ORIGINAL

Five-Year Review Report

Fourth Five-Year Review Report
for
C & R Battery Superfund Site
Chesterfield County, Virginia

September 2013
Prepared by:
United States Environmental Protection Agency
Region 3
Philadelphia, PA

Approved by:

Kathryn A. Hodgkiss, Acting Director
Hazardous Sites Cleanup Division
U. S. EPA, Region 3

9/30/2013
Date

TABLE OF CONTENTS

ORIGINAL

List of Figures

List of Tables

List of Attachments

LIST OF ABBREVIATIONS

ARAR	Applicable or Relevant and Appropriate Requirement
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
CRDL	Contract Required Detection Limits
DSCR	Defense Supply Center Richmond
EPA	U.S. Environmental Protection Agency
FIT	Field Investigation Team
GMUC	Groundwater Migration Under Control
GPRA	Government Performance Results Act
HEUC	Human Exposure Under Control
µg/L	Micrograms per Liter
MCL	Maximum Contaminant Level
ug/kg	Milligrams/kilograms
NCP	National Contingency Plan
NOAA	National Oceanic and Atmospheric Administration
NPL	National Priorities List
O&M	Operation and Maintenance
OSHA	Occupational Safety and Health Administration
PCOR	Preliminary Close Out Report
PRP	Potentially Responsible Party
RPM	Remedial Project Manager
RAO	Remedial Action Objective
RCRA	Resource Conservation and Recovery Act
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
SMCL	Secondary Maximum Contaminant Level
SWCB	Virginia State Water Control Board
UAO	Unilateral Administrative Order
USACE	U.S. Army Corps of Engineers
VDEQ	Virginia Department of Environmental Quality
VPDES	Virginia Pollution Discharge Elimination System
SWRAU	Sitewide Ready for Anticipated Use

EXECUTIVE SUMMARY

The remedy for the C & R Battery Superfund Site located in Chesterfield, Virginia included: ORIGINAL

- excavation of contaminated surface and subsurface soils;
- excavation of contaminated drainage ditch sediments;
- stabilization of the excavated soils, sediments and debris piles;
- disposal of the stabilized material in an approved industrial or sanitary landfill;
- clean closure of the former acid pond area according to RCRA closure requirements;
- backfilling of all excavated areas with soil and placement of a layer of topsoil followed by re-vegetation over all areas having lead levels above background;
- removal, treatment and disposal of the onsite nickel/cadmium batteries in an approved RCRA facility;
- implementation of an environmental monitoring plan;
- removal and offsite treatment of contaminated surface water in the drainage ditch;
- dismantlement and removal of the storage shed and removal of discarded tires for offsite disposal;
- groundwater monitoring;
- site use restrictions.

The Site achieved construction completion with the signing of the Preliminary Close-Out Report on September 28, 1993. This is the third five-year review for the Site. The trigger for this five-year review was the completion date of the third review, September 22, 2008.

The assessment of this five year review found the remedy is protective in the short term because as result of the cleanup, no one is currently exposed to contamination that poses or could pose a risk. However, in the long term the remedy is not protective because (1) no mechanism exists to prevent future exposure to risk due to low pH; and (2) the site use restrictions called for in the ROD to ensure the protection of human health and the environment have not been implemented. Site use restrictions will be implemented to keep groundwater at the Site from being used for drinking water. A groundwater remedy may be needed to address the persistent acid (low pH) found in several monitoring wells.

Cross-Program Revitalization Measure (GPRA) Measure Review

As part of this Five Year Review the GPRA Measures have also been reviewed. The GPRA Measures and their status are provided as follows:

Environmental Indicators

Human Health: Current Human Exposure Controlled (HEUC)
Groundwater Migration: Groundwater Migration Under Control (GMUC)

Sitewide RAU

The Site is not Site-Wide Ready for Anticipated Use (SWRAU) but is expected to achieve SWRAU on December 30, 2016.

FIVE-YEAR REVIEW SUMMARY FORM

Site Identification		
Site Name: C&R Battery Superfund Site		
EPA ID: VAD049957913		
Region: 3	**State:** VA	**City/County:** Chesterfield County

Site Status	
NPL status: ✓ Final ❒ Deleted ❒ Other: Partial deletion of original site.	
Remediation Status: ❒ Under Construction ❒ Operating ✓ Complete	
Multiple OUs? ❒ YES ✓ NO	**Construction Completion Date:** September 28, 1993
Has site been put into reuse? ❒ YES ✓ NO	

Review Status	
Lead agency: ✓ EPA ❒ State ❒ Other:	
Author name: Ronnie Davis	
Author title: Remedial Project Manager	**Author affiliation:** USEPA, Region 3
Review period: December 20, 2012 to September, 2013	
Date(s) of site inspection: May 15, 2013	
Type of review: ✓ Post-SARA ❒ Pre-SARA ❒ Ongoing ❒ NPL-Removal only ❒ Non-NPL Remedial Action Site ❒ NPL State/Tribe-lead ❒ Regional Discretion)	
Review number: ❒ 1 (first) ❒ 2 (second) ❒ 3 (third) ✓ Other (specify): fourth	
Triggering action: ❒ Actual RA On-site initiation by PRP ❒ Construction completion ❒ Other (specify) Completion of the RD	❒ Actual RA start at OU#____ ✓ Previous Five-Year Review Report
Triggering action date: September 22, 2008	
Due date (five years after triggering action date): September 22, 2013	

Issues/Recommendations

Issues and Recommendations Identified in the Five-Year Review:

Issue Category: Institutional Controls				
1. Issue: Site use restrictions have not been implemented.				
Recommendation: Site use restrictions will be implemented to prevent exposure to groundwater.				
Affect Current Protectiveness	**Affect Future Protectiveness**	**Implementing Party**	**Oversight Party**	**Milestone Date**
No	Yes	Zacharias Brothers	EPA	September 2014
2. Issue Category: Acid (low pH) in groundwater is still present in several monitoring wells.				
Recommendation: EPA will review Verizon's background results and determine if further study is warranted.				
Affect Current Protectiveness	**Affect Future Protectiveness**	**Implementing Party**	**Oversight Party**	**Milestone Date**
No	Yes	PRP	EPA	November 2013

=

Protectiveness Statement(s)

The assessment of this five year review found the remedy is protective in the short term because as result of the cleanup, no one is currently exposed to contamination that poses or could pose a risk. However, in the long term the remedy is not protective because (1) no mechanism exists to prevent future exposure to risk due to low pH; and (2) the site use restrictions called for in the ROD to ensure the protection of human health and the environment have not been implemented. Site use restrictions will be implemented to keep groundwater at the Site from being used for drinking water. A groundwater remedy may be needed to address the persistent acid (low pH) found in several monitoring wells.

ORIGINAL

C & R Battery Superfund Site
Chesterfield County, Virginia
Fourth Five-Year Review Report
EPA ID No.VA049957913

I. Introduction

The purpose of a five-year review is to determine whether the remedy at a site is protective of human health and the environment. The methods, findings, and conclusions of reviews are documented in Five-Year Review reports. In addition, Five-Year Review reports identify issues found during the review, if any, and identify recommendations to address them.

The Agency is preparing this Five-Year Review report pursuant to Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) §121 and the National Contingency Plan (NCP). CERCLA §121 states:

> *If the President selects a remedial action that results in any hazardous substances, pollutants, or contaminants remaining at the site, the President shall review such remedial action no less often than each five years after the initiation of such remedial action to assure that human health and the environment are being protected by the remedial action being implemented. In addition, if upon such review it is the judgement of the President that action is appropriate at such site in accordance with section [104] or [106], the President shall take or require such action.*

The Agency interpreted this requirement further in the National Contingency Plan (NCP); 40 Code of Federal Regulations (CFR) §300.430(f) (4) (ii) states:

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

The U.S. Environmental Protection Agency (EPA), Region 3, conducted this five-year review of the remedy implemented at the C & R Battery Superfund Site (C & R Battery or Site) in Chesterfield County, Virginia. This review was conducted by the Remedial Project Manager of the Site between December 2012 and September 22, 2013. This report documents the results of the review.

This is the fourth five-year review for the C & R Battery Site. The triggering action for this review is the completion of the third five-year review on September 22, 2008. The five-year review is required because Site conditions do not allow for unlimited use and unrestricted exposure.

II. Site Chronology

Table 1 - Chronology of Site Events

DATE	ACTIVITY
1973-1985	THE C & R BATTERY COMPANY OPERATED THE BATTERY BREAKING AND RECYCLING OPERATION AT THE SITE.
JULY 1987	EPA PLACED THE SITE ON THE NPL.
AUGUST 1988	EPA INITIATED THE REMEDIAL INVESTIGATION/FEASIBILITY STUDY (RI/FS).
MARCH 30, 1990	EPA ISSUED A RECORD OF DECISION (ROD).
SEPTEMBER 1990	EPA INITIATED A REMEDIAL DESIGN.
MARCH 1992	EPA ISSUED A UNILATERAL ORDER FOR BELL ATLANTIC TO PERFORM THE REMEDIAL ACTION AT THE SITE.
NOVEMBER 1992	PRP INITIATED MOBILIZATION AND SUPPORT ZONE SETUP.
SEPTEMBER 1993	EPA AND VDEQ CONDUCTED FINAL INSPECTION.
SEPTEMBER 1993	THE PRELIMINARY CLOSEOUT REPORT WAS SIGNED.
SEPTEMBER 1993	FIRST GROUNDWATER SAMPLING EVENT.
NOVEMBER 19, 1997	SITE INSPECTION FOR THE FIRST FIVE YEAR REVIEW.
JULY 29, 1998	FIRST FIVE YEAR REVIEW.
MARCH 1999	EVALUATION OF MANGANESE IN GROUNDWATER REPORT.
JULY 2000	CONCLUSION SUMMARY REGARDING MANGANESE IN GROUNDWATER.
JANUARY 21, 2002	GEOLOGIC AND METAL RESPONSE TO EPA COMMENTS ON MANGANESE IN GROUNDWATER.
NOVEMBER 21, 2002	SITE INSPECTION FOR THE SECOND FIVE YEAR REVIEW
SEPTEMBER 30, 2003	SECOND FIVE-YEAR REVIEW.
JULY 30, 2008	SITE INSPECTION FOR THE THIRD FIVE-YEAR REVIEW.
SEPTEMBER 30, 2008	THIRD FIVE-YEAR REVIEW.

