/23/07 | Fri 10/19/07 |
| 100 | Prepare Draft Ecological Risk Assessment | 30 days | Mon 7/23/07 | Fri 8/31/07 |
| 101 | EPA Review of Draft Ecological Risk Assessment | 25 days | Mon 9/3/07 | Fri 10/5/07 |
| 102 | Prepare Final Ecological Risk Assessment | 10 days | Mon 10/8/07 | Fri 10/19/07 |
| 103 | **TASK 8 Treatability Study and Pilot Testing** | **20 days** | **Fri 8/31/07** | **Thu 9/27/07** |
| 104 | 8.1 Literature Search | 20 days | Fri 8/31/07 | Thu 9/27/07 |
| 105 | **TASK 9 Remedial Investigation Report** | **75 days** | **Mon 8/13/07** | **Fri 11/23/07** |
| 106 | Prepare Draft RI Report | 7 wks | Mon 8/13/07 | Fri 9/28/07 |
| 107 | EPA Review of Draft RI Report | 25 days | Mon 10/1/07 | Fri 11/2/07 |
| 108 | Prepare Final RI Report | 15 days | Mon 11/5/07 | Fri 11/23/07 |
| 109 | **TASK 10 Remedial Alternative Screening** | **40 days** | **Mon 10/1/07** | **Fri 11/23/07** |
| 110 | Technical Memorandum 1 | 40 days | Mon 10/1/07 | Fri 11/23/07 |
| 111 | **TASK 11 Remedial Alternative Evaluation** | **30 days** | **Mon 11/26/07** | **Fri 1/4/08** |
| 112 | Technical Memorandum 2 | 30 days | Mon 11/26/07 | Fri 1/4/08 |
| 113 | **TASK 12 Feasibility Study Report** | **60 days** | **Mon 1/7/08** | **Fri 3/28/08** |
| 114 | Prepare Draft FS Report | 5 wks | Mon 1/7/08 | Fri 2/8/08 |
| 115 | EPA Review of FS Report | 25 days | Mon 2/11/08 | Fri 3/14/08 |
| 116 | Prepare Final FS Report | 10 days | Mon 3/17/08 | Fri 3/28/08 |
| 117 | **TASK 13 Post RI/FS Support** | **65 days** | **Tue 4/1/08** | **Mon 6/30/08** |
| 118 | **TASK 14 Negotiation Support (Not Applicable)** | | | |
| 119 | **TASK 15 Administrative Record (Not Applicable)** | | | |
| 120 | **TASK 16 Work Assignment Closeout** | **67 days** | **Mon 6/30/08** | **Tue 9/30/08** |

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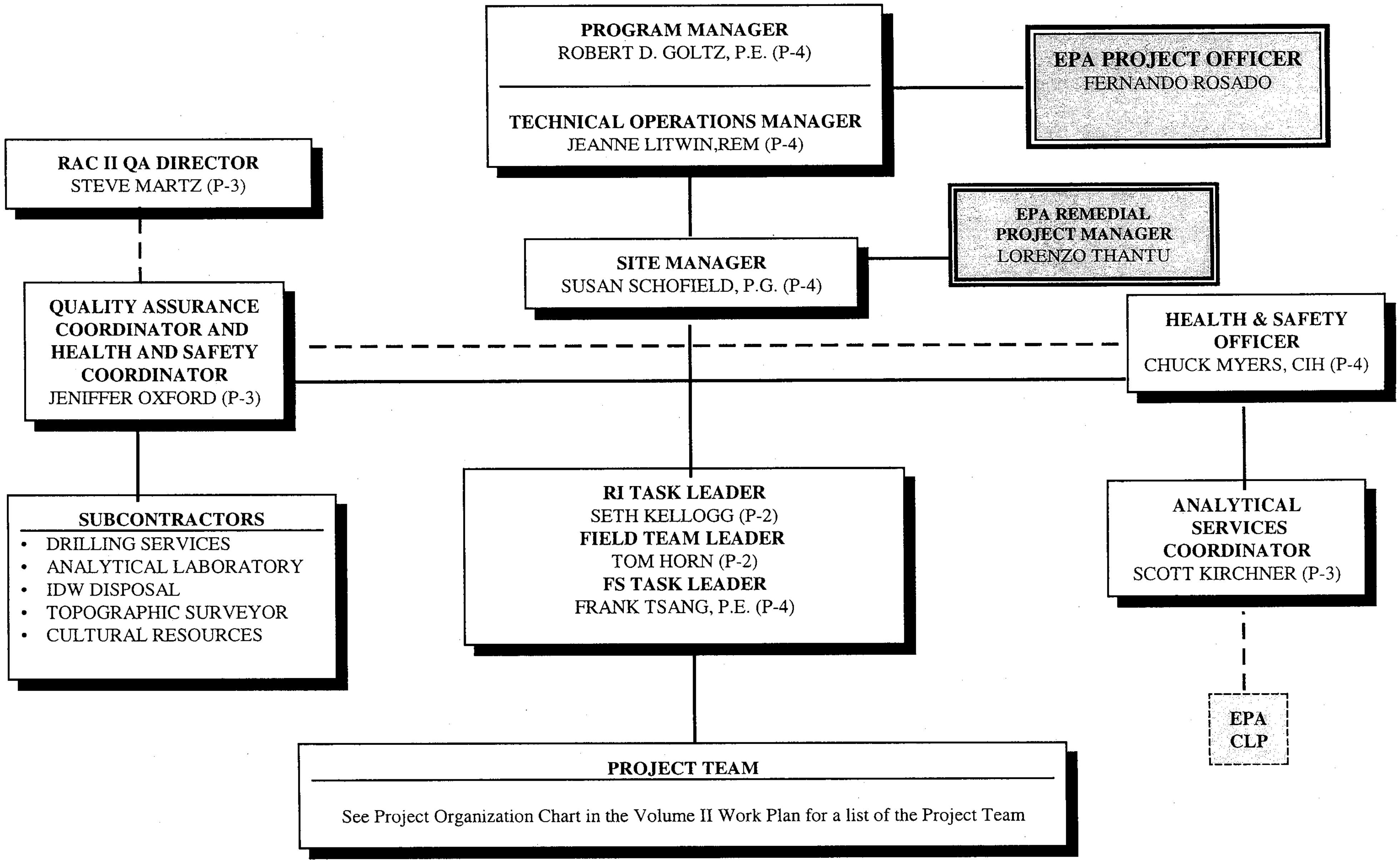
Project: Figure 6-1_Schedule_SS-yes
Date: Fri 4/28/06

Task | Split | Progress | Milestone | Summary | Project Summary



Figure 6-1
Project Schedule Hopewell Precision Site
Hopewell Junction, New York

**Figure 7-1**
**Project Organization**
**Hopewell Precision Site**
**Hopewell Junction, New York**



# Appendix A

## Data and Maps from Previous Investigations

FINAL REPORT
HOPEWELL PRECISION SITE
HOPEWELL JUNCTION, NEW YORK

JANUARY 2004

U. S. EPA Work Assignment No.: 0-330
Lockheed Martin Work Order No. R1A00330
U. S. EPA Contract No. 68-C9-223

Prepared by:

Lockheed Martin/REAC

Ken Woodruff 1/09/04
Ken Woodruff — Date
Senior Hydrogeologist

Dennis Miller 1/9/04
Dennis A. Miller — Date
Program Manager

Prepared for:

U. S. EPA/ERTC

Donald T. Bussey (CPG), Work Assignment Manager

0330-DFR-010904

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# 1.0 INTRODUCTION

## 1.1 Objectives

The objectives of this investigation were to (1) determine depth and construction details of selected domestic wells located north of Hopewell Junction, New York (NY), (2) investigate a possible correlation between well construction and contamination of some wells with volatile organic compounds (VOCs), and (3) confirm a source of the VOCs by sampling soils and groundwater in the alleged disposal area. The work was carried out by staff of the Response Engineering and Analytical Contract (REAC) under the direction of the United States Environmental Protection Agency/Environmental Response Team Center (U. S. EPA/ERTC).

## 1.2 Background

The investigation encompasses residential neighborhoods and some commercial properties located in the Town of East Fishkill, NY, approximately 2 miles north of the Village of Hopewell Junction (Figure 1). Whortlekill Creek, which drains the area, appears to be a natural hydrologic boundary and is thus the approximate western boundary of the study area. VOC contamination in domestic wells within the study area has been verified by groundwater sampling conducted under the direction of U. S. EPA Region II (Region II). The suspected source area is located on Ryan Drive just east of Route 82, and includes Nicholas Bros. Moving and the adjacent Hopewell Precision facilities. Nicholas Bros. Moving was the original site of the Hopewell Precision plant prior to the new plant being constructed in 1980.

In 1984, the New York State Department of Environmental Conservaton (NYSDEC) completed a Phase I Investigation of the original Hopewell Precision plant (now Nicholas Bros. Moving), a former sheet metal fabrication and painting operation. Wastes generated by the operation included degreasers and paint thinners that reportedly were disposed of by dumping wastes onto the ground. A Phase II Investigation was completed in 1987 and included the installation of three groundwater monitor wells (B1, B2, B3) that were screened in the glacial overburden underlying the suspected source area (Wehran Engineering, P. C., 1987). Analytical results of groundwater samples collected from the monitor wells indicated the presence of low levels of 1,1-dichloroethene (1,1-DCE), trichloroethylene (TCE), and 1,1,1-trichloroethane (1,1,1-TCA). In April 1993, additional sampling of the monitor wells by NYSDEC and the site operators detected only low levels of TCE in one of the three monitor wells. As a result of these investigations, and the apparent absence of high levels of VOCs in the groundwater beneath the facility, the site was delisted from the NYSDEC Registry of Class 2 Inactive Hazardous Waste Disposal sites in 1994.

