Second Five-Year Review Report
Addendum
Brewster Well Field Site
Village of Brewster
Putnam County, New York

Prepared by:

United States Environmental Protection Agency
Region 2
New York, New York

September 2009

EXECUTIVE SUMMARY

The second five-year review for the Brewster Well Field Superfund site, which was completed in April 2007, raised concerns about vapor intrusion at two automobile dealerships, potential residual source material underneath one of the dealership buildings, groundwater plume capture, and the overall performance of the modified groundwater management system. As a consequence of these concerns, a protectiveness determination for the site could not be made until additional information was obtained.

Based upon the collection and assessment of additional data, it has been concluded that the implemented remedial actions protect human health and the environment in the short term. Currently, there are no exposure pathways that could result in unacceptable risks. In order for the remedy to be protective in the long term, additional data need to be collected to ensure that the groundwater management system is effectively capturing the groundwater plume and that the enhanced subslab mitigation system is addressing the residual source material underneath the dealership building.

I. Introduction

A five-year review addendum is generally completed for remedies where a protectiveness determination is deferred until additional information can be obtained.

The Brewster Well Field Superfund site is being addressed in two phases, focusing on controlling the source of contamination and the clean up of the groundwater[1]. Operable Unit 1, which involves groundwater extraction and treatment, has been constructed and is currently operating. Operable Unit 2, which addressed the source of the groundwater contamination, has been completed. The second five-year review, which was completed on April 18, 2007, evaluated both operable units.

The second five-year review raised concerns about vapor intrusion potentially impacting indoor air at the Smith-Cairns Subaru dealership (formerly Alben Dry Cleaners, where the contaminant source was located) and the nearby Brady Stannard Chevrolet dealership, potential residual source material underneath the Subaru dealership building, groundwater plume capture, and the overall performance of the modified groundwater management system (GMS). As a consequence of these concerns, a protectiveness determination for the site could not be made until additional information was obtained.

This document presents information obtained since the five-year review and presents a site-wide protectiveness statement.

II. Progress Since Five-Year Review Completion

The recommendations and follow-up actions from the 2007 five-year review (see columns one and two of Table 1, attached, hereto) raised concerns about vapor intrusion potentially impacting indoor air at the Subaru and Chevrolet dealerships, potential residual source material underneath the Subaru dealership building, groundwater plume capture, and the overall performance of the modified GMS. As a consequence of these concerns, a protectiveness determination for the site could not be made until additional information was obtained.

Vapor Intrusion

In May 2006, soil gas samples were collected beneath the slab of the Subaru dealership building, beneath the asphalt pavement in the car lot, and north of the dealership and Route 202 in the car lot of the Chevrolet dealership. The sample results showed elevated volatile organic compound (VOC) concentrations beneath the slab of the Subaru dealership building. Because of concerns that vapors could be impacting indoor air at the Subaru dealership, a subslab mitigation system was installed in January 2007. Although soil gas concentrations from around the Chevrolet dealership building were not elevated, VOC concentrations in the underlying groundwater suggested that the vapor intrusion

---

[1] The primary contaminants in the soil and groundwater are tetrachloroethylene (PCE) and its reductive dehalogenation daughter products, trichloroethylene (TCE), 1,2-dichloroethylene (1,2-DCE), and vinyl chloride.

pathway should be investigated at this building, as well.

The second five-year review for the site was completed in April 2007. This review raised concerns that vapor intrusion could still potentially be impacting indoor air at the Subaru dealership and could be impacting the Chevrolet dealership. To address these concerns, in May and November 2007, indoor air and subslab samples were collected at the Subaru and Chevrolet dealership buildings. Based upon the results of the sampling, it was determined that the indoor air concentrations at the Chevrolet dealership were in the acceptable range. Therefore, vapor intrusion at this building does not pose a concern. The indoor air sample results for the Subaru dealership building, however, still showed elevated VOC concentrations. To address the indoor air problem at the Subaru dealership building, the mitigation system was enhanced in March 2008 so that it could target the residual source material (see the "Residual Source Material" section, below). Subsequent testing determined that the building subslab is under a negative vacuum. Hence, there should be no subslab source contributing to indoor air in the building.

In February 2009, indoor air samples were collected from the Chevrolet dealership building and subslab and indoor air samples were collected from the Subaru dealership building. The sample results for the Chevrolet dealership building confirmed the November 2007 results (*i.e.*, that the indoor air concentrations at the Chevrolet dealership building are in the acceptable range). The results showed that the Subaru dealership building's subslab concentrations have been substantially reduced since the installation of the mitigation system. While the majority of the indoor air concentrations are in or near the acceptable range, slightly elevated indoor air levels remain in a few samples collected from the "parts storage room." Considering the fact that the building subslab is under a negative vacuum and based upon an inventory of the products being used at the dealership, it appears that these products and/or the automobiles in the showroom are the source of the indoor air concentrations. Determining whether these products or the automobiles in the showroom are the source of the indoor air problem would likely seriously disrupt the business (they would have to be removed from the building). In a June 18, 2009 letter to the Subaru dealership, EPA suggested increasing ventilation in the building and using alternative products to the extent practicable to reduce the concentrations in the indoor air.

Residual Source Material

In January 2009, a soil investigation beneath the Subaru dealership building was performed to determine if residual soil contamination is present. The findings of this investigation indicate that high levels of VOC[2] are present in the soil at a depth of five feet beneath the parts storage room. The volume of the soil contamination appears to be fairly small. Although the removal of the soil was considered, since this would significantly disrupt the dealership's business and could potentially impact the structural integrity of the building, the subslab mitigation system was enhanced with a

---

[2] The maximum concentrations of the contaminants of concern that were detected were 95,000 micrograms per kilogram (µg/kg) PCE, 29 µg/kg TCE, 9.7 µg/kg 1,2-DCE, and 6.2 µg/kg vinyl chloride.

greater capacity blower and additional piping so that it could target the residual source material [3]. It is estimated that the enhanced subslab mitigation system will reduce the residual source material to 4 milligrams per kilogram PCE (the soil cleanup objective called for in the 1988 ROD) in one year. No additional actions are recommended.

To prevent the potential exposure to the contaminated soils and groundwater and to prevent any actions which might adversely impact the remedy, the Town of Southeast Planning Board was notified via a March 19, 2007 letter that EPA should be contacted prior to the approval of any construction on the Subaru dealership property. A similar letter was sent to the Subaru dealership on June 18, 2009. On July 29, 2009, a letter was sent to the Town of Southeast Planning Board requesting that EPA be contacted prior to the approval of any construction on the dealership property and to be informed of any planned future development in the general vicinity of the site[4]. Periodic written reminders will be issued to the planning board and the automobile dealership. These actions constitute an "informational device" institutional control[5]. In addition, on an annual basis, the site will be inspected to determine whether any intrusive activities have been performed at the site (*i.e.*, at the Subaru dealership).

Evaluation of Groundwater Plume Capture and Performance of Modified Groundwater Management System

To improve the capture of the contaminated groundwater, two new extraction wells and one combination monitoring and extraction well were installed in the source area. Additionally, one

---

[3] The enhanced subslab mitigation system draws air from beneath the subslab, capturing volatilized organics from beneath the subslab and volatilizing and capturing the VOCs from the soil. The collected vapors are vented to the atmosphere consistent with the requirements of the New York State Department of Environmental Conservation's DAR-1 Guidelines for the Control of Toxic Ambient Air Contaminants (1997).

[4] During a September 10, 2009 telephone conversation between Lisa Wong of EPA and Laurie Fricchione, Secretary for the Town of Southeast Planning Board, Ms. Fricchione confirmed that the July 29, 2009 letter was filed in the Town Planning Board's office and that EPA will be notified of any planned construction or development on the dealership property and in the general vicinity of the site.

[5] It was the intention of the 1986 and 1988 RODs that the soil and groundwater be remediated to levels that would allow for unlimited use without restriction. The 1988 ROD selected the removal of the contaminated drywell and soil adjacent to Alben Cleaners, which was considered to be the source. At the time of the decisions documents, since there did not appear to be significant risk to human health that would exist during the groundwater remediation period, institutional controls were not selected as part of the final site remedy and were not found to be necessary during the period of groundwater remediation. Since the finalization of the RODs, issues concerning institutional controls have been identified at the site. An Explanation of Significant Differences will document the incorporation of the institutional controls to the remedy.

multipoint air sparge well was installed immediately upgradient of the source area to provide a possible enhancement to the groundwater remedy. An air sparging pilot study is currently underway. Also, since the air stripper was found to be nearing the end of its useful life, it was replaced. The modified GMS became operational in fall 2007.

Groundwater data were collected in spring 2008 and GMS operational data were collected throughout 2008. Although only limited data have been collected, it is believed that the modified GMS is addressing the groundwater plume. To fully assess whether the system is capturing the groundwater plume and to evaluate system performance, the above-noted data will need to be reviewed in conjunction with future groundwater contaminant concentration and GMS operational data. In order for the remedy to be protective in the long-term, additional groundwater contaminant concentration and GMS operational data need to be collected to ensure that GMS is effectively capturing the groundwater plume.

III. Issues and Recommendations

The status of the issues and recommendations from the 2007 five-year review can be found in the third column of Table 1. No new issues or recommendations have been identified since the completion of the second five-year review.

IV. Protectiveness Statement

Based on the new information and actions taken since the second five-year review's completion date, the protectiveness statement for both operable units is being revised as follows:

The implemented remedial actions protect human health and the environment in the short term. Currently, there are no exposure pathways that could result in unacceptable risks from site-related contaminants. The exposure pathways that could result in unacceptable risks at the Smith-Cairns Subaru dealership are being addressed by the enhanced subslab mitigation system. The system will periodically be inspected to ensure that it continues to be effective. The groundwater plume is being addressed through extraction and treatment to reduce the levels of contamination to appropriate federal standards. Although a municipal water supply well is being impacted by the plume, the water supply is being treated. In order for the remedy to be protective in the long term, additional data needs to be collected to ensure that the GMS is effectively capturing the groundwater plume and that the enhanced subslab mitigation system is addressing the contaminated soil.

