February 2006

Alternatives Analysis Report

Environmental Restoration Project Clean Water/Clean Air Bond Act of 1996

South Troy Industrial Park
East Industrial Park Road
City of Troy
Rensselaer County, New York

Prepared for:

RENSSELAER COUNTY
INDUSTRIAL DEVELOPMENT AGENCY
1600 7TH Avenue
P.O. Box 5105
Troy, New York 12180

Prepared by:

C.T. MALE ASSOCIATES, P.C.
50 Century Hill Drive
P.O. Box 727
Latham, New York 12110
518.786.7400
FAX 518.786.7299
C.T. Male Project No.: 04.9138

ENVIRONMENTAL RESTORATION PROJECT
ALTERNATIVES ANALYSIS REPORT
SOUTH TROY INDUSTRIAL PARK
CITY OF TROY, NEW YORK

TABLE OF CONTENTS

ENVIRONMENTAL RESTORATION PROJECT
ALTERNATIVES ANALYSIS REPORT
SOUTH TROY INDUSTRIAL PARK
CITY OF TROY, NEW YORK

TABLE OF CONTENTS

ENVIRONMENTAL RESTORATION PROJECT
ALTERNATIVES ANALYSIS REPORT
SOUTH TROY INDUSTRIAL PARK
CITY OF TROY, NEW YORK

TABLE OF CONTENTS

FIGURES

TABLES

1.0 INTRODUCTION

1.1 Purpose and Organization

The intent of this Alternatives Analysis Report (AAR) is to present site specific remediation alternatives based on the findings and conclusions of the Remedial Investigation (RI) Report for the South Troy Industrial Park (STIP) Environmental Restoration Project (ERP) prepared by C.T. Male Associates, P.C., dated December 2005. The overall goal of the AAR is to develop and evaluate feasible remedial action(s) to either achieve compliance with established regulatory clean up guidance levels and/or to protect human health and the environment from contaminated media present at the subject site. The AAR is the technical support document for the NYSDEC's Proposed Remedial Action Plan (PRAP), which solicits public comments on the proposed remedy. The AAR and PRAP will be placed in the document repositories to allow a 45-day public comment period. Any public comments on the PRAP will be addressed by the NYSDEC in a Responsiveness Summary prior to the NYSDEC issuing a Record of Decision (ROD).

This AAR is organized and prepared in accordance with the New York State Department of Environmental Conservation (NYSDEC) DRAFT DER-10 Technical Guidance for Site Investigation and Remediation, issued December 25, 2002. The AAR consists of three (3) main sections. Section 1 is an introduction which presents the purpose of the project and background information including a site description, site history, nature and extent of site contamination, and contaminant fate and transport. Human and ecological exposure pathways are also discussed in this section. Section 2 identifies remedial alternatives available for addressing the on-site contamination and their objectives. Section 3 presents an individual and comparative analysis of each of the alternatives discussed within the report.

1.2 Project Background

The Rensselaer County Industrial Development Agency (RCIDA) submitted an application to the New York State Department of Environmental Conservation (DEC) for participation in the NYS Environmental Restoration Program (ERP) for lands owned by the RCIDA within the South Troy Industrial Park located in the vicinity of Main

Street and East Industrial Parkway in the City of Troy, Rensselaer County, New York (herein "the Site"). A Site Location Map is presented as Figure 1. NYSDEC subsequently notified the RCIDA of its eligibility to participate in the ERP and the RCIDA executed a State Assistance Contract (SAC) which required the submission, review, approval and implementation of investigative work plans under the ERP.

The ERP investigation generally involved the collection and analysis of surface soil samples; conducting exploratory test trenches, test pits and soil borings; collection and analysis of subsurface samples from the test trenches, pits and borings; installation of groundwater monitoring wells; collection and analysis of groundwater samples from the newly installed monitoring wells and select existing monitoring wells; completion of a Ground Penetrating Radar (GPR) survey on select portions of the site; review of analytical data for samples of slag and a fine light gray material collected by others from "Slag Mountain"; review and interpretation of environmental investigations completed by others of the project site and select properties adjoining the site; and completion of a Fish and Wildlife Impact Analysis.

Additional tasks that were performed as a result of discoveries made during the site investigation included a NYSDEC approved Interim Remedial Measure (IRM) to remediate buried drums and a storage tank on the northeastern portion of Parcel 1; and supplemental investigations of the site to aid in determining the nature and extent of contamination affiliated with the IRM and to further investigate impacted soils and groundwater which were discovered beneath Parcel 2 during the site investigation.

Results of the site investigation were incorporated within a Remedial Investigation/Alternatives Analysis Report (RI/AAR). The RI/AAR described the investigations conducted at the site for defining the nature and extent of contamination in surface soil, subsurface soil and groundwater. From this data decisions regarding the need for remedial actions were made and remedial options were evaluated based in part on the intended use of the Site, thus constituting the AAR. The target goals of the RI/AAR was to identify contaminants of concern, define the horizontal and vertical extent of such contamination, and to produce data of sufficient quantity and quality to support the development and analyses of remedial alternatives to aid in the development of an acceptable Remedial Action Work Plan (RAWP).

1.2.1 Site Description

The Site is located within the South Troy Industrial Park and consists of three separate parcels (denoted as Parcels 1 through 3) of vacant land located within an approximate 800-foot radius of one another.

Parcel 1 is approximately 16.955 acres in size and is located along the east and west sides of East Industrial Boulevard. The Parcel is undeveloped and littered at its surface by disposed mounds of concrete, asphalt and slag materials. The majority of the disposed slag materials originated from past excavation of a retention pond at the New Penn trucking facility, which adjoins the Parcel. The northwestern corner of the Parcel consists of "Slag Mountain", portions of which have been mined over the years for use in part as a sub base material for roads and sidewalks throughout the City of Troy. Land usage adjoining Parcel 1 includes the New Penn trucking facility, the Rensselaer County Jail; Capital Launderers, Troy Slag Products, City of Troy Public School #12, residential dwellings, the Hudson River and the New York Central Railroad tracks.

Parcel 2 is approximately 3.326 acres in size and is located along the south side of Main Street. An extension of East Industrial Parkway bisects the Parcel from north to south. The Parcel is undeveloped. Land usage adjoining Parcel-2 includes the Rensselaer County Jail, Callanan Industries, King Service (the "Alamo") which is currently being utilized as a transfer station, and the City of Troy Department of Public Works.

Parcel-3 is approximately 0.199 acres in size and consists of a narrow strip of land accessed along the north side of Main Street. Land usage surrounding Parcel-3 includes the historic Burden Iron Works office building, the City of Troy Department of Public Works, a railroad right-of-way currently leased to New York Central Railroad, King Service (the Alamo), and residential housing.

1.2.2 Site History

The Site was reportedly utilized as farmland until 1862, with west portions of the property lying at low elevations, thus constituting a flood plain to the Hudson River. In 1862, the tract of land was purchased by Henry Burden and over the following few decades converted into what was referred to as the Lower Works of the Burden Iron Works. Main manufacturing activities of the Iron Works took place within structures located south of the subject site. The Site was used in part for the disposal of manufacturing by-products such as slag, cinder and ash. Additionally, building rubble from structure fires and demolition activities were historically disposed of on the Site by the City of Troy. These materials were disposed in low lying areas of the Site to raise the Site's elevation above the Hudson River. Fill material on the Site ranges in depth from approximately six (6) to 32-feet, with Slag Mountain occupying northwest portions of the Site.

Burden Iron Works manufactured horseshoes, rivets, nails and other iron products up until about 1925, when, due to a decline in the steel industry, the company redirected its efforts to the manufacture of coke, gas and pig iron. This operation was unsuccessful, and Burden Iron Works was liquidated in 1940. During conversion of manufacturing activities in 1925, the Republic Steel Corporation began operation of the Burden Iron Works blast furnaces. The Republic Steel Company eventually acquired the entirety of the Burden Iron Works upon its liquidation in 1940, and maintained a steel manufacturing facility up until 1972. Since 1972, the Site has remained undeveloped and presently forms a part of the South Troy Industrial Park.

1.2.3 Potential Historical Contaminants of Concern

Previous investigations of the slag at the site indicate that it is not a defined hazardous waste on the basis of toxicity; however, it does have the potential to possess metals at concentration greater than regulatory guidance levels. Cinders and ash which co-mingle with the site slag and are present at grade and depth within portions of the site suggest semi-volatile organic compounds and metals are potential contaminants of concern. The existence of a former petroleum above ground storage tank within the off-site parcel referred to as the "Alamo" suggest the potential presence of petroleum products such that volatile and semi-volatile organics are potential contaminants of concern.

Pesticides, herbicides and polychlorinated biphenyls (PCBs) have no history of use or occurrence at the site such that they are not considered to be contaminants of concern.

1.2.4 Summary of the Remedial Investigation

The goal of the remedial investigation of the site was to identify and assess potential sources of contamination, and to develop a comprehensive strategy to remediate the identified contamination, as necessary to protect the environment and human health. A report entitled "Remedial Investigation/Alternatives Analysis Report, South Troy Industrial Park, East Industrial Park Road, City of Troy, New York"; dated December 2005 details all of the investigative activities which were completed and is available for review within the document repositories. The following tasks were completed as part of the RI/AAR for the site:

- Site Survey;
- Ground Penetrating Radar Survey;
- Surface Soil Sampling (inclusive of collection of background samples);
- Test Trenching and Test Pitting;
- Test Boring and Monitoring Well Installations;
- Groundwater Sampling;
- Slag Sampling;
- Effect of Tidal Influences on Groundwater Levels;
- Survey of Private and Public Wells;
- Community Dust Monitoring;
- Fish and Wildlife Impact Analysis;
- Review of Historical and Supplementary Investigations of the Site by Others; and
- Data Usability Summary Report (DUSR).

In addition to the investigative steps listed above, the following tasks were performed as a direct result of findings discovered during the course of the RI.

- Interim Remedial Measure (IRM) to address the discovery by others of buried vessels within the northeastern portion of Parcel 1 of the Site.

- Supplemental investigations (soil borings and monitoring wells) to further define impacted areas affected by the IRM and to determine the source of contaminated soils and groundwater discovered on Parcel 2 during the course of the RI.

1.3 Nature and Extent of Contamination

1.3.1 General

Sampling and analysis of several media types was conducted during the RI to determine the nature and extent of contamination at the subject site. These media types included surface soils, subsurface soils and groundwater. As discussed in previous sections of this report, the site constitutes three separate parcels depicted as Parcels 1 through 3. To aid in the development of remedial alternatives for the site, each parcel will be referenced as an Area of Concern (AOC) with the following identifying nomenclature. The subdivision of the project site into AOCs is depicted on Figure 2:

- Parcel 1 = AOC 1
- Parcel 2 = AOC 2
- Parcel 3 = AOC 3

Table 1.5.1-1 lists the frequencies (i.e., 9 of 21 sampling locations) for the contaminants of concern (COCs) in each media type and AOC. The table presents compounds and analytes that were detected at concentrations which exceeded the project Standards, Criteria and Guidance Values (SCGs) which included NYSDEC TAGM 4046 guidelines for soils and NYSDEC Division of Water Technical and Operational Guidance Series (TOGS) for groundwater. Compounds and analytes detected at concentrations which exceeded the laboratory detection limit but at concentrations below SCGs are not included on the table.

As depicted on the table, the following COCs are associated with each of the AOCs.

AOC 1

- Several SVOCs and metals were detected at varying frequencies above their respective SCGs in all surface soil sampling locations on AOC 1. Based on the foregoing, it can be concluded that surface soils throughout AOC 1 are impacted

TABLE 1.5-1: Contaminants of Concern
South Troy Industrial Park
C.T. Male Project No. 04.9138

Media	Class	Contaminant of Concern	Frequency of Exceeding SCGs (Project Site)	Frequency of Exceeding SCGs (AOC 1)	Frequency of Exceeding SCGs (AOC 2)	Frequency of Exceeding SCGs (AOC 3)
Surface Soils (mg/kg)	SVOCs	Benzo(a)anthracene	9 of 21	6 of 16	3 of 4	1 of 1
		Chrysene	11 of 21	7 of 16	3 of 4	1 of 1
		Benzo(b)fluoranthene	6 of 21	3 of 16	2 of 4	1 of 1
		Benzo(k)fluoranthene	6 of 21	3 of 16	3 of 4	0 of 1
		Benzo(a)pyrene	14 of 21	9 of 16	4 of 4	1 of 1
		Dibenz(a,h)anthracene	8 of 21	5 of 16	3 of 4	0 of 1
	Metals	Arsenic	17 of 21	12 of 16	4 of 4	1 of 1
		Barium	4 of 21	4 of 16	0 of 4	0 of 1
		Beryllium	21 of 21	16 of 16	4 of 4	1 of 1
		Cadmium	1 of 21	1 of 16	0 of 4	0 of 1
		Calcium	10 of 21	10 of 16	0 of 4	0 of 1
		Chromium	2 of 21	2 of 16	0 of 4	0 of 1
		Copper	14 of 21	11 of 16	2 of 4	1 of 1
		Iron	21 of 21	16 of 16	4 of 4	1 of 1
		Magnesium	13 of 21	12 of 16	1 of 4	0 of 1
		Manganese	1 of 21	1 of 16	0 of 4	0 of 1
		Mercury	6 of 21	3 of 16	2 of 4	0 of 1
		Nickel	14 of 21	11 of 16	3 of 4	0 of 1
		Selenium	14 of 21	13 of 16	1 of 4	0 of 1
		Zinc	21 of 21	16 of 16	4 of 4	1 of 1
Subsurface Soils (Trenches/Pits) (mg/kg)	VOCs	Acetone	1 of 47	1 of 39	0 of 8	NA
	SVOCs	Benzo(a)anthracene	14 of 47	13 of 39	1 of 8	NA
		Chrysene	7 of 47	6 of 39	1 of 8	NA
		Benzo(b)fluoranthene	2 of 47	1 of 39	1 of 8	NA
		Benzo(a)pyrene	20 of 47	19 of 39	1 of 8	NA
		Dibenz(a,h)anthracene	6 of 47	5 of 39	1 of 8	NA
	Metals	Aluminum	2 of 47	2 of 39	0 of 8	NA
		Arsenic	22 of 47	19 of 39	3 of 8	NA
		Barium	2 of 47	2 of 39	0 of 8	NA
		Beryllium	46 of 47	38 of 39	8 of 8	NA
		Calcium	11 of 47	11 of 39	0 of 8	NA
		Chromium	1 of 47	1 of 39	0 of 8	NA
		Copper	16 of 47	12 of 39	4 of 8	NA
		Iron	47 of 47	39 of 39	8 of 8	NA
		Magnesium	10 of 47	9 of 39	1 of 8	NA
		Manganese	3 of 47	3 of 39	0 of 8	NA
		Mercury	11 of 47	11 of 39	0 of 8	NA

