



# Five-Year Review Report

(Fourth Five-Year Review Report)

for

Keefe Environmental  
Services Site  
Epping, NH

July 2008

Prepared by:  
Woodard & Curran  
for  
U.S. Environmental  
Protection Agency  
Region 1

**FIVE-YEAR REVIEW REPORT**  
**(Fourth Five-Year Review Report)**

for

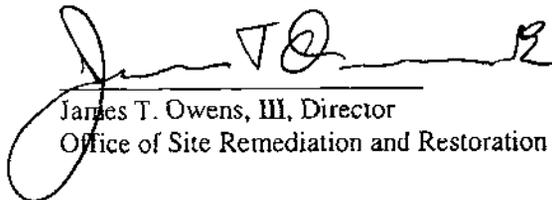
**Keefe Environmental Services Site**  
Epping, NH

July 2008

Prepared by:

U.S. Environmental Protection Agency  
Region 1  
Office of Site Remediation and Restoration

Approved by:

  
James T. Owens, III, Director  
Office of Site Remediation and Restoration

Date:

7/31/08

## Five-Year Review Summary Form

### SITE IDENTIFICATION

Site name (from WasteLan): Keefe Environmental Services

EPA ID (from WasteLan): NHD092059112

Region: 1

State: New Hampshire

City/County: Epping/Rockingham

### SITE STATUS

NPL Status: Final Deleted Other (specify)

Remediation status (choose all that apply): Under Construction Operating Complete

Multiple OUs?\* YES NO

Construction completion date: 9/21/1994

Has site been put into reuse? YES NO

### REVIEW STATUS

Lead agency: EPA State Tribe Other Federal Agency

Author name: Cheryl Sprague

Author title: Remedial Project Manager

Author affiliation: EPA

Review period:\*\*\* 2/14/2008 to 7/31/08

Date(s) of site inspection: 2/14/08

Type of review:

Post-SARA

Pre-SARA

NPL-Removal only

Non-NPL Remedial Action Site

NPL State/Tribe-lead

Regional Discretion

Review number: 1 (first) 2 (second) 3 (third) Other (specify) Fourth

Triggering action:

Actual RA Onsite Construction at OU # \_\_\_\_\_

Actual RA Start at OU # \_\_\_\_\_

Construction Completion

Previous Five-Year Review Report

Other (specify) \_\_\_\_\_

Triggering action date (from WasteLAN): 3/26/2003

Due date (five years after action date): 3/26/2008 extended to 7/31/2008

\* ["OU" refers to operable unit.]

\*\* [Review period should correspond to the actual start and end dates of the Five-Year Review in WasteLAN.]

## Five-Year Review Summary Form, cont'd

### Issues:

**1) Groundwater does not meet clean-up standards** (Concentrations of chemicals of concern (COCs) in the 1988 ROD remain above the ROD target cleanup levels at a few areas of the site. In addition, 1,4-dioxane has been added as a site COC since the previous Five Year Review).

1 a. Is it cost effective to continue pump and treat until clean-up levels are attained .

1 b. Is continued use of pump and treat necessary for containment of COCs within the GMZ (the groundwater treatment system is currently turned off to evaluate the effect on concentrations of COCs as part of a rebound study. The reactivation of the system will be determined based on the results of this study).

1 c. Will MNA attain protectiveness by reducing COCs to drinking water standards at the GMZ boundary (based on the data that has been collected to date, it is unknown to what extent natural attenuation is occurring. Natural attenuation is a process in which contaminants such as the Site COCs are degraded as a result of naturally occurring conditions in the groundwater without additional treatment.

### Recommendations and Follow-up Actions:

1. Perform cost analysis to determine if the system should be operated until drinking water standards are met or if it is feasible to attain these clean-up levels with the decreasing mass loading.
2. Update/develop conceptual site model to further evaluate fate and transport of site COCs under non-pumping conditions.
3. Continue to monitor for trends in concentrations of COCs in boundary wells or in the predicted flow paths.
4. Install additional monitoring wells as directed by evaluation and/or monitoring results.
5. Continue to expanded analytical list of parameters for attenuation indicator compounds.
6. Determine extent, if any, of natural attenuation processes.
7. Evaluate time frame anticipated to reach clean-up standards by MNA. Evaluate current boundary of GMZ to assess ability to meet clean-up standards via MNA at the boundary.

### Protectiveness Statement(s):

OU-1 - Source Control: The remedy at OU-1 has met soil clean up goals, is complete and therefore is protective of human health and the environment.

OU-2 – Management of Migration: The pump-and-treat remedy at OU-2 has been effective in reducing concentrations and preventing off-site migration of site COCs. Although the treatment system is off-line at this time for the evaluation of rebound, the establishment of the GMZ and regular groundwater monitoring provides continued protectiveness to human health and the environment. The excavation of soil from the former lagoon in 2004 has significantly reduced the potential for future impacts to groundwater and to future site workers through direct contact with this media. The pump-and-treat remedy at OU-2 is expected to be protective of human health and the environment upon completion, and in the interim, exposure pathways that could result in unacceptable risk are being monitored and controlled.

Site-wide Protectiveness Statement: Because the remedial actions at all OUs are protective, the site is protective of human health and the environment.

### Other Comments:

None



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## 1. INTRODUCTION

The purpose of this Five-Year Review is to determine if the remedy selected for the Keefe Environmental Services (KES) Superfund Site (site) in Epping, New Hampshire is protective of human health and the environment. This report provides a summary of the Five-Year Review process, investigations, and remedial actions conducted at the site, an evaluation of the monitoring data collected at the, a discussion of the issues identified during the review, and recommendations to address these issues. Another component of the Five Year Review Process is a check of state and federal regulations or Applicable or Relevant and Appropriate Requirements (ARARs) for updates and a comparison with data reported since the last Five Year Review conducted in 2003.

The current Five-Year Review is the fourth Five-Year Review that has been written for the KES site. This Five-Year Review process was initiated on February 14, 2008 with an on-site meeting between the United States Environmental Protection Agency (EPA) Region 1, the New Hampshire Department of Environmental Services (NHDES) and Woodard & Curran, the contractor for the on-site remediation system. Previous Five-Year Reviews of the site were conducted in February 1993, September 1997, and March 2003.

EPA has prepared this Five-Year Review in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) §121(c), OSWER Directive 9355.7-03B-P, and the National Contingency Plan (NCP). The purpose of the Five-Year Review is to provide an update of conditions at sites where hazardous substances have been detected and remedial action is required to return the site to a state in which there can be unlimited use and exposure by future users of the site. This Five-Year Review was triggered by the EPA signature of the third review on March 23, 2003. This current Five-Year Review is required as a matter of EPA policy, due to the fact that contaminants remain in groundwater at the site above levels that allow for unlimited use and unrestricted exposure.

As a part of the Five-Year Review process, the effectiveness of the remedial actions selected by EPA in protecting human health and the environment is evaluated.

The site was separated into two operable units (OUs):

- OU-1 (Lagoon and Surrounding Soils); and
- OU-2 (Groundwater).

EPA signed a Record of Decision (ROD) for OU-1 on November 15, 1983 which mandated the decommissioning of an on-site lagoon used to store chemical wastes and the removal of the lagoon contents. The ROD is a public document issued by the EPA that explains what cleanup alternatives will be used to reduce and eliminate contamination at a Superfund site. The ROD contains a site history, site description, enforcement activities, identification of contaminated media, the extent of response actions and a description of the selected remedy. The removal of chemical wastes and the on-site lagoon contents was completed by the end of 1984. Activities associated with implementing the remedy for OU-1 were important in reducing the hazard from contact with chemical wastes that were stored on the site and reducing the potential for additional contributions of contamination to groundwater, identified as OU-2 by the EPA.

The EPA signed a ROD for OU-2 on March 21, 1988 which included both source control and management of migration components for restoration of site conditions. The original source control component consisted of vacuum enhanced extraction of chemicals of concern (COCs) from on-site soil.

The management of migration component included the extraction of contaminated groundwater from several wells installed near the source area and treatment to remove site-related volatile organic compounds (VOCs). On June 8, 1990, EPA issued an Explanation of Significant Differences (ESD) to remove the 1988 ROD requirement of soil vacuum extraction for OU-1 because subsequent sampling showed that the concentrations of contaminants in the soils were already below the associated cleanup levels. An ESD is a document used to publicly convey a change in the original remedy selected in the ROD, based on additional data obtained during the course of investigations conducted at the site. The ESD affirms that the modified remedy does not result in any change in the protectiveness to human health and the environment.

The groundwater treatment system associated with OU-2 began operations in 1993 to remove VOCs from the groundwater. Overall, the OU-2 remedy has significantly reduced VOC contamination since the initial Five-Year Review was conducted. Results from the analyses of groundwater samples collected from monitoring wells at the site show a general decline in the ROD-specific cleanup levels from initial values (since the treatment plant began operations). In 2003, the EPA began a program to test for a new contaminant of concern, 1,4-dioxane, at several Superfund sites in Region 1. The parameter was discovered in a limited groundwater sampling program conducted at the site. Prior to this sampling event 1,4-dioxane had not been part of the EPA's analysis for groundwater at this site. In 2004 a more comprehensive sampling program was conducted to assess the extent of 1,4-dioxane distribution at the site. The results of the testing program confirmed the presence of 1,4-dioxane and EPA initiated a program to address this new contaminant in the OU-2 remedy. In 2005, an upgrade to the groundwater treatment system, to include treatment technologies for the removal and destruction of this compound, as well as the original site related compounds, was completed. This action, along with the establishment of a cleanup level for 1,4-dioxane was documented in the June 2005 ESD. As part of the planned transfer activities a groundwater management zone (GMZ) was also established at the site.

Prior to the discovery of 1,4-dioxane at the site and the installation of the high pressure oxidation (HiPOx) system, 1,4-dioxane was likely captured by the extraction system and cycled through the treatment system then recharged into the aquifer via the infiltration trench. This operation combined with the use of spray irrigation, to reduce recharge via the infiltration trench, helped minimize the migration of 1,4-dioxane. Under O&M by the State the upgraded treatment system (HiPOx) was operated intermittently for two years and a reduction in the distribution and concentration of 1,4-dioxane was achieved. As part of O&M activities, a GMZ was issued that establishes plume boundaries and restricts the use of groundwater until Ambient Groundwater Quality Standards (AGQS) are restored. After two years of operation, and in response to the decrease in both VOCs and 1,4-dioxane, the OU-2 treatment system was shut down to evaluate potential "rebound effects" on the concentrations of site contaminants at groundwater monitoring locations (during non-pumping conditions) associated with the GMZ. As of this Five-Year Review the rebound evaluation is still in progress. Continued need for the operation of the groundwater extraction and treatment system is being evaluated concurrently with the rebound study.

The site was transitioned from Long-term Response Action (LTRA) to Operation and Maintenance (O&M) by the State of New Hampshire on June 30, 2005. EPA continues to have Five-Year Review responsibilities.



## 2. SITE CHRONOLOGY

Section 2 presents the chronology of events that have taken place at the Keefe Superfund site since operations as a chemical waste storage facility began in 1978. Events are presented in chronological order in **Table 2-1**.

**TABLE 2-1: CHRONOLOGY OF SITE ACTIVITIES**

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<b>Date</b>	<b>Activity</b>
March 29, 1978	Paul Keefe proposes constructing a chemical waste storage and bulking facility to Epping Planning Board.
May 31, 1978	The Epping Planning board approved Keefe's plan.
1978	Operations at the Site began. Site features included a drum storage area, storage tanks, equipment shelters, bulking areas, and a synthetically lined lagoon.
April 1, 1979	New Hampshire Bureau of Solid Waste Management (BSWM) and Department of Public Health Services ordered Keefe to clean-up leaking storage tanks, ruptured drums, contaminated soils, and latex wastes.
May 1, 1979	As a result of frequent odor complaints the Town of Epping instituted legal action against Keefe. The town retained Wehran Engineering to perform site investigations. Keefe retained Environmental Engineers, Inc. to perform an independent assessment.
July 1, 1979	New Hampshire's Hazardous Waste Law became effective.
September 1979	Wehran Engineers began a hydrogeologic investigation at the Site.
September 27, 1979	BSWM began a well sampling program at KES and nearby residences.
October 16, 1979	The Water Supply and Pollution Control Commission (WSPCC) began a separate sampling program that included nearby streams. Carbon tetrachloride and chloroform were detected in the stream northwest of the Site.
November 1979	The state of New Hampshire issued a second cleanup order, stating that chlorinated hydrocarbons were present in Keefe wells. WSPCC began sampling nearby residential wells. Keefe installed four new monitoring wells.
December 1979	Keefe filed a motion for rehearing claiming the cleanup order was unreasonable. WSPCC issued a wetlands violation against Keefe for filling in a wetland during installation of monitoring wells.
January 1980	The state of New Hampshire claimed a violation of NH Hazardous waste regulations at the Site and filed a petition in court for mandatory injunction and civil penalties against Keefe.
April 23, 1980	A court order established contingencies for continued operation of the Keefe Site.
June 5, 1980	The Attorney General's Office notified Keefe of the recommended sampling and analysis procedures for wells and surface waters.
September 9, 1980	Master's report (Town of Epping and State of NH vs. Paul A. Keefe et al) reiterated areas of non-compliance from the previous clean-up order.
January 1981	Keefe filed for bankruptcy protection and abandoned the Site. The EPA initiated cleanup actions through contractor Ecology and Environment's Technical Assistance Team.
February 1981	The EPA declared an emergency at the Site due to the overflow potential of the on-site lagoon. EPA's Field Investigative Team (FIT) Contractor began a site investigation and stabilization of the on-site lagoon.
April 1981	Rising spring temperatures caused the rupture of drums and release of their contents onto the ground. The EPA contracted Marlyn Engineering to begin drum stabilization.
August 13, 1981	FIT submitted their Preliminary Assessment Report.
December 15, 1981	FIT performed a site inspection.
January 7, 1982	FIT performed a site inspection.
January 13, 1982	FIT submitted an Assessment of Alternatives for Temporary Stabilization of Lagoon.
March 24, 1982	FIT submitted a proposed work plan for future actions.
July 1982	The EPA hired a contractor to remove imminent health hazards, storage tank contents, and dumpsters.
September 1982	The EPA determined that initial remedial measures were appropriate for the Site and notified contractor to prepare a Remedial Action Master Plan (RAMP).
October 1982	The RAMP was submitted.
March 1983	Resource Technology Services, Inc., under contract to the WSPCC, began removal of bulk drummed waste from the Site.
July 13, 1983	Tighe & Bond was contracted by WSPCC to perform a remedial investigation (RI), lagoon justification and decommissioning bid documents.
August 26, 1983	Drum and bulk waste removal was completed.
September 8, 1983	The Keefe Site is listed on the National Priority List (NPL)

**TABLE 2-1: CHRONOLOGY OF SITE ACTIVITIES**

Date	Activity
November 4, 1983	D' Appolonia Waste Management Services was engaged by WSPCC to remove the contents of and to decommission the lagoon.
November 15, 1983	The EPA issued the Record Of Decision (ROD) for OU-1 which mandated removal of the lagoon contents and decommissioning the lagoon.
February 1984	Decommissioning of the lagoon was completed.
June 1984	Remedial Investigation (RI) for OU-2 submitted to NH WSPCC by Tighe & Bond.
October 1984	Revised RI for OU-2 submitted to NH WSPCC by Tighe & Bond.
April 1985	Revised RI for OU-2 submitted to NH WSPCC by Tighe & Bond.
January 13, 1986	A summary of existing data was submitted to WSPCC by Camp, Dresser & McKee (CDM).
May 13, 1986	The Draft RI was submitted to WSPCC by CDM.
September 1986	Supplemental RI Report for OU-2 at the Site submitted to WSPCC by CDM.
December 1987	The Supplemental RI Report was submitted to the NH Department of Environmental Services (NHDES) by CDM. A Draft Feasibility Study was also submitted to NHDES.
March 21, 1988	EPA issued the ROD for OU-2, which included both source control and management of migration components. The Source control component consisted of vacuum enhanced extraction. The Management of Migration component included the extraction and treatment of groundwater to remove VOCs.
April 1989	Draft Preliminary Design Data Evaluation Report submitted to NHDES by CDM.
April 16, 1990	A Draft Project Operations Plan for Additional Off-Site Investigations submitted to EPA by NHDES.
June 7, 1990	The Draft Project Operations Plan for Additional Off-Site Investigations was approved by EPA.
June 8, 1990	The EPA issued an Explanation of Significant Differences (ESD) for the Site, to remove the 1988 ROD requirement for soil vapor extraction, since soil sample concentrations were low enough to eliminate the need to implement the soil vapor extraction portion of the remedy.
January 1991	A Draft Off-Site Hydrogeological Evaluation Report for the Site was submitted to NHDES by CDM.
March 1991	A Draft Off-Site Hydrogeological Evaluation Report was submitted to NHDES by CDM.
1991 to 1992	Groundwater Collection and Treatment Facility design completed by CDM
1992 to 1993	The construction of a groundwater collection and treatment facility was completed by R. Zoppo, Inc.
February 22, 1993	The first Five-Year Review report was issued by the EPA.
April 1993	Operations at the groundwater collection and treatment facility commenced.
September 1993	Long-term remedial action at the groundwater collection and treatment facility initiated.
1994	A hydrogeologic evaluation was completed. Two new extraction wells were proposed as a result of this investigation (groundwater modeling and test well program completed)
September 1995	The pump-and-treat system was optimized by the removal of two low yield wells and the addition of two new wells EW-95-2 and EW- 95-7. The locations of the new wells were selected to increase groundwater extraction rates and mass flux to the treatment plant.
September 1997	The second Five-Year Review report was issued by the EPA, and stated that the remedy remained protective of human health and the environment.
August 1998	Three on-site vacuum enhanced recovery wells were installed and brought on-line to increase groundwater treatment capacity.
March 26, 2003	The third Five-Year Review was finalized for the EPA by Woodard & Curran.
May 2003	EPA and NHDES initiated a phased groundwater sampling program to evaluate the nature and extent of 1,4-dioxane in site groundwater. Based on the results of the 18 month program, the EPA and NHDES determined that a change in the treatment component of the groundwater extraction system was required.
June 2003	Soil borings were installed in the source control area, just upgradient from the extraction well network to support a human health risk assessment and to explore potential in-situ soil remedial options. The results from the soil boring program indicated a lack of significant mass in the soils; therefore, no potential risk from contact with the soils was identified and in-situ soil treatment was not performed. Results from soil sample analyses collected from test pits excavated in the former lagoon area were used to evaluate soil disposal alternatives.

**TABLE 2-1: CHRONOLOGY OF SITE ACTIVITIES**

Date	Activity
May 2004	Contaminated soils in the former lagoon, originating from the 1992 construction of the groundwater collection trench, were excavated and disposed of at an approved regulated landfill. The lagoon was formally decommissioned as part of the soil removal action. Approximately 893 tons of contaminated soil, along with the lagoon liner and piping materials, was removed from the Site and transported to regulated facilities.
December 2004	A high pressure oxidation system (HiPOx) was installed to enable treatment of 1,4-dioxane which had become a new compound of concern, based on 2003 and 2004 sample results. The modified system began operation on January 3, 2005.
May 2005	Based on comments from 2003 Five Year Review, twenty one monitoring wells in disrepair were decommissioned. Two new wells, MW-50 and MW-51, were installed to further characterize groundwater in the off-site area.
May 2005	A baseline human health risk assessment was conducted which evaluated risk due to dermal contact and ingestion of site soils and inhalation risk from soil vapor for current and future facility workers. A current/future facility worker could be potentially exposed to COPCs in soil (via direct contact), soil vapor/dust (via inhalation) and potable groundwater (via ingestion and dermal contact). The risk assessment identified unacceptable cumulative cancer and noncancer risks to a future on-site worker, primarily from the ingestion of VOCs and arsenic in (potable) site groundwater and direct contact with arsenic in soil. Risks from other exposure pathways were relatively minor in comparison with those associated with the ingestion of groundwater and direct contact with soil.
June 2005	EPA issued an ESD to establish a clean-up level for 1,4-dioxane in groundwater and to document a change in the treatment of groundwater from air stripping to a high pressure oxidation system; the off-site disposal of lagoon soils; and decommissioning of certain monitoring wells that were in disrepair or no longer required for long-term monitoring.
June 30, 2005	The Site is transferred from a EPA led long-term remedial action (LTRA) project to a State led long-term Operation and Maintenance (O&M) project. A Groundwater Management Permit application was submitted to NHDES
January 17, 2006	A Groundwater Management Permit was granted as part of the Site transition from the EPA to the NHDES. A Groundwater Management Zone (GMZ) and modified sampling schedule was implemented. Within the GMZ, the use of groundwater is restricted to non-potable uses only. A notice of the GMZ was recorded in the deeds for properties within the GMZ.
December 3, 2006	The groundwater treatment system was completely shut down as part of a rebound study to evaluate changes in concentrations of site COCs and to determine the cost effectiveness of operating the treatment system until clean-up levels are achieved in groundwater. The treatment system is being maintained so that it can easily be activated in the event that the determination is made that it should be turned back on.
March and November 2007 and May 2008	Groundwater sampling conducted as part of a rebound study to evaluate changes in concentrations of site COCs and to determine status of treatment system. A preliminary report of findings was produced in August 2007 (recommending continued rebound evaluation) and will be supplemented with November 2007 and Spring 2008 data.
February to July 2008	The forth Five-Year Review was initiated by EPA and Woodard & Curran.



### **3. BACKGROUND**

Section 3 includes a discussion of the physical characteristics of the site, land and resource use, the history of contamination, initial response actions, follow-up activities and the basis for taking action.

#### **3.1 PHYSICAL CHARACTERISTICS**

The physical characteristics of the site are described in the following subsections.

##### **3.1.1 Setting**

The KES Superfund Site property consists of approximately seven acres and is located in Epping, New Hampshire just off Exeter Road (Old Route 101), as shown in **Figure 3-1 and Figure 3-2**. Its location is approximately two miles southeast of the municipal center, north of Exeter Road and south of the Piscassic River. The site is bordered to the west by a former chicken farm (a residential property) and to the east by the New England Dragway. The Environmental Resource Return Corporation (ERRCO) also borders the site to the east and northeast. Two intermittent streams are adjacent to the site. One stream drains a wetland area to the northwest and flows northwesterly toward the Piscassic River via a small brook. An intermittent stream receives drainage from other areas and flows eastward from a wetland area south of the site toward the Fresh River.

