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Final Focused Corrective Measures Study

Norlite Corporation, Cohoes, New York

November 11, 2013

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Focused Corrective Measures Study

Norlite Corporation,
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Certification

I, Daniel Loewenstein, certify that I am currently a NYS registered professional engineer and that this Report was prepared in accordance with all applicable statutes and regulations and in substantial conformance with the DER Technical Guidance for Site Investigation and Remediation (DER-10) and that all activities were performed in full accordance with the DER-approved work plan and any DER-approved modifications.

Tables

Figures

Appendices

1. Introduction

1.1 Purpose of Report

A Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) was conducted at the Norlite Corporation (Norlite) in Cohoes, New York, from January through July 2011, as part of a RCRA 6NYCRR Part 373 Permit Application. The RFI was conducted in accordance with the approved RFI Work Plan (ARCADIS, July 2009). The results of the RFI were presented in the RCRA Facility Investigation Report, dated October 2011 (EBI Consulting 2011).

A Supplemental RFI Work Plan was developed to provide the scope for additional investigations to be conducted at the facility to address the NYSDEC comments on the 2011 RFI Report. The Supplemental RFI Work Plan was approved by the NYSDEC on June 29, 2012. The Supplemental RFI was conducted in 2012. Based on the initial Supplemental RFI investigation results, two Interim Corrective Measures (ICM) Work Plans were developed and implemented to address arsenic-containing soil in SWMU 4 and RCRA metals-containing surface soil in SWMU 12.

The purpose of this Corrective Measures Study (CMS) report is to present the proposed final corrective measures developed for the Solid Waste Management Units (SWMUs). This report also includes an evaluation of the potential corrective measures for groundwater in the SWMU 1, 7, 8 areas.

The proposed final corrective measures were selected based on an evaluation of technical, environmental, human health and institutional concerns, as well as the results of additional actions completed subsequent to the Supplemental RFI.

1.2 Site Location and Background

The Norlite facility consists of six parcels with a total land area of approximately 220 acres, located in the southern portion of the City of Cohoes and the eastern portion of the Town of Colonie, as shown on Figure 1. The majority of the site consists of a shale quarry and undeveloped land, which are located in the Town of Colonie. Most of the manufacturing at the site occurs in the approximately 40 acres in the City of Cohoes. The entrance to the site is on Saratoga Street (New York State Route 32).

Property use in the vicinity of the site includes agriculture, residential, and commercial uses. The site is bordered to the north by undeveloped land and residential areas; to the east by active Canadian Pacific (CP) railroad track, residential houses and some commercial businesses; to the south by residential and commercial areas; and to the west by undeveloped land, agricultural areas, and a few houses.

The site has been operating as an expanded shale lightweight aggregate plant since the early 1950s. Manufacturing activities conducted at the site include aggregate crushing, screening, conveying, operation of two aggregate kilns equipped with air pollution control systems (APCS), and low grade fuel (LGF) processing. Additional facilities at the site include a wastewater treatment facility, an LGF storage area, maintenance buildings, facilities for laboratory analysis, and office space.

1.3 Geology/Hydrogeology

Normanskill Shale, with minor mudstone and sandstone is present beneath the site and a majority of the surrounding area (Fisher et al. 1970). Near surface deposits at the site are lacustrine silt and clay deposited in proglacial lakes as glaciers melted (Cadwell et al. 1987). Silts and clays are described as calcareous with a variable thickness up to 100 meters.

The Soil Survey of Albany County, New York, produced and distributed by the United States Department of Agriculture, Soil Conservation Service, identified soils at the site as pits and quarry lands with some areas of silty clay and silty loam. Based on results of the investigations, overburden soil at the site consists primarily of silt and clay.

Topography at the site slopes toward the Salt Kill which flows in a north to south direction in the vicinity of the site and an unnamed tributary of the Salt Kill that flows in a west to east trend across the site. After the confluence of these streams, which is east of the quarry, the Salt Kill flows to the east towards the Hudson River. Ground elevations at the site generally range from 50 to 250 feet above mean sea level.

Based on groundwater elevations measured during the initial RFI, overburden and bedrock groundwater flow follows surface topography eastward toward the Hudson River, which is approximately one mile east of the site.

2. Nature and Extent of Contamination

The nature and extent of contamination at Norlite is discussed fully in the RFI Report and in the Supplemental RFI Letter Report, Additional Activities and Groundwater Sampling Results (ARCADIS, August 2013), and is summarized below. Areas and media not discussed in the RFI Report are also summarized below, with reference to reports developed after the RFI was complete.

2.1 Summary of Solid Waste Management Units (SWMUs)

There were 17 SWMUs identified within the Norlite facility. The purpose of the RFI was to evaluate the presence and/or extent of potential contaminants associated with 11 of the 17 SWMUs in accordance with the Part 373 Permit dated July 2007, which became effective on January 18, 2008. A summary of each of these 11 SWMUs is provided below. Corrective measures evaluated in this Focused CMS Report are related to groundwater in the vicinity of SWMUs 1, 7 and 8. A summary of all the SWMUs is provided in Table 1 below and Figure 2.

Table 1 Solid Waste Management Units

SMWU No.	SWMU Name
1	Tank Storage (LLGF & SLGF processing, USTs)
4	Surface Impoundments (South Area Only)
5	Waste Piles Areas 1 through 5
7	Tanker/Truck Roll off Staging Area
8	Employee Parking Lot Discharge Area and Floor Drain
9	Shale Fine Landfill
11	Interim Wastewater Treatment/Sludge Container Area
12	Transformer Pad Vicinity and Scrap Yard Area Soils
14	North and East Site Perimeter Fence Area
16	Quarry Pond
17	Industrial Sewers/Hazardous Waste Feed Pipeline

2.1.1 SWMU 1 – Tank Storage Area

SWMU 1 includes the Tank Storage Area, which is comprised of the Liquid Low-Grade Fuel (LLGF) and Solid Low-Grade Fuel (SLGF) processing facilities, and the underground storage and equalization tanks located adjacent to these buildings. Due to the complex nature of the operations and the presence of RCRA containment structures, investigative sampling was not conducted beneath these structures/areas.

Soil borings were drilled and monitoring wells installed during the RFI in the SWMU 1 area. Soil sample concentrations did not exceed the corresponding Residential SCOs at any of the locations. Several volatile organic compounds (VOCs) exceeded the NYSDEC GA Standards in the groundwater samples collected during the RFI.

In accordance with the approved Supplemental RFI Work Plan, additional overburden and groundwater monitoring wells were installed to define the horizontal and vertical extent of groundwater containing VOCs at concentrations greater the NYSDEC Class GA Standards. Two initial rounds of groundwater sampling were conducted in 2012, as well as one additional round in July 2013. Multiple VOCs exceeded the GA Standards in several wells during all three events, with the highest concentrations detected at SWMU 1 MW-7 and SWMU 1 MW-8.

The groundwater exceedances in the SWMU 1 area are considered an Area of Concern (AOC).

2.1.2 SWMU 4 – Surface Impoundments (South Area Only)

Several sampling events were conducted at SWMU 4 to characterize the sediment in the surface impoundments, also referred to as the settling pond and the dewatering area. The settling pond was constructed before 1980 and was located south of the two rotary kilns. The settling pond was used for operations involving collection and recirculation of wastewater from the air pollution control (APC) units. Lime, kiln dust or alkaline solution was added to the pond to neutralize the wastewater. The dewatering area was located west of and adjacent to the settling pond. The dewatering area received solids from the settling pond (ENSR 1992a).

Use of the settling pond and dewatering area ceased in 1990 after a dry APC system was installed. All shale fines and APC residue were removed from the surface impoundment prior to 1992 and were disposed as non-hazardous waste in a permitted on-site landfill (ENSR 1992a).

Soil samples were collected during the RFI to address elevated metals concentrations. Barium concentrations exceeded the Residential Soil Cleanup Objective (SCO) and arsenic concentrations exceeded the Industrial SCO in the top four feet of soil.

In accordance with the approved Supplemental RFI Work Plan, 10 additional soil samples were collected from five locations in the SWMU 4 area to confirm the results from the RFI. The arsenic concentrations exceeded the Industrial SCO in the top four feet of soil.

2.1.2.1 SWMU 4 Interim Corrective Measure

Based on the results of the sampling conducted during the Supplemental RFI, an Interim Corrective Measure (ICM) was conducted to remove the arsenic-containing soil in SWMU 4. The ICM was conducted in accordance with the New York State Department of Environmental Conservation (NYSDEC)-approved Work Plan (ARCADIS 2012).

The ICM consisted of the excavation of soil containing arsenic at concentrations greater than the NYSDEC SCO of 16 mg/kg. Excavation activities were conducted on November 13, 2012, November 29, 2012, and November 30, 2012. Soil removed during the corrective measures was stockpiled on and covered with 6-mil poly sheeting for temporary on-site staging prior to being transported to the Colonie Landfill in Colonie, New York, for disposal in accordance with applicable federal, state, and local regulations.

Confirmation sampling was conducted utilizing two methods to verify that the SCO was achieved. Sidewall and bottom soil samples were field-screened using an X-ray fluorescence (XRF) analyzer to evaluate the concentration of arsenic at the excavation limits. Where concentrations exceeded the SCO of 16 mg/kg, the excavation was extended horizontally and/or vertically. Once XRF measurements were recorded at or less than the SCO, confirmation soil samples were collected in accordance with the New York State Department of Environmental Conservation, Division of Environmental Remediation (DER)-10 Technical Guidance for Site Investigations and Remediation. Confirmation samples collected at the outer limits of the excavation were all less than the SCO for arsenic.

