Focused Feasibility Study

Kearsarge Metallurgical Corporation Superfund Site,

Conway, New Hampshire

January 2012

SDMS DocID 505034

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List of Abbreviations

DCA	1,1-Dichloroethane
1,2-DCA	1,2-Dichloroethane
DCE	1,1-Dichloroethylene
1,2-DCE	1,2-Dichloroethylene
AGQS	Ambient Groundwater Quality Standards established by the State of New Hampshire
ARAR	Applicable or Relevant and Appropriate Requirement
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulation
CVFD	Conway Village Fire District
EPA	United States Environmental Protection Agency
ESD	Explanation of Significant Differences
FeEDTA	Chelated iron
FS	Feasibility Study
FFS	Focused Feasibility Study.
ft	feet/foot
ft^2	square feet
gpm	gallons per minute
GPTS	Groundwater Pump-and-Treat System
ICLs	Interim Cleanup Levels
ISCO	*in situ* chemical oxidation
KMC	Kearsarge Metallurgical Corporation.
LTRA	Long-Term Response Action
MAROS	Monitoring and Remediation Optimization Systems
MCL	Maximum Contaminant Level
mg/kg	milligrams per kilogram, a measure of solid concentration, the equivalent of parts per million.
µg/l	micrograms per liter, a measure of liquid concentration, the equivalent of parts per billion.
MNA	Monitored Natural Attenuation
NCP	National Contingency Plan

NHBSWM	New Hampshire Board of Solid Waste Management (precursor to NHDES).
NHDES	New Hampshire Department of Environmental Services.
O&M	Operation and Maintenance
POTW	Publicly-Owned Treatment Work
RAO	Remedial Action Objectives
RI/FS	Remedial Investigation and Feasibility Study
ROD	1990 Record of Decision
SDWA	Safe Drinking Water Act
Site	Kearsarge Metallurgical Corporation Superfund Site
SRS	Soil Remediation Standards
TBC	To be considered
TCA	1,1,1-Trichloroethane
TCE	Trichloroethene
U.S.	United States
USACE	United State Army Corps of Engineers
VOC	volatile organic compound
WESTON®	Weston Solutions, Inc.

Executive Summary

Following a 1990 Record of Decision (1990 ROD) for the Kearsarge Metallurgical Corporation Superfund Site (the Site) in Conway, New Hampshire, the major events were:

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- 1992: United States Environmental Protection Agency (EPA) removed and disposed of 13,620 tons of waste pile material, 41.85 tons of crushed drums, a solvent-contaminated septic tank and 12 yards of contaminated septic soils.
- 1993: EPA built and began operating the Groundwater Pump-and-Treat System (GPTS).
- 2003: New Hampshire Department of Environmental Services (NHDES) removed 5,670 tons of solvent contaminated aquifer material.
- 2005: After pumping and treating approximately 250 million gallons of contaminated water over 12 years, groundwater treatment was halted. Approximately 225 pounds of solvents were removed from the groundwater during the 12-year pump-and-treat operations.

Currently, the remaining contamination at the Site consists of the contaminants 1,1-Dichloroethene (DCE), 1,1,1-Trichloroethane (TCA), 1,2-Dichloroethane (1,2-DCA), and 1,1-Dichloroethane (DCA) in a groundwater aquifer at concentrations that exceed Cleanup Levels based on drinking water standards and that were established in the 1990 ROD and subsequent Explanations of Significant Differences. The contaminated aquifer is approximately 0.5 acres in size and four to six-feet thick. The last two sampling rounds, December 2010 and October 2011, found the following:

Contaminant	Cleanup Level (µg/l)	Maximum Concentration (µg/l)	Number of Wells that Exceeded Cleanup Level
1,1,1-Trichloroethane	200	305	1 of 10
1,1-Dichloroethene	7	578	5 of 10
1,2-Dichloroethane	5	23	1 of 10
1,1-Dichloroethane	3,650	236	0 of 10

Since the 1990 ROD New Hampshire established an Ambient Groundwater Quality standard for DCA of 81 µg/l and for a new contaminant, 1,4-Dioxane, of 3 µg/l. In consideration of these new values, 2 wells of the 10 noted above exceed that standard for DCA. Sampling for 1,4-Dioxane began in September 2009. The October 2011 sampling round found that 3 of the 5 wells sampled exceeded the AGQS for 1,4-Dioxane. Therefore, a formal change in the cleanup level for 1,1-Dichloroethane, and the inclusion of a new cleanup level for 1,4-Dioxane, will occur in a subsequent decision document.

In 2009, EPA performed a detailed study of the remaining contamination in groundwater including evaluation of factors that would potentially support a natural attenuation approach at the Site (2009 Report). EPA concluded in the 2009 Report that the 0.5-acre contaminant plumes for DCE, TCA, and DCA were stable and not migrating.

Although the 2009 Report found that three wells were increasing in concentration for those three contaminants due to desorption from saturated soils, it was suggested that desorption would soon reach equilibrium and that the concentrations would subsequently decline. This was verified by the October 2011 sampling event as concentrations declined for all contaminants in all wells, and only exceedences for 3 contaminants were identified. Further evidence of natural attenuation being a viable remedy at the Site was noted in a study conducted by Weston Solutions, Inc., for NHDES in 2010.

Overall, approximately 375 pounds of contaminants have been removed to address groundwater contamination at the Site via the GPTS (225 lbs) and excavation of saturated soil (150 lbs). A calculation of contaminant mass has determined that less than 3 pounds of contaminants remain in the aquifer at present, primarily sorbed to the saturated soils, a 99% reduction of the original contaminant mass. The majority of these 3 pounds of contaminants slowly desorb from the saturated soils through a process called reverse matrix diffusion. Geochemical modeling that examined the GPTS found that reverse matrix diffusion would extend the time to attain cleanup levels if the GPTS resumed operation to 15 years or more. Similar modeling found that natural attenuation processes present in the aquifer would attain those same cleanup levels in approximately 18 years. Because natural attenuation is an *in situ* remedy that relies on natural processes subject to change, there is some uncertainty regarding this alternative. As a result, two additional contingent components were added to the natural attenuation alternative that is evaluated in this Focused Feasibility Study (FFS) should natural attenuation not perform as expected. These two contingent components include chemical oxidation and targeted limited groundwater pump and treatment.

Public drinking water is supplied to the area and no current risk to human health or the environment exists. Therefore, based on the success in contaminant reduction, the reduction of original contamination by 99%, the existing low groundwater concentrations, and the estimated remaining length of time until all cleanup levels are achieved, EPA, in consultation with the State, has evaluated in this FFS resuming the operation of the GPTS against Monitored Natural Attenuation (MNA) using seven of the nine criteria in the National Contingency Plan (NCP). That evaluation found that MNA and GPTS are similar except for cost. The cost is $2.6 million for GPTS and $731,000 for MNA using a discount rate of 7% over a period of 15 and 18 years, respectively.

FOCUSED FEASIBILITY STUDY
Kearsarge Metallurgical Corporation Superfund Site
Conway, New Hampshire
February 2012

1. Introduction

This Focused Feasibility Study (FFS) for the Kearsarge Metallurgical Corporation Superfund Site (the Site) in Conway, New Hampshire is written to evaluate a limited set of remedial alternatives based on the current Site conditions. Remedial activities begun in 1992 include the removal of contaminated soils and materials from the Site (Source Control) as well as the construction and operation of a 40 gallons-per-minute Groundwater Pump and Treat System (GPTS).

Originally, groundwater contamination consisted of high concentrations of Volatile Organic Compounds (VOCs) in a groundwater plume that covered as much as 10-acres. Twelve years after Source Control was completed and the GPTS began operations, Site contamination now consists of low concentrations of VOCs and 1,4-Dioxane in a 0.5-acre groundwater plume located solely on the former Kearsarge Metallurgical Corporation (KMC) property. This remaining low-level groundwater contamination is the result of slow desorption of contaminants from the saturated soils. This results in concentrations of groundwater contaminants that fall below detection limits and cleanup levels during groundwater pumping, and then slowly increase once pumping ceases.

The existing GPTS is very inefficient; removing less than 1 pound of contaminants per year at a cost of approximately $250,000. Therefore, EPA and NHDES began investigating potential alternatives to the GPTS. Based on Site conditions, the 2008 Five Year Review recommended that Monitored Natural Attenuation (MNA) be evaluated as a potential groundwater remedy at the Site.[1] Following a review of previous investigations and recent data, and discussions with NHDES, EPA prepared this document to evaluate the efficacy of resuming operation of the existing GPTS as compared to MNA.

1.1 Purpose and Organization

In Sections 2 and 3 of this FFS, three alternatives were developed to address the remedial action objectives for the Site:

1. No Action Alternative – This alternative does not include any additional actions to reduce the levels of contamination that remain in the groundwater.
2. GPTS Alternative – This alternative includes resuming operation of the existing GPTS to reduce the levels of contamination that remain in the groundwater.
3. MNA Alternative - This alternative involves reducing the levels of contamination that remain in the groundwater through natural processes.

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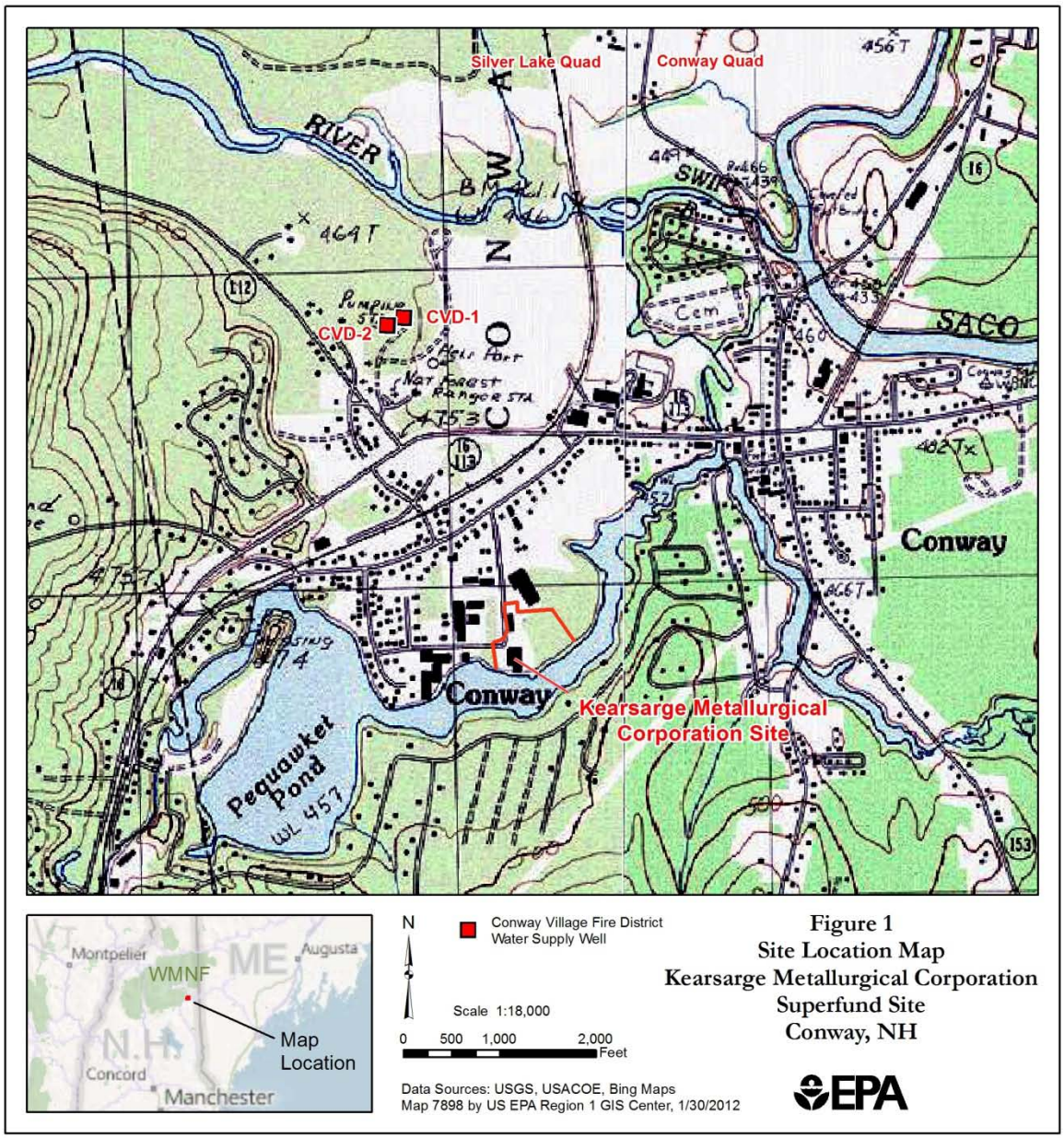
[1] *Third Five Year Review Report for the Kearsarge Metallurgical Corporation Superfund Site…*, U.S. Army Corps of Engineer, September 26, 2008, pages 66 and 67.

1.2 Site Background Information

The Site includes the property located at 123 Hobbs Street, Conway, New Hampshire 03818 as well as all areas where contamination has come to be located. The original source of contamination was on parcels 139 and 140 of the Conway Assessors Map 277. The EPA Site number is NHD062002001 and the Site ID number is 0101105.[2] The location of the Site is shown generally below in Figure 1.

Figure 1 - Location of Kearsarge Metallurgical Corporation Superfund Site.



[2] EPA Website for KMC:
http://yosemite.epa.gov/r1/npl_pad.nsf/701b6886f189ceae85256bd20014e93d/fd20cbafe1f088458525691f0063f6d1!OpenDocument
Accessed August 3, 2011.

1.2.1 Site Description

The Site is located in an industrial park on the western edge of Conway, New Hampshire, on the southeast side of Hobbs Street. The topography is flat, with several nearby large buildings housing various commercial enterprises. A residential area is 900-feet west of the KMC property. The area is served by public water and sewer provided by the Conway Village Fire District (CVFD). The closest water supply wells (CVD-1 and CVD-2) lie nearly 1 mile to the north of the Site as shown on Figure 1.

The 4,000 ft^2, groundwater treatment facility built by EPA in 1993 lies on the northern portion of the KMC property. On the same property, but south of this building is the dilapidated, original KMC building that is surrounded by a six-foot high chain-link fence. The fence was installed by NHDES to prevent unauthorized trespass and exposure to physical hazards from the building itself. The grounds surrounding this building are overgrown with native vegetation. Further east of both buildings, pioneer tree species such as birch and poplar lie within a wooded wetland. A surface water drainage culvert bisects the KMC property and conveys storm water runoff from the parking lot for the former Yield House parcel to the north of the Site into Pequawket Pond which lies a short distance to the south of the Site. Figure 2 shows the Site details.

Figure 2 - Details of the area surrounding the KMC Site.

1.2.2 Site History

KMC manufactured stainless steel valves and materials through high-quality castings using the lost-wax process. The lost-wax process produced waste casting sands and solvents. These solvents and casting sands were disposed in a wooded wetland just east of the old KMC building shown on Figure 2 in the area labeled "1992 Source Removal Area now wetland." Solvents were also discharged through the on-site septic system that was located between the old KMC building and the 1992 Source Removal Area.

Based on the Remedial Investigation and Feasibility Study performed by Camp, Dresser and McKee, Inc., under the direction of NHDES, EPA issued the 1990 ROD that selected both Source Control and Management of Migration remedies for the Site.[3,4] The Source Control component of the remedy required disposal of septic system components and soils, as well as a waste pile. EPA performed the Source Control component in 1992 by removing and disposing of 13,620 tons of waste pile material, 41.85 tons of crushed drums, a solvent-contaminated septic tank and 12 yards of contaminated septic soils from the area labeled "1992 Source Removal Area."[5] The Management of Migration component required construction of the GPTS. Construction was completed in 1993 and operations began in September 1993 with the GPTS operating at the approximate rate of 40 gallons per minute. From 1993 to 2005, GPTS removed and treated approximately 250 million gallons of contaminated water.

In April 2002, because groundwater contaminant recovery had reached an asymptote and not all groundwater cleanup levels had been attained, NHDES directed Weston, Inc., to conduct a soil-gas investigation. That investigation found that saturated subsurface Site soils still held significant quantities of solvent-contaminants and were, as a result, impacting groundwater. Therefore, in 2003, with EPA funding, NHDES removed an additional 5,670 tons of soil from the Site and re-configured the groundwater extraction trench. NHDES continued operating the GPTS until December 2005. Since that time, the groundwater treatment plant has been inactive to allow the aquifer to reach equilibrium and determine static conditions. As part of the evaluation of groundwater conditions, EPA performed a statistical assessment of contaminant conditions using the Monitoring and Remediation Optimization System software (MAROS). The results of the MAROS assessment were released in a 2009 Report. Table 1, below, summarizes the critical events in the history of the KMC Site.

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[3] *Remedial Investigation/Feasibility Study Report, Kearsarge Metallurgical Corporation Hazardous Waste Site, Conway, New Hampshire*, Camp, Dresser and McKee, Inc., June 1990.
[4] *Region 1, Record of Decision, Kearsarge Metallurgical Corporation , Conway, New Hampshire*, U.S. Environmental Protection Agency, September 28, 1990.
[5] EPA, *On-Scene Coordinator's Report, Kearsarge Metallurgical Corporation Superfund Site, Conway, New Hampshire, July 15, 1992 – October 15, 1992*, Dean Tagliaferro, OSC, Lexington Lab, EPA Region 1, page 1.

Table 1 - Chronology of Site Events.