However, a subsequent Global List Assessment Summary, prepared by Region II staff, recommended further sampling of nearby residential wells to determine if a removal action would be necessary. Consequently, a groundwater sampling program, conducted by the Region II Removal Support Team (RST) began in February 2003 and extended through August 2003. Of approximately 340 wells sampled, 44 wells were found to have TCE contamination. Treatment systems have been installed on 37 of the affected wells that had

TCE concentrations over the U. S. EPA maximum contaminant level (MCL) of 5 micrograms/liter (μg/L). Approximately 75 of the wells sampled also had detectable concentrations of 1,1,1-TCA, a possible contaminant in the original TCE fluid. However, the highest concentration of 1,1,1-TCA was approximately 12 μg/L and most concentrations did not exceed 2 to 3 μg/L. The U. S. EPA MCL for 1,1,1-TCA is 200 μg/L (U. S. EPA, 2003). Periodic sampling of selected domestic wells continues under the direction of Region II.

ERTC/REAC field activities in the study area were completed at various times between August 18, 2003 and December 4, 2003. Tasks included (1) a records search for drilling and well completion logs, (2) field measurements of both casing and well depths for those domestic wells without completion records, (3) installation of both permanent and temporary groundwater monitor wells in and near the suspected source area, (4) groundwater sampling of all monitor wells, and (5) soil sampling in the suspected source area.

### 1.3 Hydrogeology

Both well completion reports and surficial geologic mapping of the Hopewell Junction 7.5 minute quadrangle by G. Connally, under the direction of the New York State Geological Survey, indicates that the valley floors in the study area are immediately underlain by glacial fluvial sediments (Figure 2). Till deposits generally underlie local topographic highs within the valleys whereas bedrock underlies the hills to the east of the Whortlekill Valley. A prominent till deposit rises 30 to 40 feet above the valley floor on the south side of Creamery Road between Route 82 and Hamilton Drive. The thickness of the glacial sediments varies from approximately 10 feet in some places near Whortlekill Creek to over 100 feet in the central portion of the study area, east of Route 82. The glacial fluvial sediments comprise the water-table aquifer and are a highly productive groundwater source. A large number of shallow domestic wells, located both within and outside of the study area, are completed in these glacial sands and gravels, either with conventional well screens or with an open-end casing. Limited field observations indicate drawdowns are minimal when pumping the domestic wells completed in the sands and gravels. This suggests a productive aquifer with high transmissivities.

A detailed discussion of the structurally complex underlying bedrock is outside the scope of this report. Merguerian and Sanders (1992) indicate that the bedrock is composed of carbonates of the Wappinger Group (early Cambrian to early Ordovician age). However, both limestones and shales are recorded as bedrock lithologies on drilling logs from the area. The shale appears to have little primary permeability and groundwater occurs mainly in fractures. Domestic wells completed in the shales are generally 200 to 500 feet deep. Static potentiometric surfaces in the bedrock wells appear to be both higher and lower than those in the shallow overburden wells, depending on well depth and location. Well completion records indicate that, regardless of the static water levels, pumping most of the bedrock wells generally produces large drawdowns that have the potential to induce groundwater leakage from the overlying glacial sediments.

## 2.0 METHODS

### 2.1 Domestic Well Survey

The results of the domestic well sampling, carried out by the RST for Region II, indicate that TCE contamination is present mainly in shallow wells completed in the glacial sediments and also in a few deeper wells completed in bedrock. The depth and well construction details of many of the domestic wells in the study area were unknown. It was thus not clear if the contamination had reached the bedrock by natural downward vertical flow or was entering the bedrock wells through deficiencies in well construction. Therefore, REAC staff completed a field survey of approximately 200 domestic wells from August 20 through 29, 2003. Initial contact with home owners for entry permission was obtained by Region II personnel or their contractors. Follow-up contacts, where necessary, were made by REAC staff. In each domestic well, the water level, total depth, and casing depth were measured whenever possible. A weighted tape was used to measure well depths and an electronic water level meter was used to measure water levels. Casing depths were determined with a Solinst™ casing locator or with a self-potential (SP) measuring electrode system constructed by REAC personnel. Well construction factors, such as pump wiring, or the use of centralizers or torque arrestors, often made it impossible to obtain a complete set of measurements. Many wells were buried, or located in basements where the well head was not accessible. The locations of some wells were unknown. For wells in which the location was known, the well coordinates were determined, where possible, using Global Positioning System (GPS) technology. However, trees, buildings, or topography often prevented reception of GPS signals.

Prior to the field survey, approximately 45 well completion logs were obtained from the Duchess County Health Department and several more logs were gathered directly from residents during the field survey. An additional search of records in the NYSDEC was also conducted by staff of the U. S. Geological Survey office in Troy, NY through an interagency agreement with Region II. Wells having documented completion reports were not visited in the field except to obtain GPS locations. All available well data is compiled in Appendix A.

### 2.2 Installation of Permanent Monitor Wells

During September 2 through 17, 2003, six 2-inch diameter groundwater monitor wells were installed in the suspected source area (Figure 3) by a water-well drilling contractor using hollow-stem augers. While advancing the borings for the monitor wells, standard split-spoon soil samples were taken at selected depth intervals, generally every five feet, depending on the need for lithologic information at the particular location. Upon retrieval, split-spoon soil cores were screened with a photoionization detector (PID) and soil samples were taken at selected depths for analysis of VOCs. Descriptive logs of the borings can be found in Appendix B.

Wells were completed with two-inch nominal diameter Schedule 40 polyvinylchloride (PVC) casing and 20 to 30 feet of No. 10 slot PVC screen. A filter pack extended from the borehole total depth to approximately two feet above the screen, and was capped with a two-foot thick bentonite seal. The annular space above the bentonite seal to the ground surface was filled with either natural formation material or grout. Total well depths ranged from 64 to 78 feet below ground surface (bgs). The target depth was the top of consolidated bedrock but drilling refusal occurred in all cases before bedrock was reached. All wells, except EPA-5, were completed with flush-mount casings and inner locking well caps. EPA-5 was completed with approximately two feet of stick-up and a protective outer steel casing. Screen settings for all existing monitor wells on site are given in Table 1.

All of the monitor wells installed by REAC personnel and the three wells installed by the NYSDEC, were developed by pumping with a submersible pump and dedicated tubing for approximately one hour. Turbidity levels were generally negligible at the end of the development period, except in EPA-2 which still exhibited substantial turbidity. All wells were sampled over the next 48 hours following additional purging of at least three well volumes. This additional pumping also lowered the turbidity in EPA-2 to acceptable levels. Groundwater samples were collected in 40-milliliter (mL) glass vials by adjusting the variable speed submersible pump to minimum flow. The samples were then submitted using chain of custody procedures to the REAC Laboratories in Edison, New Jersey (NJ) for analysis of VOCs.

## 2.3 Borehole Geophysical Logging

A Geonics EM-39™ borehole logger was used to log the six EPA wells using natural gamma-ray and induction logging tools. The gamma-ray tool measures the natural gamma radiation of the formation material near the borehole, whereas the induction-logging tool measures the electrical conductivity. The results from both logs can be used to determine lithology, particularly when formation samples or descriptive logs are available for comparison. For this investigation, the logging data were used to look for relatively small but laterally consistent changes in overburden lithology that might influence vertical groundwater flow.

## 2.4 Installation of Temporary Shallow Monitor Wells

A Geoprobe® direct push drilling unit was used to install 23 temporary monitor wells (PZ-1 through PZ-23) at locations both topographically upgradient and downgradient from the suspected source area from October 14 to October 21, 2003 (Figure 3). Monitor Well PZ-24 was installed on December 3, 2003 following additional soil sampling at the site (Section 2.6). The decision to concentrate efforts on the shallow sediments was made after the groundwater sampling results from the deeper EPA wells were known, as discussed in Section 3.3. All wells, except PZ-18 and PZ-24, were 20 feet deep and constructed with either 0.5-inch or one-inch inner diameter PVC casing, and six to nine feet of No. 10 slot screen (Table 1). PZ-18 was 30 feet deep and was installed as part of a well triplicate which included monitor wells PZ-3 and EPA-6 (Figure 3). The three wells were screened across different depth ranges within the overburden. Well PZ-24 was screened from 10 to 16 feet bgs, rather than from 14 to 20 feet bgs, because of problems encountered during installation.

All of the temporary wells were purged and sampled, using a peristaltic pump and dedicated tubing. Samples were sent to the REAC Laboratory for analysis of VOCs. Following sampling, the well stick-up was cut off to ground surface and the wells were capped.

### 2.5 Monitor Well Surveying

The latitude and longitude of both the permanent and temporary monitor wells, were determined in the field also using GPS technology. Relative elevations were determined with an engineering level.

### 2.6 Soil Sampling

Following a review of the groundwater sampling results from the monitor wells, additional soil sampling efforts were concentrated on the east side of the Nicholas Bros. Moving Property and the adjacent Hopewell Precision facility. From December 2 through December 3, 2003, a Geoprobe was used to install 16 continuously-cored test holes to 12 feet bgs (Figure 4). Fourteen of the test holes were designated by "TH". Two test holes, located near the northern boundary of the suspected source area were intended as "background" locations and were designated by "BG". The cores were screened with a PID upon recovery and samples were selected for VOC analysis and submitted to the REAC Laboratory, based on the screening results. Shallow Monitor Well PZ-24 was also installed immediately upon completion of the soil borings.

### 2.7 Water Level Measurements

Water levels in all monitor wells, including both the permanent and temporary wells installed by REAC personnel and the wells installed by the NYSDEC, were measured on October 23 and 24, 2003 and again on December 4, 2003. The water level data were converted to relative elevations and used to construct water level elevation maps for the glacial overburden.