III. Background

Physical characteristics

The C & R Battery Site is located in an industrial area in Chesterfield County, Virginia approximately six miles southeast of Richmond, Virginia. The entire Site encompasses 11 acres. The Site is rectangular in shape and is bordered on the north, south, and west by open fields and woods. A small fuel-oil distributor, Capitol Oil Company, is located along the eastern section of the Site and is part of the Site (Figure 1, Attachment 1). The James River is located approximately 650 feet north of the Site.

Land and Resource Use

The C&R Battery Company operated a battery breaker for the purpose of separating and recovering lead from discarded automobile and truck batteries. The 4.5 acre parcel on which operations took place was owned by the Zacharias Brothers, a Virginia general partnership in Richmond, Virginia. From 1973 to 1985, the C&R Battery Company operated the battery breaking and recycling operation at the Site. Prior to this operation, the Site reportedly had no specific use and was described by the owners as a wooded vacant lot.

The Site has been fenced off and is covered with grass, weeds, and trees. There have been no changes in physical features at the Site. Up-gradient and south of the Site is the James River Logistic Center and a large building next to it that has 1401 on the front of the building. The James River Logistic Center and the 1401 building are located across Bellwood Road from the Site. A newly constructed building is located to the west of the Site. According to Randolf Moore of Verizon, the facility is used for storage of various types of equipment. Southeast of the Site is an abandoned landfill, which is about one quarter of a mile from the Site. The Landfill, which is owned by the Dupont Corporation, was used to store corrosive waste according to the Virginia Department of Environmental Quality (VDEQ).

Chesterfield County, Virginia's December 2002 development plan designates the area surrounding the C & R Battery Site as industrial, development areas where manufacturing and warehousing are predominate uses. The area is supplied by a public water system; however, there is no restriction on use of groundwater.

History of Contamination

The Site received bulk shipments of discarded batteries. The first step in recycling was to cut the batteries open and drain the battery acid into onsite ponds. The batteries were then broken open and the lead and lead compounds were recovered and stockpiled for later shipment. The battery casings were subsequently shredded and stockpiled on the Site. Crushed battery casings had been observed on the Site surface and buried throughout the Site. Product and wastes generated by the operation included lead, lead sulfide, plastic battery casing materials, and sulfuric acid.

Initial Response Activities

The (formerly) Virginia State Water Control Board (SWCB) began monitoring the Site in the late 1970's. The SWCB sampled for lead in soil, surface water, and groundwater. The results of the sampling events revealed elevated lead concentrations in soil and surface water, but not groundwater. In 1979, the SWCB conducted a sampling program at the Site specifically for soil. The data indicated that lead was present at concentrations up to 16,000 milligrams per kilogram (mg/Kg). The pH of the soils ranged from 3.3 to 6.5. The detection of arsenic, chromium, copper, and nickel were also reported. Between 1980 and 1986, the SWCB collected surface-water samples from standing water in the on-site drainage ditch and from an upstream location along Bellwood Road. The results from the surface-water sampling indicated lead concentration in the on-site drainage ditch which exceeded chronic and acute Federal Ambient Water Quality Criteria (fresh water) for lead.

The Virginia Occupational Safety and Health Administration (OSHA) inspected the Site in 1983 while the battery processing facility was still in operation. Air monitoring conducted by OSHA in breathing zones within the facility measured lead at concentrations up to 112 micrograms per cubic meter (ug/m3), which exceeded the prevailing OSHA standard of 50 ug/m3.

On February 24, 1986, the EPA Field Investigation Team (FIT) assessed groundwater, surface water, and soil contamination at the Site. On-site soil samples revealed lead concentrations up to 63,000 mg/Kg. In response to potential health concerns, the EPA conducted a removal action at the Site pursuant to Section 104 of CERCLA, 42 U.S.C. Section 9604, in the summer of 1986. The following removal actions were completed by the EPA:

- Acidic liquid was removed from on-site lagoons, neutralized and discharged into surface-water ditches on the Site.
- Lagoon sludge was blended with lime and subsequently returned to the lagoons.
- Contaminated soils were disced and mixed with lime to a depth of approximately 2 feet; however when intact batteries were found buried in the northern portion of the Site, discing was terminated.
- Shredded battery casings, contaminated soil, and debris encountered east of the drainage ditch (Capitol Oil Company area) were excavated and stockpiled on-site in debris piles. The excavated area was backfilled with clean soil to reduce hazards to Capitol Oil Company employees.
- The drainage ditch was graded and rock riprap channels and dams were installed to reduce erosion.
- A six-foot high chain link fence was installed inside the tree line to minimize the potential for human contact with contaminated materials on-site.

Basis for Taking Action

EPA placed the site on the National Priorities List (NPL) in July 1987. Subsequently, EPA initiated a Remedial Investigation/Feasibility Study (RI/FS) for the Site in August 1988. The media of concern were soils, sediment, and surface water, which contained hazardous substances and were determined by EPA to represent a threat to human health and the environment; groundwater conditions were determined not to represent a risk to human health or the environment.

Contaminants

Hazardous substances that have been released at the Site in each media include:

Soil, Sediments, On-Site Water

Antimony
Arsenic
Cadmium
Lead
Nickel
Silver
Zinc

IV. Remedial Actions

EPA issued a Record of Decision (ROD) for the Site on March 30, 1990. The Commonwealth of Virginia concurred with the selected remedy. The ROD summarized the site risks and identified an unacceptable risk to human health for non carcinogenic substances. The primary contributor and pathway were identified as ingestion of lead from soil and debris piles. Lead was present in high concentrations (orders of magnitude higher) compared to the other contaminants. Although lead is considered a probable human carcinogen, a carcinogenic potency factor was not available for lead. Therefore, a cancer risk calculation for lead was not performed. No unacceptable risk for carcinogenic substances was identified.

Concentrations of lead, cadmium, and zinc in the surface water exceeded acute and chronic ambient water quality criteria. Lead and cadmium exceeded sediment quality values used for protection of aquatic and benthic life for the environmental risk evaluation.

The remedial action objectives for the Site were developed to protect human health and the environment. These objectives are:

- Prevent exposure (inhalation, ingestion) to soil having a lead concentration greater than 1,000 mg/kg and concentrations of the other contaminants of concern greater than their action levels (See Table 2).

- Prevent migration of lead that would result in groundwater contamination in excess of

0.05 milligrams/liter (mg/l) and the migration of the other indicator chemicals in excess of their respective Maximum Contaminant Levels (MCL).

- Prevent migration of lead that would result in drainage ditch sediment contamination in excess of 450 mg/kg, and the migration of the other contaminants of concern in excess of their respective action levels.

Table 2: Remedial Action Levels

Contaminant	Medium	
	Surface Soil (mg/kg)	Sediment (mg/kg)
Antimony	77.4	**
Arsenic	10*	57
Cadmium	84*	5
Lead	1,000	450
Nickel	600*	**

* 10^{-6} Cancer Risk Level

** Levels already within acceptable risk range

The major components of the remedy selected in the ROD included the following:

1. Excavation of surface and subsurface soils containing lead above the 1,000 mg/kg action level (approximately 36,800 cubic yards).
2. Excavation of drainage ditch sediments containing lead above the 450 mg/kg action level.
3. Stabilization of the excavated 36,800 cubic yards of soils, sediments, and debris piles using a cement/pozzolan based stabilization process.
4. Disposal of the stabilized material in an approved industrial or sanitary landfill.
5. Clean closure of the former acid pond area, according to Resource Conservation and Recovery Act (RCRA) closure requirements.
6. Backfilling of all excavated areas with soil and placement of a layer of topsoil (approximately 6 inches) followed by revegetation over all areas having lead levels above 120 mg/kg (background).
7. Removal, treatment, and disposal of the on-site nickel/cadmium (Ni/Cd) batteries in an approved RCRA facility.
8. Implementation of an environmental monitoring plan to ensure the effectiveness of the remedial action and to be protective of the environment, particularly, the environmental receptors in the James River.
9. Removal and offsite treatment of any contaminated surface water in the drainage ditch.
10. Dismantlement and removal of the storage shed and removal of discarded tires for offsite disposal at an approved landfill.
11. Groundwater monitoring on a regular basis until completion of the first five-year review.
12. Appropriate site use restrictions for future use scenarios to ensure protection of public health and the environment.

Remedy Implementation

EPA issued a Unilateral Administrative Order (UAO) to the Potentially Responsible Party (PRP) on March 27, 1992 to implement the selected remedial action. Mobilization and support setup occurred in November 1992. The major components conducted for implementation of the remedy included:

1. Excavation of surface and subsurface soils containing lead above the 1,000 mg/kg action level. Verification sampling results for lead in soil remaining at the Site ranged from 12 to 590 mg/kg, with an arithmetic average lead concentration of 107 mg/kg.
2. Excavation of drainage ditch sediments containing lead above the 450 mg/kg action level. The results for lead in ditch sediments remaining in place ranged from 13 to 69 mg/kg, with an average lead concentration of 48 mg/kg.
3. Stabilization of the excavated soil, sediments, and debris piles using a cement/pozzolan based stabilization process. Full scale solidification/stabilization began on April 21, 1993 and was completed on August 20, 1993.
4. Disposal of the stabilized material in the Chambers Sanitary Landfill in Charles City County, Virginia.
5. Clean closure of the former acid pond area, according to RCRA closure requirements. The performance standards in the former acid pond required a RCRA clean closure or reestablishment of Site background concentrations for lead (120 mg/kg, as defined by EPA). The soil quality verification sampling results for lead ranged from 13 to 83 mg/kg. The concentrations of antimony, arsenic, cadmium, lead and nickel in the acid pond area following remediation were below the remedial action levels listed in the ROD.
6. Upon receipt of soil verification sampling results, all excavated areas were backfilled with topsoil (approximately 6 inches) followed by revegetation over all areas having lead levels above 120 mg/kg (background).
7. Disposal of Ni/Cd batteries at Laidlaw Environmental Services Inc. in Reidsville, North Carolina.
8. Surface water was sampled on a quarterly basis at four locations during implementation of the remedial action. Sampling began on December 12, 1992 and ended on June 21, 1993. Quarterly sampling was conducted at location A, which was located downstream of the site, at location B, which was located on-site downstream of the former acid pond area, and at location C, which was located along Bellwood Road upstream of the site.
    a. At location A, lead concentrations in surface water ranged from 140 µg/L to 220 µg/L (which exceeded Ambient Water Quality Criteria) during two surface sampling events.
    b. At location B, lead concentrations in surface water ranged from 1,600 to 2,000 µg/L. Sediments in the retention basin that exceeded the cleanup levels (450 mg/kg) were treated and disposed off-site.
    c. At location C, lead concentrations in surface water ranged from non-detect (ND) to 31 µg/L. The highest concentration of lead corresponded to the peak excavation activities, when larger areas of contaminated soil were exposed. As excavation activities progressed, less contaminated surface areas were exposed and lead concentrations in the pond decreased.