Date	Event
Pre-1964	Operation of Site as a Sawmill.
1964 - 1982	Operation of Site as KMC for manufacture of stainless steel castings.
1970s	Discharge of acids, chlorinated solvents, caustics, and flammable liquids to ground surface (waste piles) and septic system.
1979	New Hampshire Water Supply and Pollution Control Commission notifies KMC that discharges to ground/septic system are illegal.
September 1981	EPA and New Hampshire Bureau of Solid Waste Management (NHBSWM) issue verbal order to re-containerize corroded drums in the waste piles.
December 1981	NHBSWM issues Letter of Deficiency to KMC.
1982	Indian Head Bank takes possession of KMC Lot 8 (now lot 140). Site abandoned.
June 1982	Containerized wastes removed from the Site in response to verbal order from EPA and NHBSWM.
October 1982	NHBSWM issues a Notice of Violation and Order of Abatement to KMC.
December 1982	NHBSWM begins hydrologic investigation of Site.
May 1983	EPA and NHBSWM order KMC to remove waste piles from the Site.
September 21, 1984	KMC Site added to the NPL.
July 1985	Consent Order – State of New Hampshire vs. KMC, orders KMC to perform Remedial Investigation/Feasibility Study (RI/FS).
July 1985	Commencement of RI/FS activities by GEI, KMC's contractor.
1987	After producing four draft documents, the insurance carriers for KMC cease funding the RIFS.
1988	Through a cooperative agreement with EPA, NHDES selects Camp, Dresser and McKee, Inc. (CDM), to complete the RI/FS.
June 1990	CDM completes the RI/FS. EPA releases the RI/FS and Proposed Plan to the public.
September 1990	Action Memorandum issued by EPA requiring removal of seven drums of uncharacterized materials from the Site.
September 28, 1990	ROD signed by EPA to perform Source Control and construct a GPTS.
August 1992	Explanation of Significant Differences (ESD) is issued by EPA to describe changes and clarifications to the 1990 ROD.
September 1992	Source Control Completed. EPA removed and disposed of 13,620 tons of waste pile material, 41.85 tons of crushed drums, a solvent-contaminated septic tank and 12 yards of contaminated septic soils
September 1992 to 1993	GPTS was designed, built and began operation, pumping and treating 40 gallons of contaminated groundwater per minute.
May 9, 1994	EPA determines that the GPTS was functioning properly and performing as designed.

Table 1 - Chronology of Site Events.

Date	Event
May 9, 1994 – May 31, 2004	Long-term response action (LTRA), the period of operation funded by EPA to pump-and-treat groundwater.
August 1, 1994	Cooperative Agreement between the EPA and NHDES documenting the takeover by NHDES of the LTRA.
July 1998	First SARA Five-Year Review completed.
October 1999	An active soil gas survey conducted by EPA.
October 2000	GPTS was modified by installing a ground water recovery trench and extraction well EW-13A.
January 2001	Extraction trench installed and groundwater recovery begins through well EW-13A.
January 2001	Capture zone analysis performed for Conway Village Fire District Wells No. 1 and No.2.
April 2002	Passive soil gas survey completed by WESTON for NHDES.
August 2002	Vertical profiling study completed by WESTON for NHDES.
December 2002	Geoprobe coring investigations completed by WESTON and a report of the results issued.
March 2003	EPA and NHDES met with Conway's town engineer to discuss Site remediation and obtain Town's feedback on excavation of saturated soils.
July 2003	EPA and NHDES attended Town of Conway selectmen's meeting to review future excavation activities, give overview of Site status, and respond to questions.
September 2003	ESD providing for additional source material excavation and modification of the cleanup level for 1,1-DCA from 4 µg/ℓ to 3,650 µg/ℓ.
September 30, 2003	Second Five-Year Review completed by EPA Region I.
October through December 2003	Approximately 5,670 tons of soils contaminated with chlorinated solvents were excavated and removed from the Site as part of additional source material excavation.
February 2004	New extraction well EW-13B installed in excavation area and pumping begun.
February 2004	Discontinued pumping from the Hobbs Street Extraction Wells (EW-01, EW-02, EW-03) due to attainment of cleanup goals in that area.
May 31, 2004	Ten years of LTRA completed. NHDES assumes full responsibility for O&M.
June 2004	Source Removal Action Completion Report completed for NHDES by WESTON Solutions, Inc.
June 2004	Catalogue of Wells, Piezometers and Other Subsurface Investigations Report completed by WESTON Solutions, Inc.
September 2004	Kearsarge Metallurgical Corporation Reuse Assessment completed

Table 1 - Chronology of Site Events.

Date	Event
Early December 2005	GPTS turned off as agreed to by EPA and NHDES to allow stabilization phase to begin.
March 29, 2007	Preliminary Draft Post-Source Removal Data Evaluation Report completed by WESTON Solutions, Inc.
September 26, 2008	Third Five-Year review issued by EPA.
December 2009	EPA issues a 2009 report that evaluated the remaining groundwater contamination at the Site using the Monitoring and Remediation Optimization System (MAROS) software.
April 19, 2010	EPA issues an Explanation of Significant Differences to require Institutional Controls for the Site..
August 30, 2011	Institutional Control (Activity and Use Restriction) recorded by Carroll County Register of Deeds.

1.2.3 Site Conditions and Remedial Efforts

The distribution and migration of contaminants in groundwater at the Site is governed by geology and hydrology. The geology of the Site from the surface downward consists of fine-grained sand overlying dense gray silt and clay that overlies bedrock. Although the ground surface at and surrounding the Site is relatively flat, the thickness of the permeable sand is highly variable. In the area west of the Drainage Culvert and east of Hobbs Street, as shown on Figure 3, the sand varies from 8 to 12 feet thick, and thickens rapidly to the west of Hobbs Street to a depth of greater than 50 feet below the ground surface.

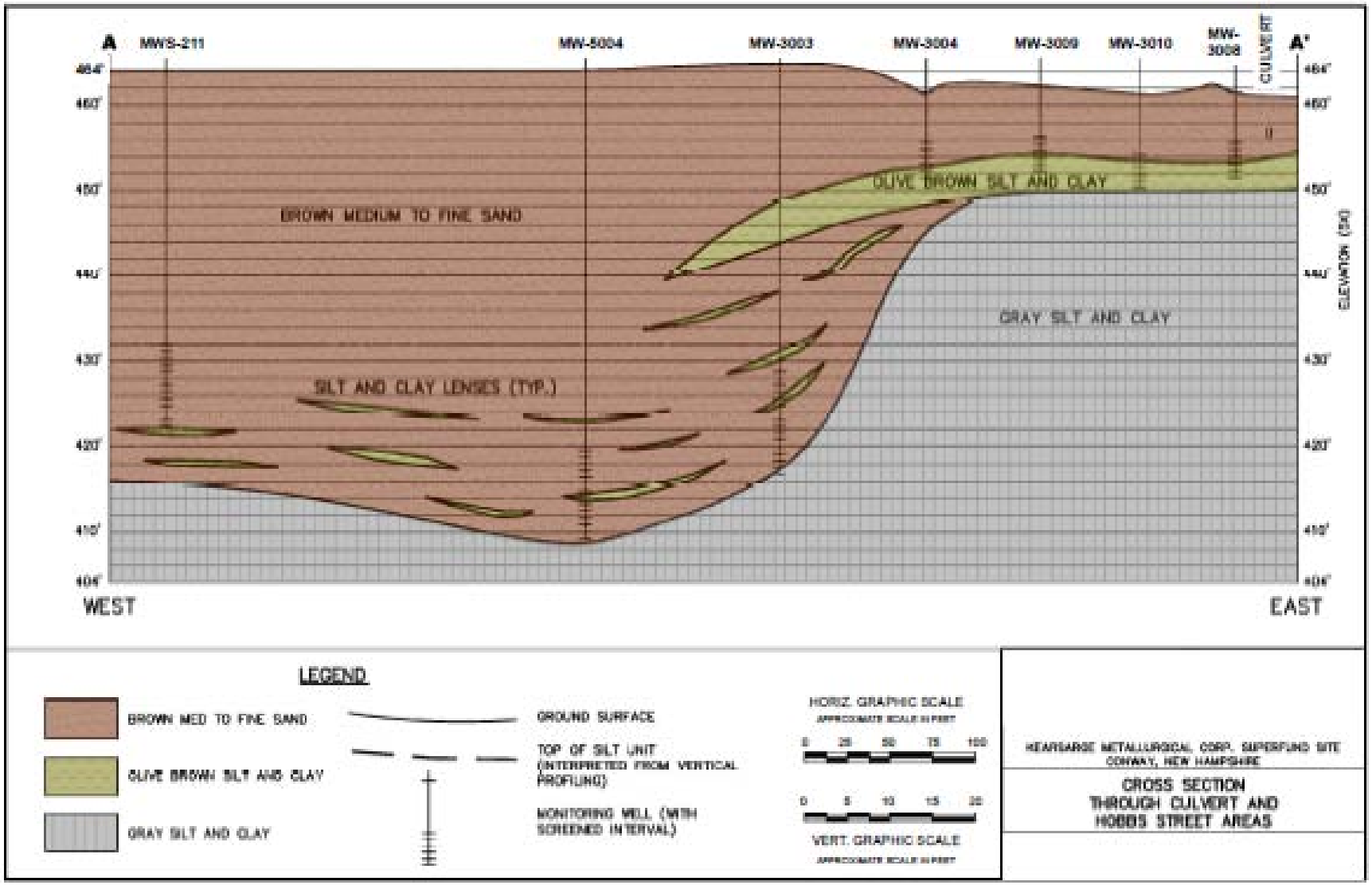


Figure 3 - Cross-section of the KMC site geology.

Figure 3 shows the cross-section of the geology from the Drainage Culvert in the east (shown in plan view on Figure 2), westward across the Site to well MWS-211. The line of the cross-section passes north of the old KMC building shown on Figure 2. The cross-section does not show the underlying bedrock that is approximately 100 feet below the ground surface.

The permeable, brown, medium-to-fine sand noted in Figure 3 contains the majority of the contaminants in a dissolved phase. The dense, gray silt and clay layer acts as an aquitard and is essentially impermeable to water and the contaminants; however, in areas where high concentrations of contaminants were in the sand layer, matrix diffusion has created a zone of highly concentrated contaminants within the silt and clay. Figure 4 shows the character and consistency of the underlying gray silt and clay layer.

Figure 4 – Material from the clay aquitard underlying the Site. This sample was recovered east of the old KMC building at a depth of 12-feet by Weston Solutions, Inc., during the November 2002 geoprobe investigation.

The groundwater hydrology is also controlled by the level of Pequawket Pond, an impoundment, and the dam that controls the water level is controlled by the State. The pond level is lowered in the fall before the pond freezes by removing boards at the outlet; and in the spring the level is raised by restoring the boards to the dam. Overall, the height of groundwater varies by 3 to 4 feet due to the pond level being raised or lowered. The elevation of groundwater adjusts rapidly to that of Pequawket Pond because the Drainage Culvert connects the groundwater to the pond along the entire eastern side of the Site. The connection of the pond level to groundwater along the Drainage Culvert produces a primarily east-west component to contaminant migration.

For purposes of this FFS, the discussion of the history of Site contamination has been divided into three phases:

1. Remedial Investigation until the issuance of the Record of Decision (1985 – 1990).
2. Active Remediation Phase (1992 – 2005).
3. Stabilization (2005 to present).

Each phase has distinct contamination and concentration types that are discussed in greater detail, below:

Remedial Investigation and Record of Decision Phase (1985 – 1990)

The disposal of liquid hazardous wastes occurred on the east side of the old KMC building labeled "Kearsarge Metallurgical Corporation" on Figure 2 during the 1970's and early 1980's. The contaminants entered the fine-grained sand as a free-phase and migrated in groundwater in a radial fashion. The contaminants included spent solvents and plating solutions. The primary contaminants in groundwater at the time of these investigations are shown in Table 2 with their maximum concentrations and frequency of detection.

Table 2 – Groundwater contaminant concentrations in 1990 and selected Cleanup Levels.[6]

Contaminant	Cleanup Level (ppb)	Maximum Concentration in 1990 (ppb)[7]	Frequency of detection[8]
Chloroform	100	171	3/24
1,1 Dichloroethane	3,650[9]	1,560	9/24
1,2 Dichloroethane	5	1,460	1/10
1,1 Dichloroethylene	7	615	4/10
Trichloroethylene	5	118	2/10
1,1,1 Trichloroethane	200	18,500	7/10
Chromium	50	10	1/24
Nickel	700	4,700	3/24

Other cleanup levels established in the 1990 ROD included those for the waste pile (chromium at 1400 mg/kg[10]) and septic system soils (1,1,1 trichloroethylene at 300 µg/g[11]).

[6] 1990 Record of Decision, EPA, page 40.
[7] 1990 Record of Decision, EPA, page 12.
[8] Maximum concentration and frequency were selected from one of two sampling periods, May 1989 and February 1990.
[9] The 1990 ROD identified a cleanup level of 4 ppb. Subsequent to that EPA evaluated the toxicity data used to establish the 1990 cleanup levels and in the September 29, 2003 Explanation of Significant Differences the Cleanup Level was increased to 3,650 ppb. Subsequently, the State of New Hampshire has established an Ambient Water Quality Criterion of 81 ppb. A new cleanup level for 1,1-DCA will be established in a subsequent decision document.
[10] The 1990 ROD identified this cleanup level as ppb, which was in error. The actual cleanup level was 1,400 parts per million (ppm). This error was identified and corrected in the 1992 Explanation of Significant Differences.
[11] 1990 Record of Decision, EPA, pages 41 and 42.

Active Remediation Phase (1992 – 2005)

The active remediation phase began in 1992 with the removal of the waste pile and ended when the GPTS was shutdown in December 2005. The surface contaminants including a waste pile, the septic tank and soils, and other contaminated material were removed in 1992.[12]

Between 1992 and 1993, EPA designed and built a groundwater treatment plant to remove and treat contaminated groundwater (GPTS). From 1993 until December 2005, EPA and NHDES operated the 40+ gallon per minute (gpm) GPTS. All extracted groundwater was treated via air-stripping and the contaminants were captured on vapor-phase carbon. The clean groundwater was discharged to the sewer operated by the Conway Village Fire District (CVFD). Discharges from the treatment plant met all cleanup levels and discharge standards established by the CVFD. The GPTS had two primary extraction areas, the "Hobbs Street wells" and the "Culvert wells."

Hobbs Street Wells

These wells extracted approximately 40 gpm of contaminated groundwater from an area west of the old KMC Building. In this location, the sands were greater than 50 feet deep, and highly permeable. The northern-most of the Hobbs Street wells, EW-4, ceased operation in 1995 as it had met all cleanup levels. The 2000 Operations Report stated that four of six monitoring wells in this area met cleanup levels. Only 1,1-DCA and TCE exceeded cleanup levels in the two wells not in compliance at that time.[13] The 2001 Operations and Maintenance Report determined that the Hobbs Street wells had attained cleanup levels and proposed to pulse the well extraction to optimize contaminant recovery.[14] By February 2004, all active remediation in the Hobbs Street wells had ceased as groundwater cleanup levels had been attained in all monitoring wells in that area. Cleanup levels have continued to be met through the present.[15]

Culvert Wells

From 1992 until 2000, groundwater was pumped at a rate of approximately 1 to 1.7 gpm from 10 extraction wells installed in two parallel lines to the east of the old KMC building. The first line (Line 1), lying in the middle of the Site, consisted of 4 wells running northwest-southeast, approximately 120 feet east of the old KMC building. The second line (Line 2), parallel to the first line, had 6 wells parallel to and 20 feet west of the Drainage Culvert shown on Figure 2.

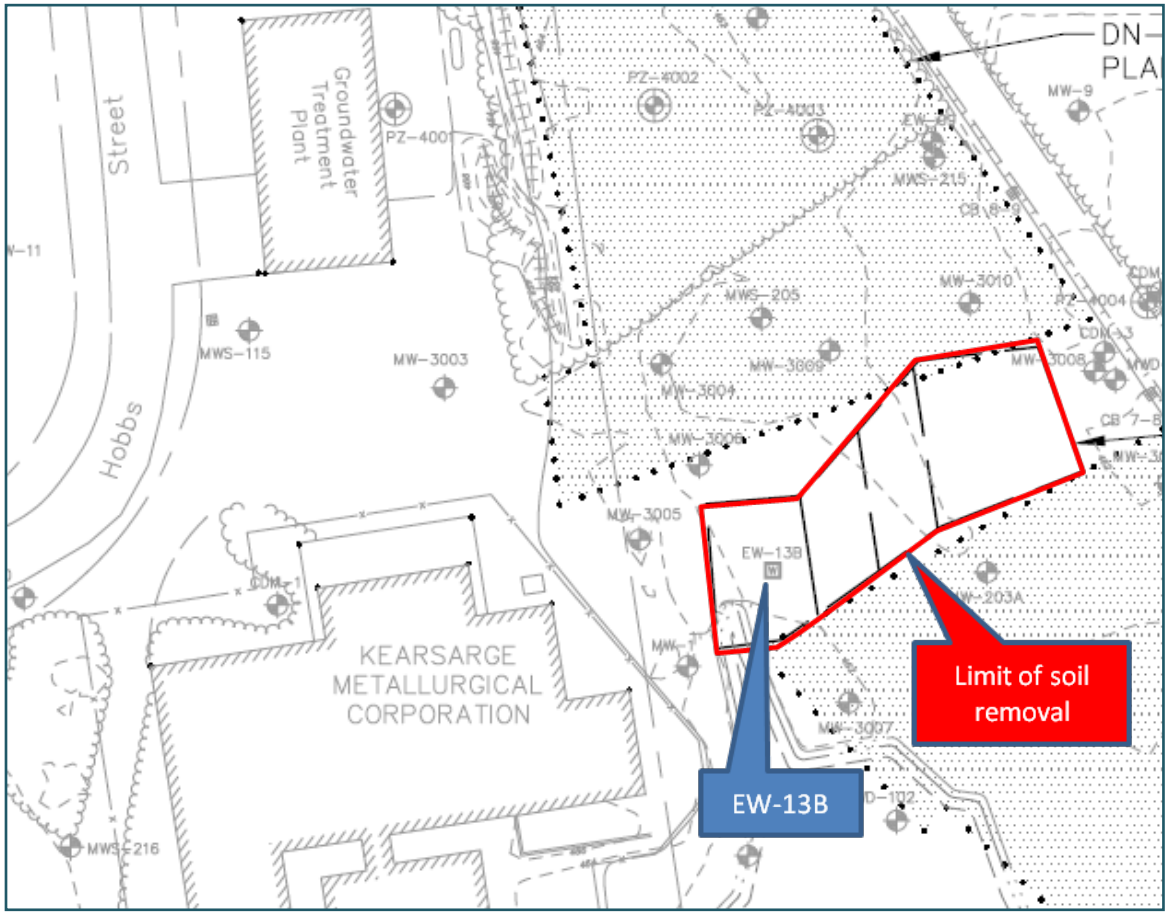
In 2000, to increase the recovery of contaminated groundwater, an extraction trench was added parallel to the ten Culvert wells and approximately 10 feet west of Line 1. The infiltration trench was 120 feet long and had a central well, EW-13A, from which contaminated groundwater was also pumped to the groundwater treatment building. The infiltration trench was installed because of the low recovery of groundwater with the ten extraction wells and the persistence of contamination despite nearly 8 years of pumping.