The southern portion of the ICM area was excavated to a depth of approximately eight feet bgs, while the northern portion was excavated to a depth of four feet. The width of the southern portion of the excavation was extended to approximately 20 feet. The northern portion of the excavation ranged in width from nine to 14 feet. The approximate length of the excavation was 115 feet.

The excavation was backfilled using site-generated lightweight aggregate (approved for use by the NYSDEC on November 28, 2012) and was placed in the excavation in two-foot lifts and compacted using approved devices to minimize settling.

The SWMU 4 ICM successfully achieved the Part 375 Industrial SCO for arsenic.

2.1.3 SWMU 5 – Waste Piles

The waste piles are locations where shale fines and/or APC dust/sludges were stockpiled during historical operations at the facility.

Surface soil samples were collected in February 1992 at Area 2, which was located northeast of the office building and is shown on Figure 2. The materials deposited in this area include shale fines from the APC bag-house and overburden soil from the quarry. According to Norlite operators, this area was operational from 1980 to the late 1980s. Analytical results are summarized below:

- No hazardous constituents were detected at concentrations that exceeded TCLP maximum concentration levels.
- VOCS, SVOCs, and PCBs were not detected in any of the soil samples.
- Metals were detected at levels that were within range of typical background concentrations.

Accordingly, no further action was proposed for this area and it is no longer considered a SWMU.

In 1988 nine groundwater monitoring wells were installed in the eastern portion of the site, where most of the manufacturing takes place. At four locations, a nested pair of shallow and deep monitoring wells were installed. A portion of these wells are no longer present at the site. Results from two sampling events were summarized by ENSR (1992a) and are provided below:

- SVOCs, pesticides, and PCBs were not detected in groundwater samples collected during these two sampling events.
- Concentrations of benzene and 1,1-dichloroethene were detected at levels that exceeded NYSDEC GA groundwater standards (0.7 µg/l for benzene and 5 µg/l for 1,1-dichloroethene). Benzene was detected at monitoring well MW-2D (5.3 µg/l) and 1,1-dichloroethene was detected at monitoring well MW-5S (13 µg/l).

Several inorganic parameters were detected at concentrations that exceeded NYSDEC GA groundwater standards, including mercury, aluminum, iron, manganese, sodium, chloride, sulfate, and ammonia.

Additional activities were conducted at SWMU 5 during the RFI in Areas 1, 3, 4 and 5. Based on the available information, the majority of the material in the waste piles was removed and placed in the shale fine landfill upon its construction. Area 1 is a former stockpile area located in the southern portion of the facility, south of the surface impoundment. Areas 3 and 4 are former stockpiles located north of the fuel processing area. At Area 4, shale fines and/or APC dust/sludges were used to backfill a portion of the former Erie Canal. Area 4 is located just south of an exposed lock. Area 5 appears to be coincident with the current location of tanker/truck roll off staging area (SWMU 7), and, therefore, was addressed by the investigation of SWMU 7. No VOCs, SVOCs or pesticides were detected at a concentration greater than the Residential SCO standards. Mercury was detected at a concentration greater than the Residential SCO standard in one sample collected from SWMU 5.

Based on the isolated nature of the one metal exceedance noted, and the lack of significant exposure pathway, no further action is required for this SWMU.

2.1.4 SWMU 7 – Tanker/Truck Roll off Staging Area

The tanker/truck roll off staging area is an approximately 250-foot by 100-foot area located adjacent to the north side of the LLGF and SLGF. The area is lined with a geomembrane liner which is covered with gravel. In order to protect the integrity of the liner, soil samples were collected, and groundwater monitoring wells were installed, outside the perimeter of the liner during the RFI.

Low concentrations of a number of VOCs, SVOCs and metals were detected at or above laboratory detection limits in soil samples collected from SWMU 7. However, no VOCs, SVOCs or metals were detected at a concentration greater than the Residential SCO standards. Analytical results indicate no pesticides were detected at or above laboratory detection limits in soil samples collected from SWMU 7.

Four groundwater sampling events were conducted during the RFI and Supplemental RFI and included at least one SWMU 7 well. Acetone was detected during the first round of RFI sampling in SWMU 7 MW-2 at a concentration exceeding the GA Guidance Value. No other VOCs, SVOCS, metals or pesticides were detected at levels exceeding the GA Guidance Values or Standards during any of the other sampling events.

Based on these results, no further action is required for this SWMU.

2.1.5 SWMU 8 Employee Parking Lot Discharge Area and Floor Drain

The northeast portion of the employee parking lot was designated as SWMU 8 during the RFI. According to historical information and discussions with Norlite personnel, a storm drain from the fuel processing area once discharged to this area. A petroleum spill associated with a fire suppression pump in the fuel processing area resulted in the discharge of petroleum to the employee parking lot. The exact nature and location of the spill are not known.

Soil characterization activities completed during the RFI at SWMU 8 did not identify the presence of any compounds at concentrations greater than NYSDEC Residential SCOs in soil, with the exception of one metal. Cadmium was detected at a concentration greater than the Residential SCO standard but less than the Industrial standard in one sample collected at a depth between 11-13 feet below ground surface.

Groundwater characterization activities completed in SWMU 8 during the RFI and Supplemental RFI did not identify the presence of any compounds at concentrations greater the New York State Class GA Standards, with the exception of acetone at one well. Acetone exceeded the respective GA Standard in SWMU 8 MW-3 during the first sampling event of the RFI.

Due to insufficient water at SWMU 8 MW-1 and damage to SWMU 8 MW-2, these wells were not sampled during the Supplemental RFI.

In June 2013, an additional bedrock monitoring well (SWMU 8 MW-4) was installed in the SWMU 8 area, near SWMU 8 MW-3. An additional round of groundwater sampling was conducted in July 2013. No compounds were detected in SWMU 8 MW-3 or SWMU 8 MW-4 during this event. Based on these soil and groundwater results, no further action is required for this SWMU.

2.1.6 SWMU 9 – Shale Fines Landfill

The Shale Fines Landfill is located in the eastern portion of the Norlite facility. The landfill has been capped and is covered with grass. The Part 373 permit called for a groundwater investigation of the landfill; however, footnote 3 of Module II, Appendix E, Table E-1 states that groundwater monitoring may be omitted if Norlite provides evidence of an approved closure and groundwater sampling results from post-closure monitoring. Norlite produced five post-closure reports prepared by ENSR (1996 through 2000) for the Shale Fine Landfill. The reports detail the post-closure monitoring of the landfill and also include copies of the Post-Closure Care Plan (ERM 1995), the NYSDEC approval letter for the Post-Closure Care Plan (dated October 5, 1995), and the NYSDEC permit for the operation of the landfill. The approved Post-Closure Monitoring Plan called for five years of post-closure monitoring, which was conducted between 1996 and 2000. Based on the information provided in the reports, which showed that the closed landfill was operating as designed with no indication of groundwater impacts, no further action is required for this SWMU.

2.1.7 SWMU 11 -- Interim Wastewater Treatment/Sludge Container Area

SMWU 11 is designated as an approximately 200-foot by 50-foot area immediately adjacent to the north side of the current wastewater treatment facility. A portion of this area currently contains methanol storage tanks.

Based on RFI soil results that did not indicate the presence of contamination at concentrations greater than the guidance values or standards, no further action is required for this SWMU.

2.1.8 SWMU 12 -- Transformer Pad Vicinity and Scrap Yard Area Soils

The transformer pad is located to south of the rotary kilns in the central portion of the facility. A PCB spill from the transformer occurred at some point in the past. The exact nature of the spill is unknown. The scrap yard area is an approximately one acre area located in the southwestern portion of the facility. The area is currently used for the storage of spare parts, supplies, and damaged/out-of-use equipment. There are past reports of a petroleum (oil or fuel) discharge from a decommissioned vehicle that was stored in the area before being sold for scrap. The exact location of the discharge is not known. The Mid-pond Settling Basin was constructed in the early 1980s on the north side of rotary kiln No. 2. The function of the Mid-pond Settling Basin was to retain supernatant wastewater from the primary settling basin, which received APC wastewater from the wet scrubbers on the rotary kilns. When the kilns were operating, discharge from the Mid-Pond Settling Basin was approximately five to 10 gallons per minute every two to three hours depending on whether one or both kilns were operating. Discharge from the Mid-Pond Settling Basin was through a filter unit into the Salt Kill and was regulated under a SPDES permit.

Prior to the RFI, soil sampling was conducted adjacent to the transformer pad, in the scrap yard, and in the mid-pond settling basin. No compounds were detected above background levels or laboratory detection limits.

During the RFI, additional soil sampling was conducted at the transformer pad and in the scrap yard. Two monitoring wells were installed downgradient of the transformer pad. Elevated metal concentrations were detected in soil samples at the transformer pad, some results exceeding the Industrial SCOs. Selenium exceeded the GA Standard at SWMU 12 MW-8 during both groundwater sampling events conducted during the RFI. Selenium again slightly exceeded the GA Standard at SWMU 12 MW-8 during the Supplemental RFI sampling events.

2.1.8.1 SWMU 12 Interim Corrective Measure

Based on the results of the soil sampling conducted during the RFI, an Interim Corrective Measure (ICM) was established to minimize the migration of surface soil in the SWMU 12 transformer pad area through the installation of an asphalt cap. The Work Plan for the SWMU 12 ICM was approved by the NYSDEC on October 24, 2012.