## 3.0 RESULTS AND DISCUSSION

### 3.1 Domestic Well Survey

Data collected from the domestic well survey, along with the TCE concentrations for the corresponding groundwater sample collected from each well by the Region II RST, are given in Appendix A. The TCE concentrations shown are for the latest sampling event if a well was sampled more than once. (In order to protect the privacy of individual homeowners, street addresses are omitted from the data tables and are assigned a location code that is available only to U. S. EPA personnel or their contractors.) Well locations with GPS coordinates, regardless of the well completion information, are shown on Figure 2.

All but three of the wells with TCE contamination and documented well construction are shallow, with depths between approximately 25 to 40 feet bgs. Well completion logs, well performance records, or extrapolation of geologic units from nearby locations with completion logs, indicates that the shallow wells are completed in the glacial sands and gravels. Many of the shallow wells appear to be older than deeper bedrock wells, and were installed before development of newer homes or subdivisions, or before VOC contamination was known to be present. Of the three deeper wells, one well is 286 feet deep but is only cased to 80 feet bgs, probably just into the top of bedrock. This well probably induces some downward flow from the overlying glacial sediments. However, TCE concentrations in groundwater samples from this well are only 2 µg/L. A second well showed TCE concentrations of approximately 98 µg/L. The well was not accessible for depth measurement and no completion log is available. Reportedly the well is approximately 90 feet deep and thus may be open to either the glacial sediments or shallow dolomitic bedrock. The third well is 225 feet deep with casing extending to 150 feet bgs, according to the well drilling contractor (personal communication). There is no clear explanation for the occurrence of TCE in this third well at a concentration of 21 µg/L. The top of bedrock is estimated from logs of nearby wells to be approximately 100 to 120 feet bgs and appears to be immediately overlain by clayey till. The well yield (15 gallons/minute) suggests possible leakage or hydraulic connection with other recharge sources, possibly through solution channels or fractures in the bedrock.

## 3.2 Overburden Stratigraphy

Formation samples collected during drilling of the six EPA monitor wells indicate that the suspected source area is underlain predominantly by coarse glacial-fluvial sands and gravels to approximately 50 feet bgs. The sands and gravels are in turn underlain by approximately 10 feet of gray till, often containing large pieces of black phyllite or shale. In places, the till may be interbedded with several feet of a fine to medium, silty, well-sorted sand. Bedrock at the site appears to be deeper than approximately 75 to 80 feet bgs, although cores from EPA-3 suggest that the bottom of this well may be close to the top of bedrock. Descriptive logs of the samples collected for the individual borings are given in Appendix B. No formation samples were collected during the installation of the temporary shallow groundwater wells.

The geophysical log data (Appendix C) did not show consistent layering in the shallow sediments that might favor lateral over vertical groundwater flow, or, that substantially changed the interpretation of lithology as observed during drilling. The gamma-ray log did not respond to the basal till underlying the coarse glacial sands and gravels as strongly as anticipated. This suggests the till has relative low concentrations of the naturally occurring isotopes potassium-40, uranium-236, and thorium-234, that account for the gamma radiation measured by the logging tool.

Large variations in conductivity log values, noted in the upper few feet of some logs (Appendix C), are attributed to the metallic flush-mount casings. However, a large anomaly that occurs at 10 feet bgs on the formation conductivity log EPA-2 may be indicative of a nearby buried tank or pipe. On most logs, the top of the water table is marked by an increase in conductivity (shift of the logs to the right) at about 10 to 15 feet bgs.

## 3.3 Groundwater Analytical Results

TCE concentrations found in samples from the various monitor wells are plotted on Figure 5. The laboratory analytical reports can be found in Appendix D. Permanent monitor wells EPA-1 through EPA-6 were installed to sample groundwater in the lower portion of the water-table aquifer and across the interface between the coarse glacial fluvial sediments and the underlying till. It was originally thought that groundwater contaminated with TCE would migrate downward to this interface and then move laterally downgradient. However, TCE was detected only in the groundwater sample from EPA-6 at approximately 3 µg/L and not in the other five monitor wells. The focus of the groundwater investigation therefore shifted to the upper portion of the groundwater table by installing and sampling shallow monitor wells (PZ-1 through PZ-24). The analytical results (Table 1) indicated that TCE was present in 17 of the shallow monitor wells at concentrations ranging from approximately 3 to 144 µg/L. Some of the higher concentrations occurred in monitor wells PZ-2 (58 µg/L), PZ-11 (88 µg/L), PZ-14 (98 µg/L), PZ-15 (72 µg/L), PZ-16 (53 µg/L), PZ-17 (63 µg/L), and PZ-24 (144 µg/L). Monitor wells PZ-2 and PZ-24 are located on the eastern side of the Nicholas Bros. Moving facility, near the present Hopewell Precision property. The remaining wells with significant TCE concentrations are located on the south side of Ryan drive, topographically and hydrologically downgradient of the suspected source area.

No TCE was found in groundwater samples collected from shallow monitor wells located near the west end of Ryan Drive, or from the north (rear) and west sides of Nicholas Bros. Moving. Results from the triplicate set of wells (EPA-6, PZ-18, PZ-23) installed at 11 Ryan Drive, just west of Nicholas Bros. Moving, indeed suggest that TCE concentrations decrease with depth. TCE concentrations at approximately 20, 30, and 70 feet bgs were 46 µg/L, 12 µg/L, and 3 µg/L respectively.

A small amount of TCE (3.3 µg/L) was found in Monitor Well PZ-23, located near the northeast corner of the present Hopewell Precision facility. Somewhat greater amounts of TCE were found in groundwater samples collected near the front of the building along Ryan Drive. No 1,1,1-TCA was found in any of the monitor wells sampled by REAC personnel.

### 3.4 Soil Sampling Results

PID field screening of the split-spoon cores (Table 2) collected during installation of monitor wells EPA-1 through EPA-6 indicated a moderate "hit" of six parts per million (ppm) at approximately 60 feet bgs in the boring for EPA-3. However, none of the core samples analyzed (Table 2) contained VOCs above the detection limits for individual compounds. Field screening of the continuous cores collected with a Geoprobe indicated PID "hits" in test holes TH-6 through TH-9 (Figure 4) up to approximately 200 ppm. However, the analytical results indicated TCE was present in only 5 of 26 samples at concentrations not exceeding 3.7 micrograms/kilogram (µg/kg). The PID results were likely spurious, due possibly to moisture in the samples. TCE concentrations in the soil samples are shown on Table 2. All of the soil samples consisted of fine to coarse, poorly sorted sands and gravels.

### 3.5 Water-Table Elevation and Groundwater Flow

Relative elevation maps for the water table underlying the suspected source area, based on measurements made in all existing site monitor wells, are shown in Figures 6 (October 23 and 24, 2003) and 7 (December 4, 2003). Elevations are referenced to an arbitrary bench mark with an assumed elevation of 100 feet. Field data can be found in Table 3. The maps suggest that the major shallow groundwater flow component is to the south, away from the alleged source area and toward the ponds and wetlands, located approximately 300 to 500 feet south of Ryan Drive. The ponds may be groundwater discharge areas during part of the year. Areas north of the Nichols Bros. Moving and Hopewell Precision facilities were considered outside the scope of this investigation and therefore no water-table elevations are available. However, the topography and existing water-table data suggest that the suspected source area is underlain by a groundwater "high" and is generally a local groundwater recharge area. Moreover, domestic wells north of the site are not contaminated with TCE and analysis of aerial photography (Mack and Matta. 2003) does not indicate other possible source areas. Thus the ponds may act as a source of contamination during those times when the water-table falls.

Further analysis of aerial photographs (Mack and Mata. 2003) also shows that a ditch crossing the west side of the present Nicholas Bros. Moving facility has intermittently discharged surface water from the site to at least one of the ponds since around the early 1970s. It is possible that contaminated surface runoff also reached the wetlands or entered the shallow groundwater system by way of the ditch.

Site groundwater levels on December 4, 2003 were approximately one to two feet higher than during October 23 to 24, 2003, resulting in slightly different water-table configurations beneath the Nicholas Bros. Moving facility. Both water-table maps are based on fairly closely spaced measurements in time, made during a relatively wet year. During summer months or during periods of low precipitation, the water-table configuration may change even more and the ponds may also function as groundwater recharge sources, releasing water to the shallow water-table.

Although water-levels were measured in the domestic wells, the levels were not converted to groundwater elevations because elevation data were not available for the well datums (usually the top of casing). Also, the levels in the domestic wells were measured without regard to when the well was last pumped. If future work is required, water-table elevations outside of the suspected source area could probably be approximated by finding the elevations of at least some of the domestic well datums, and calculating the additional water-table elevations.

A local westerly shallow groundwater flow component must also be present, driven by the elevation of the hills rising just east of the site and Route 82. Again, the area is not within the scope of investigation and data were not sufficient to accurately map this component. From the wetland areas, shallow groundwater probably flows generally westerly or southwesterly to approximately Route 82, then south to southwesterly along the axis of the Whortlekill Valley. Whortlekill Creek may be at least a partial groundwater discharge sink, but the pattern of TCE occurrence in private wells suggests that a large component of flow is parallel to the creek. The original groundwater flow pattern may have been altered by pumping of the domestic wells located on the east side of the creek.

South of Creamery Road, groundwater flow is probably deflected, mainly southwesterly, around a large till deposit located between Hamilton Drive and Route 82 (Figure 2). Drilling logs suggest that the till is relatively impermeable and may be over 100 feet thick beneath the southwest end of Hamilton Drive. Because of the absence of sands and gravels, wells along the east side of Hamilton Drive are therefore completed in bedrock. The till also provides protection against downward vertical leakage of shallow groundwater to deeper wells.

The approximate configuration of the VOC (TCE and 1,1,1-TCA) plume in the shallow water-table aquifer, based on the geology and groundwater sampling results, is shown on Figure 2. The exact position of the plume is uncertain in those areas where domestic wells are completed in bedrock, such as in the Canterberry Court area. However, the plume is assumed to generally coincide with the occurrence of the glacial outwash, even though water quality data from the glacial sediments are not always available. The present location of the plume and the apparent groundwater flow direction suggests that the contamination may eventually extend south of Clove Branch Road, possibly as far south as Red Wing Park, a probable groundwater discharge area. However, Figure 2 indicates that fine-grained lacustrine (lake) sediments ("lsc" on Figure 2) partially underlie the valley between the southern edge of the plume and the park. The thickness and hydrologic properties of the lake sediments is unknown and therefore the effect on shallow groundwater flow is uncertain.

