Third Five-Year Review Report
American Thermostat Superfund Site
Town of Catskill
Greene County, New York

Prepared by:

United States Environmental Protection Agency
Region 2
New York, New York
December 2013

Approved by:

Walter E. Mugdan, Director
Emergency and Remedial Response Division

Date: Dec. 5, 2013

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EXECUTIVE SUMMARY

This is the third five-year review for the American Thermostat Superfund site, located in the Town of Catskill, Greene County, New York. The site is protective of human health and the environment in the short-term. For the site to be protective in the long-term, ongoing chemical and hydraulic monitoring needs to be completed and data needs to be collected during the 2013/2014 heating season at a residence where a vapor intrusion mitigation measure was implemented to ensure that it is effective.

Five-Year Review Summary Form

SITE IDENTIFICATION		
Site Name: American Thermostat		
EPA ID: NYD001233634		
Region: 2	**State:** NY	**City/County:** Town of Catskill/Greene County

SITE STATUS	
NPL Status: Final	
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): Christos Tsiamis
Author affiliation: EPA
Review period: 08/29/2008 to 8/29/2013
Date of site inspection: N/A
Type of review: Policy
Review number: 3
Triggering action date: 08/29/2008
Due date *(five years after triggering action date)*: 08/29/2013

Issues/Recommendations	
OU(s) without Issues/Recommendations Identified in the Five-Year Review:	
OU1	
Issues and Recommendations Identified in the Five-Year Review:	
OU2	**Issue Category: Monitoring**
	Issue: Follow up vapor intrusion sampling is needed at a residence where a mitigation measure was implemented to ensure that the measure is effective.
	Recommendation: A follow up vapor intrusion survey should be conducted during the 2013/2014 heating season at the residence where a mitigation measure was implemented.

Affect Current Protectiveness	**Affect Future Protectiveness**	**Implementing Party**	**Oversight Party**	**Milestone Date**
No	Yes	State	State	09/2014
OU2	**Issue Category: Monitoring**			
	Issue: The conceptual site model needs to be updated.			
	Recommendation: Complete the ongoing chemical and hydraulic monitoring to update the conceptual site model.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Implementing Party**	**Oversight Party**	**Milestone Date**
No	Yes	State	State	12/2014

Protectiveness Statement

Operable Unit:	*Protectiveness Determination:*	*Addendum Due Date (if applicable):*
OU 1	Protective	N/A

The implemented OU1 actions protect human health by providing the affected and potentially affected residences with a public water supply or treatment systems.

Operable Unit:	*Protectiveness Determination:*	*Addendum Due Date (if applicable):*
OU 2	*Short-term protective*	*N/A*

The site is protective of human health and the environment in the short-term. For the site to be protective in the long-term, data needs to be collected during the 2013/2014 heating season at a residence where a mitigation measure was implemented to ensure that the mitigation measure is effective.

Sitewide Protectiveness Statement

Protectiveness Determination:	*Addendum Due Date (if applicable):*
Short-term Protective	*N/A*

Protectiveness Statement:
The site is protective of human health and the environment in the short-term. For the site to be protective in the long-term, ongoing chemical and hydraulic monitoring needs to be completed and data needs to be collected during the 2013/2014 heating season at a residence where a vapor intrusion mitigation measure was implemented to ensure that it is effective.

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 the implemented actions protect human 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 third five-year review for the American Thermostat site. 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 September 25, 1998, the approval date of the PCOR. In accordance with Section 1.3.3 of the five-year review guidance, a subsequent 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 August 29, 2008.

The site consists of two operable units (OUs). The first OU provided a clean water supply to residents near the site. The second OU covers source control and the cleanup of the contaminated groundwater. This five-year review covers both OUs.

Based upon this five-year review, it has been concluded that the site is protective of human health and the environment in the short-term. For the site to be protective in the long-term, data needs to be collected during the 2013/2014 heating season at a residence where a vapor intrusion mitigation measure was implemented to ensure that it is effective.

II. Site Chronology

Table 1 summarizes the site-related events from discovery to construction completion.

III. Background

Site Location

The site is located in a rural residential area in the Town of Catskill, Greene County, New York, approximately 30 miles southwest of Albany and five miles west of the Village of Catskill. The approximately eight-acre site is bordered by Routes 23B and Route 23 on the north and south, respectively, by a residential property on the west and by New York State-owned property on the east.

Physical Characteristics

The site contains the former American Thermostat building and the groundwater treatment plant constructed for the implementation of the groundwater remedy, both of which are located on the former American Thermostat property (the "Property"). See Figure 1.

The topography in the vicinity of the site is characterized as gently rolling foothills of the Catskill Mountains which are deeply incised by stream channels. The site is located on a slight ridge overlooking Catskill Creek Valley. Immediately west of the facility is a small valley which includes Tributary B, a tributary of Catskill Creek. East of the facility is Tributary A, which also flows into Catskill Creek, located approximately a quarter mile to the east of the site.

Site Geology/Hydrogeology

Regionally, the bedrock consists of interbedded shales and sandstones of Devonian age, known as the Catskill Formation. The Catskill Formation is made up of four distinct bedrock groups. From oldest to youngest, these groups are Hamilton, Geneses, Sonya and West Falls. The site lies within the Hamilton Group. In the vicinity of the site, groundwater is found between 5 to 8 feet below the ground surface in the overburden. The depth to bedrock varies considerably. In the vicinity of the former manufacturing building, depth to rock ranges from approximately 20 feet to 90 feet. The unconsolidated soils overlying the bedrock are primarily glacially-derived soils and sediments.

Land and Resource Use

The area surrounding the site is characterized as rural-residential. The American Thermostat Corporation was the only industrial facility in the area. There are a few full-time residences, vacation homes and several small businesses in the vicinity of the site. Approximately 5,000 people live within a 3-mile radius of the site in low-density residential areas. Until a waterline was installed to protect the public from exposure to the contaminated groundwater, all homes within ½ mile of the site used private wells. At present, all residences and businesses within the immediate vicinity of the site receive water from the municipal supply of the Village of Catskill.

Catskill Creek is classified as a trout stream and has considerable recreational value to local and visiting fishermen. The creek is also an auxiliary water supply for the Village of Catskill.

History of Contamination

From 1954 to 1985, the American Thermostat Corporation built thermostats for small appliances at the site. In 1981, NYSDEC discovered that American Thermostat employees were improperly disposing of chemicals at the site—workers had been pouring waste organic solvents down drains attached to an abandoned septic system for a number of years and they had been dumping solvents and sludges onto the parking lot. State health personnel tested wells in the vicinity of the site and found them to be contaminated with tetrachloroethylene (PCE) and trichloroethylene (TCE).

Initial Response

In February 1983, New York State entered into an interim consent order with American Thermostat Corporation and Amro Realty Corporation (an owner of the Property) in which the companies agreed to clean up the site and its surroundings; install, monitor and maintain carbon filter systems for five affected wells; supply bottled water for consumption by the affected residents; and monitor two groups of bordering private wells to determine whether any contamination had spread beyond the original affected area. The company went out of business in May 1985 and stopped providing bottled water and abandoned the maintenance of carbon filtration systems at the affected homes. The State requested that the EPA take over the maintenance of the water treatment systems, sample other private wells near the site and provide bottled water and carbon filtration systems where necessary. In addition to undertaking the work requested by the State, the EPA also installed three air stripping systems at the site. A system of seven extraction and reinjection wells and a soil vacuum extraction system were installed at the site in 1989 to accelerate the treatment of the groundwater.

Basis for Taking Action

Following the listing of the site on the National Priorities List in June 1986, the EPA undertook a focused feasibility study (FFS) to evaluate alternative water supplies for the affected and potentially affected residences at the site.

In January 1988, the EPA initiated a source control remedial investigation/feasibility study (RI/FS) to determine the nature and extent of contamination emanating from the site and to evaluate remedial alternatives. The RI concluded that the groundwater in the on-property overburden and bedrock aquifers and in the off-property bedrock aquifer was contaminated with VOCs, primarily PCE and TCE. An estimated 26,000 square feet of soil at the site were also found to be contaminated with TCE and PCE down to a maximum depth of approximately 30 feet. Contamination was also detected in portions of the building located on-site.

IV. Remedial Actions

Remedy Selection

The FFS established a remedial action objective (RAO) of eliminating the threat posed to area residents by exposure to contaminated groundwater. Based upon the results of the FFS, in January 1988, the EPA signed a Record of Decision (ROD) to achieve the RAO. The ROD called for the extension of the existing Village of Catskill water district pipeline to the affected and potentially affected areas as an interim remedy.

The source control RI/FS established the following RAOs for the site:

- Ensure protection of groundwater and surface water from the continued release of contaminants from soils.

- Restore groundwater in the affected area to levels consistent with state and federal water quality standards.
- Decontaminate the building for future use.

