CSXT RIVER STREET DERAILMENT PROJECT
DRAFT REMEDIAL ACTION WORK PLAN
480 RIVER STREET
ROCHESTER, NEW YORK

Prepared for:
CSX Transportation, Inc.
500 Water Street, J-275
Jacksonville, FL 32202

Submitted to:
New York State Department of Environmental Conservation
Region 8
6274 East Avon-Lima Road
Avon, New York 14414

Prepared by:

AMEC E & E, P.C.
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Schenectady, New York 12305

November 18, 2005
Revised July 7, 2006
Revised May 28, 2007

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ACRONYMS

AMEC	AMEC Earth and Environmental
AOC	area of concern
AS	air sparge
bgs	below ground surface
COCs	chemicals of concern
CSXT	CSX Transportation, Inc.
CY	cubic yards
EPA	Environmental Protection Agency
FLUTe	Flexible Liner Underground Technologies, Ltd. L.C.
IRM	Interim Remedial Measure
ISCO	in-situ chemical oxidation
KMnO4	potassium permanganate
µg/kg	microgram per kilogram
µg/L	microgram per liter
µm	micrometer
MNA	monitored natural attenuation
NYSDEC	New York State Department of Environmental Conservation
PID	photoionization detector
QA/QC	quality assurance/quality control
redox	reduction/oxidation
RSCOs	Recommended Soil Cleanup Objectives
SCGs	standards, criteria, and guidance
SMP	Site Management Plan
STARS	Spill Technology and Remediation Series
SVE	soil vapor extraction
STL	Severn Trent Laboratory
TAGM	Technical and Administrative Guidance Memorandum
Tapecon	Tapecon, Inc.
TOGS	Technical and Operational Guidance Series
USACE	United States Army Corp of Engineers
USEPA	United States Environmental Protection Agency
ZVI	zero valent iron

1.0 INTRODUCTION AND BACKGROUND

AMEC E & E, PC (AMEC) was retained by CSX Transportation, Inc. (CSXT) to prepare this remedial action work plan which will summarize the site background, describe the field activities conducted during the interim remedial measures (IRMs) and subsequent investigation events, review feasible remedial action alternatives, and detail the proposed remedy to address the residual impacts to the environment resulting from the December 23, 2001 derailment of a CSXT freight train in Rochester, New York.

All work has been performed by CSXT under a Voluntary Cleanup Agreement, Index# B8-0608-0202, with the New York State Department of Environmental Conservation (NYSDEC) dated March 28, 2002.

An earlier draft of this document was submitted to the NYSDEC on November 18, 2005. On March 14, 2006, CSXT received comments from the NYSDEC presenting questions about the earlier draft of the RAWP. CSXT addressed the questions with a letter dated July 7, 2006 confirming incorporation of the suggested changes into the RAWP. CSXT's response letter has been included as **Appendix F**.

1.1 Site Description

The Site is located on River Street in the City of Rochester, County of Monroe, State of New York. The derailment occurred along the CSXT railroad tracks adjacent to the Monroe County Public Boat Launch where the tracks make a westward change in direction. The site is located in area comprised of mixed industrial/commercial properties with residential areas present to the west and south. **Figure 1** details the location of the Site.

1.2 Site History

On December 23, 2001, at 3:40 p.m., a CSXT train derailed in Rochester, New York, north of the Latta Road and River Street intersection. The train consisted of 43 cars (including two diesel locomotive engines) traveling north from Kodak Park towards the RG&E Russell Station when the accident occurred. The two engines and 28 additional cars derailed. A majority of the cars contained coal. However, two of the cars were tank cars that contained acetone and one was a tank car that contained methylene chloride. The tank cars derailed slightly northeast of the Tapecon, Inc. (Tapecon) manufacturing facility and approximately 100 feet to 150 feet west of the Genesee River. The area in which the acetone and methylene chloride was spilled is approximately one mile upstream from the mouth of the Genesee River. Approximately 14,000 gallons of acetone, 16,000 gallons of methylene chloride, and 3,000 gallons of diesel fuel were released to the environment.

1.3 Previous Field Activities/Investigations

1.3.1 Emergency Response Activities

Immediately following the derailment, emergency response activities commenced including fire suppression; diesel, coal, and plastic pellet cleanup; spill delineation and containment; continuous community air monitoring; and river water quality monitoring. For a complete description of the emergency response activities refer to the *River Street Derailment Interim Remedial Measure Report*, Shaw, March 10, 2003.

1.3.2 Interim Remedial Measures

An IRM work plan for impacted soils and groundwater was developed and implemented in the summer of 2002. The IRM activities included the excavation and disposal of approximately 28,000 tons of methylene chloride and/or acetone impacted soils and the removal and disposal of 1.4 million gallons of impacted water. The 2002 IRM activities were successful in removing the vast majority of impacted methylene chloride and acetone containing soils from the affected properties. For a complete discussion of the landside IRM activities please refer to the *River Street Derailment Interim Remedial Measure Report*, Shaw, March 10, 2003.

An IRM work plan for impacted sediment was also developed and implemented in the summer of 2004. The IRM activities included the excavation, dewatering, stabilization and disposal of approximately 3,950 tons of impacted methylene chloride and acetone containing sediments. The IRM activities were successful in removing the vast majority of impacted sediment from the river. For a complete discussion of the dredging IRM activities please refer to the *Dredging Interim Remedial Measure Summary Report*, AMEC, May 20, 2005.

1.3.3 Subsurface Investigation

Following the landside IRM activities, a subsurface investigation was conducted over the course of several months in the summer of 2004 to determine to what extent, if any, residual impacts remained in the landside subsurface.

The first phase of the investigation entailed a detailed soil gas survey, consisting of 34 soil gas points, of all areas of concern (AOCs), which was undertaken on June 21, and 22, 2004. The second phase of the investigation involved the installation of 18 soil borings, the collection of 40 soil samples, and the installation of 14 groundwater monitoring wells. Monitoring well installation and development was conducted between August 2 and August 11, 2004. The third phase of the investigation involved the installation of the Flexible Liner Underground Technologies, Ltd. L.C. (FLUTe™) dense non-aqueous phase liquid liners, hydraulic characterization of the aquifer and the first round of quarterly groundwater sampling. These events were conducted August 23 through August 26, 2004.

The investigation procedures and results of the investigation were documented in the *CSXT River Street Derailment Subsurface Investigation Report*, AMEC, May 6, 2005.

1.3.4 Supplemental Petroleum Investigation

AMEC conducted a supplemental subsurface investigation around the former Rochester Marine Fire Trailer to discern if any significant petroleum impacts were present at the Site. Petroleum impacts, of an unknown origin, had been discovered during the excavation of the southern portion of the Site. The area had been previously inaccessible for investigation due to the presence of the aforementioned fire trailer.

On December 2, 2004, AMEC and its drilling subcontractor, Parratt Wolff, advanced five soil borings to between 8 and 12 feet below ground surface (bgs). Neither volatile organic compounds nor semi-volatile organic compounds were detected above the NYSDEC Technical and Administrative Guidance Memorandum (TAGM) 4046 listed Recommended Soil Cleanup Objectives (RSCOs) in any of the samples collected.

The detailed investigation procedures and results of the investigation were documented in the *CSXT River Street Derailment Subsurface Investigation Report*, AMEC, May 6, 2005.

1.3.5 Supplemental Residual Investigation

AMEC conducted a three stage supplemental subsurface investigation during the fall 2006 and winter 2007 in order to determine where a pilot study could be conducted to evaluate the effectiveness of an in-situ amendment under field conditions. In the process, the supplemental subsurface investigation also determined the extent to which residual concentrations of the two COCs, acetone and methylene chloride, remained in the subsurface at the Site two years after completion of the initial subsurface investigation in 2004. Soil sampling events were conducted in October 2006, November 2006 and January 2007. The investigation consisted of advancing 36 borings utilizing direct push technology at or within close proximity to the locations where residual COCs had been documented during the initial 2004 subsurface investigation and the IRM confirmation sampling. Soil from each boring was screened at one foot intervals and a minimum of one sample was collected and sent for laboratory analysis from every four foot section.

Analytical data resulting from the supplemental subsurface investigation indicates that the remaining residual COCs are at much lower concentrations than previously reported in the May 6, 2005 Subsurface Investigation Report. Where percent reductions were able to be calculated, they demonstrated average reductions of over 97% in two to five years.

Included as **Appendix D** is the CSXT March 21, 2007 Pilot Study Baseline Sampling Summary Letter summarizing the findings from the three sampling events.

