

FIVE-YEAR REVIEW REPORT

**Fifth Five-Year Review Report
For
Broderick Wood Products Superfund Site
Unincorporated Adams County, Colorado**

September 2016

Prepared By:

**REGION 8
UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
DENVER, COLORADO**

Approved by:



Martin Hestmark
Assistant Regional Administrator
Office of Ecosystems Protection and Remediation

Date:

9/29/16

Table of Contents

List of Acronyms	iii
Executive Summary	iv
Five-Year Review Summary Form	v
I. Introduction	1
II. Site Chronology	2
III. Background	3
A. Location.....	3
B. History	3
C. History of Contamination.....	5
IV. Remedial Actions	6
A. Remedial Investigation/Feasibility Study (RI/FS)	6
B. Remedy Selection/Implementation	7
C. Modifications to Original Remedy Due to UPRR Project	8
D. Operation & Maintenance (O&M)	10
E. Groundwater Monitoring	18
V. Redevelopment Activities	18
VI. Financial Status of PRP	19
VII. Progress Since Last Five-Year Review	19
VIII. Five-Year Review Process	19
IX. Five-Year Review Findings	20
A. Inspection of the Site	20
B. Applicable or Relevant and Appropriate Requirements.....	20
X. Data Review – O&M Components	20
A. Packaged Water Treatment System (PWTS).....	21
B. Former Impoundment Area.....	21
C. North Boundary Cutoff Trench and North Soil Bentonite Cutoff Wall	21
D. West Boundary Cutoff Trench and West Soil Bentonite Cutoff Wall	22
E. East Soil Bentonite Cutoff Wall.....	22
XI. Data Review - Groundwater Monitoring	22
XII. Assessment	23
<i>Question A: Is the remedy functioning as intended by the decision documents? No.</i>	23
<i>Question B: Are the assumptions used at the time of the remedy selection still valid? Yes.</i>	25
<i>Question C: Is there other information that calls into question the protectiveness of the remedy? No.</i>	25
XIII. Issues	26
XIV. Recommendations and Follow-Up Actions	26
XV. Protectiveness Statement	26
XVI. Next Review	26

Tables

Table 1: Chronology of Site Events	2
Table 2: Chemicals Used at Site	5
Table 3: Contaminants above LTU Treatment Standards in the Former Process Area	13
Table 4: Issues.....	26
Table 5: Recommendations and Follow-Up Actions.....	26

Figures

Figure 1: Site Map	4
Figure 2: Points of Compliance	9

List of Acronyms

ARARs	Applicable or Relevant and Appropriate Requirements
BIC	Broderick Investment Company
BWP	Broderick Wood Products
CD	Consent Decree
CDPHE	Colorado Department of Public Health and Environment
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
DMR	Discharge Monitoring Report
DNAPL	Dense Nonaqueous Phase Liquid
EPA	Environmental Protection Agency
ESD	Explanation of Significant Differences
FS	Feasibility Study
GAC	Granular Activated Carbon
HASP	Health and Safety Plan
LTU	Land Treatment Unit
NAPL	Nonaqueous Phase Liquids
NBC	North Boundary Cutoff
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NPL	National Priorities List
O&M	Operations and Maintenance
OU1	Operable Unit 1
OU2	Operable Unit 2
PAH	Polynuclear Aromatic Hydrocarbons
PCP	Pentachlorophenol
POC	Point of Compliance
PRP	Potentially Responsible Party
PWTS	Packaged Water Treatment System
RA	Remedial Action
RAO	Remedial Action Objective
RCRA	Resource Conservation and Recovery Act
RD/RA	Remedial Design/Remedial Action
RETEC	Remediation Technologies Inc.
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
SBCW	Soil-Bentonite Cutoff Wall
SOW/RAP	Statement of Work/Remedial Action Plan
TBC	To Be Considered
TWP	Trench Well Points
UPRR	Union Pacific Railroad
URSC	United Railroad Services Company
VOCs	Volatile Organic Compounds
WET	Whole Effluent Toxicity

Executive Summary

The U. S. Environmental Protection Agency (EPA) Region 8 has conducted the fifth five-year review of the remedial actions implemented at the Broderick Wood Products Superfund Site (Site) in unincorporated Adams County, Colorado. The review was conducted from January through August 2016.

The results of the five-year review indicate that the remedial action for Operable Unit 1 (OU1) of the Site is protective of human health and the environment. The remedial action for OU2 is not protective of human health and the environment. Because OU2 is not protective, the Site is not protective of human health and the environment.

The remedial action at OU2 is not protective because operation, maintenance and monitoring activities have only been conducted on a limited/sporadic basis since 2012. This is mainly due to the Potentially Responsible Party's limited financial resources and the difficulties encountered when attempting to upgrade the water treatment system to meet the more stringent requirements of a 2013 Colorado Wastewater Discharge Permit System discharge permit.

The remedy must be returned to normal operation, maintenance and monitoring to ensure protectiveness.

Five-Year Review Summary Form

SITE IDENTIFICATION		
Site name: Broderick Wood Products Superfund Site		
EPA ID: C0D000110254		
Region: 8	State: CO	City/County: Unincorporated Adams County
SITE STATUS		
NPL status: <input checked="" type="checkbox"/> Final <input type="checkbox"/> Deleted		
Remediation status (choose all that apply): <input type="checkbox"/> Under Construction <input checked="" type="checkbox"/> Operating <input type="checkbox"/> Complete		
Multiple OUs? <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO	Construction completion date: 9/30/96	
Has site been put into reuse? <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO		
REVIEW STATUS		
Reviewing agency: <input checked="" type="checkbox"/> EPA <input type="checkbox"/> State <input type="checkbox"/> Tribe <input type="checkbox"/> Other Federal Agency		
Author name: Armando Saenz		
Author title: RPM	Author affiliation: Region 8	
Review period: January to August 2016		
Date(s) of site inspection: August 24, 2016		
Type of review: <input checked="" type="checkbox"/> Statutory <input type="checkbox"/> Policy <input type="checkbox"/> Post-SARA		
Review number: <input type="checkbox"/> 1(first) <input type="checkbox"/> 2 (second) <input type="checkbox"/> 3 (third) <input checked="" type="checkbox"/> 5 (fifth)		
Triggering action: <input type="checkbox"/> Actual RA Onsite Construction <input type="checkbox"/> Actual RA Start at OU# ____ <input type="checkbox"/> Construction Completion <input checked="" type="checkbox"/> Previous Five-Year Review Report		
Triggering action date: 9/27/11		
Due date (five years after triggering action date): 9/27/16		

Issues/Recommendations				
OU(s) without Issues/Recommendations Identified in the Five-Year Review:				
OU1				
Issues and Recommendations Identified in the Five-Year Review:				
OU(s): OU2	Issue Category: Operation & Maintenance			
	Issue: Since 2012, O&M and monitoring activities have only been conducted on a limited/sporadic basis.			
	Recommendation: Return remedy to normal operation, maintenance and monitoring.			
Affect Current Protectiveness	Affect Future Protectiveness	Implementing Party	Oversight Party	Milestone Date
Yes	Yes	PRP	EPA & CDPHE	12/31/17
Protectiveness Statement(s)				
<i>Operable Unit:</i> OU1		<i>Protectiveness Determination:</i> Protective		
<i>Protectiveness Statement:</i> OU1 is protective of human health and the environment.				
<i>Operable Unit:</i> OU2		<i>Protectiveness Determination:</i> Not Protective		
<i>Protectiveness Statement:</i> OU2 is not protective of human health and the environment.				
Sitewide Protectiveness Statement				
<i>Protectiveness Determination:</i> Not Protective			<i>Addendum Due Date (if applicable):</i> Click here to enter date.	
<i>Protectiveness Statement:</i> Because OU2 is not protective, the Site is not protective of human health and the environment.				

Broderick Wood Products Superfund Site Fifth Five-Year Review Report

I. Introduction

The U. S. Environmental Protection Agency (EPA) Region 8 has conducted the fifth five-year review of the remedial actions implemented at the Broderick Wood Products (BWP) Superfund Site (Site) in unincorporated Adams County, Colorado. The purpose of five-year reviews is to determine whether the remedy at a site is protective of human health and the environment. The methods, findings, and conclusions of the review are documented in the five-year review report. In addition, the five-year review report identifies issues related to human health and the environment found during the review, if any, and identifies recommendations to address those issues. This five-year review was conducted from January through August 2016.

EPA is preparing this five-year review report pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). CERCLA 121(c), as amended, states:

If the President selects a remedial action that results in any hazardous substances, pollutants, or contaminants remaining at the site, the President shall review such remedial action no less often than each five years after the initiation of such remedial action to assure that human health and the environment are being protected by the remedial action being implemented.