To accomplish these RAOs, on June 29, 1990, a ROD was signed, selecting low temperature thermal desorption (LTTD) to excavate and treat the contaminated on-site soil and contaminated sediments located at the bottom of a pond in a residential property located adjacent to the site and extraction, air stripping, carbon adsorption and reinjection for treating the contaminated groundwater. The ROD also called for the decontamination of the building by vacuuming, dusting and wiping of approximately 67,000 square feet of the building floor, off-site disposal/treatment of the collected hazardous dust, removal and off-site disposal/treatment of 18 hazardous waste liquid drums stored in the building and removal and off-site disposal/treatment of sludge from four drainage pits inside the building.

The ROD specified that approximately 7,000 cubic yards (CY) of soil above the water table exceeding 1.0 milligram per kilogram (mg/kg) for PCE and 0.4 mg/kg for TCE[1] were to be excavated and thermally treated by LTTD. Sampling conducted during the RD, however, revealed additional contamination both in the shallow soil (above the water table) and in the deep soil (from the water table down to bedrock). Since the source material would contribute to the existing groundwater contamination problem via leaching and direct contact (for soil below the water table), the EPA concluded that remediating the additional shallow soil and the soil below the water table would be beneficial to the long-term groundwater cleanup. Based on the RD findings, it was concluded that approximately 13,000 CY of soil would need to be remediated as part of the source control remedy. These findings were documented in a July 1997 Explanation of Significant Differences (ESD).

Remedy Implementation

Alternate Water Supply

Although an alternate water supply remedy was selected in 1988, the design of the alternate water supply was not initiated by the EPA's contractor, TAMS Consultants (TAMS), until July 1990. The delay in the initiation of the RD was due to lengthy negotiations between the EPA, NYSDEC, the New York State Department of Health and the Town and the Village of Catskill aimed at resolving several complex issues regarding the new water supply system and the development of a new water district.

The plans and specifications related to the construction of the alternate water supply were completed in September 1991. TAMS awarded a remedial action (RA) contract to F.C. Compagni Construction Company, Inc. to implement the remedy in October 1991. The construction of the alternate water supply, which included the installation of approximately 3.5

[1] Based on a risk assessment performed as part of the source control RI/FS, it was determined that soils containing less than 1.0 mg/kg of PCE and less than 0.4 mg/kg of TCE would present excess carcinogenic risks of no more than $1x10^{-6}$, falling within EPA's target risk range of 10^{-4} to 10^{-6}.

miles of pipeline and connections to 52 residences, was performed from May to November 1992. The Village of Catskill assumed responsibility for maintaining the alternate water supply system in accordance with an October 1991 memorandum of understanding between the EPA and the Village of Catskill.

An RA Report associated with the alternate water supply was approved on December 29, 1992.

A large groundwater user in the area, the mobile home park Country Estates, is not connected to the alternate water supply. Country Estates employs carbon filtration on its supply wells (see the discussion about contamination in the well in the "System Operations/Operation and Maintenance" section, below). Eliminating groundwater pumping at Country Estates would be beneficial, since the Country Estate supply wells compete with the groundwater extraction system operating at the American Thermostat site and appear to have caused the expansion of the contaminated groundwater plume in a northwesterly direction. It would be advantageous for the remediation of the groundwater in the area if a connection to the public water supply line for Country Estate customers was secured, and the Country Estate wells ceased operating.

Building Decontamination

The building decontamination RD was initiated by TAMS in October 1990; the plans and specifications were completed in September 1991. TAMS awarded a contract to All-State Powervac, Inc. to implement the remedy in July 1992. The cleanup activities at the building were performed from September 14 to September 29, 1992.

An RA Report associated with the building decontamination was approved on December 31, 1992.

Soil Remediation

The soil excavation and treatment RD was initiated by TAMS in October 1990; the plans and specifications related to the soil treatment were completed in September 1992. Following the RD completion, Foster Wheeler Environmental Corporation became the EPA's contractor for the soil RA. In April 1993, Foster Wheeler Environmental Corporation awarded an RA contract to Williams Environmental Services, Inc. (Williams) to implement the soil remedy. Williams initiated the soil remediation in September 1993 and had completed the treatment of 12,670 CY of contaminated soil by May 1995. Prior to Williams' mobilization to the site, the EPA conducted preconstruction deep soil sampling to define the outer limits of the contamination. Based on these results and on the findings of post-excavation wall and floor sampling performed by Williams during the execution of the soil remedy, the EPA defined several areas for additional excavation and treatment both on the site and on the adjacent private property and estimated the total potential additional volume of contaminated soil to be 30,000 CY.

In the interest of assessing possible cost and schedule benefits, attempts were made to simply extend William's scope of work. However, based on independent cost estimates by Foster Wheeler Environmental Corporation and the EPA and on initial soil remedy bidding information,

Williams' proposal was deemed to be unacceptable. As a result, a new procurement was initiated.

Foster Wheeler Environmental Corporation awarded an RA contract for the excavation and thermal treatment of the additional soil to O'Brien & Gere Technical Services, Inc. In October 1995, O'Brien & Gere Technical Services, Inc. initiated construction of the final phase of the soil remedy and completed all thermal treatment and backfill work by December 1996. The quantity of soil treated during this phase of the soil remedy was 25,644 CY. The total amount of contaminated source material remediated was 38,314 CY.

An RA Report associated with the soil remedy was approved on September 19, 1997.

Groundwater Remediation

The groundwater remediation RD was initiated by TAMS in October 1990; the plans and specifications related to the groundwater extraction and treatment were completed in September 1993. Initiation of the groundwater RA had to be postponed until all soil RA activities at the site were completed. Following the RD completion, Foster Wheeler Environmental Corporation became the EPA's contractor for the groundwater RA. In March 1997, Foster Wheeler Environmental Corporation awarded an RA contract to Fluor Daniel GTI, Inc. to implement the groundwater remedy. The construction of the groundwater remedy began in June 1997 and was completed in July 1998.

The groundwater management system includes extraction, injection and monitoring wells installed in the overburden and bedrock aquifers. Initially, the groundwater management system consisted of 16 overburden extraction wells, 14 extraction bedrock wells, 14 injection wells and 10 monitoring wells (a number of wells have been converted or eliminated as a result of optimization efforts).

An RA Report associated with the groundwater remedy was approved on September 30, 1998.

Construction Completion

A PCOR was approved on September 25, 1998.

Institutional Controls Implementation

Since the OU1 ROD called for the extension of the existing Village of Catskill water district pipeline to the affected and potentially affected areas, institutional controls to restrict the installation of wells in the groundwater plume were not deemed necessary. The OU2 ROD did not call for institutional controls for the Property since it was envisioned that the use of the Property would be significantly encumbered by the groundwater extraction, treatment and reinjection system until groundwater standards are achieved. Nevertheless, pursuant to a Consent Decree, in 1997 the Property's owners, Amro Realty Corporation, and the Estate of Harry Moskowitz (the former president and owner of American Thermostat Corporation), recorded a

Declaration of Covenants, Conditions and Restrictions to grant the EPA and the State access to the Property to perform all response actions, including the remediation, long-term response action, state operation and maintenance and to prevent the Property's owner(s) from interfering with these activities. The deed restrictions also prohibit the use of the Property in any manner unless the EPA or the State determines that such use would not adversely affect the integrity or effectiveness of any response action at the site. The deed restrictions would also be protective of the vapor intrusion pathway. The deed restrictions apply to all successors-in-title of the Property, so they apply to the new owner who recently purchased the Property and any other future purchasers of the Property.

System Operations/Operation and Maintenance

From 1998 to 2001, groundwater monitoring was conducted on a monthly basis. In an effort to optimize the groundwater management system, in September 2000, an injection well was converted into an extraction well and an extraction well was deepened to access a zone of higher aquifer contamination. In 2001, an injection well in the vicinity of the site, where high PCE concentrations were detected, was converted into an extraction well, pumping was discontinued at one overburden and two bedrock extraction wells that had reached the groundwater standards and all of the overburden extraction wells, six monitoring wells and eight bedrock extraction wells were monitored semiannually, while the remaining bedrock extraction and monitoring wells and all nine residential wells were sampled monthly. As further optimization measures, in 2003, the pumping at five bedrock extraction wells with very low contaminant concentrations was discontinued and the sampling of eight monitoring wells which no longer yielded useful information (because of low depths and/or low concentrations) was discontinued.

At the end of the aforementioned optimization measures, the groundwater management system extracted water from nine bedrock and 14 overburden wells.[2] Groundwater monitoring in five bedrock extraction wells, six residential wells and one monitoring well were originally performed on a quarterly basis. The remaining four bedrock wells and 14 overburden wells were monitored on a semiannual basis. Based on the review of the April 2008 sampling results, it was decided that three additional bedrock wells would be sampled on a semiannual basis, since their concentrations had stabilized at relatively low levels, and two bedrock wells, which are located immediately downgradient of the source area and still had elevated concentrations of PCE would be sampled on a quarterly basis.