TABLE 1.5-1: Contaminants of Concern
South Troy Industrial Park
C.T. Male Project No. 04.9138

Media	Class	Contaminant of Concern	Frequency of Exceeding SCGs (Project Site)	Frequency of Exceeding SCGs (AOC 1)	Frequency of Exceeding SCGs (AOC 2)	Frequency of Exceeding SCGs (AOC 3)
Subsurface Soils (Trenches/Pits) (mg/kg)		Nickel	30 of 47	24 of 39	6 of 8	NA
		Selenium	21 of 47	18 of 39	3 of 8	NA
		Sodium	2 of 47	2 of 39	0 of 8	NA
		Zinc	45 of 47	38 of 39	7 of 8	NA
Subsurface Soils (Soil Borings) (mg/kg)	SVOCs	Benzo(a)anthracene	1 of 31	0 of 14	1 of 16	0 of 1
		Chrysene	1 of 31	0 of 14	1 of 16	0 of 1
		Benzo(a)pyrene	4 of 31	3 of 14	1 of 16	0 of 1
	Metals	Arsenic	4 of 11	1 of 7	2 of 3	1 of 1
		Beryllium	11 of 11	7 of 7	3 of 3	1 of 1
		Calcium	4 of 11	3 of 7	1 of 3	0 of 1
		Copper	5 of 11	3 of 7	1 of 3	1 of 1
		Iron	11 of 11	7 of 7	3 of 3	1 of 1
		Magnesium	3 of 11	3 of 7	0 of 3	0 of 1
		Nickel	8 of 11	5 of 7	2 of 3	1 of 1
		Selenium	3 of 11	2 of 7	0 of 3	1 of 1
		Zinc	10 of 11	7 of 7	2 of 3	1 of 1
Groundwater (ug/l)	VOCs	Acetone	1 of 26	1 of 12	0 of 13	0 of 1
		Methylene Chloride	1 of 26	0 of 12	1 of 13	0 of 1
		MTBE	1 of 26	1 of 12	0 of 13	0 of 1
		Benzene	5 of 26	4 of 12	1 of 13	0 of 1
		Toluene	1 of 26	1 of 12	0 of 13	0 of 1
		Ethyl Benzene	3 of 26	2 of 12	1 of 13	0 of 1
		m/p Xylenes	1 of 26	1 of 12	0 of 13	0 of 1
		o-Xylene	2 of 26	2 of 12	0 of 13	0 of 1
		Styrene	1 of 26	1 of 12	0 of 13	0 of 1
		Isopropylbenzene	2 of 26	2 of 12	0 of 13	0 of 1
	SVOCs	Naphthalene	1 of 26	1 of 12	0 of 13	0 of 1
	Metals	Cobalt	1 of 13	1 of 8	0 of 4	0 of 1
		Iron	10 of 13	6 of 8	3 of 4	1 of 1
		Manganese	10 of 13	5 of 8	4 of 4	1 of 1
		Selenium	3 of 13	3 of 8	0 of 4	0 of 1
		Sodium	8 of 13	3 of 8	4 of 4	1 of 1

with SVOCs and metals at concentrations exceeding SCGs. Additionally, impacted soils and groundwater are associated with the buried vessels and associated liquids that were removed from the northeastern portion of AOC 1.

- One VOC and several SVOCs and metals were detected at varying frequencies above their respective SCGs from all subsurface soil/fill sampling locations on AOC 1. The contaminants were detected in both native soils and overlying fill material, indicating that fill material and native soils beneath AOC 1 are impacted by these constituents.

- One (1) SVOC and several VOCs and metals were detected at varying frequencies above their respective SCGs in groundwater sampled on AOC 1. The VOCs and SVOC in groundwater are associated with the buried vessels and associated liquids that were removed from the northeastern portion of Parcel 1.

AOC 2

- Several SVOCs and metals were detected at varying frequencies above their respective SCGs in surface soil sampling locations on AOC 2. Based on the foregoing, it can be concluded that surface soils throughout AOC 2 are impacted with SVOCs and metals at concentrations exceeding SCGs.

- Several SVOCs and metals were detected at varying frequencies above their respective SCGs in subsurface soil/fill sampled from test pits and soil borings on AOC 2. The contaminants were detected in both native soils and overlying fill material, indicating that both fill material and native soils beneath AOC 2 are impacted by SVOCs and metals.

- Several VOCs and metals were detected at varying frequencies above their respective SCGs from groundwater sampled on AOC 2.

AOC 3

- Several SVOCs and metals were detected above their SCGs in the sole surface soil sampling location on AOC 3.

- Several metals were detected above their SCGs in native soils sampled through the advancement of one soil boring on AOC 3.

- Several metals were detected above their SCGs in groundwater sampled from one monitoring well installed on AOC 3.

1.3.2 Contaminant Fate and Transport

The site contaminants are predominantly metals and SVOCs in surface and subsurface soils and VOCs and metals in groundwater. One VOC (acetone) was detected at one sampling location within subsurface soils and one location in groundwater within AOC 1, and one SVOC (naphthalene) was detected in groundwater at one sampling location within AOC 1, only.

SVOCs and metals detected above SCGs in surface soil and subsurface soil and fill material will tend to adhere to surrounding soil and fill particles and not migrate into underlying groundwater. This is exemplified by the presence of only four (4) of the 14 metals and none of the SVOCs identified in the surface soil and subsurface soil/fill sampling results within the sampled groundwater. Surface soil and subsurface soil/fill metals are not anticipated to volatilize to the open atmosphere. SVOCs in surface soils and subsurface soil/fill may volatilize to the atmosphere should the soils/fill be disturbed.

The VOCs and one SVOC within groundwater exist in a dissolved phase and therefore migrate in concert with groundwater towards the Hudson River. Based on the low overall concentrations of VOCs and SVOCs in groundwater, the compounds are likely to degrade in concentration through dispersion and natural attenuation and are not likely to reach the Hudson River at concentrations above SCGs.

Metals in groundwater (those which are of low solubility) tend to adhere to surrounding soil and fill particles and are not mobil within the groundwater. Because the metals are inorganic (non-volatile), they will not volatilize into the vadose zone.

The transport mechanisms for the contaminants within the site are migration within the groundwater and/or volatilization into the atmosphere. The petroleum fuel related compounds tend to occur and migrate within the upper portions of the aquifer due to their densities being less than 1. The semi-VOC will tend to sink to the bottom of the aquifer to a less permeable soil type and migrate in the direction of groundwater flow and/or the surface of the less permeable unit. Most metals are strongly held, reducing their migration and extent of contamination. VOC and SVOC contaminants within the groundwater and vadose zone will volatilize into the unsaturated soils and fill above the water table, and eventually will diffuse into the atmosphere.

1.4 Human Exposure Pathways

Exposure pathways are means by which contaminants move through the environment from a source to a point of contact with humans. A complete exposure pathway must have five (5) parts: 1) a source of contamination; 2) a mechanism for transport of a substance from the source to the air, surface water, groundwater and/or soil; 3) a point where people come in contact with contaminated air, surface water, groundwater or soil (point of exposure); 4) a route of entry (exposure) into the body; and 5) a receptor population. Routes of entry include ingesting contaminated materials, breathing contaminated air, or absorbing contaminants through the skin. If any part of an exposure pathway is absent, the pathway is said to be incomplete and no exposure or risk is possible. In some cases, although a pathway is complete, the likelihood that significant exposure will occur is small.

The potential site related contaminants were identified as those contaminants detected in various media at the site above SCGs. The potential site related contaminants that have been identified in various media at the site are presented in Table 1.6-1.

TABLE 1.6-1: Potential Site Related Contaminants

Compound	Surface Soil	Subsurface Soil	Groundwater
Volatile Organic Compounds:			
Acetone	No	Yes	Yes
Methylene Chloride	No	No	Yes
MTBE	No	No	Yes
Benzene	No	No	Yes
Toluene	No	No	Yes
Ethylbenzene	No	No	Yes
O-Xylene	No	No	Yes
M-Xylene	No	No	Yes
P-Xylene	No	No	Yes
Styrene	No	No	Yes
Isopropylbenzene	No	No	Yes
Semi- Volatile Organic Compounds:			
Benzo(a)anthracene	Yes	Yes	No
Benzo(a)pyrene	Yes	Yes	No
Benzo(b)fluoranthene	Yes	Yes	No

TABLE 1.6-1: Potential Site Related Contaminants			
Compound	**Surface Soil**	**Subsurface Soil**	**Groundwater**
Benzo(k)fluoranthene	Yes	No	No
Chrysene	Yes	Yes	No
Naphthalene	No	No	Yes
Dibenzo(a,h)anthracene	Yes	Yes	No
Metals:			
Aluminum	No	Yes	No
Arsenic	Yes	Yes	No
Barium	Yes	Yes	No
Beryllium	Yes	Yes	No
Cadmium	Yes	No	No
Calcium	Yes	Yes	No
Chromium	Yes	Yes	No
Cobalt	No	No	Yes
Copper	Yes	Yes	No
Iron	Yes	Yes	Yes
Magnesium	Yes	Yes	No
Manganese	Yes	Yes	Yes
Mercury	Yes	Yes	No
Nickel	Yes	Yes	No
Selenium	Yes	Yes	Yes
Sodium	No	Yes	Yes
Zinc	Yes	Yes	No

Potential exposure pathways for site contaminants are a function of the contaminant, the affected media, contaminant location and the potentially impacted population. The potential exposure routes and pathways for the site include dermal contact and/or ingestion of potentially contaminated surface and subsurface soils; inhalation of potentially contaminated dust or vapors emanating from surface soils and from subsurface soils should these soils be disturbed; and dermal contact and/or ingestion of potentially contaminated groundwater.

It is the intent of the RCIDA to prepare the site, as demonstrated by completion of the ERP, for future commercial and light industrial development. The majority of the contaminants of concern were detected in surface soil, subsurface soil and at select groundwater sampling locations. At the STIP site and its surroundings, potential impacted populations include employees and residents of nearby commercial, residential and institutional entities, site visitors, trespassers on the site, and workers that may be engaged in excavation work should the site, or portions thereof, undergo future development. The following details the site COCs per media type on a site wide basis (AOC 1 through AOC 3) and their likelihood of impacting receptor populations.

- Metals and semi-volatile organic compounds were detected in surface soil at concentrations exceeding SCGs. The concentrations of these contaminants of concern may warrant remedial action in portions of the site, as they are present within surface soil that is readily accessibly to dermal contact, ingestion or inhalation. Furthermore, disturbance of the surface soils is likely should the site undergo future development. If this is the case, development activities would potentially create airborne contaminants that may be inhaled. The potential for dermal contact (including ingestion and inhalation) with exposure to the impacted surface soil and the associated impact is, therefore, anticipated to be high.

- Metals and semi-volatile organic compounds, as well as one volatile organic compound, were detected in subsurface soil and fill materials at concentrations exceeding SCGs. The concentrations of these contaminants of concern may warrant remedial action in portions of the site that are slated for future development. Disturbance of the subsurface soils and fill materials during construction activities could potentially create airborne contaminants that may be inhaled and/or ingested. The potential for dermal contact, inhalation and ingestion of the impacted subsurface soil and fill material is, therefore, anticipated to be high.

- Metals and volatile organic compounds, as well as one semi-volatile organic compound, were detected in groundwater above SCGs. Considering that the depth to groundwater is greater than 3 feet below grade, the potential for dermal contact through exposure to groundwater and the associated impact is anticipated to be low, unless groundwater is encountered and subsequently disturbed during impending future site development. Ingestion of the contaminated groundwater is unlikely since the area surrounding the site is reportedly serviced by public water and no private water supply wells used for drinking water are known to exist.

1.5 Ecological Exposure Pathways

In general, the value of the fish and wildlife resources located within the study area is low. Industrial and residential areas have eliminated much of the natural habitat in the area and have replaced it with urban wildlife habitats consisting primarily of mowed lawns with trees, paved roads, parking lots, landfills and urban structure exteriors. Overall, the cover types in the study area have been heavily influenced by urbanization.