EPA interpreted this requirement further in the NCP; 40 CFR part 300.430(f)(4)(ii) states:

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

This is the fifth five-year review of the Site. The trigger action for this review is the completion of the fourth five-year review dated September 27, 2011. The five-year review is required due to the fact that hazardous substances, pollutants, or contaminants remain at the Site above levels that allow for unrestricted use and unlimited exposure.

II. Site Chronology

Table 1: Chronology of Site Events

Date	Event
1946	Operations begin at the Site
12/45	W. S. Broderick purchases Site
8/1/80	Site Discovery
11/01/81	Wood treatment operations ceased
3/84	Phase I Investigation Report
9/21/84	NPL listing
5/21/86	Consent Decree with workplan for Phase II & Phase III RI/FS
11/5/87	Phase II RI/FS Report with supplement
6/30/88	ROD issued for OU-1
9/25/89	RA for OU-1(Step 1) - start
5/4/90	RA for OU-1 (Step 1) - complete
12/90	Phase III RI Report
7/11/91	Phase III FS Report with addendum
9/24/91	ROD amendment for OU-1
3/24/92	ROD for OU-2
6/29/92	RA for OU-1 (Step 2) - start
7/13/93	RA for OU-2 (Stage 1) - start
12/30/93	RA for OU-1 (Step 2) - complete
4/27/94	RA for OU-2 (Stage 1) - complete
3/24/95	ESD for OU-2
3/24/95	First Five-Year Review Report
1/95	Consent Decree signed for OU-2 (Stage 2) RD/RA and Full Operations
5/1/95	RA for OU-2 (Stage 2) - start
8/23/96	RA for OU-2 (Stage 2) - complete
9/30/96	Construction Completion for Site
1/18/01	Second Five-Year Review Report
7/14/04	UPRR Project - start
11/30/04	UPRR Project - complete
9/25/06	Third Five-Year Review Report
3/09	Remedy put into an “environmental protection/observation mode”
9/27/11	Fourth Five-Year Review Report

III. Background

A. Location

The triangular-shaped Site is located at 5800 Galapago Street in unincorporated Adams County, approximately one-half mile west of the intersection of Interstate Highway 25 and West 58th Avenue. The northern edge is bounded by the Fisher Ditch, an open unlined irrigation canal. The western edge is bounded by the Burlington Northern Santa Fe (BNSF) rail line tracks. The eastern edge is bounded by the Union Pacific Railroad Company (UPRR) rail line tracks. The southern point is approximately the crossing of the BNSF and UPRR tracks. See Figure 1.

Clear Creek is approximately three fourths of a mile north of the Site. The creek is a major South Platte River tributary, which flows to the northeast. Several lakes are located less than one mile from the Site. Gordon Lake is located approximately 0.4 miles to the northwest and Copeland Lake is located approximately 0.6 miles to the east. The former Dewey Lake was located 0.3 miles east of the Site. The owner of Dewey Lake, XCEL Energy, allowed the lake to empty after it stopped diverting water to it. This took the lake out of service.

The topography is generally flat, sloping slightly from south to north. There are three hydrostratigraphic units at the Site. These units are the surficial aquifer alluvium and weathered Denver Formation, the unweathered Denver aquifer and the upper Arapahoe aquifer.

B. History

W. S. Broderick purchased the majority of what is now the Site in December 1945. The remaining parcel to the west was purchased from the Chicago Burlington and Quincy Railroad Company in 1969. Prior to the Broderick purchase, the land had been owned by a variety of individuals, railroad companies and mineral processing or smelting companies. The first records of land use of the property were for construction of irrigation ditches granted through irrigation rights-of-way. In 1871, the Mountain Water Company constructed a ditch flowing west to east that just touches the southern tip of the Site before it continued on to Dewey Lake. Fisher Ditch runs west to east along the northern boundary of the Site and was constructed in 1873. This ditch carries water from Clear Creek to Copeland Lake. A lateral of the Fisher Ditch, termed the South Ditch, crossed the northeast corner of the site but was replaced by buried pipeline in 1975.

Railroad rights-of-way were granted soon after the irrigation rights-of-way. Beginning in 1881 numerous railroad companies constructed and operated different sections of track within and adjacent to the Site. At one time, the railroads maintained buildings and an engine house on the property. Currently, the Site is bounded by railroad tracks on the west and east sides.

The northeast corner was owned by mineral processing or smelting companies from 1904 to 1908. However, there are no historical records indicating smelting activities on the property.

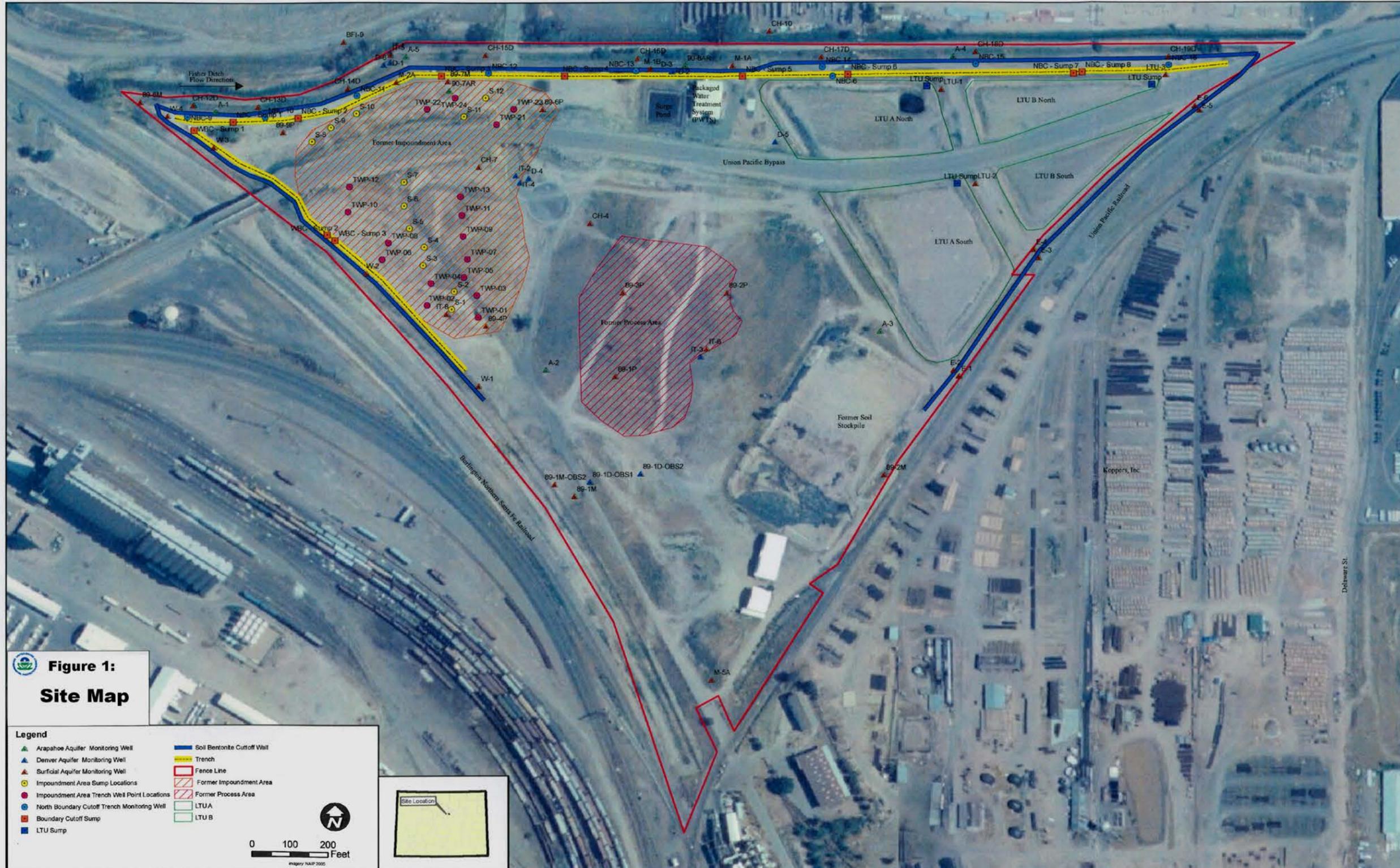


Figure 1: Site Map

C. History of Contamination

BWP operated a wood treating facility from 1947 to 1982 on the 64-acre triangular shaped piece of property. As part of the wood treatment process, BWP used creosote and pentachlorophenol (PCP) to treat power poles, fence posts, railroad ties and other wood products. Hazardous substances from the process were primarily disposed of in two unlined impoundments in the northwest portion of the property. The wood treatment process required the purchase of a number of different products over the years as shown in Table 2.