1.3.6 Quarterly Groundwater Monitoring

Quarterly groundwater sampling events have been conducted on the 14 monitoring wells by AMEC personnel since August 2004. The previous events took place on August 24, 2004, December 15, 2004, March 31, 2005, June 23, 2005, and September 14, 2005. Follow-up reporting was completed for each event and submitted to the NYSDEC.

The groundwater samples from all of the wells were analyzed for acetone and methylene chloride via the Environmental Protection Agency (EPA) method 8260. The groundwater from MW-5 was also analyzed for petroleum compounds by EPA method 8270 utilizing the NYSDEC Spill Technology and Remediation Series (STARS) list of compounds, as it is in the vicinity of the former Rochester Marine Fire Trailer.

1.3.7 Sediment and Surface Water Monitoring

Sediment monitoring occurred in ten separate sampling events, identified chronologically as Phases. Sediment samples were obtained from the Genesee River to determine the extent of impacts to the sediments and to monitor methylene chloride and acetone concentrations in sediments over time. Samples were collected from 79 locations throughout the course of the ten sampling events. In total, 370 samples were collected during these events to fully characterize the sediments adjacent to the landside of the derailment Site. Although various locations were sampled during each Phase of the sampling, a number of the sampling locations remained consistent throughout the Phases to monitor for possible migration or natural attenuation.

Surface water was sampled from the Genesee River on numerous occasions during the initial investigation, including the immediate response activities as well as subsequent monitoring events, in order to determine what the impacts of methylene chloride and acetone in the River might be. Although concentrations of methylene chloride and acetone in the River decreased to acceptable levels by January 4, 2002, additional monitoring events were conducted.

For a complete discussion of sediment and surface water monitoring activities please refer to the *River Street Derailment Interim Remedial Measure Report*, Shaw, March 10, 2003; *Remedial Action Selection/Design Report,* AMEC, October, 2 2003 and the *Dredging Interim Remedial Measure Summary Report*, AMEC, May 20, 2005.

1.4 Physical Characteristics

This section details the regional and site-specific geologic and hydrologic conditions identified during the implementation of the IRM and subsequent investigative activities for the River Street Site.

1.4.1 Regional Geologic Setting

The site is located along the floodplain of the Genesee River. The southern shores of Lake Ontario, near Rochester, New York, are underlain by Ordovician and Silurian sedimentary rocks. These units are representative of shallow marine environments that dominated the area approximately 425 million years ago. The Ordovician Queenston Shale is unconformable and overlain by the Silurian Medina Group throughout the greater Rochester area. The overburden soils overlying the area are mapped as glacial lakebed deposits (lacustrine) silts and clays (Muller and Cadwell, 1986).

1.4.2 Site Specific Geology

The River Street Derailment Site is located on the western bank of the Genesee River approximately one mile from the outlet to Lake Ontario. The Site is generally flat with a raised rail bed running approximately north-to-south through the Site. Subsurface soils vary depending upon the area of the Site. In general, the Site consists of between 19 and 35 feet of overburden material overlying the local bedrock. Bedrock in the area dips from the southwest to the northeast.

The overburden material varies throughout the Site. In general, the Site consists of four different areas that were excavated during the IRM activities. The first of these areas occupies most of the portion of the Site excavated during the IRM, and consists of between 4 and 20 feet of moderately sorted brown sands overlying organic rich silts. These silts are underlain by a tight, cohesive, tan-orange brown till which contains sub-angular to angular pebble sized matrix-supported clasts. Below the till, there is a red siltstone that is assigned to the Upper Ordovician Queenston Shale.

The second and third areas occupy the portions of the Site to the north and the south of the major excavations of the IRM. In those two areas, the soil types are similar to those described above, except that the first 4 to 6 feet of overburden consist of fill materials. Areas underlying the Tapecon property that were not excavated generally consist of tan, medium grained, moderately to well sorted, sands underlain by dense tills similar to those described above. This area lacks the organic rich silts observed on the east side of the railroad tracks.

The fourth area occupies the portion of the site that falls within the Genesee River and is comprised of accumulated sediments adjacent to the three landside areas. Collected sediments cores indicate that the upper 6 to 8 feet of the sediment consists of gray silty clay with occasional coarse material and bivalve shells. In some locations, below this stratigraphy, there is a well sorted coarse sand and pebble unit. This sand and pebble rich interval is more commonly found in borings near the center of the channel. The upper 2 to 4 feet of the sediment can be saturated. The bedrock consists of the Ordovician Queenstown Shale, which locally is a well cemented red siltstone.

1.4.3 Site Specific Hydrology

Fourteen monitoring wells, including four deep wells each nested with a shallow well, were installed at the Site to determine the extent of groundwater impacts, general aquifer characteristics, and groundwater flow direction.

Surface water at the Site generally flows from west to east towards the Genesee River. The hydrology of the Site has been affected by several factors since the derailment occurred in December of 2001. The factors include the following:

- Replacement and realignment of the utility corridors through the Site;
- Excavation of 28,000 tons of native soils and subsequent replacement of that material with moderately well sorted medium grained sands;
- Installation of a 225 feet sheet pile wall along the west bank of the Genesee River;
- Removal of that sheet pile wall to a depth of approximately 6.5 feet below mean high water along the riverbank; and
- The installation of a second sheet pile wall in the spring of 2005 for the City of Rochester waterfront revitalization project.

Since monitoring wells were not present onsite prior to the derailment, it is unclear exactly how these modifications to the Site may have effected groundwater flow, but it is assumed that groundwater would still have flowed from west to east across the Site towards the Genesee River even prior to the above discussed events.

A review of the groundwater data collected from onsite monitoring wells, indicate that there are two separate water bearing units present at the Site. The uppermost unit is an unconfined aquifer, which is typically intercepted between 6 and 10 feet below grade. This water-bearing interval is typically found in tan, moderately sorted, medium grained sands. Groundwater flow direction is generally west to east. Groundwater contours from the September 14, 2005 gauging event are illustrated on **Figure 2**.

The second water-bearing interval is observed near the top of bedrock between 18 and 20 feet below grade. This interval is typically observed in a thin (< six inches), very fine gray sand and clay lens. Groundwater flow in this zone appears to be from the northwest to the southeast towards the Genesee River.

Though these two water bearing intervals are separated through localized conditions (i.e., boring specific geology), they appear to be linked laterally across the Site. It is unclear if this was always the case at the Site, or if remedial activities including the IRM excavation and backfilling have provided pathways for groundwater to intermingle. The vertical gradient between the wells indicates the groundwater from the upper zone flows downward to the lower zones. Given the proximity to the River, groundwater around MW-8 and MW-6 has likely been affected by the excavation and removal of the original sheet pile wall and installation of the second one. Additionally, excavation around MW-6 has been observed to be greater than 6 feet below grade during City of Rochester improvement activities.

Slug test data collected from the Site indicates a moderate hydraulic conductivity (K values between 0.988-7.786 meters/day) for the formations. These values indicate the groundwater moves relatively freely throughout the formation.

Historical groundwater elevations are summarized in **Table 1**.

2.0 NATURE AND EXTENT OF RESIDUAL IMPACTS

2.1 Cleanup Objectives

Soil and groundwater analytical results for the chemicals of concern (COCs) generated during the various Site IRM actions were evaluated against site-specific cleanup levels derived from the two potentially applicable standards, criteria, and guidance (SCGs): NYSDEC TAGM 4046 RSCOs; and the NYSDEC Technical and Operational Guidance Series "TOGS-1.1.1" Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Concentrations.

The NYSDEC TOGS 1.1.1 identifies a guidance concentration of 50 micrograms per liter (µg/L) for acetone and a water quality standard concentration of 5 µg/L for methylene chloride. Since completion of the IRMs, there have been no exceedances of the applicable TOGS 1.1.1 groundwater quality standards and guidance.

As detailed above, during the initial IRM activities, residual COC concentrations were compared to the RSCOs as established by the applicable TAGM 4046 guidance document. The NYSDEC TAGM 4046 identifies a RSCO concentration of 200 micrograms per kilogram (µg/kg) for acetone and of 100 µg/kg for methylene chloride above the groundwater table and a calculated RSCO of 44 ug/kg and 40 ug/kg, respectively, below the groundwater table. The results of the IRM confirmation sampling, the 2004 subsurface investigation and the 2006/2007 supplemental subsurface investigation sampling indicate that exceedances of the applicable TAGM 4046 RSCOs remain.