[12] EPA, *On-Scene Coordinator's Report for the Kearsarge Metallurgical Corporation Superfund Site, Conway, New Hampshire*. July 15, 1992 – October 15, 1992.
[13] Weston, 2000 *Operations Report*…. May 2001. Page 4-5.
[14] Weston, 2001 Operations and Maintenance Report…. March 2002. Pages 6-1 and 6-3.
[15] Weston, *Operations and Maintenance Strategy*…, June 2004. Page 1-3.

In 2003, it was determined that significant groundwater contamination remained in the Culvert area, yet contaminant recovery was very low. Because the aquifer was shallow, averaging 10 feet in depth in this area, and the extent was limited, it was decided that the contaminated, saturated soils would be excavated, dewatered and disposed at an off-site location. Saturated soils containing more than 3 mg/kg of total volatile organic contaminants were targeted for removal.

A total of 5,670 tons of contaminated soil, sands, clay and silt were removed from the Site in 2003. It was estimated that more than 150 pounds of contaminants were removed and that less than 3 pounds remained in the aquifer in the Culvert area at the conclusion of the excavation. The resulting pit was filled with 5-feet of highly permeable crushed stone and then native material to attain a grade consistent with the surrounding topography. The excavation also resulted in the removal of the 10 Culvert area extraction wells and the 2000 extraction trench with well EW-13A. During filling of the excavation with crushed stone, extraction well EW-13B was installed and groundwater extraction continued from this area until December 2005. Figure 5, below, shows the extent of the aquifer soil excavation and the location of EW-13B. Figure 2 also shows this area as the "2003 Excavation."

Figure 5 – The location of the 2003 soil excavation area (also shown on Figure 2) and the location of EW-13B.



In May 2004, the State planted 1,300 poplar trees as a potential remedial measure to further treat groundwater with phytoremediation. These areas are partially seen in Figure 5 as shaded areas north and south of the 2003 excavation. No monitoring or research has documented the effectiveness of these trees at reducing contaminant mass or mobility. The effectiveness of phytoremediation may have been reduced as many of the trees were cut down by beavers.

Overall Performance of Active Remediation

The GPTS removed, treated and disposed of approximately 250 million gallons of contaminated water from the Site over a 12-year period. Approximately 2% of this water was extracted from the Culvert Area wells and 98% from the Hobbs Street wells. Over the life of the remedy, approximately 225 lbs of contaminants were removed from the subsurface through the pump-and-treat operation.[16] Figure 6 displays the annual recovery of all contaminants in groundwater at the Site.

Figure 6 – Pounds of Volatile Organic Compounds (VOCs) removed through groundwater extraction 1994 to 2005.

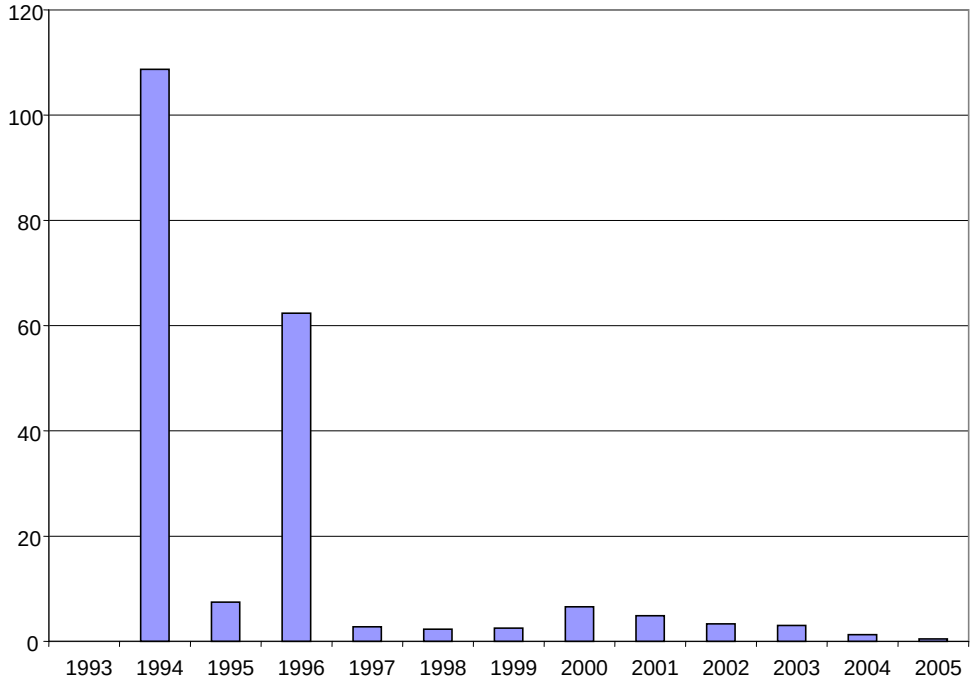


Figure 6 is Chart 1 in the 2008 Five Year Review.

Figure 6 shows the asymptotic decline in recovery of contaminants from the extraction wells at the Site. During the time the GPTS was in operation, actions were taken to continually optimize recovery to ensure that the maximum amount of contamination was removed from the groundwater. The slight increase in recovery in 2000 was due to the installation of the extraction trench. Following the soil excavation in 2003, recovery was again enhanced temporarily as the area of the excavation was filled with permeable gravel and well EW-13B was installed. In 2005, the State noted the declining recovery of contaminants from well EW-13B and asked EPA

[16] Estimated through summation of the values in Figure 6.

to discontinue operation of the GPTS to assess the rebound and static contamination remaining at the Site. EPA agreed to this strategy and the system was shutdown on December 31, 2005. The GPTS has not operated since shutdown. When in operation, the GPTS cost approximately $250,000 per year to run and has been minimally maintained since 2005.

Institutional controls enforceable by the State were recorded on the Site property on August 30, 2011 to ensure that groundwater is not used in the area. The State continues to perform groundwater monitoring both to assure that contaminants do not migrate beyond the property boundary at concentrations that exceed the cleanup levels and to assess the need for additional cleanup efforts.

Stabilization (2005 to present)

All hazardous materials at the ground surface at the Site were removed by the Source Control remedial actions conducted in 1992. In addition, the GPTS operated for 12 years removing, treating and disposing of contaminated groundwater. Further subsurface monitoring and investigations found that although the 2003 soil excavation removed significant amounts of contaminants, high concentrations of VOCs remained in a localized area in the upper portion of the silt aquitard beneath the sand aquifer in the area of well MW-3010 (See Figure 5).

To assess the extent and character of the remaining groundwater contamination at the Site, EPA commissioned the 2009 Report that included a statistical assessment of the remaining groundwater contamination. The Monitoring and Remediation Optimization System software (MAROS) was used to evaluate the character of the contaminant plumes and the efficacy of the monitoring system. The 2009 Report made the following findings:

1. Active remediation from 1993 to 2005 diminished contamination at the Site and the majority of monitoring wells showed no or low and decreasing levels of contamination.
2. Biotic and abiotic degradation pathways were actively transforming the contaminants at the Site.
3. Two areas had increasing trends as of 2008. However, due to limited source material the belief was that those concentrations would begin declining. These areas included:
    a. Well MW-3008, near the drainage culvert, which showed an increasing trend for DCE.
    b. Well MW-3003, approximately 100-feet east of Hobbs Street, which showed an increasing trend for TCA and DCE.
4. There was redundancy in the monitoring well system and the sampling frequency could be reduced. A number of monitoring locations were also declared statistically “clean.”

The 2009 Report made two recommendations: a reduced sampling effort in select monitoring wells, and increased sampling in the drainage culvert that may be intercepting contaminated groundwater. Although the concentrations in wells MW-3008 and MW-3010 increased through December 2010, the concentrations in October 2011 began to decline.

Although the 2009 Report found that biotic and abiotic degradation was reducing the original contaminants at the Site, it also found that one of the intermediate, daughter products, DCE, was

a more recalcitrant compound with a more stringent cleanup level (7 ppb) than TCA (200 ppb).[17] The 2009 Report stated that the potential for an expansion of groundwater contamination above cleanup levels was possible in areas still dominated by low concentrations of TCA that degrades to DCE.[18] The fate and transport of this Site contaminant, DCE, was found to be a concern and the 2009 Report recommended additional semi-annual monitoring over the next two to three years.[19] Table 3 compares the remaining contaminants in the wells from sampling rounds in December 2010 and October 2011.

Table 3 – VOC contamination in groundwater December 2010 and October 2011. The yellow highlighted values exceed the cleanup levels.

	1,1-DCE (ug/l)		**1,1,1-TCA (ug/l)**		**1,1-DCA (ug/l)**		**1,2-DCA (ug/l)**	
	Dec-10	**Oct-11**	**Dec-10**	**Oct-11**	**Dec-10**	**Oct-11**	**Dec-10**	**Oct-11**
EW-9	2.1	2.9	4.7	4.4	<2	<1	<2	<1
MWS-203A	2.6	2.4	<2	<1	7.3	<1	<2	<1
MW-3003	30	15.9	45	15	12	<1	<2	<1
MW-3004	<2	<1	3	1.2	<2	<1	<2	<1
MW-3006	12	4.8	22	9.9	2.5	<1	<2	<1
MW-3008	175	89.8	12	3.4	101	1.6	<4	<1
MW-3009	8.8	10.3	15	19.6	6.3	<1	<2	<1
MW-3010	578	220	289	100	235	14.1	23	5.3
MW-3011	<2	7.2	<2	<1	2.6	<1	<2	<1
MW-5003	NS	1	NS	1.8	NS	<1	NS	<1
PZ-4002	NS	<1	NS	1.2	NS	<1	NS	<1
PZ-4003	<2	<1	<2	<1	<2	<1	<2	<1
Cleanup Level	7		200		3,650[20]		5	

NS – Not sampled.

Table 3 also shows that the primary remaining contaminant of concern is DCE. This contaminant is selected for focus as it has a low cleanup level and the other contaminants are either below cleanup levels or in wells that are also contaminated with DCE. The primary wells of concern are MW-3010 and MW-3008 that contain the majority of the contaminants and the highest concentrations. Figure 7 shows the concentration trends for DCE in wells MW-3010 and MW-3008 since the shutdown of the GPTS in 2005.

[17] Environmental Protection Agency, *Final Report: Technical Assistance for the Kearsarge Metallurgical Corporation Superfund Site, Conway, New Hampshire, EPA Region 1*, Office of Solid Waste and Emergency Response. EPA-542-09-014, December 2009.
[18] EPA, *Final Report*…December 2009, Page 7.
[19] EPA, *Final Report*…December 2009, Pages 16 - 17.
[20] 1,1-DCA had a cleanup level of 4 ug/l in the 1990 ROD based on risk. That risk was re-evaluated when toxicity factors were changed and a 2003 ESD set the new cleanup level for 1,1-DCA at 3,650 ug/l. The State of New Hampshire has since established an Ambient Water Quality Criterion of 81 ppb. A new cleanup level for 1,1-DCA will be established in a subsequent decision document.
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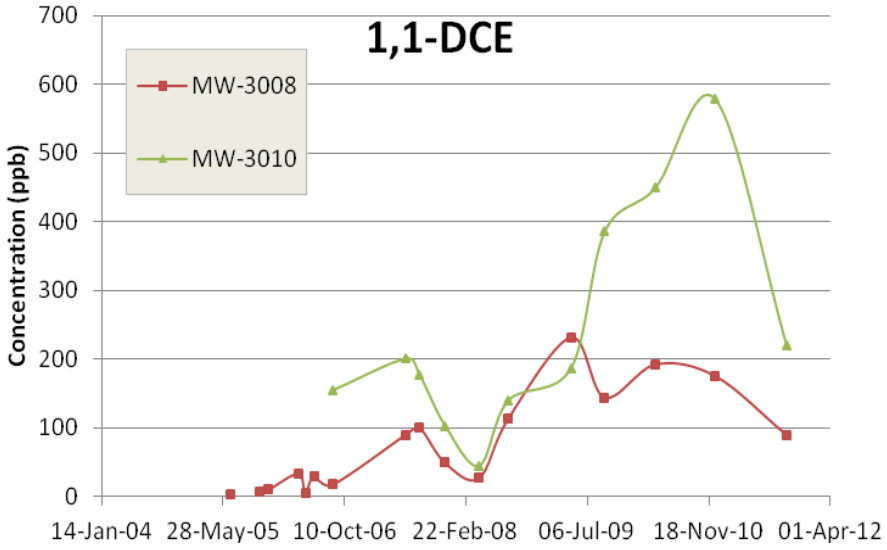
Figure 7 – Concentration trends for DCE in the two wells where it exceeds the cleanup level, 7 ppb, by a significant amount.



A contaminant of concern not identified in the 1990 ROD has recently emerged: 1,4-Dioxane. 1,4-Dioxane was commonly used as a stabilizer for many chlorinated solvents and is highly miscible in water and therefore prone to rapid transit in groundwater. Monitoring of this compound began in September 2009. It has been found in low concentrations in wells with higher concentrations of TCA. Prior EPA response actions at the Site did not set a cleanup level for 1,4-Dioxane. New Hampshire has, however, since adopted an Ambient Groundwater Quality Standard (AGQS) of 3 µg/l for 1,4-Dioxane. A cleanup level for 1,4-Dioxane will be established in a subsequent decision document. Table 4 lists the concentrations found at the Site for 1,4-Dioxane.

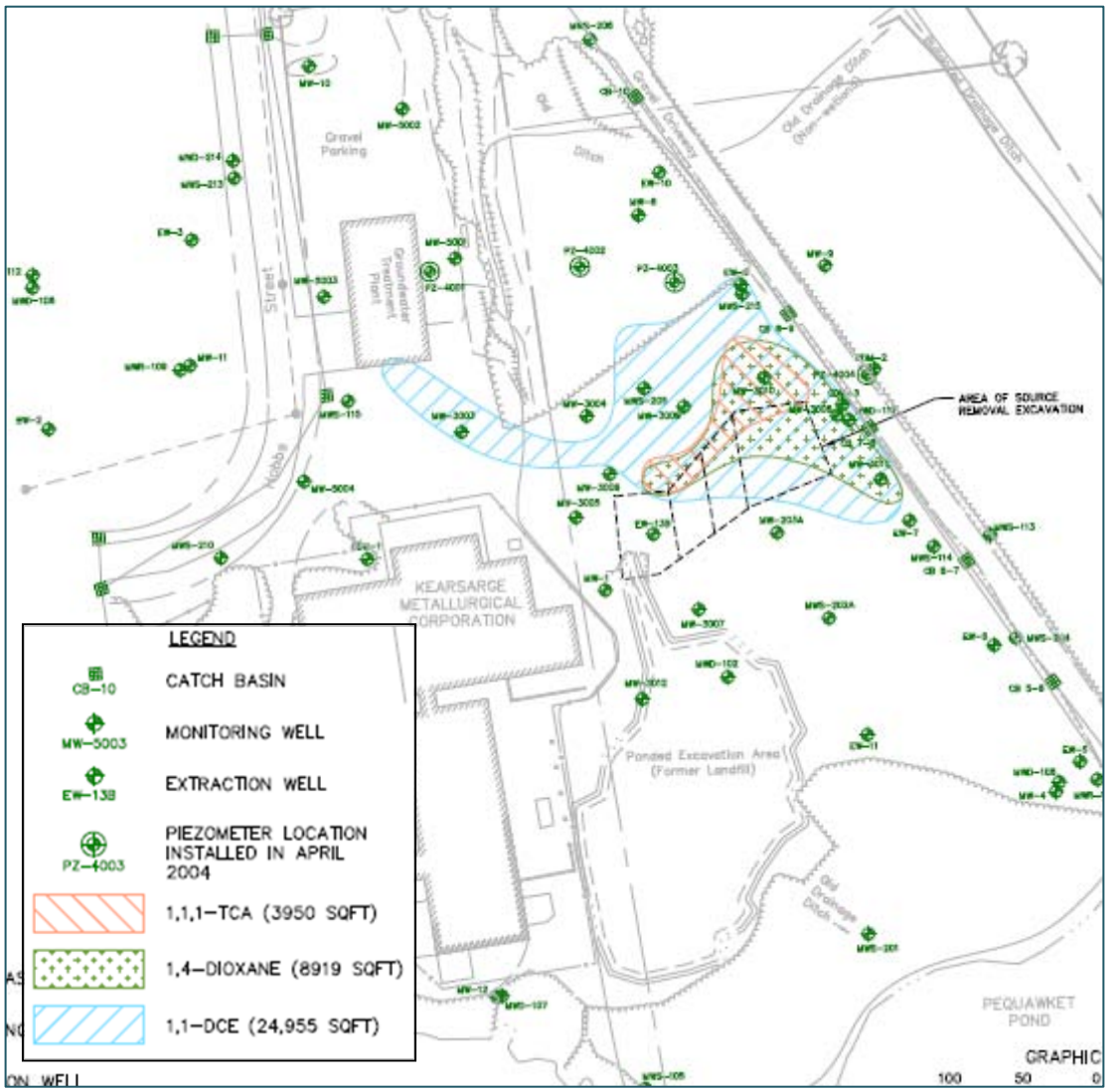
Table 4: The concentration of 1,4-Dioxane at the Site during the last two sampling events. The highlighted values exceed the New Hampshire regulatory standard.