Table 2: Chemicals Used at Site

Product	Amount	Purchase Dates
Creosote	13 million gallons	1947 to 1981
Pentachlorophenol	2,200 tons	1953 to 1981
Penta Oil #2 *	11 million gallons	1947 to 1982
Penta Oil #1 *	900,000 gallons	1959 to 1973

* - The fuel oil was used as a carrier for the PCP and creosote during the treatment process.

In August 1980, BWP submitted a Resource Conservation and Recovery Act (RCRA) permitting application and obtained interim status to operate its facility. As a result of poor waste disposal practices, BWP was investigated numerous times by the EPA and the Colorado Department of Public Health and the Environment (CDPHE). In 1981 and 1982, EPA noted several violations of RCRA requirements. In 1981, wood treatment operations ceased due to economic conditions and BWP's assets were transferred to a trust called the Broderick Investment Company (BIC). BIC became the Potentially Responsible Party (PRP) for the Site.

In early 1983, sampling was conducted and PCP was detected in soil and groundwater samples. The primary contaminants of concern are poly-nuclear aromatic hydrocarbons (PAHs), acid extractable compounds (principally PCP and other chlorinated phenolic compounds), dioxins and furans, volatile organic compounds (principally benzene, ethyl benzene, toluene, and xylene), and some toxic metals (principally arsenic, cadmium, lead, and zinc).

The main areas of concern included the former wood treatment process area, the yard area used for storage/drying and the wastewater impoundments. The wood treatment process area was located in the center of the property and contained catchment basins, above-ground storage tanks, sheds, shops, offices and a change house. The impoundments, located in the northwest portion of the property, included the main and secondary impoundments that received wastewaters during treatment operations. The yard area, located in the central portion of the property, was used to store and dry the treated wood.

IV. Remedial Actions

A. Remedial Investigation/Feasibility Study (RI/FS)

The Site was placed on the National Priorities List (NPL) in September 1984. Prior to the listing, BWP initiated preliminary site investigation activities that were later designated as Phase I activities. The results of these activities were reported in March 1984. Several conclusions were made in the Phase I Report based on the activities conducted at that time. With regard to disposal of wood-treating wastes in the surface impoundments, it was apparent that the material had migrated from the source areas down to the subsurface soil and shallow groundwater. Shallow groundwater contained low levels of dissolved wood treating compounds down-gradient of the property. Creosote and PCP also dripped onto surface soil from the treated wood in the process and yard areas. While soil was contaminated non-uniformly from ground surface to bedrock in the area of the impoundments, there was little or no soil contamination over more than half of the property. PCP contamination was found in bedrock in several locations around the impoundments and process area. Low levels of PCP were detected in seeps down-gradient of the impoundments. Surface water samples in the northern portion of the property, where water had ponded, showed elevated PCP levels. Fisher Ditch was sampled and results were below detection limits. The rate of down-gradient groundwater flow was also found to be insignificant compared to the rate of Fisher Ditch leakage (BIC, 1990).

On May 21, 1986 the U.S. District Court for the District of Colorado approved a Partial Consent Decree which established the framework for BIC to conduct a CERCLA Remedial Investigation and Feasibility Study (RI/FS). "Phase II" was conducted and a report prepared. The Phase II RI/FS concluded the following:

- Confirmation that contamination was present in the soil adjacent to the impoundments, as miscible and immiscible phases, and in the groundwater around the impoundments. The migration of wood treating compounds in groundwater was generally limited by the railroad cut west of the impoundments and by the terrace and landfill areas to the north.
- Confirmation that contamination was present in the process area as a floating immiscible phase in the groundwater but that the extent was limited because no significant waste disposal occurred in this area.
- Confirmation that contamination in the engine house area was not a result of wood treating operations, but detected metals were due to past land use activities.
- Main and secondary impoundments contained 840,000 and 1,200,000 gallons, respectively, of oils, water and sludge. The primary chemicals found included creosote compounds, PCP, volatile organics and low levels of dioxins.
- Off-site well surveys and off-site well sampling indicated no threats to groundwater users, although not all well owners allowed their wells to be sampled.
- No significant contamination was detected in Fisher Ditch. The ditch recharges groundwater at a rate of 620,000 gallons per day.
- There were no immediate risks or substantial endangerment to public health/environment.
- Preferred remedial alternatives were solidification/stabilization and impoundment closure.

EPA concluded that further studies were needed to document the nature and extent of contamination and to develop plans for a final remedy. The Phase II RI/FS Report and supplement was completed in November 1987. A Phase III RI Report was completed in December 1990.

B. Remedy Selection/Implementation

The remediation of the Site was divided into two operable units (OUs): interim actions/source control (OU1) and final remedy (OU2). BIC refused to conduct the remedies selected in decision documents for OU1 and OU2 until 1995.

Operable Unit 1 (OU1). In June 1988, the EPA issued a Record of Decision (ROD) for OU1 to address source control and the direct contact exposure pathway. The major components of the OU1 ROD were restriction of site access, excavation and on-site incineration of impoundment sludges, stockpiling or on-site incineration of visibly contaminated soils beneath the impoundments and treatment of water in the impoundments and buildings. Based on new technical data and cost information obtained subsequent to the ROD, the EPA revised its decision and issued a ROD Amendment on September 24, 1991. The ROD Amendment changed the interim action to off-site recycling of the impoundment sludges.

The remedial action objectives (RAOs) for the ROD Amendment remained the same as for the 1988 ROD: 1) address the impoundment sludges as the greatest concentration of contaminants on-site (i.e. source control); and 2) mitigate risks or pathways for ingestion and inhalation of and direct contact with the sludges. The OU1 remedy was completed in December 1993.

Operable Unit 2 (OU2). The ROD for OU2 was issued in March 1992 and addressed the principal threats at the Site including the soils, sediments, groundwater, buildings and their contents. The RAOs for the OU2 ROD were as follows: 1) control present and future risks posed by direct contact to and/or ingestion of and/or inhalation of contaminated soils, sediments and groundwater; 2) control the migration of contaminants from the soils to the aquifer systems; and, 3) prevent significant future human exposure to residual contamination in the soils, sediments and groundwater.

In implementing the OU2 remedy, EPA divided the work into two stages. Stage 1 involved constructing the Land Treatment Units (LTUs), excavating and stockpiling impacted soils, constructing a north boundary cutoff (NBC) system, constructing a packaged water treatment system (PWTS) to treat collected groundwater and demolishing of the buildings. Stage 1 was completed in April 1994.

Concurrent with Stage 1, EPA conducted additional site characterization and treatability studies. As a result of new information, it was recognized that the groundwater cleanup goals established in the 1992 ROD would not be attainable. An Explanation of Significant Differences (ESD) was published in March 1995. The revised groundwater remedy called for the following elements:

- Previous remediation goals would be met only at established Points of Compliance (POC) as shown in Figure 2.
- Based on reducing contaminant mass, new remediation goals would be set for the area within the POCs for the surficial aquifer.
- A soil-bentonite cutoff wall (SBCW) would be constructed at the northern boundary to enhance hydraulic control of groundwater moving northward in the shallow aquifer.
- Monitored natural attenuation would be implemented to address the area north of the Site and beyond the POC for the surficial aquifer.
- Additional off-site monitoring wells would be constructed.

The OU2 Stage 1 Remedial Action was operated by EPA until BIC took over operations via a 1994 Unilateral Administrative Order. A Consent Decree (CD) between EPA and BIC was later entered in June 1995. Under the CD, BIC agreed to conduct the Remedial Design/Remedial Action (RD/RA) for Stage 2 and the operation and maintenance (O&M) of the final remedy (i.e. OU2). Appendix B of the CD, the Statement of Work/Remedial Action Plan (SOW/RAP), provides the framework and performance criteria for the O&M of the final remedy. The SOW/RAP contains seven attachments including the O&M Plan.

Stage 2 included the recovery and treatment of nonaqueous phase liquids (NAPL) that exist in the surficial aquifer beneath the impoundment area, bioventing the surficial soils in the impoundment and process areas, installation of the north boundary soil-bentonite cutoff wall, improvements to the existing PWTS, installation and abandonment of specific monitoring wells and placing a one-foot soil cover throughout the property. Stage 2 was completed in September 1996. Construction completion for the Site was achieved in September 1996 with the signing of the Preliminary Close-Out Report.

C. Modifications to Original Remedy Due to UPRR Project

In 2003, Union Pacific Railroad (UPRR) approached EPA, CDPHE and BIC about a regional project that included the construction of a rail line embankment across the Site. The massive project required significant amounts of time and effort by all parties from the planning stage in mid-2003 to the completion stage in late-2004. Ultimately, the project enhanced/retrofitted the original final remedy and addressed some of the more significant issues in the 2001 Five-Year Review Report.