## 4.0 SUMMARY AND CONCLUSIONS

The results of groundwater analyses indicate the presence of TCE in the shallow water-table aquifer beneath the suspected source area at concentrations up to approximately 145 µg/L. The contamination appears to be confined to a relatively small area centered around the location of monitor wells PZ-2 and PZ-24 (Figure 5). TCE concentrations apparently decrease with depth, with the highest concentrations occurring near the top of the water-table. Thus monitor wells EPA-1 through EPA-6, and monitor wells B-1 through B-3, installed under the direction of NYSDEC, were generally located outside of the contamination plume and appear to have been screened too deep for optimum detection of VOCs. The drilling results also suggest that vertical groundwater movement to the deeper bedrock, at least beneath the suspected source area, is probably retarded by a fine-grained, relatively impermeable till that underlies the surficial sands and gravels. Data are not sufficient to determine if this is also true for the domestic well survey area. Detailed stratigraphic logs are lacking for both the surficial sands and gravels, and the bedrock. Nevertheless, it appears that contamination is presently confined to the sands and gravels of the water-table aquifer. This implies that new wells should be installed into the deep bedrock with casing extending a minimum of 50 feet into competent rock and the annular space grouted. Shallow bedrock wells extending only a few tens of feet into bedrock should be avoided.

Groundwater flow from the Nicholas Bros. Moving and Hopewell Precision facilities is generally toward the wetlands located south of Ryan Drive as determined by mapping water-table elevations in and near the site. TCE concentrations ranging between non-detect and 98 µg/L were found in groundwater samples collected from shallow monitor wells installed downgradient of the site, south of Ryan Drive. The pattern of TCE contamination in domestic wells and study of the local topography and drainage, suggests that shallow groundwater then flows generally west from the wetlands and then southwesterly near Route 82, generally parallel to Whortlekill Creek. Drilling logs, well performance, and outcrop evaluation suggest that the hydraulic conductivity of the glacial sands and gravels is high although no pump test data are immediately available.

Almost no VOCs were found in soil samples collected during this investigation. The coarse-grained surficial soils offer little or no sorption capacity to organic chemicals and contaminants appear to travel easily to the water-table. Once the alleged disposal activities ceased, vertical groundwater recharge through the shallow surficial soils above the water-table has probably flushed out any remaining VOCs.

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TABLE 1
Monitor Well Screen Depths
and TCE Concentrations in Groundwater
Hopewell Precision Site
Hopewell Junction, New York
January 2004

| Well No. | Screen Depth (feet bgs) | TCE (ug/kg) |
|---|---|---|
| B-1* | 25-40 | U |
| B-2* | 24-39 | U |
| B-3* | 25-40 | U |
| EPA-1 | 25-65 | U |
| EPA-2 | 24-64 | U |
| EPA-3 | 44-74 | U |
| EPA-4 | 38-78 | U |
| EPA-5 | 39-69 | U |
| EPA-6 | 41-71 | **2.4** |
| PZ-1 | 13.6-19.6 | U |
| PZ-2 | 12.5-18.5 | **58** |
| PZ-3 | 12.4-18.4 | **46** |
| PZ-4 | 12.6-18.6 | **30** |
| PZ-5 | 12.6-18.6 | **23** |
| PZ-6 | 12.5-18.5 | U |
| PZ-7 | 12.5-18.5 | U |
| PZ-8 | 12.5-18.5 | U |
| PZ-9 | 12.5-18.5 | **4** |
| PZ-10 | 12.5-18.5 | **27** |
| PZ-11 | 12.5-18.5 | **88** |
| PZ-12 | 12.5-18.5 | U |
| PZ-13 | 12.5-18.5 | **12** |
| PZ-14 | 9.5-18.5 | **98** |
| PZ-15 | 9.5-18.5 | **72** |
| PZ-16 | 12.5-18.5 | **53** |
| PZ-17 | 14.5-19.5 | **63** |
| PZ-18 | 26.5-29.5 | **12** |
| PZ-19 | 12.5-18.5 | **8.4** |
| PZ-20 | 12.5-18.5 | **12** |
| PZ-21 | 12.5-18.5 | U |
| PZ-22 | 12.5-18.5 | U |
| PZ-23 | 12.5-18.5 | **3.3** |
| PZ-24 | 10-16 | **144** |

TCE = trichloroethylene
bgs = feet below ground surface
ug/kg = micrograms per kilogram
* wells installed by NYSDEC
U = non-detect
bold numbers = compound detected above method detection limits

TABLE 2
TCE Concentrations in Soils
Hopewell Precision Site
Hopewell Junction, New York
January 2004

| Well No. | Depth - feet bgs | TCE ug/kg |
|---|---|---|
| EPA-3 | 55 | U |
| | 60 | U |
| | 67 | U |
| BG-1 | 0-4 | U |
| | 8-12 | U |
| BG-2 | 4-8 | U |
| TH-6 | 0-4 | U |
| | 4-8 | U |
| | 8-12 | 1.1 |
| TH-7 | 0-4 | 1.9 |
| | 4-8 | 1.9 |
| | 8-12 | U |
| TH-8 | 0-4 | U |
| TH-9 | 0-4 | U |
| | 4-8 | U |
| | 8-12 | U |
| TH-10 | 8-12 | 3.9 |
| TH-11 | 0-4 | U |
| | 4-8 | 2.4 |
| | 8-12 | U |
| TH-12 | 8-12 | U |
| TH-13 | 4-8 | U |
| TH-15 | 0-4 | U |
| | 4-8 | U |
| | 8-12 | U |
| TH-16 | 4-8 | U |
| | 8-12 | U |

U = non-detect
ug/kg = micrograms per kilogram
bgs = below ground surface

TABLE 3
Water-Table Elevation Data
Hopewell Precision Site
Hopewell Junction, New York
January 2004

| | | October 23-24, 2003 | | December 4, 2003 | |
|---|---|---|---|---|---|
| Well No. | Datum Relative Elevation - Feet | Water Level - Feet Below Datum* | Water Level Relative Elevation - Feet | Water Level - Feet Below Datum | Water Level Relative Elevation - Feet |
| B-1 | 108.20 | 16.91 | 91.29 | 15.41 | 92.79 |
| B-2 | 103.25 | 12.20 | 91.05 | 10.71 | 92.54 |
| B-3 | 108.32 | 17.15 | 91.17 | 15.50 | 92.82 |
| EPA-1 | 100.62 | 9.33 | 91.29 | 7.55 | 93.07 |
| EPA-2 | 103.23 | 11.80 | 91.43 | 9.98 | 93.25 |
| EPA-3 | 104.60 | 13.38 | 91.22 | 11.65 | 92.95 |
| EPA-4 | 104.34 | 13.05 | 91.29 | 11.50 | 92.84 |
| EPA-5 | 103.36 | 12.45 | 90.91 | 10.90 | 92.46 |
| EPA-6 | 99.06 | 8.22 | 90.84 | 6.64 | 92.42 |
| PZ-1 | 101.80 | 10.85 | 90.95 | ** | ** |
| PZ-2 | 105.29 | 14.26 | 91.03 | 12.65 | 92.64 |
| PZ-3 | 98.56 | 7.80 | 90.76 | 6.40 | 92.16 |
| PZ-4 | 103.76 | 12.90 | 90.86 | NA | NA |
| PZ-5 | 105.05 | 13.91 | 91.01 | 12.38 | 92.67 |
| PZ-6 | 103.72 | 13.52 | 90.20 | 12.80 | 90.92 |
| PZ-7 | 105.90 | 15.70 | 90.20 | 15.55 | 90.35 |
| PZ-8 | 105.63 | 14.62 | 91.01 | 13.00 | 92.63 |
| PZ-9 | 105.38 | 14.60 | 90.78 | 12.91 | 92.47 |
| PZ-10 | 96.96 | 11.75 | 85.21 | 11.00 | 85.96 |
| PZ-11 | 92.20 | 7.35 | 84.85 | 5.70 | 86.50 |
| PZ-12 | 97.30 | 12.7 ? | 84.6 ? | 11.30 | 86.00 |
| PZ-13 | 95.55 | 10.62 | 84.93 | 9.20 | 86.35 |
| PZ-14 | 88.86 | 3.30 | 85.56 | 1.75 | 87.11 |
| PZ-15 | 88.62 | 2.65 | 85.97 | 1.12 | 87.50 |
| PZ-16 | 91.71 | 6.18 | 85.53 | 4.65 | 87.06 |
| PZ-17 | 94.95 | 8.99 | 85.96 | 8.01 | 86.94 |
| PZ-18 | 98.27 | 7.45 | 90.82 | 6.00 | 92.27 |
| PZ-19 | 105.70 | 14.60 | 91.10 | 13.00 | 92.70 |
| PZ-20 | 105.40 | 15.50 | 89.90 | 12.71 | 92.69 |
| PZ-21 | 104.44 | NA | NA | 12.49 | 91.95 |
| PZ-22 | 104.70 | 13.88 | 90.82 | 12.25 | 92.45 |
| PZ-23 | 102.29 | 10.87 | 91.42 | 9.10 | 93.19 |
| PZ-24 | 105.57 | * | * | 12.96 | 92.61 |

Datum = top of casing for PZ wells, otherwise top of inner casing
Base elevation is assumed to be 100 feet at a temporary bench mark
* not installed
** destroyed
NA = not available (blocked casing)
? = value uncertain