The National Oceanic and Atmospheric Administration (NOAA) collected sediment and surface water samples at the Site on June 15, 1995 to determine if remedial activities at the Site has been successful in preventing the transport of site related contaminants to NOAA trustee habitats in the James River. NOAA concluded the Site is not a likely source of lead

contamination to the James River or to the drainage ditch below the Site. NOAA indicated analytical results of the surface water samples from the drainage ditch and James River did not contain site related trace elements in excess of chronic Ambient Water Quality Criteria.

9. A sediment basin was constructed to provide for settling of sediment from the site runoff during the construction period. Throughout the remedial action, storm water was recycled from the basin to the pug mill for inclusion with the solidification/stabilization process.
10. The storage shed, located in the south central portion of the Site, was dismantled, decontaminated, and disposed in the Chambers Sanitary Landfill in Charles City County, Virginia. Tires present on the Site were transported to Virginia Recycling, Inc. of Providence Forge, Virginia.
11. Monitoring wells MW 1-1, 6-1, 7-1, 8-1, 9-1, and 10-1 (Figure 2) were initially sampled on September 1993. The groundwater quality at the site was monitored 13 times between September 1993 and first five year review in July 1998. Lead was not detected at concentrations exceeding EPA Contract Required Detection Limits (CRDLs) in either the dissolved or total metals analyses in any of the samples. However, the pH of the groundwater was consistently low in several monitoring wells (pH of 4.2 in MW 9-1 during several sampling events). No immediate points of human exposure to the groundwater currently exist on the Site.
12. Site use restrictions have not been implemented to date, but are being pursued.

The Site achieved construction completion status when the Preliminary Close Out Report was signed on September 28, 1993.

System Operation/Operation and Maintenance (O&M)

There is no active remedial system operating at the Site. Therefore, there are no O&M costs associated with this five year review period at the C&R Battery Site.

V. Progress Since the Last Five-Year Review

The Third Five Year review called for Verizon to perform a focused feasibility study to evaluate alternatives to treat acid in groundwater. In addition, EPA requested that Verizon perform a background study of the concentration of pH in groundwater in the area. EPA asked Verizon to install an up-gradient monitoring well to obtain the pH data. Verizon requested that they collect background data from existing wells in the area, and EPA agreed to this. Verizon has submitted several groundwater data reports that are summarized in Section VI., Data Review Subsection. A status of recommendations from the 3rd FYR is shown in Table 3.

ORIGINAL

Table 3: Actions Taken Since Last Five-Year Review

Issues from previous review	Recommendations/ Follow-Up Actions	Party Responsible	Milestone Date	Action Taken and Outcome	Date (s) of Action
Institutional controls to restrict land use to industrial have not been implemented.	EPA will work with Zacharias Brothers to finalize language for deed notice. Zacharias Brothers will file notice.	Zacharias Brothers EPA	September 2014	None	
Acid (low pH) in groundwater is still present in several monitoring wells.	Verizon will perform a focused feasibility study to evaluated alternatives to treat the acid in groundwater.	Verizon	July 2009	Verizon has submitted several groundwater data reports.	December 17, 2009; June 27, 2011; April 9, 2012; August 16, 2012; November 14, 2012; March 2013

VI. Five-Year Review Process

Administrative Components

EPA notified Verizon and VDEQ in December 2012 of the initiation of the five-year review. The C & R Battery Five-Year Review team was led by Ronnie M. Davis, EPA's Remedial Project Manager (RPM) for the Site, and included Trish Taylor, EPA's Community Involvement Coordinator, and members from the Regional Technical Advisory staff with expertise in hydrogeology, biology and risk assessment. Thomas Modena, VDEQ, assisted in the review.

The review team established the review schedule whose components included:

- Community Involvement;
- Document Review;
- Data review;
- Site Inspection; and
- Five-Year Review Report Development and Review.

The schedule extended from December 2012 through September 2013.

Community Involvement

Because there are no homes in the vicinity of the Site, no community interviews were done. On July 25, 2013, a public notice (Attachment 2) was placed in the Richmond Style Weekly, a local newspaper, to inform the community that the Five-Year Review was being conducted and where the Five-Year Review Report will be available for public review, once it is finalized.

Document Review

This five year review consisted of a review of relevant documents including monitoring data. The following documents (see, also, Attachment 3) were reviewed for this five year review:

- Record of Decision (March 30, 1990)
- Administrative Order (issued March 27, 1992)
- Third Five Year Review (September 22, 2008)
- Groundwater Sampling Report (December 17, 2009)
- 2011 pH Assessment (June 27, 2011)
- Water Quality Sampling Results and Background Data (August 20, 2012)
- Water Quality Sampling Results (November 14, 2012)
- C & R Battery Water Quality Sampling Results and pH Assessment (March 2013)

Remedial actions are required to comply with the chemical-specific applicable relevant and appropriate requirements (ARARs) identified in the ROD. In performing the Five-Year Review for compliance with ARARs, only those ARARs that address the protectiveness of the remedy are reviewed. Refer to Attachment 6 for a more comprehensive ARAR discussion.

Data Review

The ROD did not call for any remedial action with respect to groundwater. However, the ROD did state groundwater was to be monitored on a regular basis until at least completion of the first five-year review. In the first FYR report, EPA requested continuation of groundwater monitoring due to consistently low pH in several wells. EPA concluded site activities contributed to high concentrations of manganese, and low pH in groundwater at the Site based on groundwater monitoring conducted after the first FYR report and documented this in the second FYR report. In the second FYR report, EPA requested additional monitoring wells be installed and monitoring be conducted to determine if a groundwater remedy is necessary. In the third FYR report, EPA concluded the PRP should prepare a focused feasibility study to evaluate alternatives to treat acidic conditions in the groundwater.

The data evaluation period for this FYR is October 2008 through March 2013. During this period, five groundwater sampling events occurred. The sampling events occurred in September 2009, April 2011, May 2012, June 2012, and August 2012. The reports typically include a short summary of the monitoring event activities, analytical results, and tables and figures to support the analytical results. Groundwater samples were submitted for laboratory analysis for the following parameters: pH; specific conductance; major cations (calcium, potassium, magnesium, and sodium); and major anions (alkalinity (total, bicarbonate and carbonate), chloride, and sulfate). The use of screening levels for comparison of the analytical data was only used for sulfate (EPA secondary maximum contaminant level (SMCL)). Several of the monitoring reports have discussed the use of potential background data for comparison to site pH levels. However, EPA has not agreed to this background data set and has requested site-specific background pH data be developed for comparison purposes for pH results.

Groundwater Sampling Report (December 17, 2009)

ORIGINAL

This report titled "Groundwater Sampling Results" was prepared by Verizon and documented the sampling results for the September 2009 sampling event and concluded residual metal concentrations were no longer detected above applicable screening criteria. The report concluded dissolved manganese concentrations in the groundwater were decreasing and below background levels. The report recommended finalizing the restrictive covenant on land use controls for the Site and ceasing the groundwater sampling.

EPA reviewed the report and concluded that the report did not provide any new information that would dispute the findings of the September 22, 2008 Five-Year Review report. Monitoring wells MW8-1, MW9-1, MW10-1, and MW11-1 had very high concentrations of acid in groundwater for many years. All of the monitoring wells are located down-gradient of the former acid pond. As a result, EPA requested that Verizon implement the recommendation of the five-year review, which is to perform a focused feasibility study to evaluate alternatives for treating the acid in groundwater.

2011 pH Assessment (June 27, 2011)

This report titled "C&R Battery Site – 2011 pH Assessment" was prepared by Verizon in response to EPA's request that Verizon demonstrate how site groundwater pH levels compare to background for shallow groundwater. Activities included the following:

- Collection of an additional round of groundwater samples in April 2011 at the six Site-specific monitoring wells (MW 6-1, 7-1, 8-1, 9-1, 10-1, and 11-1) to document the current pH conditions.

- Perform an assessment of the local groundwater conditions to evaluate applicable background pH ranges in the area.

The report compared the pH data from the six Site-specific monitoring wells to monitoring well MW-1 and wells within a 2 mile radius of the Site. In addition, major ions in the groundwater were evaluated for factors influencing pH. The report concluded the dominant factor controlling pH in groundwater at the Site is alkalinity of the groundwater, and pH trends support the fact that remedial measures to neutralize acidity at the Site was effective. Two additional sampling events were recommended to provide information on temporal variability and confirm the results of this report. EPA responded that the report conclusion was based on limited data collected from one sampling round and it was not feasible to make a conclusion with reasonable confidence. EPA recommended establishing a defensible background data set, performing a statistical analysis of pH levels with alkalinity, sulfate, and chloride, and conducting four (4) additional sampling rounds to provide sufficient data for decision making.

May 2012 Water Quality Sampling Results and Background Data (August 20, 2012)

This report titled "May 2012 Water Quality Sampling Results and Background Data Transmittal" was submitted by Verizon and provided results for the 1st quarter (4 quarterly events requested by EPA) groundwater monitoring event for the six Site-specific monitoring wells conducted in May 2012. The report also included supporting information for use in establishing background pH for the Site. The report concluded the dominant factor controlling pH in groundwater appears to be

carbon dioxide based on higher laboratory measured pH levels than field measurements. A confirmatory sampling event was conducted on June 22, 2012 to further assess the difference between the field and lab pH values.

The report also recommended the use of fourteen wells used for the Defense Supply Center Richmond (DSCR) background groundwater quality assessment for use in establishing the background pH data set for C&R Battery. EPA responded the majority of the DSCR wells were not appropriate for an up-to-date background study due to lack of recent data in addition to many of the DSCR wells being located within a trichloroethylene plume at DSCR. EPA recommended Verizon install a background well up-gradient from the Site, and near the site to provide site-specific background data.

August 2012 Water Quality Sampling Results (November 14, 2012)

This report titled "August 2012 Water Quality Sampling Results" was prepared by Verizon and provided results for the 2nd quarter groundwater monitoring event for the six site-specific monitoring wells conducted in August 2012. The report concluded the results were consistent with the 1st quarter results (May/June 2012) and the acidic pH of the groundwater is most likely due to dissolved carbon dioxide. The report recommended including dissolved gas headspace analysis for carbon dioxide concentrations in the 3rd quarter sampling event.

