FIVE-YEAR REVIEW REPORT

Second Five-Year Review Report for the Barkhamsted-New Hartford Landfill Barkhamsted-New Hartford, Connecticut

September 2008

Prepared By:

United States Environmental Protection Agency
Region 1

Boston, Massachusetts

Barkhamsted
8.3

Approved by:

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Director, Office of Site Remediation and Restoration

Date: 9/19/08

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LIST OF ACRONYMS AND ABBREVIATIONS

ARARs	Applicable or Relevant and Appropriate Requirements
bgs	Below ground surface
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
COCs	Contaminants of Concern
COPC	Contaminants of Potential Concern
CTDEP	Connecticut Department of Environmental Protection
EPA	United States Environmental Protection Agency
ELUR	Environmental Land Use Restriction
FS	Feasibility Study
FSP	Field Sampling Plan
MCLs	Maximum Contaminant Levels
MCLG	Maximum Contaminant Level Goals
MDL	Method Detection Limit
MNA	Monitored Natural Attenuation
NPL	National Priorities List
NTCRA	Non-Time Critical Removal Action
OHM	Oil and/or Hazardous Material
OMM	Operations and Maintenance Manual
OU	Operable Unit
ppm	Parts per million
ppb	Parts per billion
POTW	Publicly Owned Treatment Works
PRP	Potentially Responsible Party
PQL	Practical Quantitation Limit
PSD	Performing Settling Defendant
QAPP	Quality Assurance Project Plan
RA	Remedial Action
RAO	Response Action Objectives
RAP	Remedial Action Plan
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
ROD	Record of Decision
RPM	Remedial Project Manager
RRDD	Regional Refuse Disposal District No.1
SVOCs	Semivolatile organic compounds
VOCs	Volatile Organic Compounds

EXECUTIVE SUMMARY

The remedy selected to address contamination at the Barkhamsted-New Hartford Landfill site (hereinafter referred to as the Site), located in the town of Barkhamsted, Litchfield County, Connecticut was Monitored Natural Attenuation (MNA) of Site groundwater (deemed as the only medium requiring further remediation). This landfill was capped as part of a Non-Time Critical Removal Action (NTCRA) lead by the Connecticut Department of Environmental Protection (CTDEP) to address source materials and principal-threat wastes. The CTDEP approved the landfill closure in January 1998. The trigger for this Five-Year Review was the last Five-Year Review in September 2003. This statutory review is required since hazardous waste remains at the Site above levels that allow for unlimited use and unrestricted exposure.

The Record of Decision (ROD) indicating that MNA was the selected remedy was approved on September 28, 2001 (EPA, 2001b). Initially, the ROD required quarterly sampling of groundwater monitoring wells for two years. This was conducted at the site to coincide with the monitoring requirements set forth in Landfill Operation and Maintenance Manual (O'Brien and Gere, October 2001). Since 2005, semi-annual sampling of groundwater monitoring wells have been conducted.

The assessment of the five-year review found that the remedy is functioning as designed. The immediate threats have been addressed, and the groundwater remedy is expected to be protective of human health and the environment upon completion, when groundwater cleanup goals are achieved through MNA, which was estimated in the Feasibility Study (FS) to occur in about 16 years (O'Brien & Gere Engineers, Inc., 2001a). The MNA remedy also appears ahead of the model prediction, so the remedial goal may be achieved sooner. In the interim, exposure pathways that could result in unacceptable risks are being controlled.

FIVE-YEAR REVIEW SUMMARY FORM

SITE IDENTIFICATION		
Site Name: Barkhamsted-New Hartford Landfill		
EPA CERCLIS ID: CTD980732333		
Region 1	**State:** CT	**City/County:** Barkhamsted, CT
SITE STATUS		
NPL Status: **X** Final Deleted Other (Specify)		
Remediation Status (choose all that apply): Under Construction **X** Operating Complete		
Multiple OUs? Yes **X** No		**Construction Complete Date:** 9/28/2001
Has site been put into reuse? Yes **X** No		
REVIEW STATUS		
Lead Agency: **X** EPA State Tribe Other Federal Agency		
Authors Names: Byron Mah		
Authors' Titles/Affiliation: Byron Mah, Remedial Project Manager, U.S. EPA		
Review Period: 6/30/03 to 6/30/08		
Date(s) of Site Inspection: 6/19/08, 6/25/08, 8/6/08		
Type of Review: **X** Post-SARA Pre-SARA NPL-Removal Only Non-NPL Remedial Action Site NPL State/Tribe Lead Regional Discretion		
Review Number: 1 (first) **X 2 (second)** 3 (third) Other (specify)_____		
Triggering Action: **X** Actual RA Onsite Construction at OU# 1 (NTCRA) Actual RA Start at OU #_____ Construction Completion Previous Five-Year Review Report		
Triggering Action date (from WasteLAN): 9/22/03		
Due Date (five years after triggering action date): 9/23/08		

FIVE-YEAR REVIEW SUMMARY FORM, CONT'D.

Issues:

There were no issues that affect the protectiveness of the remedy. As a side note, however, during the annual inspection of the landfill by the EPA in the summer of 2005 erosion was discovered at one of the surface water drainage downchutes. The downchute is located on the west side of the landfill. Erosion had occurred at a point starting approximately 180 feet from the bottom edge of the landfill just below a side slope diversion ditch. The erosion had resulted in the partial sinking of the gabions that lined the downchute and the accumulation of erosion material at the base of the landfill. The downchute was repaired. This event did not impact the cap liner.

Recommendations and Follow-up Actions:

There were no issues affecting the protectiveness of the remedy requiring follow-up actions. Regarding the previous surface erosion, a recommendation was made to repair the downchute before winter. The downchute was repaired in the fall of 2005 and appears to be functioning appropriately.

Continue to review all downchutes for erosion during annual inspections. Increase frequency of inspections if downchutes appear suspect for erosion.

Protectiveness Statement(s):

As a result of previous actions at the Site, groundwater is the only medium requiring further remedial action for which Monitored Natural Attenuation (MNA) was the selected remedy. The assessment of the five-year review found that the remedy is functioning as designed. The immediate threats have been addressed, and the groundwater remedy is expected to be protective of human health and the environment upon completion, when groundwater cleanup goals are achieved through MNA, which was estimated in the Feasibility Study (FS) to occur in about 16 years (O'Brien & Gere Engineers, Inc., 2001a). The MNA remedy also appears ahead of the model prediction, so the remedial goal may be achieved sooner. In the interim, exposure pathways that could result in unacceptable risks are being controlled.

Long-Term Protectiveness:

Long-term protectiveness of the remedial action will be verified by continuing the MNA groundwater sampling program to monitor and evaluate the contaminant plume downgradient of the landfill and the potential migration of the plume. Current data indicate that the plume appears stable or a steady state condition and is shrinking in size towards the landfill (source area). Since the Remedial Action at all OUs are protective, the Site is protective of human health and the environment.

Other Comments:

There are no other comments for this 5-Year Review.

1.0 INTRODUCTION

The purpose of this five-year review is to determine whether the remedy for the Barkhamsted-New Hartford Landfill Superfund Site (Site) is protective of human health and the environment. The methods, findings and conclusions of this review are documented in this five-year review report. In addition, this report identifies issues encountered during preparation of this five-year review, along with recommendations to address such issues.