The RAWP will also evaluate these residual soil concentrations in light of the Soil Cleanup Objectives (SCOs) detailed in Table 375-6.8 of the newly amended 6 NYCRR Part 375. Although the SCOs have been challenged in court, unless and until voided, they are the relevant and appropriate criteria to be considered. Table 375-6.8 sets forth the SCOs which are protective of public health for unrestricted and restricted use, protective of groundwater quality and protective of ecological resources. However, the protection of groundwater quality SCOs are not relevant and appropriate because the IRM remove the source of contamination, the area is served by public water, and there has not been an exceedance of the applicable groundwater quality standards and guidance since the completion of the IRM. In addition, because the soils containing the COCs are not accessible to wildlife, the protection of ecological resources SCOs are not relevant and appropriate.

As detailed in Table 375-6.8(a), the Protection of Public Health – Residential SCOs (Residential SCOs) for acetone is 100,000 ug/kg and for methylene chloride is 51,000 ug/kg. The protection of Public Health – Restricted Residential Use SCOs (Restricted Residential SCOs), which is applicable to multi-family housing, is 100,000 ug/kg for both acetone and methylene chloride. The SCOs for Protection of Public Health – Commercial (Commercial SCOs) for both acetone and methylene chloride is 500,000 ug/kg.

The site-specific cleanup levels for sediment quality were developed and set forth in the Department-approved *Evaluation of Methylene Chloride and Acetone in Genesee River Sediments Associated with CSXT Derailment and Chemical Spill at Charlotte, New York*, May 9, 2002 by Shaw Environmental, Inc. In the document, Shaw identified that NYSDEC did not have an equilibrium partitioning based sediment criteria for polar organic chemicals such as acetone and methylene chloride. Based on the Tier II benchmarks published by Suter and Tsao (1996) for estimating the likelihood of toxicity to aquatic invertebrates, site-specific sediment cleanup levels of 773 ug/kg for acetone and 1,133 ug/kg for methylene chloride were established.

2.2 Areas of Concern

2.2.1 Initial Post IRM AOCs

Based on analytical collected during the IRM and 2004 subsurface investigation activities, four AOCs were identified as having residual concentrations of methylene chloride and acetone that exceeded the identified site-specific cleanup levels. The on-land AOCs, as illustrated on **Figure 3**, that exceeded the NYSDEC TAGM 4046 RSCOs are: (1) Soils in the vicinity of the CSXT railroad tracks (Tracks AOC); (2) soils located in the north end of the Tapecon parking lot (N. Tapecon AOC); and (3) soils in an area on the City of Rochester property (East AOC). Analytical results for the landside AOCs as identified during the IRMs are identified in **Table 2.**

The fourth AOC, which is illustrated on **Figure 4,** consists of the impacted river sediments that did not meet the established SCG of 1,133 ppb for methylene chloride and are. **Table 3** details the analytical results pertaining to the river sediments.

In addition, IRM sample results containing residual concentrations collected by the City have been included as **Table 6.**

These AOCs were addressed during both IRMs but closure was not obtained due to limiting factors such as; limited track down time, track bed stability, excavation sidewall stability, utilities, groundwater, sediment density and sheetpile wall stability.

2.2.2 Revised AOCs

A further evaluation of the Site's on-land residuals was conducted in the fall 2006 and winter 2007 through a focused supplemental subsurface investigation. The investigation was conducted by collecting soil samples at each of the locations where either CSXT or the City had identified residual COCs during the IRM or the 2004 subsurface investigation activities detailed above. Soil was collected at 36 locations from the depths where residuals were identified. Soil was collected in four foot sections and was evaluated at one foot intervals; documenting PID headspace readings, soil types, color, presence of moisture and other general characteristics. Following the initial field screening, one sample was collected per four foot interval for laboratory analysis.

Review of the analytical data generated during this supplemental subsurface investigation identified that significant degradation of the residual COCs occurred and likely continues. The degradation process has effectively reduced the concentrations of residual COCs in the Track and East AOCs in half and eliminated the residual COCs in the N. Tapecon AOC. A complete detail of this investigation has been included as **Appendix D.** In addition, included as a summary of the revised residual concentrations is **Table 7** and detailed on **Figure 7** are the associated residual sample locations.

Each AOC is described in more detail in the following subsections.

2.2.3 North Tapecon Residual Impacts (former N. Tapecon AOC)

Initially, residuals were identified on the Tapecon property in the northwest corner of the parking lot where a shallow excavation was completed during the land based IRM. Post excavation sampling results, included on **Table 2,** identified residuals at the bottom of the excavation approximately 6 feet bgs and on the southern sidewall at 5 feet bgs (Tape-Nexc-BOT-6.5' and Tape-Nexc-SSW5'). The lateral and vertical extent of this portion of the excavation was previously agreed upon by Haley & Aldrich, Tapecon's engineer, and was limited by the structural stability of the excavation due to excessive water influx.

Subsurface sampling events conducted in August 2004 and October 2006 evaluated existing soil conditions at nine locations in and around the former N. Tapecon AOC. Analytical results from those events have proven that the previously identified residuals from the land based IRM have effectively degraded since their initial November 2002 sampling. Because the COCs in the former N. Tapecon AOC now meet the applicable RSCOs, the area is no longer of significance and subsequently not being considered for any further remediation.

2.2.4 CSXT Railroad Tracks Residual Impacts (Track AOC)

It was agreed upon during the IRM, prior to removing the tracks that due to the presence of shallow groundwater (4 to 5 feet), excavation in this area would be limited to a depth of 5 to 6 feet bgs. Based on the bottom samples collected following excavation activities, the majority of residual impacts were quantified in the soils beneath the railroad tracks at depths greater than 6 feet. However, track excavation sidewall closure samples from the western limits indicate residual concentrations at depths between 3 to 4 feet. These impacts are limited in nature and will be addressed through the selected remedial measure.

The closure samples collected from the track excavation indicated that the soils exhibiting the highest remaining concentrations were found in the area of the Track 4 and Track 5 samples, specifically the sidewall samples labeled Track 4 SW and Track 5 SW samples (**Table 2**). CSXT attempted to remediate these areas as part of the Tapecon IRM excavation. The impacts located at Track 5 SW were able to be removed during the excavation of the northern sheet pile cell during IRM activities. However, the Track 4 SW sample location was located outside, to the east, of the southern excavation cell. This area was addressed with a four-foot excavation of the area to remove as much impacted soil as possible. Unfortunately, an underground gas line in the area limited the ability to excavate below this depth. Additionally, soil samples taken from 9 and 12 feet bgs at SB-11 during the subsequent subsurface investigation illustrate the elevated levels of methylene chloride and acetone remaining in vicinity to the tracks. **Figure 3** illustrates the original Track AOC as defined by the IRM sampling.

Following the 2006/2007 supplemental subsurface investigation residual sampling event, the Track AOC has been re-defined. Although somewhat diminished and segmented, it still encompasses several of the IRM sampling locations. However, the core area where the majority of residual concentrations are focused has been reduced and is primarily defined by GP-4, GP-5, GP-9 and SB-11 as identified on **Figure 7**.

2.2.5 East of Railroad Tracks Residual Impacts (East AOC)

While clean sidewalls and bottom samples were achieved throughout most of the IRM ‘main’ excavation, primarily located on the City of Rochester property east of the railroad tracks, it was not practicable to remove some of the impacted soils and they were left in place. The excavation, nevertheless, was generally continued in each direction until all of the impacted material was removed. The remaining residual soils were left in place due to issues regarding either the structural stability of the excavation because of running sands and excessive water influx, or to protect the stability of the railroad tracks, prevent damage to utility poles and/or guard against damage to the underground gas line.

IRM confirmation sample results from both the City and CSXT identified the East AOC as an area of the Site where residuals remained at levels above RSCOs. Several of those locations were identified as being minimally above the RSCOS and, although a majority of the samples collected by City do not overlap with the sample collected by CSXT (**Figure 3**), an area where they do, is around the utility pole (Telpole B11') located near MW-7. Residuals remain in this area as a result of soil removal being limited to a depth of 10 to 12 feet below grade which represents the depth at which water began to influx into the excavation. It was agreed upon by CSXT and the NYSDEC agreed to the removal of the majority of the impacts while limiting the possibility of damage to the adjacent gas line and preserve the structural stability of the railroad tracks immediately to the west. Bottom samples were taken and the area immediately backfilled.

Following the 2006/2007 supplemental residual sampling event, it was determined that, of the residual areas for the East AOC as identified by the City and CSXT during the IRM, the area around GP-32 / Telepole-B11' and an area around GP-38 are the only ones remaining with concentrations above RSCOs as identified on **Figure 7**.