From August 1998 to December 2003, the groundwater treatment plant operated at a pumping rate of approximately 70 gallons per minute (gpm). In December 2003, when the five bedrock wells with low contamination levels were taken offline in an effort to optimize the treatment system, the groundwater treatment plant began operating at a pumping rate ranging from 35 to 40 gpm. System performance samples were collected twice a month from the treatment plant and groundwater samples from extraction wells were tested semiannually for VOCs. During this

[2] The overburden wells have been installed on the plant grounds to capture contaminated water at the source area and to prevent it from moving into the bedrock aquifer, which is the source of potable water in the area. The bedrock wells are located on and off the plant grounds.

time period, the system consistently met groundwater cleanup levels and groundwater reinjection requirements. The treatment plant staffing includes an operator and a staff engineer. The operator typically visits the site on a daily basis to attend to equipment repairs and maintenance at the plant and at the well vaults and to perform the scheduled sampling of the wells. The plant engineer does not routinely visit the site, but performs occasional site inspections and prepares monthly project reports. The extraction and monitoring wells are sampled according to the schedule contained in the operation and maintenance (O&M) manual, as revised during subsequent optimizations of the system.

Routine maintenance of the system includes repairs of well pumps and process equipment at the treatment plant, and of the liquid carbon adsorption filter, pumping standing water from the well vaults and replenishing treatment chemicals.

NYSDEC's contractor, MACTEC Engineering and Consulting, P.C. (MACTEC) completed a remedial systems optimization (RSO) study in November 2008. The RSO study was performed to evaluate remedy performance relative to remedial goals, identify potential changes to the remedy to enhance effectiveness, reduce costs and shorten the time to closure.

In 2012, NYSDEC initiated another RSO and conducted a field investigation to:

- evaluate remedy performance relative to remedial goals;
- identify potential changes to the remedy to enhance effectiveness, reduce costs, and shorten time to closure;
- verify the site conceptual model and closure strategy;
- identify problem areas and recommend improvements; and
- evaluate progress in reaching closure.

This effort included the collection of soil samples adjacent to and beneath the building to evaluate the distribution of suspected residual soil contamination that may be a contributing to groundwater contamination, two rounds of synoptic water level measurements to evaluate the potentiometric surfaces of overburden and bedrock groundwater under static and pumping conditions, collection of sediment and surface water samples from the adjacent pond and installation and sampling of several overburden monitoring wells to evaluate the presence or absence of overburden groundwater contamination.

The results of this effort were reported by MACTEC in a January 2013 RSO Implementation Activities Report. The report included an updated conceptual site model and provided recommendations to improve the effectiveness of the groundwater management system, decrease operating costs and improve downgradient groundwater quality over time (see the "Technical Assessment Summary" for a summary of the recommendations from the RSO).

Based on the 2012 RSO effort, the groundwater extraction system has been modified and includes the operation of seven overburden extraction wells and six bedrock extraction wells. The groundwater monitoring program has also been modified and includes annual sampling of

the seven overburden wells and 24 bedrock wells. Performance testing of three residential wells is also conducted on a quarterly frequency.

MACTEC is presently conducting monitoring to evaluate the hydraulic effectiveness of the groundwater extraction and treatment system (GWETS). Under this effort, water level measurements will be taken in surrounding wells under pumping and non-pumping conditions. Groundwater quality samples will also be collected in order to monitor current conditions and the future stability of the plume during the GWETS optimization activities. MACTEC will also survey/inventory all of the wells associated with the site that are no longer being used for extraction, re-injection, and/or monitoring to determine whether decommissioning is appropriate.

MACTEC has removed the pumps from wells that will no longer be operated as extraction wells. Initial hydraulic effectiveness testing field work for extraction well EW-9 has been completed.

A treatment system revisions/redesign has been approved by NYSDEC and is in the process of being implemented by MACTEC. To date, the following items have been completed: influent and effluent tanks have been taken off-line and cleaned and are no longer being used; influent/effluent lines within the treatment plant have been modified/moved/re-plumbed; a new pad has been poured for the base of a new air stripper and the multi-media filter has been removed and replaced with an array of bag filters. In the interim, the existing system controls have been modified so that the plant can continue to operate. The filter press has been removed and the clarifier will be removed soon.

A new work assignment is being prepared to cover completing the remaining treatment system modification tasks (acquire and install a new air stripper, major overhaul/replacement of treatment system and well-head control and metering systems), monitoring well network tasks (inventory, modify/decommission wells, including extraction well EW-5), prepare an updated Site Management Plan, as well as continuing operation and monitoring for the site.

In early 1999, after VOC contamination was detected in three residential bedrock wells to the west of Scotch Rock Road and in two wells at the Country Estates, which were located beyond the previous limits of the contaminated groundwater plume, these wells were included in the groundwater monitoring program.[3] Through 2009, monitoring of the Country Estates groundwater communal water supply treatment system consisted of monthly sampling for VOCs prior to and between the two GAC vessels. The sampling frequency was changed to quarterly in 2010. When indications of breakthrough occur, the polishing vessel is made the primary unit and a new, second unit is placed as the polishing unit. Two new carbon vessels were installed in March 2011. During the reporting period, the three residential wellhead protection systems were

[3] In November 1998, the New York State Department of Health (NYSDOH) reported to EPA the detection of VOC contamination in two wells servicing the Country Estates residential development, located in the western boundary of the Town of Catskill. During sampling conducted by EPA and NYSDOH in December 1998 and January 1999, VOC contamination was detected in three additional residential wells to the west of Scotch Rock Road which, like the Country Estates wells, were located outside the previous limits of the contaminated groundwater plume. EPA installed granular activated carbon (GAC) treatment systems on the Country Estates and the three residential wells.

sampled quarterly between the two GAC units. At indication of breakthrough in the intermediate sample, units are changed with the addition of a new GAC unit as the second stage polishing step. Carbon was changed out in one residence in July 2010 and in another residence in July 2011. The monitoring and maintenance at the private wells is performed by MACTEC.

An in-situ chemical oxidation pilot study using sodium persulfate was performed by EPA in the source area groundwater in November and December 2008. The results indicate that for the four overburden extraction wells that were monitored (OW-2, OW-3, OW-5 and OW-14) (see Figure 2), significant reductions in the PCE concentrations were achieved within a short period of the oxidant injections. However, in the five years following the in-situ oxidation, PCE concentrations have rebounded in those wells, with the exception of well OW-5, to near pre-oxidation levels.

The annual O&M costs for 2012 were approximately $402,000; these costs are broken down in Table 2.The O&M costs are expected to remain the same or be reduced as a result of on-going efficiency improvements.

V. Progress Since Last Five-Year Review

As was noted above, in 2013 MACTEC completed a RSO report evaluating the American Thermostat site's remedy performance. This effort included the collection of soil samples adjacent to and beneath the building to evaluate the distribution of suspected residual soil contamination that may be contributing to groundwater contamination, synoptic water level measurements to evaluate the potentiometric surfaces of overburden and bedrock groundwater under static and pumping conditions, collection of sediment and surface water samples from the adjacent pond and installation and sampling of several overburden monitoring wells to evaluate the presence or absence of overburden groundwater contamination. The 2013 RSO report presented an updated conceptual site model and included a number of recommendations to enhance the efficiency and effectiveness of the site remedy, including modifying the extraction well network, updating treatment system and wellhead operational controls, and streamlining the treatment system to reduce the need for an on-property operator. During 2013, NYSDEC began the implementation of the recommended system modifications.

During the first review period, soil vapor intrusion (SVI) was not a concern at the nearby residential properties since contamination was not detected in the overburden at off-property locations and the water table for the underlying contaminated bedrock aquifer is located approximately 75 feet below the ground surface. The second five-year review, completed in August 2008, concluded that while the remedy was protective of human health and the environment, because of nationwide concerns regarding SVI at residential properties located near sites with VOC-contaminated groundwater, an SVI investigation at residential properties located downgradient of the site should be performed. The five-year review also indicated that on-property groundwater exceeded screening level concentrations. However, the on-site building was not occupied, so the pathway was not a concern at the time of the five-year review. Since a

portion of the building is no longer structurally sound, it is unlikely that it will be occupied in the future.

To evaluate the potential for SVI for both on-property and off-property buildings, in March 2012, at NYSDEC's request, MACTEC conducted a structure sampling program (including subslab vapor, indoor air and ambient air, where feasible). Ten residential dwellings were sampled. The testing did not show any significant indoor impacts associated with the SVI pathway in the off-property residential properties. However, the sump water at one structure showed elevated concentrations of site-related VOCs. Although indoor air results did not show a current unacceptable exposure, as a precautionary measure, the New York State Department of Health (NYSDOH) recommended that a cover be installed on the sump to limit the potential for any future exposures. A sump cover was installed in late winter 2013. NYSDOH also advised several property owners that "housekeeping" to remove volatile organic source materials, such as gasoline-powered equipment, should be undertaken.

The on-property SVI testing included the vacant former manufacturing building and the GWETS building. Based upon the SVI sample results from the former manufacturing building, SVI mitigation measures inside the former manufacturing building may be warranted if the building is occupied in the future; this is, however, unlikely, since the a portion of the building is not structurally sound. Soil vapor intrusion was determined to not to be a concern at the GWETS building. Although contaminants were detected in the GWETS indoor air samples, based on the related structure sampling results, the source has been attributed to groundwater treatment processes operating inside the building. As a work place setting, where the contaminants of concern are being handled in treatment processes within the building, this is an Occupational Health and Safety Administration-regulated occupational exposure and the potential exposures are far below applicable standards for this workplace setting.

