FEASIBILITY STUDY REPORT

Ash Road Properties – Off-Site
Town of Vestal, Broome County, New York
Site No. C704032A

Prepared for:

NEW YORK STATE | Department of Environmental Conservation

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CERTIFICATION STATEMENT

ASH ROAD PROPERTIES – OFF-SITE
FEASIBILITY STUDY REPORT
VESTAL, NEW YORK

I, Matthew Crance, certify that I am currently a New York State registered engineer and that this Feasibility Study 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 modification.

9/10/2026

Date

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LIST OF ACRONYMS

ACRONYM	Definition
°F	degrees Fahrenheit
µg/L	micrograms per liter
AFCEE	Air Force Center for Environmental Excellence
ARP	Ash Road Properties
AS/SVE	Air Sparging/Soil Vapor Extraction
bvcA	Vinyl Chloride Reductase
CAH	chlorinated aliphatic hydrocarbon
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cis-1,2-DCE	cis-1,2-dichloroethene
COC	contaminant of concern
CVOC	Chlorinated Volatile Organic Compound
DAR	Division of Air Resources
DHc	Dehalococcoides spp.
DO	dissolved oxygen
EISB	Enhanced In Situ Bioremediation
ERH	Electrical Resistance Heating
EVO	Emulsified Vegetable Oil
FS	Feasibility Study
ft bgs	feet below ground surface
g/kg	grams per kilogram
GWQS	groundwater quality standards
HRC	hydrogen release compound
IRM	Interim Remedial Measure
ISCO	In Situ Chemical Oxidation
LF	Linear Feet
mg/L	milligrams per liter
MNA	monitored natural attenuation
mS/cm	millisiemens per centimeter
mw	monitoring well
NYCRR	New York Codes, Rules, and Regulations
NYSDEC	New York State Department of Environmental Conservation
ORP	oxidation-reduction potential
OSHA	Occupational Safety and Health Administration
PCE	tetrachloroethene
PFOA	perfluorooctanoic acid
PNOD	Permanganate Natural Oxidant Demand
PRAP	Proposed Remedial Action Plan
RAO	Remedial Action Objective
RI	Remedial Investigation
ROI	radius of influence
S.U.	standard units
SCG	standards, criteria, and guidance
SCO	soil cleanup objectives

SF	square feet
SMP	Site Management Plan
SVE	soil vapor extraction
TCE	trichloroethene
tceA	Trichloroethene Reductase
TOGS	Technical and Operational Guidance Series (1.1.1)
trans-1,2-DCE	trans-1,2-dichloroethene
ug/L	micrograms per liter
USDOE	United States Department of Energy
USEPA	U.S. Environmental Protection Agency
VC	vinyl chloride
vcrA	Vinyl Chloride Reductase
VOC	volatile organic compound

1.0 INTRODUCTION

1.1 Background

This Feasibility Study (FS) Report documents the evaluation of remedial alternatives to address risks identified during the Remedial Investigation (RI, Parsons 2020) and the April 2025 groundwater sampling event for the off-site property west of the Ash Road Properties (ARP) located at 221 Sycamore Street, Vestal, Broome County, New York (**Figure 1**).

The purpose of the FS is to identify and screen potentially applicable technologies to address contamination found at the Site, to develop and compare remedial alternatives capable of remediating site contamination to New York State Standards, and to recommend an alternative for design and implementation. This FS Report has been prepared in accordance with Title 6 of the New York Codes, Rules, and Regulations for Environmental Remediation Programs (6 NYCRR) Part 375), and DER-10, *Technical Guidance for Site Investigation and Remediation* (NYSDEC 2010). This report is organized into six sections as follows:

- **Section 1** summarizes site information including a brief site description; physical and ecological characteristics; and nature and extent of impacts including key findings of the RI that pertain to the FS and results from the April 2025 groundwater sampling event.
- **Section 2** identifies regulatory and other applicable requirements; media and contaminants of concern; proposed remedial action objectives; preliminary remedial goals; and affected areas and volumes.
- **Section 3** identifies and screens potential remedial technologies that address the affected media off-site.
- **Section 4** presents and evaluates remedial alternatives in accordance with evaluation criteria that apply to the off-site area.
- **Section 5** summarizes the alternative recommended for the off-site area.
- **Section 6** lists the references cited in this document.

Following this FS, New York State Department of Environmental Conservation (NYSDEC) will prepare a Proposed Remedial Action Plan (PRAP) for the ARP off-site area that will present the agency's recommended remedy and the basis for its selection. Following a public comment period for the PRAP, NYSDEC will issue a Record of Decision that will specify the remedy to be designed and implemented.

1.2 Site Description

The ARP site is in a commercial area and has been divided into an on-site area and an off-site area. The on-site area (source area) occupies approximately 1.56 acres of the current Lowe's Home Center property located at 225 Sycamore Street, Vestal, New York. Two businesses formerly occupied the ARP on-site area as shown on **Figure 2**. Town Square Body Shop performed auto-body repairs and automotive painting, washing, and waxing while the Hall Plumbing building was occupied by a contractor's office and warehouse. The ARP on-site area is presently perimeter parking for the Lowe's Home Center store.

The ARP off-site area, and the focus of this FS, largely consists of a portion of the Town Square Mall area located at 2505 Vestal Parkway East, Vestal, New York. This property is west of the ARP on-site area near the intersection of Ash Road and Sycamore Street. A portion of the off-site area includes some asphalt parking spaces east of Sycamore Street on the Lowe's Home Center property and the remainder of the off-site area includes asphalt parking spaces west of Sycamore Street. Intermittent grass areas are located along the parking lot perimeter.

An interim remedial measure (IRM) was completed on-site between September and November 2011 to remove the source area, thus reducing continued receptor exposure to contaminants of concern (COC) in the subsurface. Source removal was achieved via soil excavation (GeoLogic NY 2013). Additionally, in June 2015, 850 pounds of a biostimulant, Carus CAP 18®, an unemulsified oil that provides an auxiliary substrate (carbon source) was injected to accelerate the ongoing biodegradation of the primary COC, tetrachloroethene (PCE). Injections occurred largely within the 2011 IRM excavation area and surrounded monitoring well MW-09S (GeoLogic NY 2015b). The ARP on-site area was issued a certificate of completion in December of the same year (NYSDEC 2015). Groundwater monitoring requirements under the Site Management Plan for the source area, in concurrence with NYSDEC, were terminated in 2022 (GeoLogic NY 2025). Groundwater sampling activities associated with the on-site wells were discontinued based on a determination that the post-remediation groundwater sampling requirements outlined in the Site Management Plan were completed/fulfilled (NYSDEC 2025a).

Analysis of the ARP on-site information led NYSDEC to establish an off-site project area to investigate the nature and extent of contamination that migrated from the on-site area. Remedial Investigation activities of the ARP off-site area were completed between 2015 and 2019 (Parsons 2020). At the request of NYSDEC, an additional groundwater sampling event was completed in April 2025. The nature and extent of impacts identified from these sampling events are described in **Section 1.5**.

1.3 Site Characteristics

Ground surface at the site is mostly covered by asphalt pavement and buildings. Local land surface topography is relatively flat. The nearest surface water body is the Susquehanna River, which is located approximately 1,946 feet to the north of the ARP off-site area. The Susquehanna River flows to the south where it eventually empties into the Chesapeake Bay.

1.3.1 Climate

The climate in the Vestal area is “humid continental climate“ according the Köppen climate classification system. Winters are cold with an average January temperature between 15- and 29-degrees Fahrenheit (ºF) and an average snowfall of 21 inches. The weather limits the construction season to April through November in most years. Precipitation is relatively evenly distributed throughout the year, ranging on average from 2.41 inches in February to 4.69 inches in June (U.S. Climate Data 2025).

1.3.2 Land Use

The ARP off-site area includes portions of properties owned by Vestal Home Improvements/Arctrust (Lowe's), Sam’s Real Estate Business (Sam's Club), and Vestal Town Square LLC (Brixmor). The ARP off-site area is primarily located west of Sycamore Street and is bordered to the south by a parking lot access road and two commercial retail stores (Barnes & Noble and Harbor Freight Tools). Various commercial retail stores border the off-site area to the north and west.

A significantly smaller portion of the ARP off-site area is located east of Sycamore Street in a portion of the Lowe’s Home Center parking lot. South of this area is a restaurant, an automotive supply business, and an automotive rental and repair business. A parking area for the Lowe’s Home Center borders the area to the north. Residential properties border the ARP on-site area to the east.

1.3.3 Geology and Soils

Based on the RI and previous investigations at and in the vicinity of the ARP off-site area, the subsurface consists of two primary units: fill material and natural material. The subsurface at the ARP off-site area can be characterized from top to bottom as detailed below. **Figures 3 and 4** show a plan view and a cross section from soil borings completed at the Site during previous investigations.

- Fill Material - Fill material consisting primarily of fine to coarse sand with fine to coarse gravel, some silt, cobbles, geotextile fabric, and other miscellaneous debris. Fill materials range in thickness from approximately 6 to 9 feet below ground surface (ft bgs).
- Natural Material - Natural material consisting primarily of fine to medium sand to silt with fine to coarse gravel, some clay and peat, clayey silt to silty clay with fine to course gravel (glacial till), and fine to course gravel with fine sand. Natural material ranges in thickness from approximately 9 to 45 ft bgs.

No true confining layer has been observed at the ARP site; however, two low permeability layers were identified and are shown on **Figure 4**. The first layer, a clayey silt with fine to medium gravel, was observed in soil borings MW-04 (approximately 8.5 ft bgs), MW-09D (approximately 8 ft bgs), and MW-02S (approximately 4 ft bgs) on the eastern side of Sycamore Street. Observation of the same low permeability layer on the west side of Sycamore Street in PMW-21D (approximately 32 ft bgs) and PMW-22D (approximately 34 ft bgs) suggests this layer dips toward the west beneath Sycamore Street. The second deeper, low permeability layer, a silty clay with fine to medium gravel, was also observed in each of these wells at shallower depths in MW-04, MW-09D and MW-02D compared to PMW-22D. This second low permeability layer also dips toward the west beneath Sycamore St. As described in **Section 1.5**, impacted soils have been observed within the saturated zone at PMW-21D and PMW-22D as well as high levels of CVOCs in groundwater. Since deep wells on the west side of Sycamore Street are limited to PMW-21D and PMW-22D, the deep groundwater plume is not completely bound in the deep aquifer wells above the first confining layer; however, it is assumed remediation will be needed at depth throughout the impacted area

1.3.4 Groundwater

Five rounds of synoptic groundwater level measurements have been completed to date in the off-site wells:

- September 2015
- November 2015
- October 2018
- October 2019
- April 2025

The average depth to groundwater ranged between 2.99 ft bgs in MW-07 (east of Sycamore Street and south of the ARP on-site area) and 11.36 ft bgs in PMW-14 (east of Sycamore Street and north of the ARP on-site area). For each of the five monitoring events, groundwater flow was northerly on the ARP site east of Sycamore Street, changing to a west-northwest flow direction near Sycamore Street (west of the ARP site). A south-to-southwest groundwater flow direction was observed along the northern portion of the ARP off-site area. Variation in groundwater flow directions can be attributed to various subsurface utilities (e.g., pumping station, deep subsurface utilities) and to a former creek channel that was filled in during development of the current area. A potentiometric surface map using the April 2025 data is included on **Figure 5**.

1.4 Sources of Chemical Parameters of Interest

The chlorinated volatile organic compounds (CVOCs) detected at the ARP off-site area, primarily PCE, trichloroethene (TCE), cis-1,2-dichloroethene (cis-1,2-DCE) and vinyl chloride (VC) were attributed in the RI to disposals that occurred at the ARP on-site and migrated in groundwater to the west. Migration of contamination is primarily the result of drainage associated with the east to west oriented former creek/drainage channel with a small contribution of influence from subsurface utilities.

1.5 Nature and Extent of Site Impacts

1.5.1 Subsurface Soil

Soil samples collected during the RI were limited to deep borings PMW-21D and PMW-22D located in the eastern ARP off-site area (Parsons 2020). The concentrations of VC, cis-1,2-DCE, TCE and PCE in one or more samples exceeded the unrestricted land use soil cleanup objectives (SCOs) at these two locations. The samples with exceedances were within the saturated zone, suggesting the groundwater plume from the ARP on-site area migrated and impacted these soils. Samples collected within the vadose zone did not exceed the unrestricted land use SCOs. The subsurface soil impacts are approximately 17 ft bgs or greater.

Groundwater samples collected from adjacent monitoring well locations (PMW-2, MW-01, and MW-09S) detected high levels of these CVOCs suggesting additional evidence the groundwater plume from the ARP on-site has impacted soils within the saturated zone off-site. No deeper soil samples were collected during investigations from other subsurface locations; however, it is generally understood that subsurface soil in contact with contaminated groundwater is also impacted.

1.5.2 Groundwater

This section summarizes results from previous sampling events including concentrations of COCs in groundwater, geochemistry (water quality) parameters, monitored natural attenuation parameters, gene-trac testing results, and impacted footprint as represented by isopleths.

1.5.2.1 COC in Groundwater

Concentrations of PCE, TCE, cis-1,2-DCE, trans-1,2-dichloroethene (trans-1,2-DCE) and VC in one or more samples from off-site monitoring wells exceeded 6 NYCRR Part 703 or NYSDEC *Technical and Operational Guidance Series* (TOGS) 1.1.1 Class GA groundwater criteria as reported previously (EA Engineering 2009; GeoLogic NY 2013; and Parsons 2020) and based on Parsons' April 2025 groundwater sampling event (data not reported previously). The concentration of chlorobenzene, benzene, perfluorooctanoic acid (PFOA) and manganese also exceeded the Class GA standard, but these are not considered COC for the off-site area. The CVOC concentrations exceeding the Class GA standards for the off-site area are shown on **Figure 6**.

As described in **Section 1.2**, injections involving a biostimulant were completed in the on-site area in the vicinity of MW-09S in June 2015. Concentrations shown for select monitoring wells on June 1, 2015 were sampled prior to the injection event. More frequent monitoring in the on-site wells has been completed as part of groundwater monitoring requirements under the Site Management Plan for the on-site area (GeoLogic NY 2015a). Data was added to **Figure 6** to show concentration changes over time in several on-site wells (MW-01, MW-02S, MW-09s,

and MW-10, GeoLogic NY 2021) and to provide additional data points to correspond with Parsons monitoring events (September 2015, November 2015, October 2018, August 2019, and April 2025).

Except for PMW-21D and PMW-22D, all wells are screened between 4 ft and 28 ft bgs. Monitoring wells PMW-21D and PMW-22D were screened between 32 ft and 42 ft bgs, respectively. Two wells, MW-2D and MW-9D, were previously installed adjacent to MW-2S and MW-9S but have since been decommissioned. These wells would have been in a hydraulically upgradient position to PMW-21D and PMW-22D. The most recent groundwater samples collected from these upgradient wells (July 2013) indicated PCE, TCE, cis-1,2-DCE, trans-1,2-DCE and VC were non-detect (GeoLogic NY 2013).

1.5.2.2 Geochemistry Measurements

Geochemistry (water quality) measurements including pH, oxidation-reduction potential (ORP), specific conductivity, dissolved oxygen (DO), and temperature are routinely collected during low flow purging prior to groundwater sampling. Stabilized water quality measurements recorded during Parsons 2018, 2019, and 2025 groundwater sampling events are presented in **Table 1**. Additional select measurements were added for wells on the east side of Sycamore Street (MW-01, MW-02S, MS-09S, and MW-10) collected as part of the Site Management Plan for the dates corresponding to groundwater sample dates shown on **Figure 6** (for full data set, see GeoLogic NY 2021). Additionally, geochemistry measurements were included for June 2015 to show the pre-injection conditions since. It should be noted, the range in depth to water measurements in **Table 1** are based on readings taken at the time of groundwater sampling and differ slightly from the values reported in **Section 1.3.4**, which are based on synoptic events that didn't always coincide with groundwater sampling.

- The pH readings ranged between 5.75 standard units (S.U.) (MW-01) and 8.69 S.U. (PMW-19). A pH below 6 S.U. inhibits sulfate reducing, methanogenic, and dechlorinating bacteria, making biological degradation mechanisms less effective (Air Force Center for Environmental Excellence [AFCEE] 2007). Biological processes are pH sensitive, and the ideal range of pH for degrading bacteria is 6 to 8 S.U. Biological activity is less likely to occur outside a range of 5 to 9 S.U. The pH range for the Ash Road off-site area is amenable to biological processes.
- At most wells (46 of 83) ORP readings were negative, indicating a reducing environment. Negative ORP readings ranged between -6.0 mV (PMW-21D) and -493.0 mV (PMW-22D). Positive ORP readings, indicating an oxidizing environment, occurred in 37 out of 83 readings and ranged between 0.0 mV (PMW-20) and 309.0 mV (PMW-02). Except for MW-2S and PMW-21D, wells with positive ORP readings contained low-level detections to no detections for CVOCs. ORP less than -200 mV indicates a strongly anerobic environment. Only one ORP reading was measured less than this threshold, -493 mV at PMW-22D, in October 2018, just over 3 years post on-site injections (which were hydraulically upgradient). Biodegradation of CVOCs is mostly known to happen under anaerobic conditions.
- Specific conductivity values ranged between 0.000 millisiemens per centimeter (mS/cm) (PMW-20) and 18.070 mS/cm (MW-09S). Specific conductivity is a general water parameter that indirectly measures the concentration of dissolved solids in water by measuring its ability to conduct an electrical current.
- Dissolved oxygen ranged between 0.00 milligrams per liter (mg/L) (multiple wells) and 10.72 mg/L (PMW-07). Dissolved oxygen readings of zero occurred in 31 out of 83 readings. Generally, anerobic bacteria are unable to thrive at dissolved oxygen concentrations greater than 0.5 mg/L, and reductive dechlorination is therefore unable to take place (U.S. Environmental Protection Agency (USEPA 1998). Dissolved oxygen concentrations less than 0.5 mg/L were measured in 52 out of 83 readings. Given the mixture of anaerobic and aerobic conditions, it appears that the groundwater is conducive to some anaerobic dechlorination, but the capacity is limited. Specifically, in MW-02S.
- Temperature values ranged between 8.48°C (MW-05) and 25.87°C (PMW-07).