2.2.6 Groundwater

To date, no groundwater samples collected during the quarterly sampling events from the 14 monitoring wells have exhibited concentrations of acetone or methylene chloride above the NYSDEC TOGS 1.1.1 guidance concentration for acetone of 50 ug/L or the standard for methylene chloride of 5 ug/L.

A summary of the groundwater analytical data is included in **Table 4**.

2.2.7 Sediment

A design quantity of 3,000 cubic yards (CY) of sediment was to be removed. Based on disposal certificates, 2,856 CY was actually removed. This is 95 percent of the project goal. Factors that made the removal of the remaining impacted sediment infeasible were:

- Concerns with the stability of the sheet pile wall and shoreline prevented deeper excavations along the riverbank.
- The density of the deeper sediments within the riverbed prevented further removal at depth with the environmental clamshell dredge.
- Methylene chloride is the primary COC and it does not readily bind to sediment.

Based on initial IRM closure sediment sampling, two of the 10 closure sample locations exhibited concentrations that exceeded the site-specific cleanup levels of 773 ug/kg for acetone and 1,133 ug/kg for methylene chloride. Closure samples DC-4 and DC-8 were identified as being above the cleanup levels at 24,000 and 1,900 ug/kg methylene chloride, respectively. DC-4 is located outside the navigational limits and will not be disturbed by current United States Army Corp of Engineers (USACE) maintenance dredging protocol. Also, DC-4 is at an elevation of 218.3 feet IGLD 85 that is only 0.4 feet above the 217.9 feet IGLD 85 target and within the specified +/- 0.5 foot construction tolerance. Closure sample DC-8 is located within the channel limits, but at a depth three feet below the USACE dredge elevation (221.3 feet IGLD 85). Therefore, the residual methylene chloride contained in that sediment should not be disturbed by current USACE maintenance dredging protocol. Also, DC-8 exhibited a methylene chloride concentration that was within the same order of magnitude as the 1,133 ug/kg site-specific cleanup level.

Because these two dredging closure sample locations exhibited residual methylene chloride above the site-specific cleanup level, CSXT implemented additional monitoring in April 2005. Sediment samples were collected from a total of six locations: SS-19A, SS-15, SS-24, DC-4/SS-90, DC-8/SS-89, and SS-88. Samples DC-4/SS-90, SS-19A and SS-88 were identified as having elevated concentrations of methylene chloride. As stated above, DC-4/SS-90 is outside of the navigational channel limits. Its concentration of 2,400 ug/kg, was also a full order of ten magnitude lower than that detected in the October 2004 closure sample. Although sample SS-19A is within the navigational limits, like DC-8/SS-89, it is located below the USACE dredging limit (221.3 feet IGLD 85) at an elevation of 220.7 feet IGLD 85. Further, additional dredging in the vicinity of SS-19A is unlikely, as the area of SS-19A must be maintained at a 4H:1V slope to ensure upland stability of the riverbank. The sample collected at the two feet depth interval at SS-88 did not meet the 1,133 ug/kg site-specific cleanup level. However, the upper sample collected at SS-88, taken 0.5 feet below the sediment surface, met the site-specific cleanup level. The elevated sample from SS-88 is at an elevation of 217 feet IGLD 85 which is 4.3 feet below the USACE maintenance dredge depth of 221.3 feet IGLD 85.

Table 3 identifies the residual sample identification numbers and their corresponding historical analytical results. **Figure 4** illustrates the locations of the exceedances.

2.3 Potential Migration and Exposure Pathways

2.3.1 Soil

The Tapecon property and the property owned by CSXT are the only properties where residual impacts were left in place at depths less than 8 feet below grade. However, natural attenuation of the residual COCs in the subsurface has occurred, and now the footprint for the residuals on the Tapecon property is minimal. The residual COCs are also covered by clean backfill and an asphalt parking lot, providing a barrier for human exposure. Although the Tapecon property is currently used for commercial/industrial purposes, and appears to have hazardous substance impacts associated with that use, it is possible that the Tapecon property could be used for multi-family residential development in the future.

The CSXT property is exclusively used as an active rail line. Exposure to the residual chemical impacts at depth in the Track AOC area is limited by approximately 4 to 6 feet of clean fill, the structure of the tracks and ballast, and the frequent train traffic. It is highly unlikely that the property will be used as residential property in the foreseeable future.

Any residual impacts in soils to the east of the tracks in the East AOC are isolated from human exposure by a layer of clean fill of approximately 12 feet in depth. In many areas of the excavation, an asphalt cap in the form of River Street provides additional protection. Further, CSXT also attempted to restore the original hydraulic barrier between the variable groundwater on the Tapecon property and the main excavation. This was attempted by installing plastic sheeting and clay soil along the western excavation wall as the excavation was backfilled. This effort, together with the significant excavation and removal of impacted soil is likely to provide additional protection ensuring the safe reuse of the property for residential or recreational uses.

2.3.2 Sediment

The ten sampling events that have been conducted since the December 2001 derailment for the purposes of both defining and monitoring the plume in the sediment have detected no evidence of lateral mobility of the site COCs. The potential for mobility has been further significantly reduced as a result of the dredging IRM which removed 2,856 CY (3,950 tons) of potential source material. River water quality samples have shown that water quality has not been affected by the site since the initial derailment. The concentrations of methylene chloride and acetone in the water have been below sample quantitation limits for the past five sampling events.

Residuals remaining within the sediments of the Genesee River are a minimum of 15 feet below the mean low water elevation of 243.4 IGLD 85 providing a barrier from human contact. As identified in the *Dredging Interim Remedial Measure Summary Report*, AMEC, May 20, 2005 residual sediments are either outside the USACE navigational dredging limits or below the specified dredge depth of 221.3 IGLD 85 significantly reducing the potential for disturbance. There is minimal risk of remobilization as a result of USACE dredging.

Previously conducted benthic macroinvertebrate and bio assay studies were utilized to evaluate the relationship between sediment toxicity and survival of organisms within those sediments. During each study the conclusion was that the site COCs did not have an adverse affect.

There is minimal risk for exposure or for increased mobility. The sediments are isolated.

3.0 SOIL REMEDIAL ALTERNATIVES EVALUATION

Although the residual impacts in the three AOCs are limited in nature and human exposure appears unlikely, the residual impacts exceeded the TAGM 4046 RSCOs indicating that the impacted soils may hold the ability to impact the unrestricted use of the groundwater at the site. This warranted a review of remedial alternatives to determine if an effective remedy could be readily implemented.

Soil alternative remedial actions identified for review were:

- Monitored natural attenuation (MNA)
- Excavation of AOCs
- Air sparge/soil vapor extraction (AS/SVE)
- Ozone sparge/SVE
- Enhanced bioremediation
- In-situ chemical oxidation (ISCO)
- In-situ heating/SVE

3.1 Preliminary Screening of Soil Alternatives

A preliminary screening of the remedial alternatives was conducted to narrow the list of potential alternatives to be evaluated. The criteria for this screening included effectiveness and implementability.

Based on this review, the following alternatives for the soils were eliminated:

- Excavation of AOCs
- AS/SVE
- Ozone sparge/SVE
- In-situ heating/SVE

3.1.1 Excavation

Excavation was not considered a viable alternative for the three AOCs due to the implementability issues discussed above that resulted in these impacted soils being left in place.

Removal of the residual soil impacts beneath the CSXT railroad tracks would require the disruption of rail traffic for an extended period of time due to the fact that accessing the impacted soils would require the disassembly of 175 feet of rails, cross-ties, and ballast. Additionally, approximately 4 to 6 feet of clean fill would need to be excavated along the length of the impacted zone and staged for replacement following the excavation of impacted soils. It would also be necessary to install a bracing system to remove soils to depth because of:

- The poor soil conditions and presence of groundwater;
- Close proximity of several utilities both above and below grade;
- Close proximity of the Tapecon manufacturing facility; and
- Close proximity of sidewalks, River Street, lighting, etc.

The primary residual impacts identified east of the railroad tracks are located within the River Street right of way below asphalt, sidewalks and utilities. These impacts were identified between the depths of 12 and 17 feet below grade. Accessing these impacts through excavation would require the removal of River Street pavement, potential utility interruptions, detouring of the traffic as well as the excavation of 311 cubic yards of clean backfill to access approximately 130 cubic yards of impacted soil. Excavation is not a viable solution to addressing the impacts under these conditions.

3.1.2 Air Sparge/Soil Vapor Extraction of Soils

AS/SVE technology would not be a highly effective nor readily implementable option.

