Worldwide Facilities Group
Environmental & Regulatory Support
Remediation Team

February 27, 2009

Mr. Nate Nemani
Project Manager
U.S. EPA, Region 5
Waste, Pesticide and Toxins Division
77 West Jackson Boulevard DW-8J
Chicago, IL 60604-3590

Dear Mr. Nemani:

Re: Request for Approval for Interim Measures Work Plan for pH Impacted Soil
GMC Powertrain Saginaw Metal Casting Operations, MID-041-793-341

Enclosed please find the Interim Measures (IM) Work Plan for pH Impacted Soil for the Saginaw Metal Casting Operations (SMCO) Facility in Saginaw, Michigan, for your review and approval.

Please call me at 313-510-4328 if you have any questions regarding this IM Work Plan.

Sincerely,

Cheryl R. Hiatt
Project Coordinator

AM/jh/17075/7
Encl.

c.c.: Mr. Peter Ramanauskas, U.S. EPA
Mr. George Bruchmann, MDEQ-WMD Lansing
Mr. Terry Walkington, MDEQ-WMD Bay City
Ms. Rhonda Klann, MDEQ-WMD Bay City
Dr. Lisa Williams, U.S. DOI, Fish and Wildlife
Ms. Jean Caufield, GM
Mr. James Walle, GM
Ms. Amanda Kurzman/Mr. Ray Ilkka, GM
Mr. Mike Tomka, CRA

Engineering West• 30200 Mound Road • Mail Code 480-111-W60 • Warren• MI 48090 • Fax 586-986-2281

"I certify that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

Signature: Cheryl R Hiatt

Name: CHERYL R HIATT

Title: Project Manager

Date: Feb 27, 2009

Engineering West• 30200 Mound Road • Mail Code 480-111-W60 • Warren• MI 48090 • Fax 586-986-2281

February 26, 2009

INTERIM MEASURES WORK PLAN FOR pH-IMPACTED SOIL (GM SMCO FACILITY)

GENERAL MOTORS CORPORATION
1629 N. WASHINGTON AVENUE
SAGINAW, MICHIGAN 48605-5073

Prepared by:
Conestoga-Rovers & Associates

651 Colby Drive
Waterloo, Ontario
Canada N2V 1C2

Office: (519) 884-0510
Fax: (519) 884-0525

web: http:\\www.CRAworld.com

FEBRUARY 26, 2009
REF. NO. 017075 (31)

TABLE OF CONTENTS

LIST OF FIGURES
(Following Text)

LIST OF APPENDICIES
(Following Text)

LIST OF ACRONYMS AND TERMS

bgs	below ground surface
CRA	Conestoga-Rovers & Associates
$FeSO_4$	ferrous sulfate
GM	General Motors Corporation
HASP	Health and Safety Plan
HCl	hydrochloric acid
IM Work Plan	Interim Measures Work Plan
IU	Investigative Unit
MDEQ	Michigan Department of Environmental Quality
OSHA	Occupational Safety and Health Administration
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
s.u.	standard units
SMCO	Saginaw Metal Casting Operations
U.S. EPA	United States Environmental Protection Agency

1.0 INTRODUCTION

GM has been conducting a Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) at the General Motors Corporation (GM) Saginaw Metal Casting Operations (SMCO) Facility at 1629 North Washington Avenue in Saginaw, Michigan (Site). The Site has the United States Environmental Protection Agency (U.S. EPA) identification number MID 041 793 340. The Site location is presented on Figure 1.1 and the Site Plan is presented on Figure 1.2. The RFI is being performed consistent with the Unilateral Administrative Order issued by the U.S. EPA in 1995 (Order). As part of the RFI, elevated pH exceeding Michigan Department of Environmental Quality's (MDEQ) current allowable groundwater pH range for residential and industrial drinking water of 6.5 to 8.5 standard units (s.u.) was identified in shallow groundwater in Investigative Unit (IU) I and in IUs that are downgradient of IU I (IU G and IU H). The locations of IUs are presented on Figure 1.2.

The leachate from soil samples collected from a small area in IU I (near the high pH in groundwater) reported pH levels exceeding 8.5. The area of soils exhibiting the elevated pH is approximately 3.4 acres in size and extends approximately 4 feet below ground surface (bgs) to where the water table is encountered. The soils are located in the former quench slag staging area of the Former Nodular Iron Plant in IU I and are believed to be the source for the observed elevated pH levels in groundwater. These soils were impacted by the high pH content of the quench slag.

This IM Work Plan details an interim measure (IM) to reduce the pH of the soils acting as the source of elevated pH in shallow groundwater impacts in IU I. The proposed IM includes in-situ treatment of soils exhibiting a pH exceeding 8.5 s.u.

2.0 RCRA FACILITY INVESTIGATION

2.1 SOIL INVESTIGATION

An extensive soil investigation was completed in IU I as part of the RFI. Thirty-six soil samples from depths varying from 0 to 4 feet bgs were collected from 14 locations. A leachate analysis was conducted on the soil samples to determine pH. The results of the analysis reported pH above 8.5 s.u. in 10 of the 14 locations. These results are shown on Figure 2.1. Additionally, groundwater samples were collected and analyzed from 7 monitoring wells within IU I. In 3 of the 7 monitoring wells, pH was reported above criteria, ranging from 9.18 to 9.31 s.u.