UPRR operates a complex set of rail lines, yards and switches in the Denver Metro area. It has sought ways to improve service and reduce congestion in the Denver area through re-alignment activities. UPRR's North Yard is a focal point for operations and the potential for re-alignment in this area was evaluated and discussed several times. Gaining alignment on shifting track corridors amongst many parties, while thinking 20, 30, or 50 years in the future was a complex and challenging assignment that required many different plans and approaches that were worked in an iterative fashion before reaching consensus.

The result of this process was called the Utah Junction Re-Alignment Project (UPRR Project in this report). One of the main purposes of the re-alignment was to eliminate the requirement of

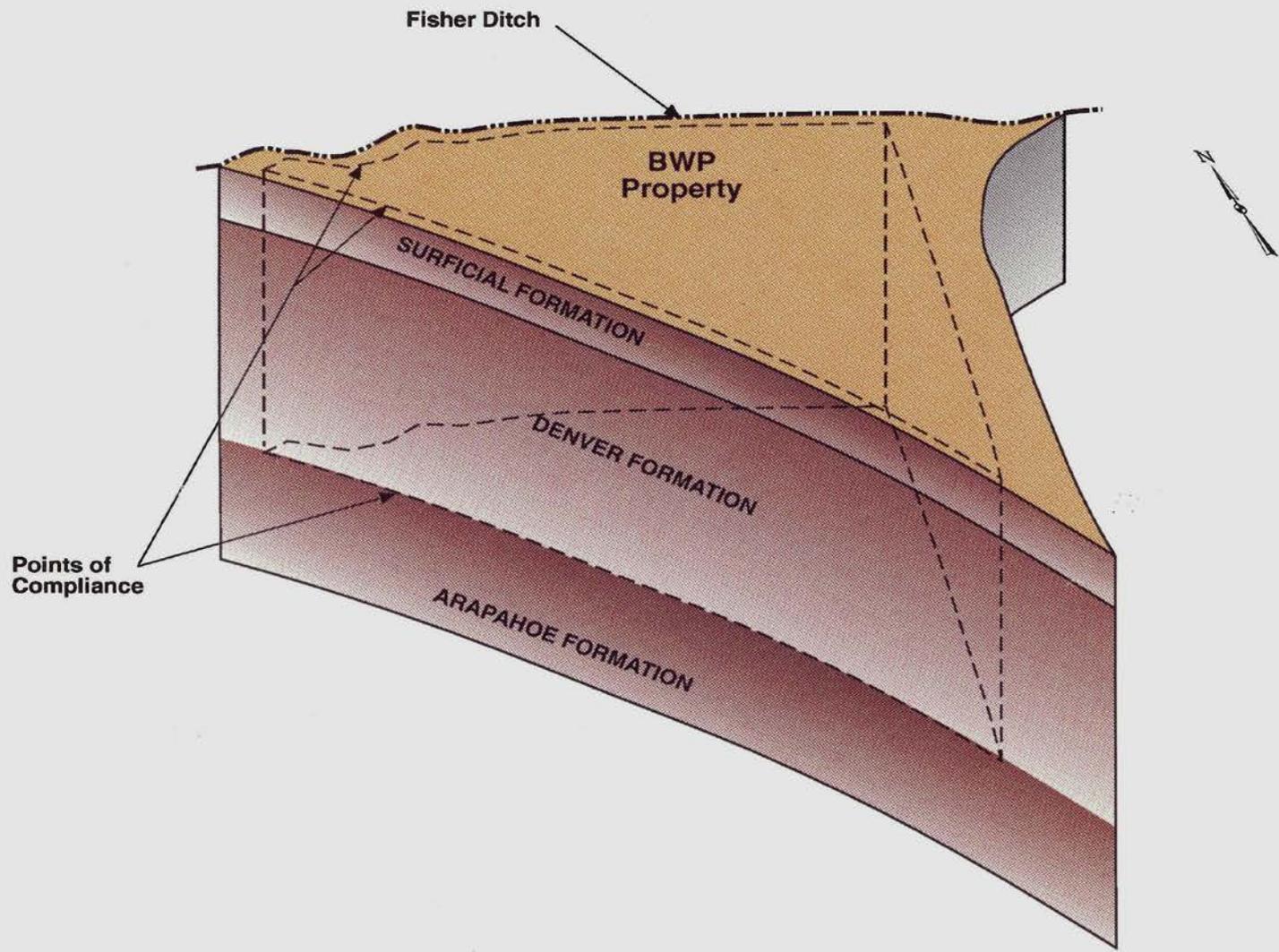


Figure 2: Points of Compliance

pulling into the North Yard and reversing direction before heading east. Also, the realignment would help reduce idling time while trains switch directions thereby reducing air emissions and traffic congestion at ground level crossings and improving health and safety.

After thorough technical review of the different options and discussions with the EPA, CDPHE, BIC and other stakeholders, the option of passing through the Site was selected. This route required design considerations for: 1) building on or through the LTUs; 2) spanning the product recovery and bio-venting systems; 3) replacing some monitoring wells; and 4) groundwater control measures and surface water drainage. The following modifications to the original remedy were designed and implemented at the Site:

- An SBCW and West Boundary Cutoff (WBC) drain line were installed along the west boundary of the Site.
- A SBCW was installed along the east boundary.
- Non-impacted soils remaining outside of the West SBCW were removed and used as fill for the embankment and other areas requiring backfill.
- Impacted soils located outside of the West SBCW were removed and stockpiled for onsite treatment in the LTUs.
- Bio-venting wells were modified for use after embankment construction.
- Product recovery trenches were extended to reach beyond the slope of the embankment.
- Decontamination facilities and utilities were relocated and upgraded to facilitate post-construction operation.
- The LTUs were modified to allow the new rail line to pass over and through them.
- Utilities crossing under the UPRR embankment were encased.
- Security fence and vegetation, impacted by the construction, were restored.

In addition, the groundwater monitoring program for the Site was significantly improved with the installation of fifteen monitoring wells that were either added or relocated to more strategic locations. Details regarding the UPRR Project can be found in the *Final Report, Modifications of the Remedial Systems on the Broderick Superfund Site* (September 2005).

D. Operation & Maintenance (O&M)

Packaged Water Treatment System (PWTS)

The PWTS was constructed in 1995 to treat groundwater contaminated with non-aqueous phase liquid (NAPL) from several groundwater sources. The treated water is discharged to an on-site storm water sewer system owned and managed by Adams County or re-injected into the former impoundment area to improve recovery of NAPL (also referred to as oil or product). Though a permit to discharge to the on-site storm water sewer system is not required, Adams County required that the PWTS secure a CDPS permit to discharge treated water to its storm water sewer system. Water discharged into the storm sewer system flows into Clear Creek north of the Site.

When operating, the PWTS treats groundwater collected from the former impoundment area, the North Boundary Cutoff (NBC) trench, the West Boundary Cutoff (WBC) trench and three LTU

sumps. The PWTS treatment process has been revised and fine-tuned several times since construction. During the UPRR Project in 2004, a 10,000-gallon tank was installed as the first step of the treatment process to increase the residence time for NAPL/water separation.

The most significant maintenance activity is the replacement of the granular activated carbon (GAC). Treated water flows through two columns containing GAC removing trace amounts of dissolved organic compounds just before discharging or re-injection. The chemical oxygen demand (COD) concentration of the discharged water is required to be analyzed weekly. An increasing COD concentration usually means that it is time to replace the GAC. During replacement of the GAC, the PWTS is shut down.

Given that the five-year CDPS discharge permit for the PWTS was due to expire in October 2010, BIC applied for a permit renewal on August 20, 2010. CDPHE provided BIC authorization to operate the PWTS until the permit was renewed or a new one was issued. A new permit was issued on September 30, 2011 (that was later modified/reissued on April 11, 2013). In order to address the more stringent requirements of the 2013 permit, the PWTS was extensively modified to incorporate a chlorine dioxide treatment system to reduce the concentration of metals in the effluent. However, even after several months of testing and operation, the modified PWTS could not meet the new requirements. More specifically, the chlorine dioxide treatment system could not lower the naturally occurring iron/manganese levels enough to meet the two-year rolling average limits. As a result, treated water is no longer being discharged from the PWTS to avoid permit violations.

According to the PRP, the more stringent requirements of the 2013 permit for PCP will also detrimentally impact the cost structure of the PWTS. Before the new permit, the PWTS was typically operated eight hours/day five days/week in order to maintain the requisite water levels and inward gradient across the soil bentonite containment walls (while providing a combined flow rate that is compatible with the PWTS and other water pumping operations). Given that usage of carbon/activated clay media is driven by PCP break-through, the significantly lower two-year rolling average limit for PCP will require more frequent change-outs at significantly higher costs - possibly tripling the costs of operating the PWTS.

