



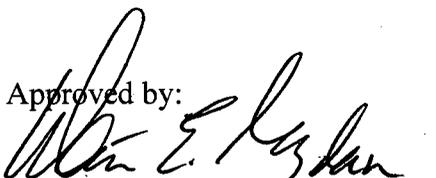
**Fourth Five-Year Review Report
for the
Marathon Battery Company Superfund Site
Village of Cold Spring
Putnam County, New York**



Prepared by:

**United States Environmental Protection Agency
Region 2
New York, New York
June 2013**

Approved by:


Walter E. Mugdan, Director
Emergency and Remedial Response Division

Date:

June 25, 2013

Table of Contents

Executive Summary	iv
Five-Year Review Summary Form	v
I. Introduction	1
II. Site Chronology	1
III. Background	1
<i>Site Location</i>	1
<i>Physical Characteristics</i>	1
<i>Site Geology/Hydrogeology</i>	2
<i>Land and Resource Use</i>	2
<i>History of Contamination</i>	2
<i>Initial Response</i>	3
<i>Basis for Taking Action</i>	3
IV. Remedial Actions	4
<i>Remedy Selection</i>	4
<i>Remedy Implementation</i>	6
<i>Institutional Controls Implementation</i>	9
<i>System Operations/Operations and Maintenance</i>	10
V. Progress Since the last Five-Year Review	11
<i>Vapor Intrusion</i>	11
<i>Evaluation of the Groundwater Plume</i>	12
<i>East Foundry Cove Marsh</i>	13
VI. Five-Year Review Process	13
<i>Administrative Components</i>	13
<i>Community Involvement</i>	13
<i>Document Review</i>	14
<i>Data Review</i>	14
<i>Site Inspection</i>	14
<i>Interviews</i>	15
<i>Institutional Controls Verification</i>	15
<i>Other Comments on Operation, Maintenance, Monitoring, and</i> <i>Institutional Controls</i>	15
VII. Technical Assessment	15
<i>Question A: Is the remedy functioning as intended by the decision</i> <i>documents?</i>	15
<i>Question B: Are the exposure assumptions, toxicity data, cleanup</i> <i>levels, and remedial action objectives used at the time of the remedy</i> <i>still valid?</i>	16
<i>Question C: Has any other information come to light that could call into</i> <i>question the protectiveness of the remedy?</i>	20
<i>Technical Assessment Summary</i>	20
VII. Recommendations and Follow-Up Actions	21
VIII. Protectiveness Statement	21
IX. Next Review	22

FIGURES

- Figure 1: Site Plan
- Figure 2: Groundwater TCE Isoconcentrations
- Figure 3: Trichloroethene Concentrations Over Time

TABLES

- Table 1: Chronology of Site Events
- Table 2: Annual Monitoring Costs
- Table 3: Documents, Data, and Information Reviewed in Completing the Five-Year Review
- Table 4: Current and Historic Concentrations of TCE
- Table 5: Other Comments on Operation, Maintenance, Monitoring, and Institutional Controls
- Table 6: Recommendation and Follow-up Action

EXECUTIVE SUMMARY

This is the fourth five-year review for the Marathon Battery Company Superfund site, located in Village of Cold Spring, Putnam County, New York. Currently, the remedy is protecting human health and the environment in the short term.

Five-Year Review Summary Form

SITE IDENTIFICATION

Site Name: Marathon Battery Company		
EPA ID: NYD010959757		
Region: 2	State: NY	City/County: Cold Spring/Putnam County

SITE STATUS

NPL Status: Deleted	
Multiple OUs? Yes	Has the site achieved construction completion? Yes

REVIEW STATUS

Lead agency: EPA If "Other Federal Agency" was selected above, enter Agency name: N/A
Author name (Federal or State Project Manager): Pamela Tames
Author affiliation: EPA
Review period: 06/10/2008 to 06/10/2013
Date of site inspections: 04/16/13 and 04/24/13
Type of review: Statutory
Review number: 4
Triggering action date: 06/10/2008
Due date (five years after triggering action date): 6/10/2013

Issues/Recommendations

OU(s) without Issues/Recommendations Identified in the Five-Year Review:
OU 1 and OU 2
Issues and Recommendations Identified in the Five-Year Review:

OU(s): 03	Issue Category: Remedy Performance
	Issue: The levels of VOCs in the groundwater plume continue to be stable. Attempts to enhance the natural degradation process have not been successful. It is suspected that source material remains in the vicinity of the shed area.

Recommendation: Methods of addressing the residual source and groundwater contamination should continue to be assessed and implemented.				
Affect Current Protectiveness	Affect Future Protectiveness	Implementing Party	Oversight Party	Milestone Date
No	Yes	PRP	EPA	06/2014

Protectiveness Statement

<i>Operable Unit:</i> OU 1	<i>Protectiveness Determination:</i> Protective	<i>Addendum Due Date (if applicable):</i> N/A
-------------------------------	--	--

The implemented actions at OU1 of the Marathon Battery Company site protect human health and the environment.

<i>Operable Unit:</i> OU 2	<i>Protectiveness Determination:</i> Protective	<i>Addendum Due Date (if applicable):</i> N/A
-------------------------------	--	--

The implemented actions at OU2 of the Marathon Battery Company site protect human health and the environment.

<i>Operable Unit:</i> OU 3	<i>Protectiveness Determination:</i> Protective	<i>Addendum Due Date (if applicable):</i> N/A
-------------------------------	--	--

The implemented actions at OU3 of the Marathon Battery Company site protect human health and the environment in the short term. In order to be protective in the long term, methods of addressing the residual source and groundwater contamination should continue to be assessed and implemented.

Sitewide Protectiveness Statement

<i>Protectiveness Determination:</i> Protective	<i>Addendum Due Date (if applicable):</i> N/A
--	--

Protectiveness Statement:
The implemented actions at the Marathon Battery Company site protect human health and the environment in the short term. In order to be protective in the long term, methods of addressing the residual source and groundwater contamination should continue to be assessed and implemented, as appropriate.

I. Introduction

This five-year review was conducted pursuant to Section 121(c) of the Comprehensive Environmental Response, Compensation, and Liability Act, as amended, 42 U.S.C. §9601 *et seq.* and 40 CFR 300.430(f)(4)(ii) and in accordance with the Comprehensive Five-Year Review Guidance, OSWER Directive 9355.7-03B-P (June 2001). The purpose of a five-year review is to ensure that implemented remedies are protective of public health and the environment and that they function as intended by the decision documents. This document will become part of the site file.

This is the fourth five-year review for the Marathon Battery Company site. Since, after the completion of the remedial action, contaminants remain on-site, a statutory five-year review is required. In accordance with the Section 1.3.3 of the five-year review guidance, a subsequent statutory five-year review is triggered by the signature date of the previous five-year review report. The trigger for this subsequent five-year review is the date of the previous five-year review report, which is June 10, 2008.

The site consists of three operable units (OUs). OU1 consists of Constitution Marsh and East Foundry Cove Marsh and is also known as "Area I." OU2 consists of East Foundry Cove, West Foundry Cove, and the Hudson River in the vicinity of the Cold Spring Pier and is referred to as "Area III." OU3 contains the former Marathon Battery Company plant grounds and the surrounding residential neighborhood and is known as "Area II." See Figure 1.

II. Site Chronology

Table 1 summarizes the site-related events from discovery to the previous five-year review for the site.

III. Background

Site Location

The Marathon Battery Company site is located in the Village of Cold Spring, Putnam County, New York.

Physical Characteristics

The site includes the grounds of a 12-acre former nickel-cadmium battery manufacturing facility, the Hudson River in the vicinity of the Cold Spring pier and a series of river backwater areas known as East Foundry Cove, East Foundry Cove Marsh, Constitution Marsh and West Foundry Cove. Before the site was remediated, a battery plant and an underground asphalt- and clay-lined vault containing spoils from dredging activities in the cove were located on the facility's grounds. Twenty-nine houses, located on Constitution Drive, are in the vicinity of the site.

Geology/Hydrogeology

The former battery plant grounds are underlain by thin, unconsolidated deposits of glacial till consisting of clay and boulders with some deposits of outwash sand and gravel resting upon fractured and faulted bedrock, mainly granite and gneiss. The degree of bedrock fracturing decreases with increasing depth. The depth to bedrock varies greatly throughout the site (2.5 feet below ground surface [fbgs] in the west corner to 89 fbgs in the southern portion of the site). In Foundry Cove, loose unconsolidated sediments three feet or less in thickness overlay a hard impermeable clay-like material. Soil permeabilities range from 4×10^{-4} to 1×10^{-2} centimeters/second.

Average depth to groundwater in the overburden aquifer ranges from approximately 25 to 30 fbgs. Groundwater flow in the overburden is generally to the south/southeast toward Foundry Cove. Groundwater flow in the bedrock is generally to the southwest toward the Hudson River. The hydraulic gradient follows the trend of the bedrock surface, and due to outcropping in the western corner, is greater in the northern portion of the site as compared to the southern portion.

Saturated aquifer thickness varies throughout the site. Saturated thickness is greatest at the southern portion of the site and thins significantly to the north. The average thickness was calculated to be 75 feet.