2.2 TREATABILITY STUDY

In-situ treatment of soil exhibiting elevated pH was identified as a potentially effective strategy for addressing the source of high pH groundwater in IU I. GM is not aware of any other sources of high pH groundwater, except the source identified in IU I. A laboratory treatability study (see Appendix A) was conducted on the soil collected from IU I. Three compounds were tested to determine the potential effectiveness of in-situ treatment to lower pH of groundwater leaching through these soils. These compounds are hydrochloric acid (HCL), ferrous sulfate ($FeSO_4$), and gypsum. The results of the study indicated that an excessive amount of gypsum would be required, which would be cost prohibitive. The use of HCL would require 0.4 g of HCL per kilogram (kg) of soil, and the use of $FeSO_4$ would require 1.0 g of FeSO2 per kg of soil to bring the pH in the leachate below 8.5, which is the MDEQ generic criteria. The study concluded that either HCL or $FeSO_4$ solutions could be used effectively to lower the pH in soil based on the cost and amount of product required. The $FeSO_4$ solution was selected for use at the Site as it is a weaker acid than HCL and does not speciate into potentially harmful by-products. The study also identified different alternatives for application of the proposed solution.

2.3 SITE GEOLOGY AND HYDROGEOLOGY

2.3.1 GEOLOGY

The ground surface at IU I typically consists of a layer of fill of varying thickness, over fluvial/marsh deposits composed of silty sand and silty clay. This, in turn, overlies glaciolacustrine deposits composed of clay with thin discontinuous sand lenses, overlying subglacial sand/gravel deposits. Bedrock in this area is encountered

approximately 84 to 106 feet below the surface on the property and is composed of hard fine sandstone, part of the Pennsylvanian Saginaw Formation.

2.3.2 HYDROGEOLOGY

Groundwater, where present, is unconfined in the upper more permeable surface fill and sand units on the property. The shallow water bearing unit is underlain by a silty clay confining layer or aquitard. The aquitard varies in thickness between 15 feet near the Saginaw River to 80 feet in the vicinity of IU I. Beneath the clay aquitard there is a confined water-bearing unit consisting of the subglacial sand/gravel deposits, which are connected to the underlying sandstone bedrock. The depth of shallow groundwater varies from 3.5 feet bgs adjacent to the Saginaw River to 9.5 feet bgs on the eastern side of the Site. Shallow groundwater is not always present as you move east, because the clay aquitard rises to the surface. Flow in the water table groundwater is generally west/northwest toward the River, although the SMCO Plant locally affects flow because of pumping drains around the main plant buildings. The deeper or bedrock water bearing unit flows generally north toward Saginaw Bay.

3.0 PROPOSED FULL-SCALE INTERIM MEASURES

The $FeSO_4$ solution was selected for use at the Site as it is a weaker acid than HCL and does not speciate into potentially harmful by-products and because the treatability study showed it was effective. Prior to application of the solution, the area will be tilled to increase infiltration and bermed to prevent runoff away from the impacted area. Interim measures will consist of spraying the elevated pH-impacted surface soil with a $FeSO_4$ solution. Clean water will then be sprayed on the soil to flush the $FeSO_4$ solution into the soil. Subsequent groundwater monitoring results will be evaluated to determine whether a second application of $FeSO_4$ solution is required in some areas.

3.1 RATIONALE FOR PROPOSED INTERIM MEASURES

This interim measure will treat the higher pH over a short period of time (i.e., 2 to 3 months) as the applied water and rainwater soak through the soil and carry the neutralizing solution. Since the average rainfall in the area is 30 to 35 inches per year, the $FeSO_4$ solution should percolate through the 4-foot depth interval within 6 months to a year considering only rainfall. Monitoring of the groundwater will determine whether or not a second application of the solution will be needed.

3.2 SCOPE OF WORK

The following sections describe the cleanup activities related to on-Site work to be conducted under this Work Plan:

4.2.1 Prepare Health and Safety Plan

4.2.2 Contractor Procurement

4.2.3 Pre-Mobilization Activities

4.2.4 Mobilization/Site Preparation

4.2.5 In-situ Soil Treatment with $FeSO_4$

4.2.6 Monitoring

4.2.7 Site Restoration and Demobilization

3.2.1 PREPARE HEALTH AND SAFETY PLAN

To ensure that all on-Site personnel are properly protected from potential exposure to Site-related constituents, a Site-specific Health and Safety Plan (HASP) will be prepared. A Site health and safety officer will complete a hazard analysis for all activities. The hazard analysis will identify the potential hazards, evaluate the level of personal protective equipment that will be used during the cleanup activities, and describe the personnel decontamination procedures required to control any potential personal exposures during implementation of this Work Plan.

The HASP will be prepared and implemented consistent with Occupational Safety and Health Administration (OSHA) 29 CFR 1910.120.