VI. Five-Year Review Process

Administrative Components

The five-year review team consisted of Christos Tsiamis (remedial project manager [RPM]), Sharissa Singh (hydrologist), Rebecca Ofrane (risk assessor) and Michael Clemetson (ecological risk assessor).

Community Involvement

On July 11, 2013, the EPA Community Involvement Coordinator for the site, Larisa Romanowski, provided the clerks for the Town of Catskill and the Village of Catskill with a flyer for posting in their respective offices and on websites. The flyer notified the public that the EPA would be conducting a five-year review of the site to assess whether the site is protective of public health and the environment and whether the implemented components of the remedy are functioning as designed. The flyer also indicated that once the five-year review is completed, the results will be made available in the local site repositories. In addition, the flyer

included the RPM's address and telephone number for questions related to the five-year review process or the site. The flyer was also displayed on the EPA webpage for the site. On July 11, 2013, Ms. Romanowski also sent e-mails to the Town of Catskill Supervisor and the Village of Catskill President informing them about the five-year review.

Document Review

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

Data Review

Soil

During the review period, soil samples were collected adjacent to and beneath the building to evaluate the distribution of suspected residual soil contamination that may be a contributing to groundwater contamination. Based upon the sample results, concentrations of PCE in the soil beneath the concrete floor and next to the southwest perimeter wall of the former manufacturing building range from 8.4 to 150 mg/kg (see Figure 3).

Groundwater

Based on the historical data and the most recent groundwater sample results, it is likely that PCE contamination persists within the overburden soils, mainly in locations underneath the former manufacturing building or in close proximity to the building's southwest wall and in the fractured bedrock and it continues to act as a source of groundwater contamination. However, a review of the monitoring well data collected since the commencement of operation of the GWETS shows an overall decreasing trend in the VOC contamination. See Figure 2 for the location of the wells.

To date, over 347 million gallons of contaminated groundwater have been treated and approximately 5,109 pounds of VOCs have been removed from the groundwater.

To help define the trends in the data, the EPA performed a Mann-Kendall Trend Test analysis[4] for total VOC concentrations in 22 wells in the 2008 five-year review. During the period 1998 to 2008, 15 of the wells showed decreasing trends (significant at the 95-percent confidence level), one well with an increasing trend and six wells with no statistically significant trend. Trend test analysis on data from 2004 to 2008 indicated statistically significant downward trends in five of the 22 wells. There were no increasing trends.

MACTEC performed a similar analysis for the 2005 through 2009 data. Seventeen of 23 wells had negative Mann-Kendall S-statistics for PCE, with seven of these indicating statistically

[4] The Mann-Kendall Test is a rank-based procedure that measures strength of the groundwater concentration in a well at a point in time.

significant (at the 95-percent level of confidence) downward trends. No statistically significant upward trends for PCE were indicated. For TCE, 15 of 23 wells had negative S-statistics, with three of these indicating statistically significant downward trends, while a statistically significant upward trend was indicated for one well. For cis-1,2-DCE, 13 of 25 wells had negative S-statistics, with five wells indicating statistically significant downward trends and two wells with statistically significant upward trends. Trend tests on the sum of the cis-1,2-DCE, PCE and TCE indicated six wells with statistically significant decreasing trends and none with statistically increasing trends.

MACTEC also performed a Mann-Kendall analysis for the 2005 through 2011 data. For PCE, 18 of 23 wells had negative S-statistics and the number of wells with statistically significant decreasing trends increased from 7 to 8, but with no statistically significant (at the 95 percent confidence level) increasing trends. For TCE, the mix was slightly different from the previous analysis; 11 of 23 wells had negative S-statistics (down from 15 in 2009), while four wells had statistically significant decreasing trends and 2 wells statistically increasing trends. For cis-1,2-DCE, the number of wells with positive S-statistics increased from 12 to 15; the number of statistically significant trends was five each for increasing and decreasing. For the total of cis-1,2-DCE, PCE and TCE, the proportion of wells with negative S-statistics remained the same (16 of 23), but the number of statistically decreasing trends increased from six to eight with no statistically increasing trends.

The specific wells with increasing or decreasing trends were not entirely the same between the 2005 to 2009 and 2005 to 2011 analyses. Some were consistent, but for some wells, there were considerable changes (*e.g.,* relatively strongly negative S-statistics became relatively strongly positive for EW-2).

Overall, the results suggest generally decreasing concentrations of PCE, TCE and the sum of cis-1,2-DCE, PCE and TCE, while the increased number of wells with positive S-statistics for cis-1,2-DCE suggest an accumulation of that compound since it is the degradation product of PCE and TCE. While there may be further degradation of cis-1,2-DCE, the relatively sparse presence of its degradation product, vinyl chloride, would suggest that this may be limited.

Distant monitoring locations (*e.g.,* EW-11, EW-14 and M-5) typically showed declining trends, while intermediate distance or source area wells showed fewer or mixed trends for the contaminants of concern. This may be understood in the light of a combination of attenuation mechanisms, changes in flow patterns, mass removal and degradation series of PCE to TCE to DCE and possibly vinyl chloride. If biological degradation is occurring, then the process may stall at the cis-1,2-DCE stage at some locations. In general, concentrations appear to be trending downward, but slowly in the source area.

Tables 6 and 7 show the changes in PCE concentrations and the percent reductions in PCE concentrations in the bedrock and overburden extraction wells achieved since the last five-year review. Table 8 shows the change in the average PCE concentration of the extracted groundwater. It should be noted that although the data covers a period of only three and a half years, sizable reductions have occurred in most of the extraction wells with only a few wells

showing either practically unchanged concentrations or slightly higher percentage increases in concentration. There are, however, two notable exceptions. The October 2011 PCE concentration for overburden extraction well OW-16 is the highest ever detected and not consistent with previous sampling. Also, the PCE concentration from extraction well EW-2 from the June 2012 sampling is very high and not consistent with previous sampling results.

MACTEC is presently conducting monitoring to evaluate the hydraulic effectiveness of the GWETS. Under this effort, water level measurements will be taken in surrounding wells under pumping and non-pumping conditions. Groundwater quality samples will also be collected in order to monitor current conditions and the future stability of the plume during the GWETS optimization activities. Upon completion of this effort, the conceptual site model should be updated.

The three residential wells located to the west of Scotch Rock Road are the historical limits of the contaminated groundwater plume. PCE and TCE have not been detected in these wells since 2006; there have, however, been sporadic low-level detections of their breakdown products.

Vapor Intrusion

To evaluate potential SVI, in March 2012, MACTEC sampled ten residential dwellings, the vacant former manufacturing building and the groundwater treatment system building. The sampling included the collection of 15 indoor air samples, ten subslab soil vapor samples, three exterior ambient air samples and one duplicate sample. Subslab soil vapor samples were not collected from five of the residential structures because the basement slabs were installed on the top of the bedrock surface.

While six of the sampled residential structures contained sumps, five of the sumps were either dry or were not in contact with the groundwater table (as evidenced by lack of recharge when the sump was turned on or stagnant/standing water was present). Concurrent with the SVI samples, a sump water sample (if present) was collected and submitted for VOC analysis.

PCE was detected in the indoor air samples collected at three of the ten residential structures at concentrations ranging from 2.3 micrograms per cubic meter ($\mu g/m^3$) to 31 $\mu g/m^3$. PCE was detected in the subslab soil vapor samples collected from three of the five residential structures at concentrations ranging from 1.7 $\mu g/m^3$ to 14 $\mu g/m^3$. TCE was detected in the indoor air sample collected at three of the ten structures at concentrations ranging from 0.23 $\mu g/m^3$ to 1.5 $\mu g/m^3$. TCE was detected in the subslab soil vapor samples from three of the five residential structures at concentrations ranging from 0.4 $\mu g/m^3$ to 2.5 $\mu g/m^3$.

PCE and TCE were detected in subslab samples collected from the vacant, former manufacturing building at concentrations as high as 83,000 $\mu g/m^3$ and 5,600 $\mu g/m^3$, respectively. Contaminant concentrations detected in indoor air samples at this building ranged from 9.4 $\mu g/m^3$ to 20 $\mu g/m^3$ for PCE and 0.21 $\mu g/m^3$ to 0.5 $\mu g/m^3$ for TCE. PCE and TCE were also detected in the subslab at the groundwater management system building at 23 $\mu g/m^3$ and 0.43 $\mu g/m^3$, respectively, and in the indoor air at concentrations of 99 $\mu g/m^3$ and 28 $\mu g/m^3$, respectively. A comparison of the

subslab results with the indoor air concentrations detected in the groundwater management system building shows that it is highly unlikely that the PCE and TCE concentrations detected in the indoor air are due to SVI. Rather, the operations of the groundwater treatment processes inside the building are the likely source of the indoor air contamination.