Based on data collected from the pumping test conducted during the supplemental RI, the specific capacity of the aquifer is 64 gallons/minute/foot and the transmissivity is 127,000 gallons/day/foot. Hydraulic conductivity and groundwater flow velocity were calculated to be 1,701 gallons/day/square foot and 6.7 feet/day, respectively. These values are indicative of a highly transmissive aquifer in which contaminants will migrate rapidly.

Land and Resource Use

The 12-acre former battery plant grounds parcel is zoned "light industrial" and is currently awaiting redevelopment. Since this portion of the site is surrounded on three sides by residential properties and the access roads leading to it are very narrow, it is unlikely that its future use will mirror its historic industrial use. Potential redevelopment scenarios include single and/or multi-family homes, senior housing and a municipal parking lot.

Scenic Hudson, a not-for-profit conservation organization, bought East Foundry Cove and East Foundry Cove Marsh, in addition to the adjacent 95-acre West Point Foundry Historic site (see below). The area is open to the public for walking, hiking, bird watching, canoeing and kayaking. Hunting and camping are not allowed. The marsh and cove areas are managed by the Audubon Society, which also manages the adjacent Constitution Marsh.

History of Contamination

Nickel-cadmium batteries were manufactured at the plant from 1952-1979. The plant's wastewater treatment system originally consisted of a lift station and piping for transfer of all

process wastewater into the Cold Spring sewer system for discharge directly into the Hudson River at the Cold Spring pier. In addition, a bypass valve was installed so that when the lift station was shut down or overloaded, a direct gravity discharge could be made into the Kemble Avenue storm sewer for discharge into Foundry Cove.

Studies conducted from 1976 to 1980 by New York University, EPA, and the New York State Department of Environmental Conservation (NYSDEC) showed high levels of cadmium contamination in Foundry Cove sediments. Samples of vegetation and various species of fish, muskrat, turtle eggs, and green heron revealed high concentrations of cadmium, as well.

Initial Response

In 1972, the U.S. Department of Justice signed a consent agreement requiring the owners/operators to remove as much cadmium from the outfall area and channel leading into the cove as was economically, technically and ecologically feasible. Dredging was performed between November 1972 and July 1973. The dredge spoils were entombed in the above-described vault.

Basis for Taking Action

The dredging that was performed by the owners/operators was not totally successful. Post-dredging monitoring continued to detect elevated cadmium concentrations in the cove's sediments, flora and fauna. Tidal action slowly flushed some of the remaining cadmium deposits from the cove into the Hudson River and into Constitution Marsh, a National Audubon Society sanctuary. Based upon these findings, in October 1981, the Marathon Battery Company site was included on the Interim National Priorities List.

In August 1983, EPA and the State of New York signed a cooperative agreement to undertake a remedial investigation and feasibility study (RI/FS) at the Marathon Battery Company site. An RI report describing the nature and extent of the contamination at and emanating from the site was completed in July 1985. The RI and risk assessment focused on contaminated sediments in the surrounding marshes, coves and the Hudson River. The results of the RI sediment sampling program indicated widespread heavy metal contamination of the sediments in Foundry Cove. The highest level of contamination occurred in East Foundry Cove Marsh in close proximity to the Kemble Avenue outfall. This area, characterized by a layer of greenish-white sediment spanning an approximately 50 by 100 foot area, showed concentrations as high as 171,000, 156,000 and 6,700 milligrams/kilogram (mg/kg) for cadmium, nickel and cobalt, respectively. Cadmium levels as high as 2,200 mg/kg were found in the Hudson River in the vicinity of the Cold Spring pier.

Human health risks were driven by the high cadmium concentrations in East Foundry Cove Marsh; unacceptable risks were associated with ingestion of surface water and sediment during recreational activities. In addition, human health risks were present from the ingestion of fish and blue crabs in the vicinity of the site. The ecological risk assessment found that cadmium contamination was evident in all trophic levels and was being bioaccumulated through the food chain.

An RI/FS for the plant area, existing buildings, adjacent residential homes and underlying groundwater was completed in 1988. Samples from the former battery facility indicated contamination as high as 120,000 mg/kg cadmium and 130,000 mg/kg nickel in the rafters, and up to 600 mg/kg cadmium on the surrounding grounds. Cadmium concentrations up to 67 mg/kg were found in soils in the adjacent residential yards. The risk assessment concluded that an unacceptable risk was associated with the ingestion of cadmium-contaminated soils and building dust. ATSDR also conducted an evaluation of the health risks associated with the ingestion of garden vegetables grown in cadmium contaminated soils. It was determined that the cadmium levels in soil posed an unacceptable risk for future residential use. Although the groundwater was not used for drinking water or any other potable water use, the Village of Cold Spring had expressed an interest in using this aquifer to supplement its fire hydrant water supply which is connected to the municipal water supply. Therefore the potential exists, if the aquifer were to be used as a water source, that residents may be exposed to VOC and inorganic contaminants present in groundwater.

IV. Remedial Actions

Remedy Selection

On September 30, 1986, a Record of Decision (ROD) was signed for Area I (OU1). The ROD established the following remedial action objectives (RAOs):

- Prevention of all biota from contacting contaminated sediments in East Foundry Cove Marsh and Constitutional Marsh contaminated sediments that would threaten them.
- Prevention of resuspension and redistribution of the contaminated sediments that would threaten the area flora and fauna.
- Minimization of the disturbance to Constitution Marsh, since this wetland is a delicate ecological habitat.

The selected remedy included:

- Dredging of the cadmium-contaminated sediments within East Foundry Cove Marsh exceeding 100 mg/kg.¹
- Placement of a clay cap and soil cover on the excavated marsh areas;
- Restoration of the marsh.
- Chemical fixation and off-site disposal of the excavated sediments.

¹ In conjunction with the clay cap and soil cover, the 100 mg/kg action level, which was based upon an analysis of available information and discussions with state and federal fish and wildlife experts, was found to be protective of human health and the environment.

- Long-term monitoring of Constitution Marsh.²

Supplemental RI activities for the former battery facility (Area II and OU3) were completed in April 1988. A ROD for OU3 was signed on September 30, 1988 which established the following RAOs:

- Reduce cadmium in soils and building dust to protect human health and the environment.
- Reduce VOCs in the groundwater to protect human health and the environment.

The selected remedy included:

- Decontamination of the inside surfaces and contents of the former battery facility to remove the heavy metal contaminated dust.
- Excavation of the cadmium contaminated soil to a level of 20 mg/kg³ on the battery plant grounds and the residential yards impacted by the site.
- Excavation of the on-site dredge spoils vault.
- Fixation of the excavated soil, dust and vault sediments.
- Off-site disposal of the cadmium-contaminated soils, sediments and dust at a facility to be arranged for by NYSDEC.
- Excavation of the volatile organic-contaminated soil hotspots followed by enhanced volatilization and replacement of the clean residuals on-site.
- Backfilling of the excavated areas with clean fill.
- Institutional controls to restrict development of the aquifer for potable or municipal use, until state or federal applicable or relevant and appropriate requirements are reached.
- Long-term monitoring of the groundwater underlying the site. Evaluation of and performance of minor repairs, if needed, to the inoperable sprinkler and heating systems inside the former battery facility.

An RI/FS report for the East Foundry Cove, West Foundry Cove and Hudson River in the vicinity of the Cold Spring pier portion of the site (Area III and OU2) was completed in June 1989. The Area III ROD (OU2) was signed on September 26, 1989. The ROD established the following

² Although cadmium-contaminated sediment hot spots were identified in Constitution Marsh, remediation of these sediments would have had a significant adverse impact on the marsh's sensitive ecosystem. In addition, the cadmium-contaminated sediments would eventually be covered with clean sediments following the remediation of the cadmium-contaminated sediments in East Foundry Cove Marsh. Therefore, long-term monitoring was selected for Constitution Marsh.

³ The 20 mg/kg cadmium action level was based upon a risk assessment performed by the Agency for Toxic Substances and Disease Registry. The risk assessment assumed that the risk pathway for humans was via ingestion of vegetables grown in cadmium-contaminated soils. NYSDOH used a slightly different analysis of vegetable ingestion and concluded that 10 mg/kg cadmium should be the action level. As a result, NYSDEC subsequently remediated those residential properties with cadmium-contaminated soil levels between 10 and 20 mg/kg.

RAOs:

- Reduce cadmium in sediments to protect aquatic organisms and protect human health.
- Reduce the transport of suspended sediments from East to West Foundry Coves and the pier area.

The selected remedy called for:

- Dredging of the contaminated sediments from East Foundry Cove to a depth of one foot, chemical fixation and off-site disposal of those sediments, and restoration of the original contours, as necessary.⁴
- Continued monitoring for the West Foundry Cove⁵.
- Sampling and analysis adjacent to and under Cold Spring Pier with dredging of any contaminated sediments determined to be a threat to the environment, followed by chemical fixation, off-site disposal and restoration of the original contours, as necessary.

Remedy Implementation

In June 1987, funds were provided to the U.S. Army Corps of Engineers (USACE) for the design of the selected remedy for Area I. Under a USACE contract, Malcolm Pirnie, Inc. (MPI) commenced the design of a containment dike around East Foundry Cove Marsh, a haul road, a railroad spur (the treated sediments and soils were to be transported off-site via a nearby rail line), a marsh excavation and restoration plan, and the treatment process.