IV. Next Review

The next five-year review for the Brewster Well Field Superfund site is required by April 2012, five years from the original second five-year review report's approval date.

Approved:

Walter E. Mugdan, Director
Emergency and Remedial Response Division

9/22/09
Date

Table 1: Status of Recommendations and Follow-Up Actions From 2007 Five-Year Review				
Issue	**Recommendations and Follow-Up Actions**	**Status of Recommendations and Follow-Up Actions**	**Affects Protectiveness (Y/N)**	
			Current	**Future**
Recent soil gas samples suggest that residual source material may be present underneath the Subaru dealership building.	An investigation into the extent, source, and characteristics of any soil contamination that could be a remaining source of groundwater contamination is necessary.	Investigation into source completed in January 2009. A source was detected underneath the Subaru dealership building.	N	N
If a site-related source is located underneath the Subaru dealership building.	An assessment of feasible options, including institutional controls, may be necessary.	A source was detected underneath the Subaru dealership building. It is being addressed by the mitigation system. To prevent the potential exposure to the contaminated soils and groundwater and to prevent any actions which might adversely impact the remedy, the Town of Southeast Planning Board was notified via a March 19, 2007 letter that EPA should be contacted prior to the approval of any construction on the Subaru dealership property. A similar letter was sent to the Subaru dealership on June 18, 2009. On July 29, 2009, a letter was sent to the Town of Southeast Planning Board and the Village of Brewster Planning and Zoning Boards requesting that EPA be contacted prior to the approval of any construction on the dealership property and to be informed of any planned future development in the general vicinity of the site. Periodic written reminders will be issued to the planning and zoning boards and the automobile dealership. These actions constitute an "informational device" institutional control.	N	N

Issue	Recommendations and Follow-Up Actions	Status of Recommendations and Follow-Up Actions	Affects Protectiveness (Y/N)	
			Current	Future
Need to further assess the vapor intrusion pathway at the Subaru dealership building and the Brady Stannard Chevrolet dealership.	The property owners should be contacted and requested to inform EPA and New York State Department of Environmental Conservation of any potential changes at the site and the building use over the next five years. Based on anticipated uses, additional subslab and indoor air monitoring may be appropriate, as well as indoor air ventilation.	In February 2009, indoor air samples were collected from the Chevrolet dealership building and subslab and indoor air samples were collected from the Subaru dealership building. The sample results showed that the indoor air concentrations at the Chevrolet dealership building are in the acceptable range. The results showed that the Subaru dealership building's subslab concentrations have been substantially reduced since the installation of the mitigation system. While the majority of the indoor air concentrations are in or near the acceptable range, slightly elevated indoor air levels remain in a few samples collected from the parts storage room. Considering the fact that the building subslab is under a negative vacuum and based upon an inventory of the products being used at the dealership, it appears that these products and/or the automobiles in the showroom are the source of the indoor air concentrations. Determining whether these products or the automobiles in the showroom are the source of the indoor air problem would likely seriously disrupt the business (they would have to be removed from the building). In a June 18, 2009 letter to the Subaru dealership, EPA suggested increasing ventilation in the building and using alternative products to the extent practicable to reduce the concentrations in the indoor air.	N	N
Need to evaluate the performance of the modified groundwater management system (GMS) in response to the optimization efforts.	Groundwater modeling and capture zone analysis update after completion of soil investigations and GMS optimization modifications (*i.e.*, new extraction wells connection to the GMS and air sparging pilot study) and availability of new operational data and subsequent sampling data.	New extraction wells connection to the GMS and air sparging pilot study underway. Groundwater data were collected in spring 2008 and GMS operational data were collected throughout 2008. To assess whether the system is capturing the groundwater plume and to evaluate system performance, these data will need to be reviewed in conjunction with future groundwater and GMS operational data.	N	N

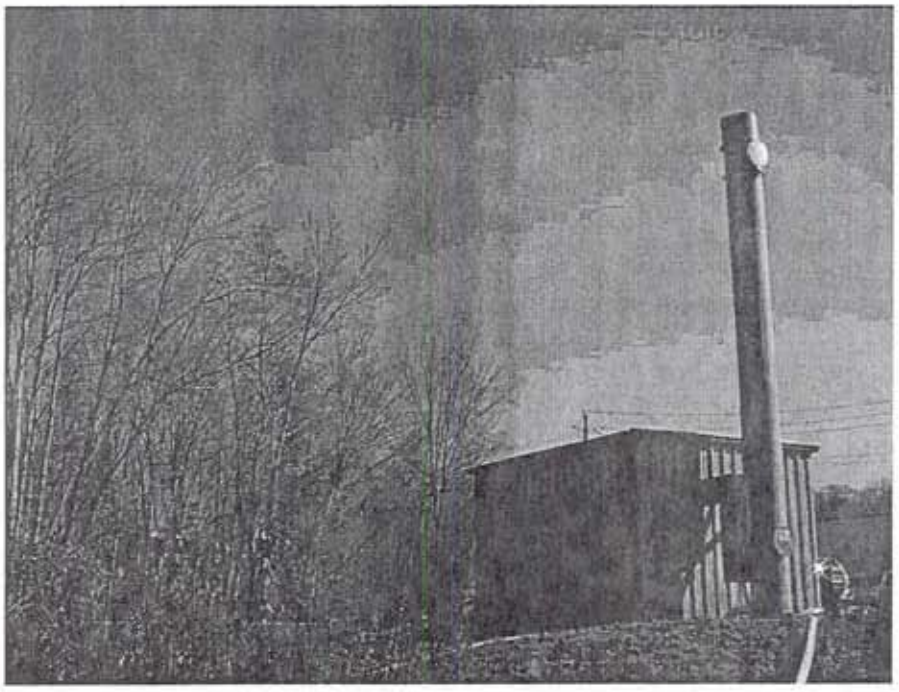
Issue	Recommendations and Follow-Up Actions	Status of Recommendations and Follow-Up Actions	Affects Protectiveness (Y/N)	
			Current	Future
Pending the outcome of soil source investigations and groundwater modeling, further adjustments in the groundwater remedy may be appropriate.	Final adjustments in the groundwater remedy should be taken prior to the transfer of the remedy to the state.	The GMS was transferred to the State in October 2007. Based upon the groundwater modeling, further adjustments may be necessary.	N	N
This report contains a number of concerns which should be addressed prior to the transfer of the GMS to the State.	A status update of the suggestions and recommendations in this report should be prepared.	Concerns were addressed prior to the transfer to the State in October 2007.	N	N

Five-Year Review Report
Brewster Well Field Site
Village of Brewster
Putnam County, New York

Prepared by:

United States Environmental Protection Agency
Region 2
New York, New York

April 2007



EXECUTIVE SUMMARY

This is the second five-year review for the Brewster Well Field Superfund site. The site is located on the northern bank of the East Branch Croton River, approximately ¾ mile east of the Village of Brewster, Town of Southeast, Putnam County, New York. Currently, the remedy is protecting human health and the environment. This review has, however, raised several concerns. There is a concern about vapor intrusion potentially impacting indoor air at the Smith-Cairns Subaru dealership (formerly Alben Dry Cleaners, where the contaminant source was located) and the nearby Brady Stannard Chevrolet dealership. Based upon subslab vapor concentrations, a subslab mitigation system was installed at the Subaru dealership. Recommendations contained in this report, if carried out, will determine whether there is any exposure and indicate if any additional actions are needed. A second concern is that the soil gas samples from beneath the Subaru dealership building suggests that residual source material may be present underneath the building. Further investigation concerning potential source material, its source and its effect on the selected remedy are necessary. The last concern is that the groundwater plume capture and the overall performance of the modified groundwater management system needs to be reevaluated. As a consequence of these concerns, a protectiveness determination for this site cannot be made until additional information is obtained. It is expected that a report addendum containing a protectiveness statement will be issued within one year of the date of this report.

Five-Year Review Summary Form

SITE IDENTIFICATION

Site name *(from WasteLAN)*: Brewster Well field

EPA ID *(from WasteLAN)*: NYD980652275

Region: 2	**State:** NY	**City/County:** Brewster/Putnam

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:** 04/11/1997

Has site been put into reuse? ☐ YES ☐ NO ■ N/A (site involves groundwater plume and not real property)

REVIEW STATUS

Lead agency: ■ EPA ☐ State ☐ Tribe ☐ Other Federal Agency _____

Author name: Lisa Wong

Author title: Remedial Project Manager	**Author affiliation:** EPA

Review period:** 04/12/2002 to 04/18/2007

Date(s) of site inspection: 02/28/2007

Type of review:

☐ Post-SARA ☐ Pre-SARA ☐ NPL-Removal only
☐ Non-NPL Remedial Action Site ☐ NPL State/Tribe-lead
☐ Regional Discretion ■ Policy ☐ Statutory

Review number: ☐ 1 (first) ■ 2 (second) ☐ 3 (third) ☐ Other (specify) _____

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)*: 04/18/2002

Due date *(five years after triggering action date)*: 04/18/2007

Does the report include recommendation(s) and follow-up action(s)? ■ yes ☐ no

Acres in use or suitable for use: **restricted:** 15 **unrestricted:** 15

* ["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 (continued)

Other Comments on Operation, Maintenance, Monitoring, and Institutional Controls

This site has ongoing operation, maintenance, and monitoring activities as part of the selected remedy. As was anticipated by the decision documents, these activities are subject to routine modification and adjustment. Prior to the transfer to the State for operation and maintenance (O&M) of the long-term response action in October 2007, several activities are necessary. EPA should make any necessary modifications and adjustments to the remedy. These modifications and adjustments may depend on the resolution of some of the issues discussed below. Lastly, the O&M Manual will need to be updated to address changes based on modifications and adjustments, as well as any state requirements.

