Five-Year Review Report

Second Five-Year Review Report
for
Macalloy Corporation

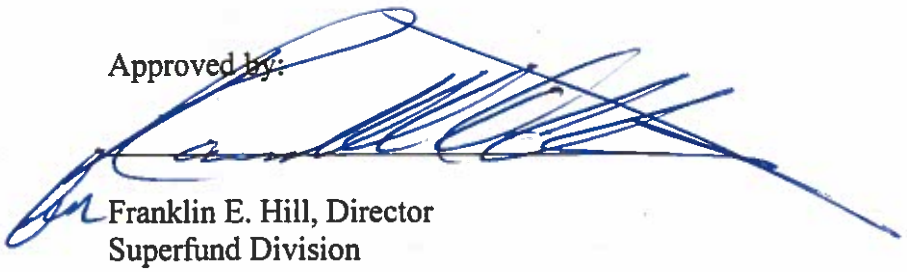
SCD003360476

Charleston
Charleston County, South Carolina

August 2015

United States Environmental Protection Agency
Region 4
Atlanta, Georgia

Approved by:



Franklin E. Hill, Director
Superfund Division

Date:

9/16/15

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List of Acronyms

ARAR	Applicable or Relevant and Appropriate Requirement
BGS	Below Ground Surface
CaS4	Liquid Calcium Polysulfide
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CIC	Community Involvement Coordinator
COC	Contaminant of Concern
CY	Cubic Yard
DPT	Direct Push Technology
EPA	United States Environmental Protection Agency
ERA	Ecological Risk Assessment
ESP	Electrostatic Precipitator
FRAR	Final Removal Action Report
FS	Feasibility Study
FYR	Five-Year Review
HRS	Hazard Ranking System
IC	Institutional Control
LBS	Pounds
LFA	Lake Fill Area
LTM	Long-term Monitoring
MCL	Maximum Contaminant Level
µg/l	Micrograms Per Liter
mg/kg	Milligrams Per Kilogram
mg/L	Milligrams Per Liter
NCP	National Contingency Plan
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
O&M	Operation and Maintenance
OCRM	SCDHEC Ocean and Coast Resource Management
OU	Operable Unit
ORP	Oxidation-reduction Potential
OSHA	Occupational Safety and Health Administration
PCOR	Preliminary Close-out Report
PRB	Permeable Reactive Barrier
PRP	Potentially Responsible Party
PSI	Pounds Per Square Inch
RAO	Remedial Action Objective
RCRA	Resource Conservation and Recovery Act
RD	Remedial Design
RFI	RCRA Facility Investigation
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
RPM	Remedial Project Manager
SCDHEC	South Carolina Department of Health and Environmental Control
SCDNR	South Carolina Department of Natural Resources
SPLP	Synthetic Precipitation Leaching Procedure

µR/HR	Micro-Roentgens per hour, or one millionth of a Roentgen per hour
USI	Unlined Surface Impoundment

Executive Summary

The Macalloy Corporation Site (the Site) is located at 1800 Pittsburgh Avenue in Charleston, South Carolina (Charleston County). The Site was used to manufacture ferrochromium alloy from 1941 to 1998 by several companies and, at various times the Department of Defense, with submerged or open arc furnaces. Waste materials generated during furnace operations included slag, wastewater, airborne waste gases, and particulate matter that were stored in unlined and lined impoundments throughout the Site. The Site is approximately 140 acres fronting Shipyard Creek in an industrial and commercial section of the Charleston Peninsula, which is formed by the confluence of the Ashley and Cooper Rivers. Currently, several industrial businesses occupy the southern portion of the Site, and an inter-modal shipping facility is planned for the northern portion with Shipyard Creek access.

During its final years of operation the plant was regulated by several federal environmental statutes, primarily the Clean Water Act, the Clean Air Act, and the Resource Conservation and Recovery Act. After production at the plant ceased in July 1998 Macalloy, the United States Environmental Protection Agency (EPA), and South Carolina Department of Health and Environmental Control (SCDHEC) decided the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) would be a more appropriate mechanism for the Site. Subsequently, it was listed on the National Priorities List (NPL) in February 2000. Upon completion of a Phase I and II Remedial Investigation and Feasibility Study, the EPA published the Record of Decision (ROD) on August 21, 2002, for the cleanup of contaminated soil, groundwater, storm water, and sediment at the Site. The following RAOs were established by the Final ROD:

- Prevent future site worker exposure to unacceptable hazard levels in groundwater
- Remediate shallow groundwater zones with the highest concentrations of hexavalent chromium to minimize long-term threats and limit hexavalent chromium migration into Shipyard Creek.
- Remediate soil that leaches hexavalent chromium to groundwater and surface water at concentrations hazardous to human health and the environment
- Mitigate offsite hexavalent chromium discharges to Shipyard Creek through a combination of the aforementioned remediation measures and a comprehensive site-wide storm management plan
- Manage storm water discharges of toxic inorganic compounds in accordance with the comprehensive storm water management plan to protect ambient saltwater quality in Shipyard Creek
- Remediate soil and debris that produce elevated levels of gamma radiation to mitigate current exposure pathways
- Mitigate exposure of benthic organisms to contaminated sediments in the Outfall 001 Tidal Creek

To accomplish these RAOs, the following remedial components were specified in the ROD:

- Soil: On-site chemical reduction and stabilization/solidification via ex situ treatment with mechanical mixing.
- Groundwater: Enhanced in-situ chemical reduction via injection and trenching.
- Radiological Material: Excavation with offsite disposal.

- Sediment: Removal, upland disposal, installation of an engineered fabric/sand cap, and restoration of Zone A tidal creek; and monitoring of Zone C Shipyard Creek.
- Surface Water/Storm Water: Comprehensive storm water management system.
- Multi-media: Institutional controls and restrictive covenants to limit land use to commercial/industrial purposes, and prohibit the use of groundwater underlying the property.
- Infrastructure: Decommission and demolish all site-wide buildings and infrastructure.

Remedial action design documents and work plans were completed and approved between January 2003 and September 2004. Construction activities for the comprehensive, site-wide remedy began on October 11, 2004, and were considered complete in accordance to the ROD upon signing of the Preliminary Close-Out Report on September 26, 2006.

The remedy at the Site currently protects human health and the environment in the short-term because the following were completed to meet RAOs:

- Radiological debris and soil was removed.
- Contaminated sediment in Zone A was removed and a clean sand cap was constructed to isolate the minimal deeper contaminants.
- Concentrations of hexavalent chromium in soil were reduced below 23 milligrams per kilograms.
- A comprehensive storm water management system was constructed to mitigate offsite storm water discharges of toxic inorganic compounds.
- Institutional controls and restrictive covenants were executed for the Site that limit future use to commercial/industrial purposes, and prohibit the use of groundwater underlying the property.

Cleanup goals established by the ROD for storm water, sediment, and marsh restoration have been met; therefore, monitoring for these components was discontinued, as recommended in the First Five-Year Review Report (U.S. EPA 2010). The First Five-Year Review Report also recommended thickness measurements of the engineered tidal creek cap be completed in 2011 and 2013. The additional measurements found negligible sand loss and parts of the former channel were indistinguishable from the surrounding tidal marsh. No additional tidal creek cap thickness monitoring events are planned.

The soil and ongoing groundwater remedy have reduced the highest concentrations of hexavalent chromium in the shallow groundwater; however, in order for the remedy to be protective in the long-term, all site shallow groundwater must show sustained concentrations of hexavalent chromium below the cleanup goal of 100 micrograms per liter. Based on the latest groundwater monitoring results, a small area of groundwater contaminated above the cleanup goal still exists.

Five-Year Review Summary Form

SITE IDENTIFICATION		
Site Name: Macalloy Corporation		
EPA ID: SCD003360476		
Region: 4	**State:** SC	**City/County:** Charleston/Charleston

SITE STATUS	
NPL Status: Final	
Multiple OUs? No	**Has the site achieved construction completion?** Yes

REVIEW STATUS
Lead agency: EPA
Author name: Robert Cole (Reviewed by EPA)
Author affiliation: State of South Carolina, Department of Health and Environmental Control
Review period: 03/01/2015 – 06/01/2015
Date of site inspection: 02/25/2015
Type of review: Policy
Review number: 2
Triggering action date: 09/01/2010
Due date *(five years after triggering action date)*: 09/01/2015

Five-Year Review Summary Form (continued)

Issues/Recommendations

OU(s) without Issues/Recommendations Identified in the Five-Year Review:
None

Issues and Recommendations Identified in the Five-Year Review:

OU(s): 1	**Issue Category:** Monitoring			
	Issue: MW061 has been damaged and is inaccessible.			
	Recommendation: Abandon and replace MW061			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Implementing Party**	**Oversight Party**	**Milestone Date**
No	Yes	PRP	EPA/State	08/01/2017
OU(s): 1	**Issue Category:** Monitoring			
	Issue: Total chromium concentrations at MW041, MW043, MW060, (and previously at MW061) remain above the RAO of 100 µg/l.			
	Recommendation: Supplemental groundwater remediation similar to the in-situ chemical reduction completed in 2005 and 2008.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Implementing Party**	**Oversight Party**	**Milestone Date**
No	Yes	PRP	EPA/State	04/01/2019
OU(s): 1	**Issue Category:** Monitoring			
	Issue: Current groundwater data suggests that the horizontal extent of the contaminant plume boundary above the RAO to the north, east, and west of MW060 is unknown.			
	Recommendation: Evaluate the need for additional monitoring locations (temporary or permanent) to delineate the remaining area of elevated chromium in groundwater. This should be done prior to any supplemental groundwater remediation.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Implementing Party**	**Oversight Party**	**Milestone Date**
No	Yes	PRP	EPA/State	08/01/2017

Sitewide Protectiveness Statement

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

Protectiveness Statement:

The remedy at the Site currently protects human health and the environment in the short-term because the following were completed to meet RAOs:

- Radiological debris and soil was removed.
- Contaminated sediment in Zone A was removed and a clean sand cap was constructed to isolate the minimal deeper contaminants.
- Concentrations of hexavalent chromium in soil were reduced below 23 milligrams per kilograms.
- A comprehensive storm water management system was constructed to mitigate offsite storm water discharges of toxic inorganic compounds.
- Institutional controls and restrictive covenants were executed for the Site that limit future use to commercial/industrial purposes, and prohibit the use of groundwater underlying the property.

Cleanup goals established by the ROD for storm water, sediment, and marsh restoration have been met; therefore, monitoring for these components was discontinued, as recommended in the First Five-Year Review Report (U.S. EPA 2010). The First Five-Year Review Report also recommended thickness measurements of the engineered tidal creek cap be completed in 2011 and 2013. The additional measurements found negligible sand loss and parts of the former channel were indistinguishable from the surrounding tidal marsh. No additional tidal creek cap thickness monitoring events are planned.

The soil and ongoing groundwater remedy have reduced the highest concentrations of hexavalent chromium in the shallow groundwater; however, in order for the remedy to be protective in the long-term, all site shallow groundwater must show sustained concentrations of hexavalent chromium below the cleanup goal of 100 micrograms per liter. Based on the latest groundwater monitoring results, a small area of groundwater contaminated above the cleanup goal still exists.

Environmental Indicators

- Current human exposures at the Site are under control.
- Current groundwater migration is under control.

Are Necessary Institutional Controls in Place?

☒ All ☐ Some ☐ None

Has EPA Designated the Site as Sitewide Ready for Anticipated Use?
☒ Yes ☐ No

Has the Site Been Put into Reuse?
☒ Yes ☐ No

Second Five-Year Review Report for Macalloy Corporation

1.0 Introduction

The purpose of a five-year review (FYR) is to evaluate the implementation and performance of a remedy in order to determine if the remedy will continue to be protective of human health and the environment. FYR reports document FYR methods, findings and conclusions. In addition, FYR reports identify issues found during the review, if any, and document recommendations to address them.

The United States EPA prepares FYRs pursuant to CERCLA Section 121 and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). CERCLA Section 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 5 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 judgment 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 President shall report to the Congress a list of facilities for which such review is required, the results of all such reviews, and any actions taken as a result of such reviews.

The EPA interpreted this requirement further in the NCP, 40 Code of Federal Regulations (CFR) Section 300.430(f)(4)(ii), which 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 initiation of the selected remedial action.

SCDHEC, in cooperation with the EPA Region 4, conducted the FYR and prepared this report regarding the remedy implemented at the Site, in Charleston, Charleston County, South Carolina. SCDHEC conducted this FYR from January 2015 to June 2015. The EPA is the lead agency for developing and implementing the remedy for the potentially responsible party (PRP)-financed cleanup at the Site. SCDHEC, as the support agency representing the State of South Carolina, has reviewed all supporting documentation and provided input to the EPA during the FYR process.

This is the second FYR for the Site. The triggering action for this policy review is the signature date of the first FYR. The FYR is required because hazardous substances, pollutants or contaminants remain at the Site above levels that allow for unlimited use and unrestricted exposure.

2.0 Site Chronology

Table 1 lists the dates of important events for the Site.

Table 1: Chronology of Site Events

Event	Date
Discovery	March 5, 1998
PRP Removal Action	June 6, 1998 to November 4, 1999
Administrative Order on Consent for Removal Action	June 13, 1998
Proposal to the NPL	October 22, 1999
Preliminary Assessment Completed	November 15, 1999
Final Listing on NPL	February 4, 2000
Administrative Order on Consent signed for Remedial Investigation/Feasibility Study (RI/FS)	March 29, 2000
PRP-lead RI/FS	March 29, 2000 to August 21, 2002
ROD	August 21, 2002
Final Pre-Design Sampling and Analysis report Submitted	January 10, 2003
Final Treatability Study Report submitted	January 13, 2003
Remedial Design submitted/approved	September 4, 2003
December 2003 Groundwater and Soil Sampling results Memorandum Submitted (presents the results of additional delineation and lithologic sampling required by the remedial design)	May 13, 2004
Remedial Action Consent Decree Entered	June 14, 2004
Remedial Action Kick-off Meeting	September 2, 2004
Final Sediment Remedial Action Work Plan Submitted	September 24, 2004
Final Soil Remedial Action Work Plan Submitted	October 4, 2004
Mobilization to Site	October 11, 2004
Injection Wells and Monitoring Wells Installation Began	October 12, 2004
Baseline Groundwater Sampling Conducted	November 4 to 16, 2004
Reductant Injections	November 14, 2004 to March 5, 2005
001 Tidal Creek Sediment Removal	December 6 to 23, 2004
001 Tidal Creek Geotextile Installation and Sand Cap Placement	December 27, 2004 to January 29, 2005
Storm Water Discharge Limitations Memorandum Submitted	January 20, 2005
Radiological Material Removal	February 1 to 12, 2005
Soil Remediation Starts	March 1, 2005
001 Tidal Creek Marsh Restoration	March 11 to 13, 2005
Site Clearing for Storm Water System Construction Began	September 10, 2005
Redox Trench Pilot Study	October 11 to 12, 2005
Complete Soil Remediation	October 31, 2005
Redox Trenches Installed	December 2 to 20, 2005
Low Carbon Slag Discovery	December 6, 2005
Low Carbon Slag Delineation	December 21, 2005 to January 17, 2006
Low Carbon Slag Removal and Stockpiling	January 28, 2006 to March 30, 2006
Low Carbon Slag Treatment	July 5, 2006
Pre-Final Walk-Through and Inspection	July 13, 2006
Punch List for Remedial Construction Complete	July 20, 2006
Interim Walk-Through and Inspection	August 7, 2006
August 7, 2006 Site Inspection Punch List	August 9, 2006
Installation of Long-Term Monitoring Wells	August 21 to 29, 2006
Final Walk-Through Inspection	September 18, 2006
Preliminary Close-Out Report signed	September 26, 2006

SCDHEC Terminated Storm Water Sampling Requirements	July 16, 2008
Repair of 001 Tidal Creek Cap	December 2008
Supplemental Groundwater Treatment	December 2008
Zone C Sediment Post-Construction Monitoring Event (Event 2)	February 2009
Long-Term Groundwater Monitoring Event 7 Report	March 2009
Long-Term Groundwater Monitoring Event 8 Report	August 2009
Year 4 Tidal Creek Cap Monitoring Report	September 2009
Long-Term Groundwater Monitoring Event 9 Report	November 2009
Zone C Sediment Post-Construction Monitoring Event 3 Report	December 2009
Long-Term Groundwater Monitoring Event 10 Report	August 2010
First Five-Year Review Report for Macalloy Corporation	September 2010
Long-Term Groundwater Monitoring Event 11 Report	March 2011
Long-Term Groundwater Monitoring Event 13 Report	January 2012
Year 1 Interim Progress Report South Carolina Department of Natural Resources (SCDNR)	February 2012
Year 2 Interim Progress Report SCDNR	January 2013
Long-Term Groundwater Monitoring Report (October 2013 Event)	May 2013
Year 3 Interim Progress Report SCDNR	February 2014
2013 Long-Term Groundwater and Tidal Creek Cap Monitoring	March 2014
2014 Annual Long-Term Groundwater Monitoring Report	January 2015

3.0 Background

3.1 Physical Characteristics

The Macalloy Corporation NPL Site, EPA ID #SCD003360476, is located at 1800 Pittsburgh Avenue in Charleston, Charleston County, South Carolina. The Site is a former ferrochromium alloy manufacturing plant situated on approximately 140 acres fronting Shipyard Creek in a highly industrialized and commercial section of the Charleston Peninsula, which is formed by the confluence of the Ashley and Cooper Rivers. The Site is directly adjacent to a tidal creek and marsh along Shipyard Creek. Figure 1 presents a map of the current configuration of the Site.

Two roads (Sewanee Rd. and Talluah Rd.) built in 2007 divide the Site into approximately 110 acre and 30 acre portions. The northern portion consists of approximately 110 acres of undeveloped land vegetated with grass and shrubs. The southern portion is approximately 30 acres in size and is currently occupied by several light industrial/commercial businesses, including:

Boasso – Depot and Transportation services to the tank container industry
Sonoco Recycling – Paper recycling
PSC Container - Industrial cleaning, transport, and container services

The topography of the Site is relatively flat with elevations ranging between 10 to 15 feet above mean sea level. Earthen ditches channel on-site storm water runoff to two engineered settling basins. Permitted discharge primarily occurs through one National Pollutant Discharge Elimination System (NPDES) outfall, with limited areas flowing directly to Shipyard Creek. Shallow groundwater beneath the Site generally flows from west to east and toward Shipyard Creek.

Figure 1: Site Location Map

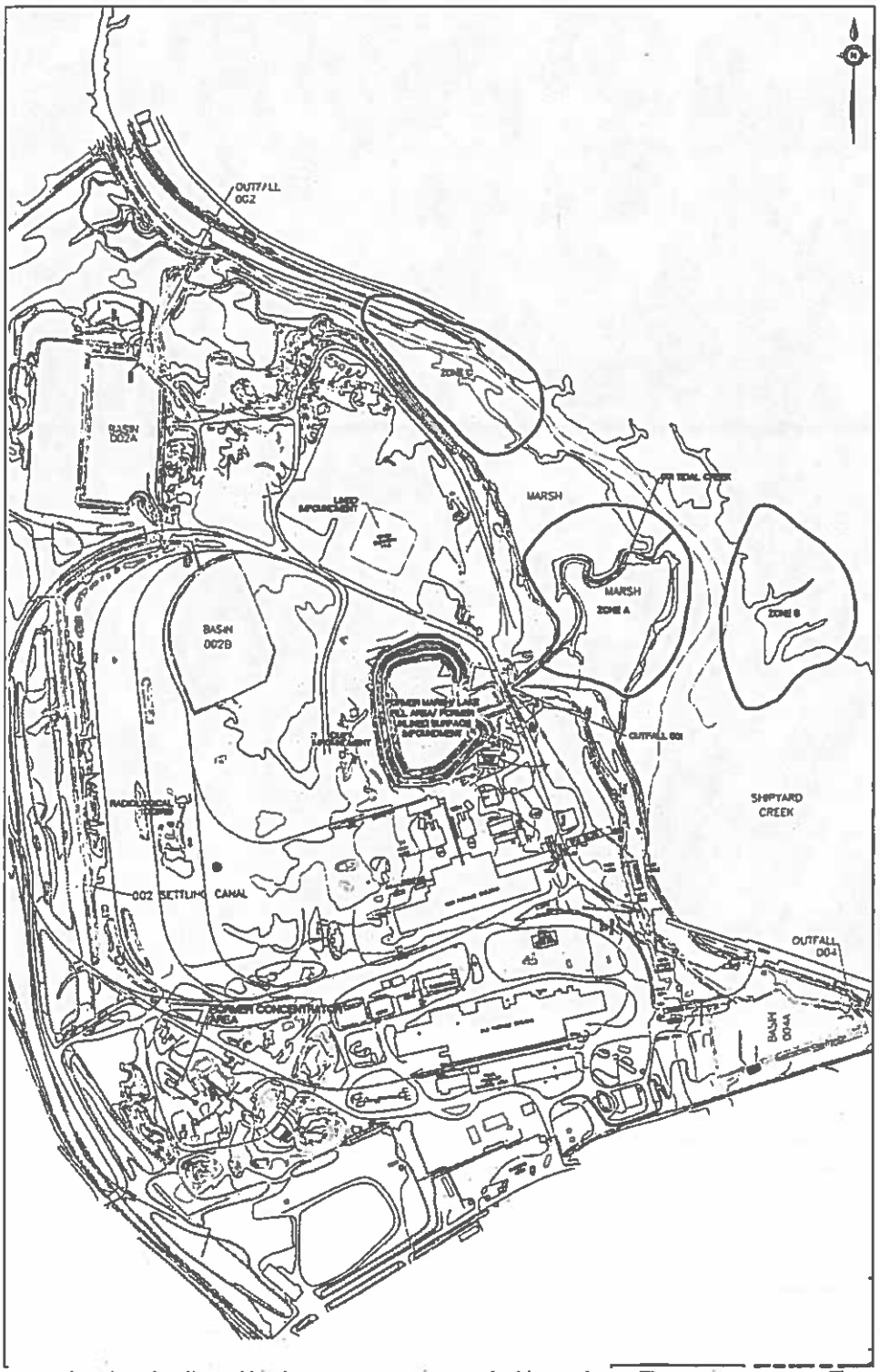
- Site Outline in red

NORTH

Macalloy Corporation NPL Site
City of Charleston, Charleston County, South Carolina

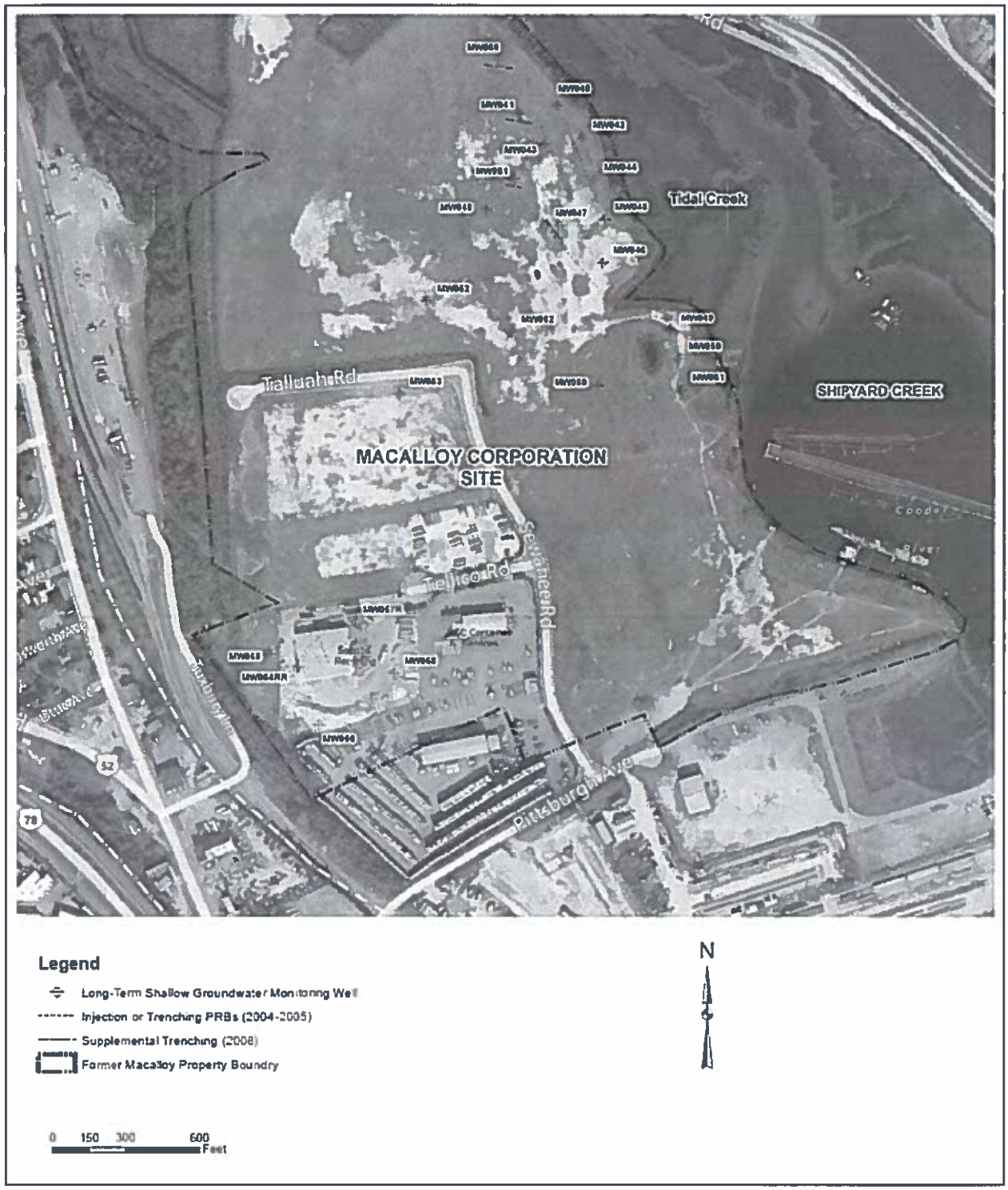
Disclaimer: This map and any boundary lines within the map are approximate and subject to change. The map is not a survey. The map is for informational purposes only regarding EPA's response actions at the Site.