1.5.2.3 Monitored Natural Attenuation (MNA)

Monitored Natural Attenuation (MNA) data is often used to evaluate how and where biodegradation may be occurring. Typically, in an uncontaminated aquifer, native organic carbon is used as the electron donor, and dissolved oxygen is the electron acceptor. Once the dissolved oxygen is consumed, anaerobic microorganisms will use alternate electron acceptors in the following order of preference, if available: nitrate, ferric iron oxyhydroxide, sulfate, and finally carbon dioxide (USEPA 1998). When PCE, TCE, and their daughter products are present, these compounds can also act as an electron acceptor. Collecting data to evaluate the distribution of electron donors at a site may help to understand how/if biodegradation is occurring. MNA will be a secondary component to any active remediation and will be useful to monitor conditions throughout the chlorinated plume.

During Parsons 2025 groundwater sampling event, MNA samples were collected from one upgradient well located outside the impacted area (MW-05), from the source area well (MW-09S), wells located downgradient of the former source area and within the limits of impact (PMW-02, PMW-05, PMW-08, PMW-09 and PMW-21D), and from one well downgradient from the source area but outside the limits of impact (PMW-12). A general summary of the natural parameters is presented below, and the complete analytical data set is included in a letter transmittal from Parsons to NYSDEC on August 18, 2025.

- Alkalinity ranged from 160 mg/L (PMW-21D) to 920 mg/L (PMW-12) and was higher in wells located outside the plume. Alkalinity could be an indicator of biodegradation and the buffering capacity of the aquifer (neutralization of weak acids).
- Chemical oxidation demand results ranged from 25 mg/L (PMW-08) to 110 mg/L (MW-05 and MW-09S). With the exception of MW-09S, chemical oxygen demand results were lower in wells located inside the plume, generally decreasing with increasing distance from the source area (MW-09S).
- Total ferrous iron ranged from non-detect (PMW-02) to 140 mg/L (MW-05), with lower concentrations inside the plume. Ferric iron is an alternate electron acceptor for microbial respiration in the absence of oxygen and nitrate. Reduction of ferric iron produces ferrous iron. Elevated levels of ferrous iron indicate that the groundwater environment is sufficiently reducing to sustain iron reduction and for anaerobic dechlorination to occur. The presence of ferrous iron greater than 1,000 ug/L is considered favorable for reducing conditions.
- Nitrate levels were non-detect at all locations except PMW-02 where nitrate was detected at 1.3 mg/L. Typically, nitrate concentrations in the contaminated portion of the aquifer need to be less than 1.0 mg/L for reductive dechlorination to occur (USEPA 1998).
- Manganese ranged from 0.653 mg/L (PMW-08) to 21 mg/L (MW-09S). Pre-injection concentrations in MW-09S in June 2015 were 10.4 mg/L (GeoLogic 2015b). The highest concentrations from April 2025 were generally correlated with the most impacted areas.
- Sulfate levels ranged from non-detect outside the plume (MW-05 and PMW-12) to 80 mg/L in the source area (MW-09S), much higher than the June 2015 pre-injection concentrations (43.7 mg/L, GeoLogic 2015b). Sulfate concentrations greater than 20 mg/L may cause competitive exclusion of dechlorination (USEPA 1998) and may support increased concentrations of cis-1,2-DCE in this area. However, sulfate concentrations less than 500 mg/L are suitable for enhanced bioremediation (Parsons 2004).
- Ethene results were below detection limits at all locations except MW-09S (0.4 mg/L). Ethane results ranged from non-detect to 0.63 mg/L (MW-09S). Ethene is the final product involved in the dechlorination of PCE/TCE. For chlorinated aliphatic hydrocarbons (CAHs), elevated levels of ethene and ethane (at least an order of magnitude greater than background levels) can be used to infer anaerobic dechlorination of CAHs. Note that ethane and ethene can be subject to rapid biodegradation, so their absence in a sample does not necessarily mean that biodegradation is not occurring.

- Chloride ranged between 99 mg/L (PMW-02) and 1,500 mg/L (MW-05), with mixed concentrations inside the plume. Chloride in MW-09s was detected at 1,400 mg/L in April 2025 compared to a pre-injection concentration of 942 mg/L in June 2015 (GeoLogic 2015b). Chloride is produced by anaerobic dechlorination of PCE/TCE. Elevated levels of chloride can indicate that dechlorination is occurring if observed concentrations are greater than three times background and consistent with PCE/TCE molar concentrations.
- Concentrations of total organic carbon range from 4.3 mg/L (PMW-02) to 107 mg/L (PMW-12). A total organic carbon concentration of less than 20 mg/L is recommended for biodegradation (Parsons 2004). This was generally observed at all wells within the impacted area except at MW-09S where Total organic carbon was detected at 21.5 mg/L; a location where concentrations of CVOCs are increasing.

There is some evidence for anaerobic biodegradation (reductive chlorination) at the Site based on MNA analytical parameters and geochemistry measurements (Section 1.5.2). This is further supported by lower concentrations of PCE and TCE in the source area well (MW-09S) with higher concentrations of the degradation products cis-1-2-DCE and vinyl chloride. Concentrations immediately downgradient of the source area in MW-02S have observed increases for all CVOCs and may be related to depletion of the former biostimulant injected in June 2015. Evidence of reductive dechlorination is further observed since there are no detections of PCE downgradient of PMW-05, rather detections are limited to TCE, cis-1,2-DCE, and trans-1,2-DCE.

1.5.2.4 Gene-Trac Testing

During Parsons April 2025 groundwater sampling event, Gene-Trac® test samples were collected from PMW-02, PMW-09, and PMW-21D to evaluate the influence of biological processes that may influence biodegradation of the CVOCs into harmless byproducts (ethene and ethane). The samples were analyzed for Dehalococcoides spp. (DHc), Trichloroethene Reductase (tceA), Dehalococcoides BAV1 Vinyl Chloride Reductase A (bvcA), and Dehalococcoides Vinyl Chloride Reductase A (vcrA). A general summary of the natural parameters is presented below, and the complete analytical data set is included in a letter transmittal from Parsons to NYSDEC on August 18, 2025.

Measurement of DHc is important because it contains the most reductive dehalogenase genes of any microbial group and is capable of reductive dechlorination of PCE, TCE, cis-1,2-DCE, trans-1,2-DCE, and vinyl chloride (Taş et al 2010, as cited in SIREM, n.d.). A DHc density of greater than 1×10^7 cells per liter of groundwater indicates there may be significant dechlorination rates present, whereas densities less than 1×10^4 indicates low concentrations of DHc and suggest site conditions are sub-optimal for high rates of dechlorination unless conditions are optimized (Lu et al 2006). Results from the 2025 sampling event show an insufficient quantity of DHc to support MNA or high rates of dechlorination without modifications to the subsurface based on non-detect results for DHc in all three wells. The absence of DHc indicates a lack of dechlorination or only partial reductive dechlorination to ethenes and is commonly associated with an increase in cis-1,2-DCE (primarily seen in MW-09S).

Data from the additional functional gene assay tests are used to assess the breakdown potential for TCE to vinyl chloride (tceA) and cis-1,2-DCE to vinyl chloride and to ethene (bvcA, and vcrA). Generally, the potential for accumulation of vinyl chloride is increased where vcrA/bvcA results are non-detect, or significantly lower than either DHc or tceA. When there is a sufficient quantity of vcrA and bvcA and they are similar to total DHc, the potential for vinyl chloride accumulation is reduced (SIREM n.d.). Results from the 2025 sampling event show insufficient quantity of bvcA, vcrA, and tceA to breakdown CVOCs to vinyl chloride and ultimately ethene as the results were non-detect for all three wells. As such, complete dechlorination is unlikely, the potential for increased concentrations of vinyl chloride is likely, and the impacted area may require bioaugmentation. An increase in vinyl chloride concentrations was observed in both the source area (MW-09S) and immediately downgradient (MW-02S).

1.5.2.5 COC Isopleths

Isopleths were developed for each COC (PCE, TCE, cis-1,2-DCE, and VC) showing concentrations above NYSDEC TOGS 1.1.1 (see **Figures 7** through **10)**. Isopleth quantiles were established by setting the lowest quantile range between non-detect and the NYSDEC TOGS 1.1.1 groundwater standard for each compound. The subsequent quantiles were generally set to show an order of magnitude change in concentration. Isopleths were drawn using the most recent groundwater sampling data (April 2025). For PMW-2 (shallow) and PMW-22D (deep), the well with the higher CVOC concentration was used in the isopleth.

As concluded in the RI Report (Parsons 2020) the groundwater contaminant plume consists of dissolved phase contamination with contaminants uniformly distributed vertically within the saturated zone. The saturated zone has a thickness of approximately 34 feet west of Sycamore Street and approximately 23 feet east of Sycamore Street based on the depth to the silty clay layer with fine to medium gravel at PMW-22D and MW-2D, respectively. Since the plume is not completely bound in the deep aquifer wells down gradient of PMW-22D, it is assumed remediation is needed at depth. The areal extent of each isopleth is based on interpretation of geology and hydrogeologic conditions observed in each well. The general areal extent of each COC is described below. Additional details regarding remediation areas, volumes and COC mass is included in **Section 2.5.**

1.5.2.6 PCE

The extent of PCE in groundwater has been defined by non-detects as shown on **Figure 7** (EA Engineering 2009; GeoLogic NY 2013; and Parsons 2020). PCE detections above the Class GA standards (5 micrograms per liter [µg/L]) were limited to shallow wells MW-01 and MW-02S (immediately east of Sycamore Street), PMW-2 and PMW-5 (west of Sycamore Street) and deeper wells PMW-21D and PMW-22D (west of Sycamore Street). The highest PCE concentration was observed in MW-02S where it increased from 52.4 µg/L in April 2021 (GeoLogic NY 2021), to 9,600 µg/L in April 2025. Similar increases were observed for TCE, cis-1,2-DCE, and VC at this monitoring well. Back diffusion from silts/clays and/or depletion of the previous injectate are likely associated with the PCE increase. Prior to the April 2025 groundwater sampling event, concentrations of PCE in the former source area (MW-09S, a shallow well east of Sycamore Street) were below Class GA standards since February 2019 (GeoLogic NY 2021).

1.5.2.7 TCE

The extent of TCE in groundwater has been defined by non-detects as shown on **Figure 8** (EA Engineering 2009; GeoLogic NY 2013; and Parsons 2020). TCE detections above the Class GA standards (5 µg/L) extends further downgradient (PMW-8) than PCE detections with a slightly larger footprint overall. The highest concentration of TCE detected was at MW-02S (3,500 µg/L) during the April 2025 event compared to 18.3 µg/L during the preceding April 2021 event. Back diffusion from silts/clays and/or depletion of the previous injectate are likely associated with the TCE increase. Unlike PCE, TCE was detected in the former source area at 81 µg/L in MW-09S.

1.5.2.8 cis-1,2-DCE

The extent of cis-1,2-DCE in groundwater has been defined by non-detects as shown on **Figure 9** (EA Engineering 2009; GeoLogic NY 2013; and Parsons 2020). Detections of cis-1,2-DCE above Class GA standards (5 µg/L) represent the COC with the largest footprint as shown by the isopleth for this compound. The areal extent of cis-1,2-DCE is similar to TCE; however, exceedances above Class GA standards were observed in PMW-9 (620 µg/L). The highest concentrations of cis-1,2-DCE detected in April 2025 were at MW-02S (2,600 µg/L) and MW-09S (2,500 µg/L) compared to 20.1 µg/L and 36.2 µg/L in April 2021 (GeoLogic NY 2021), respectively. The natural

degradation pathway for PCE appears to have stalled at cis-1,2-DCE resulting in increased concentrations on the east side of Sycamore Street.

1.5.2.9 trans-1,2-DCE

The extent of trans-1,2-DCE in groundwater has been defined and was only detected in two ARP off-site area wells during the April 2025 event: MW-09S (28 µg/L), east of Sycamore Street and PMW-09 (5.4 µg/L) at the western end of the plume just above Class GA standards (5 µg/L). Wells that define the previous parameter plumes also defined the trans-1,2-DCE plume. An isopleth was not prepared for this COC due to the limited number of exceedances and the impacts are co-located with areas impacted by other COCs.

1.5.2.10 VC

The extent of VC in groundwater has been defined by non-detects as shown on **Figure 10** (EA Engineering 2009; GeoLogic NY 2013; and Parsons 2020). VC detections above Class GA standards (2 µg/L) represent the smallest area of impact with exceedances in two wells only. The highest concentration was detected during the April 2025 event in MW-09S at 2,300 µg/L compared to 132 µg/L during the April 2021 event (GeoLogic NY 2021). VC was also detected above Class GA standards in MW-02S at 130 J µg/L in April 2025 but was below Class GA standards during the preceding April 2021 event. The natural degradation pathway for PCE/TCE appears to have stalled at cis-1,2-DCE resulting in increased concentrations on the east side of Sycamore Street.

1.5.2.11 Summary

The isopleths for the ARP off-site wells show the highest concentration for PCE, TCE, and cis-1,2-DCE are located at MW-02S (east of Sycamore Street), and for VC at MW-09S (east of Sycamore Street). The higher concentrations for PCE and TCE during the April 2025 event are likely associated with back diffusion from silts/clays and/or depletion of the previous injectate. Increased concentrations of cis-1,2-DCE and VC are likely associated with a stall in the natural degradation of the parent compound, PCE and is supported by the absence of DHc, vcrA, bvcA, and tceA). The edge of the plume is defined by non-detects (EA Engineering 2009; GeoLogic NY 2013; and Parsons 2020). The plume does not appear to be migrating and based on the detection of intermediate compounds (cis-1,2-DCE and VC), natural attenuation is occurring but may be stalling.

1.5.3 Soil Vapor

During the RI, CVOCs were detected in seven of ten soil vapor monitoring points (PSVMP-1, 3, 4, 7R, 8, 9, and 10 [Parsons 2020]). The presence of PCE, cis-1,2-DCE, TCE, VC, and 1,1-DCE in soil vapor samples is consistent with the groundwater COCs and is likely attributable to the groundwater plume. Additional evidence of soil vapor association with the groundwater plume is that the soil vapor results from points located adjacent to the groundwater plume boundaries indicated CVOCs only at low concentrations or not detected. As such, remedial alternatives for soil vapor were not evaluated in **Section 3** of this FS Report.

1.5.4 Storm Drains

Samples collected from the storm drains located on the ARP off-site area were analyzed for VOCs in October 2018 to determine if subsurface utilities in contact with groundwater were acting as a drain and conduit for contaminated groundwater. One VOC (methyl isobutyl ketone) was detected at one of the five storm drains sampled. This compound can be associated with automobile exhaust and is not a contaminant of concern for this site. Based on analytical results it can be concluded that impacted groundwater is not flowing within the storm drain utilities (Parsons 2020).

2.0 IDENTIFICATION OF REMEDIAL ACTION OBJECTIVES

2.1 Introduction

This section identifies remedial action objectives (RAOs) used to evaluate remedial action alternatives and select an appropriate remedy for the ARP off-site area.

The development of RAOs requires the identification of standards, criteria, and guidance (SCGs), consisting of applicable and promulgated federal and state statutes and regulations for the applicable media. Applicable media of concern, COC, and exposure pathways must also be identified and evaluated to form RAOs.

2.2 SCGs

"Standards and criteria" are cleanup standards and other substantive environmental requirements, criteria, or limitations promulgated under federal or state law that specifically address a hazardous substance, contaminant, remedial action, location, or other considerations.

"Guidelines" are non-promulgated criteria, advisories, and/or guidance that are not legal requirements and do not have the same status as standards and criteria; however, remedial alternatives should consider guidance documents that may be applicable to the project.

The establishment of SCGs during the FS provides a benchmark against which remedial alternatives developed can be measured and compared.

The SCGs for groundwater were obtained from 6 NYCRR 703 *Surface Water and Groundwater Quality Standards and Groundwater Effluent Limitations*, and NYSDEC TOGS 1.1.1, *Ambient Water Quality Standards and Guidance Values*, dated June 1998. Groundwater analytical results for the ARP off-site area are compared to the Class GA groundwater standards and guidance values. These standards and guidance values would be applicable for the execution of any remedial action taken at the ARP off-site area.

Any remedial program developed for implementation at the ARP off-site area will be in accordance with 6 NYCRR Part 375 and DER-10 *Technical Guidance for Site Investigation and Remediation*, and in accordance with local regulations and ordinances.

2.3 Media and Contaminant of Concern

2.3.1 Media of Concern

The RI Report for the ARP off-site area identified groundwater as the medium of concern. Depth to groundwater in the ARP off-site area ranges, on average between 2.99 ft bgs and 11.36 ft bgs with the depth to groundwater in the impacted area limited to between approximately 7 ft bgs and 10 ft bgs. Groundwater monitoring wells showing impacts from COC based on detections of CVOCs above NYSDEC TOGS 1.1.1 include shallow wells, primarily screened within a sand/silt unit between 4.5 ft bgs and 27 ft bgs, and deep wells primarily screened

within a silt/clay unit between 32 ft bgs and 42 ft bgs (Parsons 2020). The location of these wells and the corresponding groundwater monitoring data are included on **Figure 6**.

As stated in Section **1.5.1**, subsurface soil concentrations with CVOC exceedances above the SCOs were associated with soil samples within the saturated zone at depths greater than 17 ft bgs and are attributed to the groundwater VOC plume. Therefore, for the purposes of this FS, soil is not considered a media of concern.

2.3.2 Contaminants of Concern

COC are identified for the ARP off-site area based on screening groundwater monitoring data against NYSDEC TOGS 1.1.1. COC are selected so that chemicals present at levels of concern are considered in the evaluation of alternatives. The COC in the ARP off-site area include:

- PCE
- TCE
- cis-1,2-DCE
- trans-1,2-DCE
- VC

Detections of these compounds above NYSDEC TOGS 1.1.1 was limited to three monitoring wells east of Sycamore Street (MW-01, MW-02S and MW-09S) and six monitoring wells west of Sycamore Street (PMW-2, PMW-5, PMW-8, PMW-9, PMW-21D, and PMW-22D) as shown on **Figure 6**.

2.3.3 Pathways of Concern

Based on the results of the RI, pathways of concern associated with risks to human health exist through exposure to impacted groundwater during future potential construction (excavation) activities or maintenance of deep underground utilities such as sewers. Thus, groundwater is a potential direct contact exposure pathway for workers conducting excavation and subsurface work. Groundwater is not a potential ingestion exposure pathway since the ARP off-site area is served by public water, and groundwater is not used as a potable water source. As such, the groundwater ingestion pathway is not complete and therefore, not a pathway of concern.