On November 19, 2012, the area was covered with a 2.5-inch asphalt cap constructed of New York State-approved Type 6 Top Course. This cap extended beyond the area of concern and covered 3,070 square feet. Minimal site preparation was required prior to installation of the asphalt cap. No soil excavation was necessary to implement the ICM.

The SWMU 12 ICM successfully capped the area where surface soil samples exceeded the Part 375 Industrial SCOs. Norlite will inspect the asphalt cap on a weekly basis during the Part 373 RCRA Permit required Weekly Facility RCRA Inspections. Integrity issues or repairs made will be documented on the Weekly Facility RCRA Inspections. Since the ICM involves an engineering control, an institutional control and site management plan will be needed in the future as part of the final corrective action for the site.

2.1.9 SWMU 14 North and East Site Perimeter Fence Area

This SWMU is undeveloped and is currently covered by shrub vegetation and grasses. This area was investigated to assess potential impacts from site air emissions and focused on the shallow soil along the site perimeter.

Surface soil characterization activities completed during the RFI at SWMU 14 did not identify the presence of any compounds at concentrations greater than NYSDEC Residential SCOs. Based on these results, no further action is required at this SWMU.

2.1.10 SWMU 16 -- Quarry Pond

The two quarry ponds are located in the western portion of the facility. The western quarry pond is approximately seven acres. The eastern quarry pond is approximately two-thirds of an acre.

Water samples that were collected during the RFI in the western pond did not contain compounds at concentrations greater than the NYSDEC GA Standards. Therefore, no further action is required at this SWMU.

2.1.11 SWMU 17 – Industrial Sewers / Hazardous Waste Feed Pipelines

In March 1993, Norlite began use of the new LGF Tank Farm facility that included the current above-ground LGF feed pipeline. Prior to the operation of this facility, LGF was supplied to the rotary lightweight aggregate kilns via underground LGF pipelines that were buried in the area between the current LGF Tank Farm facility and the rotary lightweight aggregate kilns. The approximate location of the former underground feed lines is shown on Figure 2. Based on conversations with Norlite personnel, no surveyed drawings or plans showing the exact location and depth of the underground feed lines are available.

An undated Norlite document titled “Closure Plan for Removal of Underground LGF Line and Kiln Pump House” (Norlite Closure Plan), states that the underground feed system consisted of three buried LGF lines (designated “yellow”, “white”, and “green”) and one nitrogen vent line. The LGF lines are listed as being three-inches in diameter which are buried approximately two feet bgs. The exact construction of the piping is not documented; however, based on conversations with Norlite personnel, it is assumed that the piping is constructed of steel.

Soil sampling conducted in 1993 in the area of the underground lines, indicated that soil contained concentrations of total petroleum hydrocarbons (TPHs) and chlorinated VOCs, but the results were all less than the NYSDEC Part 375 residential SCOs.

A Norlite memorandum dated April 17, 1993, states that the “green” and “yellow” underground LGF lines were flushed with No. 2 Fuel Oil, water, and compressed air on April 16 and April 17, 1993, respectively. The memorandum also states that the lines would be capped at the lower pump pad and pump house areas. A Norlite memorandum dated April 20, 1993 states that the underground LGF vent line was purged with nitrogen on April 20, 1993 and that the line was disconnected and capped at the pump house.

In a Norlite memorandum dated March 17, 1993 (Appendix D), implementation of the buried LGF line removal detailed in the Norlite Closure Plan was postponed indefinitely at a meeting held on March 1, 1993. Based on this information, and on discussions with current Norlite personnel, the disconnected buried LGF lines are still in-place at the facility.

While the source of the SWMU 1 groundwater contamination is not known, it is potentially associated with potential historical releases from the former underground feed lines. As stated above, the underground feed lines were flushed, capped, and left in-place. Laboratory results from soil samples collected in that area did not indicate any compounds were detected above cleanup objectives. As such, no further action is required at this SWMU.

2.2 Area of Concern

The Area of Concern (AOC) identified is summarized below. The AOC is categorized within the SWMU 1, 7, 8 areas (Figure 3).

Groundwater contamination is primarily located east and southeast of the tank storage area, which includes the LLGF and SLGF processing buildings and the covered above ground storage tanks located adjacent to these buildings, coincident with the groundwater flow direction in this area. The contamination primarily consists of VOCs that exceed the corresponding NYSDEC Class GA Standards in the overburden groundwater. The monitoring wells with exceedances are shown on Figure 3. The monitoring well network is shown on Figure 4.

The highest concentrations of VOCs detected were at wells SWMU 1 MW-7, MW-8, and MW-12 (Figure 5). Based on downgradient monitoring, the VOCs are not migrating beyond the SWMU 1 area or the Norlite property boundary.

3. Groundwater Corrective Action Objectives and Technology Screening

The Corrective Action Objectives (CAOs) for groundwater in the SWMUs 1, 7, and 8 areas of the Norlite facility are the NYSDEC Class GA groundwater standards and/or guidance values, which are presented in Table 2. Compliance with the groundwater CAOs is measured at the monitoring wells downgradient (east and southweast) of the tank storage area, and at the Norlite eastern property boundary.

Final selected technologies were based on the ability to achieve the CAOs, and the physical constraints of the impacted areas.

3.1 Corrective Measure Options

Corrective measures technologies were chosen for groundwater that could potentially meet the CAOs. The following corrective measures technologies were retained for consideration for the SWMUs 1, 7 and 8 groundwater:

1. Monitored Natural Attenuation;
2. Source Removal;
3. In-Situ Treatment; and
4. No Action.

3.1.1 Monitored Natural Attenuation

MNA, also known as intrinsic remediation, bioattenuation, or intrinsic bioremediation, refers specifically to the use of natural processes, such as dilution, volatilization, biodegradation, adsorption, and chemical reactions with subsurface materials, as part of overall site remediation. MNA is a non-engineered remedial technique, which involves the degradation of the VOCs in the groundwater by naturally occurring processes (i.e., biodegradation). Such degradation is monitored over time under a long-term monitoring program.

Consideration of this option usually requires evaluation of contaminant degradation rates and pathways, and predicting contaminant concentrations at downgradient receptor points. The primary objective of this evaluation would be to demonstrate that the natural processes of contaminant degradation will reduce contaminant concentrations to less than regulatory standards or risk-based levels before potential exposure pathways are completed. In addition, long-term monitoring would be conducted throughout the process to confirm that degradation is proceeding at rates consistent with the eventual attainment of CAOs.

Long-term monitoring would include semi-annual groundwater sampling of the monitoring well network at Norlite.

The CAOs for the site can potentially be met by MNA alone in a reasonable time period, based on observed concentrations of VOCs and the following conditions:

- Groundwater contamination is not migrating off the site;
- Groundwater at the site is not used for any purpose;
- There are no vapor intrusion hazards, as all buildings located at the Site are temporary structures;
- There are no exposure pathways (inhalation, ingestion, direct contact) with the affected media.

MNA will be considered further as a primary remedial alternative for the site.

3.1.2 Source Removal

While the source of the groundwater contamination at Norlite is unknown, it is potentially associated with the former underground LGF feed line (Figure 3).

Source removal involves the physical removal of targeted media (ie., contaminated soil related to the feed line). Typical equipment used includes backhoes, draglines, clamshells, vacuum trucks, and front-end loaders. Soil sampling would confirm the removal of contaminants before backfilling. Excavation and removal of soil containing VOCs eliminates the potential for VOCs to leach from soil to groundwater.

Excavated material is typically characterized and disposed off-site at an approved waste management facility. Off-site transportation of wastes must comply with applicable federal and state shipping and manifesting regulations. Disposal cost depends on the amount of soil removed and the soil characteristics (hazardous or non-hazardous).

Excavation of source zone mass is considered an aggressive remediation method. However, as stated in the RFI Work Plan and in Section 2.1.11 of this report, soil samples collected in the vicinity of the former underground feed line indicated there are no concentrations of contaminants that exceed cleanup objectives. Therefore, source removal was not considered to be applicable to the site as the source of the contamination could not be identified. However, excavation of the former underground feed lines and associated soil in the vicinity of the area of groundwater contamination will be retained as a potential corrective measure since the soil immediately surrounding the lines could potentially be a source of the groundwater contamination.

It should be noted that the underground fuel lines and surrounding soil (if contaminated) will be removed as part of Norlite's approved RCRA Closure Plan upon shut-down of the facility.

3.1.3 In Situ Chemical Oxidation

In-situ chemical oxidation (ISCO) has been used since the early 1990s to treat environmental contaminants in groundwater, soil, and sediment. Many of these projects have focused on the treatment of chlorinated solvents (e.g., trichloroethene and tetrachloroethene), although several projects have also used the process to treat petroleum compounds [(i.e., BTEX and methyl tertiary-butyl ether (MTBE)] and semi-volatile organic compounds such as polycyclic aromatic hydrocarbons (PAHs) and pesticides.

ISCO is defined as the delivery and distribution of oxidants and other amendments into the subsurface to transform contaminants of concern into innocuous end products such as carbon dioxide (CO2), water, and inorganic compounds. Injection locations can be either permanently installed wells or temporary injection points installed using direct-push methods. When oxidants come in contact with contaminants they are broken down into non-toxic components. However, contact between the oxidant and contaminant required to facilitate the reaction is the most important technical limitation of this technology, as it can be difficult to accomplish.