Figure 2: Detailed Site Map



Disclaimer: This map and any boundary lines within the map are approximate and subject to change. The map is not a survey. The map is for informational purposes only regarding EPA's response actions at the Site.

Figure 3: Detailed Site Map Aerial with Monitoring Well Locations



Disclaimer: This map and any boundary lines within the map are approximate and subject to change. The map is not a survey. The map is for informational purposes only regarding EPA's response actions at the Site.

3.2 Land and Resource Use

Ferrochromium alloy was manufactured at the Site from 1941 to 1998. The Site was owned and operated by Pittsburgh Metallurgical Company from 1941 to 1966, Airco (British Oxygen Corporation) from 1966 to 1979, and Macalloy from 1979 to 1998, when alloy production ceased. At various times from 1942 to 1998, the United State Department of Defense owned, operated, or otherwise used portions of the Site to produce and store ferrochromium alloy, chrome ore, and slag (waste).

In February 2005, the Macalloy property was purchased by Ashley II of Charleston, LLC (Ashley II) while remediation was underway. Immediately following the completion of remedial activities in 2006, Ashley II completed site improvements (road, water, sewer, improved drainage) to the Site to accommodate an industrial park. Approximately 30 acres, located in the southern portion of the Site, are currently occupied by several light industrial/commercial businesses, including:

Boasso – Depot and Transportation services to the tank container industry
Sonoco Recycling – Paper recycling
PSC Container - Industrial cleaning, transport, and container services

In March 2007, Ashley II sold the property to Shipyard Creek Associates, LLC who currently intends to redevelop the Site's northern portion as a multi-modal facility.

The Cooper River is used for recreational fishing. Groundwater from the intermediate sand and lower sand unit may possibly be used locally within Charleston County as a water supply, but no known shallow groundwater wells are in use within a four mile radius of the Site. Drinking water to this area is supplied by the City of Charleston, which uses an upgradient surface water supply that is not influenced by the Site.

3.3 History of Contamination

The ferrochromium alloy manufacturing process involved the conversion of chromium-bearing ore (chromite) to ferrochromium in a single submerged arc electric furnace. The alloy was then shipped offsite for production of high-quality stainless steel. During operation, smelting was conducted in both submerged and open arc furnaces. Open arc (low carbon) furnaces were operated from approximately 1946 to 1967. Submerged arc furnaces were used in subsequent years. Open arc furnaces generally produce more hexavalent chromium by-product than submerged arc furnaces. The submerged arc furnace yielded approximately 180 tons of finished ferrochromium per day.

Waste materials generated during furnace operations included wastewater, airborne waste gases, and particulate matter. Water was used for cooling the furnace and as the contact cooling medium for airborne discharges from the furnace. Air emissions control equipment at the facility included three baghouses, two gas conditioning towers, and two electrostatic precipitators (ESPs). These systems generated various solid wastes, including dust collected in the ESPs and baghouses, sludge from the gas conditioning towers, and bottom sludge from an on-site NPDES permitted settling

pond (former Outfall 001). From 1988 until 1997, Macalloy operated an unlined surface impoundment (USI) for treated ESP dust just north of the ferrochromium process area.

3.4 Initial Response

During its final years of operation, the plant was regulated by several federal environmental statutes, primarily the Clean Water Act, the Clean Air Act, and the Resource Conservation and Recovery Act (RCRA). In 1992, the SCDHEC Bureau of Water Pollution Control issued Administrative Order 92-64-W requiring the Macalloy Corporation to remediate hexavalent chromium contaminated groundwater on the property. Pursuant to this order, a pump and treat groundwater remediation system was installed around the USI in 1994 and 1995. In 1996, Macalloy began the RCRA corrective action process. In January 1997, pursuant to the terms of a consent order with SCDHEC (96-38-HW), Macalloy initiated offsite disposal of treated ESP dust from the USI.

In June 1998, Macalloy and the EPA entered into a Removal Action Administrative Order on Consent to address potential releases via storm water runoff of hazardous substances from the Macalloy plant to Shipyard Creek. To comply with the order, a storm water management system was constructed that consisted of a series of earthen berms, ditches, and detention basins that collected on-site and offsite surface water. Two outfalls discharged storm water from the Site to Shipyard Creek. Surface water discharge samples collected from October 1998 to September 2000 indicated hexavalent chromium exceeded the NPDES limits. Additionally, arsenic, copper, lead, and zinc were identified as constituents of concern based on analytical results associated with surface water samples collected at the Site's discharge point to Shipyard Creek. A preliminary ecological risk evaluation was performed by the EPA during installation of the surface water management system.

In October 1998 an initial *Draft RCRA Facility Investigation (RFI)/Confirmation Sampling Investigation Work Plan* (EnSafe, November 1999), was submitted to the EPA and SCDHEC for review and comment. The initial draft RFI work plan was revised based on technical comments received from both agencies, and then resubmitted to the appropriate regulatory agencies on November 30, 1999.

Plant operations ceased in July 1998; at this time, Macalloy, the EPA, and SCDHEC decided that the CERCLA would be a more appropriate regulatory mechanism for this Site. Subsequently, the Site was proposed for inclusion on the NPL on October 22, 1999, and was listed as "final" on February 4, 2000. On March 29, 2000, Macalloy entered into an Administrative Order on Consent with the EPA to perform a CERCLA Remedial Investigation/Feasibility Study (RI/FS). The revised November 30, 1999 *RFI Work Plan* (EnSafe, 1999), formed the basis of the CERCLA RI/FS work plan, which was converted to fulfill the requirements of the March 29, 2000 agreement with the EPA. The EPA approved the RI/FS Work Plan as final on June 1, 2000.

In December 2000, the first phase of the Remedial Investigation (RI) was completed under oversight by the EPA and SCDHEC. During the first phase of the RI, the on-site nature and extent of soil and groundwater contamination was assessed and associated risks to human health and the environment were evaluated. Field activities and findings were documented in a *Final Phase I RI*

Report (EnSafe, April 2001), which was approved by the EPA on May 17, 2001. The Phase I RI Report concluded that several data gaps needed to be filled before a Feasibility Study (FS) could begin. Therefore, a second phase of the RI was conducted in June 2001, to further assess risks to human and ecological receptors from potential contamination in Shipyard Creek. Field activities and findings were documented in a *Final Phase II RI Report* (EnSafe, January 2002), which was approved by the EPA on March 21, 2002.

3.5 Basis for Taking Action

Macalloy conducted and funded two major response actions at the Site. In June 1998, Macalloy initiated a removal action under a consent order (No. 98-18-C) with the EPA to implement a surface water management plan to mitigate transport of contaminants to Shipyard Creek while a final site-wide remedy was developed. In March 2000, Macalloy entered into a consent order (No. 00-19-C) with EPA to perform a CERCLA RI/FS.

Based on the findings of the comprehensive RI, historical operations at the Site impacted soil, groundwater, surface water, and sediment. The following sections provide the basis for taking action at the Site by summarizing the RI and risk assessment conclusions, contaminants of concern, and the primary health threats.

3.5.1 Summary of RI Conclusions by Media

Soil

Approximately 60,000 cubic yards of site soil was determined to be impacted by hexavalent chromium. Soil impacted by hexavalent chromium was observed from the ground surface to approximately 15 to 20 feet below ground surface (bgs) and determined to be concentrated in and around the Marsh Lake Fill Area (LFA), the former furnace buildings, the former concentrator area, and other isolated locations across the Site. These areas were filled with material from plant operations, including raw materials, slag, sludge, and treated and untreated dust from air pollution control equipment. An additional 55,000 cubic yards of on-site material used as berm material for surface impoundments also contained elevated concentrations of hexavalent chromium. Approximately 110 cubic yards of soil and debris with gamma radiation levels greater than background levels were identified near the former concentrator area. The radionuclides detected were radium-226, thorium-232, potassium-40, and uranium-235. This material is believed to have been brought to the Site in railcars carrying feedstock for alloy production. The average depth of the radiological debris was determined to be 18 inches.

Groundwater

Five plumes of groundwater contaminated with hexavalent chromium were identified at the Site during the RI. The largest of the plumes, Plume I extended approximately from the former USI to Shipyard Creek. Hexavalent chromium concentrations of 10,000 micrograms per liter (µ/L) were measured in Plume I. Plumes II, III, and IV were smaller in size and located immediately adjacent to the eastern edge of Plume I. Plume V was identified at the plant's former concentrator area. Data collected during the RI, indicated that impacted groundwater at each of the plumes was confined to the shallow aquifer and did not penetrate a clay confining layer that exists across the Site, at approximately 20 feet bgs.

Surface Water
Surface water samples associated with the Site's storm water management system exceeded the hexavalent chromium limit at several sampling locations. Other metals including arsenic, copper, lead, and zinc were identified as being a concern due to offsite discharge to Shipyard Creek.

Sediment
Results of a site-wide Ecological Risk Assessment (ERA) concluded that sediment in 001 Tidal Creek Zone A of Shipyard Creek, formerly an outfall for on-site surface water discharging to Shipyard Creek, contained elevated levels of total chromium, nickel, and zinc. The tidal creek is approximately 1,070 feet long and varies from 15 feet to 60 feet wide. The volume of contaminated sediment was estimated to be 1,000 cubic yards to a depth of 18 inches.

3.5.2 Summary of Site Risks

As part of the RI/FS, a Baseline Risk Assessment was conducted to evaluate current and potential effects of contaminants to human health and the environment. Human health exposure pathways evaluated included ingestion, inhalation, and dermal contact with surface soils and groundwater, and ingestion of shellfish from Shipyard Creek. The EPA based its cleanup goals on an expected future industrial land use exposure scenario for an on-site worker. Groundwater ingestion was not determined to be a likely exposure pathway at the Site, since shallow groundwater is not currently used for consumption, nor will it likely be in the future. Nonetheless, shallow groundwater beneath the Site was conservatively assumed to be a source of drinking water because South Carolina classifies all groundwater as a potential underground source of drinking water.

Ecological exposure pathways evaluated included direct exposure of terrestrial and aquatic communities to site soil and Shipyard Creek sediment and surface water, as well as indirect (food-chain), exposure to species that use both habitats.

3.5.2.1 Human Health Risks

Human health risk levels for potential cancer-causing chemicals are based on the concentration of the chemical and its strength as a cancer-causing agent. A risk range of 10^{-4} to 10^{-6} for the protection of human health is considered acceptable by the EPA. This range would mean an increased chance of no more than one additional case of cancer in 10,000 (10^{-4}) to one million (10^{-6}) people. Chemicals producing harmful effects other than cancer were compared with reference doses (highest levels not causing harmful effects) to calculate a hazard quotient. A hazard quotient above 1 indicates that a constituent is present at concentrations that may produce harmful effects other than cancer.

No chemicals of concern were identified for surface soil under the future site worker (industrial) scenario. However, hexavalent chromium was identified as a contaminant in soil that could leach to shallow groundwater at concentrations hazardous to human health. Risk and hazard calculations were overwhelmingly driven by the conservative assumption that groundwater will be used as drinking water. Hexavalent chromium in shallow groundwater accounted for 91% of the hazard

associated with ingestion (hazard quotient=31). Calculated carcinogenic risk ($5x10^{-5}$) was within the EPA's acceptable risk range. Based on groundwater data collected from deep wells installed and sampled at the Site, no chemicals of concern were identified for deep groundwater, located below the clay confining unit, under the future site worker scenario.

No chemicals of concern for shellfish ingestion were identified in the human health risk assessment, under the assumption that recreational receptors would consume equal quantities of crab, oyster, and shrimp from Shipyard Creek. Using the conservative assumption that receptors consume only shrimp harvested downgradient of Macalloy; arsenic in shrimp was the only chemical that exceeded reasonable maximum exposure hazard quotient and cancer risk values. However, calculated risk levels were within the range calculated for ingesting shellfish containing arsenic at background levels. No chemicals of concern were identified for the central tendency exposure evaluations.

A general area gamma radiation survey was performed by the EPA to evaluate the nature and extent of potential radiological contamination across the Site and the potential risk posed to the public. The survey measured elevated radiation levels (twice background or higher), in an area near the former concentrator building.

3.5.2.2 Ecological Risks

During the RI/FS, risks were evaluated for ecological receptors across expected contaminant gradients in Zone A, B, and C of Shipyard Creek. Figure 2 on page 6 shows the locations of these zones in Shipyard Creek. Sediment chemistry, acute and chronic sediment toxicity testing, grass shrimp abundance, tissue chemistry, and food-chain modeling were used to assess potential risk to ecological receptors based on a multiple lines-of-evidence approach.

Zone A comprises a small tidal creek (001 Tidal Creek) that historically received process water discharges from plant operations. Sediments within this channel contained elevated concentrations of total chromium, nickel, and zinc above protective ecological criteria and exhibited chronic effects on grass shrimp in laboratory toxicity tests. For these reasons, the EPA concluded there was an unacceptable risk to the benthic community, and Zone A was retained and further evaluated in the FS.

Results from the selected measurement endpoints demonstrated that no unacceptable risk exists in Zone B.

One measurement endpoint, embryo production, indicated unacceptable risks in Zone C. However, based on the strength and magnitude of observed adverse effects and the expectation of diminishing risks following remediation, a risk management decision was made to monitor total metals and toxicity in Zone C.

3.5.2.3 Fate and Transport Summary

Soil-to-groundwater, groundwater-to-surface water, and on-site soil-and surface water-to-offsite surface water pathways and receptors were evaluated for each constituent detected at the Site.

Hexavalent chromium, antimony, arsenic, trivalent chromium, and copper were identified as contaminants having potentially significant migration pathways in the RI. Hexavalent chromium impacted soil and groundwater generally co-existed in similar areas of the Site. Hexavalent chromium groundwater concentrations also exceeded the respective surface water screening value within the plumes. The majority of the Site's impacted groundwater was determined to be located adjacent to Shipyard Creek and its' marsh. Although, hexavalent chromium was not measured in groundwater samples collected from monitoring wells installed in the vicinity of Shipyard Creek, it was determined that hexavalent chromium laden groundwater could potentially discharge to Shipyard Creek and the associated marsh. Because of the potential migration pathways for hexavalent chromium to move from soil and groundwater to surface water, hexavalent chromium was retained for further evaluation in the FS.

Antimony and arsenic exceeded site-specific screening levels and/or background concentrations in soil. Arsenic also exceeded the maximum contaminant level (MCL) and surface water screening criteria in isolated groundwater wells. However for both of these metals, no discernible groundwater plume existed at the Site and the human health risk assessment produced hazard quotients of less than 1. Antimony and arsenic were not retained for further evaluation in the FS.

Trivalent chromium exceeded its surface water screening criteria in several groundwater samples collected at the Site. However, trivalent chromium's solubility (and thus its mobility in groundwater) is very low and its presence in these samples may have been associated with solid particles remaining in the well after drilling; these solids are not mobile in groundwater. Trivalent chromium was not measured above surface water criteria in filtered groundwater samples collected from marsh wells and therefore was not retained for further evaluation in the FS.

Copper in groundwater exceeded its surface water criteria in several isolated wells; however, a discernible copper plume was not identified and copper was not measured above surface water criteria in filtered groundwater samples collected from the wells in the vicinity of Shipyard Creek. Therefore, copper was not retained for further evaluation in the FS.

4.0 Remedial Actions

In accordance with CERCLA and the NCP, the overriding goals for any remedial action are protection of human health and the environment and compliance with applicable or relevant and appropriate requirements (ARARs). A number of remedial alternatives were considered for the Site, and final selection was made based on an evaluation of each alternative against nine evaluation criteria that are specified in Section 300.430(e)(9)(iii) of the NCP. The nine criteria are:

1. Overall Protection of Human Health and the Environment
2. Compliance with ARARs
3. Long-Term Effectiveness and Permanence
4. Reduction of Toxicity, Mobility or Volume through Treatment
5. Short-Term Effectiveness
6. Implementability
7. Cost
8. State Acceptance

9. Community Acceptance

4.1 Remedy Selection

The EPA selected the remedies for each remedial component in the August 2002 ROD. The remedy components and selected remedies stated in the August 2002 ROD were:

- Radiological Material: Excavation with Offsite Disposal
- Sediment:
  Zone A 001 Tidal Creek: Removal, Upland Disposal, Capping and Restoration
  Zone C Shipyard Creek: Monitoring only
- Groundwater: Enhanced In-Situ Chemical Reduction
- Soil: On-site Chemical Reduction
- Surface Water/Storm Water: Comprehensive Storm Water Management System

A Final Remedial Design (RD) (EnSafe, September 2003) for the Site was submitted in September 2003, and a Consent Decree to conduct the remedial action was entered on June 14, 2004. The Macalloy PRP Group retained EnSafe to serve as the supervising contractor for the remedial action. ENTACT of Friendswood, Texas, was selected as the remedial construction contractor. Remedial Action, as described in bullets above, was initiated with on-site mobilization on October 11, 2004.

The EPA and SCDHEC conducted a Pre-Final Inspection at the Site on July 13, 2006, an Interim Final Inspection on August 7, 2006, and a Final Inspection on September 18, 2006. Based on these inspections and review of the Final Remedial Action Report (EnSafe, September 20, 2006), the EPA and SCDHEC concluded that the Macalloy PRP Group constructed the remedy in accordance with the ROD and approved RD plans and specifications. The Site achieved construction complete status when the Preliminary Close-Out Report (PCOR) was signed on September 26, 2006.

Radiological Material: Excavation and Offsite Disposal

Debris with gamma radiation levels exceeding twice the background levels 12 micro-Roentgens/hour was identified in shallow soil near the former concentrator area in the southwestern portion of the Site.

The following RAO was specified in the ROD for the radiological material area.

- Remediate soil and debris that produce elevated levels of gamma radiation to mitigate current exposure pathways.

The ROD proposed reducing radiation levels in soil and debris to 12 micro-Roentgens/hour. Based on the Phase II remedial investigation (EnSafe, 2002) and the evaluation of remedial alternatives during the Feasibility Study (EnSafe, 2002), removal and offsite disposal in a Subtitle D landfill was selected as the remedy for the radiological materials.

Zone A Sediment Removal

The results of a site-wide ERA indicated that sediment in the Zone A 001 Tidal Creek contained elevated levels of total chromium, nickel, and zinc.

The following RAO was specified by the ROD for the sediment in the 001 Tidal Creek.

- Mitigate exposure of benthic organisms to contaminated sediments in the Outfall 001 Tidal Creek.

The ROD called for reducing benthic organisms' exposure of chromium, nickel, and zinc in tidal creek sediment by removal with upland disposal. Specifications in the ROD included the removal of the top 18 inches of contaminated sediment using dredging equipment, dewatering of the sediment, and incorporation of the sediment into the on-site soil remedy. Based on subsequent pre-design sediment sampling, which indicated that sediment contamination was present at depths ranging from 18 to 36 inches, the remedy for Zone A was modified in the Final Design as follows:

- Dredging depth of creek channel sediments was increased from 18 to 24 inches.
- A geotextile was specified to line the dredged creek channel and minimize bioturbation in the remaining contaminated sediment.
- An 18-inch clean sand cap was used to cover the geotextile.

Pre-design sampling at ten locations in the tidal creek indicated that only three locations exhibited contamination at depths greater than 24 inches. Therefore, dredging 24 inches of sediment removed most of the contamination. Concentrations of total chromium, nickel, and zinc remaining after dredging were contained beneath the geotextile liner and sand cap. The use of the geotextile liner and sand cap served to limit the dredging depth, without compromising the ultimate goal of protecting marine organisms.

Zone C Sediment

The ERA indicated that one measurement endpoint, embryo production, in the middle portion of Zone C in Shipyard Creek exhibited unacceptable risks to benthic organisms.

Based on the strength and magnitude of observed adverse effects and the expectation of diminishing risks following site remediation, a risk management decision was made by EPA and the Natural Resource Trustees to only monitor Zone C sediment.

Groundwater: Enhanced In Situ Chemical Reduction

During the RI, five hexavalent chromium plumes were delineated in the shallow groundwater. Four of the plumes (Plumes I through IV) extended from the former LFA toward Shipyard Creek; a fifth plume (Plume V) was in the former concentrator area.

The following RAO were selected in the ROD for the groundwater:

- Prevent future site worker exposure to unacceptable hazard levels in groundwater.
- Remediate shallow groundwater zones with the highest concentrations of hexavalent chromium to minimize long-term threats and limit hexavalent chromium migration into Shipyard Creek.

The ROD documented the selection of enhanced in situ reduction using chemical reductants. The objective of the groundwater remedy is to prevent exposure to hexavalent chromium in shallow groundwater above the Safe Drinking Water Act MCL of 100 micrograms per liter (µg/l) for total chromium and to minimize hexavalent chromium migration from groundwater to Shipyard Creek. The remedy also includes a deed restriction regarding use of groundwater.

Soil: On-site Chemical Reduction

During the RI, concentrations of hexavalent chromium in soil at the LFA, former casting bay/furnace buildings, the former concentrator area, and other isolated locations across the Site, indicated a significant potential for migration from soil to groundwater.

The following RAO was specified in the ROD for the soil:

- Remediate soil that leaches hexavalent chromium to groundwater and surface water at concentrations hazardous to human health and the environment.

The ROD documented the selection of chemical reduction using mechanical mixing to convert hexavalent chromium to the less mobile (and less toxic) trivalent form, chromium (III). Bench- and pilot-scale treatability studies were conducted during the RD to evaluate chemical reductants and mixing methods. The soil cleanup goal for hexavalent chromium-impacted soil above the water table was 23 mg/kg. This value was a site-specific concentration calculated during the RI to minimize leaching of hexavalent chromium from soil to groundwater at concentrations above the drinking water MCL of 100 µg/l. The cleanup goal for soil below the water table was a synthetic precipitation leaching procedure (SPLP) concentration of 100 µg/l. Depending on the percent solids of the material, a SPLP concentration of 100 µg/l is approximately equal to hexavalent chromium concentrations in soil ranging from about 2 to 4 mg/kg.

Surface and Storm Water: Comprehensive Storm Water Management

Surface water discharge samples indicated hexavalent chromium exceeded NPDES limits. Additionally, arsenic, copper, lead, and zinc were identified as constituents of concern because of concentrations measured in surface water discharge to Shipyard Creek.

The following RAO were specified in the ROD for the storm water:

- Mitigate offsite hexavalent chromium discharges in storm water to Shipyard Creek through soil and groundwater remediation measures and a comprehensive site-wide storm water management plan.

- Manage storm water discharges of toxic inorganic compounds in accordance with the comprehensive storm water management plan to protect ambient saltwater quality in Shipyard Creek.

4.2 Remedy Implementation

As previously stated, the remedy components and selected remedies stated in the 2002 ROD were:

- Radiological Material: Excavation with Offsite Disposal
- Sediment:
  Zone A 001 Tidal Creek: Removal, Upland Disposal, Capping and Restoration
  Zone C Shipyard Creek: Monitoring only
- Groundwater: Enhanced In-Situ Chemical Reduction
- Soil: On-site Chemical Reduction
- Surface Water/Storm Water: Comprehensive Storm Water Management System

Radiological Material: Excavation and Offsite Disposal

EnSafe subcontracted with Philotechnics, Ltd, a waste management firm specializing in radiological and mixed waste, to assist with the removal action. ENTACT, the remedial construction contractor, performed the debris removal. Removal activities began on February 7, 2005, and were completed on February 9, 2005. The radiological debris area was in the southwestern portion of the Site and covered approximately 2,025 square feet. Erosion controls were placed on the downslope sides of the removal area before construction began. Initially, the entire area was excavated to a depth of 9 inches and then soil left in place was field screened using a pressurized on chamber. Initial screening indicated that material exceeding 12 micro-Roentgens/hours remained, thus additional material was removed followed by screening until the cleanup goal was achieved.

Final excavation depths ranged from 9 to 18 inches. In total, approximately 200 tons of debris and soil were excavated and transported to U.S. Ecology Idaho, Inc. in Grand View, Idaho for appropriate disposal. Upon completion of the removal activities, a confirmatory survey and inspection was performed by the EPA and SCDHEC on May 11, 2005. Further documentation is provided in the Final Removal Action Report (FRAR).

Zone A Sediment Removal

Prior to construction, a Remedial Action Work Plan (ENTACT) for sediment in 001 Tidal Creek was submitted to the EPA and SCDHEC for review and approval. In addition, a Critical Area Permit and Coastal Zone Consistency Certification were obtained from the SCDHEC Office of Ocean and Coastal Resource Management (OCRM). To minimize re-suspension of sediments outside of work areas, a floating turbidity barrier was installed at the mouth of the tidal creek, from one edge of the creek channel to the other, and secured with anchors. EnSafe monitored turbidity in Shipyard Creek during construction to verify that sediment re-suspension controls were effective.

Sediment removal began on December 6, 2004, and was completed on December 23, 2004. Due to access limitations, ENTACT used a combination of conventional and specialty excavation equipment to complete the removal in accordance with the work plan. The configuration of the creek and adjacent shoreline allowed ENTACT to use a conventional tracked excavator with a longreach excavating arm to remove sediment along the first 390 feet of creek bed. The remaining portion of the creek bed was excavated using amphibious low-ground-pressure equipment, consisting of a long-reach excavator and a hauling unit capable of holding approximately 10 cubic yards. The excavator and hauling unit were mounted on twin pontoons and which achieved ground pressures in the range of 2 to 5 pounds per square inch. A cable and pulley system attached to the amphibious excavator on shore was used to pull the hauling unit to and from the excavation area via a short haul road, which intersected the creek channel. Because these activities could only take place during low tide, work was conducted during two five-hour shifts during both daily low tides. To ensure that the excavation achieved the required 2-foot depth, ground personnel directed the excavator operator and used a surveyor's rod to continuously verify excavation depths.

