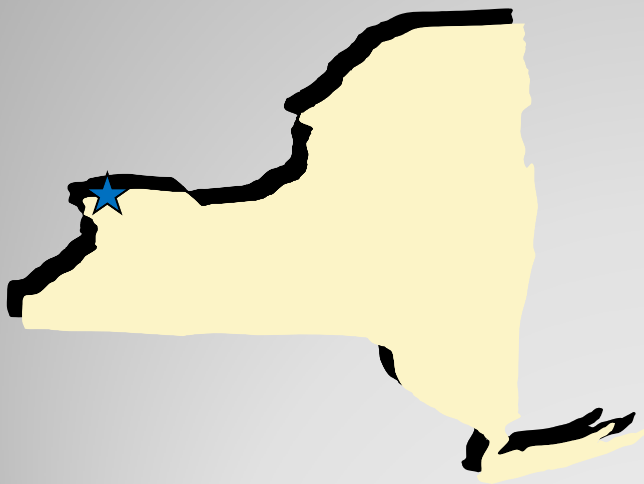
FINAL
FEASIBILITY STUDY REPORT FOR OPERABLE UNITS 1 AND 2

Old Upper Mountain Road Site (932112)
Lockport, Niagara County, New York



Prepared for:

New York State Department of Environmental Conservation
Division of Environmental Remediation

Prepared by:

EA ENGINEERING, P.C. and Its Affiliate
EA SCIENCE and TECHNOLOGY

February 2013

Feasibility Study Report for Operable Units 1 and 2 Old Upper Mountain Road (932112) Lockport, New York

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1. INTRODUCTION AND PROJECT OVERVIEW

EA Engineering, P.C. and its affiliate EA Science and Technology (EA), under contract to the New York State Department of Environmental Conservation (NYSDEC) (Work Assignment No. D004438-41) was tasked to perform a remedial investigation (RI), supplemental RI (SRI), and feasibility study (FS) at the Old Upper Mountain Road site (NYSDEC Site No. 932112) located in the Town and City of Lockport, Niagara County, New York. Under the RI and SRI, the Old Upper Mountain Road site was evaluated as three separate operable units (OUs) defined as follows:

- OU 1 is defined as the approximately 6 acres of landfill waste which make up the Old Upper Mountain Road site. Impacts associated with OU 1 and evaluated in the RI include on-site surface and subsurface soil/fill material, and on-site groundwater.

- OU 2 is defined as surface water and sediment within Gulf Creek, from the area located at the western origin of the ravine at the bulkhead outfall located to the north of the site to an area downstream where Gulf Creek meets Niagara Street.

- OU 3 is defined as the approximately 1 acre of landfill waste that makes up the portion of the Old Upper Mountain Road site located south and west of the Somerset rail line. Impacts associated with OU 3 and evaluated in the RI include on-site surface and subsurface soil/fill material, and on-site groundwater.

This FS has been prepared for OU 1 and OU 2.

1.1 PURPOSE AND SCOPE

This FS report has been prepared to develop and evaluate alternatives for remedial action and to determine which alternative is the most appropriate, cost effective, and protective of public health and the environment for OUs 1 and 2 at the Old Upper Mountain Road site.

The FS has been conducted in accordance with the most recent versions of the *Guidance for Conducting Remedial Investigations and Feasibility Studies under Comprehensive Environmental Response, Compensation, and Liability Act* (U.S. Environmental Protection Agency [EPA] 1988) and *DER-10, Technical Guidance for Site Investigation and Remediation* (NYSDEC 2010), and focused on remedial alternatives proven effective at addressing the contaminants of concern (COCs) detected in various environmental media on this site.

1.2 REPORT ORGANIZATION

The FS report has been organized as follows:

- ***Section 1***—Introduction and Project Overview

- ***Section 2***—Summary of RI, SRI, and Exposure Assessment
- ***Section 3***—Development of Remedial Action Objectives (RAOs)
- ***Section 4***—General Response Actions
- ***Section 5***—Identification and Screening of Technologies
- ***Section 6***—Scoping and Development of Remedial Alternatives
- ***Section 7***—Costing and Evaluation Criteria
- ***Section 8***—Detailed Analysis of Alternatives and Recommendations
- ***Section 9***—References.

1.3 BACKGROUND

The following sections provide a brief discussion of the site background for the Old Upper Mountain Road site. A full description of the site is provided in the Final RI Report (EA 2011a) and SRI Report (EA 2011b), which were previously prepared and finalized as separate deliverables.

1.3.1 Site Location

The site is located along Old Upper Mountain Road, in both the Town and City of Lockport, Niagara County, New York (Figures 1-1 and 1-2). The site proper (OU 1 and OU 3) is an irregular-shaped parcel that is approximately 7 acres in size. Main access to the site is located on Old Upper Mountain Road. The site sits northeast of the intersection between NYS Route 93 and NYS Route 31. An access road exists on Otto Park Place to the southeastern portion of the site (OU 3). The site consists of seven Niagara County tax parcels and is located in a mixed use area including residential, industrial, and commercial properties. Somerset Railroad bounds the property to the south and east. The northern edge of the property is bounded by private property and a ravine containing Gulf Creek (OU 2), referred to as the Gulf.

1.3.2 Property Information

The Old Upper Mountain Road site was reportedly operated as a municipal dump by the City of Lockport from 1921 to the 1950s. Access to the landfill during that time was from the viaduct under the railroad track just north of Otto Park Place. Garbage and other industrial wastes were apparently dumped at the landfill, burned, and then pushed into the ravine. The City of Lockport moved its dumping operations in the 1950s to the area known today as the Lockport City Landfill (NYSDEC Site No. 932010) located north of the Old Upper Mountain Road site along the railroad tracks.

The Old Upper Mountain Road site was reportedly used by the same clientele as the Lockport City Landfill. There was a shift in location between the two landfills in the 1950s. Clientele reportedly included Harrison Radiator, VanDeMark Chemical, Milward Alloys, Vanchlor, Upson, and Cotton Batting. Different areas of the dump were reportedly assigned to different companies.

The site was initially discovered in 1993 during a routine inspection of the Lockport City Landfill located north of the Old Upper Mountain Road site and downstream of the landfill along Gulf Creek. Evidence of ash and glass debris was noted throughout the top portion of the landfill, while recent dumping of trash/rubbish/tires was noted at the southern portion of the site. It was also noted during the inspection that a significant quantity of waste had been pushed over the embankment into the ravine through which Gulf Creek runs.

1.3.3 Site History

Based upon a review of historical information presented in the Environmental Data Resources, Inc. report, Upper Mountain Road first appears on the 1897 United States Geological Survey (USGS) topographic map along with the New York Central and Hudson River railroads, which run along the southern boundary of the site. Access to the dumping area was historically through a viaduct located under this railroad track. An additional railroad appears in the area to the east of the site, running north to south along Gulf Creek on the 1948 USGS topographical map.

The topographic maps also illustrate changes in elevation at the site which reflect changes in the size and shape of the Gulf resulting from the historic landfill operations at the site, and development of other areas surrounding the Gulf. Based upon a review of the topographic maps, the following is known regarding impacts to the ravine from landfill activities and other site development:

- According to the 1897 topographic map, the ravine and Gulf extended almost completely to the railroad track that currently serves as the southern boundary of the site. Elevation at the top of the ravine was approximately 600 ft, while the base of the ravine was approximately 520 ft.

- The 1899 topographic map illustrates no discernible changes in the shape of the Gulf, indicating that landfill operations had not yet begun.

- The 1948 topographic map shows a large portion of the site formerly within the Gulf ravine filled to grade (approximately 587 ft). Filling appears to have been completed from the southwest corner of the site to the northeast, as a small portion of the ravine remains visible just beyond the eastern edge of the filled landfill area. Additionally, an industrial structure appears in the area of the current General Motors Components Holdings, LLC (GMCH), recently the former Delphi Thermal Systems, on the 1948 USGS topographic map to the west of the site across Upper Mountain Road.

- Landfill operations at the site appear to have continued through at least 1949. The 1949 topographic map illustrates further dumping within the ravine, as the small portion along the eastern portion of the site that was unfilled in 1948 is visible as being brought to grade in this map.

- The site appears unchanged in the 1965 topographic map. However, it appears that overburden soil was removed from the northern edge of the ravine, directly across Gulf Creek from the site during this time, as the ravine is shown to be slightly wider than observed in the 1949 map. A section of Upper Mountain Road was also abandoned between 1949 and 1965, and a new section was developed along NYS Route 93. The old section of the road was left behind and named Old Upper Mountain Road. Additionally, four structures are visible along Old Upper Mountain Road directly to the north of the site, while the GMCH property is shown to have expanded from previous maps.

- The 1980 topographic map shows an expansion in the western portion of the ravine, which appears to have coincided with the installation of a bulkhead outfall along Old Upper Mountain Road, which discharges directly into the ravine and Gulf Creek. This map also denotes the presence of the GMCH wastewater treatment plant to the north of the site, in addition to another expansion at the facility across Upper Mountain Road. A large section of water is also shown within the ravine approximately 500 ft downgradient from the site.

GMCH was started in 1910 as Harrison Radiator and has expanded over the last 100 years going through several changes of management. Harrison Radiator, later Delphi Thermal Systems, have historically made radiators for cars. A wastewater treatment plant was constructed between 1965 and 1972 across the street from the industrial facility and to the north of the Old Upper Mountain Road site. The wastewater treatment plant reportedly treated and discharged hazardous waste and chemicals including hexavalent chromium, used in coating processes, into Eighteen Mile Creek. The wastewater treatment plant was closed in 2006 when the use of hexavalent chromium was eliminated and an alternative aluminum material system was selected that replaced the previous coating processes.

Currently, two off-site houses are located approximately between 175 ft and 300 ft north of the former dumping area. The two houses were unoccupied and vacant at the time the RI report was prepared (April 2011) and appear to be serviced by public water supply from the Town of Lockport. The Somerset Railroad that bisects the site and currently serves as the eastern border of the site was installed between 1980 and 1985, replacing the line initially shown on the 1948 USGS topographic map. In 2006, vehicle tracks were found on the site indicating a potential for recent surface dumping; therefore, a fence was installed to deter trespassers from dumping at the site.

As mentioned earlier, the site currently consists of seven Niagara County tax parcels owned by various entities which include CSX Transportation, Inc., Somerset Railroad Corporation, New York State Electric & Gas Corporation, the City of Lockport, Mr. Allen Penwright, Mr. Douglas Snow, and Mr. Robert H. Matheis. Most recently, the site was used as a junkyard where abandoned vehicles, used tires, boats, concrete/asphalt debris, tires, and other surface dumping occurred. Most of the vehicles and tires were removed from the site in November 2009 during the RI. In its current state, a majority of the site is unoccupied and not being used for residential or commercial purposes. The CSX Transportation, Inc and Somerset Railroad lines are currently active and were observed with infrequent use during the field investigation efforts conducted during the RI and SRI. Figure 1-3 identifies the seven Niagara County tax parcels and their reputed owners as documented during an American Land Title Association survey completed by Popli Design Group.

1.3.4 Physiography

The subject site is located on the USGS Lockport, New York 7.5-minute topographic quadrangle map, dated 1980 (Figure 1-4).

Elevation at the site ranges from approximately 510 ft in the ravine to 595 ft above mean sea level (AMSL) near the railroad tracks. The Gulf ravine acts as the northern boundary of the site. The nearest surface water feature, as noted on the topographic map, is Gulf Creek, which is adjacent to the site along the base of the Gulf. Gulf Creek flows north towards Eighteen Mile Creek. Both creeks converge and proceed to flow north into Lake Ontario.

1.3.5 Site Geology

A review of the geologic map of New York, Niagara Sheet published by the University of the State of New York, the State Education Department and dated 1970, indicates that the subject site lies within the glacial deposits above the Guelph Dolostone, which is part of the Lockport Group. According to the Environmental Data Resources, Inc. report, the subject site is located within the silty loams and bedrock associated with the Middle Silurian Period.

According to the Soil Service Geographic Database, the site is underlain by the Farmington silt loam. This soil, which has well drained, slow infiltration rates (Class C), is described as being soil with layers impeding downward movement of water, or soil with moderately fine or fine textures. Typically this soil is less than 46-in. thick, consisting of fine-grained soil, silt and clay, and lean clay.

Within 0.25 mi of the site lies the Rockland unit. This soil, which is somewhat excessively drained and has slow infiltration rates (Class C), is described as being soil with layers impeding downward movement of water, or soil with moderately fine or fine textures. Typically this soil is less than 13-in. thick.

Also within 0.25 mi of the site lies the Cayuga silty loam. This soil, which is moderately well drained and has slow infiltration rates (Class C), is described as being soil with layers impeding downward movement of water, or soil with moderately fine or fine textures. Typically this soil is less than 127-in. thick and consists of coarse-grained soil, sand, sand with fines, clayey sand, and silty sand.

1.3.6 Site Hydrogeology

Unconsolidated, fine-grained glacial deposits in the southwestern Lockport area are relatively thin, and horizontal laminations and sand lenses are uncommon. As a result of these thin deposits, shallow, unconfined aquifer groundwater flow in the area surrounding the site is expected to be highly localized and discontinuous, with flow expected to be generally to the north towards Gulf Creek. Groundwater elevations measured during the RI and SRI varied from a high of 574.61 ft AMSL at monitoring well MW-01 in January 2010 and a low of 516.31 ft AMSL at monitoring well MW-04 in August 2010.

Groundwater in the Lockport Group bedrock is primarily influenced by vertical and horizontal fractures, particularly in the upper unit, which is extensively fractured. Other contributors to bedrock groundwater in the area surrounding the site are likely to include weathered surface fractures, bedding joints, vertical joints, and small cavities within the upper bedrock formation. In addition, bedrock groundwater flow is anticipated to be influenced by several natural and manmade structures in the area, including the Niagara Escarpment and the Gulf located north of and adjacent to the site, as well as the former Frontier Stone Products Quarry located south of the site and the Erie Barge canal located southeast of the site.

1.3.7 Upland Site Ecology

Based upon activities completed on-site and information obtained from the New York Natural Heritage Program Draft Ecological Communities within New York State (NYSDEC, 2002), several distinct ecological habitat types were identified within a 0.5-mi radius of the site. These habitat types generally coincide with abandoned agricultural uses, fields, woodlot, and brush areas; and areas which are under maintenance or disturbance by residential or commercial development.

Typical habitats associated with development include urban structures, mowed lawn with trees, unpaved roads, mowed roadside areas, and gardens. Species associated with these habitats include common nighthawk (*Chordeiles minor*), American robin (*Turdus migratorius*), house sparrow (*Passer domesticus*), mourning dove (*Zenaida macroura*), mockingbird (*Mimus polyglottos*); as well as a variety of sedges, grasses, forbs, vines, low shrubs, and trees.

More diverse upland habitat is found in successional old field areas adjacent to the site, which have been cleared and plowed (for farming or development), and then abandoned. Characteristic herbs include goldenrods (*Solidago altissima, S. nemoralis, S. rugosa, S. juncea, S. canadensis,* and *Euthamia graminifolia*), bluegrasses (*Poa pratensis, P. compressa*), timothy (*Phleum pratense*), quackgrass (*Agropyron repens*), smooth brome (*Bromus inermis*), sweet vernal grass (*Anthoxanthum odoratum*), orchard grass (*Dactylis glomerata*), common chickweed (*Cerastium arvense*), common evening primrose (*Oenothera biennis*), oldfield cinquefoil (*Potentilla simplex*), calico aster (*Aster lateriflorus*), New England aster (*Aster novae-angliae*), wild strawberry (*Fragaria virginiana*), Queen-Anne's lace (*Daucus corota*), ragweed (*Ambrosia artemisiifolia*), hawkweeds (*Hieracium* spp.), dandelion (*Taraxacum officinale*), and ox-tongue (*Picris hieracioides*). Shrubs may be present, but collectively they have less than 50 percent cover in the community. Characteristic shrubs include gray dogwood (*Cornus foemina* ssp. *racemosa*), silky dogwood (*Cornus amomum*), arrowwood (*Viburnum recognitum*), raspberries

(*Rubus* spp.), sumac (*Rhus typhina, R. glabra*), and eastern red cedar (*Juniperus virginiana*). A characteristic bird is the field sparrow (*Spizella pusilla*). This is a relatively short-lived community that succeeds to a shrubland, woodland, or forest community, but provides diverse habitat for foraging and nesting birds, as well as various mammals such as white tailed deer (*Odocoileus virginianus*). Due to the limited size of other habitat types in the vicinity of the site, larger mammalian and bird of prey species are not likely to occur at the site other than periodic transient movement across the site.

1.3.8 Aquatic and Riparian Site Ecology of Gulf Creek

Gulf Creek is a semi-wadeable freestone perennial stream with gravel bed and geologic bedrock control. Its Rosgen natural channel classification is B4/1, indicating a low-sinuosity stream of moderate slope with gravel bedload and bedrock control. In areas where fill has not impacted its valley, Gulf Creek's riparian corridor and buffer are characterized by emergent wetlands and shrub/shrub or forested wetlands with periodic open water due to beaver activity. Numerous North American beaver (*Castor canadensis)* dams were observed within Gulf Creek. The creek habitat and freshwater wetlands would be of great value to fish and other aquatic fauna that exist within Gulf Creek. No observable fish species, however, were observed to be present within Gulf Creek during the RI and SRI activities.

Beaver activity has multiple impacts on the site, causing impoundment of water and sediments, creating open water and emergent wetland habitats, and potentially limiting the transport of contaminated sediments downstream. Beaver foraging reduces canopy tree recruitment and maintains emergent and scrub-shrub wetland conditions.

As these ecological conditions are typical for the site, as well as the region, these must be integrated into the alternatives for remediating the site.

2. SUMMARY OF RI, SRI, AND EXPOSURE ASSESSMENT

The following sections briefly summarize the environmental impacts at the Old Upper Mountain Road site as determined during the RI and SRI (EA 2011a and b, respectively). This section is organized by media of potential concern. The impacts associated with the environmental media are based on analytical results and their comparison with the appropriate standards, criteria, and guidance (SCGs). The media of concern discussed are soil/fill material, sediment, and groundwater.

2.1 OU 1 SURFACE AND SUBSURFACE SOIL/FILL MATERIAL

The focus of the soil/fill material screening and characterization efforts conducted during the RI was to determine the nature and extent of contamination, and assess potential exposure pathways to develop a strategy to protect human health and the environment. Evaluation of soil/fill material was performed by collecting soil/fill material samples from the ground surface, test pit, and soil boring sampling to evaluate shallower soil, while deeper soil were accessed using a drill rig. An aerial view of the site identifying the OU boundaries and soil/fill material sampling locations is shown in Figures 2-1 and 2-2, respectively.

2.1.1 Surface Soil/Fill Material

Several target analyte list (TAL) metals were reported in on-site surface soil/fill above their applicable SCGs. Lead, a COC was reported at concentrations exceeding SCGs in each of the surface soil/fill samples collected, at concentrations ranging from 170 mg/kg to 19,000 mg/kg in surface soil/fill material within OU 1. Two out of seven (approximately 29 percent) surface soil/fill samples submitted for toxicity characteristic leaching procedure (TCLP) lead analysis exhibited hazardous waste characteristics for lead (D008). A number of semivolatile organic compounds, pesticides, and polychlorinated biphenyls were also detected within surface soil/fill samples within OU 1 at concentrations above their applicable SCGs.