2.4 Remedial Action Objectives

2.4.1 Groundwater RAOs

Remedial action objectives (RAOs) are medium-specific objectives for the protection of public health and the environment. The following RAOs have been established for the ARP off-site area, and are based on the evaluation of SCGs and the nature and extent of COC, including their transport and fate, and exposure pathways.

2.4.2 RAOs for Public Health Protection

The RAOs for the protection of public health are:

- Prevent ingestion/direct contact with contaminated groundwater and/or soil impacted by groundwater.
- Prevent ingestion of groundwater with contaminant levels exceeding drinking water standards.
- Prevent contact with or inhalation of volatiles from contaminated groundwater and/or soil impacted by groundwater.

2.4.3 RAOs for Environmental Protection

The RAOs for environmental protection are:

- Restore groundwater aquifer to pre-release conditions, to the extent practicable.
- Prevent the discharge of contaminants to surface water and sediment.

2.5 Estimated Remediation Areas, Volumes, and Chemical Mass

The total area of impacted groundwater was calculated west and east of Sycamore Street based on the outermost isopleth boundary:

- The total area west of Sycamore Street is approximately 166,520 square feet (SF) which equates roughly to a rectangular area of 905 feet by 184 feet.
- The total area east of Sycamore Street is approximately 42,588 SF, which equates to 338 feet by 126 feet.

These areas were used as the basis for evaluating and pricing alternatives in **Section 4** of this FS. The average depth to groundwater within the impacted area is approximately 8.4 ft bgs with the average depth to the deepest low permeability layer west and east of Sycamore Street of approximately 42 ft bgs and 31 ft bgs, respectively. As shown in **Table 2**, the total area of exceedance above NYSDEC TOGS 1.1.1 for total chloroethenes was approximately 4.8 acres (209,108 SF), which encompasses a groundwater volume of approximately 19.9 million gallons. The estimated mass of total CVOCs within this volume above NYSDEC TOGS 1.1.1 is approximately 225 pounds.

3.0 IDENTIFICATION AND SCREENING OF REMEDIAL TECHNOLOGIES

3.1 Introduction

This section identifies and screens control methods and remedial technologies potentially capable of achieving the RAOs identified in Section 2. These control methods and remedial technologies (collectively referred to as technologies in the remainder of this report) are identified based on a variety of technical sources, current and anticipated future site use, and site physical and chemical data. The most appropriate technologies are retained for use in developing remedial alternatives.

Conventional as well as innovative technologies are presented in this section. Innovative technologies are defined as those with limited full-scale experience and/or performance and cost data.

3.2 Sources for Identifying Potentially Applicable Technologies

Information used in the identification and screening of potentially applicable technologies was gathered from a variety of sources, including the experience of Parsons. In addition, the following literature sources and databases were reviewed:

- United States Environmental Protection Agency (USEPA) Reach-It Program (http://www.epa.gov/tio/reachit.html).
- USEPA CLU-IN Technology Innovation Office (http://clu-in.org/techfocus/).
- Federal Remediation Technologies Roundtable web site (http://www.frtr.gov).
- USEPA *Guidance for Conducting Remedial Investigations and Feasibility Studies* (USEPA, 1988).
- United States Department of Energy (USDOE) Environmental Restoration Program (http://www.em.doe.gov/).

Many of these web sites include portals that allow access to additional databases.

3.3 General Response Actions

General response actions are broad categories of media-specific actions that, by themselves or in combination with other general response actions, will satisfy the RAOs. General response actions that are potentially applicable at the ARP off-site area related to groundwater are:

- No action
- Institutional controls
- Treatment
- Containment
- Removal

3.4 Development and Screening of Technologies

Each general response action can be implemented using one or more remedial technologies. Potentially applicable technologies associated with the general response actions listed above are identified and screened in **Section 3.5** of this FS.

NYSDEC DER-10 *Technical Guidance for Site Investigation and Remediation* (2010) specifies that individual technologies should be preliminarily screened based on ability to meet media-specific objectives, short-term and long-term effectiveness, and implementability. In this FS, the screening of technologies is presented as follows:

Effectiveness This criterion includes an assessment of the ability of technologies to meet media-specific objectives, and an assessment of short-term and long-term effectiveness.

Implementability This criterion includes an assessment of technical feasibility, availability of the technologies, and the administrative feasibility of implementing a control method or technology (USEPA, 1988). If a method or technology requires equipment, specialists, or facilities that are unavailable within a reasonable time, it would be eliminated from further consideration.

The screening of technologies, including the technical justification for retaining or not retaining each technology, is presented in **Table 3** for groundwater and are discussed in **Section 3.5** below.

3.5 Groundwater

3.5.1 No Action

Under "No Action," no new remedial action or further action of any type would be implemented. The no action alternative reflects site conditions as described in the 2020 RI Report (Parsons 2020). The no-action alternative would be appropriate if the site posed no current or future threat to human health or the environment, or if a previous response had eliminated the need for further remedial response. No action is retained in any FS as a general response action to serve as a baseline for comparison with other technologies.

3.5.2 Institutional Controls

Institutional controls are widely recognized as suitable for use at sites affected with chemicals (USEPA 2004). Most institutional controls are administrative or legal methods implemented by the owner or governing entities to discourage human exposure to site-related residuals.

The cost to implement institutional controls can vary widely because of site-specific circumstances, and they are often economical methods for reducing the potential for human exposure to affected media. Institutional controls that are potentially applicable to the ARP off-site area include government controls and property use or access controls.

3.5.2.1 Government Controls

Government controls include federal, state, and local government limits on site use. They can include requirements to control site use or site modifications and are implemented through zoning codes, property easements, or permits for building or excavation. These controls can be implemented at the discretion of the governing agency with jurisdiction over the site. They can be implemented by agency action or as court injunctions filed with a court of law. Government controls are retained for further evaluation.

3.5.2.2 Property Controls

Property controls consist of covenants in deeds (environmental easements) for individual properties. They can limit, for example, future site use, restrict use of surface soil or groundwater, prohibit well drilling, and define precautions needed for intrusive activities. An environmental easement may also include a Site Management Plan (SMP) identifying use restrictions and other requirements at the site. Such environmental easements can be an effective and low-cost method for preventing human exposure to affected media. Property controls are retained for further evaluation.

3.5.3 Treatment Technologies

3.5.3.1 Monitored Natural Attenuation

Monitored natural attenuation (MNA) may be an appropriate remedy for the ARP off-site area since the source of the groundwater plume, located near the former Town Square Body Shop, has been addressed to the extent feasible by means of an IRM excavation (2011) and biostimulant injections (2015) upgradient of MW-09S (Section 1.2).

An MNA remedy typically consists of long-term monitoring of a system or plume, which relies on natural processes to break the contaminants down into harmless by-products. As part of an MNA remedy, a groundwater monitoring program must be implemented to monitor plume characteristics, horizontal and vertical contaminant migration, and related controlling processes (USEPA, 1999). The MNA of chlorinated ethenes can be a viable stand-alone, low-cost remedy if the site conditions provide a natural capacity for plume attenuation sufficient to prevent unacceptable risk to human health and the environment or exceedance of groundwater criteria at regulatory points of compliance. In cases where the natural attenuation rates are not adequate, MNA can be combined with other remedies directed at reducing migration of chlorinated ethenes until MNA is a viable stand-alone remedy.

The natural attenuation capacity is dependent on degradation, adsorption, volatilization, and dispersion that are dependent on site-specific conditions. The degree of natural chlorinated ethene biodegradation is an important factor influencing the extent of chlorinated ethenes attenuation. PCE is biodegradable only under anoxic conditions through reductive dechlorination. During this process, chlorine atoms are sequentially removed resulting in formation of TCE, 1,2-DCE, VC intermediates, and finally ethene, which is an innocuous, gaseous end-product. The extent of complete biodegradation versus partial degradation to intermediates varies between sites. Under reducing conditions, abiotic degradation catalyzed by reduced iron and sulfide minerals can contribute to the attenuation of chlorinated ethenes. While PCE is not biodegradable under aerobic conditions, lesser chlorinated ethenes including TCE, 1,2-DCE, and especially VC are subject to biodegradation under aerobic conditions. Complete chlorinated ethene biodegradation can occur through the biodegradation of PCE and TCE under anoxic conditions followed by 1,2-DCE and VC biodegradation under aerobic conditions, if redox conditions allow for both, such as along a diverse plume flow path.

In the ARP off-site area, average concentrations of Permanganate Natural Oxidant Demand (PNOD, 3.2 grams per kilogram, g/kg) and Persulfate Consumption Rate (KDT, 2.05 to 4.84 g/kg) indicate subsurface conditions favor in situ bioremediation of chlorinated ethenes. Additionally, results summarizing natural attenuation parameters (fraction organic carbon, dissolved oxygen, oxidation-reduction potential, nitrate, manganese, sulfate, and methane) indicate subsurface conditions favor in situ bioremediation; however, bioaugmentation may be necessary for complete dechlorination (see Sections 1.5.2, 1.5.3 and 1.5.4).

The presence of PCE, TCE, and their breakdown into daughter products (1,2-DCE and VC) in both the on-site and off-site wells, indicates natural biodegradation is contributing to the attenuation of chlorinated ethenes at the site. Chlorinated ethene concentrations in groundwater samples generally decreased moving downgradient

(westward) away from the ARP on-site area. At several locations, cis-1,2-DCE is the predominant chlorinated ethene detected in groundwater. Although additional monitoring is required to establish CVOC concentration trends for several monitoring wells at the site, the following observations suggest biodegradation is occurring in situ at each well location located downgradient from the former source area (see **Figure 6**):

- Decreasing PCE concentrations:
  - PMW-21D (1,210 µg/L in August 2019 to 530 µg/L in April 2025)
  - PMW-2 (240 µg/L in September 2015 to 71 µg/L in April 2025)
  - PMW-22D (339 µg/L in August 2019 to 120 µg/L in April 2025)
  - PMW-5, to a lesser extent and slightly downgradient (17 µg/L in September and November 2015 to 9.3 µg/L in April 2025)
- Decreasing TCE concentrations were also detected at:
  - PMW-21D (208 µg/L in August 2019 to 88 µg/L in April 2025)
  - PMW-22D (84.2 µg/L in August 2019 to 22 µg/L in April 2025)
  - PMW-8 (73 µg/L in November 2015 to 30 µg/L in April 2025)
  - PMW-9 (163 µg/L in August 2019 to non-detect in April 2025)
- Increasing concentrations of cis-1,2-DCE were detected at:
  - MW—09S (13.9 µg/L in February 2018 to 2,500 µg/L in April 2025)
  - MW-02S (non-detect in February 2018 to 2,600 µg/L in April 2025)
  - PMW-9 (88 µg/L in September 2015 to 620 µg/L in April 2025)

To better evaluate attenuation and the time needed for impacted groundwater to reach groundwater quality standards (GWQS, TOGS 1.1.1), first-order attenuation rate constants (K-point) were calculated for total chloroethene concentration detections (PCE+TCE+1,2-DCE+VC) at monitoring wells PMW-2, PMW-5, PMW-8, PMW-21D, and PMW-22D. The best fit slope of the total chloroethene concentration over time for each well was the K-point value used to calculate the time required for a given well to reach GWQS. The average of the Class GA criteria values for PCE, TCE, 1,2-DCE, and VC was used as the GWQS (4.25 µg/L, target future concentration) for this analysis. The average K-point for these four wells was -0.075 per year with an attenuation rate range between -0.030 per year (low K-point) and -0.101 per year (high K-point).

The average, low and high K-point values for these five wells were used to “estimate” the time required to reach GWQS at other locations located within the impacted area that could not be used directly due to increasing concentrations for some compounds (MW-01, MS-02S, MW-09S, and PMW-9). Based on the estimated rates of attenuation, and assuming that concentrations continue to decrease at the same rate, the average time to reach GWQS in all nine wells is approximately 97 years from the date of the April 2025 sampling event. The shortest duration to reach GWQS is approximately 82 years and is based on the monitoring well with the highest total chloroethene concentration (MW-02S) using the highest K-point (fastest degradation rate). The longest duration to reach GWQS is approximately 271 years also based on highest concentrations in (MW-02S) using the lowest K-point (slowest degradation rate).

Appendix A.1 contains calculation sheets for PMW-2, PMW-5, PMW-8, PMW-21D, and PMW-22D showing analytical data input values, sample dates, concentration graphs versus time with best fit lines indicating the K-point, and calculated time to achieve GWQS (USEPA 2002). Additionally, a summary sheet showing the calculated time to reach GWQS using average K-point, low K-point or high K-point are also included for MW-01, MW-02S, MS-09S, and PMW-09.

Although additional monitoring is required to confirm these predictions, this analysis suggests that an MNA period of approximately 97 years or more may be required prior to concentrations reaching SCGs. Although this estimated duration may serve to limit the effectiveness of MNA as a stand-alone remedy, MNA is also commonly considered as a supplement to other technologies in a remedial alternative.

Given the indications of biodegradation observed in the data, MNA is retained for further evaluation as a supplemental in situ treatment option, and as a supplement to other technologies, for the ARP off-site area.

3.5.3.2 Enhanced In Situ Bioremediation (EISB)

In general, bioremediation is a common remediation approach for chlorinated ethene plumes in groundwater at similar sites within New York state. EISB is accomplished by introducing organic substrate(s) to stimulate anaerobic microbial reductive dechlorination. During this process, chlorine atoms are sequentially removed resulting in 1,2-DCE and VC intermediates, and finally ethene, which is an innocuous, gaseous end-product.

EISB enhances the degradation of adsorbed COCs, COCs present in low permeability soil, and DNAPL (ITRC 2007). Therefore, EISB can be applied to degrade COCs in soil and groundwater within delineated impacted areas. Example formats for treatment include:

- Closely spaced injections throughout the impacted area
- Injections into the upgradient portion of the highest concentrated area with downgradient expansion of the treatment area through the advective transport of organic substrate(s)
- Permeable reactive barriers

Commonly used injectable organic substrates include emulsified vegetable oil (EVO), hydrogen release compound (HRC), molasses, whey, sodium lactate, and combinations thereof.

Based on site conditions, and previous project experience, a combination of EVO and whey would be an effective substrate for this project. These materials are readily available, are cost-effective, and have a proven record of treating chlorinated ethene plumes like that found at the site; however, injection wells must be installed prior to implementation.

There are potential drawbacks with EISB that should be considered. The potential for daughter product formation and migration beyond an EISB treatment zone exists. This can be minimized or eliminated through one or more of several means including the use of bioaugmentation cultures, creating a treatment zone of adequate width along the flow path to provide enough time for complete COC degradation, and allowing natural biodegradation downgradient of the treatment zone to degrade the intermediates. The oxidizing groundwater conditions at the site should enhance the biodegradation of potential intermediates downgradient of the EISB treatment zone.

One additional documented concern with EISB is the potential generation of methane because of the natural degradation of introduced sources of organic carbon. The migration of methane represents a risk for methane accumulation under building slabs located downgradient of EISB application areas (NAVFAC 2018). Several conditions at the ARP off-site area limit the potential for methane accumulation under off-site structures including:

- the absence of buildings and residences in the immediate vicinity of the impacted area
- sandy and silty-sand soils that allow for dissipation of methane
- elevated dissolved oxygen concentrations (greater than 2 milligrams per liter) that allows for microbial methane oxidation thereby limiting methane migration. Concentrations at this level were observed in six wells outside the impacted area during the April 2025 sampling event as shown in Table 1 (MW-10S, PMW-04, PMW-06, PMW-07, PMW-13, and PMW-20.

COC concentration rebound (an increase in groundwater concentrations from a post-remediation low) is less prevalent with EISB relative to in-situ chemical oxidation. Reductions in COCs of about one order of magnitude or more often yield at least a one order of magnitude improvement in downgradient groundwater quality. In instances of fast groundwater flow, low mass storage in plumes (i.e., less back diffusion from silts/clays), and/or active contaminant attenuation in plumes, a two to three order of magnitude downgradient improvement in water quality may be observed generally over a period of several years. For the ARP off-site area, significant increases

in CVOC concentrations were observed during the April 2025 sampling event in MW-02S and MW-09S. Concentrations detected were higher than the pre-injection (biostimulant) concentrations from June 1, 2015 (see **Figure 6**) likely indicating concentration rebound and potential need for additional injectate in this area. Additionally, both wells are screened within the first low permeability zone (clayey silt with fine to medium gravel), and back diffusion in the absence of injectate is likely furthering the increased concentrations.

Overall, EISB would be an effective technology for mitigation of contaminants found at the site. Therefore, EISB based on an EVO and/or whey mixture or alternative is retained for further consideration.

3.5.3.3 In Situ Chemical Oxidation

In situ chemical oxidation (ISCO) involves the application of an oxidant into the subsurface to facilitate the oxidation of COCs to innocuous products such as carbon dioxide, water, and chloride. An understanding of the site's hydrogeology and contaminant distribution is necessary to design the ISCO approach in a way that maximizes the contact between the chemical oxidant and contaminant. Effective chemical oxidants for chlorinated ethenes (including PCE, TCE, cis-1,2-DCE, and VC) include permanganate (potassium or sodium permanganate) solution, activated persulfate solution, Fenton's reagent (hydrogen peroxide and iron) solution, and ozone gas. Persulfate ISCO requires the addition of a persulfate activation. Persulfate activators include caustic to raise the pH (i.e., base-activated persulfate), chelated iron, heat, and naturally occurring minerals present within the injection area.

Notable differences, advantages, and drawbacks between the above oxidants include:

- The residence time for the oxidants in order of highest to lowest residence time is permanganate > persulfate > Fenton's reagent > ozone.
- Due to the short residence time of ozone, continuous or frequent pulsing is required.
- Permanganate is the only liquid oxidant that is injected as a sole constituent, which can simplify the injection process.
- Permanganate solution and sodium persulfate are denser than water, which allows for more effective vertical transport within fractures or porous media where chlorinated ethenes are typically located.
- Off-gassing can occur during Fenton's reagent injection, leading to increased potential for surfacing and displacing COCs from the treatment area.
- Fenton's reagent and sodium persulfate can break down into products post injection that can hinder the bioremediation process in the short term but will not lead to long-term effects.
- Permanganate does not break down into products that would hinder the bioremediation process post-injection. Manganese oxide can be produced as a byproduct and possible clogging of the formation is possible.

It is anticipated that the final selection of oxidant will be conducted as part of the remedial design process. Based on the considerations and site-specific factors noted above, it is anticipated that permanganate or Fenton's reagent would likely be the most effective oxidant for the ARP off-site area.