The United States Environmental Protection Agency (EPA) must implement five-year reviews pursuant to Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) (Section 121) and the NCP. CERCLA Section 121(c) states:

> *If the President selects a remedial action that results in any hazardous substances, pollutants or contaminants remaining at the site, the President shall review such remedial action no less often than each five years after the initiation of such remedial action to assure that human health and the environment are being protected by the remedial action being implemented. In addition, if upon such review it is the judgment of the President that action is appropriate at such site in accordance with section 9604 [104] or 9606 [106], the President shall take or require such action. The President shall report to the Congress a list of facilities for which such review is required, the results of all such reviews, and any actions taken as a result of such reviews.*

The Agency reported this requirement further in the NCP; part 300.430(f)(4)(ii) of the Code of Federal Regulations (CFR) states:

> *If a remedial action is selected that results in hazardous substances, pollutants, or contaminants remaining at the site above levels that allow for unlimited use and unrestricted exposure, the lead agency shall review such action no less often than every five years after the initiation of the selected remedial action.*

This is the second five-year review for the Site. The triggering action for this review is the last Five-Year review in September 2003 following the Connecticut Department of Environmental Protection (CTDEP) approval of the non-time critical removal date (NTCRA) in 1998, which included capping of the landfill, along with implementation of a leachate management system and institutional controls. The Five-Year Review is required due to the fact that hazardous substances, pollutants, or contaminants remaining at the Site above levels that allow for unlimited use and unrestricted exposure. This Five-Year Review has been prepared following guidance provided by EPA (2001a).

The selected remedial action to reduce impact of designated Contaminants of Concern (COCs) to groundwater (deemed as the only medium requiring remediation) is Monitored Natural Attenuation (MNA) of Site groundwater. LFR Inc. (LFR) was selected as the contractor on behalf of the Potentially Responsible Party (PRP) in February 2003. The Regional Refuse Disposal District No.1 (RRDD) acting as the Performing Party conducted the initial quarterly groundwater sampling event, pursuant to the ROD, in April and May 2003 program. In 2005 after 2 years of quarterly sampling the sampling frequency changed to semi-annual.

2.0 SITE CHRONOLOGY

The chronology of the Site is addressed in Table 1, which includes significant events and dates as one operating unit (OU).

TABLE 1: CHRONOLOGY OF SITE EVENTS

Date (Month/year)	Environmental Issue/Event/milestone
September 1970	Regional Refuse Disposal District No. 1 (RRDD) was formed.
September 1972	RRDD received CTDEP soil waste permit #005-2L. The RRDD purchased the Barkhamsted property from the Town of Barkhamsted.
1970s	Operation of chemical pit that received oily sludge with metal grindings and degreasers.
January 1974	Modification to the RRDD solid waste permit was issued.
April 1974	The landfill became operational.
1974-1979	CTDEP solid waste reports document lack of daily cover material; additional issues include ponding of water on landfill surface and encroachment of brush and bulky waste onto 50-foot buffer zone.
April 1974-August 1988	Barkhamsted landfill Site was used for the disposal of solid waste.
1980	CTDEP inspection of the Site.
1981	EPA conducted a preliminary assessment for the Site.
March 1981	CTDEP requests RRDD to remove hazardous waste from the facility.
July 1981	CTDEP formerly approved disposal of metal grinding waste at Site.
1983	Two complaints received concerning the presence of a large number of drums; CTDEP requests that 25 drums containing suspect motor oil be re-located to a paved area on-Site.
November 1983	Thirty drums discovered near the scrap metal area (north of toe of landfill and NW of garage).
December 16, 1983	A modification to the landfill operating permit was issued.
1984	Requirement for a new metals grindings cell. Metal grindings were stored on Site in 55-gallon drums.

September 1986	CTDEP acknowledges handling of waste oil and batteries for recycling.
March-1987	NUS Corporation conducts site inspection, on behalf of EPA –Site receives hazard ranking score (HRS) of 52.00, later lowered to 38.05, due to low population density and fact that area served by public water supply.
November – December 1988	Disposal of solid waste at the Site because CRRA mid-Connecticut Waste to Energy Plant was inoperable.
August 1988 – October 1993	Disposal of bulky and non-processible waste only.
1988	CTDEP document states that one half of the barrels received at the Site contained unspecified amounts of chlorinated hydrocarbons or methyl ethyl ketone.
October 5, 1989	Barkhamsted Site listed on NPL.
February 1990	Minor amendment was granted to the RRDD solid waste permit allowing landfill to accept dewatered sludge from Winsted's publicly owned treatment works (POTW).
1990	CTDEP Administrative order to investigate waste materials; determine extent of impact and potential impact to soil, surface water and groundwater
October 4, 1991	CERCLA Administrative Order to Conduct Remedial Investigation/Feasibility Study (RI/FS) (Docket No. I-91-1128).
Dec 1991-Jan 1992	Limited Field Investigation (LFI) conducted by O'Brien & Gere Engineers, Inc.
December 1991	Scope of Study completed by Fuss & O'Neill per CTDEP Administrative Order No. 666.
November 1992	Landfill closure implemented. CTDEP revise permit # SW-0005-2L to address water quality monitoring plan.
October 1993	Facility ceases acceptance of waste for on-Site disposal.
April 1994	Engineering Evaluation/Cost Analysis (EE/CA) addressing NTCRA.
September 26, 1994	EPA approves NTCRA; EPA and CTDEP enter into Consent Order requiring RRDD to design and implement NTCRA.
October 1994	Landfill cover (2-ft thick) installed.
January 1995	CTDEP approves landfill closure.
February 1996	Remedial Investigation (RI) by O'Brien & Gere Engineers, Inc. (1996).
September 1996	Draft Remedial Action Plan (RAP).
1998	NTCRA completed; implementation of leachate collection system; capping of landfill and Site restoration.
June 2001	Feasibility Study Report, O'Brien & Gere Engineers, Inc. (2001a).
September 28, 2001	EPA Record of Decision (ROD) (EPA, 2001b).
November 19, 2002	Environmental Land Use Restriction (ELUR) public notice; 30-day comment period from 11/19/02 to 12/19/02.
April to June 2003	Sampling of Site groundwater monitoring wells, residential potable water wells, surface water and sediment sampling per the ROD begins.
July 2003	Drilling to install additional monitoring wells MW-120S and MW-120B.

August 23, 2003	The on-Site ELUR, dated July 24, 2003, was recorded at the Barkhamsted Land Records in Volume 124, Page 140.
September 2003	First 5-Year Review.
January 22, 2004	The off-Site Town Garage ELUR, dated December 22, 2003, was recorded in Volume 126, Page 347. The off-Site MDC ELUR, dated December 22, 2003, was recorded in Volume 126, Page 357.
February 24, 2004	The off-Site ELUR for the Morris property dated January 4, 2004 was recorded at the Barkhamsted Land Record in Volume 126, Page 689.
August 2005	EPA Site inspection discovers a downchute failure in one of the downchuts.
October to November 2005	Downchute repair conducted and completed.
April 19, 2008	Public notice that a Five-Year Review is to be conducted.
September 2008	Second Five-Year Review

3.0 BACKGROUND

3.1 Physical Characteristics

The Site is comprised of a 97.8-acre parcel of land located on the northern slope of a hill within the Farmington River Valley, located in the north central portion of Connecticut. The Site is primarily used as a transfer station and recycling center consisting of 97.84 acres located in the Towns of Barkhamsted and New Hartford, Litchfield County, Connecticut (a Site Location Map is provide as Figure 1). The capped landfill itself is approximately 13 acres. The Site is abutted to northeast by the Barkhamsted Town Garage facility and in other directions by both developed and undeveloped private properties. This includes residential properties to the east and southeast that use private wells for potable water. The town center of New Hartford lies within a one-mile radius to the south-southeast of the Site. Other areas of the Site property include an active transfer station, recycling area, maintenance and office building, and dense woods comprised primarily of hardwood and conifer trees. A Site Location Map is provided as Figure 1 and Figure 2 presents the Site Plan and Sampling Locations.

3.2 Land and Resource Use

The Site was formerly used as a solid waste landfill that received oily sludge with metal grindings and degreasers. Waste oil and batteries were handled for recycling. A NTCRA was initiated in 1992 to cap the landfill, which stopped accepting waste for on-Site disposal in October 1993. In January 1998, the CTDEP approved the landfill closure.