Accordingly, this remedial approach generally includes several injections over time accompanied by groundwater sampling and analysis. Numerous injections are typically required to remediate the treatment area. Given this, and depending on the final contaminant concentration desired, the overall costs are typically medium to high relative to other technologies. Since the reaction with the contaminant and the chemical oxidant generally occurs over a relatively short period, treatment can be more rapid than other in-situ technologies. This technology does not generate large volumes of residual waste material that must be treated and/or disposed.

ISCO can be used to treat localized source areas and dissolved-phase plumes since it is capable of treating high concentrations of contaminants by adding more oxidants. ISCO typically becomes prohibitively expensive for large areas requiring treatment to low concentration endpoints.

Advantages of ISCO typically include:

- Relatively short remediation times in areas where groundwater flow does not introduce additional contaminants with time (typically one to two years);
- Limited long-term O&M costs in such settings;
- Treats both dissolved and sorbed contaminants concurrently;
- Treats compounds that are not readily biodegradable; and
- Breakdown of contaminants without the generation of potentially more toxic degradation products.

Disadvantages of ISCO include:

- Its application to areas with only the highest contaminant concentrations is typically most cost effective;
- The need to inject large volumes of oxidant (especially in areas where groundwater flow introduces additional contaminants over a long period of time from upgradient directions);
- The need for multiple injections;
- The difficulty of contacting oxidants with groundwater contaminants intended for destruction when injecting into low permeability or heterogeneous formations;
- Health and safety issues pertaining to field personnel associated with the handling and injection of oxidants and reagents;
- Relatively high costs per volume treated; and
- Naturally occurring carbon sources increase the oxidant demand in the treatment zone. The presence of carbonates can also add to the oxidant demand for certain ISCO chemicals.

The most common oxidants utilized for ISCO are hydrogen peroxide (Fenton's reagent), potassium and sodium permanganate, and sodium persulfate. A general summary of each of these oxidants is presented below:

- **Fenton's Reagent (Hydrogen Peroxide)**- Hydrogen peroxide-based in-situ chemical oxidation is driven by the formation of a hydroxyl free radical in the presence of a metal catalyst. This reaction, known as the Haber-Weiss mechanism, was first utilized for the treatment of organic compounds in wastewater in the 1890s by H.J.H Fenton using an iron catalyst (Fenton's reagent). The hydroxyl free radical is a powerful oxidizer of organic compounds, thus many organic compounds in the subsurface that contact the chemical oxidant are readily degraded to innocuous compounds (e.g., water and carbon dioxide). Any residual hydrogen peroxide remaining after the reaction decomposes to water and oxygen. Soluble iron (ferrous iron), the transition metal catalyst added to the subsurface during injection of the oxidant mixture, is precipitated out of solution during conversion to ferric iron.

Typical hydrogen peroxide concentrations utilized for treatment with Fenton's reagent range from five to 50 percent by weight, however, concentrations less than 15 percent are utilized at a majority of sites. The hydrogen peroxide concentration used in the injection fluid is based on contaminant concentrations, subsurface characteristics, and treatment volume. Acids are also typically added to the injection solution to lower the pH of the contaminated zone if the natural pH is not low enough to promote the Fenton's reaction.

Compared to other oxidants, Fenton's reagent has a relatively short life once injected into the subsurface. Therefore, a larger number of Fenton's reagent injections may be required to sustain the oxidant in the subsurface compared to injections of other oxidants. As such, Fenton's reagent will not be considered further.

- **Sodium and Potassium Permanganate**- Permanganate is an oxidizing agent with a unique affinity for oxidizing organic compounds with carbon-carbon double bonds (ethenes), aldehyde groups, or hydroxyl groups (alcohols). There are two forms of permanganate that are used for ISCO, potassium permanganate (KMnO4) and sodium permanganate (NaMnO4). Potassium permanganate has been used in drinking water and wastewater treatment for several decades to oxidize raw water contaminants, typically for odor control. Potassium permanganate is available as a dry crystalline material, while sodium permanganate is a liquid. Permanganate turns bright purple when dissolved in water; this purple color is an indicator of unreacted chemical. Reacted permanganate is black or brown, indicating the presence of a manganese dioxide (MnO2) byproduct.

Sodium permanganate has a much higher solubility in water than potassium permanganate (up to 40 percent, allowing it to be used for ISCO at higher concentrations compared to two to five percent for potassium permanganate). Since it is supplied in liquid form, the use of sodium permanganate commonly requires no on-site mixing. The U.S. Department of Homeland Security (DHS), in accordance with securing the nation's chemical facilities, has placed potassium permanganate on a list with other chemical substances determined to be potentially dangerous. Because of the homeland security issues, paperwork, and restrictions placed on the use of potassium permanganate, potassium permanganate will not be considered further in a potential ISCO remedial alternative. Because aromatics are also a contaminant in the AOC, sodium permanganate will not be retained for further consideration.

- **Sodium Persulfate**- Sodium persulfate is a strong oxidant that derives its oxidizing potential through the persulfate anion (S2O82-). The persulfate anion is capable of oxidizing a wide range of contaminants, including chlorinated ethenes, phenols, MTBE, and low molecular weight PAHs. However, when catalyzed in the presence of heat (thermal catalyzation) or transition metals ions (i.e., ferrous iron), the persulfate ion is converted to the sulfate free radical (SO42-•), which is second only to Fenton's reagent in oxidizing potential. Sodium persulfate is supplied in an aqueous solution at concentrations up to 50 percent by weight. The use of sodium persulfate for the treatment of chlorinated VOCs is a relatively new process, but because of its ability to oxidize a wide range of contaminants, including aromatics, it will be considered further as a potential ISCO remedial alternative.

- **RegenOx**- RegenOx is a proprietary mixture of oxidants used to treat VOCs in groundwater. A RegenOx application will remove significant amounts of contamination from the subsurface and is typically applied using direct-injection techniques. The application process enables the two part product to be combined, then pressure injected into the zone of contamination and moved out into the aquifer media. Once in the subsurface, RegenOx produces a cascade of efficient oxidation reactions via a number of mechanisms including: surface mediated oxidation, direct oxidation and free radical oxidation. These reactions eliminate contaminants and can be propagated in the presence of RegenOx for periods of up to 30 days on a single injection. RegenOx produces minimal heat and is highly compatible with follow-on enhanced bioremediation applications. RegenOx will not be considered further as an ISCO remedial alternative.

ISCO, using sodium persulfate, will be considered further as a remedy.

3.1.4 No Action

A no action response would include no remedial measures or monitoring. There are no inherent costs associated with a no action remedial response for a contaminated groundwater plume. The no action alternative would be the same as MNA, without monitoring, to demonstrate reductions in VOC concentration. As such, a no-action response was not considered further.

4. Evaluation of Potential Corrective Measures

Based on the evaluations presented in Section 3, the following potential corrective measures were considered applicable to the SWMU 1, 7, 8 groundwater.

1. No Action

2. Monitored Natural Attenuation

3. Excavation of the Former Underground Feed Lines

4. In-Situ Treatment with Sodium Persulfate

The corrective measures alternatives were evaluated based on the following criteria, as outlined DER#10 Section 4.1(e):

1. Overall protectiveness of the public health and the environment;

2. Compliance with CAOs;

3. Long-term effectiveness and permanence;

4. Reduction of toxicity, mobility, and volume;

5. Short-term impacts and effectiveness; and

6. Implementability;

Estimated costs for each of the corrective measures alternatives listed above are included in **Appendix A**.

Overall protectiveness of the public health and the environment

This criterion assesses whether each alternative is protective of human health and the environment. The overall assessment of protection is based on a composite of factors assessed under other evaluation criteria; especially long-term effectiveness and performance, short-term effectiveness, and compliance with CAOs. This evaluation focuses on how a specific alternative achieves protection over time and how site risks are reduced. The analysis includes how each source of contamination is to be eliminated, reduced, or controlled for each alternative.

Compliance with CAOs

This evaluation criterion assesses how each alternative complies with applicable or relevant and appropriate CAOs, as discussed and identified in Section 3. If a CAO is not met, the basis for one of the four waivers allowed under 6 NYCRR Part 375-1.10(c)(1) is discussed. If an alternative does not meet the CAOs and a waiver is not appropriate or justifiable, it should not be considered further.

Short-term Impacts and Effectiveness

This evaluation criterion assesses the effects of the alternative during the construction and implementation phase. Alternatives are evaluated with respect to the effects on human health and the environment during implementation of the remedial action. The aspects evaluated include: protection of the community during remedial actions, environmental impacts as a result of remedial actions, time until the remedial response objectives are achieved, and protection of workers during the remedial action.

Long-term Effectiveness and Permanence

This evaluation criterion addresses the results of a remedial action in terms of its permanence and quantity/nature of waste or residual remaining at the site after CAOs have been met. The primary focus of this evaluation is the extent and effectiveness of the controls that may be required to manage the waste or residual compounds remaining in environmental media at the site and operating systems necessary for the remedy to remain effective. The factors being evaluated include the permanence of the remedial alternative, magnitude of the remaining risk, adequacy of controls used to manage residual waste, and reliability of controls used to manage residual waste.

Reduction of Toxicity, Mobility, and Volume

This evaluation criterion assesses the remedial alternative’s use of the technologies that permanently and significantly reduce toxicity, mobility, or volume of the hazardous wastes as their principal element. The NYSDEC’s policy is to give preference to alternatives that eliminate any significant threats at the site through destruction of toxic contaminants, reduction of the total mass of toxic contaminants, irreversible reduction in the contaminant’s mobility, or reduction of the total volume of contaminated media.