2.1.2 Subsurface Soil/Fill Material

Laboratory analytical results from the on-site subsurface soil/fill sampling program identified elevated concentrations of several TAL metals. Concentrations of lead in exceedence of its SCG were detected in 97 of 101 (approximately 96 percent) subsurface soil samples collected during the RI with the deepest impacts at a depth of 70–73 ft below ground surface (bgs). In OU 1, 30 out of 67 (approximately 45 percent) subsurface soil/fill samples submitted for TCLP lead analysis were identified as characteristically hazardous waste. Vertical profile borings indicated that there is no direct correlation between metals impacts and depth of fill material on-site. It appears that the types and source(s) of waste dumped at the site, rather than migration of metals through the soil/fill material, is the primary influence on metals concentration within the subsurface at OU 1.

2.1.3 Volume of Impacted Soil/Fill Material

The estimated volume of fill material contained within the 5.5 acre area of OU 1 is approximately 135,000 yd^3 or 217,500 tons estimating that 1 yd^3 of fill material is approximately equal to 1.5 tons. This volume estimate does not account for fill material that lies along the slope of the ravine to the base of Gulf Creek, or fill material that lies beneath the railroad line and ballast which bisects OU 1 and OU 3. The estimated volume of fill material that lies along the slope of the ravine to the base of Gulf Creek is 64,000 yd^3 or 106,880 tons. The resulting volume evaluated for alternatives at OU 1 is 199,000 yd^3. It is assumed that fill material beneath the railroad line will remain in place.

2.2 OU 1 GROUNDWATER

The RI groundwater program included the installation of six groundwater monitoring wells as shown in Figure 2-3 and the completion of one round of groundwater sampling. A supplemental groundwater sampling event was implemented during the SRI to validate on-site groundwater flow patterns determined during the RI and provide additional groundwater quality data with respect to NYSDEC Ambient Water Quality Standards (AWQS). Analytical results from the RI and SRI groundwater sampling events reported concentrations of metals, anions, semivolatile organic compounds, and volatile organic compounds that are in exceedance of the NYDEC AWQS. See Section 2.5 for further discussion of groundwater quality.

Groundwater flow direction was determined to flow towards the former ravine and eventually Gulf Creek. Groundwater moving within the bedrock system from the west continues in an easterly direction until it reaches the former ravine where it then moves north toward Gulf Creek. The bedrock groundwater system flowing from areas south of the site flows in a northerly direction into the former ravine and then toward Gulf Creek, while the flow from the eastern portion of the site moves west to the former ravine and then towards Gulf Creek. The former ravine identified during the subsurface investigation acts as a likely discharge point for bedrock groundwater within the vicinity of the site. An interpreted groundwater contour map illustrating the direction of groundwater flow for the August 2010 gauging event is provided in Figure 2-4.

2.3 OU 2 SEDIMENT

Concentrations of nine TAL metals were identified above the severe effect limits (SELs) in the sediment of Gulf Creek with the most prevalent metals being lead and zinc. Figure 2-5 shows sediment sample locations. Sediment with metal concentrations above the severe effect limits is considered contaminated and significant harm to benthic aquatic life is possible. None of the sediment samples submitted for TCLP lead analysis were identified as hazardous waste. It is estimated that approximately 17,500 yd^3 of impacted sediment exists within the reaches of Gulf Creek evaluated during the RI and SRI (EA 2011a and b, respectively). The specific TAL metals reported in sediment samples correlate with the TAL metals observed within the on-site fill material (OU 1) and are likely migrating to the sediments of Gulf Creek via erosion runoff and groundwater transport pathways.

2.4 OU 2 SURFACE WATER

Surface water samples were collected from Gulf Creek during separate events as part of the RI and SRI (EA 2011a and b, respectively). Surface water was collected from SW-02 at the outfall of the bulkhead at the westernmost point of Gulf Creek during the first two events; first in November 2009 and again in May 2010. Surface water was collected from SW-04 downstream from SW-02 at the breach point of a beaver dam in November 2009. Surface water samples were collected further downstream (SW-05 and SW-06) in August 2010 during the SRI. Figure 2-6 identifies each of the surface water sampling locations. Each sample collected in November 2009 and August 2010 contained concentrations of iron exceeding the AWQS for Class D, Type H(FC) or A(A) surface waters. The sample collected at SW-04 in November 2009 contained tetrachloroethylene at a concentration exceeding the corresponding AWQS as well.

2.5 ADDITIONAL GROUNDWATER/SURFACE WATER EVALUATION

Additional limited groundwater and surface water sampling events were conducted in February and April 2012 to evaluate the quality of groundwater discharging into Gulf Creek via seeps along the east side of the fill material within the base of the ravine. The additional evaluation was focused on the assessment of total versus dissolved-phase metals observed in groundwater and surface water. This assessment of water quality characteristics allows for interpretation of potential fate and transport mechanisms that are currently active at the site and potentially mobilizing COCs to off-site areas (Gulf Creek).

Total metals analysis for water samples include the metals content both dissolved in the water and present in the particulates in the water. Typically, a dissolved metals analysis of a water sample is performed by removing the particulates with a filter, then analyzing the filtered water for metals. The most common filters used for this purpose have a 0.45 um pore size.

Total metals analysis results should always be greater than or equal to dissolved metals analysis results, because dissolved metals is a subset of total metals. Dissolved metals are generally considered more mobile and biologically available. Thus, the dissolved metals results are useful for risk assessment, and fate and transport studies.

Groundwater samples were collected from monitoring wells MW-03 and MW-04, and analyzed for total and dissolved metals and mercury. Two sets of groundwater samples from each monitoring well were submitted to the laboratory for total and dissolved metal analyses. The laboratory filtered one set of groundwater samples prior to analysis. Both monitoring wells are located east of Gulf Creek and within OU 1 fill material. Monitoring well MW-03 is screened within the uppermost section of bedrock just below the fill material from 67 to 77 ft bgs (518–528 ft AMSL). Monitoring well MW-04 is screened at the same interval, from 67 to 77 ft bgs (511–521 ft AMSL); although, not within the bedrock unit, rather within the deepest saturated layer of fill material.

Surface water samples were collected from three groundwater seeps located at the base of the fill material along the east side of the ravine. Two sets of surface water samples for each sample location were submitted to the laboratory for total and dissolved metal analyses. The laboratory filtered one set of surface water samples prior to analysis. Seep 1 was the furthest downstream, with Seeps 2 and 3 located consecutively upstream. The bottom of the ravine is at approximately 512 ft AMSL. Figure 2-7 shows seep and monitoring well sample locations with a summary of the detected metals concentrations.

Concentrations of primary COC metals (lead and zinc) in unfiltered (total) samples reported higher concentrations than concentrations reported in filtered (dissolved) samples, indicating that a majority of the reported total metals concentrations are a result of suspended particulates. This would also indicate that the primary transport mechanism of metals from groundwater to surface water, and eventually Gulf Creek sediments, is via particulate flow and then deposition. Because dissolved metals are more mobile and bio-available, the environmental risks associated with groundwater and surface water at the site are considered less significant.

Additionally noted during the evaluation was that groundwater samples reported a greater number of TAL metals than all three seep samples and monitoring well MW-04 specifically reported the most metals concentrations exceeding NYSDEC AWQS for Class GA waters.

Based on the data generated during this additional water quality evaluation, it was determined that specific RAOs for groundwater were not warranted. Rather, under the potential remedial alternatives evaluated during the development of this FS, groundwater quality would be continually monitored throughout the remedial action process and post-monitoring activities.

3. DEVELOPMENT OF REMEDIAL ACTION OBJECTIVES

Goals for the remedial program have been established through the remedy selection process stated in 6 New York Code of Rules and Regulations (NYCRR) Part 375. The remedial goal for all remedial actions is considered to be the restoration of the site to the pre-disposal/pre-release conditions to the extent practicable and legal. RAOs are defined as the medium-specific or OU-specific cleanup objectives to provide protection of public health and the environment. The RAOs are based on contaminant-specific SCGs. The RAOs for the Old Upper Mountain Road site are to meet the SCGs listed in the following table.

3.1 CLEANUP STANDARDS, CRITERIA, AND GUIDANCE

Cleanup standards for soil, groundwater, and sediment are presented in the following table along with the range of contaminant detections.

SOIL/FILL – CLEANUP STANDARDS, CRITERIA, AND GUIDANCE				
	Chemical of Potential Concern	Concentration Range Detected (ppm)[1]	SCG[2] (ppm)	Frequency of Exceeding SCG
Inorganics	Lead	170-19,000 (Surface) 16-23,000 (Subsurface)	63	11/11 (Surface) 112/116 (Subsurface)
	Zinc	170-33,000 (Surface) 270-22,000 (Subsurface)	109	11/11 (Surface) 60/60 (Subsurface)

1. Based on samples collected in May 2010.
2. NYSDEC 6 NYCRR Table 375-6.8(b): Unrestricted Use Soil Cleanup Objectives.
NOTE: ppm = parts per million

GROUNDWATER – CLEANUP STANDARDS, CRITERIA, AND GUIDANCE				
	Chemical of Potential Concern	Concentration Range Detected (ppb)[1]	SCG[2] (ppb)	Frequency of Exceeding SCG
Inorganics	Lead	4.3-49,000	25	7/20
	Zinc	160-120,000	2,000	3/20

1. Based on samples collected in February and August 2010 and February and April 2012.
2. NYSDEC Division of Water Technical and Operational Guidance Series (1.1.1) AWQS (Class GA), June 1998.
NOTE: ppb = parts per billion

SEDIMENT – CLEANUP STANDARDS, CRITERIA, AND GUIDANCE				
	Chemical of Potential Concern	Concentration Range Detected (ppm)[1]	SCG[2] (ppm)	Frequency of Exceeding SCG
Inorganics	Lead	43-2,700	31	58/58
	Zinc	100-3,700	120	57/58

1. Based on samples collected in November 2009 and November, May and August 2010.
2. NYSDEC Technical Guidance for Screening Contaminated Sediment, 1999

3.2 REMEDIAL ACTION OBJECTIVES

The medium-specific RAOs for the Old Upper Mountain Road site are displayed in the following table.

OU1	
Soil/Fill	Prevent ingestion/direct contact with contaminated soil.
	Prevent migration of contaminants that would result in groundwater or surface water contamination.
	Prevent impacts to biota from ingestion/direct contact with soil causing toxicity or impacts from bioaccumulation through the terrestrial food chain.
OU2	
Sediment	Prevent direct contact with contaminated sediments.
	Prevent impacts to biota from ingestion/direct contact with sediments causing toxicity or impacts from bioaccumulation through the marine or aquatic food chain.
	Restore sediments to pre-release/background conditions to the extent feasible.

3.3 OTHER POTENTIALLY APPLICABLE REQUIREMENTS

The NYSDEC Environmental Remediation Programs guidance (6 NYCRR Part 375) requires that site remedies "conform to standards and criteria that are generally applicable, consistently applied, and officially promulgated, that are either directly applicable, or that are not directly applicable but are relevant and appropriate, unless good cause exists why conformity should be dispensed with (6 NYCRR Part 75, 375-1.8[f][2])." The primary requirements are presented in the following table.

SCGS FOR THE OLD UPPER MOUNTAIN ROAD SITE REMEDY	
Requirement	Rationale
FEDERAL	
CLEAN WATER ACT **National Pollution Discharge Elimination System 40 Code of Federal Regulations (CFR)** **Parts 122 and 404/401** The National Pollution Discharge Elimination System establishes permitting requirements, technology-based limitations and standards, control of toxic pollutants, and monitoring of effluents to assure discharge permit conditions and limits are not exceeded.	Applicable if groundwater will be extracted from ground and discharged to a surface water body.
SAFE DRINKING WATER ACT **National Primary and Secondary Drinking Water Regulations) (42 U.S.C. 300f, 40 CFR Part 141, 40 CFR Part 143)** The Safe Drinking Water Act provides a national framework to ensure the quality and safety of drinking water. The primary standards establish maximum contaminant levels and maximum contaminant level goals for chemical constituents in drinking water. Secondary standards pertain primarily to the aesthetic qualities of drinking water.	The removal action is being conducted to reduce chemical concentrations in soil and groundwater, with a goal of meeting unrestricted use levels.

SCGS FOR THE OLD UPPER MOUNTAIN ROAD SITE REMEDY	
Requirement	Rationale
CLEAN AIR ACT, as Amended (42 U.S.C. 7401) The Clean Air Act is a comprehensive law which is designed to regulate any activities that affect air quality, and provides the national framework for controlling air pollution. The National Primary and Secondary Ambient Air Quality Standards (40 CFR Part 50) set standards for ambient pollutants which are regulated within a region. The National Emissions Standards for Hazardous Air Pollutants (40 CFR Part 61) establishes numerical standards for hazardous air pollutants.	The Clean Air Act will be required if any remediation alternatives produce air emissions.
RESOURCE CONSERVATION AND RECOVERY ACT (RCRA) Provides the governing regulations for owners and operators of hazardous waste treatment, storage, and disposal facilities; and for the generators and transporters of hazardous waste.	All waste generated during the removal alternative will be characterized and handled per Resource Conservation and Recovery Act regulations, as implemented by WAC 173-303.
OCCUPATIONAL SAFETY AND HEALTH ACT (29 CFR 1910) Establishes the worker health and safety requirements for operations at hazardous waste sites.	Site activities will be conducted under appropriate Occupational Safety and Health Act standards.
Rules for Transport of Hazardous Waste (49 CFR 107, 171) The U.S. Department of Transportation establishes requirements for packaging, handling, and manifesting hazardous waste.	Any hazardous waste generated during site activities will be characterized as needed to determine packaging, handling, and transport requirements.
STATE	
NYSDEC Environmental Remediation Programs (6 NYCRR Part 375) This program applies to the development and implementation of remedial programs for environmental restoration sites.	Site cleanup will be conducted in accordance with 6 NYCRR Part 375.
Solid Waste Management Facilities (6 NYCRR Part 360) Provides standards and regulations for permitting and operating solid waste management facilities.	These regulations will be followed for off-site generation, treatment, and disposal of hazardous waste (if generated during the removal action).
Waste Transporter Permits (NYCRR Part 364) Provides standards and regulations for waste transporters.	
Land Disposal Restrictions (6 NYCRR Part 376)	
Hazardous Waste Management System (6 NYCRR Parts 370, 371, 372, 373, 375) Provides standards and regulations for the state hazardous waste management system, identification and listing of hazardous wastes, and provides standards, regulations, and guidelines for the manifest system, as well as additional standards for generators, transporters, and facilities.	
New York State Department of Transportation Rules for Hazardous Materials Transport (49 CFR, Parts 107, 171.1-500) Addresses requirements for marking, manifesting, handling, and transport of hazardous materials; applicable if off-site treatment or disposal of wastes is required.	
Water Quality Regulations for Surface Waters and Groundwater (6 NYCRR Part 700-706) Provides standards, regulations, and guidelines for the protection of waters within the state.	Water discharged from the site will comply with this guidance.
Air Quality Standards (6 NYCRR Part 257) Air quality standards are designed to provide protection from the adverse health effects of air contamination; and they are intended further to protect and conserve the natural resources and environment.	All substantive requirements of the State air pollution control regulations will be followed if air emissions are created.

SCGS FOR THE OLD UPPER MOUNTAIN ROAD SITE REMEDY	
Requirement	Rationale
LOCAL	
Land development standards, stormwater and surface water regulations, and clearing and grading requirements.	Local permits may be required depending on the selected remedial action.
Building permits and building codes.	Local permits may be required depending on the selected remedial action.

4. GENERAL RESPONSE ACTIONS

In general, remedial technologies fit into one or more category of general response actions (GRAs). GRAs are generic, medium-specific, remedial actions that will satisfy the RAOs discussed earlier. GRAs may include no action, institutional controls, containment, removal, treatment, disposal, monitoring, or a combination thereof (EPA 1988). The development of remedial alternatives for this FS begins with the identification of GRAs that can meet RAOs. These GRAs are then screened based on their effectiveness, implementability, and cost; and developed into remedial alternatives to address contaminated media at the site (e.g., soil and sediment).

4.1 SOIL

Technologies for the remediation of soil will fall into the following GRAs: no action, containment, removal, treatment, and disposal.

No Action

The no action alternative is included to be used as the baseline alternative against which other remedial alternatives are compared.

Site Management

Site management (also known as institutional controls) involves the placement of a restriction on the use of property that limits human or environmental exposure, provides notice to any individual who might come in contact with the site, or prevents actions that would interfere with the effectiveness of a remedial program or with the effectiveness and/or integrity of site management activities at or pertaining to a site.

Containment

Soil and fill containment would be accomplished by installing either a multi-media cap or impermeable liner over the waste mass to eliminate exposure and prevent transport through groundwater. Existing physical setting would require re-grading of waste surface and partial removal of waste to achieve required slopes.

Treatment

Treatment subjects contaminants to processes that alter their state, transform them to innocuous forms, or immobilize them. Potentially applicable treatment technologies for soil at this site include *in situ* biological treatment, *in situ* soil flushing, *in situ* or *ex situ* solidification, *in situ* or *ex situ* chemical stabilization, *ex situ* acid leaching, and *ex situ* vitrification.

Biological treatment involves the use of plants to treat the impacted media. This can be achieved through phytoextraction, which involves the physical removal of contaminants from the soil through plant uptake or phytoremediation, which involves contaminant break down by the plant or microbes near the root system.

Soil flushing is the use of water or other suitable aqueous solution to flush contaminants from soil. The fluid is then extracted *in situ*.

Stabilization is achieved through the use of amendments that are mixed into the soil matrix and reduce the toxicity and mobility of the contaminants. This results in the production of a monolith of waste with high structural integrity and can be done *in situ* or *ex situ*.

Acid leaching is the use of potentially hazardous acid to remove inorganic contaminants from soil.

Vitrification is the use of electric current to convert contaminants to an inert, solid form. Following vitrification, the contaminants are trapped within the treated area, eliminating mobility.

Removal

Physical removal of contaminated soil would be conducted by excavation, using standard construction equipment, i.e., excavators, to remove material from the ground and load it into transport mechanisms, i.e., trucks, for off-site treatment or disposal.

Disposal

Disposal involves transporting the soil to a landfill that will either put the soil in a lined landfill or use it for daily cover, based on characterization results. The Old Upper Mountain Road site is adjacent to the City of Lockport closed landfill, which is one location that can be considered. Another location would be an off-site commercial landfill. Alternatively, soil could be disposed of on-site, which would be followed by containment.

4.2 GROUNDWATER

No Action

The no action alternative is included to be used as the baseline alternative against which other remedial alternatives are compared.

Site Management

Site management for groundwater involves the placement of a restriction on the use of groundwater to limit exposure, provides notice to any individual who might come in contact with the groundwater, or prevents actions that would interfere with the effectiveness of a remedial program.

Containment

Groundwater containment can be accomplished by both physical and hydraulic means. Physical containment would be accomplished by installation of a physical barrier in the form of a slurry wall installed from the ground surface to the confining layer. Physical containment of contaminants such as suspended metals could be achieved by *in situ* filtration through a permeable reactive barrier. Hydraulic containment would be accomplished by pumping groundwater. This method would be followed up with treatment. Any of these methods would serve to contain contaminated groundwater or divert it from drinking water intakes or toward treatment.

Treatment

Treatment subjects contaminants to processes that alter their state, transform them to innocuous forms, or remove them from suspension. Potentially applicable treatment technologies for groundwater at this site include *ex situ* filtration, *ex situ* flocculation, or *ex situ* ion exchange. *Ex situ* filtration removes solid particles from the contaminated water by utilizing gravity or pressure differentials to run the fluid stream through a porous treatment medium.