##### **3.1.2 Topography**

The topographic relief of the site is low to moderate. Elevations vary from a height of 160 feet above mean sea level (MSL) in the northeast corner to a low of 126 feet above MSL in a wetland to the southwest. The majority of abrupt changes in elevation on the site are due to excavation and filling activities that have occurred. Till materials have been excavated from an embankment on the northeast corner of the site and used for multiple purposes, including filling areas for drainage improvement; road construction; former drum storage area grading; and waste lagoon dike construction.

##### **3.1.3 Subsurface Geological Conditions**

The site is located on the northern end of a glacial deposit composed of glacial till approximately 20 to 120 feet thick. The glacial till is surrounded by stratified silty fine to medium sand. The sand is interpreted to be outwash deposits that pinch out against the flanks of the upland till areas. The outwash deposits are overlain by thin silt and clay varying in thickness from 0 to 15 feet.

The stratigraphic positioning of clay over the outwash sand creates confined conditions in the outwash sand. The potentiometric surface for groundwater occurring in the outwash sands is at the ground surface in the spring and early summer. Groundwater flows through the till and discharges vertically to the outwash deposits. Downward hydraulic gradients are observed in the till. Upward hydraulic gradients are observed in the outwash deposits. The upward groundwater gradients and the dense underlying till beneath the outwash deposits form a hydrogeologic barrier to the downward movement of contaminants from the site.

**FIGURE 3-1: SITE LOCUS MAP**



SOURCE: TOPOI©2001 National Geographic Holdings, Inc.



BAR SCALE

1" = 2000'

CHECK GRAPHIC SCALE BEFORE USING

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**FIGURE 3-2: SITE AERIAL LOCATION MAP**



SOURCE: USDA FSA APRO AERIAL PHOTOGRAPHS,  
 DATA LAYER: 2003 NATIONAL AGRICULTURAL  
 IMAGERY PROGRAM (NAIP)



BAR SCALE  
 1" = 500'

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	<p>DESIGNED BY: PFF        DRAWN BY: PFF</p>	<p>CHECKED BY: DD        Figure 3-2.dwg</p>	<p>FOURTH 5-YEAR REVIEW REPORT</p>	<p>FIGURE 3-2</p>

### 3.2 LAND AND RESOURCE USE

The site currently consists of an open field, forested uplands, and wetland areas. The groundwater treatment facility is the only building located on the property. Land use at the site is currently zoned for commercial/light industrial and the surrounding properties currently include both commercial/light industrial as well as residential properties. The commercial properties nearby include an active recycling/composting facility, a drag racing facility and a federal firearms training facility. The remainder of the area is generally characterized as being rural. Approximately 12 residences are located on Exeter Road to the south. These residences are using private wells. The residential wells from six bordering properties have historically been tested for VOCs and 1,4-dioxane during this review period. The results did not indicate the presence of either VOCs or 1,4-dioxane. Analytical results from residential wells are included in **Appendix A**. The site is secured by a perimeter fence, which is in good condition. Future use of the property is anticipated to be industrial/commercial. The Town acquired ownership of the property in 2006 and is considering the land for future municipal use. The future use will be restricted as noted in the Groundwater Management Permit included in **appendix B**. Future residential use of the property is unlikely due to current zoning; however, no land use restrictions are in place at this time.

The site includes both terrestrial and aquatic habitats. Wetland areas were mapped during the Supplemental Remedial Investigation (RI). There are no endangered or threatened species that have been identified. Maps of the area indicate that there are no significant sand and gravel aquifers nearby.

### 3.3 HISTORY OF CONTAMINATION

The site operated as a chemical waste storage and bulking facility from 1978 until 1981, when the owners declared bankruptcy. Waste storage containers which were abandoned at the facility included 4,100 55-gallon drums, four 5,000 gallon above-ground storage tanks, four 10,000 gallon above ground storage tanks, seven dumpsters that contained sludge and contaminated soil, and a 700,000 gallon lined storage lagoon. Wastes handled during operations and abandoned in 1981 include solvents, acids, caustics, heavy metals, paint sludge, waste oils, and organic chemicals; however, soil and groundwater contamination consists primarily of chlorinated VOCs.

### 3.4 INITIAL RESPONSE AND FOLLOW-UP ACTIVITIES

In 1981, the EPA declared an emergency response because wastes stored in the lagoon were about to overflow (see former lagoon location in **Figure 3-3**). The EPA and NHDES removed substantial quantities of liquid chemical wastes from the lagoon at this time. The lagoon berms were stabilized in February of 1981 to prevent a release to the surrounding environment. Levels of liquid waste present in the lagoon were lowered the following month. Additional waste removal and drum stabilization activities began later in 1981 and continued into 1982. EPA signed a ROD for OU-1 on November 15, 1983 which mandated decommissioning of the lagoon and removal of the lagoon contents. In 1983 and 1984, to prevent further impacts to the environment, the EPA and the state removed all of the remaining waste, containers, lagoon contents, and contaminated soil for disposal at a regulated facility.

On March 21, 1988, EPA signed the ROD for OU-2, which included source control and management of migration components as the remedies for groundwater contamination. The source control component consisted of vacuum enhanced extraction of VOCs from soils. The management of migration component included groundwater extraction and treatment using an air stripper and activated charcoal to remove site-related VOCs. On June 8, 1990, EPA issued an ESD to remove the 1988 ROD requirement for OU-1 of

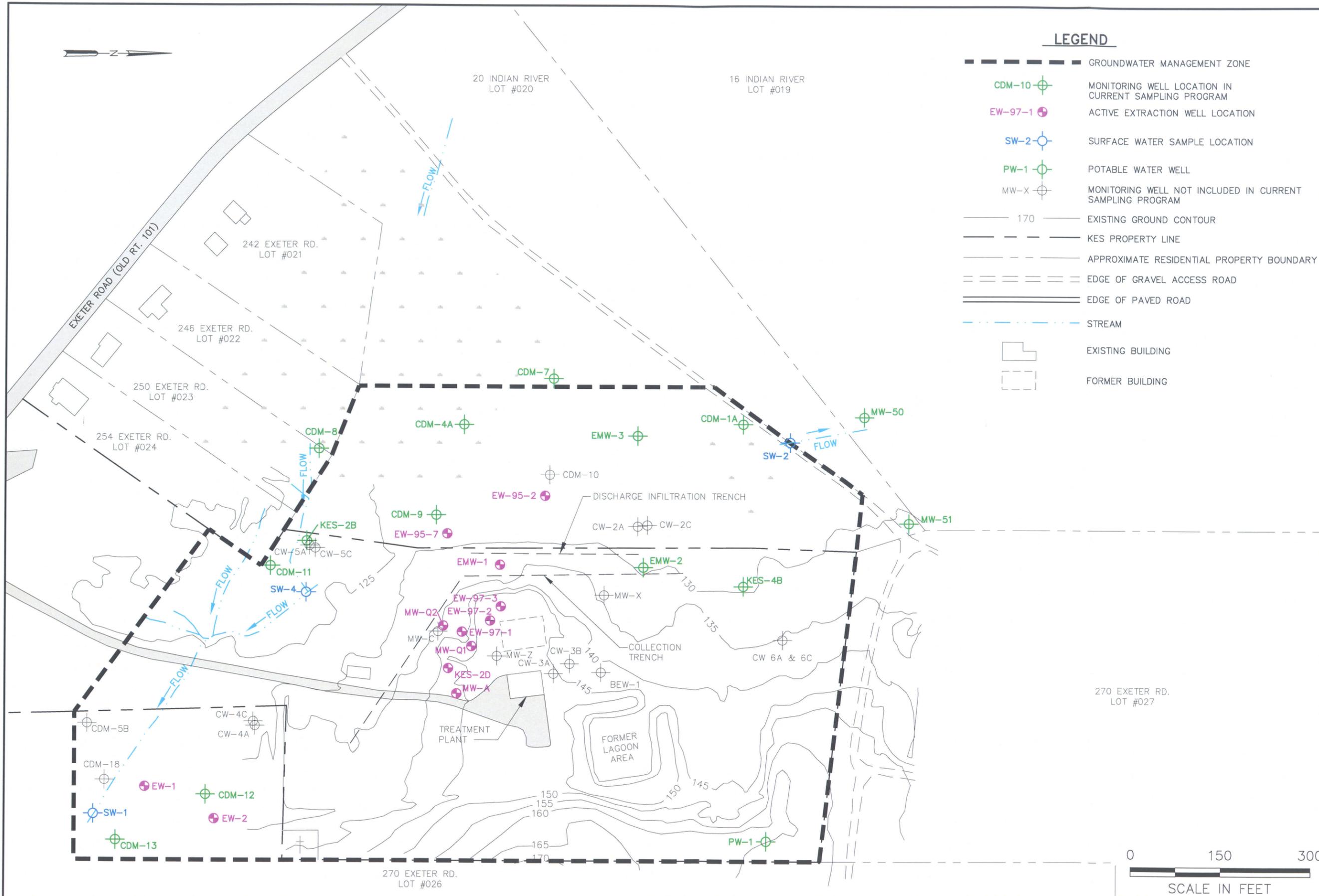
vacuum extraction of site contaminants from soil, based on sample results that indicated concentrations below cleanup levels when the ROD was issued.

**FIGURE 3-3: SITE LAYOUT**



### LEGEND

-  GROUNDWATER MANAGEMENT ZONE
-  CDM-10 MONITORING WELL LOCATION IN CURRENT SAMPLING PROGRAM
-  EW-97-1 ACTIVE EXTRACTION WELL LOCATION
-  SW-2 SURFACE WATER SAMPLE LOCATION
-  PW-1 POTABLE WATER WELL
-  MW-X MONITORING WELL NOT INCLUDED IN CURRENT SAMPLING PROGRAM
-  170 EXISTING GROUND CONTOUR
-  KES PROPERTY LINE
-  APPROXIMATE RESIDENTIAL PROPERTY BOUNDARY
-  EDGE OF GRAVEL ACCESS ROAD
-  EDGE OF PAVED ROAD
-  STREAM
-  EXISTING BUILDING
-  FORMER BUILDING



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## UPDATED SITE PLAN

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## KEEFE ENVIRONMENTAL SERVICE SITE EPPING, NEW HAMPSHIRE

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FIGURE 3-3

In 1992 the NHDES lined the former lagoon and used it as a storage area for potentially contaminated soil originating from the construction of a groundwater collection trench. The collection trench was installed as part of the groundwater collection and extraction system. Soil excavated from the construction of this trench was placed in the former lagoon. Rainfall was allowed to percolate through this soil, collect on the liner, and the resulting leachate was processed by the on-site groundwater treatment system.

In 2003 soil testing, via test pits, was performed on the soil placed into the former lagoon from construction of the groundwater collection trench. Analytical soil sampling results were used to quantify the current and future potential human health risks from direct contact with the lagoon soils or from incidental ingestion of groundwater beneath these soils. In 2004, the leaching system within the former lagoon area was decommissioned and those soils which posed an unacceptable risk were removed from the former lagoon area. The excavation was backfilled with clean topsoil material and the area was regraded. In total approximately 900 tons of soil were excavated from this area and disposed of in an approved off-site facility. The soil removal action was completed due to the potential to leach into groundwater beneath the soil and not due to any risk with exposure to the soil.

In 2003, the presence of 1,4-dioxane was first detected in groundwater samples collected at the site. This compound was added to chlorinated solvents, as a stabilizer and corrosion inhibitor. Its presence is attributed to the storage of chlorinated solvents and other chemical waste during the late 1970s and early 1980s. Although the groundwater treatment system effectively reduced concentrations of the other site-related VOCs, it was not able to effectively remediate 1,4-dioxane. EPA granted a nine month extension of the LTRA to evaluate modifications that would include treatment for 1,4-dioxane. In January 2005 a HiPOx configuration that uses hydrogen peroxide and ozone was added to the current treatment system to destroy 1,4-dioxane as well as the other COCs that were previously removed with the air stripper. In general, the supplemental treatment of the extracted groundwater has reduced concentrations of 1,4-dioxane in samples collected from many on-site and off-site monitoring locations. In addition to the decommissioning of the former lagoon area in the 2005 ESD, the EPA modified the groundwater remedy to include treatment for 1,4-dioxane.

In 2006, regulatory responsibility of the site was transferred from the EPA to the NHDES. As a part of this transfer, a GMZ was established as well as an annual monitoring program at eighteen on and off-site groundwater monitoring wells and three surface water locations. The monitoring well and extraction well locations included in the current monitoring program are included in the site Layout, **Figure 3-3**. Based on results from the 2005 human health risk assessment, an unacceptable risk remains for a future worker ingesting site groundwater; therefore, the Groundwater Management Permit currently restrict on-site groundwater to non-potable uses only.

### **3.5 BASIS FOR TAKING ACTION**

While many hazardous substances were brought to, stored and may have been released at the site, the primary chemicals of concern and the basis for the OU2 groundwater cleanup are volatile organic compounds (VOCs). The 1988 ROD established remedial action objectives to eliminate or minimize the threat posed to public health from the extent of contaminant migration at the site. The 1988 ROD included COCs for both soil and groundwater and included: benzene, tetrachloroethylene (PCE), trichloroethylene (TCE), 1,2-dichloroethane (1,2-DCA), and 1,1-dichloroethylene (1,1-DCE). Based on the EPA's ESD issued in 2005, the list of COCs was expanded to include 1,4-dioxane. These COCs and associated clean up goals are presented by medium in **Table 3-1**. The cleanup levels were based on achievable drinking water standards in groundwater.

**TABLE 3-1: MEDIA-SPECIFIC CLEANUP LEVELS FOR CHEMICALS OF CONCERN**

<b>Contaminant by Media</b>	<b>Cleanup Level (<math>\mu\text{g}/\text{kg}</math>)</b>	<b>Basis for Cleanup Level</b>
<b>Soil</b>		
Benzene	20.8	Risk
Tetrachloroethene	91	Risk
Trichloroethene	31.5	Risk
1,2-Dichloroethane	3.5	Risk
1,1-Dichloroethene	22.8	Risk
<b>Groundwater</b>		
	<b>(<math>\mu\text{g}/\text{l}</math>)</b>	
Benzene	5	MCL
Tetrachloroethene	5	MCL
Trichloroethene	5	MCL
1,2-Dichloroethane	5	MCL
1,1-Dichloroethene	7	MCL
1,4-dioxane	3	Risk

MCL – The National Primary Drinking Water Standard/Maximum Contaminant Level (MCL)

Note: Soil remediation to the proposed clean-up goals was determined necessary to attain a groundwater clean-up level that is protective of human health and the environment.

Source: 1998 Record of Decision, Tables VI-5 and VI-6 and NHDES Risk Assessment Letter Date June 28, 2004 for 1,4-dioxane.



## 4. REMEDIAL ACTIONS

This section of the Five-Year Review discusses the selection and implementation of remedial actions that have been used to reduce contamination at the Keefe site.

### 4.1 REMEDY SELECTION

As described in Sections 1 and 3, the remedial actions specified in the March 21, 1988 ROD established cleanup levels for both a Source Control Component (soil) and a Management of Migration Component (groundwater). The following subsections describe the rationale for the associated selected remedies.

#### 4.1.1 Source Control

The Source Control Component of the remedy consisted of the following remedial response objectives for soil:

- Prevent or mitigate the further release of contaminants to surrounding environmental media;
- Eliminate or minimize the threat posed to public health, welfare, and the environment from the source area; and
- Reduce the volume, toxicity, or mobility of hazardous substances, pollutants, and contaminants.

These source control objectives resulted in the establishment of the soil cleanup levels listed in **Table 3-1**. The objectives also prompted EPA to select vacuum extraction as the remedy for source control in the 1988 ROD. However, an ESD was issued in 1990 eliminating the need/requirement for vacuum extraction. Additional actions were taken in 2004 and 2005 to further evaluate source control which resulted in the soil spoil lagoon clean-up and formal decommissioning. A 2005 ESD documented the removal of the site soil spoil area contents to prevent future leaching of contaminants into groundwater above drinking water standards. The 2004 and 2005 clean-up activities related to this portion of the remedy are described in Section 4.2.1.

#### 4.1.2 Management of Migration

The Management of Migration component of the remedy consisted of the following remedial response objectives for groundwater:

- Preventing or mitigating migration of contaminants beyond their current extent; and
- Eliminating or minimizing the potential threat to public health through ingestion of contaminated groundwater.

The remedy selected by EPA to meet the objectives for Management of Migration component consisted of the following:

- Pumping of contaminated groundwater from the aquifer;
- Treating extracted groundwater on-site using air stripping, filtration, and vapor phase carbon adsorption; and
- Re-infiltration of treated water back into the aquifer.

As described in Section 3, the Management of Migration component for remedial action at the site was modified in 2005 to include treatment for an additional COC, 1,4-dioxane. The original treatment system

was modified to enable removal and destruction of site COCs and 1,4-dioxane as part of the groundwater treatment system.

## **4.2 REMEDY IMPLEMENTATION**

Activities completed during the implementation of the ROD components are described in this section.

### **4.2.1 Source Control**

The remedy selected in the ROD for source control was vacuum extraction. Pre-design field studies indicated that natural attenuation and migration to site groundwater had reduced the concentration of contaminants in soils to below the cleanup levels. Based on this finding, a 1990 ESD was issued for the site that removed vacuum extraction as a remedy component. However, in 1992, the NHDES lined the former lagoon area and used it for storage of excavated contaminated soil from construction associated with the groundwater extraction trench. Rainfall seeping through the soil stored in the lagoon became contaminated with COCs, and collected on the underlying liner. The resulting leachate was removed and remediated using the existing groundwater treatment system established at the site in 1993. After several consecutive rounds of analytical testing on the leachate from the soil spoils area indicated not detectable VOCs the treatment and leachate pumping was ceased.

In 2004, the leaching system within the former lagoon area was decommissioned and those soils which posed an unacceptable risk were removed from the former lagoon area. In total approximately 900 tons of soil were excavated from this area and disposed of in an approved off-site facility. The soil removal action was completed due to the potential to leach into groundwater beneath the soil and not due to any risk with exposure to the soil. As a result of this removal, on-site soil is no longer considered to be a threat to human health and the environment or a source for groundwater contamination. The ESD issued in June 2005 formally documents the activities conducted during the closure of the soils spoil area.

### **4.2.2 Management of Migration**

The management of migration component consists of groundwater extraction, treatment, and re-infiltration back into the aquifer. When construction of the original system was completed on June 10, 1993, the system consisted of four wells in the overburden aquifer, one well in the bedrock aquifer, and a groundwater collection trench. In 1995, the groundwater extraction system was optimized by replacing the two existing overburden wells on the off-site property to the northwest of the site (EW-3 and EW-5) with two new, more efficient extraction wells (EW-95-2 and EW-95-7). The new wells were used to maximize groundwater extraction volumes to increase the rate of contaminant removal and destruction at the on-site groundwater treatment plant. A groundwater monitoring well network was also installed to track contaminant migration through the periodic collection and analysis of samples. The results of these analyses were evaluated to measure the protectiveness of the remedy. In 1997, three additional vacuum enhanced extraction wells were installed to supplement and further optimize the extraction and remediation of on-site contaminated groundwater (EW-97-1, EW-97-2 and EW-97-3).

Semi-annual samples have been collected by NHDES at six nearby residential wells located to the south of the site. The samples are analyzed to monitor potential exposure to residents from site COCs. Since treatment of groundwater began in September 1993, none of these residential wells have had detections of any VOCs, indicating that contaminant migration has been effectively contained.

Since the startup of the groundwater treatment system in June 1993, concentrations of the contaminants in groundwater have decreased in the monitoring wells. **Table 4-1** below provides a summary of the overall remedial progress made at the site. The table shows maximum concentrations detected historically and during this reporting period for several contaminants at the site along with their respective clean-up levels. The November 2007 data are separated from the fourth Five-Year Review period (2003 through 2007) because this sampling round was conducted under non-pumping (rebound) conditions.

**TABLE 4-1: REMEDIAL ACTION PROGRESS FOR GROUNDWATER CONTAMINANTS**

Groundwater		Maximum Concentration Detected (µg/L)		
Contaminant	Cleanup Level	1988-2002	2003-2006	Nov. 2007
<i>1988 ROD Chemicals of concern</i>				
Benzene	5	330	<b>17</b>	3.8
Tetrachloroethylene	5	1,045	<b>38</b>	<b>26</b>
Trichloroethylene	5	211	<b>21</b>	<b>19</b>
1,2-Dichloroethane	5	580	<b>27</b>	5.0
1,1-Dichloroethene	7	1,954	<b>242</b>	<b>160</b>
<i>Additional Chemicals of concern</i>				
Arsenic	10	140	<b>58.3</b>	8.3 <sup>a</sup>
Chloroethane	30 <sup>b</sup>	72	7.7	5.8
Methylene chloride	5	1,230	ND	ND
Methyl ethyl ketone	4,000	32,000	ND	ND
1,2-Dichloropropane	5	197	ND	ND
Vinyl chloride	2	6.3	<b>2.2</b>	<b>2.7</b>
1,1-Dichloropropene	NE	270	ND	ND
Toluene	1,000	1,200	4.1	ND
Tetrahydrofuran	154	1,900	<b>572</b>	33
1,1,1-Trichloroethane	200	3,500	36	14
Cis-1,2-dichloroethene	70	48	27	63
1,1-dichloroethane	81	2,405	<b>206</b>	<b>187</b>
1,4-dioxane	3	140*	<b>842</b>	<b>230</b>

Clean up levels - the more conservative of EPA's Maximum Contaminant Level or New Hampshire's Ambient Groundwater Quality Standards.

NA = Not analyzed

ND = Not detected

NE = Non existent

**BOLD** indicates exceedance of MCL/NH AGQS

**BOLD/italics** indicates current chemical of concern (COC)

a. The only sample analyzed for arsenic was collected from the potable water location (bathroom) in the plant.

b. There are no EPA or NHDES groundwater cleanup levels for chloroethane. Therefore, the EPA Lifetime Health Advisory for chloromethane was used as a surrogate.