This evaluation includes: the amount of the hazardous materials that would be destroyed or treated, the degree of expected reduction in toxicity, mobility, or volume measured as a percentage, the degree in which the treatment would be irreversible, and the type and quantity of treatment residuals that would remain following treatment.

Implementability

This criterion addresses the technical and administrative feasibility of implementing an alternative and the availability of various services and materials required during its implementation. The evaluation includes: feasibility of construction and operation; the reliability of the technology; the ease of undertaking additional remedial action; monitoring considerations; activities needed to coordinate with other offices or agencies; availability of adequate off-site treatment, storage, and disposal services; availability of equipment; and the availability of services and materials.

4.1 No Action

Under the no further action (NFA) alternative, no work will be completed at the site. This alternative will serve as a baseline for comparison for all other remedial alternatives considered for the site. This alternative is considered to be ineffective because groundwater contamination would not be remediated.

4.1.1 Comparison to Evaluation Criteria

4.1.1.1 Overall protectiveness of the public health and environment

There are no exposure pathways (inhalation, ingestion, direct contact) associated with the affected media; therefore, a NFA alternative meets this criterion.

4.1.1.2 Compliance with CAOs

CAOs would not be met through the implementation of the NFA alternative.

4.1.1.3 Long-term effectiveness and permanence

The NFA alternative would be protective in the long term since there are no receptors associated with the VOCs in groundwater.

4.1.1.4 Reduction of toxicity, mobility, and volume

The NFA does not directly influence the toxicity, mobility, or volume of contaminants within groundwater at the site. However, over time the concentrations of contaminants may decrease due to natural attenuation.

4.1.1.5 Short-term impacts and effectiveness

There would have no short term impacts due to the implementation of this alternative. This alternative does not actively address groundwater contamination at the site and would not be effective in the short-term.

4.1.1.6 Implementability

This alternative requires no effort to implement.

4.2 Monitored Natural Attenuation

The MNA alternative would involve semi-annual sampling and analysis of site groundwater to document attenuation of the contaminants in groundwater resulting from natural attenuation processes. Groundwater from approximately 17 wells in the site monitoring well network would be sampled twice per year and analyzed for VOCs, field parameters, and natural attenuation (NA) parameters. Field parameters will include oxidation/reduction potential (ORP), DO, pH, temperature, and specific conductance. NA parameters will include chloride, nitrite, nitrate, sulfate, ferrous iron, ferric iron, alkalinity, dissolved sulfide, dissolved organic carbon, methane, ethane, ethene, and carbon dioxide. No active groundwater remediation is included in MNA.

4.2.1 Comparison to Evaluation Criteria

4.2.1.1 Overall protectiveness of the public health and environment

MNA would be protective of human health and the environment because groundwater containing site-related VOCs is not being used as a water supply and there are no exposures resulting from soil vapor intrusion. MNA requires minimal effort to implement and would have significantly lower capital and OM&M costs than technologies that include active treatment of the dissolved-phase VOCs in groundwater. MNA would be implemented for a period of five years.

4.2.1.2 Compliance with CAOs

VOC concentrations greater than the CAOs may decrease through natural attenuation. Long-term monitoring will document the progress of VOC reduction to concentrations less than CAOs. Since there are no groundwater receptors, the alternative would be protective of the environment.

4.2.1.3 Long-term Effectiveness

This corrective measure could potentially be effective over the long term since there is no longer a contributing source of VOCs to the subsurface in former fuel feed line area and VOC concentrations greater than the CAOs may decrease through natural attenuation. Long-term monitoring will document the progress of VOC reduction to concentrations less than CAOs.

4.2.1.4 Reduction of Toxicity, Mobility, and Volume

This corrective measure may reduce the toxicity, mobility, and volume of the VOCs in the overburden aquifer by reducing the VOC mass, and subsequently reducing concentrations in the groundwater.

4.2.1.5 Short-term Effectiveness

This corrective measure would not be effective in the short-term in reducing many of the groundwater concentrations to less than CAOs. However, since there are no groundwater receptors, the alternative would be protective of the environment.

4.2.1.6 Implementability

MNA requires minimal effort to implement and would include coordinating and conducting semi-annual groundwater sampling events.

4.3 Excavation of Former Underground Fuel Lines

As discussed in Section 3.1.2, excavation of the former underground fuel lines in the vicinity of the area of groundwater contamination (between wells SWMU 1 MW-6 and

MW-8) was retained for consideration as the soil surrounding the lines could potentially be the source of groundwater contamination. It should be noted; however, that the source of the contamination could not be identified or defined during the RFI due to the presence of the lines, various underground utilities, the SWMU 1 LGF building and associated tanks, as well as the foundation supports for the overhead fuel lines currently in use.

Excavation activities in this area would have to be accomplished using vacuum excavation techniques to avoid damage to the lines and other subsurface structures. In addition, the foundation supports for the overhead fuel lines would have to be augmented to prevent collapse.

4.3.1 Comparison to Evaluation Criteria

4.3.1.1 Overall protectiveness of the public health and environment

Excavation of the fuel lines and associated soil would be protective of human health and the environment, if they are indeed the source of the groundwater contamination, as it would remove the source of the groundwater contamination.

4.3.1.2 Compliance with CAOs

Source removal would achieve CAOs in the long term as VOC concentrations greater than the CAOs in groundwater would decrease through natural attenuation. Long-term monitoring would document the progress of VOC reduction to concentrations less than CAOs. Since there are no groundwater receptors, the alternative would be protective of the environment.

4.3.1.3 Long-term Effectiveness

This corrective measure could potentially be effective over the long term since there would no longer a contributing source of VOCs to the subsurface in former fuel feed line area (if the lines are the source of the contamination) and VOC concentrations greater than the CAOs would decrease through natural attenuation.

4.3.1.4 Reduction of Toxicity, Mobility, and Volume

This corrective measure would reduce the toxicity, mobility, and volume of the VOCs in the overburden aquifer if it removes the source of the contamination.

4.3.1.5 Short-term Effectiveness

This corrective measure would be effective in the short-term if it removes the source of the groundwater contamination.

4.3.1.6 Implementability

Excavation could be implemented using available technologies; however, this alternative would be difficult to implement for the following reasons:

1. Due to the presence of numerous underground utilities (including high-voltage electrical, water, and sanitary sewer) and overhead height restrictions, vacuum excavation methods would have to be employed. Active utilities would have to be supported or re-routed during excavation. As-built utility drawings do not exist for the facility.
2. Since the foundation supports for the overhead fuel lines are in the potential excavation area, the overhead fuel lines would have to be supported by other means during the excavation activities.
3. The presence of the SMWU 1 LGF Building tanks immediately north of the fuel lines would preclude access from that direction and would limit the northern extent of the excavation.

4.4 In-Situ Treatment with Sodium Persulfate

Given its ability to oxidize both chlorinated VOCs and aromatics, sodium persulfate was chosen for the in-situ treatment alternative. Implementation of an ISCO treatment program would include the following:

1. Bench-scale laboratory testing to evaluate the effectiveness of ISCO treatment and the amount of oxidant required for treatment.

2. Implementation and evaluation of a field pilot test to evaluate oxidant distribution and persistence in the subsurface.

3. Injection of oxidant into either temporary direct-push injection points or permanent injection wells into the subsurface.

4. Post-injection groundwater monitoring to evaluate treatment effectiveness.

The oxidant would be injected into the subsurface within the potential source treatment zone, which is shown on Figure 5 and is bounded by the SWMU 1 LGF and truck loading buildings, office buildings, a Norlite access road, and SWMU 1 MW-6. The approximate area is 2,400 square feet and the approximate depth to bedrock is 23 feet. Groundwater monitoring upgradient, downgradient, and within the treatment area would be required to evaluate the effectiveness of the ISCO injections at reducing contaminant concentrations and protecting downgradient areas from further dissolved-phase VOC migration. ISCO injections would treat the plume as the affected groundwater flows through the treatment area.

Since ISCO relies on direct contact between the oxidant solution and the contaminant, the success of the ISCO treatment would be highly dependent on the ability to effectively distribute the oxidant through the treatment area. If such distribution can be achieved, it is anticipated that the ISCO treatment is capable of reducing source area contaminant concentration to meet the CAOs for the site. Multiple injections will likely be required to sustain the oxidants in the subsurface, commonly 3 to 6 months apart. An ISCO pilot study would be conducted to evaluate the implementability, effectiveness, and feasibility of this technology at the site.

A MNA program would be included in this alterative. MNA would be implemented as a secondary component of this alternative and would involve periodic sampling and analysis of site groundwater for downgradient areas.

4.4.1 Comparison to Evaluation Criteria

4.4.1.1 Overall protectiveness of the public health and the environment

The implementation of the ISCO alternative would be protective of human health by reducing concentrations of VOCs in groundwater.

4.4.1.2 Compliance with SCGs

The implementation of ISCO as a remedy would be in compliance with CAOs because there would be a reduction of VOC concentrations within the treatment area.

4.4.1.3 Long-term effectiveness and permanence

ISCO is considered to be effective in the long-term because further migration of the dissolved phase plume could be minimized and the groundwater VOC concentrations in the treatment area would be reduced. The limiting factor to the long-term effectiveness of ISCO is the number of injections necessary to maintain the oxidant in the subsurface.