Table 4 identifies the pH values for the six Site-specific monitoring wells during this FYR period. The table also includes the average pH values for previous monitoring periods (1993-1998 and 2004-2006) at the Site. These historical pH values were identified in the May 2012 groundwater sampling report. The trends for pH values for the six Site-specific monitoring wells are illustrated in Figure 3 for this FYR period and in Figure 4 for the previous monitoring periods through this FYR. The pH values for all wells are relatively consistent in the 2012 monitoring events and this FYR period with the exception of the September 2009 monitoring event. The data from September 2009 is the lowest pH value for each well evaluated for this FYR period and is not consistent with the remaining data. Inclusion of the historical monitoring periods (1993-1998 and 2004-2006) indicates the pH values for the 2011/2012 monitoring events are relatively unchanged from the early monitoring periods, with the exception of MW 9-1. The data for MW 9-1 is inconsistent as pH values increase and decrease over 1 standard unit (su) between monitoring periods/events.

ORIGINAL

Table 4: Groundwater pH Results

Date	Location					
	MW 6-1	MW 7-1	MW 8-1	MW 9-1	MW 10-1	MW 11-1
1993-1998 *	5.3	5.3	4.5	4.1	5.0	5.0
2004-2006 *	5.3	5.5	4.5	5.4	4.9	4.9
Monitoring Data for current FYR Period						
22-Sep-09	4.5	5.0	3.9	4.0	3.9	3.6
28-Apr-11	4.9	5.7	4.6	5.2	5.4	4.8
17-May-12	5.4	5.7	4.6	4.7	5.0	4.8
11-Jun-12	5.3	5.6	4.9	4.6	4.6	4.8
30-Aug-12	5.4	5.7	4.6	4.7	4.7	4.8

Notes:
1. pH results are standard unit (SU)
2. pH results for 2009 through 2012 were field measured
3. * - pH results for the periods 1993-1998 and 2004-2006 are average pH results for these wells as reported in the May 2012 groundwater sampling report (dated August 16, 2012).

Appropriate background information has not been identified for the C&R Battery Site as of the date of this FYR report. The former up-gradient well that was abandoned in 2009 consistently showed a pH from 5 to 6, which are much higher than the 3.9 to 4.8 pH of the down-gradient monitoring wells. EPA and VADEQ are currently reviewing the March 2013 Water Quality Sampling Results and pH Assessment Summary.

Site Inspection

A site inspection of the C&R Battery Superfund Site was conducted on May 15, 2013. A site inspection checklist has been included as Attachment 4. The following individuals attended the site visit:

- Ron Davis, Remedial Project Manager, USEPA;
- Tom Modena, Project Manager, VADEQ;
- Randolph Moore, Senior Engineer, Verizon;
- Britt McMillan, ARCADIS;
- Jeff Manuszak, Geologist, ARCADIS; and
- Raymond Livermore, Environmental Engineer, USACE, Wilmington District

The weather for the site inspection was sunny and approximately 84° Fahrenheit (F). The site had received less than a half an inch of precipitation one week prior to the site inspection. The purpose of the inspection was to assess the protectiveness of the remedy. For documentation of the site visit, photos of the site were taken and are included as Attachment 5.

The site visit began with Mr. Moore and Mr. McMillan providing a historical summary of activities at the Site. The Site is currently fenced with gates and locked. The Site is overgrown with vegetation and has no structures. The former acid pond has been filled as a result of the remedial action and is currently vegetated with trees and shrubs. There were no significant concerns raised by

the attendees and no significant issues identified during the site visit. During the site visit, several of the monitoring wells were observed. The wells observed were capped, secured and in good condition with no visible damage

VII. Technical Assessment

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

Yes, the conclusion of this review is the remedy is functioning as intended by the ROD. Soil and sediment remediation was accomplished by excavation, stabilization, off-site disposal of contaminated soils and sediments and backfilling with topsoil, which met the remedial objectives to prevent exposure to lead contaminated soil and prevent migration of lead to sediments and groundwater. Groundwater monitoring data show low pH in several monitoring wells. Although acidic liquid was removed from the on-site lagoon during the 1986 removal action, EPA believes that residual acid liquid from the lagoon migrated downward through the underlying soil, causing the leaching of Mn from the soil. An additional monitoring well was installed to determine the extent of dissolved Mn concentrations. The property is fenced.

Site use restrictions identified in the ROD have not been implemented. Site use restrictions will be implemented to keep groundwater at the Site from being used for drinking water purposes and to prevent monitoring wells from being disturbed at the Site.

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

Yes, the assumptions used for the remedy selection remain valid. There have been no changes in the physical conditions of the Site or the adjacent area that would affect the protectiveness of the remedy.

Changes in Standards and To Be Considered (TBCs)

The ROD did not identify any chemical-specific ARARs. However, the RAO for groundwater was to prevent migration of lead that would result in groundwater contamination exceeding 0.05 mg/l and the migration of other indicator chemicals in excess of their respective maximum contaminant levels (MCLs). The value of 0.05 mg/l for lead in the groundwater RAO was rescinded in 1991 when EPA promulgated the Lead and Copper Rule under the Safe Drinking Water Act. The rule established an action level for lead in drinking water at 0.015 mg/l. At the time of the signing for the ROD in 1990, the MCL for arsenic was 0.050 mg/l. In 2001, EPA established a new MCL for arsenic at 0.010 mg/l.

The ROD established a residential cleanup goal for lead in soils at 500-1,000 mg/kg based upon EPA guidance at the time. Current EPA guidance sets the cleanup goal of 400 mg/kg for residential exposures to soil.

The changes in the action level for lead do not affect the protectiveness of the remedy as the contaminated groundwater is not used as a drinking water source. However, the lower action level for lead and lower MCL for arsenic may necessitate additional groundwater monitoring or groundwater treatment to achieve the groundwater RAO. The change in EPA's accepted level for cleanup of lead in residential soils from 500-1,000 mg/kg to 400 mg/kg does not affect the protectiveness of the remedy as the remedial action resulted in lead soil levels well below 400 mg/kg.

There are no new standards or changes to ARARs or TBCs that affect the protectiveness of the remedy.

Over a number of years, groundwater monitoring data have indicated that groundwater at the Site is persistently acidic. The pH in the onsite wells range from 3.9 to 4.8.

Changes in Exposure Pathways, Toxicity, and Other Contaminant Characteristic

The exposure assumptions used to develop the risk assessment included child trespasser, child and adult resident and industrial workers. Lead was identified as the primary COC that significantly contributed to site risk and exposure routes which exceeded the acceptable risk range for exposure to soil and debris piles. Lead was also identified as exceeding the action level in surface water and sediment contributing to the majority of potential risk to ecological receptors.

The exposure assumptions are considered to be protective and reasonable in evaluating risk for this Site since the land use is expected to remain industrial. In addition, water to the area is provided via the public water system. There have been no changes in the toxicity factors for the COCs since the baseline risk assessment was completed. Refer to Attachment 7 for a more comprehensive discussion regarding changes in exposure pathways, toxicity, contaminant characteristics, and risk assessment methods.

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

No, threats to the environment were identified during the RI as a result of elevated metals which exceeded ambient water quality criteria and sediment quality values for the protection of aquatic and benthic life. However, implementation of the remedy has addressed these threats by excavation and stabilization of drainage ditch sediments containing COCs above action levels. In addition, surface water monitoring indicated site-related metals had decreased below ambient water quality criteria. Low pH in groundwater has fluctuated over time at the Site since the early 1990s. The values for groundwater pH ranged from 3.6 to 5.7. Acid in groundwater brings into question the protectiveness of the remedy.

Technical Assessment Summary

According to the data reviewed, and the site inspection, the remedy is functioning as intended by the ROD. There have been no changes in the physical condition of the Site that would affect the protectiveness of the remedy. There have been no changes in the ARARs that should affect the protectiveness. There have been no changes in the toxicity factors for the COCs that were used in the

baseline risk assessment that could affect the protectiveness of the remedy. There is no other information that calls into question the protectiveness of the remedy.

VIII. Issues

Table 5 - Issues

Issue	Currently Affects Protectiveness (Y/N)	Affects Future Protectiveness (Y/N)
Site use restrictions have not been implemented.	N	Y
Acid (low pH) in groundwater is still present in several monitoring wells.	N	Y

IX. Recommendations and Follow-Up Action

Table 6 - Recommendations and Follow-Up Actions

Issue	Recommendations /Follow-up Action	Party Responsible	Oversight Agency	Milestone Date	Affects Protectiveness? (Y/N)	
					Current	Future
Site use restrictions have not been mplemented.	Site use restrictions will be implemented to prevent exposure to groundwater.	Verizon	EPA	September 2014	N	Y
Acid (low pH) in ground-water is still present in several monitoring wells.	EPA will review Verizon's background results and determine if further study is warranted.	Verizon	EPA	November 2013	N	Y

X. Protectiveness Statement

The assessment of this five year review found the remedy is protective in the short term because as result of the cleanup, no one is currently exposed to contamination that poses or could pose a risk. However, in the long term the remedy is not protective because (1) no mechanism exists to prevent future exposure to risk due to low pH; and (2) the site use restrictions called for in the ROD to ensure the protection of human health and the environment have not been implemented. Site use restrictions will be implemented to keep groundwater at the Site from being used for drinking water. A groundwater remedy may be needed address the persistent acid (low pH) found in several monitoring wells.

XI. Next Review

The next five-year review for the C & R Battery Superfund Site is required by five years from the date of this review.