Ex situ flocculation is the use of groundwater extraction through extraction wells or collection trenches to treatment. Contaminated water is mixed with hydroxides, carbonates, or sulfides and flocculants to precipitate metals from the groundwater and promote the settling and subsequent separation of the contaminant solids from the liquid.

Ex situ ion exchange is achieved by pumping groundwater through ion exchange resins made of synthetic or natural materials the size of a grain of sand with the opposite charge of the contaminated ion.

4.3 SEDIMENT

No Action

The No Further Action alternative is included to be used as the baseline alternative against which other remedial alternatives are compared.

Site Management

Site management involves the placement of a restriction on the use of property that limits human or environmental exposure, provides notice to any individual who might come in contact with the site, or prevents actions that would interfere with the effectiveness of a remedial program or with the effectiveness and/or integrity of site management activities at or pertaining to a site.

Containment

Sediment containment would be accomplished by installing a cap over the contaminated areas to eliminate exposure. Cap construction could consist of stone, sand, clay, or plastic. A reactive cap could also be constructed using sulfide complex minerals (mackinawite, gypsum, or phosphogypsum), biopolymers (chitin/chitosan), or other compounds (zeolite, organoclay, apatite) in a thin layer or mixed with sand.

Treatment

Treatment subjects contaminants to processes that alter their state, transform them to innocuous forms, or immobilize them. Potentially applicable treatment technologies for soil at this site include *in situ* chemical treatment or *in situ* biological treatment.

Chemical treatment can be accomplished by the addition of amendments to treat or stabilize the contaminants within the sediment. Stabilization reduces the toxicity and mobility of the contaminants. This results in the production of a monolith of waste with high structural integrity.

Biological treatment involves the use of wetland plants to treat the impacted media. This can be achieved through phytoextraction, which involves the physical removal of contaminants from the sediment through plant uptake or phytoremediation, which involves contaminant break down by the plant or microbes near the root system.

Removal

Physical removal of contaminated sediment would be conducted by mechanical or hydraulic dredging with dewatering, using standard dredging equipment to remove material from the creek bed and load it into transport mechanisms, i.e., trucks, for off-site treatment or disposal. Amendments would likely need to be used to modify chemical and physical properties of the sediment to facilitate handling and disposal.

Disposal

Disposal involves transporting the sediment to a landfill that will either place the sediment in a lined landfill or use it for daily cover, based on characterization results. Sediment may need to be dewatered, stabilized, or treated prior to transport in order to meet paint filter test requirements.

5. IDENTIFICATION AND SCREENING OF TECHNOLOGIES

The potentially applicable technologies identified earlier are screened using the process defined in DER-10, Technical Guidance for Site Investigation and Remediation (NYSDEC 2010). The screening process and summary of results are described below and the detailed technology screening is presented in Table 5-1.

5.1 SCREENING CRITERIA

Three preliminary screening criteria (i.e., effectiveness, implementability, and cost) were used to screen remedial technologies identified earlier for each media of concern. Definitions for these criteria are presented below.

5.1.1 Effectiveness

Effectiveness is a measure of the ability of an option to: (1) reduce toxicity, mobility, or volume of contamination; (2) minimize residual risks; (3) afford long-term protection; (4) comply with applicable or relevant and appropriate requirements; (5) minimize short-term impacts; and (6) achieve protectiveness in a limited duration. Technologies that offer significantly less effectiveness than other proposed technologies may be eliminated from the alternative development process. Options that do not provide adequate protection of human health and the environment likewise may be eliminated from further consideration.

5.1.2 Implementability

Implementability is a measure of the technical feasibility and availability of the option and the administrative feasibility of implementing it (e.g., obtaining permits for off-site activities, right-of-ways, or construction). Options that are technically or administratively infeasible or that would require equipment, specialists, or facilities that are not available within a reasonable period may be eliminated from further consideration.

5.1.3 Cost

Qualitative relative costs for implementing the remedy are considered. Technologies that cost more to implement, but that offer no benefit in effectiveness or implementability over other technologies, may be excluded from the alternative development process.

5.2 SCREENING SUMMARY

The results of the technology screening are summarized in the following two sections. The first section discusses technologies that were not retained for further analysis and the reasons for exclusion. The second section lists technologies that were retained for further analysis as individual components in remedial alternatives. The screening is presented in further detail in Table 5-1.

5.2.1 Technologies Not Retained for Further Analysis

From the list of technologies potentially applicable for remediation of chemicals and media of concern at this site, a few technologies were excluded from further consideration because they were considered ineffective, not implementable at this site, or too costly relative to the other technologies under consideration. The reasons for exclusion are explained below.

Technologies Not Retained for Soil/Fill Material Remediation

Phytoremediation was not retained because it was not considered effective for the existing depths of contamination. Phytoremediation is most effective to the depth of the root system of a particular plant. In addition, phytoremediation is generally used for lower levels of contamination than what exists at the site.

Soil flushing was not retained due to the high cost and unknown level of effectiveness. Soil flushing is an emerging technology which has not been widely implemented.

Disposal at the adjacent City of Lockport closed landfill was not retained due to the volume of contaminated soil requiring disposal and the limited capacity of the landfill.

Technologies Not Retained for Sediment Remediation

Thin layer capping with armor material, such as gravel or stone, was not retained due to uncertain effectiveness for source control.

Impermeable liner capping was not retained because it is not implementable for the large areas of contamination in Gulf Creek.

In situ subaqueous capping using a reactive cap was not retained due to difficulty in implementation and limited effectiveness for source control.

In situ and *ex situ* chemical treatment was not retained due to the moderately high cost and limited effectiveness for source control.

Hydraulic dredging was not retained due to difficulty of implementation, shallow water way within Gulf Creek, and high cost.

5.2.2 Technologies Retained for Further Analysis

Technologies that will be retained for further evaluation for the site are listed below for each media of concern. Soil and sediment technologies were combined to create combined alternatives for OU 1 and OU 2.

The following remedial alternatives are considered in this FS for OU 1:

- **Alternative 1A**—No Action
- **Alternative 1B—**Site Management
- **Alternative 2**—Complete Removal with Off-Site Disposal
- **Alternative 3—***Ex situ* Stabilization with Off-Site Disposal
- **Alternative 4—**Landfill Capping with a Part 360 Cap- Existing Landfill Footprint
- **Alternative 5**—Landfill Capping with a Part 360 Cap- Extended Landfill Footprint
- **Alternative 6**—Landfill Capping with a CleanSoil Cover- Extended Landfill Footprint
- **Alternative 7**—Partial Removal and Off-Site Disposal with *In Situ* Stabilization of Shallow Waste
- **Alternative 8**—Partial Removal, *Ex Situ* Stabilization and On-site Placement, with *In Situ* Stabilization of Shallow Waste.

The following remedial alternatives are considered in this FS for OU 2:

- **Alternative 1A**—No Action
- **Alternative 1B—**Site Management
- **Alternative 2**—Multi-Media Sub-Aqueous Capping
- **Alternative 3**—*In Situ* Sediment Amendment
- **Alternative 4—**Complete Removal with Disposal
- **Alternative 5**—Partial Removal with Multi-Media Sub-Aqueous Capping.

6. SCOPING AND DEVELOPMENT OF REMEDIAL ALTERNATIVES

The scoping for the FS was completed based on correspondence between EA and NYSDEC. EA completed the alternative comparison in accordance with DER-10 and the 1988 EPA publication *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (EPA l540lG-891004). The results of the technology screening process were summarized in a letter dated 17 June 2011 from EA to NYSDEC. Comments regarding this letter were included in a letter dated 13 July 2011 from NYSDEC to EA. Copies of each letter are provided in Appendix A. The screening of alternatives was designed to provide a basis for an overall assessment of applicable technologies based on impacted media identified at the site during the RI and SRI (EA 2011a and b, respectively).

The scoping and development of the technologies/alternatives selected during the previous step of the FS process are described below.

6.1 OU 1 ALTERNATIVES FOR SOIL/FILL MATERIAL

The OU 1 treatment area was determined based on data presented in the RI and SRI (EA 2011a and b, respectively). The area and treatment depths selected address the areas of concern within the landfill (Figure 6-1). Detailed soil/fill material alternatives screening is presented in Table 6-1.

For each remedial alternative that incorporates excavation and off-site disposal, the excavation plan and associated costing is based on the feasibility to segregate hazardous from non-hazardous soil/fill material. To evaluate the practicality of segregation, EA has included a pre-design characterization work element to identify areas of soil/fill material that exhibit hazardous waste characteristics. The pre-design characterization will involve collecting samples across the fill area and vertical profile, and analyzing these samples for waste characterization parameters. The results of the pre-design characterization would be evaluated to determine if discrete areas of soil/fill material exhibit either hazardous or non-hazardous characteristics and if these areas can be practically segregated under the excavation plan. The pre-design characterization may conclude that it is not practical to segregate waste during excavation, in which case the hazardous unit rate for off-site disposal of “unstablized” soil/fill material would be applied to all excavated material under the remedial alternative increasing the cost estimate accordingly. The remedial alternative costing sheets (Appendix B) include a notation that identifies the estimated cost of full hazardous material excavation and disposal.

6.1.1 OU 1 Alternative 1A: No Action

The no action alternative is evaluated as a procedural requirement and as a basis for comparison. This alternative would leave the site in its present condition.

6.1.2 OU 1 Alternative 1B: Site Management

Alternative 1B is to implement an environmental easement on the property to control the use of the site. This alternative would leave the site in its present physical condition, but would address the RAO "Prevent ingestion/direct contact with contaminated soil". Additionally, site perimeter controls and access points would be installed, and warning signage posted.

6.1.3 OU 1 Alternative 2: Complete Removal with Off-Site Disposal

The third potential remediation alternative to be evaluated is complete excavation and off-site disposal of soil/fill material at a commercial landfill. This alternative is aimed at removing the soil/fill material exceeding the unrestricted SCGs on the site.

Excavation is a common remedy used to remove contaminated soil from a source area. This approach can be effective at eliminating exposure and preventing transport of contaminants. Special considerations would need to be made for the Old Upper Mountain Road site due to the physical setting and grades. Ravine access would need to be modified and maintained to allow for full removal. In addition, a sewer line runs through the existing fill and would preferably be permanently re-routed for excavation to take place.

Off-site treatment and/or disposal can be expensive depending on the location of the site relative to treatment or disposal facilities, the volume of soil involved, the nature of contamination, and the availability of different treatment or disposal options in the area. The excavated area would not be completely restored to pre-existing grade; however, ravine slopes would need to be brought to 3:1 slopes using backfill for constructability. Figure 6-2 provides the proposed final conditions under this alternative.

This alternative would be implemented as follows:

- A utility locator would be brought on-site to locate known underground utilities or other obstructions that may prove problematic during excavation. This information would be utilized to either re-route these utilities outside the remediation or to accommodate their locations and future anticipated maintenance so as the remediation is not jeopardized and potential for future exposure to contaminants is minimized.

- A pre-design characterization study would take place at the site prior to the remedial design process of this alternative. This type of study would involve the installation of soil borings and collection of soil/fill material samples spaced 25-ft horizontally and 20-ft vertically. Samples would be submitted to an analytical laboratory for full TCLP analysis. The objective of this study would be to evaluate the potential for the segregation of hazardous vs. non-hazardous waste for disposal.

- Existing sewer line would be re-aligned from a manhole at the end of Old Upper Mountain Road to a manhole within the ravine in consultation with the City of Lockport.

The existing sewer line within the soil/fill material area would be removed as part of the excavation activities.

- Access roads into the ravine would be improved and maintained for the duration of the remedial action.

- Five monitoring wells would be abandoned prior to excavation activities.

- Sheet piling would be installed along the railroad tracks and Old Upper Mountain Road at the southwest and southeast boundaries of the OU 1 area.

- Approximately 228,850 loose yd^3 of soil/fill material would be excavated, to a maximum depth of 80 ft bgs.

- Based on the RI, and for the purpose of this FS, EA estimates that 43 percent of the excavated soil/fill material would be classified as hazardous waste and would be disposed of at a permitted hazardous waste landfill. The remainder of the soil/fill material would be disposed of at a general waste landfill, following acceptance. Results of the pre-design characterization study would potentially change these percentages.

- It is assumed that a dewatering system would be needed since the excavation will extend into the groundwater table; however, due to the fact that the excavation activities would be completed on the side facing the ravine, water diversion methods with settling tanks could be used prior to discharge to the creek rather than conventional pumping and dewatering techniques. Samples would need to be collected prior to discharge.

- Confirmation soil sampling would be conducted during excavation to document any remaining contamination at the bottom and sides of the excavation.

- Once excavation and disposal activities are complete, the site would be restored to 3:1 slopes along the ravine using an approved backfill source. All disturbed areas would be restored with topsoil and seed and native plantings.

- To aid in stability due to flow events and sheet flow on the ravine side, rock toe and soil stabilization fabrics could be utilized to aid in stability of the graded surface. Rock toe techniques would stabilize the bottom of the slope against Gulf Creek flows and concentrated sheet flow from the slope surface. Additionally, this would help maintain a permeable pathway for natural groundwater release to Gulf Creek. Soil stabilization fabrics and the addition of benches or other flow collection devices would aid in the safe conveyance of surface water from the slope.

6.1.4 OU 1 Alternative 3: *Ex situ* Stabilization with Off-Site Disposal

Ex situ stabilization consists of excavating contaminated soil/fill material as discussed in Section

6.1.3, staging, and stabilization treatment on-site. Soil/fill material would be mixed with amendments such as Eco-Bond® prior to off-site disposal. Stabilization is expected to reduce the toxicity of the soil/fill material and therefore reduce the cost of disposal. As with Alternatives 2–4, the sewer line runs through the existing soil/fill material and would have to be re-routed for excavation to take place. Final conditions would be identical to OU 1 Alternative 2, shown in Figure 6-2.

This alternative would be implemented as follows:

- A utility locator would be brought on-site to locate known underground utilities or other obstructions that may prove problematic during excavation. This information would be utilized to either re-route these utilities outside the remediation or to accommodate their locations and future anticipated maintenance so as the remediation is not jeopardized and potential for future exposure to contaminants is minimized.

- The existing sewer line would be re-aligned from a manhole at the end of Old Upper Mountain Road to a manhole within the ravine. The existing sewer line within the soil/fill material area would be abandoned in place.

- A bench-scale or pilot study would be completed to evaluate the effectiveness of the proposed stabilization amendment.

- Access roads into the ravine would be improved and maintained for the duration of the remedial action.

- Five monitoring wells would be abandoned prior to excavation activities.

- Sheet piling would be installed along the railroad tracks and Old Upper Mountain Road at the southwest and southeast boundaries of the OU 1 area.

- Approximately 228,850 loose yd^3 of soil/fill material would be excavated to a maximum depth of 80 ft bgs.

- Soil/fill material would be treated on-site prior to disposal at an approved facility.

- It is assumed that a dewatering system would be needed since the excavation will extend into the groundwater table; however, due to the fact that the excavation will be open on the side facing the ravine, water diversion methods with settling tanks could be used prior to discharge to the creek rather than conventional pumping techniques. Samples would need to be collected prior to discharge.

- Confirmation soil/fill material sampling would be conducted during excavation to document any remaining contamination at the bottom and sides of the excavation.

- Once excavation, treatment and disposal activities are complete, the site would be restored to 3:1 slopes along the ravine using an approved backfill source. All disturbed areas would be restored with topsoil and seed.

6.1.5 OU 1 Alternative 4: Landfill Capping with a Part 360 Cap—Existing Landfill Footprint

Landfill capping consists of the construction of a Part 360 cap system comprised of a vegetated topsoil upper layer, a barrier protection layer, geotextile drainage layer, a textured or smooth 60 mil high-density polyethylene geomembrane liner, and a geotextile gas venting layer. Installation of a cap would eliminate exposure and prevent infiltration of stormwater through soil/fill material. This would result in a reduction of production of leachate which could potentially transport contaminants off-site.

Special considerations would need to be made for cap construction at the Old Upper Mountain Road site due to the physical setting and grades. Ravine access would need to be modified and maintained to allow for partial removal of excess material that cannot be contained within the landfill cap. Existing grades of the soil/fill material are steep and would require considerable earth work and waste disposal to achieve the necessary 3:1 landfill slopes. In addition, a sewer line runs through the existing fill and would have to be re-routed for partial removal to take place. Figure 6-3 provides the approximate final conditions under this alternative.

This alternative would be implemented as follows:

- A utility locator would be brought on-site to locate known underground utilities or other obstructions that may prove problematic during excavation. This information would be utilized to either re-route these utilities outside the remediation or to accommodate their locations and future anticipated maintenance so as the remediation is not jeopardized and potential for future exposure to contaminants is minimized.

- A pre-design characterization study would take place at the site prior to the remedial design process of this alternative. This type of study would involve the installation of soil borings and collection of soil/fill material samples spaced 25 ft horizontally and 20 ft vertically in the area where soil/fill material is proposed to be removed. Samples would be submitted to an analytical laboratory for full TCLP analysis. The objective of this study would be to evaluate the potential for the segregation of hazardous vs. non-hazardous soil/fill material for disposal.

- Existing sewer line would be re-aligned from a manhole at the end of Old Upper Mountain Road to a manhole within the ravine. The existing sewer line within the soil/fill material area would be abandoned in place. Removing the sewer line from the remediation area will allow for future sewer maintenance without the possibly of disturbing contaminated soil/fill material or the proposed landfill cap.

- Access roads into the ravine would be improved and maintained for the duration of the remedial action.

- Five monitoring wells would be abandoned prior to excavation activities.

- Approximately 51,000 yd^3 of soil/fill material would be excavated from the embankment in order to achieve 3:1 slopes into the ravine. Excavated soil/fill material would be treated and remain on-site within the upper sections of OU 1 and placed at 3:1 slopes. 152,000 yd^3 would be disposed of at an off-site facility.

- Once final subgrade surfaces are complete, a four part cap system would be installed by qualified personnel, complete with an anchor trench, proper surface drainage, topsoil and seed. Surface drainage would be designed to handle stormwater surface flow, as well as flow from the existing 30 in. bulkhead.

- Eight monitoring wells would be installed following restoration for groundwater monitoring purposes.

- The site perimeter would be secured using a 9-ft Galvanized fence with barbed wire and a 7-ft high swing gate.

6.1.6 OU 1 Alternative 5: Landfill Capping with a Part 360 Cap—Extended Landfill Footprint

Landfill capping consists of the construction of a Part 360 cap system comprised of a vegetated topsoil upper layer, a barrier protection layer, geotextile drainage layer, a textured or smooth 60 mil high-density polyethylene geomembrane liner, and a geotextile gas venting layer. Installation of a cap would eliminate exposure and prevent infiltration of stormwater through soil/fill material. This would result in a reduction of production of leachate which could potentially transport contaminants off-site.

Similar to Alternative 4, special considerations would need to be made for cap construction at the Old Upper Mountain Road site due to the physical setting and grades. The required 3:1 slopes would be achieved by re-grading soil/fill material into the ravine, rather than removal and disposal off-site, as is suggested in Alternative 4. Existing grades of the soil/fill material are steep and would require considerable earth work and re-grading into the existing ravine to achieve the necessary 3:1 landfill slopes. Prior to placement of fill in the ravine, a drainage layer would be constructed to allow groundwater to follow natural flow patterns into the ravine without coming into contact with contaminated fill. In addition, a sewer line runs through the existing fill and would have to be re-routed for grading activities to take place. Figures 6-4 and 6-5 provide the approximate final conditions under this alternative.