	1,4-Dioxane (ug/l)	
	December-10	**October-11**
MW-3003	<2	<2
MW-3008	6.3	4.1
MW-3009	1.4	<2
MW-3010	34	25
MW-3011	<2	4.5
MW-5003	NS	<2
NH AGQS	3	

Figure 8 shows the extent of the groundwater plumes for TCA, DCE and 1,4-Dioxane. The only wells above cleanup levels are listed above in Tables 3 and 4. All other contaminants that exceed cleanup levels are within these groundwater plumes. One of the problems posed by 1,4-

Dioxane is because it is highly miscible in water it cannot be treated with conventional remedies. Air-stripping and carbon removal do not reduce 1,4-Dioxane concentrations in water; therefore the current GPTS was not designed to treat this contaminant and in the past simply passed this contaminant through the treatment system. Currently, the only known means of treatment of 1,4-Dioxane is UV-oxidation which has not been used at the Site and has limitations as well.

Figure 8 – Location of groundwater contaminated with TCA, DCE and 1,4-Dioxane as of September 2009.



From: Weston Solutions, Inc., *Revised Draft Final Focused Feasibility Study….*

1.2.4 Current State of Contamination and Exposure Pathways

The only remaining contamination at the Site is in groundwater limited to the area shown in Figure 8. Although Figure 8 depicts conditions as of September 2009 and concentrations have since declined, the bounds shown are a conservative estimate of the remaining contaminated plume. The exposure pathways would be through the use of groundwater for drinking water and vapor intrusion into buildings from contaminated groundwater.

The nearest groundwater user in the vicinity of the Site is the CVFD that operates two water supply wells approximately 1 mile north of the Site. A *Ground Water Supply Assessment* conducted by Emory and Garrett in 2008 for CVFD concluded that "it is unlikely that groundwater contamination from the KMC Site will ever reach these wells."[21] The current monitoring network will ensure that any migration of groundwater contaminants above cleanup levels beyond the property boundary will be detected. Public water is supplied to the entire area and institutional controls have been recorded for the Site.

1.2.5 Baseline Risk Assessment

The Site is part of a business park zoned for industrial uses. There are no private water supply wells in the area and all nearby residents and businesses are connected to the public water supply. Although the Site is abandoned and currently unoccupied, the Town plans to acquire the property and convey it to a new owner for a commercial enterprise in the near future. It is therefore very likely that the Site could be occupied for commercial/industrial uses at some time in the future. This baseline risk assessment documents an evaluation of risks to human and ecological receptors at the Site based on recent data collected at the Site and current and future use scenarios for the Site.

Evaluation of Human Health Risks at the Site

The consumption of contaminated groundwater at the Site poses a future risk. Groundwater exceeds the MCL for TCA, DCE, and 1,2 DCA. Although the risk-based concentration for DCA, 3,650 µg/l, is not exceeded presently, New Hampshire has established an Ambient Groundwater Quality Standard (AGQS) of 81 µg/l. Also, the AGQS for 1,4-Dioxane has since been set at 3 µg/l. Concentrations of DCA and 1,4-Dioxane in groundwater at the Site exceed these new AGQS and the Cleanup Levels for these compounds at the Site will be revised to 81 µg/l and 3 µg/l, respectively, in a future decision document.

Groundwater from the Site is known to discharge to Pequawket Pond via storm drains; however, contaminant concentrations detected in water samples collected from the storm drain catch basins have been below the NH Surface Water Quality Criteria for human consumption of fish. Therefore, there are no future or current unacceptable risks due to human consumption of fish caught from Pequawket Pond.[22]

The third Five-Year Review in 2008 identified two potential current exposure pathways for Site groundwater contamination to pose risks to human health: ingestion of groundwater and

[21] Emery & Garrett Groundwater, Inc., *Groundwater Supply Assessment Conway Village Fire District Production Wells CVD-1 and CVD-2; Eight-Day Pumping Test and Water Quality Analyses*, January 2008.
[22] Weston Solutions, Inc., *Revised Draft Final Focused Feasibility Study…*, December 2010. Table 4-3.

inhalation of contaminants migrating from the groundwater plume into buildings.[23] Since groundwater contamination still exceeds cleanup levels, an Activity and Use Restriction, prohibiting the use of groundwater, has been recorded in the chain-of-title for the KMC site.[24] The Activity and Use Restriction precludes any unauthorized activities which could cause exposure to Site contamination before the Site cleanup is complete. Such activities would include: disturbing the soil or using groundwater as drinking water. Although none of the soil samples collected from the Culvert Area during the Geoprobe investigations in 2008 contained VOCs that exceeded the NH Soil Remediation Standards for industrial exposure, the prohibition on disturbing soil prevents potential exposure to contaminated groundwater.[25, 26]

An evaluation of potential risks due to intrusion of VOC vapors into buildings on or near the Site was performed in 2009.[27] Maximum detected groundwater concentrations of chlorinated VOCs were compared to guidance criteria in the *New Hampshire Vapor Intrusion Guidance,* dated July 2006 and revised February 2007 (NHDES, 2007) and to guidance criteria in *EPA OSWER Draft Subsurface Vapor Intrusion Guidance (EPA530-D-02-004)* (EPA, 2002); with noted modifications and adjustments by EPA Region 1. Based on that evaluation, there were no unacceptable risks due to the vapor intrusion pathway to workers. However, since maximum concentrations of VOCs in the contaminant plume increased after that evaluation, vapor intrusion risks were re-evaluated by Weston.[28] Table 5, extracted from Weston's Table 4-2, contains the maximum concentrations of VOCs detected in April 2010 in comparison to the guidance criteria.

Although the maximum detected concentration of DCE exceeds the EPA screening criteria for residential exposure under a vapor intrusions scenario, there are currently no residences within 800 feet of the groundwater contaminant plume. Both DCA and DCE exceed the EPA screening level for volatization from residential tapwater; however, there are no local residences using groundwater as tapwater. Based on this analysis, there are no current unacceptable risks due to the vapor intrusion exposure pathway at the Site for either residential or commercial and industrial use exposures. Future exposures will be prevented through the use of Institutional Controls that prohibit residential use.

[23] EPA, 2008 Five Year Review…, September 2008. Pages 65 – 66.
[24] State of New Hampshire, *Notice of Activity and Use Restriction*, Document # 0009498, Registry of Deeds, Carroll County, August 30, 2011 @ 11:07 AM, Book #2946, Pages 0727 – 0734.
[25] The NH Soil Remediation Standards that are based on protection of human health risks through direct exposure and leaching to groundwater.
[26] Weston Solutions, Inc., *Revised Draft Final Focused Feasibility Study…*, December 2010. Table 4-1.
[27] Weston Solutions, Inc., 2-page letter to NHDES regarding vapor intrusion, April 14, 2009.
[28] Weston Solutions, Inc., *Revised Draft Final Focused Feasibility Study…*, December 2010. Table 4-2.

Table 5: Updated Vapor Intrusion Pathway Analysis, Kearsarge Metallurgical Corporation Superfund Site, Conway, New Hampshire. Table from Weston Solutions, Inc., Revised, Draft Final Focused Feasibility Study, Table 4-2.

Target VOC	Maximum Concentration Detected in 2010[1] (µg/l)	Well[1]	NHDES Groundwater to Indoor Air Screening Levels[2] (µg/l)	MCL (µg/l)	EPA Draft Groundwater to Vapor Intrusion Screening Levels[3] (for residents) (µg/l)	EPA Regional Screening Level for Residential Tapwater[5] (µg/l)	EPA Draft Groundwater to Vapor Intrusion Screening Levels (for Workers)[6] (µg/l)
PCE	<2	None	80	5	0.55[4]	0.11	3.47
TCE	<2	None	90	5	2.89[4]	2	18.21
1,1-DCA	**197**	MW-3010	10,000	NA	2,200	**2.4**	13,860
1,1-DCE	**483**	MW-3010	1,000	7	**190**[7]	**340**	1,197
1,1,1-TCA	302	MW-3010	20,000	200	3,100	9,100	19,530
VC	<2	None	10	2	0.5[4]	0.016	3.15

Notes:
Numbers in **bold** exceed vapor intrusion screening levels.
[1] New Hampshire Department of Environmental Services (NHDES) Laboratory Report, Work Order A002535 dated May 3, 2010. These values are groundwater concentrations and not vapor.
[2] NHDES Vapor Intrusion Guidance, July 2006, revised February 2007, relative to exposure to commercial & industrial workers.
[3] For 1 x 10^{-06} cancer risk or Hazard Quotient = 1, and 0.001 attenuation factor, from Table 2c (EPA, 2002).
[4] Risk-based screening level, not truncated at the MCL as in Draft Vapor Intrusion Guidance – EPA Region 1 calculation.
[5] Ingestion plus inhalation for 1 x 10^{-06} cancer risk or Hazard Quotient = 1 from EPA Regional Screening Level Table (http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/index.htm)
[6] Screening level for workers is 6.3 times higher than for residents due to shorter exposure frequency (250 vs. 350 days/year), shorter exposure duration (20 vs. 30 years) and shorter exposure time (8 vs. 24 hours/day).
[7] EPA Draft Groundwater to Vapor Intrusion Screening Levels have been set for buildings within 100 feet of the contaminant plume.

PCE = tetrachloroethylene, TCE = trichloroethylene, DCA = dichloroethane, DCE = dichloroethene, TCA = trichloroethane, VC = vinyl chloride, VOC = volatile organic compound, NA = not applicable, µg/l = micrograms per liter = parts per billion

Evaluation of Ecological Risks at the Site

The 1990 Feasibility Study identified the waste pile as the major risk to ecological receptors at the Site. In addition, TCA contaminated groundwater posed a low level chronic risk to the wetland/pond ecosystem as it entered surface water. The ecological risks at the Site have been greatly reduced, if not eliminated, by two means: the removal of source materials including the waste pile, septic tank and leaching field soil, and additional soil in the Culvert Area; and the significant reduction in the concentration of TCA in groundwater.

The present potential exposure of ecological receptors to Site contaminants is limited to groundwater contamination that discharges to the storm sewer beneath the gravel driveway in the Culvert Area and flows into Pequawket Pond. Soil and groundwater contamination is greater than 5 feet deep, which is sufficiently deep to not present a risk to ecological receptors. To evaluate potential risks to aquatic receptors in Pequawket Pond, samples of groundwater were collected in April 2009 from the storm sewer catch basins after a period of no precipitation and analyzed for VOCs. Only TCA was above detection limits (2.6 µg/l). There is no Federal Surface Water Quality Criteria standard available for TCA. Also, because the maximum groundwater concentrations for TCA do not exceed the NH Water Quality Criteria for the protection of aquatic life, groundwater discharging from the Site will not exceed standards in Pequawket Pond. Therefore, based on this evaluation, there are currently no unacceptable risks to ecological receptors at the Site.

2. Identification and Screening of Technologies

2.1 Introduction

Remedial activities at the Site have reduced historic contamination by approximately 99% both in soil and groundwater. The GPTS has become inefficient and in 2005 removed less than 1 pound of contamination from the aquifer at a cost of $250,000. Also, a new contaminant of concern, 1,4-Dioxane, has recently been discovered which cannot be treated by the current GPTS.

The current groundwater contamination shown in Figure 8 is the result of reverse matrix diffusion following the 2005 shutdown of the GPTS. The groundwater contaminant plume shown is stable, remains within Site boundaries, and is not migrating.[29] No current unacceptable risk to human health or the environment exists at the Site. Therefore, based on the actions performed from 1992 to 2005, the lack of a current unacceptable risk, and the inefficiency of the GPTS, EPA and NHDES believe that it is proper to re-consider the long-term response action for the Site as set forth in the 1990 ROD.

In re-considering the groundwater remedy, it is necessary to review the Remedial Action Objectives set forth in the 1990 ROD, evaluate those objectives with respect to the current situation at the Site, and retain or modify those objectives that are still relevant. Once the Remedial Action Objectives have been reviewed and modified as necessary, General Response Actions that are appropriate to the current situation at the Site will be determined.

[29] EPA, *Final Report*…December 2009, Pages 16 - 17.

2.2 Remedial Action Objectives

The 1990 Record of Decision developed the following seven remedial action objectives to address contamination at the Site:

1. To minimize further horizontal and vertical migration of contaminated groundwater from the KMC site.
2. To minimize any negative impact to Pequawket Pond resulting from discharge of contaminated groundwater.
3. To prevent the inhalation of wind-blown, fine, particulate materials from the Waste Piles.
4. To reduce the risk associated with ingestion of, or physical contact with, metals in the Waste Piles.
5. To prevent the possibility of a release of other contaminants that may be present within the Waste Piles.
6. To prevent the migration of contaminants from the septic system and surrounding soils that could further degrade groundwater quality.
7. To reduce the risk associated with inhalation of VOCs and physical contact with the contents or the septic system or the surrounding soils.

The remedial actions conducted from 1992 until 2005 have largely accomplished all seven of these objectives. Following the shutdown of the GPTS in 2005, contaminant concentrations re-bounded to a limited extent as outlined in preceding sections of this FFS. Table 6 summarizes the cleanup levels first proposed in the 1990 ROD, the change in the 2003 ESD, and the amendments in the State of New Hampshire's AGQS relative to those cleanup levels. Table 6 then compares those standards to the sampling round conducted in October 2011.

Table 6: Proposed Interim Cleanup Levels for groundwater contamination at the Kearsarge Metallurgical Corporation Superfund Site.

Contaminant	Interim Cleanup Level (µg/l)	Basis	Maximum Concentration in October 2011 (µg/l)	Number of Wells that Exceed the Proposed Cleanup Standard in October 2011
1,1,1-Trichloroethane	200	MCL[1]	100	0
1,1-Dichloroethene	7	MCL[1]	220	5
Trichloroethene	5	MCL[1]	ND[7]	0
1,2-Dichloroethane	5	MCL[1]	5.3	1
1,1-Dichloroethane	81[3]	AGQS[2]	14.1	0
Chloroform	80[4]	MCL	ND[6]	0
1,4-Dioxane	3[5]	AGQS	25	3
Nickel	700	HI[6]	ND[7]	0
Chromium	50	NIPDWR[4]	ND[7]	0

Notes:

[1] MCL – Maximum Contaminant Level established in the 1990 ROD.

[2] AGQS – Ambient Groundwater Quality Standards enacted by New Hampshire.

[3] 1,1-DCA had a cleanup level of 4 µg/l in the 1990 ROD based on risk. That risk was re-evaluated when toxicity factors were changed and a 2003 ESD set the new cleanup level for 1,1-DCA at 3,650 µg/l. That value was subsequently superceded by the State when it established a more stringent standard of 81µg/l under AGQS. The cleanup level for DCA will be changed in a future decision document.

[4] This values was set at 100 µg/l in the 1990 ROD (p. 40) based on the National Interim Primary Drinking Water Regulation. Since that time an MCL of 80 µg/l has been set. Although no detection of this contaminant occurred, a future decision document will adjust the cleanup level.

[5] AGQS for 1,4-dioxane was established in 2005 at 3 µg/l. The cleanup level for 1,4-Dioxane will be changed in a future decision document.

[6] HI – Hazard Index of 1.

[7] ND – Not detected. Detection limits generally at 2 ug/l for VOCs. For Chromium and Nickel the dates of last analysis are 2006 and 2004, respectively. The detection limit for Chromium was 10 ug/l and Nickel was 5 ug/l.

Of the seven original response objectives in the 1990 ROD, only one has not been fully realized due to the rebound in groundwater contaminant concentrations. To address the current conditions at the Site, the response objectives for contaminated groundwater have been revised in this FSS as follows:

1. Prevent ingestion of groundwater water having carcinogens in excess of ARARs and/or a total excess cancer risk (for all contaminants) of greater than 10^{-4}.
2. Prevent ingestion of groundwater having non-carcinogenic contaminants in excess of ARARs and/or an HI >1.
3. Restore groundwater so that carcinogens meet ARARs and the total excess cancer risk (for all contaminants) is within 10^{-4} to 10^{-6}.

4. Restore groundwater so that non-carcinogens meet ARARs and non-cancer risk is reduced to an HI<1.

5. Prevent exposure to compounds listed in Table 5 that would pose an inhalation risk to residential or commercial and industrial users.

2.3 General Response Actions

Based on both the contaminant trend through October 2011 (shown in Figure 7), and the results of previous sampling efforts, NHDES had its contractor Weston Solutions, Inc. examine the contamination at the Site with respect to future trends. The operating hypothesis was that the residual contamination currently found in the monitoring wells was the result of diffusion from a localized, subsurface VOC concentration area near MW-3010. Post-2003 excavation sampling, geoprobe analysis, and groundwater monitoring allowed Weston to estimate the amount of parent compound TCA present in the aquifer as well as the mass of daughter products such as DCE.

Weston then examined the known groundwater parameters at the Site and applied appropriate assumptions for the remaining contaminant mass, diffusion, and other parameters. Weston used two modeling approaches, the mass balance method and the pore volume flush method, and derived cleanup times of 14 to 15 years if the GPTS resumed operations.[30] Weston then examined *in situ* remedies and determined that Monitored Natural Attenuation (MNA) would attain cleanup levels in 17 to 19 years using the same assumptions. A more detailed explanation is provided in Appendix A. Therefore, to address the remaining contamination at the Site, MNA was selected for further evaluation along with No-Action and the resumption of the GPTS as described in the next section.

3. Description of the Remedial Alternatives

Because EPA and the State are re-considering a portion of the remedy already selected and implemented at the Site, this FSS is more streamlined from that provided in a typical Feasibility Study. In particular, rather than evaluating a large universe of potential alternatives, the remedies considered in this document only include the remedial components selected in the 1990 ROD and an alternative remedy. In this instance, the alternative remedy selected for evaluation is MNA. A No-Action alternative is also required to be evaluated as Section 300.430(e)(6) of the National Contingency Plan (NCP) directs that a “no action” alternative shall be developed and evaluated for all feasibility studies.[31] Furthermore, 40 CFR 300.68(f) requires consideration of the no action alternative as a baseline against which the other alternatives are compared.

Three remedial alternatives are described with respect to how each will be implemented. The only contamination remaining at the Site consists of groundwater contaminants that may migrate from its current location. Therefore, all three alternatives are Management of Migration remedies and are designated “MM.”

[30] Weston Solutions, Inc., *Revised Draft Final, Focused Feasibility Study, Kearsarge Metallurgical Corporation Superfund Site, Conway, NH*, December, 2010. This draft has not been made public, but the work is attached in Appendix 1 of this document.

[31] United States Congress, *Federal Register*, Vol. 55, No. 46, Thursday, March 8, 1990. p. 8849.