ORIGINAL

ATTACHMENT 1: FIGURES

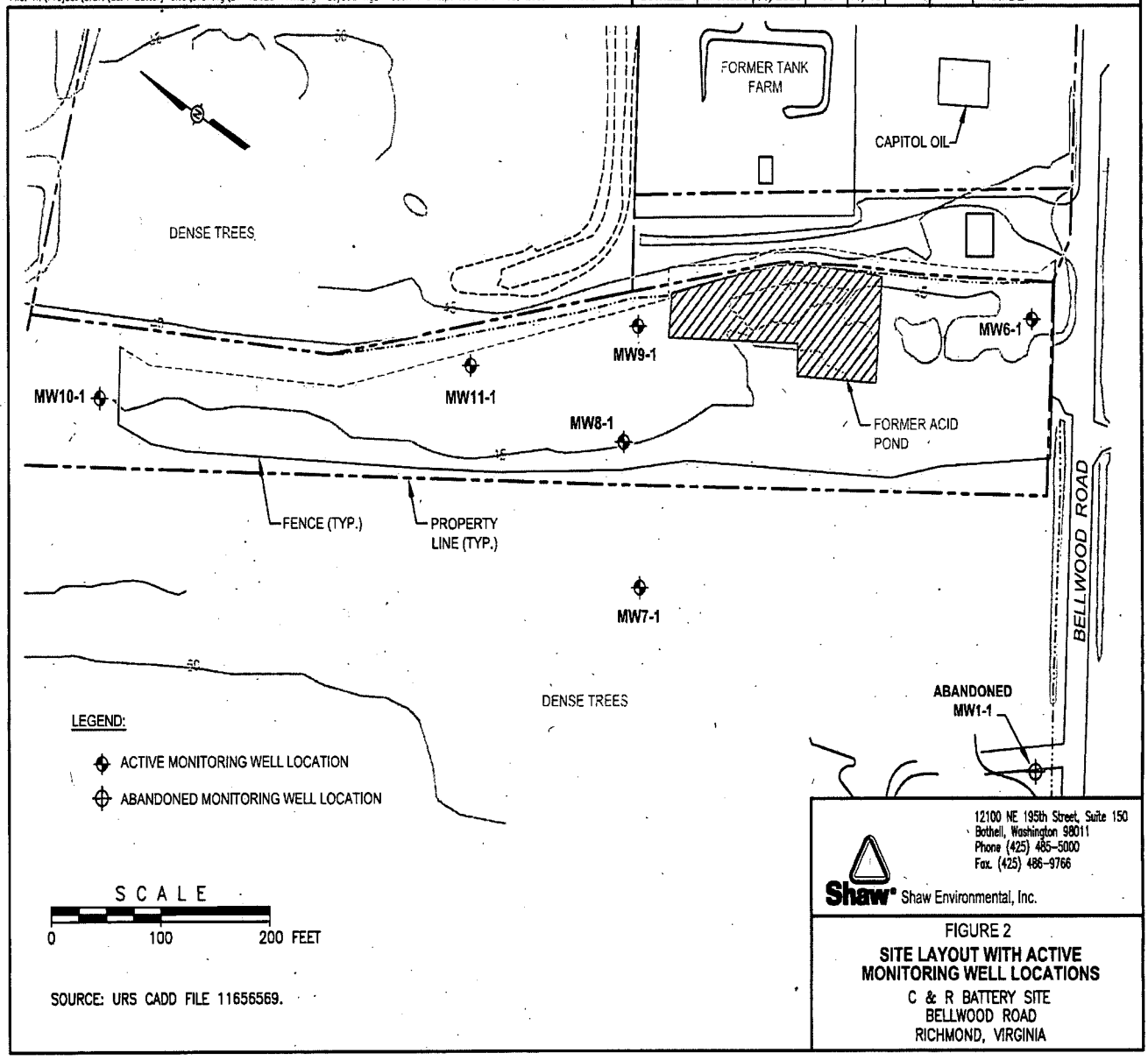
Figure 1: Site Location Map

ORIGINAL

XREF Files: IMAGE Files:

File: N:\Project\draft\C&R Battery Site\Drawing\BT-136234-A1.dwg Layout: fig2 User: maria.portacio Nov 06, 2009 - 10:05am

OFFICE	DRAWN BY		CHECKED BY		APPROVED BY		DRAWING NUMBER
BOTHELL	MPortacio	11/2009	CG	11/09			BT-136234-A1



SOURCE: URS CADD FILE 11656569.

12100 NE 195th Street, Suite 150
Bothell, Washington 98011
Phone (425) 485-5000
Fax. (425) 486-9766

Shaw® Shaw Environmental, Inc.

FIGURE 2

SITE LAYOUT WITH ACTIVE MONITORING WELL LOCATIONS

C & R BATTERY SITE
BELLWOOD ROAD
RICHMOND, VIRGINIA

Figure 3: Groundwater pH Results (2008-2013)

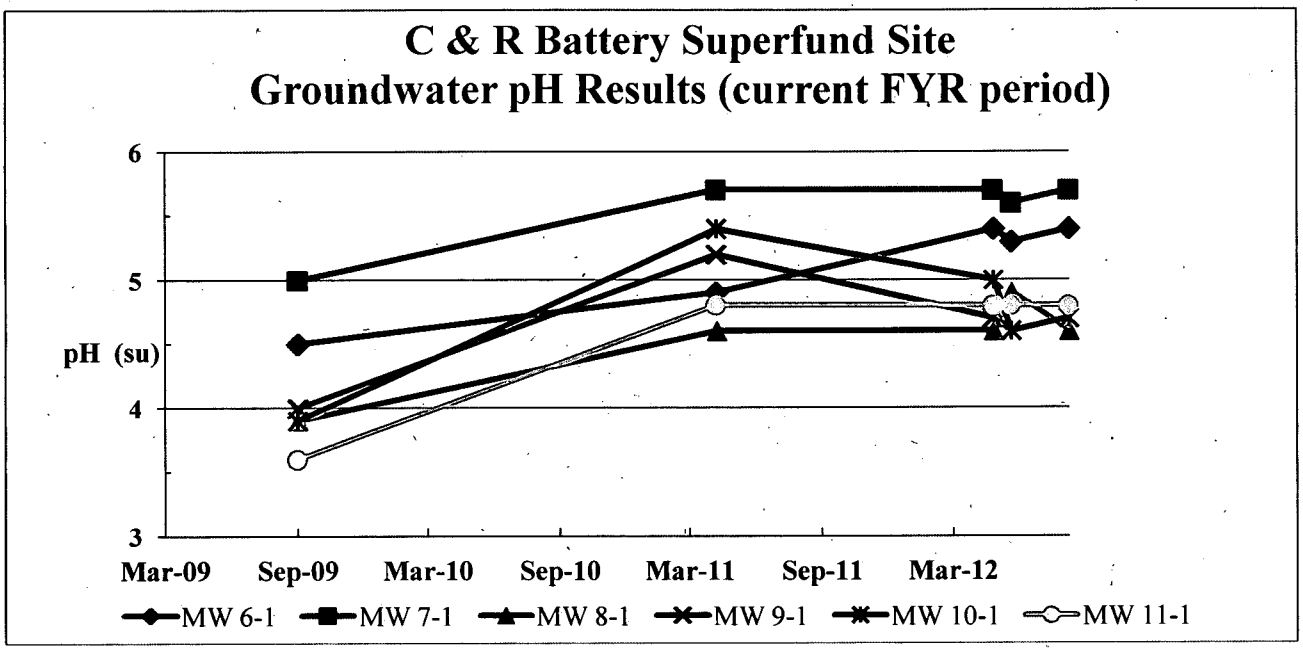
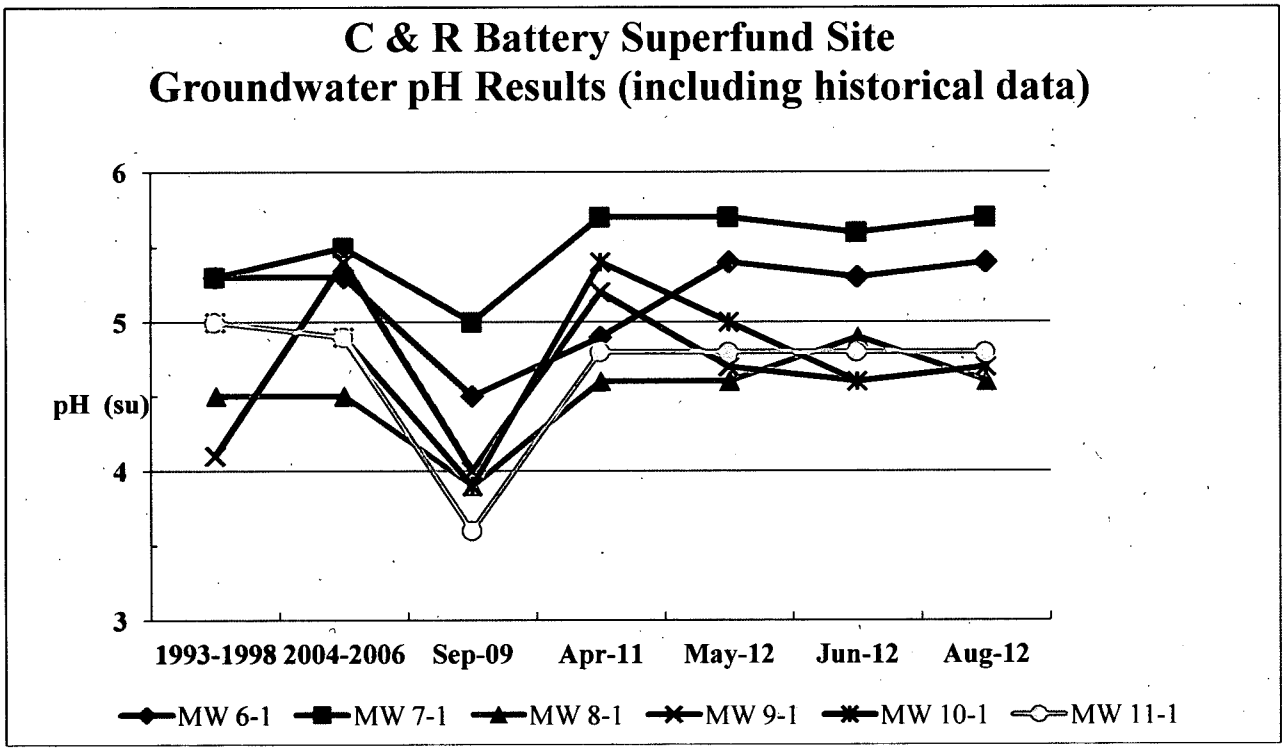


Figure 4: Groundwater pH Results (1993-2013)



ORIGINAL

ATTACHMENT 2: FIVE-YEAR REVIEW NEWSPAPER NOTICE

EPA PUBLIC NOTICE

U.S. Environmental Protection Agency Reviews Cleanup at C&R Battery Co., Inc. Superfund Site

The U.S. Environmental Protection Agency (EPA) is conducting its fourth Five-Year Review of the **C&R Battery Co., Inc. Superfund Site** located in Richmond, Chesterfield County. This review seeks to confirm that the cleanup conducted at the site, which included excavating and removing contaminated soils and capping over excavated areas, continues to be protective of human health and the environment. EPA's last formal review of the site in 2008 found that further study of the groundwater was needed before making a protectiveness determination. A summary of these activities and evaluation of the long-term protectiveness of the remedy will be included in the upcoming Five-Year Review report.