3.2.2 CONTRACTOR PROCUREMENT

A qualified, OSHA-trained remedial contractor will be procured for the application of the solution and water. The remedial contractor will be responsible for preparation of the solution and water, as well as the berming of the area and the applications of these solutions.

3.2.3 MOBILIZATION/SITE PREPARATION

Upon mobilization of the contractor at the Site, the contractor will establish security controls and designate the exclusion, contaminant reduction, and support zones by installing a temporary orange safety fence or caution tape, with warning signs, as necessary.

3.2.4 IN-SITU SOIL SURFACE TREATMENT WITH $FeSO_4$

Prior to the application of the $FeSO_4$ solution, a 2-foot high berm will be constructed with on-Site fill around the extent of the proposed area of soil surface treatment, as identified on Figure 3.1. Additionally, the soil surface treatment area will be tilled to encourage infiltration of the $FeSO_4$ solution. The equipment used to till the ground will be decontaminated within the berm area with clean water. The area with higher pH levels (above 8.5 s.u.) is approximately 3.4 acres in size. This area will be sprayed with 7,524 kg (16,590 pounds) of $FeSO_4$ dissolved in 11,000 gallons of water to produce an 18 percent $FeSO_4$ solution. The solution will be applied evenly across the surface of the

impacted area and allowed to infiltrate. An additional 11,000 gallons of clean water will be sprayed on the soil to flush the solution into the soil. This volume of water will not be enough to immediately permeate the 4-foot thickness of the high pH soil. However, it will produce a zone of low pH near the surface of the soil, and over time, precipitation will cause leaching of low pH water from this low pH zone into and through the high pH soil zone. In time, as precipitation pushes the low pH through the soil column, the entire thickness will be treated to the shallow groundwater table at a depth of 4 feet bgs. An additional application of the solution may be needed based on monitoring of the groundwater downgradient of the treatment area.

The water bearing unit in this area is perched and discontinuous. The water bearing unit is not used for any purpose and there are no downgradient receptors.

3.2.5 MONITORING

Prior to application of the solution, six shallow monitoring wells will be installed to assess the effectiveness of the treatment. The shallow wells will be installed to a depth that screens the water table. The proposed locations are identified on Figure 3.1. Samples will be collected from the six monitoring wells and analyzed for pH prior to application of the solution. The six monitoring wells will be monitored monthly for pH and will be properly abandoned following four-consecutive rounds of sampling with results below a pH of 8.5 s.u. The existing RFI monitoring wells downgradient of this area will be monitored annually for pH for 2 years to evaluate the attenuation of elevated pH in groundwater.

The results of the sampling will be evaluated and presented to U.S. EPA. The results will determine whether an additional application of the solution may be required. If the treatment shows some effectiveness in lowering groundwater pH in this area, additional monitoring will occur over an additional six months to confirm the effectiveness.

If a second application still does not show an effect after monitoring, the IM will be terminated and a report completed analyzing the issues encountered.

3.2.6 SITE RESTORATION AND DEMOBILIZATION

Once the IM is completed, the contractor will remove any temporary fencing, the decontamination pad, the equipment, and other materials and supplies brought onto the Site for the cleanup activities. The berm will be graded out into the surrounding area before equipment leaves the Site.