New York State now requires annual certification that remedy-related O&M is being performed. On an annual basis, the site will need to be inspected to determine whether any intrusive activities have been performed at the Smith-Cairns Subaru dealership or whether there is any new residential development. The annual O&M report should include a summary of the findings of the above-noted activities along with a certification that the remedy-related O&M is being performed.

Issues, Recommendations, and Follow-Up Actions

This review has raised several concerns along with recommendations for appropriate follow-up actions. One concern is that vapor intrusion could potentially be impacting indoor air at the Smith-Cairns Subaru dealership (formerly Alben Dry Cleaners, where the contaminant source was located) and the nearby Brady Stannard Chevrolet dealership. Based upon subslab vapor concentrations, a subslab mitigation system was installed at the Subaru dealership. Recommendations contained in this report, if carried out, will determine whether there is any exposure and indicate if any additional activities or actions are needed. A second concern is that the soil gas samples from beneath the Subaru dealership building suggest that residual source material may be present underneath the building. Further investigation concerning potential source material and its effect on the selected remedy are necessary. Another concern is that the groundwater plume capture and the overall performance of the modified groundwater management system need to be reevaluated. The final concern is for an orderly transfer of O&M to the State.

Protectiveness Statement

A protectiveness determination for this site cannot be made until additional information is obtained. It is expected that a report addendum containing a protectiveness statement will be issued within one year of the date of this report.

I. Introduction

This five-year review for the Brewster Well Field site, located on the northern bank of the East Branch Croton River, approximately ¾ mile east of the Village of Brewster, Town of Southeast, Putnam County, New York, was conducted by United States Environmental Protection Agency (EPA) Remedial Project Manager (RPM) Lisa Wong. The review was conducted in accordance with the Comprehensive Five-Year Review Guidance, OSWER Directive 9355.7-03B-P (June 2001)(the five-year review guidance). The purpose of five-year reviews is to ensure that implemented remedies protect public health and the environment and that they function as intended by the site decision documents. This report will become part of the site file.

In accordance with Section 1.3.2 of the five-year review guidance, a policy five-year review is triggered by the signature date of the preliminary close-out report (PCOR). The trigger for the first five-year review was April 11, 1997, the approval date of the PCOR. In accordance with the Section 1.3.3 of the five-year review guidance, a subsequent five-year review is triggered by the signature date of the last review (April 18, 2002). This second five-year review provides background information, covers the site history, discusses past data-collection efforts along with information collected in the past five years, reevaluates risk and remedy protectiveness based on updated assumptions, and makes recommendations for follow-up actions.

This site is being addressed in two phases, focusing on controlling the source of contamination and the clean up of the groundwater. Operable Unit 1 (OU1), which involves groundwater extraction and treatment, has been constructed and is currently operating. Operable Unit 2 (OU2), which addressed the source of the groundwater contamination, has been completed. This five-year review evaluated both operable units and found that, currently, the implemented remedy protects human health and the environment.

II. Site Chronology

Table 1 (attached) summarizes the site-related events from discovery to the present.

III. Background

Site Location

The 30-acre Brewster Well Field site is located on the northern bank of the East Branch Croton River, approximately ¾ mile east of the Village of Brewster, Town of Southeast, Putnam County, New York (see Figure 1, attached). The site is approximately 3 miles west of the Connecticut/New York border and approximately 47 miles north of New York City. Interstate 84 passes just to the west of the site.

Physical Characteristics

The area has a relief of over 500 feet in elevation from the valley floor to hilltops. Low areas north and south of the East Branch Croton River are classified as wetlands. Surface waters located adjacent to the site are classified as suitable as a drinking water supply and designated as suitable for trout.

Geology/Hydrogeology

The subsurface geology of the area is highly varied, giving rise to an extremely complex subsurface hydrogeology. Groundwater throughout the area may be found in both the bedrock and unconsolidated glacial sediments. Unconsolidated deposits range in thickness from a minimum of 25 feet to a maximum of 95 feet. Results of groundwater modeling and aquifer tests indicate contaminated groundwater south of the River is in hydraulic connection with waters being withdrawn from the Brewster Well Field for Village use.

Horizontal hydraulic conductivity tests revealed that the glacial till acts as an aquitard impeding migration from unconsolidated sediments into the underlying bedrock.

Land and Resource Use

The Village of Brewster is the residential community located nearest to the site. The land to the north of the site is the community of Brewster Hill. This area is largely residential, with some agricultural use. Most of the land south of the site is occupied by commercial or light industrial facilities.

A municipal water system serves the Village of Brewster, several areas in the Town of Southeast, and several business establishments and the Consolidated Rail Corporation's Putnam Junction Rail Yard. The Village of Brewster accounts for 2,200 residential users.

The East Branch Croton River flows adjacent to the site. Three thousand feet to the east of the site, the river is impounded to form the East Branch Reservoir, part of New York City's Croton watershed reservoir system. Three thousand feet from the site to the northeast, Bog Brook, a tributary to the East Branch Croton River, is impounded to form Bog Brook Reservoir, also owned by New York City. The river also contributes to the Croton Falls Reservoir, located approximately 3.5 miles downstream from the site.

General land use and drinking water sources in the vicinity of the site have not changed since the signing of the groundwater and source control Records of Decision (RODs).

History of Contamination

The Brewster Well Field was found to be contaminated with volatile organic compounds (VOCs), primarily perchloroethylene (PCE), trichloroethylene (TCE), and 1,2-dichloroethylene (DCE) in 1978. Investigations found that the source of contamination was a dry well used for disposing of

dry-cleaning wastes at Alben Dry Cleaners. The dry well had been used by the dry cleaners from the initial operation in 1965 until 1983.

Initial Response

From 1978 to 1984, the Village of Brewster used several drilling, blending, and pumping strategies to keep contaminant levels down. Under a cooperative agreement with EPA, the Village installed a full-scale air stripper in 1984, which is currently providing safe drinking water to the Village.

The site was placed on the National Priorities List of Superfund sites in December 1982.

Basis for Taking Action

From 1984 to 1986, through a cooperative agreement between the New York State Department of Conservation (NYSDEC) and EPA, NYSDEC's consultant, GHR Engineering Associates, performed a remedial investigation and feasibility study (RI/FS) to determine the nature and extent of the groundwater contamination, and to evaluate cleanup alternatives at the site. The RI concluded that the primary contaminants found in the groundwater are PCE, TCE, and 1,2-DCE, and that a plume of contamination was found to extend from the vicinity of Alben Dry Cleaners, a local dry-cleaning establishment, to the well field.

In 1988, a source control RI/FS was completed by EPA's contractor, Ebasco Services, Inc. (Ebasco). The RI concluded that a dry well located adjacent to Alben Dry Cleaners was the source of the contamination present at the well field.

IV. Remedial Actions

Remedy Selection

On September 30, 1986, a ROD was signed to address the groundwater. The selected remedy includes continuing to operate the existing air stripping system at the well field in order to continue to provide a safe and reliable water supply. The remedy also included the design and construction of a groundwater management system (GMS) to contain the groundwater contaminant plume and to restore groundwater quality south of the Croton River. The GMS was to consist of four extraction wells, treatment of the extracted groundwater by air stripping, and reinjection of the treated groundwater into eight reinjection wells. After it was constructed, due to operational difficulties related to the reinjection system, the remedy was modified via an Explanation of Significant Differences (ESD) in December 1996. The ESD changed the final disposition of the treated groundwater from reinjection to surface water discharge. The ESD also called for the monitoring of nearby wetlands and floodplains to determine whether not reinjecting the treated groundwater would have an adverse impact on them.

On September 29, 1988, a source control ROD was signed, which called for the excavation, removal, and off-site incineration of the contents of the dry well and the surrounding contaminated soils. The

primary objectives for this action were to ensure the viability of the GMS by removing any continuing source of contamination and minimize any potential risks associated with direct contact of contaminated soils.

Remedy Implementation

Groundwater

A packed tower air stripper was installed in 1984 to provide treatment of the Village of Brewster water supply.

The remedial design (RD) related to the GMS was initiated by Ebasco in December 1987. The plans and specifications for the GMS were completed in April 1989.

Ebasco awarded a remedial action (RA) contract to YWC, Inc. to construct the GMS on October 13, 1989; the construction was completed in March 1991. The GMS consists of four extraction wells (EW-1, EW-2, EW-3, and EW-4)[1] screened from approximately 20 to 32 ft below ground surface and having Goulds submersible pumps. The combined flow from the four extraction wells was designed to be 45 to 50 gallons per minute (gpm).

Water is pumped from the four extraction wells to the top of an air stripper. The stripper tower is a Hydro Group 30-inch diameter, packed tower and is filled with 25 feet of one-inch Norton plastic intalox saddles. Air to the air stripper is provided by two parallel belt-driven centrifugal blowers located inside the treatment building. The system was originally designed such that treated water would be reinjected through a series of wells, cross-gradient from the extraction wells. The intended purpose was to promote flushing of the impacted portion of the aquifer. The groundwater extraction and reinjection scenario was to create a flushing cycle between the extraction and injection wells through the center of the contaminant plume to remove additional mass adsorbed on soil particles. The RI surmised that clean up standards could be achieved south of the river in 10 years.

During the 90-day remedy shakedown, three of the four extraction wells were found not to be yielding sufficient volumes of water and the eight injection wells were not accepting sufficient volumes of water. In an attempt to rectify the operational problems, two new extraction wells were installed, two extraction wells were abandoned, and corrective actions for the third well were taken. The injection wells and new extraction wells were then redeveloped. During restart-up of the GMS, however, it was unable to process water consistent with the designed performance criteria.

In 1993, in an attempt to attain an operational and functional GMS, the U.S. Army Corps of Engineers (USACE), under an interagency agreement with EPA, commenced the redevelopment of the existing injection wells, the testing of the GMS, and the installation, development, and the testing of four new injection wells. During the performance of the injection well redevelopment field work, the USACE found buildup of fine materials and carbonate/metal oxide precipitates on the well

---

[1] Figure 2 shows the locations of the monitoring and extraction wells on the site.

casings, possibly due to the high dissolved solids/hardness content of the groundwater and resultant oxygenation of the water through the air stripping process. Subsequently, all of the injection wells were redeveloped and acid-cleaned.