The design of the oxidant concentration and volume is dependent on three characteristics:

- the quantity of oxidant required to degrade the COC mass and to overcome the natural oxidant demand (mainly soil associated)
- the desired radius of influence
- the persistence of the oxidant

The latter is less important for permanganate, which is long-lived but persistence can be critical for oxidants including Fenton's reagent that have a shorter residence time. The aqueous oxidant solutions are prepared above grade and delivered into the subsurface.

ISCO using any chemical oxidant has the potential to increase the concentration of metals in groundwater. Typically, increases in metals concentrations are limited to the treatment zone due to metals attenuation within and downgradient of the treatment area. Multiple rounds of ISCO injections are often required depending primarily on the soil type and COC mass present. An increased number of injections should be anticipated to be required for the treatment of fine soil types and where DNAPL is present.

Overall, ISCO would be an effective technology for mitigation of contaminants found at the ARP off-site area and is retained for further consideration. However, injection wells must be installed prior to implementation of ISCO. Therefore, ISCO based on either Fenton's reagent or permanganate with oxidant delivery using injection wells are retained for further evaluation as an alternative in **Section 4**. Actual selection of the oxidant would be determined during detailed design, if this technology were selected.

3.5.3.4 Electrical Resistance Heating (ERH)

Electrical Resistance Heating (ERH) is an in situ thermal remediation technology where a series of electrodes are installed in a grid pattern throughout the impacted subsurface and electrical current is passed through to each electrode. With this system, electricity passes through moisture present in soil. The resistance encountered leads to subsurface heating to the boiling point. Through this process, steam and CVOCs can be removed from saturated and unsaturated soils and groundwater, through volatilization, boiling, and/or enhanced biodegradation. Vapors are subsequently captured by soil vapor extraction wells and treated above ground, as needed for permitted discharge.

ERH would be an effective technology for mitigation of contaminants found at the ARP off-site area; however, ERH is typically used to address source area contamination where concentrations are much higher (more than 10,000 µg/L) than concentrations observed in the ARP off-site Area or where DNAPL has been observed. DNAPL has not been observed at the ARP off-site area to date. Although CVOC concentrations detected during Parsons 2025 groundwater sampling event approached 10,000 µg/L, the lower concentration levels observed across the remainder of the site, and the successful reduction in concentrations following the June 2025 biostimulant injections, ERH would be significantly more expensive compared to other remedial options.

Additionally, ERH is a more intrusive technology during construction compared to either ISCO or EISB but is similar to air sparing/soil vapor extraction (AS/SVE) construction (see Section **3.5.5.2**). Although the quantity of electrodes needed for ERH would be similar to the number of injection wells for ISCO or EISB based on similar radius of influence (ROI), installation and connection of the electric supply lines to each electrode would require extensive disruption to the subsurface, similar to the trenching required to connect vertical AS/SVE wells to the system enclosure. Furthermore, ERH requires extensive monitoring to minimize short circuiting. Lastly, there would likely be a negative public perception to having live electrodes and wires beneath an active parking lot as this technology is more commonly used in secured (fenced) industrial areas, away from the public. As such, ERH is not retained for further evaluation.

3.5.4 Containment Technologies

3.5.4.1 Subsurface Barrier Wall

A barrier wall is made of a low-permeability material. It can be installed to keep chemically affected groundwater from migrating off- site. One important factor in the success of a barrier wall for groundwater containment is the presence of a continuous low-permeability geologic unit that the wall can be keyed into. Otherwise, downward movement of groundwater beneath the wall can negate the effectiveness of the wall in limiting horizontal groundwater movement. As described in **Section 1.3.3**, the deeper of two low permeability layers consisting of "silty clay with fine to medium gravel" exists in the ARP off-site monitoring well PMW-22D at a depth of

approximately 42 ft bgs, which could potentially serve as a key-in layer for a subsurface barrier wall. The permeability of this layer is uncertain, although a silty clay is usually a relatively dense low-permeability material. Additional geotechnical analysis of this layer would be needed to verify its suitability for this approach.

Types of subsurface barrier wall technologies would include a slurry trench barrier wall, sheet pile barrier wall, geomembrane barrier wall, deep-soil mixing, compacted clay, conventional and jet grouting, and colloidal silica injection.

Considering site constraints including disruption of land use to nearby businesses, underground utilities, and the depth that the barrier wall would need to be constructed to below grade (about 40 feet to top of low permeability layer on west side of Sycamore St), this technology would not be considered implementable or feasible. Therefore, the barrier wall technology is not retained for further evaluation.

3.5.4.2 Groundwater Collection and Treatment

Groundwater collection and treatment can reverse the direction of groundwater flow toward a well or trench and into a site or point of collection. Extraction trenches and extraction wells are reliable and effective conventional methods for containing groundwater. Trenches are generally preferred if groundwater impacts extend along an elongated flow path and are less than 20 to 25 feet deep. Wells are generally preferred if the groundwater to be collected is in multiple distinct areas, if the area is broad laterally in both dimensions, if the groundwater is within sandy, relatively permeable soils, or if the need to extract groundwater is short term. Extraction wells are typically vertical wells, but horizontal wells have also been used to collect shallow groundwater.

Remedial action objectives and subsurface conditions determine the number and location of extraction trenches or wells. A groundwater flow model is often used to provide a basis for optimizing numbers and locations of collection trenches or wells. This technology can be applied in conjunction with capping and a barrier wall to achieve more rapid hydraulic steady-state conditions than containment alone.

Although groundwater collection can effectively achieve containment, groundwater collection generally is not effective for remediating groundwater to meet water quality standards. This is because of the time-dependent decrease in rate of desorption of residuals from soil, and the existence of immobile residuals that can be trapped in low-permeability zones (Doty and Travis, 1991), some of which exist on-site (clayey silt and silty clay). Past performance and modeling studies show that pumping groundwater is effective only for plume containment and some residual mass reduction. Groundwater collection and treatment is implementable at the ARP off-site area but costly. Based on these considerations, groundwater collection would not be an effective technology, and is not retained for further evaluation in this FS.

3.5.5 Removal Technologies

3.5.5.1 Soil Excavation

Soil excavation using conventional equipment such as backhoes and bulldozers is typically employed for shallow soil excavation. Targeted removal of shallow (above the groundwater table) “hot spots” or source material can be highly effective when used to supplement other technologies and increase remedy success rates. For the ARP off-site area, soils in the vadose zone did not exceed the unrestricted land use SCOs for the COCs at this site. Additionally, the source area (ARP on-site) has been removed. As such, shallow excavation techniques would not facilitate achieving the RAOs for this site.

Deeper excavations require the use of long-reach excavators or equipment such as clamshells. This technology would facilitate achieving RAOs for the site as subsurface soils are impacted above SCOs. However, deep excavations require the use of either shoring of the excavation sides or sloping of the sidewalls away from an

excavation to maintain safe working conditions and to avoid collapse. Both shoring and side slopes can add significant effort and cost to an excavation. In addition, excavation in the vicinity of occupied buildings increases the level of complexity involved with completion of a deep excavation event. Soil excavation would be a significant disruption to nearby businesses as well.

Additionally, soil excavation significantly below the water table requires water management efforts and dewatering and/or solidification of excavated soils. Impacted soils were observed at the ARP-off-site area below the water table at depths ranging between 17.5 ft bgs and 28.5 ft bgs (Parsons 2020). Related construction difficulties and cost factors include space requirements, increased processing time, and measures to prevent releases of contaminants during soil handling. As such, soil excavation is not typically cost-effective for addressing groundwater contamination. Based on these considerations, soil excavation is not retained for further evaluation.

3.5.5.2 Soil Vapor Extraction with Air Sparging

Soil vapor extraction (SVE) is a source removal option for unsaturated soil above the water table. VOCs can be removed from the subsurface by applying a vacuum through vertical or horizontal wells. The vacuum pulls the impacted vapor to the ground surface for treatment.

SVE is often used in conjunction with air sparging. Air sparging involves the active application of air into the groundwater within the impacted area. The introduction of the air transfers VOCs from groundwater and saturated soil to the unsaturated zone of soil above the water table. As air sparging pushes VOCs up from the saturated zone to the unsaturated zone, vapor extraction can remove the VOCs in the unsaturated zone. During air sparging activities, the breathing zone would be monitored for VOCs. The effectiveness of air sparging could be enhanced with the addition of ozone, which can degrade COCs in place; however, spatial limitations would still apply.

Several factors for the ARP off-site area site would inhibit the effectiveness of air sparging. The introduction of oxygen though the air sparging process would essentially temporarily eliminate any biodegradation of the chlorinated solvent plume that may be occurring, which requires anaerobic conditions. The flow of air introduced by the sparging process through the saturated zone may be difficult to accurately predict. Given the saturated thickness (approximately 35 to 40 feet), and depth of the treatment interval associated with the ARP off-site area, this remedy provides limited effectiveness. Air sparging may not be performed completely below the plume. However, given there are no identified downgradient homes impacted by soil vapor intrusion, and the maximum PCE concentration in soil vapor detected in August 2019 was 9.5 micrograms per cubic meter ($\mu g/m^3$, Parsons 2020), this remedy is implementable and poses a low risk to human health. One nearby business, Dick's Sporting Goods, has a vapor barrier that would protect human health in the event that soil vapor migrated under the building slabs (Parsons 2020).

The ARP off-site area has sufficient space for implementing this remedy since it would take place in an open parking lot; however, it would require installation of wells and trenching between wells and the SVE system enclosure. SVE with air sparging is retained for further analysis and will be evaluated in **Section 4** using horizontal wells.

4.0 DEVELOPMENT AND EVALUATION OF REMEDIAL ACTION ALTERNATIVES

4.1 Introduction

Based on the preliminary evaluation of the remedial technologies presented in **Section 3**, several technologies have been selected for development and further evaluation as a remedial alternative. Institutional controls are retained for each alternative aside from GW-1, No Action. Remedial alternatives evaluated within this Section for addressing the impacted groundwater at the ARP off-site area include:

- Alternative GW-1 No action
- Alternative GW-2 Monitored natural attenuation
- Alternative GW-3 Full-scale in situ chemical oxidation / monitored natural attenuation
- Alternative GW-4 Full-scale enhanced bioremediation / monitored natural attenuation
- Alternative GW-5 Full-scale hybrid in situ chemical oxidation and enhanced bioremediation / monitored natural attenuation
- Alternative GW-5T Targeted hybrid in situ chemical oxidation and enhanced bioremediation / monitored natural attenuation
- Alternative GW-6 Soil vapor extraction / air sparging (horizontal configuration)

4.2 Criteria For Evaluating Remedial Action Alternatives

Each of the remedial action alternatives is assessed in this FS based on eight evaluation criteria set forth in 6 NYCRR 375-1.8(f). The final criteria (community acceptance) will be addressed after the FS is completed. USEPA and NYSDEC have provided guidance for evaluating these criteria in *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA*, (USEPA, 1988), and in DER-10 *Technical Guidance for Site Investigation and Remediation* (NYSDEC 2010). These nine evaluation criteria are:

<u>Threshold Criteria</u>

- Overall protection of human health and the environment
- Compliance with SCGs

<u>Primary Balancing Criteria</u>

- Long-term effectiveness and permanence
- Reduction of toxicity, mobility, or volume through treatment
- Short-term effectiveness
- Implementability
- Cost effectiveness
- Land use

<u>Modifying Criteria</u>

- Community acceptance

With the exception of the no-action alternative, an alternative must meet the two threshold criteria to be carried through the detailed analysis of alternatives. If the threshold criteria are met, the primary balancing criteria are evaluated to select an overall remedy among the alternatives. The modifying criteria (community acceptance), will be assessed during the development of the ROD, based on the public's overall response to the alternatives described in the PRAP and the FS.

4.2.1 Threshold Criteria

4.2.1.1 Overall Protection of Human Health and the Environment

Overall protection of human health and the environment is the primary basis for developing the RAOs presented in Section 2; SCGs have been developed to meet these RAOs. Therefore, by evaluating the extent to which each of the potential alternatives would meet the standards, criteria and guidance (SCG) concentrations (NYSDEC TOGS 1.1.1), the alternatives are evaluated on their ability to meet the threshold criteria of protection of human health and the environment. This criterion addresses whether or not a remedy provides adequate protection and describes how risks posed through each exposure pathway (based on a reasonable maximum exposure scenario) are eliminated, reduced, or controlled through treatment, engineering controls, or institutional controls.

4.2.1.2 Compliance with SCGs

SCG compliance is assessed by determining whether or not an alternative meets the federal and state SCGs identified for the site as stated in Section 2.2 of this FS.

4.2.2 Primary Balancing Criteria

4.2.2.1 Long-Term Effectiveness and Permanence

The long-term effectiveness and permanence of a remedial action are evaluated based on the following criteria:

- Permanence of the remedial alternative
- Magnitude of the human exposures, ecological receptors, and/or impacts to the environment remaining after remediation
- Adequacy and reliability of controls, if any, used to manage treatment residuals or untreated wastes that remain at the site following remediation.

4.2.2.2 Reduction of Toxicity, Mobility, or Volume Through Treatment

This criterion is evaluated by measuring the effectiveness of material management technologies included as part of an overall remedial alternative. The evaluation of the reduction of toxicity, mobility, or volume through treatment involves consideration of the following:

- Type of containment and treatment
- Degree of expected reduction in toxicity, mobility, or volume
- Degree to which treatment would be irreversible
- Type and quantity of residuals that would be present following treatment.

4.2.2.3 Short-Term Effectiveness

Short-term effectiveness evaluates the effects of an alternative on human health and the environment during the construction or implementation phase of a remedial action. The following elements are considered while evaluating the short-term effectiveness of each alternative:

- Protection of the community during remedial construction
- Impacts on the environment
- Environmental impacts and impacts to site employees and remediation workers during remedial construction
- Elapsed time until remedial action objectives would be achieved.

4.2.2.4 Implementability

Implementability considers the technical and administrative feasibility of implementing an alternative and the availability of the services and materials required during its implementation. The following factors are examined as part of implementability to the extent each factor is relevant for a particular alternative:

- Ability to implement selected technologies under site conditions
- Reliability of technology
- Availability of necessary equipment, treatment materials, specialists, skilled operators, and provisions to ensure that any necessary additional resources are available
- Extent and complexity of monitoring remediation effectiveness following implementation
- Activities needed to coordinate with and obtain consent from other offices and agencies to obtain necessary approvals and permits

4.2.2.5 Cost Effectiveness

Cost effectiveness as described in DER-10 is an evaluation of the overall cost effectiveness of all phases of a remedial alternative. Cost estimates are developed for each alternative, which include initial capital costs as well as long-term operation, monitoring and maintenance (OM&M) that may be applicable for a remedy. Long term costs in the cost estimate are normalized to develop a present worth for each alternative for comparison. Using these estimates, an assessment is made as to whether the cost is proportional to the overall effectiveness of the remedy.

4.2.2.6 Land Use

Evaluation of land use assesses whether a remedial alternative is reasonable based on the current, intended, and reasonably anticipated future use of the site and its surroundings. This assessment considered factors such as:

- Current use and historical / recent development patterns
- Zoning
- Brownfield redevelopment opportunities
- Any applicable comprehensive community master plans or land use plans
- Land use of surrounding / adjacent areas
- Public comments
- Environmental justice concerns
- Federal or state land-use designations
- Population growth patterns
- Accessibility of existing infrastructure
- Proximity to culturally significant resources
- Proximity to natural resources
- Impacts to off-site groundwater
- Proximity to floodplains
- Geography and geology
- Current institutional controls applicable to the site

4.2.3 Modifying Criteria

In accordance with DER-10, community acceptance is evaluated as part of the final selection and approval of a remedy by NYSDEC. Comments submitted on the remedy during the public comment period are considered by NYSDEC for potential modifications to the remedy. As such, no evaluation of remedies for community acceptance is included in this FS Report.

4.3 Description of Remedial Alternatives for Groundwater

This section describes remedial alternatives that have been developed for the ARP off-site area to address impacted groundwater, based on the evaluation of technologies discussed in **Section 3**. Evaluation of these alternatives, with respect to criteria outlined in **Section 4.2**, is provided in **Section 4.5**.

4.3.1 Alternative GW-1: No Action

Under Alternative GW-1, no action would be taken to address site groundwater. Natural attenuation would continue in the site subsurface but would not be quantified or monitored. This alternative is used as a baseline for comparison purposes.

4.3.2 Alternative GW-2: MNA

Alternative GW-2 includes institutional controls and MNA. Under this alternative, groundwater quality would be monitored at approximately 15 wells over a 30-period. Groundwater sampling for VOCs, chloride, methane, ethane, and ethene would be performed annually at upgradient, downgradient, and impacted wells. Analytical results would undergo validation and be incorporated into an annual report. The MNA alternative would include a robust project review every five years.

4.3.3 Alternative GW-3: Full-Scale In Situ Chemical Oxidation & MNA

Alternative GW-3 includes the following technologies retained from the screening conducted in **Section 3**: institutional controls, ISCO, and MNA. Under this alternative, treatment of groundwater would be accomplished by delivering oxidants to the impacted area, which would more rapidly reduce COC concentrations than the pace of naturally occurring processes. As discussed **in Section 3.5.3.3**, for the purposes of this FS, this remedial alternative is developed based on the use of sodium permanganate. This technology is capable of remediating total CVOC plumes with concentrations greater than 1,000 µg/L.

During implementation of this alternative, oxidant will be injected into vertical injection wells within the impacted area, which is shown on **Figure 6**. Under this alternative the entire impacted area would be treated including approximately 338 feet by 126 feet area east of Sycamore Street and 905 feet by 184 feet west of Sycamore Street as shown in **Table 2**. Assuming a ROI of 20 feet, 300 injection wells would be installed at the site. Thirty-four of these wells would be installed to reach the shallow (10-25 ft bgs) zone east of Sycamore Street surrounding MW-09S and MW-02S. The remaining 266 wells would be installed as shallow and deep nested wells pairs (133 nested wells) to reach the shallow (10-25 ft bgs) and deep (25-40 ft bgs) zones west of Sycamore Street. Further assessment conducted during the design phase would determine the optimum locations for the treatment area and injection points. Under this alternative, oxidant injected on the eastern side of Sycamore Street would interfere with previous EISB injections in the former on-site area.