\* 1,4-dioxane testing was initiated in 2002 in only a few on-site well locations, all locations were sampled beginning in 2003.

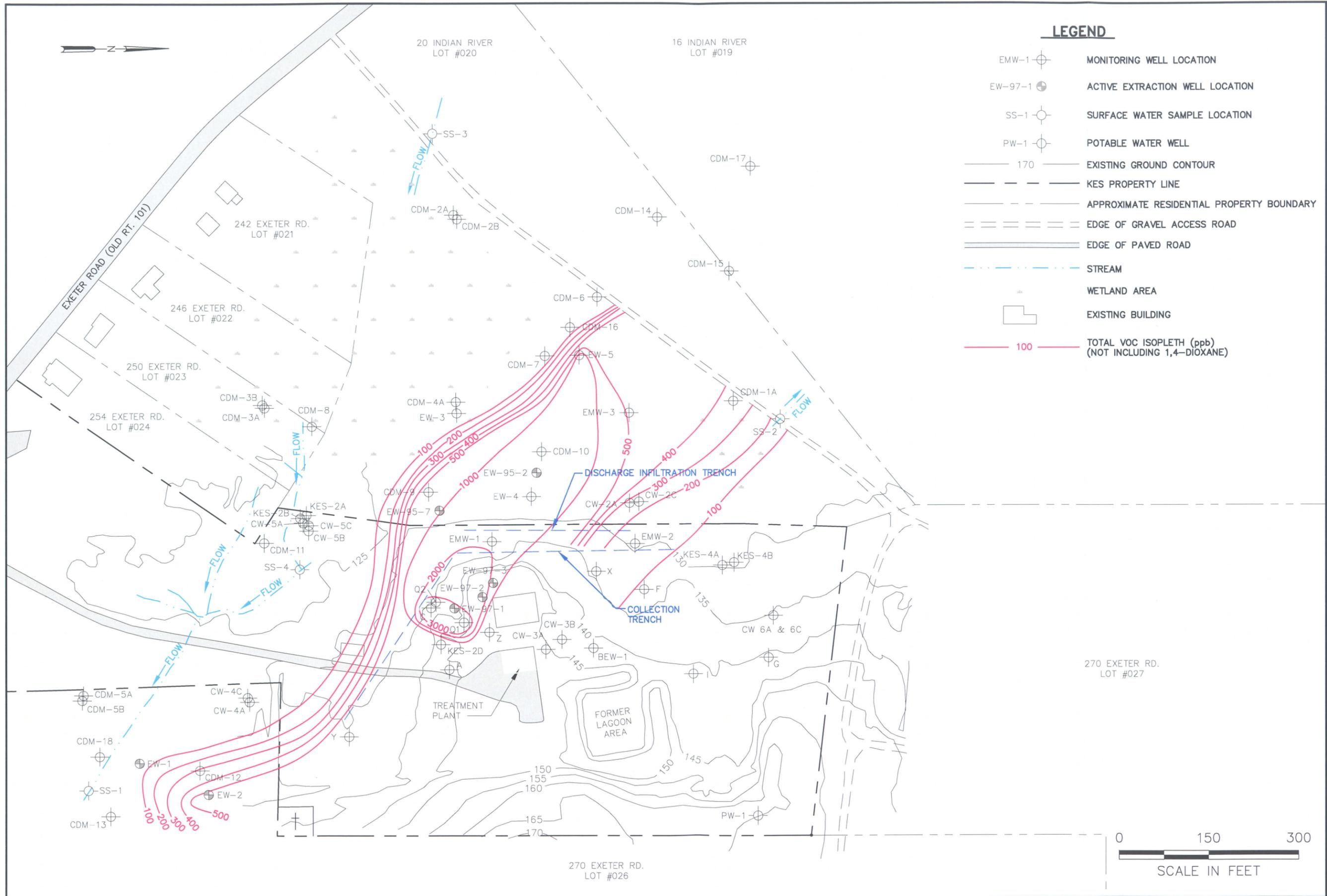
A progression of the decrease in the aerial extent of the groundwater plume through the years can be seen in **Figures 4-1, 4-2, 4-3, 4-4, 4-5 and 4-6**. Although small areas of the groundwater plume still exceed cleanup levels, primarily in the area directly below the former waste handling facility, significant reductions in the concentrations of contaminants and the size of the groundwater plume have been observed since the remedy began in 1993.

The groundwater extraction and remediation system including the multiple extraction wells, cutoff trench, infiltration trench, and the HiPOx system have effectively reduced both on-site and off-site groundwater contaminant levels. As introduced in Section 1.0, and discussed throughout this Five-Year Review report the extraction and treatment system was modified to treat for 1,4-dioxane in 2004 and operated for a period of two years prior to being shut down in December 2006 (to evaluate rebound conditions). As a result, the total VOC contours presented in the figures noted above were developed under different conditions (with and without 1,4-dioxane concentrations and under pumping and non-pumping conditions). **Figures 4-1 through 4-4** did not include the concentration of 1,4-dioxane in the total VOCs because testing for this compound was not performed until May 2003. **Figure 4-5** is the first figure that shows the total VOC isopleth with the 1,4-dioxane concentrations included. As a result of the addition of 1,4-dioxane, the total contaminant distribution appears to be more wide spread than the previous figures which did not include 1,4-dioxane. **Figure 4-5** is from the November 2006 sampling event which was conducted just prior to initiating the full scale rebound evaluation. **Figure 4-6** shows the most recent contaminant distribution based on the November 2007 sampling event (one year after beginning the rebound evaluation). This is the first groundwater monitoring sampling event conducted under non-pumping conditions. **Figures 4-5 and 4-6** show the location of the GMZ which was established in 2006 and show the monitoring wells, extraction wells and surface water locations as grouped during the establishment of the GMZ (decommissioned wells are noted in a lighter font). As part of the system modification to treat for 1,4-dioxane in 2005 several on-site monitoring wells were converted to extraction wells. Recently installed monitoring wells MW-50 and MW-51 are shown only on **Figures 4-5, 4-6 and 4-7**. These wells were installed to help define the northern boundaries of the GMZ. **Figure 4-7** shows the 1,4-dioxane contaminant distribution from May 2005 through May 2008. Exceedances of the NHDES established, 3 µg/l AGQS for 1,4-dioxane are noted by shading the reported value. Results from sampling rounds performed after the treatment system was shut down for the rebound evaluation are highlighted in yellow on **Figure 4-7**.

The remainder of this remedy implementation section provides a brief overview and discussion of these changing conditions and the adaptations made to the extractions system. The management of migration (plume) discussion is subdivided into two subsets due to the different nature of the contaminants (VOCs and 1,4-dioxane). Each subset discusses the data under both pumping and non-pumping conditions.

This summary is based on data presented in the *2007 Groundwater Quality Evaluation Report* dated August 2007, the *2007 Annual Groundwater Monitoring Report* dated January 2008 and previous groundwater quality evaluation reports which have documented the magnitude of the total VOC mass reduction at the site. A comparison of the current size and concentration of the contaminant plume with the historic contaminant plume in 1993 shows the effectiveness of the remediation efforts to date (see **Figure 4-1 through Figure 4-6**). More detailed discussions relative to the pumping and non pumping conditions and the 2007/2008 rebound study will be evaluated and presented in a separate report (*The 2008 Groundwater Quality Evaluation Report*).

**FIGURE 4-1: TOTAL VOC CONTAMINANT DISTRIBUTION – SEPTEMBER 1993 (WITHOUT 1,4-DIOXANE)**



**LEGEND**

- EMW-1 MONITORING WELL LOCATION
- EW-97-1 ACTIVE EXTRACTION WELL LOCATION
- SS-1 SURFACE WATER SAMPLE LOCATION
- PW-1 POTABLE WATER WELL
- 170 EXISTING GROUND CONTOUR
- KES PROPERTY LINE
- APPROXIMATE RESIDENTIAL PROPERTY BOUNDARY
- EDGE OF GRAVEL ACCESS ROAD
- EDGE OF PAVED ROAD
- STREAM
- WETLAND AREA
- EXISTING BUILDING
- 100 TOTAL VOC ISOPLETH (ppb)  
(NOT INCLUDING 1,4-DIOXANE)

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**TOTAL VOC DISTRIBUTION  
NOVEMBER 1993**

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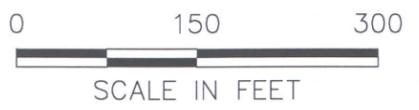
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FIGURE 4-1

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CHECKED BY: DD  
Figure 4-1.dwg

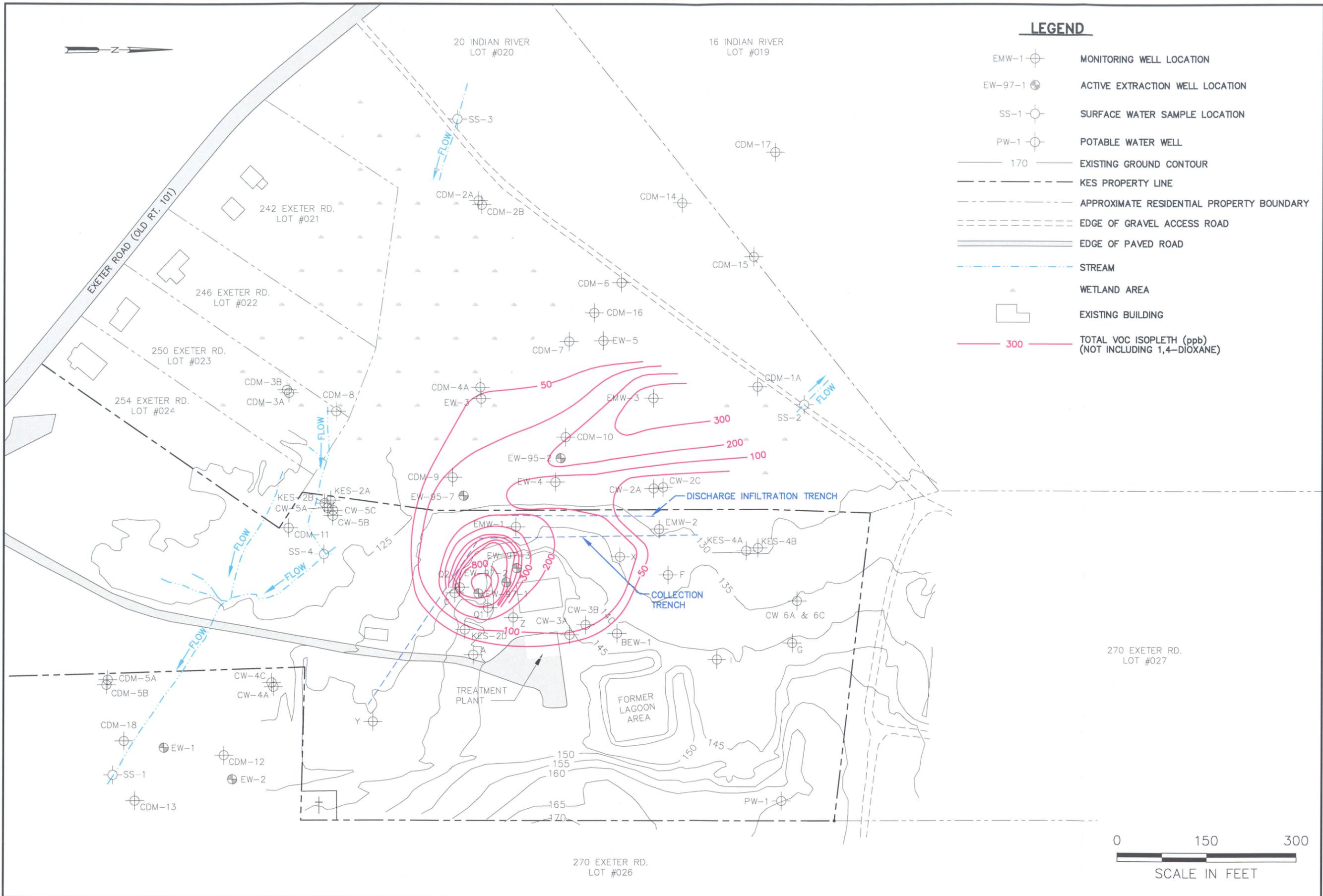
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270 EXETER RD.  
LOT #026

270 EXETER RD.  
LOT #027

**FIGURE 4-2: TOTAL VOC CONTAMINANT DISTRIBUTION – SEPTEMBER 1995 (WITHOUT 1,4-DIOXANE)**



**LEGEND**

- EMW-1 MONITORING WELL LOCATION
- EW-97-1 ACTIVE EXTRACTION WELL LOCATION
- SS-1 SURFACE WATER SAMPLE LOCATION
- PW-1 POTABLE WATER WELL
- 170 EXISTING GROUND CONTOUR
- KES PROPERTY LINE
- APPROXIMATE RESIDENTIAL PROPERTY BOUNDARY
- EDGE OF GRAVEL ACCESS ROAD
- EDGE OF PAVED ROAD
- STREAM
- WETLAND AREA
- EXISTING BUILDING
- 300 TOTAL VOC ISOPLETH (ppb)  
(NOT INCLUDING 1,4-DIOXANE)

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**TOTAL VOC DISTRIBUTION  
 SEPTEMBER 1995**

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 Figure 4-2.dwg

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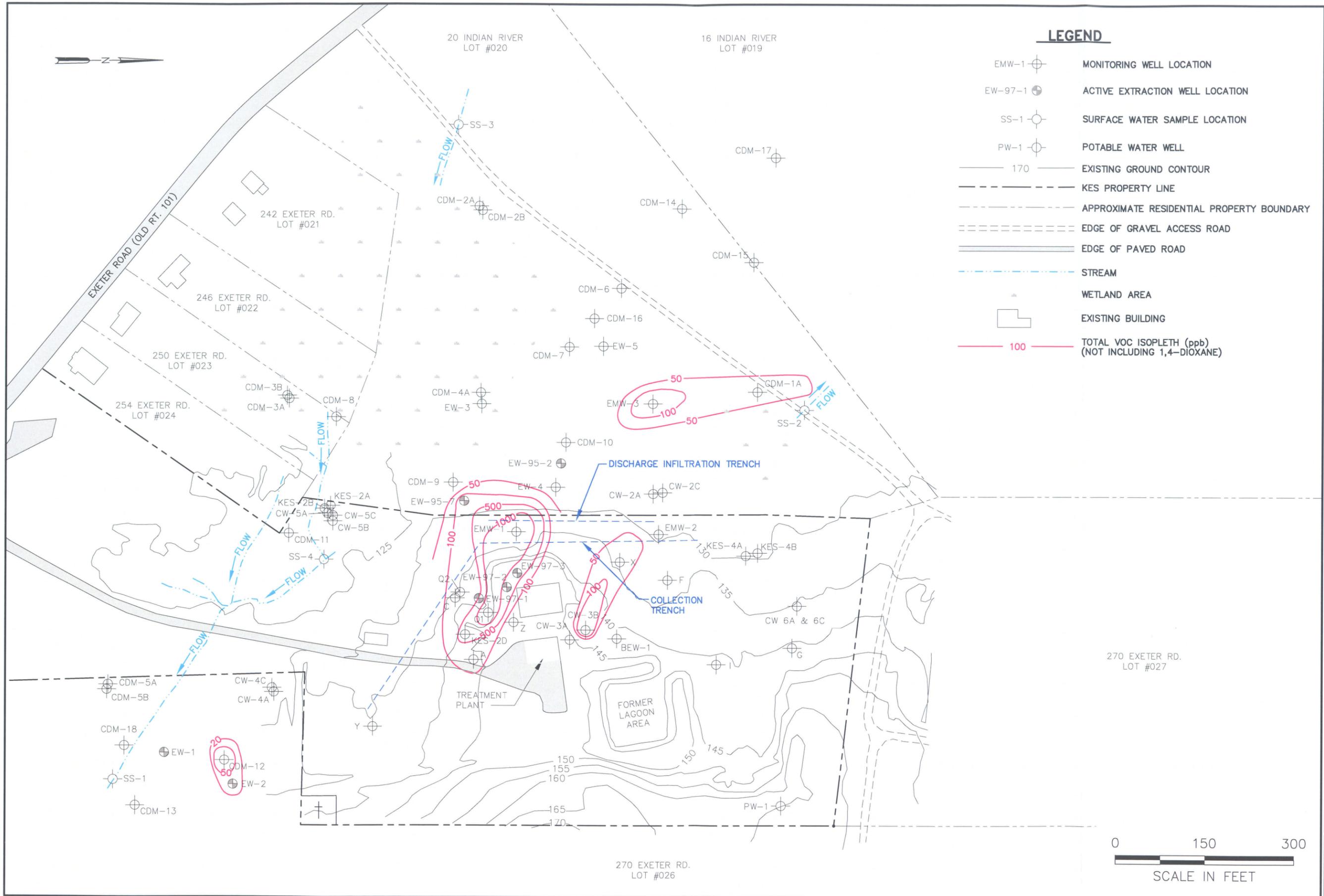
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FIGURE 4-2



270 EXETER RD.  
 LOT #026

**FIGURE 4-3: TOTAL VOC CONTAMINANT DISTRIBUTION – NOVEMBER 1999 (WITHOUT 1,4-DIOXANE)**



**LEGEND**

- EMW-1 MONITORING WELL LOCATION
- EW-97-1 ACTIVE EXTRACTION WELL LOCATION
- SS-1 SURFACE WATER SAMPLE LOCATION
- PW-1 POTABLE WATER WELL
- 170 EXISTING GROUND CONTOUR
- KES PROPERTY LINE
- APPROXIMATE RESIDENTIAL PROPERTY BOUNDARY
- EDGE OF GRAVEL ACCESS ROAD
- EDGE OF PAVED ROAD
- STREAM
- WETLAND AREA
- EXISTING BUILDING
- 100 TOTAL VOC ISOPLETH (ppb)  
(NOT INCLUDING 1,4-DIOXANE)

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**TOTAL VOC DISTRIBUTION  
 NOVEMBER 1999**

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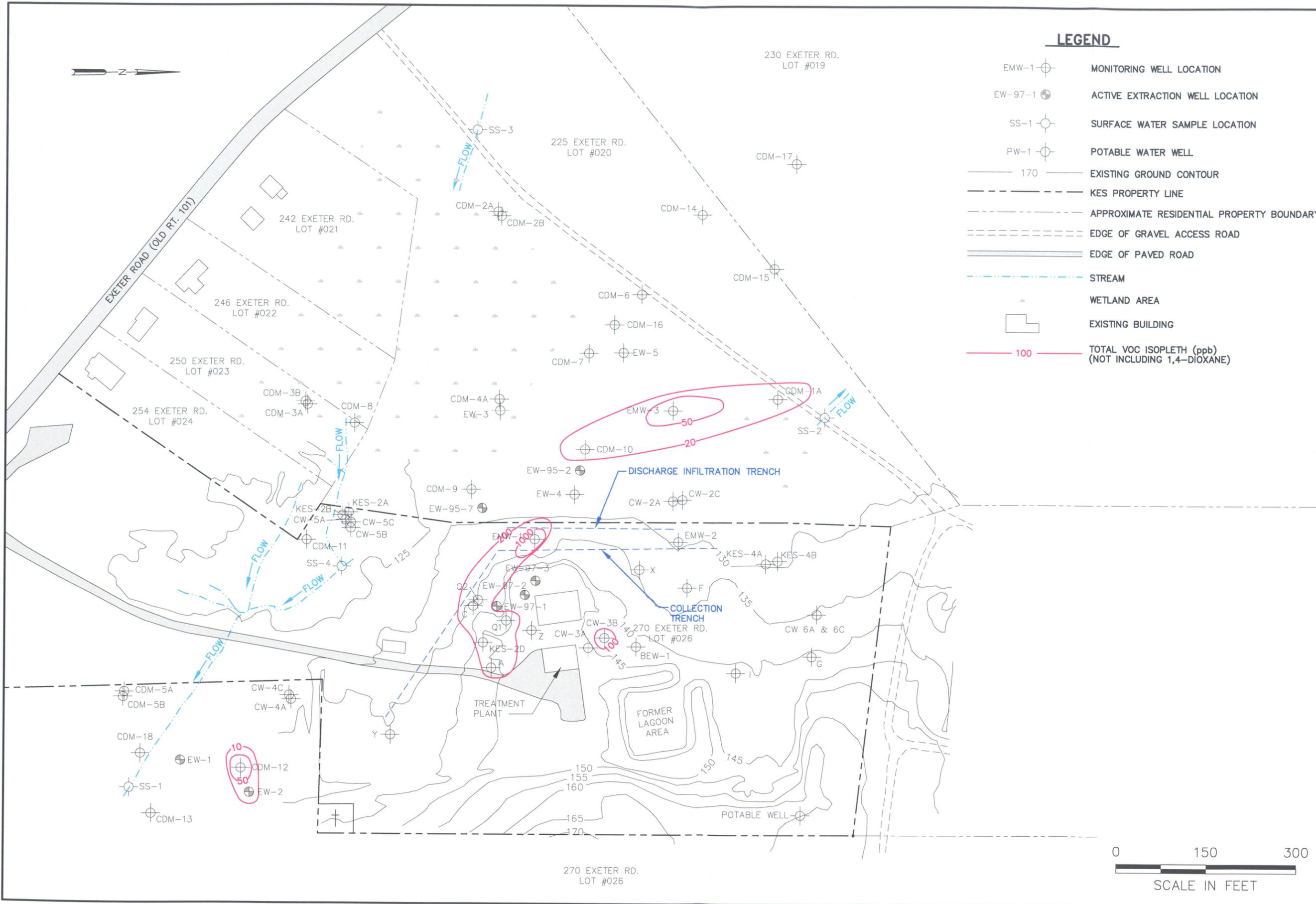
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 SCALE: AS NOTED