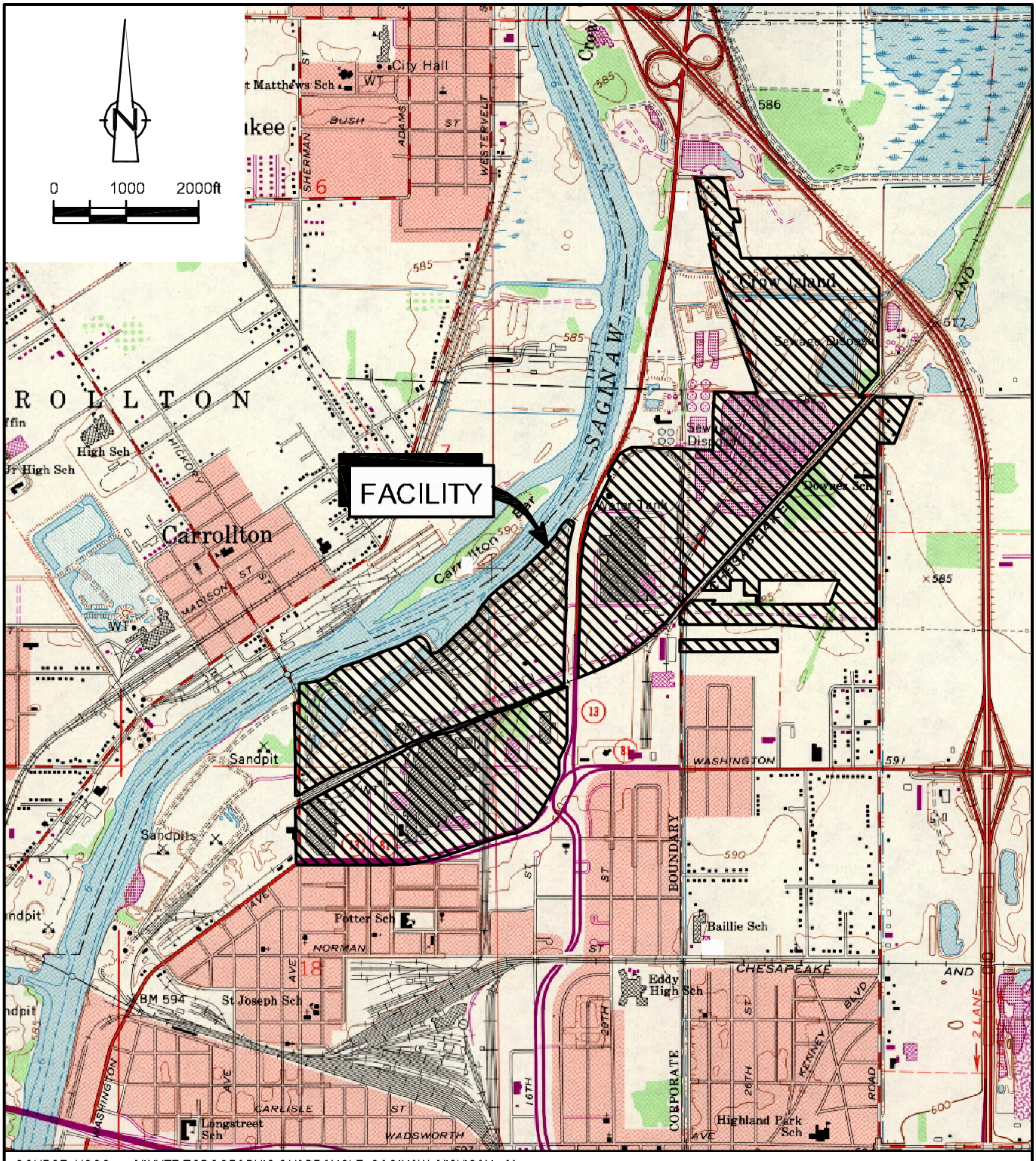
4.0 REPORTING/DOCUMENT PREPARATION

Upon the completion of the IM, a report will be prepared to present a summary of the cleanup activities. The report will include a summary of the work completed, and an evaluation of the success of the treatment.

5.0 SCHEDULE

Initiation of this IM will depend on weather conditions present during the spraying and monitoring activities. Once approval of the work plan has been obtained, a schedule of activities will be developed to allow the completion of the work during optimum weather conditions.

FIGURES



SOURCE: USGS 7.5 MINUTE TOPOGRAPHIC QUADRANGLE; SAGINAW, MICHIGAN 1967

figure 1.1

FACILITY LOCATION MAP
GENERAL MOTORS CORPORATION
SAGINAW METAL CASTING OPERATIONS

Saginaw, Michigan

N

0 200 500ft

LEGEND

A — INVESTIGATIVE UNIT BOUNDARY AND IDENTIFIER

APPROXIMATE PROPERTY BOUNDARY

NOTE: TOPO - SANBORN, 1998

SCALE VERIFICATION

THIS BAR MEASURES 1" ON ORIGINAL. ADJUST SCALE ACCORDINGLY.