Currently, EPA, CDPHE and BIC are exploring ways to address the requirements of the 2013 permit in the context of the Superfund remedial process and diminishing financial resources.

Former Process Area

In 1996, a bio-venting system was installed in the former process area to dewater and inject air into the surficial aquifer to supply oxygen and stimulate bioremediation of contamination in the subsurface medium. The system included alternating dewatering trenches and air injection lines at 50-foot spacing and approximately 200 feet in length for an area of approximately three acres. Each of the ten dewatering trenches included a middle sump and two trench well points (TWPs) used to monitor the dewatering system. Compressed air was supplied to each of the ten air injection lines installed between the dewatering trenches. The lines provided air to a total of 39 bio-venting wells that were evenly spaced along each line. The bio-venting wells had screens at

the base of the surficial aquifer. Eighteen monitoring points (MPs) were also located throughout the area to monitor the bio-venting process. Two bio-venting wells were approximately located at each MP – one in the shallow vadose zone and the other in the deep vadose zone.

The former process area was bio-vented from 1996 to 2002. The MPs were periodically monitored for oxygen and carbon dioxide (after a 14-day air injection pause) from 1997 to January 2001. Based on this data, BIC concluded performance criteria had been met in 2002.

Based on the evaluation of information in the 2003 O&M Report, EPA and CDPHE determined that bioventing in the former process area had not been conducted in accordance with the SOW/RAP. Because the infrastructure used to conduct bioventing operations had been disassembled, it was not possible to either confirm previous results or determine if the appropriate performance standards had been met. Therefore, surface/subsurface soil sampling in accordance with Attachment E of the O&M Plan was proposed to determine if bioventing was satisfactorily completed. While the standard operating procedure for soil sampling in Attachment E was originally intended to measure contaminant concentrations remaining after bioventing of the former impoundment area, it was considered a viable, cost-effective procedure to measure contaminant concentrations remaining in the former process area.

Soil sampling in the former process area was conducted in 2006. Samples were collected from six locations at various depth intervals between one and fourteen feet below ground surface. Samples were analyzed for polyaromatic hydrocarbons, pentachlorophenol, dioxins/furans and TCLP metals. Sampling results were compared against the treatment standards for LTU-related soils. Table 12 of the OU2 ROD includes treatment levels for twelve contaminants: benzo(a)pyrene, dibenzo(a,h)anthracene, 2,3,7,8-TCDD equivalent, naphthalene, PCP, phenanthrene, pyrene, toluene, total xylene, lead, arsenic and cadmium.

Sampling results indicate that some of the contaminant concentrations in the former process area are above treatment standards at five of the six sampling locations as shown in Table 3. Detection limits for benzo(a)pyrene and dibenzo(a,h)anthracene were higher than their respective treatment standards for some samples due to the presence of other contaminants at high concentrations. Dioxins were below LTU treatment standards for all samples. Using TCLP analysis, lead, arsenic and cadmium were not detected.

Table 3: Contaminants above LTU Treatment Standards in the Former Process Area

Contaminant	Concentration Range	LTU Treatment Standard
Naphthalene	Non-detect to 180 mg/kg	0.5 to 20 mg/kg
Pentachlorophenol	Non-detect to 150 mg/kg	0.5 to 40 mg/kg
Phenanthrene	Non-detect to 240 mg/kg	0.5 to 20 mg/kg
Pyrene	Non-detect to 84 mg/kg	0.5 to 20 mg/kg

Some contaminant concentrations in the subsurface soils of the former process area are above treatment standards for excavated soils at the Site. A materials management plan has been developed for all future soil excavation/handling activities in the former process area and the rest of the Site. The plan is an attachment to the environmental covenant for the Site recorded in February 2008 and further discussed in Chapter V.

Former Impoundment Area

Construction of the original system for LNAPL recovery, dewatering and bio-venting in the former impoundment area was completed in October 1995. The installation was similar to that in the former process area except for twelve dewatering trenches at 50-foot intervals over an area of approximately eight acres. Each dewatering trench has TWPs and one sump (S-1 through S-12). The twelve sumps are also capable of re-injecting water. During the NAPL recovery phase (i.e. first phase), the system is designed to alternatively pump from even numbered sumps and re-inject into odd numbered sumps in order to create a sequence of groundwater mounds and depressions and flush the LNAPL through the soil. The subsequent plan is to use the dewatering trenches in the same manner as in the former process area during the bio-venting phase (i.e. second phase) once the LNAPL recovery rate lessens to five gallons per day. The following modifications to the original system were conducted during the UPRR Project to accommodate a new rail line through the northern portion of the Site:

- Relocation of the existing electrical and main air supply line from the PWTS to the impoundment area to address concerns about the reliability of the system if buried under the rail line embankment and access for maintenance.
- Relocation of above-ground air manifolds located in the footprint of the railroad embankment to five feet beyond the toe of the embankment slope and re-routing of piping from the air manifold to bio-venting wells outside the toe of embankment slope.
- Replacement of existing piping from the air manifolds to all bio-venting wells in the footprint of the rail line embankment or the Lipan Street extension with new heavy duty air piping, at a two-foot depth, for better protections from damage during construction.
- Extension of all piping from bio-venting wells and monitoring points located within the footprint of the embankment to five feet beyond the toe of embankment slope and into

- new below-grade remote monitoring vaults.
- Removal of the following bio-venting wells during construction of the WBC given their location within the envelope of the key trench or the actual gravel ditch: 10A, 18A, 19A, 29A and 35A. It was decided not to reinstall these wells either because the impacted soils in the area had been removed or because the WBC gravel ditch was so close to the wells that it would provide a preferential pathway for injected air. The only exception was 29A which was installed fifty feet west of well 28A and in line with wells 27A to 28A.
- Removal of all existing surface vaults connected to bio-venting wells remaining in the footprint of the rail line embankment to prevent the base of the vault from severing lines during compaction of surrounding sand and soils associated with the embankment.

Stockpile Area

In 1993, a 3.5 acre portion in the southeastern part of the Site was converted into a stockpile area. A multi-layered liner system was installed throughout the area and consisting of the following elements from the bottom up: native soil, 6-inch clay layer, geo-textile membrane and 12-inch drainage sand layer (with 6-inch diameter perforated PVC piping for leachate collection at a sump located in the northern corner of the area). Lined dirt berms were placed around the stockpile area to contain excavated soils from throughout the Site and to prevent surface water run-on and run-off.

Approximately 81,000 cubic yards of contaminated soils were placed in the stockpile area for subsequent treatment in the LTUs. By 2004, most of the soil had been transferred to the LTUs and treated. However, as part of the UPRR Project in 2004, an additional 13,300 cubic yards of contaminated soils were excavated from areas along the western boundary and placed in the stockpile area. The last lift of contaminated soil was transferred from the stockpile area to the LTUs in June 2005.

Prior to dismantling of the multi-layered liner system, composite samples were collected from the 12-inch drainage sand layer and 6-inch clay layer to determine if they were contaminated. With the exception of phenanthrene and pyrene at less than 1 part per million (ppm), contaminants were not detected in the samples. The two concentrations were well below their respective treatment levels of 20 ppm. Based on the sampling results and visual observations, the drainage sand was excavated and stockpiled.

After excavation of the drainage layer, samples were collected from the berms surrounding the stockpile area. One sample detected PCP at 1.9 ppm which is significantly lower than its treatment level of 40 ppm. The other samples did not detect contaminants. The geo-textile membrane (i.e. High Density Polyethylene liner) was found to be damaged and removed off-site. The clay layer was left in place and covered with drainage sand to protect it from the elements. Reclamation activities were completed in 2006.

Land Treatment Units

In 1993, LTU A and LTU B were originally constructed in the northeast portion of the Site to

bio-remediate approximately 81,000 cubic yards of contaminated soil from the stockpile area. Each of the LTUs includes a multi-layered liner system with geo-textile membrane and 6-inch diameter drainage lines connected to sumps to collect and pump leachate to the PWTS. The combined surface area of the LTUs is 10.6 acres.

The LTUs were modified in 2004 due to the UPRR Project. Each LTU is now divided into portions north and south of the UPRR embankment. Due to grade requirements and the elevation of the embankment east of the Site, a notch was cut into the east berm of LTU B and replaced with at least an equivalent new berm and liner system. A UPRR engineering evaluation indicated that a rail line embankment over the LTUs would have no detrimental impacts on the liner systems. Due to the UPRR Project, berms that had deteriorated over the years were upgraded and runoff ditches with check dams were installed inside the berms. Stormwater is now directed toward the LTU sumps where it can be pumped to the PWTS.