From 1994 to 1995, the USACE performed a pH adjustment field study and Malcolm Pirnie, Inc. (Malcolm Pirnie), the USACE's contractor, performed a softener/chelating agents/polymers addition bench-scale treatability study. The findings of these studies indicated that while these water treatment alternatives were viable, they were extremely expensive. Subsequently, an evaluation of the viability of discharging the air-stripped water to the Croton River, in lieu of reinjecting it on-site, was performed by Malcolm Pirnie. Based on the findings of this investigation, surface water discharge was determined to be the optimal alternative to reinjection[2].

Construction of a 150-foot, 4-inch, underground discharge pipe and outfall system for the GMS was completed in September 1996, and the GMS was restarted in October 1996. In April 1997, following a joint EPA/NYSDEC final inspection which confirmed that major punch list items were resolved, the system became fully operational. The treated effluent is allowed to flow via gravity down to a gabion outfall structure at the river. The GMS is required to treat contaminated groundwater to groundwater standards and applicable state surface water discharge criteria. Additionally, as part of the long-term performance monitoring of the GMS, potential wetland and flood plain related impacts associated with the surface water discharge are to be evaluated on an annual basis.

In late 2001, a Remedial System Evaluation (RSE)[3] was conducted at the site. The results were presented in a 2002 report[4].

---

2 The modification to the selected remedy (*i.e.*, changing the final disposition of the treated groundwater from reinjection to surface water discharge) was documented in an ESD, which was issued in December 1996.

3 In *OSWER Directive No. 9200.0-33, Transmittal of Final FY00 - FY01 Superfund Reforms Strategy, dated July 7,2000*, the Office of Solid Waste and Emergency Response outlined a commitment to optimize Fund-lead groundwater extraction and treatment systems. To fulfill this commitment, the EPA Technology Innovation Office (TIO) and Office of Emergency and Remedial Response, through a nationwide project, assists the ten EPA Regions in evaluating their Fund-lead groundwater extraction and treatment systems. The site evaluations are conducted by EPA-TIO contractors, GeoTrans, Inc. and the USACE, using a process called RSE, which was developed by the USACE. The RSE process is meant to evaluate performance and effectiveness, identify cost savings through changes in operation and technology, assure clear and realistic remediation goals and an exit strategy, and verify adequate maintenance of Government-owned equipment. The Brewster Well Field site was chosen to receive an RSE based on an initial screening of the groundwater extraction and treatment systems managed by EPA Region 2.

4 Remedial System Evaluation, Brewster Well Field Superfund Site, Brewster, New York, Final Report, April 2002

The Applicable or Relevant and Appropriate Requirements for groundwater cleanup include EPA's Maximum Contaminant Levels (MCLs) and New York State's groundwater quality standards. The action level established for TCE at the site is 5 micrograms per liter[5] (µg/l). Based on the analytical results associated with the GMS influent and effluent sampling, it has been concluded that the GMS is effectively treating the VOC-contaminated water to concentrations meeting the action levels and is complying with the State Pollutant Discharge Elimination System (SPDES) surface water discharge criteria.

Source Control

The source control RD was initiated by Ebasco in October 1988. The plans and specifications related to the removal of the dry well were completed in August 1990. Ebasco awarded an RA contract to GSX Services, Inc. to implement the RD in April 1991.

In August 1991, the drywell was excavated and confirmation sampling at the excavation limits was performed. Eight truckloads (approximately 20 tons each) of contaminated sediments and soils were removed. The excavation, which was accomplished using sheet piles, was completed down to 15 feet below the ground surface to the water table. Final confirmation samples showed that the target cleanup goal of 4 mg/kg for PCE in the unsaturated zone was accomplished[6]. Therefore, the remediation of the source of contamination has reduced contamination of the soils in the unsaturated zone to acceptable health-based levels. Residual soil contamination in the saturated zone is being addressed as part of the contamination plume by the GMS.

Institutional Controls Implementation

It is the intention of the decision documents that the soil and groundwater be remediated to levels that would allow for unlimited use without restriction. At the time of the decisions documents, there did not appear to be any significant risk to human health that would exist during the groundwater remediation period and no institutional controls were selected as part of the final site remedy or were found to be necessary during the period of groundwater remediation. Nevertheless, EPA acknowledges that a municipal water system serves the area. In addition, new wells cannot be installed without prior approval by the County Health Department, thereby preventing the installation of new wells in the contaminated plume. There are three private water supply wells located downgradient of the source area. Two of these wells are located outside of the current plume area and the other well is screened below the plume. Since treatment of the water extracted from these wells is required by the Putnam County Department of Heath, these wells are protected.

In this review, several concerns have been raised about the performance of the remedy. Specifically, soil gas samples from beneath the Subaru dealership building suggest that additional source material

---

5 Proposed MCL at the time of ROD issuance.

6 Based on a risk assessment performed as part of the source control RI/FS, it was determined that soils containing less than 4 mg/kg of PCE would present excess carcinogenic risks of no more than $1x10^{-6}$, falling within EPA's target risk range of 10^{-4} to10^{-6}.

may be present underneath the building. Depending upon the results of further investigation concerning the potential source material and its effect on the selected remedy, institutional controls may be necessary.

System Operations/Operation and Maintenance/Monitoring

Since April 1997, the GMS has operated at a pumping rate of approximately 50 gpm.

Extraction and monitoring well integrity inspections and maintenance are performed on a regular basis.

In November 2005, extraction well EW-4 became non-functional due to an electrical motor control circuit fault (burnt breaker switch) and pump motor failure. Since this well was pumping water with low VOC concentrations, the failed pump motor was not replaced and the well was taken off-line.

The groundwater monitoring system includes monitoring wells installed in the shallow, intermediate, and deep zones in the aquifer, as well as extraction wells and former injection wells. Historically, the depth of contamination has been detected down to the intermediate zone. Since 2002, groundwater monitoring has been conducted on a quarterly basis in approximately eight shallow and intermediate wells. In addition, a more comprehensive sampling effort, consisting of 16 shallow and intermediate monitoring wells, took place annually.

Monitoring wells DGC-11I and DGC-17I became non-functional as a result of frost damage. Since these wells were subsequently determined to not be needed for the current monitoring/sampling program, repairs to these wells were not made.

To refine the plume delineation, additional monitoring wells were installed around the source area and in the residual contaminant plume from December 2004 to February 2007. As part of GMS optimization efforts, since it appeared that the groundwater plume has shifted due to the influence of the Village of Brewster's water supply extraction system located to the north of the river (significantly lower levels of contamination were being extracted from wells EW-3 and EW-4; see Figure 3), to provide better capture of the contaminated groundwater, two new extraction wells and one combination monitoring and extraction well were installed in the source area. Underground piping to connect the new extraction wells to the site GMS is to be installed in Spring 2007. Additionally, one multipoint air sparge well was installed immediately upgradient of the source area to provide a possible enhancement to the groundwater remedy. An air sparging pilot study is currently being developed.

The GMS has consistently met cleanup action levels and surface water discharge standards. GMS staffing includes an operator, staff engineer, and field sampling technician. The operator attends to unscheduled system shutdowns after being notified via telemetry. The operator visits the site on a weekly basis for four to eight hours. The plant engineer does not routinely visit the site, but performs some site sampling, acid washing, and prepares project reports (monthly, quarterly and annual). The wells (extraction and monitoring) are sampled according to the schedule contained in the operation and maintenance (O&M) manual.

Routine maintenance of the system includes acid washing the packing on a monthly basis to prevent fouling of the system. The 4-inch underground line was replaced with a larger 6-inch line in September 2003 when it became clogged with scale and could not be cleaned effectively via mechanical or chemical methods. The individual flow rate from each of the four extraction wells is not available because the system was not designed to allow individual measurement.

The estimated annual O&M costs are $300,847; these costs are broken down in Table 2 (attached).

The packed tower air stripper which is providing treatment to the Village of Brewster water supply continues to be properly operated and maintained by the Village. The Village water supply is a public water supply that is covered under the Safe Drinking Water Act, as well as State and County requirements.

The 1996 ESD called for the monitoring of nearby wetlands and floodplains to determine whether not reinjecting the extracted groundwater would have an adverse impact on them. Monitoring has been performed since the issuance of the ESD. The monitoring has found that not recharging the water that is extracted and treated is not adversely affecting the wetland areas at the site. The monitoring will continue.

V. Progress Since Last Five-Year Review

The first five-year review for this site made a number of recommendations and identified several followup actions. The recommendations and followup actions, as well as their implementation status, are summarized in Table 3 (attached). As can be seen by Table 3, the recommendations and follow-up actions have, for the most part been addressed. The new extraction wells that were recently installed in the source area need to be connected via underground piping to the GMS. It is anticipated that this work will be performed in Spring 2007. Following the completion of the implementation of ongoing remedy optimization modifications and the subsequent collection of operational and sampling data, the groundwater modeling and capture zone analysis will be updated to re-evaluate the groundwater plume capture and the performance of the modified GMS.

Because of EPA's concerns that workers could potentially be exposed to contaminated groundwater during construction activities and the potential installation of water supply wells associated with the Durkin Farms subdivision, EPA advised the Town of Southeast Planning Board via an April 1, 2002 letter that to insure that the groundwater plume control that is currently in place will not be adversely affected by pumping groundwater at any new development, field studies, such as pumping tests and, if necessary, tracer testing and/or flow modeling by qualified professional(s) for the area intended to be developed would need to be conducted. EPA also indicated that it would need to review the work plans related to the performance of these studies and the results of such studies. It does not appear that the Durkin Farms subdivision project is currently proceeding.

EPA also sent a March 16, 2007 letter to the Planning Board, requesting to be notified of any planned construction on the Smith-Cairns Subaru dealership property. A letter will also be sent to the Subaru dealership property owner.