What is an EPA Five-Year Review?

EPA inspects Superfund sites every five years to ensure that cleanups conducted remain fully protective of human health and the environment. These regular reviews, which are required by federal law when contaminants remain at a site, include:

- Inspection of the site and cleanup technologies;
- Review of monitoring data, operating data, and maintenance records, and
- Determination if any new regulatory requirements have been established since EPA's original cleanup decision was finalized.

When will EPA's Five-Year Review Report be available?

The Five-Year Review report will be available at **http://epa.gov/5yr** by September 2013.

For more information

There are several ways to review information on this site. The Administrative Record (AR), which includes EPA decision documents used for selecting the cleanup remedy, is available for public review at **www.epa.gov/arweb**. You may also review the AR and other information at:

EPA Region 3 Public Reading Room
Attn: Paul Van Reed (3HS42)
1650 Arch Street, 6th floor
Philadelphia, PA 19103
Phone: (215) 814-3157 (Call to make an appt.)

You may also contact

If you have any concerns or information about a change in current site conditions, please contact:

Trish Taylor
EPA Community Involvement Coordinator
Phone: (215) 814-5539 or (800) 553-2509
Email: taylor.trish@epa.gov

OR

Ron Davis
EPA Remedial Project Manager
Phone: (215) 814-3230
Email: davis.ron@epa.gov

For more information on this site, visit: http://go.usa.gov/bAuQ

ORIGINAL

ATTACHMENT 3: LIST OF DOCUMENTS REVIEWED

LIST OF DOCUMENTS REVIEWED

ARCADIS Inc., C&R Battery Site – August 2012 Water Quality Sampling Results, EPA ID VAD049957913, November 14, 2012.

ARCADIS Inc., C&R Battery Site, EPA ID VAD049957913, May 2012 Water Quality Sampling Results and Background Data Transmittal, August 16, 2012.

ARCADIS Inc., C&R Battery Site – 2011 pH Assessment, EPA ID VAD049957913, April 9, 2012.

ARCADIS Inc., January 10, 2012 Meeting Summary, C&R Battery Site – EPA VAD049957913, January 16, 2012.

ARCADIS Inc., C&R Battery Site – 2011 pH Assessment, EPA ID VAD049957913, June 27, 2011.

NUS Corporation, Final Remedial Investigation Report, Volumes 1, 2, and 3, C&R Battery Site, Chesterfield County, Virginia, January 1990.

Shaw Environmental, Inc., Groundwater Sampling Results, C&R Battery Site, Richmond, Virginia, EPA ID VAD049957913, December 17, 2009.

U.S. Environmental Protection Agency, Region III, Letter to Randolph Moore from Ronnie Davis, October 17, 2012.

U.S. Environmental Protection Agency, Region III, Letter to Jamie McElman (Verizon) from Ronnie Davis, August 10, 2011.

U.S. Environmental Protection Agency, Region III, Third Five-Year Review Report, C&R Battery Superfund Site, Chesterfield County, Virginia, September 22, 2008.

U.S. Environmental Protection Agency, Region III, Second Five-Year Review Report, C&R Battery Superfund Site, Chesterfield County, Virginia, September 30, 2003.

U.S. Environmental Protection Agency, Region III, Five-Year Review Report, C&R Battery Superfund Site, Chesterfield County, Virginia, July 29, 1998.

U.S. Environmental Protection Agency, Region III, Record of Decision, C&R Battery Company, Inc., EPA ID VAD049957913, OU 01, Chesterfield County, Virginia, March 30, 1990.

ORIGINAL

ATTACHMENT 4: SITE INSPECTION CHECKLIST

I. SITE INFORMATION

Site name: C&R Battery Superfund Site	**Date of inspection:** May 15, 2013
Location and Region: Chesterfield County, VA Region III	**EPA ID:** VAD049957913
Agency, office, or company leading the five-year review: EPA and USACE	**Weather/temperature:** Sunny/84° F

Remedy Includes: (Check all that apply)

- ☐Landfill cover/containment
- ☐Access controls
- ✓Institutional controls
- ☐Groundwater pump and treatment
- ☐Surface water collection and treatment
- ☐Monitored natural attenuation
- ☐Groundwater containment
- ☐Vertical barrier walls

Other: Excavation of soils and sediments above action levels, stabilization, and off-site disposal. Clean closure of former acid pond area. Removal and off-site treatment and disposal of surface water in drainage ditch. Implementation of environmental monitoring plan to ensure protectiveness. Groundwater monitoring on regular basis and appropriate site use restrictions.

Attachments: Inspection team roster attached Site map attached

II. INTERVIEWS (Check all that apply)

1. **O&M site manager** Not applicable
   Name Title Date
   Interviewed ☐at site ☐at office ☐by phone Phone no. _____
   Problems, suggestions; ☐Report attached _____

2. **O&M staff** Not applicable
   Name Title Date
   Interviewed ☐at site ☐at office ☐by phone Phone no. _____
   Problems, suggestions; ☐Report attached _____

3. **Local regulatory authorities and response agencies** (i.e., State and Tribal offices, emergency response office, police department, office of public health or environmental health, zoning office, recorder of deeds, or other city and county offices, etc.) Fill in all that apply.
   Agency Virginia Department of Environmental Quality
   Contact Thomas Modena, Project Manager, May 15, 2013, 804-698-4183
   Name Title Date Phone no.
   Problems; suggestions; Report attached No issues noted.

   Agency _____
   Contact _____
   Name Title Date Phone no.
   Problems; suggestions; Report attached _____

   Agency _____
   Contact _____
   Name Title Date Phone no.
   Problems; suggestions; Report attached _____

   Agency _____
   Contact _____
   Name Title Date Phone no.
   Problems; suggestions; Report attached _____

4. **Other interviews** (optional) ☐Report attached.

III. ON-SITE DOCUMENTS & RECORDS VERIFIED (Check all that apply)

1. **O&M Documents**
   - ☐O&M manual ☐Readily available ☐Up to date ✓N/A
   - ☐As-built drawings ☐Readily available ☐Up to date ✓N/A
   - ☐Maintenance logs ☐Readily available ☐Up to date ✓N/A

   Remarks _____

ORIGINAL

2. **Site-Specific Health and Safety Plan** ☐Readily available ☐Up to date ✓N/A
   ☐Contingency plan/emergency response plan ☐Readily available ☐Up to date ✓N/A
   Remarks_____

3. **O&M and OSHA Training Records** ☐Readily available ☐Up to date ✓N/A
   Remarks_____

4. **Permits and Service Agreements**
   ☐Air discharge permit ☐Readily available ☐Up to date ✓N/A
   ☐Effluent discharge ☐Readily available ☐Up to date ✓N/A
   ☐Waste disposal, POTW ☐Readily available ☐Up to date ✓N/A
   ☐Other permits_____ ☐Readily available ☐Up to date ✓N/A
   Remarks_____

5. **Gas Generation Records** ☐Readily available ☐Up to date ✓N/A
   Remarks_____

6. **Settlement Monument Records** ☐Readily available ☐Up to date ✓N/A
   Remarks_____

7. **Groundwater Monitoring Records** ☐Readily available ☐Up to date ✓N/A
   Remarks_____

8. **Leachate Extraction Records** ☐Readily available ☐Up to date ✓N/A
   Remarks_____

9. **Discharge Compliance Records**
   ☐Air ☐Readily available ☐Up to date ✓N/A
   ☐Water (effluent) ☐Readily available ☐Up to date ✓N/A
   Remarks_____

10. **Daily Access/Security Logs** ☐Readily available ☐Up to date ✓N/A
    Remarks_____

IV. O&M COSTS

1. **O&M Organization**
   ☐State in-house ☐Contractor for State
   ☐PRP in-house ☐Contractor for PRP
   ☐Federal Facility in-house ☐Contractor for Federal Facility
   Other_____

2. **O&M Cost Records**
   ☐Readily available ☐Up to date
   ☐Funding mechanism/agreement in place
   Original O&M cost estimate_____ ☐Breakdown attached

   Total annual cost by year for review period if available

   From_____ To_____ _____ ☐Breakdown attached
   Date Date Total cost
   From_____ To_____ _____ ☐Breakdown attached
   Date Date Total cost
   From_____ To_____ _____ ☐Breakdown attached
   Date Date Total cost
   From_____ To_____ _____ ☐Breakdown attached
   Date Date Total cost
   From_____ To_____ _____ ☐Breakdown attached
   Date Date Total cost

3. **Unanticipated or Unusually High O&M Costs During Review Period**
   Describe costs and reasons:_____

V. ACCESS AND INSTITUTIONAL CONTROLS ✓Applicable ☐N/A

A. Fencing

1. **Fencing damaged** ☐Location shown on site map ✓Gates secured ☐N/A
   Remarks: Fencing is present at the site (installed during the removal action), but was not identified as part of the remedy. Fencing is in good condition.

B. Other Access Restrictions

1. **Signs and other security measures** ☐Location shown on site map ✓N/A
   Remarks: _____

C. Institutional Controls (ICs)

1. **Implementation and enforcement**
   Site conditions imply ICs not properly implemented ☐Yes ✓No ☐N/A
   Site conditions imply ICs not being fully enforced ☐Yes ✓No ☐N/A
   Type of monitoring (*e.g.*, self-reporting, drive by) Not applicable
   Frequency _____
   Responsible party/agency _____
   Contact _____
   Name Title Date Phone no.
   Reporting is up-to-date ☐Yes ☐No ✓N/A
   Reports are verified by the lead agency ☐Yes ☐No ✓N/A
   Specific requirements in deed or decision documents have been met ☐Yes ✓No ☐N/A
   Violations have been reported ☐Yes ☐No ✓N/A
   Other problems or suggestions: ☐Report attached
   Remarks: ICs in the form of deed restrictions in the ROD have not been implemented.
2. **Adequacy** ☐ICs are adequate ✓ICs are inadequate ☐N/A
   Remarks: ICs have not been implemented to date.

D. General

1. **Vandalism/trespassing** ☐Location shown on site map ✓No vandalism evident
   Remarks _____
2. **Land use changes on site** ☐N/A
   Remarks: None.
3. **Land use changes off site** ☐N/A
   Remarks: Some construction, but not inconsistent with industrial use in area.