The current use of the Site includes an active waste transfer station, recycling area, with a maintenance and office building. The capped landfill is fenced. The current use for the surrounding area is residential, commercial and recreational. The Metropolitan District

Commission (MDC) owns undeveloped land along the Farmington River, which is used for recreational purposes, including fishing, swimming and boating.

One surface water body, designated as the "Un-named Brook", originates south of the Site and flows along the western portion of the landfill area. Beyond the landfill, the brook proceeds to the northeast and flows under Route 44, where it enters the Farmington River floodplain and a series of small beaver ponds. The brook eventually flows into the Farmington River, located approximately 0.25 miles southeast of the Site. The Farmington River is a Class B River for recreational fishing and boating.

The groundwater aquifer underlying the Site is currently not used as a drinking water source, but nearby commercial and residential areas use off-Site wells for potable water. These off-Site potable wells are not within the zone of Site-related groundwater plumes. Groundwater at the Site is estimated to flow to the northeast. Downgradient of the Site, groundwater flow is more easterly toward the Farmington River. Groundwater contour maps for April 2008 for the overburden and shallow bedrock are included as Figures 3 and 4, respectively. Due to the affected groundwater at the Site an Environmental Land Use Restriction (ELUR) was placed on the Site to document the groundwater contamination, which was recorded at the Barkhamsted Land Record on February 24, 2004. In addition, the ELUR noted that groundwater is not to be used for drinking or other purposes, that there is to be no building on the cap or residential use immediately downgradient, that there is no disturbance to the cap and it is to be properly maintained to prevent exposure.

3.3 History of Contamination

The Barkhamsted landfill was used for the disposal of solid waste between April 1974 and August 1988. The property is owned and operated by the Regional Refuse Disposal District No. 1 (RRDD). RRDD is a corporate entity that was established on May 25, 1970 upon the adoption of its charter by the Towns of Barkhamsted, Colebrook, New Hartford and Winchester. On September 21, 1972, RRDD received a permit from the State of CTDEP approving the establishment of a solid waste disposal area. The Site began operating as a landfill in 1974.

The Site was used for the disposal of solid waste between April 1974 and August 1988. After August 1988, the landfill was used only for the disposal of bulky and non-processible waste with the exception of a period during November and December 1988 when the Connecticut Resources Recovery Authority (CRRA) Mid-Connecticut Waste to Energy Plant was inoperable. In 1998 a landfill cap and leachate collection system, surrounded by a fence, were constructed pursuant to a NTCRA under CERCLA authority. Table 1 provides a chronology of major environmental issues, events and milestones at the Site, as documented in the Remedial Investigation (RI) report (O'Brien & Gere Engineers, Inc., 1996) and Feasibility Study (FS) report (O'Brien & Gere Engineers, Inc., 2001a).

Historical wastes accepted at the landfill included the following:

- Municipal solid waste;

- Industrial wastes, including metal grinding waste, oily sludge with metal grinding and degreasers; barrels containing unspecified amounts of chlorinated hydrocarbons and methyl-ethyl-ketone (MEK) and keratin; and

- Dry metal grinding waste.

3.4 Initial Response Actions

In 1981, EPA conducted a Site inspection, based on previous findings of the CTDEP. EPA's 1981 inspection included collection and analysis of Site groundwater samples. Laboratory analytical results of Site groundwater indicated concentrations of xylenes, toluene, 1,1-dichloroethane (1,1-DCA), 4-methyl-2-pentatnone and vinyl chloride (VC). EPA inspection report also indicated the presence of metals at the Site (including cadmium, chromium, copper, lead, manganese, nickel and zinc) attributed to the historical disposal of oily metal grinding sludges. Additionally, during U.S. EPA's inspection, leachate was observed to be discharging from the landfill into the Un-named Brook. Pursuant to Section 105(8)(b) of CERCLA, the Site was proposed for inclusion on the National Priorities List (NPL) on June 21, 1988 and was subsequently listed on the NPL on October 5, 1989. Administrative orders were issued by CTDEP (1990) and EPA (1991) to investigate waste materials and disposal activities on the Site, along with the extent of impact to soil, groundwater and surface water.

In 1994, a NTCRA was implemented at the Site, which included re-location of impacted soil and sediment to a paved portion of the Site, along with installation of a leachate collection system and landfill cap. The NTCRA was completed in 1998. A risk assessment was prepared prior to NTCRA implementation to assess post-NTCRA risks to human and ecological receptors. Groundwater was deemed as the only medium requiring remediation.

Subsurface investigations conducted from 1992 to 2000 are documented in the RI and FS reports. These investigations indicated the following:

- Soil sampling analytical results indicated concentrations of volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), pesticides and polychlorinated biphenyls (PCBs). Table 1-1 of the FS Report (O'Brien & Gere Engineers, Inc., 2001a) identifies contaminants of potential concern (COPCs), including VOCs, SVOCs and inorganics. Soils containing constituents detected at concentrations exceeding applicable or relevant and appropriate criteria were addressed in the NTCRA.

- Surface water sampling and leachate seep sediment sampling results indicated concentrations of SVOCs, pesticides and PCBs. Sediments samples collected from hydrogeologically downgradient locations (to the landfill) and leachate seep sediment samples indicated concentrations of VOCs, SVOCs, metals, pesticides and PCBs.

Prior to the RI, 31 groundwater monitoring wells were installed at the Site. Twenty-two additional wells were installed during the RI. COCs based on groundwater investigations include 14 VOCs, 4 SVOCs and 4 inorganics. Groundwater sampling conducted since the RI have shown a decreasing trend in most contaminant concentrations.

3.5 Summary of Basis for Taking Action

Hazardous substances in concentrations above health based levels were identified during the RI/FS. The RI identified COCs that have been released at the Site in each media, which are identified below and also in Table 2. EPA completed a baseline human health risk assessment in February 1996 and updated in April 2000. Using EPA's risk assessment guidance, potential human health effects associated with exposure to COCs were estimated for various exposure scenarios. Calculated risks for some exposure scenarios fell outside EPA's acceptable range, which formed the basis for the response actions. An ecological risk assessment conducted within the same time period determined that it was not likely that the contaminants found at the Site would cause significant ecological impacts.

The COCs were selected from the constituents detected in groundwater based on the unacceptable risks that these contaminants present. Groundwater was the only medium that poses an unacceptable post-NCTRA risk to human health. Since COCs have migrated in overburden and bedrock groundwater, off-Site impacts are a concern, specifically to nearby potable water supplies. As documented in U.S. EPA's Record of Decision (ROD) (EPA, 2001b), the primary objective is restoration of Site groundwater by MNA, which has been designated as the final Site environmental remedy with an expected duration of approximately 16 years. Installation of additional groundwater monitoring wells occurred in July 2003 to fill in data gaps and assess the performance of the MNA.

The only medium that potentially poses an unacceptable post-NTCRA risk to the environment is sediment. Although the actual risk is uncertain, it is likely that decreased leachate, biodegradation of organic contaminants, and natural sedimentation will ameliorate these possible risks. Surface water and sediment sampling is to be conducted to assess this possible risk. Based on surface water sampling conducted in 2000 (subsequent to the NTCRA), there are no known constituents exceeding applicable criteria in surface water, as identified in the ecological risk assessment presented in the FS. Leachate seeps are expected to gradually diminish in discharge volume over time or dry up.

COCs for groundwater, as addressed in the ROD, include the following:

Acetone
Benzene
1,2-dichloroethane
1,2-dichloropropane
Chloroethane
Manganese
Toluene
2-Butanone (MEK)
4-methyl-2-pentanone
1,4-dichlorobenzene

Chloroform	Bis(2-ethyl hexyl) phthalate
Chloromethane	2,4-dimethylphenol
Dibromochloromethane	4-methylphenol
Methylene chloride	Arsenic
Trichloroethene (TCE)	Chromium (total)
Vinyl chloride (VC)	Lead

A complete list of the COC and other compounds analyzed is included in Table 2.