FIGURE 4-3

**FIGURE 4-4: TOTAL VOC CONTAMINANT DISTRIBUTION – NOVEMBER 2001 (WITHOUT 1,4-DIOXANE)**



**LEGEND**

- EMW-1 MONITORING WELL LOCATION
- EW-97-1 ACTIVE EXTRACTION WELL LOCATION
- SS-1 SURFACE WATER SAMPLE LOCATION
- PW-1 POTABLE WATER WELL
- 170 EXISTING GROUND CONTOUR
- KES PROPERTY LINE
- APPROXIMATE RESIDENTIAL PROPERTY BOUNDARY
- EDGE OF GRAVEL ACCESS ROAD
- EDGE OF PAVED ROAD
- STREAM
- WETLAND AREA
- EXISTING BUILDING
- 100 TOTAL VOC ISOPLETH (ppb)  
(NOT INCLUDING 1,4-DIOXANE)

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**TOTAL VOC DISTRIBUTION  
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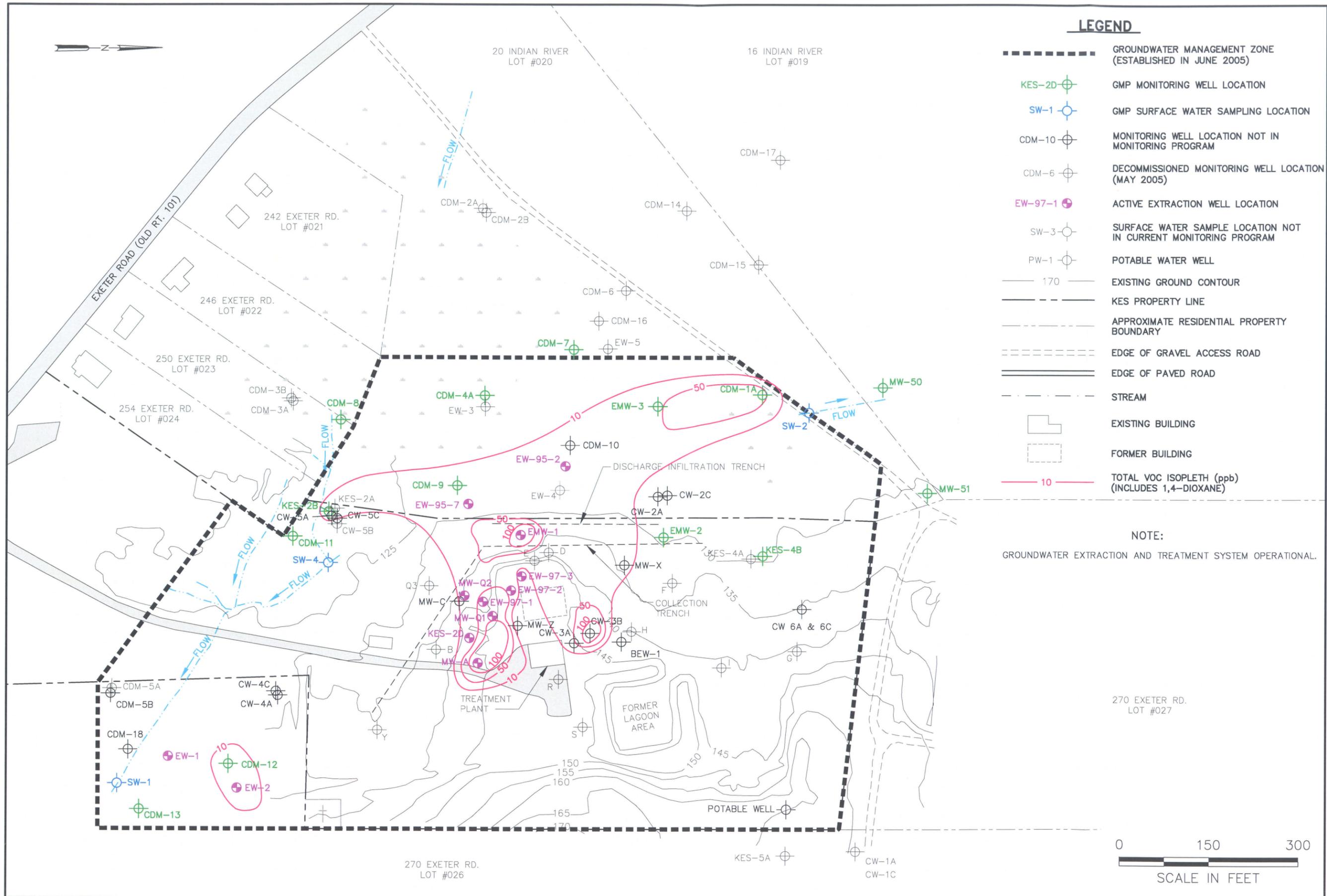
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 DRAWN BY: EVR  
 Figure 4-4.dwg

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 SCALE: AS NOTED

FIGURE 4-4



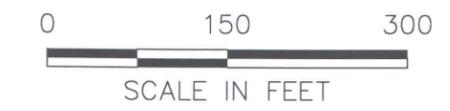
**FIGURE 4-5: TOTAL VOC CONTAMINANT DISTRIBUTION – NOVEMBER 2006 (WITH 1,4-DIOXANE)**



**LEGEND**

- GROUNDWATER MANAGEMENT ZONE (ESTABLISHED IN JUNE 2005)
- KES-2D GMP MONITORING WELL LOCATION
- SW-1 GMP SURFACE WATER SAMPLING LOCATION
- CDM-10 MONITORING WELL LOCATION NOT IN MONITORING PROGRAM
- CDM-6 DECOMMISSIONED MONITORING WELL LOCATION (MAY 2005)
- EW-97-1 ACTIVE EXTRACTION WELL LOCATION
- SW-3 SURFACE WATER SAMPLE LOCATION NOT IN CURRENT MONITORING PROGRAM
- PW-1 POTABLE WATER WELL
- 170 EXISTING GROUND CONTOUR
- KES PROPERTY LINE
- APPROXIMATE RESIDENTIAL PROPERTY BOUNDARY
- EDGE OF GRAVEL ACCESS ROAD
- === EDGE OF PAVED ROAD
- - - - - STREAM
- EXISTING BUILDING
- FORMER BUILDING
- 10 TOTAL VOC ISOPLETH (ppb) (INCLUDES 1,4-DIOXANE)

NOTE:  
GROUNDWATER EXTRACTION AND TREATMENT SYSTEM OPERATIONAL.



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TOTAL VOC WITH 1,4-DIOXANE  
DISTRIBUTION - NOVEMBER 2006

KEEFE ENVIRONMENTAL SERVICE SITE  
EPPING, NEW HAMPSHIRE

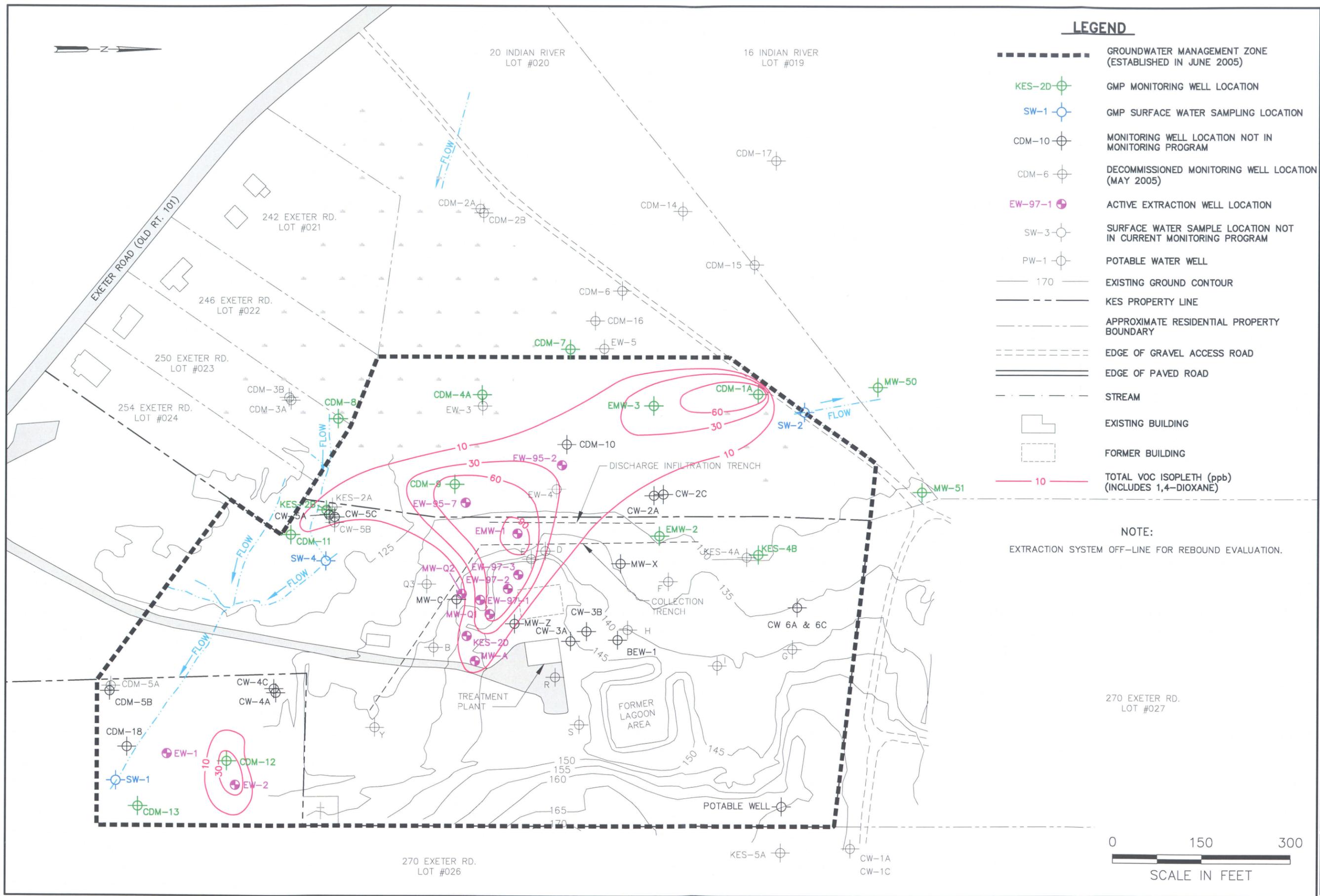
JOB NO: 93424  
DATE: JULY 2008  
SCALE: AS NOTED

FIGURE 4-5

DESIGNED BY: EVR  
CHECKED BY: DD  
DRAWN BY: EVR  
Figure 4-5.dwg  
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FOURTH 5-YEAR REVIEW REPORT

**FIGURE 4-6: TOTAL VOC CONTAMINANT DISTRIBUTION – NOVEMBER 2007 (WITH 1,4-DIOXANE)**



**LEGEND**

- GROUNDWATER MANAGEMENT ZONE (ESTABLISHED IN JUNE 2005)
- KES-2D GMP MONITORING WELL LOCATION
- SW-1 GMP SURFACE WATER SAMPLING LOCATION
- CDM-10 MONITORING WELL LOCATION NOT IN MONITORING PROGRAM
- CDM-6 DECOMMISSIONED MONITORING WELL LOCATION (MAY 2005)
- EW-97-1 ACTIVE EXTRACTION WELL LOCATION
- SW-3 SURFACE WATER SAMPLE LOCATION NOT IN CURRENT MONITORING PROGRAM
- PW-1 POTABLE WATER WELL
- 170 EXISTING GROUND CONTOUR
- KES PROPERTY LINE
- - - APPROXIMATE RESIDENTIAL PROPERTY BOUNDARY
- - - - - EDGE OF GRAVEL ACCESS ROAD
- ==== EDGE OF PAVED ROAD
- - - - - STREAM
- EXISTING BUILDING
- FORMER BUILDING
- 10 TOTAL VOC ISOPLETH (ppb) (INCLUDES 1,4-DIOXANE)

NOTE:  
EXTRACTION SYSTEM OFF-LINE FOR REBOUND EVALUATION.



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**TOTAL VOC WITH 1,4-DIOXANE  
DISTRIBUTION - NOVEMBER 2007**

DESIGNED BY: MLB	CHECKED BY: DD
DRAWN BY: EVR	Figure 4-6.dwg

KEEFE ENVIRONMENTAL SERVICE SITE  
EPPING, NEW HAMPSHIRE

FOURTH 5-YEAR REVIEW REPORT

JOB NO: 93424.01
DATE: JULY 2008
SCALE: AS NOTED

FIGURE 4-6

**FIGURE 4-7: 1,4-DIOXANE CONTAMINANT DISTRIBUTION – 2005 TO 2008**



20 INDIAN RIVER LOT #020

16 INDIAN RIVER LOT #019

242 EXETER RD. LOT #021

246 EXETER RD. LOT #022

250 EXETER RD. LOT #023

254 EXETER RD. LOT #024

270 EXETER RD. LOT #026

270 EXETER RD. LOT #027

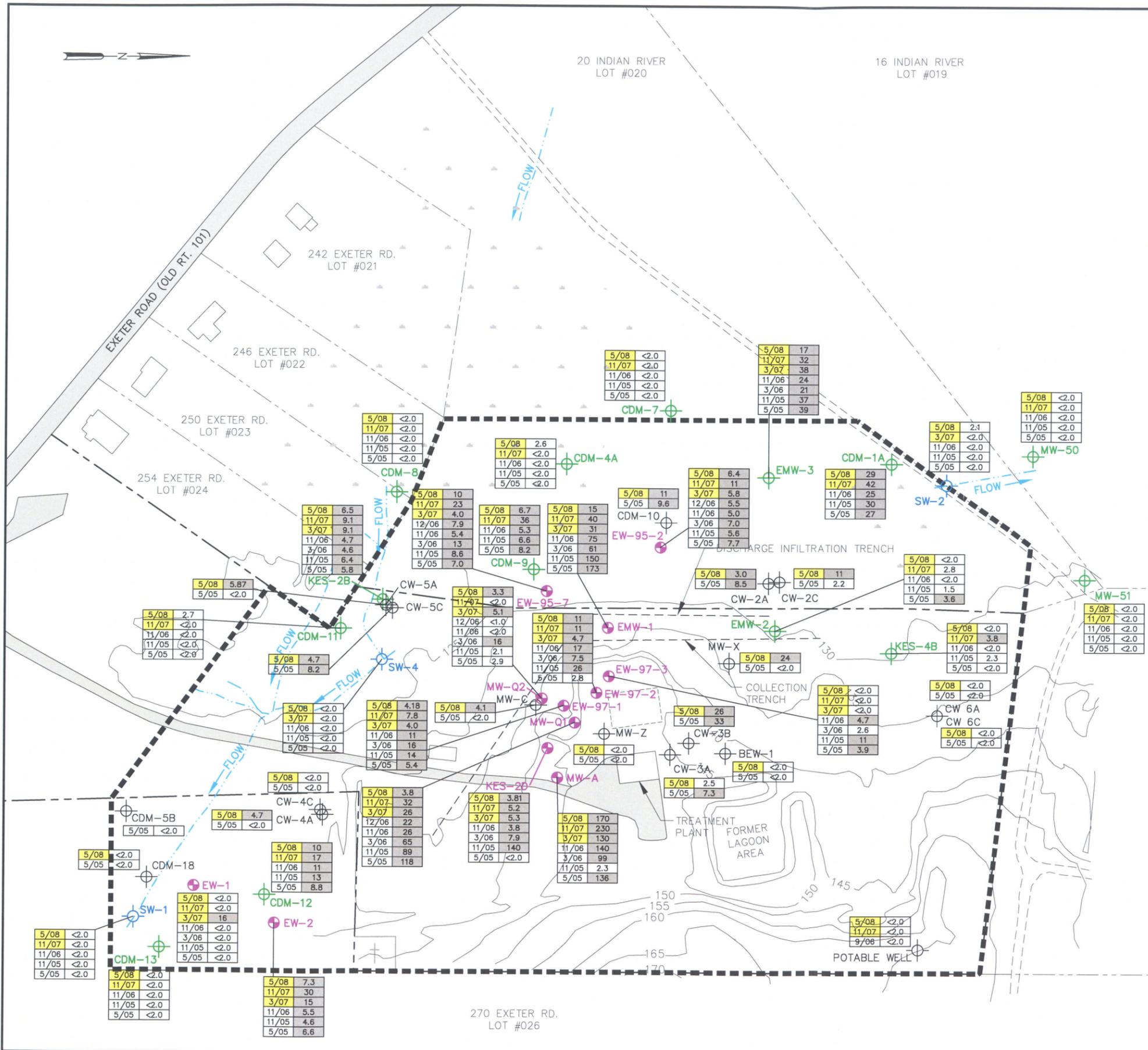
### LEGEND

- GROUNDWATER MANAGEMENT ZONE (ESTABLISHED IN JUNE 2005)
- KES-2D GMP MONITORING WELL LOCATION
- SW-1 GMP SURFACE WATER SAMPLING LOCATION
- CDM-10 MONITORING WELL LOCATION NOT IN MONITORING PROGRAM
- EW-97-1 ACTIVE EXTRACTION WELL LOCATION
- SW-3 SURFACE WATER SAMPLE LOCATION NOT IN CURRENT MONITORING PROGRAM
- PW-1 POTABLE WATER WELL
- 170 EXISTING GROUND CONTOUR
- KES PROPERTY LINE
- APPROXIMATE RESIDENTIAL PROPERTY BOUNDARY
- EDGE OF GRAVEL ACCESS ROAD
- EDGE OF PAVED ROAD
- STREAM
- EXISTING BUILDING
- FORMER BUILDING

5/08	6.4
11/07	11
3/07	5.8
12/06	5.5
11/06	5.0
3/06	7.0
11/05	5.6
5/05	7.7

1,4-DIOXANE CONCENTRATION (ug/l)  
 < = NOT DETECTED AT REPORTING LIMIT  
 SHADING INDICATES CONCENTRATION DETECTED IN EXCESS OF 3 ug/l AGQS

**NOTE:**  
 HIGHLIGHTED DATES ARE FOR SAMPLES COLLECTED DURING REBOUND EVALUATIONS (I.E., EXTRACTION SYSTEM NOT OPERATIONAL).



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**1, 4 - DIOXANE  
 CONTAMINANT DISTRIBUTION  
 2005 - 2008**

KEEFE ENVIRONMENTAL SERVICE SITE  
 EPPING, NEW HAMPSHIRE

FOURTH 5-YEAR REVIEW REPORT

JOB NO: 93424.01  
 DATE: JULY 2008  
 SCALE: AS NOTED

FIGURE 4-7

DESIGNED BY: MLB  
 CHECKED BY: DD  
 DRAWN BY: EVR  
 Figure 4-7.dwg

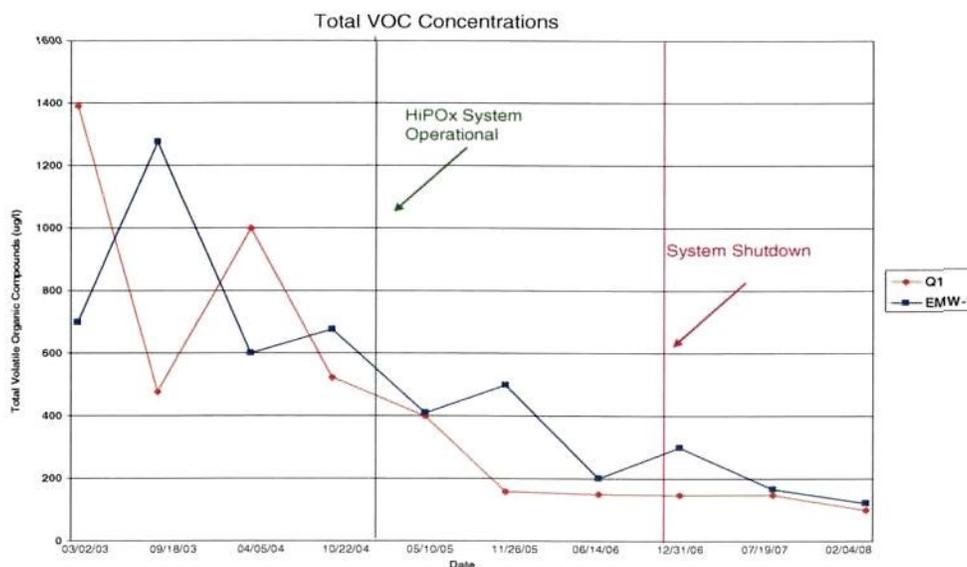
## CONTAMINANT DISTRIBUTION SUMMARY

Elevated concentrations of VOCs (including 1,4-dioxane) are present in groundwater at the site. Although some slight increases in concentrations can be observed, these concentrations are generally consistent with previous results and only a few individual VOC constituents continue to remain in excess of NHDES AGQS. A review of the monitoring results from the fall 2007 sampling event (under non-pumping conditions) shows that only two compounds, 1,4-dioxane, and 1,1-DCE, are currently detected in excess of AGQS criteria in off-site monitoring wells but within the GMZ. All other constituents detected during the 2007 groundwater sampling event were detected at levels below AGQS criteria or were detected in current extraction well locations (consistent with previous results under pumping conditions).

