**FINAL**

**SECOND RCRA PERIODIC REVIEW REPORT**

**WATERVLIET ARSENAL**

**WATERVLIET, ALBANY COUNTY, NEW YORK**

**MAIN MANUFACTURING AREA AND SIBERIA AREA**

***Prepared for:***

****

**UNITED STATES ARMY ENVIRONMENTAL COMMAND**

**2450 CONNELL ROAD, BLDG 2264**

**FORT SAM HOUSTON, TX 78234**

***Prepared by:***

 

**August 2015**

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**Periodic Review Report**

**Watervliet Arsenal**

**Watervliet, Albany County, New York**

Approved by:

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_

 *Signature Date*

JoAnn Kellogg

Environmental Program Manager

Directorate of Public Works,

Watervliet Arsenal

Approved By:

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_

 *Signature Date*

Lee H. Schiller Jr.

Colonel, U.S. Army

Commander Watervliet Arsenal

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**Attachment B: Site Inspection Checklist**

**Attachment C: Site Inspection Photographs**

**Attachment D: Health Risk Assessment Tables**

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**List of Acronyms**

AFU Air Filtration Unit

CAO Corrective Action Objective

cDCE cis-1,2-dichloroethene

cfm cubic feet per minute

CMS corrective measure study

COC chemical of concern

CSF cancer slope factor

CVOC chlorinated volatile organic compound

DCA 1,1-dichloroethane

DCE dichloroethene

DNAPL dense nonaqueous phase liquid

EC engineering control

GAC granular activated carbon

HRC® Hydrogen Release Compound

HI hazard index

IC institutional control

ICM interim corrective measure

IUR Inhalation Unit Risks

lbs/year pounds per year

LTM long-term monitoring

LUC land use control

MMA Main Manufacturing Area

MNA monitored natural attenuation

MPI Malcolm Pirnie, Inc.

µg/L microgram per liter

NE northeast

NW northwest

NWK Kansas City District

NYCRR New York Codes, Rules and Regulations

NYSDEC New York State Department of Environmental Conservation

NYSDOH New York State Department of Health

O&M operation and maintenance

PAH polycyclic aromatic hydrocarbons

PCB polychlorinated biphenyls

PCE tetrachloroethene

PRW permeable reactive wall

RCRA Resource Conservation Recovery Act

RFA RCRA Facility Assessment

RfC reference concentration

RfD reference dose

RFI RCRA Facility Investigation

SA Siberia Area

SCG Standard Criteria or Guidance

SDEF standard default exposure factor

SE southeast

SMP Site Management Plan

SOB Statement of Basis

SSDS Sub-Slab Depressurization System

SW southwest

TACOM Tank-Automotive and Armaments Command

TCA 1,1,1-trichloroethane

TCE trichloroethene

USACE United States Army Corps of Engineers

USEPA United States Environmental Protection Agency

VC vinyl chloride

VI vapor intrusion

VISL Vapor Intrusion Screening Level

WVA Watervliet Arsenal

Executive Summary

A Periodic Review has been completed for the Watervliet Arsenal located in Watervliet, New York. Corrective or Remedial Actions taken pursuant to RCRA (through a Consent Order or Corrective Action Permit) do not generally require a 5-Year or Periodic Review, however the Defense Environmental Restoration Program (DERP) Manual give the Services broad authority to conduct protectiveness and optimization reviews at any DERP site. The Army Environmental Command encourages such reviews for all sites that do not achieve unlimited use and unrestricted exposure or require long term monitoring. These reviews are periodic in nature and loosely apply Environmental Protection Agency discretionary review guidance. This is the second Periodic Review for the site.

Watervliet Arsenal (WVA) is an active U.S. Army installation covering approximately 140 acres located in Watervliet, New York (**Figure 1**). WVA was established in 1813 for the manufacture of guns and cannons. As shown on **Figure 2**, the WVA consists of the 125 acre Main Manufacturing Area (MMA) and the 15 acre Siberia Area (SA). Soil, groundwater and soil vapor are the impacted media at the WVA.

Soil contamination in the SA and MMA historically exceeded the New York State Department of Environmental Conservation soil clean-up objectives (SCO) for commercial/industrial sites and also the Technical and Administrative Guidance Memorandum (TAGM) 4046 SCO. The main soil contaminants identified in the SA Statement of Basis are polycyclic aromatic hydrocarbons (PAHs), arsenic, chromium and lead. The SA has two asphalt caps in place, providing an incomplete pathway for the dermal and inhalation pathways for the surface soil. Previous remedies include excavation and disposal of burn pit soil and landfarming. The main soil contaminants identified in the MMA Statement of Basis are arsenic, chromium, lead, mercury, and semi-volatile organic compounds (SVOCs). The primary soil remedy at the MMA is site management through land use controls.

Groundwater contamination in the SA and MMA historically exceeded New York State Department of Environmental Conservation Technical and Operational Guidance Series 1.1.1. The SA Statement of Basis identifies chlorinated volatile organic compound (CVOCs) and SVOCs, including PAHs as the groundwater contaminants at the SA. The MMA Statement of Basis identifies CVOCs as the groundwater contaminants at the MMA. Monitored Natural Attenuation and Long-Term Groundwater Monitoring are the remedies applied to both MMA and SA groundwater. SA also has a passive (natural groundwater flow) underground permeable iron reactive wall.

To address the soil vapor intrusion concerns, the Statement of Basis for the MMA selected the continued operation of previously installed Sub-Slab Depressurization Systems (SSDS) in building basements that exceeded the New York State Department of Health vapor intrusion guidance values. Currently eight buildings at the MMA are equipped with SSDS. Building 40, where installation of an SSDS was not practical due to building conditions, utilizes air filtration units in an above-ground vapor mitigation system.

Since contaminated groundwater and soil vapor remain at the site, the selected remedy includes engineering controls and institutional controls to protect human health and the environment. The Statement of Basis includes a series of institutional controls in the form of site restrictions.

Performance and operational data for the WVA corrective measures were reviewed and it was determined that all of the corrective actions are functioning effectively.

**Summary of New Issues/Recommendations**

There were no issues or deficiencies identified during this review period that would prevent the remedy from being effective and protective of human health and the environment. However, several concerns, not affecting the protectiveness of the remedy were identified. The concerns and recommendations are discussed in **Sections 8.0** and **9.0** for the MMA and **Sections 17.0** and **18.0** for the SA.

**Effectiveness/Protectiveness Determination**

The remedies at the MMA are effective and protective of human health and the environment.

The remedies at the SA are effective and protective of human health and the environment.

**Periodic Review Summary Form**

|  |
| --- |
| **SITE IDENTIFICATION** |
| **Installation Name:** Watervliet Arsenal |
| **EPA Region:** 2 | **State:** NY | **City/County:**  Watervliet/Albany |
| **SITE STATUS** |
| **RCRA Permit:**  Yes**Does Permit Requires PR:** Yes | **Other State Authority:** Click here to enter text. |
| **Number of Sites?** Two Operable Units, WVAA-25 and WVAA-32 | **Lead Regulatory Agency**EPA |
| **REVIEW STATUS** |
| **Major Command:** IMCOM  |
| **Installation Environmental Chief:** JoAnn Kellogg |
| **Lead Author name:** JoAnn Kellogg (Installation Environmental Chief) |
| **Lead Author affiliation:** Watervliet Arsenal |
| **Review period:** September 1, 2014 – September 1, 2015 |
| **Date of site inspection:** November 4, 2014 |
| **Type of review:** Periodic Review – Army Policy |
| **Review number:** 2 |
| **Initial Triggering action date:** September 2010 (previous Review) |
| **Due date *(five year cycle)*:** September 30, 2015 |

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| **Issues/Recommendations Identified in the Periodic Review** |
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| No issues affecting the protectiveness of the remedy were identified.  |

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| **Effectiveness/Protectiveness Statement** **Main Manufacturing Area (MMA)** |
| *Effectiveness/Protectiveness Determination:*Protective |  |
| *Effectiveness/Protectiveness Statement*: |  |   |
| The remedies at the MMA are effective and protective of human health and the environment.The selected remedies for the MMA address groundwater contamination and vapor intrusion. The selected remedies also included development of a Site Management Plan (SMP), consisting of a Land Use Control Plan and a Monitoring Plan. Monitored Natural Attenuation and Long Term Groundwater Monitoring are the remedies applied to the MMA groundwater.To address the soil vapor intrusion concerns, Sub-Slab Depressurization Systems (SSDS) operate in building basements that exceeded the New York State Department of Health vapor intrusion guidance values. Currently eight buildings at the MMA are equipped with SSDS. Building 40, at which installation of SSDS was not practical due to building conditions, utilizes air filtration units in an above-ground vapor mitigation system. Since contaminated groundwater and soil vapor remain at the site, the selected remedy included engineering controls and institutional controls to protect human health and the environment. The Statement of Basis included a series of institutional controls in the form of site restrictions. Performance and operational data for the WVA MMA corrective measures were reviewed and it was determined that all of the corrective actions are functioning effectively.  |

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| **Effectiveness/Protectiveness Statement** **Siberia Area (SA)** |
| *Effectiveness/Protectiveness Determination:*Protective |  |
| *Effectiveness/Protectiveness Statement*: |  |   |
| The remedies for the Siberia Area are effective and protective of human health and the environment. Exposure pathways that could result in unacceptable risks are being controlled.Monitored Natural Attenuation and Long Term Groundwater Monitoring are the remedies applied to the SA groundwater. The SA groundwater remedy also included a passive (natural groundwater flow) underground permeable iron reactive wall.Since contaminated soils and groundwater remain at the site, the selected remedy included engineering controls and institutional controls to protect human health and the environment.Performance and operational data for the WVA SA corrective measures were reviewed and it was determined that all of the corrective actions are functioning effectively. |

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| **AEDB-R Reporting** |
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| --- |
| **Results (summary of the protectiveness statements):** |
| The WVA MMA corrective measures are functioning effectively.The selected remedies for the MMA address the Corrective Action Objectives for groundwater contamination and vapor intrusion. The selected remedies also included development of a Site Management Plan (SMP), consisting of a Land Use Control Plan and a Monitoring Plan. The corrective measures eliminate or mitigate all significant threats to public health and the environment.The WVA SA corrective measures are functioning effectively.The selected remedies for the SA address the Corrective Action Objectives for soil and groundwater contamination. The selected remedies also include Institutional Controls to limit site use. The corrective measures eliminate or mitigate all significant threats to public health and the environment. |

|  |
| --- |
| **Recommended Actions (summary of the issues/recommendations):** |
| No issues affecting the effectiveness/protectiveness of the MMA or SA remedies were identified during the review. However, several concerns, not affecting the protectiveness of the remedy were identified and are detailed in Sections 8.0 and 17.0 of the Periodic Review. |

|  |
| --- |
| **Implementation Plans (how to implement the actions with milestone dates):**  |
| **Complete recommendations by milestone dates. NA**  |

|  |
| --- |
| **IAP Tool** |
| The WVA MMA corrective measures are functioning effectively.The selected remedies for the MMA address the Corrective Action Objectives for groundwater contamination and vapor intrusion. The selected remedies also included development of a Site Management Plan (SMP), consisting of a Land Use Control Plan and a Monitoring Plan. The corrective measures eliminate or mitigate all significant threats to public health and the environment.The WVA SA corrective measures are functioning effectively.The selected remedies for the SA address the Corrective Action Objectives for soil and groundwater contamination. The selected remedies also included Institutional Controls to limit site use. The corrective measures eliminate or mitigate all significant threats to public health and the environment.No issues affecting the effectiveness/protectiveness of the MMA or SA remedies were identified during the review. However, several concerns, not rising to the level of a “protectiveness issue” were identified and are detailed in Sections 8.0 and 17.0 of the Periodic Review. |

# Introduction

The Watervliet Arsenal (WVA) is a 140-acre government-owned installation under the command of the U.S. Army Tank-Automotive and Armaments Command (TACOM). Located in the city of Watervliet, New York, the WVA is situated on the western shore of the Hudson River five miles north of the city of Albany, as shown on **Figure 1**.

On October 12, 1993, the WVA entered into an Order on Consent Docket No. II RCRA-3008-h-93-0210 with the New York State Department of Environmental Conservation (NYSDEC) and the United States Environmental Protection Agency (USEPA) to remediate the property. The WVA consists of two primary areas: the 125 acre Main Manufacturing Area (MMA), where manufacturing and administrative operations occur, and the 15 acre Siberia Area (SA), which is primarily used for the storage of raw and hazardous materials, finished goods, and supplies brought from the MMA.

WVA’s MMA and SA Area are not National Priorities List sites. However, per the Consent Order, both areas were assigned a USEPA I.D. number: NY7213820940/ Site No. 401034A. The MMA is tracked under U. S. Army Installation Restoration Program Environmental Database numbers WVAA-32. The SA is tracked under U. S. Army Installation Restoration Program Environmental Database number WVAA-25 (NYSDEC & USEPA, 2008). The Order on Consent required the WVA to identify and fully investigate the nature, rate of migration, and extent of contamination at the facility, evaluate potential corrective measures, and implement these remedies as Interim and Final Corrective Measures.

Corrective or Remedial Actions taken pursuant to RCRA (through a Consent Order or Corrective Action Permit) do not generally require a 5-Year or Periodic Review, however the Defense Environmental Restoration Program (DERP) Manual give the Services broad authority to conduct protectiveness and optimization reviews at any DERP site. The Army Environmental Command encourages such reviews for all sites that do not achieve unlimited use and unrestricted exposure or require long term monitoring. These reviews are periodic in nature and loosely apply Environmental Protection Agency discretionary review guidance. This Periodic Review addresses both areas at WVA. The review was performed during September 2014 through September 2015 by the U. S. Army Corps of Engineers (USACE), Kansas City District (NWK). The USEPA is the lead regulatory agency but they have delegated most of their duties at the WVA to the NYSDEC.

This is the second Periodic Review for the MMA and the SA. **Sections 2.0** through **10.0** of this Periodic Review relate to the MMA and **Sections 11.0** through **19.0** relate to the SA. Soil, groundwater, and soil vapor are the impacted media at the WVA. The methods, findings, and conclusions of the review are documented in this report along with issues found during the reviews and recommendations to address them.

# Watervliet Arsenal Chronology – Main Manufacturing Area

A chronology of important site events and relevant dates for the MMA are presented below in **Table 1**.

**Table 1: Chronology of Site Events - MMA**

| **Event** | **Date** |
| --- | --- |
| Initial release timeframe | Before 1940 to 1970s |
| Initial discovery of problem or contamination | Before 1978 |
| Initial Investigation – Expanded Site Investigation | 1978 |
| Oil Pollution Source Elimination Study performed | January 1980 |
| Installation Assessment of Watervliet Arsenal by the U.S. Army Toxic and Hazardous Materials Agency | May 1980 |
| Administrative Order on Consent between the WVA, USEPA and NYSDEC (Docket No, II RCRA-3008(h)-93-0210) (Consent Order) | September 1993 |
| RCRA Facility Investigation of the MMA performed | 1995 -- 2000 |
| Soluble Oil Line Removal Certification Report for the MMA completed | June 1998 |
| RCRA Facility Investigation Report for the MMA completed | November 2000 |
| Building 110 Tank Investigation | May 2001 |
| Final Environmental Baseline Survey performed | August 2001 |
| Final Exposure Assessment of the MMA completed | May 2003 |
| Long-Term Monitoring 2002 Data Summary Report | September 2003 |
| Long-Term Monitoring May 2003 Data Summary Report | December 2003 |
| Long-Term Monitoring October 2003 Data Summary Report | July 2004 |
| Corrective Measures Work Plan for Building 40 Bedrock Groundwater in the MMA | July 2004 |
| Corrective Measures Monitoring Plan for Building 40 Bedrock Groundwater in the MMA | August 2004 |
| Long-Term Monitoring 2004 Data Summary Report | December 2004 |
| Long-Term Monitoring Plan 2008 Update | June 2008 |
| Vapor Intrusion Investigation at the MMA | August 2008 |
| Vapor Intrusion Interim Corrective Measures Work Plan for the Main Manufacturing Area completed | July 2009 |
| Long-Term Monitoring Plan 2009 Update | 2009 |
| Building 40 Bedrock Groundwater Corrective Measures Performance Evaluation Report completed | January 2010 |
| Long-Term Monitoring 2009 Data Summary Report | January 2010 |
| Long-Term Monitoring Plan 2010 Update | 2010 |
| First Periodic Review completed | September 2010 |
| Vapor Intrusion Interim Corrective Measures Construction Certification Report completed  | September 2010 |
| Final Statement of Basis for MMA completed  | October 2012 |
| Site Management Plan completed | November 2013 |
| Long-Term Monitoring 2013 Data Summary Report | March 2014 |

# Watervliet Arsenal Background – Main Manufacturing Area

## Site Description

The WVA consists of two primary areas: the Main Manufacturing Area (MMA) comprises about 125 acres, where manufacturing and administrative operations occur, and the SA comprises about 15 acres, which is primarily used for the storage of raw and hazardous materials, finished goods, and supplies brought from the MMA. These areas are shown on **Figure 2**. The MMA building numbers are shown on **Figure 3.** Additional background information specific to the SA is provided in **Section 12.0** of this Periodic Review.

The WVA was established in 1813 by the U.S. War Department and is a national registered historic landmark. The original purpose of the WVA was to distribute supplies to troops along the northern and western frontiers. Over the years, the main function of the WVA changed from the production of small arms ammunition, cannon cartridges, and leather goods to the production of the nation’s first 16-inch gun. The WVA also played a major role in the research and development of cannons, mortars, and recoilless rifles. From 1950 to 1970, the WVA built anti-aircraft weapons, the 90 mm gun for the medium tank, the 152 mm gun launcher, the lightweight 60 mm mortar, and a new 8-inch gun/howitzer for use in the Korean and Vietnam Wars. The WVA MMA currently manufactures large caliber cannons and mortars. Past operations at the MMA included solvent degreasing of machined materials, chromium wastewater collection and treatment (from plating operations), and storage of metal chips coated with cutting oils.

To the east of WVA, Broadway Street (Route 32) and a six-lane interstate highway (I-787) separate the WVA from the Hudson River. Residential and light commercial properties are located along the northern and southern site boundaries. To the west of the MMA are: residential properties, Perfection Plating (former manufacturer of metal plates for brake pads and currently under remediation by NYSDEC), the SA, Shaker Tire Sales, and land owned by the town of Colonie.

## Physical Charactristics

### Physiography and Topography

The MMA ranges in elevation from approximately 18 feet above mean sea level at the eastern site boundary, along the Hudson River, to approximately 75 feet above mean sea level along the western boundary of the MMA. Topography at the site generally slopes gently to the east and west from the topographic high. The topography of the area is believed to have been significantly altered through the filling and construction activities at the site (i.e. road construction and building foundation construction).

### Geology

The major overburden unit identified in the MMA is fill, consisting of brown or dark gray silty sand with angular gravel. The fill material is the only unit consistently found throughout the site, with the thickest amount of fill in the eastern portion of the MMA. Underlying the fill are the following native overburden units: a fine-grained alluvium, a coarser alluvium, and glacial till. These units are not present in all areas of the site.

The bedrock underlying the site is a black, medium-hard laminated shale, showing some characteristics of minor metamorphism. The bedrock can be described in three ways based on the degree of weathering observed. The first is an extremely weathered zone approximately four feet thick. During the site investigations, this highly weathered bedrock unit was encountered at depths ranging from near ground surface to approximately 20 feet below ground surface. Beneath this extremely weathered bedrock is a zone of less weathered shale showing minimal competency. Competent bedrock is generally encountered at depths ranging from approximately 1.5 feet below ground surface to 18 feet below ground surface. The upper portion of the competent bedrock was found to be fissile and highly fractured with 45 to 60 degree bedding planes. The depth to competent bedrock was based on auger refusal during drilling activities.