In September 1989, MPI began the Area III design. In September 1991, the portion of the Area II design associated with the excavation of the dredge spoils vault and the cadmium-contaminated soils on the former battery plant grounds and the enhanced volatilization of the VOC-contaminated soils⁶ commenced. A consolidated design for Areas I, II (the dredge spoils vault and the plant grounds), and III was completed in May 1992.

Since the proposed treatment area, the proposed location for the haul road, East Foundry Cove Marsh, and East Foundry Cove were located within the West Point Foundry National Historic

⁴ Since most of the contamination was located in the top four inches of the sediment, removal of one foot of sediment would achieve the 95% removal rate and the cleanup goal of about 10 mg/kg which was sought in the 1989 ROD.

⁵ Although West Foundry Cove sediments are contaminated with cadmium, since they would eventually be covered with clean sediments following the remediation of the cadmium-contaminated sediments in the other portions of the site, long-term monitoring was selected for West Foundry Cove.

⁶ A search for VOC-contaminated soils on the plant grounds during the design failed to find any hot spots and the enhanced volatilization aspect of the remedial design was eliminated. This was documented in an August 1993 Explanation of Significant Differences (ESD). The subsequent demolition of the former battery plant revealed elevated levels of VOCs in some sections of the sealed process trenches and an ejector pit, which were removed and disposed of off-site.

District, a cultural resources survey was conducted. The cultural resources survey indicated that five archaeologically-sensitive areas would be impacted as a result of construction activities. Accordingly, a data recovery plan was developed to recover, remove, stabilize, conserve and curate artifacts from these areas and thereby document these archeological resources. Through these efforts, over 145,000 prehistoric and Civil War era artifacts were analyzed, documented and recovered. The artifacts were temporarily transferred to the Orange County Historical Society for display and research. Some of the artifacts are now located at the Putnam County Historical Society and the remainder are in storage in the Village of Cold Spring.

On March 26, 1989, EPA issued a unilateral administrative order (UAO) to the potentially responsible parties (PRPs), Marathon Battery Company, Gould Inc., and Merchandise Dynamics (the property owner), requiring them to decontaminate the interior of the 114,000-square foot former battery plant (which at the time was an abandoned book repository) and its contents, to recycle the decontaminated books, and to dispose of contaminated materials properly. Following a pilot-scale study conducted by ENSR Consulting and Engineering, Marathon Battery Company and Gould Inc.'s contractor,⁷ to evaluate decontamination techniques, the facility, as well as 4,170 pallets containing approximately 2.5 million books, was decontaminated. Based on the results of the sampling of 76 rolloffs which were filled with debris from the building and HEPA vacuum filters from the decontamination work, 12 were determined to contain hazardous debris and were disposed of at Chemical Waste Management's hazardous landfill in Model City, New York. The remaining rolloffs were sent to Waste Management's Modern Landfill in York, Pennsylvania. While the book and building decontamination work was completed in December 1991, due to the limited production rate of available book recycling companies, the recycling of the books continued until March 1993.

Following the completion of field investigations to delineate the areas of the adjacent properties that required remediation more fully, in May 1992, this portion of the Area II remediation effort commenced. When the remedial action was completed in March 1993, approximately 1,600 cubic yards of contaminated soil had been excavated, stabilized and removed from the site.

After the completion of the comprehensive remedial design for Areas I, II (the dredge spoils vault and the plant grounds), and III, bids for the implementation of the remedial action were solicited by the USACE. EPA and the PRPs, however, negotiated a settlement the week prior to the bid opening, and the bidding process was halted. A Consent Decree, in which Gould Inc. agreed to perform the remedial action, and the remaining PRPs, Marathon Battery Company and the U.S. Army⁸, agreed to a cash settlement, was entered with the Southern District Court on April 1, 1993.

Gould Inc., as the settling work defendant, took over the solicitation of the contract and chose Severson Environmental Services as its contractor. The USACE performed oversight of the work effort.

⁷ The bankrupt Merchandise Dynamics did not comply with the UAO.

⁸ Since the U.S Army helped design and operate the battery facility, it is also a PRP.

The temporary haul road, rail spur, treatment facilities and dike were completed in early August 1993. Full-scale dredging of East Foundry Cove Marsh and East Foundry Cove and the excavation of the plant grounds began in September 1993. The treated sediments and soils were stockpiled on the treatment area for curing and post-treatment testing prior to off-site disposal at City Management Landfill in Michigan. All treated materials were subjected to the Toxicity Characteristics Leaching Procedure as required by EPA and the Extraction Procedure Toxicity Test as required by the State of Michigan.

Dredging in the Hudson River in the vicinity of the Cold Spring pier was completed in July 1994 and dredging of East Foundry Cove continued until February 1994. All dredged areas underwent post-remediation sampling. The dredged areas in the Hudson River and East Foundry Cove were surveyed to determine whether the proper dredging depth was achieved. In East Foundry Cove Marsh, post-dredging cadmium levels in the sediments did not exceed the 100 mg/kg action level, averaging 11.75 mg/kg. In the Hudson River and East Foundry Cove, an average of 10 mg/kg cadmium remained, which was consistent with the ROD requirement that at least one foot of sediment and 95% of the contamination be removed.

The collection of ice and snow on the former battery facility's roof during the winter of 1994 resulted in the collapse of a 10,000 square foot section of the roof, thereby exposing a portion of the concrete foundation to the outside elements. This particular portion of the foundation contained numerous trenches which were used for waste disposal during the manufacture of nickel-cadmium batteries. Sample analyses revealed that elevated levels of cadmium and nickel remained encased in the rubble-filled and cemented-over trenches. Due to the concern that continued exposure to the elements and freeze/thaw cycles may cause the concrete floor and/or trenches' cement caps to heave and crack, possibly resulting in a release of contaminated dust, the PRPs agreed to demolish the building and remove the foundation and process trenches. Demolition of the former battery facility began in September 1994 and was completed in January 1995.⁹

Following the demolition of the former battery facility, it was discovered that a cadmium nitrate tank located on a pedestal immediately adjacent to the plant had leaked onto the underlying soil prior to the closing of the plant in 1979. In an attempt to remove this cadmium-contaminated soil, a 20 by 60-foot area was excavated to a depth of approximately 22 feet (approximately two feet above the groundwater table). While post-excavation sampling of this area showed that some cadmium contamination remained in the saturated soils at levels above the 20 mg/kg action level, and that cadmium was present in the groundwater, it was determined that excavating an additional four feet of contaminated soil to a depth of 26 feet (two feet below the water table), placing two feet of limestone at the bottom of the excavation (to raise pH levels and keep the cadmium insoluble), and backfilling the excavation with clean fill would be protective of public health and the environment.¹⁰

⁹ As was noted above, the selected remedy for the former battery facility involved decontamination to remove the heavy metal-contaminated dust. A June 1994 ESD documented the incorporation of the demolition of the facility.

¹⁰ The noted modification to the remedy was documented in a May 1995 ESD.

At the completion of the marsh remediation and restoration activities in April 1995, the marsh was planted with cattails, bull rush, arrow arrum and upland shrubs in specified areas. Growth of these plants was interrupted by significant ice scour and an invasion of geese, which destroyed approximately 40% of the newly-planted marsh areas. A geese control plan was devised and denuded areas were replanted during molting season when the geese would not be able to fly onto the site. The plantings are being monitored on a regular basis by the warden of the adjacent National Audubon sanctuary, Constitution Marsh.

The plant grounds were regraded and reseeded in July 1995. Thirteen monitoring wells remained in place on the plant grounds for the long-term monitoring of the groundwater for VOCs and cadmium until 2003, when 11 wells were decommissioned due to the absence of contamination. In 2005, an additional groundwater monitoring well was installed to delineate the groundwater plume more completely. Five temporary wells were also installed to assist in the groundwater plume delineation.

In all, 189,265 tons of treated soils and sediments were transported off-site (via 1,979 railcars) to City Management Landfill in Michigan. Chemical Waste Management's hazardous waste landfill in Model City, New York received 906 tons of hazardous materials.

A remedial action report associated with the remediation of the adjacent properties was approved on September 28, 1993. A remedial action report associated with the East Foundry Cove, East Foundry Cove Marsh, Hudson River in the vicinity of the Cold Spring pier, former battery facility, and plant grounds portions of the site was approved on September 18, 1995. A Superfund site close-out report was approved on September 28, 1995. The site was deleted from the National Priorities List on October 18, 1996.

Institutional Controls Implementation

The 1988 and 1989 RODs provided for the application of institutional controls to prevent perforation of the cap in the marsh, human consumption of contaminated blue claw crabs, and the potable use of on-site groundwater.

The New York State Commissioner of Health, on April 21, 1977, issued a health advisory that crabs from Foundry Cove not be consumed. An expansion of the advisory was made in the spring of 1981, advising the public to eat not more than one meal a week of crabs taken from the Hudson River.

Deed restrictions were placed by the PRPs barring the construction of on-site groundwater wells without the approval of EPA and excavation deeper than 15 feet within the pedestal area. On November 14, 2003, Gould added the deed restrictions when it transferred ownership of the factory grounds to Ken Kearney.

In a prospective purchaser agreement with EPA and covenant not to sue dated October 10, 1996, Scenic Hudson Land Trust Inc., a conservation group, agreed to limit disturbances to the marsh

and not to expose or puncture the protective clay cap covering it and to not construct or use any groundwater wells on the property or any new lots or parcels created from the property without EPA approval.