Groundwater sampling of up to 15 existing monitoring wells (upgradient, downgradient and within the impacted area) would be completed and include a baseline (pre-injection) event; a post pilot test event, and post-injection event. Based on experience at similar sites, a two-day injection pilot test (roughly 2,000 gallons of sodium permanganate) will be conducted prior to full-scale implementation, which would be used to gauge site conditions during an injection event and to refine plans for the full-scale events. Following completion of the pilot study, and interpretation of the data, the full-scale injection event would be conducted. Based on the size of the treatment area, effective porosity of 20 percent, and natural oxidant demand, approximately 209,000 gallons of 10 percent sodium permanganate, or equivalent oxidant mass, would be injected over the course of five weeks.

The presence of underground utilities can be of concern for ISCO projects, as bedding material and/or utility lines can serve as preferential pathways for injections (as well as for contaminants). Additionally, some oxidants can adversely impact certain types of pipes. Permanganate typically has less potential for causing adverse impacts to utilities. The anticipated treatment zone under this alternative would likely be set a distance between 10 and 15 feet away from most underground utilities, which are typically routed under roadways. In addition, the injection depth intervals (likely ranging from 7 to 42 feet deep, corresponding to impacted groundwater discussed in Section 2.3.1) would add a degree of protection for underground utilities within the area, which are not typically buried as deep. Additional precautionary measures, such as installation of monitoring wells adjacent to sensitive utilities can be implemented, to confirm adverse impacts are not being caused by ISCO activities. Further consideration will be given during the design phase to assess potential impacts on utilities, and appropriate mitigation steps.

Following the full-scale injection, it is assumed the project would transition to an MNA phase at which time, groundwater sampling would move to an annual basis using the same 15 monitoring wells sampled pre- and post-injection. Annual monitoring would continue for ten years under this alternative with a more robust monitoring program completed every five years. During each sampling event, wells would be monitored for COCs. Assuming this remedial alternative is able to achieve a two-order magnitude reduction in COCs following treatment, higher than anticipated concentrations will remain at MW-02S and MW09S during this ten-year period as rebound of the COCs or incomplete dechlorination is likely. The COC rebound and cis-1,2-DCE/vinyl chloride stall was observed in these two wells approximately ten years following the on-site injections suggesting an additional injectate is warranted and/or may require incorporating alternatives to mitigate the cis-1,2-DCE and vinyl chloride stall (refer to Section 1.5.2.6). For purposes of cost estimating in this FS, it has been assumed, approximately 50 percent of the original injection volume will be injected after the initial ten-year period to facilitate achieving an additional order magnitude reduction in COCs.

Appendix A.2 contains the calculation sheets for PMW-2, PMW-5, PMW-8, PMW-21D, and PMW-22D showing analytical data input values with concentrations of COCs two orders of magnitude less than the concentrations used for calculating the time to achieve GWQS with MNA alone. These calculation sheets also include sample dates, concentration graphs versus time with best fit lines indicating the K-point (USEPA, November 2002). Additionally, a summary sheet showing the estimated time to reach GWQS for other wells located in the impacted area (PMW-09, MW-01, MW-02S, and MW-09S) using an average K-point (-0.075 per year), low K-point (-0.03 per year) or high K-point (-0.10 per year) are also included. The concentrations for MW-02S and MW09S were reduced by three orders of magnitude in these calculations to demonstrate a three-order magnitude reduction assuming two injection events. The overall average time predicted to reach GWQS under this scenario, after completing a second injection at ten years is an additional 7 years (17 years from first injection). Further assessment of this duration would be conducted during the design, and after implementation of the initial remedy.

For the purpose of estimating costs in this FS, monitoring every two years for an additional 10 years (years 10 through 20) with robust monitoring every five years to assess the effectiveness of the remedy was assumed.

4.3.4 Alternative GW-4: Full-Scale Enhanced Bioremediation & MNA

Alternative GW-4 includes the following technologies retained from the screening conducted in **Section 3**: institutional controls, EISB, and MNA. Under this alternative, treatment of groundwater would be accomplished by introducing organic substrate(s) to stimulate anaerobic microbial reductive dechlorination, which would more rapidly reduce COC concentrations than the pace of naturally occurring processes. Evaluation of amendments to facilitate overcoming the degradation product stall at MW—02S and MW-09S will be considered during the design phase.

Under this alternative, a blend of EVO and whey (or equivalent alternative) would be injected as the organic carbon sources into vertical injection wells within the impacted area shown on **Figure 6**. Under this alternative the entire impacted area would be treated including approximately 338 feet by 126 feet area east of Sycamore Street and 905 feet by 184 feet west of Sycamore Street. Assuming a ROI of 20 feet, 300 injection wells would be installed at the site. Thirty-four of these wells would be installed to reach the shallow (10-25 ft bgs) zone east of Sycamore Street surrounding MW-09S and MW-02S. The remaining 266 wells would be installed as shallow and deep nested wells pairs (133 nested wells) to reach the shallow (10-25 ft bgs) and deep (25-40 ft bgs) zones west of Sycamore Street. Further assessment conducted during the design phase would determine the optimum locations for the treatment area and injection points.

Injections under this alternative would require bioaugmentation (addition of dehalococcoides and/or other alternatives) as data from the April 2025 sampling event show an insufficient quantity of DHc to support MNA or high rates of dechlorination. The absence of DHc indicates a lack of dechlorination or only partial reductive dechlorination to ethenes and is commonly associated with an increase in cis-1,2-DCE (currently seen in MW-09S). The April 2025 functional gene assay data also suggested the potential for increased concentrations of vinyl chloride and was observed in both the source area (MW-09S) and immediately downgradient (MW-02S, see **Section 1.5.4**). This data further necessitates bioaugmentation in the impacted targeted treatment areas.

Groundwater sampling of up to 15 existing monitoring wells (upgradient, downgradient and within the impacted area) would be completed and include a baseline (pre-injection) event, post pilot test event, and post-injection event. Based on experience at similar sites, a four-day injection pilot test (roughly 2,000 pounds of EVO) will be conducted prior to full-scale implementation, which would be used to gauge site conditions during an injection event and to refine plans for the full-scale event. Following completion of the pilot study, and interpretation of the data, the full-scale injection event would be conducted. Based on the size of the treatment area and an effective porosity of 20 percent, approximately 94,000 pounds of EVO would be injected over a ten-week period.

Following completion of the injection activities, it is assumed the project would transition to an MNA phase, at which time groundwater sampling would move to an annual basis using the same 15 monitoring wells sampled pre- and post-injection. Annual monitoring would continue for ten years under this alternative with a more robust monitoring program completed every five years. Assuming this remedial alternative is able to achieve a two-order magnitude reduction in COCs following treatment, higher than anticipated concentrations will remain at MW-02S and MW09S during this ten-year period as rebound of the COCs or incomplete dechlorination is likely. The COC rebound and cis-1,2-DCE/vinyl chloride stall was observed in these two wells approximately ten years following the on-site injections suggesting an additional injectate is warranted and/or may require incorporating alternatives to mitigate the stall (refer to **Section 1.5.2.6**). For purposes of cost estimating in this FS, it has been assumed, approximately 50 percent of the original injection volume will be injected after the initial ten-year period to facilitate achieving an additional order magnitude reduction in COCs. As described in **Section 4.3.3**, the overall average time predicted to reach GWQS under this scenario, after completing a second injection at ten years is an additional 7 years (17 years from first injection). Further assessment of this duration would be conducted during the design, and after the implementation of the remedy.

For the purposes of estimating costs in this FS, monitoring every other year would continue for an additional 10 years (years 10 through 20) with robust monitoring every five years to assess the effectiveness of the remedy.

4.3.5 Alternative GW-5: Targeted In Situ Enhanced Bioremediation & MNA

Alternative GW-5 includes the following technologies retained from the screening conducted in **Section 3**: institutional controls, EISB and MNA. Treatment of groundwater would be accomplished using a targeted approach limiting remediation to impacted areas with total CVOC concentrations greater than 300 µg/L. This would restrict treatment to distinct areas west of Sycamore Street around PMW-9 and PMW-2/PMW-21D/PMW-22D, and east of Sycamore Street (MW-02S and MW-09S).

Under this alternative, assuming a ROI of 20 feet, 40 nested well pairs would be installed west of Sycamore Street including 20 nested injection wells around PMW-9 and 20 nested wells around PMW-2/PMW-21D/PMW-22D. Additionally, four shallow wells would be oriented around MW-09S, and five shallow wells would be positioned north of MW-09S, parallel to the eastern side of Sycamore Street. The shallow interval is roughly 10 to 25 ft bgs while the deep interval is approximately 25 to 40 ft bgs. Further assessment conducted during the design phase would determine the optimum locations for the treatment areas and injection points.

An EVO/whey substrate (or appropriate alternative) would be injected into both the shallow and deep nested wells located east and west of Sycamore Street. Positioning shallow wells upgradient of PMW-21D and PMW-22D, parallel to the eastern side of Sycamore Street facilitates creating a biostimulant "barrier wall" for the shallow groundwater to pass through. As stated in **Section 1.3.3** a shallow confining layer is present on the eastern side of Sycamore Street and the layer dips toward the west beneath Sycamore Street. Creation of the "barrier wall" would inhibit downgradient (westward) migration of residual contaminants from the eastern side of Sycamore Street. Injections under this alternative would require bioaugmentation (addition of dehalococcoides and/or other alternatives) as data from the April 2025 sampling event show an insufficient quantity of DHc to support MNA or high rates of dechlorination. The absence of DHc indicates a lack of dechlorination or only partial reductive dechlorination to ethenes and is commonly associated with an increase in cis-1,2-DCE (currently seen in MW-09S). The April 2025 functional gene assay data also suggested the potential for increased concentrations of vinyl chloride and was observed in both the source area (MW-09S) and immediately downgradient (MW-02S, see **Section 1.5.4**). This data further necessitates bioaugmentation in the impacted targeted treatment areas.

Groundwater sampling of up to 15 existing monitoring wells (upgradient, downgradient and within the impacted area) would be completed and include a baseline (pre-injection) event, post pilot test event, and post-injection event. Based on experience at similar sites, a two-day injection pilot test (roughly 2,000 pounds of EVO and whey) will be conducted prior to completing targeted injections. Following completion of the pilot study, and interpretation of the data, the targeted injection event would be conducted. Based on the size of the treatment area, effective porosity of 20 percent, and natural oxidant demand, approximately 30,000 pounds of EVO, whey (or alternative), and appropriate bioaugmentation would be injected over a four-week period.

Following completion of the injection activities, it is assumed the project would transition to an MNA phase, at which time groundwater sampling would move to an annual basis using the same 15 monitoring wells sampled pre- and post-injection. Annual monitoring would continue for ten years under this alternative with a more robust monitoring program completed every five years. Assuming this remedial alternative is able to achieve a one-order magnitude reduction in COCs following treatment, higher than anticipated concentrations will remain at MW-02S and MW-09S during this ten-year period as rebound or incomplete dechlorination of the COCs is likely. The COC rebound and cis-1,2-DCE/vinyl chloride stall was observed in these two wells approximately ten years following the on-site injections suggesting an additional injectate is warranted and/or may require incorporating

alternatives to mitigate the stall (refer to **Section 1.5.2.6**). Under this scenario, it would take an average period of approximately 56 years until GWQS were fully met in all wells, but may take much longer (see **Appendix A.3**)

For purposes of cost estimating in this FS, and to achieve reaching GWQS sooner, it has been assumed, approximately 50 percent of the original injection volume will be injected after the initial ten year period to facilitate achieving an additional order magnitude reduction in COCs within the target areas shown on **Figure 11**. A third injection will be completed in year 20 using approximately 25 percent of the original injection volume to maintain appropriate conditions in the subsurface and to achieve GWQS in a shorter time period and presumably an additional order magnitude reduction (three order magnitude reduction overall). It is estimated that GWQS may be achieved within the 30-year period provided the injections are repeated every ten years.

For the purposes of estimating costs in this FS, annual monitoring would continue for an additional 10 years (years 10 through 20), and then reduce to semi-annual monitoring for the last ten years (years 20 through 30) to assess the effectiveness of the remedy with robust five-year monitoring periods.

4.3.6 Alternative GW-6: Soil Vapor Extraction & Air Sparging (Horizontal Configuration)

Alternative GW-6 includes the following technologies retained from the screening conducted in **Section 3**: institutional controls, AS/SVE, and MNA. Under this alternative, treatment of groundwater would be accomplished by introducing air into horizontal wells below/at the base of impacted groundwater, causing the COCs to volatilize where they are subsequently collected via horizontal SVE wells located above the groundwater table. Trenching will be used to connect the wells to a single AS/SVE system enclosure equipped with appropriately sized blowers, monitoring equipment and discharge treatment technology, if warranted. The system enclosure would likely be located just west of Sycamore Street within the impacted area shown on **Figure 6.** Although an AS/SVE system could be designed using vertical wells, the horizontal configuration was retained for analysis in this FS since it would use fewer well points and require less trenching compared to a vertical configuration.

Under this alternative, groundwater sampling of up to 15 existing monitoring wells (upgradient, downgradient and within the impacted area) would be completed and include a baseline event prior to system operation. Additionally, a pilot test would be required to evaluate the ROI of the AS and SVE wells, as well as to further understand the geology and hydrogeology of the impacted area.

Under this alternative the entire impacted area would be treated including approximately 338 feet by 126 feet area east of Sycamore Street and 905 feet by 184 feet west of Sycamore Street. For air sparging, assuming a ROI of 20 feet, nine AS wells, each approximately 1,250 linear feet (LF) in length would be required for the planned treatment area. The AS wells would be installed to a depth of approximately 45 ft bgs. For soil vapor extraction, assuming a ROI of 40 feet, four SVE wells, each approximately 950 LF in length would be required. The horizontal SVE wells would be installed above the water table at a depth of approximately 4.5 ft bgs. Minimal trenching would be required under this alternative to connect each well to the AS/SVE system enclosure (approximately 200 LF). The number of wells, locations, and screened intervals would be finalized during detailed design based on results from the pilot study.

Following construction of the AS/SVE system, the project would transition to an operation, monitoring and maintenance phase. For cost estimating purposes in this FS, it was assumed the system would operate for five years and then be shut off. During the operational period, it is assumed bi-monthly visits are necessary to ensure system efficiency. Annual groundwater sampling events using the same 15 monitoring wells sampled during the baseline monitoring event will be completed for the first 15 years followed by monitoring every other year for years 16 through 25. A more robust monitoring program would be conducted every five years over a twenty-five-year period (5-year, 10-year, 15-year, 20-year, and 25-year). During each sampling event, wells would be monitored for COCs, until SCGs for groundwater were met. Assuming this remedial alternative is able to achieve

a two-order magnitude reduction in COCs following treatment, a period of approximately 25 years would be estimated until SCGs were fully met (see **Appendix A.4**). Further assessment of this duration would be conducted during the design, and after the implementation of the remedy.

4.4 Remedial Alternative Cost Estimates

In accordance with DER-10, estimates have been developed for the remedial action costs that would be required for construction and implementation of the alternatives listed in **Section 4.3**. For each alternative, these estimates account for:

- All direct and indirect capital and engineering costs, including labor, materials, equipment, land purchase costs, etc.
- Costs associated with Institutional Controls that may be required for a remedy, including associated legal, administrative, and capital costs
- Long-term costs associated with remedy monitoring
- Remedial costs normalized to represent net present worth

Cost estimates for alternatives listed in **Sections 4.3** are presented in **Appendix B** and summarized for comparison purposes in **Table 4**. In estimating costs for each of the remedial alternatives under consideration, several assumptions were made, based on engineering judgment and practices. Assumptions for each alternative are documented on the associated estimate sheet in **Appendix B**.

4.4.1 Social Costs

NYSDEC has established a Value of Carbon guidance to be used by State entities to aid decision-making and for the State to demonstrate the global societal value of actions to reduce greenhouse gas emissions in line with the requirements of the Climate Leadership and Community Protection Act (NYSDEC 2025b). Social cost values for the Ash Road off-site area were calculated for carbon dioxide, methane, and nitrous oxide for each alternative since these are the primary greenhouse gases that will be generated as part of the remedial action. **Table 5** shows the social costs for the proposed remedial alternatives in 2020 dollars per metric ton over the lifetime of each alternative. The detailed calculations for social costs are included in **Appendix C**.

Alternative GW-6 (SVE/AS) had the highest social cost, at approximately $115 million using an average of discount rates. Elevated social costs associated with this alternative are driven by the electricity requirement to operate the system for five years. Alternatives GW-2 and GW-5 had the next-highest social costs at approximately $2.9 million and $3.3 million, respectively, using the average of discount rates. Alternatives GW-3 and GW-4 had the lowest social costs, at approximately $2.6 million and $2.7 million, respectively, using the same discount rate. The social costs associated with GW-3 and GW-4 are slightly lower than GW-2 and GW-5 due to a shorter MNA period and fewer injections. There are no social costs under Alternative GW-1 since no work is planned for the “no-action” scenario.

For all alternatives, carbon dioxide has the highest emissions; however, nitrous oxide is the most significant driver of social cost based on the discount rates applied. Sources of greenhouse gases would include construction equipment (e.g., drilling rigs, skid steer) for well installation, trucking and hauling emissions for disposal of investigation derived waste, delivery of injectate, and personnel vehicles used to complete MNA monitoring under each alternative.

4.5 Climate Change Vulnerability Assessment

Climate change will impact the long-term and cost-effectiveness of the proposed alternatives, and will have implications for the design of the selected remedy. A climate change vulnerability assessment has therefore been performed for the proposed alternatives for the Ash Road off-site area.

4.5.1 Footprint Analysis

Parsons utilized the Spreadsheets for Environmental Footprint Analysis (SEFA) developed by the USEPA to quantify the environmental footprint for each alternative. The footprint analysis for each alternative is included in **Table 6**. The detailed summary tables are included in **Appendix D**.

In general, alternative GW-6 (SVE/AS/MNA) had the highest carbon footprint based on carbon dioxide equivalents at approximately 3,576 tons and is primarily based on the electrical requirement to operate the system for five years. Alternative GW-4 (EISB/MNA) had the second highest carbon footprint (428 tons) followed by GW-3 (ISCO/MNA) at 277 tons. The carbon dioxide equivalents under alternative GW-4 are larger because a greater volume of injectate is required under this alternative compared to GW-3, resulting in more deliveries to the site correlating to increased vehicle emissions. Additionally, the larger injectate volume under GW-4 requires a longer injection period, further contributing to increased emissions. Except for MNA (GW-2), carbon dioxide equivalents under alternative GW-5 (targeted EISB/MNA) were the lowest at 204.8 tons.