AS/SVE technology exhibits some similar characteristics to excavation, although on a smaller scale. In order to implement AS/SVE, it would be necessary to install several injection and extraction points interconnected with a series of trenches that would traverse the affected areas. The fact that there are three separate AOCs further complicates the installation process. In order to construct the required subsurface piping system and wells, the railroad tracks, Tapecon parking lot and the recently completed River Street (redevelopment project) would be disturbed and require restoration. Suspension of, or impacts to, the rail and vehicular traffic would be unavoidable for extended periods of time. In addition, logistical issues, such as installing several thousand linear feet of system piping and wells in such a manner to avoid existing utilities throughout the area, would need to be addressed. Implementation of an AS/SVE system would require long term maintenance and operation activities since the treatment time frame may take up 3 to 5 years. It would also be necessary to procure a secure and inconspicuous location from which the system can operate. Future disturbances are probable to address sections of the piping network requiring replacement or repair.

3.1.3 Ozone Sparge/Soil Vapor Extraction of Soils

Ozone sparging would be more effective and efficient in treating the residual impacts than AS technology. However, volatile organic carbon vapors may be generated as a result of ozone sparging and the strong oxidation reactions. As a result, vapor control equipment (e.g., a SVE and treatment system) is often needed to operate in conjunction with the ozone sparging system to capture and prevent the vapors from migrating to, entering and impacting subsurface utilities or nearby structures. Ozone has a very short half life in the subsurface so this approach would require numerous injection locations and would continue for a longer period of time than other oxidation options in order to achieve RSCOs. Therefore, the implementability issues of installing a SVE system exist as well as, major health and safety concerns for the workers and community during with the handling, injection, and treatment using ozone.

3.1.4 In-situ Heating/Soil Vapor Extraction of Soils

In-situ heating is an effective, but costly, remedial alternative, better suited for free product and lower permeable scenarios. As with the AS and ozone sparging, an SVE system would be required to capture the volatilized chemicals. Installation of the SVE and heating system would create the same implementability and logistical issues as discussed in the previous sections.

3.2 Focused Evaluation of Soil Alternatives

The following remedial alternatives were selected for further evaluation and applicability:

- MNA
- Enhanced bioremediation
- ISCO

3.2.1 Monitored Natural Attenuation

MNA relies on natural attenuation processes to achieve site-specific remediation objectives within a time frame that is reasonable compared to that offered by other more active methods. The 'natural attenuation processes' that are at work in such a remediation approach include a variety of physical, chemical, or biological processes that, under favorable conditions, act without human intervention to reduce the mass, toxicity, mobility, volume, or concentration of impacts in soil or groundwater.

MNA for the Site would consist of no further action other than the continuation of the on-going quarterly groundwater monitoring events and the implementation of institutional controls as part of a Site Management Plan (SMP).

3.2.2 Enhanced Bioremediation

Enhanced bioremediation is the stimulation of naturally occurring microbes by distributing liquid or gaseous amendments through impacted soils to enhance in situ biological degradation of organic impacts. Nutrients, oxygen, or other amendments may be used to enhance biodegradation and chemical desorption from subsurface materials.

A patented combination of slow-release oxygen, major-, minor-, and micro-nutrients, and a pH buffering agent like EHC-O™ is the proposed enhanced bioremediation amendment for the Site. This unique combination of materials facilitates the aerobic bioremediation of soils, sediment or groundwater environments impacted by various organic and inorganic compounds. For organic constituents amenable to aerobic biodegradation processes (e.g., petroleum hydrocarbons, certain pesticides/herbicides, solvents, etc.), EHC-O™ significantly stimulates the catabolic activity of the indigenous microflora, thereby accelerating the rate of constituent degradation and removal of the residual COCs. The COCs are solvents that are amenable to the aerobic biodegradation process and the EHC-O™ is anticipated to accelerate their removal.

3.2.3 In-situ Chemical Oxidation

ISCO involves the addition of a liquid oxidizing agent(s) to the subsurface to facilitate reactions that chemically convert hazardous chemicals to non-hazardous compounds that are more stable, less mobile, and/or inert. Complete mineralization to carbon dioxide and water is the desired endpoint of an ISCO process.

Two of the most common oxidizing agents were considered to address the residual soil impacts: Potassium permanganate (KMnO4) and Fenton's reagent.

Fenton's reagent is produced on site by adding an iron catalyst to a hydrogen peroxide solution. An injected 10 percent solution of peroxide is common for this application. A pH adjustment may be needed, as Fenton's reagent is more effective at acidic pH. For permanganate application, a 1 percent to 4 percent solution is prepared on site from KMnO4 crystals that are delivered in bulk to the site.

The most common oxidant delivery method involves the injection of oxidants through constructed wells. A patented process is used to inject the Fenton's reagent.

Some well documented drawbacks do exist for ISCO.

- Subsurface heterogeneity can cause uneven distribution of oxidants. There is no control of the subsequent movement of the oxidant after its release.
- Injection wells may eventually become clogged from entrained silt, biological growth, mineral precipitates, or other factors.
- Porosity of the subsurface may be reduced due to the formation of metal oxide precipitates.
- ISCO most often requires more than one application of oxidant to address rebound effects.

- With ISCO systems using $KMnO_4$, the pH of the system must be between 3 and 10 and the rate of the reaction increases with higher oxidant-to-contaminant loading rates. With ISCO systems using Fenton's Reagent, reduction of pH to levels between 4 and 5 is needed. Naturally occurring buffering agents, such as carbonates, may prevent pH from being reduced to this level.
- Hydrogen peroxide in Fenton's reagent decomposes rapidly before it travels far from the well. Anaerobic bioremediation can be impeded when oxygen from the hydrogen peroxide is introduced in the treatment zone.
- Fenton's reagent is inhibitory to microbial populations around the injection points. These populations return to normal over time, but are temporarily disrupted.
- ISCO requires strict health and safety procedures for high-pressure injection. For Fenton's reagent, care should be given for exothermic reactions (i.e., release of heat) and handling hydrogen peroxide.

3.3 Comparative Analysis

Each of these alternatives was evaluated comparatively with respect to the criteria identified in 6 NYCRR Part 375 with the exception of cost and community acceptance. Specifically, the evaluation criterion includes:

- Protection of human health and the environment
- SCGs
- Short-term effectiveness and impacts
- Long-term effectiveness and permanence
- Reduction of toxicity, mobility, or volume
- Implementability

3.3.1 Protection of Human Health and the Environment

Each of the alternatives has the ability to protect human health and the environment. Currently no exposure pathways exist as each AOC is protected by four to 12 feet of clean fill and active railroad tracks or asphalt pavement. Implementation of either in-situ technology would not create exposure pathways and would reduce, if not eliminate, residual soil impacts. Selection of MNA would require the execution of institutional controls in the form of a SMP to ensure exposure pathways were properly managed during any future sub-grade disturbances.

3.3.2 Standards, Criteria, and Guidance

The SCGs for soils and groundwater at the River Street site are the NYSDEC TAGM 4046 RSCOs and the NYSDEC TOGS 1.1.1. Specifically, the NYSDEC TAGM 4046 RSCOs identify concentrations of 200 μg/kg for acetone and 100 μg/kg for methylene chloride above the groundwater table, and calculated RSCOs of 44 ug/kg and 40 ug/kg, respectively, for soils below the groundwater table. The NYSDEC TOGS 1.1.1 guidance is 50 μg/L for acetone and the NYSDEC TOGS 1.1.1 standard is 5 μg/L methylene chloride. At this point, soils exceed the TAGM 4046 RSCOs in the two remaining land side AOCs, but the TOGS 1.1.1 guidance and standard have been achieved.

In addition, to the applicable RSCO guidance values established by TAGM 4046, the newly amended Table 375-6.8(b) details the relevant and appropriate Residential SCOs and Restricted Residential SCOs which will also be evaluated as benchmarks for the RWAP. The Residential SCOs for acetone and methylene chloride are 100,000 ug/kg and 51,000 ug/kg respectively and the Restricted Residential SCOs for both acetone and methylene chloride is 100,000 ug/kg.

Enhanced bioremediation and ISCO has the potential to achieve the site SCGs within a timely manner (<2 years). MNA, however, does not actively address the residual impacts and relies solely on the passive physical and biological mechanisms in the subsurface to degrade the acetone and methylene chloride to acceptable levels. An attainment time frame is estimated between 5 and 10 years.

3.3.3 Short-term Effectiveness and Impacts

Since no actions would be implemented for MNA, no short-term risks to workers, the community, or the environment would be presented as a result of construction activities.