VI. Five-Year Review Process

Administrative Components

The five-year review team consisted of Lisa Wong (Remedial Project Manager [RPM]), Chloe Metz (risk assessor), and Richard Krauser (hydrogeologist).

Community Involvement

The EPA Community Relations Coordinator for the Brewster Well field site, Cecilia Echols, published a notice in the *Putnam County Courier,* a local newspaper, on March 21, 2007, notifying the community of the initiation of the five-year review process. The notice indicated that EPA would be conducting a five-year review of the remedy for the site to ensure that the implemented remedy remains protective of public health and the environment and is functioning as designed. It was also indicated that once the five-year report is completed, the results will be made available in the local site repository. In addition, the notice included the RPM's address and telephone number for questions related to the five-year review process or the Brewster Well Field site.

Document Review

The documents, data, and information which were reviewed in completing the five-year review are summarized in Table 4 (attached).

Data Review

Based upon the recommendations of the RSE, additional monitoring wells were installed south of extraction well EW-1 and near the source area.

The primary groundwater contaminants are PCE and its reductive dehalogenation daughter products, TCE, 1,2-DCE, and vinyl chloride. The highest concentrations of PCE and TCE have been in wells DGC-6I and TH-7. The concentrations of PCE and TCE in these two wells have decreased since the RI. Since the concentrations of DCE and vinyl chloride have increased in these wells, it is likely that biodegradation is occurring in combination with the extraction of the contaminated groundwater by the GMS. The highest concentrations of PCE and TCE are currently in the newly installed well ERT6I near the source area. Figure 3 illustrates the extent of the groundwater contamination.

The extraction wells were fitted with hardware in 2000 to permit sampling of each well. These data indicate that the highest levels of PCE and TCE are extracted from wells EW-1 and EW-2, located the farthest distance from the river. Significantly lower levels of contamination are extracted from wells EW-3 and EW-4. Well EW-4 was taken off-line due to burnt breaker switch and pump motor failure. Flow from well EW-3 will be evaluated and it will be determined if well EW-3 is still needed for plume capture once the three new extraction wells are operating.

In February 1997, under state authorities, a gasoline service station's leaking underground storage tanks and associated contaminated soil (located less than 100 feet upgradient from the Brewster Well

Field site GMS) were removed and excavated, respectively. As a result of this leakage of gasoline, methyl tertiary butyl ether (MTBE) has been detected in several on-site monitoring wells and in the influent of the GMS' air stripper. While MTBE has been detected in the GMS' surface water discharge, the levels are in compliance with the SPDES discharge criteria. The Village monitors for MTBE and has not detected any MTBE in its water supply system.

Currently, surface water is sampled upstream, downstream, and at the discharge point for the treated effluent. The sample results indicate that the surface water does not contain site contaminants. Since the river flows to the East Branch Reservoir, which is part of New York City's Croton watershed reservoir system, surface water sampling will continue to ensure that the groundwater plume is not impacting the surface water.

Currently, the Brewster Well Field pumps approximately 250,000 to 350,000 gallons per day from four wells. While VOCs have been detected in the influent, they are not detected in the treated water. As can be seen by Table 5 (see attached), the average concentrations of VOCs detected in the influent were essentially the same during the review period.

Since the levels of VOCs in the groundwater near the source area are still elevated and based upon recent soil gas samples from beneath the Subaru dealership, it is believed that a residual source of groundwater contamination may be present underneath the building. This warrants further evaluation (see Issues and Recommendations, below).

Site Inspection

A site inspection was performed on February 28, 2007. The following parties were in attendance.

Lisa Wong, EPA RPM, Region II
Chloe Metz, EPA Risk Assessor, Region II
Richard Krauser, EPA Hydrogeologist, Region II
Carl Hoffman, Environmental Program Specialist, NYSDEC
Gerald Rider, Section Chief, NYSDEC
Lou Gasparini, Plant Operator, Sevenson
Dave Nelson, USACE Project Engineer

The inspection found a well-maintained and functional facility. The packing in the air stripper, however, becomes fouled with calcium carbonate deposits. To prevent plugging, the column is cleaned monthly by shutting down the wells and circulating acetic acid through the column packing for 48 hours. After cleaning, the used acid is diluted and discharged slowly to the river. The biological accumulation on the distribution plate at the top of the air stripper is removed and cleaned using a bleach solution once per year.

The clogging problem had been evaluated. Fitting improvement modifications for the discharge line were made. A sequestering agent was added to the water in an attempt to prevent the effluent line from plugging and also possibly eliminate the need for or minimize the frequency of the periodic cleaning of the air stripper packing. It was, however, subsequently determined that the agent could

not meet the desired effectiveness and resulted in increased biological growth. The monthly packing cleaning as described above was found to be the optimal maintenance solution for addressing the deposit buildup and clogging.

Interviews

No interviews were conducted during the review period.

Institutional Controls Verification and Effectiveness

New wells cannot be installed without prior approval by the County Health Department, thereby preventing the installation of new wells in the contaminated plume. There are three private water supply wells located downgradient of the source area. Two of these wells are located outside of the current plume area and the other well is screened below the plume. Since treatment of the water extracted from these wells is required by the Putnam County Department of Heath, these wells are protected.

In this review, several concerns have been raised about the performance of the remedy. Specifically, soil gas samples from beneath the Subaru dealership building suggest that additional source material may be present underneath the building. Depending upon the results of further investigation concerning the potential source material and its effect on the selected remedy, institutional controls may be necessary.

Other Comments on Operation, Maintenance, and Institutional Controls

Table 6 (attached) summarizes several observations and offers suggestions to resolve these issues.

VII. Technical Assessment

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

It is the intention of the decision documents that the soil and groundwater be remediated to levels that would allow for unlimited use without restriction.

Plume Containment

The 1986 ROD called for the continued operation of the existing air stripping system at the well field so as to continue to provide a safe and reliable water supply. This remedial action is functioning as intended. The Village of Brewster's air stripping system is well maintained and meets all treatment goals as described earlier. The system is properly operated and has no history of noncompliance.

The ROD and ESD also called for a GMS to contain the groundwater contaminant plume and to restore groundwater quality south of the East Branch Croton River. While all of the groundwater contamination to the south of the river does not appear to be within the capture zone of the GMS'

four extraction wells, the Village of Brewster's water supply extraction system, located to the north of the river, likely captures any contaminated groundwater that passes under the river. Therefore, the Village of Brewster's water supply extraction system in combination with the GMS have effectively contained the groundwater plume. The GMS' effluent also meets all surface water discharge requirements[7]. However, groundwater monitoring results do not indicate that the mass reduction of PCE is occurring at the rate anticipated. In order to address the concern recommendations for the reevaluation of this remedy are included. Data also indicate the significant presence of PCE daughter products TCE, DCE and vinyl chloride (presumably, as a result of bacterial degradation).

Source Area Removal

The 1988 ROD called for the excavation, removal, and off-site incineration of the contents of the dry well and the surrounding contaminated soils. The primary objectives for this action were to ensure the viability of the GMS by removing any continuing source of contamination and minimize any potential risks associated with direct contact of contaminated soils.

Wetlands

The original remedy called for the reinjection of the treated groundwater so as not to adversely impact area wetlands and flood plains. Because of operational difficulties related to reinjecting the treated effluent, a surface water discharge system was installed pursuant to an ESD. Continued review of pumping and non-pumping monitoring well water level data and local rainfall data collected since the last 5-year review indicate relatively little changes in groundwater elevations, apparently, associated with temporal and/or seasonal variations. Not recharging the water that is extracted and treated does not appear to adversely affect the wetland areas at the site. The two new extraction wells installed near the source area are located further away from the wetland areas than the current wells. Therefore, they are not expected to adversely affect the wetland areas at the site.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy still valid?

There are no changes in the physical conditions of the site or site uses that would affect the protectiveness of the selected remedy. The land use considerations and potential exposure pathways considered in the baseline human health risk assessment are still valid. The source area, which included the dry well and the surrounding soil, has been excavated, removing potential direct contact (*i.e.*, ingestion or dermal contact with soil) exposures to on-site workers and the public. Potential exposure to contaminated groundwater has been eliminated since most residents get their water from the public supply, which is treated to meet state and federal drinking water standards. There are three private wells downgradient from the source area. Two of these wells are beyond the plume and the other well is screened below the plume. New wells cannot be installed in the Village without

---

[7] Groundwater treatment to EPA's MCLs and New York State's groundwater quality standards is also being met under the ROD's originally called for treatment of extracted groundwater and reinjection of the treated groundwater into the subsurface.

prior approval by the County Health Department, thereby preventing the installation of new wells in the contaminated plume. An exposure pathway that was not considered in the original risk assessment is vapor intrusion into indoor air. This pathway is discussed below in Question C.

Aspects of the risk assessment have changed since the original risk assessment for the Brewster Well Field site was performed in 1986. For example, the cancer slope factor (CSF) for PCE, the primary contaminant of concern in the assessment, has changed from 5.2×10^{-2} $(mg/kg\text{-}day)^{-1}$ to 5.2×10^{-1} $(mg/kg\text{-}day)^{-1}$. Since the exposure pathways to contaminated soil and groundwater have been eliminated, this change in toxicity value does not render the remedy less protective.

Source Control

The contaminated unsaturated soil from the dry well area was removed in 1991 to reduce the risk to receptors who may become exposed to contaminated soil and to remove the source of contamination to the groundwater[8]. The cleanup criterion for PCE was 4 mg/kg. Post-excavation confirmational samples indicated that this was achieved. Because PCE toxicity values have changed since the ROD, the new risk-based 10^{-6} concentration (calculated to be protective for long-term exposure) would be 0.5 mg/kg. Nonetheless, the cleanup value that was used in 1991 is still within EPA's target risk range of 10^{-4} to 10^{-6}. The residual levels of PCE in soil in the dry well area, therefore, do not pose an unacceptable risk.

Recent soil gas samples from beneath the Subaru dealership indicate that residual source material may be present underneath the building. The material would not be available for direct contact but could be contributing to vapors migrating from the subsurface into indoor air. This pathway is discussed below in Question C.