Geotextile installation and placement of clean sand backfill began on December 28, 2004, and was completed on January 29, 2005. Upon completion of sediment removal, geotextile fabric was placed across the excavated area and secured using 24-inch-long hooked steel reinforcing bars. Adjacent sections of fabric were overlapped a minimum of 2 feet. To the extent practical, clean sand backfill was placed over the geotextile during the shift in which the geotextile was placed. Conventional and amphibious excavation equipment and hand shovels were used to perform the backfill. Thickness was verified during placement by probing the backfill using a steel reinforcing bar marked at the prescribed 18-inch depth.

Excavated sediment was staged in an earthen bermed, temporary holding area on the shore immediately north of the creek. Kiln dust was immediately added to the excavated sediment in the holding area to solidify the sediment. The solidified sediment was then placed in approximate 500-cubic-yard (CY) stockpiles for use on-site during the soil remedy. Because the kiln dust soaked up the water in the sediment, water was not discharged from the holding area and water quality sampling was not necessary.

During sediment removal and sand cap placement, a portion (less than 1 acre) of the adjacent tidal marsh was disturbed. The disturbed area was returned to approximate original grade at the completion of remediation activities in January 2005. As required by the Critical Area Permit, a Marsh Restoration Plan (ENTACT, January 2005) was then submitted to OCRM in January 2005. Upon OCRM approval of the plan on February 14, 2005, marsh restoration was performed March 11 through March 13, 2005. Restoration activities included planting 5,900 1-gallon Spartina alternifiora on 3-foot centers (approximately 120 plants per 1,000 square feet). In addition, 196 feet of shoreline were restored by planting 40 5-gallon Baccharis halimifolia on 5-foot centers.

Thickness Measurements

Yearly measurement events of the tidal creek cap thickness were required by the FRAR after construction was completed. EnSafe conducted measurement events as outlined by the FRAR in June 2006, June 2007, June 2008, and June 2009. Measurements were attained by inserting a rod

into the sand cap to determine the depth of clean sand above the geotextile at 100-foot intervals along the centerline of the creek. Any thickness less than 18 inches was evaluated for severity of sand loss and the need for repair.

Maintenance and Repair

From 2006 to 2008, yearly tidal creek cap thickness reports indicated that exposed geotextile fabric was observed near Transect 3 (Ensafe 2008). Approximately 16 linear feet of fabric was pulled away from the sides of the creek and out from under the 18 inch sand cap. The Macalloy PRP Group contracted ENTACT to repair the cap and EnSafe to document and report field activities. Field activities were conducted on December 22, 2008, and in accordance to the Technical Memorandum 001 Tidal Creek- Work Plan to Repair Cap near Transect 3 (EnSafe, December 1, 2008). Sediment beneath the exposed liner was removed with shovels to approximately 18 inches bgs. Excavated sediment was temporarily staged adjacent to the repair area to allow for reuse of the material. The existing geotextile liner was not damaged and therefore, was replaced across the excavated area and secured. The staged sediment was then replaced over the geotextile liner and graded to the natural contours of the creek bed. Stability of the repair will be observed in future thickness surveys. On February 9, 2009, EnSafe submitted the 001 Tidal Creek Cap Repair Completion Report Technical Memorandum (EnSafe, 2009) to the EPA and SCDHEC documenting all completed work activities.

Additional Tidal Creek Cap monitoring was recommended in the previous FYR. Monitoring events occurred in 2011 and 2013. Although several transects had less than the design thickness of 18-inches of sand over the geotextile liner in 2013, only minimal sand losses were observed at Transects 1 through 5 since the previous monitoring event in 2011. Site discharges to the tidal creek were discontinued prior to remedial activities; therefore, the former channel at the most landward portion of the creek, approximately Transect 6 through Transect 11 and half of the tidal creek channel, has filled in with sediment, is densely vegetated with cordgrass and a thick root mat, and is nearly indistinguishable from the surrounding tidal marsh. No additional tidal creek cap thickness monitoring events are currently planned.

Groundwater: Enhanced in Situ Chemical Reduction

The EPA performed an in situ chemical reduction pilot study in three phases between mid-2001 and January 2003 to examine the feasibility of treating hexavalent chromium in groundwater using soluble reductants and to establish design criteria for full-scale implementation. The EPA's pilot study recommended installation of reduction/oxidation (redox) zones in the form of permeable reactive barriers (PRBs) to treat groundwater downgradient of source areas. This approach was recommended over a plume-wide injection strategy due to technical and cost concerns. The study concluded that long-term redox zones could be created by injection of a ferrous sulfate and sodium dithionite solution into short-term wells screened across the shallow aquifer. The study found that an injection radius of influence of 7.5 feet could be achieved at an injection rate of 10 to 15 gallons per minute and an injection pressure of 10 pounds per square inch (psi). The EPA pilot study formed the basis for final design and implementation of groundwater remediation.

Following additional delineation and lithologic investigations in December 2003 the groundwater injection strategy was optimized in June 2004. In general, this involved reorientation of redox barriers, and modification of the chemical reductant. A ratio of 0.1 Molar (M) ferrous sulfate to 0.1 M sodium dithionite was injected into the aquifer where there was not enough naturally occurring iron in the saturated zone to facilitate treatment. Transects that had sufficient naturally occurring iron in the aquifer received a combination of 0.1 sodium dithionite along with 0.4 M potassium carbonate buffer to raise the pH, encourage precipitation of ferrous carbonate (siderite) and improve sorption of ferrous iron.

Injection well installation began in October 2004 and was completed in November 2004. Chemical injection began November 14, 2004, and was completed March 5, 2005. Sodium dithionite buffered with potassium carbonate was injected into 119 wells in Transects 2, 5, 6, and 7. The sodium dithionite/ferrous sulfate solution was injected into 84 wells in Transects 1, 3, 4, and 8.

Both reductants were diluted on-site with municipal water in clean holding tanks designed to minimize aeration and were then injected into the subsurface. The potassium carbonate buffer was blended on-site with the sodium dithionite immediately prior to injection. The system was designed
to regulate the injection flow rate and pressure through a manifold designed to inject up to five wells at the same time. The reductant volumes used to complete the redox barrier zones are summarized below.

Table 2: Reductant Volumes

Chemical Reductant	Diluted Solution (Gallons)	Full-Strength Solution (Gallons)	Number of Injection Wells
Sodium dithionite + potassium carbonate	300,917	37,150	119
Sodium dithionite +ferrous sulfate	182,352	72,941	84
TOTAL	**483,269**	**110,091**	**203**

During implementation it was not possible to effectively inject chemical reductants at the designed quantities into a number of wells in Plumes I, II, III, IV and most of the wells in Plume V. These quantities were not possible due to breakthrough around the well seal or at the ground surface caused by subsurface obstructions, variability, or low permeability aquifer matrix materials. Of the 203 injection wells, 115 successfully accepted 70% or more of the design volume. The remaining locations were evaluated for alternative injection mechanisms.

Because of the difficulties encountered with injecting chemicals into conventional wells at a number of locations, redox barriers and/or PRBs in the form of in situ trenches were evaluated in a pilot test trench. This alternative did not require a change in the fundamental design of chemical reductive barriers or the type of reductants; rather, the delivery mechanism was modified to overcome injection difficulties.

Based on positive results from the pilot test, full-scale trench installation was conducted from December 2 to December 20, 2005. In all, approximately 625 feet of trench was installed. The

trenches were created by first excavating and staging vadose zone soil. Aquifer matrix material in the saturated zone and the chemical reductants were mixed in cells using a trackhoe to distribute the chemicals to a depth of 20 feet bgs and across the entire vertical and horizontal extents of the barrier. The dry forms of the chemicals were applied in the same molar ratios as those used for the injection wells.

For each 50 linear feet of trench, approximately 3,000 pounds (lbs) of ferrous sulfate, 3,500 lbs of sodium hydrosulfite, and 30 CY of #789 crushed (gravel) were used. The addition of gravel facilitated hydraulic interaction and maintained groundwater gradient balance. The trenches were then capped with the vadose zone material removed during trench construction and returned to original grade.

During the five monitoring events from October 2006 to October 2007 (Events 1 through 5), two long term effectiveness groundwater monitoring wells (MW041 and MW047) showed persistent concentrations of total chromium above the cleanup goal (100 µg/l). Total chromium was used as a conservative surrogate measurement for hexavalent chromium in post-treatment samples, due to the matrix interferences with the hexavalent chromium method caused by the chemical reductants in the PRBs. An "X" laboratory data qualifier was used to indicate a hexavalent chromium result had matrix interference. Figure 3 presents a map of monitoring well locations. Historical groundwater results are available in Appendix G. In November 2007 SCDHEC requested the installation and sampling of three new monitoring wells to assess the northern and southern extent of chromium and arsenic in the vicinity of MW041 and MW047. Further, SCDHEC requested a supplemental groundwater treatment to address the areas of residual total chromium above the cleanup goal.

In February 2008, monitoring wells (MW060, MW061, and MW062) were installed and sampled to the north, west, and south of MW041 and MW047. Two subsequent monitoring events (Events 5A and 6) showed elevated total chromium concentrations above the cleanup goal at MW060 and MW061, and low concentrations below the cleanup goal at MW062. Based on this data, a residual chromium plume was identified from MW047 to MW060, with each direction delineated with exception of the northern extent. No monitoring wells were located north of MW060.

To delineate the chromium plume to the north of MW060, a direct push technology (DPT) assessment was conducted in the vicinity. In July 2008 eight, one-inch diameter temporary wells were installed; groundwater was sampled and analyzed for hexavalent and total chromium. Hexavalent and total chromium results from the filtered and unfiltered samples were less than 19 µg/l and below the cleanup goal (100 µg/l). The DPT assessment indicated that the plume was confined to the north by temporary well TW08 and to the northwest by TW01, TW02, TW03, and TW04.

Additionally, groundwater samples collected from MW060, MW061, and MW062 indicated that total chromium concentrations above the cleanup goal were isolated to the vicinity of MW041, MW047, MW060, and MW061.

To address sustained total chromium concentrations above the cleanup goal in the vicinity of MW041, MW047, MW060, and MW061, the EPA and SCDHEC requested a supplemental groundwater treatment similar to the PRBs constructed in 2005.

Additional PRBs were installed by ENTACT and EnSafe from December 19 to December 21, 2008. A summary of the PRB installation is provided below and is presented in the Supplemental Groundwater Treatment Completion Report (EnSafe, February 9, 2009). Supplemental groundwater treatment near monitoring wells MW041, MW047, MW060, and MW061 consisted of the installation of redox zones in the form of PRBs using trenching methods and components similar to those constructed at the Site in 2005 and described in the FRAR. One PRB was installed approximately 25 feet upgradient of each of the aforementioned monitoring wells, intersecting groundwater flow, for a total of four PRBs and 350 linear feet.

Table 3: Supplemental PRB Dimensions and Components

PRB Location	Length (ft)	Depth (ft bgs)	Approximate Width (ft)	Ferrous sulfate (lbs)	Sodium Hydrosulfate (lbs)	#789 Gravel (cubic yard)
MW041	100	18	4	6000	7000	60
MW047	100	18	4	6000	7000	60
MW060	100	18	4	6000	7000	60
MW061	50	18	4	3000	3500	30
TOTALS	350	-	-	21000	24500	210

Notes:
PRB = Permeable reactive barriers
ft = Feet
lbs = Pounds

Soil: On-site Chemical Reduction

Prior to construction activities, a Soil Specific Remedial Action Work Plan (ENTACT, 2004) was prepared and submitted to the EPA and SCDHEC. The work plan addressed chemical reductant selection, soil mixing approach, erosion prevention and sediment controls, site demolition and debris disposal, wastewater management, and site restoration.

Site demolition began shortly after the October 2004 mobilization and included the dismantlement, decontamination, and offsite disposal or recycling of all facility buildings, foundations, former groundwater treatment system components, monitoring wells, concrete pads, rail track, utilities, miscellaneous piping, aboveground storage tanks, underground storage tanks, and miscellaneous debris.

Full-scale soil treatment in the primary soil remediation areas began on March 22, 2005, and was completed on October 13, 2005. Over 160,000 CY of soil was treated in these areas. In general, soil treatment consisted of excavating contaminated soil and mixing with the reductant until the cleanup goal was attained. The soil cleanup goal for hexavalent chromium-impacted soil above the water table was 23 mg/kg. This value was a site-specific concentration calculated during the RI to minimize leaching of hexavalent chromium from soil to groundwater at concentrations above the drinking water MCL of 100 µg/l. The cleanup goal for soil below the water table was a synthetic

precipitation leaching procedure (SPLP) concentration of 100 µg/l. Depending on the percent solids of the material, a SPLP concentration of 100 µg/l is approximately equal to hexavalent chromium concentrations in soil ranging from about 2 to 4 mg/kg.

The water-table elevation was estimated to be 5 feet below final grade. Based on this estimate, only soil with hexavalent chromium SPLP concentrations less than or equal to 100 µg/l could be placed at depths greater than 5 feet bgs. Soil with SPLP concentrations greater than 100 µg/l, but with total hexavalent chromium concentrations less than 23 mg/kg, could be placed within the top 5 feet.

The following details the key activities conducted during soil treatment:

- Site material that had been stockpiled above original site grade in the LFA was excavated and placed in approximate 500-CY stockpiles for treatment. Each stockpile was assigned a unique identifier and marked in the field with labeled pin flags. Stockpiling began on January 17, 2005.

- A full-scale soil treatment demonstration was conducted from February 1 through 12, 2005. Approximately 1,000 CY of above grade material and 1,000 CY of below grade material were mixed with 1% calcium sulfide powder by weight using a pug mill or a tracked excavator.

- The initial demonstration proved unsuccessful and a second demonstration was completed from March 3 through March 21, 2005, using liquid calcium polysulfide (CaS4). Each stockpile was mixed with CaS4 at application rates ranging from 2% to 5% by weight using a pug mill or a tracked excavator.

- Based on the results of the demonstration, full-scale soil treatment of above-grade stockpiles using 3% CaS4 by weight was initiated on March 22, 2005. Mixing was accomplished primarily with a tracked excavator. Above-grade material was excavated to the approximate grade of surrounding areas.

- Treated stockpiles were sampled and analyzed in the field laboratory using HACH test kits for hexavalent chromium. Initially, all treated stockpile samples were also submitted to a laboratory for comparison with results from the field laboratory. After comparing test results on 19 treated stockpile samples, the field laboratory results were deemed adequate for treatment verification and, on March 29, 2005, submission of samples to the laboratory was reduced to 10% as a quality control measure.

- The 500-CY stockpiles that met cleanup goals were consolidated into two larger stockpiles based on hexavalent chromium concentrations. Material with SPLP concentrations less than 100 µg/l was acceptable for placement below 5 feet bgs and was consolidated into one stockpile. Material with SPLP concentrations greater than 100 µg/l, but with total concentrations less than 23 mg/kg, was acceptable for placement in the top 5 feet and was consolidated into a second stockpile. Stockpiles that did not meet cleanup goals were retreated and resampled until the goals were met.

- Below-grade excavation and treatment was initiated in the Casting Bay/Furnace Area on March 30, 2005. Due to the presence of extensive concrete slabs and foundations (many of which required removal), excavation in the area continued periodically and was completed in September 2005.

- Below-grade excavation and treatment was initiated on the west side of the LFA on May 10, 2005. Below-grade material was stockpiled in 500-CY piles and treated with 3% CaS4 by weight. Excavations were completed in 25-foot-square grids to the bottom design elevations. A laser level and survey rod was used to verify that excavation depths were achieved.

- Upon achieving design excavation depths, below-grade excavations were backfilled to pre-excavation grades using treated stockpile material suitable for placement below the water table.

- Excavation and ex situ treatment continued with excavations generally proceeding from north to south working from the west side of the remediation area to the east side.

- Hexavalent chromium-impacted groundwater encountered during excavation was treated with CaS4 prior to backfilling. Excess water was "pushed" ahead of the backfill until the water approached the existing ground surface elevation. Then, the water was either allowed to infiltrate and/or was pumped into a temporary holding pond within the remediation area. Water in the excavations and in the holding pond was periodically sampled for hexavalent chromium concentrations to ensure that adequate reductant had been added and that hexavalent chromium concentrations were less than 100 µg/l.

- Upon completion of soil treatment in October 2005, soil strength enhancement activities were initiated in the LFA. Strength enhancement activities included reworking the upper 2 to 3 feet of treated soil using bulldozers, tracked excavators, and a sheepsfoot compactor. Areas of soft wet soil were excavated or wind-rowed to a depth of 2 to 3 feet, allowed to air dry, and recompacted.

- Verification that adequate soil strength had been achieved was conducted by S&ME of Mount Pleasant, South Carolina, using cone penetration testing. Areas that did not meet strength requirements were mixed with Portland cement and retested. Soil strength enhancement was completed in July 2006.

Soil excavation also occurred at isolated "hot spots" across the Site at depths ranging from 1 to 7 feet bgs and as identified during the RI. Excavated soil from areas outside the soil remediation area was transported to the soil remediation area and stockpiled for treatment and placement. Samples of treated hot spot stockpiles were collected and analyzed for hexavalent chromium in the field laboratory. Ten percent of samples were sent to a laboratory for verification. Approximately 5,000 CY of soil was effectively treated from the "hot spot" areas on-site.

In December 2005, during site grading activities immediately east of the former concentrator area, ENTACT encountered a layer of dense white material suspected to be low carbon slag and furnace rubble from the earliest days of the ferrochromium plant's operation. The material ranged from about 2 feet to 7 feet in thickness and ranged from 1 to 4 feet below existing grades. Initial hexavalent chromium analysis of the material conducted in the field laboratory indicated most of the material to be below the cleanup goal of 23 mg/kg. The low carbon slag/furnace rubble was excavated, placed in approximate 500-CY stockpiles, and sampled. Although only two piles had concentrations greater than the cleanup goal, all piles were treated with 3% CaS4 and placed within the soil remediation area. Approximately 22,500 CY of low carbon slag/furnace rubble was treated and backfilled on-site.

Performance standards and construction Quality Assurance/Quality Control requirements for the soil remedy were detailed in the Pre-and Post Construction Sampling and Analysis Plan and the Construction Quality Assurance Plan (EnSafe, September 4, 2003) in the Final Design for the Macalloy Corporation Site, Charleston, South Carolina. Specific performance standards included verification that soil remediation areas were treated to meet the cleanup goal and placed within the designated limits.

To improve soil geotechnical properties for potential future redevelopment of the Site, the Final Design included stabilization of soil with agents such as Portland cement to achieve unconfined compressive strengths of 50 pounds per square inch in the top foot and 15 pounds per square inch from 1 to 5 feet bgs. After the property was purchased by Ashley II, the strength requirements were modified to support the new redevelopment plans for the Site. The new strength requirements primarily consisted of a cone tip pressure of 25 tons per square foot for the top 5 feet of soil based on cone penetration testing. The new Ashley II requirements also called for a 6-inch layer of clean fill to be placed over treated soil to minimize erosion.

Surface and Storm Water: Comprehensive Storm Water Management

The storm water remedy selected in the ROD focused on mitigating pollutant discharge into Shipyard Creek by constructing a comprehensive storm water management system that meets the requirements of the South Carolina Storm Water Management and Sediment Reduction Act of 1991, as administered by OCRM. The selected storm water remedy, in conjunction with the selected soil and groundwater remedies, was developed to meet the hexavalent chromium cleanup goals in storm water discharges from the Site to Shipyard Creek, and to control sediment (total suspended solids) concentrations in discharge water, thereby reducing arsenic, copper, lead, zinc, and other metals.

Key remedial performance standards for the storm water management system established in the ROD are summarized below:

- Design storm water detention basins and other conveyances to reduce suspended sediment concentrations and handle peak flows from the 10-year, 24-hour storm event.

- Relocate and consolidate storm water outfalls into one discharge.

- Regrade Site topography and construct ponds, berms, and swales to accommodate storm water for future Site use.

A comprehensive storm water management plan, presented in the Final Design, was prepared to meet the ROD performance criteria. In February 2005, the Site was purchased by Ashley II, who later contracted General Engineering and Environmental LLC of Charleston to redesign the storm water management system to accommodate future Site development and the ROD performance criteria. The redesigned plan was approved by the EPA and OCRM on September 9, 2005 and October 13, 2005, respectively. The redesigned storm water plan included the following additional components:

- No storm water from offsite watersheds.
- Underground pipe sections were sealed with rubber gasket joints to minimize the potential for groundwater infiltration.
- Design elements (migration barriers) were added to minimize preferential groundwater flow along underground pipes and into ditches and ponds.

Construction of the storm water management system was considered complete upon signing of the PCOR in September 2006. ENTACT was the primary construction contractor and EnSafe performed daily inspections to verify that ROD-established performance criteria were satisfied. A map of the completed storm water management system is provided in Figure 4 on page 27.

4.3 Operation and Maintenance (O&M)

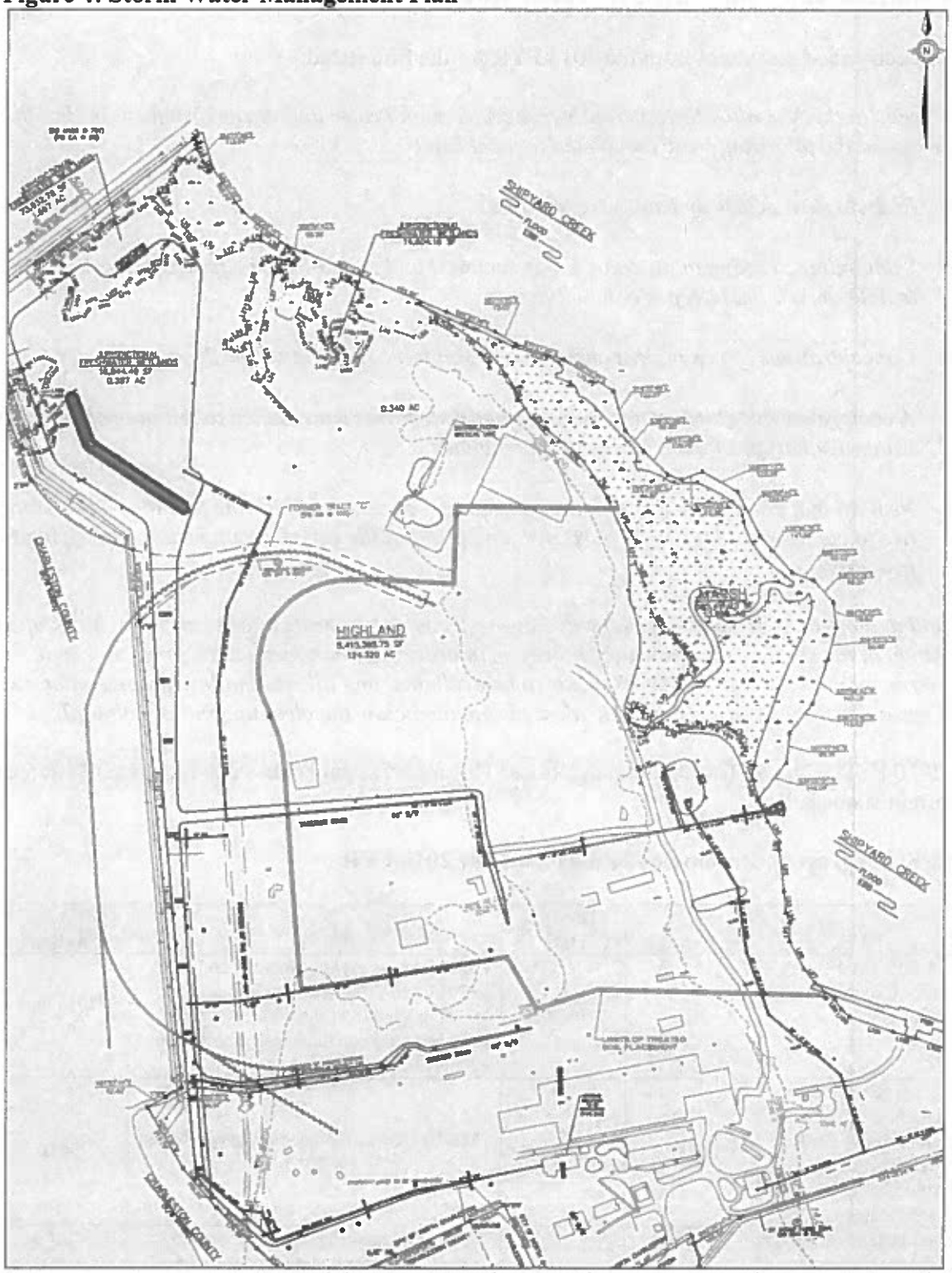
EnSafe Inc., contracted by the former property owner Macalloy, performed remedial effectiveness monitoring through 2014 in accordance with the FRAR (EnSafe 2006) and the First FYR (EPA 2010). EnSafe Inc. is no longer contracted to perform this work. The EPA and SCDHEC are discussing who will perform future on-site O&M/groundwater monitoring.

Over the last five years, groundwater monitoring was reduced from a semi-annual to an annual frequency in 2012, while maintaining the protectiveness and effectiveness of the remedy. See Table 4 on page 27 for O&M costs.