4.0 REMEDIAL ACTIONS

The following sections discuss the initial plans, implementation history and current status of the remedy.

4.1 Remedy Selection and Remedial Action Objectives

The ROD for the Site was signed on September 28, 2001 (EPA, 2001b). Monitored Natural Attenuation (MNA) was selected as the remedial option to reduce groundwater impacts at the Site. The remedy at this Site is designed to protect human health and the environment by eliminating, reducing or controlling exposures to human and environmental receptors through monitored natural reductions in toxicity, engineering controls and institutional controls. More specifically, groundwater cleanup levels will be achieved through natural attenuation processes. Environmental land use restrictions would prohibit residential use of the Site, use of groundwater for drinking or any other purpose, and avoid disturbance of the landfill cap installed under the NTCRA. Environmental land use restrictions of down-gradient properties would prohibit the installation of any wells and use of groundwater for any purpose.

The primary goal of the selected remedy is to ensure that the area down-gradient of the landfill will no longer present an unacceptable risk to humans via groundwater and will be suitable for unrestricted use. Approximately 16 years are estimated as the amount of time necessary to achieve the goals consistent with residential use. The expected outcome of the site itself is to remain as a refuse / recycling / disposal facility, with restricted use of land and groundwater at the landfill itself, unrestricted use in all other areas.

Remedial action objectives (RAOs) were developed to aid in the development and screening of alternatives. These RAOs were developed to mitigate and prevent existing and future potential threats to human health and the environment. The following RAOs identified in the ROD were developed because of data collected during the RI and the alternatives evaluated in the FS (O'Brien & Gere Engineers, Inc., 2001a). These RAOs for the selected remedy for the Site are further broken into two categories: groundwater and sediment.

Groundwater

The RAOs for groundwater for human health are as follows:

- Prevent ingestion or dermal contact with groundwater having constituent concentrations exceeding EPA Safe Drinking Water Act non-zero MCLGs or Maximum Contaminant Levels (MCLs), or in their absence, the more stringent of an excess cancer risk of 1 x 10^{-6} for each substance or a hazard quotient of 1 for each non-carcinogenic substance. (Please note that this RAO applies to all areas where the groundwater has been impacted by contamination from the landfill including areas beneath the landfill. For information on MCLGs please refer to NCP Section 300.403(e)(2)(i)B and Section 300.403(e)(2)(i))

- Restore groundwater beyond the compliance boundary (limits of the landfill –See Figure 2) to MCLs or any more stringent CT Remediation Standards (background concentrations), or in their absence, the more stringent of an excess cancer risk of 1 x 10^{-6} for each substance or a hazard quotient of 1 for each non-carcinogenic substance.

Sediment

The RAOs for sediment for environmental protection are as follows:

- Protect benthic invertebrates and mammals from ingesting contaminated prey from direct contact with, or ingestion of, sediment having constituent concentrations exceeding a hazard index of 1.

- Prevent releases of constituents from sediments that would result in surface water levels exceeding federal Ambient Water Quality Criteria, Connecticut Water Quality Standards, or in their absence, a hazard index of 1.

4.1.1 Source Control

The source control was addressed by the NTCRA, which included re-location of impacted soil and sediment to a paved portion of the Site, along with installation of a leachate collection system and landfill cap. During the performance of the NTCRA, an approximate 340-foot reach of the Un-named Brook was relocated on the west side of the landfill, with the former section of the brook being covered with soil. Moreover, sediments were excavated from an approximately 70-foot reach of the brook and placed beneath the cap during the NTCRA construction. The EPA has determined that there are no present contaminant sources at the Site and no additional actions are anticipated during implementation of the final cleanup remedy.

4.1.2 Management of Migration

The major components of the management of migration remedy selected in the ROD includes:

- Long-term monitoring of groundwater, surface water (including seeps), and sediment;
- Restoration of contaminated groundwater via natural attenuation;
- Environmental land use restrictions (ELURs);
- Public education program; and
- Five-year reviews.

4.2 Remedy Implementation

In 1992 landfill closure was implemented in accordance with the Landfill Closure Plan (Fuss & O'Neill, 1992). In January 1995 the CTDEP approves the landfill closure. In April 1997, the Remedial Action Plan for the NCTRA was prepared, which included (O'Brien & Gere Engineers, Inc., 1997):

- Relocation of impacted soil, sediment and refuse to within the limits of the area to be capped;
- Installation of a leachate collection system with a 15,000-gallon underground leachate holding tank;
- Capping of the landfill with a low-permeability capping system;
- Relocation of an the Un-named Brook;
- Vertical extension of groundwater monitoring wells located within the limits of the capped area and abandonment of monitoring wells no longer being used;
- Site restoration;
- Installation of perimeter security fencing; and
- Institutional controls for protection of the landfill cap using ELURs. The ELURs indicate the groundwater contamination, that groundwater is not to be used for drinking or other purposes, that there is to be no building on the cap or residential use immediately downgradient, that there is no disturbance to the cap and it is to be properly maintained to prevent exposure.

In January 1998 the NTCRA was completed. Since then, community involvement activities were conducted. In June 2001 the Feasibility Study (FS) was completed (O'Brien & Gere Engineers, Inc., 2001a). On September 28, 2001, the ROD was signed, which selected MNA as the remedy (EPA, 2001b). A Consent Decree was signed by the PRPs on various dates between September and November 2002 and by government

representatives between September 2002 and January 2003, which was entered by the court on May 7, (United States *v.* Regional Refuse District No. 1, et al., 2003).

Pursuant to the terms of the Consent Decree, RRDD is performing the RA. In spring of 2003 RRDD initiated the long-term monitoring of groundwater. Periodic monitoring data continues to be collected in support of restoration of contaminated groundwater via monitored natural attenuation.

MNA remedy provides for both source control and management of groundwater migration. The approximate clean up time frames for the selected remedy is 16 years to reach groundwater cleanup levels. Statutory 5-year reviews will be conducted as long as waste is in place.

4.3 System Operations/Operation and Maintenance (O&M)

RRDD is conducting the long-term monitoring and maintenance activities at the Site. There are two components to the long-term monitoring and maintenance activities, one for the CTDEP and the MNA activities for the EPA. For the CTDEP, a landfill post-closure Operation and Maintenance Manual (OMM) was completed in October 2001 (O'Brien & Gere Engineers, Inc., 2001b). O&M activities include the following:

- Routine inspection and maintenance of constructed features, including the landfill cap, gas venting system, leachate collection and storage system, surface water runoff facilities, the in-stream sedimentation basin, access roads, groundwater monitoring system and physical Site security;
- Mowing of the cap;
- Performance of a Long-term monitoring program including groundwater, surface water (including seeps) and sediment;
- Response to alarm and unforeseen circumstances;
- Coordination of leachate removal and disposal; and
- Evaluation of O&M and monitoring activities and identification of proposed changes to the O&M Manual or Site procedures/policies that would provide a safer and/or more cost-effective operation.

Visual Site monitoring of the landfill occurs on a routine basis to evaluate evidence of erosion; cap differential settlement; the condition of the perimeter fencing, gates, locks and signs; condition of gas monitoring probes; drainage structures and surrounding property structures. The existing groundwater monitoring wells and immediate surrounding area is reviewed during each sampling event.

To date, the CTDEP O&M activities have been ongoing since the capping of the landfill. The MNA sampling activities were initiated in April 2003 with the first quarterly sampling event.

With regard to O&M costs, the following is the total annual system O&M costs for the groundwater, potable well, surface water and sediment sampling, analysis and reporting during the first 5-year period until January 2008. This does not include the mowing, leachate disposal, the downchute repair or other maintenance activities.