This alternative would be implemented as follows:

- A utility locator would be brought on-site to locate known underground utilities or other obstructions that may prove problematic during excavation. This information would be utilized to either re-route these utilities outside the remediation, or to accommodate their locations and future anticipated maintenance so as the remediation is not jeopardized and potential for future exposure to contaminants is minimized.

- Existing sewer line would be re-aligned from a manhole at the end of Old Upper Mountain Road to a manhole within the ravine. The existing sewer line within the soil/fill material area would be abandoned in place. Removing the sewer line from the remediation area will allow for future sewer maintenance without the possibly of disturbing contaminated soil/fill material or the proposed landfill cap.

- Access roads into the ravine would be improved and maintained for the duration of the remedial action.

- A drainage layer consisting of nonwoven geotextile, 6-in. perforated pipe, and a 24-in. layer of gravel would be placed within the extended footprint of the landfill.

- Five monitoring wells would be abandoned prior to excavation activities.

- Approximately 51,000 yd^3 of soil/fill material would be excavated from the embankment in order to achieve 3:1 slopes into the ravine. Excavated soil/fill material would remain on-site within the upper sections of OU 1 and placed at 3:1 slopes into the ravine over the drainage layer.

- Once final subgrade surfaces are complete, a four-part cap system would be installed by qualified personnel, complete with an anchor trench, proper surface drainage, topsoil, and seed. Surface drainage would be designed to handle stormwater surface flow, as well as flow from the existing 30 in. bulkhead.

- Eight monitoring wells would be installed following restoration for groundwater monitoring purposes.

- The site perimeter would be secured using a 9-ft Galvanized fence with barbed wire and a 7-ft high swing gate.

6.1.7 OU 1 Alternative 6: Landfill Capping with a Clean Soil Cover—Extended Landfill Footprint

Landfill capping with a soil cap consists of the construction of a multi-layer soil cap composed of a vegetated topsoil upper layer, and an 18 in. barrier soil layer. Installation of a cap would eliminate exposure and reduce infiltration of stormwater through soil/fill material. This would result in a reduction of production of leachate which could potentially transport contaminants off-site.

Similar to Alternatives 4 and 5, special considerations would need to be made for cap construction at the Old Upper Mountain Road site due to the physical setting and grades. The required 3:1 slopes would be achieved by re-grading soil/fill material into the ravine, rather than removal and disposal off-site, as is suggested in Alternative 4. Existing grades of the soil/fill material are steep and would require considerable earth work and re-grading into the existing ravine to achieve the necessary 3:1 landfill slopes. Prior to placement of fill in the ravine, a drainage layer would be constructed to allow groundwater to follow natural flow patterns into the ravine without coming into contact with contaminated fill.

In addition, a sewer line runs through the existing fill and would have to be re-routed for grading activities to take place. Figures 6-4 and 6-5 provide the approximate final conditions under this alternative.

This alternative would be implemented as follows:

- A utility locator would be brought on-site to locate known underground utilities or other obstructions that may prove problematic during excavation. This information would be utilized to either re-route these utilities outside the remediation or to accommodate their locations and future anticipated maintenance so as the remediation is not jeopardized and potential for future exposure to contaminants is minimized.

- Existing sewer line would be re-aligned from a manhole at the end of Old Upper Mountain Road to a manhole within the ravine. The existing sewer line within the soil/fill material area would be abandoned in place. Removing the sewer line from the remediation area will allow for future sewer maintenance without the possibly of disturbing contaminated soil/fill material or the proposed landfill cap.

- Access roads into the ravine would be improved and maintained for the duration of the remedial action.

- A drainage layer consisting of nonwoven geotextile, 6-in. perforated pipe, and a 24-in. layer of gravel would be placed within the extended footprint of the landfill.

- Five monitoring wells would be abandoned prior to excavation activities.

- Approximately 51,000 yd^3 of soil/fill material would be excavated from the embankment in order to achieve 3:1 slopes into the ravine. Excavated soil/fill material would remain on-site within the upper sections of OU 1 and placed at 3:1 slopes into the ravine over the drainage layer.

- Once final subgrade surfaces are complete, a soil cap system would be installed by qualified personnel, complete with proper surface drainage, topsoil, and seed. Surface drainage would be designed to handle stormwater surface flow, as well as flow from the existing 30 in. bulkhead.

- Eight monitoring wells would be installed following restoration for groundwater monitoring purposes.

- The site perimeter would be secured using a 9-ft Galvanized fence with barbed wire and a 7-ft high swing gate.

6.1.8 OU 1 Alternative 7: Partial Removal and Off-Site Disposal with *In Situ* Stabilization of Shallow Waste

This alternative would consist of the removal of soil/fill material from contaminated depths that range from 20 to 80 ft bgs. Soil/fill material would be removed to achieve 3:1 or otherwise stable slopes within the ravine. This area is in the center of OU 1 and would lengthen the existing ravine to the southwest. The sewer line that runs through the existing soil/fill material would have to be re-routed for partial removal to take place. Figure 6-6 provides the final conditions under this alternative.

Remaining soil/fill material would be treated *in situ* with a stabilizing amendment, such as Eco-Bond®, to reduce the mobility and leachability of the contaminants. Soil/fill material that remains at 3:1 slopes in the center of the ravine would be graded to create a flat treatment surface area, treated with an amendment, and then returned to 3:1 slopes for final restoration.
Special considerations would need to be made for the Old Upper Mountain Road site due to the physical setting and grades. Ravine access would need to be modified and maintained to allow for partial removal.

This alternative would be implemented as follows:

- A utility locator would be brought on-site to locate known underground utilities or other obstructions that may prove problematic during excavation. This information would be utilized to either re-route these utilities outside the remediation or to accommodate their locations and future anticipated maintenance so as the remediation is not jeopardized and potential for future exposure to contaminants is minimized.

- A pre-design characterization study would take place at the site prior to the remedial design process of this alternative. This type of study would involve the installation of soil borings and collection of soil/fill material samples spaced 25-ft horizontally and 20-ft vertically in the area where soil/fill material is proposed to be removed. Samples would be submitted to an analytical laboratory for full TCLP analysis. The objective of this study would be to evaluate the potential for the segregation of hazardous vs. non-hazardous soil/fill material for disposal.

- Existing sewer line would be re-aligned from a manhole at the end of Old Upper Mountain Road to a manhole within the ravine. The existing sewer line within the soil/fill material area would be abandoned in place. Removing the sewer line from the remediation area will allow for future sewer maintenance without the possibly of disturbing amended soil/fill material or the proposed soil cover system.

- A bench-scale or pilot study would be completed to evaluate the effectiveness of the proposed stabilization amendment.

- Access roads into the ravine would be improved and maintained for the duration of the remedial action.

- Five monitoring wells would be abandoned prior to excavation activities.

- Sheet piling would be installed along the railroad tracks at the southwest boundary of the OU 1 area.

- Approximately 217,478 loose yd^3 of soil/fill material would be excavated, from a minimum depth of 20 ft bgs and a maximum depth of 50 ft bgs.

- Based on the RI, and for the purpose of this FS, EA estimates that 43 percent of the excavated soil is hazardous and would be disposed of at a permitted hazardous waste landfill. The remainder of the soil would be disposed of at a general waste landfill, following acceptance. Results of the pre-design characterization study would potentially change these percentages.

- It is assumed that a dewatering system would be needed since the excavation will extend into the groundwater table; however, due to the fact that the excavation activities would be completed on the side facing the ravine, water diversion methods with settling tanks could be used prior to discharge to the creek rather than conventional pumping techniques. Samples would need to be collected prior to discharge.

- To aid in stability due to flow events and sheet flow on the ravine side, rock toe and soil stabilization fabrics could be utilized to aid in stability of the graded surface. Rock toe techniques would stabilize the bottom of the slope against Gulf Creek flows and concentrated sheet flow from the slope surface. Additionally, this would help maintain a permeable pathway for natural groundwater release to Gulf Creek. Soil stabilization fabrics and the addition of benches or other flow collection devices would aid in the safe conveyance of surface water from the slope.

- Remaining soil/fill material would be treated with a stabilization amendment, such as Eco-Bond®, using deep mixing equipment (i.e., augers).

- All disturbed areas would be restored to 3:1 grades and covered with topsoil and seed.

- Eight monitoring wells would be installed following restoration.

6.1.9 OU 1 Alternative 8: Partial Removal, *Ex Situ* Stabilization and On-site Placement with *In Situ* Stabilization of Shallow Waste

Similar to Alternative 7, this alternative would consist of the removal of soil/fill material from contaminated depths that range from 20 to 80 ft bgs; however, instead of being disposed off-site, removed fill would be treated *ex situ* and disposed of on-site into the area from which it was excavated and into the ravine to achieve 3:1 slopes. A similar drainage layer as discussed for Alternatives 5 and 6 would be placed within the ravine prior to placement of the treated fill. The sewer line that runs through the existing soil/fill material would have to be re-routed for excavation to take place.

Shallow soil/fill material would be treated *in situ* with a stabilizing amendment, such as Eco-Bond®, to reduce the mobility and leachability of the contaminants.

Ravine access would need to be modified and maintained to allow for partial removal and placement. Figure 6-7 provides the final conditions under this alternative.

This alternative would be implemented as follows:

- A utility locator would be brought on-site to locate known underground utilities or other obstructions that may prove problematic during excavation. This information would be utilized to either re-route these utilities outside the remediation, or to accommodate their locations and future anticipated maintenance so as the remediation is not jeopardized and potential for future exposure to contaminants is minimized.

- Existing sewer line would be re-aligned from a manhole at the end of Old Upper Mountain Road to a manhole within the ravine. The existing sewer line within the soil/fill material area would be abandoned in place. Removing the sewer line from the remediation area will allow for future sewer maintenance without the possibly of disturbing amended soil/fill material or the proposed soil cover system.

- A bench-scale or pilot study would be completed to evaluate the effectiveness of the proposed stabilization amendment.

- Access roads into the ravine would be improved and maintained for the duration of the remedial action.

- A drainage layer consisting of nonwoven geotextile, 6-in. perforated pipe and a 24-in. layer of gravel would be placed within the extended footprint of the landfill.

- Five monitoring wells would be abandoned prior to excavation activities.

- Sheet piling would be installed along the railroad tracks at the southwest boundary of the OU 1 area.

- Approximately 217,478 loose yd^3 of soil/fill material would be excavated, to a minimum depth of 20 ft bgs and a maximum depth of 50 ft bgs.

- Excavated soil would be staged onsite and treated prior to placement within the excavation and into the ravine.

- It is assumed that a dewatering system would be needed since the excavation will extend into the groundwater table; however, due to the fact that the excavation activities would be completed on the side facing the ravine, water diversion methods with settling tanks could be used prior to discharge to the creek rather than conventional pumping techniques. Samples would need to be collected prior to discharge.
- Shallow soil/fill material would be treated with a stabilization amendment, such as Eco-Bond®, using deep mixing equipment (i.e., augers).

- All disturbed areas would be restored to 3:1 grades, and covered with topsoil and seed.

- Eight monitoring wells would be installed following restoration.

6.2 OU 2 ALTERNATIVES FOR SEDIMENT

The OU 2 treatment areas were determined based on data presented in the RI and SRI. The area and depths selected address the area of concern within the operable unit (Figure 6-8). Detailed sediment alternatives screening is presented in Table 6-1. As OU 2 includes the active stream and floodplain of Gulf Creek, special considerations are required for the safe conveyance of base and flood flow within the stream, as well as the ecological potential of the site. Alternatives must be able to work with or resist the geomorphic processes active within the riparian corridor to prevent exposure, suspension, and transport of contaminated materials.

6.2.1 OU 2 Alternative 1A: No Action

The no action alternative is evaluated as a procedural requirement and as a basis for comparison. This alternative would leave the site in its present condition.

6.2.2 OU 2 Alternative 1B: Site Management

Alternative 1B is to implement an environmental easement on the property to control the use of the site. This alternative would leave the site in its present physical condition, but would address the RAO "Prevent ingestion/direct contact with contaminated sediment". Additionally, site perimeter controls and access points would be installed, and warning signage posted.

6.2.3 OU 2 Alternative 2: *In Situ* Multi-Media Sub-Aqueous Capping

In Situ multi-media sub-aqueous capping would be utilized in the active floodplain and sediments of Gulf Creek. In this alternative, contaminated sediments would be covered by clean sand, soil, cobble, top soil, and/or organic matter to recreate a floodplain surface and stream system above the contaminated sediment. Figure 6-9 provides the final conditions under this alternative.

This alternative would be implemented as follows:

- A utility locator would be brought on-site to locate known underground utilities or other obstructions that may prove problematic during work activities within Gulf Creek. This information would be utilized to either temporarily re-route these utilities outside the remediation or to accommodate their locations and future anticipated maintenance needs.

- The existing sewer line would be re-aligned either outside of OU 2 or in such a way as to limit its impact on the remediation area and accommodate future maintenance without jeopardizing the remediation.

- A detailed 1-ft contour survey would be collected by a licensed surveyor to document the existing conditions of Gulf Creek, including limits of wetlands and waterways, trees, utilities, topographic features, and other relevant existing conditions.

- In order to understand the magnitude of flow, velocity and shear forces associated with typical floodplain conditions on Gulf Creek, a detailed hydrologic and hydraulic (H&H) study would be completed for Gulf Creek at the points of interest, including the top of OU 2 and the lower extent of remediation. This would include mapping of the existing and proposed conditions floodplain. Analysis of any tributaries or drainages contributing within the work area would also be performed.

- A detailed fluvial geomorphic analysis would be completed for Gulf Creek. Estimates of bed load and suspended sediment load would be documented using field sampling and predictive modeling techniques. Testing would be utilized to determine if contaminated sediments are being significantly transported into or out of Gulf Creek. Analysis of the stable dimensional, plan and profile forms of Gulf Creek would be documented for restoration of the stream following capping activities. If the existing condition of Gulf

Creek at this location is sufficiently impaired, a stable reference reach site would be identified and surveyed at this stage.

- Clearing, chipping and grubbing of woody material and subgrade preparation of the OU 2 area. Subgrade would be prepared by amending contaminated sediment with stone in order to stabilize softer areas which lack the bearing capacity to support a cap.

- Pipe diversion of base flow with storm capacity of Gulf Creek, as well as dewatering and maintenance of flow measures would be utilized to create a stable work area. Flow diversion of outfalls from OU 1 may be required depending on construction sequencing. The previous H&H modeling study would be used for flow diversion and pipe sizing criteria.

- Installation of the multimedia cap. The multimedia cap would be installed with surface materials and contours conforming to the restored condition of Gulf Creek through the remediation area, including new stream channel, riffles, pools, and grade controls to ensure the long-term stability of the multimedia cap. The cap would be underlain by a protective layer of geotextile, to define the lower limit of the cap in the event of any future dredging and/or excavation in Gulf Creek. This geotextile underlayment is typically non-woven geotextile and is orange in color to serve as a warning of the contaminated materials below.

- Once dredging and cap placement activities are completed, the site would be stabilized with an appropriate wetland and riparian seed mix. It is recommended that any vegetative community established be in accordance with the native ecology and beaver morphology present in similar systems. Additionally, the creation of an emergent or scrub-shrub system with beaver activity would decrease the likelihood of the establishment of large trees, which through flood flows, wind or other natural processes could uproot, damaging the multimedia capping system and risking exposure of contaminated sediments beneath.

Capping activities would have the effect of uplifting the existing stream and the shallow groundwater table. Depending on the extent of potential uplift, groundwater investigation would need to be conducted to determine the impact of this increase in shallow groundwater elevation on the remediation alternative selected for OU 1.

In order to preserve the integrity of OU 2's capping system, grade control structures maintaining the new base level of Gulf Creek would be required. To maintain a stable transition of flow to the lower reaches of Gulf Creek, as well as preserve fish passage and other functions and values of the stream system, these grade controls may be required in coordination with the remedial action area. Through geomorphic investigation, these extents should be able to be determined. The design of these grade controls is essential to preserving the integrity of the *in situ* capping system. As sediment transport cannot realistically be limited to zero, designing grade control structure capacity and shape to produce areas of net long-term sediment deposition is essential to preserving the capping system. Riffle grade control devices, where higher velocities and grade transitions can occur, would be designed for immobility under extreme flow conditions and will allow that portion of the cap to resist flood flow shear stresses and continue to prevent exposure of contaminated sediments. In addition to preserving the capping system, this will also allow a stable stream system to be restored and self-mitigating project impacts.

Following completion, the cap, including structures designed for sediment deposition and riffle grade control devices would be inspected in conjunction with surface water sampling events, which would be conducted semi-annually for the first 5 years and annually thereafter. The cap inspection and sampling event will serve to monitor effectiveness of the cap and identify any areas requiring repair.

6.2.4 OU 2 Alternative 3: *In Situ* Sediment Amendment

The third potential remediation alternative to be evaluated is the amendment of contaminated sediments with apatite and gypsum. Gypsum is typically derived from the mining industry. Apatite is typically derived from byproducts of the fishing industry because it is the primary component of fish bones. Apatite has been used in soil and sediment remediation as an amendment because it has been shown to bind lead, zinc, and other cationic metals in recalcitrant phosphate forms that are not soluble, bioavailable, or toxic. Gypsum has been used as a remediation amendment for mercury because it provides pH adjustment and a source of sulfur, both of which encourage formation of cinnabar, a form of mercury that is relatively non-toxic and non-bioavailable. The successful use of these amendments is dependent upon bench scale studies and pilot testing as part of remedial design phases of the work. It also requires construction of measures to ensure sediments remain in place to avoid downstream transport and long-term monitoring. Figure 6-10 provides the final conditions under this alternative.

The alternative would be implemented as follows:

- A utility locator would be brought on-site to locate known underground utilities or other obstructions that may prove problematic during work activities within Gulf Creek. This information would be utilized to either temporarily re-route these utilities outside the remediation or to accommodate their locations and future anticipated maintenance needs.

- The existing sewer line would be re-aligned either outside of OU 2 or in such a way as to limit its impact on the remediation area and accommodate future maintenance without jeopardizing the remediation.

- A detailed 1-ft contour survey would be collected by a licensed surveyor to document the existing conditions of the site, including limits of wetlands and waterways, trees, utilities, topographic features, and other relevant existing conditions.

- A pre-design characterization study would take place at the site prior to the remedial design process of this alternative. Such a study would involve the installation of borings and collection of sediment core samples. Sampling would focus on the top 2 ft of the sediment surface where human and ecological exposures are most likely. Borings would be located in a 25 × 25 ft grid to examine variation in metal chemistry horizontally. Samples would be submitted to an analytical laboratory for bench scale testing. Different rates of application of apatite and gypsum amendment would be tested to determine their effect on metal solubility. The objective of this study would be to determine the site-specific amounts of these amendments to be proposed for amendment, as well as the extents of amendment activity. Bench scale studies would be followed by a small pilot test of amendment rates and application method over selected plots of sediment.

- In order to understand the magnitude of flow, velocity, and shear forces associated with typical floodplain conditions on Gulf Creek, a detailed H&H study would be completed for Gulf Creek at the points of interest, including the top of OU 2 and the lower extent of remediation. This would include mapping of the existing and proposed conditions floodplain. Analysis of any tributaries or drainages contributing within the work area would also be performed.

- A detailed fluvial geomorphic analysis would be completed for Gulf Creek, documenting the existing conditions in order to serve as a template for restoring flow post-remedy. Estimates of bed load and suspended sediment load would be documented using field sampling and predictive modeling techniques. Testing would be utilized to determine if contaminated sediments are being significantly transported into or out of Gulf Creek. Analysis of the stable dimensional, plan and profile forms of Gulf Creek would be documented for restoration of the stream following capping activities. If the existing condition of Gulf Creek at this location is sufficiently impaired, a stable reference reach site would be identified and surveyed at this stage.