The distribution of total VOCs including 1,4-dioxane from the November 2007 monitoring event is presented in **Figure 4-6**. Overall, this distribution and trend in contaminant concentrations is consistent with previous results, which have been reported generally on an annual basis to the NHDES since 1994. Further evaluation of contaminant concentrations and an assessment of trends are presented in the Groundwater Quality Evaluations Reports. A summary of contaminant concentrations is presented below:

### VOLATILE ORGANIC COMPOUNDS

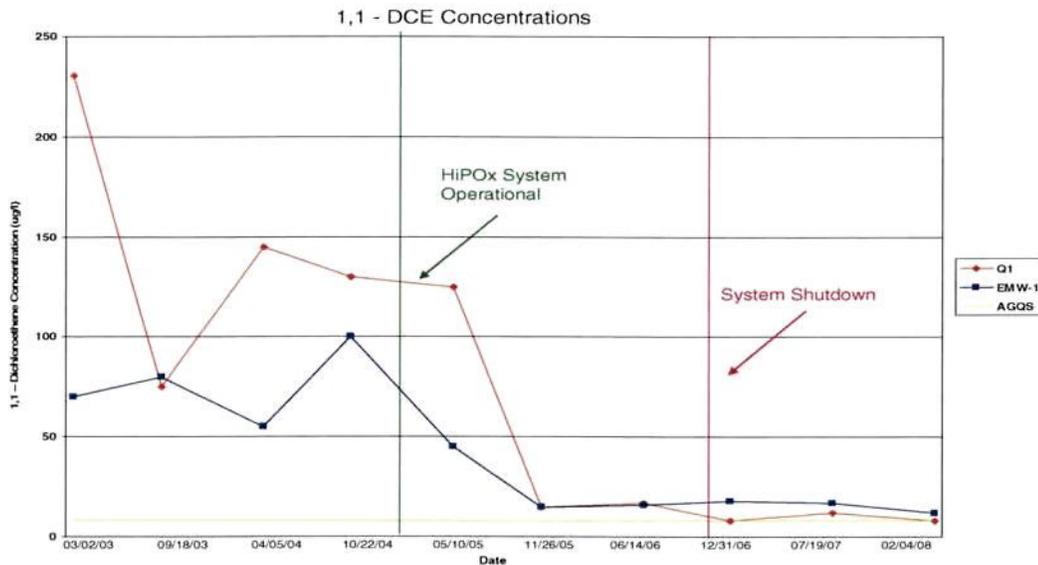
Concentrations of VOCs in excess of their respective AGQS have consistently been detected in monitoring wells within the established GMZ; however decreasing values have generally been observed throughout the monitoring well network. Consistent with previous results, some of the higher concentrations of VOCs were detected in monitoring wells EMW-1 and Q1 in the November 2007 sampling event. Both wells are located in the area southwest of the treatment plant, which has historically contained the highest concentrations of VOCs in groundwater and the most significant exceedances of the AGQS. As shown in the graph below, total VOC concentrations have decreased by approximately 87% in monitoring well EMW-1 and 95% in monitoring well Q1 since the May 2003 sampling event.



As previously discussed, both of the wells depicted above were converted to extraction wells during the spring of 2005 (which appears to have contributed in the observed total VOC concentration decrease), but have not been operational since the treatment plant shutdown in December 2006.

Although **Figures 4-1 through 4-6** show an overall decrease in concentration and distribution of total VOCs, some monitoring locations demonstrated increasing concentrations of VOCs during the November 2007 sampling event (rebound). In particular, monitoring wells CDM-1A and CDM-9 and extraction well EW-2 exhibit slightly higher VOC concentrations when compared to previous monitoring results. Monitoring well CDM-9 is located in close proximity to and downgradient of monitoring well EMW-1, in the area southwest and west of the treatment plant, respectively. Total VOC concentrations in this monitoring well (EMW-1) demonstrated a slight decrease in 1,1-DCA, 1,2-DCA, 1,1-DCE and cis 1,2-DCE but a slight increase in 1,4-dioxane during the November 2007 sampling. Total VOC concentrations at monitoring well CDM-9 and CDM-1A (located northwest of the treatment plant) appear to follow a similar pattern with increase in both VOCs and 1,4-dioxane. However, the concentrations of all VOCs in the monitoring wells immediately downgradient of CDM-9 (monitoring well CDM-8) and CDM-1A (monitoring wells MW-50 and MW-51) remain non-detect.

Groundwater AGQS exceedances, historic and current, are summarized in **Table 4** of the *2007 Annual Groundwater Monitoring Report*, dated January 2008. As shown, aside from 1,4-dioxane (which is discussed separately), only one compound (1,1-DCE) remains in excess of AGQS criteria in more than one off-site location sampled within the GMZ. However, the decrease of 1,1-DCE concentrations is indicative of the historic reduction in the overall number of detections as well as detections in excess of the AGQS as is illustrated in the graph below for monitoring wells Q-1 and EMW-1.

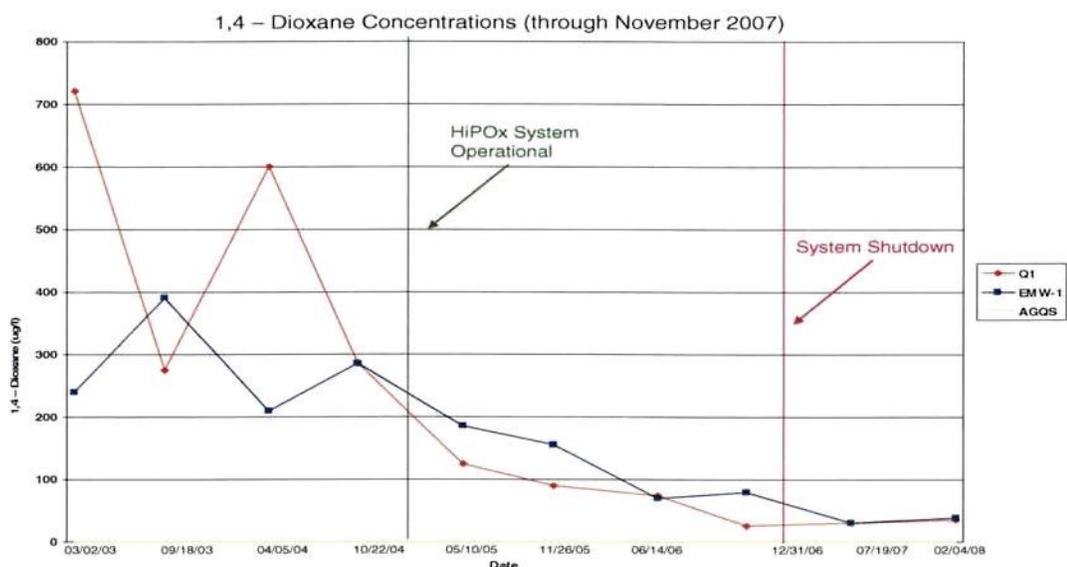


## 1,4-DIOXANE

As noted earlier in this report (Section 1.0 and 3.4), a new compound of concern, 1,4-dioxane, was initially detected in samples collected at the site in 2003. Results from the analyses of samples collected during an expanded sampling program in 2004 indicated that 1,4-dioxane was present in site groundwater; however, it was not detected in samples collected from any of the six nearby residences. As a result of the discovery of this new COC (and the adoption of a new NHDES AGQS for 1,4-dioxane of 3 µg/l), the groundwater extraction and treatment system was modified in 2005. A high pressure oxidation (HiPOx) system was installed because the existing treatment system, which consisted of air stripping and vapor phase carbon adsorption, was not effective for removing 1,4-dioxane from groundwater. To facilitate the removal of 1,4-dioxane from groundwater in the on-site areas exhibiting high concentrations, some monitoring wells were converted to extraction wells. The modified system effectively treated

groundwater for 1,4-dioxane in addition to the other COCs. The HiPOx system began operations in January 2005 and continued through December 2006. Since the system came on-line, concentrations of 1,4-dioxane have decreased significantly in groundwater at several locations including EMW-1, KES-2D, MW-Q1, and MW-Q2 (monitoring wells converted to extraction wells). The conversion of the plant to treat for the new COC was performed by the EPA in order to meet the scheduled transfer date from LTRA to O&M by the State which was set for June 30, 2005. Under the transfer O&M plan, the new system was operated for two years and then turned off to monitor the site for rebound of contaminants.

The 1,4-dioxane contaminant distribution is presented in **Figure 4-7** (2005 to 2008). Overall, 1,4-dioxane continues to be the predominant VOC detected in excess of the NHDES AGQS (3 µg/l), although generally decreasing concentrations have been observed since initial sampling and analyses were performed for 1,4-dioxane in May 2003. The November 2007 sampling event results indicated that 1,4-dioxane concentrations have decreased significantly since the addition of the HiPOx system. Consistent with previous monitoring results and also correlating with other AGQS exceedances discussed above, 1,4-dioxane concentrations remain relatively high in monitoring wells EMW-1 and Q1. The historic concentrations of 1,4-dioxane in these wells follow a similar decrease in VOCs concentrations (which also appears to be the result of converting these wells to extraction wells). This is illustrated in the graph below.



As shown in **Figure 4-7**, concentrations of 1,4-dioxane were detected at a highest concentration of 170 µg/l during the May 2008 sampling round (MW-A). Concentrations in both monitoring wells EMW-1 and Q1 are lower than the previous sampling event (both of which were conducted under non-pumping conditions). Overall, concentrations are down from a high of 842 µg/l detected in duplicate samples in monitoring well Q1 in May 2003. Concentrations of 1,4-dioxane exceeding 100 µg/l were detected in 7 out of 23 monitoring locations originally sampled in May 2003. Concentrations exceeding 100 µg/l were detected in only 1 of 47 locations sampled in May 2008 (MW-A). Concentrations exceeding 10 µg/l were detected in 10 of 47 locations sampled in May 2008.

While the groundwater quality at the site continues to improve some areas have contaminant concentrations that continue to exceed the AGQS. In addition, some increasing contaminant concentrations are being observed. Based on this information, the groundwater quality at the site will continue to be monitored, as required by the GMP. Additionally, the results of a future supplemental groundwater quality evaluation will be used to review rebound and assess the need to restart the treatment system. The monitoring results of future sampling rounds will continue to be evaluated to determine compliance with applicable AGQS and assess the clean-up progress of the site. The next round of groundwater sampling required by the GMP is scheduled for November 2008.

#### SITE MONITORING / CONCEPTUAL MODEL

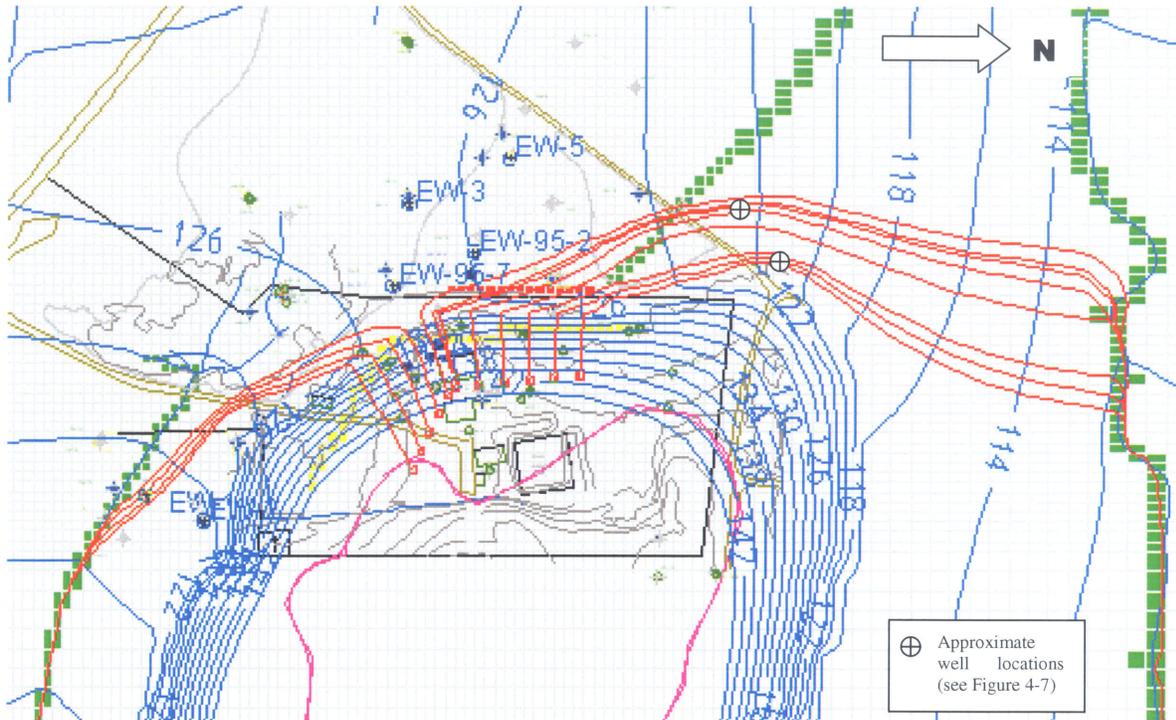
Monitoring well locations included in the current sampling program are shown on **Figure 3-2**. Typically the site is monitored twice per year in the spring and fall. Spring sampling monitors the performance of the treatment operations while the fall sampling program is performed to comply with the requirements of the GMP. Analytical results from upcoming sampling events will be used to evaluate future operations of the groundwater extraction and treatment system. In addition, the collection of parameters for a future potential MNA evaluation was initiated in November 2007. Further details of the site's sampling program can be found in the *KES Sampling and Analytical Plan (SAP)* updated in May 2008. As of July 2008 (this Five-Year Review period) the groundwater treatment system remains off while potential rebound conditions are evaluated. The extraction and treatment system has not been operational since December 2006 in order to allow groundwater to return to normal flow conditions and to allow for the evaluation of this effect on the migration of groundwater concentrations at monitoring locations around the site..

Prior to initiating the rebound study and during the development of the GMZ, the adequacy of the existing monitoring well network under shut-down conditions was evaluated using the modeled flow field and particle tracking (refer to the Item C of the "*Application for Groundwater Permit*" dated June 6, 2005 for additional details on the groundwater model). The results of this analysis are presented in **Figure 4-8** below. In general, the flow paths indicated that the monitoring network south and west of the site is adequate for evaluating post-shutdown conditions in the GMZ. To the north and northwest of the site, however, the particle tracking results suggested the potential need for additional monitoring wells. As a result, two additional monitoring wells were installed (MW-50 and MW-51) in May 2005 (as noted earlier in this report). Both locations were installed to the north and northeast of monitoring well CDM-1A and surface water monitoring location SW-2.

The groundwater model was also used to simulate the effect of the shutdown of the remediation system on the site flow-field. The potentiometric contours resulting from average recharge conditions in the post-shutdown flow regime are also depicted in **Figure 4-8**. The flow field essentially returns to steady-state or pre-remediation conditions at the site. In order to better depict the movement of groundwater from the site, particles were introduced into the flow-field and allowed to move through the flow system. The paths of these particles are shown in red and generally are perpendicular to the potentiometric contours. Groundwater movement from the plant area moves generally westward until reaching the

groundwater divides present west of the site. Then particles split and flow to the south toward the brook (which ultimately drains to the Fresh River) or north toward the Piscassic River.

**FIGURE 4-8: SIMULATED POST SHUT-DOWN FLOW FIELD**



The monitoring well data collected, to date, under non-pumping conditions and data collected in November 2008 will be evaluated further to determine if the GMZ established for the site will remain protective. In general, the modeling/particle tracking indicates the shallow flow path is not toward the residential wells. Currently no exceedances of the AGQS have been detected outside the established GMZ and no parameters have been detected in the residential wells. Residential sampling will continue for 1,4-dioxane which is expected to be the most mobile site contaminant.

A detailed evaluation relative to the pumping and non pumping conditions and the 2007/2008 rebound study will be performed and presented in a separate report (*The 2008 Groundwater Quality Evaluation Report*). Site characterization data will be integrated into a conceptual model for the site. This will include a three dimensional representation that integrates the information on the groundwater model (hydrogeologic conditions) and the source, fate and transport of contaminants. The conceptual model along with site data will be used to evaluate the potential efficacy of continued pumping and treating or possibly changing to monitored natural attenuation as a remedy.

### 4.3 SYSTEMS OPERATIONS/LONG TERM REMEDIAL ACTION

In June 1993, construction of the OU-2 Groundwater Collection and Treatment Facility (GCTF) was completed and system start-up commenced. The system was designed to extract and treat up to 60 gallons per minute (gpm) using metals precipitation, air stripping, vapor phase carbon adsorption, and re-injection/infiltration of treated groundwater. During the startup period, the system was monitored and evaluated to confirm all construction activities were complete and system components were functioning as designed. Equipment checks were completed on pumps, motors and control systems. In September 1993, the NHDES and EPA awarded a long-term operations contract for the O&M of the GCTF. The LTRA project included full-time site coverage (system operations and maintenance), security, hydrogeological assessments, and engineering evaluations and recommendations. The contractor met all performance objectives and significantly improved the performance of the groundwater extraction system to maximize mass flux of contaminants into the facility.

The original groundwater treatment system, which was designed to remove COCs specified in the 1988 ROD, consisted of five groundwater extraction wells, a collection trench, a pump station, metals removal, pressure filtration, air stripping, vapor treatment, sludge dewatering, and effluent disposal. Groundwater was collected through an on-site groundwater collection trench and an on-site and off-site extraction well network. The original effluent discharge system consisted of an on-site leach field and an off-site infiltration trench. This system was supplemented with an on-site spray irrigation system to dispose of treated effluent via evapotranspiration.

Originally, the cleanup was expected to take 10 years at the design flow rate of 60 gpm; however, due to the naturally occurring tight soils at the site, the system was only capable of extracting only 8 to 10 gpm of groundwater from the subsurface; thereby, more than doubling the anticipated cleanup duration. In 1994, a hydrogeological evaluation of the aquifer was conducted. The study identified design limitations of the existing pumping, collection, and recharge systems. Based on these results, engineering improvements to the system including the installation of two strategically placed extraction wells significantly increased the effectiveness of the system. Groundwater was first extracted from the new wells in September 1995 and in less than two years, monitoring results and hydrogeologic modeling showed approximately a 70% reduction in the area of the contaminant plume (off-site) and a five-fold reduction in concentration levels. In addition, the spray irrigation program was initiated in 1995 in an effort to prevent hydraulic mounding at the infiltration trench and to reduce on-site contamination observed in the till surrounding the site. From April through November (weather dependent), an average of approximately 60-90 percent of the treatment plant discharge was diverted from the infiltration trench to the spray irrigation system. A Vacuum Enhanced Extraction System (VEES) was also installed to further enhance the on-site remediation effort. Three additional wells were installed between 1997 and 1998 as part of the VEES. The vacuum enhanced recovery extraction wells were placed on-line in August 1998 to further optimize the removal of contaminated groundwater at the site. Improvements in the efficiency of groundwater extraction from the wells resulted in an increase in the removal rate to approximately 20+ gallons per minute, accelerating remediation of on-site groundwater.

In 2005 groundwater treatment was further modified with the addition of the HiPOx unit to accommodate the extraction and destruction of 1,4-dioxane because the air stripper used to treat the other COCs was not intended for nor capable of removing 1,4-dioxane. Under the modified system to treat for 1,4-dioxane, groundwater is pumped from the extraction wells and collection trench (as with the originally modified extraction system as noted above) and additional wells that were converted from monitoring wells during the 2005 system upgrade. These additional extraction wells (converted monitoring wells) were the on-site monitoring wells with highest 1,4-dioxane concentrations.

Treatment of the extracted groundwater for iron removal was discontinued because influent iron concentrations were low. Currently, when the system is operational, influent groundwater is pumped to the lamella clarifier and flows to an equalization tank via gravity. From the flow equalization tank groundwater is pumped through pressure filters to the HiPOx unit feed tank. The removal of 1,4-dioxane and other COCs is achieved through the addition of hydrogen peroxide and ozone. An ozone generator is installed as part of the HiPOx system and is used to produce ozone from an oxygen supply. The addition of peroxide and ozone to the extracted groundwater resulted in the oxidation and destruction of 1,4-dioxane and other site-related COCs. The treated groundwater is collected in an effluent discharge tank and ultimately discharged to either the infiltration trench and/or spray irrigation system. Since the treatment system modification there has been an overall decrease in concentrations of 1,4-dioxane in the site groundwater. The results from future sampling rounds will be used to monitor trends in concentrations at monitoring locations.

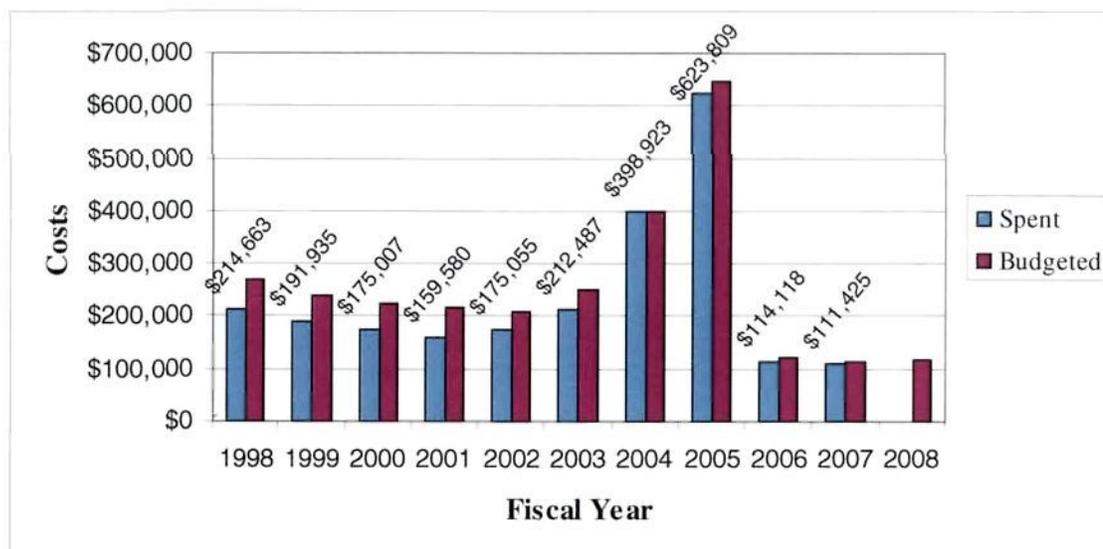
In December 2006 the treatment of groundwater with the HiPOx system was discontinued in order to assess the effect of interrupting continuous pump and treat activities on concentrations of COCs. Groundwater sample locations continue to be closely monitored to measure effects from turning off the treatment system. The analytical results associated with these activities will be reviewed to evaluate whether the treatment system should be restarted. The HiPOx and air stripper systems are being maintained so that they can return to service to treat VOCs confirmed in the groundwater.

The site transitioned from LTRA to O&M by the State in June 2005; however, the O&M contractor has not changed. The current contract allows for site coverage (system operations and maintenance, when operable or monitoring during rebound), security, hydrogeological assessments, and evaluations/recommendations).