Site Inspection

While the site is routinely inspected by NYSDEC, a five-year review site inspection was not performed by the EPA.

Interviews

No interviews were conducted for this review.

Institutional Controls Verification

The 1997 *Declaration of Covenants, Conditions and Restrictions* remain in force and are on file at the Greene County Clerk's office.

Other Comments on Operation, Maintenance, Monitoring and Institutional Controls

Table 4 presents several comments and offers suggestions for their resolution. Table 4 also presents a number of recommendations stemming from the RSO.

VII. Technical Assessment

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

Alternate Water Supply

The 1988 ROD called for the extension of the existing Village of Catskill water district pipeline to the affected and potentially affected areas. The construction of the alternate water supply connected 52 affected and potentially affected residences to the Village of Catskill's water supply. The Village of Catskill is presently maintaining the alternate water supply system. The alternate water supply is functioning as intended by the 1988 ROD.

GAC treatment systems were installed on the three residential wells to the west of Scotch Rock Road and in two wells at the Country Estates residential development. The systems have been maintained as a precautionary measure since 2003, and the VOC levels in these wells have been either below the Maximum Contaminant Levels (MCLs) or non-detect for PCE, TCE and the daughter products.

Building Decontamination

The 1990 ROD specified that, in order for the former manufacturing building to be utilized in the future, hazardous dust would have to be removed from contaminated surfaces and all hazardous materials in drums and drainage pits in the building would be removed and disposed.

An inspection on September 29, 1992 verified that the building had been cleared of all debris, visible dust had been vacuumed from the floors and the drainage pits had been power washed.

Presently, the building is in disrepair and a portion of it is structurally unsound.

Source Control

The 1990 ROD, as modified by the 1997 ESD, called for the cleanup of the contaminated soil at the site in order to eliminate the threat to human health from possible ingestion or dermal contact with the soil. The analytical results from post-excavation soil samples collected from the excavation limits indicated that the residual levels of PCE and TCE were well below the 1.0 mg/kg and 0.4 mg/kg target levels, respectively. Therefore, the remediation of the source of contamination has reduced contamination of site soils to acceptable health-based levels in the areas that were excavated. Based on the historical data and the most recent groundwater sample results, it is likely PCE contamination persists within the overburden soils, mainly in locations underneath the former manufacturing building or in close proximity to the building's southwest wall and in the fractured bedrock, and it continues to act as a source of groundwater contamination.

Additionally, sediment and surface water collected from the tributaries adjacent to the site, as well as Catskill Creek, did not contain elevated contaminants. Sediments from a small pond on an adjacent residential property were excavated and treated. Since the exposure pathways have been addressed, the remedy is functioning as intended for ecological receptors.

Groundwater Restoration

The 1990 ROD called for the extraction and treatment of the contaminated groundwater so as to contain the migration of the contaminant plume and, in time, to achieve federal and state groundwater standards.

The Applicable or Relevant and Appropriate Requirements for groundwater cleanup include the EPA's MCLs and New York State's groundwater quality standards. The action level established for PCE and TCE is 5 µg/l (the proposed MCL and New York State's groundwater quality standard at the time of ROD issuance). Based on the analytical results associated with the groundwater management system influent and effluent VOC sampling and monitoring, it has been concluded that the groundwater management system is effectively treating the VOC-contaminated water to concentrations meeting the action levels. The groundwater treatment

system's effluent, which is currently discharged to a nearby tributary via a swale, also meets all discharge requirements.

MACTEC completed a RSO study in January 2013. The RSO evaluated remedy performance relative to remedial goals, adequacy of prior site characterization efforts, identified potential changes to the remedy to enhance effectiveness, reduce costs and shorten the time to closure, verified the site conceptual model and closure strategy, identified problem areas and recommended improvements and evaluate progress in reaching closure. The report provided recommendations to improve the effectiveness of the groundwater management system, decrease operating costs and improve downgradient groundwater quality over time (see the "Technical Assessment Summary," below, for a summary of the recommendations from the RSO). Based on the findings of the RSO, NYSDEC has proceeded with implementation of a number of system optimizations

Monitoring well data indicates that concentrations in both shallow and bedrock wells downgradient from the source area continue to decline for PCE, TCE and daughter products. However, some wells on-site continue to exhibit high concentrations of PCE and TCE. Therefore, it is possible that the groundwater goals identified in the ROD may not be achievable in the source areas.

MACTEC is presently conducting monitoring to evaluate the hydraulic effectiveness of the GWETS. Under this effort, water level measurements will be taken in surrounding wells under pumping and non-pumping conditions. Groundwater quality samples will also be collected in order to monitor current conditions and the future stability of the plume during the GWETS optimization activities. Upon completion of this effort, the conceptual site model should be updated.

In summary, based upon the results of the five-year review, it has been concluded that the alternate water supply is functioning as intended by the 1988 ROD. While the GWETS is effectively extracting and treating the groundwater plume as intended by the 1990 ROD, the high pumping rate Country Estates wells continue to draw the contaminated plume in their direction. Decreases in the levels of VOC contamination in the groundwater are a direct result of the groundwater extraction and treatment system. The three residential wells located to the west of Scotch Rock Road are the historical limits of the contaminated groundwater plume. PCE and TCE have not been detected in these wells since January 2006; there have, however, been sporadic low level detections of their breakdown products.

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

The soil exposure assumptions and toxicity values that were used to estimate the potential cancer risks and non-cancer hazards in the risk assessment supporting the 1990 ROD followed EPA guidance. The process that was used in the human health risk assessment is still valid. While toxicity data for PCE and TCE have been updated since the ROD, the cleanup criteria used for soil excavation (1.0 mg/kg for PCE and 0.4 mg/kg for TCE) remains protective of human health.

The groundwater exposure assumptions and toxicity values that were used to estimate the potential cancer risks and non-cancer hazards in the risk assessment supporting the 1990 ROD followed EPA guidance. The process that was used in the human health risk assessment is still valid. The Country Estates mobile home park and three off-site residential properties remain on groundwater wells and have GAC treatment systems. The three residential systems are maintained and sampled by the State regularly. As a community water supply, operation of the Country Estates treatment system is the responsibility of that property owner. All other properties are connected to a municipal water supply. The federal MCL for PCE and TCE remains at 5 µg/l, and despite high concentrations of PCE in extraction wells, discharge concentrations are below discharge criteria.

The groundwater use is not expected to change during the next five years, the period of time considered in this review. Therefore, the groundwater remedy is protective, since routes of exposure have been interrupted or the groundwater is treated prior to use.

Although the ecological risk assessment screening values used to support the 1990 ROD do not reflect current values, the exposure assumptions remain appropriate and, thus, the remedy remains protective of ecological resources.

The property currently houses the former manufacturing building and the groundwater management system building. The land use is not expected to change in the next five years.

Vapor intrusion had not been evaluated at the site before the 2008 five-year review. That five-year review recommended such an assessment. NYSDEC completed a SVI investigation at the site in 2012. Commercial structures located on the Property and nearby residential structures were evaluated for subslab and indoor air, where possible. The former manufacturing building on-property is currently unoccupied, but did show levels of elevated subslab VOCs, including PCE and TCE. The maximum PCE subslab value was 83,000 µg/l, exceeding the commercial noncancer subslab screening value of 1,750 µg/l (which is higher than the cancer 10^{-4} value). The maximum TCE subslab concentration was 5,600 µg/l, exceeding the commercial noncancer subslab screening value of 88 µg/l (also higher than the respective cancer 10^{-4} value). The indoor air values for both TCE and PCE were within the EPA's acceptable risk ranges. Therefore, further monitoring or mitigation may be necessary if the building structure is modified or if there is a change in its use in the future. Since a portion of the building is no longer structurally sound, it is, however, unlikely that it will be occupied in the future.

PCE and TCE were detected in the subslab at the groundwater management system building at 23 $\mu g/m^3$ and 0.43 $\mu g/m^3$, respectively and in the indoor air at concentrations of 99 $\mu g/m^3$ and 28 $\mu g/m^3$, respectively. A comparison of the above subslab results with the indoor air concentrations detected in the buildings shows that it is highly unlikely that the PCE and TCE concentrations detected in the indoor air sample collected from the groundwater management system building are due to soil vapor intrusion. Rather, the groundwater treatment processes inside the building are the source of the indoor air contamination.

To evaluate the potential for SVI for off-property buildings, in March 2012, ten residential dwellings were sampled. The testing did not show any significant indoor impacts associated with the soil vapor intrusion pathway in the off-property residential properties. However, the sump water at one structure showed elevated concentrations of site-related VOCs. Although indoor results did not show a current unacceptable exposure, as a precautionary measure NYSDOH recommended that a cover be installed on the sump to limit the potential for any future exposures. The sump cover was installed in late winter 2013 and a confirmatory sampling event will be performed during the 2013/2014 heating season. NYSDOH also advised several property owners that "housekeeping" to remove volatile organic source materials, such as gasoline-powered equipment, should be undertaken.