APPENDIX A
Domestic Well Survey Data
Hopewell Precision Site
Hopewell Junction, New York
January 2004

abbreviations used on data table:

ags = feet above ground surface    CD = casing depth    Ft = feet    PPB = parts per billion

S&G = sand and gravel    TCE = Trichloroethylene    TOC = top of casing    WD = well depth

lm = limestone or dolomite    min = minimum    NA = well not available for measurement

NM = not measured because of obstruction or mechanical problems

no entry = data not available    < = less than    > = greater than    ~ = approximately    ? = uncertain

## Residential Well Location Code for Appendix A

| Code | No. | Street |
|---|---|---|
| 0 | 5 | Baris Ln. |
| 1 | 6 | Baris Ln. |
| 2 | 11 | Baris Ln. |
| 3 | 18 | Baris Ln. |
| 4 | 4 | Canterberry Ct. |
| 5 | 5 | Canterberry Ct. |
| 6 | 10 | Canterberry Ct. |
| 7 | 14 | Canterberry Ct. |
| 8 | 18 | Canterberry Ct. |
| 9 | 19 | Canterberry Ct. |
| 10 | 20 | Canterberry Ct. |
| 11 | 23 | Canterberry Ct. |
| 12 | 24 | Canterberry Ct. |
| 13 | 27 | Canterberry Ct. |
| 14 | 31 | Canterberry Ct. |
| 15 | 32 | Canterberry Ct. |
| 16 | 33 | Canterberry Ct. |
| 17 | 34 | Canterberry Ct. |
| 18 | 35 | Canterberry Ct. |
| 19 | 36 | Canterberry Ct. |
| 20 | 3 | Cavelo |
| 21 | 5 | Cavelo |
| 22 | 78 | Clove Branch |
| 23 | 91 | Clove Branch |
| 24 | 94 | Clove Branch |
| 25 | 95 | Clove Branch |
| 26 | 98 | Clove Branch |
| 27 | 99 | Clove Branch |
| 28 | 100 | Clove Branch |
| 29 | 122 | Clove Branch |
| 30 | 124 | Clove Branch |
| 31 | 126 | Clove Branch |
| 32 | 104 | Creamery Rd. |
| 33 | 106 | Creamery Rd. |
| 34 | 107 | Creamery Rd. |
| 35 | 112 | Creamery Rd. |
| 36 | 116 | Creamery Rd. |
| 37 | 119 | Creamery Rd. |
| 38 | 120 | Creamery Rd. |
| 39 | 123 | Creamery Rd. |
| 40 | 124 | Creamery Rd. |
| 41 | 130 | Creamery Rd. |
| 42 | 134 | Creamery Rd. |
| 43 | 137 | Creamery Rd. |
| 44 | 145 | Creamery Rd. |
| 45 | 146 | Creamery Rd. |
| 46 | 149 | Creamery Rd. |
| 47 | 153 | Creamery Rd. |
| 48 | 154 | Creamery Rd. |
| 49 | 161 | Creamery Rd. |
| 50 | 167 | Creamery Rd. |
| 51 | 173 | Creamery Rd. |
| 52 | 175 | Creamery Rd. |
| 53 | 191 | Creamery Rd. |
| 54 | 204 | Creamery Rd. |
| 55 | 206 | Creamery Rd. |
| 56 | 32 | Dogwood Rd. |
| 57 | 1 | Frances Dr. |
| 58 | 26 | Frances Dr. |
| 59 | 60 | Frances Dr. |
| 60 | 63 | Frances Dr. |
| 61 | 64 | Frances Dr. |
| 62 | 67 | Frances Dr. |
| 63 | 68 | Frances Dr. |
| 64 | 71 | Frances Dr. |
| 65 | 72 | Frances Dr. |
| 66 | 73 | Frances Dr. |
| 67 | 77 | Frances Dr. |
| 68 | 3 | Hamilton Dr. |
| 69 | 5 | Hamilton Dr. |
| 70 | 6 | Hamilton Dr. |
| 71 | 15 | Hamilton Dr. |
| 72 | 16 | Hamilton Dr. |
| 73 | 17 | Hamilton Dr. |
| 74 | 18 | Hamilton Dr. |
| 75 | 19 | Hamilton Dr. |
| 76 | 21 | Hamilton Dr. |
| 77 | 22 | Hamilton Dr. |
| 78 | 24 | Hamilton Dr. |
| 79 | 26 | Hamilton Dr. |
| 80 | 27 | Hamilton Dr. |
| 81 | 29 | Hamilton Dr. |
| 82 | 31 | Hamilton Dr. |
| 83 | 4 | Hamilton Rd. |
| 84 | 5 | Hamilton Rd. |
| 85 | 8 | Hamilton Rd. |
| 86 | 10 | Hamilton Rd. |
| 87 | 11 | Hamilton Rd. |
| 88 | 12 | Hamilton Rd. |
| 89 | 14 | Hamilton Rd. |
| 90 | 15 | Hamilton Rd. |
| 91 | 16 | Hamilton Rd. |
| 92 | 18 | Hamilton Rd. |
| 93 | 19 | Hamilton Rd. |
| 94 | 20 | Hamilton Rd. |
| 95 | 21 | Hamilton Rd. |
| 96 | 22a | Hamilton Rd. |
| 97 | 22b | Hamilton Rd. |
| 98 | 23 | Hamilton Rd. |
| 99 | 24 | Hamilton Rd. |
| 100 | 25 | Hamilton Rd. |

## Residential Well Data
## Hopewell Precision Site
## Hopewell Junction, New York
## January 2004

| Location Code | TCE (ppb) | Well Depth (ft-TOC) | Casing Depth (ft-TOC) | Depth to Rock (ft-TOC) | Rock Type | Overburden Type | Stick-up (ft-ags) | Pump Depth (ft-TOC) | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| 0 | | ~40 | NA | | | | NA | NA | Buried. WD - verbal |
| 1 | U | 25 (?) | NA | | | | NA | NA | Inaccessible. WD - verbal |
| 2 | U | 138.3 | 8 (min) | | | | 1.5 | ? | Jet pump. |
| 3 | U | 200 (?) | NA | | | | NA | NA | Buried. WD - verbal |
| 4 | U | 206 | 67 | 53 | shale | clay/boulders | 1.0 | 160 | Info from well record. |
| 5 | U | 145.5 | 66 | 53 | shale | clay/boulders | NM | ? | CD - could not determine. |
| 6 | U | 306 | 64 | 50 | shale | clay/boulders | 1.0 | 260 | Info from well record. |
| 7 | U | 226 | 72 | 58 | shale | clay/boulders | 1.0 | 180 | Info from well record. |
| 8 | U | 286 | 72 | 58 | shale | clay/boulders | 1.0 | 240 | Info from well record. |
| 9 | U | 406 | 70 | 56 | shale | clay/boulders | 1.0 | 360 | Info from well record. |
| 10 | U | 246 | 72 | 58 | shale | clay/boulders | 1.0 | 220 | Info from well record. |
| 11 | U | 176 | 62 | 46 | shale | clay/boulders | 1.0 | 140 | Info from well record. |
| 12 | U | 166 | 61 | 47 | shale | clay/boulders | 1.0 | 120 | Info from well record. |
| 13 | U | 206 | 62 | 46 | shale | clay/boulders | 1.0 | 160 | Info from well record. |
| 14 | U | 166 | 62 | 46 | shale | clay/boulders | 1.0 | 120 | Info from well record. |
| 15 | U | 206 | 64 | 50 | shale | clay/boulders | 1.0 | 140 | Info from well record. |
| 16 | U | 226 | 62 | 48 | shale | clay/boulders | 1.0 | 180 | Info from well record. |
| 17 | U | 86 | 62 | 48 | shale | clay/boulders | 1.0 | 60 | Info from well record. |
| 18 | U | 206 | 62 | 48 | shale | clay/boulders | 1.0 | 160 | Info from well record. |
| 19 | U | 86 | 64 | 50 | shale | clay/boulders | 1.0 | 50 | Info from well record. |
| 20 | U | 235 | 147 | 129 | | | 0.9 | | |
| 21 | U | 63 | NM | | | | NM | ? | CD (?). Downhole obstructions. |
| 22 | U | < 100 | NM | | | | NA | NM | Buried - basement. WD - verbal |
| 23 | U | 25 (?) | NA | | | | NA | NA | Buried. WD - verbal |
| 24 | U | 46.5 | NM | | | | NM | ? | |
| 25 | U | ~60 (?) | 43.5 (min) | | | | 0.2 | ? | Obstruction at 43.5 ft. WD - verbal |
| 26 | U | ~24 (?) | NA | | | | NA | NA | Inaccessible. Covered in basement. |
| 27 | U | ~156 (?) | ~100 (?) | | | | NM | ? | |
| 28 | U | 35 | NM | | | | NM | NM | |
| 29 | U | ~215 (?) | ~185 (?) | | | | 1.5 | | |