Table 3: Annual System Sampling & Analysis O&M Estimated Costs

Dates		Total Cost Estimate rounded to nearest $1,000
From	To	
3/03	1/04	$393,000
1/04	1/05	$228,000
1/05	1/06	$139,000
1/06	1/07	$113,000
1/07	1/08	$105,000

4.3.1 Operation and Maintenance (O&M) Issues

This section summarizes issues that were not normal O&M activities. During monitoring well sampling, some wells could not be sampled typically due to well head damage from snow plows or obstructions in the well such as a pump and tubing stuck in the well. Typically these repairs were made or obstructions removed prior to the next sampling event. However, some well obstructions could not be removed.

Due to the cleanup goals being set in the ROD at low background concentrations the analytical laboratory sometimes has a problem achieving these concentrations. As many COC concentrations are still above their background concentrations, this is not an immediate issue, but the required detection limits will need to be achieved particularly as the COC concentrations decrease. This will be addressed with the laboratory.

With regard to the landfill cap, the western downchute erosion identified in the summer of 2005 was repaired in the fall of 2005. There was a significant cost for the repair of the downchute, but it had no impact on the remedy. The cap liner was not affected, only the drainage structure and soil cover. Ongoing monitoring of the cap should identify cap issues prior to them potentially affecting the remedy.

5.0 PROGRESS SINCE THE LAST FIVE-YEAR REVIEW

This is the second Five-Year Review for the Site. A summary of the progress for this review period (2003 to 2008) is presented in the following subsections.

5.1 Protectiveness Statement from Last Review

The following is the Protectiveness Statement from the last review in 2003:

> As a result of previous actions at the Site, groundwater is the only medium requiring further remedial action, for which Monitored Natural Attenuation (MNA) was the selected remedy. The assessment of the Five-Year review found that the remedy is functioning as designed. The immediate threats have been addressed and the remedy is expected to be protective of human health and the environment when groundwater cleanup goals are achieved through MNA, which was estimated in the Remedial Investigation and Feasibility Study (RI/FS) to occur in about 16 years. In the interim, exposure pathways that could result in unacceptable risks are being controlled.

5.2 Status of Recommendations and Follow-up Actions from Last Review

A summary of the 2003 recommendations and follow-up actions from the last review are summarized as follows.

Status of Issues and/or Recommendations and Follow-Up Actions from 2003

Issues	Recommendations and Follow-Up Actions	2008 Comment/Status
Discovery of four 55-gallon drums suspected of containing purged groundwater by MW-111.	The drum's contents were tested, removed and the contents placed in the leachate holding tank for disposal.	Completed in 2003.
Three groundwater monitoring wells (MW113-I, MW113-D and MW4-R were inaccessible.	Repair of damaged wells MW113- I and MW113-D do not appear necessary at this time. Their potential need will be evaluated based on new Site data.	The wells MW113- I and MW113-D are upgradient wells in an un-impacted area and are not required. Well MW-4R's obstruction was removed in April 2008 after several prior attempts. This well will continue to be used.
Not an issue in 2003, but a recommendation.	Continued monitoring of Site groundwater, seeps, soil, surface water and sediment.	The MNA remedy will continue to monitor Site groundwater, seeps, surface water and sediment. There is currently no plan to monitor soil at the Site.
Not an issue in 2003, but a recommendation.	Continue to verify that natural attenuation is occurring.	This is an ongoing task in the review of the data.
Not an issue in 2003, but a recommendation.	Adoption of ELUR for properties other than the RRDD facility – on Site discussed first, see next item.	The on-Site ELUR, dated July 24, 2003, was recorded at the Barkhamsted Land Records in Volume 124, Page 140 on August 27, 2003.
Not an issue in 2003,	Adoption of ELUR for	There are three off-Site ELURs. The Town

but a recommendation.	properties other than the RRDD facility – off Site.	Garage ELUR, dated December 22, 2003, was recorded in Volume 126, Page 347 on January 22, 2004. The MDC ELUR, dated December 22, 2003, was recorded in Volume 126, Page 357 on January 22, 2004. The Morris property ELUR, dated January 4, 2004 was recorded at the Barkhamsted Land Record in Volume 126, Page 689 on February 24, 2004.
Not an issue in 2003, but a recommendation.	Continued maintenance of the landfill cap cover.	This is an ongoing activity conducted by the RRDD.
Not an issue in 2003, but a recommendation.	To more clearly define the extent of the COCs, it was recommended that additional wells be sampled in future sampling events. The additional wells proposed to be sampled include wells MW-105S and B, MW-108 S and B, MW-109B, MW-117S and B and MW-118S and B.	This comment was made at the start of the sampling program. A review of the data since then indicates that the plume is stable and is not moving significantly to the east. Therefore, these wells were not sampled. To better assess the MNA process between impacted and un-impacted areas a new well couplet was installed to the north of well MW-103 by the Barkhamsted DPW garage. Several soil borings were advanced in this area to determine the location of the wells. The new well couplet (MW-120S &120B) was installed in July 2003.

5.3 Results of Implemented Actions, Including Whether They Achieved the Intended Purpose

The results or status of the implemented actions are summarized in Section 5.2. The storm water downchute repair of 2005 is working, and these downchutes are checked during the RRDD and EPA Site inspections. Therefore, the actions to address the issues set forth in Section 5.2 have achieved or are achieving their intended purpose. For the remedy, the MNA sampling and analysis activities are being implemented and are achieving their goal of documenting the MNA remedy, which is proceeding as planned.

5.4 Status of Any Other Prior Issues

The issues from the 2003 Five-Year Review are summarized in Section 5.2. There were no other issues reported in the 2003 Five-Year Review.

6.0 FIVE-YEAR REVIEW PROCESS

6.1 Administrative Components and Community Involvement

On March 20, 2008 a meeting of the Five-Year Review team was led by Byron Mah of EPA, who is the Remedial Project Manager (RPM) for the Barkhamsted Site. The other meeting members included Michael Baer, Eric Nichols and Allen Walker of LFR, Inc. who are conducting the MNA remedy for the RRDD. The Five-Year Review process and schedule were discussed.

On April 19, 2008 a public notice was published in the Register Citizen to announce that the Five-Year Review was to be conducted. A copy of the notice was also provided to the CTDEP Site contact, Maurice Hamel.

As documented in the ROD and the last Five-Year Review, the level of community concern and involvement has varied, and since the completion of the NTCRA, community interest has been minimal. During the past 5 years, the RRDD and LFR have received no community inquiries other than the people involved with the sampling of the potable wells. These inquiries are associated with the sampling schedule and obtaining copies of the sampling results.

6.2 Document Review

Site-related documents reviewed as part of this effort. The documents were compared to six aspects of the Site including:

- Basis for the Response Action;
- Implementation of the Response;
- Operation and Maintenance;
- Remedy Performance;
- Legal Documentation; and
- Community Involvement.

6.3 Data Review

Groundwater, surface water, seep and stream sediment monitoring pursuant to the ROD was initiated in April and May of 2003. Groundwater, surface water and seep monitoring was initially conducted quarterly for 2 years and then semi-annually to present. Sediment sampling is conducted annually in the spring.

In general, most contaminants were detected at their highest levels early in the remedial history of the Site, prior to the NTCRA and landfill capping in 1998. These higher contaminant concentrations were followed by a drop in contaminant levels, which was likely the result of removal and capping activities at the Site as the source material was capped, limiting migration.

Since 2003, the contaminant concentrations have been decreasing or are in a steady state condition. The following tables summarize the historical sampling results:

- Table 4a – Summary of Historical Groundwater VOC results;
- Table 5 - Summary of Historical Groundwater metal results;
- Table 6 - Summary of Historical Surface water metal results;
- Table 7 – Summary of Historical sediment metal results;
- Table 8 – Summary of Analytical Results – 2003 to 2008 VOCs and SVOCs in Groundwater; and
- Table 9 - Summary of Analytical Results – 2003 to 2008 Metals in Groundwater.