- Clearing, chipping, and grubbing of woody material and subgrade preparation of the OU 2 area. This would allow the amendment of sediments without being impeded by existing vegetation.

- Pipe diversion of base flow with storm capacity of Gulf Creek, as well as dewatering and maintenance of flow measures would be utilized to create a stable work area. Flow diversion of outfalls from OU 1 may be required depending on construction sequencing. The previous hydrologic modeling study would be used for diversion flow and pipe sizing criteria.

- Amendment of sediments. Sediment amendments would be applied to the surface of the sediment and worked in place by tilling. It is anticipated that final grades would match closely with existing grades unless adverse conditions or concern over the stability of newly disturbed soil adjacent to Gulf Creek were encountered. Additional amendment of soil with sand or stone may be required if materials are unsuitable for placement due to high organic content, insufficient bearing capacity, or other geotechnical issues.

- Gulf Creek would be restored to its pre-existing stream pattern and profile, or an otherwise stable and suitable stream form.

- Once sediment amendment activities are completed, the site would be stabilized with an appropriate wetland and riparian seed mix. It is recommended that any vegetative community established be in accordance with the native ecology and beaver morphology present in similar systems.

This alternative would require the complete disturbance and re-stabilization of the floodplain and creek bed in all areas where testing indicates contamination exceeding the SCGs for the site.

Following completion, surface water from the creek would be sampled to monitor effectiveness of the sediment amendment. Surface water samples would be collected on a semi-annual basis for the first 5 years and annually thereafter.

6.2.5 OU 2 Alternative 4: Complete Removal and Disposal

The fourth potential remedial alternative to be evaluated is complete excavation and on-site disposal of sediment. This alternative is aimed at removing the sediments exceeding SCGs at OU 2.

Mechanical dredging is a common remedy used to remove contaminated sediment from a source area. This approach can be effective at eliminating exposure and preventing transport of contaminants.

On-site disposal would be completed in conjunction with on-site disposal for fill at OU 1. Sediment would be dewatered, stabilized, and graded on top of OU 1 fill at a 3:1 slope. The landfill cap would be completed in accordance with the selected remedy for OU 1 (Part 360 Cap if OU 1 Alternative 3 is selected, or soil cap if OU 1 Alternative 6 is selected). In the event that on-site disposal is not possible, the cost for off-site disposal has been calculated as well.

The dredged area would be restored to a stable riparian corridor with stable stream and floodplain, and those grades may or may not match the present existing grades. Figure 6-11 provides the final conditions under this alternative.

This alternative would be implemented as follows:

- A utility locator would be brought on-site to locate known underground utilities or other obstructions that may prove problematic during dredging activities. This information would be utilized to either re-route these utilities outside the remediation or to accommodate their locations and future anticipated maintenance.

- A detailed 1-ft contour survey would be collected by a licensed surveyor to document the existing conditions of the Gulf Creek corridor, including limits of wetlands and waterways, trees, utilities, topographic features, and other relevant existing conditions.

- In order to understand the magnitude of flow, velocity and shear forces associated with typical floodplain conditions on Gulf Creek, a detailed H&H study would be completed for Gulf Creek at the points of interest, including the top of OU 2 and the lower extent of remediation. This would include mapping of the existing and proposed conditions floodplain. Analysis of any tributaries or drainages contributing within the work area would also be performed.

- A detailed fluvial geomorphic analysis would be completed for Gulf Creek. Estimates of bed load and suspended sediment load would be documented using field sampling and predictive modeling techniques. Testing would be utilized to determine if contaminated sediments are being significantly transported into or out of the site. Analysis of the stable dimensional, plan, and profile forms of Gulf Creek would be documented for restoration of the stream following dredging activities. If the existing condition of Gulf Creek at this location is sufficiently impaired, a stable reference reach site would be identified and surveyed at this stage.

- Clearing, chipping, and grubbing of woody material and subgrade preparation of the OU 2 area.

- Pipe diversion of base flow with storm capacity of Gulf Creek, as well as dewatering and maintenance of flow measures would be utilized to create a stable work area. Flow diversion of outfalls from OU 1 may be required depending on construction sequencing.

- Dredging of the contaminated sediment and replacement of the sediment with an uncontaminated soil layer at the appropriate grades to restore stream and wetland functions and enable re-vegetation and stabilization. Grade control structures may be necessary in certain location to prevent scour and erosion to the replaced soil materials.

- Dredged sediment would be stockpiled on-site for dewatering, stabilized using Portland cement or a similar product, and placed atop OU 1 graded fill. Sediment would be compacted in place prior to landfill construction completion.

- Once dredging activities are completed, the site would be stabilized with an appropriate wetland and riparian seed mix and topsoil for growing medium. It is recommended that any vegetative community established be in accordance with the native ecology and beaver morphology present in similar systems. Additionally, the creation of an emergent or scrub-shrub system with beaver activity would decrease the likelihood of the establishment of large trees, which through flood flows, wind or other natural processes could uproot.

6.2.6 OU 2 Alternative 5: Selective Dredging with Multi-Media Sub-Aqueous Capping

The fifth potential remediation alternative to be evaluated is an integration of Alternatives 2 and 4, dredging selected sediment areas and capping others. In this alternative, portions of the floodplain of OU 2 would be dredged with sediments being disposed of on-site in conjunction with on-site disposal for fill at OU 1. Dredged sediment would be dewatered, stabilized, and graded on top of OU 1 fill at a 3:1 slope. The landfill cap would be completed in accordance with the selected remedy for OU 1 (Part 360 Cap if OU 1 Alternative 3 is selected, or soil cap if OU 1 Alternative 6 is selected). In the event that on-site disposal is not possible, the cost for off-site disposal has been calculated as well.

Dredging could potentially be implemented for partial depths in this scenario, with capping of contaminated sediment taking the place of a full depth removal. Portions of the site with less potential for exposure or transport of contaminated sediment, or sediment at appropriate deep depths after dredging could then be capped to prevent exposure. This alternative would limit the quantity of dredging over a full removal. Figure 6-12 provides the final conditions under this alternative.

This alternative would be implemented as follows:

- A utility locator would be brought on-site to locate known underground utilities or other obstructions that may prove problematic during dredging and capping activities. This information would be utilized to either re-route these utilities outside the remediation or to accommodate their locations and future anticipated maintenance so as the remediation is not jeopardized and potential for future exposure to contaminants is minimized.

- A pre-design characterization study would take place at the site prior to the remedial design process of this alternative. This type of study would involve the installation of soil borings and collection of soil samples spaced 25-ft horizontally, to the termination depth of the sediment layer vertically, with samples collected every 1 ft. Samples would be submitted to an analytical laboratory for full TCLP analysis. The purpose would be to identify sediment depths with lower concentrations of metals which could be capped instead of excavated.

- A detailed 1-ft contour survey would be collected by a licensed surveyor to document the existing conditions of the site, including limits of wetlands and waterways, trees, utilities, topographic features, and other relevant existing conditions.

- In order to understand the magnitude of flow, velocity, and shear forces associated with typical floodplain conditions on Gulf Creek, a detailed H&H study would be completed for Gulf Creek at the points of interest, including the top of OU 2 and the lower extent of remediation. This would include mapping of the existing and proposed conditions floodplain. Analysis of any tributaries or drainages contributing within the work area would also be performed.

- A detailed fluvial geomorphic analysis would be completed for Gulf Creek. Estimates of bed load and suspended sediment load would be documented using field sampling and predictive modeling techniques. Testing would be utilized to determine if contaminated sediments are being significantly transported into or out of the site. Analysis of the stable dimensional, plan and profile forms of Gulf Creek would be documented for restoration of the stream following capping activities. If the existing condition of Gulf Creek at this location is sufficiently impaired, a stable reference reach site would be identified and surveyed at this stage. This model would also be used for proposed conditions to predict and modify the transport potential of any capping media to be exposed to flood flows, in such a way to size it for stability to prevent future exposure of contaminants through scour.

- Clearing, chipping, and grubbing of woody material and subgrade preparation of the OU 2 area. Additional amendment of soil with sand or stone may be required if subgrade materials are unsuitable for placement due to high organic content, insufficient bearing capacity, or other geotechnical issues

- Pipe diversion of base flow with storm capacity of Gulf Creek, as well as dewatering and maintenance of flow measures would be utilized to create a stable work area. Flow diversion of outfalls from OU 1 may be required depending on construction sequencing.

- Dredging of the contaminated sediment and replacement of the sediment with an uncontaminated soil layer at the appropriate grades to restore stream and wetland functions and enable re-vegetation and stabilization. Grade control structures may be necessary in certain location to prevent scour and erosion to the replaced soil materials.

- Dredged sediment would be stockpiled on-site for dewatering, stabilized using Portland cement or a similar product, and placed atop OU 1 graded fill. Sediment would be compacted in place prior to landfill construction completion.

- Multimedia capping of residual sediment which exceeds thresholds for exposure. The multimedia cap would be installed with surface materials and contours conforming to the restored condition of Gulf Creek through the remediation area, including new stream channel, riffles, pools, and grade controls to ensure the long-term stability of the multimedia cap. The cap would be underlain by a protective layer of geotextile, to define the lower limit of the cap in the event of any future excavation in the area. This geotextile underlayment is typically non-woven geotextile and is orange in color to serve as a warning of the contaminated materials below. Depending on the extent of contamination, this cap may only be present in certain areas where a full-depth excavation of contaminated sediments does not occur, or potentially directly over contaminated sediments at the existing ground surface.

- Once excavation and cap placement activities are completed, the site would be stabilized with an appropriate wetland and riparian seed mix to stabilize the capped and dredged areas. Topsoil amendment may be necessary. It is recommended that any vegetative community established be in accordance with the native ecology and beaver morphology present in similar systems. Additionally, the creation of an emergent or scrub-shrub system with beaver activity would decrease the likelihood of the establishment of large trees, which through flood flows, wind or other natural processes could uproot, damaging the multimedia capping system and risking exposure of contaminated sediments beneath.

In this alternative, virtually all contaminated areas would be disturbed and require stabilization, either due to dredging or capping activities.

Following completion, the cap would be inspected semi-annually for the first 5 years and annually thereafter. The cap inspection will serve to monitor effectiveness of the cap and identify any areas requiring repair.

7. COSTING AND EVALUATION CRITERIA

This section describes the process for the detailed analysis of remedial alternatives for the Old Upper Mountain Road site and also presents the cost estimates used as part of the analysis.

The detailed analysis of the remedial alternatives is presented in Table 6-2.

7.1 CRITERIA USED FOR ANALYSIS OF ALTERNATIVES

The criteria to which potential remedial alternatives are compared (and used during this detailed analysis) are defined in 6 NYCRR Part 375 and are listed below:

- Overall protectiveness of public health and the environment
- Conformance to SCGs
- Long-term effectiveness and permanence
- Reduction in toxicity, mobility, or volume of contamination through treatment
- Short-term impacts and effectiveness
- Implementability
- Cost-effectiveness
- Land use
- Community acceptance.

A description of the criteria and how alternatives are evaluated against them follows.

***Overall Protectiveness of Public Health and the Environment*—**This criterion is an overall evaluation of each alternative's ability to protect public health and the environment.

***Conformance to Standards, Criteria, and Guidance*—**Compliance with SCGs addresses whether a remedy would meet environmental laws, regulations, and other standards and criteria. The SCGs were presented in Section 3.

***Long-Term Effectiveness and Permanence*—**This criterion evaluates the long-term effectiveness of the remedial alternatives after implementation. If wastes or treated residuals remain on-site after the selected remedy has been implemented, the following items are evaluated: (1) magnitude of the remaining risks, (2) adequacy of the engineering and/or institutional controls intended to limit the risk, and (3) reliability of these controls.

***Reduction of Toxicity, Mobility, or Volume of Contamination through Treatment*—**The degree to which the alternative permanently reduces the toxicity, mobility, or volume of hazardous substances including the adequacy of the alternative in destroying the hazardous substances, reduction or elimination of hazardous substance releases and sources of releases, degree of irreversibility of waste treatment process, and characteristics and quantity of treatment residuals generated. Preference is given to alternatives that permanently and significantly reduce the toxicity, mobility, or volume of the wastes at the site.

***Short-Term Impacts and Effectiveness*—**Evaluation of the short-term effectiveness for an alternative includes consideration of the risk to human health and the environment associated with the alternative during construction and implementation, and the effectiveness of measures that will be taken to manage such risks. Impacts from remedial action implementation include vehicle traffic; temporary relocation of residences/buildings; temporary closure of public facilities; odor; open excavations; and noise, dust, and safety concerns associated with extensive heavy equipment activity. The greatest short-term risk to human health is related to safety and general construction activity.

***Implementability*—**The technical and administrative feasibility of implementing each alternative is evaluated. Technical feasibility includes the difficulties associated with construction of the remedy and the ability to monitor its effectiveness. For administrative feasibility, the availability of the necessary personnel and materials is evaluated along with potential difficulties in obtaining specific operating approvals, access for construction, institutional controls, and so forth.

***Cost-Effectiveness*—**Capital costs and annual operation, maintenance, and monitoring costs are estimated for each alternative and compared on a present worth basis. Although cost-effectiveness is the last balancing criterion evaluated, where two or more alternatives have met the requirements of the other criteria, it can be used as the basis for the final decision.

***Land Use*—**The current and anticipated future use of the site will be considered. Land use must comply with applicable zoning laws and maps.

***Community Acceptance*—**Public comments will be considered after the close of the public comment period.

7.2 COST ASSUMPTIONS

Cost assumptions were prepared for each alternative using EPA's *Guide to Developing and Documenting Cost Estimates during the Feasibility Study* (EPA 1996). Net present value of the project costs was estimated using an interest rate of 5 percent. The cost assumptions were calculated using the most common products and application methods available for a remedial alternative. The EPA guidance was used in conjunction with *DER-10 Technical Guidance for Site Investigation and Remediation* (NYSDEC 2010).

7.3 COSTS

Based on the results of the remedial technology screening in Table 6-1, the following cost estimates were prepared for each remedial alternative. Appendix B includes detailed cost estimates developed for each remedial alternative evaluated.

7.3.1 OU 1: Soil/Fill Material and Groundwater

OU 1 Alternative 1A: No Action

Present Worth *$0*
Capital Cost *$0*
Annual Costs (Years 0) *$0*

OU 1 Alternative 1B: Site Management

Present Worth *$160,000*
Capital Cost *$99,000*
Annual Costs (Years 1-30) *$4,000*

OU 1 Alternative 2: Complete Removal with Off-Site Disposal

Present Worth *$43,609,000*
Capital Cost *$43,609,000*
Annual Costs (Years 0) *$0*

OU 1 Alternative 3: ***Ex situ*** **Stabilization with Off-Site Disposal**

Present Worth *$40,509,000*
Capital Cost *$40,509,000*
Annual Costs (Years 0) *$0*

OU 1 Alternative 4: Landfill Capping with a Part 360 Cap—Existing Landfill Footprint

Present Worth *$26,975,000*
Capital Cost *$26,552,000*
Annual Costs (Years 1-5) *$34,000*
Annual Costs (Years 6-30) *$25,000*

OU 1 Alternative 5: Landfill Capping with a Part 360 Cap—Extended Landfill Footprint

Present Worth *$5,974,000*
Capital Cost *$5,693,000*
Annual Costs (Years 1-5) *$24,000*
Annual Costs (Years 6-30) *$16,000*

OU 1 Alternative 6: Landfill Capping with a Clean Soil Cover—Extended Landfill Footprint

Present Worth *$4,208,000*
Capital Cost *$3,927,000*
Annual Costs (Years 1-5) *$24,000*
Annual Costs (Years 6-30) *$16,000*

OU 1 Alternative 7: Partial Removal and Off-Site Disposal with *In Situ* Stabilization of Shallow Waste

Present Worth *$41,721,000*
Capital Cost *$41,500,000*
Annual Costs (Years 1-5) *$23,000*
Annual Costs (Years 6-30) *$11,000*

OU 1 Alternative 8: Partial Removal, *Ex Situ* Stabilization and On-site Placement, with *In Situ* Stabilization of Shallow Waste

Present Worth *$23,557,000*
Capital Cost *$23,336,000*
Annual Costs (Years 1-5) *$23,000*
Annual Costs (Years 6-30) *$11,000*

7.3.2 OU 2: Sediment

OU 2 Alternative 1: No Action

Present Worth *$0*
Capital Cost *$0*
Annual Costs (Years 0) *$0*

OU 2 Alternative 1B: Site Management

Present Worth *$87,000*
Capital Cost *$41,000*
Annual Costs (Years 1-30) *$3,000*

OU2 Alternative 2: *In Situ* Multi-media Sub-aqueous Capping

Present Worth *$2,889,000*
Capital Cost *$2,775,000*
Annual Costs (Years 1-5) *$11,000*
Annual Costs (Years 6-30) *$5,000*

OU 2 Alternative 3: *In Situ* Sediment Amendment

Present Worth $2,334,000
Capital Cost $2,295,000
Annual Costs (Years 1-5) $4,000
Annual Costs (Years 6-30) $2,000

OU 2 Alternative 4: Complete Removal with Disposal

Present Worth .... $4,638,000 ($5,239,000[a])
Capital Cost .... $4,638,000 ($5,239,000[a])
Annual Costs (Years 0) $0

OU 2 Alternative 5: Partial Removal with Multi-Media Sub-Aqueous Capping

Present Worth .... $3,887,000 ($4,603,000[a])
Capital Cost .... $3,875,000 ($4,591,000[a])
Annual Costs (Years 0) $760 ($760)

a. Indicates cost for off-site disposal.

8. DETAILED ANALYSIS OF ALTERNATIVES AND RECOMMENDATIONS

The purpose of this FS was to develop, screen, and evaluate potential remedial alternatives for the Old Upper Mountain Road site. Remedies were identified and screened in accordance with EPA and NYSDEC guidance. Individual alternatives for OU1 and OU 2 were combined for evaluation and are described below.

Remedial alternatives were developed in this FS, as identified below.

The following combinations of the OU 1 and OU 2 remedial alternatives are considered in this FS:

- **Alternative 1A—**No Action
- **Alternative 1B—**Site Management
- **OU 1 Alternative 5 or 6, and OU 2 Alternative 4—**OU 1 Landfill Capping and OU 2 Complete Removal with Disposal at OU 1
- **OU 1 Alternative 5 or 6, and OU 2 Alternative 5—**OU 1 Landfill Capping and OU 2 Partial Removal with On-site Disposal at OU 1 with Multi-Media Sub-Aqueous Capping
- **OU 1 Alternative 2 and OU 2 Alternative 2—**OU 1 Complete Removal with Off-Site Disposal and OU 2 Multi-Media Sub-Aqueous Capping
- ***OU 1 A*lternative 7 and OU 2 Alternative 3—**OU 1 Partial Removal and Off-site Disposal with *In Situ* Stabilization of Shallow Waste with OU 2 *In Situ* Sediment Amendment
- **OU 1 Alternative 3 and OU 2 Alternative 2—**OU 1 *Ex-Situ* Stabilization with Off-Site Disposal and OU 2 Multi-Media Sub-Aqueous Capping.
- **OU 1 Alternative 4 and OU 2 Alternative 2—**OU 1 Landfill Capping with a Part 360 Cap within the Existing Landfill Footprint with OU 2 Multi-Media Sub-Aqueous Capping
- **OU 1 Alternative 8 and OU 2 Alternative 5—**OU 1 Partial Removal, *Ex Situ* Stabilization and On-site Placement, with *In Situ* Stabilization of Shallow Waste, and OU 2 Partial Removal with On-site Disposal at OU 1 with Multi-Media Sub-Aqueous Capping.