3.1. No-Action Alternative (MM-1)

Under the No-Action alternative (MM-1), it is assumed that no treatment or removal would occur and any reduction in toxicity or volume of contaminants would occur as a result of natural processes similar to the MNA remedy. No monitoring of groundwater would occur and therefore, no assessment of any reduction or potential expansion of groundwater contamination would occur. No Five-Year Reviews to assess protectiveness would be performed and no monitoring of Institutional Controls would occur. MM-1 represents the minimum proposed remedial action for addressing the remaining contamination at the Site. No cleanup time is provided as attainment would not be verified.

3.2. Groundwater Pump-and-Treat Alternative (MM-2)

Groundwater Pump-and-Treat (MM-2) was the selected remedy for Management of Migration in the 1990 ROD and was implemented from 1993 until 2005. The implementation of that remedy evolved from 1993 to 2005 as the distribution of contaminants in groundwater changed as a result of remedy operation. To respond to the present contamination, the components of this alternative include:

- Resuming operation of the GPTS to treat the contaminated groundwater.
- Extraction of groundwater from extraction well EW-13B in the Culvert Area at a rate of 4 to 6 gallons per minute (8,700 gallons per day maximum).
- Operating the GPTS including the addition of sequestering agent to prevent deposition of metals in process equipment and removal of volatile organic compounds through air stripping.
- Discharge of the treated groundwater to the local publicly owned treatment works (POTW).
- Long-term groundwater monitoring.
- The Institutional Controls would be revised to prevent construction of homes on the Site in the future to address a potential unacceptable risk from vapor intrusion.
- Five-Year CERCLA reviews.

Previous decision documents did not formally require Five Year reviews; however, these reviews are required for both MM-2 and MM-3 by statute. Based on the modeling presented in Appendix A, the cleanup time under this alternative is estimated to be approximately 15 years.

3.3. Monitored Natural Attenuation Alternative (MM-3)

MNA provides no active treatment, containment, or recovery of contaminants. MM-3 will rely on natural processes to prevent migration and reduce concentrations of contaminants to cleanup levels. The evidence and details for MNA are provided in Appendix C. The components of MM-3 include:

- Long-term groundwater monitoring to measure the success of attenuation mechanisms in the aquifer functioning to reduce contamination and prevent migration.
- The Institutional Controls would be revised to prevent construction of homes on the Site in the future to address a potential unacceptable risk from vapor intrusion.
- Five-Year CERCLA reviews.

Because Monitored Natural Attenuation is not an active remedy and it still may not achieve cleanup levels at the Site due to unknown factors, a phased contingency approach is included in this alternative. If MM-3 does not reduce contamination or fails to prevent migration, the MNA alternative will be supplemented with additional response actions. The decision to design and implement additional response actions would be triggered by either of the following conditions:

- The concentration of either 1,1-DCE or 1,1-DCA in wells MW-3010 or MW-3008 rises above the concentration found in December 2010; for MW-3010: 578 ppb and 235 ppb, respectively, and for MW-3008: 175 ppb and 101 ppb, respectively, in any sampling event, or;
- The concentration of any contaminant in any of the monitored wells increases by 100% over its December 2010 concentration, and is above its cleanup level, in any sampling event.

Should either of these conditions exist, an oxidizing compound would be injected into the aquifer to destroy Site contaminants. Following treatment, additional monitoring will be performed and additional injections may be necessary. Stabilization and further monitoring will then be performed to determine if this *in situ* treatment of the source in combination with MNA will meet the remedial action objectives.

If *in situ* treatment of the source is not successful[32], or migration of the contaminant plume outside the Site boundary occurs, then a small-scale mobile pump-and-treat system would be designed and used to capture the remaining contaminants and restore the aquifer. Additional details regarding this contingent remedy are provided in Appendix C.

4. Analysis of Alternatives

This assessment compares the strengths and weaknesses of each remedial alternative described above using seven of the nine criteria established in the NCP. The other two criteria, state acceptance and public acceptance are determined based upon comments received after a Proposed Plan is made available for comment. After consideration of the comments received, EPA will issue a decision document, which, in this case, would be an Amended Record of Decision.

Under its legal authorities, EPA's primary responsibility at Superfund sites is to undertake remedial actions that are protective of human health and the environment. In addition, Section 121 of CERCLA establishes several other statutory requirements and preferences, including: a requirement that EPA's remedial action, when complete, must comply with all federal and more stringent state environmental standards, requirements, criteria or limitations, unless a waiver is invoked; a requirement that EPA select a remedial action that is cost-effective and that utilizes permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable; and a preference for remedies in which treatment which permanently and significantly reduces the volume, toxicity or mobility of the hazardous substances is a principle element over remedies not involving such treatment.

[32]In situ source treatment would be unsuccessful if either of conditions listed above that trigger action reoccurred.

The nine criteria for the evaluation of each alternative are divided into three groups: Threshold Criteria that each alternative must meet to be carried forward in the analysis; Balancing Criteria which measure the performance of each alternative; and Modifying Criteria which are assessed once this FFS and Proposed Plan are presented for public review and comment. In the subsections that follow, each criterion is explained and then the three remedial alternatives described in Section 3 are evaluated with respect to how they satisfy the goals of that criterion. The evaluation was conducted in accordance with the *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA* (EPA, 1988) and summarizes the relevant information necessary to compare each alternative with respect to their benefits and draw-backs.

4.1. Threshold Criteria

Overall Protection of Human Health and the Environment

This criterion addresses whether or not an alternative provides adequate protection and describes how site risks posed through each exposure pathway are eliminated, reduced, or controlled through treatment, engineering or institutional controls. This criterion draws on the assessments conducted under other criteria especially long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs. This criterion also considers whether the alternatives pose any unacceptable short-term or cross-media impacts.

Contamination currently exists in a small portion of the aquifer at levels that present an unacceptable risk. There is the potential for inhalation risk through vapor intrusion should homes be built on the Site. The No-Action alternative, MM-1, would not be protective as no monitoring or evaluation of the contamination that remains in the aquifer would occur. The other two Alternatives (MM-2 and MM-3) would be equally protective as both would reduce contaminant concentrations to safe levels. This would be confirmed by monitoring which is a component of both Alternatives MM-2 and MM-3. In addition, action would be taken under both Alternatives MM-2 and MM-3 to prevent construction of homes on the Site in the future. Finally, an evaluation of the remedial progress for MM-2 and MM-3 would occur every five years to determine whether the remedy is continuing to be protective of human health and the environment.

Compliance with Applicable or Relevant and Appropriate Requirements

Compliance with applicable or relevant and appropriate requirements (ARARs) addresses whether or not a remedy will meet all Federal, and more stringent State, environmental standards, requirements, criteria or limitations, unless a waiver is invoked under CERCLA §121(d)(4). Section 121(d) of CERCLA requires that remedial actions at CERCLA sites at least attain ARARs, unless they are waived. Tables D1 through D7 in Appendix D list the ARARs for each remedial alternative. Alternative MM-1 would not comply with chemical-specific ARAR requirements. MM-2 and MM-3 will meet all ARAR requirements.

4.2. Balancing Criteria

Long-Term Effectiveness and Permanence

This criterion evaluates the ability of a remedy to maintain reliable protection of human health and the environment over time, once clean-up levels have been met. This criterion includes the evaluation of the residual risk that will remain following remediation and the adequacy and reliability of institutional controls.

Because there is no evaluation of conditions under Alternative MM-1, attainment of cleanup levels cannot be ascertained and the magnitude of the residual risk would, therefore, also be unknown. In addition, under the No Action Alternative there are no monitoring of institutional controls in place to prevent exposure to Site contaminants that could result in a potential future unacceptable risk.

Both Alternatives MM-2 and MM-3 will reduce the concentration of contaminants in groundwater to acceptable levels and therefore the magnitude of the residual risk is greatly reduced. Long-term monitoring would be conducted to confirm that levels continue to remain below cleanup levels. Monitoring is a highly reliable method to evaluate the remaining residual contamination. In addition, both of these alternatives include Institutional Controls to prevent a potential future unacceptable risk. In order for Institutional Controls to be effective and protective, they must be adequately monitored and maintained. As a result, the adequacy and reliability will be dependent on how well the Institutional Controls are monitored, maintained and enforced.

Reduction of Toxicity, Mobility, and Volume Through Treatment

This criterion evaluates the degree to which each alternative employs recycling or treatment, including how treatment is used to address the threats posed by the site. This evaluation considers the following factors:

- Treatment processes and what they will treat.
- Amount of hazardous materials treated or destroyed and how the principle threat is addressed.
- Degree of expected reduction in toxicity, mobility, or volume (as a percentage).
- The degree to which treatment will be irreversible.
- The type and quantity of treatment residuals that will remain following treatment.
- Does the remedy satisfy the statutory preference for treatment as a principle element.

The most significant remaining issue at the Site is that contamination exceeds groundwater cleanup levels in a very limited area. Alternative MM-1, No-Action, would likely reduce the toxicity, mobility and volume of groundwater contaminants through *in situ* biotic and abiotic reactions. However, no evaluation of conditions under MM-1 would occur to ascertain these reductions of groundwater contaminants.

Alternative MM-2 would actively eliminate the groundwater plume and treat contaminants, but will also generate a solid residual requiring transport and treatment. MM-2 will capture VOC contaminants on activated carbon that will need to be shipped off-site for disposal. MM-2 will also likely discharge some amount of 1,4-dioxane to the CVFD, if allowed, unless additional treatment is applied and successful.

Alternative MM-3 would reduce the toxicity, mobility and volume of remaining groundwater contaminants through *in situ* biotic and abiotic reactions to acceptable levels. The evidence for the MNA mechanism described for MM-3 is provided in Appendix C. Reductions through MNA are irreversible. Finally, there would not be any treatment residuals unless either of the two contingencies was used to meet cleanup levels.

Short-Term Effectiveness

This criterion evaluates the period of time needed to achieve protection and whether any adverse impacts on human health and the environment may occur during the construction and implementation period, until cleanup levels are achieved. This evaluation considers the following factors:

- Protection of community from exposure to dust, poor air-quality, and transportation impacts.
- Protection of workers during remedial actions.
- Environmental impacts that result from construction and what mitigation measures may be taken.
- Time until the remedial response objectives are met.

Under Alternative MM-1, there would be no short term impacts from construction/implementation to the community, workers or the environment as no actions would be taken under this alternative. There is no estimate as to when groundwater cleanup levels would be met and the vapor intrusion remedial action objective would never be met. For both MM-2, Groundwater Pump-and-Treat, and MM-3, Monitored Natural Attenuation, there would be limited impacts to the community or to the workers in the short-term as under both these Alternatives there are minimal construction activities (treatment system O&M, installing signs for institutional controls, groundwater sampling, etc.) required to implement the remedy and there are few, if any, exposure pathways for contaminants to reach the community, workers or the environment. Because MM-2 has already been built and MM-3 will likely not require any construction (unless contingencies must be implemented), no significant community or environmental impacts are expected from construction under either alternative. Under both alternatives, workers would use appropriate health and safety measures when handling contaminated material.

The time to cleanup for MM-2, as outlined in Appendix A is approximately 15 years while MM-3 is estimated to attain cleanup levels in groundwater in 18 years.

Implementability

This criterion evaluates the technical and administrative feasibility of implementing a remedy, including the availability of materials and services needed to implement a particular option. This evaluation considers the following:

- Technical difficulties and unknowns associated with a technology.
- Reliability of the technology and technical problems that may lead to schedule delay.
- Ease of undertaking additional remedial action.

- Monitoring to determine the effectiveness of the remedy and evaluate the risk of exposure.
- Administrative feasibility and coordination with other offices and agencies.
- Availability of services and materials.

The No-Action alternative, MM-1, requires no implementation. For MM-2, Groundwater Pump-and-Treat, the treatment plant is already in place on-site and was previously operated effectively to control the contaminant plume at the Site. The treatment plant was shut down and winterized in December 2005. The effort required to resume operation would include restoration of winterized equipment, repairing or replacing broken and aged equipment, and obtaining supplies necessary for day-to-day operations. Materials and skilled staff are readily available to reinstate, operate and maintain the treatment system. The local POTW (CVFD) would need to agree to accept the treated plant effluent. But that is unlikely to pose a problem with implementation since the local POTW had previously accepted the effluent before shutdown of the GPTS, and the flow is likely to be only 6 gpm or less. The addition of 1,4-Dioxane to the discharge may require additional treatment prior to discharge to the POTW.

Pumping from extraction well EW-13B would be expected to recapture most of the existing plume in the Culvert Area. Although groundwater concentrations would temporarily attain cleanup goals shortly after resuming operations of the GPTS , reestablishment of the plume would be expected if the GPTS was discontinued before contaminants had been depleted in the silt and clay layer. Diffusion of contaminants out of the silt and clay layer would be the time-limiting factor in the permanent, long-term attainment of cleanup goals. Due to the low transmissivity of the silt and clay layer, groundwater extraction from the silt and clay layer would be very slow and inefficient.

Alternative MM-3, Monitored Natural Attenuation, can also be easily implemented. There are no significant technical issues associated with groundwater monitoring or establishing additional institutional controls. Should MNA need to be supplemented, chemical oxidation would also be easy to implement as, the target zone for treatment is shallow and may be reached through conventional means. However, the silt and clay layer may make oxidant delivery to the contaminants difficult. If limited short-term pump-and-treat is required, the area to be addressed is small and easily accessible, but would be rate-limiting due to silt and clay layers.

There are no significant technical issues associated with MM-3 other than groundwater monitoring and enforcement of institutional controls. MM-2 would require additional work to re-start the treatment plant and arrange for disposal of the treated water. Neither alternative would require coordination with other agencies other than the CVFD. Finally, both alternatives would require some coordination to revise the Institutional Control but this is not expected to be difficult.

<u>Cost</u>

This criterion evaluates costs including the capital costs, operation and maintenance (O&M) costs, and total project present-worth costs. Direct capital costs include those for construction, equipment, land and site development, buildings and services, relocation expenses, and disposal. Indirect costs include those for engineering, startup/shakedown costs, and contingencies. Annual O&M costs include operating labor costs, maintenance materials and labor, auxiliary materials

and energy, disposal of treatment residuals, purchased services, administrative costs, insurance, taxes, licensing, maintenance reserve and contingency funds, rehabilitation costs, and periodic Site Reviews.

The capital costs associated with Alternative MM-2 would include: restoration of the winterized equipment, repairing or replacing broken and aged equipment, obtaining the necessary supplies for day to day operations, and the labor to complete these tasks. The O&M costs include plant O&M, annual monitoring events, and Five-Year CERCLA site reviews over a period of 15 years.

The only capital costs for Alternative MM-3 are associated with establishing, maintaining and enforcing additional institutional controls. The O&M costs include groundwater monitoring, maintenance of institutional controls, and Five-Year CERCLA site reviews. The costs for the the contingencies (if needed) would be added to that of MM-3. A summary of the overall costs for each of the alternatives is presented below in Table 7. The details are provided in Appendix B.

Table 7: Summary of costs for the remedial alternatives.

MM-1: No Action	
Capital Costs (present worth)	$0
Annual Operations and Maintenance (present worth)	$0
Total Present Worth Costs (7% discount rate)	**$0**
MM-2: Groundwater Pump-and-Treat	
Capital Costs (present worth)	$69,575
Annual Operations and Maintenance (present worth)	$291,918
Total Present Worth Costs (7% discount rate over 15 years)	**$2,606,046**
MM-3: Monitored Natural Attenuation	
Capital Costs (present worth)	$23,000
Annual Operations and Maintenance (present worth)	$115,698
Total Present Worth Costs (7% discount rate over 18 years)	**$730,674**
Chemical Oxidation Implemented under MM-3 and a potential additional cost to that alternative	
Total Capital Cost (present worth)	**$72,050**
Focused Pump and Treat Implemented under MM-3 and a potential additional cost to that alternative	
Capital Costs (present worth)	**$31,625**
Annual Operations and Maintenance (present worth)	**$45,210**

4.3. Modifying Criteria

The final two criteria are classified as the modifying criteria and include state or support agency acceptance, and community acceptance. These modifying criteria are usually evaluated following comment on the FFS, and are addressed once a decision by EPA has been made and the Amended Record of Decision is being prepared.

- State Acceptance: This assessment evaluates the technical and administrative issues and concerns the New Hampshire Department of Environmental Services may have regarding the proposed remedial alternatives. This criterion will be addressed in the Responsiveness Summary once comments on the Proposed Plan have been received.

- Community Acceptance: This assessment evaluates the issues and concerns the public may have regarding each of the proposed remedial alternatives. Similar to the State Acceptance, this criterion will be addressed in the Responsiveness Summary once comments on the Proposed Plan have been received.

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Appendices

Appendix A: Remedial Time Frame Models

Appendix B: Remedy Costs

Appendix C: Details of Monitored Natural Attenuation

Appendix D: Applicable and Relevant and Appropriate Requirements

Appendix A: Cleanup Time Calculations
Remedial Time Frame Model

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Prepared for NHDES, December 2010.

The estimated time to attain cleanup goals at the site was evaluated by focusing on concentrations of 1,1-dichloroethylene (DCE) and its parent compound, 1,1,1-trichloroethane (TCA). DCE exceeds its cleanup goal of 7 ug/L in 7 wells, with a maximum concentration of 214 ug/L in MW-3010. Based on the evaluation conducted by GSI Environmental (p. 15, GSI, 2009), when TCA is degraded, an estimated 20% will be converted to DCE. When conducting the modeling, it was assumed that there would be no decrease in DCE mass at the site due to degradation, but that 20% of the TCA would be converted to DCE, adding to the overall mass of DCE at the site. It was assumed that attenuation of DCE at the site would only be achieved by dilution and dispersion. Concentrations of TCA in groundwater are not expected to control the remedial time frame other than by adding to the DCE concentrations on site. TCA has a much higher cleanup goal (200 ug/L) than DCE and currently only exceeds the cleanup goal in one well (MW-3010) with a concentration of 302 ug/L. Two other contaminants also exceed the cleanup goals. The emerging contaminant 1,4-dioxane exceeds its cleanup goal of 3 ug/L in three wells, with a maximum concentration of 35 ug/L in MW-3010. The contaminant 1,2-dichloroethane exceeds the cleanup goal of 5 ug/L in one well, MW-3010, at a concentration of 17 ug/L. Overall, DCE is the most widespread contaminant, with the greatest exceedance of the cleanup goals (over 30 times the cleanup goal) and is clearly the contaminant that will control the remedial time frame.