Groundwater

The exposure assumptions used to evaluate the threat posed by the groundwater considered ingestion, dermal contact, and inhalation of vapors from showering and household water use, as well as from the air strippers. The risk assessment was conducted prior to implementation of the current guidance for human health risk assessments. While the process for selecting and evaluating chemicals of potential concern is not the same as the one that is used today, the outcome would be the same—the potential carcinogenic risk related to exposure to the groundwater is in excess of the target risk range of 10^{-4} to10^{-6}.

In the 1986 ROD for OU1, the remedial action objectives included the continued operation of the packed tower on the Village's water supply to provide safe water and to contain and restore the groundwater. The packed tower is effectively providing potable drinking water. The Village's extraction system in combination with the GMS will continue to contain the plume. While the ROD anticipated 10 years of extraction and treatment to meet MCLs, the anticipated duration of the pumping to reach MCLs is not presently known.

---

[8] Residual soil contamination in the saturated zone is being addressed by the GMS.

Groundwater data collected from existing monitoring wells in the last two years (2005 and 2006), as well as from recently installed wells in the source area, indicates that PCE and its breakdown products vinyl chloride, trichloroethylene, and cis-1,2-dichloroethylene exceed drinking water standards, which were the remedial goals for the site. However, aside from the former Alben Dry Cleaners property area where the dry well was located, concentrations of these contaminants are generally lower than what has previously been observed at the site, showing that the remedy is improving the quality of the groundwater. Completing the effort to optimize the GMS will likely lead to further reductions in site-related contamination.

An ecological evaluation was conducted in 1986. It cited studies regarding the low likelihood of chlorinated solvent bioaccumulation in fish. It also emphasized the high volatility of these chemicals that translates to a low residency time in surface water. Since the time of this evaluation, new ecological risk guidance has been published as well as benchmark surface water concentrations that can be used to screen data for potential problems and further evaluation. The 2001 quarterly samples taken upstream and downstream of the treatment system outfall have not detected the chemicals of potential concern. This indicates that neither the groundwater plume nor the treatment effluent is impacting surface water in the river.

Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

The soil vapor intrusion pathway was not evaluated in the RIs for OU1 and OU2 or in the last 5-year review because the contribution of groundwater and soil contamination to vapors indoors was not well understood until recently. A soil gas evaluation in the vicinity of the former dry well and downgradient was performed as part of the GMS optimization efforts in May 2006. Soil gas samples were collected beneath the slab of the Subaru dealership building, beneath the asphalt pavement in the car lot, and north of the dealership and Route 202 in the car lot of the Brady Stannard Chevrolet dealership. Soil gas samples were collected only beneath the car lot of the Brady Stannard Chevrolet dealership, and not beneath the building's slab.

The maximum detected concentrations of PCE and TCE from beneath the Subaru dealership's slab were 176,197 micrograms per cubic meter ($\mu g/m^3$) and 4,723 $\mu g/m^3$, respectively, suggesting that residual contamination may still exists in the vicinity of the source area. Because of concerns that the subslab vapors could be impacting indoor air, a subslab mitigation system was installed in January 2007. Indoor air sampling of the dealership building will be performed in late March or early April 2007 to verify the effectiveness of the mitigation system. Although soil gas concentrations from around the Brady Stannard dealership were not elevated, concentrations of site-related groundwater contaminants in wells DGS-19S and ERT-19D suggest that the vapor intrusion pathway should be investigated at this building, as well. Vinyl chloride was found at 84 $\mu g/l$ and PCE at 210 $\mu g/l$. These concentrations exceed the groundwater screening values found in Table 2c of the *Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils* (USEPA, 2002). Subslab samples to ensure that vapors are not collecting beneath the Brady Stannard building are recommended.

Technical Assessment Summary

Based upon the data reviewed and the site inspection, it has been concluded that the remedy appears to be functioning as intended by the RODs, as modified by the ESD. Efforts are currently underway to optimize the performance of the GMS so that groundwater can be treated more effectively and be restored to drinking water levels sooner. There have been no changes in the physical conditions of the site that would affect the protectiveness of the remedy. However, new information about the soil vapor intrusion pathway and soil gas data collected from beneath the Subaru dealership suggest that additional data needs to be collected to fully evaluate this pathway. Changes in toxicity factors and risk assessment practices do not affect the protectiveness of the remedy.

Based upon the results of the five-year review, it has been concluded that:

- The Village-supplied drinking water meets water quality standards.
- The GMS treated water meets the surface water discharge criteria[9].
- The 2006 quarterly surface water samples collected upstream and downstream of the treatment system outfall did not show VOCs. This indicates that the GMS' effluent and the contaminated groundwater are not impacting the surface water in the river.
- While the toxicity level for PCE in soil has changed, the residual levels of PCE in soil do not pose an unacceptable risk.
- The effluent line leading from the air stripper discharge sump to the river is no longer plugged with calcium carbonate following its replacement with a larger diameter pipe and implementation of fitting improvement modifications.
- Two extraction wells (EW-3 and EW-4) are pumping relatively low VOC concentration water (EW-4 was taken off-line due to burnt breaker switch and pump motor failure). The three new extraction wells installed in the source area will likely maximize efficiency by extracting groundwater in more highly contaminated areas.

The groundwater plume will not likely be remedied to MCLs in ten years as estimated in the ROD; however, the PCE is showing significant degradation. Enhancements to the groundwater remedy should be considered.

Monitoring for potential impacts on the wetlands and floodplains should continue to evaluate any impacts related to the GMS optimization modifications.

VIII. Issues/Recommendations, and Follow-up Actions

Table 7 (attached) contains recommendations and follow-up actions which should ensure long-term protectiveness. This review has raised several concerns along with recommendations for appropriate follow-up actions. One concern is that vapor intrusion could potentially be impacting indoor air at

---

[9] Groundwater treatment to EPA's MCLs and New York State's groundwater quality standards is also being met under the ROD's originally called for treatment of extracted groundwater and reinjection of the treated groundwater into the subsurface.

the Smith-Cairns Subaru dealership (formerly Alben Dry Cleaners, where the contaminant source was located) and the nearby Brady Stannard Chevrolet dealership. Based upon subslab vapor concentrations, a subslab mitigation system was installed at the Subaru dealership. Recommendations contained in this report, if carried out, will determine whether there is any exposure and indicate if any additional activities or actions are needed. A second concern is that the soil gas samples from beneath the Subaru dealership building suggests that residual source material may be present underneath the building. Further investigation concerning potential source material and its effect on the selected remedy are necessary. Another concern is that the groundwater plume capture and the overall performance of the modified groundwater management system needs to be reevaluated. The final concern is for an orderly transfer of the GMS to the State.

IX. Protectiveness Statement

A protectiveness determination for this site cannot be made until additional information is obtained (see Table 7). It is expected that a report addendum containing a protectiveness statement will be issued within one year of the date of this report.

X. Next Review

The next five-year review for the Brewster Well Field Site should be completed before April 2012. However, due to the number of concerns raised in this review and the number of issues and recommendations, it is suggested that a status update on the recommendations and suggestions, be prepared before this site is transferred to the State.

Approved:

William McCabe

George Pavlou, Director
Emergency and Remedial Response Division

4-18-07

Date

List of Acronyms

DCE	1,2-Dichloroethene
DGC	Dunn Geoscience Corporation
EPA	(United States) Environmental Protection Agency
ESD	Explanation of Significant Differences
FS	Feasibility Study
GMS	Groundwater Management System
MCL	Maximum Contaminant Level
NYSDEC	New York State Department of Environmental Conservation
PCE	Tetrachloroethene
OU	Operable Unit
RAO	Remedial Action Objective
RI	Remedial Investigation
ROD	Record of Decision
TCE	Trichloroethene
TH	(New York State Department of Transportation) Test Holes
USACE	United States Army Corps of Engineers
VOCs	Volatile organic compounds

List of Figures

SOURCE: TERRASERVER DRG (DANBURY CONNECTICUT, UNITED STATE). PROJECTION: WGS84; UNITS: ARC DEGREES. WEST LONGITUDE=73° 41' 21.12" W, NORTH LATITUDE=41° 32' 04.13" N, EAST LONGITUDE=73° 17' 43.51" W, SOUTH LATITUDE= 41° 14' 20.55"N.