4.5.2 Climate Exposure Assessment

The following climate change vulnerabilities were assessed for the Ash Road off-site area using the New York State Energy Research & Development Authority (NYSERDA) New York State Climate Impacts Assessment (NYSERDA 2024). These vulnerabilities will be considered in the design phase of the selected remedy in order to most effectively meet the RAOs. **Table 7** shows the relative sensitivity of each alternative to the vulnerabilities below.

4.5.2.1 Precipitation

Precipitation across New York State is projected to increase by between 6 and 17 percent by the end of the century. This increase in precipitation is not anticipated to negatively impact the remedial alternatives proposed; however, increased precipitation may “flush” injectates through the remediation area quicker. Additionally, for alternative GW-6 (AS/SVE), increased precipitation will likely lead to increased operation and maintenance costs to manage larger volumes of condensate which tend to accumulate following large rain events. Lastly, increased precipitation under GW-1 or GW-2 could result in increased mobility of contaminants and subsequently, increased risk of exposure to contamination.

4.5.2.2 Temperature

Average temperatures are projected to increase in all regions of the state. Temperatures are projected to rise between 5- and 11-degrees Fahrenheit (°F) by the end of the century. All four seasons are projected to continue warming across all regions of the state. Winter temperatures are projected to increase between 3.9 and 8.2°F by the middle of the century and between 5.5 and 12.5°F by the end of the century. Days above 90°F and days above 95°F are projected to become more common across all regions of New York. Multiday heat waves are expected to occur more often and last longer in the decades ahead. The number of days with a heat index above 85°F and the number of days with a heat index above 95°F are expected to increase across the state. So is the maximum heat index. New York City, Albany, Buffalo, and Rochester are projected to see some of the largest

increases. These increased temperatures will increase the risk of heat-related illnesses for field staff who will be performing groundwater monitoring as part of Alternatives (GW-2, GW-3, GW-4, and GW-5) in addition to SVE/AS system monitoring and maintenance (GW-6).

The number of days per year with temperatures below 0°F are projected to decrease across the state. The number of days per year below freezing (32°F) are also projected to decrease. The decrease in days with temperatures below freezing will decrease risks associated with icy pavement.

4.5.2.3 Extreme Events

Heavy rainstorms are projected to happen more often and become more intense as the climate continues to warm. High winds and flooding from hurricanes and tropical storms are expected to increase. While the number of hurricanes and tropical storms might not increase, storms that do form are projected to be stronger and shift farther north. Nor'easters are difficult to project, but models suggest they could become more intense. These extreme weather events will increase risks associated with hazardous travel conditions, and may also lead to disruptions in electricity service that would result in disruptions to the SVE/AS system operation in GW-6.

Long multiyear droughts are not expected to increase in New York State. However, short-term seasonal droughts lasting weeks or months could increase, especially in the summer. This is because of precipitation falling in more intense bursts with longer dry spells in between, as well as higher temperatures in the summer causing more water to evaporate. Reduced snow cover can also play a role, as soils dry out sooner when snow melts earlier.

4.5.2.4 Rivers

The Ash Road off-site area is located approximately 1,946 feet south of the Susquehanna River. The site is located within Zone C (areas of minimal flooding) as shown on a 1984 Flood Insurance Rate Map (FEMA, 1984).

Higher river flows are projected in the northeastern United States in the winter due to wetter conditions. Extreme inland floods are also projected to become larger and more intense in general. Risks associated with flooding may pose future impacts to the Site, despite the site currently designated as being in an area with minimal flooding.

4.6 Evaluation of Remedial Alternatives for Groundwater

In this section, an analysis of the remedial alternatives described in **Section 4.3**, with respect to each of the evaluation criteria presented in **Section 4.2**, is presented.

4.6.1 Alternative GW-1: No Action

4.6.1.1 Overall Protection of Human Health and the Environment

This alternative would be considered protective of the environment, as would all other alternatives, since there is no evidence of groundwater at the site discharging to surface water at concentrations above Class GA standards or causing other significant environmental impacts.

COCs present in site groundwater are known to naturally degrade, and evidence suggests this is occurring at the ARP off-site area since COC concentrations are generally decreasing over time, although complete dechlorination seems unlikely based on the accumulation of select degradation products (cis-1,2-DCE in PMW-09, MW-02S and MW-09S; and vinyl chloride in MW-02S and MW-09S). However, this alternative would not be considered an effective means of achieving the RAOs for the Site and would not be protective of human health. Any naturally occurring degradation of the impacted groundwater plume would continue and would eventually result in

compliance with site SCGs. As presented in Section 3.5.3.1, the average timeline for this natural degradation to occur is 97 years and is longer than the typical 30-year monitoring period associated with remedy implementation. Under this alternative, there would be no institutional controls in place to prevent future exposure to impacted groundwater.

4.6.1.2 Compliance with SCGs (GW-1)

Since no action would be taken, any action-specific or location-specific SCGs would be met. Compliance with chemical-specific SCGs may eventually be met. However, this would be dictated by the pace of naturally occurring biodegradation process that may be in place, which are estimated to take on average 97 years. Under this alternative, this process and compliance with SCGs would not be monitored.

4.6.1.3 Long-Term Effectiveness (GW-1)

This alternative would not provide significant long-term effectiveness, since the potential for transport and migration of contaminants would not be eliminated, and potential exposure routes would go unaddressed. On-going impacts of groundwater would be unmitigated.

4.6.1.4 Reduction of Toxicity, Mobility, or Volume Through Treatment (GW-1)

The toxicity and volume of site contaminants in groundwater would continue to be reduced slowly over time from on-going natural attenuation. Mobility of contaminants would not be reduced.

4.6.1.5 Short-Term Effectiveness (GW-1)

Implementation of this remedy would have no effect on the community as no action would occur. Current potential direct exposure to site groundwater is minimal.

4.6.1.6 Implementability (GW-1)

A *no action* alternative is implementable.

4.6.1.7 Cost (GW-1)

No capital or O&M costs are associated with this alternative.

4.6.1.8 Land Use (GW-1)

This alternative would allow for the present and anticipated future use of the ARP off-site and surrounding area to continue unhindered.

4.6.2 Alternative GW-2: MNA

4.6.2.1 Overall Protection of Human Health and the Environment (GW-2)

This alternative would be considered protective of the environment since there is no evidence of groundwater at the site discharging to surface water at concentrations above Class GA standards or causing other significant environmental impacts.

COCs present in site groundwater are known to naturally degrade, and evidence suggests this is occurring at the ARP off-site area since COC concentrations are generally decreasing over time, although complete dechlorination seems unlikely based on the accumulation of select degradation products (cis-1,2-DCE in PMW-09, MW-02S and

MW-09S; and vinyl chloride in MW-02S and MW-09S). This alternative would be considered protective of human health, since potential human health impacts are minimal and would be addressed by institutional controls. Under this alternative, institutional controls would be implemented to prevent future exposure to impacted groundwater (e.g., an environmental easement to prevent the installation of a groundwater well and to set restrictions on excavation and other construction activities where workers could come into contact with contaminated groundwater). Naturally occurring degradation of the impacted groundwater plume would continue, and would eventually result in compliance with site SCGs, as presented in Section 3.5.3.1, although the timeline for this degradation to occur may be on average 97 years.

4.6.2.2 Compliance with SCGs (GW-2)

For Alternative GW-2, since no active remedial action would be taken, any action-specific or location-specific SCGs would be met. Compliance with chemical-specific SCGs would eventually be met. This process would be dictated by the pace of natural attenuation, which is estimated to take on average 97 years at all locations. Under this alternative, this process and compliance with SCGs would be monitored.

4.6.2.3 Long-Term Effectiveness (GW-2)

This alternative would not provide acceptable long-term effectiveness, since the potential for transport and migration of contaminants would not be eliminated, but natural attenuation would continue to degrade COCs over time. Institutional controls would mitigate some potential exposure routes. Institutional controls would not be effective in mitigating on-going impacts of contaminants in groundwater.

4.6.2.4 Reduction of Toxicity, Mobility, or Volume Through Treatment (GW-2)

The toxicity and volume of site contaminants in groundwater would continue to be reduced slowly over time from on-going natural attenuation. Mobility of contaminants would not be reduced.

4.6.2.5 Short-Term Effectiveness (GW-2)

Implementation of this remedy would have minimal effect on the community and would be unlikely to result in human exposures, adverse environmental impacts, or nuisance conditions. Current potential direct exposure to site groundwater is minimal.

4.6.2.6 Implementability (GW-2)

This alternative would be implementable. Application of institutional controls would require legal counsel, and property owner consent, but they are implementable.

4.6.2.7 Cost (GW-2)

Total estimated present value cost for this alternative is $967,000. Table 4 summarizes costs estimated for this alternative. Appendix B provides the cost spreadsheets and other assumptions that form the basis for this cost estimate.

4.6.2.8 Land Use (GW-2)

This alternative would allow for the present and anticipated future use of the ARP off-site and surrounding area to continue unhindered.

4.6.3 Alternative GW-3: In Situ Chemical Oxidation / MNA

4.6.3.1 Overall Protection of Human Health and the Environment (GW-3)

This alternative would be considered protective of the environment since there is no evidence of groundwater at the site discharging to surface water at concentrations above Class GA standards or causing other significant environmental impacts.

This alternative would likely be an effective means of achieving the RAOs for the ARP off-site area, and also would likely be protective of human health. The introduction of the oxidants into the subsurface would destroy existing contaminants, leaving environmentally benign by-products. On-going natural degradation processes that may be in place downgradient of the treatment area would continue. An MNA period would gauge degradation trends until SCGs have been met. Institutional controls would be put into place to prevent future direct exposure to impacted groundwater until SCGs are achieved.

4.6.3.2 Compliance with SCGs (GW-3)

Based on experience at numerous similar sites, and analysis of conditions at the ARP off-site area, it is expected that chemical-specific SCGs would be met following one full-scale injection, followed by a second round of injections, 10 years later, using 50 percent of the original injection volume, coupled with MNA over a 17-year period. Implementation in compliance with action-specific and location-specific SCGs would also be expected of the remedial action contractor.

4.6.3.3 Long-Term Effectiveness (GW-3)

Following two rounds of treatment and MNA, this alternative would provide long-term effectiveness, as contaminants present in and around the ARP off-site area should be permanently eliminated within an average timeframe of 17 years based on first order attenuation rate constant calculations (Appendix A.2). Potential exposure of contaminated groundwater is low, and the use of institutional controls would be implemented to further reduce potential exposures until SCGs are met.

4.6.3.4 Reduction of Toxicity, Mobility, or Volume Through Treatment (GW-3)

The toxicity, mobility, and volume of contamination would be reduced by the oxidation process introduced into the subsurface by this alternative and would continue during the MNA process until SCGs have been met.

4.6.3.5 Short-Term Effectiveness (GW-3)

It is anticipated that three injection events (one pilot event, one full-scale event, and one event at 50 percent) would be required for this alternative. A series of injection wells would be required to inject oxidants into the groundwater. It is anticipated that these injection wells would be installed in the ARP off-site area and would not impact public accessibility to roads, sidewalks, etc. However, well installation may result in increased noise and traffic within the surrounding community during the construction period. Additionally, well installation may disrupt adjacent businesses as construction would take place in active parking lots. Construction safety risk would need to be addressed through the development and implementation of a health and safety plan in accordance with Occupational Safety and Health Administration (OSHA) requirements. Injections would require careful planning and execution to limit off gasses or daylighting of the injected media, which could cause concern with the local community. Potential risks to underground utilities due to oxidants would need to be mitigated through the design process, and through additional steps taken during implementation.

Implementation of the MNA phase of the project would be unlikely to result in human exposures or adverse environmental impacts.

4.6.3.6 Implementability (GW-3)

This alternative would be implementable. Access agreements would be required for short-term periods for injection events, and in the long-term access to monitoring wells for MNA. Experienced personnel, equipment, and materials needed for this alternative are readily available due to the relative widespread use of this technology at other remediation sites. Monitoring activities associated with MNA are routine, and similar to sampling activities that have taken place at this site as part of the RI. Application of institutional controls would require legal counsel, and property owner consent, but they are implementable.

4.6.3.7 Cost (GW-3)

Total estimated present value cost for this alternative is $6,495,000. Table 4 summarizes costs estimated for this alternative. Appendix B provides the cost spreadsheets and other assumptions that form the basis for this cost estimate.

4.6.3.8 Land Use (GW-3)

This alternative would lead to a moderate impact on current land use during well installation by temporarily reducing the capacity of the parking lot. Following well installation, this alternative would allow for the present, and anticipated future use of the ARP off-site and surrounding area to continue unhindered except during periods of injection and scheduled groundwater monitoring events.

4.6.4 Alternative GW-4: Enhanced Bioremediation / MNA

4.6.4.1 Overall Protection of Human Health and the Environment (GW-4)

This alternative would be considered protective of the environment since there is no evidence of groundwater at the site discharging to surface water at concentrations above Class GA standards or causing other significant environmental impacts. This alternative would likely be an effective means of achieving the RAOs for the ARP off-site area and would therefore likely be protective of human health. The introduction of the injected substrate into the subsurface would expedite and enhance the natural degradation processes that are already occurring. On-going natural degradation processes that may be in place downgradient would continue. A long-term monitoring program would gauge degradation trends until SCGs have been met. Institutional controls would be put into place to prevent future direct exposure to impacted groundwater until SCGs are achieved.

4.6.4.2 Compliance with SCGs (GW-4)

Based on experience at numerous similar sites, and analysis of conditions at the ARP off-site area, it is expected that chemical-specific SCGs would be met following one full-scale injection, followed by a second round of injections, 10 years later, coupled with MNA over a 17-year period. Implementation in compliance with action-specific and location-specific SCGs would also be expected of the remedial action contractor.

4.6.4.3 Long-Term Effectiveness (GW-4)

Following treatment and MNA, this alternative would provide long-term effectiveness, as contaminants present in and around the ARP off-site area would be permanently eliminated within an average timeframe of 17 years based on first order attenuation rate constant calculations (Appendix A.2). Potential exposure of contaminated groundwater is low, and the use of institutional controls would be implemented to further reduce potential exposures until SCGs are met.

4.6.4.4 Reduction of Toxicity, Mobility, or Volume Through Treatment (GW-4)

The toxicity, mobility, and volume of contamination would be reduced by the degradation process introduced into the subsurface by this alternative and would continue during the MNA process until SCGs have been met.

4.6.4.5 Short-Term Effectiveness (GW-4)

It is anticipated that three injection events (one pilot event, one full-scale event, and one event at 50 percent) would be required for this alternative. A series of wells would be required to inject the media into the groundwater. It is anticipated that these injection wells would be installed in the ARP off-site area, and would not impact public accessibility to roads, sidewalks, etc. However, well installation may result in increased noise and traffic within the surrounding community during the construction period. Additionally, well installation may disrupt adjacent businesses as construction would take place in active parking lots. Construction safety risk would need to be addressed through the development and implementation of a health and safety plan in accordance with OSHA requirements. Injections would require careful planning and execution to limit methane that would be generated as a result of the biodegradation process. While this would not limit the effectiveness of the remedy, it may pose a concern if it accumulates in soil vapor adjacent to businesses in the vicinity. This generation can be reduced through deliberate formulation of the substrate, and can be monitored during implementation, but cannot be fully eliminated.

Implementation of the MNA phase of the project would be unlikely to result in human exposures or adverse environmental impacts.

4.6.4.6 Implementability (GW-4)

This alternative would be implementable. Access agreements would be required for short-term periods to install wells and inject the substrate, and in the long-term access to monitoring wells for MNA. Experienced personnel, equipment, and materials needed for this alternative are readily available due to the relative widespread use of this technology at other remediation sites. Monitoring activities associated with MNA are routine, and similar to sampling activities that have taken place at this site as part of the RI. Application of institutional controls would require legal counsel, and property owner consent, but are implementable.

4.6.4.7 Cost (GW-4)

Total estimated present value cost for this alternative is $7,425,000. Table 4 summarizes costs estimated for this alternative. Appendix B provides the cost spreadsheets and other assumptions that form the basis for this cost estimate.

4.6.4.8 Land Use (GW-4)

This alternative would lead to a moderate impact on current land use during well installation by reducing the capacity of the parking lot. Following well installation, this alternative would allow for the present, and anticipated future use of the ARP off-site and surrounding area to continue unhindered except during periods of injection and scheduled groundwater monitoring events.

4.6.5 Alternative GW-5: Targeted Enhanced Bioremediation and MNA

4.6.5.1 Overall Protection of Human Health and the Environment (GW-5)

This alternative would be considered protective of the environment since there is no evidence of groundwater at the site discharging to surface water at concentrations above Class GA standards or causing other significant environmental impacts.

This alternative would likely be an effective means of achieving the RAOs for the ARP off-site area and would therefore likely be protective of human health. The introduction of the injected substrate into the subsurface would expedite and enhance the natural degradation processes that are already occurring. On-going natural degradation processes that may be in place downgradient would continue. A long-term monitoring program would gauge degradation trends until SCGs have been met. Institutional controls would be put into place to prevent future direct exposure to impacted groundwater until SCGs are achieved.

4.6.5.2 Compliance with SCGs (GW-5)

Based on experience at numerous similar sites, and analysis of conditions at the ARP off-site area, it is expected that chemical-specific SCGs would be met following three injection events spaced at 10 year intervals (year 0, 10, and 20) with injection volumes at 100 percent, 50 percent, and 25 percent, respectively. The injections would be followed by MNA over a 27-year period. Implementation in compliance with action-specific and location-specific SCGs would also be expected of the remedial action contractor.

4.6.5.3 Long-Term Effectiveness (GW-5)

Following treatment and an MNA period, this alternative would provide long-term effectiveness, as contaminants present in and around the ARP off-site area would be permanently eliminated within an average timeframe of 27 years based on first order attenuation rate constant calculations (Appendix A.2). The targeted treatment will not fully address the vapor intrusion pathway in areas where injections did not occur; however, the potential exposure of contaminated groundwater is low outside the treated areas, and the use of institutional controls would be implemented to further reduce potential exposures until SCGs are met.

4.6.5.4 Reduction of Toxicity, Mobility, or Volume Through Treatment (GW-5)

The toxicity, mobility, and volume of contamination would be reduced by the degradation process introduced into the subsurface by this alternative and would continue during the MNA process until SCGs have been met.