Constitution Marsh is owned by New York State and zoned as a wildlife sanctuary. Access to the marsh is restricted by the Audubon Society, which manages the marsh.

System Operations/Operation and Maintenance

Annual site inspections are conducted to examine the restored marsh for invasive vegetative species, determine the percentage of vegetative cover on the cap in East Foundry Cove Marsh, identify irregular settlement, bubbles, erosion or other disturbances which might affect the integrity of the cap and vegetative cover, check the integrity of the fencing surrounding the plant grounds, and check the integrity of the monitoring wells. Maintenance is performed as necessary.

In accordance with the site monitoring plan, site monitoring originally included the collection of groundwater, surface water, sediment and wildlife tissue samples and the performance of marsh vegetation inventories annually. Laboratory analyses included metals for sediments, VOCs and metals for groundwater, metals for surface water, and metals for wildlife analyses. Since during the second five-year review period, there had not been a change in the wetland surface water and soil sample results and since the levels of contaminants present in the surface water and East Foundry Cove Marsh soil concentrations do not pose a significant threat to the environment, sampling and analysis of surface water, wildlife tissue samples and East Foundry Cove Marsh soils are no longer performed.

A hydrogeologic investigation was conducted by the PRPs' contractor, AGC, in 2003 at the request of EPA. The purpose of the investigation was to delineate the chlorinated solvent plume and to evaluate if biodegradation through reductive dechlorination were occurring.¹¹ The investigation concluded that the VOC plume had not been delineated and may extend off-site, and that biodegradation is limited in extent and is not likely to occur to at significant levels under natural conditions.

In order to address the chlorinated solvent plume in groundwater, two in-situ bioremediation events were conducted at the site. The purpose of the bioremediation was to augment reductive dechlorination, thereby decreasing concentrations of trichloroethylene (TCE).¹² Fourteen injection wells were installed perpendicular to the inferred groundwater flow and one downgradient monitoring well was installed.

¹¹ Chlorinated solvents can biodegrade through the process of reductive dechlorination, where anaerobic bacteria gain energy by sequentially replacing a chlorine atom with a hydrogen atom on a chlorinated solvent. Hydrogen is generally supplied by the fermentation of organic carbon.

¹² While tetrachloroethylene (PCE) is present in the groundwater, the concentrations fluctuate marginally below the groundwater standard.

The first event was conducted in February 2005. Hydrogen Release Compound (HRC[®])¹³ was pumped into each injection well. Post-injection groundwater sampling results indicated that although hydrogen concentrations decreased in all of the wells (indicating the consumption of hydrogen and a possible change in oxidation/reduction conditions), a significant change in TCE concentrations did not occur as a result of the injection.

A second in-situ bioremediation event was conducted in October 2006. Due to the limited results of the first event conducted with HRC[®], HRC-Advanced[®] was chosen as the substrate for the second bioremediation event. HRC-Advanced[®] contains lactic and fatty acids for both rapid and long-term fermentation. HRC-Advanced[®] was pumped into five of the injection wells. Post-injection sampling results once again indicated that a significant change in TCE concentrations did not occur as a result of the injection.

The estimated annual inspection, maintenance, sampling, and monitoring costs are \$81,000; these costs are broken down in Table 2.

V. Progress Since Last Five-Year Review

The third five-year review, which was completed in June 2008, concluded that the implemented OU1 and OU2 remedies protect human health and the environment by controlling exposure pathways that could result in unacceptable risks. The levels of contaminants remaining in the surface sediments are protective of the environment and human health. Institutional controls restricting the consumption of crabs and the disturbance of the marsh address concerns regarding contaminated subsurface sediments. The five-year review raised concerns about vapor intrusion at adjacent residential properties and the delineation of the groundwater plume related to OU3. As a result, a protectiveness determination for OU3 and the site could not be made until additional information was obtained. Based upon the collection and assessment of additional groundwater and vapor intrusion data, an addendum to the third five-year review was issued in July 2011, which concluded that the implemented remedial actions protect human health and the environment in the short term and that there were no exposure pathways that could result in unacceptable risks. The five-year review addendum indicated that the levels of VOCs in the groundwater plume continue to be stable and that attempts to enhance the natural degradation process were not successful. It was recommended that the PRPs continue to evaluate alternative methods of addressing the groundwater contamination.

The additional monitoring that was performed since the third five-year review is discussed below.

Vapor Intrusion

In January 2009, soil gas samples were collected beneath the slabs of nine residences located

¹³ HRC[®] was chosen as the substrate for bioaugmentation because it is a slow release compound that produces lactic acid when hydrated. When fermented by microbes, the lactic acid provides the hydrogen necessary for the reductive dechlorination process.

along Constitution Drive, a residential street adjacent to the former factory grounds. The sample results showed elevated VOC concentrations beneath the slab of two residences located closest to the VOC source area on the former factory grounds. In March 2009, these two residences underwent indoor air sampling and a second round of subslab sampling. In addition, a residence located across Constitution Drive also underwent its initial subslab vapor intrusion sampling. The subslab VOC concentrations for all of three residences were below EPA's screening levels, indicating that there was no vapor intrusion issue at the site. However, since low levels of VOCs were found in the indoor air of one home in the living space, but not the basement, the PRPs installed a mitigation system¹⁴ at this residence as a precautionary measure in September 2009. In February 2012, the two homes closest to the site of the former solvent shed had their subslabs and indoor air retested. The subslab VOC concentrations for these residences remain below EPA's screening levels. Since the vapor mitigation system was installed as a precautionary measure by the PRPs on one home and the other home has a radon vapor mitigation system, EPA will not require follow up sampling by the PRPs as part of the CERCLA response activities.

Evaluation of Groundwater Plume

In July 2009, AGC, the PRPs' contractor, installed three groundwater monitoring wells along Constitution Drive to refine the delineation of the off-site portion of the VOC-contaminated groundwater plume. In addition, six locations were sampled using a HydroPunch® groundwater sampler on the plant grounds within the former footprint of the battery plant in order to delineate the VOC-contaminant groundwater plume vertically and horizontally. Piezometers were installed at three of the six locations for future groundwater level measurements and sampling activities. Samples were also collected for microcosm studies to evaluate the feasibility of and parameters necessary for co-metabolic aerobic remediation.

Groundwater samples collected in August 2009 indicated that the main source of the groundwater contamination is at the location of the solvent shed formerly situated near the southwest corner of the now-demolished factory. The maximum TCE groundwater sample result of 180 micrograms per liter ($\mu\text{g/l}$) was taken from an injection well (IW-8) located within the footprint of the former solvent shed. Groundwater samples continue to be collected on an annual basis. The VOC levels in the groundwater plume exhibit a small downward trend from sampling event to sampling event. One of the three newly-installed monitoring wells continues to exhibit VOC levels slightly above Maximum Contaminant Levels, while VOCs in the other two wells were less than 1 $\mu\text{g/l}$.

Based upon the results of the groundwater sampling effort described above, it was concluded that the boundaries of the plume have been delineated. Figure 2 shows the outline of the VOC plume.

¹⁴ The subslab mitigation system draws air from beneath the subslab, capturing volatilized organics from beneath the subslab. 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).

A January 2011 report entitled "Groundwater Protectiveness Determination Report" was prepared by AGC. The report, which proposed the use of an air sparge and soil vapor extraction (AS/SVE) system¹⁵ to enhance the degradation of VOCs in the groundwater, was approved by EPA. In January 2012, a two-day AS/SVE pilot-test (Phase 1) was conducted. Based upon the results of this test, in March 2012, two additional air sparge wells were installed and the AS/SVE system was restarted (Phase 2). The AS/SVE system operated continuously from March to June 2012 and the system was monitored on a biweekly basis. Groundwater samples were taken periodically following system shutdown. An analysis of the results showed that while this configuration was capable of removing VOCs from the groundwater, some areas near the source area did not exhibit any change in contaminant levels. A recommendation was made to increase the number of air sparge, soil vapor extraction and vapor monitoring wells to six, four and three, respectively, and rerun the treatment system for a longer period of time. In April 2013, the additional wells were installed. A custom designed treatment trailer arrived at the site on June 10, 2013. The treatment system (Phase 3) will run for a minimum of six months.

East Foundry Cove Marsh

Numerous bare areas remain in the marsh due to unforeseen settlement of backfill used to restore the marsh, goose and deer predation, invasive plant and animal species and tidal action. Pilot studies performed prior to the last five-year review dealt with the removal of invasive plant species and various methods to lessen the effects of tidal action. In 2009, a series of six 15-foot diameter test plots were installed at different elevations within existing bare areas and planted with a variety of wetland plants to determine which species would grow best at specific water depths. Each test plot was protected with fencing to prevent predation by geese. The results of the marsh plant pilot study were used to determine where and what type of plants should be planted the following planting season. In 2010, large bare areas of the marsh between the 0 to 2-foot water depths were planted. Additional fencing was installed to protect the plants against predation. The plants were monitored through the 2011 season. Many of the plants survived. During the 2012 planting season, lilies were planted in the deeper water depths, but did not survive the season due to competition from water chestnut plants, an invasive species. During the 2013 planting season, about 500 plants were planted in areas of previous plant survival (0 to 2-foot water depth) in order to increase the density of the vegetation. Also, beavers destroyed trees planted along the former dike area leading to some erosion. This area will be replanted with bushes which are unpalatable to the beavers.