###  Hydrogeology

Due to the shallow depth of bedrock and the limited amount of overburden in several areas of the WVA, groundwater is encountered within different geologic units (overburden, weathered bedrock, or bedrock) depending on the location (Refer to **Attachment E-Geology and Hydrogeology Figures E-1 through E-7**)**. Figure E-8** represents the potentiometric surface of the shallow water bearing unit and **Figure E-9** represents the potentiometric surface of the intermediate water bearing unit. Groundwater is encountered in the bedrock at the western end of WVA (topographic high and local recharge area); progressing eastward toward the Hudson River, groundwater is encountered in the weathered bedrock and then in the overburden deposits. The only area at WVA which has sufficient saturated thickness of individual geologic units and hydraulic data to construct individual potentiometric maps for overburden, weathered bedrock, and bedrock, is in the vicinity of Building 25 (**Figures E-10 through E-12**).

Groundwater flow in bedrock in the MMA is primarily controlled by the degree of fracturing within the bedrock itself and in the local recharge area, which is coincident with a topographic high along a bedrock ridge in the central portion of the facility. The most prominent feature on the potentiometric surface is a groundwater divide trending approximately north to south through Buildings 135 and 130 (shown on **Figure E-9**). This feature appears to follow the bedrock ridge shown on the bedrock contour map (**Figure E-13**). The primary discharge area for groundwater from the MMA is the Hudson River, which is located to the east of WVA. As shown in the Potentiometric Contour Maps for the MMA (**Figures E-8 through E-12)**, groundwater in the area surrounding Building 25 flows from west to east towards the Hudson River, with a component of flow to the northeast. In the Building 40 area, groundwater in the bedrock unit flows to the east-southeast. West of the groundwater divide, shallow groundwater flow discharges west toward the Kromma Kill stream. Groundwater occurs as a contiguous water table aquifer on each side of the groundwater divide.

### Surface Water

The majority of the MMA is relatively impervious to rainfall except at the residential and

recreational areas of the northeastern portion of the WVA. Precipitation which collects on impermeable surfaces in the MMA typically is transported down paved streets and into the WVA storm sewer system. The majority of surface water runoff collected in the MMA is discharged through Outfall 003 into the Hudson River. In other areas of the MMA, storm water is discharged through other outfalls into the Hudson River, onto the Delaware & Hudson property west of WVA, and into the SA storm sewer system.

## Land and Resource Use

The WVA is zoned industrial. The MMA is located within a light industrial area. Residential and light commercial properties are located along the northern and southern site boundaries. To the west of the MMA are residential properties; the SA, which extends into the town of Colonie; commercial properties; lands formerly owned by the Delaware and Hudson Railroad; and Canadian Pacific railroad tracks. The MMA is bound on the east by Broadway (Route 32) and interstate highway I-787, which separate the WVA from the Hudson River.

The WVA currently manufactures large caliber cannons and mortars. Manufacturing operations at the MMA include forging and machining of gun tubes, chrome plating, heat treating, and materials testing. An on-site industrial wastewater treatment plant treats acidic rinse waters from chromium plating operations and soluble waste oils from machining operations. Past operations at the MMA included solvent degreasing of machined materials, chromium wastewater collection and treatment (from plating operations), and storage of metal chips coated with cutting oils.

## History of Contamination

Contamination of site media started in the early 1900s when the WVA began large scale manufacturing processes.Activities conducted at the WVA include the manufacturing of tubes and tube assemblies for cannons, cannon components, mortars, and recoilless rifles. The primary hazardous wastes generated at the WVA are acid and cyanide wastes from plating operations. Additional hazardous wastes generated from site operations include halogenated and non-halogenated solvent wastes, asbestos, mercury containing wastes, small quantities of soluble oils, pesticides, cleaning solutions, and laboratory waste. Chlorinated solvents were used prior to 1982 in vapor degreasing operations. Petroleum, oil, and lubricants have been and are currently used in machining operations. There are eleven underground storage tanks (USTs) which store waste oil.

In the past, during high production periods, WVA generated several hundred tons of scrap metals per year, most in the form of shavings (called “chips”) that were contaminated with oil. During the 1950's and 1960's the chips were stored on the ground in the area south of Building 132 in the far western portion of the MMA. Since the 1970s, the chips were stored in a containment structure located in the SA prior to shipment off-site for recycling. Also, it was a common practice in the past to spray a mixture of oil and solvents for dust control. This practice may be responsible for some of the POL contamination in the MMA.

## Initial Response

Title 6 of the New York Codes, Rules and Regulations (NYCRR) Part 373 includes RCRA Corrective Actions. This requires owners and/or operators of hazardous waste treatment, storage and disposal facilities to investigate and, when appropriate, remediate releases of hazardous wastes and/or constituents to the environment.

In relation to this facility, the NYSDEC, in conjunction with the USEPA Region 2, issued an Administrative Order on Consent to the WVA pursuant to Section 3008(h) of the RCRA and the Hazardous and Solid Waste Amendments of 1984, 42 United States Code Section 6901, and Section 71-2727 of the New York State Environmental Conservation Law. This order, which was effective October 12, 1993, required the WVA to identify and fully investigate the nature, rate of migration, and extent of contamination at the facility through a RCRA Facility Investigation (RFI), evaluate potential corrective measures through a Corrective Measures Studies (CMS), and implement these remedies as Interim and Final Corrective Measures.

A RFI, subsequent CMSs, and Long-Term Monitoring (LTM) were performed to characterize and monitor the nature and extent of contamination at the site.

The RFI and subsequent studies determined that the groundwater contamination in the MMA primarily consists of chlorinated volatile organic compounds (CVOCs), which were used prior to 1982 in vapor degreasing operations. Groundwater containing CVOCs at concentrations greater than guidance values is found in the following general areas: Building 20, Building 25, Building 40, and Building 114. Building 40 indoor air and soil gas sampling, conducted between February 2003 and February 2006, determined that corrective measures would be required in portions of Building 40 due to the presence of CVOCs in indoor air at concentrations greater than guidance values. The vapor intrusion (VI) investigations conducted between 2007 and 2008 within, and adjacent to, the MMA determined that corrective measures would be required for Buildings 20, 21, 22, 25, 114, 120, 121, and 130 due to the presence of CVOCs in soil vapor and/or indoor air at concentrations greater than guidance values.

The Interim Corrective Measures (ICM) implemented for Building 25 Groundwater, Building 40 Groundwater, and VI Mitigation are discussed below. The LTM Program for groundwater, initiated in 1999 to support investigations and implemented corrective actions, is also discussed.

### Building 25 Interim Corrective Measure

Based on data collected during the RFI and LTM program, aquifer conditions at Building 25 were generally favorable for the degradation of CVOCs in both the overburden and bedrock groundwater via reductive dechlorination. However, for reductive dechlorination to completely degrade CVOCs, the geochemical conditions in the subsurface must be ideal. Testing found that a lack of an energy source in the subsurface could potentially limit the microbial processes that result in complete reductive dechlorination. The injection of Hydrogen Release Compound (HRC®) was therefore selected as an ICM to add an energy source to the system and enhance the natural attenuation processes in the overburden and bedrock groundwater at Building 25.

In February 2004, approximately 1,350 pounds of HRC® was injected into the overburden, and approximately 2,600 pounds of HRC® was injected into the bedrock to enhance the natural attenuation of CVOCs in the groundwater near Building 25. The results of this ICM indicated that the injection of HRC® was successful in promoting biodegradation of CVOCs in both the overburden and bedrock groundwater through reductive dechlorination. Trends in the concentration of daughter products and the concentrations of dissolved gases (carbon dioxide, methane, and ethene) in the groundwater indicate that complete degradation of the CVOCs is still occurring more than 10 years after the ICM injections. CVOC concentrations in the most down-gradient monitoring well (MW-7) were significantly reduced to concentrations less than NYSDEC Class GA Groundwater Standards. These results indicate that biodegradation of the CVOCs in the groundwater at Building 25 will continue in the future. This conclusion has been supported by groundwater results from groundwater monitoring events conducted from 2006 through 2013. Data trends for the Building 25 Area groundwater sampling results are discussed in **Section 6.4** of this Review.

### Building 40 Interim Corrective Measure

RFI studies conducted at Building 40 indicated dissolved-phase CVOC concentrations and the potential presence of dense non-aqueous phase liquid (DNAPL) in bedrock groundwater. Based on the data, and lack of current surficial sources, the bedrock matrix is likely acting as a continuing source of groundwater contamination.

The Building 40 in-situ chemical oxidation ICM was initiated in September 2004 with injection of sodium permanganate on the west side of Building 40 followed by full scale injections into all injection wells in August 2005. However, due to the geology of the site, adequate distribution of the permanganate injections could not be maintained due to clogging of the injection points and bedrock fractures. This resulted in insufficient CVOC destruction in the bedrock groundwater. The results of the ICM showed that the permanganate injections had not decreased CVOC concentrations at the property boundary to less than the NYSDEC Class GA Standards. It was recognized by all parties (WVA, NYSDEC, USEPA and Malcolm Pirnie, Inc. (MPI)) that, due to the likely presence of DNAPL in the fractured bedrock at the site, achievement of the groundwater standards (TOGS 1.1.1) is not likely using currently available technologies.

### Long-Term Groundwater Monitoring Program

Groundwater samples were collected from the overburden and bedrock wells during the RFI and subsequent LTM program, which began in 1999. The LTM Program is focused on the MMA property boundary and the areas of groundwater concern, most notably the Building 20, 25, 40, and 114/121 areas. The monitoring is conducted in accordance with the approved WVA LTM Plan Update (MPI, 2010). The parameters analyzed include CVOCs for all wells, and semi-volatile organic compounds (SVOCs), metals and monitored natural attenuation (MNA) parameters, for some wells. The LTM results are documented in the Groundwater LTM Monitoring Reports and the WVA LTM Database. The LTM wells for MMA are shown in **Figure 4**. The 2010 - 2013 groundwater sampling results are presented in the 2010 - 2013 LTM Data Summary Reports and are discussed in **Section 6.4** of this Review.

### Soil Vapor Intrusion Interim Corrective Measures

At the request of the NYSDEC and the New York State Department of Health (NYSDOH), and in response to the publication of NYSDOH Guidance for Evaluating Soil Vapor Intrusion (October 2006 & amended June 2007), WVA conducted VI studies in the MMA in November 2007 and February 2008 with agency oversight from NYSDEC and NYSDOH. The Vapor Intrusion Investigation Report (MPI, 2008) presented the results of the 2007 and 2008 supplemental VI investigation.

A total of 26 buildings in the MMA were sampled and analyzed for CVOCs during at least one of the two investigation phases. The evaluation also assessed whether soil vapor at the WVA southern property boundary, and northern property boundary adjacent to the SA, contained CVOCs. Based on the results of the investigations, no further action was required at the off-site residences, the WVA property boundary, and at WVA Buildings 9, 18, 19, 23, 24, 35, 38, 44, 108, 110, 112, 115, 124, and 126. Sub-slab CVOC concentrations at the Building 15 motor pool, which has office space used by the National Guard, will require monitoring of the indoor air, but no corrective measures. CVOCs detected in the sub-slab at Buildings 116 and 123 were also in the range where indoor air monitoring would be required. However, since Building 116 is not occupied and Building 123 is only periodically used for painting operations, no monitoring will be conducted at these buildings. Indoor air monitoring will be conducted at Buildings 116 and 123 if the use of either building changes in the future.

Nine buildings (Buildings 20, 21, 22, 25, 40, 114, 120, 121, and 130) were found to require mitigation. For all buildings except Building 40, the ICMs consisted of the installation and operation of Sub-Slab Depressurization Systems (SSDSs). The use of an SSDS at Building 40 was not practical due to the age and construction of the building foundation consisting of field stone and a partial basement. Therefore, eight indoor air filtration units (AFUs) were installed in the impacted areas of the building in 2006 and were activated in 2007.

The construction, installation, and startup testing of the SSDSs was completed on September 3, 2010 and these activities are summarized in the Construction Certification Report (MPI, 2010). Annual operation, maintenance, and monitoring of the MMA SSDSs was reported separately through 2011, and added to the annual LTM Report in 2012 with the approval of the NYSDEC.

Building locations where VI corrective measures were implemented are shown in **Figure 5**.

The performance monitoring sampling results and the Operations and Maintenance (O&M) activities associated with the SSDS are presented in the 2013 LTM Data Summary Report and are discussed in **Section 6.4** of this Review.

## Basis for Taking Action

The RCRA Corrective Action process began with investigations to evaluate potential areas of the

facility that may have been impacted by hazardous wastes and/or hazardous constituents. Based on the results of investigations, the NYSDEC determined that hazardous wastes and/or

hazardous constituents have been released at the facility. The impact of releases of hazardous

wastes and/or hazardous constituents at the facility were characterized and evaluated.

Surface soil contamination is generally not present since the majority of process areas at MMA

are covered by asphalt, concrete, or buildings. Subsurface soil contamination is primarily related

to the presence of polycyclic aromatic hydrocarbons (PAHs) and metals. Chromium and arsenic

were the primary inorganic contaminants detected in the subsurface soil samples.

Groundwater contamination in the MMA is primarily CVOCs. The presence of these compounds in groundwater is assumed to be from vapor degreasing operations conducted in the MMA prior to 1982. Petroleum, oils, and lubricants associated with historic machining operations are also present beneath some of the manufacturing buildings as light non-aqueous phase liquids.

The analytical data collected for the facility includes the following:

**Table 2: Analytical Data Collected for the WVA**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Media** | **VOCs** | **SVOCs** | **Inorganics** | **Pesticides** | **PCBs** |
| Soil | X | X | X | X | X |
| Groundwater | X | X | X | X | X |
| Soil Vapor | X |  |  |  |  |
| Indoor Air | X |  |  |  |  |

Notes: VOCs – Volatile Organic Compounds

SVOCs – Semi-Volatile Organic Compounds

PCBs – Polychlorintated Biphenyls

The data identified chemicals of concern (COCs). A “chemical of concern” is a hazardous waste that is sufficiently present in frequency and concentration in the environment to require evaluation for corrective action. The RFI Report contains a full discussion of the data and the nature and extent of contamination. The environmental media requiring action are summarized in the Final Corrective Measures and Response to Comments on the Statement of Basis (SOB) for the MMA, dated October 2012.

The COCs identified at the MMA are:

* Soil – Metals (arsenic, chromium, lead, mercury), SVOCs (benzo(a)anthracene, benzo(a)pyrene)
* Groundwater – CVOCs: 1,1,1-trichloroethane (TCA), 1,1-dichloroethane (DCA), 1,1-dichloroethene (1,1-DCE), cis-1,2-dichloroethene (cDCE), trichloroethene (TCE), vinyl chloride(VC)
* Soil Vapor – CVOCs: carbon tetrachloride, chloromethane, TCE, tetrachloroethene (PCE)
* Indoor Air – CVOCs: TCE

Cleanup objectives were based on a comparison of the detected COCs with the soil and groundwater NYSDEC standards. Detections of COCs above the NYSDEC regulatory standards provided the basis for taking action at the site.

The established cleanup objectives for the MMA are:

Soil: NYCRR Part 375-6.8(b), Restricted Use Soil Cleanup Objectives for the Protection of Public Health for Commercial Use

**Table 3: WVA MMA Cleanup Objectives - Soils**

|  |  |  |
| --- | --- | --- |
| **Analyte** | **Unrestricted SCGa** **(ppm)** | **Restricted Use SCGb** **(ppm)** |
| **SVOCs** |  |  |
| Benzo(a)anthracene | 1 | 5.6 |
| Benzo(a)pyrene | 1 | 1 |
| **Metals** |  |  |
| Arsenic | 13 | 16 |
| Chromium | 30 | 1500 |
| Lead | 63 | 1000 |
| Mercury | .18 | 2.8 |

Notes:

a – SCG: Standard Criteria or Guidance, Part 375-6.8(a), Unrestricted Soil Cleanup Objectives

b – SCG: Part 375-6.8(b), Restricted Use Soil Cleanup Objectives for the Protection of Public Health for Commercial Use

Groundwater: For groundwater, the NYSDEC Class GA (Groundwater Class A, i.e. drinking water standards) groundwater standards, per 6 NYCRR Part 703, Surface Water and Groundwater Quality Standards, documented in the “NYSDEC Technical and Operational Guidance Series (TOGS) 1.1.1 Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations” apply. Investigations found groundwater contamination in excess of TOGS 1.1.1. Common contaminant compounds in excess of TOGS 1.1.1 were TCE, PCE, cis and trans DCE and VC. LTM wells in excess of TOGS 1.1.1 in May 2009 and October 2009 are shown in **Figures 6 and 7**, respectively.

**Table 4: WVA MMA Cleanup Objectives - Groundwater (NYSDEC Class GA Groundwater Standards & Guidance Values)**

|  |  |
| --- | --- |
| **CVOCs** | **SCGa (ppb)** |
| 1,1,1-Trichloroethane | 5 |
| 1,1-Dichloroethane | 5 |
| 1,1-Dichloroethene | 5 |
| 1,2-Dichloroethene | 5 |
| Trichloroethene | 5 |
| Vinyl Chloride | 2 |

Notes:

a – SCG: Ambient Water Quality Standards and Guidance Values (TOGs 1.1.1), 6 NYCRR Part 703, Surface water and Groundwater Quality Standards, and Part 5 of the New York State Sanitary Code (10 NYCRR Part 5)

Soil Vapor & Indoor Air: NYSDOH Guidance for Evaluating Soil Vapor Intrusion in the State of New York

The RFI and subsequent studies found groundwater and indoor air containing CVOCs at concentrations greater than guidance values. Based on the results of the investigations, the NYSDEC determined that corrective measures were required to address some of the areas investigated. The locations of the ICMs for VI in the MMA are shown on **Figure 5**.

The ICMs implemented at the site are discussed in **Section 3.5**, Initial Response, of this report.

After completion of the ICMs, some contamination remained in the subsurface at the site. The CMS evaluated investigation results and the completed ICMs, and identified the final corrective measures to address the remaining contamination. The cleanup objectives and final corrective measures selected for the WVA MMA are detailed in the Final Corrective Measures and Response to Comments on the Statement of Basis for the Watervliet Arsenal Main Manufacturing Area, October 2012, and are discussed in **Section 4.1** of this report.

# Corrective Actions: Main Manufacturing Area

## Remedy Selection

The cleanup objectives and final corrective measures are detailed in the Final Corrective Measures and Response to Comments on the Statement of Basis for the Watervliet Arsenal Main Manufacturing Area, October 2012.

### Summary of the Cleanup Objectives

The goal for the corrective measure program is to restore the facility to pre-disposal conditions to the extent feasible. At a minimum, the corrective measures shall eliminate or mitigate all significant threats to public health and the environment presented by the contamination identified at the facility. The established cleanup objectives for this facility are listed below and discussed in more detail in **Section 3.6** of this report:

Soil: Part 375-6.8(b), Restricted Use Soil cleanup Objectives for the Protection of Public Health for Commercial Use

Groundwater: New York State Groundwater Standards (6 NYCRR Part 700), Division of Water TOGS

Soil Vapor & Indoor Air: NYSDOH Guidance for Evaluating Soil Vapor Intrusion in the State of New York

###  Summary of the Environmental Impacts and Human Health Exposures

The selected remedy for MMA addresses the following human health and environmental exposure pathways:

Groundwater

 Human Health:

-Prevent direct contact with, or inhalation of volatiles from, contaminated groundwater

 Environment:

-Prevent the discharge of contaminants to surface water at concentrations exceeding applicable standards

-Remove the source of groundwater or surface water contamination

Soil

 Human Health:

-Prevent contact with contaminated soil

Soil Vapor

 Human Health:

-Mitigate impacts to public health resulting from existing, or the potential for, soil VI into buildings at the facility.

### Summary of Selected Remedies

The selected remedies for MMA address the Corrective Action Objectives (CAOs) for groundwater contamination and VI. The selected remedies also required development of a Site Management Plan (SMP), consisting of a Land Use Control (LUC) Plan and a Monitoring Plan. The final corrective measures for groundwater and VI, and the SMP, are summarized below.

#### Building 25 Groundwater Final Corrective Measure

Based on the results of site investigations and the completed ICM, No Further Action with continued LTM of the ongoing MNA is the final corrective measure for the groundwater at Building 25. Based on the results and conclusions from the Enhanced Bioremediation ICM, the proper geochemistry and nutrient supply necessary for sustaining natural attenuation of CVOCs is present. The CVOCs in the groundwater at Building 25 are localized to the Pilot Study Area and are not migrating beyond the WVA boundary; therefore, the final corrective measure should achieve cleanup objectives for the groundwater at Building 25 over the long term.