4.6.5.5 Short-Term Effectiveness (GW-5)

It is anticipated that one pilot injection for vegetable oil/whey blend (or equivalent alternative), one full-scale injection EVO/whey blend, a second injection at 50 percent of the original volume, and a third injection at 25 percent of the original volume would be required for this alternative. A series of injection wells would be required to inject substrate into the groundwater. It is anticipated that these injection points would be installed in the ARP off-site area and would not impact public accessibility to roads, sidewalks, etc. However, well installation may result in increased noise and traffic within the surrounding community during the construction period. Additionally, well installation may disrupt adjacent businesses as construction would take place in active parking lots. Construction safety risk would need to be addressed through the development and implementation of a health and safety plan in accordance with OSHA requirements. Injections would require careful planning and execution to limit off gasses or daylighting of the injected media, which could cause concern with the local community, and limit methane that would be generated as a result of the biodegradation process. While methane generation would not limit the effectiveness of the remedy, it may pose a concern if it accumulates in soil vapor

adjacent to businesses in the vicinity. This generation can be reduced through deliberate formulation of the substrate, and can be monitored during implementation, but cannot be fully eliminated.

Implementation of the MNA phase of the project would be unlikely to result in human exposures or adverse environmental impacts.

4.6.5.6 Implementability (GW-5)

This alternative would be implementable. Access agreements would be required for short-term periods to install wells and for injection events, and in the long-term access to monitoring wells for MNA. Experienced personnel, equipment, and materials needed for this alternative are readily available due to the relative widespread use of these technologies at other remediation sites. Monitoring activities associated with MNA are routine, and similar to sampling activities that have taken place at this site as part of the RI. Application of institutional controls would require legal counsel, and property owner consent, but they are implementable.

4.6.5.7 Cost (GW-5)

Total estimated present value cost for this alternative is $3,530,000. Table 4 summarizes costs estimated for this alternative. Appendix B provides the cost spreadsheets and other assumptions that form the basis for this cost estimate.

4.6.5.8 Land Use (GW-5)

This alternative would lead to a moderate impact on current land use during well installation by reducing the capacity of the parking lot. Following well installation, this alternative would allow for the present, and anticipated future use of the ARP off-site and surrounding area to continue unhindered except during periods of injection and scheduled groundwater monitoring events.

4.6.7 Alternative GW-6: Soil Vapor Extraction / Air Sparging (Horizontal Configuration)

4.6.7.1 Overall Protection of Human Health and the Environment (GW-6)

This alternative would be considered protective of the environment since there is no evidence of groundwater at the site discharging to surface water at concentrations above Class GA standards or causing other significant environmental impacts.

The introduction of air into the groundwater would volatilize the COCs, which would subsequently be collected by soil vapor extraction wells before the impacted air reaches the surface; therefore, there would be no human exposure to contamination. Ongoing natural attenuation processes that may be in place would continue after completion of the AS/SVE program. An MNA period would gauge degradation trends until SCGs have been met, and institutional controls would be put into place to prevent future direct exposure to impacted groundwater.

4.6.7.2 Compliance with SCGs (GW-6)

It is expected that chemical-specific SCGs would be met following five years operation of the AS/SVE system and furthered by natural attenuation. Implementation in compliance with action-specific and location-specific SCGs would be required by the remedial contractor and would be detailed in the remedial design and remedial action work plan that would be prepared.

4.6.7.3 Long-Term Effectiveness (GW-6)

Following operation of the AS/SVE system for a five-year period followed by natural attenuation, this alternative would provide long-term effectiveness, as contaminants present in and around the ARP off-site area would be permanently eliminated within an average timeframe of 25 years based on first order attenuation rate constant calculations (Appendix A.2). Potential exposure of contaminated groundwater is low, and the use of institutional controls would be implemented to further reduce potential exposures until SCGs are met.

4.6.7.4 Reduction of Toxicity, Mobility, or Volume Through Treatment (GW-6)

The toxicity, mobility, and volume of contamination would be reduced by the AS/SVE process and would continue during the MNA process until SCGs have been met.

4.6.7.5 Short-Term Effectiveness (GW-6)

This alternative would involve the trenching and installation of horizontal AS and SVE wells, as well as establishment of staging area for the AS/SVE equipment and a longer-term location for the system enclosure. During trenching and installation activities, road closures and utility relocations might be required to complete this alternative, which would require significant planning and coordination with numerous public entities. Additionally, well installation may disrupt adjacent businesses as construction would take place in active parking lots. Public and construction worker health and safety would need to be addressed under this alternative by developing and implementing a health and safety plan in accordance with OSHA requirements.

Under this alternative, potential dust and volatile emissions, construction water, and soil would need to be properly managed to minimize short-term risks associated with migration of constituents.

Implementation of the MNA phase of the project would be unlikely to result in human exposures or adverse environmental impacts.

4.6.7.6 Implementability (GW-6)

This alternative would be implementable. Access agreements would be required for short-term periods to install wells and complete trenching, and in the long term, access to monitoring wells for MNA. Experienced personnel, equipment, and materials needed for this alternative are readily available due to the relative widespread use of these technologies at other remediation sites. Installation of the AS wells may be more difficult to implement due to the depths required (45 ft bgs). Air modeling would be required as part of the remedial design to evaluate the need to treat effluent vapors from the system discharge to ensure compliance with NYSDEC Division of Air Resources (DAR) emission contaminant guidelines.

Monitoring activities associated with MNA are routine, and similar to sampling activities that have taken place at this site as part of the RI. Application of institutional controls would require legal counsel, and property owner consent, but they are implementable.

4.6.7.7 Cost (GW-6)

Total estimated present value cost for this alternative is $8,192,000. Table 4 summarizes costs estimated for each alternative. Appendix B provides the cost spreadsheets and other assumptions that form the basis for this cost estimate.

4.6.7.8 Land Use (GW-6)

This alternative would lead to a high impact on current land use, as trenching, well installation, and establishment of the staging area would reduce the capacity of the parking lot. Following trenching and well

installation, only the staging area would remain, which would only minimally reduce the parking capacity of the lot. Lower impact to land use would occur during subsequent monitoring or system maintenance events.

4.6 Comparative Analysis of Groundwater Alternatives

A comparative analysis between the groundwater remedial alternatives is presented in the following sections. In order for an alternative to be considered for selection, the first two criteria must be met.

4.6.1 Overall Protection of Human Health and the Environment

All alternatives are protective of the environment, since there is no evidence of groundwater at the site discharging to surface water at concentrations above Class GA standards or causing other significant environmental impacts.

Although potential risks to human health from groundwater are minimal, Alternative GW-1 would not be protective of human health, as impacted groundwater would remain in place without institutional controls and would remain unmitigated. Therefore, Alternative GW-1 will not be considered further.

Alternative GW-2 would be considered protective of human health since potential exposures would be mitigated by the emplacement of institutional controls.

Alternatives GW-3, GW-4, GW-5, and GW-6 would satisfy this criterion, as each would result in the elimination or destruction of the highest levels of contamination in groundwater. Lower levels of contamination downgradient of the targeted treatment/removal areas would continue to naturally attenuate.

4.6.2 Compliance with SCGs

Alternative GW-2 would not immediately result in compliance with SCGs, although it would eventually meet the SCGs as natural attenuation continues to occur.

Alternatives GW-3, GW-4, GW-5, and GW-6 rely on active remedial approaches and long-term monitoring to achieve SCGs. Treatment under these alternatives would rapidly address highest levels of contamination, and a period of MNA would be implemented to monitor conditions downgradient where treatment would be less effective. It is estimated compliance with SCGs at all monitoring wells would be achieved on average, within 97 years under GW-2, 27 years under GW-5, 25 years under GW-6, and 17 years under GW-3 and GW-4.

4.6.3 Long-Term Effectiveness

Alternative GW-2 would be expected to eventually achieve long-term effectiveness, with groundwater concentrations estimated to degrade below SCGs at all well locations in approximately 97 years. The concentrations of contaminants in groundwater in the ARP off-site area are such that in situ treatment (ISCO and/or enhanced biodegradation) would be expected to have comparable long-term effectiveness over an estimated 17 years.

Alternatives GW-3, GW-4, and GW-6 would involve active remediation to the entire impacted area, whereas GW-5 would be limited to areas with total CVOCs greater than 300 µg/L. Each of these alternatives would rely on MNA to continue contaminant mass reduction following treatment. Additionally, under GW-5, the vapor intrusion exposure pathway would not fully be resolved in untreated areas and would rely on institutional controls.

4.6.4 Reduction of Toxicity, Mobility, or Volume Through Treatment

Alternative GW-2 would result in gradual reduction of toxicity and volume as natural attenuation continues to occur. Alternatives GW-3, GW-4, GW-5 and GW-6 would result in a significant reduction of toxicity, mobility, and volume through treatment in the fastest time period compared to GW-2.

For the purpose of this FS, it was assumed the total CVOC concentration in the impacted area could be reduced by two orders magnitude for Alternatives GW-3, GW-4, and GW-6 and achieve SCGs on average within 17 years, 17 years, and 25 years, respectively. Alternative GW-3 (ISCO) would likely result in a more pronounced decline in groundwater concentrations as compared to GW-4 (EISB), as the permanganate would begin oxidizing COCs immediately upon injection. Alternative GW-4 would rely on the development of a biological culture following injections to reduce COC concentrations in groundwater, which would take a period of time. Alternative GW-2 would not reduce groundwater concentrations of COCs in the short-term and is expected to take on average 97 years. Alternative GW-5 is a best-fit option for remediating groundwater and achieving SCGs within a 24-year time period assuming three rounds of injection are able to achieve an overall reduction in COC concentrations of three-orders of magnitude.

4.6.5 Short-Term Effectiveness

Alternative GW-2 would have a minimal impact on the surrounding community, in that no active remedial work would take place in the community. Alternatives GW-3 and GW-4 would have some impact on the community, with the potential for some nuisance conditions relating to noise and traffic during injection well installation. Alternative GW-5 would have less impact on the community than the previous alternatives since fewer wells would require installation. Alternative GW-6 would have the least impact to the surrounding community as it requires the fewest number of wells to be installed and the required trenching is minimal.

Construction activities related to each alternative should avoid peak shopping seasons and times since the parking lots where the injection or AS/SVE wells are proposed for installation are actively used. Construction may have to take place at night or other off hours for any alternative. The location of utilities would need to be thoroughly investigated and some possibly relocated to implement each remedy.

Another consideration is that Alternatives GW-3 (through potential impacts to underground utilities), GW-4 and GW-5 (through potential for methane generation) have potential short-term effectiveness and safety risks. Although the potential for each can be reduced through the design process, the risk of methane generation in Alternatives GW-4 and GW-5 would have the potential for more significant short-term impacts than GW-3.

4.6.6 Implementability

Alternative GW-2 would require legal counsel, and property owner consent but is readily implementable. Alternatives GW-3, GW-4, GW-5, and GW-6 are readily implementable.

For the purposes of this FS, the construction footprint needed to implement GW-3, GW-4, GW-5, and GW-6 is assumed to be available on the ARP off-site area. Should conditions warrant expansion of injections beyond the ARP off-site area, the nature of the activities and the equipment typically employed are relatively small and would have significantly less impact on the surrounding community.

4.6.7 Cost

Based on cost estimates developed for this FS, Alternative GW-2 is the least costly option outside of no action. Alternative GW-6 is the most expensive cost option. Alternative GW-5 is the most cost effective and

technologically efficient option; however, FS cost estimates are prepared to an accuracy of -30 percent / +50 percent. This range accounts for the potential for additional variables that may be identified during later stages of the remedial design, which may change the cost to implement a remedy. These factors could conceivably impact the approach of one remedial alternative to a greater degree in comparison to another alternative. Considering this range, potential costs associated with Alternatives GW-3, GW-4, GW-5, and GW-6 overlap, and can be considered comparable, although significantly more costly than Alternative GW-2 and to a lesser extent GW-5.

4.6.8 Land Use

Each alternative would impact present use of the site during implementation of the remedy but would ultimately allow for anticipated future use of the site.

5.0 RECOMMENDED REMEDIAL ACTION ALTERNATIVE

Based on the analysis of alternatives presented in Section 4, Parsons recommends implementing Alternative GW-5 – *Targeted Enhanced Bioremediation and MNA* to remediate groundwater at the ARP off-site area. This alternative would provide for a proactive and rapid reduction of COCs in the impacted area with the highest levels of COCs in groundwater (greater than 300 µg/L). **Figure 11** presents a conceptual layout for the anticipated injection locations. Although the estimated cost of this alternative is higher than GW-2, it is considerably less than the remaining alternatives, provides a greater immediate reduction in COC concentrations in groundwater (compared to GW-2), has the potential for faster compliance with SCGs (compared to GW-2), and has reduced short-term impacts associated with installing fewer wells or trenching requirements (compared to Alternatives GW-3, GW-4, and GW-6) making it the most protective alternative.

To implement Alternative GW-5, the subsurface would be prepared to receive substrate in liquid form. A pilot test would be conducted to confirm treatment effectiveness and design the remedy. During implementation, the EVO/whey or equivalent alternative would be added during one injection followed by the monitoring of ongoing natural attenuation of the plume downgradient. A second round of injections using 50 percent of the original injection volume would be implemented after 10 years and a third round of injections using 25 percent of the original injection volume after 20 years. Repeat injections are recommended to allow more rapid and cost-effective achievement of SCGs. It is recommended that the PRAP include language to allow for the consideration of adaptive management in the treatment methodology during implementation.

Injections under this alternative would require bioaugmentation (addition of dehalococcoides and/or other alternatives) as data from the April 2025 sampling event show an insufficient quantity of DHc to support MNA or high rates of dechlorination. The absence of DHc indicates a lack of dechlorination or only partial reductive dechlorination to ethenes and is commonly associated with an increase in cis-1,2-DCE (currently seen in MW-09S). The April 2025 functional gene assay data also suggested the potential for increased concentrations of vinyl chloride and was observed in both the source area (MW-09S) and immediately downgradient (MW-02S, see **Section 1.5.4**). This data further necessitates bioaugmentation in the impacted targeted treatment areas to circumvent the cis-1,2-DCE and vinyl chloride stall. Groundwater monitoring would continue until RAOs are met.

Based on results from other sites and an analysis of the ARP off-site characteristics, Alternative GW-5 can meet the two threshold evaluation criteria of protecting human health and the environment at the site and complying with site SCGs. ISCO has been effectively implemented at other similar sites throughout New York. The estimated present value for Alternative GW-5T is $3,530,000. Except for MNA (GW-2), carbon dioxide equivalents under alternative GW-5 (targeted EISB/MNA) were the lowest at 204.8 tons.

As discussed, a pre-design investigation is recommended to provide additional data upon which the full-scale remediation would be designed. Implementation of Alternative GW-5 at the ARP off-site area will reduce the concentrations of COCs in groundwater, thereby reducing impacts to soil vapor, and potential for soil vapor intrusion, over time.