#### **4.4 ANNUAL GROUNDWATER MONITORING AND TREATMENT COSTS**

Since the last Five-Year Review was completed several changes have been made to the treatment system and significant clean-up progress was made during transfer activities (from LTRA to O&M by the State). **Figure 4-9**, below indicates the budgeted and actual cost over the past two Five-Year Review periods. During the last Five-Year Review the system operated fairly consistently and O&M costs were optimized as a result of several improvement projects. These optimization projects (chemical, electrical, sampling and analysis, etc.) enabled the costs of the project to decrease each year. Overall, the annual fee billed was reduced from approximately \$238K per year at the start of the LTRA to approximately \$175K per year at the completion of the LTRA contract. However, in 2003 the discovery of a new COC and planning for LTRA transfer activities resulted in higher budgeted expenses. Transfer activities including, but not limited to, 1) decommissioning of the soil spoil area; 2) decommissioning of an old decontamination pad and removal of an abandon building; 3) updated human health risk assessment; 4) establishment of a refurbished monitoring well network and groundwater management zone and 5) development of transfer plans and O&M manuals resulted in the increase in costs seen from contract years 2003 through 2005. In 2004/2005 the costs were also impacted by the design, purchase and installation of the 1,4-dioxane treatment system. Currently, the annual costs to perform O&M are in the range of \$100K to \$130K per year (with the treatment system operating in a pulsed mode). The first two years of O&M after site transfer averaged approximately \$112K per year. During this period the system was operated in a pulsed mode (winter rebound from December to March). The anticipated O&M costs moving forward are estimated to be in the same order of magnitude. Improvements made during site transfer activities will help keep future O&M costs below the pre-transfer cost range. Currently the treatment system is off-line for the rebound evaluation and operator checks have been reduced to weekly. Due to the rebound evaluation, the costs budgeted have been increased for groundwater monitoring and reporting. The next sampling event is scheduled for May 2008.

**FIGURE 4-9: ANNUAL TREATMENT SYSTEM COSTS**



Currently, the operator monitors site activity, checks the status of the process equipment and performs site walkthroughs and security checks. Access to the site is restricted by a perimeter fence. To date, no unauthorized access of the facility or grounds has been reported.

Monitoring will continue as required in the GMP to monitor the GMZ and during additional sampling rounds, as necessary, for evaluation of rebound conditions. At any time, the system can be restarted if rebound conditions (monitoring data) indicate the current shutdown does not remain protective of human health and the environment. The historic groundwater quality data indicated a significant reduction in contaminants at several areas of the site. These reductions can be seen through the comparison of **Figures 4-1 through 4-6**. After thirteen years of operation of the groundwater collection and treatment system, the VOCs detected in the groundwater have been significantly reduced or eliminated.

EPA and NHDES are currently evaluating the continued long-term performance of the groundwater extraction and treatment system. One of the criteria being evaluated is cost efficiency of the system. Treatment systems can become less cost efficient as measured in mass removed/destroyed compared to costs. This decrease in efficiency is related to the decreasing groundwater concentrations. Currently, fourteen groundwater-monitoring wells, twelve extraction wells, the on-site water supply and three surface water locations within the GMZ at the site are sampled on an annual basis in November. During each spring, groundwater samples are collected from two monitoring wells and the twelve extraction wells. The majority of the monitoring wells are sampled using low flow sampling techniques. The monitoring locations are depicted in **Figure 3-2**. Results from both sampling events are used to monitor groundwater conditions and the protectiveness of the remedy. The sampling schedule may be modified once the effects of the shut down have been fully assessed. The May 2008 sampling event has been expanded in scope.

In conjunction with the Groundwater Management Permit issued by the NHDES in January 2006, institutional controls that restrict groundwater use have been implemented until clean-up goals have been achieved. Three properties are affected by this restriction as summarized in **Table 4-2** below.

**TABLE 4-2: PROPERTIES SUBJECT TO GROUNDWATER RESTRICTIONS IN GMP**

<b>Owner/Address</b>	<b>Tax Map/Lot</b>	<b>Deed Reference Book/Page</b>
Town of Epping Dean Shankle, Town Administrator 157 Main Street Epping, NH 03042	38/025	4237/250
Billy White 20 Indian River Road Epping, NH 03042	38/020	3470/1844
Environmental Resources Return Corp. 270 Exeter Road Epping, NH 03042	38/026	3103/2880

A copy of the Groundwater Management Permit is presented in **Appendix B**.



## 5. PROGRESS SINCE LAST FIVE-YEAR REVIEW

The previous Five-Year Review for the site was completed in 2003. The conclusion from the 2003 review was that the remedy remained protective of human health and the environment. Several issues were identified and recommendations for follow-up actions were provided. These recommendations and the associated follow-up actions are summarized below.

### 1. Continue groundwater monitoring and conduct an evaluation of alternative in-situ treatment technologies and/or removal actions.

Follow-up Actions:

- Groundwater monitoring continues biannually in accordance with the O&M plan. A spring and fall sampling event monitors system performance through the analysis of groundwater samples collected from the larger extraction wells, the modified monitoring/extraction wells and the treatment plant influent and effluent (when the system is operational). A fall sampling event monitors the GMZ through the analysis of groundwater samples collected along the perimeter of the GMZ boundary and in areas of high VOC contamination.
- Additional field investigation activities were conducted in 2003 and 2004 in the management of migration area. The results of the soil boring program indicated a lack of significant VOC contaminant mass within the site soils, and therefore an in-situ treatment technology was not recommended.
- In 2005, a HiPOx system that uses ozone and hydrogen peroxide was added to the current groundwater treatment system. Currently, the air stripper and vapor phase carbon adsorption units are being bypassed because the HiPOx unit is adequately removing all of the COCs to levels below clean-up standards. The air stripper unit will remain on-site and be maintained for any future use, if necessary. The system was designed to reduce concentrations of all site related VOCs including 1,4-dioxane from groundwater within the GMZ.
- From December 2006 through July 2008 the treatment plant was shut down as part of a rebound study to evaluate the effect on concentrations of COCs at the extraction wells and off-site monitoring locations. The results from current and future sampling rounds are being used to evaluate rebound conditions and will determine the continued need for operating the groundwater extraction and treatment system.

### 2. Evaluate institutional controls to reflect future site conditions.

Follow-up Actions:

- A Baseline Human Health Risk Assessment was conducted in May 2005 to evaluate the potential for health effects from exposure to site COCs in soil and groundwater through dermal contact, incidental ingestion and inhalation. The assessment identified that there remains an unacceptable risk for a future on-site worker from exposure to these compounds through the ingestion of contaminated site ground water.
- A GMZ was established in 2006 to monitor groundwater conditions at the site. As part of managing site groundwater under the GMZ, there is a restriction on its use for non-potable

purposes. This condition was included as a part of the Groundwater Management Permit and pertains to the parcel that includes the site as well as two adjacent parcels of land.

- Concentrations of several COCs exceed cleanup levels in the latest round of groundwater sampling results, indicating that site groundwater cannot currently be used as a potable water source. The groundwater will continue to be monitored under the GMZ until drinking water standards are achieved. The GMZ will remain in place and be renewed as required.

### **3. Repair damaged wells and secure unsecured wells.**

*Follow-up actions:*

- Damaged and unsecured wells at the site were repaired in May 2005, as part of the site transfer activities. Off-site wells are secured by locks.
- During the establishment of the GMZ, as submitted in the Application for Groundwater Management Permit (GMP), by Woodard & Curran (W&C, June 2005), the adequacy of the monitoring well network under shut-down conditions was evaluated using the established site groundwater model (modeled flow field and particle tracking, refer to Section 4.2.2). In general, the flow paths developed as a result of the analysis indicate that the monitoring network present south and west of the site is adequate for evaluating post-shutdown conditions in the proposed groundwater management zone. To the north and northwest of the site, however, the particle tracking results suggested the potential need for additional monitoring wells. As a result, two additional monitoring wells were installed (MW-50 and MW-51) in May 2005. Both locations were installed to the north and northeast of monitoring well CDM-1A and surface water monitoring location SW-2 to provide additional data in the off-site areas to help define the GMZ. To date, these wells have not indicated any site related COCs.

### **4. Formerly decommission inactive wells.**

*Follow-up actions:*

- In May 2005 twenty-one groundwater monitoring and extraction wells were decommissioned at the site as part of the transition of site responsibility from EPA to NHDES. A memorandum that included a table of the abandoned monitoring locations was sent to EPA and NHDES on June 29, 2005. In preparing the application for a GMP, as referenced above, an inventory of monitoring wells and extraction wells was used to establish a proposed groundwater quality monitoring program. In summary, from 1979 to 2005, 73 groundwater monitoring and extraction wells were installed as part of the site investigation and subsequent remediation activities. Forty-two (42) of these wells were determined to be viable long-term monitoring wells and continue to be used to characterize groundwater quality. Twenty-one (21) wells were determined to be unviable or no longer necessary, and were therefore decommissioned. The wells were selected for decommissioning based on the following: 1) they had either been non-detect for site COCs for two consecutive sampling rounds and were determined to not be required to define the extent of the GMZ, or 2) they were in disrepair and determined not to be required to define the extent of the GMZ.

## **5. Review ARARs for new groundwater compounds of potential concern.**

The state and federal drinking water standards are used as cleanup levels for the site. The NHDES and EPA websites were checked to determine if these standards had been updated since the last Five Year Review was conducted in 2003. Concentrations of COCs were compared against these standards to identify exceedances. In addition, compounds other than the COCs that are reported with the analytical methods that were used were compared against these standards. The results of these comparisons are described below.

Follow-up actions:

- Analyses of groundwater samples collected from 2003 through 2005 indicated that the site groundwater was contaminated with 1,4-dioxane which was not being treated and removed by the current air stripping system. A HiPOx treatment system was installed to reduce concentrations of this contaminant in the groundwater. The June 2005 ESD documents this change and establishes the cleanup standard for 1,4-dioxane in groundwater. In the absence of a National Primary Drinking Water Standard/Maximum Contaminant Level (MCL) for 1,4-dioxane, the New Hampshire Division of Public Health Services (DPHS), Bureau of Environmental and Occupational Health (BEOH) developed a risk-based groundwater remediation goal for 1,4-dioxane of 3 micrograms per liter (3 µg/l). This remediation value is applicable to a site with 1,4-dioxane contaminated groundwater that is to be restored to potable quality.
- Arsenic, methylene chloride, methyl ethyl ketone (MEK), 1,2-dichloropropane, 1,1-dichloropropene, toluene, 1,1,1-trichloroethane (1,1,1-TCA), 1,1-dichloroethane (1,1-DCA), chloroethane, cis-1,2-dichloroethene (cis-1,2-DCE), diethyl ether, methylene chloride, vinyl chloride and tetrahydrofuran (THF) are monitored as additional compounds of potential concern based on detections that exceeded associated state and/or federal drinking water standards in groundwater samples collected in 2002. Analytical results for these compounds from the most recent sampling round, November 2007, were compared against current standards. Only vinyl chloride and 1,1-DCA had detections that exceeded applicable drinking water standards. The results for the other additional compounds of potential concern were either non-detects or detections below the applicable standards.

## **6. Collect soil samples from the on-site stockpile. Evaluate a future trespasser future site worker direct contact exposure scenario.**

Follow-up actions:

- In 1992 excavated soil from a trench constructed to collect groundwater was stored in the former lagoon area (soil spoil area). In 2004, in order to formally close the soil spoil area and address potential contaminant migration to groundwater via precipitation leaching through this soil, soil and leachate samples were collected. The soil sampling results indicated residual contamination still existed which could, in the future, leach into the groundwater above drinking water standards. Due to its discrete and relatively small area in size, the presence of contaminants above the NHDES S-1 (and MCP S-1/GW-1) criteria, and the desire for a permanent solution, excavation and off-site disposal was determined to be the most protective, cost-effective, and permanent alternative and would allow for a future unrestricted access to the Soil Spoil Area.

- In 2004, approximately 900 tons of contaminated soils from the former lagoon, along with the lagoon liner and associated piping, were excavated and disposed of at an approved, regulated landfill. The soil spoil area was then formally decommissioned as part of the 2005 transfer from Long Term Remedial Action to Operation and Maintenance,
- Soil samples collected from the soil spoil area were also used to evaluate future trespasser and future worker exposure. These soil data, when compared to the NHDES Method 1 Soil criteria (which account for both potential risks resulted from direct exposure to the soil and the potential impacts from soil leaching into site groundwater) include concentrations of VOCs below the NHDES RCMP S-1 residential soil criteria or were subject to the removal actions noted above.



## 6. FIVE-YEAR REVIEW COMPONENTS

### 6.1 ADMINISTRATIVE COMPONENTS

The NHDES contracted with Woodard & Curran to assist in the preparation of this Five-Year Review report. The review was conducted between February 2008 and April 2008 per Amendment # 18 of the original operations and maintenance agreement between the State of New Hampshire and Woodard & Curran. In a letter dated November 2, 2007 the EPA enlisted the services of the NHDES to prepare this Five-Year Review report. Funding for completing this report was provided by EPA through the Multi-Site Cooperative Agreement (MSCA) with the NHDES. The NHDES amended the existing O&M contract with Woodard & Curran to include the technical assistance required to prepare the report. The amendment was approved by the New Hampshire Governor and Executive Council on January 30, 2008. The review is being conducted at the direction of EPA's Remedial Project Manager (RPM) Cheryl Sprague and NHDES RPM Tom Andrews.

### 6.2 COMMUNITY INVOLVEMENT

EPA issued a press release on March 4, 2008 that was published in the Exeter News Letter and on the EPA website announcing EPA's review of the KES site cleanup. The press release encouraged public participation. There is no established Community Advisory Group. So far, EPA and NHDES have received little participation or involvement from the local community regarding the current Five-Year Review. Site-related documents are available for review at the Harvey-Mitchell Memorial Library in Epping, New Hampshire. According to library staff, there has been very limited interest in these documents.

### 6.3 DOCUMENT REVIEW

In preparation of the 2008 Five-Year Review report relevant documents including decision documents, work plans, and various monitoring reports were reviewed. A list of these documents is provided in **Appendix C**.

In addition, an inventory was taken of site-related documents available for public review at the Harvey Mitchell Memorial Library, located on Main Street in Epping, NH. Reports from some of the early investigations conducted in the 1980s were available. Other site-related information included newspaper clippings from the early 1980s, EPA fact sheets, and descriptions of historical enforcement activities. More recent documents related to remedial activities, groundwater investigations and other site developments have not been received at the library. With the exception of the Supplemental Remedial Investigation Report (CDM, 1986) and Remedial Investigation Report (Tighe and Bond, 1985), none of the documents included as references in **Appendix C** were available at the town library

#### Data Review

In 1983 the EPA signed a ROD for the decommissioning of the on-site lagoon (OU-1) which included the removal and disposal of its contents and nearby soil. In 1984 activities associated with decommissioning the lagoon were completed. The ROD signed by EPA in 1988 associated with remediation of on-site and off-site groundwater (OU-2) contained two components; source control and management of migration. The following subsections provide an update on activities related to implementing these methods for reducing concentrations of site-related COCs in the groundwater.

### 6.3.1 Source Control

As required in the 1988 ROD, the source control component at the site, OU-1, consisted of vacuum enhanced vapor extraction of COCs from on-site soil to eliminate future potential contributions to underlying groundwater. This requirement was eliminated in EPA's 1990 ESD because pre-design field studies indicated that natural attenuation of site groundwater had reduced concentrations of contaminants in source soils to below the cleanup levels. Based on those findings, the 1990 ESD issued for the site formally removed vacuum extraction as a remedy component.

In 1992 during construction of a groundwater collection trench, NHDES lined the former lagoon and used it as a place to stockpile the excavated soil. Rainfall seeping through the soil stored in the lagoon became contaminated with COCs, and collected on the underlying liner. The resulting leachate was removed and remediated using the existing groundwater treatment system established at the site in 1993. After several consecutive rounds of analytical testing on the leachate from the soil spoils area indicated non detectable VOCs the treatment and leachate pumping was ceased. As part of a 2003 investigation to determine concentrations of COCs in this soil, sixteen test pits were excavated in the former lagoon. Analytical results of soil samples collected from test pits during the investigation indicated the presence of COCs and several metals at some of the locations. In 2004, the leaching system within the former lagoon area was decommissioned and those soils which posed an unacceptable risk were removed from the former lagoon area. In total approximately 900 tons of soil, the lagoon liner and associated piping were excavated from this area and disposed of in an approved off-site facility. The soil removal action was completed due to the potential exposures to leachate of contaminated soil into groundwater beneath it and not due to any risk with direct exposures to the contaminated soil. As a result of this removal, on-site soil is no longer considered to be a risk to human health and the environment or a source for groundwater contamination. Clean fill was used to close the excavation. The ESD issued in June 2005 formally documents the activities conducted during the closure of the soil spoil area.

### 6.3.2 Management of Migration

The remedy selected by EPA in the 1988 ROD to manage migration of COCs in groundwater was a pump-and-treat system as described in Section 1 and 4. The goal for the operation of the system is to reduce the concentrations of COCs in site groundwater to below the associated cleanup levels and risk based criteria established in the ROD. The cleanup levels represent state and federal drinking water standards. These standards are presented in **Table 3-1**.

The downward trends for the original five VOCs targeted for cleanup at the site in the 1988 ROD (i.e., benzene, PCE, TCE, 1,2-DCA, and 1,1-DCE) and 1,4-dioxane (see **Table 4-1**) demonstrate that there has been substantial progress in contaminant reduction in the groundwater. The cleanup progression can also be seen in **Figures 4-1 through 4-7** which illustrate how concentrations have decreased over the period of remediation, and how the area of the contaminant plume has been reduced. However, groundwater in small isolated areas of the site still contains concentrations of COCs that exceed cleanup levels. Monitoring locations for COCs that exceeded cleanup levels based on the November 2007 sampling results are summarized in **Table 6-1**.

**Table 6-2** contains a summary of the maximum concentrations as well as the frequency of detection of COCs over three time intervals since the 2003 Five-Year Review; 2003 to 2004, 2005 to 2006 and November 2007. Future sampling events are scheduled to be completed biannually (spring and fall) with the fall round coinciding with the GMP monitoring.

**TABLE 6-1 MONITORING WELL DETECTIONS EXCEEDING CLEANUP LEVELS – NOVEMBER 2007**

Monitoring Location	Contaminant of Concern							
	Benzene	1,1-DCA	1,1-DCE	PCE	TCE	VC	1,4-dioxane	1,2-DCA
Clean-up Level	5 µg/l (MCL)	81 µg/l (MCL)	7 µg/l (MCL)	5 µg/l (MCL)	5 µg/l (MCL)	2 µg/l (MCL)	3 µg/l (Risk)	5 µg/l (MCL)
CDM-1A			X (7.3)				X (42)	
CDM-9			X (13)				X (36)	
CDM-12							X (17)	
EMW-1			X (16)				X (40)	
EMW-3							X (32)	
EW-2				X (26)	X (19)	X (2.7)	X (30)	
EW-95-2							X (11)	
EW-95-7			X (7.9)				X (23)	
EW-97-1							X (7.8)	
EW-97-2				X (11)			X (11)	
KES-2B							X (9.1)	
KES-2D							X (5.2)	
KES-4B							X (3.8)	
MW-A		X (187)	X (160)				X (230)	X (5.0)
MW-Q1			X (8.9)	X (5.0)			X 32)	
Totals	0	1	6	3	1	1	15	1

Notes:

X = Cleanup Standard Exceedance (value in µg/l)

1,1-DCA = 1,1-dichloroethane

1,1-DCE = 1,1-dichloroethene

PCE = tetrachlorethene

TCE = trichloroethene

VC = vinyl chloride

1,2-DCA = 1,2-dichloroethane

VOLATILE ORGANIC COMPOUNDS

A review of monitoring well exceedances identified above in **Table 6-1** shows that the MCL for 1,1-DCE was exceeded at six locations in November 2007, the MCL for PCE was exceeded at three locations, and four other compounds (1,1-DCA, TCE, VC and 1,2-DCA) were exceeded at one location. While groundwater still exceeds the cleanup levels at a limited number of sampling locations on the site, but within the GMZ, the pump and treat remedy has effectively reduced the concentrations of contaminants and the aerial extent of the groundwater contamination at the site.

A comparison of the 2003 to 2004 period to the most recent sampling period in November 2007 indicates a decrease in the maximum concentrations that have been detected for several COCs. Of the original five targeted VOCs identified in the 1988 ROD, the maximum concentrations of benzene, 1,2-dichloroethane and 1,1-dichloroethene have significantly decreased over this time period. Maximum concentrations of trichloroethene and tetrachlorethene have remained essentially the same. Since the groundwater treatment system was turned off in December 2006, a comparison of the 2005 to 2006 concentrations to the November 2007 results was also conducted to evaluate potential effects to on-site groundwater. Over this period of time, concentrations of benzene, 1,2-dichloroethane and tetrachlorethene decreased while concentrations of 1,1-dichloroethene and trichloroethene increased. There were no order of magnitude increases or decreases in concentrations of COCs over this period. Sufficient data is not yet available to

conclusively determine if there has been an effect on groundwater from the treatment system shutdown. Results from future sampling events will be used to identify trends in concentrations of COCs. Future operation of the groundwater treatment system will be based upon upward or downward trends that are indicated for COCs since the system was shut down.

In addition to the five groundwater COCs identified in the 1988 ROD, additional VOCs were detected at levels exceeding applicable federal and state drinking water standards in samples collected in 2002. These compounds included arsenic, methylene chloride, methyl ethyl ketone (MEK), 1,2-dichloropropane 1,1,1-trichloroethane (1,1,1-TCA), 1,1-dichloroethane (1,1,-DCA), chloroethane, cis-1,2-dichloroethylene (cis-1,2-DCE), diethyl ether, methylene chloride, and tetrahydrofuran (THF). These compounds were included as “Additional Chemicals of concern” in the previous Five-Year Review conducted in 2003. Summary data have been included for these compounds in **Tables 4-1, 6-1 and 6-2**. A review of analytical results for samples collected in November 2007 indicates that only two of these compounds, vinyl chloride and 1,1-dichloroethane, had detections that exceeded applicable drinking water standards. All of the other compounds were either not detected or detected at concentrations below the applicable standard. The majority of the chemicals now listed as COCs were not included in the ROD because they were not initially detected at levels exceeding applicable drinking water standards. Vinyl chloride and cis-1,2-dichloroethene are daughter products, suggesting that natural attenuation processes may be occurring at the site. Analytical results from future sampling events will be closely monitored to determine the extent of natural attenuation processes in reducing concentrations of COCs.