#### Building 40 Groundwater Final Corrective Measure

As discussed in **Section 3.5.2**, due to the geology at Building 40, the permanganate injections had not decreased CVOC concentrations at the property boundary to less than the NYSDEC Class GA Standards. Based on the results of the ICM and subsequent technology review, it was determined that achievement of the cleanup objective for the Building 40 bedrock groundwater is not technically feasible using currently available technologies. The area is served by public drinking water supplies; therefore no one is using the contaminated groundwater. Since there are no known exposure pathways, except for VI discussed below, No Further Action beyond MNA, documented through groundwater LTM, was selected as the final corrective measure for the Building 40 bedrock groundwater.

The Building 40 corrective measure will protect human health and the environment by monitoring CVOC concentrations greater than the cleanup objectives to ensure that CVOCs do not migrate beyond their current extent and/or increase in magnitude. Under the corrective measure, concentrations of CVOCs in the groundwater will be reduced and further migration of CVOCs in the groundwater offsite will diminish as a result of the continued degradation of PCE and TCE to non-toxic byproducts by natural attenuation processes. There are no known off-site receptors that are impacted by the groundwater from the Building 40 area.

As discussed in **Section 6.6**, the NYSDEC Project Manager noted that while the AFUs address the indoor air concerns, there is no active treatment of the groundwater at Building 40. Even though remediation of the Building 40 groundwater may be technically infeasible, this NYSDEC concern was identified as an issue in **Section 8.0** of this Review.

#### Vapor Intrusion Final Corrective Measure

No Further Action with continued operation and monitoring of the SSDSs identified in **Section 3.5.4** is the final corrective measure for VI in Buildings 20, 21, 22, 25, 114, 120, 121, and 130; and continued operation of the indoor AFU is the final corrective measure for Building 40. Building 15 does not require corrective measures but indoor air will be monitored. There are currently no unmonitored structures in the vicinity of the contamination, nor are any new structures likely planned for the future.

#### Site Management Plan (Land Use Control Plan and Monitoring Plan)

The selected remedies for the MMA required development of a SMP that includes a LUC Plan and a Monitoring Plan.

 Land Use Controls Plan

The LUC Planidentifies all use restrictions and engineering controls (ECs) for the site and details the steps and media-specific requirements necessary to ensure the LUCs remain in place and effective. This plan includes, but may not be limited to:

1) An Excavation Plan which details the provisions for management of future excavations and other actions that could otherwise disturb residual subsurface contamination.

2) Land use restrictions, including restrictions on groundwater use, and an acceptable method for evaluating potential impact that the remaining contaminants have on future development.

3) Provisions to maintain site cover to allow for industrial use of the site. Any site redevelopment will maintain a site cover, which may consist either of structures such as buildings, pavement, and sidewalks, or a minimum one-foot soil cover in areas where the upper foot of exposed surface soil will exceed the applicable soil cleanup objectives.

4) Provisions for the evaluation of the potential for soil VI for; any buildings developed on the site, including the provision for implementing actions recommended to address exposures related to soil VI.

5) Provisions for the management and inspection of the identified ECs.

6) Periodic certification to USEPA and NYSDEC, submitted by a professional engineer or environmental professional acceptable to NYSDEC, stating that the LUCs in-place are unchanged from the previous certification, and that nothing has occurred that would impair the ability of the LUC to protect public health or the environment or constitute a violation or failure to comply with the SMP.

Monitoring Plan

The Monitoring Planassesses the performance and effectiveness of the groundwater and VI remedies. The plan includes, but may not be limited to:

1) Monitoring of groundwater and indoor air to assess the performance and effectiveness of the remedy.

2) A schedule of monitoring and frequency of submittals to NYSDEC.

3) Monitoring for VI of buildings occupied or developed on site, as required.

## Remedy Implementation

The implementation status of the remedies selected for the MMA identified in **Section 4.1,** are summarized below:

### Building 25 and Building 40 Groundwater Remedy Implementation

Based on the results of site investigations and the completed ICM, No Further Action with continued LTM of the ongoing MNA is the final corrective measure for the groundwater at Building 25. No Further Action beyond MNA, documented through groundwater LTM, was selected as the final corrective measure for the Building 40 bedrock groundwater. The LTM Program, initiated in 1999, will continue to assess the performance and effectiveness of the remedy.

### Building 20 and Building 114 Groundwater Remedy Implementation

A final corrective measure, specific to the groundwater contamination in the vicinity of Buildings 20 and 114, was not selected. However, monitoring wells are included in the LTM Program to monitor the groundwater contamination trends at these locations.

### Vapor Intrusion Remedy Implementation

No Further Action with continued operation and monitoring of the SSDSs is the final corrective measure for VI in Buildings 20, 21, 22, 25, 114, 120, 121, and 130; and continued operation of the indoor AFUs at Building 40. The construction, installation, and startup testing of the SSDSs were completed on September 3, 2010. The eight indoor AFUs, installed in the impacted areas of Building 40 in 2006, were activated in 2007.

### Site Management Plan

A 2013 SMP, including a LUCs Plan and Monitoring Plan, has been developed. The SMP specifies the methods necessary to ensure compliance with all ECs and institutional controls (ICs) required by the SOB for contamination that remains at the site. This plan has been approved by the NYSDEC, and compliance with this plan is required by the SOB.

## Remedy Operation and Maintenance Activities

The site contains contamination left after completion of the corrective actions. ECs and ICs have been incorporated into the site remedy to control exposure to remaining contamination during the use of the site to ensure protection of public health and the environment. The SOB requires compliance with the SMP and all ECs and ICs placed on the site. The ICs place restrictions on site use, and mandate operation, maintenance, monitoring and reporting measures for all ECs and ICs. The procedures required to manage the remaining contamination at the site include: (1) implementation and management of all EC and ICs; (2) media monitoring; (3) O&M of all treatment, collection, containment, or recovery systems; (4) performance of periodic inspections, certification of results, and submittal of Periodic Review Reports; and (5) defining criteria for termination of treatment system operations.

To address these requirements, the SMP includes three plans: (1) an Engineering and Institutional Control Plan for implementation and management of EC and ICs; (2) a Site Monitoring Plan; and (3) an Operation and Maintenance Plan for implementation of remedial collection, containment, treatment, and recovery systems.

### Engineering Controls and Institutional Controls Plan

Since remaining contaminated groundwater and soil vapor exist beneath the site, ECs and ICs are required to protect human health and the environment.

#### Engineering Control System

ECs include SSDSs at several MMA buildings and AFUs at Building 40.

##### Sub-Slab Depressurization Systems (SSDS)

As presented in the Construction Certification Report (MPI, 2009), three types of SSDS units are used for corrective measures at the WVA.

Type A SSDS - These are used at Buildings 21 and 114. These SSDSs use regenerative blowers. The effluent air from these systems is treated using vapor-phase granular activated carbon (GAC).

Type B SSDS – These are used at Building 20 and Building 25. These SSDSs use positive-displacement rotary-lobe blowers. These systems are used where multiple extraction wells are required to provide negative sub-slab pressures over large areas. The effluent air streams from these SSDSs are combined and treated using vapor-phase GAC.

Type C SSDS – These are used at Buildings 21, 22, 120, 121, and 130. These SSDSs (with the exception of the Building 120 SSDS) use individual in-line fans for each extraction well. The Building 120 SSDS uses a high pressure fan system and is connected to two extraction wells. The effluent air from these SSDSs vents directly to the atmosphere.

##### Building 40 Air Filtration Units (AFUs)

Due to the construction and age of the Building 40 foundation (field stone with partial basement), an SSDS was not applicable. Therefore, indoor air filtration was utilized as the mitigation measure for the Building 40 indoor air. The mitigation measure consisted of the installation of eight AFUs in the impacted areas of the building. These units consist of 1,000 to 2,000 cubic feet per minute (cfm) capacity AFUs equipped with GAC/permanganate filter media for CVOC treatment. The AFUs were installed in 2006 and were activated in January 2007. The WVA monitors the operation of the units during monthly inspections and during semi-annual filter media testing. Filter media is replaced based on the results of the testing.

#### Institutional Controls

ICs are required by the SOB to: (1) implement, maintain and monitor EC systems; (2) prevent future exposure to remaining contamination; and, (3) limit the use and development of the site to commercial/industrial uses only.

The site has a series of ICs in the form of site restrictions. Adherence to these ICs is required by the SOB. Site restrictions that apply to the Controlled Property (designated as the “Area Included in the SMP” on **Figure 3**) are:

* The portions of the site applicable to the SMP may only be used for commercial or industrial purposes provided that the long-term ECs and ICs included in the SMP are employed.
* The portions of the site applicable to the SMP may not be used for a more stringent level of use (such as unrestricted use) without additional remediation and amendment of the SOB, as approved by the NYSDEC.
* All future activities on the property that could encounter the remaining contamination must be conducted in accordance with the SMP.
* The use of the groundwater underlying the property is prohibited without treatment rendering it safe for intended use.
* The potential for VI must be evaluated for any buildings developed in the area covered by the SMP, and any potential impacts that are identified must be monitored or mitigated;
* Farming on the property is prohibited.
* In accordance with Sections 2.3 and 5.2 of the SMP, the WVA will submit to NYSDEC a written statement that certifies, under penalty of perjury, that: (1) controls employed at the site are unchanged from the previous certification or that any changes to the controls were approved by the NYSDEC; and, (2) nothing has occurred that impairs the ability of the controls to protect public health and environment or that constitute a violation or failure to comply with the SMP.
* Prior to the construction of any enclosed structures located over areas that contain remaining contamination and the potential for soil VI, a soil VI evaluation will be performed to determine whether any mitigation measures are necessary to eliminate potential exposure to vapors in the proposed structure.

LUCs identified in the SMP will be maintained until the hazardous substances reach levels that allow unlimited use and unrestricted exposure or until the NYSDEC determines that continued operation is technically impracticable or not feasible. The U.S. Army TACOM is responsible for implementing the LUCs with regard to property. If the property is transferred out of federal ownership, all continuing LUCs, reporting requirements, and any other obligations related to the property will be satisfied through the United States’ conveyance of a deed restriction and/or environmental easement prior to any such transfer of deed to the property. Any such deed restriction/environmental easement would require the transferee, and subsequent transferees, to satisfy all of TACOM’s obligations relating to the property. TACOM acknowledges that, notwithstanding this intention, it or any successor federal entity remains ultimately responsible for satisfying the remedial obligations set forth in the SOB relating to the property if any subsequent transferee fails to satisfy the remedial obligations.

### Site Monitoring Plan

The SMP describes the measures for evaluating the performance and effectiveness of the remedy to reduce or mitigate contamination at the site. Monitoring efforts include groundwater monitoring, SSDS performance monitoring, AFU performance monitoring, and a Site-Wide Inspection.

#### Groundwater Monitoring

Groundwater monitoring is performed on an annual basis to assess the performance of the various corrective measures and to document the stability and attenuation of the remaining groundwater contamination. Monitoring will be performed in accordance with the latest approved LTM Plan (Malcolm Pirnie, 2010).

The network of monitoring wells has been installed to monitor both up-gradient and down-gradient groundwater conditions at the site. There are a total of 58 groundwater monitoring wells in the MMA that are sampled under the LTM Plan. Of these, 14 wells monitor the saturated overburden; six wells monitor either the overburden and weathered bedrock saturated zones (hybrid wells) or the weathered bedrock; and 38 wells monitor the bedrock at varying depths. Monitoring wells currently sampled in the MMA as part of the LTM are listed in **Table 5** with selection rationale, analytes, and sampling frequency. The well locations are also shown on **Figure 4.** Wells sampled annually are sampled during the spring (typically in May-June). Select wells (7 of the 58 MMA wells) in site boundary areas are sampled every five years during the spring sampling event. These pent-annual wells were last sampled in 2011, and will be sampled again in 2016.

Groundwater samples collected as part of the LTM program are analyzed for CVOCs and SVOCs by SW-846 Methods 8260 and 8270, respectively, and RCRA-metals by SW-846 Methods 6010 and 7470. Field parameters, consisting of temperature, pH, specific conductivity, dissolved oxygen, oxidation-reduction potential, and turbidity are measured. MNA parameters consisting of dissolved oxygen, redox potential, chloride, nitrite, nitrate, sulfate, ferrous iron, alkalinity, dissolved sulfide, dissolved organic carbon, and dissolved gases (methane, ethane, ethene, and carbon dioxide) are also analyzed.

#### Sub-Slab Depressurization System Performance Monitoring

Performance monitoring will be performed on an annual basis during the heating season to assess the performance of the corrective measures, in accordance with the approved ICM Work Plan (MPI, 2009) and the subsequent CMS (ARCADIS, 2011). Effluent air samples are collected from the Type A and B SSDSs and indoor air sampling is conducted in Buildings 20, 21, 23, 25, 35, 110, 114, 116, 120, 121, 123, and 130.

Pre- and post-carbon effluent samples are collected from the Type A (Building 21 and 114), and Type B (Building 20 and 25) SSDSs. The purpose of the sampling is to evaluate CVOC discharge mass and assess removal efficiency of the SSDS GAC vessels. Effluent samples are collected from the SSDS pre-carbon and post-carbon sampling ports using six-liter Summa Canisters equipped with thirty-minute flow-controllers. Indoor air samples are collected using 6 liter Summa Canisters in accordance with the ICM Work Plan (MPI, 2009). The samples are submitted to an Analytical Services Protocol certified laboratory following chain-of-custody procedures for analysis of CVOCs by USEPA Method TO-15.

#### Air Filtration Unit Performance Monitoring

Sections 3.3.3 and 4.2.2 of the SMP require performance monitoring during AFU operation. Carbon/Permanganate filter media samples are required to be collected from the Building 40 AFUs semi-annually to assess the performance of the remedy. Samples of the filter media from below the top surface of the media bed in each filter module are collected into sample bags. The samples are submitted to the AFU manufacturer’s laboratory for analysis of percent saturation of the carbon media with respect to CVOCs. Carbon media are replaced when the samples indicate approximately 70-80 percent saturation. As noted in **Section 4.3.2.2**, indoor air samples are collected from buildings with SSDSs. The SMP does not require collection of indoor air samples from Building 40.

#### Site-wide Inspection

In accordance with Sections 3.4 and 5.1.2 of the SMP, Site-wide inspections are performed on a regular schedule at a minimum of once a year. Site-wide inspections are also performed after all severe weather conditions that may affect ECs or monitoring devices. During these inspections, an inspection form is completed. Site-wide inspection forms are provided in electronic format in the Periodic Review Reports. The form will compile sufficient information to assess the following:

* Compliance with all ICs, including site usage.
* An evaluation of the condition and continued effectiveness of ECs.
* General site conditions at the time of the inspection.
* The site management activities being conducted including, where appropriate, confirmation sampling and a health and safety inspection.
* Compliance with permits and schedules included in the Operation and Maintenance Plan.
* Confirm that site records are up to date.

### Operations and Maintenance Plan

The O&M Plan describes the measures necessary to operate, monitor and maintain the mechanical components of the remedy selected for the site. The plan includes O&M requirements for the SSDSs, AFUs, and groundwater monitoring wells.

#### Sub-Slab Depressurization System Operations & Maintenance

As outlined in Section 4.2.1 of the SMP, daily operational monitoring, monthly system checks, and quarterly monitoring events are conducted during the operation of the SSDSs. Daily operational system monitoring are conducted remotely through the programmable logic controller telemetry for the Type A and Type B SSDSs. Type C systems are checked on a minimum bi-weekly basis to confirm they are operating. The monthly system checks monitor system performance and confirm that equipment is functioning properly. The quarterly monitoring events evaluate overall performance of the SSDSs and provide information to support any changes to the systems to optimize their operation. Monthly system checks consist of the following activities:

* Recording of system performance parameters (i.e., flows, pressures, and temperatures).
* Any required maintenance.
* Monitoring of volatile vapor concentrations in the air effluent using a

photoionization detector.

* Flow measurements.
	+ Balancing of flows.

Quarterly monitoring consists of the same activities as the monthly system checks, but also includes sampling of air effluent for systems with off-gas treatment.

Records of bi-weekly (Type C SSDSs), monthly, and quarterly system checks will be maintained throughout the operation of the SSDSs.

#### Air Filtration Units Operations & Maintenance

The first six years of AFU operation has shown the systems maintain adequate air flow through the filter media, treating the air as it circulates through the building, and preventing residual CVOCs below the building slab from causing exceedences of indoor air standards. Continued maintenance of this treatment will be confirmed by routine operational monitoring and reporting. Monthly system checks are required to confirm that the equipment is functioning properly and provide information to support any changes to the system to optimize its operation. Semi-annual sampling of the filter media sampling is required to confirm that the carbon/permanganate media are providing treatment.

#### Groundwater Monitoring Wells Operations & Maintenance

Repairs and/or replacement of wells in the monitoring well network will be performed based on assessments of structural integrity and overall performance.

## Inspections, Reporting, and Certifications

In accordance with Section 5.1.2 of the SMP, all inspections and monitoring events required by the EC and ICs Plan (**Section 4.3.1**), the SMP (**Section 4.3.2**), and the O&M Plan (**Section 4.3.3**) will be recorded on their appropriate forms. All applicable inspection forms and other records, including all media sampling data and system maintenance reports, generated for the site during the reporting period will be provided in electronic format in the Periodic Review Report.

Per the SMP, the results of the inspection and site monitoring data will be evaluated as part of the EC/IC certification to confirm that the:

* EC/ICs are in-place, are performing properly, and remain effective;
* The Monitoring Plan is being implemented;
* O&M activities are being conducted properly; and,
* The site remedy continues to be protective of public health and the environment and is performing per the SOB.

After the last inspection of the reporting period, a qualified environmental professional will prepare the following certification:

For each IC or EC identified for the site, I certify that all of the following statements are true:

* The inspection of the site to confirm the effectiveness of the ICs and ECs required by the remedial program was performed under my direction;
* The IC and/or EC employed at this site is unchanged from the date the control was put in-place, or last approved by the Department;
* Nothing has occurred that would impair the ability of the control to protect the public health and environment;
* Nothing has occurred that would constitute a violation or failure to comply with any site management plan for this control;
* Access to the site will continue to be provided to the Department to evaluate the remedy, including access to evaluate the continued maintenance of this control;
* If a financial assurance mechanism is required under the oversight document for the site, the mechanism remains valid and sufficient for the intended purpose under the document;
* Use of the site is compliant with the environmental easement;
* The EC systems are performing as designed and are effective;
* To the best of my knowledge and belief, the work and conclusions described in this certification are in accordance with the requirements of the site remedial program; and
* The information presented in this report is accurate and complete.

# Progress Since Last Review - Main Manufacturing Area

The effectiveness statement from the 2010 Periodic Review for the MMA was as follows:

The remedy for the Main Manufacturing Area at Watervliet Arsenal is effective, and exposure pathways that could result in unacceptable risks are being controlled.

No specific issues were identified in the 2010 Periodic Review. General recommendations included continued monitoring of the MMA groundwater, optimization of the groundwater monitoring program, perform O&M on existing SSDSs and installing new systems as necessary, and maintenance of ICs.

The final corrective measures for the MMA were selected in the Final Corrective Measures and Response to Comments on the Statement of Basis, October 2012. The Groundwater LTM Program continues and the current results are discussed in **Section 6.4** of this report; the testing and O&M activities performed on the existing SSDSs are also discussed. The annual LTM Reports include suggestions for optimizing the groundwater monitoring program. A comprehensive optimization evaluation is planned for 2015 and the evaluation results will be presented in an updated LTM Plan. ICs are in-place and are routinely inspected and verified.

# Periodic Review Process - Main Manufacturing Area

## Identification of Review Team Members

This second Periodic Review is performed for WVA’s MMA by the USACE, NWK. It is intended for use by the WVA, and the United States Army Environmental Command for post-closure management. The Watervliet Environmental Office and the United States Army Environmental Command have maintained ongoing discussions with NYSDEC as the lead regulatory agency overseeing Watervliet's environmental restoration program.