Residential Well Data
Hopewell Precision Site
Hopewell Junction, New York
January 2004

| Location Code | TCE (ppb) | Well Depth (ft-TOC) | Casing Depth (ft-TOC) | Depth to Rock (ft-TOC) | Rock Type | Overburden Type | Stick-up (ft-ags) | Pump Depth (ft-TOC) | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| 30 | 6.4 | 30(?) NA | NA | | | | NA | NA | Covered. Inaccessible. |
| 31 | U | > 27.5 | 27.5 (min) | | | | 0.6 | ? | Obstruction - 27.5 ft. |
| 32 | U | 40 | 40 | NA | | gravel | 1.0 | 25 | Info from well record. |
| 33 | 2 | 286 | 80 | 61 | shale (?) | gravel w/clay | 1.0 | ? | Info from well record. |
| 34 | U | ~140 (?) | NM | | | | NM | NM | Inaccessible (tree). WD - verbal |
| 35 | 8.5 | 40 | 40 | NA | | gravel | 1.0 | ? | Info from well record. |
| 36 | 7.4 | 40 | 40 | NA | | gravel | 1.0 | 26 | Info from well record. |
| 37 | 4.8 | ~16 | NA | | | | NA | NA | Buried. WD - verbal |
| 38 | 7.2 | NM | NM | | | | NM | NM | Not measured. |
| 39 | 48 | NM | NM | | | | NM | NM | Not measured. |
| 40 | 130 | ~33 (?) | NM | | | | < 0.0 | NM | Below slap. WD - verbal |
| 41 | 76 | 46 | NM | | | | 0.95 | NM | |
| 42 | 120 | 48 (?) | 48 (?) | | | | 0.0 | ~42 | WD - verbal |
| 43 | 37 | NM | NM | | | | NA | NM | Buried. |
| 44 | U | NM | NM | | | | | | |
| 45 | U | 205 | 172 | 152 | shale (?) | | 0.35 | ? | |
| 46 | U | NM | NM | | | | NM | NM | |
| 47 | U | 300 | > 95 | | | | 1.9 | ~95 | Obstruction at 95 ft. WD - verbal |
| 48 | U | 20.2 | NM | | | | 0.7 | ? | |
| 49 | U | NM | NM | | | | NM | NM | |
| 50 | 98 | ~92 (?) | NA | | | | NA | NA | Buried - front yard. WD - verbal. |
| 51 | U | 90 (?) | NA | | | | NA | NM | Buried-front yard. WD - verbal |
| 52 | U | 63 | 61 | NA | NA | S&G | 1.0 | ? | Info from well record. |
| 53 | | ~ 27 | NA | | | | NA | NA | Buried - WD - verbal |
| 54 | NS | 307 | 50 | 10 | shale/slate | clay w/shale | 2.0 | ? | Info from well record. |
| 55 | U | 307 | 40 | 25 | shale | clay w/shale | 2.0 | ? | Info from well record. |
| 56 | U | 130 | 122 | 122 | dolomite ls | clay/clay shale | 2.0 | 120 | Info from well record. |
| 57 | U | 280 (?) | 81 | 81 | shale (?) | ? | 1.4 | | WD and rock depth - verbal |
| 58 | NS | 56 | 36 | 36 | shale | gravel | 1.0 | | Info from well record. |
| 59 | U | 166 | 62 | 46 | shale | clay/boulders | 1.0 | | Info from well record. |
| 60 | NS | 407 | 20 | 12 | shale | S&G | 2.0 | | Info from well record. |
| 61 | U | 126 | 52 | 38 | shale | clay/boulders | 1.0 | | Info from well record. |
| 62 | NS | 266 | 31 | 5 | shale | clay/boulders | 1.0 | | Info from well record. |
| 63 | U | 67 | 60 | 52 | shale | gravel | 2.0 | | Info from well record. |
| 64 | NS | 247 | 20 | 12 | shale | ? | 2.0 | | Info from well record. |

Residential Well Data
Hopewell Precision Site
Hopewell Junction, New York
January 2004

| Location Code | TCE (ppb) | Well Depth (ft-TOC) | Casing Depth (ft-TOC) | Depth to Rock (ft-TOC) | Rock Type | Overburden Type | Stick-up (ft-ags) | Pump Depth (ft-TOC) | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| 65 | U | 62 | 60 | 37 | shale | S&G | 2.0 | | Info from well record. |
| 66 | NS | 267 | 20 | 2 | shale | NA | 2.0 | | Info from well record. |
| 67 | U | 67 | 60 | 52 | shale | S&G | 2.0 | | Info from well record. |
| 68 | U | 170 (?) | 5 (?) | | | | NA | | Buried. WD/CD - verbal |
| 69 | U | 150(?) NM | NM | | | | | | |
| 70 | U | 114 | 52 (?) | | | | 0.5 | | Obstruction at 52 ft. |
| 71 | U | 133.2 | 45 (min) | | | | 0.65 | | |
| 72 | U | ~204 | 75 (?) | | | | 1.3 | | (RST data) |
| 73 | U | 242.7 | 31 | ? | ? | ? | 1.2 | | |
| 74 | U | NM | NM | | | | | | |
| 75 | U | 146 | 100 | 85 | ls (?) | ? | 1.0 | | |
| 76 | U | 187 | 72 | 59 | ls (?) | clay | 1.8 | 140 | Info from well record. (m) |
| 77 | U | 226 | 155 | 136 | ls | clay till | 1.0 | | Info from well record. |
| 78 | NS | 246 | 120 | 111 | ls | S&G; clay @ 60' | 1.0 | | Info from well record. |
| 79 | NS | 120 (?) | 90-120 (?) | | | | NM | 90 | Well info - verbal |
| 80 | U | 137.5 | 117 (?) | | | | 0.6 | | Well under back deck. |
| 81 | U | 125.7 | 80.8 | 67 | ls (?) | | 1.35 | | |
| 82 | U | 208 | 78.6 | 65 | ls (?) | | 0.85 | | |
| 83 | U | 184.3 | 50 or TD? | | | | 0.3 | | |
| 84 | U | 61 | 55 | NA | NA | S&G | 1.0 | | Info from well record. |
| 85 | U | 102 | 60 | 57 | dolomite ls | S&G | 2.0 | | Info from well record. |
| 86 | U | 102 | 80 | 77 | dolomite ls | S&G | 2.0 | | Info from well record. |
| 87 | 67 | 25 (?) | NM | | | | NM | NM | Dug well - shallow. |
| 88 | U | 122 | 120 | 102 | ? | S&G | 2.0 | | Info from well record. |
| 89 | U | 110 (?) | NA | | | | NA | NA | Buried. WD - verbal |
| 90 | 91 | 38.0 (?) | 33.7 (?) | | | | NM | ? | Obstructions at 38.0 and 33.7 ft. |
| 91 | U | ~75-80 (?) | NM | | | | NM | NM | WD - verbal |
| 92 | U | 124 | 95 | 80 | ? | ? | 1.65 | 80 | Info from well record of owner |
| 93 | 70 | NM | NM | | | | NM | NM | Refused by owner. |
| 94 | U | ~49 (?) | 32.8 (?) | | | | 0.5 | 32.8 (?) | WD (verbal). |
| 95 | U | 189.3 | > 100 | | | | 1.0 | | |
| 96 | U | 242.8 | ~242 (?) | | | | 0.3 | | CD (verbal). |
| 97 | 22 | NM | NM | | | | | | Not measured by REAC. |
| 98 | U | NM | NM | | | | NM | NM | Covered by bush. Inaccessible. |
| 99 | U | 187 | 139 | 139 | ? | hardpan (till) | 2.0 | ? | Info from well record of owner. |

Residential Well Data
Hopewell Precision Site
Hopewell Junction, New York
January 2004

| Location Code | TCE (ppb) | Well Depth (ft-TOC) | Casing Depth (ft-TOC) | Depth to Rock (ft-TOC) | Rock Type | Overburden Type | Stick-up (ft-ags) | Pump Depth (ft-TOC) | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| 100 | 78 | NA | NA | | | | NA | NA | Buried. |
| 101 | 21 | 225 | 150 | | | | NM | | WD; CD: verbal (driller) |
| 102 | U | 146.2 | 34.2 | 23 | | | 0.7 | | |
| 103 | U | 125.7 | > 100 | | | | 1.85 | | |
| 104 | U | ~60 (?) | 37.3 | 26 | | | 1.5 | 45.5 (?) | Obstruction at 45.5 ft. WD - verbal |
| 105 | U | NM | NM | | | | | | |
| 106 | U | 57.7 | 44 (min) | | | | 1.0 | 44 (?) | Obstruction at 44 ft. |
| 107 | U | 170.5 | 64 (min) | | | | -0.5 | | Obstruction at 64 ft. |
| 108 | U | 244.2 | ? | | | | NM | | |
| 109 | U | 214.2 | 76 (?) | | | | 0.75 | | Obstruction at 76 ft. |
| 110 | U | 266 | 90 | 71 | ? | gravel; till @ 50' | 1.0 | | Info from well record. |
| 111 | U | 167 | > 100 | | | | 1.4 | | |
| 112 | U | 150(?) NM | NM | | | | | | |
| 113 | U | 450 | 150 | 132 | | | 1.5 | | WD/CD (verbal). |
| 114 | U | 130 (?) | 98 | 83 | | | 0.45 | 103 (?) | Obstruction at 103 ft. WD - verbal |
| 115 | U | 155 | > 100 | | | | 1.0 | | |
| 116 | U | 44.2 | NM | | | | 0.7 | | |
| 117 | U | 209.6 | 62.7 (min) | | | | 0.3 | | Obstruction at 62.7 ft. |
| 118 | U | ~124 | ~78 | | | | 1.4 | | |
| 119 | U | 123.4 | ? | | | | 1.15 | | CD (?). High Fe corrosion. |
| 120 | U | 105 (min) | 64.2 (min) | | | | 0.9 | | |
| 121 | U | 47.7 (min) | NM | | | | 0.9 | | Obstruction at 47.7 ft. |
| 122 | U | 130 | 90 | 75 | | | NM | | Yield: 100 gpm (from well record). |
| 123 | U | 325 | 105 | 90 | | | NM | NM | |
| 124 | 180 | 35 | NM | | | | NM | | |
| 125 | U | 132 | ~132 (?) | | | | 0.9 | | |
| 126 | 170 | 25.7 | NM | | | | 0.0 | | |
| 127 | 220 | 28.8 | NM | | | | 0.0 | 24.5 | |
| 128 | 23 | 29.4 | NM | | | | 0.75 | | |
| 129 | 81 | 142.7 | 20.3 | ? | | | 1.0 | | |
| 130 | 7 | 29.0 | NM | | | | 0.2 | | |
| 131 | 59 | 38.9 | NM | | | | 0.1 | 29 | |
| 132 | 6.2 | > 25.9 | NM | | | | 1.0 | 25.9 | |
| 133 | U | 19.8 | 19.8 (?) | | | | 0.6 | | |
| 134 | U | 29.8 | ~23 (?) | | | | 0.74 | | |