The value of fish and wildlife resources to humans is very limited within the study area. Access to the Hudson River is restricted by the residential and business properties and fences; there is no hunting allowed within the City of Troy. As a result, the value of these resources to humans was determined to be low.

No evidence of stress resulting from chemical residues was observed within the study area. As a result, it was determined that fish and wildlife resources within the study area are most likely not adversely affected.

2.0 DEVELOPMENT OF ALTERNATIVES

2.1 Introduction

The RI of the site included intrusive and non-intrusive investigations to determine the presence and severity of COCs within surface soils, subsurface soils and groundwater for each of the designated AOCs. The RI also included an IRM that involved the excavation and disposal of buried vessels and associated liquids from the northeastern portion of AOC 1. The results of the RI were used develop and evaluate the remedial alternatives described within this report. Because the site is sub-divided into three AOCs, the referenced COCs per media type will be designated to each of the AOCs.

Feasible remedial action(s) are identified to achieve compliance with established regulatory cleanup guidance levels and to protect human health and the environment. The remedial alternatives for each of the AOCs are developed based on published literature and current knowledge of the technologies commonly employed in similar situations and circumstances.

2.2 Remedial Action Objectives

Table 2.2-1 summarizes the COCs within each medium and AOC, and the remedial action objectives (RAOs) identified for each medium. The COCs include compounds and analytes which exceeded their respective SCGs. Affected populations described in the table include employees and residents of nearby residential, commercial and institutional entities, site visitors, trespassers on the site, and workers that may be engaged in excavation work should the site, or portions thereof, undergo future development.

Table 2.2-1: Contaminants of Concern for Site Media and Remedial Action Objectives

AOC	Media Type	COCs	Remedial Action Objectives
AOC 1 (Parcel 1)	Surface Soil	SVOCs and Metals	Prevent affected populations from direct contact and ingestion of contaminated surface soils and inhalation of vapors that may emanate from the soils should they be disturbed during future site development or from

Table 2.2-1: Contaminants of Concern for Site Media and Remedial Action Objectives			
AOC	**Media Type**	**COCs**	**Remedial Action Objectives**
			airborne particulates that may be generated through disturbance of the materials.
AOC 1 (Parcel 1)	Subsurface Soil	SVOCs, Metals and one VOC	Prevent affected populations from contact, ingestion and inhalation of vapors that may emanate from subsurface soils that may be disturbed during future site development.
	Groundwater	VOCs Metals and one SVOC	Prevent affected populations from contact and ingestion of groundwater should it be encountered during future development of the site.
AOC 2 (Parcel 2)	Surface Soil	SVOCs and Metals	Prevent affected populations from direct contact and ingestion of contaminated surface soils and inhalation of vapors that may emanate from the soils should they be disturbed during future site development or from airborne particulates that may be generated through disturbance of the materials.
	Subsurface Soil	SVOCs and Metals	Prevent affected populations from contact, ingestion and inhalation of vapors that may emanate from subsurface soils that may be disturbed during future development of the site.
	Groundwater	VOCs, Metals and one SVOC	Prevent affected populations from contact and ingestion of groundwater should it be encountered during future development of the site.
AOC 3 (Parcel 3)	Surface Soil	SVOCs and Metals	Prevent affected populations from direct contact and ingestion of contaminated surface soils and inhalation of vapors that may emanate from the soils should they be disturbed during future site development or from airborne particulates that may be generated through disturbance of the materials.

Table 2.2-1: Contaminants of Concern for Site Media and Remedial Action Objectives			
AOC	Media Type	COCs	Remedial Action Objectives
	Subsurface Soil	Metals	Prevent affected populations from contact, ingestion and inhalation of vapors that may emanate from subsurface soils that may be disturbed during future development of the site.
	Groundwater	Metals	Prevent affected populations from contact and ingestion of groundwater should it be encountered during future development of the site.

As depicted on the table, SVOCs and metals are the primary contaminants of concern in surface and subsurface soils, while VOCs and metals are the primary contaminants of concern in groundwater. The contaminants of concern were detected within the three (3) media types at varying frequencies and are segregated by AOC, as follows.

- **AOC 1:** SVOCs and metals, as well as one VOC, were detected above SCGs in surface and subsurface soils. VOCs, metals and one SVOC (naphthalene) were detected above SCGs in groundwater.
- **AOC 2:** SVOCs and metals were detected above SCGs in surface and subsurface soils. VOCs and metals were detected above SCGs in groundwater.
- **AOC 3:** Metals and SVOCs were detected above SCGs in surface soils. Metals were detected above SCGs in subsurface soils and groundwater.

The remedial action objectives are to control and possibly eliminate COCs present in the various areas and media within the site, with the ultimate goal of protecting human health and the environment.

2.3 General Response Actions

Three (3) AOCs (Parcels 1, 2 and 3) within the project site were identified as being impacted by varying concentrations of VOCs, SVOCs and metals above SCGs. As such, general response actions were developed for addressing COCs present within the AOCs through site specific remedial alternatives. The intent of the general response actions is to address contamination and mitigate the potential for exposure to the contamination and to a lesser extent potential off-site impacts from the subject site. The following provides the approximate areas to which treatment, containment, or exposure reduction technologies may be applied to each of the AOCs.

- **AOC 1:** AOC 1, including the IRM location, has an approximate area of 16.955 acres (740,302 square feet) and is underlain with fill (primarily slag) at depths that range from eight (8) to 32 feet bgs for an average thickness of 20 feet of fill material. If an assumption is made that approximately two (2) vertical feet of native soils underlying the fill material is impacted with metals and SVOCs, then the total estimated quantity of impacted surface and subsurface soils/fill on Parcel 1 is approximately 603,209 cubic yards.

  Groundwater beneath AOC 1 is impacted by nine (9) VOCs, one SVOC and five (5) metals, with the VOC impacts being confined to shallow groundwater in the immediate area of the IRM, and the metals detected at varying frequencies from all wells that were sampled as part of the RI. The top of the native silt and/or bedrock layer that underlies shallow groundwater across the AOC is approximately eight (8) to 32 feet bgs for an average depth of 20 feet. Depth to shallow groundwater levels measured on several occasions during the RI averaged from approximately four (4) to 19 feet bgs, for an average depth of 11.5 feet bgs. Subtracting the average groundwater depth from the average depth to the native silt layer yields an average groundwater column of 8.5 feet across the AOC. Multiplying the average groundwater column (8.5 feet) by the area (740,302 square feet) of AOC 1 and a soil porosity of 0.30 equates to approximately 14 million gallons of impacted groundwater.

  As discussed above, impacted soils and groundwater are present within the IRM backfilled excavation area. According to the "Summary of IRM Activities" Report (Exhibit 7 in RI/AAR) the total area excavated for removal of the buried vessels was approximately 10 feet in width by 22 feet in length (2,200 square feet), which was the measurement of polyethylene used to segregate impacted soils from non-impacted soils. Based on PID readings and organoleptic observations made during the installation of soil borings that were subsequently converted to monitoring wells within the backfilled IRM excavation (CTM-1 and CTM-1S), impacted soils are present from approximately 10 to 25 feet bgs (15 linear feet), with groundwater encountered at approximately 12.5 feet bgs and extending to the termination depth of CTM-1 at 29 feet bgs (16.5 linear feet of water column). Based on the information provided, the following volumes of impacted media can be approximated.

1) The approximate volume of impacted soils equates to the square footage of the impacted area (2,200 square feet) multiplied by the vertical footage of impacted soils (15 linear feet) for a total of 33,000 cubic feet of soils that converts to approximately 1,222 cubic yards of impacted soils.

2) The approximate volume of impacted groundwater equates to the square footage of the impacted area (2,200 square feet) multiplied by the vertical footage of the water column (16.5 linear feet) and a soil porosity of 0.30 for a total of 10,890 cubic feet of water that converts to approximately 18,500 gallons of impacted groundwater. It should be noted that benzene was detected in groundwater at concentrations slightly above SCGs at monitoring wells CTM-101 (4.0 ug/l) and CTM-105 (3.4 ug/l), which are located down gradient of the IRM area.

- **AOC 2:** AOC 2 has an approximate area of 3.326 acres (144,880 square feet) and is underlain with fill at depths that range from four (4) to 16 feet bgs for an average thickness of 10 feet of fill material. If an assumption is made that approximately two (2) vertical feet of soils underlying the fill material is impacted with metals and SVOCs, then the total estimated quantity of impacted surface and subsurface soils/fill on Parcel 2 is approximately 64,391 cubic yards.

  Underground piping that historically served as a delivery mechanism for fuel oil to the former aboveground storage tank within the "Alamo" is located beneath northern portions of AOC 2. The piping has not been found to be a contributing source to contaminants discovered in groundwater beneath the AOC during the course of the RI. As a component of the remedial alternatives of the AOC, portions of the pipe located beneath the AOC will be removed, along with any associated residual product within it. The length of piping passing beneath the AOC is approximately 170 linear feet. The approximate dimensions of a concrete pipe access pit located on northern portions of the AOC is eight (8) feet long by four (4) feet wide by four (4) feet deep. The floor of the pit is underlain with concrete. Calculations for the approximate volumes of concrete and piping to be removed are as follows.

1) 170 linear feet of concrete piping and two (2) caps to seal the two open ends of the piping exiting the AOC.

2) The total square footage of concrete within the pit equates to approximately 128 square feet.

The existing road that traverses AOC 2 will be left in place and will serve as a barrier to contact.

- **AOC 3:** AOC 3 has an approximate area of 0.199 acres (8,668 square feet) and is underlain with fill at depths that range from six (6) to eight (8) feet bgs for an average thickness of seven (7) feet of fill material. If an assumption is made that approximately two (2) vertical feet of soils underlying the fill material is impacted with metals, then the total estimated quantity of impacted surface and subsurface soils/fill beneath AOC 3 is approximately 2,889 cubic yards. Groundwater levels taken on November 21, 2005 show the depth to groundwater at AOC 3 to be approximately 22 feet bgs. As such, groundwater is not viewed as being an issue relevant to remedial alternatives for the AOC as it is located at depths that are greater than the vertical limits of the excavation.

In developing remediation goals for the subject site, the following design considerations were evaluated relative to economical and feasible solutions for addressing the site contaminants:

- It is the intent of the RCIDA and consistent with current zoning to sell the land to developers for the purpose of commercial/light industrial use. Therefore, the remedial action needs to reduce and possibly eliminate potential exposure to the COCs for workers associated with development of the site and future building occupants in a non-residential use scenario.

2.4 Development of Alternatives

The following sections present a selection of remedial alternatives that may be implemented to address the general response actions discussed in the previous section of this report. The alternatives are discussed for each AOC. Three (3) remedial alternatives have each been developed for AOC 1 and AOC 3. Two (2) remedial alternatives have been developed for AOC 2. The alternatives are summarized, as follows.

AOC 1: 1) No Action with institutional controls, 2) barrier to contact with site management plan (SMP), institutional controls and groundwater monitoring with no action relative to the IRM, and 3) barrier to contact with SMP, institutional controls, groundwater monitoring and remediation of the IRM source area either through multi-phase extraction and treatment, treatment via chemical oxidation or soil sparging with soil vapor extraction.

AOC 2: 2) No action with institutional controls, and 2) barrier to contact with SMP, institutional controls, groundwater monitoring and excavation and disposal of the former underground oil pipeline and concrete pipe trench.

AOC 3: 1) No action with institutional controls, 2) barrier to contact with SMP, institutional controls and groundwater monitoring, and 3) excavation and disposal of impacted soils and fill material and replacement with clean fill and institutional controls.

2. 4.1 Area of Concern 1

2.4.1.1 Alternative No. 1 - No Action

The No Action Alternative is evaluated as a procedural requirement and as a basis for comparison to other remedial alternatives. This alternative allows the AOC to remain in its current condition with the implementation of institutional controls. Since this alternative would leave contaminated soil and groundwater on site, institutional controls in the form of an environmental easement and groundwater use restrictions would be required to notify future owners and/or developers of the restricted use of the property.

2.4.1.2 Alternative No. 2 - Barrier to Contact with SMP, Institutional Controls and Groundwater Monitoring With No Action Relative to the IRM

Alternative No. 2 will include the following tasks:

1. Clearing and grubbing of all vegetation,
2. Grading the entirety of the AOC, including "Slag Mountain" (just the on-site portion),
3. Re-use of all leveled material and material from slag mountain not subject to off-site disposal for site re-grading,
4. Emplacement of a 12-inch soil cover as a barrier to contact for the entirety of the site, including the re-establishment of appropriate vegetative cover (i.e., landscaped grasses),
5. Implementation of a SMP that would provide specific requirements for site development, use and occupation including annual site inspections,
6. Implementation of institutional controls in the form of an environmental easement and groundwater/soil/fill restrictions to notify future owners and/or developers of the restricted use of the property,
7. Continued groundwater monitoring at select monitoring wells (i.e., down gradient wells CTM-2, CTM-10 and MW-8 (ESI), central wells CTM-13 and CTM-11, upgradient well CTM-3 and IRM vicinity wells CTM-1, CTM-1S, CTM-101, CTM-101S and CTM-105) to be conducted annually for years 1, 2 and 3 and then for year 5 and year 10. Monitoring wells not utilized for monitoring purposes will be decommissioned, and
8. No action relative to impacted soils/fill and groundwater within the IRM area.