Based on the analytical results, figures were prepared of the COC concentrations from the start of the MNA monitoring in the spring of 2003 and for the most recent sampling result from the spring of 2008. The following figures were prepared:

- Figure 5: Overburden Total VOCs and SVOCs Concentration Map - April 30 - May 8, 2003;
- Figure 5A: Overburden Total VOCs and SVOCs Concentration Map - April 2008;
- Figure 6: Overburden Total BTEX Concentration Map - April 30 - May 8, 2003;
- Figure 6A: Overburden Total BTEX Concentration Map - April 2008;
- Figure 7: Shallow Bedrock Total VOCs and SVOCs Concentration Map - April 30 - May 8, 2003;
- Figure 7A: Shallow Bedrock Total VOCs and SVOCs Concentration Map - April 2008;
- Figure 8: Shallow Bedrock Total BTEX Concentration Map - April 30 - May 8, 2003; and
- Figure 8A: Shallow Bedrock Total BTEX Concentration Map - April 2008.

A review of these figures indicates that the plume concentrations and size has decreased with time from 2003 to 2008. The extent of the plume is reduced and it is located closer to the source area.

With regard to the surface water, seep and sediment sampling, the results of this sampling are consistent or lower than that of the post-NTCRA sampling. For post-NTCRA sampling, the ROD indicated an acceptable risk for surface water and seeps and ongoing monitoring for sediment due to an uncertain risk. The uncertain risk was an ecological risk for benthic invertebrates. The ROD also noted that barium and manganese were identified as the only compounds exceeding the probable effects concentration (PEC) benchmark. Since 2003, the start of the post-ROD sampling, higher concentrations of barium and manganese were detected in the upstream sample Sed-3 (located at SW-3). The concentrations of these compounds were lower in the downstream samples. Typically the middle sample (Sed-16) detected slightly higher barium and manganese concentrations than the downstream sample (Sed-9). As noted in Table 7 the PEC concentration for barium and manganese were exceeded in the upstream sample, the barium PEC was typically slightly exceeded in the mid-stream sample and there was one PEC exceedence for barium in 2007 in the downstream sample. The greater metal concentrations in the upstream sample may suggest a possible local condition with the metals occurring naturally in higher concentrations upstream. The upstream location is undeveloped with no obvious source for metals. The concentration change may also be associated with the relocation of the stream during the NTCRA.

An evaluation of the natural attenuation processes at the Site included evaluating four indicators that are recommended in the Use of Monitored Natural Attenuation at Superfund, RCRA Corrective Action, and Underground Storage Tank Sites (OSWER Directive No. 9200.4-17P, April 21, 1999) for evaluating the performance of an MNA remedy. The four indicators are:

- Demonstrate that natural attenuation is occurring according to expectations;
- Detect changes in environmental conditions that may reduce the efficacy of the natural attenuation processes;
- Identify potentially toxic or mobile transformation products; and
- Verify that the plume is not expanding either downgradient, laterally, or vertically.

Since completion of the cap in 1998, the contaminants for which groundwater cleanup levels were established have decreased in concentration. Many contaminants are below the MCL and some are at or approaching the respective cleanup goal of background concentrations in recent sampling events. As set forth previously, Figures 5 to 8A present the total VOC, SVOC and BTEX concentrations in the spring of 2003 and the spring of 2008. These figures indicate the decreasing trend in contaminant levels and in the extent of the contamination in the groundwater. These figures indicate a reduction of the plume in downgradient directions, as well as vertically, and the plume is nearer to the original source area. The concentrations of toluene, benzene and trichloroethene, which are some of the more prevalent and higher concentration COC, are decreasing in

concentration. This decreasing trend can be seen in source area wells MW-1S and MW-101S to downgradient wells MW-4S, MW-5S, MW-5B, MW-102B, MW-120B and MW-111B. Based on a review of the MNA data, the data indicates that the groundwater attenuation process conceptualized in the ROD is proceeding essentially as expected.

The evaluation of the MNA parameters is further discussed in Section 7.2.3 of this report.

6.4 Site Inspections

On 6/19/08, 6/25/08, and 8/6/08 EPA conducted inspections at the site for the benefit of the 2nd 5 Year Review. The team consisted of Byron Mah, Jean Choi, and Rudy Brown.

As a result of the inspections, EPA has the following observations:

1. The overall LF surface conditions were very good.

2. The repaired downchute appeared very good. In 2005 a downchute was eroded due to a series of heavy rains that did not drain along the downchutes. A repair was made to the downchute.

3. However, one of the downchutes located in the mostly southern slope was full of vegetation on the downchute. The area was treated and part of the cap was mowed as a result of this finding. Upon re-inspection, EPA discovered some erosion that could lead to a potential downchute failure in the future. RRDD#1 has been notified of this and will address this maintenance as part of their on going O&M activities. Please also see inspection memorandum and inspection checklist in Appendix A.

Please note that the operator of the landfill also has regular cap inspections by an independent inspector as part of CTDEP requirements.

6.5 Interviews

Interviews were conducted with various parties connected to the Site. Donald Stein, Barkhamsted's first selectman was interviewed on September 2, 2008. No significant problems regarding the Site were identified during the interview. There were no concerns expressed about the protectiveness of the remedy or the operation of the facility.

Jim Hart, the administrator for the Site, (June 19, 2008) did not indicate significant problems regarding the Site. He presented a draft redevelopment master plan that considers the subdivision of lots on the RRDD property that are not contaminated with the waste on site. He indicated that they are considering the installation of wells up gradient and side gradient from the landfill in order to service these lots with potable water. EPA indicated that he would have to demonstrate that this use of water would not have an impact on the remedy.

7.0 TECHNICAL ASSESSMENT

7.1 Question A: Is the Remedy functioning as intended by the decision documents?

Yes, the review of documents, ARARs, risk assumptions, and the results of the Site inspection indicate that the remedy is functioning as intended by the ROD as an operating remedial action. A copy of the ARARs for the Site is attached at Appendix B. The capping of the landfill, and the collection of leachate have achieved the remedial objectives to minimize the migration of contaminants to groundwater and surface water and prevent direct contact with, or ingestion of, contaminants in soil and sediments. The effective implementation of institutional controls has prevented exposure to contaminated landfill materials.

Operation and maintenance of the cap and drainage structures has been effective, except for the noted downchute repair in 2005. The landfill inspections should be sufficient to identify cap issues, as occurred in identifying the downchute repair need. There is also an increased awareness of the need to maintain the downchutes, so unscheduled visual checks of the downchutes occur more frequently.

Opportunities for system optimization observed during this review include some reduction in monitoring wells to be sampled and/or the frequency of the sampling. These modifications to the monitoring well network are set forth in Section 9 – Recommendations and Follow-up Actions.

The institutional controls, or ELURs, that are in place include prohibitions on the use or disturbance of groundwater until cleanup levels are achieved, and prohibitions on excavation activities, disturbance of the cap, and any other activities or actions that might interfere with the implemented remedy. No activities were observed that would have violated the institutional controls. The cap and the surrounding area were undisturbed, and no new uses of groundwater were observed. The fence around the Site is intact and in good repair.

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, some cleanup levels and toxicity data may have changed since the remedy selection, but the initial and changed parameters are still valid.

7.2.1 Changes in Exposure Pathways

The exposure pathways as indicated in the risk assessment and ROD are provided in Appendix C. There have been no changes in the physical conditions of the Site since approval of the decision documents. However, as of 2002 EPA prepared a Draft Vapor Intrusion Guidance document. This guidance addresses EPA's concern about inhalation

of VOCs from contaminated groundwater or soils which currently underlie buildings as well as which may come to be situated underneath a structure at some point in the future.