Table 12 of the OU2 ROD includes treatment levels for twelve contaminants in soils and sediments in the LTUs: benzo(a)pyrene, dibenzo(a,h)anthracene, 2,3,7,8-TCDD equivalent (TCDD), naphthalene, PCP, phenanthrene, pyrene, toluene, total xylenes, lead, arsenic, and cadmium. Fixed treatment standards were set for benzo(a)pyrene, dibenzo(a,h)anthracene and TCDD. TCLP lead, arsenic, and cadmium are required to meet RCRA standards. To meet LDRs, alternate treatability variance levels were determined for the RCRA K001 constituents. A threshold concentration was determined for each of the contaminants based on site conditions and a percent reduction range was determined according to EPA policy. Treatment is considered complete when contaminant levels fall within or below the percent reduction range applied to the threshold concentration. Initial and follow-up sampling is conducted for each lift of soil.

Through 2003, six lifts of soil were added to LTU A and four lifts of soil were added to LTU B. Contaminated soil, excavated during the UPRR Project, was taken to the stockpile area and subsequently placed in the LTUs for treatment. Four lifts were added to LTU A in 2004/2005 and one lift was added to LTU B in 2004. Documentation indicates that all of the lifts met the treatment standards in the ROD.

In 2006, the soil in the LTUs was sampled at different depths to confirm treatment. Sampling results indicate that treatment levels were achieved for metals, dioxins and semivolatile analytes. Naphthalene was observed above the treatment level in only one sample collected from one to five feet below ground surface. Sampling results of leachate from sumps vary widely, but have indicated PCP levels above the treatment standard of 1 µg/L.

The soil in LTU B and the portion of LTU A south of the rail line embankment has been bioremediated to treatment levels in accordance with the OU2 ROD. However, the LTUs have not been capped, closed and maintained in accordance with the OU2 ROD and RCRA ARARs. The portion of LTU A north of the embankment will remain open to receive soil excavated from future redevelopment activities.

Boundary Cutoff Trenches & Soil Bentonite Cutoff Walls

North Boundary. The NBC trench system was installed in 1993 to create a groundwater depression along the northern boundary by water extraction that would prevent groundwater contaminants from migrating off-site to the north. The system includes eight individual drain lines in accordance with eight sumps (NBC Sumps 1 through 8 from west to east) and ranging from 150 to 450 feet in length. The drain lines were installed near the base of the surficial aquifer in a gravel-filled trench and are connected to the sumps which are equipped with pumps that operate intermittently using float switches. In addition, LNAPL, near monitoring well NBC 12, can be recovered by pumping nearby NBC Sumps 3 and 4.

The SBCW was installed in September 1995 to further control the spread of impacted groundwater, reduce pumping of the NBC system (caused in large part by the proximity to the Fisher Ditch) and assist in dewatering the surficial aquifer. The SBCW is essentially a trench (excavated down to the upper portions of the weathered Denver bedrock) and filled with a mixture of low permeability soil and bentonite. Eight pairs of monitoring wells, one on each side of the SBCW, were installed along the SBCW to allow monitoring of the groundwater gradient. The eight wells south of the SBCW are identified as NBC9 through NBC16. The corresponding wells north of the SBCW are identified as CH12D through CH19D. The major purpose of the SBCW is to maintain a hydraulic gradient toward the Site.

In order to assess whether an inward groundwater gradient has been maintained, groundwater elevations are taken from the paired monitoring wells. Differential groundwater elevations are calculated by subtracting the groundwater elevation of the paired well inside the wall from that of the paired well outside the wall. If the outside monitoring well groundwater elevation is higher than that of the paired inside monitoring well, the differential will be positive and indicate an inward groundwater gradient.

West Boundary. During the UPRR Project, several additions and modifications were made to existing systems at the Site to address concerns regarding the potential for off-site migration of potentially impacted groundwater. The first modification was associated with the existing BNSF rail line running north to south along the western edge of the Site that had to be lowered by approximately eight feet to accommodate the UPRR mainline bridge. Excavation activities had the potential to impact the direction of groundwater flow at the northwest corner of the Site. To minimize the potential for contaminated groundwater to flow westward, the existing NBC trench and SBCW, along the northern boundary, had to be extended to the western boundary. These extensions were designated as the West Boundary Cutoff (WBC) trench and West SBCW.

These associated systems were also intended to significantly reduce the total rate of groundwater flow onto the Site because groundwater that would normally enter the Site from the western boundary would be diverted from the Site. Prior to construction of the West SBCW, impacted soils from the immediate area were excavated and stockpiled for subsequent treatment.

In May 2004, the West SBCW was installed along the western boundary of the Site as shown in Figure 1. The wall is 1100 feet long and keyed 4 to 6 feet into the weathered Denver bedrock to limit groundwater flow under the wall. It is connected to the North SBCW and was designed to function in combination with the North SBCW to prohibit the off-site flow of contaminated groundwater in the surficial aquifer.

The West SBCW was installed with a trenching machine using an in-situ process that combines bentonite slurry with native soils to achieve an impermeable vertical barrier. The toe of the West SBCW was imbedded into the weathered rock substrata a minimum of 5 feet as determined by the trencher's laser-grade elevation system. The structural strength of the wall was increased in the area where the rail line embankment would cross over by adding Portland cement to the soil-bentonite mixture. Soil-cement-bentonite samples were tested for hydraulic conductivity and unconfined compressive strength with all samples passing design specifications.

The WBC trench system was installed in May 2004 parallel to and approximately 25 feet inside of the West SBCW. The purpose of the system is to provide the means to control groundwater levels in the surficial aquifer and reduce the potential for groundwater to flow under or through the WSBCW. Before installation of the West SBCW, groundwater in the area flowed north-northwest. After installation, groundwater flow in the area is managed by extracting groundwater using sumps from the former impoundment area, WBC and NBC trenches.

The WBC trench system includes three individual drain lines and three associated sumps. The trench system was installed using a "one-pass" trenching process where a deep chain trencher installs the drainage pea gravel and 4-inch smooth-wall slotted drain pipe together in one continuous operation. Each drain line has a turned-up clean-out on one end and a 14-inch sump riser at the other end and is positioned linearly along the western boundary. The chain trencher penetrated one-foot deep into the weathered rock substrata as determined by the trencher's laser-grade elevation system. The drain lines slope down to the sump riser inverts. Each sump is equipped with a 2-HP submersible electric pump actuated by water level control sensors. The sumps and ancillary equipment are protected by fiberglass enclosures located on slab-on-grade concrete pads. Water recovered from the trench is collected and pumped to the PWTS for treatment.

East Boundary. In addition to the modifications made along the western boundary, the existing SBCW was extended to the eastern boundary of the Site during the UPRR Project. This extension was designated the East SBCW and was installed in May 2004 along the eastern boundary of the Site as shown in Figure 1. It is 1400 feet long and keyed 4 to 6 feet into the weathered Denver bedrock to limit groundwater flow under the wall. It is connected to the North SBCW and designed to prevent off-site migration of groundwater at the eastern boundary and prevent migration of contaminated groundwater from the Koppers Site onto the Site. Prior to installation of the East SBCW, groundwater flowed toward the northeast. After installation of the East SBCW, groundwater flow is directed towards the north and collected by the NBC sumps.

The East SBCW was installed in a similar manner as the West SBCW. The structural strength of

the wall was increased in the area where the rail line embankment would cross over by adding Portland cement to the soil-bentonite mixture. All soil-cement-bentonite samples, tested for hydraulic conductivity and unconfined compressive strength, passed design specifications.

In order to monitor the performance of the East SBCW, three sets of paired wells in the surficial aquifer were installed along the wall. One well of each pair was installed west (E-2, E-4 and E-6) and the other well east (E-1, E-3 and E-5) of the East SBCW. As with the North SBCW, the performance goal for the East SBCW is to maintain a groundwater elevation that is lower on the inside of the wall than outside of the wall. The inward groundwater gradient is maintained by redirecting the groundwater to the NBC trench and using the NBC sumps to pump the water to the PWTS. An inward groundwater gradient prevents off-site migration of contaminated groundwater along the eastern boundary.

E. Groundwater Monitoring

The groundwater monitoring program includes a total of 79 monitoring wells (58 surficial aquifer wells, 13 Denver aquifer wells and 8 Arapahoe aquifer wells). The 47 wells that are supposed to be sampled include 27 surficial aquifer wells, 12 Denver aquifer wells and 8 Arapahoe aquifer wells. 24 wells are supposed to be sampled on an annual basis and thirteen wells (performance wells associated with the UPRR Project) are supposed to be sampled on a quarterly basis.