VI. Five-Year Review Process

Administrative Components

The five-year review team consisted of Pamela Tames (remedial project manager [RPM]),

¹⁵ Air sparge wells are used to inject air into the groundwater plume, while at the same time soil vapor extraction wells remove the volatilized VOCs from the unsaturated soils, thereby remediating the contaminated groundwater and soils.

Michael Scorca (hydrologist), Mindy Pensak (biologist) and Lora Smith (risk assessor).

Community Involvement

Following the completion of the five-year review, the EPA community involvement coordinator (CIC) for the Marathon Battery Company site, Cecelia Echols, will publish a notice in the local newspaper, notifying the community of the findings of the five-year review. The notice will also indicate that the five-year review will be made available in the local site repository. In addition, the notice will include the addresses and telephone numbers for the RPM and CIC for questions related to the five-year review process or the Marathon Battery Company site.

Document Review

The documents, data and information which were reviewed in completing the five-year review are summarized in Table 3.

Data Review

In accordance with the site monitoring plan, monitoring includes the collection of groundwater, West Foundry Cove sediment samples and a vegetative inventory of East Foundry Cove Marsh. Five rounds of post-construction sampling have been conducted since the third five-year review was conducted in 2008. Laboratory analyses included cadmium for sediments, and VOCs for groundwater.

Concentrations of TCE at on-property monitoring wells MB-3 and MW-7S (see Tables 4 and 5) generally have exhibited declining trends since the 1990's, but remain well above the New York State standard (5 µg/l). During this five-year review period, PCE concentrations in these two wells were relatively stable, fluctuating marginally below the New York State standard of 5 µg/l. The PRPs continue to evaluate technologies to address residual TCE contamination present on site.

One off-property well (OSMW-3) that was installed along Constitution Drive in 2009 has had fairly stable levels of TCE above the New York State standard, ranging from 8.9 to 17 ug/l (see Figure 3). The other two off-property wells (OSMW-1 and OSMW-2), which are downgradient from OSMW-3, have had VOC concentrations below 1 ug/l.

Sediment samples were collected from East Foundry Cove. Although there was some variation in the level of cadmium concentrations in the post-remediation samples, the amount of cadmium remaining in the sediment remains close to background levels which is more than an order-of-magnitude lower than the cadmium concentrations in the pre-remediation samples.

Numerous bare areas remain in the marsh due to unforeseen settlement, goose and deer predation, and tidal action. In addition, invasive plant and animal species have invaded some areas of the marsh. The remaining areas of the marsh contain a healthy variety of wetland plants. Invasive species such as purple loosestrife and phragmites have been greatly reduced through the use of

beetles and Round Up (a pesticide). Goose exclusion fencing has been placed around the marsh to prevent predation of young plants. The fencing is regularly maintained.

Site Inspection

The need for ongoing five-year reviews stems from the presence of cadmium contamination beneath the soil cap in East Foundry Cove Marsh, in the sediments of the unremediated West Foundry Cove and Constitution Marsh, in the soils at depth on the former plant grounds, and VOC groundwater contamination underlying the former factory grounds.

EPA's five-year review team conducted a site inspection on April 24, 2013 and the annual Marsh monitoring visit was performed on April 16, 2013 with representatives from Scenic Hudson (the property owner), the settling work PRP, NYSDEC, USACE and NOAA in attendance as part of this five-year review. The review team found that the fence surrounding the former battery plant and the monitoring wells are intact. Bare areas still exist within East Foundry Cove Marsh. In addition, it was observed that beavers destroyed trees planted along the former dike area leading to some erosion.

Interviews

No interviews were conducted for this review.

Institutional Controls Verification

The 1996 prospective purchaser agreement and 2003 deed restriction remain in effect and are on file at EPA and the Putnam County Clerk's office, respectively.

In 1977, the New York State Commissioner of Health issued a health advisory that crabs from Foundry Cove not be consumed. An expansion of the advisory was made in 1981, advising the public to eat not more than one meal a week of crabs taken from the Hudson River. The New York State Department of Health published its most recent health advisories in an annual report titled, "Chemicals in Sportfish and Game, 2012-2013 Health Advisories" and can be found at http://www.health.ny.gov/environmental/outdoors/fish/health_advisories/docs/advisory_booklet.pdf. Advice regarding ingestion of crabs near the site is included in this report.

Other Comments on Operation, Maintenance, Monitoring and Institutional Controls

Table 5 presents some observations and offers suggestions for their resolution.

VII. Technical Assessment

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

The three RODs for the site addressed unacceptable risks posed by the site through the excavation of contaminated soils on the former plant grounds and adjacent properties, dredging of the contaminated sediments in East Foundry Cove Marsh, East Foundry Cove, and the Hudson River in the vicinity of the Village of the Cold Spring pier, placement of a clay cap and soil cover on the excavated marsh areas in East Foundry Cove Marsh, natural attenuation for the groundwater, and the application of institutional controls to prevent perforation of the cap, human consumption of contaminated blue claw crabs, and the potable use of on-site groundwater.

While the remedies to address the contaminated soils and sediments are functioning as intended by the decision documents, the contamination levels in the groundwater have remained relatively stable since the remediation was completed. Institutional controls are effectively in place to prevent unacceptable groundwater use. Advice regarding the consumption of contaminated blue crabs in the vicinity of the site is presented in the New York State Department of Health annual report previously referenced. To ensure that the plume is not migrating off-site, monitoring should continue. In addition, the AS/SVE pilot study should continue to ascertain whether or not it can enhance the degradation of the contamination in the groundwater.

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

Sediment

The 1986 and 1989 RODs (OU1 and OU2, respectively) addressed sediment contamination in East Foundry Cove Marsh and Constitution Marsh (OU1) and in East Foundry Cove, West Foundry Cove and the Hudson River in the vicinity of the Cold Spring Pier (OU2). These RODs were signed prior to the implementation of Risk Assessment Guidance for Superfund used currently by EPA. However, the process that was used remains valid. A public health evaluation was performed using the basic methodology described in the *Superfund Public Health Evaluation Manual (1986)*. The following remedial objectives were established for sediment: 1) prevention of resuspension and redistribution of the contaminated sediments that would threaten the area flora and fauna and 2) minimization of the disturbance to Constitution Marsh, since this wetland is a delicate ecological habitat. In the absence of standards or criteria for contaminant levels of cadmium, nickel and cobalt in sediments, to evaluate remedial alternatives for East Foundry Cove Marsh and Constitution Marsh, it was necessary to establish an acceptable cadmium contaminant level for the site. Based upon a probabilistic human health impact assessment, 900 mg/kg was found to be acceptable to protect public health. A sediment cadmium remediation goal of 100 mg/kg under a clay cap was selected to be protective of human and ecological health. The sediment exposure pathway evaluated was ingestion of cadmium-contaminated sediments in the surface water during water sports. The OU1 remedy sought to prevent exposure to contaminated sediments by excavation, chemical fixation and off-site disposal of all sediments in East Foundry Cove Marsh which were above the remediation goal of 100 mg/kg. The marsh was then capped with a bentonite clay cap overlain with clean soil and revegetated. The OU2 remedy sought to prevent exposure to contaminated sediments by dredging the top one foot of sediment in East Foundry Cove and the Hudson River in the vicinity of the Cold Spring Pier, followed by chemical fixation and off-site disposal. The average post-excavation cadmium concentration in East

Foundry Cove was approximately 12 mg/kg. Monitored natural attenuation was selected as the remedy for Constitution Marsh and West Foundry Cove, since these are depositional areas and the remediation of the other areas would result in a clean sediment cover. The sediment cadmium concentrations in both Constitution Marsh and West Foundry Cove are following a general decreasing trend. The current EPA residential regional screening level (RSL) for cadmium in soil is 70 mg/kg which is higher than the selected cleanup goal of 20 mg/kg and higher than the remaining contamination as shown by the post-remediation sampling results. It is noted that this is a residential screening level which is also more conservative than necessary for a recreational scenario. Nickel and cobalt were found to be less toxic to humans than cadmium and were dredged with the cadmium contamination. As a result, the selected remedy and cleanup goal continue to remain protective of human health.

Soil

The 1988 ROD (OU3) and the three subsequent ESDs (1993, 1994 and 1995) addressed the plant building, site soils, adjacent residential soils, and the dredge spoils vault. The remedial action objective was to eliminate exposure to contaminated soils. As part of the remedy, the contents of the former plant building were decontaminated and removed, the building was demolished and contaminated soils beneath it were removed. In addition, cadmium-contaminated soil on the battery plant grounds and nearby residential yards, as well as cadmium-contaminated sediment from the dredge spoils vault and soils down to two feet below the water table in the area of a leaking tank were excavated and disposed off-site. This ROD was also signed prior to the implementation of Risk Assessment Guidance for Superfund used currently by EPA. However, the process that was used remains valid. Soil exposure pathways evaluated include: ingestion of contaminated soil/dust, direct contact with soil/building dust, inhalation of soil/building dust, and inhalation of fumes during a fire event in the building. The COCs identified were: cadmium, nickel, chloroform, TCE, PCE, 1,1,1-trichloroethane and 1,2-dichloroethane. The inhalation of cadmium-contaminated dust (soils) emanating from the former factory grounds was identified as the pathway of greatest risk to nearby residents and persons entering the property and its buildings. A back calculation was performed to determine a site-specific cadmium soil cleanup goal. In order to achieve a risk level of 10^{-6} or lower, cadmium in soils would need to be less than 56 mg/kg. The selected cleanup goal for site and residential soils was 20 mg/kg based on an ATSDR risk estimate for residents consuming home grown vegetables. The selected cleanup goal is more conservative than the current EPA residential RSL for cadmium in soil of 70 mg/kg. As a result, the selected remedy and cleanup goal continue to remain protective of human health.