As noted above, the following RAOs were established for the site:

- Eliminate the threat posed to area residents by exposure to contaminated groundwater.
- Ensure protection of groundwater and surface water from the continued release of contaminants from soils.
- Restore groundwater in the affected area to levels consistent with state and federal water quality standards.
- Decontaminate the building for future use.

These RAOs are still valid.

Remediating the contaminated soils on the property and contaminated sediments both on and off the property eliminated potential ecological exposure.

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

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

- The Village-supplied drinking water and the carbon treatment systems meet water quality standards.
- While site soils were excavated, treated and backfilled to protective levels, elevated concentrations of PCE exist in the overburden soil beneath the concrete floor and in close proximity to the southwest perimeter wall of the former manufacturing building, as well as in the bedrock.
- The building has been decontaminated.
- While the GWETS is operating properly to extract and treat the contaminated groundwater, the high pumping rate pumping Country Estates wells continue to draw the contaminated plume in their direction.
- Although concentrations are generally decreasing, on-site monitoring wells in the vicinity

of the source area continue to have elevated concentrations of PCE and TCE.

- The treated groundwater meets discharge criteria.
- The fence around the site is intact and in good repair.
- The groundwater monitoring wells are functional.
- Decreases in the levels of VOC contamination in the groundwater are a direct result of the groundwater extraction and treatment system. The three residential wells located to the west of Scotch Rock Road are the historical limits of the contaminated groundwater plume. PCE and TCE have not been detected in these wells since January 2006; there have, however, been sporadic low level detections of their breakdown products.
- There is no evidence of trespassing, vandalism or damage (to the extraction wells, monitoring wells, or fence).

Based upon the results of the RSO and the five-year review, the following suggestions are made:

- Continue pumping at highly contaminated overburden extraction wells OW-2, OW-3, OW-5, OW-7, OW-9, OW-10, OW-11, OW-13, OW-14, OW-15 and OW-16 to reduce migration of contamination into the bedrock aquifer.[5]
- Properly abandon the unneeded overburden extraction wells.
- Replace the existing well pumps in all extraction wells with variable speed pumps.
- Decommission extraction wells, as appropriate, based on a well inventory and the results of the hydraulic testing.
- Continue pumping the bedrock extraction wells EW-2, EW-5, EW-6, EW-7, EW-9 and EW-16 to hydraulically contain and treat the most contaminated area PCE of bedrock groundwater.
- Continue to maintain the carbon treatment systems at the three residential properties.
- Conduct a hydraulic evaluation of the extraction wells to determine the optimum sustainable pumping rates that result in hydraulic capture of the source area, including the area around well IW-9.
- Install additional water level monitoring wells, as necessary, to evaluate/demonstrate hydraulic capture at the site.
- Monitor selected wells to evaluate the changes in concentration resulting from the recommended changes to the extraction well array.
- If, after three years of monitoring the selected monitoring wells, the results do not show reason to re-activate the off-site inter-plume extraction wells, the decommissioned off-site wells should be appropriately abandoned.
- Evaluate the need to install downgradient monitoring points to monitor potential effects of discontinuing off-site bedrock extraction wells (likely plume shift).
- Properly abandon all bedrock wells not being used for extraction or monitoring.

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[5] The RSO recommended continue pumping at highly contaminated overburden extraction wells OW-2, OW-3, OW-5, OW-7, OW-13, OW-14 and OW-16 to reduce migration of contamination into the bedrock aquifer. Overburden wells OW-9, OW-10, OW-11 and OW-15 were added since the PCE concentrations in these wells are high enough to warrant continuation of extraction and treatment of the groundwater.

- Update the long-term monitoring plan within the Site Management Plan.
- Retrofit the remaining extraction wells with electronics in above-ground structures eliminating the need for frequent inspections due to weather-related issues.
- Install flow metering on all extraction wells.
- Streamline the treatment train to remove unused components, replace old and outdated components (air stripper) and modify the treatment train to focus on needed components focusing on operator friendly and less maintenance to reduce overall operating costs.[6]
- Upgrade system controls and automate the auto-alarm system for remote monitoring.
- The number, location and depth of the unused monitoring wells should be determined and inventoried.
- Monitoring wells that may prove useful for long-term monitoring purposes, based on their location and depth, should be re-developed to see if they are still viable. Viable wells should be reconditioned and incorporated into the long-term groundwater monitoring program. Monitoring wells that are no longer useful should be properly abandoned.
- Since high concentrations of PCE (1,200-3,400 µg/l) and TCE (620-1,900 µg/l) were found in injection well IW-9, it is suggested that hydraulic containment of bedrock groundwater in the vicinity of this well be achieved, if possible.
- To reduce the time needed to extract and treat the contaminated groundwater, the EPA intends to discuss with NYSDEC possible ways to address the residual soil contamination.

Based on recent packer testing of discreet contamination zones in extraction well EW-5, the RSO recommended shortening the depth of that well from 301 feet to 230 feet "to minimize pumping of cleaner water from the bottom of the borehole." The EPA intends to further discuss with NYSDEC the merits of this recommendation.

VIII. Issues, Recommendations and Follow-Up Actions

Table 5 contains recommendations and follow-up actions which should ensure long-term protectiveness.

IX. Protectiveness Statement

The site is protective of human health and the environment in the short-term. For the site to be protective in the long-term, ongoing chemical and hydraulic monitoring needs to be completed

[6] Changes to the groundwater treatment should be made in consultation with the EPA, since certain modifications may require a formal change to the groundwater treatment portion of the remedy as described in the ROD.

and data needs to be collected during the 2013/2014 heating season at a residence where a vapor intrusion mitigation measure was implemented to ensure that it is effective.

X. Next Review

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

Table 1: Chronology of Site Events	
Event	**Date(s)**
NYSDEC discovers improper disposal of chemicals at the site	1981
NYSDOH detects PCE and TCE contamination in wells in the vicinity of the site	1981
New York State enters into interim consent order with American Thermostat Corporation	1983
American Thermostat Corporation goes out of business	1985
Site is placed on National Priorities List	1986
Focused feasibility study for alternate water supply completed	1987
Record of Decision for alternate water supply	1988
Source control and groundwater Remedial Investigation/Feasibility Study initiation completed	1988
Record of Decision for source control	1990
Remedial design for alternate water supply completed	1991
Remedial design for building decontamination completed	1991
Completion of alternate water supply	1992
Completion of building decontamination	1992
Remedial design for soil remediation completed	1992
Remedial design for groundwater remedy completed	1993
Initiation of soil remediation	1993
Completion of Phase I of soil remediation	1995
Completion of Phase II of soil remediation	1996
Explanation of Significant Differences for soil remediation	1997
Initiation of construction for groundwater remedy	1997
Completion of construction for groundwater remedy, initiation of remedy	1998
Preliminary site close-out report	1998
First five-year review	2003
Second five-year review	2008
Remedial System Optimization	2012-2013

Table 2: Annual Operation and Maintenance (O&M) Costs	
Costs (Actual for 2012)	**Cost per Year**
Annual Groundwater Management System and Residential Systems O&M	$323,966
Monitoring	$15,004
Reporting	$63,454
Total Estimated Cost	$402,454

Table 3: Documents, Data and Information Reviewed in Completing the Five-Year Review
Record of Decision (alternate water supply), EPA, January 1988
Record of Decision (source control), EPA, June 1990
LTEVF Operations Reports, prepared by O'Brien & Gere, Inc. for Foster Wheeler Environmental Corporation, 1996
Remedial Action Report (source control), Foster Wheeler Environmental, July 1997
Explanation of Significant Differences, EPA, July 1997
Remedial Action Report (groundwater remedy), Foster Wheeler Environmental, September 1998
Well Informational Manual, Foster Wheeler Environmental, August 1998
Preliminary Site Close-Out Report, EPA, September 1998
Extraction, Monitoring and Residential Well Sampling Data, 1998 - 2003
Operations, Maintenance and System Effectiveness Reports, prepared by IT Corporation
Groundwater Remediation Monthly Progress Reports (September 1998-March 2003), prepared by Foster Wheeler Environmental, Inc. for EPA
Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils, EPA, November 2002
First Five-Year Review, September 2003
Second Five-Year Review, August 2008
Final Remedial System Optimization Report, American Thermostat Site MACTEC Engineering and Consulting, P.C., November 2008

Confidential Soil Vapor Intrusion Evaluation Letter Report, American Thermostat Site Characterization , MACTEC Engineering and Consulting, P.C., May 18, 2012
Periodic Review Report (2010 – 2011), American Thermostat Site, Prepared for the New York State Department of Environmental Conservation by MACTEC Engineering and Consulting, P.C., May 2012
RSO Implementation Activities Report, American Thermostat Site, Prepared for the New York State Department of Environmental Conservation by MACTEC Engineering and Consulting, P.C., January 2013
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 ROD