GENERAL MOTORS CORPORATION
SAGINAW METAL CASTING OPERATIONS

SAGINAW, MICHIGAN

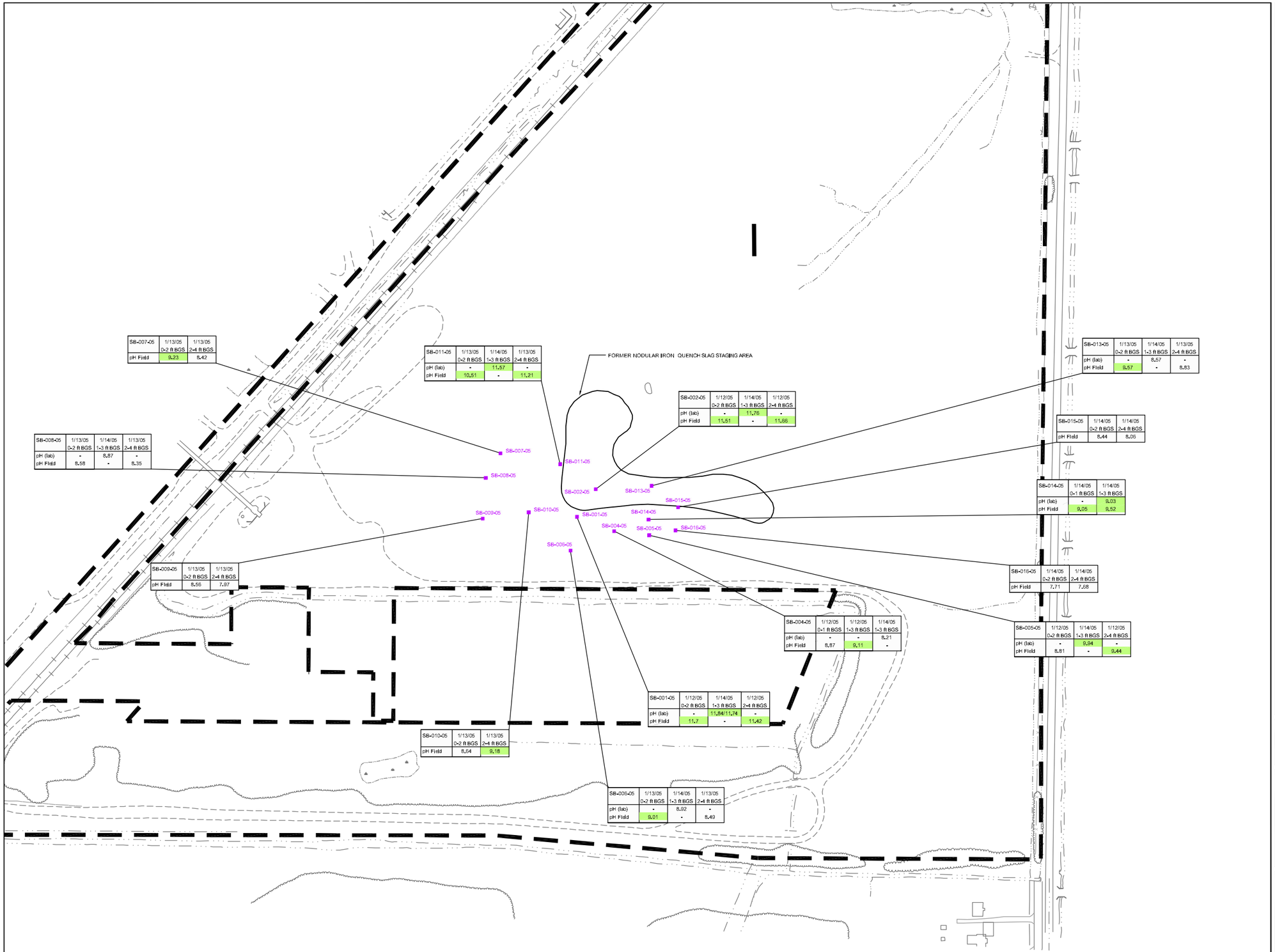
FACILITY PLAN

CONESTOGA-ROVERS & ASSOCIATES

Source Reference:
MICHIGAN STATE PLANE SOUTH, NAD 83 USING INTERNATIONAL FEET, NGVD 88

Project Manager:	Reviewed By:	Date:	
I.R.	M.T.	FEBRUARY 2009	
Scale: 1" = 500'	Project N°: 017075-30	Report N°: 031	Drawing N°: 1.2

017075-30(031)GN-WA002 FEB 26/2009



SB-007-05	1/13/05 0-2 ft BGS	1/13/05 2-4 ft BGS
pH Field	9.23	8.42

SB-011-05	1/13/05 0-2 ft BGS	1/14/05 1-3 ft BGS	1/13/05 2-4 ft BGS
pH (lab)	-	11.57	-
pH Field	10.51	-	11.21

SB-013-05	1/13/05 0-2 ft BGS	1/14/05 1-3 ft BGS	1/13/05 2-4 ft BGS
pH (lab)	-	8.57	-
pH Field	9.57	-	8.83

SB-002-05	1/12/05 0-2 ft BGS	1/14/05 1-3 ft BGS	1/12/05 2-4 ft BGS
pH (lab)	-	11.76	-
pH Field	11.51	-	11.66

SB-015-05	1/14/05 0-2 ft BGS	1/14/05 2-4 ft BGS
pH Field	8.44	8.06

SB-008-05	1/13/05 0-2 ft BGS	1/14/05 1-3 ft BGS	1/13/05 2-4 ft BGS
pH (lab)	-	8.87	-
pH Field	8.58	-	8.35

SB-014-05	1/14/05 0-1 ft BGS	1/14/05 1-3 ft BGS
pH (lab)	-	9.03
pH Field	9.05	8.52

SB-009-05	1/13/05 0-2 ft BGS	1/13/05 2-4 ft BGS
pH Field	8.56	7.97

SB-016-05	1/14/05 0-2 ft BGS	1/14/05 2-4 ft BGS
pH Field	7.71	7.68

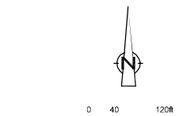
SB-004-05	1/12/05 0-1 ft BGS	1/12/05 1-3 ft BGS	1/14/05 1-3 ft BGS
pH (lab)	-	-	8.21
pH Field	8.87	9.11	-

SB-005-05	1/12/05 0-2 ft BGS	1/14/05 1-3 ft BGS	1/12/05 2-4 ft BGS
pH (lab)	-	9.94	-
pH Field	8.81	-	9.44

SB-001-05	1/12/05 0-2 ft BGS	1/14/05 1-3 ft BGS	1/12/05 2-4 ft BGS
pH (lab)	-	11.84/11.74	-
pH Field	11.7	-	11.42

SB-010-05	1/13/05 0-2 ft BGS	1/13/05 2-4 ft BGS
pH Field	8.64	9.18

SB-006-05	1/13/05 0-2 ft BGS	1/14/05 1-3 ft BGS	1/13/05 2-4 ft BGS
pH (lab)	-	8.92	-
pH Field	9.01	-	8.49



LEGEND

A — — INVESTIGATIVE UNIT BOUNDARY AND IDENTIFIER

SOIL BORING LOCATION - RFI

SB-013-05	9/5/00
pH Field	8.19

SAMPLE LOCATION
SAMPLE DATE
RESULT
PARAMETER
GSI CRITERIA (pH >9)

SCALE VERIFICATION

THIS BAR MEASURES 1" ON ORIGINAL. ADJUST SCALE ACCORDINGLY.