With the exception of cadmium-contaminated soils exceeding the 20 mg/kg cleanup level in a 20-by 60-foot area of saturated soils at a depth of 26 feet (two feet below the water table), all of the soils on the former battery facility grounds have been remediated to 20 mg/kg. The soils on the residential yards have been remediated to 10 mg/kg by NYSDEC. Measures were taken to ensure that there is no route of exposure to the contaminated soils present at depth, including: placement of two feet of limestone at the bottom of the excavation (to raise pH levels and keep the cadmium insoluble), the backfilling of the excavation with clean fill, and the placement of institutional controls to restrict excavation within the former pedestal area on the former battery plant grounds.

Surface Water

As part of the 1989 (OU2) ROD, surface waters of East Foundry Cove, West Foundry Cove and the Hudson River in the vicinity of Cold Spring Pier were analyzed. In dissolved samples, cadmium concentrations were below drinking water standards. It was found that most of the metals were bound to re-suspended sediments in the water column. Therefore, surface water was not considered a medium of concern unless it contained suspended solids. No remediation goal was selected for surface water. Currently, the EPA evaluates incidental ingestion of surface water while recreating using the total water samples (inclusive of suspended particles). The highest total cadmium concentration was 1.1 ug/l. The current NYS Part 703 Surface Water Standard for cadmium based on health (water source) is 5 ug/l. The current EPA RSL for cadmium in tapwater is 6.9 ug/l. The tapwater RSL is far more conservative than necessary to evaluate a recreational direct contact scenario. Even still, the highest detected concentration of cadmium is below this screening level and the state standard. Therefore, the selected remedy remains protective of human health.

Groundwater

Groundwater was evaluated as part of the 1988 (OU3) ROD. The remedial goal for groundwater was to restore it to drinking water standards. The drinking water model that was utilized assumed the same default ingestion rate used currently and use conservative maximum contaminant concentrations. The excavation and treatment of soils contaminated with VOCs beneath the former battery plant were expected to remove much of the source of contamination to groundwater. Groundwater samples, however, indicate that while the levels of TCE in the groundwater have been slowly decreasing since the implementation of the remedial action, the concentrations continue to be an order of magnitude above the New York State standard and EPA MCL of 5 ug/l. For the last five years, PCE concentrations have remained marginally below the New York State standard and EPA MCL of 5 ug/l. Groundwater monitoring was implemented as part of the 1988 OU3 remedy where the ingestion of groundwater, inhalation of organics during domestic use and contamination of groundwater by the dredge spoils vault pathways were evaluated. The additional AS/SVE wells are expected to decrease TCE and PCE concentrations further. While the remedial goal has not been met, since residents receive public water and an institutional control is in place to prohibit the installation of groundwater wells on the plant grounds, the remedy remains protective of human health.

Biota

The 1986 and 1989 RODs (OU1 and OU2, respectively) dealing with sediment contamination in East Foundry Cove Marsh and Constitution Marsh (OU1) and East Foundry Cove and the Hudson River in the vicinity of the Cold Spring Pier (OU2) also addressed biota uptake of contaminants from sediment. The biota exposure pathways evaluated were: ingestion of fish and blue crabs. Cadmium levels in fish and blue crab were not found to be an immediate health hazard. Additionally, a state fishing advisory is in effect for blue crabs in this area of the Hudson River. The following remedial action objective was established for biota: Prevention of all biota from contacting East Foundry Cove and Marsh, Constitution Marsh and the Hudson River

contaminated sediments that would threaten them. As part of this ROD, East Foundry Cove and Marsh and Hudson River sediments contaminated with cadmium, nickel and cobalt were dredged and disposed of off-site. In Constitution Marsh, no active remediation was recommended since this wetland is a delicate ecological habitat and contamination was minimal compared with the East Foundry Cove Marsh. It was further anticipated that cadmium-contaminated sediments in Constitution Marsh would eventually be covered with clean sediments following the remediation of the cadmium-contaminated sediments in East Foundry Cove Marsh, rendering them unavailable for biota uptake.

Killifish and crayfish were sampled as indicator species and surrogates for edible fish and crab species since fish and crab in this area are more mobile and receive contamination from other sources. In 2000, the killifish and crayfish results were the same as the selected background location (Manitou Bay). The state fish advisory remains in effect for fish and blue crabs.

Vapor Intrusion

Based on a recommendation from the third five-year review, a vapor intrusion investigation was performed at the adjacent residences on Constitution Drive. In January 2009, sub-slab soil gas samples were collected from nine residences. The sample results showed elevated VOC concentrations beneath the slab of two residences. In March 2009, these two residences underwent indoor air sampling and a second round of sub-slab sampling. In addition, a residence located across Constitution Drive also underwent sub-slab vapor intrusion sampling. The sub-slab VOC concentrations for all of these residences were below EPA's action levels. Of the two homes that had indoor air sampled, one had low levels of VOCs in the living space but not the basement. In response to EPA's request, the PRPs pre-emptively installed a mitigation system at this residence as a proactive measure in September 2009. The other residence did not have VOCs above EPA's action levels, but the owner had recently installed a radon mitigation system similar to the VOC mitigation system. In February 2012, both of these homes had their sub-slab and indoor air retested and the sub-slab VOC concentrations remained below EPA's action levels.

Since the last five-year review, EPA's Integrated Risk Information System (IRIS) has updated the toxicity profiles on both TCE and PCE. As a result, EPA now evaluates the vapor intrusion pathway for these contaminants differently. The EPA risk assessor re-evaluated all vapor intrusion data against the new toxicity values and arrived at the same previous conclusions. Based on the most recent round of data collected in 2012, PCE levels are now below all action and screening levels in the sub-slab and indoor air. TCE in one residence was detected above EPA action levels in the sub-slab but was not detected in the indoor air. The continued operation of the mitigation systems in conjunction with the expansion of the AS/SVE system on the plant grounds are expected to minimize sub-slab concentrations of PCE and TCE further. Since no one is currently exposed to contaminant vapors and no one is expected to be in the future, the remedy remains protective of human health.

Current and Future Land Use

The land-use assumptions, exposure assumptions and pathways, cleanup goals and remedial action objectives considered in the decision documents remain valid.¹⁶ Residential cleanup objectives were used to remediate the site. The former factory facility grounds are currently zoned for light industrial use; however, the current property owner has expressed interest in rezoning the property for residential use. If the property were rezoned the remedy would still be protective, since residential cleanup objectives were used to remediate the site. Since the contaminated sediments and soils have been dredged/excavated and disposed of off-site and institutional controls are in place to preclude use of contaminated groundwater for potable purposes and prevent excavation of greater than 15 feet in the pedestal area, a future residential scenario could be supported. Currently, East Foundry Cove and East Foundry Cove Marsh, in addition to the adjacent 95-acre West Point Foundry Historic site are owned by Scenic Hudson and used for recreational purposes. It is anticipated that future land use of these areas will remain the same into the foreseeable future.

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

There is no information that calls into question the protectiveness of the remedy.

Technical Assessment Summary

Vegetation inventories in East Foundry Cove Marsh were performed annually during the review period. Sizable exposed areas in addition to infestations of phragmites and purple loosestrife continue to affect the full recovery of the marsh.¹⁷ Healthy areas of the marsh show a large variety of vegetation suitable for sustaining wildlife and include cattails, arrow arum, saltmarsh fleabane, water plantain, wild rice, spikerush, pickeralweed, wild millet, tickseed and water hemp. In October 2007, bare areas of the marsh were surveyed and the elevations were compared to those taken at the completion of construction activities in 1995. It appears that these bare areas have subsided up to two feet and are no longer at the proper elevation to promote the growth of cattails. A pilot study was conducted during the summer of 2008 to determine which wetland species could be successfully grown at the lower elevation. Additional plantings took place in 2009, 2010, 2012 and 2013.

¹⁶ The remedial action objectives included prevention of all biota from contacting East Foundry Cove Marsh and Constitution Marsh contaminated sediments that would threaten them, prevention of resuspension and redistribution of the contaminated sediments that would threaten the area flora and fauna, minimization of the disturbance to Constitution Marsh, a delicate ecological habitat, reduce cadmium in sediments to protect aquatic organisms and protect human health and reduce the transport of suspended sediments from East and West Foundry Coves and the Pier Area, eliminate exposure to contaminated soils, and restore the groundwater to drinking water standards.

¹⁷ Due to the difficulty and potential for disturbing the cap, physical removal of the phragmites and purple loosestrife has not been attempted. Beetles have been successfully used in the marsh to control the spread of purple loosestrife. A permitted pesticide, Round Up, was used to eradicate the phragmites.