Table 4: Other Comments on Operation, Maintenance, Monitoring and Institutional Controls	
Comment	**Suggestion**
Extraction wells EW-2 and OW-16 show significant, unexplained increases in PCE concentrations in the most recent sample results.	The subject wells should be re-sampled to determine the basis for the increases.
The RSO recommended pumping a number of overburden extraction wells to reduce the migration of contamination into the bedrock aquifer.	Continue pumping extraction wells OW-2, OW-3, OW-5, OW-7, OW-9, OW-10, OW-11, OW-13, OW-14, OW-15 and OW-16 to reduce migration of contamination into the bedrock aquifer.[7]
There are overburden extraction wells that are no longer needed.	Properly abandon the unneeded overburden extraction wells.
The existing well pumps in all of the extraction wells should be replaced with variable speed pumps.	Replace the existing well pumps in all extraction wells with variable speed pumps.
Some extraction wells may need to be decommissioned.	Based on a well inventory and the results of the hydraulic testing, decommission extraction wells, as appropriate.
Bedrock extraction wells EW-2, EW-5, EW-6, EW-7, EW-9 and EW-16 should continue to be pumped to hydraulically contain and treat the most contaminated area PCE of bedrock groundwater.	Continue pumping the bedrock extraction wells EW-2, EW-5, EW-6, EW-7, EW-9 and EW-16.
The carbon treatment systems at the three residential properties should continue to be maintained.	Continue to maintain the carbon treatment systems at the residential properties.
The optimum sustainable pumping rates that result in hydraulic capture of the source area, including the area around injection well IW-9 should be determined.	Conduct a hydraulic evaluation of the extraction wells to determine the optimum sustainable pumping rates that result in hydraulic capture of the source area, including the area around injection well IW-9.
Additional water level monitoring wells might be needed to evaluate/demonstrate hydraulic capture at the site.	Install additional water level monitoring wells, as necessary, to evaluate/demonstrate hydraulic capture at the site.
Selected wells should be monitored to evaluate changes in concentration	Monitor selected wells to evaluate the changes in concentration resulting from the recommended

[7] The RSO recommended continue pumping at highly contaminated overburden extraction wells OW-2, OW-3, OW-5, OW-7, OW-13, OW-14 and OW-16 to reduce migration of contamination into the bedrock aquifer. Overburden wells OW-9, OW-10, OW-11 and OW-15 were added since the PCE concentrations in these wells are high enough to warrant continuation of extraction and treatment of the groundwater

resulting from the recommended changes to the extraction well array.	changes to the extraction well array.
A determination should be made as to whether the decommissioned off-site wells should be appropriately abandoned.	If, after three years of monitoring the selected monitoring wells, the results do not show reason to re-activate the off-site inter-plume extraction wells, the decommissioned off-site wells should be appropriately abandoned.
The need for downgradient monitoring points to monitor potential effects of discontinuing off-site bedrock extraction wells (likely plume shift) should be evaluated.	Evaluate the need to install downgradient monitoring points to monitor potential effects of discontinuing off-site bedrock extraction wells.
All bedrock wells not being used for extraction or monitoring should be abandoned.	Properly abandon all bedrock wells not being used for extraction or monitoring.
The long-term monitoring plan should be updated within the Site Management Plan.	Update the long-term monitoring plan within the Site Management Plan.
The remaining extraction wells should be retrofitted with electronics in above-ground structures eliminating the need for frequent inspections due to weather-related issues.	Retrofit the remaining extraction wells with electronics in above-ground structures.
Flow metering is needed on all extraction wells.	Install flow metering on all extraction wells.
Unused and outdated treatment components should be replaced and the treatment train should be modified to focus on needed components focusing on operator friendly and less maintenance to reduce overall operating costs.	Streamline the treatment train to remove unused components, replace old and outdated components (air stripper) and modify the treatment train to focus on needed components focusing on operator friendly and less maintenance to reduce overall operating costs.[8]
System controls should be updated and the auto-alarm system should be automated for remote monitoring.	Upgrade system controls and automate the auto-alarm system.
The number, location and depth of the unused monitoring wells should be determined and inventoried.	Inventory the number, location and depth of the unused monitoring wells.
Based on their location and depth, some monitoring wells may prove useful for	Monitoring wells that may prove useful for long-term monitoring purposes, based on their location

[8] Changes to the groundwater treatment should be made in consultation with the EPA, since certain modifications may require a formal change to the groundwater treatment portion of the remedy as described in the ROD.

long-term monitoring purposes.	and depth, should be re-developed to see if they are still viable. Viable wells should be reconditioned and incorporated into the long-term groundwater monitoring program. Monitoring wells that are no longer useful should be properly abandoned.
To reduce the time needed to extract and treat the contaminated groundwater, means to address the residual soil contamination should be evaluated.	The EPA should discuss with NYSDEC possible ways to address the residual soil contamination.

Table 5: Recommendations and Follow-up Actions

Issue	Recommendations and Follow-up Actions	Party Responsible	Oversight Agency	Milestone Date	Affects Protectiveness (Y/N)	
					Current	Future
Follow up vapor intrusion sampling is needed at a residence where a mitigation measure was implemented to ensure that the measure is effective.	A follow up vapor intrusion survey should be conducted during the 2013/2014 heating season at the residence where a mitigation measure was implemented.	NYSDEC	NYSDEC	9/30/14	N	Y
The conceptual site model needs to be updated.	Complete the ongoing chemical and hydraulic monitoring to update the conceptual site model.	NYSDEC	NYSDEC	12/31/14	N	Y

Table 6: Tetrachloroethylene Concentrations in Bedrock Extraction Wells						
Well Number	Highest Detected PCE Concentration Since 1998 (µg/l)[a]	April 2003 PCE Concentration (µg/l)	April 2008 PCE Conc. (µg/l)	October 2011 PCE Concentration (µg/l)	Reduction in PCE since April 2008	Overall Reduction in PCE
EW-1	490	ND	NS	NS	NA	NA
EW-2	19,000	320	220	270 June 2012: 11,000 (average)	INCREASE NA	99% 42%
EW-3	100	NS	NS	NS	NA	NA
EW-4	5,800	2.1	NS	NS	NA	NA
EW-5	2,300	60	NS	NS	NA	NA
EW-6	15,000	610	320	380	INCREASE	97%
EW-7	32,000	4,700	1,000	1,400	INCREASE	96%
EW-8	200	0.89	NS	NS	NA	NA
EW-9	18,000	1,200	380	210	45%	99%
EW-10	850	680	77	240	INCREASE	72%
EW-11	1,300	3,400	48	17	65%	99%
EW-12	5,000[b]	1,300	190	ND	100%	100%
EW-13	10	0.89[c]	NS	NS	NA	NA
EW-14	3,800	63	1	ND	100%	100%
EW-15	310[d]	2.3	NS	NS	NA	NA
EW-16	12,000[e]	2,000	8,500	6,600 June 2012: 1875(average)	22% 78%	45% 84%

Notes:

a= highest detected concentration during first two years of operation
b= highest detected concentration since deepening of well on 9/00
c= (4/01) discontinued pumping and sampling
d= highest detected concentration since converted into extraction well on 9/00
e= highest detected concentration since converted into extraction well on 11/01
ND=not detected
NS=not sampled
NA=not applicable

Table 7: Tetrachloroethylene Concentrations in Overburden Extraction Wells

Well Number	Highest Detected PCE Concentration Since 1998 (µg/l)[a]	April 2003 PCE Concentration (µg/l)	April 2008 PCE Concentration (µg/l)	October 2011 PCE Concentration (µg/l)	Reduction in PCE since April 2008	Overall Reduction in PCE
OW-1	19,000	780	260	160	38%	99%
OW-2	5,100	1,700	1,200	1,100	8%	78%
OW-3	22,000	16,000	8,600	5,400	37%	75%
OW-4	9,300	2,000[b]	NS	NS	NA	NA
OW-5	7,800	4,600	9,100	8,400	8%	NA
OW-6	270	120	33	31	6%	89%
OW-7	14,000	1,800	950	730	23%	95%
OW-8	8.9	4.2[a]	NS	NS	NA	NA
OW-9	1,200	280	350	440	INCREASE	63%
OW-10	1,400	470	380	320	16%	77%
OW-11	34,000	410	340	270	21%	99%
OW-12	1,600	140	19	14	26%	99%
OW-13	3,800	2500	900	630	30%	83%
OW-14	79,000	35,000	16,000	17,000	INCREASE	78%
OW-15[d]	7,800	1,600	420	270	36%	97%
OW-16	5,600	200	72	8,700	LARGE INCREASE	NA

Notes:

a= (4/01) discontinued pumping and sampling
b= (10/01) no longer being sampled
ND=not detected
NS=not sampled
NA=not applicable

Table 8: Reduction of PCE Concentrations in Influent Tank at the Water Treatment Plant[a]	
Sample Date	PCE Concentration in Influent Tank (µg/l)
October 1998	2,600
October 2002[b]	1,100
November 2003	1,100 – 1,200
December 2003[c]	1,400 – 1,900
January 2004	1,500 – 1,800
February 2004[d]	2,000 - 2800
March 2004	2,300 – 2,800
April 2004	2,300 – 2,300
Average	2,417
November 2007[e]	940 – 1,200
December 2007	1,200 - 880
January 2008	1,200 – 1,400
February 2008	1,300 – 1,300
Average	1,177
2010 Average	783
2011 Average	996