8.1 COMPARISON OF OU 1/OU 2 ALTERNATIVES

8.1.1 Overall Protection of Public Health and the Environment

This criterion is an overall evaluation of each alternative's ability to protect public health and the environment.

Alternative 1A does not fulfill this criterion. Alternative 1B will moderately protect public health by the implementation of institutional controls. Through containment, OU 1 Alternative 5 or 6 with OU 2 Alternative 4 or 5, and OU 1 Alternative 4 with OU 2 Alternative 2 close-off the soil/fill material and sediment exposure pathway and, thereby, preventing human contact with remaining contamination. OU 1 Alternative 2 with OU 2 Alternative 2 and OU 1 Alternative 3 with OU 2 Alternative 2 fulfill this criterion by completely removing the contaminants from OU 1 and closing off the sediment exposure pathway through containment. OU 1 Alternative 7 with OU 2 Alternative 3 and OU 1 Alternative 8 with OU 2 Alternative 5 moderately fulfill this criterion by reducing contaminant mobility.

8.1.2 Standards, Criteria, and Guidance

Compliance with SCGs addresses whether a remedy will meet environmental laws, regulations, and other standards and criteria.

Alternatives 1A and1B do not meet this criterion. OU 1 Alternative 5 or 6 with OU 2 Alternative 4 or 5, and OU 1 Alternative 4 with OU 2 Alternative 2 will fulfill this criterion by containing soil/fill material and sediment exceeding SCGs. OU 1 Alternative 7 with OU 2 Alternative 3 fulfills this criterion by removing a large amount of soil/fill material exceeding SCGs, and by stabilizing the remaining soil/fill and sediment. OU 1 Alternative 2 or 3 with OU 2 Alternative 2 will fulfill this criterion by removing all soil/fill material and containing all sediment exceeding SCGs. OU 1 Alternative 8 with OU 2 Alternative 5 will fulfill this criterion by stabilizing soil/fill and sediment and containing residual sediment.

8.1.3 Long-Term Effectiveness and Permanence

This criterion evaluates the long-term effectiveness of the remedial alternatives after implementation. If wastes or treated residuals remain on-site after the selected remedy has been implemented, the following items are evaluated: 1) the magnitude of the remaining risks, 2) the adequacy of the engineering and/or institutional controls intended to limit the risk, and 3) the reliability of these controls.

Alternative 1A will not provide long-term effectiveness or permanence. Alternative 1B would not provide long-term effectiveness as a stand-alone alternative; however, this alternative would complement other alternatives. The remaining combinations of alternatives would moderately fulfill this criterion; all alternative combinations involve leaving untreated waste on-site and would require periodic monitoring and maintenance.

8.1.4 Reduction of Toxicity, Mobility, or Volume of Contamination

Preference is given to alternatives that permanently and significantly reduce the toxicity, mobility, or volume of the wastes at the site.

Alternatives 1A and 1B will not reduce the toxicity, mobility, or volume of contamination. OU 1 Alternative 7 with OU 2 Alternative 3 and OU 1 Alternative 8 with OU 2 Alternative 5 will fulfill this criterion by reducing the volume and mobility of contamination by soil/fill material removal, soil/fill material treatment, and sediment containment. The remaining alternative combinations will fulfill this criterion by reducing the volume and mobility of contamination by soil/fill material removal, soil/fill material containment, sediment containment/amendment, and groundwater monitoring.

8.1.5 Short-Term Impacts and Effectiveness

This criterion evaluates the potential short-term adverse impacts of the remedial action upon the community, the workers, and the environment during the construction and/or implementation. The length of time needed to achieve the remedial objectives is also estimated and compared against the other alternatives.

Alternatives 1A and 1B do not pose additional risk to the community, workers, or environment, as there are no construction activities involved. The remaining alternative combinations pose increased short-term risks to the public during excavation/dredging, grading, treatment, and other site activities through the production of dust; these effects can be reduced through the implementation of standard dust mitigation construction practices. Workers can potentially be exposed to contaminated media during excavation and/or treatment activities involved. Risks can be minimized by implementing health and safety controls. These alternative combinations will pose increased short-term risks to the environment in the form of air emissions.

8.1.6 Implementability

This criterion evaluates the technical and administrative feasibility of implementing each alternative.

All proposed alternatives are implementable and have been used nationally.

8.1.7 Cost-Effectiveness

This criterion evaluates estimated capital costs; and annual operation, maintenance, and monitoring costs on a present-worth basis.

Alternatives 1A and 1B are the least expensive, but are also the least effective. OU 1 Alternatives 5 and 6 are similar in cost; as are OU 1 Alternatives 2, 3, and 7; and OU 1 Alternatives 4 and 8. All OU 2 alternatives are similar in cost. There are significant cost differences associated with any type of soil/fill material disposal options (i.e., OU 1 Alternatives

2, 3, and 7), as opposed to capping the soil/fill material on-site. OU 1 Alternative 2 with OU 2 Alternative 2, OU 1 Alternative 7 with OU 2 Alternative 3, and OU 1 Alternative 3 with OU 2 Alternative 2 are the most effective since a majority of the waste is removed from the site, but carry significant cost burdens, while OU 1 Alternative 5 or 6 with OU 2 Alternative 4 or 5 provide a large cost savings and meet all SCGs.

8.1.8 Land Use

Alternatives 1A and 1B would not affect the future use of the site since contamination would remain. Contaminated soil/fill material and/or sediment would remain on-site for all of the alternative combinations; however, under OU 1 Alternative 5 or 6 with OU 2 Alternative 4 or 5, remaining fill and/or sediment would be capped and the land use would be restricted to landfill use only. Under OU 1 Alternative 7 with OU 2 Alternative 3 and OU 1 Alternative 8 with OU 2 Alternative 5, the soil/fill material and sediment would be stabilized and less mobile, but land use would be restricted. Under OU 1 Alternative 2 or 3 with OU 2 Alternative 2, soil/fill material would be removed from the site but sediment would be contained in place. Under OU 1 Alternative 4 and OU 2 Alternative 2, all of the soil/fill and sediment remaining on-site would be capped and the land use would be restricted to landfill use.

8.1.9 Community Acceptance

This criterion evaluates concerns of the community regarding the investigation and the evaluation of alternatives. Remedial alternatives for the Old Upper Mountain Road site have not been presented to the community for comment at this point.

8.2 RESTORATION TO PRE-DISPOSAL CONDITIONS

OU 1 Alternative 6 with OU 2 Alternative 4 is recommended because it fulfills the screening criteria at the lowest cost.

9. REFERENCES

EA Engineering, P.C. and its Affiliate EA Science and Technology (EA). 2011a. Remedial Investigation Report. Old Upper Mountain Road Site (932112), Lockport, Niagara County, New York. April.

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U.S. Environmental Protection Agency (EPA). 1988. *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (EPA l540lG-891004).

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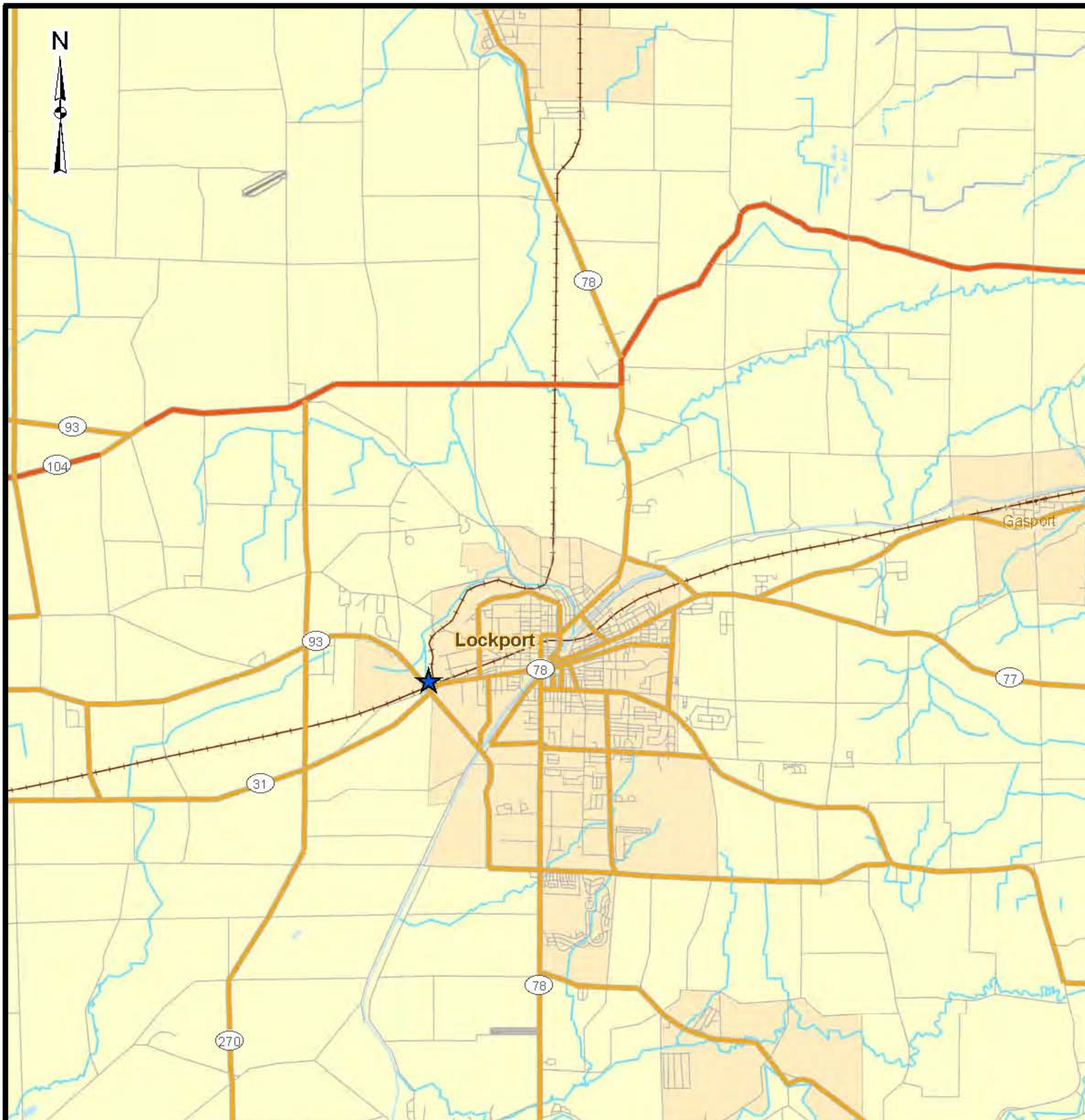


Legend

★ Old Upper Mountain Road Site Location

0 1 2 4 Miles

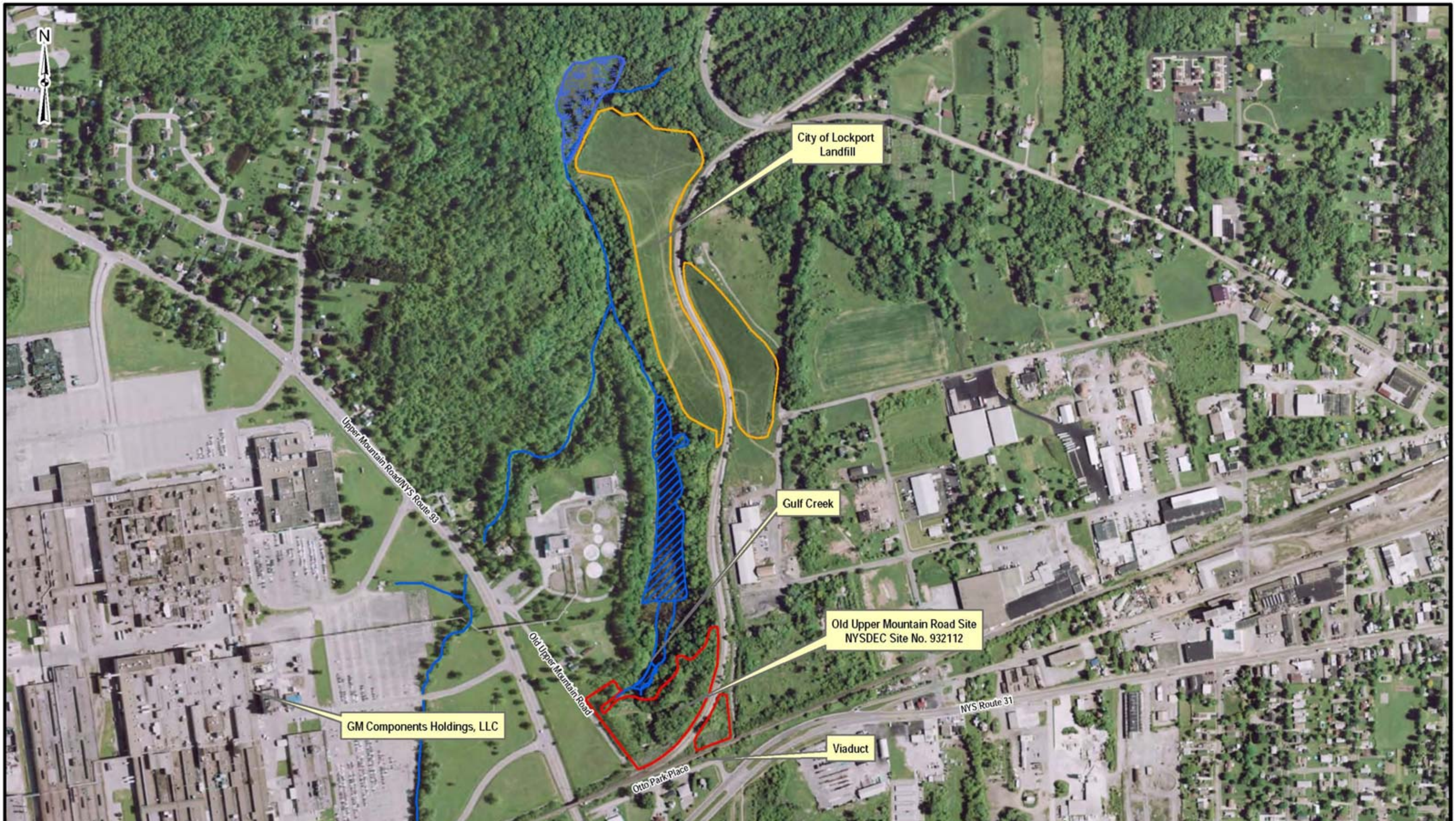
1 in = 2 miles

ESRI Street Maps USA

OLD UPPER MOUNTAIN ROAD (932112)
FEASIBILITY STUDY REPORT
LOCKPORT, NEW YORK

FIGURE 1-1
Site Location

PROJECT MGR:	DESIGNED BY:	CREATED BY:	CHECKED BY:	SCALE:	DATE:	PROJECT NO:	FILE NO:
RSC	DCC	DCC	RSC	AS SHOWN	FEBRUARY 2013	1490705	GIS/PROJECTS/ FIGURE1-1.MXD



Source: NYS GIS Clearing House

OLD UPPER MOUNTAIN ROAD (932112) FEASIBILITY STUDY REPORT LOCKPORT, NEW YORK			FIGURE 1-2 Site and Surrounding Area	
PROJECT MGR: RSC	DESIGNED BY: DCC	CREATED BY: DCC	CHECKED BY: RSC	PROJECT NO: 1490705

Scale: 0 – 250 – 500 – 1,000 Feet 1 inch = 500 feet		
DATE: FEBRUARY 2013	SCALE: AS SHOWN	FILE NO: GIS/PROJECTS/ FIGURE1-2.MXD

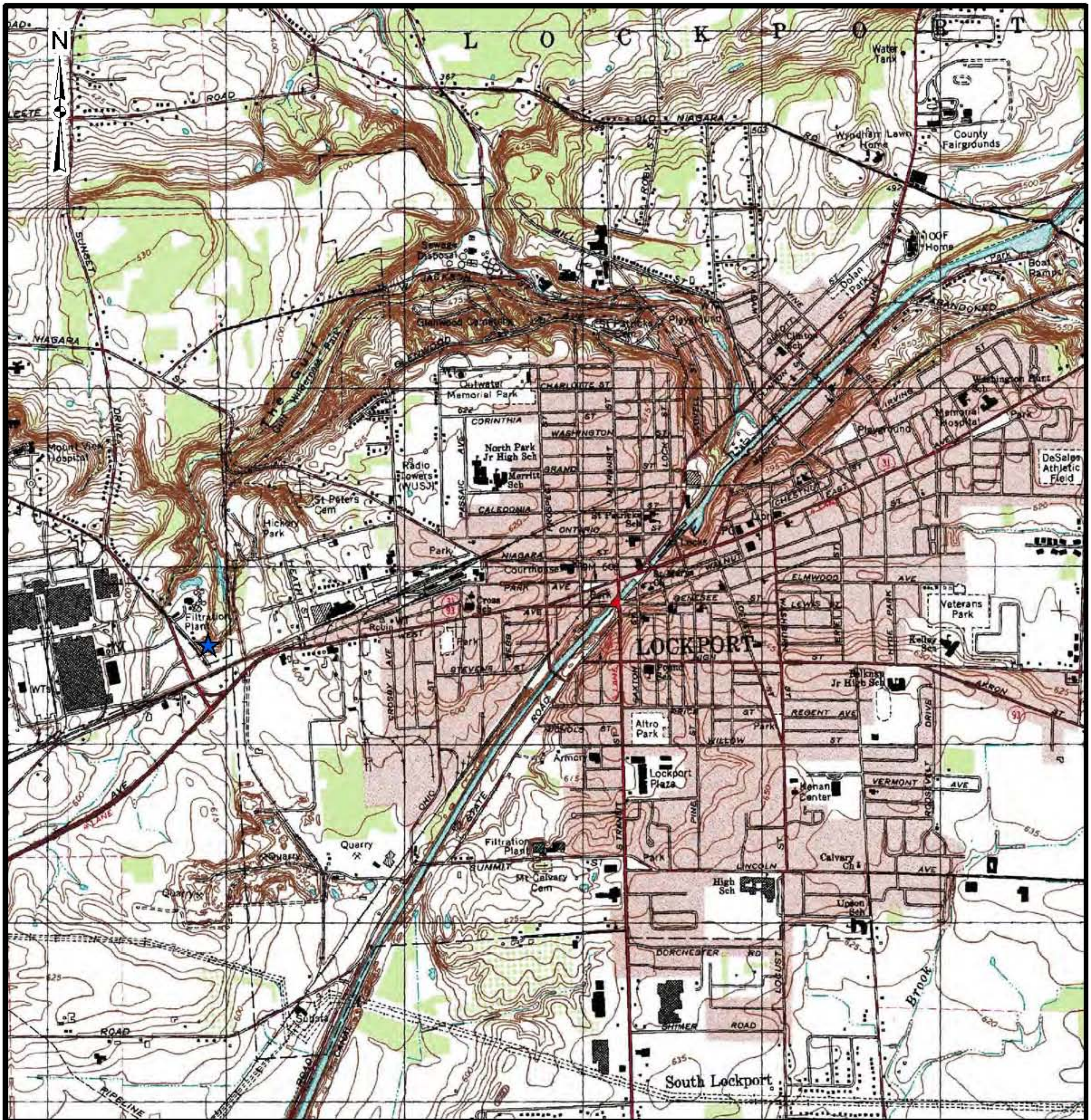
Legend
- Approximate Site Boundary
- Approximate City of Lockport Landfill Site Boundary
- Streams/Surface Water
- Water