Table 4: Operation and Maintenance Costs

Year	Total Long-term Monitoring Costs	Long-Term Monitoring Activity
2010	$28,000	Groundwater Monitoring
2011	$31,000	$28,000 for groundwater monitoring; $3,000 for tidal creek cap measurements
2012	$14,200	Groundwater monitoring
2013	$17,700	$14,500 groundwater monitoring; $3,200 for tidal creek cap monitoring
2014	$15,000	Groundwater monitoring

Figure 4: Storm Water Management Plan



Disclaimer: This map and any boundary lines within the map are approximate and subject to change. The map is not a survey. The map is for informational purposes only regarding EPA's response actions at the Site.

5.0 Progress Since the Last Five-Year Review

The protectiveness statement from the 2010 FYR for the Site stated:

The remedy at the Macalloy Site currently protects human health and the environment in the short-term because the following were completed to meet RAOs:

- *Radiological debris and soil was removed.*
- *Contaminated sediment in Zone A was removed and a clean sand cap was constructed to isolate the minimal deeper contaminants.*
- *Concentrations of hexavalent chromium in soil were reduced below 23 mg/kg.*
- *A comprehensive storm water management system was constructed to mitigate offsite storm water discharges of toxic inorganic compounds.*
- *Institutional controls and restrictive covenants were executed for the Site that limit future use to commercial/industrial purposes, and prohibit the use of groundwater underlying the property.*

The soil and ongoing groundwater remedy have reduced the highest concentrations of hexavalent chromium in the shallow groundwater; however, in order for the remedy to be protective in the long-term, monitoring well MW054R needs to be evaluated and all site shallow groundwater must show sustained concentrations of hexavalent chromium below the cleanup goal of 100 µg/l.

The 2010 FYR included five recommendations. This report summarizes each recommendation and its current status below.

Table 5: Progress on Recommendations from the 2010 FYR

Recommendations	Party Responsible	Milestone Date	Action Taken and Outcome	Date of Action
Zone A 001 Tidal Creek – Monitor Cap thickness in 2011 and 2013	PRP	7/30/2015	Cap thickness measurements conducted in 2011 and 2013 found only minimal losses to sand over the geotextile liner. No additional cap thickness monitoring events planned	2011 and 2013
Locate, assess condition, and re-sample MW054R if possible. Raise flush mount casing to accommodate future road elevation changes.	PRP	7/30/2008	MW054R was replaced by MW054RR in 2010.	2010
Evaluate vegetation and sediment buildup in the storm water management system and clean if necessary.	PRP	7/1/2015	The storm water management system is visually inspected annually coinciding with the annual groundwater sampling event.	2014

Recommendations	Party Responsible	Milestone Date	Action Taken and Outcome	Date of Action
Continue long term effectiveness groundwater monitoring on semi-annual basis for next two years and then annually thereafter, depending on results. MW049, MW050, MW051, MW052 and MW059 will be dropped from the long-term monitoring network, but will not be abandoned. The following 16 wells were recommended for the sampling network: MW040 to MW048, MW054R, MW055, MW056, MW057R, MW060 MW061 and MW062.	PRP	6/1/2015	The effectiveness of annual sampling and the number and placement of wells is evaluated after every sampling event.	Last annual groundwater sampling event was in 2014.

6.0 Five-Year Review Process

6.1 Administrative Components

The EPA Region 4 initiated the FYR in March 2015 and scheduled its completion for August 2015. The EPA RPM Craig Zeller led the EPA Site review team, which also included the EPA legal and community involvement personnel. The SCDHEC FYR coordinator was Robert Cole, and the SCDHEC team included community involvement coordinator (CIC), Donna Moye. The review schedule consisted of the following activities:

- Community notification
- Document review
- Data collection and review
- Site inspection
- Local interviews
- FYR Report development and review

6.2 Community Involvement

In April 2015, SCDHEC published a public notice in *The Post and Courier* newspaper in Charleston, SC announcing the commencement of the FYR process for the Site, providing contact information for RPM Craig Zeller and CIC Donna Moye and inviting community participation. The press notice is available in Appendix B. No one contacted the EPA as a result of the advertisement.

The final FYR Report will be made available to the public upon completion. Copies of the document will be placed in the designated Site repository: Charleston County Main Library, located at 68 Calhoun Street in Charleston, SC.

6.3 Document Review

ARARs Review

CERCLA Section 121(d)(1) requires that Superfund remedial actions attain "a degree of cleanup of hazardous substance, pollutants, and contaminants released into the environment and of control of further release at a minimum which assures protection of human health and the environment." The remedial action must achieve a level of cleanup that at least attains those requirements that are legally applicable or relevant and appropriate.

- Applicable requirements are those cleanup standards, standards of control and other substantive requirements, criteria or limitations promulgated under federal environmental or state environmental or facility siting laws that specifically address a hazardous substance, remedial action, location or other circumstance found at a CERCLA site.

- Relevant and appropriate requirements are those standards that, while not "applicable," address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site. Only those state standards more stringent than federal requirements may be applicable or relevant and appropriate.

- To-Be-Considered criteria are non-promulgated advisories and guidance that are not legally binding, but should be considered in determining the necessary remedial action. For example, To-Be-Considered criteria may be particularly useful in determining health-based levels where no ARARs exist or in developing the appropriate method for conducting a remedial action.

Chemical-specific ARARs are health- or risk-based numerical values or methodologies which, when applied to site-specific conditions, result in the establishment of numerical values. These values establish an acceptable amount or concentration of a chemical that may remain in, or discharged to, the ambient environment. Examples of chemical-specific ARARs include MCLs under the federal Safe Drinking Water Act and ambient water quality criteria enumerated under the federal Clean Water Act.

Action-specific ARARs are technology- or activity-based requirements or limits on actions taken with respect to a particular hazardous substance. These requirements are triggered by a particular remedial activity, such as discharge of contaminated groundwater or in-situ remediation.

Location-specific ARARs are restrictions on hazardous substances or the conduct of the response activities solely based on their location in a special geographic area. Examples include restrictions on activities in wetlands, sensitive habitats and historic places.

Remedial actions are required to comply with the chemical-specific ARARs identified in the ROD. In performing the FYR for compliance with ARARs, only those ARARs that address the protectiveness of the remedy are reviewed.

The 2002 ROD for the Site identified ARARs for the selected response actions. These included (but were not limited to) the following:

- CERCLA (104, 106, 107, 120, 121, 122)
- Safe Water Drinking Act MCLs (40 CFR 141.11-141.16) and MCLGs (40 CFR 141.50-141.51)
- Clean Water Act Federal Water Quality Criteria (51 Federal Register 43665)
- South Carolina Drinking Water Regulations (SC R.61-58.5)
- South Carolina Water Classification and Standards (SC R.61-68)
- Fish and Wildlife Coordination Act (16 U.S.C. 661 et seq.) (33 CFR Part 320 to Part 330; 40 CFR Part 6.302)
- RCRA Location Requirements (40 CFR Part 264.18)
- Ocean and Coastal Resource Management (SC R 30)
- Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities: Location Standards (SC R 61-79.264.18)
- Hazardous Waste Management Location Standards (SC R 61-104)
- CERCLA 121 (d)(3)
- CWA National Pollutant Discharge Elimination System (NPDES) (40 CFR 122, 125, 129, 136)
- CWA Wetlands regulations Part 404 (40 CFR 230)

The ARARs identified in the 2002 ROD were reviewed and no changes to existing ARARs or new ARARs were identified which have a significant effect on the protectiveness of the selected remedies. Some chemical or media specific ARARs are discussed below.

Groundwater ARARs

In South Carolina, all groundwater is classified Class GB, which meets the definition of underground sources of drinking water (R.61-68, WATER CLASSIFICATIONS &

STANDARDS, Effective June 22 , 2012). The objective of the groundwater remedy is to prevent exposure to chromium (VI) concentrations in shallow groundwater above the MCL specified by the Safe Drinking Water Act for total chromium (100 µg/L) and to minimize the migration of chromium (VI) from groundwater to Shipyard Creek.

Table 6: Previous and Current ARARs for Groundwater COCs

OU	Parameter	Cleanup Goal (µg/l)	Based On	2015 ARAR Notes
1	Chromium (VI)	100	MCL for total chromium	No change in MCL

Soil ARARs

The RAO of the EPA's selected soil remedy was to prevent the leaching of chromium (VI) from site soil to groundwater at concentrations exceeding the groundwater cleanup level of 100 µg/L for total chromium. A soil cleanup level of 23 mg/kg was calculated based on site-specific leaching ratios and the groundwater cleanup level.

Radiological Materials ARARs

The RAO of the EPA's selected remedy was to prevent exposure to radiation levels greater than twice the measured background concentration (12 µR/hr).

Sediment ARARs

The objective of the sediment remedy is to eliminate exposure to benthic organisms from unacceptable concentrations of chromium, nickel, and zinc. Based on the results of the Ecological Risk Assessment, the area of greatest ecological concern was defined as the 001 tidal creek. The EPA's selected remedy was sediment removal with upland disposal.

A derivation of sediment concentrations expected to provide adequate protection of ecological receptors at the Macalloy Site is presented in Table 7 below:

Table 7: Derivation of Sediment Concentration

Contaminant	Protective Range (mg/kg)
total chromium	219 – 258
nickel	33 – 35.7
zinc	132 – 163

Institutional Control Review

Charleston County identifier numbers for the parcels associated with the Site are: 4660000010, 4660000063, 460000060, 4660000009, 4660000061, 4660000065, and 4660000066 which are

owned by Shipyard Creek Associates; and parcel 4660000062, which is owned by Sonoco Recycling LLC.

As a part of the site-wide remedy, institutional controls and restrictive covenants were executed for the Site that limit future use to commercial/industrial purposes, and prohibit the use of groundwater underlying the property. These institutional controls were approved by the EPA and SCDHEC in May 2006 and have been officially recorded with the Charleston Register of Mesne Conveyance Office. A copy of the restrictive covenant is provided in Appendix F. Current and future land use for the Site is industrial and commercial use only.

Table 8 lists the institutional controls associated with areas of interest at the Site. Figure 5 shows the location of the parcel boundaries associated with the Site.

Table 8: Institutional Control (IC) Summary Table

ICs Needed	ICs Called for in the Decision Documents	Impacted Parcel	IC Objective	Instrument in Place
YES	YES	4660000010	Limit future use to commercial/ industrial purposes, and prohibit the use of groundwater underlying the property.	Yes
YES	YES	4660000063	Limit future use to commercial/ industrial purposes, and prohibit the use of groundwater underlying the property.	Yes
YES	YES	4660000060	Limit future use to commercial/ industrial purposes, and prohibit the use of groundwater underlying the property.	Yes
YES	YES	4660000009	Limit future use to commercial/ industrial	Yes

			purposes, and prohibit the use of groundwater underlying the property.	
YES	YES	4660000062	Limit future use to commercial/ industrial purposes, and prohibit the use of groundwater underlying the property.	Yes
YES	YES	4660000061	Limit future use to commercial/ industrial purposes, and prohibit the use of groundwater underlying the property.	Yes
YES	YES	4660000065	Limit future use to commercial/ industrial purposes, and prohibit the use of groundwater underlying the property.	Yes
YES	YES	4660000066	Limit future use to commercial/ industrial purposes, and prohibit the use of groundwater underlying the property.	Yes

TBD = To Be Determined
NA = Not Applicable

Figure 5: Institutional Control Base Map

Parcel 4660000062 owned by Sonoco Recycling LLC. The rest are owned by Shipyard Creek Associates.
All parcels shown are subject to limiting future use to commercial/industrial purposes,
and prohibiting the use of groundwater underlying the property.

NORTH

Macalloy Corporation NPL Site

Disclaimer: This map and any boundary lines within the map are approximate and subject to change. The map is not a survey. The map is for informational purposes only regarding EPA's response actions at the Site

6.4 Data Review

The current groundwater monitoring program includes annual collection of samples from 16 shallow monitoring wells and analysis of total chromium, hexavalent chromium, and arsenic to gauge effectiveness of the remedy. Hexavalent chromium had a RAO established of 100 µg/l in the 2002 ROD. As specified in the Final Removal Action Report (EnSafe 2006), the Long Term Monitoring (LTM) program uses total chromium as a conservative, surrogate measurement for the presence of hexavalent chromium in the groundwater. Chemical reductants placed in the subsurface during the remedial action generate matrix interferences with the hexavalent chromium analytical method, thereby requiring significant dilutions/increases in the reporting limit. Due to matrix interference, subsequent discussion of results will focus largely on total chromium.

Per the FRAR (EnSafe 2006), although concentrations of some heavy metals, including arsenic, temporarily increased following the remedial action, these concentrations were expected to decrease over time as chromium concentrations and oxidation-reduction potential (ORP) stabilize. As documented in the Optimized Remedial Groundwater Program Technical Memorandum (EnSafe, January 2008) and previous LTM reports, the metals barium, cadmium, lead, mercury, selenium, and silver stabilized at low levels, and thus, were eliminated from the LTM program. Due to its continued presence in several wells, arsenic remains in the groundwater sampling program. However, elevated arsenic concentrations are mostly confined to the treatment zone and are expected to decrease as geochemistry stabilizes.

Quarterly and semi-annual groundwater monitoring was performed subsequent to remedial action through October 2011. Following the semi-annual monitoring, annual monitoring was performed through October 2014, as recommended by the EPA's First FYR (2010). Historical groundwater monitoring results are available in Appendix G.

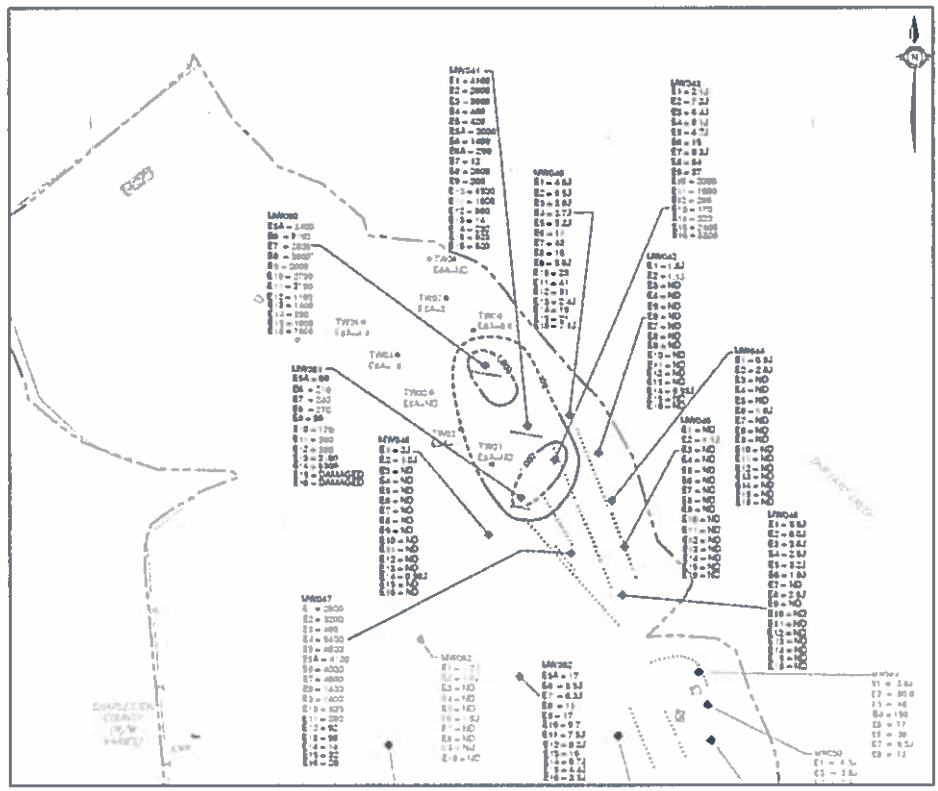
Based on depth-to-water measurements and groundwater elevation calculations, the flow of shallow groundwater in October 2014 was similar to historical monitoring events with a radial pattern to Shipyard Creek (north and east), and northwest.

During the latest sampling event in 2014, total chromium was reported below the cleanup goal of 100 µg/l at 10 of 13 monitoring wells (three wells were inaccessible during the sampling event). Total chromium was measured above the cleanup goal at three (MW041, MW043, and MW060) monitoring wells with a maximum concentration of 3,300 µg/l at MW043. Based on the results, the horizontal extent of the contaminant plume boundary above the cleanup goal to the north, east, and west of MW060 is unknown, as shown on Figure 6.

Although total chromium remained above the cleanup goal at MW041, MW043, and MW060, an overall decreasing trend was observed at MW041 and MW060 since monitoring began. Total chromium concentrations at MW043 have increased by more than three orders of magnitude since Event 1 to a historical high of 3,300 µg/L. MW061 was damaged prior to sampling in 2013 and has not been repaired or replaced. No groundwater samples could be collected. During the

last sampling event for MW061 in 2012, total chromium was above the cleanup goal with a concentration of 6,300 µg/L and with an increasing historical trend.

Figure 6: Total Chromium in Groundwater (with inferred isoconcentrations)



NOTES:

E16=17 EVENT 16 TOTAL CHROMIUM CONCENTRATION OF 17ppb
RED TEXT INDICATES CONCENTRATION EXCEEDED THE CLEANUP GOAL OF 100ppb
ND NOT DETECTED
* = CONCENTRATION CORRECTED
J = ESTIMATED CONCENTRATION
NF = NOT FOUND

LEGEND:

TOTAL CHROMIUM ISOCONCENTRATION (DASHED WHERE INFERRED)
TW05 TEMPORARY GROUNDWATER MONITORING WELL (2008)
MW060 LONG TERM GROUNDWATER MONITORING WELL – ACTIVE SAMPLING
MW059 LONG TERM GROUNDWATER MONITORING WELL – INACTIVE SAMPLING

GROUNDWATER REMEDIAL ACTION:

• • • • • • INJECTION OR TRENCHING 2004–2005, 2008

Disclaimer: This map and any boundary lines within the map are approximate and subject to change. The map is not a survey. The map is for informational purposes only regarding EPA's response actions at the Site.

6.5 Site Inspection

On February 25, 2015, the following participants performed the site inspection: Robert Cole, Tim Kadar, SCDHEC; Craig Zeller, EPA RPM; Chad Tripp, EnSafe.

Participants toured the Site and observed monitoring wells and adjacent properties. Monitoring wells were all secured and labeled, except for MW061 which was damaged. The Site is well maintained. The completed site inspection checklist is included in Appendix D. Photographs from the inspection are included in Appendix E.

The public notice for the FYR was published in the Monday, April 6, 2015 edition of The Post & Courier newspaper, in Charleston.

After the site inspection, SCDHEC staff visited the designated site repository, Charleston County Main Library, 68 Calhoun Street, Charleston, SC as part of the site inspection. Staff determined that the Site documents were up to date through the ROD.

The Community Involvement Summary is located in Appendix C.

6.6 Interviews

The FYR process included interviews with parties affected by the Site, such as regulatory agencies involved in site activities or aware of the Site. The purpose was to document the perceived status of the Site and any perceived problems or successes with the phases of the remedy implemented to date. All of the interviews were completed by email or phone after the site inspection. The interviews are summarized below. Appendix C provides the complete interviews below and additional interviews that were conducted as a part of the FYR. Also, the Community Involvement Summary is located in Appendix C.

Craig Zeller: Craig Zeller is the EPA Remedial Project Manager for the Site. Mr. Zeller completed his interview July 10, 2014 via email. Mr. Zeller stated that he was satisfied with the cleanup and reuse as a port facility is pending. Part of the property is already in reuse. He is not aware of any complaints. He would like to see additional injections to reduce chromium concentrations in isolated areas of contamination that remain.

Chad Tripp: Chad Tripp is the EnSafe representative for the Site. Mr. Tripp completed his interview May 1, 2015, via email. Mr. Tripp stated that remedial implementation and effectiveness have met expectations, and the Site is now ideal for commercial reuse/development. He also stated that contaminant levels have significantly reduced over time as a result of the remedial action. An isolated pocket of residual contamination remains in the shallow groundwater in the vicinity of MW60 and should be monitored until remedial goals are achieved. EnSafe Inc., contracted by the former property owner Macalloy, performed remedial effectiveness monitoring through 2014 in accordance with the Final Removal Action Report (EnSafe 2006) and the First Five Year Review Report (EPA 2010). EnSafe Inc. is no longer contracted to perform this work, and is not knowledgeable of who will perform future on-site

O&M/groundwater monitoring. Mr. Tripp stated that he was not aware of any O&M difficulties in the last five years.

Charles Williams: Charles Williams is the SCDHEC representative for the Site. Mr. Williams completed his interview on May 1, 2015, via email. Overall the remedy is performing as expected, however, DHEC has recommended re-injection occur in a couple of problem spots where contamination seems to persist and that damaged monitoring wells be abandoned and replaced. The reuse of the Site is going well. DHEC had the following comments from the review of the 2014 Annual Long-Term monitoring Report:

1. For future monitoring events plans should be made with the recycling facility to make sure that wells MW054RR, MW056, and MW058 are accessible to be sampled. If the next two sampling event results are below the 100ppb cleanup goal SCDHEC recommends abandonment of these wells.

2. SCDHEC agrees with the recommendation to abandon and replace MW061.

3. SCDHEC would like to discuss the possibility of reinjection near wells MW060 and MW041 or the installation of new monitoring wells down gradient to ensure contaminated groundwater is not impacting Shipyard Creek.

Wannette Mallette: Wannette Mallette is a project manager for the City of North Charleston in the Planning and Zoning Department. She completed her interview via email on May 11, 2015. She was aware of cleanup activities at the Site. She stated that EPA might convey site-related information in the future by placing a public notice in the local paper of general circulation (if it has not done so), using an email-marketing service, or generating fact sheets for distribution to the stakeholder list. She also stated that EPA had not kept her informed about on-going remediation activities and milestones. She stated that there had been reports of vandalism and trespassing on the property. She stated that the Macalloy Site is now owned by Branch Properties, LLC who intend to develop a functionality "on dock" state-of-the-art intermodal facility on a part of the Macalloy property to serve the Navy Base Container Terminal as well as the other terminals in the Port of Charleston. The reminder of the land at Macalloy will be developed for distribution centers, warehouses, and related logistics uses.

7.0 Technical Assessment

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

The review of documents, ARARs, risk assumptions and the site inspection indicate that the remedy is functioning as intended by the 2002 ROD.

On-site soil was remediated to reduce levels of chromium (VI) that could leach to groundwater or surface water. The remedial goal of 23 mg/kg was obtained using on-site chemical reduction and stabilization/solidification via ex situ treatment with mechanical mixing.

All soil and debris that were identified in the Final Design with elevated levels of gamma radiation was excavated and disposed of offsite at the time of the remedial action.

Based on the performance standards presented in the FRAR, and data from the 001 Tidal Creek Cap thickness monitoring reports, the remedial action continues to operate and function as designed. Benthic organism exposure to contaminated sediment in the Zone A 001 Tidal Creek was mitigated by the excavation and disposal of sediment to a depth of 24 inches, and with the placement of a geotextile and 18 inch thick sand cap. From 2006 to 2008, yearly tidal creek cap thickness reports indicated that a 16 foot portion of the 18-inch thick engineered sand/geotextile fabric cap was eroded and needed repair. In December 2008, EnSafe and ENTACT repaired the cap by re-securing the geotextile fabric and adding clean sand with non-mechanical methods. Cap thickness monitoring in 2011 and 2013 found only minimal sand losses. No additional tidal creek cap thickness monitoring events are currently planned.

During the latest groundwater sampling event in 2014, total chromium was reported below the cleanup goal of 100 micrograms per liter (µg/L) at 10 of 13 monitoring wells. Total chromium was measured above the cleanup goal at three (MW041, MW043, and MW060) monitoring wells with a maximum concentration of 3,300 µg/L at MW043. The horizontal extent of the contaminant plume boundary above the cleanup goal to the north, east, and west of MW060 is unknown.

Although total chromium remained above the cleanup goal at MW041, MW043, and MW060, an overall decreasing trend was observed at MW041 and MW060 since monitoring began. Total chromium concentrations at MW043 have increased by more than three orders of magnitude since Event 1 to a historical high of 3,300 µg/L. MW061 was damaged prior to sampling in 2013 and has not been repaired or replaced. No groundwater samples could be collected. During the last sampling event for MW061 in 2012, total chromium was above the cleanup goal with a concentration of 6,300 µg/L and with an increasing historical trend. Overall, the remedy is functioning well. There remains a small area of elevated chromium that needs to be addressed.

7.2 Question B: Are the exposure assumptions, toxicity data, cleanup levels and RAOs used at the time of remedy selection still valid?

There have been no changes to exposure assumptions, or RAOs at the Site.

Soil
On-site soil was remediated to reduce levels of chromium (VI) that could leach to groundwater or surface water. The remedial goal of 23 mg/kg was obtained using on-site chemical reduction and stabilization/solidification via ex situ treatment with mechanical mixing.

Radioactive Materials
The RAO of the EPA's selected remedy was to prevent exposure to radiation levels greater than twice the measured background concentration (12 μR/hr). All soil and debris that were identified in the Final Design with elevated levels of gamma radiation was excavated and disposed of offsite at the time of the remedial action.

Groundwater
The RAO for groundwater remedy was to prevent exposure to chromium (VI) concentrations in shallow groundwater above the MCL specified by the Safe Drinking Water Act for total chromium (100 μg/l) and to minimize the migration of chromium (VI) from groundwater to Shipyard Creek. There was no change to the MCL for total chromium so the RAO remains valid and protective.

Sediment
The EPA's selected remedy was sediment removal with upland disposal based on values shown in Table 7, page 32. Sediment removal began on December 6, 2004, and was completed on December 23, 2004. Geotextile installation and placement of clean sand backfill began on December 28, 2004, and was completed on January 29, 2005.

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

No other information has come to light that could call into question the protectiveness of the remedy.