#### 1,4 DIOXANE

The 3 µg/l cleanup standard for 1,4-dioxane was exceeded at 15 locations in November 2007. MW-A had the highest concentration of 1,4-dioxane in 2007 at 230 µg/l. The distribution of monitoring wells with 1,4-dioxane exceedances is more widespread than for other VOC exceedances and includes three monitoring points near the western boundary of the GMZ, as shown in **Figure 4-7** (2005 to 2008). Overall, 1,4-dioxane continues to be the predominant VOC detected in excess of the NHDES AGQS (3 µg/l), although generally decreasing concentrations have been observed since initial sampling and analyses were performed for 1,4-dioxane in May 2003. The November 2007 sampling event results indicated that 1,4-dioxane concentrations have decreased significantly since the addition of the HiPOx system. While groundwater concentrations still exceed the cleanup levels at a limited number of sampling locations on the site, but within the GMZ, the pump and treat remedy has effectively reduced concentrations of contaminants. Because 1,4-dioxane was only recently discovered at the site historical distributions of this compound are not known. Due to the nature of this compound (i.e., highly soluble and mobile in groundwater with little affinity for soils) it is likely that this compound will migrate quicker than other VOCs. As a result of these properties 1,4-dioxane will be the indicator compound for the migration of the plume. Monitoring during rebound will continue to be performed and increases in concentration (rebound) will be compared to determine if it is occurring at wells located along the predicted flow path.

The 2007/2008 rebound study will be evaluated in a separate report (*The 2008 Groundwater Quality Evaluation Report*) which will provide a basis for anticipated plume migration and the expected duration before clean-up levels can be attained.

## **6.4 SITE INSPECTION**

An inspection of the site was conducted on February 14, 2008 by the contractor, Woodard & Curran. The inspection included a walkover focused on the treatment plant, extraction wells, monitoring wells, closed lagoon, and perimeter fence. The perimeter fence appeared to be secure around the entire boundary of the

site and the gate is locked to effectively prevent unauthorized access when there is no site-related activity. No trespassing signs were posted at regular intervals on the outside of the fence. Not all monitoring wells were locked; however, they were all in good condition. Some monitoring wells were not locked (due to not having protective casings or due to sampling equipment placed in the well). However, these wells were secured by the perimeter fence as noted above. Since there was extensive snow cover at the time of the inspection, not all features such as flush mounted wells and wellhead manholes could be observed. The plant operator, Art Hoffman, was not aware of vandalism or trespassing on the site.

Although the treatment plant was not operational, it was observed to be in good physical condition. The plant operator has been maintaining the facility in a ready state should the system need to be placed on-line. A list of start-up maintenance is being compiled by the plant operator. Chemicals used to treat groundwater were properly stored. The treatment plant was neat and free from clutter.

Site paperwork was available and well organized. The necessary operations and maintenance manuals were readily available and up-to-date. Groundwater monitoring records, discharge compliance records, and daily access logs were all available in the treatment plant.

No significant land use changes have taken place on-site since the previous Five-Year Review. A zoning change created a commercial zone corridor between Route 125 and the site. The upgradient property east of the site which recycles construction material appears to have expanded operations. There is a monitoring well on this property just outside of the perimeter fence on the northern side of the site. There were no indications that activities on the adjacent lot have affected groundwater quality or the effectiveness of the remedy.

The site inspection checklist is included in **Appendix D** with the site interviews and contacts.

**TABLE 6-2: SUMMARY OF GROUNDWATER DETECTIONS IN EXCEEDENCE OF MCLS**

Table 6-2

## Summary of Cleanup Standard Exceedances in Groundwater

Contaminant	NHDES AGQS	2003-2004		2005-2006		Nov-07			
		Maximum Detected GW Concentration	Number of Monitoring Wells with Detections	Maximum Detected GW Concentration	Number of Monitoring Wells with Detections	Maximum Detected GW Concentration	Number of Monitoring Wells with Detections	# of Wells with Detected Concentrations in excess of Cleanup Standards	Monitoring Wells with Detected Concentrations in excess of Cleanup Standards
<b>ROD Parameters</b>									
Benzene	5	17	7 out of 61	8.6	5 out of 44	3.8	2 out of 27	None	None
Tetrachloroethene	5	26	8 out of 61	38	6 out of 44	26	5 out of 27	3	MW-Q1, EW-2, EW-97-2
Trichloroethene	5	21	10 out of 61	8.9	4 out of 44	19	4 out of 27	1	EW-2
1,2-Dichloroethane	5	27	9 out of 61	10	5 out of 44	5	4 out of 27	1	EMW-1
1,1-Dichloroethene	7	242	27 out of 61	147	17 out of 44	160	13 out of 27	6	MW-A, MW-Q1, EMW-1, EW-95-7, CDM-1A, CDM-9
1,4-Dioxane*	3	842	34 out of 61	173	24 out of 44	230	18 out of 27	15	MW-A, MW-Q1, CDM-1A, CDM-9, CDM-12, KES-2B, KES-2D, KES-4B, EW-2, EW-95-7, EW-95-2, EW-97-1, EW-97-2, EMW-1, EMW-3
<b>Volatile Organic Compounds (ug/l)</b>									
Chloroethane	NE	7.7	4 out of 61	3	2 out of 44	5.8	4 out of 27	None	None
Chloromethane	30	ND	0 out of 61	ND	0 out of 44	6.5	1 out of 27	None	None
1,2-Dichlorobenzene	600	ND	0 out of 61	2.5	1 out of 44	5.8	2 out of 27	None	None
1,1-Dichloroethane	81	206	33 out of 61	164	23 out of 44	187	14 out of 27	1	MW-A
cis-1,2-Dichloroethene	70	27	15 out of 61	15	9 out of 44	63	9 out of 27	None	None
Diethyl ether	1,400	40	8 out of 61	16	6 out of 44	8	3 out of 27	None	None
MTBE	13	2.5	6 out of 61	6.8	5 out of 44	9.9	2 out of 27	None	None
Tetrahydrofuran	154	572	9 out of 61	248	6 out of 44	33	1 out of 27	None	None
Toluene	1,000	4.1	4 out of 61	ND	0 out of 44	ND	0 out of 27	None	None
1,1,1-Trichloroethane	200	36	9 out of 61	14	7 out of 44	14	4 out of 27	None	None
Vinyl chloride	2	2.2	4 out of 61	ND	0 out of 44	2.7	1 out of 27	1	EW-2
o-Xylene	10,000	ND	0 out of 61	3	1 out of 44	ND	0 out of 27	None	None
<b>Total Inorganic Analytes (ug/l)</b>									
Arsenic	10	58.3	19 out of 21	11.3	1 out of 1	8.3	1 out of 1	None	None
Iron	NE	NA	Not Analyzed	NA	Not Analyzed	6,950	10 out of 10	None	None
<b>Water Quality Parameters (ug/l)</b>									
Alkalinity (as CaCO3)	NE	NA	Not Analyzed	NA	Not Analyzed	173,000	10 out of 10	None	None
Carbon, organic	NE	NA	Not Analyzed	NA	Not Analyzed	14,000	10 out of 10	None	None
Chloride	NE	NA	Not Analyzed	NA	Not Analyzed	28,000	10 out of 10	None	None
Methane	NE	NA	Not Analyzed	NA	Not Analyzed	690	5 out of 10	None	None
Nitrate as nitrogen	10,000	NA	Not Analyzed	NA	Not Analyzed	170	4 out of 10	None	None
Sulfate	500,000	NA	Not Analyzed	NA	Not Analyzed	63,000	10 out of 10	None	None
<b>Notes:</b> Reported in ug/l = micrograms per liter (ppb)      ND = not detected      NA = Not Applicable AGQS = New Hampshire Ambient Groundwater Quality Standards      ug/L = micrograms per liter      * = 1,4 dioxane added in 2005 ESD NE = Standard Not Established for this compound      GW = Groundwater									
Additional samples were collected for Arsenic in 2003/2004 for evaluation in an updated HHRA. Typically only 1 well (the on-site potable water well) is sampled for arsenic. Bottled water is provided to site workers. Additional water quality parameters were added in 2007 for future MNA analysis									

## 6.5 SITE INTERVIEWS

Prior to the site inspection on February 14, 2008, interviews were conducted with representatives from EPA, NHDES and Woodard & Curran. The purpose of the interviews was to get the perspectives from people who have been very involved in the remedial progress at the site. The following is a summary of the information obtained from these interviews.

Ms. Cheryl Sprague is the Region I EPA RPM for the site. Ms. Sprague indicated that the project has been well operated and going as planned. Indicating that she believed the selected remedy was working as intended and is protective of human health and the environment. She is comfortable with the transfer of regulatory authority to the State of New Hampshire. EPA is contacted about the site at a frequency of approximately once per year by local citizens. Public notices prepared by EPA are published in the local newspaper to inform residents regarding site-related events such as the Five-Year Review process. EPA has a website that describes the history, remedial actions, the current status, and other site-related information. The website can be found at the following address: <http://www.epa.gov/region1/superfund>. Ms. Sprague's contact information is contained in **Appendix D**.

Mr. Thomas Andrews, NHDES RPM was also interviewed. Mr. Andrews reported that the site cleanup is progressing well and that the improvements made to the groundwater treatment system have been effective in reducing concentrations of contaminants that are present in the groundwater. Mr. Andrews also reported good communication between the State, EPA, the site contractor, Woodard & Curran, Town of Epping, and nearby property owners. Mr. Andrews indicated that the State will continue to monitor groundwater results to assure the remedial action is effective in continuing cleanup progress and remains protective of human health and the environment. The State gets inquiries about the site at a frequency of approximately twice per year. The public is referred to the State of New Hampshire's One Stop website or the EPA website. The One Stop website consists of a database of information related to hazardous waste sites in New Hampshire. Website information for the Keefe Environmental Services site can be found at <http://des.nh.gov/onestop> (click on Remediation & Initial Response Spill Sites then type in site number 198710024).

The Town of Epping planner, Mr. Clay Mitchell, was also contacted via e-mail to solicit information regarding the Town's perception of the cleanup progress at the site. Mr. Mitchell indicated that there had been a zoning change between Route 125 and the site, creating a commercial zone corridor. He mentioned that the Town had laid the groundwork for expansion of a water and sewer network to the area around the site. Mr. Mitchell was unaware of any commercial interest in the site although he did mention that the Town was interested in potential development for sources of alternative energy. Mr. Mitchell is not aware of any plans for residential use of the property. Mr. Mitchell informed the new Town Administrator, Mr. Dean Shankle, of the preparation of this report. Woodard & Curran was contacted by Mr. Shankle and informed that the Town would like to use the site as a future location for the DPW garage. The Town is interested in pursuing this within the next year.

Mr. Art Hoffmann, facility operator for the site contractor, Woodard & Curran, was interviewed to obtain information regarding the ongoing site activities. He confirmed that the treatment system had been turned off in December 2006. The HiPOx unit is still maintained so that it can easily be reactivated, if required. The estimated time required for the treatment system to be brought back on-line is approximately two weeks. Prior to the shut down, the treatment system was able to meet the compliance goals. Mr. Hoffman currently stops into the plant once a week for housekeeping and routine maintenance. With the installation of the Supervisory Control and Data Acquisition (SCADA) system the plant can be monitored from off-site locations. Mr. Hoffman reported that no trouble or vandalism has occurred at the site.

The librarian at the Epping Town Library was also contacted. Library staff indicated that few individuals have accessed site-related documents.



## 7. TECHNICAL ASSESSMENT

The following sections evaluate the OU-2 remedy based on its function in accordance with decision documents, its adherence to valid risk data and scenarios, and any other information that could have affected the remedy's protectiveness. The ARARs and To Be Considered (TBC) Guidance for the site identified during the development of the ROD, along with current COCs, ARARs and TBCs, are provided in **Appendix E** of this report.

This section was prepared consistent with the EPA June 2001 Comprehensive Five-Year Review Guidance document (EPA 2001). As such, it addresses the questions regarding the technical assessment as laid out in the guidance document and presented in the subsections below. Because the source control remedial action as presented in the March 1988 ROD was deemed unnecessary based on pre-design field study soil analytical results, these questions are primarily applied to the groundwater management of migration portion of the remedy currently functioning at the site.

In June 2005, the site transitioned from an EPA-lead LTRA to a State lead long-term O&M project. As a part of the transition to the O&M phase, an updated Baseline Human Health Risk Assessment (HHRA) (Woodard & Curran, May 2005) was performed to evaluate current and potential future risks at the site. The 2005 HHRA was evaluated from groundwater, soil, soil gas, surface water and wetland soil/sediment data collected through 2004. From these data, medium-specific COCs were selected, based on a comparison of maximum detected concentrations to chemical- and medium-specific risk-based screening criteria. Receptors evaluated included both a current and future trespasser exposed to surface water and sediment in the site wetlands, a current/future facility worker exposed to COCs in indoor air, soil and groundwater (used as a potable water source), and a construction/utility worker exposed to soil, groundwater and ambient air. Future residential use of the site was not evaluated, as the property is presently zoned for industrial or commercial use and any future plans are likely to include commercial or industrial redevelopment only. Although residential properties abut the site to the south and east, site related COCs have not been detected in groundwater samples collected from these properties; therefore, there are no complete exposure pathways (i.e., ingestion, direct contact with potable groundwater or inhalation via vapor intrusion) for these receptors. Noncancer hazard indices (HI) and incremental lifetime cancer risks (ILCR) were estimated for each exposure scenario outlined above. Risks were generated for both central tendency (CT) and reasonable maximum exposure (RME) scenarios and the cumulative risks were compared to USEPA and NHDES risk limits.

The results of the HHRA concluded that cumulative cancer and noncancer risks for the trespasser and construction/utility worker scenarios did not exceed EPA or NHDES risk criteria under either CT or RME scenarios. For the facility worker RME scenario, however, cumulative cancer and noncancer risks exceeded EPA and NHDES risk limits. This risk was primarily attributable to the ingestion of VOCs and arsenic from groundwater, and direct contact with arsenic in soil. Risks incurred from exposure to site-related COCs via the inhalation of indoor air were relatively minor, indicating that vapor migration into indoor air was not a significant exposure pathway. Because the risks are cumulative, exposure via inhalation was included in the overall assessment of risk, however the actual contribution from inhalation was minor when compared to the risks from contact and ingestion. Of the cumulative cancer risk estimated for the facility worker scenario, 78% was attributed solely to the ingestion of arsenic in groundwater. The presence of arsenic in groundwater in and around the site is assumed to be attributable to local, natural elevated conditions of arsenic in groundwater in the region and not to site-related releases. Risks related to only VOCs in groundwater however, remained above acceptable risk criteria.

Specific to arsenic in groundwater, a comprehensive sampling event was conducted on site monitoring wells in 2004 (a total of 21 monitoring wells). Analytical data from this event indicated that

concentrations of arsenic were detected in 20 of the 21 on-site wells tested, at concentrations ranging from approximately 5 to 58 µg/L. A review of the data indicated that there did not appear to be a consistent trend of elevated concentrations relative to the most impacted areas of the site (i.e., some of the highest arsenic concentrations were found in on-site monitoring wells in which concentrations of VOCs were low or not detected [e.g., bedrock monitoring well "MW-X"] and lower concentrations of arsenic [below AGQS criteria] were found in monitoring wells exhibiting historically elevated levels of VOCs and 1,4-dioxane [e.g., monitoring well Q-1]). Additionally, concentrations of arsenic detected in private residential drinking water wells and the upgradient on-site potable water well (unimpacted by other constituents associated with the site) were generally consistent with concentrations detected in on-site wells, further indicating that the arsenic is naturally-occurring. These results are consistent with regional groundwater data that indicate that elevated arsenic concentrations are prevalent in southeastern New Hampshire groundwater. A study conducted by the United States Geological Survey (USGS, 2003) found that arsenic in groundwater in Rockingham County (in which the site is located) was present at concentrations of up to 215 µg/L, and that concentrations were highly dependent upon the underlying geologic formations. Groundwater from Eastern Epping (in which the Site is located), in particular, has been shown to contain arsenic at concentrations ranging from 26 µg/L to 50 µg/L. A summary of this study can be found in **Appendix F**.

A GMZ was established for the site and two adjacent properties to control potential future risks associated with use of groundwater as a potable water supply. Groundwater monitoring requirements were established in the Groundwater Management Permit issued in January 2006. In December 2006, the NHDES and EPA agreed to shut down the groundwater treatment system and conduct a rebound study.

Since the groundwater treatment system was turned off in December 2006, three rounds of monitoring well testing have been completed. The first round was completed in March 2007, a second round completed in November 2007 (corresponding with the annual GMZ testing) and a third round completed in May 2008. A baseline round was conducted in November 2006 just prior to the planned shutdown. There were no order of magnitude increases or decreases in concentrations of COCs over the period. Sufficient data is not yet available to conclusively determine if there has been an effect on groundwater from the treatment system shutdown. Results from future sampling events will be used to identify trends in concentrations of COCs. Future operation of the groundwater treatment system will be based upon upward or downward trends that are indicated for COCs since the system was shut down. The next round of monitoring well sampling is scheduled for November 2008 (corresponding with the annual GMZ testing)

Since the Groundwater Management Permit was issued in January 17, 2006 there have been no non-compliance issues with the GMZ. All boundary wells tested have not detected concentrations of COCs that exceed the NHDES AGQS. Reports were submitted to the NHDES in January 2007 and January 2008 for the sampling and analytical testing performed in November 2006 and November 2007, respectively.

## **7.1 QUESTION A: IS THE REMEDY FUNCTIONING AS INTENDED BY THE DECISION DOCUMENTS?**

Yes.

Remedial Action Performance: A review of groundwater data indicate that there has been significant improvement in the quality of groundwater at the site and the aerial extent of the groundwater plume has diminished. After 13 years of operation of groundwater treatment, the VOCs in groundwater have been

significantly reduced or eliminated. Although groundwater clean-up levels are not met for all contaminants at this time, they are expected to be met at the completion of the remedial action.

In addition, the GMZ currently restricts use of the site's groundwater to non-potable uses.

Monitoring Results: As discussed in Section 4.2.2 and 6.4.2 of this report, the analysis of analytical data shows primarily downward trends for the original five VOCs targeted for cleanup at the site in the 1988 ROD (i.e., benzene, PCE, TCE, 1,2-DCA, and 1,1-DCE) and 1,4-dioxane added in the 2005 ESD. This demonstrates that there has been substantial progress in contaminant reduction in the groundwater. Groundwater in small isolated areas of the site however, still contains concentrations of COCs that exceed cleanup levels.

In general, based on the 2007 data, with the exception of 1,4-dioxane, groundwater samples collected have concentrations of COCs that exceed cleanup levels in only a small portion of wells. ROD VOC exceedances occurred in eight wells including two monitoring wells (CDM-1A and CDM-9) and six extraction wells (which are currently non-pumping wells). The distribution of 1,4-dioxane exceedances is more widespread with 15 wells exceeding the 1,4-dioxane cleanup level of 3 ug/l.

LTRA/Costs: The LTRA costs for the past Five-Year Review period and this current review were presented in Section 4.4 and **Figure 4-9**. In general, costs for O&M activities at the site have decreased since the beginning of the LTRA. Prior to transferring the site to the NHDES for O&M, the EPA completed several site transfer projects that have enabled ongoing O&M costs to be reduced. The current anticipated budget for O&M of the facility is \$110K to \$130K per year.

Opportunities for Optimization: Optimization in the form of the installation of new extraction wells at optimized locations took place in 1995 and again in 1997. Since that time improvements in groundwater quality have been noted. The groundwater monitoring network was re-evaluated during site transfer activities and the establishment of the GMZ. During this Five-Year Review period, the locations and number of wells included in the monitoring network was modified based on agreement by the EPA and NHDES (several wells were decommissioned and two new wells were installed). Further optimization was performed to enable the treatment system to treat the new COC, 1,4-dioxane. As part of that optimization a SCADA system was installed to enable remote monitoring of the treatment system. Currently the system is off-line for the rebound evaluation. Future optimization will be dependent on the evaluation of monitoring data. If rebound conditions necessitate the extraction and treatment of groundwater then several optimization opportunities will be evaluated, including the effectiveness of well head treatment technologies.

Indicators of Remedy Problems: Based on the site inspections performed and the evaluation of the performance of the remedy, there are no remedy problems that can be identified which could lead to the remedy being not protective or suggest protectiveness is at risk unless changes are made.

Implementation of Institutional Controls: As stated above, the NHDES became the lead agency for the site and transitioned the site into a long-term O&M program in June 2005. As part of that transfer to long-term O&M, a GMZ was established for the site and two adjacent properties. Groundwater monitoring requirements were established in the GMP, issued in January 2006. The Town acquired ownership of the property in 2006 and is considering the land for future municipal use. The future use will be restricted as noted in the groundwater management permit (see Appendix E). Future residential use of the property is unlikely due to current zoning; however, no land use restrictions are in place at this time.

## **7.2 QUESTION B: ARE THE EXPOSURE ASSUMPTIONS, TOXICITY DATA, CLEANUP LEVELS AND REMEDIAL ACTION OBJECTIVES (RAOS) USED AT THE TIME OF REMEDY SELECTION STILL VALID?**

Yes.

As previously discussed, an updated baseline HHRA was conducted in May 2005. The purpose of this HHRA was to determine the current and potential future risks at the site and to evaluate the need for institutional controls on land use and/or groundwater use at the site. Because it was concluded that use of site groundwater as a potable water supply would pose an unacceptable risk to future facility workers, a GMZ was established to prevent such exposures. Since 2005, the exposure assumptions, toxicity data, cleanup levels and RAOs have not substantially changed such that the conclusions of the HHRA are invalidated or the remedy is no longer protective for the site, as discussed in the following sections.