The enhanced bioremediation amendment, EHC-O™, is an oxygen release product that will pose no short-term risks to workers, the community, or the environment during application. Standard safety and operating procedures must be followed by the equipment operators and workers during injection of the amendment. Level D personal protective equipment (PPE) and air monitoring will be required. Migration of the material will not be an issue. Once the slurry is injected, it will be forced away from the injection point approximately 5 to 10 feet. The slurry will begin to breakdown and will release oxygen, nutrients, and buffer that will move an additional 5 to 10 feet. In the saturated zone, oxygenated groundwater will travel downgradient where microbial activity will be stimulated and the degradation of methylene chloride and acetone will occur. In the unsaturated media, distinct zones of activity will be created and will not migrate far from the point of injection. Achievement of the SCGs should be realized between 12 to 18 months following application.

The ISCO treatment timeframe associated with using the KMnO4 oxidant are very similar to EHC-O™ however, due to the likelihood of rebound, multiple injections may be required to meet the SCGs. Additionally, three properties warrant concern. First, KMnO4 is derived from mined potassium ores which, by their nature, typically contain salt and metal impurities (e.g., arsenic, chromium, lead). Second, KMnO4 is a strong oxidant and should be applied carefully. Third, KMnO4 in flowable form contains silica, which can accumulate in wells and plug the screen. As with other chemical oxidation technologies, the success of its use relies heavily on its ability to come into contact with the site impacts. The delivery mechanism must be capable of dispersing the oxidant throughout the treatment zone.

Fenton's reagent could provide rapid (6 to 12 months), aggressive treatment of the residual methylene chloride and acetone. Since Fenton's requires the proper balance of two to three chemicals to be effective, achieving the proper balance is critical to provide the desired results. This can be hard to accomplish. Like KMnO4, the success of its use relies heavily on its ability to come into contact with the site impacts and due to rebound effects may require multiple injections to meet the SCGs. Significant safety measures are necessary to ensure the safety of the workers, community and the environment. On-site reactive chemical handling and storage are required. Application of Fenton's reagent can produce gases if not carefully managed. Therefore, there is an increased risk of fugitive vapors entering building structures, and utility conduits. Fenton's may also significantly alter aquifer geochemistry and cause clogging of aquifer through precipitation of minerals in pore spaces.

3.3.4 Long-term Effectiveness and Permanence

MNA would not reduce the long-term risk of direct contact with the impacted soils. However, the volume and toxicity of the impacted media would gradually decrease over an extended period of time through natural degradation and attenuation. Redevelopment of the AOC and changes in the usage could present an increased potential for risks to human health and the environment.

Both enhanced bioremediation and ISCO technologies would provide a permanent long-term remedy.

3.3.5 Reduction of Toxicity, Mobility, and Volume

MNA would permit the volume and toxicity of impacted soils to gradually decrease over an extended period of time. It is reasonable to expect this process to take no longer than 30 years given the current conditions. Currently, there are no known direct exposure routes to the impacted subsurface soils. Each area is covered with between 5 and 12 feet of clean fill and capped with asphalt or an active railway line.

Reduction of toxicity and volume would be realized with the implementation of enhanced bioremediation and ISCO due to various destructive mechanisms. Significant reduction of the COCs would be most rapid with Fenton's (6 - 12 months). EHC-O™ and KMnO4 treatment duration is 12 to 18 months.

Mobility of impacts and/or reaction off-gases is possible with ISCO, thereby creating a risk of fugitive vapors to enter near-by building structures, and utility conduits. Migration of the EHC-O™ material will not be significant. Once the slurry is injected, it will be forced away from the injection point approximately 5 to 10 feet. Oxygen will emanate from the slurry and will move away an additional 5 to 10 feet and will be carried by groundwater until it is completely utilized.

3.3.6 Implementability

No construction would be required to implement the MNA alternative. Subsequently, technical feasibility and performance are not an issue.

Implementation of both in-situ technologies would require: Procurement of a right-of-way permit with the City of Rochester and an access agreement with Tapecon; preparation and implementation of a traffic plan; coordination of track protection; careful evaluation of above and below ground utilities and obstructions; and an area for equipment staging and product mixing.

Special precautions would be required during the storage, handling, and application of ISCO oxidizers. On-site reactive chemical handling and storage are required. Application of Fenton's reagent can produce significant quantities of explosive off-gas. Therefore, there is an increased risk of fugitive vapors entering building structures, and utility conduits.

3.4 Remedy Selection

Based on the focused evaluation and comparative analysis described in the previous sections of this report, enhanced bioremediation, utilizing EHC-O™ is the proposed remedy.

This alternative is a permanent, effective, safe and readily implementable technology that can significantly reduce or eliminate the COCs in a relatively short time frame without adversely affecting the community and environment.

4.0 SEDIMENT REMEDIAL ALTERNATIVES EVALUATION

Although the residual sediment impacts are limited in nature and human exposure appears highly unlikely, the residual impacts remaining in hot spots within the sediment AOC exceed the site-specific cleanup levels and warranted a review of remedial alternatives to determine if an effective remedy could be readily implemented.

Sediment alternative remedial actions identified for review were:

- No further action
- Natural attenuation with institutional controls
- Dredging

4.1 Preliminary Screening of Sediment Alternatives

The remedial alternatives identified were discussed in the *Remedial Action Selection/ Design Report* prepared by AMEC (October 2003) for the IRM sediment activities. Each alternative will be evaluated below.

4.2 Focused Evaluation of Sediment Alternatives

The remedial alternatives were evaluated to assess their applicability.

4.2.1 No Further Action

No further action, as the name implies, entails that no further active remedial measures will be implemented to achieve the sediment site-specific cleanup levels nor will the natural attenuation processes be monitored. Nevertheless, it is recognized that natural attenuation processes will be at work. The natural attenuation processes at work in such a remediation approach include a variety of physical, chemical, or biological processes that, under favorable conditions, act without human intervention to reduce the mass, toxicity, mobility, volume, or concentration of impacts in soil, sediments or groundwater.

4.2.2 Natural Attenuation with Institutional Controls

The ‘natural attenuation with institutional controls’ remedial alternative is similar to the ‘no further action’ remedial alternative in that the remediation approach includes a variety of physical, chemical, or biological processes that, under favorable conditions, act without human intervention to reduce the mass, toxicity, mobility, volume, or concentration of impacts in soil or groundwater. In addition, however, this remedial alternative includes the institutional control of a Sediment Management Plan (SMP). The SMP protects workers, the community, and the environment in the event the sediments containing residual levels of the COCs were to be disturbed.

4.2.3 Dredging

Dredging would involve the removal of the residual impacts through the use of a general dredging technology such as mechanical, hydraulic or excavation in the dry. If dredging were selected the available technologies would be evaluated for this site and the appropriate selection implemented.

Implementation of additional dredging would require an extensive review of available technologies and implementability because the dredging IRM was completed to the extent feasible as detailed in the May 20, 2005, Dredging Interim Remedial Measure Summary Report. Limiting and controlling factors are: stability of the shoreline and river bank, density of the deeper sediments, disruption to the redeveloped water front, and reestablishment of infrastructure considered necessary to complete the project. As with the IRM that was already implemented at the site, dredging operations would require another extensive mobilization of equipment and intensive preparations including: attaining an acceptable lay down area; the preparation of a sediment processing/offloading area; installation of a temporary haul road; shoreline preparation; setup of site facilities (construction trailer, power, telephone, decontamination stations and water treatment system); and installation of fencing.

Engineering controls (turbidity barrier, closed bucket, etc.) would be employed, as during the IRM, to minimize the release of COCs during the remediation process as dredging could cause the short-term release of COCs from sediments during the remediation work.

River, community, and work area environmental media monitoring as well as permitting would also be required.

4.3 Comparative Analysis

Each of these alternatives was evaluated comparatively with respect to the criteria identified in 6 NYCRR Part 375 with the exception of cost and community acceptance. Specifically, the evaluation criterion includes:

- Protection of human health and the environment
- SCGs

- Short-term effectiveness and impacts
- Long-term effectiveness and permanence
- Reduction of toxicity, mobility, or volume
- Implementability

4.3.1 Protection of Human Health and the Environment

Each of the alternatives has the ability to protect human health and the environment. Currently no exposure pathways exist as each residual sediment location is either located at least 15 feet below the surface, and outside the navigational channel or below USACE dredge limits. Further, historical river water quality analytical results have verified that the residual COCs in the sediment are not adversely affecting the water column above them.

Implementation of either the ‘no further action’ or ‘natural attenuation with institutional controls’ would not create exposure pathways unless future development or revised USACE dredging protocol results in the disturbance of the residual sediment impacts. Selection of ‘natural attenuation with institutional controls’, in the form of a SMP, would further mitigate against exposure pathways being inadvertently created by properly managing any future disturbances.