7.4 Technical Assessment Summary

The review of documents, ARARs, risk assumptions and the site inspection indicate that the remedy is functioning as intended by the 2002 ROD. RAOs selected for the Site are still valid and have been met for the radiological debris area, storm water, site-wide soil. Zone A Tidal Creek sediment, and Zone C sediment. The ongoing groundwater remedy via in situ chemical reduction is functioning and has effectively reduced most total chromium concentrations below the cleanup goal. The groundwater remedy has limited contaminate flow to Shipyard Creek. A small area with residual chromium above the cleanup goal remains.

There have been no changes in exposure assumptions, toxicity data, risk assessment methods, and cleanup goals used at the time of remedy selection that would affect the protectiveness of the remedy. Current and planned future land use has not changed, nor is there any other information that calls into question the protectiveness of the site-wide, comprehensive remedy.

8.0 Recommendations and Follow-up Actions

Table 9 provides recommendations to address the current site issues.

Table 9: Issues, Recommendations and Follow-ups

Issue	Recommendation / Follow-Up Action	Party Responsible	Oversight Agency	Milestone Date	Affects Protectiveness?	
					Current	Future
MW061 has been damaged and is inaccessible.	Abandon and replace MW061	PRP	EPA and State	08/01/2017	No	Yes
Total chromium concentrations at MW041, MW043, MW060, (and previously at MW061) remain elevated above the RAO of 100 µg/l.	Supplemental groundwater remediation similar to the in-situ chemical reduction completed in 2005 and 2008.	PRP	EPA and State	04/01/2019	No	Yes
Current groundwater data suggests that the horizontal extent of the contaminant plume boundary above the RAO to the north, east, and west of MW060 is unknown.	Evaluate the need for additional monitoring locations (temporary or permanent) to delineate the remaining area of elevated chromium in groundwater. This should be done prior to any supplemental remediation.	PRP	EPA and State	08/01/2017	No	Yes
EnSafe is no longer contracted to perform the annual groundwater monitoring.	Identify an alternate mechanism to obtain annual groundwater monitoring.	EPA and State	EPA and State	2/01/2016	No	Yes

The following item, though not expected to affect protectiveness, warrant additional follow-up:

> *Future groundwater monitoring events plans should be made with the adjacent recycling facility to make sure that wells MW054RR, MW056, and MW058 are accessible to be sampled. If the next two sampling event results are below the RAO, abandonment of these wells should be discussed.*

9.0 Protectiveness Statements

The remedy at the Site currently protects human health and the environment in the short-term because the following were completed to meet RAOs:

- Radiological debris and soil was removed.
- Contaminated sediment in Zone A was removed and a clean sand cap was constructed to isolate the minimal deeper contaminants.
- Concentrations of hexavalent chromium in soil were reduced below 23 milligrams per kilograms.
- A comprehensive storm water management system was constructed to mitigate offsite storm water discharges of toxic inorganic compounds.
- Institutional controls and restrictive covenants were executed for the Site that limit future use to commercial/industrial purposes, and prohibit the use of groundwater underlying the property.

Cleanup goals established by the ROD for storm water, sediment, and marsh restoration have been met; therefore, monitoring for these components was discontinued, as recommended in the First Five-Year Review Report (U.S. EPA 2010). The First Five-Year Review Report also recommended thickness measurements of the engineered tidal creek cap be completed in 2011 and 2013. The additional measurements found negligible sand loss and parts of the former channel were indistinguishable from the surrounding tidal marsh. No additional tidal creek cap thickness monitoring events are planned.

The soil and ongoing groundwater remedy have reduced the highest concentrations of hexavalent chromium in the shallow groundwater; however, in order for the remedy to be protective in the long-term, all site shallow groundwater must show sustained concentrations of hexavalent chromium below the cleanup goal of 100 µg/l. Based on the latest groundwater monitoring results, a small area of groundwater contaminated above the cleanup goal still exists.

10.0 Next Review

The next FYR will be due within five years of the signature/approval date of this FYR.

Appendix A: List of Documents Reviewed

First Five Year Review; Macalloy Corporation Site, Charleston, South Carolina, EnSafe, September 1, 2010.

Groundwater

First Quarter Long-Term Groundwater Monitoring Report; Macalloy Corporation Site, Charleston, South Carolina, EnSafe, January 17, 2007
Event 2 Long-Term Groundwater Monitoring Report; Macalloy Corporation Site, Charleston, South Carolina, EnSafe, March 27, 2007
Event 3 Long-Term Groundwater Monitoring Report; Macalloy Corporation Site, Charleston, South Carolina, EnSafe, June 28, 2007
Long-Term Groundwater Monitoring Report Event 4, Macalloy Corporation Site, Charleston, South Carolina, EnSafe, September 2007
Long-Term Groundwater Monitoring Report Event 5, Macalloy Corporation Site, Charleston, South Carolina, EnSafe, December 21, 2007
Optimized Remedial Groundwater Program Technical Memorandum, Macalloy Corporation NPL Site, Charleston, South Carolina, EnSafe, January 8, 2008
Long-Term Groundwater Monitoring Report Interim Event 5A Macalloy Corporation Site, Charleston, South Carolina, EnSafe, March 4, 2008
Long-Term Groundwater Monitoring Report Event 6, Macalloy Corporation Site, Charleston, South Carolina, EnSafe, May 15, 2008
Delineation of Potential Plume in the Vicinity of MW060 Technical Memorandum, Optimized Remedial Groundwater Program, Macalloy Corporation NPL Site, Charleston, South Carolina, EnSafe, June 20, 2008
Supplemental Groundwater Treatment at MW041, MW047, MW060 and MW061 Technical Memorandum, Macalloy Corporation NPL Site, Charleston, South Carolina, EnSafe, September 29, 2008
001 Tidal Creek- Work Plan to Repair Cap Near Transect 3 Technical Memorandum, Macalloy Corporation NPL Site, EnSafe, December 1, 2008
001 Tidal Creek Cap Repair Completion Report Technical Memorandum, Macalloy Corporation NPL Site, EnSafe, February 9, 2009
Supplemental Groundwater Treatment Completion Report, Macalloy Corporation NPL Site, EnSafe, February 9, 2009
Long-Term Groundwater Monitoring Report - Event 7 Macalloy Corporation Site, Charleston, South Carolina, EnSafe, March 18, 2009
Long-Term Groundwater Monitoring Report Event 8, Macalloy Corporation Site, Charleston, South Carolina, EnSafe, August 24, 2009, EnSafe, (2007, November).
Long-Term Groundwater Monitoring Report Event 9,Macalloy Corporation Site, Charleston, South Carolina, EnSafe, November 23, 2009.
Long-Term Groundwater Monitoring Report Event 10,Macalloy Corporation Site, Charleston, South Carolina, EnSafe, June 18, 2010.
Long-Term Groundwater Monitoring Report Event 11,Macalloy Corporation Site, Charleston, South Carolina, EnSafe, January 28, 2011.
Long-Term Groundwater Monitoring Report Event 12,Macalloy Corporation Site, Charleston, South Carolina, EnSafe, August 16, 2011.

Groundwater (continued)

Long-Term Groundwater Monitoring Report Event 13,Macalloy Corporation Site, Charleston, South Carolina, EnSafe, January 21, 2012.

Long-Term Groundwater Monitoring Report Event 14,Macalloy Corporation Site, Charleston, South Carolina, EnSafe, October 2012.

Long-Term Groundwater Monitoring Report Event 15,Macalloy Corporation Site, Charleston, South Carolina, EnSafe, October 2013.

Long-Term Groundwater Monitoring Report Event 16,Macalloy Corporation Site, Charleston, South Carolina, EnSafe, October 2014.

Tidal Marsh

Year 2 Marsh Restoration Monitoring, Macalloy Corporation Site, Charleston, South Carolina, EnSafe, July 27, 2007

Year 3 Marsh Restoration Monitoring, Macalloy Corporation Site, Charleston, South Carolina, EnSafe, July 30, 2008

Zone A 001 Tidal Creek

Tidal Creek Year 1 Annual Cap Monitoring Report, Macalloy Corporation Site, Charleston, EnSafe, June 29, 2006

Year 2 Tidal Creek Cap Monitoring Report, Macalloy Corporation Site, Charleston, South Carolina , EnSafe, July 27, 2007

Year 3 Tidal Creek Cap Monitoring Report, Macalloy Corporation Site, Charleston, South Carolina , EnSafe, June 30, 2008

Year 4 Tidal Creek Cap Monitoring Report, Macalloy Corporation Site, Charleston, South Carolina, EnSafe, September 10, 2009

Year 5 Tidal Creek Cap Monitoring Report, Macalloy Corporation Site, Charleston, South Carolina, EnSafe, 2010.

Year 6 Tidal Creek Cap Monitoring Report, Macalloy Corporation Site, Charleston, South Carolina, EnSafe, August 2011.

Tidal Creek Cap Monitoring Report (along with LTM Groundwater report), Macalloy Corporation Site, Charleston, South Carolina, EnSafe, March 2014.

Zone C sediment

Zone C Sediment Post-Construction Monitoring Report (Event 1); Macalloy Corporation Site, Charleston, South Carolina, EnSafe, December 8, 2006

Zone C Sediment Post-Construction Monitoring Report (Event 2); Macalloy Corporation Site, Charleston, South Carolina, EnSafe, February 10, 2009

Zone C Sediment Post-Construction Monitoring Report (Event 3); Macalloy Corporation Site, Charleston, South Carolina, EnSafe, December 8, 2009

Appendix B: Press Notice

Public Notice

Macalloy Corporation Superfund Site
North Charleston, Charleston County, South Carolina

The U.S. Environmental Protection Agency (EPA) and the South Carolina Department of Health and Environmental Control (DHEC) are conducting a 5-year review of the Macalloy Corporation Superfund site located at 1800 Pittsburgh Avenue in North Charleston, SC. The facility manufactured ferrochromium alloy from 1941 to 1998. The site was placed on the National Priorities List (NPL) in February 2000. Clean up work started at the site in October 2004 and was completed in September 2006. The First 5-Year Review for the site was completed in September 2010. Activities conducted at the site since that time have primarily involved groundwater and sediment monitoring.

The purpose of the review is to evaluate remedial activities of the past five years and make sure that the cleanup continues to protect human health and the environment. During the review, DHEC staff will conduct interviews with local residents, officials, and others who are familiar with the site. We value input about site conditions and want to hear any concerns of the local community. **You are encouraged to participate in the review by contacting us with your comments or questions through May 6, 2015.**

The 5-year review process is expected to be complete in summer 2015, at which time a report will be written on our findings. Any comments received about the site will be summarized in the report. The report will be available on EPA's website and at the Charleston County Main Library at 68 Calhoun Street in Charleston. For more information about the Macalloy Corporation site, please visit:
http://www.epa.gov/region4/superfund/sites/npl/southcarolina/macalsc.html.

For comments, questions, or to participate in an interview, please contact:

Technical Comments: Craig Zeller, EPA Project Manager, at (404) 562-8827, or by e-mail at zeller.craig@epa.gov.

Community Involvement: Donna Moyc, DHEC Community Liaison, at (803) 898-1382, or by e-mail at moyedd@dhec.sc.gov.

Please share this with others you know who might be interested.

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South Carolina Department of Health and Environmental Control

Appendix C: Community Involvement Summary Package and Interview Forms

Superfund Five-Year Review - Community Involvement Summary
July 2015

Macalloy Corporation
North Charleston, Charleston County, South Carolina

Staff of the South Carolina Department of Health and Environmental Control (DHEC) conducted this second Superfund Five-Year Review (FYR) of the Macalloy Corporation site located at 1800 Pittsburgh Avenue in North Charleston (Charleston County), South Carolina. On April 6, 2015, DHEC placed a public notice in *The Post and Courier* newspaper in Charleston, South Carolina, announcing the beginning of the FYR process for the site. The notice requested community involvement in the FYR process and provided contact information for EPA Remedial Project Manager (RPM), Craig Zeller, and DHEC Public Participation Coordinator (PPC), Donna Moye. The public comment period closed on May 6, 2015. DHEC did not receive any public comment in response to the public notice. The public notice is attached.

The Macalloy Corporation manufactured ferrochromium alloy from 1941 to 1998. The site was placed on the National Priorities List (NPL) in February 2000. Cleanup work started at the site in October 2004 and was completed in September 2006. The first Five-Year Review for the site was completed in September 2010. Activities conducted at the site since that time have primarily involved groundwater and sediment monitoring. A 20-acre area of groundwater contamination is confined within the site boundary. All residents and businesses in the area receive water from the public water system.

As part of this FYR, DHEC PPC Donna Moye notified four key members of the Lowcountry Alliance for Model Communities (LAMC). LAMC was formed in 2005 and has been comprised of five presidents and other leaders representing seven of the most economical distressed neighborhoods in the City of North Charleston, including Union Heights, a neighborhood with low-income and minority residents located just west of the Macalloy site, past the CSX rail line. Staff of DHEC and EPA's Office of Environmental Justice & Sustainability have worked with LAMC on various environmental issues in the past. The LAMC members who were contacted did not express interest in participating in a phone interview. No formal documentation was found to identify residents who may have been contacted during the 2010 FYR of the site. For these reasons, in addition to lack of interest in response to the public notice, no further follow-up with residents was conducted during this FYR.

Wannetta Mallette, Project Manager for the City of North Charleston Planning and Zoning Department participated in this Five-Year Review by answering questions. Ms. Mallette's participation in this Five-Year Review was valued due to her ongoing involvement with various environmental issues in the North Charleston area. Ms. Mallette indicated that while she was aware of former environmental issues at the site, she does not feel that EPA has kept her

informed about ongoing remediation activities and milestones. She suggested that an e-mail marketing service or fact sheets distributed to a stakeholder list, as well as a public meeting to update local residents of the site status would be beneficial, in addition to publishing a public notice in the newspaper. Ms. Mallette was aware of minor infractions such as vandalism and trespassing on the site property. Ms. Mallette shared her knowledge of property ownership, current zoning, and future redevelopment plans for the property. Ms. Mallette's interview form is attached.

Upon completion the Five-Year Review report will be made available for review in the following designated public repository: Charleston County Main Library located at 68 Calhoun Street in Charleston.

Attachments:

Five-Year Review Public Notice for the Macalloy Corporation Superfund Site;
Current EPA Web Page for the Macalloy Corporation Superfund Site
E-Mail Correspondence with LAMC Inviting Participation in Five-Year Review Process; and
E-Mail Correspondence/Interview with Wannetta Mallette, Project Manager with the City of North Charleston Planning and Zoning Department.

Public Notice

Macalloy Corporation Superfund Site
North Charleston, Charleston County, South Carolina

The U.S. Environmental Protection Agency (EPA) and the South Carolina Department of Health and Environmental Control (DHEC) are conducting a 5-year review of the Macalloy Corporation Superfund site located at 1800 Pittsburgh Avenue in North Charleston, SC. The facility manufactured ferrochromium alloy from 1941 to 1998. The site was placed on the National Priorities List (NPL) in February 2000. Clean up work started at the site in October 2004 and was completed in September 2006. The First 5-Year Review for the site was completed in September 2010. Activities conducted at the site since that time have primarily involved groundwater and sediment monitoring.

The purpose of the review is to evaluate remedial activities of the past five years and make sure that the cleanup continues to protect human health and the environment. During the review, DHEC staff will conduct interviews with local residents, officials, and others who are familiar with the site. We value input about site conditions and want to hear any concerns of the local community. **You are encouraged to participate in the review by contacting us with your comments or questions through May 6, 2015.**

The 5-year review process is expected to be complete in summer 2015, at which time a report will be written on our findings. Any comments received about the site will be summarized in the report. The report will be available on EPA's website and at the Charleston County Main Library at 68 Calhoun Street in Charleston. For more information about the Macalloy Corporation site, please visit:
http://www.epa.gov/region4/superfund/sites/npl/southcarolina/macalsc.html.

For comments, questions, or to participate in an interview, please contact:

Technical Comments: Craig Zeller, EPA Project Manager, at (404) 562-8827, or by e-mail at zeller.craig@epa.gov.

Community Involvement: Donna Moye, DHEC Community Liaison, at (803) 898-1382, or by e-mail at moyedd@dhec.sc.gov.

Please share this with others you know who might be interested.

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South Carolina Department of Health and Environmental Control

http://www.epa.gov/region4/superfund/sites/npl/southcarolina/macalsc.html

Region 4: Superfund

Last updated on 10/9/2012

Macalloy Corporation

Site Summary Profile

EPA ID: SCD003360476
Location: North Charleston, SC
Lat/Long: 32.838050, -079.951190
Congressional District: 06
NPL Status: Proposed: 10/22/99; Final: 2/04/00
Affected Media: Ground water, Sediment, Soil
Cleanup Status: Construction complete - physical cleanup activities have been completed
Human Exposure Under Control: Yes
Groundwater Migration Under Control: Yes
Sitewide Ready for Anticipated Use: Yes
Site Reuse/Redevelopment: Site is in partial reuse – industrial land uses are located on site
Site Manager: Craig Zeller (zeller.craig@epa.gov)

National Information

- CERCLIS Site Profile
- Additional Site Documents
- Site Location
- Site Contaminants of Concern
- Site Aliases

Photos/Multimedia

Aerial view of the Macalloy Corporation site prior to cleanup.

- Site Location and Background
- Threats and Contaminants
- Investigation and Cleanup Responsibility / Oversight
- Site Cleanup Plan
- Cleanup Progress
- Enforcement Activities
- Community Involvement
- Future Work
- Additional Information

Additional Resources

- Site Cleanup Terms - can be found in EPA's glossary
- EPA Guides to Cleanup Technologies
- Superfund Community Involvement (PDF) (17 pp 130K, About PDF)

Current Site Status

The Macalloy Corporation site includes the area where a ferrochromium alloy smelting plant operated from 1941 until 1998. EPA placed the site on the National Priorities List (NPL) in 2000 because of contaminated ground water, sediment and soil resulting from facility operations. EPA, the South Carolina Department of Health and Environmental Control (SCDHEC) and the Macalloy Potentially Responsible Party Group, the site's potentially responsible parties (PRPs), have investigated site conditions and taken steps to clean up the site in order to protect people and the environment from contamination. Site contamination does not currently threaten people living and working near the site. By monitoring ground water, placing institutional controls on the site property and undertaking Five-Year Reviews, EPA, SCDHEC and the site's PRPs continue to protect people and the environment from site contamination.

Site Location and Background

The site is located at 1800 Pittsburgh Avenue on a section of the Charleston Peninsula formed by the confluence of the Ashley and Cooper Rivers in Charleston, South Carolina. A tidal creek and marsh along Shipyard Creek border the site to the north and east, industrial and commercial land uses border the site to the south, and a CSX rail line borders the site to the west. Union Heights, a neighborhood with low-income and minority residents, is located just west of the site, past a CSX rail line. The Koppers Co., Inc. (Charleston Plant) Superfund site is located approximately one half-mile south of the site.

From 1941 until 1998, a ferrochromium alloy smelting plant operated at the site. Plant operations included separating metal content from its ore using furnaces. Pittsburgh Metallurgical Company operated the plant from 1941 to 1966; Airco (British Oxygen Corporation) operated the plant from 1966 to 1979; and Macalloy Corporation operated the plant from 1979 to 1998. The Department of Defense has owned, operated or used areas of the site to produce and store ferrochromium alloy, chrome ore and slag since 1942. Operations at the site also collected an estimated 80,000 tons of air pollution control material, consisting of collected particulate dust and sludge, in an unlined surface reservoir on site. The plant discharged process water off site to the Shipyard Creek and a wetlands area. In 2000, EPA listed the site on the NPL.

In 2005, Ashley II of Charleston, LLC purchased the site and developed approximately 30 acres on the southern portion of the site into an industrial park. Approximately 110 acres on the northern portion of the site remains undeveloped and covered with trees and shrubs. The site's cleanup can support industrial land uses.

View site location map.

Threats and Contaminants

Site investigations found contamination in ground water, sediment and soil that could potentially harm people in the area. Contamination resulted from waste disposal practices at the site. Contaminants of concern include hexavalent chromium, nickel, zinc and chromium.

Contamination affected a 20-acre area of ground water, which is confined within the site boundary.

Investigation and Cleanup Responsibility / Oversight

Macalloy PRP Group, the site's PRPs, led site investigation and cleanup activities, with oversight provided by EPA and SCDHEC.

Site Cleanup Plan

In 2002, EPA issued a cleanup plan (a Record of Decision, or ROD) for the site. The plan included the following activities:

- Treating soil to prevent the spread of contamination from soil to ground water.
- Treating contaminated ground water by adding chemicals to the aquifer that create conditions necessary to remove contaminants from ground water.
- Digging up and disposing of approximately 1,000 cubic yards of contaminated sediment from the tidal creek.
- Covering the dug-up area with a cap.
- Implementing a stormwater management plan to reduce contamination from discharging to Shipyard Creek.

A research partnership with EPA's Office of Research and Development during site investigations and studies resulted in the selection of chemical reduction as the cleanup plan for ground water treatment in the ROD.

Summaries of site cleanup approaches are also available online in key site cleanup documents, including the ROD.

Cleanup Progress

In 1998, the site's PRPs began short-term cleanup activities to reduce contaminants flowing into Shipyard Creek. Cleanup activities included construction of structures designed to remove solids from stormwater runoff prior to discharge.

During 1999, the PRPs dug up approximately 40,000 tons of contaminated dust in the reservoir, treated it and disposed of it at an off-site landfill. From 2004 until 2006, the PRPs conducted the remaining cleanup activities.

In November 2006, EPA recognized the site as the Superfund program's 1,000th Construction Completion at a celebration held at the site.

The PRPs completed surface water sampling in 2008.

The site's third Five-Year Review, completed in 2010, found that the cleanup remains protective of human health and the environment.

Summaries of cleanup activities are also available in Five-Year Reviews online.

Enforcement Activities

EPA negotiated legal agreements with the site's PRPs to investigate and clean up the site. The PRPs continue to fund monitoring and oversight activities.

The ROD and Five-Year Reviews online provide additional information on specific legal agreements for the site.

Community Involvement

EPA has worked with the community and its state partner to develop a long-term cleanup plan for the site, reflecting the Agency's commitment to safe, healthy communities and environmental protection. Community engagement and public outreach are core components of EPA program activities.

EPA has conducted a range of community involvement activities to solicit community input and to make sure the public remains informed about site activities throughout the cleanup process. Outreach efforts have included public notices, interviews and public meetings.

Future Work

Semi-annual ground water monitoring is ongoing.

EPA completed the last Five-Year Review in 2010 and plans to complete the next Five-Year Review in 2015.

Additional Information

EPA keeps additional site documents and information in a site information repository at the location below. EPA also posts site documents, when available, on EPA's CERCLIS Site Profile page. For documents not available on the website, please contact the Region 4 Freedom of Information Office.

Site Repository

Charleston County Main Library
68 Calhoun Street
Charleston, SC 29401

Macalloy Corporation Superfund Site - DHEC & EPA 5-Year Review

Moye, Donna

Mon 4/6/2015 6:02 PM

Sent Items

To: rahimkarriem9@gmail.com <rahimkarriem9@gmail.com>; herb1373@yahoo.com <herb1373@yahoo.com>; muhammade@dnr.sc.gov <muhammade@dnr.sc.gov>; skipmikell@aol.com <skipmikell@aol.com>;

Cc: Tolton, Richelle <TOLTONRD@dhec.sc.gov>;

2 attachments (272 KB)

Macalloy Corporation - Final Public Notice with EPA Comments Incorporated (April 2015).docx; EPA Fact Sheet on Five-Year Review - Superfund Today.pdf;

Dear Mr. Rahim, Mr. Muhammad, Mr. Karriem & Mr. Mikell,

I hope this e-mail finds each of you well. As LAMC members, I wanted to let you know about a 5-Year Review that is currently being conducted by the South Carolina Department of Health and Environmental Control (DHEC) and the United States Environmental Protection Agency (EPA) on the Macalloy Corporation Superfund Site located just east of the Union Heights neighborhood at 1800 Pittsburgh Avenue. The purpose of the 5-Year Review is to evaluate remedial activities of the past five years and make sure that the cleanup at the site continues to protect human health and the environment.

Input from the community is an important part of the 5-Year Review process. We are interested in talking with local residents, officials, and others who are familiar with the site. We value input about site conditions and want to hear any concerns of the local community. For your information, I'm attaching the public notice and EPA's Fact Sheet on 5-Year Reviews of Superfund sites. The public notice for the 5-Year Review was be published in today's edition of *The Post & Courier* newspaper. Additional information about the Macalloy Corporation site can be found on EPA's website at: http://www.epa.gov/region4/superfund/sites/npl/southcarolina/macalsc.html.

Please let me know by May 6, 2015 if you or someone you know from the Union Heights Community would be interested in participating in a phone interview. If you have questions about the cleanup or environmental history of the site, you may contact EPA's project manager for the site, Craig Zeller, at (404) 562-8827, or by e-mail at zeller.craig@epa.gov.

Thanks so much and please let me know if you have any questions.

Sincerely,
Donna Moye
Public Participation Coordinator
Bureau of Land and Waste Management
South Carolina Department of Health and Environmental Control

(803) 898-1382

Public Notice

Macalloy Corporation Superfund Site
North Charleston, Charleston County, South Carolina

The U.S. Environmental Protection Agency (EPA) and the South Carolina Department of Health and Environmental Control (DHEC) are conducting a 5-year review of the Macalloy Corporation Superfund site located at 1800 Pittsburgh Avenue in North Charleston, SC. The facility manufactured ferrochromium alloy from 1941 to 1998. The site was placed on the National Priorities List (NPL) in February 2000. Clean up work started at the site in October 2004 and was completed in September 2006. The First 5-Year Review for the site was completed in September 2010. Activities conducted at the site since that time have primarily involved groundwater and sediment monitoring.