The WVA MMA Periodic Review effort included the following team members: Samuel Ezekwo, EPA Region II Remedial Project Manager; Larry Alden, NYSDEC Project Lead; Maureen Schuck, NYSDOH; JoAnn Kellogg, WVA Environmental Program Manager; Brian Roberts, Project Manager, and Kenneth Kamp, Project Engineer, USACE, NWK.

## Community Involvement

Since there was no community interest to form a Restoration Advisory Board, the WVA does not have a Board that meets periodically to discuss ongoing environmental restoration activities. However, public notices were provided and public comment periods were conducted for the MMA SOB. The public may view project documents at the WVA.

## Document Review

This Periodic Review consisted of a review of relevant MMA documents, which primarily included:

* Long-Term Monitoring Plan Update (MPI, 2010)
* Vapor Intrusion Interim Corrective Measures Work Plan, Main Manufacturing Area, WVA (MPI, 2009)
* Construction Certification Report, Vapor Intrusion Interim Corrective Measures, Watervliet Arsenal, Main Manufacturing Area (MPI, September 2010)
* Final Corrective Measures and Response to Comments on the Statement of Basis, Watervliet Arsenal, Main Manufacturing Area (October 2012)
* Site Management Plan, Watervliet Arsenal, Main Manufacturing Area (ARCADIS, February 2013)
* Long-Term Monitoring Data Summary Reports (2011 – 2013), WVA (ARCADIS, 2012-2014)

A complete list of documents reviewed for this Periodic Review is included in **Attachment A**.

## Data Review

The performance monitoring sampling results and O&M activities are detailed in the annual LTM Data Summary Reports.

### Performance Data Evaluation

#### Groundwater Monitoring Data Performance Evaluation

The groundwater monitoring well locations in the MMA are shown on **Figure 4**. Sixteen sampling zones within six MMA wells (WVA-MW-79 and multi-level wells WVA-MW-82R through WVA-MW-86R) were added to the LTM Plan in 2009 and are sampled annually to monitor the bedrock groundwater quality in the vicinity of Building 40. Seven wells, identified as “Pent-annual” wells on **Figure 4** are sampled every five years. These seven wells, sampled in 2006 and 2011, provide site boundary data. No exceedances of the NYSDEC Class GA standards for VOCs or SVOCs were recorded in these 7 boundary wells in either the 2006 or 2011 sampling events.

Data reviewed for this Periodic Review report focused on the spatial and temporal distribution of contaminant concentrations. In accordance with the LTM Plan (2009), 51 of the 58 MMA wells (including all zones of the five Building 40 Boundary Wells included in the LTM Plan) were scheduled for sampling during the 2010, 2012, and 2013 monitoring events. The 2011 monitoring event included the seven MMA boundary wells that are sampled every five years.

Analytical results for MMA LTM groundwater samples from the 2009, 2010, 2011, 2012, and 2013 events are summarized on **Figures 6 - 11**. Thesefigures show exceedances of NYSDEC Class GA (fresh groundwater classification) VOC standards for groundwater samples collected from the MMA LTM monitoring wells during each sampling event. NYSDEC Class GA standards for SVOCs were not exceeded in any samples collected from the LTM monitoring wells during any of the 2009 -2013 monitoring events. Based on the history of SVOC detections below NYSDEC Class GA standards, removal of the SVOC parameter from future monitoring events should be considered.

As depicted in **Figures 6 - 11**, CVOC concentrations in MMA groundwater samples collected from the 2009-2013 monitoring events have consistently exceeded Class GA standards for CVOCs in four general areas:

* East of Building 40;
* East of Building 25;
* East of Building 20; and
* In the area of Buildings 114/121 Groundwater Data

Due to the spatial and geological separation between the areas of concern in the MMA LTM program, analysis of trends in concentrations of parameters over the entire MMA is not practical. However, trends in total contaminant concentrations in samples collected from representative monitoring wells in the areas of concern discussed above have been utilized to evaluate variations in groundwater conditions. Additionally, trends in MNA parameters from the same representative monitoring wells have been utilized to evaluate the degree to which contaminants are degrading naturally.

**Figures 12 through 19** from the 2013 LTM Report present trends in total CVOC concentrations in groundwater samples from the following representative LTM wells located in the listed areas of concern:

* Building 40 Area: MW-82R, MW-83, MW-84R, MW-85R, MW-86R.
* Building 25 Area: 86EM-SP-1A, 25-MW-2, 25-MW-3, and 25-MW-7
* 114/121 Area: AW-MW-52, AW-MW-64, and MW-121S
* Building 20 Area: AW-MW-35

##### Building 40 Area Groundwater Data Trends

As shown on **Figures 12 through 16** (representing data from 2004 – 2013), total CVOC concentrations in samples collected from the multi-level boundary well network east of Building 40 are generally stable or decreasing, with the exception of MW-82R-2, MW-84R-1, MW-84R-2, MW-85R-2, MW-86R-2 and MW-86R-3 which showed increases in cDCE.

In accordance with the LTM Plan’s contingency evaluation protocol, well-specific and contaminant-specific statistical “trigger” concentrations have been established that initiate a contingency evaluation in the event groundwater monitoring data indicate a potential change in site conditions. CVOC concentrations in the Building 40 area wells did not exceed the established trigger values during the 2010 sampling event. However, CVOC concentrations from select wells in the Building 40 area exceeded the established trigger values during the 2011-2013 sampling events. The trigger values for PCE and TCE were exceeded in MW-85R-2 in 2011 and PCE was exceeded again at this well in 2012 (although the PCE concentration decreased from 6,700 micrograms per liter (μg/L) in 2011 to 5,100 μg/L in 2012). The trigger values for cDCE in MW-84R-2 and VC in MW-86R-2 were exceeded in 2012 and 2013. However, the increases in cDCE concentrations in these wells have been coincident with decreases in PCE concentrations, indicating degradation of primary contaminant mass.

Based on the LTM Plan’s contingency evaluation protocol mentioned above, no additional sampling was required for any of the wells that exceeded the trigger values. The increase in total CVOCs in these wells observed in 2013 will be evaluated in comparison with next year’s monitoring data.

#####  Building 25 Area Groundwater Data Trends

**Figure 17** (representing data from 1998-2013) shows generally decreasing overall trends in total CVOC concentrations in samples collected from monitoring wells WVA-25-MW-2 and WVA-25-MW-7. These trends are likely associated with the HRC® ICM pilot study at Building 25.

Prior to 2010, results for WVA-25-MW-3 did not show a definitive trend. Data since 2010 show an overall downward trend in total CVOC concentrations. In 2010, cDCE, the primary detected VOC, was reported at 190 µg/L. Since 2010, cDCE concentrations have consistently decreased and it was detected at 110 µg/L in 2013.

Total CVOC concentrations in WVA-25-MW-2 had shown a steady decrease since 2010 until a small increase in 2013. The primary VOCs detected in WVA-25-MW-2 since 2009 are cDCE, TCE, and VC. From a high of 64 µg/L in 2009, cDCE concentrations had decreased to a low of 25 µg/L in 2012, before increasing to 33 µg/L in 2013 (the average concentration for cDCE over this period was 41 µg/L). TCE, detected at 33 µg/L in 2011, decreased to a low of 11 µg/L in 2012, before increasing to 24 µg/L in 2013 (the average concentration for TCE over this period was 21 µg/L). VC, detected at 21 µg/L in 2009, was not detected in 2012, but was again detected in 2013 at 8 µg/L (the average concentrations for VC over this period was 9 µg/L). The small increases in VOC concentrations at WVA-25-MW-2 since 2012 are well within historical values of the specific VOC analytes. The increase in total CVOCs in this well observed in 2013 will be evaluated in comparison with subsequent year’s monitoring data.

Trends in total CVOC concentrations in samples collected from monitoring well 86EM-SP-1A are stable and do not appear to have been affected by the HRC® ICM pilot study.

VOC concentrations in Building 25 area groundwater samples from the 2010-2013 sampling events did not exceed the established trigger values.

##### Buildings 20 Area Groundwater Data Trends

As shown on **Figure 18** (representing data from 1998-2013), CVOC concentrations in monitoring well WVA-AW-MW-35 are generally stable. Total CVOC concentrations have fluctuated in recent years (varying from 50 µg/L to 85 µg/L) but have remained below the highest detection of 110 µg/L recorded in 1999.

##### Buildings 114/121 Area Groundwater Data Trends

As shown on **Figure 19** (representing data from 1998-2013), the generally stable or decreasing trends in total CVOC concentrations evident in samples collected from monitoring wells WVA-AW-MW-52 and WVA-AW-MW-64 continued in 2013. Although punctuated by increases in 2007 and 2010, the overall trend in total CVOC concentrations in WVA-MW-121S appears to be stable. CVOC concentrations in Building 114 area groundwater samples from the 2013 sampling event did not exceed the established trigger values.

##### Monitored Natural Attenuation (MNA) Parameters (Building 20 Area, Building 25 Area, and Building 114/121 Area)

**Figures 20** through **27** (representing data from 1999-2013) present trends in MNA paramenter concentrations in groundwater samples from the same representative LTM wells located in the listed areas of concern (except Building 40 Area).

As shown on **Figures 20** through **27**, generally decreasing sulfide concentrations with simultaneous production of carbon dioxide suggest that dehalogenating microbial communities are present and consuming available substrate. The production of the dissolved gases methane, ethane, and/or ethene, as well as chloride support microbial break down of CVOCs at the site.

#### Sub-Slab Depressurization Systems Performance Data Assessment

Pre- and post-carbon effluent samples are collected from the Type A SSDSs (Building 21 and 114), and Type B SSDs (Building 20 and 25). The purpose of the sampling is to evaluate CVOC discharge mass and assess removal efficiency of the SSDS GAC vessels. The effluent sampling results are summarized in **Tables 6** through **8. Tables 9** through **12** provide a summary of the estimated CVOC mass removal for the Type A and B SSDSs.

As discussed in **Section 4.3.3.1** of this Periodic Review, Section 4.2.1 of the SMP requires quarterly sampling of the effluent from those systems that vent directly to the atmosphere (the Type C Systems). Pre- and post-carbon effluent samples were not collected from the Type C SSDSs (Buildings 21, 22, 120, 121, and 130) in 2013 (the lack of sampling in 2013 is identified as a concern in **Section 8.0**).

Performance data for each SSDS follows and a summary of the performance data is provided at the end of this Section.

##### Building 20 SSDS Performance Data

Pre- and post-carbon effluent samples were collected on May 30 and December 16, 2013 from the Building 20 SSDSs. As shown in **Table 6**, cDCE, TCA, TCE, PCE, chloromethane, and carbon tetrachloride were detected in the May and December 2013 pre-carbon effluent samples. **Table 6** shows that the highest concentrations of CVOCs in May and December 2013 were TCE (47 μg/m3 and 40 μg/m3 , respectively) and PCE with a concentration of 13 μg/m3 measured from each system. **Table 6** shows that these results are less than the 2012 pre-carbon effluent sample concentrations. As shown in **Table 6**, VC, cDCE, chloroethane, 1,1-DCE, DCA, TCA, 1,2-DCA, TCE, PCE, chloromethane, and/or carbon tetrachloride were detected at low levels in the May and December 2013 post-carbon effluent samples.

As shown in **Table 6**, the total CVOC concentrations in the pre-carbon effluent samples from the Building 20 SSDS was 67 μg/m3 in May 2013 and 58 μg/m3 in December 2013. As shown in **Table 9**, based on a flow of 128 cfm in May 2013 and 134 cfm in December 2013, the Type B SSDS was removing CVOCs at a rate of 0.28 pounds per year (lbs/year) and 0.25 lbs/year, respectively.

##### Building 21 SSDS Performance Data

Pre- and post-carbon effluent samples were collected on May 30 and December 16, 2013 from the Building 21 SSDS (Note: No SSDS air samples were collected from the Building 21 SSDS during the May 30, 2013 sampling event due to a defective Summa canister; and no post-carbon effluent air sample was collected during the December 16, 2013 sampling event because significant condensation was discharging from the post-carbon effluent sample port.).

As shown in **Table 7**, the December 2013 pre-carbon effluent sample from the Building 21 SSDS contained cDCE (19 μg/m3), TCE (43 μg/m3), PCE (5.8 μg/m3), 1,1-DCE (0.08 μg/m3), chloromethane (0.19 μg/m3), and carbon tetrachloride (0.71 μg/m3). The concentrations of cDCE, TCE and PCE decreased from the October 2012 sampling event (19 μg/m3, 43 μg/m3, and 5.8 μg/m3, respectively). As noted in the 2013 LTM Report, no post-carbon effluent sample was collected due to high moisture levels discharging from the sample port.

As shown in **Table 7**, the total CVOC concentration in the December 2013 pre-carbon effluent sample from the Building 21 Type A SSDS was 69 μg/m3. **Table 10** shows that flow from the SSDS was approximately 27 cfm. This corresponds to a total estimated CVOC removal mass of 0.06 lbs/year.

##### Building 25 SSDS Performance Data

As shown in **Table 6**, the May 2013 pre-carbon effluent samples contained cDCE (2.3 μg/m3), TCA (14 μg/m3), TCE (230 μg/m3), and PCE (12 μg/m3). **Table 6** shows that cDCE, TCA, TCE, PCE, chloromethane, and carbon tetrachloride were detected in the December 2013 pre-carbon effluent samples at concentrations of 3 μg/m3, 10 μg/m3, 240 μg/m3, 14 μg/m3, 0.58 μg/m3, and 0.96 μg/m3, respectively.

**Table 6** shows that carbon tetrachloride and chloromethane were not detected in previous samples; however, the concentrations of these compounds are several orders of magnitude less than the compounds with the highest concentrations. As shown in **Table 6**, the May and December 2013 total CVOC concentrations have decreased by more than 50% compared to the 2012 total CVOC concentrations. Low level concentrations of VC, cDCE, 1,1-DCE, DCA, TCA, TCE, PCE, chloromethane, chloroethane, and/or carbon tetrachloride were detected in the May and December 2013 post-carbon effluent samples.

As shown in **Table 6**, the May and December 2013 pre-carbon effluent samples from the

Building 25 SSDS contained total CVOC concentrations of 258 μg/m3 and 264 μg/m3, respectively. **Table 11** shows that, at a flow of 143 cfm in May 2013, the system was removing 1.2 lbs/year. Based on the December 2013 flow rate of 146 cfm, the system was removing CVOCs at a rate of approximately 1.3 lbs/year.

##### Building 114 SSDS Performance Data

As shown in **Table 8**, the May 2013 Building 114 pre-carbon effluent air samples contained cDCE (41 μg/m3), TCE (370 μg/m3), PCE (1,000 μg/m3) and carbon tetrachloride (1.7 μg/m3). **Table 8** shows that the concentrations of these compounds decreased since the October 2012 sampling event. The May 2013 post-carbon effluent air samples contained cDCE (16 μg/m3), VC (0.084 μg/m3) and chloromethane (0.26 μg/m3).

**Table 8** shows that the total CVOC concentration in the pre-carbon effluent sample from the May 2013 was 1,411 μg/m3. As shown in **Table 12**, based on a flow of 45 cfm, the system was removing CVOCs at a rate of 2.1 lbs/year.

##### SSDS Performance Data Summary

The Type A (Buildings 21 and 114), Type B (Buildings 20 and 25), and Type C SSDSs (Buildings 21, 22, 120, 121, and 130) continue to operate at levels consistent with startup testing performance data.

Pre- and post-carbon effluent samples were collected from the Type A and B SSDSs in May 2013 and December 2013 with a few exceptions. Pre-carbon effluent data show decreased CVOC concentrations compared to 2012 samples for the Type A SSDSs and the Type B SSDSs. Based on the December 2013 pre- and post-carbon effluent air sampling results, the GAC removal efficacy for the Building 20/25 SSDS combined effluent is greater than 95 percent. May 2013 sample data indicated that the GAC removal efficacy for the Building 114 system is approximately 98 percent. Based on the December 2013 pre-carbon sample results and SSDS flow measurements, the total annual CVOC mass removed from the SSDSs ranged from 0.06 lbs/year from the Building 21 SSDS to 2.1 lbs/year from the Building 114 SSDS. Minor CVOC breakthrough was detected in the December 2013 samples from the Building 20/25 SSDSs.

Post-carbon effluent samples were not able to be collected from the Building 21 SSDS due to a defective Summa canister and significant condensation discharge from the effluent sampling port. Therefore, the carbon efficacy for this system during the 2013 operating period could not be evaluated. However, the previous carbon exchange for the Building 21 SSDS occurred in November 2012, and breakthrough in those GAC vessels didn’t occur until approximately two years of operation. This information, coupled with the fact that the Building 21 pre-carbon effluent sample concentrations continue to decrease over time, indicate that the existing GAC vessels would still be effective after only being in service for 15 months.

#### Air Filtration Units Performance Data Assessment

The SMP requires monthly system checks and semi-annual performance monitoring of the Building 40 AFUs. Filter media samples are required to be collected semi-annually and submitted to the AFU manufacturer’s laboratory for analysis of percent saturation of the carbon media with respect to the CVOCs. Carbon media are replaced when the samples indicate approximately 70-80 percent saturation. Performance data for the AFUs was not available for this review. The lack of data was noted as a concern in **Section 8.0** of this Periodic Review.

#### Indoor Air Data Performance Monitoring

Indoor air samples were collected on December 16, 2013 from Buildings 15, 20, 21, 22, 25, 114, 120, 121, and 130. Samples were collected using six-liter Summa Canisters in accordance with the ICM Work Plan (MPI, 2009). The samples were submitted to Eurofins/Air Toxics, Folsom, California, following chain-of custody procedures for analysis of CVOCs by USEPA Method TO-15. Indoor air sample results are summarized in **Table 13**. The 2013 LTM Report did not identify any results above the New York State indoor air target values.

It was noted that the list in Section 3.3.2 of the SMP of the buildings requiring indoor sampling did not correspond with the buildings that were actually sampled in 2013. This discrepancy was noted as a concern in **Section 8.0** of this Periodic Review. The 2013 LTM Report recommended modifying the sample collection duration for indoor air sampling from an 8 hour period to a 24 hour period due building access limitations. This concern was also included in **Section 8.0** of this Periodic Review.

### Operation and Maintenance Activities – Data Evaluation

#### Sub-Slab Depressurization System Operations and Maintenance Data

O&M is required on a monthly basis in accordance with the ICM Work Plan and as described below. A summary of the O&M data for Buildings 20, 21, 22, 25, 114, 120, 121, and 130 is provided in **Tables 14 through 22**. The field checklists for the O&M inspections are provided in Appendix C of the 2013 LTM Report but are not included in this Review.

##### Building 20 SSDS Operation and Maintnenance Data

The Building 20 SSDS (Type B) operated without interruption except for routine maintenance during 2013. The average SSDS flow was consistent with startup parameters.

The GAC in the two 1,000-pound vessels was last replaced on April 18, 2012. Due to high differential pressure across the secondary GAC vessel, the secondary GAC vessel was bypassed for much of the 2013 calendar year until the issue was able to be resolved. It is suspected that corrosion in the base of the GAC vessel due to condensation is breaking free from the interior of the GAC vessel and continuing to restrict flow through the carbon support screen. The restriction in the GAC vessel will be evaluated during the next carbon exchange.

##### Building 21 SSDS Operation and Maintenance Data

Building 21 uses both Type A and Type C systems for mitigation.

The Type A SSDS operated with only one minor disruption due to a power outage during 2013 with an average flow consistent with startup parameters. The flow meter continues to display false readings, which is suspected to be the result of high moisture in the effluent air stream. However, the false flow meter readings did not shut down or inhibit performance of the SSDS. To monitor performance of the SSDS, direct readings from the effluent air stream are measured monthly using a portable anemometer. In November 2013, the secondary carbon vessel was bypassed due to a high differential pressure. It is suspected that the moisture in the effluent air stream condensed in the GAC vessel and froze, causing a flow restriction and high differential pressure. The vessel will be evaluated when average daily temperatures remain above freezing.

The Type C SSDS operated continuously during the 2013 calendar year. However, limited

access to extraction point EW-2 precluded flow and vacuum measurements for the majority of the year. Operation of the SSDS blower was confirmed from the building exterior. Extraction point EW-2 was replaced in November 2012 due to low flow readings and expected blockage in the extraction point. Subsequent flow monitoring in 2013 indicates that replacing the extraction point had limited effect on improving the performance of the system. Therefore, it is expected that the subsurface materials (known to contain high clay content) may be preventing communication between the extraction point and the subsurface.