GENERAL MOTORS CORPORATION
SAGINAW METAL CASTING OPERATIONS

SAGINAW, MICHIGAN

INVESTIGATIVE UNIT I
RESULTS OF SOIL LEACHATE STUDY

CONESTOGA-ROVERS & ASSOCIATES

Source References:
MICHIGAN STATE PLANE SOUTH, NAD 83 USING INTERNATIONAL FEET, NGVD 88
TOPO - SANBORN, 1996

Project Manager:	Reviewed By:	Date:	
I.R.	M.T.	FEBRUARY 2009	
Scale: 1" = 120'	Project N°: 017075-30	Report N°: 031	Drawing N°: 2.1

017075-30(031)GN-WA003 FEB 26/2009

FORMER NODULAR IRON QUENCH SLAG STAGING AREA

SB-007-05	1/13/05 0-2 ft BGS	1/13/05 2-4 ft BGS
pH Field	9.23	8.42

SB-011-05	1/13/05 0-2 ft BGS	1/14/05 1-3 ft BGS	1/13/05 2-4 ft BGS
pH (lab)	-	11.57	-
pH Field	10.51	-	11.21

SB-002-05	1/12/05 0-2 ft BGS	1/14/05 1-3 ft BGS	1/12/05 2-4 ft BGS
pH (lab)	-	11.76	-
pH Field	11.51	-	11.66

SB-008-05	1/13/05 0-2 ft BGS	1/14/05 1-3 ft BGS	1/13/05 2-4 ft BGS
pH (lab)	-	8.87	-
pH Field	8.58	-	8.35

SB-013-05	1/13/05 0-2 ft BGS	1/14/05 1-3 ft BGS	1/13/05 2-4 ft BGS
pH (lab)	-	8.57	-
pH Field	9.57	-	8.83

SB-015-05	1/14/05 0-2 ft BGS	1/14/05 2-4 ft BGS
pH Field	8.44	8.06

SB-014-05	1/14/05 0-1 ft BGS	1/14/05 1-3 ft BGS
pH (lab)	-	9.03
pH Field	9.05	9.52

SB-009-05	1/13/05 0-2 ft BGS	1/13/05 2-4 ft BGS
pH Field	8.56	7.97

SB-016-05	1/14/05 0-2 ft BGS	1/14/05 2-4 ft BGS
pH Field	7.71	7.68

SB-004-05	1/12/05 0-1 ft BGS	1/12/05 1-3 ft BGS	1/14/05 1-3 ft BGS
pH (lab)	-	-	8.21
pH Field	8.87	9.11	-

SB-005-05	1/12/05 0-2 ft BGS	1/14/05 1-3 ft BGS	1/12/05 2-4 ft BGS
pH (lab)	-	9.94	-
pH Field	8.81	-	9.44

SB-001-05	1/12/05 0-2 ft BGS	1/14/05 1-3 ft BGS	1/12/05 2-4 ft BGS
pH (lab)	-	11.84/11.74	-
pH Field	11.7	-	11.42

SB-010-05	1/13/05 0-2 ft BGS	1/13/05 2-4 ft BGS
pH Field	8.64	9.18

SB-006-05	1/13/05 0-2 ft BGS	1/14/05 1-3 ft BGS	1/13/05 2-4 ft BGS
pH (lab)	-	8.82	-
pH Field	9.01	-	8.49

SB-007-05 SB-011-05 SB-002-05 SB-013-05 SB-015-05 SB-008-05 SB-010-05 SB-001-05 SB-014-05 SB-009-05 SB-004-05 SB-005-05 SB-016-05 SB-006-05

0 40 120ft

LEGEND

- INVESTIGATIVE UNIT BOUNDARY AND IDENTIFIER
- SOIL BORING LOCATION - RFI
- SOIL SURFACE TREATMENT AREA
- PROPOSED TEMPORARY MONITORING WELL LOCATIONS

SB-013-05	9/5/00	SAMPLE LOCATION / SAMPLE DATE
pH Field	8.19	RESULT

PARAMETER

GSI CRITERIA (pH >9)

SCALE VERIFICATION

THIS BAR MEASURES 1" ON ORIGINAL. ADJUST SCALE ACCORDINGLY.