### **7.2.1 Review of the Chemicals of Concern (COCs)**

In the 2005 HHRA, COCs were selected for each medium through a comparison of maximum detected concentrations to medium-specific risk-based screening criteria. Such benchmarks included EPA Region 9 Preliminary Remediation Goals (PRGs) for soil (residential) and tap water (EPA Region 9, 2004), and EPA Target Groundwater Concentrations and Soil Gas Screening Levels (EPA 2002), as recommended by EPA Region 1. A constituent was excluded as a COC if it was detected in less than 5% of the samples. A minimum of 20 samples was required for exclusion.

Woodard & Curran reviewed these sources of screening criteria and determined that neither has been updated since 2005. However, additional groundwater data have been generated since the 2005 HHRA; therefore, an evaluation of current groundwater data was conducted to determine if the COC list has changed from that presented in the 2005 HHRA.

A comparison of groundwater analytical results from 1988-2002 (previous Five-Year Review), 2003-2006 and current 2007 data is provided along with groundwater cleanup levels in **Table 4-1** (provided earlier in this report) for the five human health indicator compounds identified in the ROD as well as additional COCs identified during the 2005 HHRA. Concentrations of most contaminants in groundwater have either decreased or remained the same between 2004 and 2007, with the exception of chloromethane and cis-1,2-dichloroethene. The maximum concentration of chloromethane increased from non-detect in 2002-2004 to 6.5 µg/L in 2007. This concentration is well below the risk-based screening level (tap water PRG) of 160 µg/L; therefore, chloromethane is not retained as a COC. The maximum concentration of cis-1,2-dichloroethene increased from 34 µg/L (in 2002-2004) to 63 µg/L in 2007. The 2007 concentration of cis-1,2-dichloroethene slightly exceeds the PRG for cis-1,2-dichloroethene of 61 µg/L and; therefore, has been retained as a COC in groundwater. The inclusion of cis-1,2-dichloroethene as an additional groundwater COC will not change the conclusions of the HHRA that site groundwater, used as a potable water source, poses a significant risk of harm to human health.

### **7.2.2 Changes in Exposure Assessment**

Land use at the site has not changed since the HHRA was conducted in 2005. Currently, a small controls building for the pump-and-treat system is located on the property, which is occasionally visited by

operations and management personnel. Exposure to soil is expected to be minimal, and primarily associated with maintenance of the grounds (e.g., occasional mowing).

In 2006, a GMZ was implemented for the site and adjacent properties. The GMZ prohibits use of groundwater at the site. The 2005 HHRA evaluated risks associated with the drinking water exposure pathways (i.e., ingestion, dermal contact, inhalation of vapors while showering); however, these pathways are now considered incomplete while the GMZ is in effect. Groundwater is not used as a drinking water supply in the site facility; instead, bottled water is provided to employees. Also evaluated in the 2005 HHRA, health risks associated with the vapor intrusion pathway do not exceed the EPA risk limits for either cancer or non-cancer effects. Therefore, current site conditions do not pose a risk to facility workers.

The property is currently zoned for commercial/industrial use. Future land use is expected to remain as such. Therefore, future residential use of the property is not anticipated. Residential properties abut the site to the south and east. As discussed in the 2005 HHRA, groundwater on these properties is not impacted by site-related COCs and therefore, there are no complete exposure pathways for off-site residential receptors. Groundwater monitoring data for these properties is provided in **Appendix A**. As seen in this data, no VOCs were detected in any of the groundwater samples collected between 2002 and 2006.

There are no other anticipated changes in receptors or exposure pathways since the HHRA was conducted in 2005. Therefore, the exposure scenarios evaluated in the 2005 HHRA (trespasser, construction worker and facility worker) appropriately encompass the types of exposures currently expected at the site.

**Table E-1 in Appendix E** summarizes the applicable human receptors and exposure pathways identified for both current and future site uses.

### 7.2.3 Changes in Toxicity Data

As discussed in the 2005 HHRA, under the RME scenario, both cancer and noncancer risks estimated for the facility worker exceeded EPA and NHDES risk limits. Ingestion of VOCs and arsenic in potable water, and direct contact with arsenic in soil were the major contributors to that risk. Risks incurred from site-related COCs via the inhalation of indoor air were relatively minor, indicating that vapor migration into indoor air is not a significant exposure pathway.

Toxicity values presented in the 2005 HHRA were compared with current (2008) values from USEPA sources, as presented in **Table E-2 and E-3**. With a few exceptions, the toxicity values for COCs remained constant between 2005 and 2008. The only differences are as follows:

- The oral Reference Dose (RfD) of 1,1-dichloroethane increased from 0.1 mg/kg/day (HEAST 1997) to 0.2 mg/kg/day (EPA Provisional Peer-Reviewed Toxicity Value for Superfund (as provided in EPA Region 3 RBC table, 10/11/2007));
- The inhalation Reference Concentration (RfC) of 0.005 mg/m<sup>3</sup> for 1,2-dichloroethane (Region III RBC, October 2004<sup>1</sup>) increased to 2.45 mg/m<sup>3</sup> (ATSDR Minimal Risk Level; ATSDR 2001);

- The oral Cancer Slope Factor (CSF) for tetrachloroethene (PCE) increased from 0.052 (mg/kg/day)<sup>-1</sup> (California Environmental Protection Agency [CalEPA]) to 0.54 (mg/kg/day)<sup>-1</sup> (CalEPA OEHHA Toxicity Criteria Database, [www.oehha.ca.gov/risk/chemicalDB](http://www.oehha.ca.gov/risk/chemicalDB), 2008); and
- The inhalation Unit Risk (UR) for PCE increased from 0.00058 (mg/m<sup>3</sup>)<sup>-1</sup> to 0.0059 (mg/m<sup>3</sup>)<sup>-1</sup> (CalEPA 2008).

An increase in the RfD or RfC results in a corresponding decrease in non-cancer risks. Therefore, noncancer risks associated with exposure to 1,1-dichloroethane would be reduced by one-half and noncancer risks associated with 1,2-dichloroethane would be reduced approximately 500 times. Because neither of these two compounds contributes to excessive noncancer risk for any of the scenarios evaluated, these changes in noncancer toxicity values do not significantly change the outcome of the 2005 HHRA.

An increase in the CSF or UR results in a corresponding increase in cancer risks. Tetrachloroethene is a COC in both soil gas (indoor air) and groundwater. For cancer risks associated with inhalation of VOCs in indoor air (resulting from potential soil gas emissions), the change in the UR would increase the incremental lifetime cancer risk (ILCR) estimated for PCE in the 2005 HHRA by approximately 10 times, from  $2 \times 10^{-8}$  to  $2 \times 10^{-7}$  for the RME facility worker scenario. Because the cancer risks from this exposure pathway, using the updated UR value, do not exceed the EPA risk limit and do not contribute to the majority of cumulative cancer risk for the facility worker scenario, this change in the UR does not alter the outcome of the 2005 HHRA. For groundwater exposures, cumulative cancer risks exceed the cancer risk limit. The ten-fold increase in CSF for PCE results in a ten-fold increase in the ILCR for this compound. However, the cumulative cancer risk for groundwater, as presented in the 2005 HHRA, exceeds the cancer risk limit, due to VOCs and arsenic in groundwater; therefore, the change in the CSF does not significantly alter the conclusions of the 2005 HHRA, and these changes do not alter the protectiveness of the remedy.

#### 7.2.4 Changes in Risk Assessment Methods

Since the HHRA was conducted in 2005, there have been no substantial changes in USEPA or NHDES risk assessment methodologies that would result in conclusions different from those previously reached.

all analysis.

\* = >90% non-detects

<sup>1</sup> Region III RBC table provides inhalation toxicity values as reference doses (RfDi) for non-cancer effects or cancer slope factors (CSFi) for cancer effects. The RfDi and CSFi values were converted to RfCs (noncancer) and UR (cancer) for consistency with values reported in the 2005 HHRA report. These conversion equations are pres

## 7.2.5 Review of Remedial Action Objectives

Remedial Action Objectives (RAOs) at the site were established to return groundwater to drinking water standards, since groundwater may be used as a potential drinking water source. Although groundwater at the site is not currently used for potable water (and future use is currently restricted through a GMZ), these standards are the applicable RAOs for the site, such that groundwater may once again be used as a drinking water source in the future. The 2005 HHRA identified drinking water ingestion and dermal contact with groundwater as the primary exposure pathways that resulted in excess noncancer hazard and cancer risk, with risks from other relevant exposure pathways (i.e., inhalation of indoor air, direct contact with soil) being relatively minor contributors to the overall risk. Therefore, the drinking water standards remain appropriately conservative RAOs for the site.

The drinking water standards identified for the site include Federal Maximum Contaminant Levels (MCLs) and New Hampshire Code of Administrative Rules (Env-Or-600; effective 2-1-07) Ambient Groundwater Quality Standards (AGQS). Both MCLs and AGQS are applicable drinking water standards. For compounds that did not have promulgated MCLs, Federal Health Advisories (HAs) or NHDES GW-1 Groundwater Standards (which are designed to be protective of groundwater used as a potable supply of drinking water) were identified as To Be Considered (TBC).

Federal MCLs were last updated in 2006; however, MCLs identified for COCs have not changed since the 2005 HHRA was conducted. For all COCs except 1,4-dioxane, New Hampshire AGQS have not changed since 2005. At the time of the risk assessment, there was no promulgated New Hampshire AGQS for 1,4-dioxane, although NHDES issued a draft value of 3 µg/L in 2004. This 3 µg/l value was promulgated as the AGQS in September 2005. Federal HAs were also updated in 2006. Updated HA values are the same or less conservative than MCLs. NHDES GW-1 Groundwater Standards were also updated in 2007, and are equivalent to the NH AGQSs.

A comparison of 2002 and 2006/2007 ARARs and TBCs is presented in **Table E-4**.

As shown in **Table 4-1**, earlier in this report with the exception of cis-1,2-dichloroethene and 1,4-dioxane, concentrations of all chemicals have decreased since 1988. Based on the 2002-2006 data, the following chemicals exceed drinking water standards: benzene, PCE, TCE, 1,2-dichloroethane, 1,1-dichloroethene, arsenic, vinyl chloride, tetrahydrofuran, 1,1-dichloroethane and 1,4-dioxane. Based on 2007 data, fewer COCs exceed drinking water standards. These are limited to PCE, TCE, 1,1-dichloroethene, vinyl chloride, 1,2 dichloroethane, 1,1-dichloroethane and 1,4-dioxane.

## 7.2.6 Expected Progress toward meeting Remedial Action Objectives (RAOs)

Remedial Action Objectives for groundwater were established in the 1988 ROD to eliminate or minimize the threat posed to the public health, welfare and environment from the current extent of contaminant migration at the site. Cleanup levels are equivalent to Federal MCLs or the state of New Hampshire's AGQS drinking water standards or risk-based standards. These criteria are protective of human receptors, given the types of exposures anticipated to occur at the site.

While groundwater concentrations of various constituents still exceed cleanup levels at a limited number of sampling locations, the pump-and-treat remedy has effectively reduced concentrations of all COCs. Based on this information, the groundwater quality at the site will continue to be monitored, as required by the GMP. Groundwater monitoring events associated with the GMP are scheduled to continue

annually each November until concentrations of COCs have reached associated clean-up standards. The analytical results will be compared to these standards to monitor the progress of the groundwater cleanup.

The aerial extent of the groundwater plume appears to be diminishing as the site is being remediated (**Figures 4-1 through 4-6**). A review of the groundwater quality data collected since the remedy began in 1993 suggests that there has been a significant reduction in the concentrations of contaminants found in the groundwater flow system. After 13 years of operation, the VOCs detected in the groundwater have been significantly reduced or eliminated in certain areas. The 1995 extraction well network has effectively contained and captured the off-site groundwater contamination to the west and northwest. The 1997 VER extraction well network, which operated for approximately 8 years, has reduced the dispersal of contaminated on-site groundwater to the southwest and west of the treatment plant (however, the 1997 wells did not pump significant amounts of groundwater due to low permeability soils and slow recharge of the wells). The addition of the HiPOx system was completed in January 2005 and results of the 2006 groundwater monitoring indicated that concentrations of dissolved VOCs, including 1,4-dioxane have decreased in concentration since that time. Generally, concentrations of the VOCs monitored at the site either met the ROD/AGQS cleanup levels or have reached asymptotic levels under pumping conditions. Therefore, as described in the June 2005 O&M Plan (and based on the results of the groundwater quality evaluation reports), the recommendations to initiate an extended rebound period beginning in December 2006 was implemented. The rebound study was implemented to monitor the extent of contaminant rebound in the groundwater after shutting down the system. Because soil contamination is not a significant concern and the source was removed during initial response actions there has not been a significant rebound of site COCs in groundwater beneath the site at this time. As a result, the collection of Monitored Natural Attenuation (MNA) parameters was recommended to assess the viability of allowing MNA to reduce the remaining concentrations at the site to drinking water standards within the GMZ. Woodard & Curran collected the first round of MNA data in November 2007 to begin the evaluation of MNA for meeting the remedial action objectives.

During transfer from LTRA to O&M by the State it was determined that the groundwater treatment system would operate for two years and then shut down while site conditions were evaluated to determine continued operation. Based on the O&M Plan, if after 2 years of operation of the treatment system, exceedances of cleanup levels are not detected in the boundary wells of any site-related chemicals of concern, then it can be determined that the operation of the treatment system has effectively captured and contained the extent of the groundwater contamination and that the GMZ requirement is being met. Based on this information and the apparent decreasing and/or stable average trend analysis performed within each geographic area, Woodard & Curran recommended the completion of a cost evaluation in order to determine if it will remain cost effective to continue pump and treat operations until cleanup levels are met. This evaluation will be reviewed in conjunction with the MNA evaluation and will ensure the remedy remains protective of human health and the environment. Currently data collection is being performed and an evaluation for determining the effectiveness of MNA at the site (in meeting the RAOs) is also being planned and will be completed by March 2009. This evaluation in conjunction with a cost analysis will be performed in order to "Evaluate Termination of the Treatment System", as outlined in the O&M Plan dated June 29, 2005.

The groundwater treatment plant will be kept off-line until at least the beginning of March 2009 as part of the rebound evaluation. Analytical results were collected in May 2008 and will be collected again in November 2008. This data will be used to assess whether the system will remain off-line or will be reactivated. A review of sample results for an expanded analytical list of chemical parameters including ferrous iron, chloride ion, methane, ethene, ethane, nitrate, sulfate and dissolved organic carbon will be used to evaluate the extent of natural attenuation potential in on-site groundwater. If it is determined that

natural attenuation is occurring or likely to occur, potential enhancements will be reviewed to determine if they could be added to further accelerate the degradation of COCs by natural attenuation.

#### The MNA Evaluation

In order to determine if MNA is a viable option to meet the site cleanup levels, an evaluation of the sites chemical and geochemical data will be performed. Based on the overall decrease in the contaminant mass on the site, current data support that appropriate conditions likely exist and will continue to exist for natural attenuation. The attenuation processes that are occurring likely include: biodegradation, dispersion, dilution, sorption, volatilization and chemical or biological stabilization, transformation, or destruction. However, in order to specifically aid in the evaluation of natural attenuation processes, Woodard & Curran began the collection of additional analytical data. Based on this information, Woodard & Curran recommended that each of the GMP/long-term and system performance sampling locations (a total of 26 monitoring locations) be analyzed for additional MNA parameters in conjunction with the scheduled sampling events (November 2007, May 2008 and November 2008). A MNA evaluation will be completed by March 2009 which includes an analysis of the available chemical and geochemical data. Woodard & Curran's evaluation will follow approved protocols such as the "Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Ground Water", EPA/600/R-98/128; September 1998, or equivalent.

### **7.3 QUESTION C: HAS ANY OTHER INFORMATION COME TO LIGHT THAT COULD CALL INTO QUESTION THE PROTECTIVENESS OF THE REMEDY?**

No.

Currently, concentrations of COCs exceed ROD and ESD established cleanup levels. Overall, a downward trend of COCs has been observed since the last Five-Year Review indicating that the remedy continues to function as intended. The remedy remains protective, and no other information has been discovered that would call into question the protectiveness of the remedy at this time.



## 8. ISSUES

The responsibilities for the treatment system and groundwater monitoring program was transferred from EPA to the State for O&M on June 30, 2005. The plant is currently off-line for a rebound evaluation. The treatment system is currently monitored and maintained under a contract agreement between Woodard & Curran and the NHDES. The project is 100 percent funded by the State with limited EPA oversight. As discussed earlier in this report, concentrations of some COCs still remain at or above ROD cleanup levels (see **Table 3-1**) in limited areas of the site. Overall, a downward trend is observed for most groundwater COCs indicating that the remedy has been successful in reducing the extent of the groundwater plume, removing significant contaminant mass, and protecting human health and the environment. Groundwater monitoring will continue at the site until cleanup levels have been achieved.

At this time, and consistent with the 2005 O&M Plan, it is appropriate to evaluate the cost effectiveness of operating the groundwater treatment system until cleanup levels are met throughout the site. If pumping and treating is not a cost-effective approach due to the decreasing groundwater contaminant concentrations, nor required to contain contamination within the established GMZ boundaries, are there other remedial options (including natural attenuation processes) that can reduce the remaining COCs to drinking water standards within the GMZ in a reasonable time period.

Key issues identified during this Five-Year Review for the site are summarized in **Table 8-1** below.

<b>Table 8-1 Summary of Issues</b>		
Issues	Affects Protectiveness (Y/N)	
	Current	Future
<b>1) Groundwater does not meet clean-up standards</b>	N	N
a) Is it cost effective to continue pump and treat until clean-up levels are attained?	N	N
b) Is continued use of pump and treat necessary for containment of COCs within the GMZ?	N	N
c) Will MNA attain protectiveness by reducing COCs to drinking water standards within the GMZ in a reasonable time period? .	N	N



## 9. RECOMMENDATIONS AND FOLLOW-UP ACTIONS

Recommendations and follow-up actions for the site are summarized in **Table 9-1** below.

**TABLE 9-1: RECOMMENDATIONS AND FOLLOW-UP ACTIONS**

Issue	Recommendations / Follow-up Actions	Party Responsible	Oversight Agency	Milestone Date	Affects Protectiveness	
					Current	Future
<p><b>I. Groundwater is not at cleanup levels:</b></p> <p>A) Is it cost effective to continue pump and treat until clean-up levels are attained</p>	<p>Perform analysis to determine if the system can cost-effectively be operated until drinking water standards are met or if it is feasible to attain clean-up levels with the decreasing mass loading.</p>	NHDES	NHDES	12/31/2008	No	No
<p><b>I. Groundwater is not at cleanup levels:</b></p> <p>B) Is continued use of pump and treat necessary for containment of COCs within the GMZ</p>	<p>Update/develop conceptual site model to further evaluate fate and transport of site COCs under non-pumping conditions.</p> <p>Continue to monitor for trends in concentrations of COCs in boundary wells or in the predicted flow paths.</p> <p>Install additional monitoring wells as directed by evaluation and/or monitoring results.</p>	NHDES	NHDES	03/31/2009	No	No
<p><b>I. Groundwater is not at cleanup levels</b></p> <p>C) Will MNA attain protectiveness by reducing COCs to drinking water standards within the GMZ in a reasonable time period.</p>	<p>Continue to expanded analytical list of parameters for attenuation indicator compounds. Determine extent, if any, of natural attenuation processes.</p> <p>Evaluate time frame anticipated to reach clean-up standards by MNA.</p> <p>Evaluate current boundary of GMZ to assess ability to meet clean-up standards via MNA at the boundary.</p>	NHDES	NHDES	07/31/2009	No	No



## 10. PROTECTIVENESS STATEMENT

OU-1 - Source Control: The remedy at OU-1 has met soil clean up goals, is complete and therefore is protective of human health and the environment.

OU-2 – Management of Migration:

The pump-and-treat remedy at OU-2 has been effective in reducing concentrations and preventing off-site migration of site COCs. Although the treatment system is off-line at this time for the evaluation of rebound, the establishment of the GMZ and regular groundwater monitoring provides continued protectiveness to human health and the environment. The excavation of soil from the former lagoon in 2004 has significantly reduced the potential for future impacts to groundwater and to future site workers through direct contact with this media. The pump-and-treat remedy at OU-2 is expected to be protective of human health and the environment upon completion, and in the interim, exposure pathways that could result in unacceptable risk are being monitored and controlled.

### Site-wide Protectiveness Statement

Because the remedial actions at all OUs are protective, the site is protective of human health and the environment.



## **11. NEXT REVIEW**

The next (fifth) Five-Year Review is scheduled for 2013.

The fifth Five-Year Review will be triggered by the EPA signature of this fourth review. The fifth Five-Year Review will be required as a matter of EPA policy, due to the fact that contaminants remain in groundwater at the site and are likely to remain above levels that allow for unlimited and unrestricted use.

## GLOSSARY OF ACRONYMS AND ABBREVIATIONS

ARAR	Applicable or Relevant and Appropriate Requirement
AGQS	Ambient Ground Water Quality Standard
bgs	below ground surface
CDM	Camp Dresser & McKee
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COC	chemical of concern
CTE	central-tendency exposure
DCA	dichloroethane
DCE	dichloroethylene
DWEL	Drinking Water Equivalent Level
EMW	extraction monitoring well
ESD	Explanation of Significant Differences
GCTF	Groundwater Collection and Treatment Facility
gpm	gallons per minute
GW	groundwater
KES	Keefe Environmental Services
LTRA	Long-Term Remedial Action
MCL	Maximum Contaminant Level
MEK	methyl ethyl ketone
mg/kg	milligrams per kilogram
MNA	Monitored Natural Attenuation
MSL	Mean Sea Level
MW	monitoring well
NCP	National Contingency Plan
NA	not applicable
ND	not detected
NHDES	New Hampshire Department of Environmental Services
NPL	National Priorities List
NS	not sampled
O&M	operation and maintenance
OU	operable unit
PCE	tetrachloroethylene
ppb	parts per billion
RAO	remedial action objective
RI	Remedial Investigation
ROD	Record of Decision
RPM	Remedial Project Manager
RME	reasonable maximum exposure
TBC	to be considered
TCA	trichloroethane
TCE	trichloroethylene
THF	tetrahydrofuran
µg/L	micrograms per liter
EPA	United States Environmental Protection Agency
VOCs	volatile organic compounds
VEES	vacuum enhanced extraction system