V. Redevelopment Activities

Most of the Site has been remediated and is ready for beneficial reuse. BIC platted and subdivided the Site into viable commercial parcels with the approval of Adams County. The Site (as is most of the surrounding area) is zoned for I-2 and I-3 industrial uses as defined by Adams County. A second access road has been constructed at the northern boundary of the Site to facilitate redevelopment of the Site.

In December 2006, BIC signed an environmental covenant (EC) that places activity/use limitations on the Site. The EC was eventually recorded in February 2008 and prohibits the use of groundwater, construction of water wells and land uses that would interfere with or adversely affect current/future remedial activities at the Site. All soil excavation and handling activities at the Site are guided by a materials management plan attached to the EC. Generally, the EC assures that the restrictions (i.e. ICs) will remain in-place with the transfer of land in perpetuity.

In January 2007, BIC sold the vast majority of the Site to Scott Contracting which had planned to sell two-acre parcels for development. Scott Contracting acquired the property by providing BIC a secure promissory note in the amount of \$2.4M. Essentially, the property served as security for the promissory note which was to be paid with the sale of the two acre parcels.

In 2012, Brannan Sand and Gravel acquired the land owned by Scott Contracting and completed construction of its asphalt paving operations in 2013.

VI. Financial Status of PRP

In May 2007, a long running dispute between EPA and BIC over cost billing led to the realization that BIC had limited assets with which to conduct the response actions at the Site. Because it was EPA's desire to have BIC operate/maintain the final remedy for as long as possible, EPA proposed a modification to the 1995 CD to address the disputed billings and future billings. Under the *Stipulation and Modification of Consent Decree*, signed in June 2008, EPA and BIC agreed that:

- 1) The Disputed Cost Fund (holding the disputed billings) would be released/returned to BIC;
- 2) BIC would dedicate all of its assets/revenues to fund the response actions at the Site;
- 3) BIC would submit annual financial reports to EPA; and,
- 4) EPA would suspend and not bill BIC for future response costs commencing January 1, 2006.

In March 2009, BIC sent a letter notifying EPA that the remedy would have to be put into an "environmental protection/observation mode" due to cash flow problems caused by the "nationwide economic difficulties." The letter stated that all O&M and monitoring activities would have to be shut down, except periodic operation of the NBC trench and PWTS.

With proceeds from the Brannon deal in 2012, BIC attempted to return the remedy to normal operation, maintenance and monitoring. But, it was hindered by the more stringent requirements of the 2013 permit and a dire financial situation.

VII. Progress Since Last Five-Year Review

There were five issues/recommendations in the last five-year review report dated September 27, 2011. BIC attempted to return the remedy to normal operation, maintenance and monitoring, but, was hindered by the more stringent requirements of the 2013 permit and a dire financial situation. The other four issues/recommendations (dealing with improving/optimizing remedy performance) were also not implemented, since the remedy was never returned to normal operation, maintenance and monitoring.

VIII. Five-Year Review Process

The five-year review for the Site was led by Armando Saenz, EPA Project Manager. The following team members participated in the five-year review:

- Richard Sisk, EPA Attorney
- Wendy Naugle, CDPHE Project Manager

The review consisted of the following activities: review of relevant documents; review of technical/risk assessment information and ARARs; and, an inspection of the Site. A notice that

the five-year review was in progress was placed in local newspapers on February 17, 2016. A notice of the completion of the review will be placed in the local newspaper after the signing of this report.

IX. Five-Year Review Findings

A. Inspection of the Site

The Site was inspected on August 24, 2016. The PWTS was not operating and it was obvious that the areas (where remedial activities are conducted) had not been maintained for quite some time. The LTUs and former impoundment area were covered with large/high weeds and bushes which made it difficult to get to the various components of the remedy. Trash was scattered throughout the LTUs and there was an RV around and small boat on the LTUs. The fences surrounding the Site, rail line and remedial areas were in good shape.

Brannon Sand and Gravel, an asphalt paving contractor, takes up the vast majority of the Site. It was bristling with activity – dump trucks were continuously coming in and out of the Site at a fast pace. Brannon's Division Manager, Theran Olson, briefly described their operation and was not aware of any issues with the remedy and remedial activities. There were no signs of excavation activities by Brannon.

B. Applicable or Relevant and Appropriate Requirements

As part of the five-year review, state and federal Applicable and Relevant and Appropriate Requirements (ARARs) were reviewed. The primary purpose of this review was to determine if any newly promulgated or modified requirements of federal and state environmental laws have changed the protectiveness of the remedies implemented at the Site. The list of ARARs reviewed were those included in the 1992 ROD. No newly promulgated ARARs were identified.

Overall, the review does not indicate any changes to regulations that would affect the remedy nor its protectiveness. EPA and CDPHE will continue to monitor this Site and any future changes or modifications in ARARs will be reported in the next five-year review.

X. Data Review – O&M Components

In January 2016, BIC sent EPA the *Broderick Wood Products 5-Year Summary Report from 2011 – 2015* (Summary Report) that was supposed to summarize remedial activities conducted at the Site from 2011 to 2015. However, the report was essentially a compilation of data collected from the 2014 O&M Report. The report has little to no discussion on groundwater sampling results given that monitoring has not been conducted since 2012. The report also shows that all O&M/monitoring activities are either not being conducted or being conducted on a limited/sporadic basis.

The RAOs and the POCs are potentially not being met because of the lack of monitoring data and the limited/sporadic operation of the remedy. The RAOs for the remedy are as follows: 1) control present and future risks posed by direct contact to and/or ingestion of and/or inhalation of contaminated soils, sediments and groundwater; 2) control the migration of contaminants from the soils to the aquifer systems; and, 3) prevent significant future human exposure to residual contamination in the soils, sediments and groundwater. The POCs are as shown in Figure 2. The impacts of the more stringent requirements of the 2013 permit and BIC's dire financial situation on the performance of the remedy components are discussed in this chapter (O&M Components) and the next chapter (Groundwater Monitoring).

A. Packaged Water Treatment System (PWTS)

Since 2011, the PWTS has been operated and maintained on a limited/sporadic basis. The PWTS must be returned to normal operation. Once the PWTS has been operated normally for a year, increasing the utilization rate should be evaluated to shorten the time required for long-term groundwater remediation. This may be facilitated by improved planning for GAC replacement and by a preventative maintenance and inspection program to assist in identifying and repairing/replacing equipment or piping that may be near failure before shutting down the PWTS is necessary.

B. Former Impoundment Area

Since 2011, the PWTS and, therefore, the NAPL recovery system in the former impoundment area have been operated and maintained on a limited/sporadic basis. No significant amount of NAPL has been recovered since 2011 according to the Summary Report and 2014 O&M Report.

The NAPL recovery system must be returned to normal operation in conjunction with the PWTS. Once the system has been operating normally for a year, effective/efficient water management procedures to maximize NAPL recovery should be developed and documented in an updated O&M Plan. Subsequent dewatering and re-injection rates should be recorded on a monthly basis to evaluate their effectiveness in recovering NAPL. TWP water and NAPL level measurements should be evaluated regularly to determine if a series of mounds and depressions have been established.

C. North Boundary Cutoff Trench and North Soil Bentonite Cutoff Wall

Since 2011, the PWTS and, therefore, the NBC trench system have been operated and maintained on a limited/sporadic basis. Groundwater elevations from the paired monitoring wells along the North SBCW have not been taken since 2014 (and sporadically before then) according to the Summary Report and 2014 O&M Report. Therefore, an inward groundwater gradient has potentially not been maintained along the northern boundary of the Site since 2011.

The NBC trench system must be returned to normal operation in conjunction with the PWTS. In addition, groundwater elevations must be taken from the paired monitoring wells along the North SBCW on a quarterly basis.

D. West Boundary Cutoff Trench and West Soil Bentonite Cutoff Wall

Monitoring the performance of the West SBCW presents a difficult challenge. The UPRR Project essentially required the excavation of the surficial aquifer immediately west of the West SBCW. A steep embankment is present west of the wall, particularly along the northern portion. This makes installation of paired performance wells, similar to those installed along the East and North SBCWs, impossible. In addition, the drainage ditch west of the embankment was excavated into the weathered Denver formation immediately below the surficial aquifer. As a result, the surficial aquifer in the area of the drainage ditch and west of the northern portion of the Site is dry. This makes maintaining and monitoring an inward groundwater gradient for the surficial aquifer, required for the North and East SBCWs, impractical

The WBC trench system has been sporadically operated and maintained since 2011 and must be returned to normal operation in conjunction with the NBC trench system and PWTS.

E. East Soil Bentonite Cutoff Wall

Since 2011, the PWTS and, therefore, the NBC trench system have been operated and maintained on a limited/sporadic basis. Groundwater elevations from the paired monitoring wells along the East SBCW have not been taken since 2014 (and sporadically before then) according to the Summary Report. Therefore, an inward groundwater gradient has potentially not been maintained along the eastern boundary of the Site since 2011.