The time required for concentrations of DCE in overburden groundwater to drop below the cleanup goal of 7 ug/l has been evaluated using two methods. The first method (Mass Balance Method) estimated the annual contaminant mass removal via groundwater flow across a given cross-sectional area on a mass-balance basis, based on current groundwater concentrations in the source zone. The annual mass removal thus calculated was deducted from the current estimated source zone contaminant mass on an annual basis. The second method (Pore Volume Flush Method) assumed a time interval during which one pore volume of groundwater would flush through the source zone. The contaminant mass removal per pore volume flush of groundwater was based on the concept that the ground water contaminant concentrations in the source zone will be in equilibrium with the contaminant mass adsorbed to the soil before exiting the source zone. The number of the flushes required to reduce the groundwater concentration exiting the source zone to below cleanup goals, and the time frame necessary to achieve that number of flushes was calculated.

Mass Balance Method

The mass balance method estimated the mass of DCE contamination that is transported from the source area via groundwater on a semi-annual (6-month) basis and deducted that from the total estimated mass within the source area. The mass of DCE contained in the groundwater was calculated based on an assumed cross-sectional groundwater flow area in the upper sand layer downgradient of the source area and hydraulic conductivity and hydraulic gradient estimates using Darcy's Law. Based on typical groundwater elevation contours, the groundwater was assumed to be flowing from the source area in a northeast direction. The location of the cross-sectional area used for this model is shown on Figure 1. The 150 ft width of the cross-sectional area used in the model was based on the size of the plume where DCE is currently exceeding the cleanup goal and extends from MW-3010 to MW-3011. The depth of the cross-sectional area was based on the saturated thickness of the upper sand aquifer which varies seasonally. A depth of 1.16 ft was used for one half of the year, and 3.56 ft was used for the other half of the year based on average seasonal groundwater elevations. The semi-annual groundwater flow volume through the cross-sectional area and the observed DCE concentration data were used to calculate a mass of DCE that is leaving the source area each 6-month period (or "time-step"). Future concentrations of DCE in groundwater were estimated by applying a percentage reduction from the initial concentrations based on the overall mass reduction of the source. A 6-month time step was selected for this analysis because large seasonal variations in dissolved DCE concentrations and groundwater elevations are typically observed at the Site. The 6-month time step allows the higher concentration to be used for half of each year and the lower concentration for the remainder of the year to simulate the seasonal variation. Additional time steps were added until the estimated concentration in groundwater dropped below the cleanup goal of 7 ug/L.

Pore Volume Flush Method

The pore volume flush method estimates the mass of DCE exiting the low permeability (silt/clay) layer horizontally into the former excavation area in each pore water flush. One flush volume using this method will be the volume of groundwater in the source zone, defined as the approximately 60 ft by 70 ft area of the low permeability silt and clay layer where soil contaminant concentrations exceed 500 ppb for the total combined TCA and DCE concentrations. Figure 2 shows the outline of the source zone. The time steps used in this model have been defined as the time during which the groundwater travels through the source zone. For the natural attenuation scenario, the groundwater has been assumed to flow through the source zone from southwest to northeast toward monitoring wells MW-3010 and MW-3008. For the pumping scenario, it has been assumed that extraction well EW-13B, located in the former excavation, would be used for groundwater extraction. During pumping, the groundwater would flow from northwest to southeast toward EW-13B.

The groundwater velocity has been estimated using Darcy’s Law, with assumed hydraulic conductivity, gradient, and porosity. Therefore, the time required for one flush, and the volume of groundwater in one flush has been calculated based on the size of the source zone and the Darcy velocity. The DCE concentration in each flush has been estimated based on the adsorption coefficient for the equilibrium between soil concentration and water concentration. Once one flush is complete the total contaminant mass in the system would decline by the mass removed by the flush. Then a new batch of clean groundwater will enter into the system, contaminant concentrations will again equilibrate between the groundwater and soil, and the

same volume of groundwater containing contaminants will exit the system to complete another flush. Once each pore water volume from the source zone exits the low permeability source zone and enters the upper sand layer and the gravel filled former excavation, it will mix with, and will be diluted, by the groundwater flowing through the former excavation area and the upper sand layer. The dilution factor has been based on the ratio of the flow through the source zone to the flow through the upper sand layer where the monitoring wells are located. The model estimates the number of source zone pore water volume flushes required for the groundwater contaminant concentration exiting the source zone to be sufficiently low so that it does not result in exceedances of the cleanup goal for DCE (7 ug/L) in the upper sand layer. With an initial pore water concentration in the source zone based on equilibrium with soil concentration, and a final target concentration of 7 ug/L DCE in the upper sand groundwater, the number of the flushes required, and hence the number of years until groundwater cleanup will be achieved, has been estimated.

Results of Remedial Time Frame Modeling

The estimates of the time until cleanup goals are attained, as calculated using the two different modeling approaches, are presented below.

Table A1: Modeled Cleanup times

Modeling Approach	Monitored Natural Attenuation Alternative	Pump and Treat Alternative
Mass Balance Method	18.5 Years	15.4 Years
Pore Volume Flush Method	17.3 Years	13.9 Years

Appendix B: Cost Calculations

Cost of MM-1: No-Action
There is no cost associated with MM-1.

Cost of MM-2: Re-starting the Original, 1990 ROD Remedy

Table B1a: Capital Costs Groundwater Pump-and-Treat

Item	Rate	Amount	Units	Cost
Restore the treatment plant and equipment	$55,000			$55,000
Project Management and administration (health & safety, permitting, field office, reporting)	15% of above			$8,250
Subtotal				$63,250
Contingency	10% of Subtotal			$6,325
Total Capital Costs (Present Worth)				$69,575

Table B1b: Operation and Maintenance Costs (annual basis)

Item	Rate	Amount	Units	Cost
Annual Plant Labor and Operation 1. Plant Operator 2. Project Manager/Engineer 3. Discharge fee to POTW 4. Plant Operating Expenses (electricity, supplies, etc.) **Subtotal**	1. $100 2. $160 3. $3 4. $,000	1,040 120 3,000 12	Hours Hours 1,000 gallons month	$104,000 $19,200 $9,000 $48,000 **$180,200**
Monitoring: Annual groundwater monitoring	$50,355			$50,355
Five Year Reviews: Includes 1 extra round of sampling prior to 5 Year Reviews in 2013, 2018 and 2023.	$34,825			$34,825
Contingency	10% of Subtotal			$26,538
Total Capital Costs (Present Worth)				$291,918

Table B1c: Summary of Costs Groundwater Pump-and-Treat over 15 Years

Item	Yearly Undiscounted Cost	Cost
Capital Costs	$69,575	**$69,575**
O & M Costs 1. Treatment Plant 7% Discount Rate 2. Annual Groundwater Monitoring 7% Discount Rate 3. 5 Year Reviews & 1 monitoring round. 7% Discount Rate **Subtotal O & M Present Worth Cost** **7% Discount Rate**	 $180,200 $50,355 $34,825	 $1,756,133 $490,733 $59,016 **$2,305,882**
Total O&M Costs with 10% Contingency 7% Discount Rate		$2,536,471
Total Present Worth Costs 7% Discount Rate		$2,606,046

Cost of MM-3: Proposed Alternative to the 1990 ROD Remedy, Monitored Natural Attenuation

Table B2a: Capital Costs Monitored Natural Attenuation

Item	Rate	Amount	Units	Cost
Sampling and Analysis Plan	$20,000			$20,000
Contingency (% is greater as more unknowns)	15% of Subtotal			$3,000
Total Capital Costs (Present Worth)				$23,000

Table B2b: Operation and Maintenance Costs (annual basis)

Item	Rate	Amount	Units	Cost
Annual Assessment of Remedial Progress	$200	Hour	100 hours	**$20,000**
Monitoring: Annual groundwater monitoring	$50,355			$50,355
Five Year Reviews: Includes 1 extra round of sampling prior to 5 Year Reviews in 2013, 2018 and 2023.	$34,825			$34,825
Contingency	10% of Subtotal			$10,518
Total Capital Costs (Present Worth)				$115,698

Table B2c: Summary of Costs Monitored Natural Attenuation over 18 Years

Item	Yearly Undiscounted Cost	Cost
Capital Costs	$69,575	**$69,575**
O & M Costs 1. Annual Groundwater Monitoring 7% Discount Rate 2. 5 Year Reviews & 1 monitoring round. 7% Discount Rate **Subtotal O & M Present Worth Cost** **7% Discount Rate**	 $50,355 $34,825	 $541,982 $59,016 **$600,999**
Total O&M Costs with 10% Contingency 7% Discount Rate		$661,099
Total Present Worth Costs 7% Discount Rate		$730,674

Cost of Chemical Oxidation

For the purposes of evaluation and costing of this alternative, activated persulfate has been selected as the oxidant, although other chemical oxidants, such as Fenton's Reagent (catalyzed hydrogen peroxide), or permanganate could potentially be used. Activated persulfate is a strong oxidizer and offers the following advantages in comparison with other oxidants:

- Persulfate is more persistent in the subsurface than hydrogen peroxide Fenton's Reagent. Therefore, it has a wider range of options for field application and subsurface delivery.
- Because of the higher stability of persulfate, diffusive transport into low permeability zones, such as the silt and clay layer at the Site, would be possible.
- Persulfate has a strong affinity for oxidizing organic compounds including chlorinated ethenes, chlorinated ethanes, chlorinated methanes. Weaker oxidants such as permanganate would not be as effective on chlorinated ethanes, such as 1,1,1-TCA.
- Persulfate is a more stable oxidizing agent, so dangers of rapid decomposition are not as great as with peroxide and ozone.

The optimum pH range for chemical oxidation with persulfate is seven to eight, but it is effective over a wide pH range. Therefore, no pH adjustment is required. Activated persulfate generates the sulfate radical (SO4-), one of the strongest and most versatile oxidizing species available, capable of destroying many of the most recalcitrant compounds including 1,1,1-TCA, 1,1-DCE, and their breakdown products. Successful pilot and full-scale applications of activated persulfate have been performed in over 30 states. These applications demonstrate the ability of activated persulfate to treat a wide range of contaminants under varying site conditions. Persulfate must be activated in order to produce the sulfate radical. There are several methods of

persulfate activation including natural metals, heat, lime (high pH), chelated iron, and peroxides. Chelated iron (FeEDTA) has been selected as the activation agent for development and costing of this alternative; however, other activators could also be used.

For costing purposes, it was assumed that 1,000 pounds of sodium persulfate and 400 pounds of FeEDTA activator would be combined in a solution that would be injected into the subsurface via existing monitoring wells, newly installed polyvinyl chloride wells, or temporary Geoprobe borings. Costs for this alternative include the use of a Geoprobe drill rig for one week to install injection points, miscellaneous equipment and supplies, 120 hours of labor to plan and perform the injections in the field, and 200 hours to prepare the work plan and completion report. Effectiveness of the ISCO enhancement would be evaluated based on the analytical results from the next annual groundwater monitoring round.

Table B2d: Capital Costs Chemical Oxidation

Item	Rate	Amount	Units	Cost
Sodium Persulfate	$1.50	1000	lbs	$1,500
Iron EDTA Activator	$5	400	lbs	$2,000
Labor to prepare Work Plan and Final Report	$200	200	hours	$40,000
Labor to perform injections	$100	120	hours	$12,000
Injections	$10,000			$10,000
Subtotal				$65,500
Contingency	10% of Subtotal			$6,550
Total Capital Costs (Present Worth)				$72,050

Cost of Small-Scale Focused Pump and Treat

The component would consist of a seasonal, focused groundwater pump-and-treat system that would be mobile and deployed as-needed. Additional consideration of methods to treat 1,4-Dioxane would be needed as the original groundwater pump-and-treat remedy did not treat this contaminant and it would be inappropriate to discharge to the environment.

Table B2e: Capital costs Small-Scale Focused Pump and Treat

Item	Rate	Amount	Units	Cost
Install seasonal pump system	$25,000			$25,000
Project Management and administration (health & safety, permitting, field office, reporting)	15% of above			$3,750
Subtotal				$28,750
Contingency	10% of Subtotal			$2,875
Total Capital Costs (Present Worth)				$31,625

Table B2f: Operation and Maintenance Costs (annual basis)

Item	Rate	Amount	Units	Cost
Annual Plant Labor and Operation 1. Plant Operator 2. Project Manager/Engineer 3. Carbon filter 4. Plant Operating Expenses (supplies, misc.) **Subtotal**	1. $100 2. $160 3. $300 4. $100	300 60 1 12	Hours Hours Year month	$30,000 $9,600 $300 $1,200 **$41,100**
Monitoring: Annual groundwater monitoring	Already priced in Table B2c			
Five Year Reviews: Includes 1 extra round of sampling prior to 5 Year Reviews in 2013, 2018 and 2023.				
Contingency	10% of Subtotal			$4,110
Total Capital Costs (Present Worth)				$45,210

All costs are detailed in Tables C-2, C-3, C-4, and C-5 in Appendix C of the Weston Draft Final Revised Focused Feasibility Study.

Appendix C: Monitored Natural Attenuation

Introduction

This Focused Feasibility Study evaluates the existing GPTS as well as Monitored Natural Attenuation (MNA) at the Kearsarge Metallurgical Corporation Superfund Site (the "Site"). The GPTS operated at the Site for more than 12 years. During that time, more than 375 pounds of contaminants were removed from the Site. It is estimated that 3 pounds of contaminants remain in a half-acre area in an unconfined aquifer that lies 3 to 6 feet below the ground surface and is approximately 8 to 10 feet thick. The only contaminants that still exceed cleanup levels at the Site are the chlorinated solvents 1,1,1-trichloroethane (TCA), 1,1-dichloroethene (DCE), 1,1-dichloroethane (DCA), and 1,2-dichloroethane (1,2-DCA).

A recently identified contaminant, 1,4-dioxane, which was used to stabilize solvents, has been found at the Site since monitoring for it began in 2009. The concentrations of these contaminants are relatively low. The calculated cleanup time for the Site found in Appendix A is nearly identical for active groundwater pump-and-treat as compared to MNA because the source of these contaminants is the upper-most clay layer that has absorbed the contaminants and releases them slowly through reverse matrix diffusion.

MNA relies on natural processes to achieve site cleanup. EPA and the NHDES have published several documents that describe the specifics of how MNA functions and the necessary considerations. This Appendix will describe how MNA will be employed at the site, explain how MNA will work for the contaminants, explain how progress will be assessed and what measures will be taken if MNA fails to contain migration of contaminants.

Description of the Employment of Monitored Natural Attenuation at the Kearsarge Metallurgical Corporation Superfund Site

The monitoring program would evaluate long-term behavior of the contaminant plume, verify that natural attenuation breakdown products do not pose additional risks, determine actual (rather than predicted) attenuation rates for refining predictions of the remediation time-frame, and document when site-specific remediation objectives have been attained. Based on the recommendations in the *Final Report: Technical Assistance* prepared by GSI in 2009 (GSI, 2009, pp.13-14), the existing monitoring program at the Site was updated in April 2010 *Sampling and Analysis Plan* (WESTON, 2010b).

Monitoring results will be reviewed on an annual basis and evaluated. Based on that evaluation one or more of the following decisions will be made[33]:

- Continue the monitoring program without change.
- Modify the monitoring program.
- Modify the Institutional Controls.
- Implement one or both of the contingencies.
- Verify the attainment of cleanup levels.

[33] *Performance Monitoring of MNA Remedies for VOCs in Ground Water*, EPA/600/R-04/027 April 2004, p. 57.

Evidence that Monitored Natural Attenuation is a Viable Remedy for the Kearsarge Metallurgical Corporation Superfund Site

MNA was selected for evaluation as an alternative to the existing GPTS based on the observation of degradation of contaminants at the Site. The natural processes active at the Site that contribute to contaminant attenuation include biodegradation, abiotic transformation, dispersion, and sorption. Prior investigations at the Site have found the following:

- The production of daughter products that were not formerly associated with the Site, notably 1,1-DCE.
- Three years after the shutdown of the pump-and-treat system in December 2005, the contaminant plume rebounded and expanded in size. However, by August 2008, the size of the plume had stabilized and contracted to a limited extent, indicating that natural attenuation has kept pace with the release of contaminants from the silt and clay layer.
- Analysis of the 1,1,1-TCA and 1,1-DCE plume stability from 2006 to 2009 using MAROS tools found that the 1,1,1-TCA mass in the entire plume showed a largely decreasing trend, with evidence of ongoing degradation, while there was a relatively stable trend for the total mass of 1,1-DCE in the plume.[34]
- A significant portion of 1,1,1-TCA was determined to be degraded, through biotic and abiotic means, to acetic acid which is ultimately mineralized.[35]
- The monitoring wells delineating the boundary of the contaminant plume (including PZ-4002, PZ-4003, EW-10, MW-9, PZ-4004, EW-6, MWS-202A, MW-3005, MW-5003, and MW-3004) continued to show non-detectable or below cleanup goal levels during the latest monitoring events.

Another means of assessing the efficacy of MNA is an examination of the post-rebound phase concentrations of all the contaminants. Table C1, below, illustrates the decline in concentration for all the contaminants that are above detection limits. These results may not be fully comparable with the December 2010 results in that the concentrations of the contaminants at the Site are affected by the changing water table. The saturated thickness of the aquifer in the Culvert Area wells is highly dependent upon the level of Pequawket Pond. Typically the water level in the pond is lowered by approximately 2 to 3 feet in November and then restored in April. Because the saturated interval in the Culvert Area wells is approximately 4 to 5 feet thick, such a modification of the local hydrology may have profound effects on the level of groundwater and the concentration of contaminants. The effect of lowering the pond level is quickly transmitted through the aquifer by infiltration from the shore and the drainage culvert coupled with the gravel fill added into the 2003 excavation.