Dredging could potentially cause the short-term release of COCs especially from the denser sediments, during the remediation work. Engineering controls (turbidity barrier, closed bucket, etc.) would be required to mitigate the release of COCs during the remediation process.

4.3.2 Standards, Criteria, and Guidance

The site-specific cleanup levels for sediments approved by the NYSDEC and the USACE are 773 ug/kg for acetone and 1,133 ug/kg for methylene chloride. River water quality must comply with the NYSDEC TOGS 1.1.1 guidance of 50 µg/L for acetone and the NYSDEC TOGS 1.1.1 standard of 5 µg/L methylene chloride.

Dredging has the potential to achieve the site-specific cleanup levels over the long-term, but exceed the site-specific cleanup levels for river water quality in the short-term. Neither ‘no further action’ nor ‘natural attenuation with institutional controls’ actively addresses the residual impacts and both rely solely on the passive physical and biological mechanisms in the subsurface to degrade the acetone and methylene chloride to acceptable levels. An attainment time frame is estimated between 15 and 30 years.

4.3.3 Short-term Effectiveness and Impacts

Since no actions would be implemented for the 'no further action' and the 'natural attenuation with institutional controls' options, no short-term risks to workers, the community, or the environment would be presented as a result of construction activities.

Dredging could potentially cause the short-term release of COCs from sediments to the water column during the remediation work. Engineering controls (turbidity barrier, closed bucket, etc.) would be required to mitigate the release of COCs during the remediation process. Real-time community, work zone, and river water monitoring would be required to ensure dredging operations either did not result in, or minimized, the exceedance of the action levels.

4.3.4 Long-term Effectiveness and Permanence

'No further action' would not reduce the potential risk of direct contact with the impacted sediments for a number of years. However, the volume and toxicity of the impacted media would gradually decrease over an extended period of time through natural degradation and attenuation. Disturbance of the residual locations as a result of changes in the USACE dredging protocol could present an increased potential for risks to human health and the environment.

'Natural attenuation with institutional controls' would not reduce the potential risk of direct contact with the impacted sediment for a number of years. However, the volume and toxicity of the impacted media would gradually decrease over an extended period of time through natural degradation and attenuation. Disturbances of the residual locations would be managed by the SMP to mitigate risks to the workers, community, and the environment.

Assuming that dredging could be effectively implemented, it would provide a permanent long-term remedy following the attainment of the site-specific cleanup levels.

4.3.5 Reduction of Toxicity, Mobility, and Volume

'No further action' and 'natural attenuation with institutional controls' would permit the volume and toxicity of impacted soils to gradually decrease over an extended period of time. It is estimated that this process would take no longer than 30 years. The remaining impacted sediment does not appear to be mobile. Currently, there are no known direct exposure routes to the impacted sediments. Future disturbances of the residuals could result in the mobilization of the COCs. The SMP would manage the implementation of the disturbances if the 'natural attenuation with institutional controls' were to be implemented.

Reduction of toxicity and volume would be realized with the implementation of dredging technology. Treatment duration is one to two months. Short-term mobility of impacts is likely during the implementation of dredging, thereby creating a risk of the release of COCs from sediments during the remediation work.

4.3.6 Implementability

No construction would be required to implement the ‘no further action’ or the ‘natural attenuation with institutional controls’ alternative. As a result, technical feasibility and performance are not an issue. Both of these remedial alternatives are implementable.

Dredging, at best, is potentially implementable for only a portion of the residual sediment and would require: extensive mobilization of equipment; intensive site preparations (attaining an acceptable lay down area; the preparation of a sediment processing/offloading area; installation of a temporary haul road; shoreline preparation; setup of site facilities (construction trailer, power, telephone, decontamination stations and water treatment system); and installation of fencing); engineering controls; river, community, and work area monitoring; and permitting. Because the sediment that could potentially be dredged is very dense in nature, its removal would require a technology potentially more disruptive than that implemented during the IRM. Further, additional dredging in the vicinity of SS-19A is infeasible, as the area of SS-19A must maintain the 4H:1V slope to ensure upland stability of the riverbank.

4.4 Remedy Selection

Based on the focused evaluation and comparative analysis described in the previous sections of this report, natural attenuation with institutional controls in the form of a SMP is the proposed remedy.

This alternative is a safe and readily implementable option that will pose no short-term risks to workers, the community, and the environment while providing a vehicle to manage the risks in the relatively unlikely event that future development plans or revised dredging protocols will disturb the residual sediment impacts.

5.0 PROJECT PLANS AND SPECIFICATIONS

5.1 EHC-O™ Amendment

EHC-O™ is an integrated source of oxygen, major-, minor-, and micro-nutrients, and a pH buffering agent. This unique combination of materials facilitates the aerobic bioremediation of various organic and inorganic compounds including the COCs, impacting soils, sediment or groundwater. EHC-O™ will significantly stimulate the catabolic activity of the indigenous microflora, thereby accelerating the rate of constituent removal.

The amendment is supplied in 30 or 35 lb pails as a powder which can be mixed with soil or slurried in water. Application techniques vary widely depending on specific site conditions. For the RAWP, the application method selected will be injection of the amendment as a slurry directly into the subsurface utilizing Geoprobe® direct push technology. In specific locations, injection depths close to the surface may not allow direct push injection without surfacing of the amendment. In those instances, the ECH-O™ amendment may be surface applied or added as a thin slurry through a temporary injection pipe. **Appendix A** contains manufacturer literature on EHC-O™.

5.2 Bench Scale Study

In April through June of 2006, a bench scale study was conducted to evaluate the effectiveness of EHC™ (anaerobic biodegradation) and EHC-O™ (aerobic biodegradation) amendments mixed into representative soils withdrawn from the Site. The study was conducted at the laboratories of Adventus Americas, Inc. (AAI) in Mississauga, ON, CA. The study included spiking of sub-average concentration samples collected from the site to better approximate the residual COC concentrations observed. The amendments were added to both saturated and unsaturated soils, and degradation of the COCs was observed in four sampling events spread over 70 days. The objective was to determine whether the anaerobic or aerobic pathways for degradation of the COCs could best be optimized.

Results from the test were mixed. AAI reported a decrease in COC concentrations in both the saturated and unsaturated control samples that did not contain any amendment. The decrease in the control soils was observed and was most likely the result of the soils being handled during collection and spiking, thereby being altered from their natural state exposing additional surface area, introducing oxygen, and possibly activating slow or dormant microbes.

AAI observed a decrease in COC concentrations in saturated soils that was faster and more complete than the decrease observed in the control indicating that the EHC™/EHC-O™

compounds were working effectively in the saturated zone. However, the unsaturated soils had similar results to those observed in the controls, with no major advantage observed for either amendment.

Overall, the results of this study identified that the EHC-O™ amendment would be able to treat acetone and methylene chloride in the saturated zone and potentially the unsaturated zone. The most significant difference in the saturated and unsaturated tests was the presence of higher moisture in the former. This prompted the question whether to conduct a pilot study on-site to further evaluate the effectiveness of EHC-O™ on the COCs under actual field conditions where natural moisture enhancement of the unsaturated zone would occur.

5.3 Pilot Study

Based on the results of the bench scale study it was originally determined that conducting a pilot study could provide additional data supporting and elaborating on the previously drawn conclusions. To properly conduct the pilot study it was imperative to identify an area of the site where the study could be easily implemented and contained substantial concentrations of the COCs. It was determined that the area to be utilized for the study was in the Track AOC in the vicinity of the Track 5 and Northend SW samples. The Tapecon north excavation and Track SW-2/3 area were also considered, but excluded due to physical obstructions or lower COC concentrations.

Once the proposed study area was identified, it was necessary to document the current baseline COC concentrations in order to evaluate the effectiveness of the EHC-O™ amendment. Therefore, a sampling plan was developed and implemented to determine the current concentrations of COCs in the soils at the Track 5 and Northend SW location.

Following review of analytical data collected during the baseline sampling, it was determined that residual COC concentrations had significantly decreased. This led to an expansion of the sampling program into the 2006/2007 supplemental subsurface investigation which concluded that COC concentrations had diminished across the site and that it was not necessary to proceed with a Pilot Study.

Rather, based on this new information and in the interest of time, it was more cost-effective to proceed directly to injection of the EHC-O™ amendment into those subsurface areas still containing residual COCs in excess of the TAGM RSCOs. Although, the bench scale study had mixed results for the unsaturated soils, it did identify that the EHC-O™ amendment would work well in the saturated zone and since a majority of the identified residuals occur in the saturated zone, it is anticipated that moving directly to the full scale amendment injection will adequately address Site residuals and achieve the remedial action objectives.