The purpose of the review is to evaluate remedial activities of the past five years and make sure that the cleanup continues to protect human health and the environment. During the review, DHEC staff will conduct interviews with local residents, officials, and others who are familiar with the site. We value input about site conditions and want to hear any concerns of the local community. **You are encouraged to participate in the review by contacting us with your comments or questions through May 6, 2015.**

The 5-year review process is expected to be complete in summer 2015, at which time a report will be written on our findings. Any comments received about the site will be summarized in the report. The report will be available on EPA's website and at the Charleston County Main Library at 68 Calhoun Street in Charleston. For more information about the Macalloy Corporation site, please visit:
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Please share this with others you know who might be interested.

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South Carolina Department of Health and Environmental Control

EPA United States Environmental Protection Agency

Superfund Today

FOCUS ON FIVE-YEAR REVIEWS INVOLVING THE COMMUNITY

Checking Up On Superfund Sites:
The Five-Year Review

The U.S. Environmental Protection Agency (EPA) conducts regular checkups, called five-year reviews, on certain Superfund sites. EPA looks at sites where cleanup left wastes that limit site use. For example, EPA will look at a landfill to make sure the protective cover is not damaged and is working properly. EPA will also review sites with cleanup activity still in progress after five-years.

The Five-Year Review is:

- a regular EPA checkup on a Superfund site that has been cleaned up—with waste left behind;
- where clean-up activities were initiated five years earlier;
- a way to make sure the cleanup continues to protect people and the environment; and
- a chance for you to tell EPA about site conditions and any concerns you have.

In both cases, EPA checks the site to make sure the cleanup continues to protect people and the environment. The EPA review team conducts the review and writes a report on its findings. At some sites, other federal agencies, a state agency, or an Indian tribe may do the review, but EPA stays in the process and approves the report.

During the review, EPA studies information on the site, including the cleanup and the laws that apply, and inspects the site to make sure it continues to be protective. EPA needs information from people who are familiar with the site. As someone living close to the site, you may know about things that can help the review team decide if the remedy is still protective. Here are some examples of things to tell EPA about:

- Broken fences, unusual odors, dead plants, materials leaving the site, or other problems
- Buildings or land around the site being used in new ways
- Any unusual activities at the site, such as dumping, vandalism, or trespassing
- Ways the cleanup at the site has affected the neighborhood.

For More Information...

... about a Superfund site in your neighborhood, please call the toll-free Superfund/TRI, EPCRA, RMP and Oil Information Center at 1-800-424-9346 or the Community Involvement Coordinator in the EPA regional office for your site. Your local EPA office can tell you where you can go to review files on every Superfund site in your area. Often, EPA holds community meetings to let people who live near a site know about site activities. You also may find useful information on the Superfund home page (www.epa.gov/superfund) by clicking on "Superfund Sites Where You Live." For more information on the review process, see "Comprehensive Five Year Review Guidance," EPA 540-R-01-007, OSWER 9355.7-03B-P, June 2001.

The Five-Year Review
Continuing to Protect You and the Environment

Step 1: Develop Plan

To plan a five-year review, the site manager forms a review team, which may include an EPA Community Involvement Coordinator, scientists, engineers, and others. The team members decide what they will do at the site and when they will do it. The Community Involvement Coordinator is the member of the team who works with your community during the review.

Your role: EPA will announce the start of the review, probably through a notice in a newspaper or a flyer. Review the notice to see when the review will start.

Step 2: Collect Information

The review team members collect information about site cleanup activities. They talk with people who have been working at the site over the past five years, as well as local officials, to see if changes in local policy or zoning might affect the original cleanup plan. The team usually visits the site to see if the cleanup equipment is working properly, take new samples, review monitoring data, and review records of activities during the past five years. They may give you a call or meet with you in person.

Your role: If you know anything about unusual site activities at or around the site, such as trespassing or odors,or have any other concerns, call the Community Involvement Coordinator at once.

Step 3: Announce Findings and Publish Report

The review team uses the information collected to decide if your community and the environment are still protected from the contaminated material left at the site or from the remediation still in progress. When cleanup goals are not being met, or when problems come up, the review team will call the cleanup activities "non-protective." If a Superfund site is determined to be non-protective, the regions will initiate the necessary actions to ultimately make the site protective. When the team finishes the five-year review, it writes a report about the information that includes background on the site and cleanup activities, describes the review, and explains the results. The review team also writes a summary and announces that the review is finished. They tell your community (via public notices, flyers, etc.) where to find copies of the report and summary—at a central place called the site repository—for anyone to see.

Your role: Read about the site and learn about the cleanup methods being reviewed. Review the report. Ask the Community Involvement Coordinator any questions you have about the site.

What Happens After The Review?

As long as contaminated materials at the site stop people from freely using the land, EPA will do a review every five years. EPA also regularly monitors the site based on an operations and maintenance plan it develops. For example, the site manager may visit the site and read reports about activities at the site. Also, the site workers may visit the site to cut the grass, take samples, or make sure equipment is working. If you see any problems or things that concern you—don't wait for the five-year review—let EPA know right away.

U. S. EPA
Office of Solid Waste and Emergency Response
5204P

EPA 540-F-01-011
9355.7-26
December 2009

Superfund 5-Year Review of Macalloy Corporation (Charleston County)

Moye, Donna

Wed 5/6/2015 2 23 PM

To wmallette@northcharleston org <wmallette@northcharleston org>,

Cc Cole, Robert <colerb@dhec sc gov>;

1 attachment (18 KB)

Macalloy Corporation - Local Government Interview Questions (May 2015).docx

Wannetta Mallette, Project Manager
Planning and Zoning Department
City of North Charleston
2500 City Hall Lane, 3rd Floor
North Charleston, SC 29406

Hi, Wannetta.....

As you are aware, the U.S. Environmental Protection Agency (EPA) and the South Carolina Department of Health and Environmental Control (DHEC) are conducting a Five-Year review of the Macalloy Corporation site located at 1800 Pittsburgh Avenue in North Charleston. This is a federal Superfund site with past cleanup activities and ongoing groundwater and sediment monitoring. The purpose of the review is to evaluate remedial activities of the past five years and make sure that the cleanup continues to protect human health and the environment. During the review, DHEC staff conducts interviews with local residents, officials, and others who are familiar with the site.

During the review, we will typically interview either the City Administrator or City Manager where the site is located. Because of your continued involvement with environmental issues in North Charleston, I was hoping that you could assist me by answering the questions on the attached Five-Year Review Interview Form. You can let me know if it would be more convenient for you to answer the questions via a phone call. The interview will only take a few minutes of your time and will provide us with valuable information for the official Five-Year Review Report submitted to EPA.

Please let me know if you can answer the attached questions and if there are any other city officials that you feel could offer input. As you know, additional background information on the site, can be found at: http://www.epa.gov/region4/superfund/sites/npl/southcarolina/macalsc.html.

I look forward to hearing from you at your soonest convenience.

Sincerely,

Donna Moye
Public Participation Coordinator
Bureau of Land and Waste Management
South Carolina Department of Health and Environmental Control
2600 Bull Street
Columbia, SC 29201
(803) 898-1382
moyedd@dhec.sc.gov

Macalloy Corporation Superfund Site
(North Charleston, Charleston County, South Carolina)
Five-Year Review Interview Form

Site Name:	**Macalloy Corporation 1800 Pittsburgh Avenue**	**EPA ID No.:**	**SCD003360476**
Interviewer Name:	**N/A**	**Affiliation:**	
Subject Name:	**Wannetta Mallette, Project Manager Planning and Zoning Dept.**	**Affiliation:**	**City of North Charleston**

Subject Contact Information: **(843) 740-5835 or wmallette@northcharleston.org**

Time: **Date:**
Interview Location:

Interview Format (check one): **In Person** **Phone** **Email** **Other:**

Interview Category: **Local Government**

Are you aware of the former environmental issues at the Site and the cleanup activities that have taken place to date?

Do you feel well-informed regarding the Site's activities and remedial progress? If not, how might EPA convey site-related information in the future?

Have there been any problems with unusual or unexpected activities at the Site, such as emergency response, vandalism or trespassing?

Are you aware of any changes to state laws or local regulations that might affect the protectiveness of the Site's remedy?

Are you aware of any changes in projected land use(s) at the Site?

Has EPA kept involved parties and surrounding neighbors informed of activities at the Site? How can EPA best provide site-related information in the future?

Do you have any comments, suggestions or recommendations regarding any aspects of the project?

RE: Superfund 5-Year Review of Macalloy Corporation (Charleston County)

Mallette, Wannetta <wmallette@northcharleston.org>

Mon 5/11/2015 4:37 PM

To Moye, Donna <moyedd@dhec.sc.gov>;

1 attachment (14 KB)

Macalloy Corporation Superfund Site.docx;

Donna,

Please find attached my comments. You may also receive comments from Adam MacConnell.

Wannetta

From: Moye, Donna [mailto:moyedd@dhec.sc.gov]
Sent: Wednesday, May 06, 2015 2:23 PM
To: Mallette, Wannetta
Cc: Cole, Robert
Subject: Superfund 5-Year Review of Macalloy Corporation (Charleston County)

Wannetta Mallette, Project Manager
Planning and Zoning Department
City of North Charleston
2500 City Hall Lane, 3rd Floor
North Charleston, SC 29406

Hi, Wannetta.....

As you are aware, the U.S. Environmental Protection Agency (EPA) and the South Carolina Department of Health and Environmental Control (DHEC) are conducting a Five-Year review of the Macalloy Corporation site located at 1800 Pittsburgh Avenue in North Charleston. This is a federal Superfund site with past cleanup activities and ongoing groundwater and sediment monitoring. The purpose of the review is to evaluate remedial activities of the past five years and make sure that the cleanup continues to protect human health and the environment. During the review, DHEC staff conducts interviews with local residents, officials, and others who are familiar with the site.

During the review, we will typically interview either the City Administrator or City Manager where the site is located. Because of your continued involvement with environmental issues in North Charleston, I was hoping that you could assist me by answering the questions on the attached Five-Year Review Interview Form. You can let me know if it would be more convenient for you to answer the questions via a phone

call. The interview will only take a few minutes of your time and will provide us with valuable information for the official Five-Year Review Report submitted to EPA.

Please let me know if you can answer the attached questions and if there are any other city officials that you feel could offer input. As you know, additional background information on the site, can be found at: http://www.epa.gov/region4/superfund/sites/npl/southcarolina/macalsc.html.

I look forward to hearing from you at your soonest convenience.

Sincerely,
Donna Moye
Public Participation Coordinator
Bureau of Land and Waste Management
South Carolina Department of Health and Environmental Control
2600 Bull Street
Columbia, SC 29201
(803) 898-1382
moyedd@dhec.sc.gov

Macalloy Corporation Superfund Site

Five-Year Review Interview Form

May 11, 2015

Subject Name: Wannetta Mallette, Project Manager
City of North Charleston
Planning and Zoning Department

Interview Category: Local Government

Responses:

1. Yes.
2. EPA might convey site-related information in the future by placing a public notice in the local paper of general circulation (if it has not done so), using an email-marketing service, or generating fact sheets for distribution to the stakeholder list.
3. Reported minor infractions such as vandalism and trespassing have been reported.
4. While the properties are currently zoned M-2, Heavy Industrial, the city's Comprehensive Development Plan's Future Land Use Map designates part of the site for "Conservation".
5. The Macalloy site is now owned by Branch Properties, LLC who intend to develop a functionality "on dock" state-of-the-art intermodal facility on a part of the Macalloy property to serve the Navy Base Container Terminal as well as the other terminals in the Port of Charleston. The reminder of the land at Macalloy will be developed for distribution centers, warehouses, and related logistics uses.
6. EPA has not kept me informed about on-going remediation activities and milestones. (See response #2).
7. EPA/SCDHEC should schedule a public meeting to update the public of the project status.

From: Cole, Robert [mailto:colerb@dhec.sc.gov]

Sent: Thursday, April 30, 2015 10:21 AM

To: Chad Tripp

Subject: Macalloy

I know you are no longer getting paid on this project, but I need to get some info about the O&M costs for the last five years. Do you have easy access to a table outlining the costs for the last five years? Also, I have some questions that normally get sent to the person responsible for O&M. The questions are:

1. What is your overall impression of the project; including cleanup, maintenance, and reuse activities (as appropriate)?

Overall, remedial implementation and effectiveness have met expectations, and the site is now ideal for commercial reuse/development.

2. What is your assessment of the current performance of the remedy in place at the Site?

Remedial performance has met expectations.

3. What are the findings from the monitoring data? What are the key trends in contaminant levels that are being documented over time at the Site?

Contaminant levels have significantly reduced over time as a result of the remedial action. An isolated pocket of residual contamination remains in the shallow groundwater in the vicinity of MW60 and should be monitored until remedial goals are achieved.

4. Is there a continuous on-site O&M presence? If so, please describe staff responsibilities and activities. Alternatively, please describe staff responsibilities and the frequency of site inspections and activities if there is not a continuous on-site O&M presence. EnSafe Inc., contracted by the former property owner Macalloy, performed remedial effectiveness monitoring through 2014 in accordance with the Final Removal Action Report (EnSafe 2006) and the First Five Year Review Report (EPA 2010). EnSafe Inc. is no longer contracted to perform this work, and is not knowledgeable of who will perform future onsite O&M/groundwater monitoring.

5. Have there been any significant changes in site O&M requirements, maintenance schedules or sampling routines since start-up or in the last five years? If so, do they affect the protectiveness or effectiveness of the remedy? Please describe changes and impacts. Remedial effectiveness monitoring has been optimized since implementation, as presented in the First Five Year Review Report and subsequent monitoring reports. Most recently over the last five years, groundwater monitoring was reduced from a semi-annual to an annual frequency in 2012, while maintaining the protectiveness and effectiveness of the remedy.

6. Have there been unexpected O&M difficulties or costs at the Site since start-up or in the last five years? If so, please provide details.

None within the last five years.

Re: Macalloy

Williams, Charles J.

Fri 5/1/2015 8:01 AM

To Cole, Robert <colerb@dhec.sc.gov>;

1. What is your overall impression of the project; including cleanup, maintenance, and reuse activities (as appropriate)? Overall the remedy is performing as expected, however, DHEC has recommended re-injection occur in a couple of problem spots where contamination seems to persist and that damaged monitoring wells be abandoned and replaced. The reuse of the site is going well.

2. What is your assessment of the current performance of the remedy in place at the Site? DHEC has recommended re-injection occur in a couple of problem spots where contamination seems to persist.

3. Are you aware of any complaints or inquiries regarding site-related environmental issues or remedial activities from residents in the past five years? No

4. Has your office conducted any site-related activities or communications in the past five years? If so, please describe the purpose and results of these activities. Only site visits to check on maintenance of the site.

5. Are you aware of any changes to state laws that might affect the protectiveness of the Site's remedy? No

6. Are you comfortable with the status of the institutional controls at the Site? If not, what are the associated outstanding issues? Yes, we are comfortable with the institutional controls at the site.

7. Are you aware of any changes in projected land use(s) at the Site? No

8. Do you have any comments, suggestions or recommendations regarding the management or operation of the Site's remedy?
DHEC had the following comments from the review of the 2014 Annual Long-Term monitoring Report

1. For future monitoring events plans should be made with the recycling facility to make sure that wells MW054RR, MW056, and MW058 are accessible to be sampled. If the next two sampling event results are below the 100ppb cleanup goal SCDHEC recommends abandonment of these wells.

2. SCDHEC agrees with the recommendation to abandon and replace MW061.

3. SCDHEC would like to discuss the possibility of reinjection near wells MW060 and MW041 or the installation of new monitoring wells down gradient to ensure contaminated groundwater is not impacting Shipyard Creek.

--

Charles J. Williams, III, Project Manager
Federal Remediation Section
Division of Site Assessment, Remediation and Revitalization
Bureau of Land and Waste Management
South Carolina Department of Health and Environmental Control
Phone (803) 898-0876 Fax (803) 898-1297
e-mail williacj@dhec.sc.gov

From: Cole, Robert
Sent: Thursday, April 30, 2015 10:24 AM
To: Williams, Charles J.
Subject: Macalloy

M questions for the FYR follow. Please complete at your convenience.

1. What is your overall impression of the project; including cleanup, maintenance, and reuse activities (as appropriate)?

2. What is your assessment of the current performance of the remedy in place at the Site?

3. Are you aware of any complaints or inquiries regarding site-related environmental issues or remedial activities from residents in the past five years?

4. Has your office conducted any site-related activities or communications in the past five years? If so, please describe the purpose and results of these activities.

5. Are you aware of any changes to state laws that might affect the protectiveness of the Site's remedy?

6. Are you comfortable with the status of the institutional controls at the Site? If not, what are the associated outstanding issues?

7. Are you aware of any changes in projected land use(s) at the Site?

8. Do you have any comments, suggestions or recommendations regarding the management or operation of the Site's remedy?

Thanks!

Robert Cole
State & Federal Site Assessment Section

SCDHEC Bureau of Land & Waste Management
(803) 898-0787
colerb@dhec.sc.gov

Macalloy Superfund Site (Charleston, Charleston, SC)
Five-Year Review Interview Form

Site Name: Macalloy Corporation Site **EPA ID No.:**

Interviewer Name: Robert Cole **Affiliation:** SCDHEC

Subject Name: Craig Zeller **Affiliation:** EPA

Subject Contact Information: 4045628827
Time: 0830 **Date:** 6/15/15
Interview Location: Phone

Interview Format (circle one): Phone

Interview Category: EPA Remedial Project Manager

1. What is your overall impression of the project; including cleanup, maintenance, and reuse activities (as appropriate)? Great cleanup. The maintenance of the site has been handled well, and parts of the site are being reused.

2. What have been the effects of this Site on the surrounding community, if any? Reuse is pending as a port facility. When the port facility is complete it will be a great benefit to the community. There has been economic analysis showing the current reuse of the property has made an impact as well.

3. Are you aware of any complaints or inquiries regarding site-related environmental issues or remedial activities since the implementation of the cleanup? No.

4. What is your assessment of the current performance of the remedy in place at the Site? The current performance is adequately protective. There is a small area of elevated chromium remaining in onsite groundwater.

5. Are you comfortable with the status of the institutional controls at the Site? If not, what are the associated outstanding issues? Yes

6. Are you aware of any community concerns regarding the Site or the operation and management of its remedy? If so, please provide details. No

7. Do you have any comments, suggestions or recommendations regarding the management or operation of the Site's remedy? The site needs additional supplemental remediation similar to what occurred in 2005 and 2008. Additional injections would likely reduce the remaining chromium plume to below RAO levels and the site could be pushed toward delisting.

8. What is your overall impression of the project; including cleanup, maintenance, and reuse activities (as appropriate)? Very happy overall.

Appendix D: Site Inspection Checklist

FIVE-YEAR REVIEW SITE INSPECTION CHECKLIST

I. SITE INFORMATION

Site Name: Macalloy Corporation	**Date of Inspection: February 25, 2015**
Location and Region: Charleston, SC, Region 4	**EPA ID: SCD003360476**
Agency, Office or Company Leading the Five-Year Review: EPA Region 4	**Weather/Temperature: 50s and overcast**

Remedy Includes: (Check all that apply)

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

Attachments: ☐ Inspection team roster attached ☐ Site map attached

II. INTERVIEWS (check all that apply)

1. **O&M Site Manager** Chad Tripp (Name) EnSafe (Title) Date
   Interviewed ☐ at site ☒ by email ☐ by phone Phone: ____
   Problems, suggestions ☐ Report attached: Section 6.6 includes summarized interview question responses.
2. **O&M Staff** ____ (Name) ____ (Title) mm/dd/yyyy (Date)
   Interviewed ☐ at site ☐ at office ☐ by phone Phone: ____
   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). Fill in all that apply.

Agency SCDHEC
Contact Charles Williams (Name) | Project Manager (Title) | Date | ---------- (Phone No.)
Problems/suggestions ☐ Report attached: Section 6.6 includes summarized interview question responses.

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: _____

Agency _____
Contact _____ (Name) | _____ (Title) | _____ (Date) | _____ (Phone No.)
Problems/suggestions ☐ Report attached: _____

4. **Other Interviews** (optional) ☐ Report attached: Section 6.6 includes summarized interview question responses.

Craig Zeller, EPA RPM

III. ON-SITE DOCUMENTS AND 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: _____

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
	☐ _____	

2. **O&M Cost Records**

☐ Readily available ☐ Up to date

☐ Funding mechanism/agreement in place ☒ Unavailable

Original O&M cost estimate: see estimates and costs in section 4.3 starting on page 26 of this FYR.
☐ Breakdown attached

Total annual cost by year for review period if available

From: mm/dd/yyyy Date	To: mm/dd/yyyy Date	_____ Total cost	☐ Breakdown attached
From: mm/dd/yyyy Date	To: mm/dd/yyyy Date	_____ Total cost	☐ Breakdown attached
From: mm/dd/yyyy Date	To: mm/dd/yyyy Date	_____ Total cost	☐ Breakdown attached
From: mm/dd/yyyy Date	To: mm/dd/yyyy Date	_____ Total cost	☐ Breakdown attached
From: mm/dd/yyyy Date	To: mm/dd/yyyy Date	_____ Total cost	☐ Breakdown attached

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: _____

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): _____

Frequency: _____

Responsible party/agency: _____

Contact _____ _____ mm/dd/yyyy _____

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

2. **Adequacy** ☒ ICs are adequate ☐ ICs are inadequate ☐ N/A

Remarks:

D. General

1. **Vandalism/Trespassing** ☐ Location shown on site map ☒ No vandalism evident

Remarks: _____

2. **Land Use Changes On Site** ☒ N/A

Remarks: _____

3. **Land Use Changes Off Site** ☒ N/A

Remarks:

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. 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: MW061 damaged; well on SONOCO not observed (covered with pallets of recycled material)

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: _____

VIII. OTHER REMEDIES

If there are remedies applied at the site and 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.

IX. 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 designed to accomplish (e.g., to contain contaminant plume, minimize infiltration and gas emissions).

The remedy is effective and functioning as designed to remove contaminants from the groundwater.

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.

There are no known O&M issues.

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. There are no known early indications of potential remedy problems.
D.	**Opportunities for Optimization**
	Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy. There are no known opportunities for optimization.

Appendix E: Photographs from Site Inspection Visit

Photo Log for Site Inspection – Macalloy Corporation Site

February 25, 2015

Photo 1 – MW051 – not locked

Photo 2 – South looking west

Photo 3 – Outfall looking east

Photo 4 – looking northeast from outfall

Photo 5 – MW050

Photo 6 – MW049

Photo Log for Site Inspection – Macalloy Corporation Site

February 25, 2015

Photo 7 – Stormwater retention pond looking south

Photo 8 – From pond looking west

Photo 9 –MW046 looking north

Photo 10 – MW045 looking west

Photo 11 – MW044

Photo 12 – MW042

Photo Log for Site Inspection – Macalloy Corporation Site

February 25, 2015

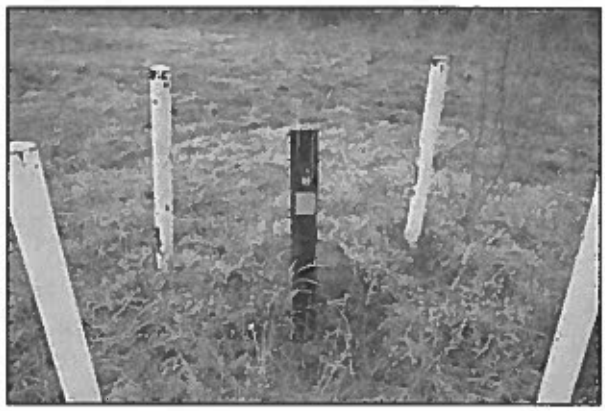


Photo 13 – MW040

Photo 14 – MW041

Photo 15 – MW060

Photo 16 – From MW60 looking south

Photo 17 – MW043 with drum in foreground

Photo 18 – MW061 destroyed

Photo Log for Site Inspection – Macalloy Corporation Site

February 25, 2015

Photo 19 – MW048

Photo 20 – North middle looking SSW

Photo 21 – MW017

Photo 22 – MW062 two risers knocked down

Photo 23 – Tires in roadside ditch; West side Sewanee

Photo 24 – East side of Sewanee Rd; debris

Photo Log for Site Inspection – Macalloy Corporation Site

February 25, 2015

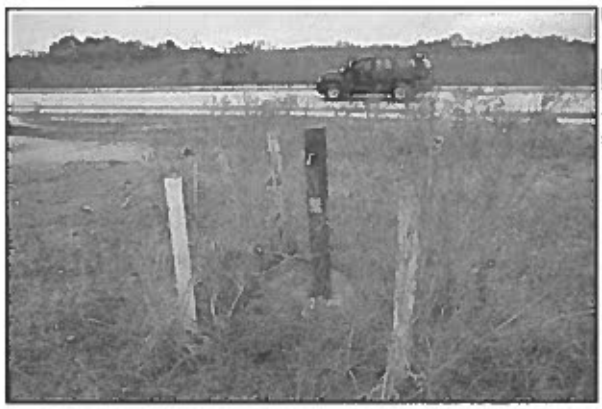


Photo 25– MW053

Photo 26 – Material near MW053

Photo 27 – Looking south

Photo 28 – Original outfall looking east

Photo 29 – Original outfall on bank looking east

Photo 30 – Waste by original outfalls (south)

Appendix F: Restrictive Covenants

BK 0 585PG298

STATE OF SOUTH CAROLINA	)	
	)	**DECLARATION OF COVENANTS**
COUNTY OF CHARLESTON	)	**AND RESTRICTIONS**

THIS DECLARATION OF COVENANTS AND RESTRICTIONS (Declaration) is made and entered into this 22 day of May of 2006, by Ashley II of Charleston, LLC, a South Carolina limited liability company (hereinafter referred to as Ashley II) and the South Carolina Department of Health and Environmental Control (Department).