2.4.1.3 Alternative No. 3 - Barrier to Contact with SMP, Institutional Controls, Groundwater Monitoring and Remediation of the IRM

Alternative No. 3 will include the following tasks:

1. Clearing and grubbing of all vegetation,

2. Grading the entirety of the AOC, including "Slag Mountain" (just the on-site portion),

3. Re-use of all leveled material and material from Slag Mountain not subject to off-site disposal for site re-grading,

4. Emplacement of a 12-inch soil cover as a barrier to contact for the entirety of the site, including the re-establishment of appropriate vegetative cover (i.e., landscaped grasses),

5. Implementation of a SMP that would provide specific requirements for site development, use and occupation including annual site inspections,

6. Implementation of institutional controls in the form of an environmental easement and groundwater/soil/fill restrictions to notify future owners and/or developers of the restricted use of the property,

7. Continued groundwater monitoring at select monitoring wells (i.e., down gradient wells CTM-2, CTM-10 and MW-8 (ESI), central wells CTM-13 and CTM-11, upgradient well CTM-3 and IRM vicinity wells CTM-101, CTM-101S and CTM-105) to be conducted annually for years 1, 2 and 3 and then for year 5 and year 10. Monitoring wells not utilized for monitoring purposes will be decommissioned, and

8. Remediation of the IRM excavation area through application of one (1) of the following technologies.

    a) In-situ treatment of impacted soils and groundwater in the IRM excavation area by multi-phase extraction and treatment and continued groundwater monitoring,

    b) In-situ treatment of impacted soils and groundwater in the IRM excavation area by chemical oxidation and continued groundwater monitoring, and

    c) In-situ treatment of impacted soils and groundwater in the IRM excavation area by air sparging and soil vapor extraction technologies and continued groundwater monitoring.

2.4.2 Area of Concern 2

2.4.2.1 No Action

The No Action Alternative is evaluated as a procedural requirement and as a basis for comparison to other remedial alternatives. This alternative allows the AOC to remain in its current condition with the implementation of institutional controls. Since this alternative would leave contaminated soil and groundwater on site, institutional controls in the form of an environmental easement and groundwater use restrictions would be required to notify future owners and/or developers of the restricted use of the property.

2.4.2.2 Alternative No. 2 - Barrier to Contact with SMP, Institutional Controls and Groundwater Monitoring With Removal of the Subground Piping and Pipe Pit

Alternative No. 2 will include the following tasks:

1. Clearing and grubbing of all vegetation,
2. Grading the entirety of the AOC,
3. Re-usage of all leveled material not subject to off-site disposal for site re-grading,
4. Emplacement of a 12-inch soil cover as a barrier to contact for the entirety of the site, inclusive of the re-establishment of appropriate vegetative cover (i.e., landscaped grasses). The existing road that traverses AOC 2 currently provides an adequate barrier to contact,
5. Implementation of a SMP that would provide specific requirements for site development, use and occupation including annual site inspections,
6. Implementation of institutional controls in the form of an environmental easement and groundwater/soil/fill restrictions to notify future owners and/or developers of the restricted use of the property,
7. Continued groundwater monitoring at select monitoring wells to include all existing shallow wells (i.e., CTM-9, CTM-203, CTM-208, CTM-212, CTM-213, CTM-214, CTM-215, and CTM-216 to be conducted annually for years 1, 2 and 3 and then for year 5 and year 10. Monitoring wells not utilized for monitoring

purposes (i.e., CTM-7, CTM-8, CTM-205 and CTM-210) will be decommissioned, and

8. Removal of the buried historic fuel oil pipe and capping of the cut ends, and removal and backfill of the concrete pipe pit.

2.4.3 Area of Concern 3

2.4.3.1 Alternative No. 1 - No Action

The No Action Alternative is evaluated as a procedural requirement and as a basis for comparison to other remedial alternatives. This alternative allows the AOC to remain in its current condition with the implementation of institutional controls. Since this alternative would leave contaminated soil and groundwater on site, institutional controls in the form of an environmental easement and groundwater use restrictions would be required to notify future owners and/or developers of the restricted use of the property.

2.4.3.2 Alternative No. 2 - Barrier to Contact with SMP, Institutional Controls and Groundwater Monitoring

Alternative No. 2 will include the following tasks:

1. Clearing and grubbing of all vegetation,
2. Grading the entirety of the AOC,
3. Re-usage of all leveled material not subject to off-site disposal for site re-grading,
4. Emplacement of a 12-inch soil cover as a barrier to contact for the entirety of the site, inclusive of the re-establishment of appropriate vegetative cover (i.e., landscaped grasses),
5. Implementation of a SMP that would provide specific requirements for site development, use and occupation including annual site inspections,
6. Implementation of institutional controls in the form of an environmental easement and groundwater restrictions to notify future owners and/or developers of the restricted use of the property, and

7. Continued groundwater monitoring at monitoring well CTM-6 (to be conducted annually for years 1, 2 and 3 and then for year 5 and year 10).

2.4.3.3 Alternative No. 3 – Excavation and Disposal of Impacted Soils and Fill Material, Backfilling of the Excavation and Institutional Controls.

Alternative 3 will include the following tasks.

1. Clearing and grubbing of all vegetation,
2. Excavation and disposal of all impacted soils and fill material and collection and analyses of confirmatory samples to ensure NYSDEC TAGM 4046 objectives are met, and backfill of the excavation with clean soil, and
3. Implementation of institutional controls in the event that residual contaminants remain within the AOC, and for groundwater usage.

3.0 DETAILED ANALYSIS OF ALTERNATIVES

3.1 Introduction

Each remedial alternative was evaluated based on specific criteria set forth in 6NYCRR Part 375-1.10. The evaluation criteria will be used by the NYSDEC in the selection process for the most appropriate remedy considering the site conditions, level of implementation, and cost-effectiveness. From this AAR and the RI Report, the Department will prepare a Proposed Remedial Action Plan (PRAP) to be submitted to the public with the RI Report and the AAR. The Department will address any issues raised by the public in a Responsiveness Summary. The final remedy for the site will be documented in the Record of Decision (ROD) prepared by NYSDEC after a 45 day public comment period.

The first seven (7) of the following eight (8) criteria form the basic components of the detailed analysis of each alternative whereby each criteria is compared to the others to determine the preferred remedy. The Department will use criteria #8 in their evaluation once the public comment period has ended.

1. Overall protection of public health and the environment;
2. Compliance with Standards, Criteria, and Guidance (SCGs);
3. Short-term effectiveness;
4. Long-term effectiveness;
5. Reduction of toxicity, mobility, and volume;
6. Implementability;
7. Cost; and
8. Community acceptance.

The remedial alternative approach of no action with institutional controls could be applied to most sites where low level of contamination is present and fully delineated, and does not pose a significant threat to human health or the environment. This alternative is best suited for low level contamination.

Institutional controls are means of attaching restrictions to the property to limit site activities and future use of the property, and to assure due diligence in notification of prospective purchasers and the public. These restrictions could also include installation of fencing or other means to limit access to the site or a particular area of the site. The site's current and future land use plays a significant role in selecting the most effective institutional controls. Examples of institutional controls typically include land use and drinking water use restrictions, deed restrictions, environmental easements and notification in public registries of excavation and construction work activity, and appropriate posting of informational signs at the site. Depending on the severity of contamination, institutional controls could be required along with other feasible remedial alternatives. For the purpose of analyzing the alternatives below, specific examples of institutional controls (as discussed above) are not referenced, but would ultimately be selected based on the results of remedial action performed.

3.1.1 Area of Concern 1

3.1.1.1 Overall Protection of Human Health and the Environment

Alternative 1: No Action

Overall protection of human health and the environment would not be improved in the short term by implementing the No Action alternative (Alternative No. 1). The level of protection to human health and the environment could be evaluated over time by periodically assessing the contaminant concentrations through groundwater monitoring over an extended period of time (30 years). However, metals and SVOCs detected in soils and fill material above the water table will more than likely persist over time. Impacts to the environment may be slightly mitigated with respect to VOCs in groundwater, as these may diminish in concentration over time through natural attenuation and/or migration with groundwater flow direction into the Hudson River.

Overall protection of human health and the environment would not be improved if no action is taken relative to the IRM excavation area. The IRM area is viewed as a source area containing impacted soils and groundwater. Constituents detected above SCGs within the soil and fill material will continue to leach into the groundwater and persist within the AOC.

Alternative 2: Barrier to Contact with SMP, Institutional Controls and Groundwater Monitoring With No Action Relative to the IRM

Protection of human health and the environment would be achieved upon completion of this alternative because an exposure barrier to the impacted soils, fill and groundwater would be created. Additionally, the implementation of a SMP and institutional controls would establish the technical and legal requirements for future construction and site maintenance activities at the AOC, and would limit groundwater, soil, and fill material use and disturbance by potential future site owners and/or developers. Groundwater monitoring would be conducted for an extended period of time at the select monitoring wells identified in Section 2.4.1 to gauge site conditions. Potential exposure to AOC contaminants would occur if the barrier to cover were breached or if the SMP and institutional controls were not adhered to during development activities and future site ownership.

Remediation would not be conducted in the IRM area, which is viewed as a source for VOC contaminants. Neglecting to address the IRM area would allow impacted soils and fill material in this area to continue leaching contaminants into underlying groundwater, thus accentuating impacts to the AOC. A road is proposed to traverse the area of the IRM. Construction activities associated with the road may expose workers to the contaminated media. To prevent exposure to contaminated soil vapors, the IRM area would be restricted from future development.

Alternative 3: Barrier to Contact with SMP, Institutional Controls, Groundwater Monitoring and Remediation of the IRM

Implementation of this alternative would provide all of the benefits of Alternative 2 with the addition of the remediation of the IRM area. Removal of contaminated soils, fill and groundwater in the IRM area would effectively mitigate contaminants from leaching from this source area, thus providing additional protection to public health and the environment. Remediation of the source area would be completed by one of three methods 1) the in-situ treatment of soils, fill and groundwater in the IRM area by multi-phase extraction and treatment, 2) the in-situ treatment of soils, fill and groundwater within the IRM via in-situ chemical oxidation, and 3) the in-situ treatment of soils, fill and groundwater within the IRM via the installation and operation of an air sparging and soil vapor extraction system.

Long term groundwater monitoring would be conducted at select monitoring wells identified in Section 2.4.1.

3.1.1.2 Compliance with Standards, Criteria, and Guidance (SCGs)

Alternative 1: No Action

Compliance with SCGs would not be attained if the No Action alternative is implemented because the impacted media would not be addresses through remedial efforts and would be allowed to remain on site. Additionally, no protection would be afforded to the community relative to COCs in surface and subsurface soils. Institutional controls placed on the AOC would provide limited protection to future owners and/or site developers.

Alternative 2: Barrier to Contact with SMP, Institutional Controls and Groundwater Monitoring With No Action Relative to the IRM

Compliance with SCGs would not be attained through implementation of Alternative No. 2, although the community will be protected from contaminants through placement of a barrier to contact with a SMP and institutional controls. The contaminants may reduce in toxicity over time. A reduction in contaminants to concentrations below SCGs within the IRM area would be difficult to attain without addressing the IRM source contamination.

Alternative 3: Barrier to Contact with SMP, Institutional Controls, Groundwater Monitoring and Remediation of the IRM

Compliance with SCGs should be attained in the IRM area upon completion of remedial activities in this area, which would also serve to remove a known contaminant source area from the AOC. Compliance with SCGs would not be attained relative to remaining contaminants within the AOC. However, all of the protections offered to the community and the long term monitoring of the AOC would be consistent with those identified in Alternative 2.

3.1.1.3 Short Term Effectiveness

Alternative 1: No Action

The effectiveness of the No Action Alternative would be realized in the short term and could be implemented within three months. There would be no short term reduction in the potential for impacts to human health. There will be no impact to the community or the environment during implementation of the No Action Alternative.

Alternative 2: Barrier to Contact with SMP, Institutional Controls and Groundwater Monitoring With No Action Relative to the IRM

The short term effectiveness of this remedy would be realized upon installation of the barrier to contact and implementation of the SMP and institutional controls. Long term groundwater monitoring would provide a gauge for contaminant persistence within this medium. The short term effectiveness relative to the IRM would not be realized because the contaminants within the IRM area would continue to leach into underlying groundwater, thus accentuating impacts to the AOC.

Short term adverse impacts to affected populations through the implementation of Alternative No. 2 include the possible ingestion, dermal contact and inhalation of site contaminants during site grading and leveling activities and application of the barrier to contact. To minimize these impacts, dust suppression techniques in the form of the application of water and community dust monitoring at a minimum will need to be conducted.

Alternative 3: Barrier to Contact with SMP, Institutional Controls, Groundwater Monitoring and Remediation of the IRM

The short term effectiveness for this remedy would be immediate relative to the IRM area because a contaminant source area will be eliminated. The short term effectiveness for the remainder of the AOC would be consistent with those identified in Alternative 2.

Short term adverse impacts to affected populations through the implementation of Alternative No. 3 include the possible ingestion, dermal contact and inhalation of site contaminants during site grading and leveling, application of the barrier to contact and remedial activities associated with the IRM area. To minimize these impacts, dust suppression techniques in the form of the application of water and community dust monitoring at a minimum would need to be conducted.