Residential Well Data
Hopewell Precision Site
Hopewell Junction, New York
January 2004

| Location Code | TCE (ppb) | Well Depth (ft-TOC) | Casing Depth (ft-TOC) | Depth to Rock (ft-TOC) | Rock Type | Overburden Type | Stick-up (ft-ags) | Pump Depth (ft-TOC) | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| 135 | U | > 25.5 | NM | | | | 0.3 | 25.5 | |
| 136 | U | 28.8 | NM | | | | 1.0 | | |
| 137 | U | > 25.3 | NM | | | | 0.75 | 25.3 | Pump at 25.3 ft. |
| 138 | U | 306 | 150 | 141 | dolomite | S&G; clay till @ 30' | 1.4 | | Info from well record. |
| 139 | U | 205 | 72 | 59 | | | 1.0 | | Info from well record of owner. |
| 140 | U | 245 | ? | | | | 1.0 | NM | WD - verbal |
| 141 | U | 40 (?) | 40 (?) | | | | 0.95 | NM | WD - verbal |
| 142 | 150 | 33.2 | NM | | | | 0.3 | ? | |
| 143 | U | 26.6 | NM | | | | NM | ? | |
| 144 | U | ~200 (?) | ~200 (?) | | | | 1.0 | ? | Cased entire length? |
| 145 | U | 30 (?) | NA | | | | NA | NA | Covered. Inaccessible. |
| 146 | U | 30-35 | NM | | | | NM | NM | WD - verbal |
| 147 | U | 240 (?) | NA | | | | NA | NA | Buried. WD - verbal |
| 148 | U | 300 (?) | 62 (min) | | | | 1.8 | ? | Obstruction at 62 ft. WD - verbal |
| 149 | U | 605 | 230 | 101 | shale | ? | 1.0 | 560 | Info from well record of owner. |
| 150 | U | 42 (?) | NM | | | | 0.0 | | Cap bolted too tight. WD - verbal |
| 151 | U | 74.7 | 46.4 (min) | | | | 0.6 | ? | Obstruction at 46.4 ft. |
| 152 | U | 40.2 (?) | NM | | | | 0.3 | 40.2 (?) | Possible obstruction at 40.2 ft. |
| 153 | U | 18 (?) | NM | | | | NA | NM | Buried - back yard. WD - verbal |
| 154 | U | 48 (?) | NM | | | | NA | NM | Buried - front yard. WD - verbal |
| 155 | U | 109.7 | 86 (min) | | | | 2.7 | | |
| 156 | U | 228 | > 100 | | | | 1.7 | | |
| 157 | U | 546 | 76 | 62 | shale | clay/boulders | 1.0 | | Info from well record. |
| 158 | 14.6 | 36 (?) | NA | | | | NA | NA | Basement (inaccessible). WD - verbal |
| 159 | 38.8 | NM | NA | | | | NA | NA | Buried. |
| 160 | 2.8 | NM | NA | | | | NA | NA | Basement (inaccessible). No info. |
| 161 | 31.6 | ~25 (?) | NA | | | | NA | NA | Basement (inaccessible). WD - verbal |
| 162 | 24 | 75(?)NM | NM | | | | NM | NM | Not measured by REAC. |
| 163 | 1.4 | 25(?) NM | NM | | | | | | Not measured by REAC. |
| 164 | U | 150-200 (?) | NA | | | | NA | NA | Buried. WD - verbal |
| 165 | U | > 151 | 24 (?) | | | | 1.0 | ? | Obstruction at 24 ft. |
| 166 | U | 226 | 208 | 161 | shale | clay/boulders | 1 | 160 | Info from well record. |
| 167 | U | 210(?) NM | NM | | | | | | |
| 168 | U | 100(?) NM | NM | | | | | | |
| 169 | 2.6 | NM | NM | | | | NM | NM | Not measured. |

Residential Well Data
Hopewell Precision Site
Hopewell Junction, New York
January 2004

| Location Code | TCE (ppb) | Well Depth (ft-TOC) | Casing Depth (ft-TOC) | Depth to Rock (ft-TOC) | Rock Type | Overburden Type | Stick-up (ft-ags) | Pump Depth (ft-TOC) | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| 170 | 67 | 40.5 (?) | NM | | | | 1.3 | 40.5 (?) | Possible obstruction at 40.5 ft. |
| 171 | U | 176(?) NM | NM | | | | | | |
| 172 | 130 | 20(?) NM | NM | | | | NA | NM | Buried. |
| 173 | 81 | 22 (bgs) | NM | | | | 0.5 | NA | Well point in basement w/ jet pump. |
| 174 | 120 | NM | NM | | | | NM | NM | Not measured by REAC. |
| 175 | 170 | 30 (?) | NM | | | | NA | NM | Buried. WD - verbal |
| 176 | U | 87 (?) | > 17 | | | | 0.2 | ? | Obstruction at 17 ft. WD - verbal |
| 177 | U | 28.7 | NM | | | | 0.8 | ? | |
| 178 | 38 | NM | NM | | | | NA | NM | Covered. Inaccessible. |
| 179 | U | 28 (?) | NM | | | | NA | NM | Covered. WD (verbal). |
| 180 | 4.1 | 32 | NM | | | | 2.15 | ? | |
| 181 | 52 | ~45 (?) | 17.7 (?) | | | | 3.0 | 17.7 (?) | Obstruction at 17.7 ft. WD - verbal |
| 182 | U | ~60 (?) | ? | | | | 0.65 | 16.6 (?) | Obstruction at 16.6 ft. WD - verbal |
| 183 | U | 39 (?) | NM | | | | NA | NM | Buried. WD -verbal |
| 184 | U | 36.2 | NM | | | | 0.9 | | |
| 185 | U | 40.7 | NM | | | | 0.55 | | |
| 186 | U | 200 | 180 | 160 | shale (?) | | 1.35 | | Info from well record of owner. (m) |
| 187 | U | 40 (?) | 40 (?) | | | | 1.5 | | WD/CD - verbal |
| 188 | U | 27.7 (?) | NM | | | | 0.85 | 27.7 (?) | Possible obstruction at 27.7 ft. |
| 189 | U | 30.7 (?) | NM | | | | 1.05 | 30.7 (?) | Possible obstruction at 30.7 ft. |
| 190 | U | 17.2 | NM | | | | NA | | Dug well. Never sampled. |
| 191 | U | ~300 | >100 | | | | < 0.0 | NA | Unused well. WD - verbal |
| 192 | U | 181.5 | 63 (?) | | | | 1.5 | | Obstruction at 63 ft. |
| 193 | 1.1 | 22.3 | NM | | | | 1.0 | | |
| 194 | U | 28.5 (min) | NM | | | | 0.2 | | Possible obstruction at 28.5 ft. |
| 195 | U | 35.7 | 18.75 | | | | 0.7 | | |
| 196 | U | 300(?) NM | NM | | | | | | |
| 197 | U | 150(?) NM | NM | | | | | | |
| 198 | U | > 235 | 29.7 | | | | 2.0 | | |
| 199 | 0.5 | ~48 (?) | ~48 (?) | | | | 0.7 | | WD/CD - verbal |
| 200 | U | 92.5 | 92.5 | | | | 0.7 | | |

**SMITH LABORATORY**
ENVIRONMENTAL TESTING
4 SCENIC DRIVE & RT. 9
HYDE PARK, NEW YORK 12538
(845) 229-6538

**COPY**

DCHD / Red Wing Park
#54474
(EPA 8021)

Dear Client:

Attached please find the report prepared by Eastern Laboratory Services concerning the chemical analysis of your sample(s).

The information contained in this report is true and accurate to the best of our ability. Smith Laboratory makes no guarantee or warranty with respect to this report and assumes no liability in excess of the amount invoiced. If you have any questions regarding its contents or if you require any further assistance, please do not hesitate to call. We look forward to serving you in the future.

Sincerely,

Anne G. Smith
Laboratory Director

Received: 1/ 7/05 3:41PM;
FROM : Smith Lab
845 229 6538 -> DUTCHESS COUNTY HEALTH DEPART; Page 8
PHONE NO. : 845 229 6538 Jan. 07 2005 03:58PM P6

SMITH LABORATORY
41 Scenic Drive
Hyde Park, NY 12538-1313
(845)229-6536 voice
(845)229-6538 fax

# CHAIN OF CUSTODY

Turnaround time requested: Regular ____ RUSH** ____ (** surcharge)
** Date required: ____

Copy results to Local Health Dept? YES ____ NO ____

Amt. Due: ____
Amt. Paid: Bill
Bal. Due: ____
Date Paid: ____
Initials: KP

REPORT: DCHD Rich Robbins
387 Main St
Poughkeepsie NY 12601
Phone No.: ____

BILL: same

FACILITY: Red Wing Park Beach
T. East Fishkill

Order ID # 3265

| Smith Lab Sample No. | Sample Identification and Sampling Point | Sample type DW/WW | Grab | Comp # hrs | first draw | Treatment & residual | Date/time sampled | Analysis required | Container & preservatives | sl | Samp Temp °C |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 54474AB | Swim area | SW | ✓ | | | | 6/28/04 | 8021 | w/ HCL 2x40mL | ✓ | |
| | " " | SW | ✓ | | | | 6/28/04 | 8021 | | | |
| | | | | | | | | | | | |
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| | | | | | | | | | | | |

Sampled by: Client (KP)
Relinquished by: ____ Received by: ____ Date: ____ Time: ____
Relinquished by: ____ Received by: ____ Date: ____ Time: ____
Relinquished by: ____ Received at lab by: Klg Date: 6/28/04 Time: 320
Method of shipment: ____ Comments: ____

ELS Ltd
Eastern Laboratory Services Ltd
quality ■ accuracy ■ reliability

ENVIRONMENTAL
390 N. Pennsylvania Ave.
South Waverly, PA 18840-2826
Phone (570) 888-0169
FAX (570) 888-0717

COPY

# Certificate of Analysis

| | | |
|---|---|---|
| Smith Laboratories<br>4 Scenic Drive, Box 6<br>Hyde Park NY, 12538 | Project: General Testing<br>Project No: 54474/DCHD-Red Wing Park<br>Project Manager: Anne Smith | Reported:<br>07/06/04 16:11 |

## ANALYTICAL REPORT FOR SAMPLES

| Sample ID | Laboratory ID | Matrix | Date Sampled | Date Received |
|---|---|---|---|---|
| 54474-Swim Area | 4G02050-01 | Water | 06/28/04 00:00 | 07/02/04 09:14 |

*The results in this report apply to the samples analysed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.*

Eastern Laboratory Services, Ltd.