Where there are several VOCs identified in the groundwater at the Site and there are on-Site buildings, the indoor vapor concern was considered and evaluated. There is an on-Site Garage is located cross-gradient to the plume with VOCs. This Garage has an office on the eastern side of this structure. The EPA OSWER Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils (Subsurface Vapor Intrusion Guidance), dated November 2002 was used to assess the possible indoor air pathway along with the Connecticut RSR groundwater criteria.

With regard to this building, monitoring wells MW-S-3 (upgradient) to the south, MW-1S (crossgradient) to the west and MW-4S downgradient and north were used for the evaluation. MW-102S (crossgradient) to the east was also reviewed, but the only VOC detected was one J-flagged (estimated) acetone value and the SVOC bis-(2-ethylhexyl)phthalate, which is not considered sufficiently volatile per the Subsurface Vapor Intrusion Guidance. Therefore, there are no VOC affects to the west of the building. Of these monitoring wells, 1S is the well most affected by VOCs. Of the detected VOCs, only benzene was detected above its target groundwater concentration of 5 ppb in Table 2C of the guidance document. In the upgradient well S-3, benzene has never been detected above 5 ppb. In downgradient well 4S, benzene has not been detected above 5 ppb since June 15, 2004 and the highest benzene concentration detected in this well was 6.39 ppb on August 12, 2003.

This office is located cross-gradient to the plume with VOCs, is not located over the plume and an immediately upgradient well has not had VOCs detected above guidance criteria since the MNA sampling started in 2003. The cross gradient and downgradient wells are only slightly above or are below the EPA guidance criteria. In addition, the Connecticut RSR groundwater criteria for the indoor air pathway were reviewed. None of the VOCs in these wells exceed the Connecticut RSR proposed GWVC criteria for residential or industrial/commercial settings. For benzene, the Connecticut RSR proposed GWVC criteria for residential is 130 ug/l and for industrial/commercial settings it is 310 ug/l. Based on the Site conditions and guidance, the vapor intrusion pathway does not appear to be a concern for the on-Site office building. The groundwater flow direction and data do not suggest this will become an issue in the future, but if a change in the groundwater flow direction occurs or VOCs are detected in the upgradient well, such conditions would warrant further attention. Therefore, no changes in exposure pathways have occurred that would affect the protectiveness of the remedy. A copy of the Vapor Intrusion Pathway Summary Page and tables is included as Appendix D.

7.2.2 Changes in Toxicity, ARARs, and Other Contaminant Characteristics

Changes in Toxicity

(Not applicable). Because all groundwater cleanup goals were established based on the CT RSRs (as the most stringent of the criteria identified in the remedy) which were in turn based on background levels or limits of analytical resolution, there are no changes in toxicity and other contaminant characteristics that would affect the chosen remedy. Furthermore, as the groundwater cleanup levels established in the 2001 ROD are consistent with site specific background levels of contamination, they and the remedy are viewed as being protective of public health consistent with CERCLA expectations for remedial actions,).

Changes in ARARs, Standards, and TBCs (To Be Considered)

Cleanup levels were established in the ROD for groundwater for all chemicals of concern identified in the Baseline Risk Assessment found to pose an unacceptable risk to either public health or the environment. Cleanup levels were set based on the ARARs (*e.g.*, non-zero Drinking Water Maximum Contaminant Level Goals (MCLGs), MCLs, and more stringent State Remediation Standard Regulations), as available. This resulted in groundwater cleanup levels for each chemical of concern being set at its background concentration, per Connecticut RSRs, Section 22a-133k-3(a). A list of tentative background concentrations was presented in the ROD. During the Remedial Action Phase, EPA in consultation with CTDEP will determine whether these concentrations represent background for this Site. EPA will only change these values in the ROD if they are necessary pursuant to Section 117(c) of CERCLA. A process often referred to as an Explanation of Significant Differences.

There is one change that has occurred in the Applicable, Relevant, or Appropriate Requirements (ARARs) and To Be Considereds (TBCs) since the ROD was signed. EPA adopted a lower Maximum Concentration Level (MCL) standard for arsenic in groundwater. This changed the standard from 50 ppb to 10 ppb, which became effective on January 22, 2006. This change in the arsenic MCL is greater than the more restrictive background concentration of 5 ppb as established in the ROD.

Other risk based cleanup goals as presented in the ROD remain substantively unchanged.

7.2.3 Expected Progress Towards Meeting RAOs

Groundwater modeling conducted during the FS (O'Brien & Gere Engineers, Inc. 2001a) estimated that natural attenuation would achieve the groundwater cleanup levels in the overburden in approximately 15.6 years, and in the bedrock aquifer in approximately 6 years. These results were obtained by simulating the flow of groundwater and the migration and attenuation of two COCs, 4-methylphenol and 2-butanone. At the time, these compounds were present in relatively high concentrations in groundwater. Consequently, the cleanup times for these compounds were considered to represent

conservative estimates of the time for remediation of all groundwater COCs. Based on calibration to trends in the groundwater monitoring data through the RI/FS period, rates of contaminant degradation were projected into the future through the process of the model calibration. However, due to uncertainties associated with contaminant transport modeling, the predicted cleanup times were considered rough estimates.

Previous review of historical groundwater quality data (Section 6.3) indicated that the concentrations of Site-related constituents are either remaining relatively stable, or are decreasing over time. Geochemical evidence that indicated subsurface conditions are amenable for microbially-mediated degradation included the following:

- an abundance of dissolved organic carbon that can be used as a carbon source (electron donor) by microbes;
- anaerobic conditions that sustain reductive dechlorination;
- presence of organic compounds that can undergo fermentation reactions (BTEX, ketones) that produce hydrogen, which can be utilized by microbes during reductive dechlorination;
- low concentrations of nitrate that will not suppress the reductive dechlorination pathway;
- low sulfate concentrations within the plume as compared to background, suggesting utilization as an electron acceptor;
- some degree of increased alkalinity in the plume compared to background suggesting that the plume is biologically active;
- decreases in oxidation-reduction potential in the plume as compared to background, suggesting the geochemical conditions within the plume are reducing due to biological activity;
- the presence of methane that suggests highly reducing conditions and microbial degradation; and
- groundwater pH ranges that are suitable for microbial populations.

In 2003, a long-term groundwater-monitoring program was initiated that was designed to assess the progress of natural attenuation over time. Summary results of the last five years of this monitoring program are shown in Tables 4 to 9. These data indicate that the COC concentrations are decreasing with time or are relatively stable. In some cases the decreases are significant, such as the total VOCs have decreased by about 1 order of magnitude (10,000 down to 1,000 ug/L (or 1 ppm)) in well MW-101S, which is located just downgradient of the landfill boundary and is indicated on isoconcentration contour figures. Isoconcentration contour figures for total VOCs and SVOCs and total BTEX are

shown in Figures 5 through 8A for 2003 and 2008 that further indicate the overall decline in concentrations.

With regard to the model for the two COCs, 4-methylphenol and 2-butanone, the sampling results indicate that actual Site conditions are following the general trend of the model predictions, and are generally decreasing in concentration at a greater rate than the model predictions. Graphs of concentration versus time for these two COCs are indicated on Figures 9 to 12. These graphs are presented for wells MW-101S and MW-5S, which represent the more affected monitoring wells located within the centerline of the plume. This graph shows the initial model predictions for the natural attenuation and groundwater extraction alternatives, along with the actual measured concentrations. These graphs indicate that the measured concentrations are lower than the model predictions, and that plume attenuation has exceeded expectations.