3.1.1.4 Long Term Effectiveness

Alternative 1: No Action

There would be little long term effectiveness if the No Action remedy is chosen. Some reduction in contaminant persistence may be achieved by natural attenuation; however, metals and SVOCs in surface and subsurface soils and metals in groundwater would persist for an undefined period of time. The remedy would not meet RAOs in that there would be little protection to the community to site contaminants.

Alternative 2: Barrier to Contact with SMP, Institutional Controls and Groundwater Monitoring With No Action Relative to the IRM

The long term effectiveness of Alternative No. 2 would be achieved by a barrier to contact that would protect the community from site contaminants, although the source area within the IRM excavation would be allowed to persist. There should be minimal long-term risks to human health if 1) the barrier to contact remains intact and is inspected annually, 2) the SMP is adhered to by all related personnel during site development activities and operations by site occupants, 3) institutional controls are implemented and followed by future site owners and developers, and 4) groundwater monitoring is conducted on a pre-determined frequency to gauge site contaminant persistence, mobility and toxicity. The barrier to contact, SMP and institutional controls should meet site RAOs in that present and affected populations would be afforded protection from site contaminants.

The contaminants remaining within the AOC would be segregated from human contact once the barrier to contact is in place. The barrier to contact would be an effective means of protection from site contaminants if it is consistently inspected to ensure that it has not been breached by naturally occurring and/or man made incidents. Additionally, if future site development should occur; buildings, parking lots, walkways and landscaped areas would also serve as additional barriers to contact.

Alternative 2 would provide no long term effectiveness relative to the continued leaching of contaminants within the IRM area into underlying groundwater. The IRM area would be an ongoing source of site contaminants.

Because contaminated soil and fill would remain beneath the soil cover, this alternative would not provide a permanent remedy. However, the engineering and institutional controls are reliable, and the magnitude of the remaining risk is small.

Alternative 3: Barrier to Contact with SMP, Institutional Controls, Groundwater Monitoring and Remediation of the IRM

This alternative is similar to Alternative No. 2 with the exception that contaminants within the IRM area would be addressed via one of three remedial activities, thus eliminating a contaminant source area. Removal of the contaminant source area would be permanent, would have long term effectiveness, and would eliminate any additional impacts to the AOC from the IRM area. The RAOs for the site would be met employing this remedy.

Because contaminated soil and fill would remain beneath the soil cover, this alternative would not provide a permanent remedy. However, the engineering and institutional controls are reliable, and the magnitude of the remaining risk is small.

3.1.1.5 Reduction of Toxicity, Mobility or Volume with Treatment

Alternative 1: No Action

This remedy would not reduce the toxicity, mobility or volume of the AOC contaminants; however, some reduction may be achieved by natural attenuation. However, since the site would not be monitored, measurements for the effectiveness of natural attenuation would not be implemented.

Alternative 2: Barrier to Contact with SMP, Institutional Controls and Groundwater Monitoring With No Action Relative to the IRM

This alternative would not reduce the toxicity, mobility or volume of the AOC contaminants, with the exception of a small degree of natural attenuation, which would be monitored via long-term groundwater monitoring. The barrier to contact, SMP and institutional controls would serve as a mechanism to protect human health from the contaminants.

Alternative 3: Barrier to Contact with SMP, Institutional Controls, Groundwater Monitoring and Remediation of the IRM

The toxicity, mobility and volume of contaminants in the IRM area would be eliminated employing this alternative as the contaminant source area would be removed. However, this alternative would not reduce the toxicity, mobility or volume of the AOC contaminants, with the exception of a small degree of natural attenuation, which would be monitored via long-term groundwater monitoring.

3.1.1.6 Implementability

Alternative 1: No Action

The implementability of the No Action alternative involves the drafting of legal documents for the institutional controls, and therefore is highly implementable.

Alternative 2: Barrier to Contact with SMP, Institutional Controls and Groundwater Monitoring With No Action Relative to the IRM

Implementing Alternative No. 2 is feasible in that mounds of debris and slag, as well as "Slag Mountain", would be leveled and re-graded on site as backfill. Materials that are encountered during leveling and grading that cannot be re-used within the AOC would be segregated and disposed of off site. The barrier to contact would consist of clean imported fill and topsoil that would be hydro seeded. Groundwater monitoring would be conducted at select wells (section 2.4.1) for a specified time period at frequencies to include years 1, 2 and 3 and years 5 and 10. These involve standard construction methods, for which materials and personnel are readily available, and so this alternative is readily implementable. A SMP and institutional controls would be developed to protect affected populations during implementation of the remedial alternative and as guidance for future land owners and developers. No action would be taken relative to remedial activities concerning the IRM area.

Alternative 3: Barrier to Contact with SMP, Institutional Controls, Groundwater Monitoring and Remediation of the IRM

The implementability of Alternative 3 is consistent with Alternative 2 with the addition of the remediation of the IRM area. This would be accomplished through either 1) the in-situ treatment of impacted soils, fill and groundwater within the IRM area via multi-phase extraction and treatment, 2) the in-situ treatment of impacted soils, fill and groundwater within the IRM area via chemical oxidation, and 3) the in-situ treatment of impacted soils, fill and groundwater within the IRM via air sparging and soil vapor extraction. The above alternatives involve standard construction methods, for which materials and personnel are readily available, and so this alternative is readily implementable.

3.1.1.7 Cost

The associated costs for each of the remedial alternatives for AOC 1 are presented in detail in Table 3.1.1 located within the Tables section of the report. Table 3.1.1-1 presents the approximate costs for each of the alternatives.

TABLE 3.1.1-1: Lump Sum Costs Per Alternative for AOC 1 (Present Worth)

Description of Alternative	Estimated Lump Sum Cost
Alternative 1: No Action with institutional controls	$23,000.00
Alternative 2: Barrier to contact with SMP, institutional controls and groundwater monitoring with no action relative to the IRM	$2,084,000.00
Alternative 3(a): Barrier to contact with SMP, institutional controls, groundwater monitoring and remediation of the IRM by multi-phase extraction and treatment	$2,298,000.00
Alternative 3(b): Barrier to contact with SMP, institutional controls, groundwater monitoring and remediation of the IRM by air sparging and soil vapor extraction	$2,315,000.00
Alternative 3(c): Barrier to contact with SMP, institutional controls, groundwater monitoring and remediation of the IRM by in-situ chemical oxidation	$2,378,000.00

3.1.2 Area of Concern 2

3.1.2.1 Overall Protection of Human Health and the Environment

Alternative 1: No Action

Overall protection of human health and the environment would not be improved by implementing the No Action alternative (Alternative No. 1). The level of protection to human health and the environment could be evaluated over time by periodically assessing the contaminant concentrations through groundwater monitoring over an extended period of time (30 years). However, metals and SVOCs detected in soils and fill, and metals detected in groundwater would persist over time.

Alternative 2: Barrier to Contact with SMP, Institutional Controls, Groundwater Monitoring and Removal of the Underground Piping and Pipe Pit

Protection of human health and the environment would be achieved upon completion of this alternative (Alternative No. 2) because an exposure barrier to the contaminated soils, fill and groundwater would be created. Additionally, the implementation of a SMP and institutional controls would establish the technical and legal requirements for future construction activities at the AOC, and would limit groundwater, soil, and fill material use and disturbance by potential future site owners and/or developers. Groundwater monitoring would be conducted for an extended period of time at select monitoring wells (see Section 2.4.2) to gauge site conditions. Exposure to AOC contaminants would occur if the barrier to cover were breached or if the SMP was not adhered to during construction or site use activities.

The removal of the historic underground ground oil pipes and associated pipe pit would effectively eliminate this potential contaminant source and therefore be protective of human health and the environment.

3.1.2.2 Compliance with Standards, Criteria, and Guidance (SCGs)

Alternative 1: No Action

Compliance with SCGs would not be attained if the No Action alternative is implemented because the impacted media would not be addressed through remedial efforts and will be allowed to remain on site. The SVOCs would slowly degrade while the metals would persist.

Alternative 2: Barrier to Contact with SMP, Institutional Controls, Groundwater Monitoring and Removal of the Underground Piping and Pipe Pit

Compliance with SCGs would not be attained through implementation of Alternative No. 2, although the community would be protected from contaminants through placement of a barrier to contact with a SMP and institutional controls. AOC contaminants may reduce in toxicity over time, and the removal of the underground piping and pipe trench would eliminate a potential source area. Groundwater monitoring at select wells (see Section 2.4.2) would aid to gauge the persistence of the contaminants over time.

3.1.2.3 Short Term Effectiveness

Alternative 1: No Action

The effectiveness of the No Action Alternative will be realized in the short term and could be implemented within three months. There would be no short term reduction in the potential for impacts to human health. There will be no impact to the community or the environment during implementation of the No Action Alternative.

Alternative 2: Barrier to Contact with SMP, Institutional Controls, Groundwater Monitoring and Removal of the Underground Piping and Pipe Pit

The short term effectiveness of Alternative 2 would be achieved by placing a barrier to contact over the site preventing human contact from existing site contaminants and by implementing a SMP and institutional controls to protect human health. The removal of the fuel pipes would effectively eliminate a potential source area.

Short term adverse impacts to affected populations through the implementation of Alternative No. 2 include the possible ingestion, dermal contact and inhalation of site contaminants during site grading, application of the barrier to contact and excavation of the underground piping and pipe trench. To minimize these impacts, dust suppression techniques in the form of the application of water and community dust monitoring should be conducted.

3.1.2.4 Long Term Effectiveness

Alternative 1: No Action

There would be little long term effectiveness if the No Action remedy is chosen. Some reduction in contaminant persistence may be achieved by natural attenuation, however, metals and SVOCs in surface and subsurface soils, and metals in groundwater would persist. Institutional controls alone would have limited effectiveness at meeting RAOs in the future.

Alternative 2: Barrier to Contact with SMP, Institutional Controls, Groundwater Monitoring and Removal of the Underground Piping and Pipe Pit

The long term effectiveness of Alternative No. 2 would be achieved by a barrier to contact that would protect the affected populations from site contaminants and would remove a potential contaminant source area (historic piping and trench). The long-term effectiveness and permanence of the remedy would be based on the following: 1) the barrier to contact remains intact and is inspected annually, 2) the SMP is adhered to by all related personnel during site development activities, 3) institutional controls are implemented and followed by future site owners and developers, and 4) groundwater monitoring is conducted on a pre-determined frequency to gauge site contaminant persistence, mobility and toxicity. The remedy would meet RAOs in that public health would be protected from site contaminants by the physical barrier and administrative SMP and institutional controls.

The contaminants remaining within the AOC will be segregated from human contact once the barrier to contact is completed. The barrier to contact would be an effective means of protection from site contaminants if it is consistently inspected to ensure that it has not been breached by naturally occurring and/or man made incidents. Additionally, if future site development should occur, then buildings, parking lots, walkways and landscaped areas would also serve as additional barriers to contact.

Because contaminated soil and fill would remain beneath the soil cover, this alternative would not provide a permanent remedy. However, the engineering and institutional controls are reliable, and the magnitude of the remaining risk is small.

3.1.2.5 Reduction of Toxicity, Mobility or Volume with Treatment

Alternative 1: No Action

This remedy would not reduce the toxicity, mobility or volume of the AOC contaminants. Some reduction may be achieved by natural attenuation. However, since the site would not be monitored, measurements for the effectiveness of natural attenuation would not be evaluated.

Alternative 2: Barrier to Contact with SMP, Institutional Controls, Groundwater Monitoring and Removal of the Underground Piping and Pipe Pit

This alternative would not reduce the toxicity, mobility or volume of the AOC contaminants, with the exception of the removal of a potential source area that may be present in the underground piping and trench and through natural attenuation, which would be monitored via long-term groundwater monitoring. The barrier to contact, SMP and institutional controls would serve as a mechanism to protect human health from the contaminants.

3.1.2.6 Implementability

Alternative 1: No Action

Alternative 1 is easily implemented as it involves the drafting of legal documents for the institutional controls.

Alternative 2: Barrier to Contact with SMP, Institutional Controls, Groundwater Monitoring and Removal of the Underground Piping and Pipe Pit

Implementing Alternative No. 2 is feasible in that the barrier to contact can be successfully installed and the historic piping and concrete trench can be excavated and disposed off site with normal and available construction techniques.

Groundwater monitoring would be conducted at select wells (see Section 2.4.2) for a specified time period at frequencies to include years 1, 2 and 3 and years 5 and 10. A SMP and institutional controls would be developed to protect the community during implementation of the remedial alternative and as guidance for future land owners and developers.

3.1.2.7 Cost

The associated costs for each of the remedial alternatives for AOC 2 are presented in detail in Table 3.1.2 located within the Tables section of the report. Table 3.1.2-1 presents the approximate costs for each of the alternatives.

TABLE 3.1.2-1: Lump Sum Costs Per Alternative for AOC 2 (Present Worth)

Description of Alternative	Estimated Lump Sum Cost
Alternative 1: No Action with institutional controls	$14,000.00
Alternative 2: Barrier to contact with SMP, institutional controls and groundwater monitoring with removal of the sub ground piping and pipe pit	$422,000.00

3.1.3 Area of Concern 3

3.1.3.1 Overall Protection of Human Health and the Environment

Alternative 1: No Action

Overall protection of human health and the environment would not be improved by implementing the No Action alternative (Alternative No. 1). The level of protection to human health and the environment could be evaluated over time by periodically assessing the contaminant concentrations through groundwater monitoring over an extended period of time (30 years). However, metals and SVOCs detected in soils and fill, and metals detected in groundwater would persist over time.