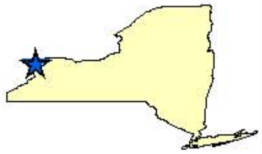
Source: NYS GIS Clearing House

OLD UPPER MOUNTAIN ROAD (932112) FEASIBILITY STUDY REPORT LOCKPORT, NEW YORK			FIGURE 1-3 Niagara County Tax Parcel Identification		0 50 100 200 Feet 1 inch = 100 feet		
PROJECT MGR: RSC	DESIGNED BY: RSC	CREATED BY: JCP	CHECKED BY: RSC	PROJECT NO: 1490705	DATE: FEBRUARY 2013	SCALE: AS SHOWN	FILE NO: GIS/PROJECTS/ FIGURE1-3.MXD

Legend

Property Line





Legend

★ Old Upper Mountain Road Site Location

0 150 300 600 Feet

1 inch = 300 feet

Source: USGS

OLD UPPER MOUNTAIN ROAD (932112)
FEASIBILITY STUDY REPORT
LOCKPORT, NEW YORK

FIGURE 1-4
USGS Topographic Map

PROJECT MGR:	DESIGNED BY:	CREATED BY:	CHECKED BY:	SCALE:	DATE:	PROJECT NO:	FILE NO:
RSC	DCC	DCC	RSC	AS SHOWN	FEBRUARY 2013	1490705	GIS/PROJECTS/ FIGURE1-4.MXD

OLD UPPER MOUNTAIN ROAD (932112) FEASIBILITY STUDY REPORT LOCKPORT, NEW YORK			FIGURE 2-1 Operable Units Approximate Boundaries	
PROJECT MGR: RSC	DESIGNED BY: DCC	CREATED BY: DCC	CHECKED BY: RSC	PROJECT NO: 1490705

Feet
0 250 500 1,000
1 inch = 500 feet

DATE: FEBRUARY 2013	SCALE: AS SHOWN	FILE NO: GIS/PROJECTS/ FIGURE2-1.MXD

Legend
Operable Unit 1 - Approximate Boundary
Operable Unit 1A - Approximate Boundary
Operable Unit 2 - Approximate Boundary

Source: NYS GIS Clearing House

OLD UPPER MOUNTAIN ROAD (932112) FEASIBILITY STUDY REPORT LOCKPORT, NEW YORK		FIGURE 2-2 Surface and Subsurface Soil Sample Locations		Feet 0 35 70 140 1 inch = 71 feet
PROJECT MGR: RSC	DESIGNED BY: RSC	CREATED BY: JCP	CHECKED BY: RSC	PROJECT NO: 1490705
DATE: FEBRUARY 2013	SCALE: AS SHOWN	FILE NO: GIS/PROJECTS/ FIGURE2-2.MXD		

Source: NYS GIS Clearing House

Legend

- Vertical Profile Soil Boring Location - May 2010 (Augered)
- Soil Boring Locations - May 2010 (Direct-Push and Auger)
- Surface Soil Locations
- Limits of Test Pit Excavations - May 2010

OLD UPPER MOUNTAIN ROAD (932112) FEASIBILITY STUDY REPORT LOCKPORT, NEW YORK			FIGURE 2-3 Groundwater Monitoring Well Locations		Feet 0 30 60 120 1 inch = 60 feet		
PROJECT MGR: RSC	DESIGNED BY: RSC	CREATED BY: JCP	CHECKED BY: RSC	PROJECT NO: 1490705	DATE: FEBRUARY 2013	SCALE: AS SHOWN	FILE NO: GIS/PROJECTS/ FIGURE2-3.MXD

Legend

Monitoring Well Location

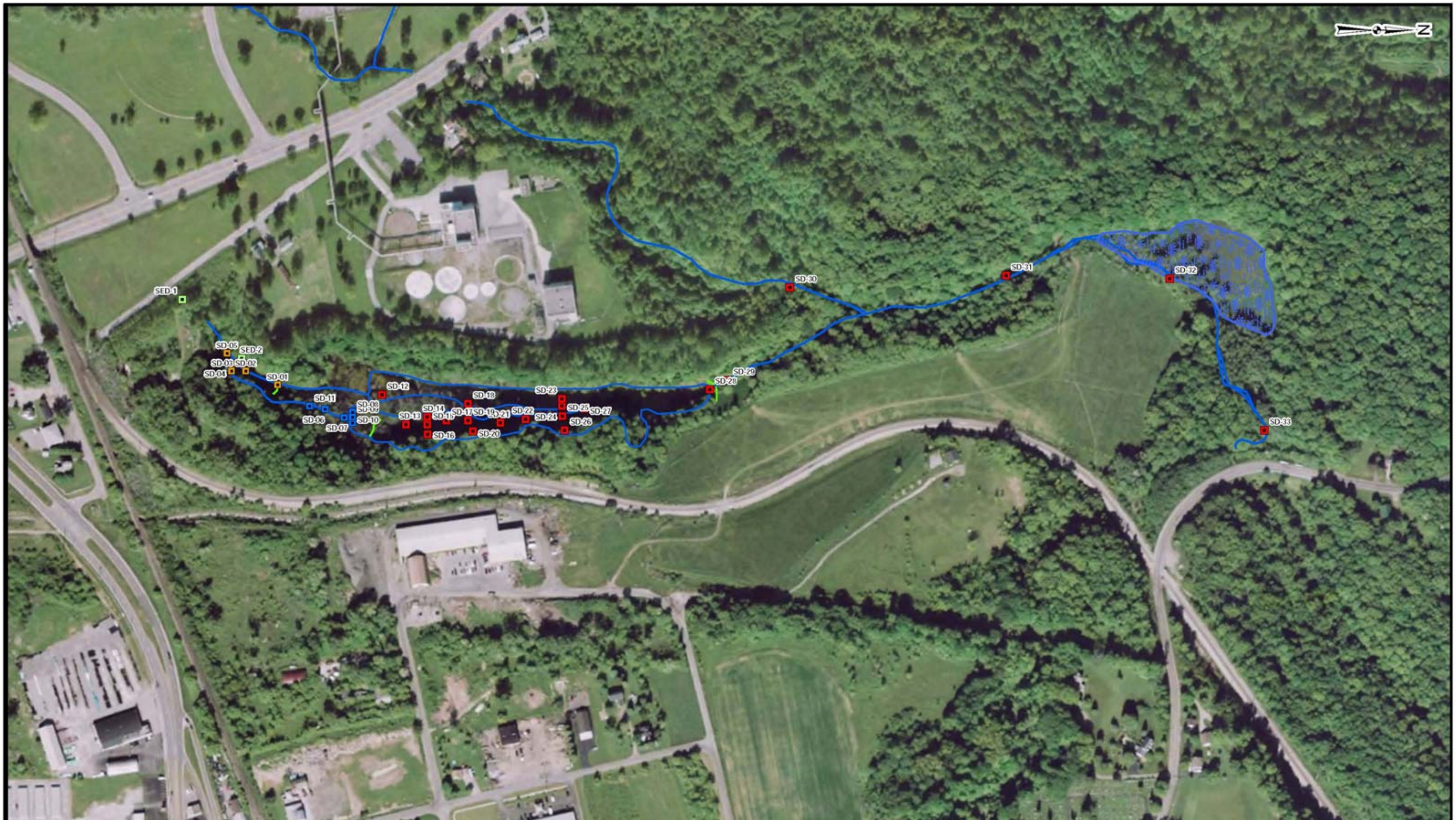
Source: NYS GIS Clearing House

OLD UPPER MOUNTAIN ROAD (932112) FEASIBILITY STUDY REPORT LOCKPORT, NEW YORK			FIGURE 2-4 Interpreted Groundwater Contour Map August 2010		0 30 60 120 Feet 1 inch = 60 feet	
PROJECT MGR: RSC	DESIGNED BY: RSC	CREATED BY: SAB	CHECKED BY: RSC	PROJECT NO: 1490705	DATE: FEBRUARY 2013	SCALE: AS SHOWN

FILE NO:
GIS/PROJECTS/
FIGURE2-4.MXD

Legend
Interpreted Groundwater Contour
Inferred Groundwater Contour
Groundwater Flow Direction

Source: NYS GIS Clearing House



OLD UPPER MOUNTAIN ROAD (932112)
FEASIBILITY STUDY REPORT
LOCKPORT, NEW YORK

FIGURE 2-5
Sediment Sampling Locations

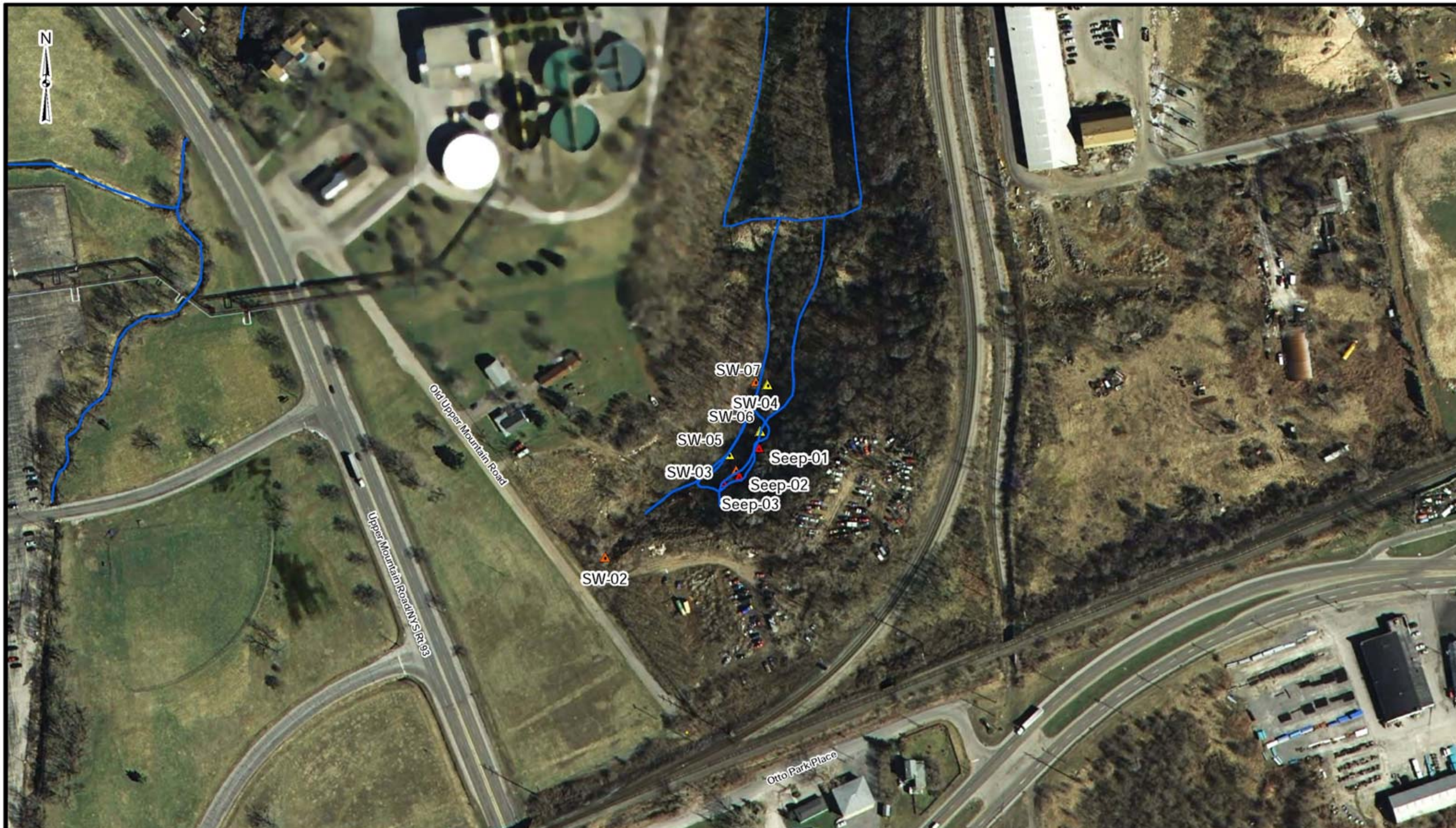
Feet
0 150 300 600
1 inch = 300 feet

PROJECT MGR:	DESIGNED BY:	CREATED BY:	CHECKED BY:	PROJECT NO:	DATE:	SCALE:	FILE NO:
RSC	RSC	JCP	RSC	1490705	FEBRUARY 2013	AS SHOWN	GIS\Projects\ FIGURE2-3.MXD

Legend

- Sediment Sample Location - November 2009
- Sediment Sample Location - May 2010
- Sediment Sample Location - August 2010
- Sediment Sample Location - NYSDEC 2007
- Beaver Dam

Source: NYS GIS Clearing House

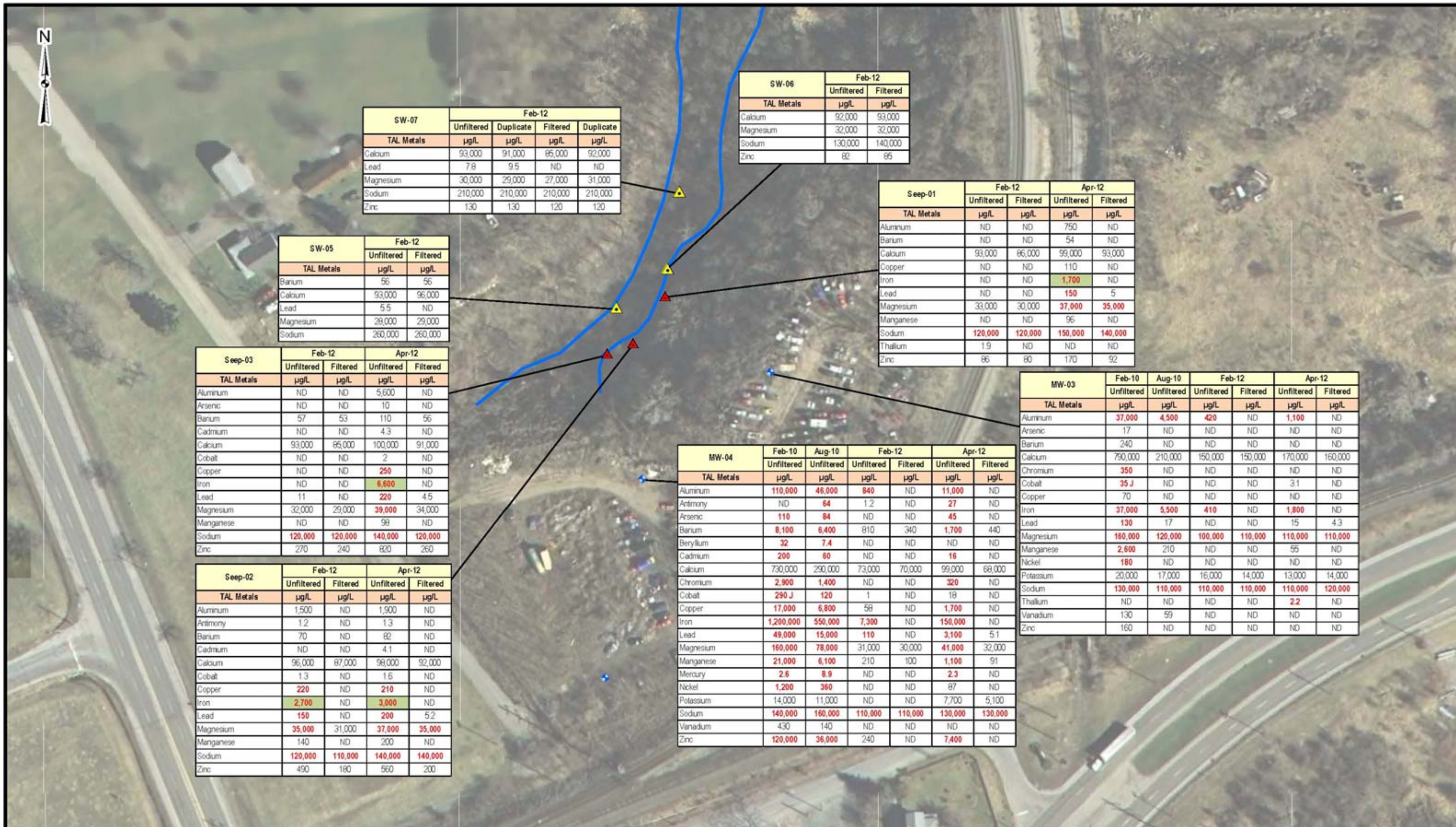


OLD UPPER MOUNTAIN ROAD (932112) FEASIBILITY STUDY REPORT LOCKPORT, NEW YORK			FIGURE 2-6 Surface Water Sample Locations		0 85 170 340 Feet 1 inch = 165 feet
PROJECT MGR: RSC	DESIGNED BY: RSC	CREATED BY: DCC	CHECKED BY: RSC	PROJECT NO: 1490705	DATE: FEBRUARY 2013

SCALE: AS SHOWN	FILE NO: GIS/PROJECTS/ FIGURE2-2.MXD

Legend

- Surface Water Sample Location - 2009
- Surface Water Sample Location - Aug 2010
- Surface Water Sample Location - February/April 2012
- Seep Sample Location - February/April 2012



SW-07	Feb-12			
	Unfiltered	Duplicate	Filtered	Duplicate
TAL Metals	µg/L	µg/L	µg/L	µg/L
Calcium	93,000	91,000	85,000	92,000
Lead	7.8	9.5	ND	ND
Magnesium	30,000	29,000	27,000	31,000
Sodium	210,000	210,000	210,000	210,000
Zinc	130	130	120	120

SW-06	Feb-12	
	Unfiltered	Filtered
TAL Metals	µg/L	µg/L
Calcium	92,000	93,000
Magnesium	32,000	32,000
Sodium	130,000	140,000
Zinc	82	85

SW-05	Feb-12	
	Unfiltered	Filtered
TAL Metals	µg/L	µg/L
Barium	56	56
Calcium	93,000	96,000
Lead	5.5	ND
Magnesium	28,000	29,000
Sodium	260,000	260,000

Seep-01	Feb-12		Apr-12	
	Unfiltered	Filtered	Unfiltered	Filtered
TAL Metals	µg/L	µg/L	µg/L	µg/L
Aluminum	ND	ND	750	ND
Barium	ND	ND	54	ND
Calcium	93,000	86,000	99,000	93,000
Copper	ND	ND	110	ND
Iron	ND	ND	1,700	ND
Lead	ND	ND	150	5
Magnesium	33,000	30,000	37,000	35,000
Manganese	ND	ND	96	ND
Sodium	120,000	120,000	150,000	140,000
Thallium	1.9	ND	ND	ND
Zinc	86	80	170	92

Seep-03	Feb-12		Apr-12	
	Unfiltered	Filtered	Unfiltered	Filtered
TAL Metals	µg/L	µg/L	µg/L	µg/L
Aluminum	ND	ND	5,600	ND
Arsenic	ND	ND	10	ND
Barium	57	53	110	56
Cadmium	ND	ND	4.3	ND
Calcium	93,000	85,000	100,000	91,000
Cobalt	ND	ND	2	ND
Copper	ND	ND	250	ND
Iron	ND	ND	6,600	ND
Lead	11	ND	220	4.5
Magnesium	32,000	29,000	39,000	34,000
Manganese	ND	ND	98	ND
Sodium	120,000	120,000	140,000	120,000
Zinc	270	240	820	260