Notes:

a: Presently, the influent tank combines water from 9 bedrock and 14 overburden extraction wells.
b: Treatment flow rates for Oct-Dec 2002 ranged from 68-73 gpm
c: As part of optimization, 5 bedrock wells with low contaminant concentrations were taken off-line. As a result, the treatment flow rate for December dropped to 39 gpm from an average of 64 gpm during the previous two months.
d: Treatment flow rates for Feb-April 2004 ranged from 32-37 gpm
e: Treatment flow rates for Nov 2007-Feb 2008 ranged from 36-40 gpm

Greene County digital orthoimagery (2009) obtained from New York State GIS Clearinghouse at: http://www.nysgis.state.ny.us

N

0 65 130 Feet

Prepared/Date: MJW 10/10/12
Checked/Date: RHA 10/10/12

RSO IMPLEMENTATION REPORT
AMERICAN THERMOSTAT SITE
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Figure 1: Site Plan

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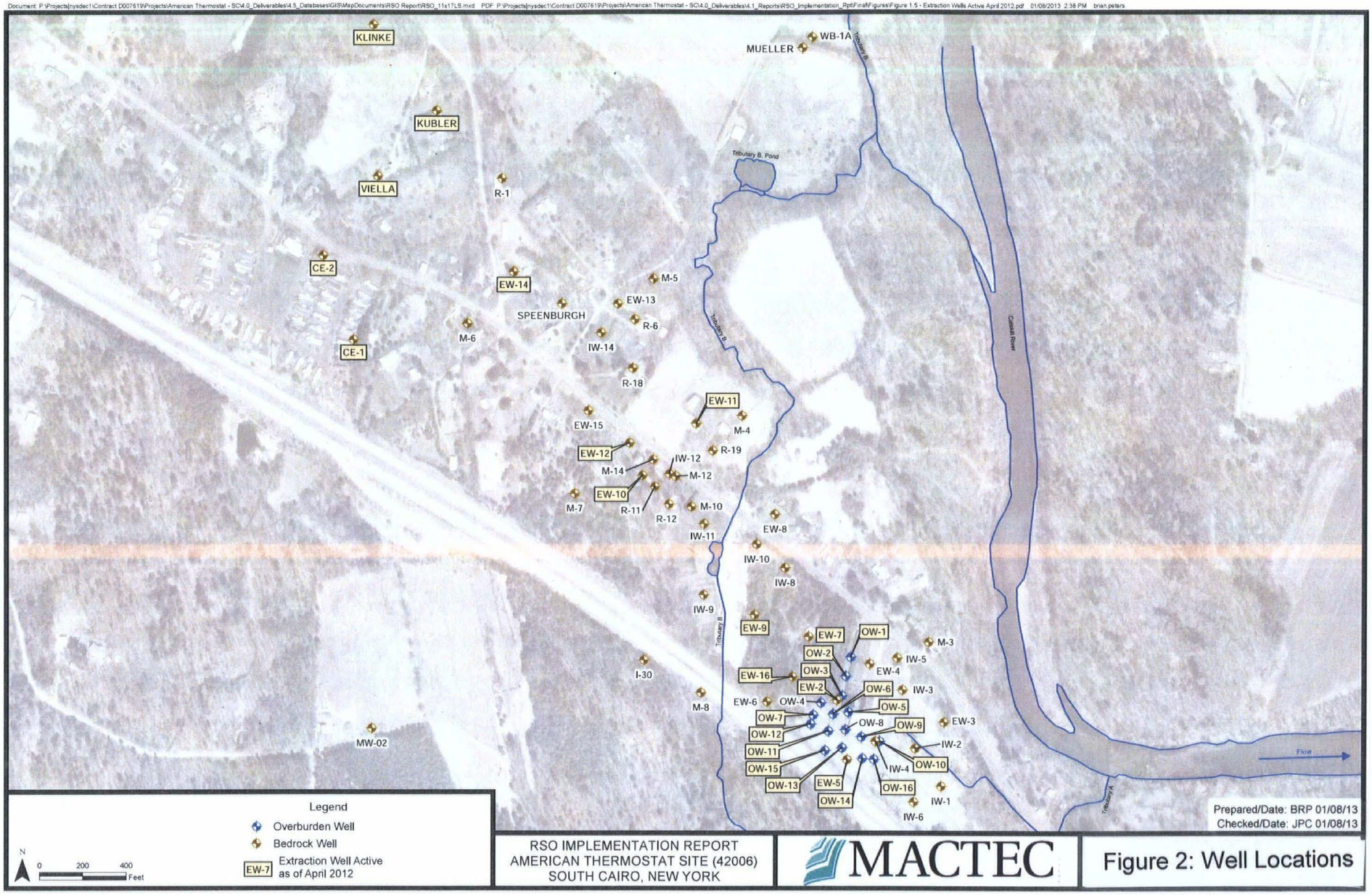

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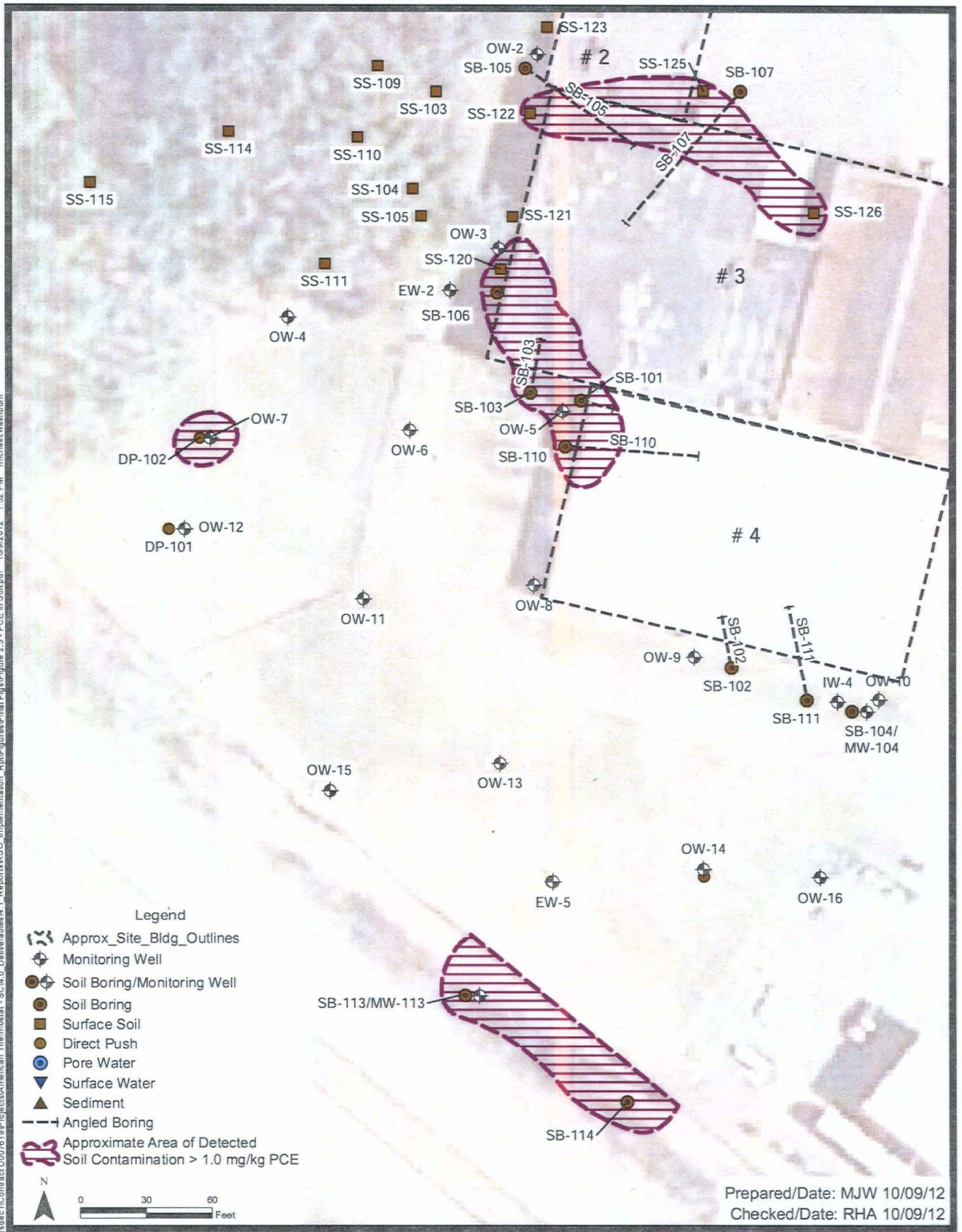
Figure 2: Well Locations



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INTERPRETED PCE DISTRIBUTION
IN SOIL (>1mg/Kg)
Project 3612-11-2212 **Figure 3**

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