Alternative 2: Barrier to Contact with SMP, Institutional Controls and Groundwater Monitoring

Protection of human health and the environment would be achieved upon completion of this alternative (Alternative No. 2) because an exposure barrier to the impacted soils, fill and groundwater would be created. Additionally, the implementation of a SMP and institutional controls would establish the technical and legal requirements for future development activities at the AOC, and would establish deed limit groundwater, soil, and fill material use and disturbance by potential future site owners and/or developers. Groundwater monitoring would be conducted for an extended period of time at select monitoring wells to gauge site conditions. Exposure to AOC contaminants could occur if the barrier to cover were breached or if the SMP was not adhered to during construction and future site utilization activities.

Alternative 3: Excavation and Disposal of Impacted Soils and Fill Material, Backfilling of the Excavation, and Implementation of Institutional Controls

Protection of human health and the environment would effectively be realized through the implementation of Alternative 3 as all of the contaminated soil and fill in excess of SCGs would be excavated and removed from the AOC for disposal.

3.1.3.2 Compliance with Standards, Criteria, and Guidance (SCGs)

Alternative 1: No Action

Compliance with SCGs would not be attained if the No Action alternative is implemented because the impacted media would not be addressed through remedial efforts and would be allowed to remain on site. Additionally, no protection would be afforded to affected populations relative to COCs in surface and subsurface soils. Institutional controls placed on the AOC would provide limited protection to future owners and/or site developers.

Alternative 2: Barrier to Contact with SMP, Institutional Controls and Groundwater Monitoring

Compliance with SCGs would not be attained through implementation of Alternative No. 2, although the affected populations would be protected from contaminants through placement of a barrier to contact with a SMP and institutional controls. AOC contaminants may reduce in toxicity over time by natural attenuation and groundwater monitoring will aid to gauge the persistence of the contaminants over time.

Alternative 3: Excavation and Disposal of Impacted Soils and Fill Material, Backfilling of the Excavation, Barrier to Contact with SMP, Institutional Controls and Groundwater Monitoring

Completion of Alternative No. 3 would involve removal of all contaminated soil and fill in excess of SCGs, therefore, compliance with SCGs would be achieved.

3.1.3.3 Short Term Effectiveness

Alternative 1: No Action

The effectiveness of the No Action Alternative would be realized in the short term and could be implemented within three months. There would be no short term reduction in the potential for impacts to human health. There would be no impact to the community or the environment during implementation of the No Action Alternative.

Alternative 2: Barrier to Contact with SMP, Institutional Controls and Groundwater Monitoring

The short term effectiveness of Alternative 2 would be achieved by placing a barrier to contact that would protect the community from existing site contaminants and by implementing a SMP and institutional controls to protect future affected populations.

Short term adverse impacts to affected populations through the implementation of Alternative No. 2 include the possible ingestion, dermal contact and inhalation of site contaminants during site grading and leveling and application of the barrier to contact. To minimize these impacts, dust suppression techniques in the form of the application of water and community dust monitoring would need to be conducted.

Alternative 3: Excavation and Disposal of Impacted Soils and Fill Material, Backfilling of the Excavation, Barrier to Contact with SMP, Institutional Controls and Groundwater Monitoring

The short term effectiveness of Alternative 3 will be immediate in that contaminated soils and fill will be removed and disposed of off-site.

The community would be protected during the remedial action by establishing a work zone that excludes unauthorized individuals, by performing the earthwork activity in accordance with the SMP and by employing effective dust suppression techniques (application of water) and community dust monitoring. There would be no significant environmental impacts as a result of implementing this alternative.

This alternative would have the greatest potential for short term impacts to site workers and the community because a large volume of subsurface soils and fill would be excavated and transported off-site.

3.1.3.4 Long Term Effectiveness

Alternative 1: No Action

There would be limited long term effectiveness if the No Action remedy is chosen. Some reduction in contaminant persistence may be achieved by natural attenuation, however, metals and SVOCs in surface and subsurface soils, and metals in groundwater would likely persist.

Alternative 2: Barrier to Contact with SMP, Institutional Controls and Groundwater Monitoring

The long term effectiveness and permanence of Alternative No. 2 would be achieved by creating a barrier to contact that would protect the community from site contaminants and by providing a SMP and institutional controls controlling site usage and development and maintenance practices. There should be minimal long-term risks to human health if 1) the barrier to contact remains intact and is inspected annually, 2) the SMP is adhered to by all related personnel during site development activities, 3) institutional controls are implemented and followed by future site owners and developers, and 4) groundwater monitoring is conducted on a pre-determined frequency to gauge site contaminant persistence, mobility and toxicity.

The contaminants remaining within the AOC would be segregated from the community once the barrier to contact is completed. The barrier to contact would be an effective means of protection from site contaminants if it is consistently inspected to ensure that it has not been breached by naturally occurring and/or man made incidents. Additionally, if future site development should occur, then buildings, parking lots, walkways and landscaped areas would also serve as additional barriers to contact.

Alternative 3: Excavation and Disposal of Impacted Soils and Fill Material, Backfilling of the Excavation, Barrier to Contact with SMP, Institutional Controls and Groundwater Monitoring

Implementing the excavation of all contaminated soils and fill in excess of SCGs at the site (Alternative No. 3) is a long term and permanently effective means of remediating contamination at the site. There should be no residual risks remaining upon completion of this alternative. This alternative is considered to be a reliable means of reducing the potential impacts to human health and the environment.

3.1.3.5 Reduction of Toxicity, Mobility or Volume with Treatment

Alternative 1: No Action

This remedy would not reduce the toxicity, mobility or volume of the AOC contaminants; however, some reduction may be achieved by natural attenuation. However, since the site would not be monitored, measurements for the effectiveness of natural attenuation would not be evaluated.

Alternative 2: Barrier to Contact with SMP, Institutional Controls and Groundwater Monitoring

This alternative would not reduce the toxicity, mobility or volume of the AOC contaminants, with the exception of a small degree of natural attenuation, which would be monitored via long-term groundwater monitoring. The barrier to contact, SMP and institutional controls would serve as a mechanism to protect the community from the contaminants.

Alternative 3: Excavation and Disposal of Impacted Soils and Fill Material, Backfilling of the Excavation, Barrier to Contact with SMP, Institutional Controls and Groundwater Monitoring

Implementation of this alternative would eliminate contaminants within surface and subsurface soils. The implementation of institutional controls should eliminate exposure to residual contaminants for future site owners and/or developers with the exception of groundwater which would be addressed through institutional controls.

3.1.3.6 Implementability

Alternative 1: No Action

The implementability of the No Action alternative involves the drafting of legal documents for the institutional controls, which is easily implemented.

Alternative 2: Barrier to Contact with SMP, Institutional Controls and Groundwater Monitoring

Implementing Alternative No. 2 is feasible in that the site can be leveled and re-graded and the barrier to contact successfully installed employing common engineering and construction practices.

Groundwater monitoring would be conducted at select wells for a specified time period at frequencies to include years 1, 2 and 3 and years 5 and 10. A SMP and institutional controls would be developed to protect affected populations during implementation of the remedial alternative and as guidance for future land owners and developers.

Alternative 3: Excavation and Disposal of Impacted Soils and Fill Material, Backfilling of the Excavation, Barrier to Contact with SMP, Institutional Controls and Groundwater Monitoring

The technical difficulties that are anticipated during implementation of the excavation and disposal of soils and fill portion of this alternative include undermining the integrity of the concrete wall separating the AOC from its west adjoining "Alamo" site (sheeting will be needed) and the space restraints imposed by the configuration of the AOC, which consists of a strip of land that is narrow from east to west. Otherwise, the action is a normal earthwork construction project. In addition, concern for the railroad tracks adjacent to the property may require extensive structural protection and coordination with the owner. These could cause extensive delays during the design phase, and increase the difficulty of the project.

3.1.3.7 Cost

The associated costs for each of the remedial alternatives for AOC 3 are presented in detail in Table 3.1.3 located within the Tables section of the report. Table 3.1.3-1 presents the approximate costs for each of the alternatives.

TABLE 3.3.3-1: Lump Sum Costs Per Alternative for AOC 3 (Present Worth)	
Description of Alternative	**Estimated Lump Sum Cost**
Alternative 1: No Action with institutional controls	$10,000.00
Alternative 2: Barrier to contact with SMP and institutional controls	$68,000.00
Alternative 3: Excavation and disposal of impacted soils and fill material, backfilling of the excavation and implementation of institutional controls	$601,000.00

3.2 Comparative Analysis

Utilizing the evaluation criteria, each remedial alternative for each AOC identified in this AAR is compared to the others to identify the most preferred remedy for each of the AOCs. For comparative purposes the criteria are ranked on a high, moderate and low basis.

3.2.1 Area of Concern 1

Three remedial alternatives were presented for AOC 1. These included 1) No Action with institutional controls, 2) barrier to contact with SMP, institutional controls and groundwater monitoring with no action relative to the IRM, and 3) barrier to contact with SMP, institutional controls, groundwater monitoring and remediation of the IRM source area by in-situ treatment via multi-phase extraction and treatment, chemical oxidation or soil sparging with soil vapor extraction.

The No Action alternative is the least expensive, yet least effective alternative for the protection of human health and the environment.

Alternative 2 is highly effective in that it protects the community from contaminants by placement of a barrier to contact with SMP and institutional controls. However, this alternative does not remove the known contaminant source area within the IRM area. The cost for this alternative is slightly less than the costs that would be incurred with Alternative 3, which is discussed below.

Alternative 3 is the most costly of the alternatives, yet is the most effective in that it addresses the IRM contaminant source that is located in an area that is slated for construction of a road. If the contaminants in the IRM area are not addressed, they would continue leaching into the environment and may accentuate the volume of existing contaminants within the AOC. Additionally, these contaminants may be encountered during future development activities and would need to be addressed at that time. The volatile organic contaminants in this area are highly mobile in both water and vapor phases. Yet they are easily treatable using conventional technology at a reasonable cost. For these reasons, Alternative 3 is the preferred remedy for AOC 1. Three (3) remedial alternatives are presented within Alternative 3 to address the IRM area. These include 1) the in-situ treatment of impacted soils, fill and groundwater by multi-phase extraction and treatment, 2) the in-situ treatment of impacted soils, fill and groundwater via chemical oxidation, and 3) the in-situ treatment of impacted soils/fill and groundwater via air sparging and soil vapor extraction. Of the three sub-alternatives, the multi-phase extraction and treatment of impacted soils, fill and groundwater is the preferred remedy to address the IRM area in that it removes the contaminant source in the short term (two years) and is also the least costly.

Based on analyses of the three alternatives, Alternative 3 appears to be the most effective alternative for AOC 1 in that it provides a barrier to contact with SMP and institutional controls, while removing a contaminant source area.

3.2.2 Area of Concern 2

Two remedial alternatives were presented for AOC 2. These included 1) No action with institutional controls, and 2) barrier to contact with SMP, institutional controls, groundwater monitoring and excavation and disposal of the former underground oil pipes and concrete pipe trench.

The No Action alternative is the least expensive, yet least effective alternative for the protection of human health and the environment.

Alternative 2 would effectively protect public health and the environment at a reasonable cost and is therefore the alternative of choice. The alternative will include a barrier to contact with SMP, institutional controls, groundwater monitoring and excavation and disposal of the former underground oil pipes and concrete pipe trench running through the site.

3.2.3 Area of Concern 3

Three remedial alternatives were presented for AOC 3. These included 1) No action with institutional controls, 2) barrier to contact with SMP, institutional controls and groundwater monitoring, and 3) excavation and disposal of impacted soils and fill material and replacement with clean fill and emplacement of institutional controls.

The No Action alternative is the least expensive, yet least effective alternative for the protection of human health and the environment.

Alternative 2 is effective in that it protects the community from site contaminants in soils and fill and implements a SMP and institutional controls to dictate conditions for future site development. Based on the size and configuration of AOC 3, buildings are not anticipated for development within this area. Alternative 2 is easily implemented and would have minimal short term impacts. Alternative 2 is less costly than Alternative 3, which is discussed below.