VI. GENERAL SITE CONDITIONS

A. Roads ☐Applicable ✓N/A

1. **Roads damaged** ☐Location shown on site map ☐Roads adequate ✓N/A
   Remarks _____

B. Other Site Conditions

Remarks _____

VII. LANDFILL COVERS ☐Applicable ✓N/A

A. Landfill Surface

1. **Settlement** (Low spots) ☐Location shown on site map ☐Settlement not evident
   Areal extent _____ Depth _____
   Remarks: _____
2. **Cracks** ☐Location shown on site map ☐Cracking not evident
   Lengths _____ Widths _____ Depths _____
   Remarks _____
3. **Erosion** ☐Location shown on site map ☐Erosion not evident
   Areal extent _____ Depth _____
   Remarks _____
4. **Holes** ☐Location shown on site map ☐Holes not evident
   Areal extent _____ Depth _____
   Remarks _____

ORIGINAL

5. **Vegetative Cover** ☐Grass ☐Cover properly established ☐No signs of stress
☐Trees/Shrubs (indicate size and locations on a diagram)
Remarks_____

6. **Alternative Cover (armored rock, concrete, etc.)** ☐N/A
Remarks_____

7. **Bulges** ☐Location shown on site map ☐Bulges not evident
Areal extent_____ Height_____
Remarks_____

8. **Wet Areas/Water Damage** ☐Wet areas/water damage not evident
☐Wet areas Location shown on site map Areal extent_____
☐Ponding Location shown on site map Areal extent_____
☐Seeps Location shown on site map Areal extent_____
☐Soft subgrade Location shown on site map Areal extent_____
Remarks_____

9. **Slope Instability** ☐Slides ☐Location shown on site map ☐No evidence of slope instability
Areal extent_____
Remarks_____

B. Benches ☐Applicable ☐N/A

(Horizontally constructed mounds of earth placed across a steep landfill side slope to interrupt the slope in order to slow down the velocity of surface runoff and intercept and convey the runoff to a lined channel.)

1. **Flows Bypass Bench** ☐Location shown on site map ☐N/A or okay
Remarks_____

2. **Bench Breached** ☐Location shown on site map ☐N/A or okay
Remarks_____

3. **Bench Overtopped** ☐Location shown on site map ☐N/A or okay
Remarks_____

C. Letdown Channels ☐Applicable ☐N/A

(Channel lined with erosion control mats, riprap, grout bags, or gabions that descend down the steep side slope of the cover and will allow the runoff water collected by the benches to move off of the landfill cover without creating erosion gullies.)

1. **Settlement** ☐Location shown on site map ☐No evidence of settlement
Areal extent_____ Depth_____
Remarks_____

2. **Material Degradation** ☐Location shown on site map ☐No evidence of degradation
Material type_____ Areal extent_____
Remarks_____

3. **Erosion** ☐Location shown on site map ☐No evidence of erosion
Areal extent_____ Depth_____
Remarks_____

4. **Undercutting** ☐Location shown on site map ☐No evidence of undercutting
Areal extent_____ Depth_____
Remarks_____

5. **Obstructions** Type_____ ☐No obstructions
☐Location shown on site map Areal extent_____
Size_____
Remarks_____

6. **Excessive Vegetative Growth** Type_____
☐No evidence of excessive growth
☐Vegetation in channels does not obstruct flow
☐Location shown on site map Areal extent_____
Remarks_____

D. Cover Penetrations ☐Applicable ☐N/A

1. **Gas Vents** ☐Active ☐Passive
☐Properly secured/locked ☐Functioning ☐Routinely sampled ☐Good condition
☐Evidence of leakage at penetration ☐Needs Maintenance ☐N/A
Remarks_____

2. Gas Monitoring Probes
☐Properly secured/locked ☐Functioning ☐Routinely sampled ☐Good condition
☐Evidence of leakage at penetration ☐Needs Maintenance ☐N/A
Remarks_____

3. Monitoring Wells (within surface area of landfill)
☐Properly secured/locked ☐Functioning ☐Routinely sampled ☐Good condition
☐Evidence of leakage at penetration ☐Needs Maintenance ☐N/A
Remarks_____

4. Leachate Extraction Wells
☐Properly secured/locked ☐Functioning ☐Routinely sampled ☐Good condition
☐Evidence of leakage at penetration ☐Needs Maintenance ☐N/A
Remarks:_____

5. Settlement Monuments ☐Located Routinely surveyed ☐N/A
Remarks_____

E. Gas Collection and Treatment ☐Applicable ☐N/A

1. Gas Treatment Facilities
☐Flaring ☐Thermal destruction ☐Collection for reuse
☐Good condition ☐Needs Maintenance
Remarks_____

2. Gas Collection Wells, Manifolds and Piping
☐Good condition ☐Needs Maintenance
Remarks_____

3. Gas Monitoring Facilities (*e.g.*, gas monitoring of adjacent homes or buildings)
☐Good condition ☐Needs Maintenance ☐N/A
Remarks_____

F. Cover Drainage Layer ☐Applicable ☐N/A

1. Outlet Pipes Inspected ☐Functioning ☐N/A
Remarks_____

2. Outlet Rock Inspected ☐Functioning ☐N/A
Remarks_____

G. Detention/Sedimentation Ponds ☐Applicable ☐N/A

1. Siltation Areal extent_____ Depth_____N/A
☐Siltation not evident
Remarks_____

2. Erosion Areal extent_____ Depth_____
☐Erosion not evident
Remarks_____

3. Outlet Works ☐Functioning ☐N/A
Remarks_____

4. Dam ☐Functioning ☐N/A
Remarks_____

H. Retaining Walls ☐Applicable ☐N/A

1. Deformations ☐Location shown on site map ☐Deformation not evident
Horizontal displacement_____ Vertical displacement_____
Rotational displacement_____
Remarks_____

2. Degradation Location shown on site map ☐Degradation not evident
Remarks_____

I. Perimeter Ditches/Off-Site Discharge Applicable ☐N/A

1. Siltation ☐Location shown on site map ☐Siltation not evident
Areal extent_____ Depth_____
Remarks_____

2. Vegetative Growth ☐Location shown on site map ☐N/A

ORIGINAL

☐Vegetation does not impede flow
Areal extent_____ Type_____
Remarks_____

3. **Erosion** ☐Location shown on site map ☐Erosion not evident
Areal extent_____ Depth_____
Remarks_____

4. **Discharge Structure** ☐Functioning ☐N/A
Remarks_____

VIII. VERTICAL BARRIER WALLS ☐Applicable ✓N/A

1. **Settlement** ☐Location shown on site map ☐Settlement not evident
Areal extent_____ Depth_____
Remarks_____

2. **Performance Monitoring** Type of monitoring_____
☐Performance not monitored
Frequency_____ ☐Evidence of breaching
Head differential_____
Remarks_____

IX. GROUNDWATER/SURFACE WATER REMEDIES ☐Applicable ✓N/A

A. Groundwater Extraction Wells, Pumps, and Pipelines ☐Applicable ☐N/A

1. **Pumps, Wellhead Plumbing, and Electrical**
☐Good condition ☐All required wells properly operating ☐Needs Maintenance ☐N/A
Remarks_____

2. **Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances**
☐Good condition ☐Needs Maintenance
Remarks_____

3. **Spare Parts and Equipment**
☐Readily available ☐Good condition ☐Requires upgrade ☐Needs to be provided
Remarks_____

B. Surface Water Collection Structures, Pumps, and Pipelines ☐Applicable ☐N/A

1. **Collection Structures, Pumps, and Electrical**
☐Good condition ☐Needs Maintenance
Remarks_____

2. **Surface Water Collection System Pipelines, Valves, Valve Boxes, and Other Appurtenances**
☐Good condition ☐Needs Maintenance
Remarks_____

3. **Spare Parts and Equipment**
☐Readily available ☐Good condition ☐Requires upgrade ☐Needs to be provided
Remarks_____

C. Treatment System ☐Applicable ☐N/A

1. **Treatment Train** (Check components that apply)
☐Metals removal ☐Oil/water separation ☐Bioremediation
☐Air stripping ☐Carbon adsorbers
☐Filters_____
☐Additive (*e.g.*, chelation agent, flocculent)_____
☐Others_____
☐Good condition ☐Needs Maintenance
☐Sampling ports properly marked and functional
☐Sampling/maintenance log displayed and up to date
☐Equipment properly identified
☐Quantity of groundwater treated annually_____
☐Quantity of surface water treated annually_____
Remarks_____

2. **Electrical Enclosures and Panels** (properly rated and functional)
☐N/A ☐Good condition ☐Needs Maintenance
Remarks_____

3. **Tanks, Vaults, Storage Vessels**
☐N/A ☐Good condition ☐Proper secondary containment ☐Needs Maintenance
Remarks_____

4. Discharge Structure and Appurtenances

☐N/A ☐Good condition ☐Needs Maintenance

Remarks_____

5. Treatment Building(s)

☐N/A ☐Good condition (esp. roof and doorways) ☐Needs repair

☐Chemicals and equipment properly stored

Remarks_____

6. Monitoring Wells (pump and treatment remedy)

☐Properly secured/locked ☐Functioning Routinely sampled ☐Good condition

☐All required wells located ☐Needs Maintenance ☐N/A

Remarks

D. Monitoring Data

1. Monitoring Data

☐Is routinely submitted on time ☐Is of acceptable quality

2. Monitoring data suggests:

☐Groundwater plume is effectively contained ☐Contaminant concentrations are declining

E. Monitored Natural Attenuation

1. Monitoring Wells (natural attenuation remedy)

✓Properly secured/locked ✓Functioning Routinely sampled ✓Good condition

☐All required wells located ☐Needs Maintenance ☐N/A

Remarks: Remedy required groundwater monitoring for six site wells through completion of the first five year review. Monitoring has continued to be required by EPA due to acidic conditions in the groundwater.

X. OTHER REMEDIES

If there are remedies applied at the site which are not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy. An example would be soil vapor extraction.

XI. OVERALL OBSERVATIONS

A. Implementation of the Remedy

Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emission, etc.).

_____

_____

_____

_____

B. Adequacy of O&M

Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy.

_____

_____

_____

_____

C. Early Indicators of Potential Remedy Problems

Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs that suggest that the protectiveness of the remedy may be compromised in the future.

_____

_____

_____

_____

D. Opportunities for Optimization

ORIGINAL

Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy.