The PWTS, NBC and WBC trench systems must be returned to normal operation. In addition, groundwater elevations must be taken from the paired monitoring wells along the East SBCW on a quarterly basis.

XI. Data Review - Groundwater Monitoring

According to the Summary Report and 2014 O&M Report, groundwater monitoring has not been conducted since 2012. Without groundwater monitoring data, the overall performance of the remedy cannot be evaluated. Specifically, the following questions cannot be answered without regularly measuring the nature/extent of contamination in and characteristics of the surficial, Denver and Arapahoe aquifers:

- Are the contaminants in the surficial aquifer increasing or decreasing, migrating off the property above remediation levels in violation of the vertical planes (i.e. vertical POCs) and/or migrating down to the Denver aquifer?
- Are the contaminants in the Denver aquifer increasing or decreasing, migrating off the property above remediation levels in violation of the vertical POCs and/or migrating down to the Arapahoe aquifer?
- Are the contaminants in the Arapahoe aquifer present and above remediation levels in violation of the horizontal plane (i.e. horizontal POC) between the Denver/Arapahoe

aquifers?

- Is natural attenuation north of the property occurring effectively/efficiently?
- Do the potentiometric surfaces of the aquifers confirm or contradict current assumptions about groundwater flow and extent of contamination?
- Are the components of the remedy functioning effectively/efficiently and meeting the performance criteria?
 - Are the trenches/walls of the remedy potentiometrically functioning as designed?
 - Is the surficial aquifer being contained within the property?
 - Is the LTU lining system working (i.e. not leaking)?

Groundwater monitoring must be conducted to be able to evaluate the overall performance of the remedy.

XII. Assessment

Question A: Is the remedy functioning as intended by the decision documents? No.

- **Plans & Reports:** The O&M Plan needs to be thoroughly revised to accurately/effectively reflect current conditions, especially in light of the more stringent requirements of the 2013 permit. In turn, the format and content of subsequent O&M Reports will need to be revised to reflect the revised O&M Plan. Also, the interpretative and evaluative components of subsequent O&M Reports will need to be improved.
- **Implementation of Institutional Controls and Other Measures:** Access controls are in place at the Site. The Site and remedial areas are surrounded by a six-foot link fence with warning signs. In addition, there is a six-foot fence along both sides of the UPRR rail line. All fences are in good condition.

ICs, called for in the 1992 ROD, have been implemented. The ICs remain in place and no uses and/or activities at the Site are inconsistent with the ICs. An EC, recorded in February 2008, prohibits the use of groundwater, construction of water wells and land uses that would interfere with or adversely affect current/future remedial activities at the Site. All soil excavation and handling activities at the Site are guided by a materials management plan attached to the EC.

- **Remedial Action Performance:** Since 2012, the final remedy has been operated and maintained on a limited/sporadic basis due to the more stringent requirements of the 2013 permit and BIC's dire financial situation. The remedy has not been conducted in accordance with the ROD, ESD and CD.

Groundwater monitoring has not been conducted since 2012. In general, the RAOs and the POCs are potentially not being met because of the limited/sporadic operation of the remedy and lack of monitoring data. Without groundwater monitoring data, the overall performance of the remedy cannot be evaluated.

Groundwater elevations from the paired monitoring wells along the North SBCW and East SBCW have not been taken since 2014 (and sporadically before then). Therefore, inward groundwater gradients may not have been maintained along the northern and eastern boundaries of the Site.

The PWTS, NAPL recovery system, NBC and WBC trench systems must be returned to normal operation. In addition, groundwater elevations must be taken from the paired monitoring wells along the North SBCW and East SBCW on a quarterly basis to determine if the inward groundwater gradients are being maintained along the northern and eastern boundaries of the Site. Groundwater monitoring must be conducted to properly evaluate the overall performance of the remedy.

- **System O&M:** Operation of the remedy has not proceeded in a sequence or pace that would most effectively contain or remove contamination at the Site. The success of the remedy will critically depend on removing most if not all of the LNAPL in the former impoundment area. Effective/efficient water management procedures to maximize LNAPL recovery have not been developed, documented nor utilized.

Once the NAPL recovery system has been operated normally for a year, dewatering and re-injection rates should be recorded on a monthly basis to evaluate their effectiveness in recovering LNAPL. Water and NAPL level measurements should be evaluated regularly to determine if a series of mounds and depressions have been established.

The PWTS had a utilization rate of only 70 percent before the more stringent limits of 2013 permit were required. Once the PWTS has been operated normally for a year, increasing the utilization rate should be evaluated to shorten the time required for long-term groundwater remediation. This may be facilitated by improved planning for GAC replacement and by a preventative maintenance and inspection program to assist in identifying and repairing/replacing equipment or piping that may be near failure before shutting down the PWTS is necessary.

- **Cost of O&M:** Since 2011, the final remedy has been operated and maintained on a limited/sporadic basis due to the more stringent requirements of the 2013 permit and BIC's dire financial situation. BIC's estimates an average cost of \$174k per year for normal O&M of the remedy (without having to meet the more stringent requirements of the 2013 permit).

According to BIC, the more stringent requirements of the 2013 permit for PCP will detrimentally impact the cost structure of the PWTS. Before the new permit, the PWTS was typically operated eight hours/day five days/week in order to maintain the requisite water levels and inward gradient across the soil bentonite containment walls (while providing a combined flow rate that is compatible with the PWTS and other water pumping operations). Given that usage of carbon/activated clay media is driven by PCP break-through, the significantly lower two-year rolling average limit for PCP will require

more frequent change-outs at significantly higher costs - possibly tripling the costs of operating the PWTS.

- **Opportunities for Optimization:** Outside of the numerous activities that have already been recommended, there are no other opportunities for optimization at this time.
- **Early Indicators of Potential Remedy Failure:** In order to address the more stringent requirements of the 2013 permit, the PWTS was extensively modified to incorporate a chlorine dioxide treatment system to reduce the concentration of metals in the effluent. However, even after several months of testing and operation, the modified PWTS could not meet the new requirements. More specifically, the chlorine dioxide treatment system could not lower the naturally occurring iron/manganese levels enough to meet the two-year rolling average limits. As a result, treated water is no longer being discharged from the PWTS to avoid permit violations.

Question B: Are the assumptions used at the time of the remedy selection still valid? Yes.

- **Changes in Standards:** No newly promulgated or modified ARARs that would affect the protectiveness of the remedies implemented at the Site were found.
- **Changes in Exposure Pathways:** No changes in the site conditions that affect exposure pathways were identified as part of this five-year review.

Changes in Toxicity and Other Contaminant Characteristics: Since the time of the RODs, changes in toxicity and other factors for contaminants of concern do not call into question the protectiveness of the remedy.

- **Changes in Risk Assessment Methods:** Since the time of the RODs, changes in risk assessment methodologies do not call into question the protectiveness of the remedy.

Question C: Is there other information that calls into question the protectiveness of the remedy? No.

XIII. Issues

Table 4: Issues

<i>Issue No.</i>	<i>Issue</i>	<i>Currently Affects Protectiveness</i>	<i>Affects Future Protectiveness</i>
1	Since 2012, O&M and monitoring activities have only been conducted on a limited/sporadic basis.	Yes	Yes

XIV. Recommendations and Follow-Up Actions

Table 5: Recommendations and Follow-Up Actions

<i>Issue</i>	<i>Recommendations/Follow-Up Actions</i>	<i>Party Responsible</i>	<i>Oversight Agency</i>	<i>Milestone Date</i>	<i>Affects Current Protectiveness?</i>	<i>Affects Future Protectiveness?</i>
1 O&M and Monitoring Not Conducted as Required	Return remedy to normal operation, maintenance and monitoring.	PRP	EPA & CDPHE	12/31/17	Yes	Yes

XV. Protectiveness Statement

Institutional controls are in place to restrict use of the contaminated groundwater and the residents/businesses in the area are served by the municipal water system. The remedial action at OU1 is protective of human health and the environment. The remedial action at OU2 is not protective of human health and the environment. Because OU2 is not protective, the Site is not protective of human health and the environment.

The remedial action at OU2 is not protective because O&M and monitoring activities have only been conducted on a limited/sporadic basis since 2012. This is mainly due to the PRP's limited financial resources and the difficulties encountered when attempting to upgrade the water treatment system to meet the more stringent requirements of a 2013 CDPS discharge permit.

The remedy must be returned to normal operation, maintenance and monitoring to ensure protectiveness.

XVI. Next Review

The next review will be conducted within five years of the completion of this five-year review report. The completion date is the date shown on the signature page of this report.