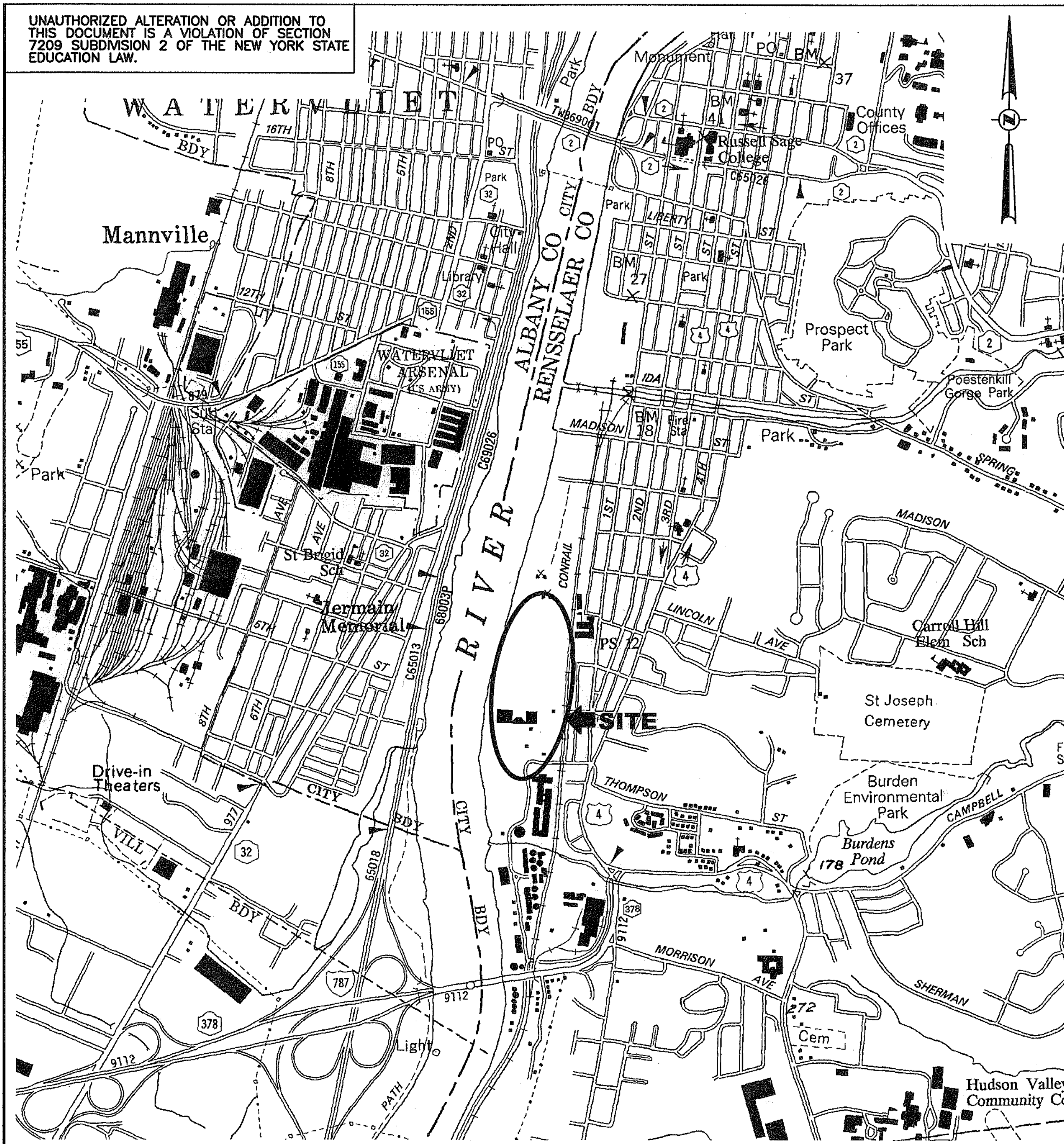
Alternative 3 is the most costly and least implementable of the alternatives as it involves the excavation and disposal of impacted soils and fill beneath the entire site and replacement with clean fill material. Implementing this alternative would be difficult due to the possible undermining of a concrete wall that separates the site from the Alamo and due to the narrow configuration of the site. Additionally, AOC 3 is located along the New York Central Railroad, which may raise issues relative to minimum distance requirements for on site remedial equipment and structural stability of the tracks. Excavation of 2,900 cubic yards of fill from the parcel would create the potential for significant short term impacts that would have to be controlled. Although the contaminants will be removed from the AOC, the AOC is not expected to be developed with buildings in the future. Based on the foregoing, Alternative 2 appears to be the remedial remedy most suited to the AOC.

FIGURE 1

SITE LOCATION MAP

NO XREFS

UNAUTHORIZED ALTERATION OR ADDITION TO THIS DOCUMENT IS A VIOLATION OF SECTION 7209 SUBDIVISION 2 OF THE NEW YORK STATE EDUCATION LAW.



MAP REFERENCE:
NYSDOT 1993 TROY SOUTH QUADRANGLE

Date	RECORD OF WORK	Appr.

Drafter: JAM	Checker: KM
Appr. by:	Proj. No. 04.9138

FIGURE 1 – SITE LOCATION MAP
SOUTH TROY INDUSTRIAL PARK

CITY OF TROY | RENSSELAER COUNTY, NY

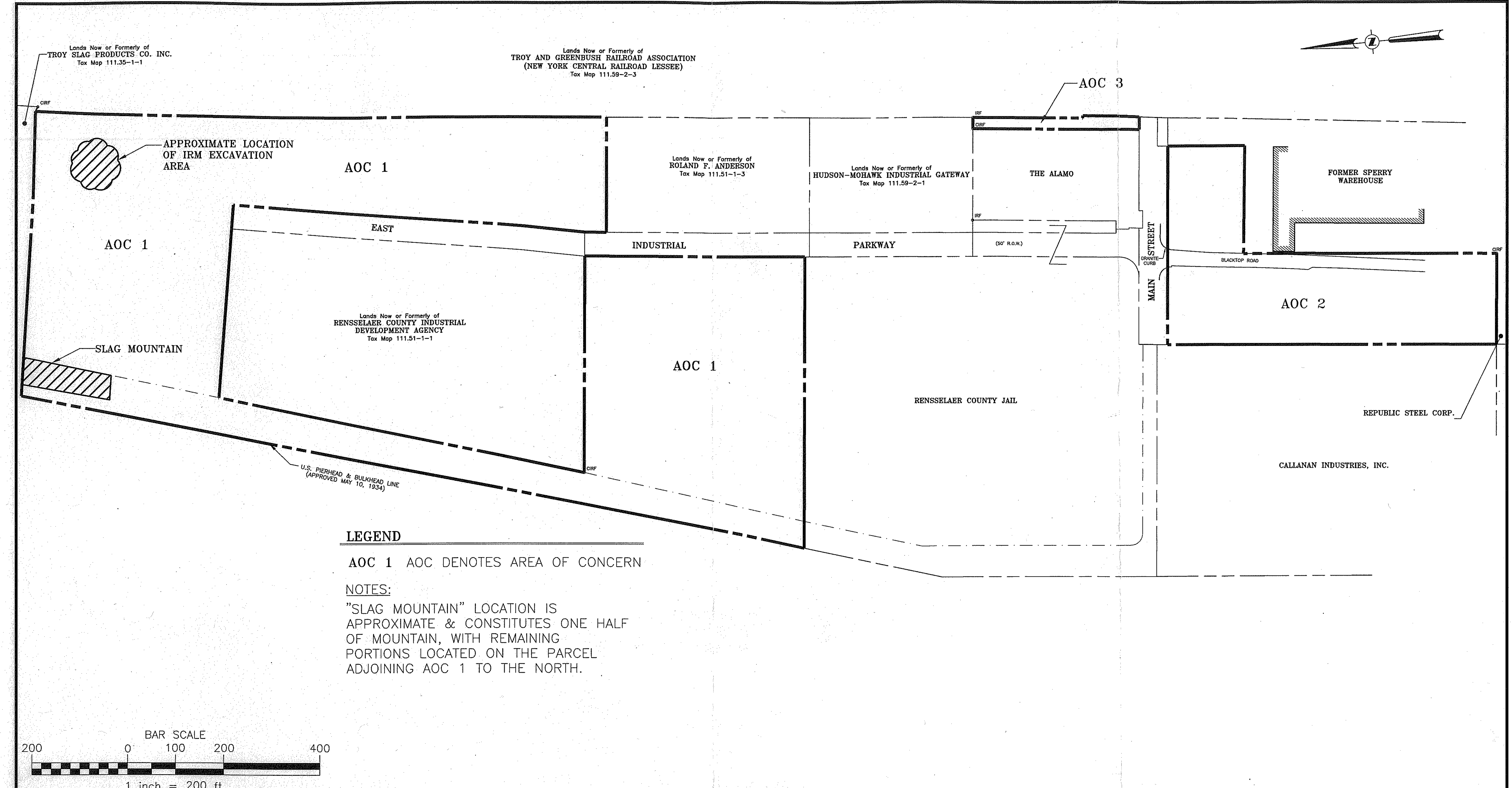
C.T. MALE ASSOCIATES, P.C.
50 CENTURY HILL DRIVE, P.O. BOX 727, LATHAM, NY 12110
518.786.7400 * FAX 518.786.7299
Architecture & Building Systems Engineering * Civil Engineering
Environmental Services * Survey & Land Information Services

SCALE: 1"=500'± | DATE: JUNE 2004

CAD DWG. FILE NAME: site location map.dwg

FIGURE 2

AREAS OF CONCERN



CAD DWG. FILE NAME: AREAS OF CONCERN F2.DWG

NOTE:
1.) THE LOCATIONS AND FEATURES DEPICTED ON THIS MAP ARE APPROXIMATE AND DO NOT REPRESENT AN ACTUAL FIELD SURVEY.

MAP REFERENCE:
1.) BOUNDARY SURVEY PREPARED BY C.T. MALE ASSOCIATES, P.C., DWG. NO.:01-564, DATED OCT. 8, 2001.

DATE		REVISIONS RECORD/DESCRIPTION	DRAFTED	CHECK	APPR.
	1				
	2				
	3				
	4				
	5				
	6				
	7				
	8				
	9				

DESIGNED :
DRAFTED : J. KARON
CHECKED : S. BIEBER
PROJ. NO: 04.9138
SCALE : 1"=200'
DATE : DEC. 21, 2005

FIGURE 2
AREAS OF CONCERN

SOUTH TROY INDUSTRIAL PARK BROWNFIELDS INVESTIGATION

CITY OF TROY — RENSSELAER COUNTY, NEW YORK

C.T. MALE ASSOCIATES, P.C.
50 CENTURY HILL DRIVE, P.O. BOX 727, LATHAM, NY 12110
518.786.7400 * FAX 518.786.7299
ARCHITECTURE & BUILDING SYSTEMS ENGINEERING * CIVIL ENGINEERING
ENVIRONMENTAL SERVICES * SURVEY & LAND INFORMATION SERVICES

SHEET 1 OF 1
DWG. NO: 05-XXXX

TABLE 3.1.1

COST ESTIMATES FOR REMEDIATION OF AOC 1

TABLE 3.1.1: Engineer's Estimate for Areas of Concern (AOC)
South Troy Industrial Park Troy, NY
C.T. Male Project No.: 04.9138

Bid Item #	Work Item	Units	Est. Units		Unit Rate		Estimated Fee
AOC#1	**Parcel 1 Removal of Slag Mountain and Placement of Soil Cover**						
	Institutional Controls						
1	Legal and Filing Fees	LS	1	$	5,000.00	$	5,000.00
	Preparation of Site						
2	Mobilization/Demobilization	LS	1	$	5,000.00	$	5,000.00
3	Site Preparation, Fencing and Decon Pad	LS	1	$	6,695.00	$	6,695.00
4	Clear and Grub	ACRE	17	$	7,550.00	$	128,350.00
5	Rough Grading (Dozer)	DAY	10	$	1,195.00	$	11,950.00
6	Disposal of Site Debris	TON	200	$	70.00	$	14,000.00
7	Dust Suppression	DAY	70	$	813.00	$	56,910.00
8	Handling of surface concrete/slag to crusher area	DAY	5	$	3,000.00	$	15,000.00
	Removal of Slag Mountain, Crush and Transport Onsite						
9	Mobilization/Demobilization	LS	1	$	10,000.00	$	10,000.00
10	Portable Crusher (capable of 1600 tons per day)	DAY	30	$	3,680.00	$	110,400.00
11	Excavator and Hammer (2 machines)	DAY	30	$	4,264.00	$	127,920.00
12	Loader (2 machines)	DAY	30	$	2,446.00	$	73,380.00
13	Onsite Dump truck (3 trucks)	DAY	30	$	1,428.00	$	42,840.00
	Processing of Surface Slag						
14	Portable Crusher (capable of 1600 tons per day)	DAY	30	$	3,680.00	$	110,400.00
15	Excavator and Hammer	DAY	30	$	2,132.00	$	63,960.00
16	Loader	DAY	30	$	1,223.00	$	36,690.00
17	Onsite Dump truck (2 trucks)	DAY	30	$	952.00	$	28,560.00
	Placement of Slag Onsite						
18	Dozer	DAY	20	$	1,195.00	$	23,900.00
19	Smooth Drum Vibratory Roller	DAY	10	$	433.20	$	4,332.00
	Parcel 1 Placement of Soil Cover to Contact						
20	Supply and install a demarcation layer beneath clean imported fill and soil cover	MSF	740	$	250.00	$	185,000.00
21	Supply and place general fill (12"), preliminary grade, and final grade soil cover	CY	27,420	$	20.00	$	548,400.00
22	Apply hydro seed to the soil cover and protect until establishment of vegetative cover acceptable to Engineer	MSF	740	$	100.00	$	74,000.00
					Subtotal	***$***	***1,682,687.00***
23	Engineering (10%)					$	168,268.00
23	Site Management Plan	LS	1	$	12,000.00	$	12,000.00
24	Site Survey (topography pre barrier and post barrier)	LS	1	$	8,000.00	$	8,000.00
25	Field Oversight and Air Monitoring	DAY	70	$	900.00	$	63,000.00
26	Soil Analytical	EACH	20	$	300.00	$	6,000.00
					Total Capital Cost	***$***	***1,939,955.00***
	Long Term Costs						
27	Site Management Plan Requirements (30 years)						
27a	Periodic Site Inspection and Certification by an Environmental Professional (Present Value)	EACH	30	$	1,200.00	$	18,000.00
27b	Periodic O&M such as Cover maintenance and Repair (Present Value)	EACH	30	$	5,000.00	$	77,000.00
27c	Miscellaneous Site Work (2 days annually- Present Value)	EACH	30	$	1,200.00	$	18,000.00
27d	Groundwater Sampling and Analyses (Years 1 - 5, 10 & 15) (Present Value)						
	Analytical	EACH	7	$	3,500.00	$	18,705.00
	Field Work	EACH	7	$	600.00	$	3,210.00
	Equipment	EACH	7	$	500.00	$	2,675.00
	Disposal of drummed purge water	EACH	7	$	250.00	$	1,335.00
	Reporting	EACH	7	$	900.00	$	4,810.00
	Subtotal - Long Term Costs (Annual & Present Value)			***$***	***13,150.00***	***$***	***143,735.00***
					Grand Total	***$***	***2,083,690.00***

* Note: Price reflects the removal of slag mountain only on IDA property. (70%)

C.T. MALE ASSOCIATES, P.C.