##### Building 22 SSDS Operation and Maintenance Data

Both of the Type C SSDSs operated continuously throughout the 2013 calendar year with average flows consistent with startup parameters.

##### Building 25 SSDS Operation and Maintenance Data

The Building 25 SSDS (Type B) operated without interruption except for routine maintenance during 2013. During 2013, the SSDS average flow was consistent with startup parameters. The pressure differential across the secondary carbon vessel is high due to a restriction in the GAC support screen and effluent air is currently being directed to bypass this vessel. The restriction in the GAC vessel will be evaluated during the next carbon exchange.

##### Building 114 SSDS Operation and Maintenance Data

The Building 114 SSDS (Type A) operated for a total of approximately 7,050 hours in 2013 with limited interruption with the exception of January and December. The system was off during the January 2013 and December 2013 inspections due to the knockout tank being full; which, in January 2013, was subsequently drained and the system restarted. In December 2013, the condensate in the knockout tank was frozen. The tank was thawed and drained, and the system restarted on December 17, 2013. The average flow for the B114 system during 2013 was greater than startup parameters.

No SSDS air samples were collected from the Building 114 system during the December 16, 2013 sampling event because the system was not operating due to a frozen vapor knockout tank.

##### Building 120 SSDS Operation and Maintenance Data

The Type C SSDS operated continuously during 2013 without interruption with average flow consistent with startup parameters.

##### Building 121 SSDS Operation and Maintenance Data

The Type C SSDS operated continuously during 2013 without interruption. The average flow and the average vacuum pressure were consistent with startup parameters.

##### Building 130 SSDS Operation and Maintenance Data

Building 130 contains highly secured weapons storage which prevents regular access to the extraction well. Consequently, regular flow and vacuum measurements were not possible during 2013. However, inspection of the blower from the building exterior confirmed continuous operation of the Type C SSDS. The average flow and the average vacuum pressure were consistent with startup parameters.

##### SSDS Operation Summary

The Type A (Building 21 and 114) and Type B (Building 20 and 25) SSDSs were inspected in accordance with the ICM Work Plan and generally performed consistent with startup test results.

Based on total run-time hours, the Building 21 and Building 114 SSDSs operated for approximately 99 percent and 92 percent, respectively, of the total available run-time for the year. The Building 21 SSDS had only minor interruptions related to power failures.

High condensate levels in the Building 21 effluent air stream are the suspected cause of continued false flow meter readings. However, this did not impact system performance

or operation. System flow is currently being monitored using an anemometer.

The Building 114 system was shut down two times in 2013 due to high levels in the vapor knockout tank. No additional interruptions were reported. No significant repairs were required to the Building 114 system in 2013.

The Building 20 and Building 25 SSDSs each operated at approximately 99 percent of the total available run-time for the year. The LTM Report indicated that the secondary GAC vessel for the Building 20 and 25 combined effluent is currently off line due to high differential pressure readings. However, based on the December 2013 post-carbon effluent sample results, the primary carbon vessel is effectively removing the majority of CVOCs from the effluent air. No other significant issues were reported with these systems.

The Type C SSDSs (Buildings 21, 22, 120, 121, and 130) were generally inspected in accordance with the ICM Work Plan, with the exception of the Building 130 system, which has restricted access. None of the Type C SSDSs required significant repairs or had any interruptions in 2013. Diminished flow rates measured in the Building 21 system is likely caused by high clay content in the sub-surface soil.

#### Building 40 Air Filtration Units Operations and Maintenance Data

O&M data for the AFUs was not available for this review. The lack of data is noted as a concern in **Section 8.0** of this Periodic Review.

#### Groundwater Monitoring Wells Operations and Maintenance Data

One well was not sampled (WVA-MW-79) because the water contained permanganate (from the in-situ treatment at Building 40). All other wells in the MMA were sampled in accordance with the LTM Plan. The LTM reports did not identify any damaged wells. No well maintenance activities were recorded.

### Site-Wide Inspection Results

Site-Wide Inspections, as described in **Section 4.3.2.4** are required at a minimum of once per year. Inspection forms are to be completed and included in the Periodic Review Reports. Additionally, as mentioned in **Section 4.3.1.2**, the WVA is required to submit an annual written statement to NYSDEC certifying that ICs are in-place and continue to protect the public health and the environment. The inspection forms and certification letters to NYSDEC were not available for this review. Documentation of the Site–wide Inspections is included as a concern in **Section 8.0** of this Periodic Review.

## Site Inspection

A site inspection was conducted on November 4, 2014. Attendees at the site inspection included the following:

* JoAnn Kellogg, WVA Environmental Program Manager
* Mr. Andy Vitolins, Malcolm Pirnie
* Steve Wood, USACE, Baltimore District
* Brian Roberts, Engineer, USACE, NWK
* Kenneth Kamp, Engineer, USACE, NWK

The site inspection included a general tour of the MMA and SA to obtain an understanding of the surrounding land use and an overview of the groundwater monitoring program. The SSDSs were inspected. The capped areas, permeable reactive wall remedy, and the monitoring well network in the SA were observed. Concerns noted during the inspection of the SA are noted in **Section 15.5**.

The site inspection checklist is included in **Attachment B**. Photos from the site inspection are included in **Attachment C**.

## Interviews

Ms. JoAnn Kellogg and Mr. Andy Vitolins reviewed project background information and completed actions, and provided an overview of the ongoing remediation efforts during the site visit. Following the site inspection, the regulators involved with the project were contacted.

Mr. Samuel Ezekwo, Remedial Project Manager with USEPA Region 2, was contacted for input on the ongoing remediation efforts. Mr. Ezekwo deferred to NYSDEC for comments.

Mr. Larry Alden, NYSDEC Project Lead, provided feedback on the WVA remediation project. A summary of Mr. Alden’s comments follows:

* Mr. Alden indicated that the SSDSs and Building 40 AFUs seemed to be working well and were being properly monitored and maintained.
* The Groundwater Monitoring/MNA Program for the MMA and the SA is running smoothly and the reactive wall remedy at the SA appears to be very effective.
* The WVA and the NYSDEC are still working to get a comprehensive Site Management Plan in DEC format that addresses both the SA as well as the MMA. The NYSDEC is receiving reports and other updates from the WVA.
* Mr. Alden discussed the contamination source areas at Building 40 and the building locations with SSDSs. He noted that while the filtration units at Building 40 make the building safe for occupation, they do not address the root cause of the problem. In-situ chemical oxidation was tested, but it was not effective due to the nature of the soil and the fact that a definitive source area has not been identified. He stated that it is fortunate that I-787 and the Hudson River are down-gradient of Building 40. If there were other buildings or homes at this location, “this would be a different story”. For long-term remediation of the site, WVA should be thinking about locating and treating the source of contamination at Building 40 rather than just managing the symptoms. Mr. Alden indicated that this issue is particularly important for Building 40 because of the magnitude of the contamination, but really the same argument could be made for any of the buildings with SSDSs.

#  Technical Assessment - Main Manufacturing Area

The Periodic Review must determine whether the remedy at a site is effective and is protective of human health and the environment. Three questions are used to provide a framework for organizing and evaluating data and information and to ensure all relevant issues are considered when determining the effectiveness/protectiveness of a remedy. These questions are assessed for the site in the following paragraphs. At the end of the section is a summary of the technical assessment.

## Question A

***Is the remedy functioning as intended by the decision documents?***

### Corrective Action Performance

Yes. Except for the concerns noted in the subsections below and summarized in **Section 8.0**, the remedy prescribed for the MMA is being performed and is functioning as intended. As stated in the SOB for the MMA, the goal for the corrective measures implemented at the site is to restore the facility to pre-disposal conditions to the extent feasible. At a minimum, the corrective measures shall eliminate or mitigate all significant threats to the public health and the environment presented by the contamination identified at the facility through the proper application of scientific and engineering principles.

The elements of the final corrective measure are as follows:

* No Further Action with continued LTM of the ongoing MNA for Building 25 groundwater,
* No Further Action for Building 40 groundwater, beyond MNA, documented through groundwater LTM,
* No Further Action with continued operation and monitoring of the SSDSs for VI in Buildings 20, 21, 22, 25, 114, 120, 121, and 130; and,
* Site management and LUCs to protect public health and the environment for contamination remaining at the site after the ICMs.

The LTM Program for groundwater continues and generally shows gradually decreasing or stable contaminant concentrations. Buildings with SSDSs are operated and maintained and continue to address the inhalation pathway. ICs are in place, preventing exposure to contaminated soils. Additional remedy performance details are provided below.

**Groundwater Remedy**

The groundwater remedy monitors CVOC concentrations greater than the CAOs to ensure that CVOCs do not migrate to potential receptors beyond the WVA boundary. Under the corrective measure, concentrations of CVOCs in the groundwater will eventually be reduced and further off-site migration of CVOCs in the groundwater will diminish through continuing degradation of PCE and TCE through MNA processes to non-toxic byproducts, ultimately reducing both the concentration and mass of the contaminants in the groundwater.

The LTM Plan’s contingency evaluation protocol established well- and contaminant-specific statistical “trigger” concentrations that initiate a contingency evaluation in the event groundwater monitoring data indicate a potential change in site conditions. Groundwater data, previously discussed in **Section 6.4.1.1**, was evaluated and compared to the LTM Plan trigger values.

CVOC concentrations in the Building 25 Area groundwater samples from the 2013 sampling event did not exceed the established trigger values.

CVOC concentrations in Building 40 groundwater samples from the 2013 sampling event did not exceed the established trigger values, except for cDCE in MW-84R-2 and VC in MW-86R-2, both of which also exceeded trigger values in 2012. However, the increases in cDCE concentrations in these wells have been coincident with decreases in PCE concentrations, indicating degradation of primary contaminant mass. Therefore, in accordance with LTM Plan’s contingency evaluation protocol, no additional sampling is required. The increase in total CVOCs in the Building 40 area wells observed in 2013 will be evaluated in comparison with next year’s monitoring data.

CVOC concentrations in the Building 20 Area and the Buildings 114/121 Area show generally stable or decreasing trends in total CVOC concentrations and samples from the 2013 sampling event did not exceed the established trigger values.

In summary, the groundwater generally shows gradually decreasing or stable contaminant concentrations and the MNA data discussed in **Section 6.4.1.1** supports microbial break down of CVOCs at the site.

**SSDS Operation, Air Filtration Units at Building 40, and Indoor Air Monitoring**

Performance data for the SSDSs was presented in **Section 6.4.1.2**. Indoor air data for the buildings with the SSDSs is presented in **Section 6.4.1.4**. Performance data for the AFUs at Building 40 was not available for review. Additionally, indoor air sampling is not performed at Building 40.

The Type A (Building 21 and 114) and Type B (Building 20 and 25) SSDSs were inspected in accordance with the ICM Work Plan and generally performed consistent with startup test results.

The Type C SSDSs (Buildings 21, 22, 120, 121, and 130) were generally inspected in accordance with the ICM Work Plan, with the exception of the Building 130 system, which

has restricted access. Diminished flow rates measured in the Building 21 system is likely caused by high clay content in the sub-surface soil. The performance issues associated with the building 21 Type C SSDS are discussed in **Sections 7.1.4** and **8.0**.

Indoor air samples were collected from Buildings 15, 20, 21, 22, 25, 114, 120, 121, and 130. The 2013 LTM Report did not identify any results above the New York State indoor air target values.

### System Operations and Maintenance

Remedy O&M activities are detailed in **Section 4.3** of this Review. O&M activities are required for the Groundwater Monitoring Program, the SSDSs, the AFUs at Building 40, and the
ICs. O&M activities and O&M data for these remedy components are discussed in **Sections 6.4.2** and **6.4.3** of this Periodic Review.

All monitoring wells included in the 2013 annual sampling event were in good condition. MW-79 near Building 40 is functional, but it was not sampled because of the presence of permanganate associated with a completed ICM. The LTM reports did not identify any damaged wells. No well maintenance activities were recorded.

The Type A (Building 21 and 114) and Type B (Building 20 and 25) SSDSs were inspected in accordance with the ICM Work Plan. No significant repairs were required for these systems. None of the Type C SSDSs required significant repairs or had any interruptions in 2013.

The 2012 SOB included an estimated annual cost of $112,000 to operate the MMA remedy. The WVA Environmental Program Manager provided the following O&M costs for 2010 - 2013 (Note: The costs provided by WVA were for efforts at both the MMA and SA):

* The annual O&M cost for SSDSs maintenance and indoor sampling was $102,000.
* Groundwater sampling and well maintenance cost (for both the MMA and SA) was $53,000.
* Total annual costs for 2010, 2011, 2012, and 2013 were $155,000.

### Opportunities for Optimization

The WVA plans to review the groundwater sampling program in 2015. Based on this review, wells may be deleted from the program and/or new wells may be recommended. Additionally, the analyte list and sampling frequency may be revised based on this evaluation. As an example, the dissolved gases (methane, ethane, ethene), which is a relatively expensive analysis, can be reduced or eliminated if the conditions are not highly reducing.

Performance issues at the Building 21 Type C SSDS, and the potential discontinuation of this system, are discussed in the following section.

### Early Indicators of Potential issues

As discussed in **Section 6.4.2.1** of this Periodic Review, minor issues were noted for several of the SSDSs. While the noted issues do not affect the effectiveness/protectiveness of the remedy, evaluation of the systems was identified as a concern in **Section 8.0**.

The Building 21 Type C SSDS extraction well has had restricted flow due to subsurface soil conditions. Since indoor air quality has not been negatively impacted by the lack of SSDS flow, and no improvement in performance was documented following replacement of the extraction well in 2012, the 2013 LTM Report recommended that the SSDS be turned off to conserve energy and indoor air quality continue to be monitored in accordance with the ICM Work Plan. If future indoor air sample data indicate VI is causing an exposure pathway to subsurface CVOCs, additional corrective measures will be implemented.

### Implementation of Institutional Controls and Other Measures

Ms. JoAnn Kellogg, the WVA Environmental Program Manager**,** indicated that she views the site during weekly and monthly storage tank inspections. Work orders are submitted for repairs as needed. Additionally, an annual letter is sent to the NYSDEC. The Site-wide Inspection Forms referenced in **Section 4.3.2.4** and the annual certification letter to the State referenced in **Section 4.3.1.2** were not available to include in this Periodic Review. Documentation of the Site-wide Inspection is included as a concern in **Section 8.0**.

## Question B

***Are the exposure assumptions, toxicity data, cleanup levels, and corrective action objectives (CAOs) used at the time of the remedy selection still valid?***

Yes. While there have been changes in toxicity data and risk assessment methods, they still support the protectiveness of the remedy. The exposure assumptions, cleanup levels, and corrective action objectives have not changed. All these factors are thus still valid for the MMA at WVA. The health risk assessment tables referenced in the following subsections are included in **Attachment D**.

### Changes in Standards

The established cleanup objectives for the facility are:

Soil. Soil Cleanup Objectives are from Part 375-68(b) of the SCGs for commercial use. The chemicals of concern (COCs) are arsenic, chromium, lead, mercury, benzo(a)anthracene, and benzo(a)pyrene. **Table D-1** shows the SCGs at the time of the 2010 Periodic Review and current values. As shown in the table, these levels have not changed since the time of remedy selection.

 Groundwater. The NYSDEC Class GA (drinking water) Groundwater Quality Standards, from 6 NYCRR Part 703, are applicable to groundwater at the MMA. COCs for the MMA are TCA, DCA, 1,1-DCE, TCE, cDCE, and VC. As shown in **Table D-2**, these values have not changed since the time of remedy selection.

### Changes in Exposure Pathways

* *Have any human health or ecological routes of exposure or receptors changed or been newly identified (e.g., dermal contact where none previously existed, new populations or species identified on site or near the site) that could affect the effectiveness/protectiveness of the remedy?*

No human health or ecological routes of exposure or receptors have changed or been newly identified that could affect the effectiveness/protectiveness of the remedies.

* *Are there newly identified contaminants or contaminant sources?*

No new contaminants or contaminant sources were identified during the Periodic Review period.

* *Are there unanticipated byproducts of the remedy not previously addressed by the decision documents (e.g., byproducts not evaluated at the time of remedy selection)?*

No unanticipated toxic byproducts of the remedies have been identified.

* *Have physical site conditions (e.g., changes in anticipated direction or rate of groundwater flow) or the understanding of these conditions changed in a way that could affect the effectiveness/protectiveness of the remedy?*

No changes in site conditions were identified during this Periodic Review that would affect exposure pathways. There have been no land use changes, nor are land use changes anticipated. No new contaminants, sources, or routes of exposure were identified. There is no indication that hydrologic or geologic conditions were inadequately characterized.

### Changes in Toxicity or Other Contaminant Characteristics

**Oral Non-Cancer Toxicity**

As shown in **Table D-3**, oral Reference Doses (RfD) for most of the COCs in both soil and groundwater from the MMA have not changed. The chemical DCA now has a Provisional Peer Reviewed Toxicity Value oral RfD of 0.2 milligrams per kilogram per day (mg/kg/day), previously there was no value.

**Inhalation Non-Cancer Toxicity**

**Table D-4** shows that most of the Reference Concentration (RfC) have not changed since the last Periodic Review for the MMA (USEPA, 2012). Arsenic has a RfC of 0.00015 milligrams per cubic meter (mg/m3) published by the California EPA, previously there was not a value.

**Oral Cancer Toxicity**

**Table D-5** shows oral Cancer Slope Factors (CSFs) for the COCs have not changed since the last Periodic Review. California EPA has published an oral CSF of 5.7x10-3 (mg/kg/day)-1 for DCA.

**Inhalation Cancer Toxicity**

**Table D-6** shows that none of the Inhalation Unit Risks (IURs) for the COCs have changed.

**Toxicity Summary**

None of the previously published toxicity values for the COCs at the MMA have changed since the time of remedy selection. Some new toxicity values have been generated, but these new toxicity values do not call the effectiveness of the remedies into question.

### Changes in Risk Assessment Methods

* *Have standardized risk assessment methodologies changed in a way that could affect the effectiveness/protectiveness of the remedy?*

**Standard Default Exposure Factors**

In December 2014, EPA made several changes to the standard default exposure factors (SDEFs) used in Superfund risk assessments to calculate daily intake of chemicals for human receptors, as shown in **Table D-7**.

**Non-Cancer Oral Ingestion of Groundwater**

The standard form of the equations for calculating daily intakes of chemicals by oral ingestion is:

$$ADI= C\_{medium}\*\frac{IR\*EF\*ED}{BW\*AT}$$

where ADI = average daily intake,

 Cmedium = concentration of chemical in medium being ingested,

 IR = ingestion rate,

 EF = exposure frequency,

 ED = exposure duration,

 BW = body weight, and

 AT = averaging time

The only factor that changes in this equation when applied to a child resident is a decrease in the amount of water consumed from 1 liter per day (L/day) to 0.78 L/day, resulting in a 22% decrease in the non-cancer ADI.

For an adult, the amount of water has increased from 2.0 L/day to 2.5 L/day and the adult body weight has increased from 70 kilograms (kg) to 80 kg. The total percent change in ADI can be calculated using the equation:

$$\%∆ADI=\left(100\*\frac{{IR\_{new}}/{BW\_{new}}}{{IR\_{old}}/{BW\_{old}}}\right)-100$$

The total change in ADI, %ΔADI, due to the changes in intake rate and body weight is an increase of 9.4 percent.

The changes in exposure factors for groundwater ingestion do not affect risk estimates in such a way as to call the effectiveness/protectiveness of the remedies into question. Also, as previously noted, restrictions are in-place to prevent drinking water exposure at the site.

**Non-Cancer Dermal Exposure**

The non-cancer ADI for dermal exposure is given by the equation:

$$ADI=C\_{medium}\*PC\*SA\*ET\*EF\*\frac{ED}{(BW×AT)}$$

Where PC = permeability constant, specific to chemical being absorbed,

SA = exposed surface area of skin

 ET = exposure time, and the other values are the same as above.