4.4.1.4 Reduction of toxicity, mobility, and volume

ISCO is considered to be effective at reducing the toxicity, mobility, or volume of the plume because ISCO can convert the VOCs to non-toxic byproducts if sufficient contact can be achieved.

4.4.1.5 Short-term impacts and effectiveness

ISCO would be effective in the short-term since ISCO treatment oxidizes VOCs almost immediately upon contact. However, ISCO is ineffective at treating groundwater upgradient and downgradient of the ISCO injection locations. Implementation and initial operation of this alternative is not expected to pose significant risk to the community. Risks to workers, which include potential exposure to oxidants and to contaminated soils and groundwater during well and equipment installation, are readily controlled using standard work practices and engineering controls. Air emissions during implementation are also monitored and can be controlled within acceptable levels with standard work practices and engineering controls.

4.4.1.6 Implementability

ISCO treatment could be implemented using readily available technologies and is considered easy to implement. However, the success of the treatment would be dependent on the degree to which the oxidant solution is able to come into contact with the contaminants and the number of injections required. There would be minimal disruption to site activities during ISCO injection events because no surface structures are needed, other than injection wells. ISCO injections do not generate significant waste, so treatment and disposal considerations are negligible. Utility clearance confirmation is necessary prior to conducing any subsurface drilling.

5. Proposed Final Corrective Measure

The VOCs in the groundwater are localized to the SWMU 1, 7, 8 areas and are not migrating beyond the Norlite property. Groundwater containing site-related VOCs is not being used as a water supply and there are no exposures resulting from soil vapor intrusion. As such, MNA is equally as protective of the environment as in-situ treatment and excavation. A combination of long-term monitoring accompanied by natural attenuation is the proposed final corrective measure for the groundwater in the SWMU 1, 7, 8 areas.

6. References

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Tables

Table 2
Corrective Action Objectives (CAOs) for Groundwater
Norlite Corporation
SWMU 1
Cohoes, New York

Analyte	**Corrective Action Objective (ug/l)**
Organic Compounds	
1,1-Dichloroethane	5.0
1,2-Dichlorobenzene	3.0
1,2-Dichloroethane	0.6
Acetone	50*
Benzene	1.0
Chlorobenzene	5.0
cis-1,2-Dichloroethene	5.0
Ethylbenzene	5.0
Isopropylbenzene	5.0
2-Butanone	50*
Methyl Tert Butyle Ether	10.0
Trichloroethene	5.0
Vinyl chloride	2.0

Notes:
CAOs = NYSDEC Class GA groundwater standards
* NYSDEC Class GA groundwater guidance values

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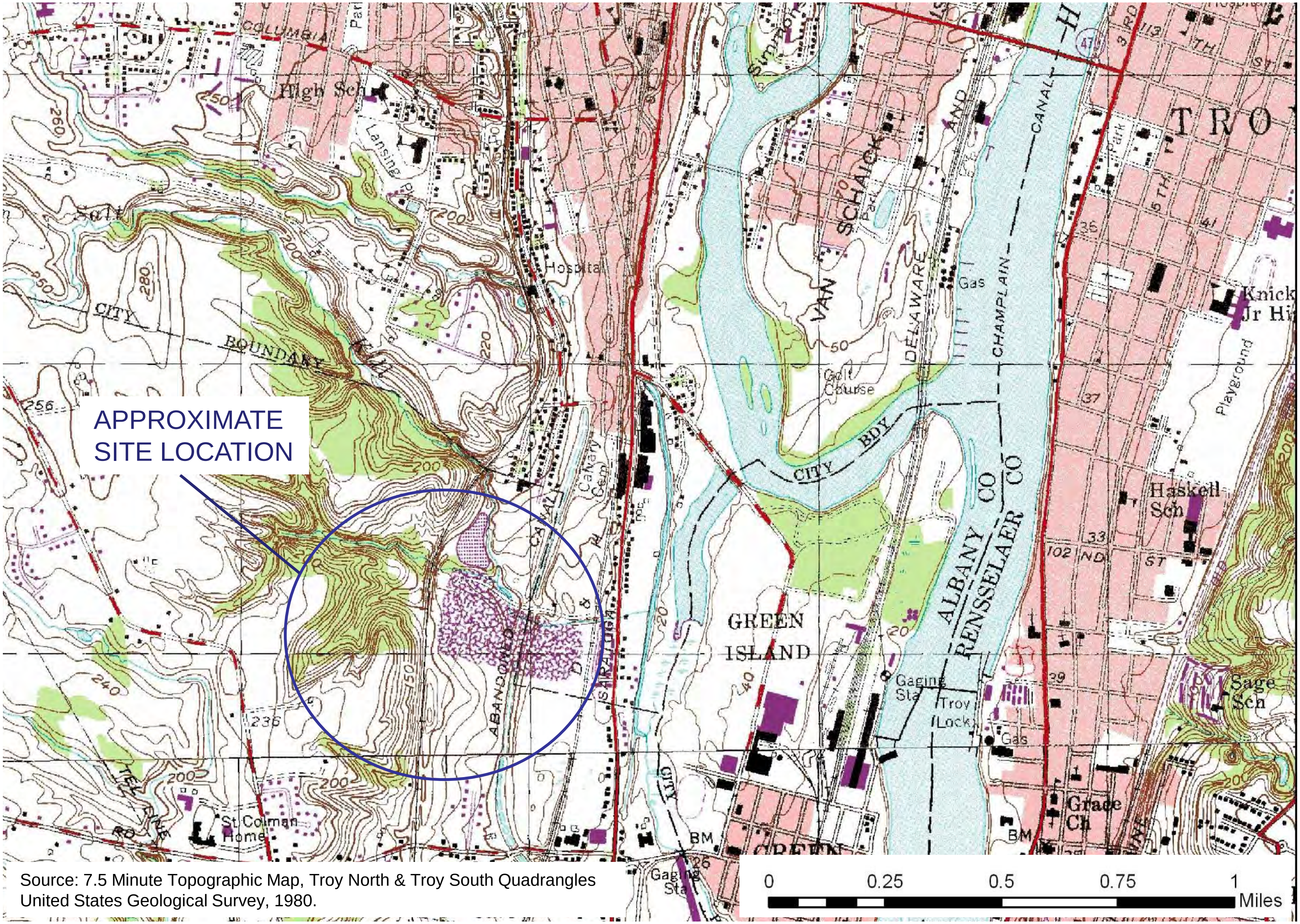
Figures



Source: 7.5 Minute Topographic Map, Troy North & Troy South Quadrangles
United States Geological Survey, 1980.

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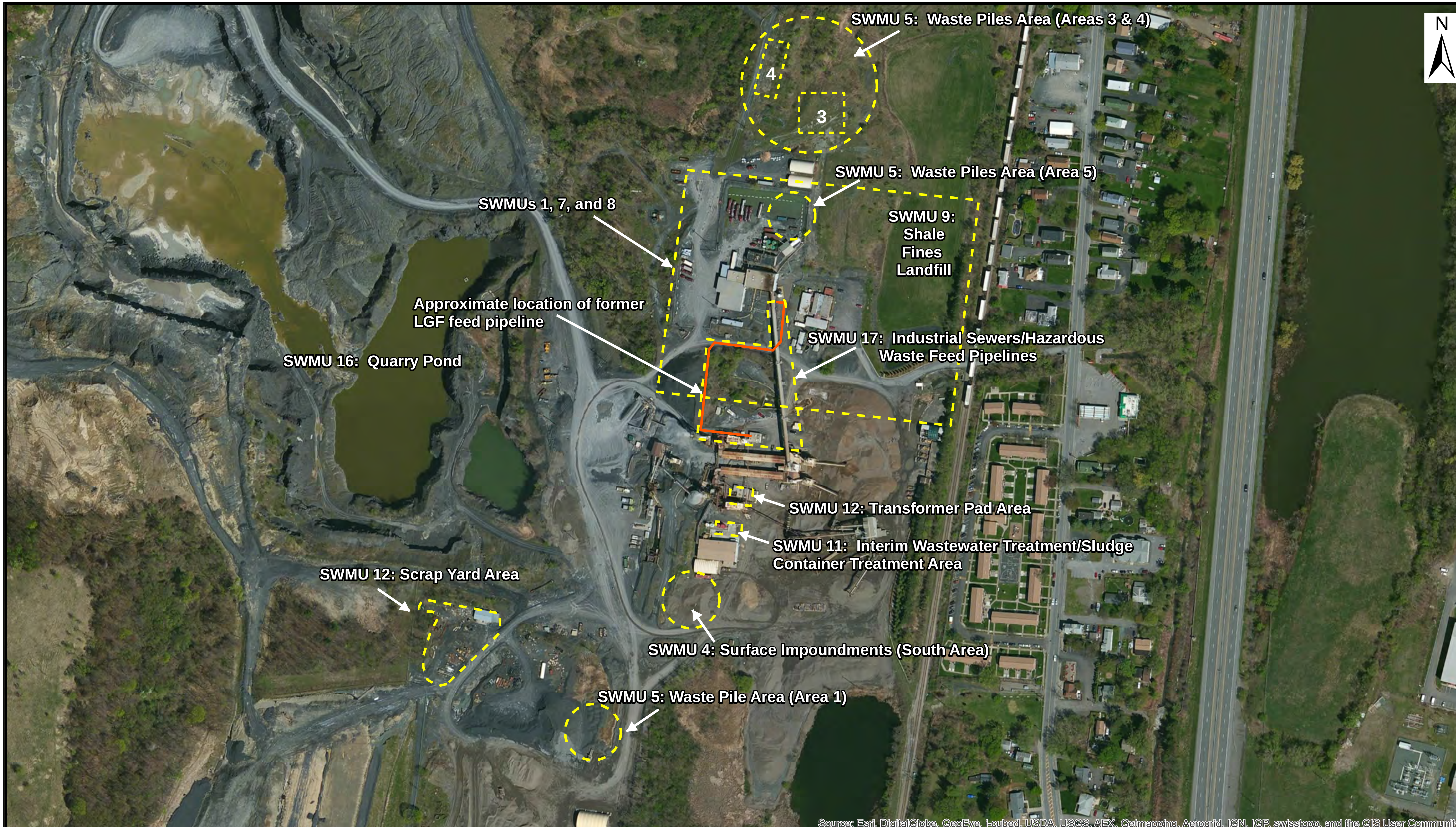
ARCADIS	NORLITE CORPORATION CORRECTIVE MEASURES STUDY	**SITE LOCATION**	AUGUST 2013 FIGURE 1



Notes:
Basemap image: New York State GIS Clearinghouse Orthoimagery, 2011.