[34] *Final Report: Technical Assistance*, (GSI, 2009, p.16)
[35] *Final Report: Technical Assistance*, (GSI, 2009, p.5)

Table C1: Site contaminants comparing Interim Cleanup Levels for groundwater with monitoring results from December 2010 and October 2011.

Contaminant	Interim Cleanup Level (µg/l)	Maximum Concentration (µg/l)		Number of Wells that Exceed the Cleanup Standards	
		Dec-10	Oct-11	Dec-10	Oct-11
1,1,1-Trichloroethane	200	305	100	1	0
1,1-Dichloroethene	7	578	220	5	5
Trichloroethene	5	ND	ND	0	0
1,2-Dichloroethane	5	23	14.1	1	1
1,1-Dichloroethane	81[1]	236	14	2	0
Chloroform	100	ND	ND	0	0
1,4-Dioxane	3	34	25	2	3
Nickel	700	NA	NA	NA	NA
Chromium	50	NA	NA	NA	NA

ND – Not detected. Detection limits generally at 2 ug/l for VOCs.
NA - For Chromium and Nickel the dates of last analysis are 2006 and 2004, respectively, and were below detection levels and therefore cleanup levels. The detection limits for Chromium and Nickel at that time were 10 ug/l and 5 ug/l, respectively.
[1] 1,1-DCA had a cleanup level of 4 ug/l in the 1990 ROD based on risk. That risk was re-evaluated when toxicity factors were changed and a 2003 ESD set the new cleanup level for 1,1-DCA at 3,650 ug/l. That value was superceded by the State establishing more stringent standards under AGQS.

Table C1 helps focus the MNA analysis with respect to compounds. Trichloroethene and Chloroform had cleanup levels that have been met at the Site for many years. Also, while exceeding the cleanup level in one well, 1,2-DCA does not have concentrations that are likely to increase to the magnitude of DCE. Monitoring of Trichloroethene, Chloroform, and 1,2-DCA will continue; however, they will not be assessed during the MNA effort unless significant concentrations are discovered. Likewise, Nickel and Chromium originally had cleanup levels assigned, but have met those levels for several years. The MNA assessment will continue only for those contaminants that still exceed cleanup levels, 1,1,1-Trichloroethane, 1,1-Dichloroethene, 1,1-Dichloroethane, and 1,4-Dioxane.

Performance and Assessment of Natural Attenuation of Individual Contaminants

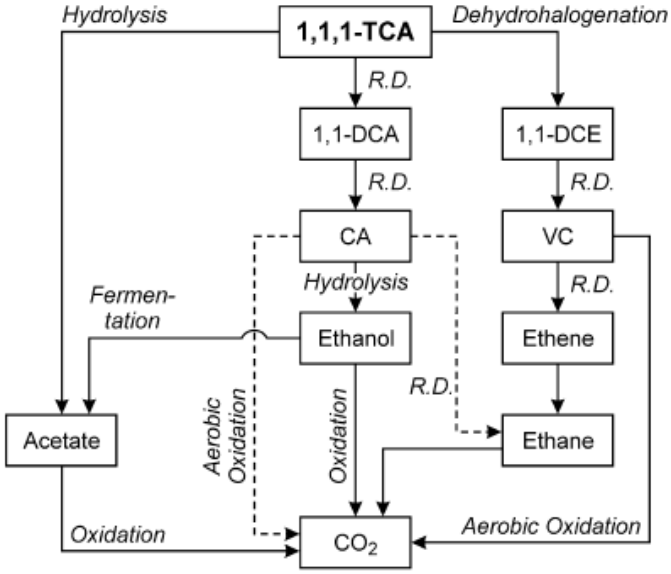
1,1,1-Trichloroethane

In 1990 the maximum concentration of 1,1,1-Trichloroethane or TCA was 18,500 µg/l and it was found in the majority of the wells. Literature reviews have found that TCA is degraded biotically and abiotically.[36] Abiotic reactions consist of hydrolysis and elimination

[36] Scheutz, et. al., Natural and enhanced anaerobic degradation of 1,1,1-trichloroethane and its degradation products in the subsurface – A critical review, Water Resources, Volume 45, 2011, p. 2701 – 2723.

reactions that result in acetic acid and DCE, respectively. The quantity converted to the more toxic DCE is 20% of the TCA and the reported half-life of TCA ranges from 7 to 9 years at a groundwater temperature of 10ºC. TCA is also reductively dechlorinated to chloroethane with an intermediate product of DCA. Figure C1, below, demonstrates the potential pathways of TCA degradation.

Figure C1: Potential degradation pathways for TCA. This figure is taken from Scheutz, et.al., 2011 (Figure 2). "R.D." represents reductive dechlorination.



Although there has been no work to document the mineral composition of the aquifer sands, degradation of TCA also occurs through metal-catalyzed reduction via iron minerals such as Mackinawite (FeS) to DCA. The presence of DCE and DCA indicate that degradation of TCA is a dominant mechanism at the Site. Lastly, in the last two sampling rounds, December 2010 and October 2011, TCA had maximum concentrations of 305 and 100 µg/l, respectively. The last sampling round had no wells that exceeded the established cleanup level (200 µg/l). Therefore, it is expected that the concentration of TCA in MW-3010, may occasionally exceed cleanup levels in the future, but that overall concentrations are declining and will attain and maintain cleanup levels.

1,1-Dichloroethene

One product of TCA degradation, 1,1-Dichloroethene (DCE), presents the greatest drinking water risk at the Site. This is because it has a lower cleanup level than TCA, 7 µg/l, and is slower to degrade to less toxic forms. In 1990 the maximum concentration at the Site was 615 µg/l and it was found in four of the 10 wells monitored. In December of 2010 and October 2011 the maximum concentration was 578 and 220 µg/l, respectively and in each case was found at concentrations exceeding the cleanup level in 5 of the 10 wells sampled. Table C2 compares the concentrations of the parent compound TCA with DCE during the October 2011 sampling round, highlighting in yellow the results that exceed cleanup levels.

Table C2: Comparison of results of sampling for TCA and DCE in October 2011, Kearsarge Metallurgical Corporation Superfund Site, Conway, New Hampshire.

Monitoring Well	**1,1,1-TCA** ug/l	**1,1-DCE** ug/l
EW-9	4.4	2.9
MWS-203A	<1	2.4
MW-3003	15	15.9
MW-3004	1.2	<1
MW-3006	9.9	4.8
MW-3008	3.4	89.8
MW-3009	19.6	10.3
MW-3010	100	220
MW-3011	<1	7.2
MW-5003	1.8	1
PZ-4002	1.2	<1
PZ-4003	<1	<1
Cleanup Level	200	7

What Table C2 shows is that the amount of parent TCA compound has declined sufficiently to deny a future source for more DCE production. An examination of historic DCE data finds that the maximum concentration generally stayed below 800 µg/l during the period 2001 to 2003, prior to the soil excavation. These results indicate a steady state of production. Degradation mechanisms for DCE are much less vigorous than for TCA; however, there was a relatively stable trend for the total mass of DCE in the plume.[37]

Although concentration increases were observed from 2005 to 2010 in two wells in the Culvert area, specifically in MW-3008 and MW-3010, the plume has not increased in size in recent years. The monitoring wells delineating the extent of the plume (including PZ-4002, PZ-4003, EW-10, MW-9, PZ-4004, EW-6, MWS-202A, MW-3005, MW-5003, and MW-3004) continued to show non-detectable or below cleanup goal levels during the latest monitoring events. Monitoring wells MW-3003 and MW-5003 are along the axis of the western lobe of the plume which is approaching the western property boundary of the Site. Monitoring well MW-5003 is located close to the property boundary and had exceedences of the 1,1-DCE cleanup goal in late 2007 and early 2008. Since rebounding to a maximum concentration of 12 µg/L at this location in January 2008, 1,1-DCE has exhibited a clear decreasing trend and has remained below the cleanup goal (7 µg/L) for the last five consecutive monitoring rounds. In addition, upgradient monitoring well MW-3003 has also begun to show a declining trend and as of October 2011 had a concentration of 15.9 µg/l. Table C3 shows the value of 1,1-DCE in wells during the December 2010 and October 2011 sampling rounds.

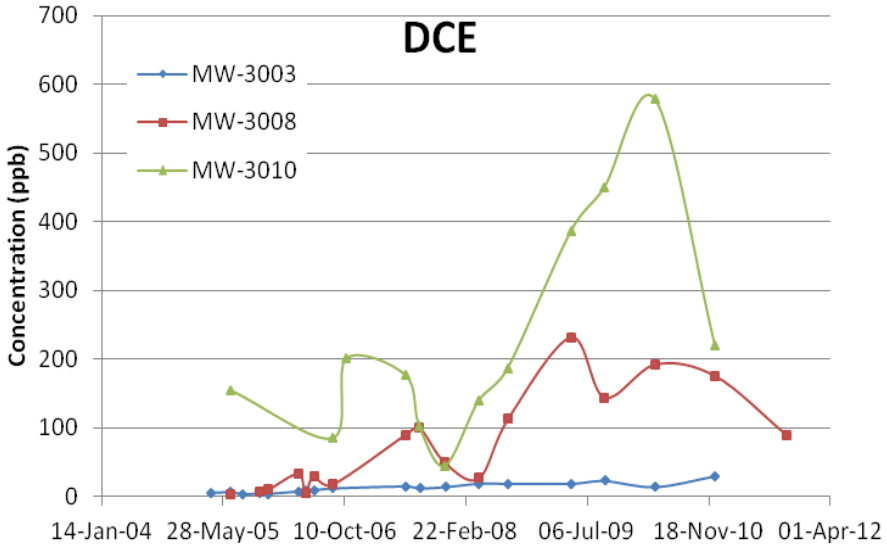
[37] GSI, 2009, p.16.

Table C3: Monitoring results for DCE in December 2010 and October 2011. The values that exceed the cleanup level (7 ug/l) are highlighted in yellow.

	1,1-DCE (ug/l)	
	December-10	**October-11**
EW-9	2.1	2.9
MWS-203A	2.6	2.4
MW-3003	30	15.9
MW-3004	<2	<1
MW-3006	12	4.8
MW-3008	175	89.8
MW-3009	8.8	10.3
MW-3010	578	220
MW-3011	<2	7.2
MW-5003	NS	1
PZ-4002	NS	<1
PZ-4003	<2	<1
Cleanup Level	7	

Figure C2 shows the concentration trends of 1,1-DCE since the treatment plant shutdown in 2005.

Figure C2: Trends in the three wells with the highest concentration of DCE from 2005 to the present. The cleanup level is 7 ppb.



DCE exceeds its cleanup level by a greater amount than any other contaminant and is present in 5 of the 10 wells monitored. However, as indicated in the MAROS analysis, it is

unlikely to migrate or increase significantly. Future monitoring will need to carefully consider the trend of contamination.

1,1-Dichloroethane

In 1990 1,1-Dichloroethane (DCA) was detected in only one well at a concentration of 1,560 ppb. Its cleanup level is presently set at 5 ppb as a result of New Hampshire AGQS. DCA is a daughter product of TCA. Its concentration at the site has fluctuated with the results of the last two sampling rounds and presently exceeds cleanup levels in only well MW-3010 as shown below in Table C4:

Table C4: A comparison of the concentrations of 1,1-DCA in all wells in December 2010 and October 2011. The values that exceed cleanup levels are highlighted in yellow.

	1,1-DCA (ug/l)	
	December-10	**October-11**
EW-9	<2	<1
MWS-203A	7.3	<1
MW-3003	12	<1
MW-3004	<2	<1
MW-3006	2.5	<1
MW-3008	101	1.6
MW-3009	6.3	<1
MW-3010	235	14.1
MW-3011	2.6	<1
MW-5003	NS	<1
PZ-4002	NS	<1
PZ-4003	<2	<1
Cleanup Level	81	

DCA is not expected to be a significant hurdle in attaining cleanup objectives at the Site.

1,4-Dioxane

This compound has only been recently recognized as a contaminant of concern at Superfund Sites. Commonly used with TCA as a stabilizer, it is highly miscible in water. It has also been shown to be resistant to most remedial measures including those used for the groundwater remedy at the site, carbon filtration and air-stripping. 1,4-Dioxane has also been shown to be resistant to biological degradation.[38] Monitoring of this compound began in September 2009 at the Site. Table C5 shows the range of concentrations.

[38] Department of Defense, Strategic Environmental Research and Development Program, *Final Report, ER-1422: Biodegradation of 1,4-Dioxane*, August 2007.

Table C5: The concentration of 1,4-Dioxane at the Site for the December 2010 and October 2011 sampling rounds. The values that exceed the State AGQS (3 ug/l) are highlighted in yellow.

	1,4-Dioxane (ug/l)	
	December-10	October-11
EW-9	NS	NS
MWS-203A	NS	NS
MW-3003	<2	<2
MW-3004	NS	NS
MW-3006	NS	NS
MW-3008	6.3	4.1
MW-3009	1.4	<2
MW-3010	34	25
MW-3011	<2	4.5
MW-5003	NS	<2
PZ-4002	NS	NS
PZ-4003	NS	NS
Cleanup Level	3	

Because there is a very short history of monitoring for this compound, its resistance to biodegradation, and its low cleanup level, monitoring for this contaminant should be increased. This compound was not addressed during the 2008 MAROS assessment and therefore requires additional data before an assessment of plume stability is made. A number of assumptions can be made as to the fate of 1,4-Dioxane: because it is highly miscible, it is likely that the contamination was rapidly collected by the original groundwater pump-and-treat system and was sent to the POTW. Because 1,4-Dioxane is resistant to nearly all forms of treatment outside of UV-oxidation, it is likely that it passed through the POTW and was discharged to the Saco River. Therefore, the fate of remaining concentrations of 1,4-Dioxane under MNA will likely be dispersion.

Other Daughter Product Contaminants of Concern

Several compounds that may generate risk are identified in the literature as being potential daughter products from the degradation of TCA. These compounds include Chloroethane (CA) and Vinyl Chloride (VC). Although there are no established cleanup levels or drinking water standards for CA, the concentrations are quite low at the Site, as shown on Table C6. Table C6 also shows the low concentration of VC at the Site. Only one well, highlighted in Table C6 below, had VC in concentrations that exceed the drinking water MCL of 2 µg/l.

Table C6: The concentration of Chloroethane and Vinyl Chloride in October 2011.

Monitoring Well	Vinyl Chloride (µg/l)	Chloroethane (µg/l)
EW-9	<1	<1
MWS-203A	<1	<1
MW-3003	<1	<1
MW-3004	<1	<1
MW-3006	<1	<1
MW-3008	1.4	49.7
MW-3009	<1	<1
MW-3010	2.5	21
MW-3011	<1	3.4
MW-5003	<1	<1
PZ-4002	<1	<1
PZ-4003	<1	<1

Sampling performed in 2006 for MNA parameters found little acetic acid, another degradation product of TCA. The daughter products of TCA degradation are CA, VC and acetic acid. Those daughter products are generally degraded in aerobic environments and slowly in anaerobic. Therefore, it would be expected that those compounds would accumulate. However, considering the results found for CA, VC and acetic acid, and the character of the hydrology at the Site, it is probable that the compounds are being rapidly degraded in an aerobic portion of the aquifer. The aerobic condition is generated during the seasonal influx of oxygenated water from the drainage culvert as Pequawket Pond fills in spring. Aerobic biobarriers have been installed at some sites to treat these contaminants.[39] Therefore, although monitoring of these compounds will continue, it is not likely they will exceed cleanup levels.

General Conclusions Regarding Monitored Natural Attenuation

All contaminants of concern at the Site have stable plumes that are not migrating and concentrations in a small number of wells that appear to have stabilized or are receding. Groundwater contaminant plume migration is unlikely: but if it were to occur, it would most likely be to the west. Monitoring of the current network of wells must continue, and in the case of 1,4-Dioxane be expanded, to assess the potential for migration or increases in any of the contaminants of concern.

[39] Scheutz, et. al., p. 2709.

Appendix D: Applicable and Relevant and Appropriate Requirements

Introduction

Applicable and Relevant and Appropriate Requirements (ARARs) are displayed in Table format for each of the remedial alternatives that are evaluated. The No Action alternative has only chemical specific ARARs that apply. The ARARs tables that follow are:

- D1 – Chemical specific ARARs for the No-Action Alternative MM-1
- D2 – Chemical specific ARARs for the Groundwater Pump-and-Treat Alternative MM-2.
- D3 – Chemical specific ARARs for the Monitored Natural Attenuation Alternative MM-3.
- D4 – Action specific ARARs for the Groundwater Pump-and-Treat Alternative MM-2.
- D5 – Action specific ARARs for the Monitored Natural Attenuation Alternative MM-3.

TABLE D1: CHEMICAL-SPECIFIC ARARs
Alternative MM-1 No Action
Kearsarge Metallurgical Corporation, Conway, New Hampshire

STATUTE / REGULATION	STATUS	REQUIREMENT SYNOPSIS	CONSIDERATION IN THE FEASIBILITY STUDY PROCESS	ACTION TAKEN TO ATTAIN ARAR
FEDERAL				
Safe Drinking Water Act – Maximum Contaminant Levels (MCLs) 40 CFR 141.11—141.16 40 CFR 141.60—141,62	Relevant and Appropriate	Maximum Contaminant Levels (MCLs) have been promulgated for several common organic and inorganic contaminants. These levels regulate the concentration of contaminants in public drinking water supplies, and are relevant and appropriate for groundwater aquifers used for drinking water.	MCLs must be met for water used as drinking water.	No monitoring would be conducted under Alternative MM-1 so there is no way to determine if these will be met.
Safe Drinking Water Act Maximum Contaminant Levels Goals (non-zero MCLGs), 40 CFR 141.50-141.51	Relevant and Appropriate	The level of a contaminant in drinking water below which there is no known or expected risk to health. MCLGs allow for a margin of safety and are non-enforceable public health goals.	Non-zero MCLGs are relevant and appropriate as the groundwater is a potential federal drinking water source.	No monitoring would be conducted under Alternative MM-1 so there is no way to determine if these will be met.
Guidelines for Groundwater Classification under the EPA Groundwater Protection Strategy June, 1988 EPA Number: 813R-880001	To Be Considered	Describes the procedures and information needed to classify groundwater; defines classes, concepts, and key terms related to groundwater classification system	Groundwater at the site is classified as a potential drinking water source under this federal classification system.	Drinking water standards will be used as cleanup standards based upon this federal classification.