For changes in the dermal absorption ADI for a child, the %ΔADI is given by the equation:

$$\%∆ADI=\left(100\*\frac{SA\_{new}\*ET\_{new}}{SA\_{old}\*ET\_{old}}\right)-100$$

The only changes in the SDEFs are a decrease of exposed surface area for children from 6,600 to 6,738 square centimeters (cm2) and of the showering time from 1.0 to 0.54 hours. The effects of these changes are that the dermal ADI using new exposure factors show a 47.8 percent decrease.

For changes in the dermal absorption ADI for an adult, the %ΔADI is given by the equation:

$$\%∆ADI=\left(100\*\frac{{SA\_{new}\*ET\_{new}}/{BW\_{new}}}{{SA\_{old}\*ET\_{old}}/{BW\_{old}}}\right)-100$$

The exposed surface area for adults has increased from 18,000 to 20,900 cm2; the showering time has increased from 0.58 to 0.71 hours; and the body weight has increased from 70 to 80 kg. The effects of these changes are that the dermal ADIs using new SDEFs show a 24.4 percent increase.

**Cancer Ingestion Exposure**

For cancer, residential exposures have been addressed using a combined child/adult scenario. Under the old SDEFs, it was assumed that an individual might live in a house for a period of 30 years, 6 years of that as a 1-6 year-old child weighing 15 kg and another 24 as an adult with a 70 kg bodyweight. The new SDEFs assume a shorter residence time and greater bodyweight, as well as the previously noted changes in the amount of water ingested per day by both the child and adult.

The equation of the oral cancer %ΔADI for the combined child-adult scenario is:

$$\%∆ADI=\left(100\*\frac{\frac{IR\_{new-child}\*ED\_{child}}{BW\_{child}}+\frac{IR\_{new-adult}\*ED\_{new-adult}}{BW\_{new-adult}}}{\frac{IR\_{old}\*ED\_{child}}{BW\_{child}}+\frac{IR\_{old-adult}\*ED\_{old-adult}}{BW\_{old-adult}}}\right)-100$$

The overall effect of these changes would be a 13.7 percent decrease in lifetime ADI and cancer risks. This change would not call the effectiveness/protectiveness of the remedies into question.

**Cancer Dermal Exposure**

The equation of the dermal cancer %ΔADI for the combined child-adult scenario is:

$$\%∆ADI=$$

$$\left(100\*\frac{\frac{SA\_{new-child}\*ET\_{new-child}\*ED\_{child}}{BW\_{child}}+\frac{SA\_{new-adult}\*ET\_{new-adult}\*ED\_{new-adult}}{BW\_{new-adult}}}{\frac{SA\_{old-child}\*ET\_{old-child}\*ED\_{child}}{BW\_{child}}+\frac{SA\_{old-adult}\*ET\_{old-adult}\*ED\_{old-adult}}{BW\_{old-adult}}}\right)-100$$

The effect of the changes previously cited on cancer resulting from dermal exposure is an 18.2 percent decrease in lifetime ADI and cancer risk.

Overall, these changes in SDEFs cause decreases in estimates of ADI of chemicals for most scenarios. These changes do not bring the effectiveness/protectiveness of the remedies into question.

**Vapor Intrusion**

The EPA developed a Vapor Intrusion Screen Level (VISL) calculator made available May 2014. The VISL calculator is used to calculate risk-based screening levels for comparison to site data to help determine whether chemicals found in groundwater or soil gas can pose a significant risk through VI. The VISL calculator is not expected to cause changes in risk estimates that would call the effectiveness/protectiveness of the remedies into question.

**Other**

Prior to the current Periodic Review, the USEPA made other changes to risk assessment methods, including changes to methods of calculating inhalation risks (RAGS Part F, 2009), calculating dermal risks (RAGS Part E, 2004); calculating cancer risks for mutagenic carcinogens EPA, 2005); and selecting toxicity values from available Federal, State, and other value sources (toxicity hierarchy memorandum, 2003). These changes in risk assessment methodologies do not affect risk estimates in a way that could affect the effectiveness/protectiveness of the remedies.

## Question C

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

### Ecological Risks

No additional information has come to light that indicates ecological risks could call the effectiveness/protectiveness of the remedy into question.

### Natural Disaster Impacts

No natural disasters were noted to have occurred in the region over the past five years that would affect the protectiveness of the remedy.

### Any Other Information That Could Call Into Question the Protectiveness of the Remedy?

One possible concern at the MMA is that 1,1,1-TCA was once a significant contaminant in the groundwater. Historically, 1,4-dioxane was used at concentrations of several percent as a preservative of 1,1,1-TCA to prevent catalytic destruction of the solvent when stored in aluminum bottles. 1,4-dioxane is classified as a Class B2 carcinogen and is quite soluble and very persistent. It will migrate faster in groundwater so that 1,4-dioxane can appear at points further from the source without 1,1,1-TCA. It is also a more potent carcinogen so that it may pose a greater cancer risk than 1,1,1-TCA. Difficulties in analyzing 1,4-dioxane result in it frequently being excluded from the analytical suite, but the presence of 1,1,1-TCA is a strong indicator of its likely presence. It is recommended that some sampling should be conducted in areas where 1,1,1-TCA has previously been detected to determine whether 1,4-dioxane is present with further follow-up dependent on the results. This concern is included in **Section 8.0** of this Periodic Review.

Otherwise no information has been found that could call the effectiveness of the remedy into question. It is apparent that the WVA works closely and proactively with the USEPA and NYSDEC to address potential environmental issues that include soil, groundwater, and soil gas vapor at WVA Main Manufacturing Area.

## Technical Assessment Summary

The LTM Program for groundwater generally shows gradually decreasing or stable contaminant concentrations and the MNA data supports microbial break down of CVOCs at the site. Buildings with SSDSs continue to address the inhalation pathway. ICs are in place, preventing exposure to contaminated soils. Monitoring wells are in good condition. A few operational issues with the SSDSs were noted however they do not affect the effectiveness/protectiveness of the remedy.

Exposure pathways are unchanged. The noted changes in toxicity data and risk assessment methods do not affect the protectiveness of the remedy.

Historically, 1,4-dioxane was used at concentrations of several percent as a preservative of 1,1,1-TCA. The presence of 1,1,1-TCA is a strong indicator of its likely presence. It is recommended that some sampling should be conducted in areas where 1,1,1-TCA has previously been detected to determine whether 1,4-dioxane is present and if follow-up actions are needed.

# Issues - Main Manufacturing Area

There were no issues or deficiencies identified during the review that affect protectiveness of the remedy. However, several concerns not rising to the level of a “protectiveness issue” were identified.

1. Sections 2.3 and 5.2 of the SMP, requires the WVA to submit to the NYSDEC a written statement that certifies, that: (1) controls employed at the site are unchanged from the previous certification or that any changes to the controls were approved by the NYSDEC; and, (2) nothing has occurred that impairs the ability of the controls to protect public health and environment or that constitute a violation or failure to comply with the SMP. The signed certification will be included in the Annual Monitoring Report. Copies of the annual certifications were not available for review. This concern is discussed in **Sections 4.1** and **4.3.1.2** of this Periodic Review.

2. In accordance with Sections 3.3.3 and 4.2.2 of the SMP, carbon/permanganate filter media samples are required to be collected from the Building 40 AFUs semi-annually to assess the performance of the remedy. Carbon media are replaced when the samples indicate approximately 70-80 percent saturation. Additionally, in accordance with Section 4.3.2.1 of the SMP, the WVA monitors the operation of the units during monthly inspections. Records of the monthly inspections and the semi-annual media sampling events are not included in the Annual LTM Report. This concern is discussed in **Sections 4.3.2.3** and **4.3.3.2** of this Periodic Review.

3. Section 3.3.2 of the SMP requires collection of indoor air samples from the buildings with SSDSs to assess the performance of the corrective measures. Building 40 is equipped with AFUs to treat indoor air. The SMP does not include similar indoor air sampling to assess the performance of the AFU corrective measure. This concern is discussed in **Section 4.3.2.3** of this Periodic Review.

4. In accordance with Sections 3.4 and 5.1.2 of the SMP, Site-Wide Inspections are required to be performed on a regular schedule at a minimum of once a year. Site-Wide Inspections focus on a review of IC compliance, site management activities, and general site conditions. Site-Wide Inspections are also performed after all severe weather conditions that may affect ECs or monitoring devices. During these inspections, an inspection form will be completed and electronic copies will be included in the Periodic Review Reports. Site-Wide Inspection forms were not available for inclusion in the Periodic Review. This concern is discussed in **Section 4.3.2.4** of this Periodic Review.

5. The SSDSs inspection and monitoring documentation from the 2013 LTM Report has been included in the current Periodic Review. However, some data reports were not included in the 2013 LTM Report. O&M documentation for the monthly performance checks of the SSDSs were missing for the period from June 2013 through October 2013 (refer to **Section 6.4.2.1** of this report). Additionally, during the monthly checks, photoionization detector results were not measured at several of the systems (mechanical issues). Quarterly sampling data results for the Type C SSDSs were not included in the annual report (refer to **Section 6.4.1.2** of this report).

6. The list of buildings requiring indoor sampling in the SMP, Section 3.3.2, did not correspond with the buildings that were actually sampled in 2013. This discrepancy was discussed in **Section 6.4.1.4** of the Periodic Review.

7. The 2013 LTM Report recommended modifying the sample collection duration for indoor air sampling from an 8 hour period to a 24 hour period due building access limitations. This concern was discussed in **Section 6.4.1.4** of this Periodic Review.

8. Minor issues were noted for the SSDS at Buildings 20 (Type A SSDS), 21 (Type A SSDS), 25 (Type B SSDS), and 114 (Type A SSDS). The operational concerns are discussed in **Sections 6.4.2.1** and **7.1.4** of this Periodic Review and are summarized below:

Building 20: Possible corrosion causing restricted flow in the GAC vessel

Building 21 Type A System: Flow meter displays false readings. Flow restriction in the GAC vessel

Building 25: GAC vessel restriction

Building 114: Frozen condensate in the knockout tank

9. The Building 21 Type C SSDS extraction well has had restricted flow due to subsurface soil conditions. Since indoor air quality has not been negatively impacted by the lack of SSDS flow, and no improvement in performance was documented following replacement of the extraction well in 2012, the 2013 LTM Report recommended that the SSDS be turned off to conserve energy and indoor air quality continue to be monitored in accordance with the ICM Work Plan. If future indoor air sample data indicate VI is causing an exposure pathway to subsurface CVOCs, additional corrective measures will be implemented. This recommendation is discussed in **Sections 6.4.2.1** and **7.1.4** of this Periodic Review.

10. The NYSDEC noted they are continuing to work with the WVA to get a comprehensive Site Management Plan in NYSDEC format that addresses both the SA as well as the MMA. The NYSDEC comment is discussed in **Section 6.6** of this Periodic Review.

11. The NYSDEC noted that the current use of AFUs at Building 40 has made it safe for the building to be occupied. However, the contamination source has not been located and addressed. This issue is particularly important for Building 40 because of the magnitude of the contamination, but the same issue relates to the buildings with SSDSs. The NYSDEC comment is discussed further in **Section 6.6** of this Periodic Review.

12. 1,1,1-TCA was once a significant contaminant in the MMA groundwater. Historically, 1,4‑dioxane was used at concentrations of several percent as a preservative in 1,1,1‑TCA to prevent catalytic destruction of the solvent when stored in aluminum bottles. 1,4‑dioxane is classified as a Class B2 carcinogen and is quite soluble and very persistent. It will migrate faster in groundwater so that 1,4‑dioxane can appear at points further from the source without 1,1,1‑TCA. It is also a more potent carcinogen so that it may pose a greater cancer risk than 1,1,1‑TCA. Difficulties in analyzing 1,4‑dioxane result in it frequently being excluded from the analytical suite, but the presence of 1,1,1‑TCA is an indicator of its likely presence. This observation is discussed in **Section 7.3** of this Periodic Review.

# Recommendations and Follow-Up Actions - Main Manufacturing Area

**Table 23** provides a list of the recommended actions to address the concerns identified in **Section 8.0.**

**Table 23: Main Manufacturing Area Concerns and Recommended Actions**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  |  |  |  |
| **Concern** | **Recommendation** |
| **Concern 1:** Copies of the annual site controls certifications were not available for review. | Include certification of the EC and ICs in the Annual LTM Reports. |
| **Concern 2:** Records of the monthly inspections and the semi-annual media sampling events for the Building 40 AFUs are not included in the Annual LTM Report. | Finalize the sampling and monitoring requirements for the Building 40 AFUs in the SMP. Ensure the scope of work for the annual LTM efforts concur with the final SMP. |
| **Concern 3:** The SMP does not include indoor air sampling to assess the performance of the Building 40 AFU corrective measure.  | Consider including the requirement for indoor air sampling at Building 40 in the SMP. |
| **Concern 4:** Site-Wide Inspections focusing on a review of IC compliance, site management activities, and general site conditions are required by the SMP. Site-Wide Inspection forms were not available for inclusion in the Periodic Review. | Complete the Site-Wide Inspection forms and include them in the Annual LTM Reports. |
| **Concern 5:** Some data reports for the SSDS monitoring and inspections were not included in the 2013 LTM Report.  | Inspect and monitor the SSDSs in accordance with the requirements of the Final SMP and include documentation in the Annual LTM Reports.  |
| **Concern 6:** The list of buildings requiring indoor sampling in the SMP, Section 3.3.2, did not correspond with the buildings that were actually sampled in 2013.  | Reconcile the indoor air sampling requirements identified in the SMP with the actual project requirements. |
| **Concern 7:** The 2013 LTM Report recommended modifying the sample collection duration for indoor air sampling from an 8 hour period to a 24 hour period due to building access limitations.  | Evaluate the 2013 LTM Report recommendation to modify the sample collection duration for indoor air sampling from an 8 hour period to a 24 hour period due to building access limitations.  |

|  |  |
| --- | --- |
| **Concern** | **Recommendation** |
| **Concern 8:** Minor operational issues were noted for the SSDS at Buildings 20, 21, 25, and 114. | Evaluate the minor issues noted for the SSDS at Buildings 20 (Type A SSDS), 21 (Type A SSDS), 25 (Type B SSDS), and 114 (Type A SSDS). |
| **Concern 9:** The 2013 LTM Report recommended that the SSDS be turned off to conserve energy and indoor air quality continue to be monitored in accordance with the ICM Work Plan. | Evaluate the 2013 LTM Report recommendation to discontinue use of the Building 21 SSDS.  |
| **Concern 10:** The NYSDEC noted the WVA lacks a comprehensive Site Management Plan that addresses both the SA as well as the MMA.  | Finalize a Site Management Plan for the MMA and SA. |
| **Concern 11:** The NYSDEC noted that the contamination source at the buildings with SSDs and AFUs has not been located and addressed. | Consider investigating and addressing the contamination sources at Building 40 and at the locations where SSDSs have been installed. |
| **Concern 12:** The presence of 1,1,1 TCA is an indicator that 1,4-dioxane may also be present at the site.  | Consider conducting sampling in areas where 1,1,1-TCA has previously been detected to determine whether 1,4-dioxane is present, with further follow-up dependent on the results. |

# Effectiveness/Protectiveness Statement - Main Manufacturing Area

The remedies at the MMA are effective and protective of human health and the environment.

The selected remedies for the MMA address groundwater contamination and VI. The selected remedies also included development of a Site Management Plan (SMP), consisting of a Land Use Control Plan and a Monitoring Plan.

Monitored Natural Attenuation and Long Term Groundwater Monitoring are the remedies applied to the MMA groundwater.

To address the soil VI concerns, SSDSs operate in building basements that exceeded the New York State Department of Health VI guidance values. Currently eight buildings at the MMA are equipped with SSDSs. Building 40, at which installation of a SSDS was not practical due to building conditions, utilizes air filtration units in an above-ground vapor mitigation system.

Since contaminated groundwater and soil vapor remain at the site, the selected remedy includes engineering controls and institutional controls to protect human health and the environment. The Statement of Basis includes a series of institutional controls in the form of site restrictions.

Performance and operational data for the WVA MMA corrective measures were reviewed and it was determined that all of the corrective actions are functioning effectively.

# Site Chronology - Siberia Area

A chronology of important site events and relevant dates for the SA are presented below in **Table 24**.

**Table 24: Chronology of Site Events**

| **Event** | **Date** |
| --- | --- |
| Siberia Area purchased by the WVA | May 1942 |
| Initial release timeframe | 1942 to 1970s |
| Initial discovery of problem or contamination | November 1986 |
| Preliminary Site Investigation  | December 1986 |
| Additional Investigations before RCRA Facility Investigation (RFI) | 1980 to 1991 |
| Phase 1 RFI Report completed | December 1991 |
| Administrative Order on Consent between the WVA, USEPA and NYSDEC | May 1993 |
| Final RFI completed | December1997 |
| Exposure Assessment (EA) completed | December 1998 |
| Installation of Permeable Iron Reactive Wall | 1999 |
| Burn Pit Interim Corrective Measures | 2000 |
| Corrective Measures Study (CMS) completed | February 2001 |
| First Long-Term Groundwater Monitoring Event | May 2001 |
| Interim Corrective Measures Work Plan for Soils | November 2002 |
| Implementation of Soils Corrective Measures | November 2002 – October 2005 |
| Construction Certification Report for the Soils Corrective Measures | May 2006 |
| Statement of Basis for the Siberia Area issued | September 2008 |
| Long-Term Monitoring 2009 Data Summary Report | January 2010 |
| Long-Term Monitoring Plan Update | 2010 |
| First Periodic Review | September 2010 |
| Vapor Intrusion Interim Corrective Measures Construction Certification Report | September 2010 |
| Long-Term Monitoring 2010 Data Summary Report | September 2010 |
| Long-Term Monitoring 2011 Data Summary Report | August 2011 |
| Long-Term Monitoring 2012 Data Summary Report | February 2013 |
| Long-Term Monitoring 2013 Data Summary Report | March 2014 |

# Watervliet Arsenal Background – Siberia Area

## Site Description

The SA comprises about 15 acres of the 140-acre WVA and is primarily used for the storage of raw and hazardous materials, finished goods, and supplies brought from the MMA. The SA is shown on **Figure 2**. To assist in the descriptions of locations within the SA, it has been divided into four quadrants: southwest (SW), southeast (SE), northeast (NE), and northwest (NW), see **Figure 28**.

A more detailed discussion of the operational history of the WVA is provided in **Section 3.1**.

## Physical Characteristics

### Geology

According to the "Surficial Geologic Map of New York - Hudson-Mohawk Sheet, 1987", a majority of the SA is underlain by recent alluvial deposits. These are defined as fine sand and gravel deposits overlain by silt. The SA, which is at a lower elevation than the MMA located to the east, is generally underlain by a layer of fill (sand, shale fragments, slag, cinders, brick, wire, wood and concrete). Alluvium, lenses of peat, and lacustrine clay deposits were encountered beneath the layer of fill material. Bedrock beneath the SA is also the Snake Hill shale. During the SA investigation, highly weathered shale was encountered from approximately 3.5 feet bgs to 31 feet bgs. In general, competent bedrock was encountered at approximately 12 feet bgs. The upper portion of the competent bedrock was found to be fissile and highly fractured with 45 to 60 degree bedding planes. **Figures E-14** through **E-18** in **Attachment E** provide geologic cross-sections of the SA.

### Hydrogeology

The majority of the overburden deposits in the SA are saturated and hydraulically well connected with the weathered bedrock. The primary exception is in the NW Quadrant where several monitoring wells are screened in and above a dense clayey silt layer with relatively low permeability. Approximately ten feet of channel deposits underlie this clayey silt unit in the NW quadrant. Wells screened in the channel deposits do not exhibit good hydraulic communication with the wells screened in the clayey silt. Vertical hydraulic head differences of approximately three to eight feet (downward) have been observed between these two units during both high and low water table conditions.

During the majority of the year the water table is within the overburden deposits, but during seasonal low water table conditions the water table declines into the weathered bedrock over much of the site. Groundwater levels in the SA have historically equaled or exceeded ground surface elevations during the snow melt runoff season or high precipitation events, which can inundate the site. The depth to groundwater in the overburden deposits varies from approximately two feet below the ground surface along the westerly edge of the NW Quadrant to approximately six feet below the ground surface along the easterly property line. The water table responds quickly to recharge events, and during times of low precipitation the water table may be present in the shale bedrock over portions of the SA.