RECITALS

WHEREAS, this Declaration of Covenants and Restrictions is entered into pursuant to S.C. Code §44-56-200 et seq.; and

WHEREAS, Ashley II is the owner of certain real property in Charleston County, South Carolina, more particularly described in Exhibit A attached hereto and incorporated herein by reference ("Property"); and

WHEREAS, contaminants in excess of allowable concentrations for unrestricted use remain at the Property; and

WHEREAS, the Property was previously used as a ferrochromium alloy manufacturing plant and is currently designated as Superfund Site SCD003360476 pursuant to the Comprehensive Environmental Compensation and Liability Act ("CERCLA"), 42 U.S.C. Section 9601 et seq.; and

WHEREAS, the Property is the subject of Consent Agreement 05-06-HW (CA) entered into to by the Department and Ashley II, pursuant to the Comprehensive Environmental Response Compensation and Liability Act (CERCLA), 42 U.S.C. §§ 9601, et seq. and the South Carolina Hazardous Waste Management Act (HWMA), S.C. Code Ann. § 44-56-200.

WHEREAS, the Property has undergone and is undergoing remediation pursuant to the United States Environmental Protection Agency ("EPA") Record of Decision relating to the Macalloy Corporation Site, signed August 21, 2002, by the Director of the Waste Management Division, EPA Region 4 ("ROD") and the Consent Decree between the United States of America and Macalloy Corporation and The BOC Group, Inc., Civil Action Number 2 04 1201 18 (the "Consent Decree");

WHEREAS, the remedial and other work required under the ROD and Consent Decree shall hereafter be referred to as the "Consent Decree Work"; and

2005-0740

WHEREAS, the Property may be used for certain purposes without further remediation beyond the Consent Decree Work and requires that certain restrictions are placed on development and use of the Property; and

WHEREAS, Ashley II has agreed to impose restrictions on the manner in which the Property may be developed; and

WHEREAS, it is the intention of all parties that EPA is a third party beneficiary of said restrictions and said restrictions shall be enforceable by the EPA, Department, and their successor agencies.

NOW, THEREFORE, KNOW ALL MEN BY THESE PRESENTS that Ashley II hereby declares and covenants on behalf of itself, its heirs, successors, and assigns that the Property described in Exhibit A shall be held, mortgaged, transferred, sold, conveyed, leased, occupied, and used subject to the CA dated March 8, 2005, to include the following restrictions, which shall touch and concern and run with the title to the Property.

1. Ashley II hereby covenants for itself, its heirs, successors and assigns that the Property shall not be used for the following purposes: residential, agricultural, child day care facilities, schools, or elderly care facilities. Further, Ashley II hereby covenants for itself, its heirs, successors, and assigns that the Property shall not be used for recreational purposes unless the specific recreational activity is approved by the Department or its successor agencies.

2. Ashley II covenants for itself, its heirs, successors and assigns that groundwater beneath the Property may not be used for drinking or irrigation purposes without prior approval from the EPA and the Department or their successor agencies. Groundwater wells may be installed and maintained for the purpose of groundwater monitoring and sampling and as may otherwise be required by law. Any said ground water monitoring, sampling or remediation wells shall be kept capped and locked, except when in active use to monitor, assess, or remediate water quality on or under the Property.

3. Ashley II covenants for itself, its heirs, successors and assigns that the EPA, the Department, their successor agencies, and all other parties performing response actions under EPA's or the Department's oversight shall be provided reasonable access for (i) inspecting the property (ii) monitoring, (iii) verifying information, (iv) sampling the property, (v) assessing the need for additional response or quality control practices, (vi) implementing the Consent Decree Work, (vii) inspecting and copying records, (viii) assessing the responsible party's compliance, (ix) assessing compliance with existing land use

restrictions under the Consent Decree and this Declaration, or to take samples as may be necessary to enforce the this Declaration.

4. The covenants and restrictions set forth herein shall run with the title to the Property and shall be binding upon Ashley II, its heirs, successors and assigns. It is expressly agreed that the Department shall have the right to enforce these covenants and restrictions upon Ashley II, its successors, and assigns. Ashley II and its heirs, successors, and assigns shall include the following notice on all deeds, mortgages, plats, or any legal instruments used to convey any interest in the Property (failure to comply with this paragraph does not impair the validity or enforceability of these covenants):

> NOTICE: This Property is Subject to Declaration of Covenants and Restrictions and any subsequent Amendments Recorded at Book _____, Page _____, Register of Mesne Conveyance Office for Charleston County, South Carolina.

5. Ashley II, its heirs, successors, assigns and any subsequent purchaser of the Property shall submit to the EPA and the Department a statement of maintenance of the covenants and restrictions as set forth above annually on May 31st of every year. This reporting requirement is the obligation of each owner of the Property, or portion of the Property, as of May 31 of each year. Once title to all or a portion of the Property has been conveyed by Ashley II or any subsequent owner, such predecessor in title shall no longer have any responsibility for submission of the Report with respect to the portion of the Property it previously owned.

6. This Declaration shall remain in place until such time as the Department has made a written determination that the covenants and restrictions set forth herein are no longer necessary. The Department shall not consent to any such termination unless the requirements of the ROD have been met. This Declaration shall not be amended without the written consent of the Department or its successor agency. The Department shall not consent to any such amendment or termination without the consent of EPA.

7. It is expressly agreed that EPA is not the recipient of a real property interest but is a third party beneficiary of the Declaration of Restrictive Covenants, and as such, has the right of enforcement.

8. This Declaration only applies to the Property expressly identified in Exhibit A and does not impair the Department's authority with respect to the Property or other real property under the control of Ashley II.

IN WITNESS WHEREOF, Ashley II of Charleston, LLC has caused this instrument to be executed as of the date first above written.

WITNESSES:

ASHLEY II OF CHARLESTON, LLC
A SOUTH CAROLINA LIMITED LIABILITY COMPANY

By: Robert L. Clement

Robert L. Clement, III
Authorized Member

STATE OF SOUTH CAROLINA)
COUNTY OF CHARLESTON) ACKNOWLEDGEMENT

I, Lauren Howell (Notary Public), do hereby certify that, Robert Clement, an authorized representative of the Ashley II of Charleston, LLC, personally appeared before me this day and acknowledged the due execution of the foregoing instrument, on behalf of the Ashley II of Charleston, LLC.

Witness my hand and official seal this 22 day of May, 2006.

Notary Public for South Carolina
My Commission Expires: 6/7/2014

LAUREN A. HOWELL NOTARY PUBLIC SOUTH CAROLINA

IN WITNESS WHEREOF, the Department has caused this instrument to be executed as of the date first above written.

WITNESSES:

South Carolina Department of Health and Environmental Control

By: _____

Robert W. King, Jr., P.E., Deputy Commissioner, Environmental Quality Control

Kathy J. Rogers

South Carolina Department of Health and Environmental Control

STATE OF SOUTH CAROLINA)

) ACKNOWLEDGEMENT

COUNTY OF RICHLAND)

I, Barry B. Nelson (Notary Public), do hereby certify that, Robert W. King, Jr., P.E., Deputy Commissioner Environmental Quality Control of the South Carolina Department of Health and Environmental Control, personally appeared before me this day and acknowledged the due execution of the foregoing instrument.

Witness my hand and official seal this 26 day of May, 2006.

Notary Public for South Carolina

My Commission Expires: February 2nd, 2009

EXHIBIT A

EXHIBIT A

(Description of Real Estate)

(Attached to Contract of Sale between Macalloy Corporation, Seller, and Ashley II of Charleston, LLC, Purchaser)

PARCEL 1:

All that piece, parcel or tract of land, situate, lying and being in the County of Charleston, State of South Carolina, east of Meeling Street Road, and west of Shipyard Creek, and having such size, shape, dimensions, and buttings and boundings as are more clearly shown and delineated on a plat thereof bearing legend. "Boundary Plat as shown on existing Plats and Records of Property of Airco Alloys Division Airco, Inc.", dated July 12, 1977, by Cummings and McCrady, Inc., Engineers, and recorded in the R.M.C. Office for Charleston County in Plat Book AJ, at Page 67, which said plat is hereby made a part and parcel hereof, reference to which said plat is hereby made for a more full and complete description.

PARCEL 2:

All that certain piece, parcel or tract of land, situate, lying and being in the North Charleston Sewer District, formerly St. Philip's and St. Michael's Parish, in Charleston County, State of South Carolina, known and designated as Tract "C", measuring and containing 1.40 acres, all of which is more fully shown and delineated on a plat made by Davis & Floyd Engineers, Inc., dated March 13, 1979, entitled "Plat showing Tract C. Property of Seaboard Coast Line Railroad Co., about to be conveyed to Airco, Inc., located off Meeling Street, Charleston County, recorded in Plat Book AN at Page 103, reference to which said plat is hereby made for a more full and complete description.

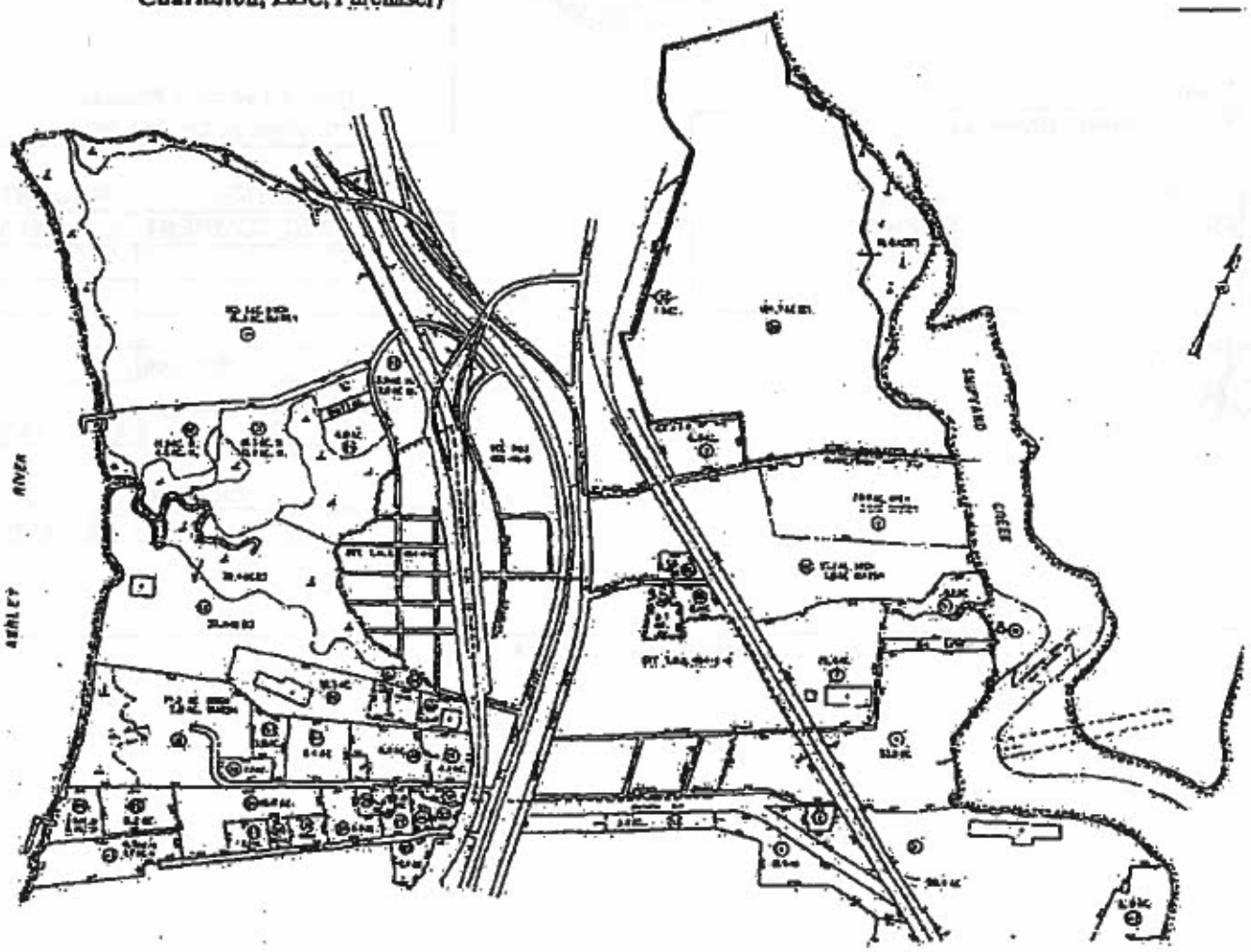
Save and excepting, however, from the above property the salt marsh which contains 17 acres more or less title to which shall remain in the name of Seller. If all or any portion of the salt marsh is not conveyed to NOAA by Seller, Seller shall convey at no cost to the Purchaser all or the remaining portion of the salt marsh to Purchaser by quit claim deed within 90 days following complete resolution of the claim by NOAA and others for alleged damages to natural resources.

Being the same property conveyed to Macalloy Corporation by deed of Airco, Inc. dated July 11, 1979 and recorded July 17, 1979 in book U 119 at Page 72.

SCHEDULE A-1

(Tax Map)

(Attached to Contract of Sale between Macalloy Corporation, Seller, and Ashley II of Charleston, LLC, Purchaser)



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RECORDER'S PAGE

***NOTE*: This page MUST remain with the original document**

FILED

May 31, 2006

3:19:44 PM

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Charlie Lybrand, Register
Charleston County, SC

Filed By:

Young Clement Rivers, LLP

P.O. Box 993
Charleston SC 29402

DESCRIPTION	AMOUNT
DEC/COV/REST	$ 14.00
Postage	
TOTAL	$ 14.00

DRAWER:

	B - ECP

DO NOT STAMP BELOW THIS LINE

U. S. Environmental Protection Agency, Region 4 Announces a Five-Year Review for the Macalloy Corporation Superfund Site in North Charleston, Charleston County, SC

The U.S. Environmental Protection Agency (EPA) and the South Carolina Department of Health and Environmental Control (SCDHEC) is conducting a Five-Year Review of the remedy for the Macalloy Corporation Superfund Site (the Site) in North Charleston, SC. The purpose of the Five-Year Review is to evaluate the protectiveness of cleanup actions taken at the Site.

Background: Macalloy Corporation is a 125-acre parcel located at 1800 Pittsburgh Avenue, North Charleston, SC 29405. The facility manufactured ferrochromium alloy from 1941 to 1998 by smelting chromite ore, coke, silica gravel and bauxite in submerged electric arc furnaces. Ferrochromium alloy was used in the production of high quality stainless steel. The Site was placed on the National Priorities List in February 2000 for environmental assessment and remediation under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). EPA issued the Record of Decision (ROD) for the Site in August 2002. Clean up work started at the Site in October 2004, pursuant to the terms of a Consent Decree between EPA, Macalloy, and British Oxygen Corporation. Construction was completed at the Site in September 2006.

Storm water monitoring was conducted monthly until July 2008, when data indicated performance standards where achieved. Monitoring continues for groundwater, sediment quality, and sand cap thickness in the restored tidal creek. Approximately 20 acres of the Site have been redeveloped as an industrial park. Planning for future beneficial use of the remaining Site area is underway.

Five-Year Review Schedule: The National Contingency Plan requires that remedial actions that result in any hazardous substances, pollutants, or contaminants remaining at the Site above levels that allow for unlimited use and unrestricted exposure be reviewed every five years to ensure protection of human health and the environment. The first Five-Year Review for this Site is anticipated to be completed by February 2010.

EPA invites community participation in the Five-Year Review process.

EPA is conducting this Five-Year Review to evaluate the effectiveness of the remedy and ensure that the remedy remains protective of human health and the environment. As part of the Five-Year Review process, the EPA is available to answer any questions about the Site. Community members who have questions about the Site, the Five-Year Review process, or who would like to participate in a community interview, are asked to contact the following:

Craig Zeller
Remedial Project Manager
(404) 562-8227
zeller.craig@epa.gov

Sherryl A. Carbonaro
Community Involvement Coordinator
(800) 564-7577
carbonaro.sherryl@epa.gov

Mailing Address: U. S. EPA, 61 Forsyth St., S.W.,
Atlanta, GA 30303-8960

For more information on the Macalloy Site, please visit:

The EPA web page at www.epa.gov/region4/waste/npl/nplsc/macalosc
or
The Site Administrative Record at:
The Charleston Main Library; 68 Calhoun Street, Charleston, SC 29401. CZ2-213007

Appendix G: Historical Groundwater Results

From:

2014 Long-Term Groundwater Monitoring Report
Macalloy Corporation Site
Table 4-3

Table 4-3
Historical Groundwater Monitoring Results

Well Identification	Sample Date	Event	Analytical Results					Geochemistry Measurements		
			Sample Type	Fraction	Arsenic	Chromium	Hexavalent Chromium	Turbidity (NTU)	ORP (mV)	pH
MW040	10/24/2006	Event 01	N	T	10 U	4.6 J	10 U	10	48	6.78
MW040	1/30/2007	Event 02	N	T	3.9 J	6.5 J	10 U	1.6	2.74	6.71
MW040	4/23/2007	Event 03	N	T	10 U	3.9 J	3.5 J	0	388	6.95
MW040	7/17/2007	Event 04	N	T	10 U	2.7 J	10 U	7	149	6.59
MW040	10/22/2007	Event 05	N	T	10 U	5.2 J	10 U	26	151	7.00
MW040	4/17/2008	Event 06	N	T	10 U	11	6.5 J	3.5	339	6.96
MW040	10/28/2008	Event 07	N	T	10 U	43	35	0	88	7.38
MW040	4/16/2009	Event 08	N	T	5 J	16	3.3 J	131	196	6.30
MW040	10/19/2009	Event 09	N	T	10 U	5.6 J	5.6 J	6	28	6.89
MW040	4/27/2010	Event 10	N	T	10 U	23	23	8	80	6.52
MW040	10/26/2010	Event 11	N	T	10 U	41	34	8	46	5.98
MW040	4/20/2011	Event 12	N	T	10 U	31	29	4	149	6.85
MW040	10/5/2011	Event 13	N	T	10 U	2.4 J	10 U	13	54.4	6.64
MW040	10/16/2012	Event 14	N	T	10 U	19	32	9.98	81.8	6.87
MW040	10/28/2013	Event 15	N	T	2.7 J	21	25	2.68	121	6.68
MW040	10/14/2014	Event 16	N	T	3 J	7.1 J	6.4 J	0.72	7.8	6.45
MW041	10/24/2006	Event 01	N	T	10 U	4100	3700	2	158	6.18
MW041	1/30/2007	Event 02	N	T	10 U	2600	2200	1.2	313	6.06
MW041	4/23/2007	Event 03	N	T	10 U	3500	3200	0	354	6.34
MW041	7/17/2007	Event 04	N	T	10 U	480	540	9	239	5.80
MW041	10/23/2007	Event 05	N	T	10 U	420	310	0	177	6.15
MW041	2/11/2008	Event 5A	N	T	10 U	2000	1700	8	320	6.20
MW041	4/17/2008	Event 06	FD	T	10 U	1500	1500	0	236	6.22
MW041	4/17/2008	Event 06	N	T	10 U	1400	1600	0	236	6.22
MW041	7/9/2008	Event 6A	FD	D		240	250	3	169	5.51
MW041	7/9/2008	Event 6A	FD	T		260	260	3	169	5.51
MW041	7/9/2008	Event 6A	N	D		240	250	3	169	5.51
MW041	7/9/2008	Event 6A	N	T		290	270	3	169	5.51
MW041	10/27/2008	Event 07	N	T	10 U	12	6.0 J	9	182	6.22
MW041	4/15/2009	Event 08	N	T	10 U	2600	1300	2.1	148	6.13
MW041	10/19/2009	Event 09	N	T	42	200	100000 UX	4	-146	6.06
MW041	4/26/2010	Event 10	N	T	37	4500	100000 UX	30	-63	5.71
MW041	10/26/2010	Event 11	N	T	42	1600	100000 UX	4	-98	5.50
MW041	4/20/2011	Event 12	N	T	32	580	100000 UX	1.2	-108	6.19
MW041	10/6/2011	Event 13	N	T	72	14	100000 UX	0.8	-112	6.14
MW041	10/16/2012	Event 14	N	T	8 J	230	100000 UX	9.2	108.5	6.11
MW041	10/28/2013	Event 15	N	T	39	920	1000 UX	8.84	126.4	6.16
MW041	10/20/2014	Event 16	N	T	20	620 B	10000 UX	28	13.3	6.10
MW041	10/20/2014	Event 16	FD	T	18	620 B	10000 UX	28	13.3	6.10
MW042	10/24/2006	Event 01	N	T	10 U	1.6 J	10 U	12	-14	6.43
MW042	1/30/2007	Event 02	N	T	10 U	1.1 J	10 U	1	175	6.41
MW042	4/24/2007	Event 03	N	T	10 U	10 U	10 U	0	134	6.49
MW042	7/17/2007	Event 04	N	T	10 U	10 U	10 U	9	36	6.25
MW042	10/22/2007	Event 05	FD	T	10 U	10 U	10 U	9	36	6.25
MW042	10/22/2007	Event 05	N	T	10 U	10 U	10 U	6	-14	6.68
MW042	4/16/2008	Event 06	N	T	10 U	10 U	100 UX	6.2	4	6.12
MW042	10/28/2008	Event 07	N	T	10 U	10 U	10 U	0	41	7.10
MW042	4/16/2009	Event 08	N	T	10 U	10 U	10 U	78	64	6.17
MW042	10/19/2009	Event 09	N	T	10 U	10 U	33 J	1	13	6.61
MW042	4/27/2010	Event 10	N	T	10 U	10 U	100 UX	2	13	6.50
MW042	10/27/2010	Event 11	N	T	10 U	10 U	100 UX	4	63	5.78
MW042	4/20/2011	Event 12	N	T	10 U	10 U	10 U	2.5	21	6.56
MW042	4/20/2011	Event 12	FD	T	10 U	10 U	100 UX	2.5	21	6.56
MW042	10/5/2011	Event 13	N	T	10 U	10 U	100 UX	0.5	37.3	6.45
MW042	10/17/2012	Event 14	N	T	2.7 J	0.53 J	10 U	1.41	71.7	6.68
MW042	10/29/2013	Event 15	N	T	3.4 J	10 U	10 U	0.75	116.6	7.12
MW042	10/20/2014	Event 16	N	T	10 U	10 U	100,000 UX	0.52	46.5	6.81

Table 4-3
Historical Groundwater Monitoring Results

Well Identification	Sample Date	Event	Analytical Results					Geochemistry Measurements		
			Sample Type	Fraction	Arsenic	Chromium	Hexavalent Chromium	Turbidity (NTU)	ORP (mV)	pH
MW043	10/24/2006	Event 01	N	T	35	2.1 J	1000 UX	1	-116	6.62
MW043	1/30/2007	Event 02	N	T	44	7.2 J	10000 UX	0.3	-105	7.01
MW043	4/24/2007	Event 03	N	T	37	6.4 J	1000 UX	0	-41	6.61
MW043	7/17/2007	Event 04	N	T	41	8.1 J	10000 UX	9	-109	6.37
MW043	10/23/2007	Event 05	N	T	42	4.7 J	1000 UX	2	-136	6.80
MW043	4/16/2008	Event 06	N	T	35	15	1000 UX	56	-80	6.46
MW043	10/28/2008	Event 07	N	T	42	8.3 J	100 UX	2.5	-121	7.68
MW043	4/16/2009	Event 08	N	T	35	64	1000 UX	26	-81	6.51
MW043	10/19/2009	Event 09	N	T	37	37	10000 UX	3	-111	6.73
MW043	4/27/2010	Event 10	N	T	5.3 J	2000	1300	6	74	6.46
MW043	10/27/2010	Event 11	N	T	21	1000	580	6	36	5.50
MW043	4/20/2011	Event 12	N	T	20	290	1000 UX	4.5	6	6.16
MW043	10/6/2011	Event 13	N	T	34	170	1000 UX	5	-16.6	6.07
MW043	10/17/2012	Event 14	N	T	24	220	10000 UX	2.88	89	6.32
MW043	10/28/2013	Event 15	N	T	6.3 J	2400	2300	4.12	147	6.58
MW043	10/20/2014	Event 16	N	T	3 J	3300 B	10,000 UX	8.99	80.1	6.58
MW044	10/24/2006	Event 01	N	T	17	0.9 J	1000 UX	4	-140	6.92
MW044	1/30/2007	Event 02	N	T	24	2.8 J	10000 UX	8.5	-78	6.60
MW044	4/24/2007	Event 03	N	T	18	10 U	10000 UX	5	-68	6.83
MW044	7/17/2007	Event 04	N	T	25	10 U	10000 UX	8	-135	6.40
MW044	10/23/2007	Event 05	N	T	19	10 U	10000 UX	17	-132	6.76
MW044	4/16/2008	Event 06	N	T	12	1.6 J	1000 UX	146	-87	6.80
MW044	10/28/2008	Event 07	N	T	14	10 U	1000 UX	24.7	-78	7.24
MW044	4/16/2009	Event 08	N	T	21	10 U	1000 UX	41	-80	6.12
MW044	10/21/2009	Event 09	N	T	14	10 U	10000 UX	9.3	-90	6.67
MW044	10/21/2009	Event 09	FD	T	18	10 U	10000 UX	9.3	-90	6.67
MW044	4/27/2010	Event 10	N	T	5.3 J	10 U	1000 UX	10	-21	7.09
MW044	10/27/2010	Event 11	N	T	10 U	10 U	1000 UX	6	-40	6.14
MW044	10/27/2010	Event 11	FD	T	6.4 J	10 U	1000 UX	6	-40	6.14
MW044	4/21/2011	Event 12	N	T	7 J	10 U	1000 UX	3.2	-77	6.65
MW044	10/5/2011	Event 13	N	T	11	10 U	1000 UX	0.8	-66.6	6.53
MW044	10/17/2012	Event 14	N	T	10 U	10 U	1000 UX	2.81	77.4	6.60
MW044	10/29/2013	Event 15	N	T	10 U	10 U	100 U	7.69	193.7	7.13
MW044	10/20/2014	Event 16	N	T	10 U	10 U	100,000 UX	2.73	7.91	6.71
MW045	10/25/2006	Event 01	N	T	17	10 U	10 U	9.8	-249	7.91
MW045	1/30/2007	Event 02	N	T	15	1.1 J	10 U	19	-297	8.26
MW045	4/24/2007	Event 03	N	T	22	10 U	2.6 J	2	-237	6.70
MW045	7/17/2007	Event 04	N	T	30	10 U	10 U	9	-264	7.42
MW045	10/23/2007	Event 05	N	T	22	10 U	10 U	43	-263	8.17
MW045	4/16/2008	Event 06	N	T	19	10 U	10 U	22	-233	8.16
MW045	10/29/2008	Event 07	FD	T	32	10 U	10 U	0	-235	9.11
MW045	10/29/2008	Event 07	N	T	33	10 U	10 U	0	-235	9.11
MW045	4/16/2009	Event 08	N	T	15	10 U	10 U	10	-236	7.40
MW045	10/20/2009	Event 09	N	T	29	10 U	4.2 J	0	-234	7.96
MW045	4/27/2010	Event 10	N	T	26	10 U	10 U	14	-215	8.07
MW045	10/27/2010	Event 11	N	T	32	10 U	10 U	4	-126	6.84
MW045	4/21/2011	Event 12	N	T	26	10 U	10 U	9.5	-234	7.56
MW045	10/4/2011	Event 13	N	T	42	10 U	1000 UX	16	-231.9	7.42
MW045	10/4/2011	Event 13	FD	T	40	10 U	100 U	16	-231.9	7.42
MW045	10/17/2012	Event 14	N	T	43	10 U	100 U	8.2	-193.1	7.50
MW045	10/29/2013	Event 15	N	T	46	10 U	1000 UX	10.4	-202.2	7.93
MW045	10/20/2014	Event 16	N	T	26	10 U	100000 UX	8.77	-196.4	7.51