5.4 Remedial Approach

To address the remaining residual subsurface COCs as identified in **Section 2.0**, AMEC has prepared an EHC-O™ Injection Work Plan (IWP) which has been included as **Appendix E**. The IWP includes two main components; a blanket injection of the amendment between GP-6 and GP-9 which incorporates the center of the Track Excavation including GP-5 and SB-11/BT-2; and focused injections at areas GP-1, GP-2, GP-13, GP-24, GP-29, GP-30, GP-32, GP-34, GP-37 and GP-38.

5.4.1 EHC-O™ Application Method

Various methodologies were considered to apply the amendment including soil mixing, injection through a well network using existing wells and newly installed wells, injection through horizontal wells, and direct push injection. Only direct push injection allowed for application at a specific depth, the ability to complete the injection without significantly impacting rail and vehicular traffic, and permitted the selection of injection point locations around utilities. The projected number of injection points and pounds of product required are presented below.

Injection Point Details

Location	# of Injection Points	Pounds of EHC-O™
Track	29	10,990
East	4	1,1675
Totals	**33**	**12,665**

The quantity of the injection points is based on a conservative radius of influence of 20 feet. **Figure 5** illustrates the location of the injection points and the treatment zones.

Approximately 4,556 gallons of water will be required for preparing the 25 percent solids slurry of EHC-O™. A mixing tank and mixer will be required along with a generator to power the equipment.

Once the slurry is prepared, it will be injected utilizing direct push technology, by advancing the probe to the desired treatment depth, then releasing the expendable tip on the probe, and finally withdrawing the direct push rod across the impacting zone while pumping the amendment. Depending on the thickness of the impacted zone, multiple injections will be completed at each point. For example, if a residual location has a treatment zone thickness of 6 feet, then three injections will be implemented, one in each 2-foot interval. In locations where shallow residual impacts are present (above 3 ft bgs), surface application or addition of a thin slurry through a temporary pipe may be implemented.

Pursuant to the discussions in previous sections, modifications in the injection depths and interval thickness along the western side wall of the Track IRM excavation will be made to provide the necessary remedial treatment to the localized identified impacts.

Table 5 presents the injection details, EHC-O™ mass calculations, and slurry preparation details.

5.5 Performance Monitoring

5.5.1 Soil Baseline and Effectiveness Monitoring

Another five soil borings will be advanced in the primary Track AOC to provide baseline analytical data on the methylene chloride and acetone soil concentrations prior to the EHC-O™ injection event. Soil sampling will also be completed in close proximity to the original five sample locations three times following the initial injection for effectiveness monitoring. These samples will be collected at months 3, 6 and 12. The proposed locations of these borings are identified on **Figure 6**.

Soil borings will be advanced until the treatment zone is reached. Two samples will be collected per boring. One sample will be collected from the top two feet of the treatment zone and one soil sample will be collected from the bottom two feet of the treatment zone. A Thermo OVM 580B PID with an 11.7 electron volt lamp will also be used to screen the soils. Readings will be recorded on the boring logs.

Soil samples collected for analysis will be placed in a laboratory provided container, sealed, labeled and placed on ice, until shipment to Severn Trent Laboratory (STL) in Amherst, New York. Soil samples will be analyzed for acetone and methylene chloride in accordance with EPA method 8260.

5.5.2 Baseline and Effectiveness Groundwater Monitoring

Quarterly groundwater sampling events have been conducted on the existing 14 monitoring wells since August 2004. The groundwater gauging and sampling events will continue for four quarterly events following the injection activities.

Groundwater samples collected for analysis will be placed in a container provided by the laboratory, sealed, labeled and placed on ice, until shipment to STL. The samples will be analyzed for acetone and methylene chloride in accordance with EPA method 8260. Laboratory analysis of natural attenuation parameters (total heterotrophic plate counts, total and dissolved iron, chloride, sulfate, and nitrate) will also be performed on four of the monitoring wells, MW-4, MW-6, MW-7, and MW-8 on a quarterly basis. During each quarterly groundwater monitoring event, the 14 monitoring wells will have field parameters (pH, oxygen, reduction potential, dissolved oxygen, temperature, and conductivity) documented and evaluated.

5.5.3 Remedial Action Final Report

After the completion of the remedial activities, a Remedial Action Final Report will be prepared to document the field activities conducted. The report will contain details of the injection and baseline sampling events, identify any difficulties encountered during the implementation of the remedy and soil boring, present the analytical results of the baseline soil sampling event, and provide a complete copy of the laboratory analytical report.

5.5.4 Effectiveness Monitoring

The effectiveness monitoring reports will be prepared to document the soil and groundwater monitoring events. The reports will include, but not be limited to, discussion of the field activities, copies of the field logs, a tabulated results summary comparing analytical data to the applicable NYSDEC TAGM 4046 RSCOs, NYSDEC TOGS 1.1.1 values and the relevant and appropriate Table 375-6.8 Residential SCOs. Also include for review will be groundwater contour maps and a complete copy of the laboratory reports.

5.6 Sediment Management Plan

With respect to the COCs in sediment, based on the focused evaluation and comparative analysis described in the previous sections, natural attenuation with institutional controls, in the form of a SMP is selected as the remedy. The SMP is included in this work plan as **Appendix C**. The SMP was prepared as a stand-alone document to facilitate its distribution, replication, and use.

6.0 HEALTH AND SAFETY PLAN

A site-specific Health and Safety Plan was created and periodically updated for the initial investigation, IRMs, dredging activities, and subsequent subsurface investigation. This plan will be updated and modified for use during the proposed activities in this work plan. All of the chemical data will remain the same. However, several aspects of the plan will require modification. These include, but are not limited to, rally points, emergency contact phone numbers, project personnel, required air monitoring, and analysis of hazards associated with the enhanced bioremediation amendment material handling and injection.

7.0 QUALITY ASSURANCE / QUALITY CONTROL

Appropriate Quality Assurance/Quality Control (QA/QC) samples will be collected during the baseline soil sampling event, the subsequent quarterly soil and groundwater monitoring events, and any other environmental media monitoring events. QA/QC samples include: blind duplicates, matrix spike, matrix spike duplicates, and trip blanks.

Blind duplicates are co-located samples of the same media (i.e., soil or groundwater) which are submitted to the laboratory under a different identification number to check the laboratories repeatability of sample results. Approximately 10 percent of the samples will be duplicated during each sampling event with a minimum of two samples per event per media.

The laboratory will be requested to perform a matrix spike and matrix spike duplicate at a frequency of 10 percent of the samples collected with a minimum of twice per sampling event per media. Additional media will be provided to the laboratory to ensure the proper amount of sample is present to perform these QA/QC analyses.

A sample of deionized water will be placed into a sample container at the laboratory and will accompany the containers and samples throughout the sampling process. These samples will provide a measure of the possible cross-contamination of samples through contact with the sample containers and through leaks or diffusion through the containers caps.

If it becomes necessary, pursuant to the SMP (whenever any work by others will occur that holds the potential to impact the sediments being managed under the SMP), for CSXT to sample, remove, or otherwise address any of the residual sediments, and analytical is necessary, the QA/QC measures described above will be implemented.

8.0 SCHEDULE

Quarterly groundwater monitoring events will be conducted as currently scheduled in June, September and December 2007. The EHC-O™ Injection Work Plan is schedule to be implemented during the summer of 2007 following NYSDEC, NSYDOH and MCDOH approval. The effectiveness monitoring will begin three months following the EHC-O™ injection and continue as outlined above. Following the final effectiveness sampling event, one year from the injection date, CSXT will evaluate all data for the Site and prepare a summary report.

There is no "schedule" associated with the sediment SMP. However, in the event that CSXT were to become involved with sediment work, it will notify NYSDEC of the schedule of the affected party and its schedule for any sediment quality sampling and analysis.

9.0 REFERENCES

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U.S. EPA National Functional Guidelines for Organic Data Review (EPA540/R-99/008)

USEPA Region IX, Preliminary Remediation Goals, 2002

FIGURES

TABLES

APPENDIX A

EHC-O™ Manufacturer Information

APPENDIX B

EHC-O™ Case Studies

APPENDIX C

Genesee River Sediment Management Plan

APPENDIX D

March 21, 2007 Pilot Study Baseline Sampling Summary Letter

APPENDIX E

EHC-O™ Injection Work Plan

APPENDIX F

CSXT Response Letter to NYSDEC March 14, 2006 RAWP Comments