TABLE 3.1.1: Engineer's Estimate for Areas of Concern (AOC)
South Troy Industrial Park Troy, NY
C.T. Male Project No.: 04.9138

Bid Item #	Work Item	Units	Est. Units		Unit Rate		Estimated Fee
AOC#1 ALT.-1	**Parcel 1 Subsurface Treatment in IRM Area by Multi Phase Extraction**						
	Remediation System Design and Start Up						
1	Design	LS	1	$	15,000.00	$	15,000.00
2	Electrical Service	LS	1	$	10,000.00	$	10,000.00
3	Treatment Shed	LS	1	$	15,000.00	$	15,000.00
4	Capital Equipment	LS	1	$	35,000.00	$	35,000.00
5	Installation of Extraction Points and Associated Piping	LS	1	$	25,000.00	$	25,000.00
6	System Start-Up	DAY	10	$	480.00	$	4,800.00
	System Operation and Maintenance (2 Years)						
7	Electric (Present Value)	YEAR	2	$	12,000.00	$	21,482.00
8	Weekly System Monitoring (Present Value)	YEAR	2	$	25,000.00	$	44,645.00
9	Required Parts and Repairs (Present Value)	YEAR	2	$	5,000.00	$	8,930.00
10	Groundwater Sampling and Analysis (Quarterly)(Present Value)	YEAR	2	$	6,000.00	$	10,715.00
11	Reporting (Quarterly GW and System Performance)(PV)	YEAR	2	$	4,800.00	$	8,575.00
12	Carbon Drums for Treatment of Groundwater	EACH	20	$	250.00	$	5,000.00
13	Carbon Drums Disposal	EACH	20	$	250.00	$	5,000.00
14	Decommission	LS	1	$	5,000.00	$	5,000.00
					Total	***$***	***214,147.00***
AOC#1 ALT.-2	**Parcel 1 Subsurface Treatment in IRM Area by Chemical Oxidation**						
	Chemical Oxidation Treatment						
1	Pilot Study	LS	1	$	10,000.00	$	10,000.00
2	Injection Well Installation	LS	1	$	15,000.00	$	15,000.00
3	Initial Chemical Treatment	CY	1,500	$	100.00	$	150,000.00
4	Groundwater Sampling and Analysis (Quarterly)	YEAR	1	$	6,000.00	$	6,000.00
5	Second Chemical Treatment	CY	750	$	100.00	$	75,000.00
6	Decommission	LS	1	$	5,000.00	$	5,000.00
					Subtotal	***$***	***261,000.00***
	Engineering						
7	Design and Oversight (10%)					$	26,100.00
8	Reporting(per injection episode)	LS	2	$	1,200.00	$	2,400.00
9	Closure Report	LS	1	$	2,000.00	$	2,000.00
					Total	***$***	***291,500.00***
AOC#1 ALT.-3	**Parcel 1 Installation and Operation of Air Sparge/SVES System within IRM Area**						
	Remediation System Design and Start Up						
1	Design	LS	1	$	15,000.00	$	15,000.00
2	Electrical Service	LS	1	$	10,000.00	$	10,000.00
3	Treatment Shed	LS	1	$	15,000.00	$	15,000.00
4	Capital Equipment	LS	1	$	15,000.00	$	15,000.00
5	Installation of VES/Air Sparge points and Associated Piping	LS	1	$	25,000.00	$	25,000.00
6	System Start-Up	DAY	10	$	480.00	$	4,800.00
	System Operation and Maintenance (3 Years)						
7	Electric (Present Value)	YEAR	3	$	12,000.00	$	32,145.00
8	Weekly System Monitoring (Present Value)	YEAR	3	$	25,000.00	$	66,965.00
9	Required Parts and Repairs (Present Value)	YEAR	3	$	5,000.00	$	13,395.00
10	Groundwater Sampling and Analysis (Quarterly)(Present Value)	YEAR	3	$	6,000.00	$	16,075.00
11	Reporting (Quarterly GW and System Performance)(Present Value)	YEAR	3	$	4,800.00	$	12,860.00
12	Decommission	LS	1	$	5,000.00	$	5,000.00
					Total	***$***	***231,240.00***

TABLE 3.1.2

COST ESTIMATES FOR REMEDIATION OF AOC 2

TABLE 3.1.2: Engineer's Estimate for Areas of Concern (AOC)
South Troy Industrial Park Troy, NY
C.T. Male Project No.: 04.9138

Bid Item #		Work Item	Units	Est. Units		Unit Rate		Estimated Fee
AOC #2		**Parcel 2 Removal of Concrete Chase way and Placement of Soil Cover**						
		Institutional Controls						
	1	Legal and Filing Fees	LS	1	$	5,000.00	$	5,000.00
		Removal of Concrete Chase way and Backfill						
	2	Mobilization/Demobilization	LS	1	$	1,000.00	$	1,000.00
	3	Excavator, 2.0 CY, Hydraulic Hammer	DAY	1	$	1,021.80	$	1,021.80
	4	Excavator, 2.0 CY	DAY	5	$	910.00	$	4,550.00
	5	Off-site Disposal of Concrete	CY	30	$	11.00	$	330.00
	6	Asbestos Abatement of Pipes	LS	1	$	19,000.00	$	19,000.00
	7	Cap/Remove Associated Pipes	EACH	6	$	1,000.00	$	6,000.00
	8	Disposal of Residual Waste from within Pipes (55 gallon drum)	EACH	10	$	300.00	$	3,000.00
	9	Transport and Off-site Disposal of Contaminated Soil (assumed Non-Haz)	TON	500	$	60.00	$	30,000.00
	10	Backfill/Compact with Sand, 12" Lifts, Off-site Source	CY	500	$	10.00	$	5,000.00
		Decommission of Monitoring Wells						
	11	Well Abandonment	EACH	4	$	250.00	$	1,000.00
		Placement of Soil Cover						
	12	Mobilization/Demobilization	LS	1	$	10,000.00	$	10,000.00
	13	Site Preparation, Fencing and decon pad	LS	1	$	3,540.00	$	3,540.00
	14	Site Clear and Grub	ACRE	3	$	7,550.00	$	22,650.00
	15	Disposal of Site Debris	TON	50	$	70.00	$	3,500.00
	16	Dust Suppression	DAY	15	$	813.00	$	12,195.00
	17	Supply and install a demarcation layer beneath clean imported fill and soil cover	MSF	126	$	250.00	$	31,500.00
	18	Supply and place general fill (12"), preliminary grade, and final grade soil cover to contact	CY	4,700	$	20.00	$	94,000.00
	19	Apply hydro seed to the soil cover and protect until establishment of vegetative cover acceptable to Engineer	MSF	126	$	100.00	$	12,600.00
						Subtotal	***$***	***265,886.80***
	20	Engineering (10%)					$	27,100.00
	21	Site Management Plan	LS	1	$	10,000.00	$	10,000.00
	22	Site Survey (topography pre cover and post cover)	LS	1	$	5,000.00	$	5,000.00
	23	Field Oversight and Air monitoring	DAY	18	$	900.00	$	16,200.00
	24	Soil Analytical	EACH	4	$	300.00	$	1,200.00
						Total Capital Cost	***$***	***325,386.80***
		Long Term Costs						
	25	Site Management Plan Requirements (30 years)						
	25a	Periodic Site Inspection and Certification by an Environmental Professional (Present Value)	EACH	30	$	600.00	$	9,000.00
	25b	Periodic O&M such as Cover maintenance and Repair (Present Value)	EACH	30	$	3,000.00	$	46,000.00
	25c	Miscellaneous Site Work (2 days annually- Present Value)	EACH	30	$	1,200.00	$	18,000.00
	25d	Groundwater Sampling and Analyses (Years 1 - 5, 10 & 15) (Present Value)						
		Analytical	EACH	7	$	2,500.00	$	13,360.00
		Field Work	EACH	7	$	480.00	$	2,565.00
		Equipment	EACH	7	$	500.00	$	2,675.00
		Disposal of drummed purge water	EACH	7	$	250.00	$	1,335.00
		Reporting	EACH	7	$	750.00	$	4,010.00
		Subtotal - Long Term Costs (Annual & Present Value)			***$***	***9,280.00***	***$***	***96,945.00***
						Grand Total	***$***	***422,331.80***

TABLE 3.1.3

COST ESTIMATES FOR REMEDIATION OF AOC 3

TABLE 3.1.3: Engineer's Estimate for Areas of Concern (AOC)
South Troy Industrial Park Troy, NY
C.T. Male Project No.: 04.9138

Bid Item #	Work Item	Units	Est. Units	Unit Rate	Estimated Fee
AOC #3 ALT.-1	**Parcel 3 Placement of Soil Cover**				
	Institutional Controls				
1	Legal and Filing Fees	LS	1	$ 5,000.00	$ 5,000.00
	Placement of Soil Cover				
2	Mobilization/Demobilization	LS	1	$ 5,000.00	$ 5,000.00
3	Site Preparation, Fencing and Decon Pad	LS	1	$ 2,000.00	$ 2,000.00
4	Site Clear and Grub	ACRE	0.199	$ 7,550.00	$ 1,502.45
5	Disposal of Site Debris	TON	10	$ 70.00	$ 700.00
6	Dust Suppression	DAY	5	$ 813.00	$ 4,065.00
7	Supply and install a demarcation layer beneath clean imported fill and soil cover	SF	8,668	$ 0.25	$ 2,167.00
8	Supply and place general fill (12"), preliminary grade, and final grade soil cover to contact	CY	330	$ 20.00	$ 6,600.00
9	Apply hydro seed to the soil cover to contact and protect until establishment of vegetative cover acceptable to Engineer	SF	8,668	$ 0.10	$ 866.80
				Subtotal	***$ 27,901.25***
10	Engineering (20%)				$ 5,580.00
11	Site Management Plan	LS	1	$ 5,000.00	$ 5,000.00
12	Site Survey (topography pre cover and post cover)	LS	1	$ 5,000.00	$ 5,000.00
13	Field Oversight and Air Monitoring	DAY	5	$ 900.00	$ 4,500.00
14	Soil Analytical	EACH	1	$ 300.00	$ 300.00
				Total Capital Costs	***$ 48,281.25***
	Long Term Costs (30 years)				
15	Periodic O&M such as Cover Maintenance and Repair (Present Value)	EACH	30	$ 1,000.00	$ 15,000.00
16	Periodic Site Inspection and Certification by an Environmental Professional (Present Value)	EACH	30	$ 330.00	$ 5,000.00
	Subtotal - Long Term Costs (Annual & Present Value)			***$ 1,330.00***	***$ 20,000.00***
				Total	***$ 68,281.25***
AOC #3 ALT.-2	**Parcel 3 Excavate and Disposal of Fill Material and Backfill with Clean Imported Fill**				
	Institutional Controls				
1	Legal and Filing Fees	LS	1	$ 5,000.00	$ 5,000.00
	Excavation of Fill and Replacement with Clean Imported Backfill				
2	Mobilization/Demobilization	LS	1	$ 5,000.00	$ 5,000.00
3	Site Preparation, Fencing and Decon Pad	LS	1	$ 2,000.00	$ 2,000.00
4	Site Clear and Grub	ACRE	0.199	$ 7,550.00	$ 1,502.45
5	Disposal of Site Debris	TON	10	$ 70.00	$ 700.00
6	Dust Suppression	DAY	10	$ 813.00	$ 8,130.00
7	Sheeting Installation	SF	25	$ 1,020.00	$ 25,500.00
8	Excavator, 2.0 CY	DAY	10	$ 909.80	$ 9,098.00
9	Transportation and Disposal of Impacted Soil (assume non-hazardous)	TON	6,610	$ 60.00	$ 396,600.00
10	Supply and place general fill to increase site grade (to replace the fill removed)	CY	3,890	$ 20.00	$ 77,800.00
11	Apply hydro seed to the soil cover and protect until establishment of vegetative cover acceptable to Engineer	SF	8,668	$ 0.10	$ 866.80
				Subtotal	***$ 532,197.25***
12	Site Survey (topography)	LS	1	$ 5,000.00	$ 5,000.00
13	Field Oversight and Air Monitoring	DAY	10	$ 900.00	$ 9,000.00
14	Soil Analytical	EACH	4	$ 300.00	$ 1,200.00
15	Engineering (10%)				$ 53,220.00
				Grand Total	***$ 600,617.25***