TABLE D1: CHEMICAL-SPECIFIC ARARs
Alternative MM-1 No Action
Kearsarge Metallurgical Corporation, Conway, New Hampshire

STATUTE / REGULATION	STATUS	REQUIREMENT SYNOPSIS	CONSIDERATION IN THE FEASIBILITY STUDY PROCESS	ACTION TAKEN TO ATTAIN ARAR
STATE				
State: Env-Dw 700 New Hampshire Water Quality Standards	Relevant and Appropriate	These regulations set forth New Hampshire drinking water quality standards for water supply systems based on health and technical practicability. The aquifer at the site is not currently being used for drinking water. When Ambient Groundwater Quality Standards (AGQS) are more stringent than federal levels, the state levels must be met.	AGQS must be met for water used as drinking water.	No monitoring would be conducted under Alternative MM-1 so there is no way to determine if these will be met.
Env-Ws 312-315 State Drinking Water Quality Standards: MCLs and MCLGs	Relevant and Appropriate	This provision identifies and regulates contaminants in drinking water.	MCLs and non-zero MCLGs must be met for water used as drinking water.	No monitoring would be conducted under Alternative MM-1 so there is no way to determine if these will be met.

TABLE D2: CHEMICAL-SPECIFIC ARARs
Alternative MM-2 Pump and treat
Kearsarge Metallurgical Corporation, Conway, New Hampshire

STATUTE / REGULATION	STATUS	REQUIREMENT SYNOPSIS	CONSIDERATION IN THE FEASIBILITY STUDY PROCESS	ACTION TAKEN TO ATTAIN ARAR
FEDERAL				
Safe Drinking Water Act Maximum Contaminant Levels (MCLs) 40 CFR 141.11—141.16 40 CFR 141.60—141,62	Relevant and Appropriate	Maximum Contaminant Levels (MCLs) have been promulgated for several common organic and inorganic contaminants. These levels regulate the concentration of contaminants in public drinking water supplies, and are relevant and appropriate for groundwater aquifers used for drinking water.	MCLs must be met for water used as drinking water.	Treatment under this alternative will result in groundwater that meets these standards.
Safe Drinking Water Act – Non-zero Maximum Contaminant Level Goals (MCLGs) 40 CFR 141.50—51	Relevant and Appropriate	The level of a contaminant in drinking water below which there is no known or expected risk to health. MCLGs allow for a margin of safety and are non-enforceable public health goals.	Non-zero MCLGs must be met for water used as drinking water.	Treatment under this alternative will result in groundwater that meets these standards.
Guidelines for Groundwater Classification under the EPA Groundwater Protection Strategy June, 1988 EPA Number: 813R-880001	To Be Considered	Describes the procedures and information needed to classify groundwater; defines classes, concepts, and key terms related to groundwater classification system	Groundwater at the Site is classified as a potential drinking water source under this federal classification system.	Drinking water standards will be used as cleanup standards based upon this federal classification.

TABLE D2: CHEMICAL-SPECIFIC ARARs
Alternative MM-2 Pump and treat
Kearsarge Metallurgical Corporation, Conway, New Hampshire

STATUTE / REGULATION	STATUS	REQUIREMENT SYNOPSIS	CONSIDERATION IN THE FEASIBILITY STUDY PROCESS	ACTION TAKEN TO ATTAIN ARAR
STATE				
Env-Dw 700 New Hampshire Water Quality Standards	Relevant And Appropriate	These regulations set forth New Hampshire drinking water quality standards for water supply systems based on health and technical practicability. The aquifer at the site is not currently being used for drinking water. When Ambient Groundwater Quality Standards (AGQS) are more stringent than federal levels, the state levels must be met.	AGQS must be met for water used as drinking water.	Treatment under this alternative will result in groundwater/drinking water that meet these standards.
Env-Ws 312 315 State Drinking Water Quality Standards MCLs and MCLGs	Relevant and Appropriate	This provision identifies and regulates contaminants in drinking water.	MCLs and non-zero MCLGs must be met for water used as drinking water.	Treatment under this alternative will result in drinking water that meets these standards.

TABLE D3: CHEMICAL-SPECIFIC ARARs
Alternative MM-3 Monitored Natural Attenuation
Kearsarge Metallurgical Corporation, Conway, New Hampshire

STATUTE / REGULATION	STATUS	REQUIREMENT SYNOPSIS	CONSIDERATION IN THE FEASIBILITY STUDY PROCESS	ACTION TAKEN TO ATTAIN ARAR
FEDERAL				
Safe Drinking Water Act – Maximum Contaminant Levels MCLs) 40 CFR 141.11—141.16 40 CFR 141.60—141,62	Relevant and Appropriate	Maximum Contaminant Levels (MCLs) have been promulgated for several common organic and inorganic contaminants. These levels regulate the concentration of contaminants in public drinking water supplies, and are relevant and appropriate for groundwater aquifers used for drinking water.	MCLs must be met for water used as drinking water.	Alternative MM-3 would meet these requirements by reducing the concentration of contaminants through natural processes.
Safe Drinking Water Act – Non-Zero Maximum Contaminant Level Goals (MCLGs) 40 CFR 141.50—51	Relevant and Appropriate	The level of a contaminant in drinking water below which there is no known or expected risk to health. MCLGs allow for a margin of safety and are non-enforceable public health goals.	Non- zero MCLGs must be met for water used as drinking water.	Alternative MM-3 would meet these requirements by reducing the concentration of contaminants through natural processes.
Guidelines for Groundwater Classification under the EPA Groundwater Protection Strategy June, 1988 EPA Number: 813R-880001	To Be Considered	Describes the procedures and information needed to classify groundwater; defines classes, concepts, and key terms related to groundwater classification system.	Groundwater at the site is classified as a potential drinking water source under this federal classification system.	Drinking water standards will be used as cleanup standards based upon this federal classification.

TABLE D3: CHEMICAL-SPECIFIC ARARs
Alternative MM-3 Monitored Natural Attenuation
Kearsarge Metallurgical Corporation, Conway, New Hampshire

STATUTE / REGULATION	STATUS	REQUIREMENT SYNOPSIS	CONSIDERATION IN THE FEASIBILITY STUDY PROCESS	ACTION TAKEN TO ATTAIN ARAR
STATE				
Env-Dw 700 New Hampshire Water Quality Standards	Relevant and Appropriate	These regulations set forth New Hampshire drinking water quality standards for water supply systems based on health and technical practicability. The aquifer at the site is not currently being used for drinking water. When Ambient Groundwater Quality Standards (AGQS) are more stringent than federal levels, the state levels must be met.	AGQS must be met for water used as drinking water.	. Alternative MM-3 would meet these requirements by reducing the concentration of contaminants through natural processes and contingent remedies.
Env-Ws 312 - 315 State Drinking Water Quality Standards: MCLs and MCLGs	Relevant and Appropriate	This provision identifies and regulates contaminants in drinking water.	MCLs/non-zero MCLGs must be met for water used as drinking water.	. Alternative MM-3 would meet these requirements by reducing the concentration of contaminants through natural processes and contingent remedies.

TABLE D4: ACTION-SPECIFIC ARARs
Alternative MM-2 Pump and Treat
Kearsarge Metallurgical Corporation, Conway, New Hampshire

STATUTE / REGULATION	STATUS	REQUIREMENT SYNOPSIS	CONSIDERATION IN THE FEASIBILITY STUDY PROCESS	ACTION TAKEN TO ATTAIN ARAR
FEDERAL				
Resource Conservation and Recovery Act (RCRA) 42 USC §§ 6901 *et seq.* Standards for identification and listing of hazardous waste 40 CFR Part 261	Applicable	New Hampshire has been delegated the authority to administer these RCRA standards through its state hazardous waste management regulations. These provisions have been adopted by the State.	Applicable to contaminated materials generated by capture of contaminants on activated carbon.	Materials will be analyzed to determine if hazardous.
RCRA Standards applicable to generators of hazardous waste 40 CFR Part 262	Applicable	New Hampshire has been delegated the authority to administer these RCRA standards through its state hazardous waste management regulations. These provisions have been adopted by the State.	Applicable to contaminated materials generated by capture of contaminants on activated carbon.	Materials will be properly manifested and then shipped off-site.
RCRA – Subtitle C Hazardous Waste Regulations 40 CFR Part 264, Subparts F (groundwater monitoring), I (containers), J (tanks).	Relevant And Appropriate	New Hampshire has been delegated the authority to administer these RCRA standards through its state hazardous waste management regulations. These provisions have been adopted by the State.	Hazardous waste will be generated by the capture of contaminants on activated carbon. Groundwater monitoring will be conducted,	To the extent containers or tanks are used these requirements will be met. Groundwater monitoring requirements will be looked to establish the groundwater monitoring program.

TABLE D4: ACTION-SPECIFIC ARARs
Alternative MM-2 Pump and Treat
Kearsarge Metallurgical Corporation, Conway, New Hampshire

STATUTE / REGULATION	STATUS	REQUIREMENT SYNOPSIS	CONSIDERATION IN THE FEASIBILITY STUDY PROCESS	ACTION TAKEN TO ATTAIN ARAR
RCRA – Subtitle C Hazardous Waste Regulations 40 CFR Part 264, Subparts B, C and D	Relevant and Appropriate	These regulations establish general facility standards, standards for prevention/ preparedness and contingency/emergency procedures for owners/operators of hazardous waste treatment storage and disposal facilities.	Hazardous substances will be extracted from the groundwater and treated/stored.	The substantive requirements of these regulations will be followed by this Alternative.
Clean Water Act General Pretreatment Regulations for Existing and New Sources of Pollution 40 CFR 403	Applicable	Pretreatment standards for discharges to a POTW.	Hazardous substances/pollutants will be extracted from the groundwater then treated and shipped to a POTW for disposal.	Treatment system has already been designed to meet pretreatment standards for most contaminants. Further investigation will be required to ensure that discharges of 1,4-dioxane meet pretreatment requirements.
New Hampshire Ambient Air Quality Standards, Env-A 300	Applicable	These regulations set requirements on the control of fugitive emissions and dust.	Compliance with these requirements will be required for any construction activities that might result in the generation of fugitive dust.	Construction under Alternative MM-2 will be conducted in accordance with these requirements.

TABLE D4: ACTION-SPECIFIC ARARs
Alternative MM-2 Pump and Treat
Kearsarge Metallurgical Corporation, Conway, New Hampshire

STATUTE / REGULATION	STATUS	REQUIREMENT SYNOPSIS	CONSIDERATION IN THE FEASIBILITY STUDY PROCESS	ACTION TAKEN TO ATTAIN ARAR
Draft Guidance for Evaluating Vapor Intrusion to Indoor Air Pathways from Groundwater and Soils (Subsurface Vapor Intrusion Guidance EPA 530-D-02-004 November, 2002 67 FR 71169 (Nov. 29, 2002)	To Be Considered	Guidance for assessing and mitigating vapor intrusion risk.	Vapor Intrusion pathway investigated as part of the FS.	Potential future risk from vapor intrusion if homes built on the Site. ICs to prevent this included in this alternative.
STATE				
Env-Ws 904 Pretreatment Standards	Applicable	Provides standards for indirect discharge of pollutants to POTW.	Hazardous substances/pollutants will be extracted from the groundwater then treated and shipped to a POTW for disposal.	Treatment system has already been designed to meet pretreatment standards for most contaminants. Further investigation will be required to ensure that discharges of 1,4-dioxane meet pretreatment requirements.
Env-Wm 702.10 – 702.13	Applicable	Establishes groundwater monitoring requirements.	Groundwater monitoring will be a component of this alternative.	Will be used to develop a groundwater monitoring plan.

TABLE D5: ACTION-SPECIFIC ARARs
Alternative MM-3 Monitored Natural Attenuation
Kearsarge Metallurgical Corporation, Conway, New Hampshire

STATUTE / REGULATION	STATUS	REQUIREMENT SYNOPSIS	CONSIDERATION IN THE FEASIBILITY STUDY PROCESS	ACTION TAKEN TO ATTAIN ARAR
FEDERAL				
Resource Conservation and Recovery Act (RCRA) 42 USC §§ 6901 *et seq.* Standards for identification and listing of hazardous waste 40 CFR Part 261	Potentially Applicable	New Hampshire has been delegated the authority to administer these RCRA standards through its state hazardous waste management regulations. These provisions have been adopted by the State.	Applicable to contaminated materials generated by capture of contaminants on activated carbon should pump and treat be needed as a contingent remedy.	If contaminated material is generated, it will be analyzed to determine if hazardous.
RCRA Standards applicable to generators of hazardous waste 40 CFR Part 262	Potentially Applicable	New Hampshire has been delegated the authority to administer these RCRA standards through its state hazardous waste management regulations. These provisions have been adopted by the State.	Applicable to contaminated materials generated by capture of contaminants on activated carbon should pump and treat be needed as a contingent remedy.	If hazardous waste is generated, it will be properly manifested and then shipped off-site.
RCRA – Subtitle C Hazardous Waste Regulations 40 CFR Part 264 Subparts F (groundwater monitoring), I (containers), J (tanks).	Potentially Relevant And Appropriate	New Hampshire has been delegated the authority to administer these RCRA standards through its state hazardous waste management regulations. These provisions have been adopted by the State.	Hazardous waste will be generated by the capture of contaminants on activated carbon should pump and treat be needed as a contingent remedy. Groundwater monitoring will be conducted.	To the extent containers or tanks are used these requirements will be met. Groundwater monitoring requirements will be used to establish the groundwater monitoring program.

TABLE D5: ACTION-SPECIFIC ARARs
Alternative MM-3 Monitored Natural Attenuation
Kearsarge Metallurgical Corporation, Conway, New Hampshire

STATUTE / REGULATION	STATUS	REQUIREMENT SYNOPSIS	CONSIDERATION IN THE FEASIBILITY STUDY PROCESS	ACTION TAKEN TO ATTAIN ARAR
RCRA – Subtitle C Hazardous Waste Regulations 40 CFR Part 264 Subparts B, C and D	Potentially Relevant And Appropriate	These regulations establish general facility standards, standards for prevention/ preparedness and contingency/emergency procedures for owners/operators of hazardous waste treatment storage and disposal facilities.	Hazardous substances will be extracted from the groundwater and treated/stored should pump and treat be needed.	The substantive requirements of these regulations will be followed by this Alternative should pump and treat be needed.
Safe Drinking Water Act Underground Injection Wells 42 USC §300h 40 CFR Part 144—147	Potentially Applicable	Regulates the construction, operation, permitting, and closure of injection wells that place fluids underground for storage or disposal.	Necessary if chemical oxidation is employed.	Chemical oxidation will meet the substantive discharge requirements.

TABLE D5: ACTION-SPECIFIC ARARs
Alternative MM-3 Monitored Natural Attenuation
Kearsarge Metallurgical Corporation, Conway, New Hampshire

STATUTE / REGULATION	STATUS	REQUIREMENT SYNOPSIS	CONSIDERATION IN THE FEASIBILITY STUDY PROCESS	ACTION TAKEN TO ATTAIN ARAR
Clean Water Act General Pretreatment Regulations for Existing and New Sources of Pollution 40 CFR 403	Potentially Applicable	Pretreatment standards for discharges to a POTW.	Hazardous substances/pollutants will be extracted from the groundwater then treated and shipped to a POTW for disposal should pump and treat be needed.	Treatment system has already been designed to meet pretreatment standards for most contaminants should pump and treat be needed. Further investigation will be required to ensure that discharges of 1,4-dioxane meet pretreatment requirements should pump and treat be needed.
Draft Guidance for Evaluating Vapor Intrusion to Indoor Air Pathways from Groundwater and Soils (Subsurface Vapor Intrusion Guidance EPA 530-D-02-004 November, 2002 67 FR 71169 (Nov. 29, 2002)	To Be Considered	Guidance for assessing and mitigating vapor intrusion risk.	Vapor Intrusion pathway investigated as part of the Weston Focused Feasibility Study.	Potential future risk from vapor intrusion if homes built on the Site. ICs to prevent this included in this alternative.

TABLE D5: ACTION-SPECIFIC ARARs
Alternative MM-3 Monitored Natural Attenuation
Kearsarge Metallurgical Corporation, Conway, New Hampshire

STATUTE / REGULATION	STATUS	REQUIREMENT SYNOPSIS	CONSIDERATION IN THE FEASIBILITY STUDY PROCESS	ACTION TAKEN TO ATTAIN ARAR
Use of Monitored Natural Attenuation at Superfund, RCRA Corrective Action, and Underground Storage Tank Sites OSWER Directive 9200.4-17P April 21, 1999	To Be Considered	Used to evaluate monitored natural attenuation remedies.	Used to develop and evaluate information for Appendices A and C in this Focused Feasibility Study.	Will be used to evaluate progress of the remedy.

TABLE D5: ACTION-SPECIFIC ARARs
Alternative MM-3 Monitored Natural Attenuation
Kearsarge Metallurgical Corporation, Conway, New Hampshire

STATUTE / REGULATION	STATUS	REQUIREMENT SYNOPSIS	CONSIDERATION IN THE FEASIBILITY STUDY PROCESS	ACTION TAKEN TO ATTAIN ARAR
STATE				
Env-Ws 904 Pretreatment Standards	Potentially Applicable	Provides standards for indirect discharge of pollutants to POTW.	Hazardous substances/pollutants will be extracted from the groundwater then treated and shipped to a POTW for disposal should pump and treat be needed.	Treatment system has already been designed to meet pretreatment standards for most contaminants should pump and treat be needed. Further investigation will be required to ensure that discharges of 1,4-dioxane meet pretreatment requirements should pump and treat be needed.
Env-Wm 702.10 – 702.13	Applicable	Establishes groundwater monitoring requirements**.**	Groundwater monitoring will be a component of his alternative.	Will be used to develop a groundwater monitoring plan.
New Hampshire Ambient Air Quality Standards, Env-A 300	Potentially Applicable	These regulations set requirements on the control of fugitive emissions and dust.	Compliance with these requirements will be required for any construction activities that might result in the generation of fugitive dust.	Any construction under Alternative MM-3 will be conducted in accordance with these requirements.