Groundwater flows generally to the north-northwest in the NE quadrant of the SA, and generally to the west across the remainder of the SA. **Figures E-19** and **E-20** from the RFI show the potentiometric groundwater levels at the bedrock layer throughout the SA in 1995 and 1996. **Figures E-21** and **E-22** show the potentiometric groundwater levels in the bedrock and overburden layers at the SA from the 2004 LTM report.

### Surface Water

Surface water in the SA that does not infiltrate is generally directed into the existing storm sewers. The WVA storm sewers are connected to the city of Watervliet storm sewer network which eventually discharges into the Hudson River.

## Land and Resource Use

A majority of the SA is utilized by the New York National Guard for vehicle and equipment storage. However, sections of the SA still house Buildings 145 (SW), 141 (NW) and 153 (NE), the Main Electrical Substation (SW), former burning pits (NE) and Chip Handling Facility (NW). Ground cover in the SA is approximately 50% asphalt/pavement, 25% gravel, 20% buildings, and 5% vegetation. **Figure 28** shows the various buildings and facilities at the SA.

The western property line of the SA is used by the Delaware and Hudson Railroad (now operating as Canadian Pacific). To the north and northeast, the SA is bordered by residential properties. On the eastern property line is Perfection Plating, which formerly manufactured metal plates for brake pads, and is currently under study by the NYSDEC. On the southern boundary are Shaker Tire Sales and lands owned by the town of Colonie (formerly owned by the Delaware and Hudson railroad yard).

## History of Contamination

The SA was purchased by the WVA in May 1942. The SA was a swampy area to the west of the MMA and was immediately filled in with debris consisting of slag, cinders, wood, brick and available debris of various unknown origin. Once filled in, two areas were used for burning combustible material (i.e., scrap lumber and sanitary wastes) until 1967. In the past, metal chips coated with cuttings oils, salvaged scrap metals, and scrap lumber were stored directly on the ground surface at the SA. The handling of these materials may have contributed to soil and groundwater contamination in the SA (NYSDEC 2012). In addition, the WVA has reported that mixtures of oils and solvents removed from underground storage tanks were sprayed on the ground for dust control. Current operational procedures prohibit all of these activities.

Currently, the SA is used for the interim storage of raw materials, hazardous materials, finished goods, and supplies brought in from the MMA. Elevated levels of chromium, including hexavalent chromium, and lead have also been detected in the soil and groundwater in the NE quadrant of the SA. This chromium and lead contamination is attributed to the Perfection Plating facility located hydraulically and topographically up-gradient of the site.

## Initial Response

Environmental investigations in the SA began in November 1986 with the discovery of oil containing polychlorinated biphenyls (PCBs) during construction of Building 151. A RCRA Facility Assessment (RFA) was prepared in December 1986, with updates in December 1987 and March 1992, which identified solid waste management units in the SA. Based on the RFA Report and the results of studies, it was determined that additional, detailed sampling was needed. Since then, numerous soil and groundwater sampling activities have been completed to better delineate the extent of contamination within the SA.

Following the RFA, an RFI was conducted by MPI at the SA from 1994 to 1995. Additional investigations and ICMs were completed by MPI from 1996 to 2002. CVOCs, petroleum hydrocarbons, PAHs, and metals were detected in the groundwater and soil at the SA during the RFI. Based on the results of the RFI, a CMS was initiated by MPI on behalf of the USACE Baltimore District to evaluate, develop, and recommend remedial alternatives for the impacted areas of the SA. As a preliminary step in the CMS process, additional investigations were conducted, after completion of the RFI, to further define the extent of soil and groundwater contamination (NYSDEC 2012).

Based on the results of the RFI and CMS investigations, a preliminary screening of corrective measure technologies identified for the SA was completed. Concurrent with the CMS studies, a human health and ecological exposure assessment was completed to document potential risks resulting from environmental conditions at the SA.

Based on the preliminary screening report and the exposure assessment, bench scale and pilot scale treatability studies were conducted to evaluate the applicability and effectiveness of various treatment technologies for treatment of soil and groundwater. The pilot studies included a permeable iron reactive wall (PRW) as a corrective action for groundwater contaminated by CVOCs, bioremediation for soil (landfarming) contaminated with petroleum hydrocarbons and PAHs, in-situ chemical oxidation for a localized area of bedrock groundwater containing CVOCs, and enhanced biological treatment of groundwater contaminated with petroleum hydrocarbons. The following remedies were implemented as ICMs:

Area of Concern (AOC) 1 - Soil Contamination:

* Enhanced bioremediation via landfarming
* Capping
* Excavation and off-site disposal
* Institutional Controls

AOC 2 - Groundwater Contamination:

* Source removal at the Former Burn Pit
* Treatment of volatile organic contamination by a permeable iron reactive wall
* Monitored natural attenuation of groundwater.

Given that several pilot treatability studies, which also served as ICMs, had already been implemented at the site, and that these pilot studies/ICMs have reduced or eliminated source areas and prevented further migration of contaminants from the site, the WVA proposed that a Focused CMS Report would be sufficient to meet the requirements of the Administrative Order on Consent between the WVA, USEPA, and NYSDEC.

The Focused CMS Report summarized the results of the ICMs and pilot studies, and recommended final corrective measures for the SA based on the results of the investigations, technology screening, and pilot studies conducted to date. Bioremediation using landfarming techniques, excavation and off-site disposal, and capping were recommended for soil contaminated with petroleum hydrocarbons and PAHs. The PRW was recommended as the long-term corrective measure for overburden and weathered bedrock groundwater contaminated with CVOCs. MNA accompanied by groundwater LTM was the recommended corrective measure for the localized bedrock groundwater CVOC contamination. Similarly, MNA and LTM were recommended corrective actions for groundwater contaminated with petroleum hydrocarbons after completion of source treatment through landfarming and excavation of petroleum contaminated soil.

The Focused CMS Report for the SA was approved in August 2003. The CMS Certification Report was approved by the NYSDEC and USEPA in August 2007. The ICMs are summarized in the CMS report. A Construction Certification Report detailing the SA soil remedy activities was approved by NYSDEC on August 31, 2007. The SOB that proposed final remedies for the soils and groundwater contamination in the SA was issued in 2008 (SOB, 2008).

## Basis for Taking Action

Organic contaminants present in the soil consist of CVOCs, petroleum hydrocarbons, and PAHs; inorganic soil contaminants consist of chromium, lead, and arsenic. Soil CVOCs were located in the source area of the Former Burn Pit (NE), with petroleum hydrocarbons and associated PAHs at the Main Substation area (SW), Chip Handling Facility (NW), Former Burn Pit (NE), and the PCB area (SE). Chromium was the most extensive and widespread inorganic contaminant, with maximum concentrations detected in the NE and SW. Lead contamination was predominantly along the eastern fence line and in the SW. Arsenic contamination was widespread in the SA with the maximum concentrations in surface and shallow soils along the eastern, northern, and western fence lines. Concentrations of chromium, lead, and arsenic generally decreased with soil depth.

Off-site soil and sediment samples from a drainage ditch were collected from areas adjacent to the NE and NW quadrants of the WVA property during the RFI and CMS field activities to assess the impacts of the SA contamination on the surrounding area. PAHs and inorganic contaminants were detected in the off-site surface soil and sediment samples, but at significantly lower concentrations than the maximum concentrations detected within the SA. The CAOs for the soils, which were developed with the concurrence of the NYSDOH, are shown in **Table 25**.

Groundwater contamination in the SA consists of petroleum hydrocarbons and CVOCs. The PAHs which were found to exceed NYSDEC Class GA groundwater standards were: benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, bis(2-ethylhexyl)phthalate, chrysene, indeno(1,2,3-cd)pyrene, naphthalene, and phenol. The CVOCs which were detected at concentrations greater than the NYSDEC Class GA groundwater standards were: PCE, TCE, cDCE, and VC. CVOC contaminants were present in the overburden as well as bedrock groundwater and appeared to be migrating northward from their source, at the Former Burn Pit, towards the property line.

The SA is an industrial use area, as imposed by the ICs. The primary exposure pathways consist of dermal contact with contaminated surface soils, dermal contact to contaminated subsurface soils and groundwater through excavation within the SA, and inhalation of contaminated soil vapor at on-site structures.

Cleanup objectives were based on a comparison of the detected COCs with the soil and groundwater NYSDEC standards. Detections of COCs above the NYSDEC regulatory standards provided the basis for taking action at the site.

# Corrective Actions - Siberia Area

## Remedy Selection

The following implemented ICMs were recommended to become final remedies in the 2008 SOB for the SA.

### Area of Concern 1 Soil Remedies

For soil remediation in the SA, the following technologies were proposed:

* Enhanced bioremediation (landfarming)
* Capping
* Excavation and off-site disposal
* ICs

The asphalt cap locations are shown on **Figure 29**. A Construction Certification Report detailing the SA soil remedy activities was approved by the NYSDEC on August 31, 2007.

### Area of Concern 2 Groundwater Remedies

For groundwater remediation in the SA, the following technologies were proposed:

* Source removal at the Former Burn Pit
* In-situ groundwater treatment through a PRW
* MNA

Source removal and in-situ groundwater treatment have already been implemented and have succeeded in removing the contaminant source, and preventing dissolved CVOCs in exceedance of the NYSDEC GA Standards from migrating off-site. MNA is also occurring as demonstrated through ongoing LTM. Thus, these remedies were considered appropriate to become final remedies because they are effective and they do not incur ongoing costs other than monitoring and potentially recharging or refreshing the PRW to extend its effective life.

MNA was considered appropriate for this site because:

* Contaminants from the burn pit source area were removed;
* Contaminants in the bedrock reached a stable distribution where the contaminant plume edge did not appear to be migrating due to natural attenuation;
* CVOC contaminants in the overburden are being chemically reduced by passing through the PRW;
* Monitoring showed that no contamination was migrating off-site above groundwater standards; and
* WVA and the surrounding properties are serviced through public potable water by the city of Watervliet and the town of Colonie. Therefore, no pathway for ingestion or contact with contaminated groundwater was present to residents or WVA personnel.

## Remedy Implementation

Remedies for the soil and groundwater contamination present at the SA were implemented as ICMs, identified in the CMS, and later approved as final remedies in the 2008 SA SOB.

### Area of Concern 1 Soil Remedy Implementation

#### Enhanced Bioremediation

Bio-treatability studies indicated that naturally occurring bio-degrading organisms exist onsite and are using the total petroleum hydrocarbons and PAH's as a source of carbon. To assure removal of recalcitrant PAH's down to the CAOs, bio-enhancement was used. This entailed the addition of fertilizer, moisture, a bulking agent (wood chips) and mixing of the soil on a routine basis.

The CAOs for the soils, which were developed with the concurrence of the NYSDOH, are shown in **Table 25**.

During the summer of 2003 and 2004 approximately 13,300 cubic yards of soil were actively treated through landfarming in a number of treatment cells. When the soils reached levels below

CAOs or when monitoring showed a continuing reduction in concentrations due to natural attenuation, these areas (approximately 2.9 acres) were graded and covered with a geotextile and

gravel. Landfarming treatment was completed in January 2006.

In addition, as an ICM for the Burn Pit area, all contaminated soils and materials disposed of in the area of the pit were excavated and treated by enhanced bioremediation during the landfarming pilot study.

#### Capping

An asphalt cap was placed on approximately 90,000 square feet (2.1 acres) of the site where

landfarming was not feasible. Two areas were capped at a depth of approximately six inches. Capping of these areas was completed during July 2004. The two areas that were capped are shown on **Figure 29**.

#### Excavation and Disposal

Approximately 3,500 cubic yards of soil that was not amenable to bioremediation or capping were excavated and disposed of off-site.

#### Institutional Controls

Institutional controls through land use restrictions, and engineering measures such as signage and fencing, have been imposed to limit future use of the site. If the property is transferred out of federal ownership, all continuing LUCs, reporting requirements, and any other obligations related to the property will be satisfied through the United States’ conveyance of a deed restriction and/or environmental easement prior to any such transfer of deed to the property. A Site-Wide Soils Management Plan outlines procedures for disposal of excavated soils from areas where contamination remains on-site at levels above CAOs. The Site-Wide Soils Management Plan was not provided for this Periodic Review for further evaluation; a hard-copy of the document was observed during the site inspection.

LUCs at the SA prevent exposure to contaminants above CAOs. LUCs include any type of physical, legal, or administrative mechanism that restricts the use of, or limits access to, real property. The SOB does not explicitly list all of the LUCs in-place at the SA, however the restricted access to the area, fencing and signage, and limiting site use to only industrial, greatly inhibits potential exposure to site contaminants.

Currently, the SA is not incorporated into the WVA SMP discussed in **Section 4.1** of the MMA portion of this report. This is included as a concern in **Section 17.0**.

### Area of Concern 2 Groundwater Remedy Implementation

#### Source Removal

Debris and soil beneath the Former Burn Pit area was identified as the source of soil and groundwater petroleum hydrocarbons and CVOC contamination in the NE quadrant of the SA. An ICM was conducted in June and July of 2000 to remove approximately 1,500 cubic yards of contaminated soil and debris from this area. The extent of the contaminated materials was identified in a February 2000 field investigation, supplemented by visual inspection during the

excavation. Soil material was treated on-site as part of the landfarming program. Oversized material, including wood block flooring, construction and demolition debris, stabilization fabric, and other materials were sent off-site for disposal.

A low-permeability clay layer was used as the first lift of backfill material in the excavation. This restricts groundwater infiltration through materials that may contain residual CVOC contaminants leached from the Burn Pit. Groundwater monitoring down-gradient of the Former Burn Pit area have shown a dramatic decrease in contaminant concentrations since the contaminant source was removed. Residual contaminants are being effectively treated by the PRW.

#### Reactive Iron Wall

In November and December of 1998 the WVA installed a system to treat CVOC contaminated groundwater in the overburden using two PRWs, as shown in **Figure 31**. The As-built construction details for the trenches are shown in **Figure 36**. The Former Burn Pit is located hydraulically up-gradient of where the two PRWs were placed. The treated water includes groundwater in weathered bedrock that migrates into the overburden before it leaves the site. The PRW consists of zero-valent iron that degrades chlorinated contaminants into non-toxic byproducts using oxidation-reduction reactions. This technology was implemented as an ICM and was proposed and approved to become a component of the final groundwater remedy at the SA.

#### Monitored Natural Attenuation

The LTM program for the SA includes annual samples from 19 monitoring wells in overburden, weathered bedrock, and bedrock. The program also includes three samples from storm sewer lines and one from the bedding material beneath a sanitary sewer line. These monitoring points are selected to monitor the Former Burn Pit area, the PRW, the storm sewers (large collection areas), and the perimeter of the facility to ensure that contaminants are not migrating off-site. These wells and the sampling parameters are identified in **Table 26** with well locations shown on **Figure 30**.

## Remedy Operation and Maintenance Activities

The LTM program began in May 2002 and is conducted in accordance with the LTM Plan, last updated August 2010. **Table 26** outlines the sampling frequency and which wells are sampled for CVOCs and SVOCs. MNA parameters are recorded for the wells not associated with the PRWs or storm sewer. LTM is required under the SOB as part of the MNA remedy and to verify the remedies at the SA are effectively treating the site contaminants. Monitoring wells at the up-gradient and down-gradient sides of the PRWs also verify the zero-valent iron has not been completely passivated. Monitoring well maintenance occurs as necessary with inspections occurring at least annually as part of the sampling activities.

Regular inspections of the cap occur by Department of Public Works employees. Asphalt cracks and areas of ponding are patched or filled in as needed. No documentation of the inspections was provided for this report other than what is included in the LTM Reports, this concern is included in **Section 17.0**.

A passive SSDS was installed during the construction of Building 153 as an extra level of safety because of prior VI issues in the MMA and due to the building’s proximity to the PRW and Former Burn Pit. The passive SSDS is not individually listed as a remedy under the VI systems in the SOB or LTM Reports. The building is occupied and maintained by the National Guard. No records of indoor sampling at Building 153 were submitted for this Periodic Review to evaluate. Consideration should be given to performing an indoor sampling event at Building 153 to verify the passive system is adequate; this concern is included in **Section 17.0**.

# Progress Since Last Review - Siberia Area

The effectiveness statement from the 2010 Periodic Review for the SA was as follows:

The remedies for SA are effective and exposure pathways that could result in unacceptable risks are being controlled.

One issue was identified in the 2010 Periodic Review regarding small cracks and ponding at the asphalt cap in the NW quadrant of the SA. A recommendation was made to seal any cracks and fill any low areas where ponding may occur. All repairs have been made to the identified issues.

No other work has occurred at the SA since the last Periodic Review. Four annual LTM reports have been documented since the last Periodic Review with sampling trends showing that contamination is generally declining across the site.

# Periodic Review Process - Siberia Area

## Identification of Review Team Members

Refer to **Section 6.1** in the MMA portion of this Review.

## Community Involvement

Since there was no community interest to form a Restoration Advisory Board, the WVA does not have a Board that meets periodically to discuss ongoing environmental restoration activities. However, public notices were provided and public comment periods were conducted for the SA SOB document. The public may view project documents at the WVA.

## Document Review

This Periodic Review for the SA consisted of a review of relevant documents, which primarily included:

* RCRA Facilities Investigation, Siberia Area, Watervliet Arsenal, 1995. (MPI, 1995)
* Corrective Measures Study, Siberia Area, Watervliet Arsenal, July 2003. (CMS, 2003)
* Statement of Basis, Watervliet Arsenal, Siberia Area, September 2008. (NYSDEC, 2008)
* First Periodic Review Main Manufacturing Area and Siberia Area. September 2010 (USACE, 2010)
* Long-Term Monitoring Plan Update, Main Manufacturing Area (WVAA-32), Siberia Area (WVAA-25), August. (MPI, 2010)
* Long-Term Monitoring 2010 Data Summary Report, September. (MPI, 2010)
* Long-Term Monitoring 2011 Data Summary Report, August. (MPI, 2011)
* Long-Term Monitoring 2012 Data Summary Report, February. (MPI, 2013)
* Long-Term Monitoring 2013 Data Summary Report, March. (MPI, 2014)

A complete list of documents reviewed for this Periodic Review are included in **Attachment A**.

## Data Review

### Groundwater Monitoring Data Performance Evaluation

Groundwater data from the 2010, 2011, 2012, and 2013 sampling events were reviewed as part of this Periodic Review.

#### Volatile Organic Compounds and Semi-Volatile Organic Compounds

**Figure 31** shows the locations of and **Table 27** summarizes the exceedances of NYSDEC Class GA standards for groundwater samples collected from the SA monitoring wells during the September 2013 LTM event. CVOC exceedances occurred in samples from ten of the 32 SA LTM wells sampled during the September 2013 LTM event.

NYSDEC Class GA standards for SVOCs were not exceeded in any of the groundwater samples collected from the SA LTM wells during the September 2013 event.

The number of samples containing CVOCs and SVOCs at concentrations that exceed NYSDEC Class GA standards in the SA have been generally decreasing since the April 2000 sampling event (**Figure 32**). Consistent with results from previous monitoring events, CVOC concentrations in the SA groundwater samples generally exceeded Class GA standards only in the area of the Former Burn Pit and in monitoring wells up-gradient of the PRW.

**Figure 33** shows the locations of and **Table 28** summarizes the exceedances of NYSDEC Class GA standards for groundwater samples collected from the SA monitoring wells during the August 2012 LTM event. CVOC exceedances occurred in samples from twelve of the 32 SA LTM wells sampled during the August 2012 LTM event.

NYSDEC Class GA standards for SVOCs were not exceeded in any of the groundwater samples collected from the SA LTM wells during the August 2012 event.

**Figure 34** shows the locations of and **Table 29** summarizes the exceedances of NYSDEC Class GA standards for groundwater samples collected from the SA monitoring wells during the August 2011 LTM event. CVOC exceedances occurred in samples from twelve of the 32 SA LTM wells sampled during the August 2011 LTM event.

NYSDEC Class GA standards for SVOCs were not exceeded in any of the groundwater samples collected from the SA LTM wells during the August 2011 event.