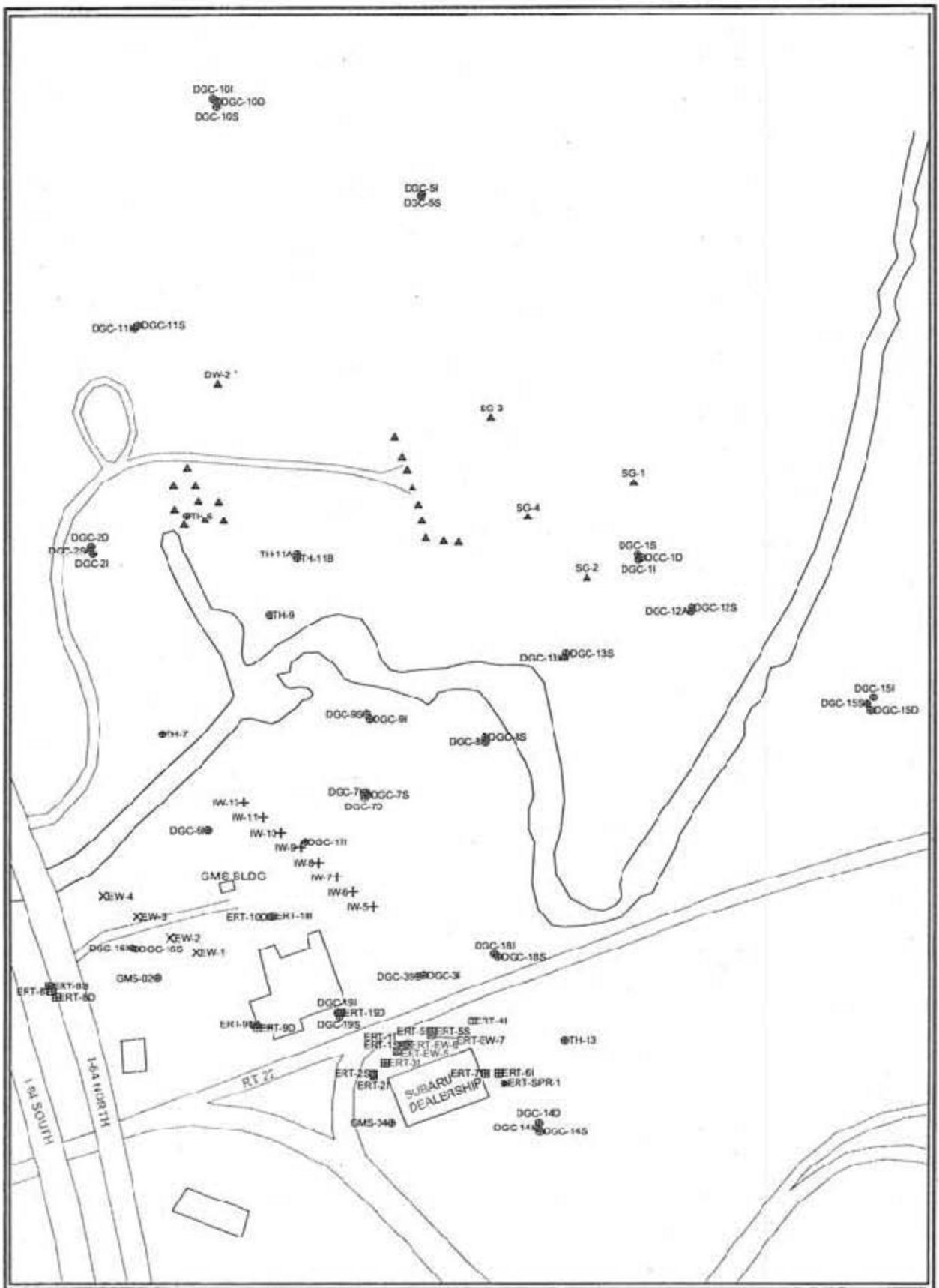
EarthTech

A tyco International Ltd. Company

FIGURE 1
SITE LOCATION MAP

BREWSTER WELL FIELD SUPERFUND SITE
VILLAGE OF BREWSTER - TOWN OF SOUTHEAST
PUTNAM COUNTY, NEW YORK

92066.01 DECEMBER 2006



LEGEND

- ▲ VILLAGE WELLS
- ✚ GMS INJECTION WELLS
- ✕ GMS EXTRACTION WELLS
- ⊕ SHALLOW MONITORING WELL
- ⊕ INTERMEDIATE MONITORING WELL
- ⊕ DEEP MONITORING WELL
- ⊞ US EPA/ERT SHALLOW MONITORING WELL
- ⊞ US EPA/ERT INTERMEDIATE MONITORING WELL
- ⊞ US EPA/ERT DEEP MONITORING WELL
- ⊠ US EPA/ERT SHALLOW EXTRACTION WELL
- ⊠ US EPA/ERT INTERMEDIATE MONITORING WELL
- ✱ US EPA/ERT MULTIPOINT SPARGE WELL

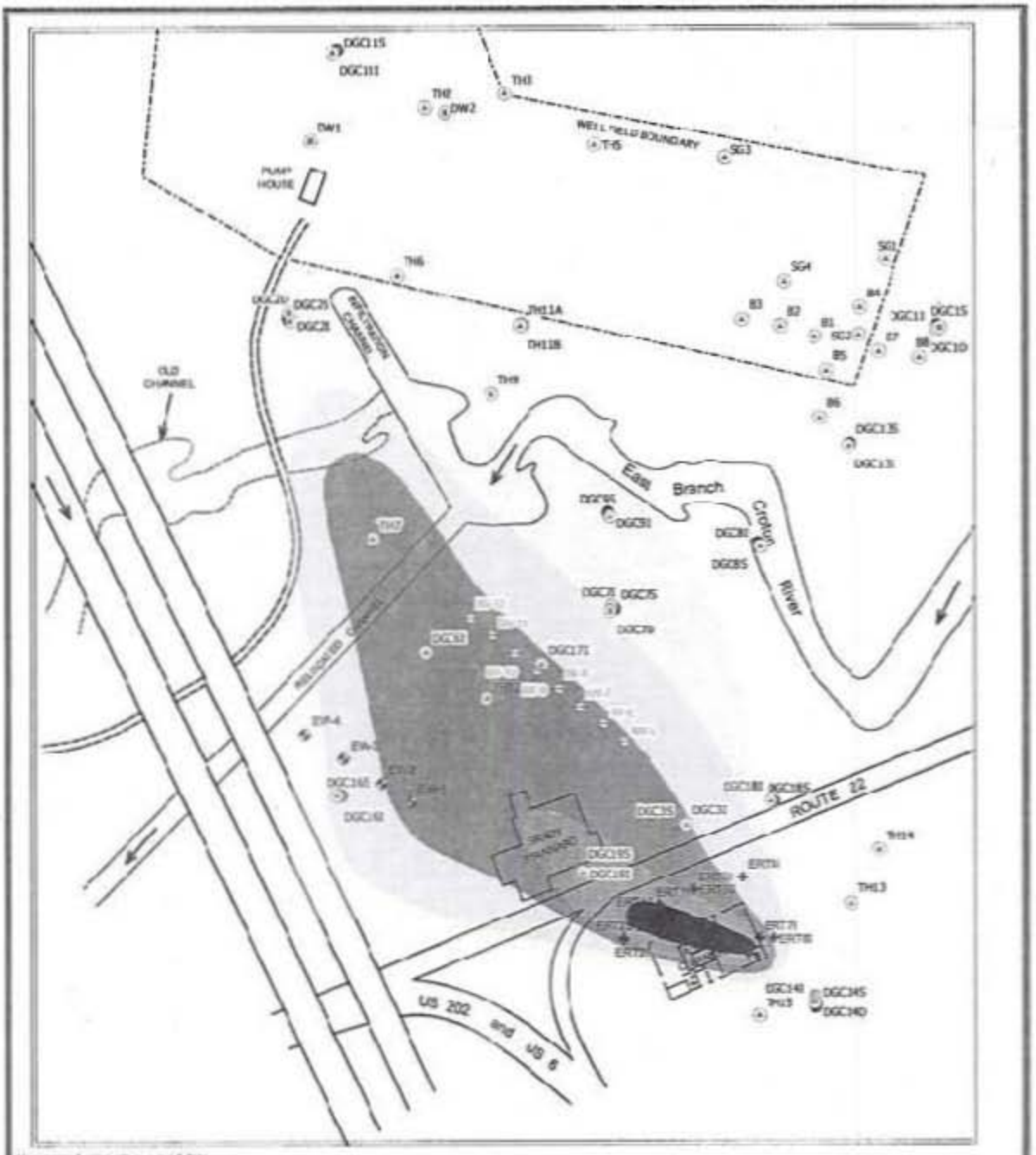
0 150 300
FEET

N W E S

EarthTech
A tyco International Ltd. Company

FIGURE 2
WELL LOCATION MAP
BREWSTER WELL FIELD SUPERFUND SITE
VILLAGE OF BREWSTER - TOWN OF SOUTHEAST
PUTNAM COUNTY, NEW YORK

92066.01 DECEMBER 2006



Map created using site surveyed data.

Map Creation Date: September 2006
Coordinate system: New York State Plane Feet
FIPS: 3101
Datum: NAD83
Units: Feet

Feet
210 0 210 420

Legend

Brewster Wells
- Shallow
- Intermediate
- Deep
- Extraction
- Injection
- Prepacked Monitor Wells

Schematic Concentrations (µg/L)
- >1
- 10
- 100
- 1000
- 10000

Data: g:\arcnewprojects\reac4\00-170
MXD file: g:\arcinfoprojects\reac4\EAC0070_brewster\170_CVOC_Plume

U.S. EPA Environmental Response Team
Response Engineering and Analytical Contract
EP-C-04-032
W.A.# 0-170

Figure 3
Schematic Total CVOC Plume.
Data Combined from June 2005 and September 2006 Sampling
Brewster Well Field Site
Brewster, NY
September 2006

Table 1: Chronology of Site Events	
Event	**Date**
Volatile organic compounds detected in Brewster Well Field	1978
Site placed on National Priorities List	1982
Packed Tower installed for the Village's Well Field	1984
Record of Decision for groundwater	1986
Remedial Design for groundwater started	1987
Record of Decision for source control	1988
Remedial Design for source control started	1988
Superfund State Contract executed	1988
Remedial Design for groundwater completed	1989
Remedial Action for groundwater started	1990
Remedial Design for source control completed	1990
Remedial Action for source control started	1991
Remedial Action for source control completed	1991
Explanation of Significant Differences for groundwater	1996
Remedial Action completed for groundwater	1997
Preliminary Site Close-Out Report	1997
Long Term Remedial Response started	1997
Remedial System Evaluation	2001-2002
First Five-Year Review conducted	2002
Groundwater Management System Optimization Efforts	2002-2007

Table 2: Annual Operating Costs	
Estimated Costs for Contract Performance	Cost per Year
Sampling and Analysis and Equipment Rental	$105,666
Operator Checks	$8,352
Reports	$29,696
Electric & Phone	$8,813
Emergency Monitor	$689
Tower and Effluent Line Rinse	$12,797
Site Maintenance, Repairs, and Field Supplies	$19,585
Travel/per diem	$17,590
Contract Project Management	$26,403
Misc (Shipping, Reproduction)	$10,680
USACE Administration, Oversight, Review, QA, Data Analysis	$60,576
Total Estimated Cost	$300,847

Table 3: Recommendations and Follow-up Actions from the 2002 Five-Year Review		
Issue	**Recommendations and Follow-up Actions**	**Status**
The effluent line leading from the air stripper discharge sump to the river has plugged with calcium carbonate and a third-party notification system needs to be replaced with an autodialer	Sequestering agent addition[8], underground discharge piping modifications, and failsafe system autodialer installation[9]	Completed
Determine whether additional monitoring wells/piezometers would provide better plume delineation, determine anticipated VOC mass removal, and determine the overall remediation time frame.	Modeling and capture zone analysis.	Completed and to be updated after completion of GMS optimization modifications.
Wetlands and floodplains impact evaluation	Evaluate impacts of groundwater extraction without reinjection on wetlands and floodplains	Completed. Continue to evaluate impacts of GMS optimization modifications, if necessary.
Damaged/nonfunctioning monitoring wells	Properly abandon, repair, or reconstruct	Repairs completed for wells that are part of current monitoring/sampling network.
Two extraction wells are pumping low VOC concentration water	Supplemental extraction wells installed and to be connected via underground piping to the GMS	Anticipate completion in June 2007.
The groundwater plume will not likely be remedied to MCLs in ten years; however, the PCE is showing significant degradation.	Evaluate viability of enhanced biodegradation (following modeling and capture zone analysis update and enhanced biodegradation field pilot study, if needed).	Anticipate completion in September 2007.