ATTACHMENT 5: SITE VISIT PHOTOGRAPHS

ORIGINAL

Photograph 1: Front Gate

Photograph 2: James River Logistics Center Bellwood Road across from C&R Battery

Photograph 3: Monitor Well MW-6 (Looking east toward Capitol Oil)

Photograph 4: Former Acid Pond (Looking east)

ORIGINAL

Photograph 5: Northwest view at midsection of Site

Photograph 6: North view towards fence at back of Site

Photograph 7: Monitor Well MW-9 (Looking north)

Photograph 8: East view across former Acid Pond toward Capitol Oil

ORIGINAL

ATTACHMENT 6: ARAR ANALYSIS MEMORANDUM

Changes in Clean Up Standards and Applicable or Relevant and Appropriate Standards (ARARs) Discussion for the C&R Battery Superfund Site Fourth Five Year Review

Introduction: As part of the five-year review process, cleanup levels, standards, to-be-considered criteria (TBCs) and ARARs must be reviewed for changes. Changes (if any) are then evaluated to determine if the changes affect the protectiveness of the remedy. The 1990 ROD identified only chemical- and action-specific ARARs for the site. No location-specific ARARs were listed in the 1990 ROD.

ARARs Identified in the 1990 ROD:

1. Resource Conservation and Recovery Act (RCRA), 40 CFR Parts 261-270 – These standards pertained to how wastes at the site were managed during active cleanup processes (i.e., generation, transportation, treatment, storage and disposal of hazardous wastes).
2. RCRA Subtitle C Closure Requirements – These requirements applied to how the former acid pond was closed under RCRA due to the presence of characteristically hazardous wastes in the pond. EPA stated in the third five-year review that these standards had been met.
3. RCRA Land Disposal Restrictions (LDRs) – These standards would have applied to how and where wastes generated at the site were treated and disposed of.
4. Clean Water Act (CWA) – These standards applied to how any waste water generated during the remedial action should any waste water be discharged from a point source to navigable waters of the US.
5. Clean Air Act/Virginia Air Pollution Regulations – These standards would have pertained to any pollutants emitted applied during the course of remediation.
6. Occupational Safety and Health Administration Act (OSHA) – These standards for worker protection would have applied during remedial actions taken at the site.
7. Virginia Erosion and Sediment Control Law – These standards would have applied to any excavation activities conducted during cleanup actions.
8. Criteria for Offsite Disposal – These standards would have applied to any offsite disposal of wastes which would have been done in accordance with federal and state requirements for sanitary/industrial landfills.
9. Endangered Species Act of 1978, Fish and Wildlife Coordination Act, Fish and Wildlife Improvement Act of 1978, and Fish and Wildlife Conservation Act of 1980 – These standards would have applied to the excavation and surface water discharge activities of the remedial action.

These ARARs applied to, and were attained during, the actual on-site remedial actions already completed at the site and as such are no longer relevant to current actions or conditions at the site nor would any changes to them affect the protectiveness of the remedy. Therefore, they were not evaluated for changes during this Five Year Review.

To-Be-Considered (TBC) Criteria Identified in the ROD:

1. EPA's cleanup levels of 500-1000 mg/kg lead for residential areas per EPA OSWER Directive dated 7 September 1989.
2. EPA-established Reference Doses (RFDs) used to develop risk-based cleanup levels for inorganics.
3. EPA-established carcinogenic potency factors used in developing risk-based cleanup levels for arsenic.

ORIGINAL

Changes in ARARs or TBC Criteria: The 1990 ROD did not identify any chemical-specific ARARs. In particular, it did not call out the Safe Drinking Water Act Maximum Contaminant Levels (MCLs) as ARARs for groundwater at the site. However, the Remedial Action Objective (RAO) for groundwater was to prevent migration of lead that would result in groundwater contamination exceeding 0.05 mg/l and the migration of other indicator chemicals in excess of their respective MCLs.

The 0.05 mg/l MCL for lead used in the groundwater RAO was rescinded in 1991 when EPA promulgated the Lead and Copper Rule under the Safe Drinking Water Act. The rule established an action level for lead in drinking water at 0.015 mg/l. [See 56 FR 26460, 7 June 1991.]

At the time of the signing of the ROD in 1990, the MCL for arsenic was 0.050 mg/l. In January 2001, EPA established a new MCL for arsenic at 0.010 mg/l.

The ROD established a residential cleanup goal for lead in soils at 500-1000 mg/kg based upon EPA guidance for lead at the time. Current EPA guidance sets the cleanup goal of 400 mg/kg for residential exposures to soil.

Effects of Changes to ARARs and TBC Criteria on the Protectiveness of the Remedy:

The changes in MCLs for lead and arsenic do not affect the protectiveness of the remedy as the contaminated groundwater is not used as a drinking water source. However, the lower action level for lead and the lower MCL for arsenic may, in fact, affect the duration of groundwater monitoring and/or trigger the need for additional groundwater treatment in order to achieve the groundwater RAO.

The change in EPA's generally accepted level for cleanup of lead in residential soils from 500-1000 mg/kg to 400 mg/kg does not affect the protectiveness of the remedy as remedial action completed at the site resulted in soil lead levels well below 400 mg/kg.

Conclusion: There are no newly promulgated standards or changes to either ARARs or TBC Criteria that affect the protectiveness of the remedy.

ATTACHMENT 7: RISK ASSESSMENT & TOXICOLOGY ANALYSIS MEMORANDUM

This memorandum is prepared to address Question B of the technical assessment, "*Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the remedy selection still valid?*" to determine whether the remedy is protective.

Changes in Standards and To Be Considereds (TBCs)

Changes in cleanup standards and applicable or relevant and appropriate requirements (ARARs) are discussed in the ARAR Analysis Memorandum. There are no newly promulgated standards or changes to the ARARs or TBCs that affect the overall protectiveness of the remedy.

Changes in Exposure Pathways, Toxicity, and Other Contaminant Characteristics

The C & R Battery Site (the Site) is located in an industrial area in Chesterfield County, Virginia. The entire Site is approximately 11 acres, and is bordered to the north by woods and to the south and west by warehouse facilities. A small fuel-oil distributor borders the Site on the east. The James River is located approximately 650 feet north of the Site. The Site was a battery-sawing and shredding facility designed to recover lead from discarded auto and truck batteries. It operated from 1973 until 1985. The battery breaker was a mobile unit and operations were moved throughout the Site. Prior to the remedial action, crushed battery casings were observed on the Site surface and buried throughout the Site. No other activities that may have produced additional contaminants are known to have occurred on the Site. The Site has been fenced off and is covered with grass, weeds, and trees. Groundwater beneath the Site is classified as a Class 2A aquifer, a current and potential source of drinking water, and flows in a northwesterly direction towards the James River. The area is supplied by a public water system; however, there is no restriction on use of groundwater. Land use in the area is designated as heavy industrial. There have been no changes in the physical conditions of the site that would affect the protectiveness of the remedy.

Hazardous substances that have been released at the Site in each medium include:

Soil	Sediment	Surface Water
Antimony	Antimony	Antimony
Arsenic	Arsenic	Arsenic
Cadmium	Cadmium	Cadmium
Lead	Lead	Lead
Nickel	Nickel	Nickel
Silver	Silver	Silver
Zinc	Zinc	Zinc

The media of concern were soils, sediment, and surface water, which contained hazardous substances and were determined by the U.S. Environmental Protection Agency (EPA) to represent a threat to human health and the environment.

The action levels identified in the 1990 Record of Decision (ROD) are provided in the table below.

Contaminant	Remedial Action Levels		MCL[1]
	Surface Soil (mg/kg)	Sediment (mg/kg)	Groundwater (mg/L)
Antimony	77.4	-[b]	0.006
Arsenic	10[a]	57	0.01[c]
Cadmium	84[a]	5	0.005
Lead	1,000	450	0.05[d]
Nickel	600[a]	-[b]	no data

Notes:
[1] Only the maximum contaminant level (MCL) for lead was listed in the ROD.
[a] 10^{-6} cancer risk level.
[b] Levels already within acceptable risk range.
[c] As of 01/23/2006.
[d] Current action level is 0.015 mg/L.
mg/kg = milligrams per kilogram
mg/L = milligrams per liter

There have been no changes in the toxicity factors that could affect the protectiveness of the remedy based on the comparison of the toxicity data available at the time of the remedy selection and the current toxicity values as shown in the table below.

Chemical	Toxicity Values							
	RfD_o (mg/kg-day)		SF_o $(mg/kg\text{-}day)^{-1}$		RfC_i (mg/m^3)		IUR $(ug/m^3)^{-1}$	
	Previous[a]	Current[b]	Previous[a]	Current[b]	Previous	Current[b]	Previous	Current[b]
Antimony	4.0E-04	4.0E-04	--	--	--	--	--	--
Arsenic	--	3.0E-04	1.5E+00	1.5E+00	--	1.5E-05	1.4E-02	4.3E-03
Cadmium	2.9E-04	1.0E-03 (diet)	--	--	--	1.0E-05	1.7E-03	1.8E-03
	2.9E-04	5.0E-04 (water)	--	--	--	1.0E-05	1.7E-03	1.8E-03
Lead	1.4E-03	--	--	--	1.5E-03	--	--	--
Nickel	1.0E-02	2.0E-02	--	--	--	9.0E-05	2.4E-04	2.6E-04
Silver	3.0E-03	5.0E-03	--	--	--	--	--	--
Zinc	2.1E-01	3.0E-01	--	--	--	--	--	--

Notes:
[a] Derived from Table 6-1, Final RI Report, Volume I of III: Text, January 1990.
[b] Obtained from the EPA RSL Summary Table (TR=1E-6, HQ=1) May 2013.
IUR = inhalation unit risk
mg/kg-day = milligrams per kilogram per day
mg/m^3 = milligrams per cubic meter
RfC_i = inhalation reference concentration
RfD_o = oral reference dose
SF_o = oral slope factor
ug/m^3 = micrograms per cubic meter
-- = no data

Changes in Risk Assessment Methods

There has been no change to the standardized risk assessment methodology that could affect the protectiveness of the remedy.

Expected Progress Towards Meeting RAOs

The assessment of this five year review found the remedy is protective in the short term because as result of the cleanup, no one is currently exposed to contamination that poses or could pose a risk. However, in the long term the remedy is not protective because (1) no mechanism exists to prevent future exposure to risk due to low pH; and (2) the site use restrictions called for in the ROD to ensure the protection of human health and the environment have not been implemented. Site use restrictions will be implemented to keep groundwater at the Site from being used for drinking water. A groundwater remedy may be needed to deal with the persistent acid (low pH) found in several monitoring wells.