GENERAL MOTORS CORPORATION
SAGINAW METAL CASTING OPERATIONS

SAGINAW, MICHIGAN

INVESTIGATIVE UNIT I
PROPOSED IN-SITU TREATMENT AREA

CONESTOGA-ROVERS & ASSOCIATES

Source References:
MICHIGAN STATE PLANE SOUTH, NAD 83 USING INTERNATIONAL FEET, NGVD 88
TOPO - SANBORN, 1996

Project Manager:	Reviewed By:	Date:	
I.R.	M.T.	FEBRUARY 2009	
Scale: 1" = 120'	Project N°: 017075-30	Report N°: 031	Drawing N°: 3.1

017075-30(031)GN-WA004 FEB 26/2009

APPENDIX A

LABORATORY TREATABILITY STUDY

CONESTOGA-ROVERS & ASSOCIATES

2055 Niagara Falls Blvd., Suite #3
Niagara Falls, New York 14304
Telephone: (716) 297-6150 Fax: (716) 297-2265
www.CRAworld.com

DRAFT MEMORANDUM

TO:	Cheryl Hiatt	REF. NO.:	017075
FROM:	Michael Tomka/Alan Weston/Sophia Dore/adh/3	DATE:	January 2, 2008
C.C.:	John-Eric Pardys		
RE:	**Treatment Options for High pH Soil, SMCO, Saginaw, Michigan**		

1.0 INTRODUCTION

An area of high pH soil exists at the GM SMCO Facility in Saginaw, Michigan (Site). The area is approximately 3.4 acres and the pH of the vadose zone soil ranges from 9 to as high as 11.84. The high pH soil extends approximately 4 feet below ground surface (bgs) where the water table is encountered. The area is the former quench slag staging area in IU I. This area is believed to be acting as a source for observed elevated pH in groundwater.

A laboratory treatability study was performed on soil from this area to determine the amount of hydrochloric acid (HCl), ferrous sulfate ($FeSO_4$), or gypsum that would be required to adjust the pH of water leaching through this soil to below 9. The study found that 0.4 gram (g) HCl per kilogram (kg) of soil was required to adjust the pH of the soil to below pH 9; 1 g of $FeSO_4$ per kg of soil was required to adjust the pH of the leachate from the soil to below pH 9; and gypsum was not a viable option for treatment of the high pH soil. Various options exist for applying HCl or $FeSO_4$ to the high pH soil.

This memorandum contains the results of this treatability study as well as available application methods.

2.0 TREATABILITY STUDY OBJECTIVES

The primary objective of this laboratory study was to gather the data necessary to determine the dose of HCl, ferrous sulfate, or gypsum required to reduce the pH of water leaching through this soil to below 9 for the area.

3.0 BENCH SCALE TREATABILITY STUDY

3.1 TASK 1. INITIAL CHARACTERIZATION

A soil sample was received from the Site at Conestoga-Rovers & Associates' (CRA's) Treatability Study Laboratory, Niagara Falls, New York on September 7, 2007. The sample was visually examined and the pH of the sample was analyzed. Fifty (50) grams (g) of soil was placed in a beaker. Seventy (70) milliliters (mL)

of distilled water were added to the beaker in order to measure the initial pH. The initial pH of the soil was 10.7 standard unit (s.u.).

3.2 TASK 2. pH ADJUSTMENT TESTS

A series of titration tests were conducted in order to determine how much HCl, ferrous sulfate, or gypsum was required to adjust the pH of the soil to below pH 9. Fifty (50) g of soil was placed in a beaker. Seventy (70) mL of distilled water was added to the beaker. Then 1 mL of 0.1 N HCl, 1 mL of 1 percent ferrous sulfate solution, or 1 g gypsum powder was added, and the pH was recorded after each adjustment. Additional 1-mL or 1-g increments were added until the target pH of 9 was achieved.

The results of these tests indicated that 5.5 mL of 0.1 N HCl were required to adjust the pH of 50 g of soil from pH 10.7 to pH 8.94. This dose is equivalent to 0.4 g of HCl per kilogram (kg) of soil or 3,010 kg of HCl for the high pH soil (3.4 acres by 4 feet deep)

Five (5) mL of 1 percent $FeSO_4$ were required to adjust the pH of 50 g of soil from 10.57 to 8.97. This dose is equivalent to 1 g of $FeSO_4$ per kg of soil or 7,524 kg of $FeSO_4$ for the high pH soil (3.4 acres by 4 feet deep).

It was not possible to adjust the pH of the soil to below pH 9 using gypsum. Gypsum is soluble in water at 2 g per liter. In order for the gypsum to change the pH of the soil, it must be dissolved in water. 4.2 g of gypsum were added to 50 g of soil along with over 2 liters of water, and the pH had dropped from 10.7 to 9.42. Therefore, adjusting the pH of the soil to below 9 would require a dose of gypsum in excess of 85 g per kg soil and the addition of approximately 60 liters of water per kg of soil or 639,553 kg of gypsum and 451 million liters of water for the high pH soil (3.4 acres by 4 feet deep).