Based upon the results of the five-year review, it has been concluded that the remedy is functioning as intended by the RODs. Specifically,

- The soil cover in East Foundry Cove Marsh is intact and in good condition.
- The vegetative cover is in good condition over two thirds of the Marsh and it is spreading very slowly over the remaining bare areas.
- Organic buildup in East Foundry Cove Marsh, which supports vegetative growth by increasing nutrient levels, is occurring.
- The fence around the site is intact and in good repair.
- The groundwater monitoring wells installed within and around the site are functional.
- There is no evidence of trespassing, vandalism or damage (to the cap and vegetative cover, monitoring wells or fence).
- Groundwater contaminant levels continue to be stable.

A review of the groundwater monitoring data indicates that low levels of VOCs are still present in the groundwater. The PRPs are continuing to assess technologies to remediate the groundwater plume.

Compared to the initial post-remediation sampling results, the average cadmium concentration in East Foundry Cove sediment samples is greatly reduced, having stabilized at an average concentration of 25 mg/kg over the past few sampling events. Cadmium concentrations in sediment samples collected in West Foundry Cove (depositional area) generally show a decreasing trend. Cadmium levels in post-remediation sediment samples taken in 2012 in these areas range from 1.3 to 137 mg/kg, which is well below the pre-remediation maximum concentration of 569 mg/kg.

VIII. Recommendations and Follow-Up Actions

Table 6 identifies a concern related to the groundwater contamination and contains a recommendation and follow-up action which should ensure long-term protectiveness.

IX. Protectiveness Statement

The implemented actions at OU1 and OU2 protect human health and the environment.

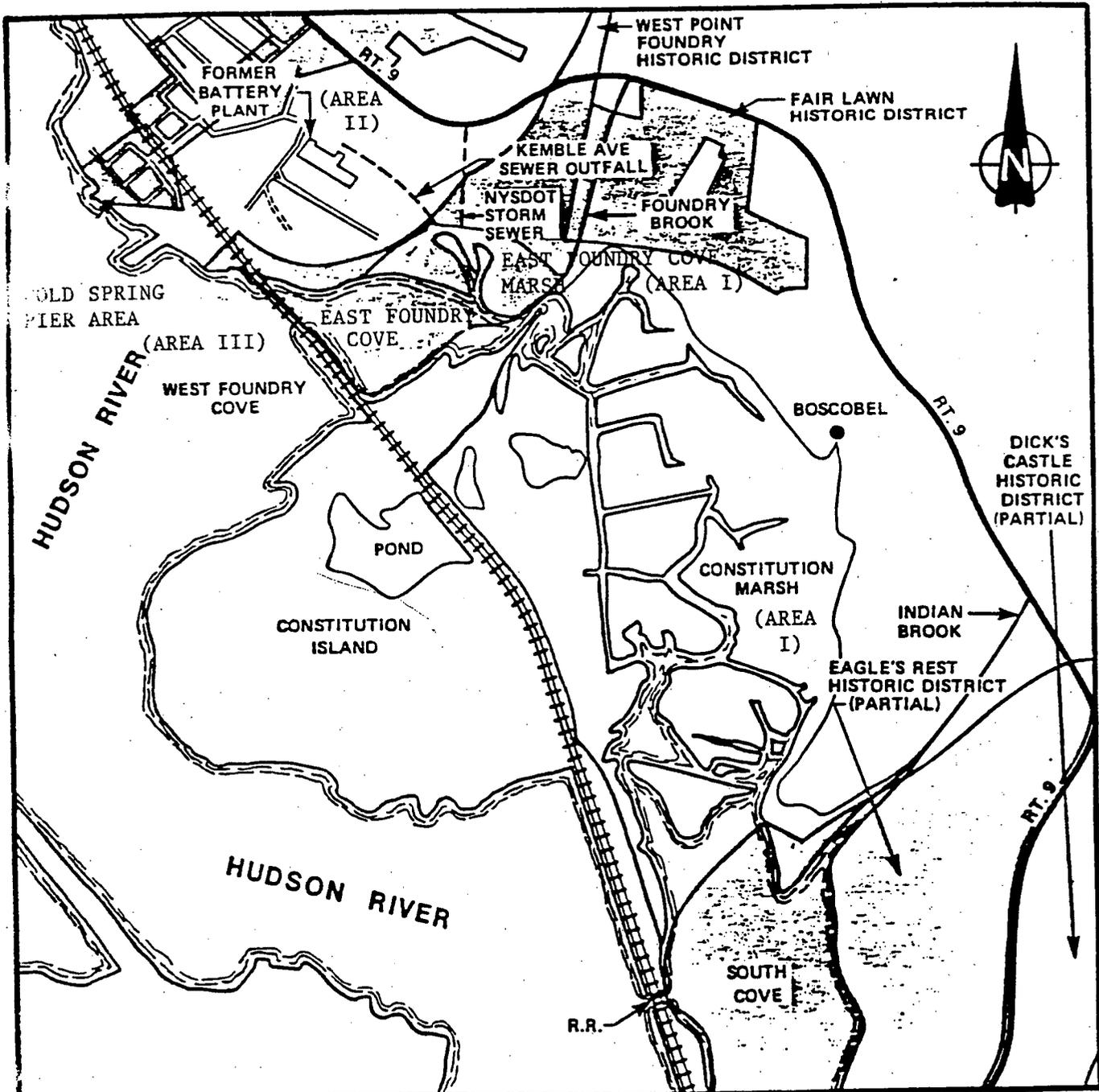
The implemented actions at OU3 protect human health and the environment in the short term. In order to be protective in the long term, methods of addressing the groundwater contamination should continue to be assessed and implemented as appropriate.

The implemented actions at the site protect human health and the environment in the short term. In order to be protective in the long term, methods of addressing the groundwater contamination should continue to be assessed and implemented as appropriate.

X. Next Review

The next five-year review for the site will be completed five years from the date of this review.

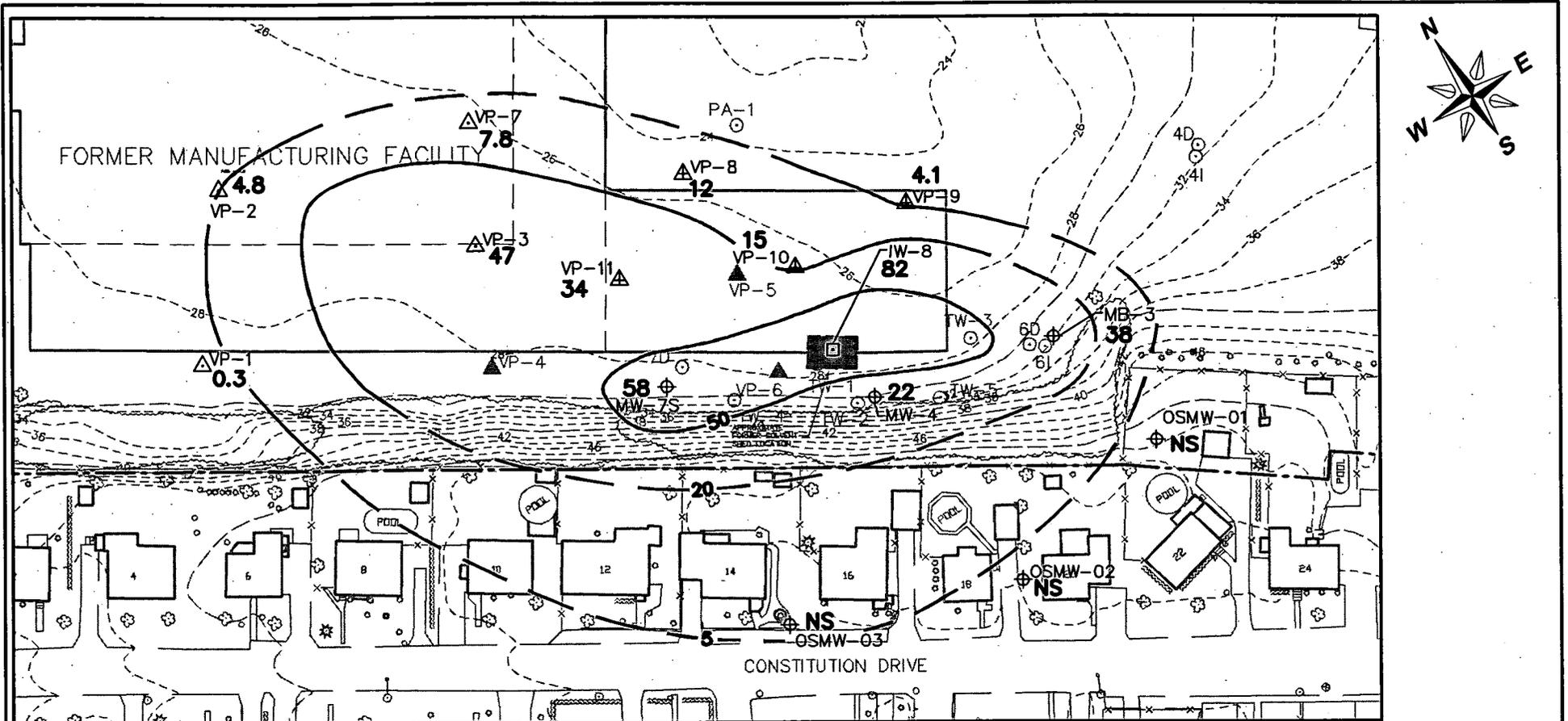
Marathon Battery Company Site
Figure 1



EBASCO

SCALE





LEGEND

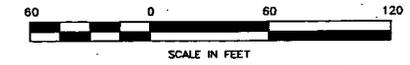
- Existing Contour
- Existing Building
- Existing Edge of Paving
- Existing Right of Way
- Existing Tree Line
- Existing Lot Line
- Approximate Property Line
- OSMW-03 Existing Monitoring Well
- IW-8 Existing Injection Well Converted to Monitoring Well

- VP-1 Existing Piezometer
- 20 Groundwater Isoconcentration Line (µg/L) - Dashed Where Inferred
- VP-8 Existing Piezometer
- NS Not Sampled

- VP-5 Vertical Profiling Location Abandoned at Completion
- PA-1 Abandoned Historic Groundwater Monitoring Well

It is a violation of the New York Education Article 145 - Engineering and Land Surveying, Section 7209 (2) law for any person, unless he is acting under the direction of a licensed professional engineer or land surveyor, to alter an item in any way. If an item bearing the seal of an engineer or land surveyor is altered, the altering engineer or land surveyor shall affix to the item his seal and the notation "altered by" followed by his signature and the date of such alteration, and a specific description of the alteration.