Table 4-3
Historical Groundwater Monitoring Results

Well Identification	Sample Date	Event	Analytical Results					Geochemistry Measurements		
			Sample Type	Fraction	Arsenic	Chromium	Hexavalent Chromium	Turbidity (NTU)	ORP (mV)	pH
MW046	10/25/2006	Event 01	N	T	10 U	5.6 J	100000 UX	24	-12	5.85
MW046	1/30/2007	Event 02	N	T	5.3 J	6 J	100000 UX	0.1	-54	6.38
MW046	4/24/2007	Event 03	N	T	10 U	3.6 J	100000 UX	8	-22	5.91
MW046	7/17/2007	Event 04	N	T	7.1 J	2.8 J	100000 UX	0	-63	5.67
MW046	10/23/2007	Event 05	N	T	6.0 J	3.2 J	100000 UX	6	-60	5.96
MW046	4/16/2008	Event 06	N	T	10 U	1.9 J	100 UX	0	-53	6.10
MW046	10/29/2008	Event 07	N	T	6.6 J	10 U	100000 UX	0	-47	6.99
MW046	4/16/2009	Event 08	N	T	8.4 J	2.6 J	100000 UX	10	-31	5.78
MW046	10/20/2009	Event 09	N	T	10 U	10 U	10000 UX	0	-45	6.26
MW046	4/27/2010	Event 10	N	T	10 U	10 U	10000 UX	18	-35	6.19
MW046	10/27/2010	Event 11	N	T	10 U	10 U	10000 UX	7	-22	6.45
MW046	4/21/2011	Event 12	N	T	6.4 J	10 U	10000 UX	9	-51	6.21
MW046	10/4/2011	Event 13	N	T	7 J	10 U	10000 UX	9.2	-86.3	6.27
MW046	10/17/2012	Event 14	N	T	3.3 J	10 U	10000 UX	1.84	-16.1	6.22
MW046	10/29/2013	Event 15	N	T	7.4 J	10 U	10000 UX	20.5	-30.3	6.61
MW046	10/20/2014	Event 16	N	T	10 U	10 U	10000 UX	9.13	-54.9	6.62
MW047	10/25/2006	Event 01	N	T	9.7 J	**2900**	1000 UX	9.8	-44	6.32
MW047	1/30/2007	Event 02	N	T	**15**	**3200**	10000 UX	32.2	-143	6.99
MW047	4/24/2007	Event 03	N	T	**38**	**460**	10000 UX	0	-111	6.58
MW047	7/17/2007	Event 04	N	T	6.0 J	**5400**	**1400**	8	49	6.06
MW047	10/23/2007	Event 05	N	T	**11**	**4800**	10000 UX	81	-44	6.34
MW047	2/11/2008	Event 5A	FD	T	3.8 J	**4700**	**220**	2	-106	6.50
MW047	2/11/2008	Event 5A	N	T	3.9 J	**4100**	**4100**	2	-106	6.50
MW047	4/16/2008	Event 06	N	T	10 J	**4000**	10000 UX	104	-61	6.37
MW047	10/28/2008	Event 07	N	T	6.2 J	**4500**	**3700**	34.5	-235	9.11
MW047	4/16/2009	Event 08	N	T	**18**	**1400**	10000 UX	29	-142	6.50
MW047	10/21/2009	Event 09	N	T	**14**	**1400**	10000 UX	10.4	4	6.13
MW047	4/27/2010	Event 10	N	T	9.9 J	**420**	1000 UX	8	10	5.92
MW047	10/27/2010	Event 11	N	T	**11**	**280**	10000 UX	8	-21	5.78
MW047	4/21/2011	Event 12	N	T	**12**	**92**	10000 UX	2.1	4	5.80
MW047	10/6/2011	Event 13	N	T	**11**	**55**	10000 UX	2	6.9	5.78
MW047	10/17/2012	Event 14	N	T	5 J	**14**	100 UX	2.08	155.1	5.60
MW047	10/17/2012	Event 14	FD	T	5 J	13	100 UX	2.08	155.1	5.60
MW047	10/29/2013	Event 15	N	T	8.3 J	**32**	1000 UX	0.78	85.2	6.26
MW047	10/21/2014	Event 16	N	T	10 U	**28 B**	1000 UX	0.77	-215.2	6.28
MW048	10/25/2006	Event 01	N	T	7.6 J	2 J	10000 UX	2	58	5.89
MW048	1/30/2007	Event 02	FD	T	7.5 J	0.82 J	10 U	0	507	6.45
MW048	1/30/2007	Event 02	N	T	7.2 J	1 J	**11**	0	507	6.45
MW048	4/27/2007	Event 03	FD	T	4.2 J	10 U	10 U	5	501	5.97
MW048	4/27/2007	Event 03	N	T	4.4 J	10 U	10 U	5	501	5.97
MW048	7/18/2007	Event 04	N	T	10 U	10 U	10000 UX	0	68	5.69
MW048	10/23/2007	Event 05	N	T	10 U	10 U	100 UX	0	77	5.93
MW048	4/16/2008	Event 06	FD	T	10 U	10 U	10 U	5	155	6.15
MW048	4/16/2008	Event 06	N	T	10 U	10 U	10 U	5	155	6.15
MW048	10/28/2008	Event 07	N	T	10 U	10 U	100 UX	0	74	6.38
MW048	4/16/2009	Event 08	N	T	10 U	10 U	10 U	4	358	6.11
MW048	10/20/2009	Event 09	N	T	10 U	10 U	100 UX	3.2	82	6.13
MW048	10/20/2009	Event 09	FD	T	10 U	10 U	100 UX	3.2	82	6.13
MW048	4/27/2010	Event 10	N	T	10 U	10 U	10 U	0	93	6.20
MW048	10/27/2010	Event 11	N	T	10 U	10 U	100 UX	2	51	5.73
MW048	4/21/2011	Event 12	N	T	10 U	10 U	10000 UX	0	79	6.08
MW048	10/5/2011	Event 13	N	T	10 U	10 U	100 UX	0.1	58.8	6.04
MW048	10/17/2012	Event 14	N	T	3.6 J	0.58 J	100 U	0.94	98.2	5.99
MW048	10/29/2013	Event 15	N	T	3.1 J	10 U	100 U	0.34	75.7	6.15
MW048	10/21/2014	Event 16	N	T	10 U	10 U	100 U	0.23	-70	6.10

Table 4-3
Historical Groundwater Monitoring Results

Well Identification	Sample Date	Event	Analytical Results					Geochemistry Measurements		
			Sample Type	Fraction	Arsenic	Chromium	Hexavalent Chromium	Turbidity (NTU)	ORP (mV)	pH
MW049	10/25/2006	Event 01	N	T	10 U	3.8 J	1000 UX	0	-127	6.91
MW049	1/31/2007	Event 02	N	T	10 U	**80**	1000 UX	74.2	-42	6.84
MW049	4/26/2007	Event 03	N	T	6.3 J	**48**	10000 UX	26	-112	6.46
MW049	7/18/2007	Event 04	N	T	3.9 J	**150**	10000 UX	126	-118	6.43
MW049	10/25/2007	Event 05	N	T	10 U	**17**	10 U	113	-83	6.66
MW049	4/15/2008	Event 06	N	T	10 U	**36**	10 U	132	-180	6.92
MW049	10/30/2008	Event 07	N	T	10 U	9.5 J	10 U	13.2	-174	8.32
MW049	4/16/2009	Event 08	N	T	10 U	**13**	1000 UX	15	-166	7.02
MW050	10/25/2006	Event 01	N	T	6.6 J	4.3 J	10 U	0	-172	7.35
MW050	1/31/2007	Event 02	N	T	7.1 J	3.8 J	10 U	0	-181	7.90
MW050	4/26/2007	Event 03	N	T	4.1 J	3.9 J	10 U	0	-188	7.41
MW050	7/18/2007	Event 04	N	T	6.1 J	4.9 J	10 U	9	-220	7.11
MW050	10/25/2007	Event 05	N	T	10 U	6.4 J	10 U	0	-172	7.61
MW050	4/15/2008	Event 06	N	T	10 U	4.0 J	10 U	76	-249	7.67
MW050	10/30/2008	Event 07	FD	T	5.7 J	3.0 J	10 U			
MW050	10/30/2008	Event 07	N	T	10 U	3.4 J	10 U	0	-210	9.19
MW050	4/16/2009	Event 08	N	T	10 U	4.3 J	10 U	34	-284	7.66
MW051	10/25/2006	Event 01	N	T	10 U	2.7 J	1000 UX	0	-353	7.73
MW051	1/31/2007	Event 02	N	T	10 U	10 U	100 UX	<1	-227	7.96
MW051	4/24/2007	Event 03	N	T	10 U	3 J	100 UX	0	-314	7.65
MW051	7/18/2007	Event 04	FD	T	10 U	10 U	10000 UX			
MW051	7/18/2007	Event 04	N	T	10 U	10 U	10000 UX	7	-352	7.35
MW051	10/25/2007	Event 05	N	T	10 U	10 U	100 UX	0	-324	7.84
MW051	4/15/2008	Event 06	N	T	10 U	1.3 J	1000 UX	0.5	-307	7.47
MW051	10/29/2008	Event 07	N	T	10 U	10 U	100 UX	0	-333	9.73
MW051	4/16/2009	Event 08	N	T	10 U	10 U	100 UX	32	-349	7.46
MW052	10/25/2006	Event 01	FD	T	10 U	1.2 J	1000 UX			
MW052	10/25/2006	Event 01	N	T	10 U	1.2 J	1000 UX	3	71	6.06
MW052	1/31/2007	Event 02	N	T	10 U	1 J	1000 UX	2.2	162	6.55
MW052	4/27/2007	Event 03	N	T	10 U	10 U	100 UX	9	117	6.06
MW052	7/18/2007	Event 04	N	T	10 U	10 U	10000 UX	7	52	5.81
MW052	10/23/2007	Event 05	N	T	10 U	10 U	1000 UX	6	38	5.99
MW052	4/15/2008	Event 06	N	T	10 U	1.5 J	100 UX	5.1	108	5.63
MW052	10/29/2008	Event 07	N	T	10 U	10 U	1000 UX	0	24	6.55
MW052	4/16/2009	Event 08	N	T	10 U	10U	100 UX	47	124	6.01
MW052	10/20/2009	Event 09	N	T	10 U	10U	1000 UX	6.2	60	6.03
MW052	4/28/2010	Event 10	N	T	10 U	10 U	10 U	4	167	5.86
MW053	10/26/2006	Event 01	N	T	**12**	1.2 J	1000 UX	0	0	6.60
MW053	1/31/2007	Event 02	N	T	8.2 J	10 U	1000 UX	12.7	-90	7.09
MW053	4/27/2007	Event 03	N	T	8.6 J	10 U	10000 UX	77	-100	6.50
MW053	7/18/2007	Event 04	N	T	**22**	6.6 J	10000 UX	30	-130	6.38
MW053	10/24/2007	Event 05	N	T	**21**	2.8 J	10000 UX	11	-107	6.53
MW053	4/15/2008	Event 06	N	T	**21**	4.6 J	10000 UX	30.4	-84	6.38
MW054	10/26/2006	Event 01	N	T	**220**	2 J	10000 UX	0	-169	6.66
MW054	1/31/2007	Event 02	N	T	**140**	0.91 J	10000 UX	39.7	-164	7.11
MW054	4/27/2007	Event 03	N	T	**98**	10 U	100000 UX	9	-157	6.59
MW054	7/19/2007	Event 04	N	T	7.8 J	5.4 J	1000 UX	248	-72	6.34

Table 4-3
Historical Groundwater Monitoring Results

Well Identification	Sample Date	Event	Analytical Results					Geochemistry Measurements		
			Sample Type	Fraction	Arsenic	Chromium	Hexavalent Chromium	Turbidity (NTU)	ORP (mV)	pH
MW054	10/25/2007	Event 05	N	T	**18**	10 U	100000 UX	0	-146	6.70
MW054R	4/17/2009	Event 08	N	T	**19 ***	10 U *	10000 UX *	10	-158	6.76
MW054RR	10/28/2010	Event 11	N	T	**50**	10 U	10000 UX	10	-130	6.22
MW054RR	4/22/2011	Event 12	N	T	**78**	10 U	10000 UX	1.7	-175	6.87
MW054RR	10/7/2011	Event 13	N	T	**150**	0.27 J	10000 UX	7	-144	6.82
MW054RR	10/18/2012	Event 14	N	T	**140**	0.35 J	10000 UX	9.81	-108.7	6.78
MW054RR	10/30/2013	Event 15	N	T	**64**	10 U	1000 UX	23	-111.7	7.03
MW055	10/26/2006	Event 01	N	T	7.3 J	1 J	100000 UX	22	25	5.90
MW055	1/31/2007	Event 02	N	T	10 U	0.68 J	10000 UX	16.2	144	5.84
MW055	4/27/2007	Event 03	N	T	8.8 J	10 U	10000 UX	25	14	5.78
MW055	7/19/2007	Event 04	FD	T	9.5 J	10 U	1000 UX	25	14	5.78
MW055	7/19/2007	Event 04	N	T	8.5 J	10 U	1000 UX	83	39	5.39
MW055	10/25/2007	Event 05	N	T	6.6 J	10 U	10000 UX	0	47	5.46
MW055	10/30/2008	Event 07	N	T	6.4 J	10 U	1000 UX	27.8	73	5.83
MW055	10/21/2009	Event 09	N	T	7.8 J	10 U	10000 UX	18.4	115	5.03
MW055	4/28/2010	Event 10	N	T	7 J	10 U	10000 UX	4	105	4.96
MW055	4/28/2010	Event 10	FD	T	8.2 J	10 U	10000 UX	4	105	4.96
MW055	10/28/2010	Event 11	N	T	7.1 J	10 U	10000 UX	29	108	4.27
MW055	10/28/2010	Event 11	FD	T	6.5 J	10 U	10000 UX	29	108	4.27
MW055	4/22/2011	Event 12	N	T	9.3 J	10 U	100000 UX	15	134	4.74
MW055	10/7/2011	Event 13	N	T	7.8 J	1.1 J	10000 UX	14	138	4.75
MW055	10/18/2012	Event 14	N	T	4.9 J	0.9 J	10000 UX	6.39	-185.7	5.07
MW055	10/30/2013	Event 15	N	T	6 J	0.7 J	10000 UX	14.6	175.4	3.59
MW055	10/21/2014	Event 16	N	T	10 U	0.56 JB	10000 UX	8.61	109.8	4.42
MW056	10/26/2006	Event 01	N	T	10 U	0.86 J	100 UX	0	-5	6.23
MW056	1/31/2007	Event 02	FD	T	10 U	10 U	100 UX	0	48	6.67
MW056	1/31/2007	Event 02	N	T	10 U	0.8 J	100 UX	0	48	6.67
MW056	4/27/2007	Event 03	N	T	10 U	10 U	100 UX	0	25	6.18
MW056	10/25/2007	Event 05	N	T	10 U	44	100 UX	40	21	6.19
MW056	10/28/2010	Event 11	N	T	6.4 J	5.9 J	1000 UX	8	-111	5.52
MW057	10/26/2006	Event 01	N	T	7.1 J	0.82 J	1000 UX	0	-78	7.03
MW057	1/31/2007	Event 02	N	T	9.4 J	1.4 J	1000 UX	3.8	-78	7.17
MW057	4/27/2007	Event 03	N	T	7.8 J	10 U	1000 UX	7	-88	6.75
MW057	7/19/2007	Event 04	N	T	4.5 J	10 U	100 UX	44	-58	6.63
MW057	10/24/2007	Event 05	FD	T	10 U	10 U	100 UX	0	-72	6.94
MW057	10/24/2007	Event 05	N	T	4.8 J	10 U	100 UX	0	-72	6.94
MW057R	10/21/2009	Event 09	N	T	6.4 J	10 U	100 UX	8.4	-52	7.06
MW057R	4/28/2010	Event 10	N	T	10 U	10 U	100 UX	10	-101	6.70
MW057R	10/28/2010	Event 11	N	T	10 U	10 U	100 UX	4	-36	6.38
MW057R	4/22/2011	Event 12	N	T	10 U	10 U	10 U	1	-9	6.80
MW057R	10/7/2011	Event 13	N	T	10 U	10 U	100 UX	0.2	-76.9	6.82
MW057R	10/18/2012	Event 14	N	T	10 U	0.26 J	10 U	0.66	-218.7	6.88
MW057R	10/30/2013	Event 15	FD	T	10 U	10 U	100 U	0.54	-60.2	7.11
MW057R	10/30/2013	Event 15	N	T	2.7 J	10 U	100 U	0.54	-60.2	7.11
MW057R	10/21/2014	Event 16	N	T	10 U	10 U	100 U	0.18	-35.4	6.84
MW058	10/26/2006	Event 01	FD	T	10 U	2 J	100 UX	7.9	-38	6.82
MW058	10/26/2006	Event 01	N	T	10 U	2.2 J	100 UX	7.9	-38	6.82
MW058	1/31/2007	Event 02	N	T	3.9 J	0.97 J	100 UX	4.7	-6	7.24
MW058	4/27/2007	Event 03	FD	T	10 U	10 U	1000 UX	10	-31	6.55
MW058	4/27/2007	Event 03	N	T	4.9 J	10 U	1000 UX	10	-31	6.55
MW058	10/24/2007	Event 05	N	T	10 U	4.5 J	100 UX	0	-59	7.01
MW058	10/21/2009	Event 09	N	T	**16**	**59**	1000 UX	2.9	-105	7.09
MW058	4/28/2010	Event 10	N	T	**22**	**32**	1000 UX	52	-260	6.60
MW058	4/22/2011	Event 12	N	T	**14**	10 U	1000 UX	1	-118	6.64
MW058	10/7/2011	Event 13	N	T	**20**	7.9 J	10000 UX	3.6	-104.5	6.38

Table 4-3
Historical Groundwater Monitoring Results

Well Identification	Sample Date	Event	Analytical Results					Geochemistry Measurements		
			Sample Type	Fraction	Arsenic	Chromium	Hexavalent Chromium	Turbidity (NTU)	ORP (mV)	pH
MW059	10/25/2006	Event 01	N	T	10 U	1.8 J	100 UX	0	-39	6.37
MW059	1/30/2007	Event 02	N	T	10 U	1.8 J	1000 UX	1.1	-2	6.44
MW059	4/24/2007	Event 03	N	T	10 U	10 U	100 UX	1	95	6.12
MW059	7/18/2007	Event 04	N	T	10 U	10 U	10 U	3	28	3.16
MW059	10/25/2007	Event 05	N	T	10 U	10 U	1000 UX	0	-1	6.35
MW059	4/15/2008	Event 06	N	T	10 U	1.5 J	1000 UX	1	46	5.99
MW059	10/29/2008	Event 07	N	T	10 U	2.8 J	100 UX	0	-7	7.14
MW059	4/16/2009	Event 08	N	T	10 U	10 U	10 U	25	34	6.04
MW060	2/11/2008	Event 5A	N	T	5.0 J	**2400**	**220**	7	155	6.39
MW060	4/17/2008	Event 06	N	T	10 U	**3100**	**3300**	17.7	208	6.51
MW060	10/27/2008	Event 07	N	T	7.5 J	**2800**	**2900**	10	81	6.76
MW060	4/17/2009	Event 08	N	T	10 U *	**3900 ***	**3800 ***	9	135	6.46
MW060	10/19/2009	Event 09	N	T	**35**	**2000**	1000 UX	8	-8	6.36
MW060	4/26/2010	Event 10	N	T	**24**	**2700**	1000 UX	100	91	5.86
MW060	10/26/2010	Event 11	N	T	**28**	**2100**	10000 UX	8	-6	5.40
MW060	4/20/2011	Event 12	N	T	**27**	**1100**	10000 UX	8.5	-42	5.97
MW060	10/5/2011	Event 13	N	T	**14**	**1400**	10000 UX	36	-40.2	6.06
MW060	10/16/2012	Event 14	N	T	**13**	**890**	100000 UX	10.2	8.2	6.07
MW060	10/28/2013	Event 15	N	T	3.2 J	**1800**	**230**	28.6	162.1	6.02
MW060	10/14/2014	Event 16	N	T	2.8 J	**1600**	**1400**	9.86	83.2	5.87
MW061	2/11/2008	Event 5A	N	T	4.6 J	**60**	**73**	0	260	6.22
MW061	4/16/2008	Event 06	N	T	10 U	**210**	**220**	0	329	6.30
MW061	10/28/2008	Event 07	N	T	10 U	**240**	**190**	3	90	6.67
MW061	4/16/2009	Event 08	N	T	10 U	**270**	**250**	5	216	6.36
MW061	10/20/2009	Event 09	N	T	**25**	**59**	10000 UX	4.1	-84	6.35
MW061	4/27/2010	Event 10	N	T	**18**	**170**	100000 UX	0	-60	6.28
MW061	4/27/2010	Event 10	FD	T	**24**	**180**	100000 UX	0	-60	6.28
MW061	10/27/2010	Event 11	N	T	**29**	**380**	10000 UX	6	37	5.90
MW061	4/21/2011	Event 12	N	T	**29**	**380**	10 U	1	-83	6.17
MW061	10/6/2011	Event 13	N	T	**34**	**2100**	10000 UX	11	-51.8	6.18
MW061	10/17/2012	Event 14	N	T	**59**	**6300**	**6800**	1.33	97.8	6.44
MW062	2/11/2008	Event 5A	N	T	10 U	**17**	100 UX	3	-288	7.13
MW062	4/15/2008	Event 06	N	T	10 U	8.5 J	1000 UX	0	-291	7.04
MW062	10/29/2008	Event 07	N	T	10 U	6.3 J	100 UX	0	-306	9.31
MW062	4/16/2009	Event 08	FD	T	10 U	**11**	100 UX	3	-305	6.99
MW062	4/16/2009	Event 08	N	T	10 U	**11**	100 UX	3	-305	6.99
MW062	10/20/2009	Event 09	N	T	10 U	**17**	1000 UX	0	-325	7.43
MW062	4/28/2010	Event 10	N	T	10 U	9.7 J	1000 UX	6	-260	7.24
MW062	10/27/2010	Event 11	N	T	20 U	7.5 J	1000 UX	2	-275	6.69
MW062	4/21/2011	Event 12	N	T	10 U	8.2 J	100 UX	0	-295	7.13
MW062	10/4/2011	Event 13	N	T	10 U	**19**	1000 UX	3	-304.1	6.80
MW062	10/18/2012	Event 14	N	T	10 U	8.7 J	10 U	0.41	-236.2	7.03
MW062	10/18/2012	Event 14	FD	T	10U	7.9 J	10U	0.41	-236.2	7.03
MW062	10/30/2013	Event 15	N	T	3.9 J	4.4 J	100 UX	2.11	-268.3	7.16
MW062	10/21/2014	Event 16	N	T	10 U	3.5 JB	1000 UX	1.64	-315.4	7.12

Notes:

All units are micrograms per liter (µg/L) unless noted otherwise.

B	=	Analyte detected in method blank at estimated concentrations that did not significantly affect results.
NTU	=	Nephelometric Turbidity Units
mV	=	millivolts
N	=	Normal
FD	=	Field duplicate
U	=	Parameter not detected above the reporting limit.
J	=	Estimated concentration less than the reporting limit but greater than or equal to the method detection limit.
X	=	Detection limits are elevated due to matrix interference
*	=	Concentration corrected; see October 2010 Monitoring Report for details.

Blank cells indicate the parameter was not analyzed.

Bold values are detections above the reporting limit.

Yellow shading indicate value is greater than the cleanup goal of 100 µg/L for Cr or Cr(VI)