3.3 SUMMARY OF TREATABILITY STUDY RESULTS

	Hydrochloric Acid (HCL)	*Ferrous Sulfate ($FeSO_4$)*	*Gypsum*
Amount of product required to bring pH to below 9 (per kg of soil)	0.4 g	1.0 g	>85 g
Total amount of product required assuming an area of 3.4 acres by 4 feet deep	3,010 kg	7,524 kg	639,553 kg with 451 million L of water
Technically feasible	yes	yes	no

4.0 OPTIONS FOR HCL OR $FeSO_4$ APPLICATION

Option 1. Ex Situ Treatment

The impacted soil, approximately 148,000 cubic feet, would be excavated and treated in batches in a large tank. In the tank, the soil would be mixed with HCl or $FeSO_4$. The treated soil would then be returned to the Site. The dose of HCl required would be 0.04 pound per cubic foot of soil. The dose of $FeSO_4$ required would be 0.11 pound per cubic foot of soil. In order to disperse the low pH reagents adequately in the soil, the HCl or $FeSO_4$ would be diluted so that 1.7 gallons of liquid is added per cubic foot of soil. The resulting concentrations would be 0.28 percent HCl or 0.78 percent $FeSO_4$.

Option 2. In Situ Injection

The impacted soil would be injected in situ with 0.04 pound per cubic foot of soil HCl or 0.11 pound per cubic foot of soil $FeSO_4$ applied as 1.7 gallons of 0.28 percent HCl or 0.78 percent $FeSO_4$ per cubic foot of soil. The total volume of acid required for the Site would be 251,600 gallons. Fifty-two (52) injection wells would be used to inject 4,838 gallons of acid per well. The injections would be performed under pressure. A downgradient recovery well would be installed prior to the injections, and groundwater would be pumped from the recovery well during treatment and for 3 months after the treatment was performed to control the release of high or low pH leachate to groundwater.

Option 3. In Situ Soil Mixing

The impacted soil would be mixed in situ with 0.04 pound per cubic foot of soil HCl or 0.11 pound per cubic foot of soil $FeSO_4$ applied as 1.7 gallons of 0.28 percent HCl or 0.78 percent $FeSO_4$ per cubic foot of soil. The total volume of acid required for the Site would be 251,600 gallons. The mixing of the soil would be performed using large-scale vertical auger soil mixing equipment. The high pH soil area would be divided into sections depending on the mixing radius of the auger selected. The acid would be sprayed onto the surface of the soil, and the auger would be used to mix the acid into the 4-foot soil depth. A downgradient recovery well would be installed prior to the application of the acid, and groundwater would be pumped from the recovery well during treatment and for 3 months after the treatment was performed to control the release of high or low pH leachate to groundwater.

Option 4. On-Site Treatment

The impacted soil would be excavated and treated in batches on Site. Each batch would be approximately 500 cubic yards. The 500 cubic yards of soil would be spread in a layer 1,500 square yards in area and 1-foot thick. The treatment area should have a low permeability or a compacted clay layer or synthetic liner would be installed, if needed, to prevent any leachate from reaching subsurface soil and groundwater. The dose of reagent should be sprayed evenly onto the soil layer. As before, a dose of 0.04 pound per cubic foot of soil HCl or 0.11 pound per cubic foot of soil $FeSO_4$ applied as 1.7 gallons of 0.28 percent HCl or 0.78 percent $FeSO_4$ per cubic foot of soil. For each 500 cubic yard layer, 22,950 gallons of acid would be sprayed. Another layer of soil would then be spread on the top of the first soil layer, followed by reagent application. A third layer would then be added and treated with the reagent. The three batches of soil would then be mixed by a front loader or other earth moving equipment such as a pile turner, tested to ensure correct pH and stockpiled. The above approach can be similarly applied for the remaining soil. Eleven (11) batches of 500 cubic yards would need to be treated. At the end of the treatment, all the stockpiles can be transported and used for backfilling or returned to their original location.

Option 5. In-Situ Soil Surface Treatment with $FeSO_4$

The surface of the impacted soil would be sprayed with a $FeSO_4$ solution. 7,524 kg (16,590 pounds) of $FeSO_4$ would be dissolved in 11,000 gallons of groundwater to produce an 18 percent $FeSO_4$ solution. A further 11,000 gallons of clean water would then be sprayed on the soil to flush the $FeSO_4$ solution into the soil. This volume of water would not be enough to permeate the 4-foot thickness of the high pH soil. However, it would produce a zone of low pH near the surface of the soil, and over time, precipitation should cause leaching of low pH water through the high pH soil zone and, in time, the entire thickness will

be treated. If preferential flow paths reduce dispersion, a second application of $FeSO_4$ solution may be required in some areas.

5.0 RECOMMENDATION

Option 1, the ex situ treatment using a treatment tank is the most labor intensive option. This process would require numerous batches, which would each involve placing the soil in the tank, removing the treated soil from the tank, and storing it. Therefore, this option is not recommended for further consideration.

The efficiency of the in situ options, Options 2 and 3, would depend on the hydrology of the Site, including the ease of installation and operation of the recovery well and how effectively the recovery well would control releases to groundwater. If groundwater control could not be accomplished in a cost-effective manner, then these options would not be viable for treatment. Option 3 would be preferred to Option 2, because the mixing would be better.

Option 4, the on-Site mixing option, would be a viable option if an area of low permeability exists where the treatment could be performed.

Option 5, the in situ surface treatment of the soil with $FeSO_4$ solution, is the most preferred option. It would not treat the high pH soil immediately, but over time, it should treat the soil. It is estimated that since the average rainfall in the area is 30 to 35 inches per year, the $FeSO_4$ will percolate through the 4-foot depth interval in less than 6 months.