0 120 240 480 720 960 Feet

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NORLITE CORPORATION
COHOES, NEW YORK

CORRECTIVE MEASURES STUDY

SOLID WASTE MANAGEMENT UNITS (SMWUs)

ARCADIS-US, INC

AUGUST 2013
FIGURE 2

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Legend

Wells highlighted with yellow contained concentrations of VOCs that exceeded NYSDEC GA Standards.

Monitoring Well Bedrock Damaged Destroyed Overburden

0 30 60 120 180 240 Feet

Source: Basemap image - New York State GIS Clearinghouse Orthoimagery, 2011.

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CORRECTIVE MEASURES STUDY

ARCADIS-US, INC

AREAS OF CONCERN
SWMUs 1,7, and 8

AUGUST 2013
FIGURE 3

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Legend

Monitoring Well Bedrock Overburden Damaged Destroyed

Feet 0 35 70 140 210 280

Basemap image: New York State GIS Clearinghouse Orthoimagery, 2011.

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COHOES, NEW YORK

CORRECTIVE MEASURES STUDY

MONITORING WELL NETWORK
SWMUs 1, 7, 8, 9

ARCADIS-US, INC

AUGUST 2013

FIGURE 4

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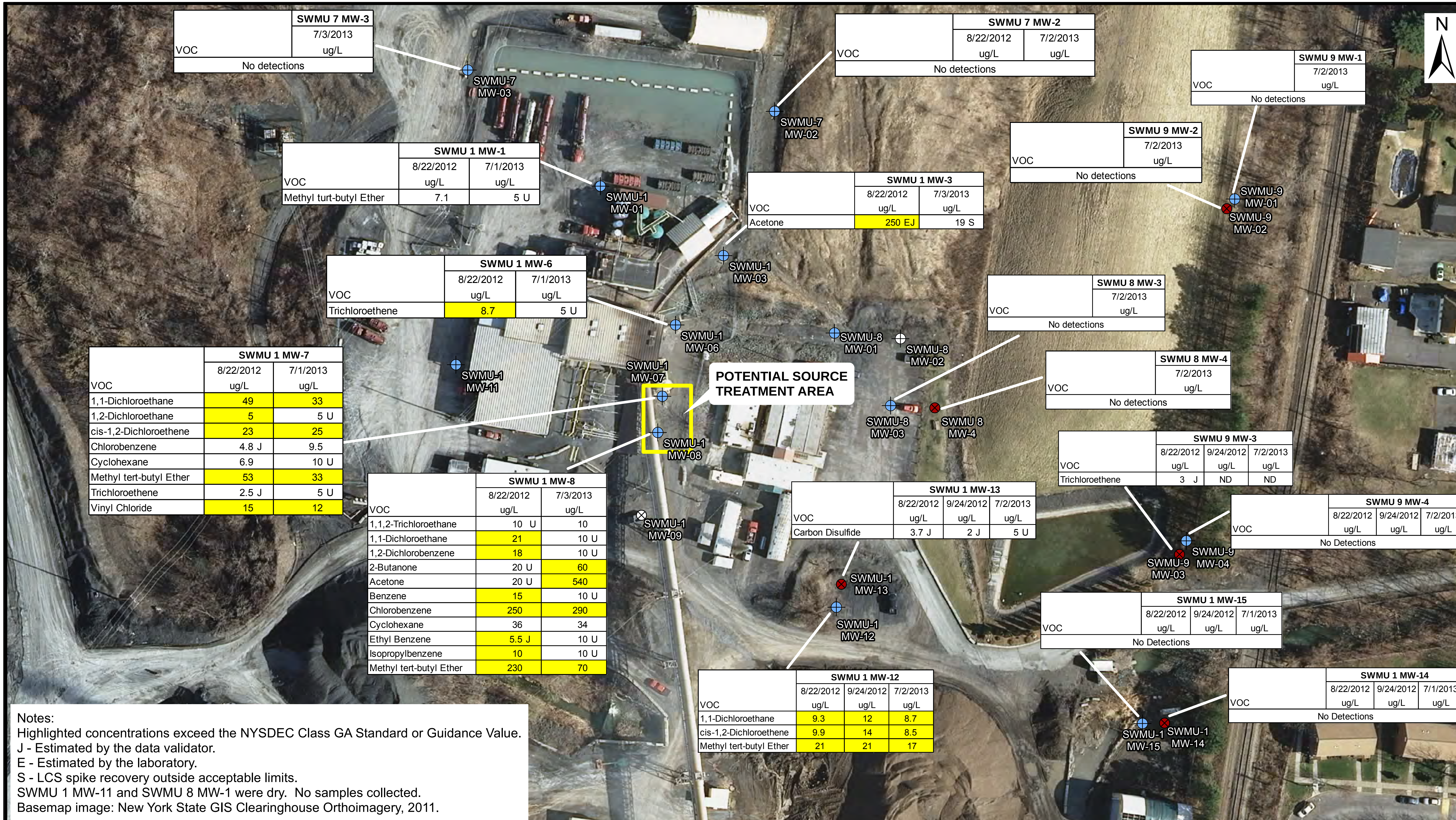

VOC	SWMU 7 MW-3 7/3/2013 ug/L
No detections	

VOC	SWMU 7 MW-2 8/22/2012 ug/L	7/2/2013 ug/L
No detections		

VOC	SWMU 9 MW-1 7/2/2013 ug/L
No detections	

VOC	SWMU 1 MW-1 8/22/2012 ug/L	7/1/2013 ug/L
Methyl turt-butyl Ether	7.1	5 U

VOC	SWMU 9 MW-2 7/2/2013 ug/L
No detections	

VOC	SWMU 1 MW-3 8/22/2012 ug/L	7/3/2013 ug/L
Acetone	250 EJ	19 S

VOC	SWMU 1 MW-6 8/22/2012 ug/L	7/1/2013 ug/L
Trichloroethene	8.7	5 U

VOC	SWMU 8 MW-3 7/2/2013 ug/L
No detections	

VOC	SWMU 1 MW-7 8/22/2012 ug/L	7/1/2013 ug/L
1,1-Dichloroethane	49	33
1,2-Dichloroethane	5	5 U
cis-1,2-Dichloroethene	23	25
Chlorobenzene	4.8 J	9.5
Cyclohexane	6.9	10 U
Methyl tert-butyl Ether	53	33
Trichloroethene	2.5 J	5 U
Vinyl Chloride	15	12

VOC	SWMU 8 MW-4 7/2/2013 ug/L
No detections	

VOC	SWMU 9 MW-3 8/22/2012 ug/L	9/24/2012 ug/L	7/2/2013 ug/L
Trichloroethene	3 J	ND	ND

VOC	SWMU 1 MW-8 8/22/2012 ug/L	7/3/2013 ug/L
1,1,2-Trichloroethane	10 U	10
1,1-Dichloroethane	21	10 U
1,2-Dichlorobenzene	18	10 U
2-Butanone	20 U	60
Acetone	20 U	540
Benzene	15	10 U
Chlorobenzene	250	290
Cyclohexane	36	34
Ethyl Benzene	5.5 J	10 U
Isopropylbenzene	10	10 U
Methyl tert-butyl Ether	230	70

VOC	SWMU 1 MW-13 8/22/2012 ug/L	9/24/2012 ug/L	7/2/2013 ug/L
Carbon Disulfide	3.7 J	2 J	5 U

VOC	SWMU 9 MW-4 8/22/2012 ug/L	9/24/2012 ug/L	7/2/2013 ug/L
No Detections			

VOC	SWMU 1 MW-15 8/22/2012 ug/L	9/24/2012 ug/L	7/1/2013 ug/L
No Detections			

VOC	SWMU 1 MW-12 8/22/2012 ug/L	9/24/2012 ug/L	7/2/2013 ug/L
1,1-Dichloroethane	9.3	12	8.7
cis-1,2-Dichloroethene	9.9	14	8.5
Methyl tert-butyl Ether	21	21	17

VOC	SWMU 1 MW-14 8/22/2012 ug/L	9/24/2012 ug/L	7/1/2013 ug/L
No Detections			

Notes:
Highlighted concentrations exceed the NYSDEC Class GA Standard or Guidance Value.
J - Estimated by the data validator.
E - Estimated by the laboratory.
S - LCS spike recovery outside acceptable limits.
SWMU 1 MW-11 and SWMU 8 MW-1 were dry. No samples collected.
Basemap image: New York State GIS Clearinghouse Orthoimagery, 2011.