Seep-02	Feb-12		Apr-12	
	Unfiltered	Filtered	Unfiltered	Filtered
TAL Metals	µg/L	µg/L	µg/L	µg/L
Aluminum	1,500	ND	1,900	ND
Antimony	1.2	ND	1.3	ND
Barium	70	ND	82	ND
Cadmium	ND	ND	4.1	ND
Calcium	96,000	87,000	98,000	92,000
Cobalt	1.3	ND	1.6	ND
Copper	220	ND	210	ND
Iron	2,700	ND	3,000	ND
Lead	150	ND	200	5.2
Magnesium	35,000	31,000	37,000	35,000
Manganese	140	ND	200	ND
Sodium	120,000	110,000	140,000	140,000
Zinc	490	180	560	200

MW-04	Feb-10	Aug-10	Feb-12		Apr-12	
	Unfiltered	Unfiltered	Unfiltered	Filtered	Unfiltered	Filtered
TAL Metals	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Aluminum	110,000	46,000	840	ND	11,000	ND
Antimony	ND	64	1.2	ND	27	ND
Arsenic	110	84	ND	ND	45	ND
Barium	8,100	6,400	810	340	1,700	440
Beryllium	32	7.4	ND	ND	ND	ND
Cadmium	200	60	ND	ND	16	ND
Calcium	730,000	290,000	73,000	70,000	99,000	68,000
Chromium	2,900	1,400	ND	ND	320	ND
Cobalt	290 J	120	1	ND	18	ND
Copper	17,000	6,800	58	ND	1,700	ND
Iron	1,200,000	550,000	7,300	ND	150,000	ND
Lead	49,000	15,000	110	ND	3,100	5.1
Magnesium	160,000	78,000	31,000	30,000	41,000	32,000
Manganese	21,000	6,100	210	100	1,100	91
Mercury	2.6	8.9	ND	ND	2.3	ND
Nickel	1,200	360	ND	ND	87	ND
Potassium	14,000	11,000	ND	ND	7,700	5,100
Sodium	140,000	160,000	110,000	110,000	130,000	130,000
Vanadium	430	140	ND	ND	ND	ND
Zinc	120,000	36,000	240	ND	7,400	ND

MW-03	Feb-10	Aug-10	Feb-12		Apr-12	
	Unfiltered	Unfiltered	Unfiltered	Filtered	Unfiltered	Filtered
TAL Metals	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Aluminum	37,000	4,500	420	ND	1,100	ND
Arsenic	17	ND	ND	ND	ND	ND
Barium	240	ND	ND	ND	ND	ND
Calcium	790,000	210,000	150,000	150,000	170,000	160,000
Chromium	350	ND	ND	ND	ND	ND
Cobalt	35 J	ND	ND	ND	3.1	ND
Copper	70	ND	ND	ND	ND	ND
Iron	37,000	5,500	410	ND	1,800	ND
Lead	130	17	ND	ND	15	4.3
Magnesium	160,000	120,000	100,000	110,000	110,000	110,000
Manganese	2,600	210	ND	ND	55	ND
Nickel	180	ND	ND	ND	ND	ND
Potassium	20,000	17,000	16,000	14,000	13,000	14,000
Sodium	130,000	110,000	110,000	110,000	110,000	120,000
Thallium	ND	ND	ND	ND	2.2	ND
Vanadium	130	59	ND	ND	ND	ND
Zinc	160	ND	ND	ND	ND	ND

OLD UPPER MOUNTAIN ROAD (932112)
FEASIBILITY STUDY REPORT
LOCKPORT, NEW YORK

FIGURE 2-7
TAL Metals Within Groundwater, Surface Water, and Groundwater Seeps - February and April 2012

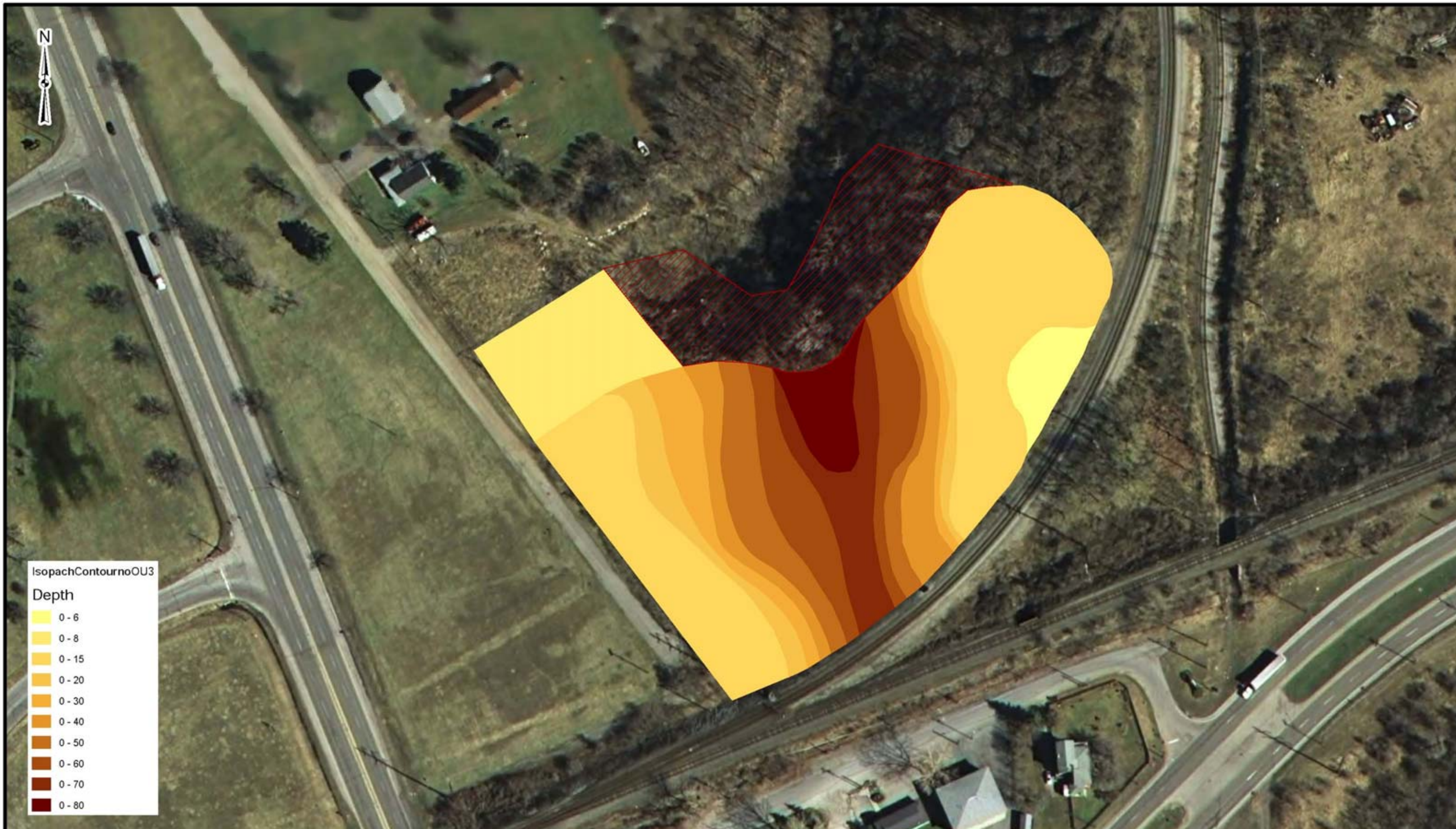
Feet
0 50 100 200
1 inch = 100 feet

PROJECT MGR: RSC | DESIGNED BY: RSC | CREATED BY: DCC | CHECKED BY: RSC | PROJECT NO: 1490705 | DATE: FEBRUARY 2013 | SCALE: AS SHOWN | FILE NO: GIS/PROJECTS/FIGURE2.MXD

Legend
- Seep Samples - February and April 2012
- Surface Water Samples - February and April 2012
- Monitoring Well
- Gulf Creek

Source: NYS GIS Clearing House
TAL Target Analyte List
ND Not Detected
µg/L Micrograms per Liter (Parts Per Billion)

Values in RED indicate concentration is above the NYSDEC AWQS for Class GA waters (Groundwater)
Shaded values indicate concentration is above the NYSDEC AWQS for Class D, Type H(FC) or A(A) surface waters



Source: NYS GIS Clearing House

OLD UPPER MOUNTAIN ROAD (932112)
FEASIBILITY STUDY REPORT
LOCKPORT, NEW YORK

FIGURE 6-1
OU1 Treatment Areas
and Depths

Feet
0 55 110 220
1 inch = 100 feet

Approximate escarpment area

PROJECT MGR:	DESIGNED BY:	CREATED BY:	CHECKED BY:	PROJECT NO:	DATE:	SCALE:	FILE NO:
RSC	RSC	JCP	RSC	1490705	FEBRUARY 2013	AS SHOWN	GIS\Projects\ FIGURE6-1.MXD

OLD UPPER MOUNTAIN ROAD (932112)
FEASIBILITY STUDY REPORT
LOCKPORT, NEW YORK

FIGURE 6-2
OU1 Alternative 2 and 5:
Complete Removal
Final Conditions

PROJECT MGR:	DESIGNED BY:	CREATED BY:	CHECKED BY:	PROJECT NO:	DATE:	SCALE:	FILE NO:
RSC	MEM	SAB	RSC	1490705	FEBRUARY 2013	AS SHOWN	GIS\Projects\ FIGURE6-2.MXD

Upward 3:1 Backfill Slope Direction

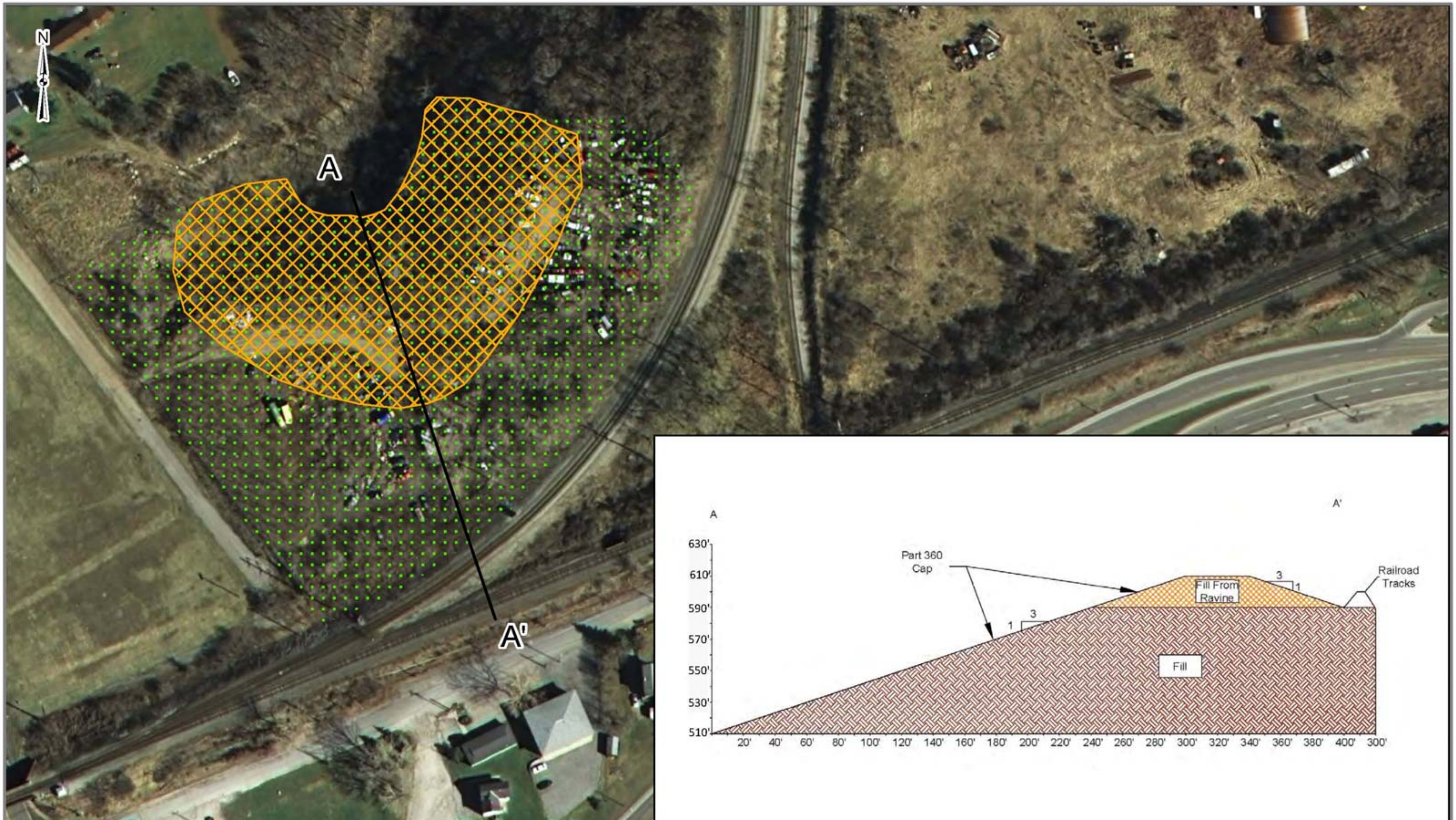
Fill Removed

Sheet Piling

Source: NYS GIS Clearing House

0 45 90 180 Feet

1 inch = 90 feet



OLD UPPER MOUNTAIN ROAD (932112)
FEASIBILITY STUDY REPORT
LOCKPORT, NEW YORK

FIGURE 6-3
OU1 Alternative 4:
Landfill Capping with a Part 360 Cap-
Existing Landfill Footprint

PROJECT MGR:	DESIGNED BY:	CREATED BY:	CHECKED BY:	PROJECT NO:	DATE:	SCALE:	FILE NO:
RSC	MEM	MEM	RSC	1490705	FEBRUARY 2013	AS SHOWN	GIS\Projects\ FIGURE6-3.MXD

Source: NYS GIS Clearing House

Feet
0 50 100 200

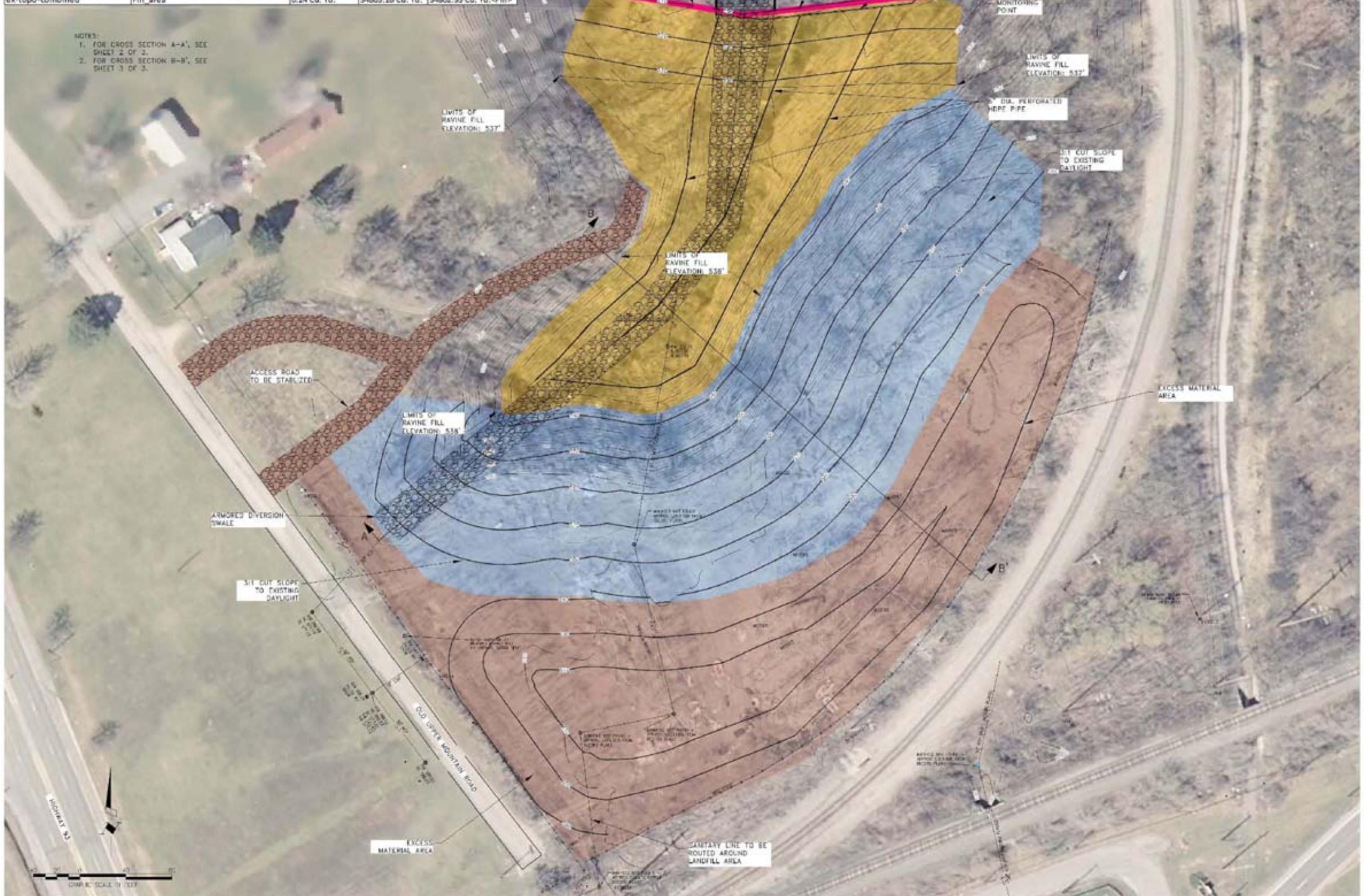
1 inch = 100 feet

Cut Back to 3:1 Slope

Cover with Part 360 Cap

cut area of along south bank at 3:1 slope				
Base Surface	Comparison Surface	Cut	Fill	Net
ex-topo-combined	Cut area	52883.54 Cu. Yd.	40.76 Cu. Yd.	52842.78 Cu. Yd.<Cut>
Excess fill area (south area by railroad) with 3:1 slopes, high point 615				
Base Surface	Comparison Surface	Cut	Fill	Net
ex-topo-combined	excess material area	0.14 Cu. Yd.	37533.94 Cu. Yd.	37533.79 Cu. Yd.<Fill>
Fill area in Ravine to elevation 536 ft, 3:1 daylight slope				
Base Surface	Comparison Surface	Cut	Fill	Net
ex-topo-combined	Fill_area	0.24 Cu. Yd.	34803.16 Cu. Yd.	34802.93 Cu. Yd.<Fill>

NOTES:
1. FOR CROSS SECTION A-A', SEE SHEET 2 OF 3.
2. FOR CROSS SECTION B-B', SEE SHEET 3 OF 3.



Source: NYS GIS Clearing House

OLD UPPER MOUNTAIN ROAD (932112) FEASIBILITY STUDY REPORT LOCKPORT, NEW YORK			FIGURE 6-4 OU 1 Alternative 5 and 6: Landfill Capping- Extended Landfill Footprint				
PROJECT MGR: RSC	DESIGNED BY: RSC	CREATED BY: MEM	CHECKED BY: RSC	PROJECT NO: 1490705	DATE: FEBRUARY 2013	SCALE: AS SHOWN	FILE NO: GIS\Projects\ FIGURE6-4.MXD

Note: For cross-sections and details, see Figure 6-5