Two additional graphs of the centerline of the plume as it passes through the landfill are indicated in Figures 13 and 14 for total VOC and SVOC, total BTEX, and MNA parameters ferrous iron, methane, dissolved oxygen (DO), nitrate and chemical oxygen demand (COD). Figure 13 presents the graph of these data for November 2003, and Figure 14 shows the data for April 2008. These figures indicate low contaminant concentrations in groundwater upgradient of the landfill, increased concentrations in the landfill and declining concentrations downgradient of the landfill. The patterns of indicator parameters are consistent and expected, with DO and nitrate decreasing in the landfill as a result of biological activity, and rebounding downgradient, while the other parameters COD, methane and ferrous iron increase within the landfill footprint and then tend to attenuate downgradient of the landfill. The peak concentrations of most COCs show a marked decrease from 2003 to 2008, consistent with the overall decrease in the concentration of COCs within the plume.

Graphs of groundwater concentration trends with time for the COCs benzene; toluene; 1,4-dichlorobenzene; trichloroethene and 2,4-dimethlyphenol show similar decreasing concentration trends. These graphs are presented in Appendix E. For the COC metals arsenic, chromium and lead, the groundwater concentrations are typically at non-detect concentrations as indicated in Table 5. Higher concentrations are observed in the centerline of the plume starting in the landfill and immediately downgradient, but generally at low concentrations. A graph of the arsenic groundwater concentration trends is also included in Appendix E for the wells where arsenic has consistently been detected.

With regard to the surface water, seep and sediment sampling, the results of this sampling are consistent or lower than that of the post-NTCRA sampling indicating good progress towards meeting the RAO. For post-NTCRA sampling, the ROD indicated an acceptable risk for surface water and seeps and ongoing monitoring for sediment due to an uncertain risk. The uncertain risk was an ecological risk for benthic invertebrates. The ROD also noted that barium and manganese were identified as the only compounds exceeding the probable effects concentration (PEC) benchmark. Since 2003, the start of the post-ROD sampling, higher concentrations of barium and manganese were detected in the upstream sample Sed-3 (located at SW-3). The concentrations of these compounds were lower in

the downstream samples. Typically the middle sample (Sed-16) detected slightly higher barium and manganese concentrations than the downstream sample (Sed-9). As noted in Table 7the PEC concentrations for barium and manganese were exceeded in the upstream sample, the barium PEC was typically slightly exceeded in the mid-stream sample and there was one PEC exceedence for barium in 2007 in the downstream sample. The greater metal concentrations in the upstream sample may suggest a possible local condition with the metals occurring naturally in higher concentrations upstream. The upstream location is undeveloped with no obvious source for metals. The concentration change may also be associated with the relocation of the stream during the NTCRA.

7.3 Questions C: Other information that could call into question the protectiveness of the remedy?

No, there is no information that calls into question the protectiveness of the remedy.

7.4 Technical Assessment Summary

The review of documents, ARARs, risk assumptions, and the results of the Site inspection indicate that the remedy is functioning as intended by the ROD. The exposure assumptions, cleanup levels, and remedial action objectives (RAOs) used at the time of remedy selection remain valid. Some changes in agency-recognized toxicity factors have occurred for selected Site-related chemicals, but these changes have not affected cleanup levels, nor are they expected to significantly affect overall Site risk. Long-term monitoring data indicate that the groundwater plume is shrinking, contaminant concentrations are decreasing or are stable and that acceptable progress is being made towards meeting RAOs.

8.0 ISSUES

As of the date of this writing, there have been no significant problems or issues that prevent the response action from being protective of human health and the environmental upon completion.

9.0 RECOMMENDATIONS AND FOLLOW-UP ACTIONS

There were no issues affecting the protectiveness of the remedy requiring follow-up actions. However, there are recommendations not directly related to the protectiveness of the remedy that are presented here. These recommendation and follow-up actions include improved operation & maintenance (O&M) activities, better laboratory performance and a revised sampling plan to optimize the remedy.

For the O&M activities the focus of this recommendation is associated with the monitoring of the cap and its integrity based on the 2005 downchute failure. As part of the EPA annual inspection, the cap is reviewed. The RRDD uses an engineer to conduct

quarterly landfill inspections for compliance with Connecticut requirements. The RRDD has informed this engineer of the downchute issue to increase the awareness of the downchute conditions in reporting to the RRDD. The RRDD will also notify the EPA of a condition that may affect the integrity of the downchute.

Based on the decreasing size of the plume and COC concentrations, a revised sampling plan to optimize the remedy is recommended. This includes changes in wells to be sampled and the frequency of the sampling. As an example, the plume is now deeper downgradient in the monitoring well couplet MW-111. Currently, MNA parameters are sampled in the shallow well MW-111S and MW-111B; however, there are increased contaminant concentrations in the deeper well MW-111I (intermediate bedrock), which is not monitored for MNA parameters. Therefore, it is recommended that MW-111S no longer be monitored for MNA parameters, but well MW-111I will have the MNA parameters added to its suite of analyses.

Refer to Table 12 for a complete listing of recommended changes to sampling locations, rationale and frequency to optimize the remedy.

10.0 PROTECTIVENESS STATEMENT

This five-year review has found that the remedy is functioning as designed. The groundwater remedy is expected to be protective of human health and the environmental upon completion, when groundwater cleanup goals are achieved through MNA, which was estimated in the Remedial Investigation and Feasibility Study (RI/FS) to occur in about 16 years. In the interim, exposure pathways that could result in unacceptable risks are being controlled and institutional controls are preventing exposure to, or the ingestion of, contaminated groundwater. Long-term protectiveness of the remedial action will be verified by obtaining additional groundwater samples to evaluate the contaminant plume extent and MNA progress. Because the Remedial Action at all OUs are protective, the Site is protective of human health and the environment.

11.0 NEXT REVIEW

The due date for the second five-year review is September 2013.

REFERENCES

Fuss & O'Neill 1992. RRDD#1 Landfill Closure Plan, Barkhamsted CT, September.

O'Brien & Gere Engineers, Inc. 1996. Remedial Investigation (RI) -Barkhamsted-New Hartford Landfill Superfund Site. February.

O'Brien & Gere Engineers, Inc. 1997. Remedial Action Plan for Non-Time Critical Removal Action, Barkhamsted-New Hartford Landfill Superfund Site.

O'Brien & Gere Engineers, Inc. 2001a. Feasibility Study-Barkhamsted-New Hartford Landfill Superfund Site. June.

O'Brien & Gere Engineers, Inc. 2001b. Operation and Maintenance manual-Barkhamsted Landfill Pleasant Valley, Connecticut Landfill Closure. October.

State of Connecticut Department of Environmental Protection 1990. Consent Order #SRD-072 between the State of Connecticut and the Regional Refuse Disposal District No. 1.

United States Environmental Protection Agency (U.S. EPA) 1991. Administrative Order on Consent. Docket #I-91 –1128 between the EPA, the State of Connecticut, and the PRP Group. October 4.

United States Environmental Protection Agency (U.S. EPA) 2001a. Comprehensive Five-Year Review Guidance. June.

United States Environmental Protection Agency (U.S. EPA) 2001b. EPA Superfund Record of Decision: Barkhamsted – New Hartford Landfill, EPA ID: CTD980732333, OU1, Barkhamsted, CT. EPA/OD/R01-01/001, September 28.

United States of America and State of Connecticut *v.* Regional Refuse Disposal District No. 1, et al. 2003. Consent Decree, U.S. District Court for the District of Connecticut. May 7.

United States Environmental Protection Agency (U.S. EPA): OSWER Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils (Subsurface Vapor Intrusion Guidance), dated November 2002, EPA530-D-02-004.

State of Connecticut Department of Environmental Protection: Draft Proposed Revisions to the Remediation Standard Regulations (RSR).

Appendices for this Five-Year Review are available by placing a request using the Customized CERCLIS/RODS Report Order Form.

http://www.epa.gov/superfund/sites/phonefax/rods.htm