[8] Determined it could not meet the desired effectiveness and resulted in increased biological growth.

[9] Determined to be not cost-effective.

Table 3: Recommendations and Follow-up Actions from the 2002 Five-Year Review		
Issue	**Recommendations and Follow-up Actions**	**Status**
Potential exposure to contaminated groundwater and impacts to treatment systems and plume control as a result of land development	Notified Town of Southeast Planning Board regarding concerns related to limiting potential exposure and minimizing potential impacts to the treatment systems and plume control. To insure that the groundwater plume control that is currently in place will not be adversely affected by pumping groundwater at the new development, field studies and/or flow modeling would need to be conducted. EPA would need to review the work plans related to the performance of these studies and the results of such studies.	As needed[10]
Potential exposure to contaminated groundwater and subsurface (below 15 feet) residual soil contamination in the vicinity of the former dry well if construction is performed in this area in the future.	Notified Town of Southeast Planning Board regarding concerns related to preventing potential exposure to contaminated groundwater and should this area be disturbed as a result of construction activities below 15 feet in this area. Requested that EPA be contacted prior to approval of any construction in this area.	As needed

[10] During the previous 5-year review, there appeared to be some interest in developing an area downgradient of the Brewster Well Field. Currently there are no plans for new development in this area.

Table 4: Documents, Data, and Information Reviewed in Completing the Five-Year Review	
Document Title, Author	**Submittal Date**
Remedial Investigation Report, GHR Engineering Associates	July 1986
Record of Decision, EPA	September 1986
Record of Decision, EPA	September 1988
Remedial Action Report, EPA	September 1991
Revised Final Work Plan Malcolm Pirnie, Inc.	January 1995
Interim Treatability Study Report Malcolm Pirnie, Inc.	February 1995
Explanation of Significant Differences, EPA	December 1996
Report of Findings, Volume 1: Aquifer Test Results, Malcolm Pirnie, Inc.	February 1997
Remedial Action Report, EPA	October 1997
Preliminary Site Close-Out Report, EPA	April 1997
Bi-Monthly Reports, Sevenson Environmental Services, Inc.	July 2002 - January 2007
Annual Reports, Sevenson Environmental Services, Inc.	August 2003 - January 2007
Contractor Quality Control Program, Sevenson Environmental Services, Inc.	April 2000
Long-Term Remedial Action Work Plan, Sevenson Environmental Services, Inc.	October 2000
Sampling and Analysis Plan for Long-Term Remedial Response Activities, Sevenson Environmental Services, Inc.	November 2000
Quality Control Summary Report Sevenson Environmental Services, Inc.	January 2001
Remediation System Evaluation, Brewster Well Field Superfund Site, Brewster, New York	April 2002
2005 Village of Brewster Water Quality Report, Village of Brewster	April 2006
May 2006 Sub-Slab/Soil Gas Installation and Sampling Trip Report, Lockheed Martin	June 2006
May 2006 Soil Gas Investigation Trip Report, Lockheed Martin	July 2006
August-September 2006 Prepacked Monitoring Wells Installation and Sampling, Lockheed Martin	September 2006
October-November 2006 Well Installation Trip Report, Earth Tech, Inc.	December 2006

Table 4: Documents, Data, and Information Reviewed in Completing the Five-Year Review	
Document Title, Author	**Submittal Date**
Remedial Investigation Report, GHR Engineering Associates	July 1986
Record of Decision, EPA	September 1986
Record of Decision, EPA	September 1988
Remedial Action Report, EPA	September 1991
Revised Final Work Plan Malcolm Pirnie, Inc.	January 1995
Interim Treatability Study Report Malcolm Pirnie, Inc.	February 1995
Explanation of Significant Differences, EPA	December 1996
Report of Findings, Volume 1: Aquifer Test Results, Malcolm Pirnie, Inc.	February 1997
Remedial Action Report, EPA	October 1997
Preliminary Site Close-Out Report, EPA	April 1997
Bi-Monthly Reports, Sevenson Environmental Services, Inc.	July 2002 - January 2007
Annual Reports, Sevenson Environmental Services, Inc.	August 2003 - January 2007
Contractor Quality Control Program, Sevenson Environmental Services, Inc.	April 2000
Long-Term Remedial Action Work Plan, Sevenson Environmental Services, Inc.	October 2000
Sampling and Analysis Plan for Long-Term Remedial Response Activities, Sevenson Environmental Services, Inc.	November 2000
Quality Control Summary Report Sevenson Environmental Services, Inc.	January 2001
Remedial System Evaluation, Brewster Well Field Superfund Site, Brewster, New York	April 2002
2005 Village of Brewster Water Quality Report, Village of Brewster	April 2006
May 2006 Sub-Slab/Soil Gas Installation and Sampling Trip Report, Lockheed Martin	June 2006
May 2006 Soil Gas Investigation Trip Report, Lockheed Martin	July 2006
August-September 2006 Prepacked Monitoring Wells Installation and Sampling, Lockheed Martin	September 2006
October-November 2006 Well Installation Trip Report, Earth Tech, Inc.	December 2006

Table 4: Documents, Data, and Information Reviewed in Completing the Five-Year Review	
Conceptual Model and Capture Zone Analysis Report, Earth Tech, Inc.	March 2007
EPA guidance for conducting five-year reviews and other guidance and regulations to determine if any new applicable or relevant and appropriate requirements relating to the protectiveness of the remedy have been developed since EPA issued the RODs	

Table 5: Village of Brewster Water Supply Influent Sample Results by Year

Contaminant	2002			2003			2004			2005		
	High	Low	Average	High	Low	Average	High	Low	Average	High	Low	Average
Tetrachloroethene	6.7	3.3	4.7	4.3	3.4	3.9	4.2	3.2	3.55	4.9	3.6	4.48
Trichloroethene	4.1	1.7	2.7	3.0	2.3	2.6	2.7	2.0	2.25	3.0	2.3	2.8
cis-1,2-dichloroethene	8.5	3.7	5.9	6.3	3.4	5.1	12	3.8	6.5	5.1	2.5	3.85

Units are micrograms per liter

Table 6: Other Comments on Operation, Maintenance, Monitoring, and Institutional Controls	
Comment	**Suggestion**
Groundwater extraction without reinjection could potentially have an adverse impact on the wetlands and floodplains	Continue to monitor for potential impacts on the wetlands and floodplains, if necessary following GMS optimization modifications.
New York State now requires annual certification that remedy-related operation and maintenance (O&M) is being performed.	On an annual basis, the site will be inspected to determine whether any intrusive activities have been performed at the site (*i.e.*, the Subaru dealership or a new residential development). The annual O&M report should include a summary of the findings of the above-noted activities, along with a certification that remedy-related O&M is being performed.

Table 7: Recommendations and Follow-up Actions

Issue	Recommendations and Follow-up Actions	Party Responsible	Oversight Agency	Milestone Date	Affects Protectiveness (Y/N)	
					Current	Future
Recent soil gas samples suggest that residual source material may be present underneath the Subaru dealership building.	An investigation into the extent, source, and characteristics of any soil contamination that could be a remaining source of groundwater contamination is necessary.	EPA	EPA	April 2007 start; October 2007 complete	N	Y
If a site-related source is located underneath the Subaru dealership building.	An assessment of feasible options, including institutional controls, may be necessary.	EPA	EPA	October 2007 start; October 2008 complete	N	Y
Need to further assess the vapor intrusion pathway at the Subaru dealership building and the Brady Stannard Chevrolet dealership.	The property owners should be contacted and requested to inform EPA and NYSDEC of any potential changes at the site and the building use over the next five years. Based on anticipated uses, additional subslab and indoor air monitoring may be appropriate, as well as indoor air ventilation.	EPA	EPA	April 2007 start; October 2008 complete	N	Y
Need to evaluate the performance of the modified groundwater management system (GMS) in response to the optimization efforts.	Groundwater modeling and capture zone analysis update after completion of soil investigations and GMS optimization modifications (*i.e.*, new extraction wells connection to the GMS and air sparging pilot study) and availability of new operational data and subsequent sampling data.	EPA	EPA	November 2007 and periodically, thereafter (semiannual, annual, or biannual), if necessary	N	N

Issue	Recommendations and Follow-up Actions	Party Responsible	Oversight Agency	Milestone Date	Affects Protectiveness (Y/N)	
					Current	Future
Pending the outcome of soil source investigations and groundwater modeling, further adjustments in the groundwater remedy may be appropriate	Final adjustments in the groundwater remedy should be taken prior to the transfer of the remedy to the state.	EPA	EPA	To be determined	N	N
This report contains a number of concerns which should be addressed prior to the transfer of the GMS to the State.	A status update of the suggestions and recommendations in this report should be prepared.	EPA	EPA	October 2007	N	N