Barbara Hohman

Reviewed by Barbara Hohman, QA Manager

PA 08380 NY 11216

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FAX (570) 888-0717

# Certificate of Analysis

| | | |
|---|---|---|
| Smith Laboratories<br>4 Scenic Drive, Box 6<br>Hyde Park NY, 12538 | Project: General Testing<br>Project No: 54474/DCHD-Red Wing Park<br>Project Manager: Anne Smith | **Reported:**<br>07/06/04 16:11 |

**54474-Swim Area**
**4G02058-01 (Water)**

| Analyte | Result | Reporting Limit | Units | Dilution | Batch | Prepared | Analyzed | Method | Notes |
|---|---|---|---|---|---|---|---|---|---|
| **SW846/8021B Halogenated and Volatile Organics** | | | | | | | | | |
| Benzene | ND | 0.5 | ug/l | 1 | 4070639 | 07/03/04 | 07/03/04 | SW846/8021B | |
| Bromobenzene | ND | 0.5 | " | " | " | " | " | " | |
| Bromochloromethane | ND | 0.5 | " | " | " | " | " | " | |
| Bromodichloromethane | ND | 0.5 | " | " | " | " | " | " | |
| Bromoform | ND | 0.5 | " | " | " | " | " | " | |
| Bromomethane | ND | 0.5 | " | " | " | " | " | " | |
| n-Butylbenzene | ND | 0.5 | " | " | " | " | " | " | |
| sec-Butylbenzene | ND | 0.5 | " | " | " | " | " | " | |
| tert-Butylbenzene | ND | 0.5 | " | " | " | " | " | " | |
| Carbon tetrachloride | ND | 0.5 | " | " | " | " | " | " | |
| Chlorobenzene | ND | 0.5 | " | " | " | " | " | " | |
| Chloroethane | ND | 0.5 | " | " | " | " | " | " | |
| Chloroform | ND | 0.5 | " | " | " | " | " | " | |
| Chloromethane | ND | 0.5 | " | " | " | " | " | " | |
| 2-Chlorotoluene | ND | 0.5 | " | " | " | " | " | " | |
| 4-Chlorotoluene | ND | 0.5 | " | " | " | " | " | " | |
| Dibromochloromethane | ND | 0.5 | " | " | " | " | " | " | |
| Dibromomethane | ND | 0.5 | " | " | " | " | " | " | |
| 1,2-Dibromoethane (EDB) | ND | 0.5 | " | " | " | " | " | " | |
| 1,2-Dibromo-3-chloropropane | ND | 0.5 | " | " | " | " | " | " | |
| 1,2-Dichlorobenzene | ND | 0.5 | " | " | " | " | " | " | |
| 1,3-Dichlorobenzene | ND | 0.5 | " | " | " | " | " | " | |
| 1,4-Dichlorobenzene | ND | 0.5 | " | " | " | " | " | " | |
| Dichlorodifluoromethane | ND | 0.5 | " | " | " | " | " | " | |
| 1,1-Dichloroethane | ND | 0.5 | " | " | " | " | " | " | |
| 1,2-Dichloroethane | ND | 0.5 | " | " | " | " | " | " | |
| 1,1-Dichloroethene | ND | 0.5 | " | " | " | " | " | " | |
| cis-1,2-Dichloroethene | ND | 0.5 | " | " | " | " | " | " | |
| trans-1,2-Dichloroethene | ND | 0.5 | " | " | " | " | " | " | |
| 1,2-Dichloropropane | ND | 0.5 | " | " | " | " | " | " | |
| 1,3-Dichloropropane | ND | 0.5 | " | " | " | " | " | " | |
| 2,2-Dichloropropane | ND | 0.5 | " | " | " | " | " | " | |
| 1,1-Dichloropropene | | | | | | | | | |

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Barbara Hohman

Reviewed by Barbara Hohman, QA Manager

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# Certificate of Analysis

| | | |
|---|---|---|
| Smith Laboratories<br>4 Scenic Drive, Box 6<br>Hyde Park NY, 12538 | Project: General Testing<br>Project No: 54474/DCHD-Red Wing Park<br>Project Manager: Anne Smith | Reported:<br>07/06/04 16:11 |

**54474-Swim Area**
**4G02050-01 (Water)**

| Analyte | Result | Reporting Limit | Units | Dilution | Batch | Prepared | Analyzed | Method | Notes |
|---|---|---|---|---|---|---|---|---|---|
| **SW846/8021B Halogenated and Volatile Organics** | | | | | | | | | |
| cis-1,3-Dichloropropene | ND | 0.5 | ug/l | 1 | 4070639 | 07/03/04 | 07/03/04 | SW846/8021B | |
| trans-1,3-Dichloropropene | ND | 0.5 | " | " | " | " | " | " | |
| Ethylbenzene | ND | 0.5 | " | " | " | " | " | " | |
| Hexachlorobutadiene | ND | 0.5 | " | " | " | " | " | " | |
| Isopropylbenzene | ND | 0.5 | " | " | " | " | " | " | |
| p-Isopropyltoluene | ND | 0.5 | " | " | " | " | " | " | |
| Methylene chloride | ND | 0.5 | " | " | " | " | " | " | |
| n-Propylbenzene | ND | 0.5 | " | " | " | " | " | " | |
| Styrene | ND | 0.5 | " | " | " | " | " | " | |
| 1,1,1,2-Tetrachloroethane | ND | 0.5 | " | " | " | " | " | " | |
| 1,1,2,2-Tetrachloroethane | ND | 0.5 | " | " | " | " | " | " | |
| Tetrachloroethene | ND | 0.5 | " | " | " | " | " | " | |
| Toluene | ND | 0.5 | " | " | " | " | " | " | |
| 1,2,3-Trichlorobenzene | ND | 0.5 | " | " | " | " | " | " | |
| 1,2,4-Trichlorobenzene | ND | 0.5 | " | " | " | " | " | " | |
| 1,1,1-Trichloroethane | ND | 0.5 | " | " | " | " | " | " | |
| 1,1,2-Trichloroethane | ND | 0.5 | " | " | " | " | " | " | |
| Trichloroethene | ND | 0.5 | " | " | " | " | " | " | |
| Trichlorofluoromethane | ND | 0.5 | " | " | " | " | " | " | |
| 1,2,3-Trichloropropane | ND | 0.5 | " | " | " | " | " | " | |
| 1,2,4-Trimethylbenzene | ND | 0.5 | " | " | " | " | " | " | |
| 1,3,5-Trimethylbenzene | 0.5 | 0.5 | " | " | " | " | " | " | |
| Vinyl chloride | ND | 0.5 | " | " | " | " | " | " | |
| m,p-Xylene | ND | 0.5 | " | " | " | " | " | " | |
| o-Xylene | ND | 0.5 | " | " | " | " | " | " | |
| Naphthalene | ND | 0.5 | " | " | " | " | " | " | |
| Methyl tert-butyl ether | ND | 0.5 | " | " | " | " | " | " | |
| *Surrogate: Chlorofluorobenzene (PID)* | | 95.0 % | | 70-130 | " | " | " | " | |
| *Surrogate: Chlorofluorobenzene (ELCD)* | | 102 % | | 70-130 | | | | | |

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Eastern Laboratory Services, Ltd.

Barbara Hohman

Reviewed by Barbara Hohman, QA Manager

PA 08380 NY 11216


N
E
W
S
Magnetic North

**Legend**

⊙ Soil Boring Locations

Map created using USGS DOQQ (1997) and site survey GPS data. Parcel data provided by RST contract, and georeferenced to the DOQQ.
Map Creation Date: December 2003

Coordinate System: UTM, Zone 18N
Datum: NAD83
Units: Meters

150 0 150 300 Feet

U.S. EPA Environmental Response Team Center
Response Engineering and Analytical Contract
68-C99-223
W.A. # R1A00330

Figure 4
Location of Soil Borings
Hopewell Precision Site
Hopewell Junction, NY

Data: g:\arcviewprojects\330
.MXD file: g:\arcinfoprojects\reac3\R1A00330HopewellJunction\330_HPwellmap_f4


N
W E
S
Magnetic North

## Legend

B - 1: NYSDEC Monitor Well

EPA - 1: EPA/ERTC Permanent Monitor Well

PZ - 1: EPA/ERTC Temporary Shallow Monitor Well

TCE: 12: TCE Concentration, micrograms per liter
U = non-detect
TCE = Trichloroethylene

Map created using USGS DOQQ (1997) and site survey GPS data. Parcel data provided by RST contract, and georeferenced to the DOQQ.
Map Creation Date: December 2003

Coordinate System: UTM, Zone 18N
Datum: NAD83
Units: Meters

150 0 150 300 Feet

U.S. EPA Environmental Response Team Center
Response Engineering and Analytical Contract
68-C99-223
W.A. # R1A00330

Figure 5
TCE Concentrations in Groundwater
Hopewell Precision Site
Hopewell Junction, NY

Data: g:\arcviewprojects\330
.MXD file: g:\arcinfoprojects\reac3\R1A00330HopewellJunction\330_HP1003_TCE_f5