ADVANCED Geoservices Engineering P.C.
*Engineering for the Environment. Planning for People.*TM
 1055 ANDREW DRIVE, SUITE A, WEST CHESTER PA, 19380
 tel 610.840.9100 fax 610.840.9199 www.advancedgeoservices.com



Groundwater TCE Isoconcentrations	
SCALE:	1" = 60'
PROJECT NUMBER:	NY95-219
DATE:	

Figure 2

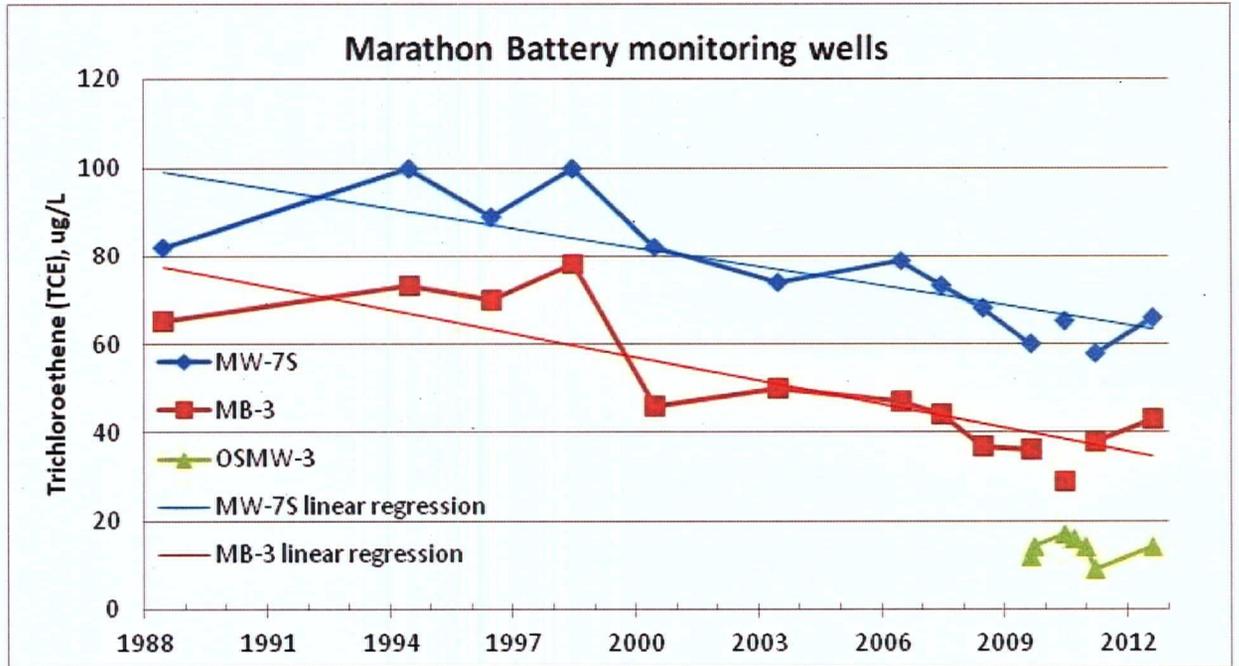


Figure 3: Trichloroethene Concentrations Over Time

Table 1: Chronology of Site Events

Event	Date(s)
High levels of cadmium contamination were discovered in Foundry Cove sediments by New York University, EPA and the New York State Department of Environmental Conservation	Early 1970s
U.S. Department of Justice required owners/operators to remove cadmium from the outfall area and channel leading into the Cove and place in an on-site vault	1972
Dredging of Foundry Cove conducted	1972-1973
Marathon Battery Company site included on the Interim National Priorities List	1981
NYSDEC undertakes RI/FS	1983
EPA's contractor, Ebasco Services, Inc., conducts a Supplemental RI/FS	1986-1989
ROD issued selecting remedy for Area I (OU1)	1986
ROD issued selecting remedy for Area II (OU3)	1988
Unilateral Administrative Order required owners to decontaminate the former battery plant and its contents	1989
ROD issued selecting remedy for Area III (OU2)	1989
Consent Decree entered by the Southern District of New York with the PRPs to undertake the construction of the selected remedy for the site	1993
Site remedy implemented by Severson Environmental Services, Inc.	1993-1995
ESD Issued	1993
ESD Issued	1994
ESD Issued	1995
Final Close-Out Report approved	1995
Marathon Battery Company Site deleted from the NPL	1996
First Five-Year Review conducted	1998
Second Five-Year Review conducted	2003
Third Five-Year Review conducted	2008
Third Five-Year Review addendum conducted	2011

Table 2: Annual Monitoring Costs	
Estimated Costs for Contract Performance	Cost per Year
Sampling and analysis	\$40,000
Site inspection/maintenance	\$41,000
Total estimated cost	\$81,000

Table 3: Documents, Data and Information Reviewed in Completing the Five-Year Review

Record of Decision, EPA, September 1986

Record of Decision, EPA, September 1988

Record of Decision, EPA, September 1989

RD/RA Report, Malcolm Pirnie, Inc., 1992

ESDs, EPA, August 1993, June 1994, and May 1995

Close-Out Report, EPA, 1995

Long-Term Monitoring Plan, Advanced GeoServices Corp., December 1995

Five-Year Review Report, EPA, June 1998

1998 Annual Report, Long-Term Monitoring Program, Advanced GeoServices Corp., 1999

1999 Annual Report, Long-Term Monitoring Program, Advanced GeoServices Corp., 2000

1999 Biological Sampling/Monitoring Report, Advanced GeoServices Corp., 2000

2000 Annual Report, Long-Term Monitoring Program, Advanced GeoServices Corp., 2001

2001 Sampling Event Report, Long-Term Monitoring Program, Advanced GeoServices Corp., 2001

Table 3: Documents, Data and Information Reviewed in Completing the Five Year Review

2002 Sampling Event Report, Long-Term Monitoring Program, Advanced GeoServices Corp., 2003
Five-Year Review Long-Term Monitoring Program Report, Advanced GeoServices Corp., 2001
Long-Term Monitoring Program Sampling Event Report, Advanced GeoServices Corp., 2003
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, 2001
Second Five Year Review, EPA, June 2003
Groundwater Delineation for VOCs, Plant Grounds, Advanced GeoServices Corp., January 2004
Long-Term Monitoring Program Sampling Event Report, Advanced GeoServices Corp., 2008
Long-Term Monitoring Program Sampling Event Report, Advanced GeoServices Corp., 2009
Long-Term Monitoring Program Sampling Event Report, Advanced GeoServices Corp., 2010
Groundwater Protectiveness Determination Report January 2011
Long-Term Monitoring Program Sampling Event Report, Advanced GeoServices Corp., 2011
Long-Term Monitoring Program Sampling Event Report, Advanced GeoServices Corp., 2012
Groundwater Natural Attenuation Enhancement Pilot-Test Completion Report January 2013

Table 4: Levels of Trichloroethylene in the Groundwater from 1988-2012 (micrograms per liter)													
Well	1988	1994	1996	1998	2000	2003	2006	2007	2008	2009	2010	2011	2012
MW-7S	82	100	89	100	82	74	79	73	68	60	65	58	66
MB-3	65	73	70	78	46	50	47	44	37	36	29	38	43

Table 5: Other Comments on Operation, Maintenance, Monitoring and Institutional Controls	
Comment	Suggestion
Large bare areas exist in the marsh due to subsidence of the cap and predation.	The goose fencing should be maintained and plantings should continue, as necessary.
New York State now requires annual certifications that institutional controls that are required by RODs are in place and that remedy-related operation and maintenance (O&M) is being performed.	The annual O&M reports should include a certification that remedy-related O&M is being performed.

Table 6: Recommendation and Follow-up Action

Issue	Recommendation and Follow-Up Action	Party Responsible	Oversight Agency	Milestone Date	Affects Protectiveness (Y/N)	
					Current	Future
The levels of VOCs in the groundwater plume continue to be stable. Attempts to enhance the natural degradation process have not been successful. It is suspected that source material remains in the vicinity of the shed area.	Methods of addressing the residual source and groundwater contamination should continue to be assessed and implemented.	PRPs	EPA	6/14	N	Y