Legend

Monitoring Well Bedrock Overburden Damaged Destroyed

Feet 0 40 80 160 240 320

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NORLITE CORPORATION
COHOES, NEW YORK

CORRECTIVE MEASURES STUDY

SUMMARY OF GROUNDWATER VOC DETECTIONS AND POTENTIAL SOURCE TREATMENT AREA SWMUs 1, 7, 8, 9

ARCADIS-US, INC

AUGUST 2013

FIGURE 5

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Appendix A

Correctives Measures Cost Estimates

Table A-1
Corrective Measures Cost Summary

Alternative 1
No Action (Site Management Plan)

OPINION OF PROBABLE COST

Site:	Norlite Facility
Location:	Cohoes, New York
Phase:	CMS (-30% to +50%)
Base Year:	2013
Date:	August 2013

Description: Alternative 1 consists of a site management plan.

CAPITAL COSTS:

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES:
Site Management Plan	1	lump sum	$25,000	$20,000	
SUBTOTAL				$20,000	
Project Management	15%			$3,000	
Remedial Oversight/Reporting	10%			$2,000	
TOTAL CAPITAL COST				**$25,000**	

OPERATION, MAINTENANCE, AND MONITORING (OM&M) COSTS

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES:
SUBTOTAL				$0	
TOTAL ANNUAL O&M COST				**$0**	

PRESENT VALUE ANALYSIS:

COST TYPE	YEAR	TOTAL COST	TOTAL COST PER YEAR	DISCOUNT FACTOR (5%)	PRESENT VALUE	NOTES:
Capital	1	$25,000	$25,000	1.00	$25,000	Capital + 1st Year O&M Costs
Annual OM&M	2-10	$0	$0	#DIV/0!	$0	
		$0			$25,000	
TOTAL PRESENT VALUE OF ALTERNATIVE					**$25,000**	

Table A-2
Corrective Measures Cost Summary

Alternative 2
Site Management Plan plus Monitored Natural Attenuation

OPINION OF PROBABLE COST

Site:	Norlite Facility
Location:	Cohoes, New York
Phase:	CMS (-30% to +50%)
Base Year:	2013
Date:	August 2013

Description: Alternative 2 consists of a site management plan and long-term groundwater monitoring using the existing well network to document the natural attenuation of contaminants over time. Capital costs are incurred in Year 1. O&M costs are incurred in Years 1-10.

CAPITAL COSTS:

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES:
Site Management Plan	1	lump sum	$25,000	$20,000	
SUBTOTAL				$20,000	
Project Management	15%			$3,000	
Remedial Oversight/Reporting	10%			$2,000	
TOTAL CAPITAL COST				**$25,000**	

OPERATION, MAINTENANCE, AND MONITORING (OM&M) COSTS

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES:
Site Monitoring					
Groundwater Sampling Labor	48	HR	$85	$4,080	Annual sampling - 17 wells
Groundwater Sample Analysis	18	EA	$100	$1,800	VOCs w/ 1 duplicate per event
Reporting	10	HR	$100	$1,000	
Sampling Equipment	1	LS	$1,500	$1,500	
Well Maintenance	1	LS	$500	$500	
SUBTOTAL				$8,880	
TOTAL ANNUAL O&M COST				**$8,880**	

PRESENT VALUE ANALYSIS:

COST TYPE	YEAR	TOTAL COST	TOTAL COST PER YEAR	DISCOUNT FACTOR (5%)	PRESENT VALUE	NOTES:
Capital	1	$33,880	$33,880	1.00	$33,880	Capital + 1st Year O&M Costs
Annual OM&M	2-10	$79,920	$8,880	7.11	$63,117	
		$79,920			$96,997	
TOTAL PRESENT VALUE OF ALTERNATIVE					**$97,000**	

Table A-3
Corrective Measures Cost Summary

Alternative 3
IN-SITU TREATMENT USING ISCO

OPINION OF PROBABLE COST

Site:	Norlite Facility
Location:	Cohoes, New York
Phase:	CMS (-30% to +50%)
Base Year:	2013
Date:	August 2013

Description: Alternative 3 consists of Alternative 1 (SMP and MNA), plus groundwater source area ISCO using sodium persulfate, followed by long-term monitoring. Capital costs are incurred in Year 1. O&M costs occur in Years 1-10.

CAPITAL COSTS:

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES:
Pilot Testing					
Pilot test work plan and permitting	1	LS	$7,500	$7,500	
Install injection and monitoring wells	6	EA	$500	$3,000	Geoprobe
Pilot Testing (includes labor and oxidant)	1	LS	$35,000	$30,000	
Baseline and Post-Injection Monitoring	2	LS	$5,000	$10,000	5 wells
Pilot test reporting	1	LS	$10,000	$7,500	
SUBTOTAL				$58,000	
Full-Scale ISCO Planning and Well Installation					
Remedial Design and Permitting	1	LS	$25,000	$25,000	
Injection Point Install	20	EA	$500	$10,000	Geoprobe
Persulfate	17,000	LB	$1.55	$26,350	
NAOH (25 wt. %0	3,000	GAL	$4.68	$14,040	
Injection Contractor	10	DAY	$3,000.00	$30,000	
Field oversight	200	HR	$85	$17,000	2 staff
Baseline and Post-Injection Monitoring	2	LS	$15,000	$30,000	20 wells
Reporting	1	LS	$10,000	$10,000	
SUBTOTAL				$162,390	
Contingency	10%			$16,239	
SUBTOTAL				$236,629	
Project Management	15%			$35,494	
TOTAL CAPITAL COST				**$272,123**	

OPERATION, MAINTENANCE, AND MONITORING (OM&M) COSTS

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES:
Site Monitoring					
Groundwater Sampling Labor	48	HR	$85	$4,080	Annual sampling - 17 wells
Groundwater Sample Analysis	18	EA	$100	$1,800	VOCs w/ 1 duplicate per event
Reporting	10	HR	$100	$1,000	
Sampling Equipment	1	LS	$1,500	$1,500	
Well Maintenance	1	LS	$500	$500	
SUBTOTAL				$8,880	
TOTAL ANNUAL O&M COST				**$8,880**	

PRESENT VALUE ANALYSIS:

COST TYPE	YEAR	TOTAL COST	TOTAL COST PER YEAR	DISCOUNT FACTOR (5%)	PRESENT VALUE	NOTES:
Capital	1	$281,003	$281,003	1.00	$281,003	Capital + 1st Year O&M Costs
Annual OM&M	2-10	$79,920	$8,880	7.11	$63,117	
.		$360,923			$344,121	
TOTAL PRESENT VALUE OF ALTERNATIVE					**$344,000**	

Table
Corrective Measures Cost Summary

Alternative 4
EXCAVATION OF FORMER LGF LINES WEST OF SWMU 1 MW-8

OPINION OF PROBABLE COST

Site: Norlite Facility
Location: Cohoes, New York
Phase: CMS (-30% to +50%)
Base Year: 2013
Date: October 2013

Description: Alternative 3a consists of Alternative 1 (SMP and MNA), plus removal of the buried former LGF feed lines west of monitoring well SMWU 8 MW-1. Capital costs are incurred in Year 1. O&M costs (long-term monitoring) occur in Years 1-10.

CAPITAL COSTS:

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES:
Site Management Plan	1	LS	$20,000	$20,000	
Mobilization/Demobilization	1	LS	$5,000	$5,000	
Construct and Remove Equipment Decontamination Pad	1	LS	$15,000	$15,000	
Construction and Maintenance of Material Staging Area	1	LS	$20,000	$20,000	
Vacuum Excavation in limited access areas	243	CY	$200	$48,600	
Select Fill Importation, Placement, and Compaction	243	CY	$35	$8,505	
Solid Waste Characterization	5	Each	$750	$3,750	
Solid Waste Transportation and LLTD	365	Ton	$120	$43,740	Assumes Haz. Disposal
Miscellaneous Waste Disposal	1	LS	$5,000	$5,000	
SUBTOTAL				$149,595	
Contingency for Overhead Fuel Line Temp. Support	2	Footer	$50,000	$100,000	
Contingency	15%			$22,439	Excavation stabilization
SUBTOTAL				$280,539	
Project Management	10%			$28,054	
Remedial Oversight/Reporting	10%			$28,054	
TOTAL CAPITAL COST				**$336,647**	

OPERATION, MAINTENANCE, AND MONITORING (OM&M) COSTS

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES:
Site Monitoring					
Groundwater Sampling Labor	48	HR	$85	$4,080	Annual sampling - 17 wells
Groundwater Sample Analysis	18	EA	$100	$1,800	VOCs w/ 1 duplicate per event
Reporting	10	HR	$100	$1,000	
Sampling Equipment	1	LS	$1,500	$1,500	
Well Maintenance	1	LS	$500	$500	
SUBTOTAL				$8,880	
TOTAL ANNUAL O&M COST				**$8,880**	

PRESENT VALUE ANALYSIS:

COST TYPE	YEAR	TOTAL COST	TOTAL COST PER YEAR	DISCOUNT FACTOR (5%)	PRESENT VALUE	NOTES:
Capital	1	$345,527	$345,527	1.00	$345,527	Capital + 1st Year O&M Costs
Annual OM&M	2-10	$79,920	$8,880	7.11	$63,117	
.		$425,447			$408,645	
TOTAL PRESENT VALUE OF ALTERNATIVE					**$409,000**	