**Figure 35** shows the locations of and **Table 30** summarizes the exceedances of NYSDEC Class GA standards for groundwater samples collected from the SA monitoring wells during the August 2010 LTM event. CVOC exceedances occurred in samples from twelve of the 32 SA LTM wells sampled during the August 2010 LTM event.

NYSDEC Class GA standards for SVOCs were not exceeded in any of the groundwater samples collected from the SA LTM wells during the August 2010 event.

#### Permeable Reactive Wall Sampling

Seven wells (WVA-SA-MW-49, 54, 59, 60, 66, 70, and 76) which were installed as part of the installation of the PRW are sampled annually using Passive Diffusion Bag samplers, in accordance with the EPA letter dated September 20, 2002 and analyzed for CVOCs only. WVA‑SA‑MW‑85 was added to the Passive Diffusion Bag sampling wells after being installed side-gradient to WVA‑SA‑MW‑70 to ensure contamination was not passing around the PRW and infiltrating the sewer system. Currently, the monitoring wells which are located on the down-gradient side of PRW “Wall A” (the wall closest to the Former Burn Pit Area) are not sampled. This is discussed in more detail in **Section 16.1.4**.

Detections above NYSDEC GA Standards for cDCE have occurred at WVA-SA-MW-60 in the 2010 (12 µg/L), 2011 (17 µg/L), 2012 (37 µg/L), and 2013 (12 µg/L) groundwater sampling events. A single detection above NYSDEC GA Standards for vinyl chloride occurred at WVA-SA-MW-60 in 2012 (94 µg/L). A side-gradient monitoring well is not present to the east to determine a definitive edge of the contaminant plume. Due to the relatively low level of exceedances at WVA-SA-MW-60 and the lack of down-gradient detections, this concern does not impact the protectiveness of the remedy, however it is included as a concern in **Section 17.0**.

Detections above NYSDEC GA Standards for cDCE have occurred at WVA-SA-MW-70 in the 2010 (56 µg/L), 2011 (60 µg/L), 2012 (64 µg/L), and 2013 (7.9 µg/L) groundwater sampling events. Detections above NYSDEC GA Standards for vinyl chloride also occurred at WVA‑SA‑MW‑70 in 2010 (4 µg/L), 2011 (7 µg/L), and 2012 (10 µg/L). A side-gradient monitoring well is present to the west (WVA-SA-MW-85) and has had no exceedances in the 2010, 2011, 2012, or 2013 LTM sampling events.

**Figure 32** presents the total CVOC concentrations in wells up-gradient and down-gradient of the PRW system from the most recent sampling event in 2013. Total CVOC concentrations in both up-gradient and down-gradient PRW monitoring wells have decreased since the beginning of LTM. Groundwater trends indicate that the ICMs at the Former Burn Pit and the PRW are successfully reducing total CVOC concentrations up-gradient and down-gradient of the PRW.

### Operation and Maintenance Activities – Groundwater Monitoring Wells

Three wells were not sampled in 2013 because either the water contained permanganate (WVA‑SA‑MW‑78), or the well was dry (WVA-SA-MW 76, WVA-SA-MW-77). No other issues with well sampling were identified in the 2013 sampling event.

One well (WVA-SA-MW-78) was not sampled in the 2012 event because of the presence of permanganate. No other issues with well sampling were identified in the 2012 sampling event.

One well (WVA-SA-MW-78) was not sampled in the 2011 event because of the presence of permanganate. No other issues with well sampling were identified in the 2011 sampling event.

Three wells were not sampled in 2010 because either the water contained permanganate (WVA‑SA‑MW‑78), the well was dry (MPI-SA-MW‑33), or the well was damaged (WVA‑SA‑MW‑82). No other issues with well sampling were identified in the 2010 sampling event.

## Site Inspection

A site inspection was conducted on November 4, 2014 following the inspection at the MMA. Attendees at the site inspection included the following:

* JoAnn Kellogg, WVA Environmental Program Manager
* Mr. Andy Vitolins, Malcolm Pirnie
* Steve Wood, USACE, Baltimore District
* Brian Roberts, Engineer, USACE, Kansas City District
* Kenneth Kamp, Engineer, USACE, Kansas City District

The site inspection included a general tour of the SA to obtain an understanding of the surrounding land use and an overview of the groundwater monitoring program. The capped areas, PRW remedy, and the monitoring well network were observed.

During the site inspection, remnants of a monitoring well cap were observed at the PRW. It was believed the monitoring well had been damaged during snow clearing and the well had been replaced. The damaged well was not identified in the 2013 LTM report; a 2014 LTM report was not available for inclusion in this Periodic Review. It is believed the monitoring well was damaged during the 2013 winter and repaired in 2014.

The asphalt cap areas were observed to be in good condition, however some issues were observed near the PRWs which included damaged bollards (likely associated with the damaged well discussed above), as well as surface drippings from fuel, oil, or grease attributed to the National Guard vehicles which are parked in the vicinity. These concerns are discussed further in **Section 17.0** and **Section 18.0**.

The site inspection checklist is included in **Attachment B**. Photos from the site inspection, including the damaged well, are included in **Attachment C**.

## Interviews

Ms. JoAnn Kellogg and Mr. Andy Vitolins reviewed project background information and completed actions, and provided an overview of the ongoing remediation efforts during the site visit. Following the site inspection, the regulators involved with the project were contacted.

Mr. Samuel Ezekwo, Remedial Project Manager with USEPA Region 2, was contacted for input on the ongoing remediation efforts. Mr. Ezekwo deferred to NYSDEC for comments.

Mr. Larry Alden, NYSDEC Project Lead, provided feedback on the WVA remediation project. A summary of Mr. Alden’s comments relating to the SA follows:

* The Groundwater Monitoring/MNA Program for the SA is running smoothly and the reactive wall remedy appears to be very effective.
* The WVA and the NYSDEC are still working to get a comprehensive Site Management Plan in NYSDEC format that addresses both the SA as well as the MMA. The NYSDEC is receiving reports and other updates from the WVA.

# Technical Assessment - Siberia Area

The Periodic Review must determine whether the remedy at a site is effective and is protective of human health and the environment. Three questions are used to provide a framework for organizing and evaluating data and information and to ensure all relevant issues are considered when determining the effectiveness/protectiveness of a remedy. These questions are assessed for the site in the following paragraphs. At the end of the section is a summary of the technical assessment.

## Question A

***Is the remedy functioning as intended by the decision documents?***

Yes. The remedies in place for the SA at the WVA are functioning as intended by the SOB.

### Corrective Action Performance

The objective of the remedy prescribed for the SA soil is to prevent human contact with soil containing CVOCs and metals above the CAOs. The asphalt cap prevents contact with contaminated soils. Furthermore, the capping prevents off-site transport of soil contaminants during periods of high precipitation which cause the site to be inundated. The cap remedy has been effective.

The SA groundwater remedy includes a PRW of zero-valent iron and MNA. The WVA and surrounding residents are supplied potable water through the city of Watervliet and the town of Colonie; the groundwater remedies prevent contact with contaminated groundwater.

Groundwater monitoring of wells up-gradient and down-gradient of the walls has shown the PRW to be highly effective in reducing CVOC contaminants to levels that are consistently below groundwater standards. The 2010-2013 LTM reports show the PRW is reducing all groundwater contamination which passes the PRW to below the Class GA groundwater standards, per 6 NYCRR Part 703, Surface Water and Groundwater Quality Standards, documented in the NYSDEC TOGS 1.1.1. Groundwater contamination which may be bypassing the PRW has consistently been shown to be significantly reduced, likely due to MNA, with no further down-gradient detections. The groundwater remedy is operating effectively.

To maintain the effectiveness of the PRW remedy, water quality parameters and contaminant levels should continue to be monitored to ensure contamination is not bypassing the PRW and the zero-valent iron has not been passivated. The effectiveness of the MNA portion of the groundwater remedy could not be fully evaluated in this Periodic Review due to the lack of MNA parameters reported in the LTM reports. MNA parameters should be collected and reported in the annual LTM Reports for the SA, similar to what occurs in the MMA, to document the progress of the MNA portion of the remedy. Documentation of MNA progress in the SA is included as a concern in **Section 17.0**.

### System Operations and Maintenance

Remedy O&M activities are detailed in **Section 13.3** of this report. O&M is required for the groundwater monitoring under the MNA remedy, groundwater monitoring as part of the PRW remedy, and inspection and repairs for the cap remedy. O&M data is discussed in **Section 15.4.2**

All 32 monitoring wells included in the 2013 annual LTM sampling event were identified to be in good condition during the sampling event. It could not be definitively determined on-site which monitoring well had been damaged, as discussed in **Section 15.5**. Three monitoring wells were not sampled during the 2013 monitoring event: WVA-SA-MW-76 and WVA‑SA‑MW‑77 monitoring wells were dry at the time of sampling, and WVA‑SA‑MW‑78 contained permanganate, due to activities associated with the CMS pilot study that injected permanganate at the source area.

Regular inspections of the cap occur by Department of Public Works employees, asphalt cracks and areas of ponding are patched or filled in as needed. No documentation of these inspections was provided for this report other than what is included in the LTM Reports. Similarly, no indoor air sampling has been provided for the passive SSDS at Building 153. These items are included as concerns in **Section 17.0**.

The total O&M costs for the MMA and SA for 2010 - 2013 were provided by the WVA Environmental Program Manager and consisted of:

* The annual O&M cost for SSDSs maintenance and indoor sampling was $102,000.
* Groundwater sampling and well maintenance cost (for both the MMA and SA) was $53,000.
* Total annual costs for 2010, 2011, 2012, and 2013 were $155,000.

### Implementation of Institutional Controls and Other Measures

ICs are in-place which designate the SA as industrial use and further outlines procedures for disposal of any excavated soils with contamination from the site above CAOs. Signage, fencing, and LUCs prevent incidental contact with contaminated soils at the SA.

The SA SOB does not explicitly identify an inspection frequency or a need for inspections to verify ICs are being followed and remain effective. The ICs are verified during the annual LTM sampling events and during regular inspections by the Department of Public Works. However it would be beneficial to incorporate the SA IC inspection efforts into the SMP which is currently exclusive to the MMA. This concern is included in **Section 17.0**.

### Early Indicators of Potential Issues

Currently, water quality parameters are being recorded on the field data forms during groundwater sampling events in accordance with the LTM plan, but it is unclear if the data is being reviewed and evaluated as an indicator to the contaminant reduction potential at the site. Furthermore, natural attenuation parameters are evaluated under the MMA section of the LTM report but not for the SA. Evaluation of natural attenuation parameters would assist in documenting the effectiveness of MNA at the SA.

Over time, the PRWs will passivate. To maintain the effectiveness of the PRW remedy, the monitoring wells on the down-gradient side of PRW “Wall A” should be periodically sampled and evaluated for parameters and analytes which will assist in identifying passivation and the performance of the PRW.

These concerns do not impact the protectiveness of the remedy, but would be an additional, low cost activity to support the remedy’s effectiveness in treating contamination, as well as indicating when the PRW may be approaching the end of its’ design life. These concerns are included in **Section 17.0**.

### Opportunities for Optimization

The WVA plans to review the groundwater sampling program in 2015. Based on this evaluation, wells may be deleted from the program and/or new wells may be recommended.

## Question B

***Are the exposure assumptions, toxicity data, cleanup levels, and corrective action objectives (CAOs) used at the time of the remedy selection still valid?***

Yes. While there have been changes in toxicity data and risk assessment methods, these still support the protectiveness of the remedy. The exposure assumptions, cleanup levels, and corrective action objectives have not changed. All these factors are thus still valid for the SA at WVA. The health risk assessment tables referenced in the following subsections are included in **Attachment D**.

### Changes in Standards

The established cleanup objectives for the facility are:

**Soil**

Soil Cleanup Objectives are from Part 375-68(b) of the SCGs for commercial use. The COCs include several PAHs, arsenic, chromium, and lead. **Table D-8** lists all of the COCs and shows the SCGs at the time of the 2010 Periodic Review and the current values. As shown in the table, these levels have not changed since the time of remedy selection.

**Groundwater**

The NYSDEC Class GA (drinking water) Groundwater Quality Standards, from 6 NYCRR Part 703, are applicable to groundwater at the SA. COCs for the groundwater in the SA are PCE, TCE, cDCE, VC, numerous PAHs, bis(2-ethylhexyl)phthalate, and phenol. **Table D-9** shows these values have not changed since the time of remedy selection.

### Changes in Exposure Pathways

* *Have any human health or ecological routes of exposure or receptors changed or been newly identified (e.g., dermal contact where none previously existed, new populations or species identified on site or near the site) that could affect the effectiveness/protectiveness of the remedy?*

No human health or ecological routes of exposure or receptors have changed or been newly identified that could affect the effectiveness/protectiveness of the remedies.

* *Are there newly identified contaminants or contaminant sources?*

No new contaminants or contaminant sources were identified during the Periodic Review period.

* *Are there unanticipated byproducts of the remedy not previously addressed by the decision documents (e.g., byproducts not evaluated at the time of remedy selection)?*

No unanticipated toxic byproducts of the remedies have been identified.

* *Have physical site conditions (e.g., changes in anticipated direction or rate of groundwater flow) or the understanding of these conditions changed in a way that could affect the effectiveness/protectiveness of the remedy?*

No changes in site conditions were identified during this Periodic Review that would affect exposure pathways. There have been no land use changes, nor are land use changes anticipated. No new contaminants, sources, or routes of exposure were identified. There is no indication that hydrologic or geologic conditions were inadequately characterized.

### Changes in Toxicity or Other Contaminant Characteristics

**Oral Non-Cancer Toxicity**

As shown in **Table D-10**, oral RfDs for most of the COCs in both soil and groundwater from the SA have not changed. The chemical TCE has a new oral RfD of 0.0005 mg/kg/day.

**Inhalation Non-Cancer Toxicity**

**Table D-11** shows that most of the RfC have not changed since the last Periodic Review for the SA. Arsenic has a RfC of 0.00015 mg/m3 published by the California Environmental Protection Agency, previously there was not a value. TCE has a new RfC of 0.002 mg/m3.

**Oral Cancer Toxicity**

**Table D-12** shows oral CSFs for the COCs, mostly, have not changed since the time of remedy selection. The oral CSF for TCE has increased while the oral CSF for PCE has decreased.

**Inhalation Cancer Toxicity**

**Table D-13** shows that most of the IURs for the COCs have not changed, except for an increase in the TCE IUR and a decrease in the IUR for PCE.

**Toxicity Summary**

None of the previously published toxicity values for the COCs at the SA have changed since the time of remedy selection. The cancer toxicity values for TCE have increased. Some new toxicity values have been generated, but these new toxicity values do not call the effectiveness of the remedies into question.

### Changes in Risk Assessment Methods

Changes in risk assessment methods have been discussed in detail in the MMA portion of this Periodic Review, **Section 7.2.4**.

## Question C

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

### Ecological Risks

No additional information has come to light that indicates ecological risks could call the effectiveness/protectiveness of the remedy into question.

### Natural Disaster Impacts

No natural disasters were noted to have occurred in the region over the past five years that would affect the protectiveness of the remedy.

### Any Other Information That Could Call Into Question the Protectiveness of the Remedy

No other information has become available that could call into question the protectiveness of the remedy.

## Technical Assessment Summary - Siberia Area

Capping of the contaminated soils at the SA has effectively eliminated the potential for dermal exposure to contamination. The PRW has shown to be effective at reducing groundwater contamination at the SA to below Class GA groundwater standards. A full evaluation of the effects of MNA at the SA could not be performed due to the lack of MNA parameter data.

Exposure pathways are unchanged. The noted changes in toxicity data and risk assessment methods do not affect the protectiveness of the remedy.

Some administrative issues related to the SA actions were discussed in previous sections of this Periodic Review. Although the identified issues do not affect the effectiveness/protectiveness of the remedy, they are included as items to evaluate in **Section 17.0** and **Section 18.0**.

# Issues - Siberia Area

There were no issues or deficiencies identified during the review that affect protectiveness of the remedy. However, several concerns, not rising to the level of a “protectiveness issue” were identified.

1. The passive SSDS at Building 153 is maintained by the National Guard, however no indoor air sampling records have been provided to fully evaluate the VI mitigation at the building.

2. The NYSDEC noted that they are continuing to work with the WVA to get a comprehensive Site Management Plan in NYSDEC format that addresses both the SA as well as the MMA. Currently, the SMP only requires site-wide inspections be performed on a regular schedule at the MMA, however to maintain the integrity of the asphalt cap and the effectiveness of the ICs, inspections should occur at the SA. The NYSDEC comment is discussed in **Section 6.6** and **Section 15.6** of the Periodic Review.

3. Concerns near the PRWs included damaged bollards and monitoring wells, as well as fuel, oil, or grease drippings from National Guard vehicles and equipment that are parked at the area. Photographs of these concerns are included in **Attachment C**.

4. It is unclear to what extent the water quality parameters and MNA parameters are being evaluated. Water quality parameters serve as indicators that conditions are suitable for contaminant degradation and can indicate when a PRW has become passivated and no longer functioning. Natural attenuation parameters are reported under the MMA portion of the LTM Report and should also be included for the SA to document the effectiveness of MNA at the SA.

5. A monitoring well with no detections above NYSDEC GA Standards is not present to the east of WVA-SA-MW-60 to identify the edge of the contaminant plume.

# Recommendations and Follow-Up Actions - Siberia Area

**Table 31** provides a list of the recommended actions to address the concerns identified in **Section 17.0.**

**Table 31: Siberia Area Concerns and Recommended Actions**

|  |  |
| --- | --- |
| **Concern** | **Recommendation** |
| **Concern 1:** No indoor air sampling records have been provided to fully evaluate the VI mitigation at Building 153. | Consider including the requirement for indoor air sampling at Building 153 in the SMP, or perform an indoor air sampling event prior to the next Periodic Review to verify VI mitigation in the building is effective. |
| **Concern 2:** The NYSDEC noted the WVA lacks a comprehensive Site Management Plan that addresses both the SA as well as the MMA.  | Finalize a Site Management Plan for the MMA and SA. |
| **Concern 3:** Damaged bollards and monitoring wells, as well as fuel, oil, or grease drippings from National Guard vehicles and equipment were noted during the site inspection. | Consider measures to better mark the bollards and monitoring well network at the SA so that snow removal equipment does not inadvertently damage them. Also, utilize the regular inspections (a requirement of the MMA SMP – see Concern 2) to ensure new site contaminants are not being introduced. |
| **Concern 4:** It is unclear to what extent the water quality parameters and MNA parameters are being evaluated. MNA parameters are reported under the MMA portion of the LTM Report and should also be included for the SA to document the effectiveness of MNA at the SA. | Include a review and evaluation of water quality standards in the Annual LTM Reports for the groundwater sampling performed at the PRWs. The collection and analysis of water quality parameters, as well as CVOCs, from monitoring wells on the down-gradient side of PRW “Wall A” will further support the contaminant reduction occurring at the PRW, as well as assist in indicating when the PRW is approaching the end of its design life. This sampling may be performed on a less frequent basis than the annual LTM sampling to reduce costs. |
| **Concern 5:** A monitoring well with no detections above NYSDEC GA Standards is not present to the east of WVA-SA-MW-60 to identify the edge of the contaminant plume. | Consider placing well(s) side-gradient to the PRW to establish an edge of the contaminant plume, include any new side-gradient wells into the LTM plan. Multiple wells may be warranted to ensure samples are collected from each geologic zone. |

# Effectiveness/Protectiveness Statement - Siberia Area

The remedies for the SA are effective and protective of human health and the environment. Exposure pathways that could result in unacceptable risks are being controlled.

Monitored Natural Attenuation and Long-Term Groundwater Monitoring are the remedies applied to the SA groundwater. The SA groundwater remedy also includes a passive (natural groundwater flow) underground permeable iron reactive wall.

Since contaminated soils and groundwater remain at the site, the selected remedy includes engineering controls and institutional controls to protect human health and the environment.

Performance and operational data for the WVA SA corrective measures were reviewed and it was determined that all of the corrective actions are functioning effectively.

# Next Review: Main Manufacturing Area and Siberia Area

The next Periodic Review for the Main Manufacturing Area and the SA is expected by August 31, 2020, five years from the date of this Review.