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TABLES

Table 1: Geochemistry Data
Ash Road Off-Site Feasibility Study
Vestal, NY

Well	Screen Interval[1]		Location with respect to source area	Approx. Distance from Source Area (ft.)[5]	Direction from Source Area[5]	Is Well Within Limits of Impacted Area?	Max CVOC Concentration[2] (ug/L)	Date	DTW[3]	Depth to Product (DNAPL)	DO[4]	pH[4]	ORP[4]	Temp.[4]	Spec. Cond.[4]	Turbidity[4]
	Top	Bottom							(ft.)		(mg/L)	(S.U.)	(mV)	(C)	(mS/cm)	(NTU)
MW-01	7.0	17.0	Downgradient	184	Northwest	Yes	270 (cis-1,2-DCE)	6/1/2015[6]	9.81	NM	0.9	6.62	178.6	11.44	2.086	NM
							19.3 (PCE)	2/26/2018	10.64	NM	2.80	6.61	128.4	12.80	2.341	NM
							14.7 (PCE)	10/24/2018	9.33	N/A	0.00	5.75	67.0	15.36	2.670	0.0
							16.2 (PCE)	2/7/2019	9.80	NM	2.74	6.19	147.1	12.95	2.790	NM
							14.5 (PCE)	4/6/2021	10.60	NM	2.12	6.37	147.3	11.90	1.379	NM
							16 (PCE)	4/21/2025	10.60	N/A	1.49	6.82	58.0	13.86	2.580	5.7
MW-2S	7.0	17.0	Downgradient	125	Northwest	Yes	3,000 (PCE)	6/1/2015[6]	8.41	NM	0.69	7.14	285.4	10.31	2.653	NM
							7.9 (PCE)	2/26/2018	8.76	NM	5.12	7.03	112.1	10.68	0.954	NM
							1.2 (PCE)	10/24/2018	6.18	N/A	1.00	6.99	88.0	13.49	1.380	0.0
							464 (PCE)	2/7/2019	8.35	NM	5.66	7.03	110.6	11.84	0.934	NM
							52.4 (PCE)	4/6/2021	9.21	NM	0.41	6.97	-118.4	10.30	1.002	NM
							9600 (PCE)	4/18/2025	9.22	N/A	0.60	7.39	15.0	13.96	3.540	10.7
MW-05	6.0	16.0	Up-gradient	414	East	No	109 (CB)	10/24/2018	6.96	N/A	0.00	6.07	-90.0	14.80	3.940	0.0
							170 (CB)	4/16/2025	7.76	N/A	0.47	7.13	-139.0	8.48	4.970	>1000
MW-9S	5.0	15.0	Source Area	0		Yes	2,300 (PCE)	6/1/2015[6]	7.3	NM	2.3	7.46	250.6	12.54	3.022	NM
							13.9 (cis-1,2-DCE)	2/26/2018	Not Measured	NM	6.03	7.01	-104.2	10.93	18.070	NM
							793 (cis-1,2-DCE)	10/25/2018	8.58	N/A	0.00	6.09	-42.0	14.75	7.270	24.3
							834 (VC)	2/7/2019	6.88	NM	3.26	6.40	-70.2	11.57	5.892	NM
							132 (VC)	4/6/2021	7.50	NM	0.32	6.36	-35.6	10.10	2.988	NM
							2500 (cis-1,2-DCE)	4/22/2025	7.57	N/A	0.47	6.95	-79.0	12.65	4.380	28.5
MW-10S	5.0	15.0	Downgradient	86	West	No	4.5 (PCE)	6/1/2015[6]	6.61	NM	0.97	7.37	255.5	13.26	3.022	NM
							Non-Detect	2/26/2018	5.98	NM	5.69	6.99	139.1	9.87	3.149	NM
							Non-Detect	2/7/2019	6.47	NM	5.92	7.04	106.1	10.50	1.881	NM
							Non-Detect	4/6/2021	6.74	NM	2.83	6.93	124.0	9.70	1.619	NM
							0.56 J (PCE)	4/21/2025	7.24	N/A	2.16	7.04	133.0	13.59	2.070	0.0
PMW-01	5.0	15.0	Downgradient	386	Northwest	No	Non-Detect	10/23/2018	7.72	N/A	0.41	6.67	85.0	16.62	3.660	125.0
							Non-Detect	8/13/2019	8.43	N/A	0.00	6.89	285.0	18.14	4.800	0.9
							Non-Detect	4/15/2025	9.01	N/A	1.41	7.15	99.0	15.06	2.950	4.1
PMW-02	4.5	14.5	Downgradient	334	West	Yes	302 (cis-1,2-DCE)	10/19/2018	5.81	N/A	0.00	6.23	166.0	17.40	2.710	0.5
				334	West		401 (cis-1,2-DCE)	8/13/2019	7.50	N/A	0.00	6.29	309.0	25.00	2.630	5.5
				334	West		190 (TCE)	4/18/2025	7.99	N/A	0.30	6.38	140.0	12.60	3.070	29.4
PMW-03	9.0	19.0	Downgradient	317	West	No	Non-Detect	10/23/2018	6.25	N/A	0.00	6.23	-102.0	16.82	5.490	59.7
							Non-Detect	8/15/2019	7.10	N/A	0.00	6.90	-79.0	16.89	5.490	3.4
							Non-Detect	4/16/2025	7.69	N/A	0.39	7.19	-146.0	10.06	7.830	36.9
PMW-04	7.0	17.0	Downgradient	550	Northwest	No	3.2 (cis-1, 2-DCE)	10/23/2018	5.25	N/A	0.00	6.29	-85.0	16.97	15.700	114.0
							1.1 (cis-1, 2-DCE)	8/14/2019	7.74	N/A	0.42	6.38	-149.0	20.14	14.500	55.3
							Non-Detect	4/17/2025	8.87	N/A	4.29	7.27	-75.0	10.29	12.300	274.0
PMW-05	7.0	17.0	Downgradient	527	West	Yes	53.7 (cis-1, 2-DCE)	10/23/2018	6.37	N/A	0.00	6.20	-43.0	14.70	3.280	0.0
							67.3 (cis-1, 2-DCE)	8/13/2019	6.26	N/A	0.37	6.48	-177.0	17.74	3.570	3.4
							21 (TCE)	4/16/2025	7.92	N/A	0.62	7.20	-108.0	9.82	3.010	1.3
PMW-06	8.0	18.0	Downgradient	517	West	No	0.54 (cis-1, 2-DCE)	10/23/2018	6.33	N/A	0.00	6.64	-74.0	18.61	6.250	551.0
							7.2 (cis-1, 2-DCE)	8/14/2019	7.50	N/A	0.00	7.06	46.0	17.40	6.100	15.9
							Non-Detect	4/17/2025	5.57	N/A	4.10	8.09	-39.0	10.12	7.000	113.0
PMW-07	5.0	15.0	Downgradient	918	West	No	Non-Detect	10/25/2018	8.26	N/A	10.72	7.33	-70.0	12.52	9.690	0.0
							Non-Detect	8/14/2019	9.10	N/A	0.00	6.61	-27.0	25.87	9.490	43.0
							Non-Detect	4/18/2025	9.49	N/A	5.88	8.26	48.0	11.20	7.090	291.0
PMW-08	15.0	25.0	Downgradient	887	West	Yes	48.5 (TCE)	10/19/2018	5.51	N/A	0.00	7.20	-51.0	17.70	2.010	3.3
							40.4 (TCE	8/14/2019	7.40	N/A	0.48	6.78	-143.0	15.82	2.180	1.0
							30 (TCE)	4/15/2025	7.77	N/A	0.87	7.02	-61.0	12.75	2.060	0.0
PMW-09	17.0	27.0	Downgradient	881	West	Yes	216 (cis-1, 2-DCE)	10/24/2018	7.48	N/A	0.00	6.89	-118.0	13.53	2.870	0.0
				881	West		252 (cis-1, 2-DCE)	8/14/2019	8.31	N/A	0.39	6.67	-172.0	19.30	2.710	4.2
				881	West		620 (cis-1, 2-DCE)	4/17/2025	8.86	N/A	0.39	7.27	-94.0	13.72	3.150	0.0
PMW-10	8.0	18.0	Downgradient	1174	West	No	Non-Detect	10/22/2018	6.62	N/A	0.00	6.97	-140.0	17.26	8.340	12.5
				1174	West		Non-Detect	8/16/2019	6.95	N/A	0.00	6.95	-106.0	19.12	8.200	14.8
				1174	West		Non-Detect	4/18/2025	4.30	N/A	0.42	7.79	-177.0	11.14	9.140	13.0
PMW-11	7.0	17.0	Downgradient	1156	West	No	Non-Detect	10/22/2018	4.30	N/A	0.00	6.13	-86.0	15.81	12.100	190.0
							Non-Detect	8/16/2019	4.61	N/A	0.39	6.51	-176.0	25.55	8.070	19.8
							Non-Detect	4/18/2025	5.68	N/A	0.33	7.32	-140.0	13.84	10.600	12.6
PMW-12	18.0	28.0	Downgradient	1135	West	No	Non-Detect	10/22/2018	7.95	N/A	0.00	5.93	-25.0	14.16	2.840	118.0
							Non-Detect	8/16/2019	8.60	N/A	0.00	6.23	-18.0	17.48	2.550	89.7
							Non-Detect	4/15/2025	8.84	N/A	0.72	6.61	-73.0	14.96	3.960	13.7
PMW-13	8.0	18.0	Downgradient	439	Northwest	No	Non-Detect	10/22/2018	9.73	N/A	2.30	7.15	116.0	13.45	1.510	0.0
							Non-Detect	8/15/2019	10.25	N/A	2.75	6.67	117.0	16.86	3.630	2.2
PMW-14	7.0	17.0	Downgradient	392	North	No	Non-Detect	10/24/2018	10.59	N/A	0.00	6.69	50.0	14.49	1.510	0.0
							Non-Detect	8/15/2019	11.15	N/A	0.00	6.95	100.0	20.35	1.640	0.0
							Non-Detect	4/15/2025	11.64	N/A	0.75	6.94	37.0	13.43	1.940	5.4
PMW-15	9.0	19.0	Downgradient	1398	West	No	Non-Detect	10/18/2018	9.40	N/A	0.00	6.76	-62.0	13.43	1.650	53.4
							Non-Detect	8/16/2019	3.40	N/A	0.46	6.23	-100.0	10.00	1.980	41.7
PMW-16	10.0	20.0	Downgradient	957	West	No	Non-Detect	10/22/2018	7.50	N/A	0.00	6.41	-92.0	15.23	4.750	0.0
							Non-Detect	8/16/2019	8.60	N/A	0.00	6.37	-63.0	19.37	3.790	0.0
							Non-Detect	4/17/2025	8.87	N/A	0.35	7.27	-145.0	13.34	3.330	11.6

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Table 1: Geochemistry Data
Ash Road Off-Site Feasibility Study
Vestal, NY

Well	Screen Interval[1] Top	Screen Interval[1] Bottom	Location with respect to source area	Approx. Distance from Source Area (ft.)[5]	Direction from Source Area[5]	Is Well Within Limits of Impacted Area?	Max CVOC Concentration[2] (ug/L)	Date	DTW[3] (ft.)	Depth to Product (DNAPL)	DO[4] (mg/L)	pH[4] (S.U.)	ORP[4] (mV)	Temp.[4] (C)	Spec. Cond.[4] (mS/cm)	Turbidity[4] (NTU)
PMW-17	8.0	18.0	Upgradient	983	Southwest	No	Non-Detect	10/24/2018	8.41	N/A	0.00	6.00	99.0	15.63	5.810	0.0
							0.57 (cis-1,2-DCE)	8/14/2019	8.70	N/A	0.00	6.54	117.0	20.80	4.890	0.0
PMW-18	4.0	14.0	Downgradient	622	Southwest	No	Non-Detect	10/22/2018	7.69	N/A	0.00	6.52	202.0	15.33	2.020	0.0
							Non-Detect	8/12/2019	8.65	N/A	0.00	6.43	223.0	20.21	2.250	0.0
							Non-Detect	4/17/2025	9.15	N/A	0.44	7.27	48.0	9.74	2.930	18.9
PMW-19	10.0	20.0	Upgradient	545	Southwest	No	Non-Detect	10/18/2018	5.25	N/A	3.35	7.72	58.0	12.89	1.250	22.7
							Non-Detect	8/12/2019	13.24	N/A	0.00	8.69	177.0	21.11	0.927	180.0
PMW-20	13.0	23.0	Downgradient	402	Southwest	No	Non-Detect	10/18/2018	8.80	N/A	3.44	8.04	155.0	12.94	2.150	8.6
							Non-Detect	8/15/2019	4.89	N/A	6.44	8.46	0.0	21.07	0.000	112.0
							Non-Detect	4/16/2025	5.06	N/A	4.39	8.52	-74.0	11.64	4.630	766.0
PMW-21D	32.0	42.0	Downgradient	228	Northwest	Yes	601 (PCE)	10/19/2018	8.16	N/A	0.00	7.08	82.0	12.83	0.946	18.4
							1210 (PCE)	8/15/2019	8.89	N/A	1.07	6.25	-6.0	18.61	1.400	2.4
							530 (PCE)	4/21/2025	9.47	N/A	0.31	6.62	98.0	14.21	1.290	49.7
PMW-22D	32.0	42.0	Downgradient	329	West	Yes	121 (cis-1, 2-DCE)	10/19/2018	6.73	N/A	0.04	6.99	-493.0	12.56	0.804	5.4
							394 (cis-1, 2-DCE)	8/16/2019	7.61	N/A	0.36	6.21	-10.0	16.91	2.140	1.9
							190 (cis-1, 2-DCE)	4/21/2025	8.20	N/A	0.79	7.38	-45.0	14.56	1.320	10.4
								Min	3.40	**Min**	0.00	5.75	-493.0	8.48	0.000	0.0
								Max	13.24	**Max**	10.72	8.69	309.0	25.87	18.070	766.0

Notes:

1. Screen Interval in feet below ground surface (ft bgs)
2. Maximum detection for any single CVOC: PCE, TCE, Cis-1,2-DCE, Trans-1,2-DCE, or Vinyl Chloride
3. DTW is measured from top of casing
4. Data is based on stabilized readings recorded using a Horiba flow through cell
5. Source area is considered MW-09S
6. Measurements taken prior to injection event

* Depth to bottom measurements were not taken on the groundwater sampling log; depth to bottom taken from 2025 synoptic event

** Depth to bottom measurements were not taken on the groundwater sampling log; PMW-15 is inaccessible during 2025 sampling event

***Depth to bottom measurements taken September 24, 2024 during a site inspection.

Abbreviations and Acronyms:

C: Celsius
CB: chlorobenzene
CVOC: chlorinated volatile organic compound
cis-1,2-DCE: Cis, 1-2-dichloroethene
DTB: depth to bottom
DO: dissolved oxygen
DTW: depth to water
ft: feet
mg/L: milligrams per Liter
Spec. Cond.: Specific Conductivity
ms/cm: millisiemens per centimeter
mV: millivolts
N/A indicates no observed NAPL
NM: Not measured
NTU: nephelometric turbidity unit
ORP: oxidation reduction potential
PCE: tetrachloroethene
S.U.: standard unit
TCE: trichloroethene
VC: vinyl chloride

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Table 2
Area, Volume, and Mass of Contaminant Calculations
Ash Road Off-Site Feasibility Study
Vestal, New York

Location	Representative Concentration[1]	Approx. Dimensions	Area	Volume of soil in saturated zone[2]	Volume of Impacted Groundwater[3]	Mass of Contaminant
	(µg/L)	*(sq ft)*	*(sq ft)*	*(cf)*	*(gal)*	*(lbs)*
West of Sycamore St.	395	905 x 184	166,520	5,661,700	16,939,800	56
East of Sycamore St.	6,923	338 x 126	42,588	979,500	2,930,700	169
TOTAL	**TOTAL**		**209,108**	**6,641,200**	**19,870,500**	**225**

Notes:

1. Concentration based on average of total chloroethenes (PCE + TCE + cis-1,2-DCE + trans,1-2DCE + 1,1-DCE + VC):

West of Sycamore Street - April 2025 groundwater data from wells PMW-2, PMW-5, PMW-8, PMW-9, PMW-21D and PMW-22D.

East of Sycamore Street - April 2025 groundwater data from wells MW-01, MW-02S and MW-09S.

2. Thickness of saturated zone used to calculate volume:

West of Sycamore Street is approximately 34 ft bgs.

East of Sycamore Street is approximately 23 ft bgs.

3. Assume 40% porosity

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Table 3
Screening of Remedial Technologies for Groundwater
Ash Road Off-Site Feasibility Study
Vestal, New York

GENERAL RESPONSE ACTION	RESPONSE ACTION	TECHNOLOGY OR CONTROL METHOD	EFFECTIVENESS	IMPLEMENTABILITY	RELATIVE COST	RETAINED OR NOT RETAINED FOR FURTHER EVALUATION
No Action	No action	No action	Not effective at reducing site contaminants or reducing possible exposure.	Readily implementable.	No cost	Retained, only for comparison to other alternatives
Institutional Controls	Access Controls	Government Controls	Would be effective at reducing possible exposure to contamination left in place.	Difficult to implement on private properties and residences.	low	Retained
		Property Controls	Would be effective at reducing possible exposure to contamination left in place.	Difficult to implement on private properties and residences.	low	Retained
Treatment	Monitored Natural Attenuation	Monitored Natural Attenuation	Limited effectiveness, based on conditions observed during the remedial investigations, natural biodegradation of PCE appears to be occurring.	Readily implementable.	Low	Retained
	In-situ treatment	Enhanced Bioremediation	Highly effective, traditional technology implemented to mitigate chlorinated ethenes. Effectiveness can be impacted by nature of impacted media (sand/gravel vs. fine silt).	Implementable, injection wells must be installed and may disrupt businesses during installation. Low impact to surrounding businesses during injections.	Medium	Retained
	In-situ treatment	Electrical Resistance Heating	Highly effective to mitigate chlorinated ethenes, though technology typically used in the source area with high concentrations or if DNAPL is present.	Implementable, electrodes must be installed and connected to central location. Would be disruptive to business during installation. Requires extensive monitoring and likely negative public perception to live electrical lines in subsurface.	High	Not retained
	In-situ treatment	Chemical Oxidation	Highly effective, traditional technology implemented to mitigate chlorinated ethenes. Effectiveness can be impacted by nature of impacted media (sand/gravel vs. fine silt).	Implementable, injection wells must be installed and may disrupt businesses during installation. Low impact to surrounding businesses during injections.	Medium	Retained
Containment	Barrier Wall	Subsurface Barrier Wall	Would be effective to isolate contaminated groundwater to single area. Would not be effective to address potential off-site deep CVOC sources including silts and clays.	Considering site constraints including the depth to a confining layer and disruptions to surrounding businesses, this is not considered implementable.	Medium to High	Not retained
	Groundwater Collection	Groundwater Collection	Would only be effective where wells or trench could collect groundwater, therefore limited effectiveness throughout impacted area. Also, technology would only collect and would not be effective on immobile residuals in the system.	Would require treating large volumes of water, thickness of the saturated zone is approximately 30 - 40 ft. Remedial goals unachievable in the short- to medium-term.	Medium to High	Not retained
Removal	Soil Excavation	Mechanical Excavation	Potential hotspot excavation targeting areas with high concentrations can be reliable and effective. Will not address potential off-site CVOCs sources including silts and clays or groundwater impacts.	Difficult and costly to implement considering the excavation depth (approx. 40 ft based on impacted soils analyzed in RI). Source removal has been completed at the Ash Road Property On-Site (i.e., the source material area).	Medium to High	Not retained
	Soil Vapor Extraction and Air Sparging	Soil Vapor Extraction and Air Sparging	Limited effectiveness, the introduction of oxygen though the air sparging process would essentially eliminate any biodegradation of the chlorinated solvent plume that may be occurring.	Implementable but challenging with the space required to install sparging and vapor collection system, including the depths the system would be required to be installed to. Would be disruptive to nearby businesses.	Medium	Retained

TABLE 4
COST ESTIMATE ASSUMPTIONS FOR RETAINED ALTERNATIVES
ASH ROAD PROPERTIES OFF-SITE FEASIBILITY STUDY

Alternative	Technology	Key Elements	Average Duration to Reach GWQS**	Capital Cost	Present Value of O&M Cost	Estimated Total Present Worth *
GW-1	No action	No Cost, Retained for Comparison	97 years	$ -	$ -	$ -
GW-2	MNA	30 Year Program (sampling/ reporting) More extensive monitoring - 5 Yr Intervals 15 Wells sampled per event VOC, Ethene, Ethane, Methane, Chloride	97 years	$ 56,400	$ 910,600	$ 967,000
GW-3*	**FULL SCALE**: In situ Chemical Oxidation / MNA	**Goal:** Achieve 2 order magnitude reduction in concentration in impacted area with initial injection, and 1 additional order of magnitude reduction after second injection Pilot Study: Sodium Permanganate (2,000 gal, 2 days) **Round 1:** One full-scale injection (~207,000 gal, over 5 weeks) 300 wells (133 nested shallow/deep well pairs west of Sycamore St and 34 shallow east of Sycamore St) **Round 2:** Reinjection after 10 years: assume 50% of original volume Years 0-10 annual groundwater monitoring; Years 10-20 monitoring every other year More extensive monitoring - every 5 years for 20 years	17 Years	$ 5,331,000	$ 1,164,000	$ 6,495,000
GW-4*	**FULL SCALE**: Enhanced Bioremediation / MNA	**Goal:** Achieve 2 order magnitude reduction in concentration in impacted area with initial injection, and 1 additional order of magnitude reduction after second injection Pilot Study: Blend of Vegetable Oil & Whey or alternative (2,000 lbs over 4 days) **Round 1:** One full-scale injection [~94,000 pounds (714,400 gal), over 50 days] 300 wells (133 nested shallow/deep well pairs west of Sycamore St and 34 shallow east of Sycamore St) **Round 2**: Reinjection after 10 years: assume 50% of original volume Years 0-10 annual groundwater monitoring; Years 10-20 monitoring every other year More extensive monitoring - every 5 years for 20 years	17 Years	$ 6,157,000	$ 1,268,000	$ 7,425,000
GW-5	**TARGETED:** In situ Enhanced Bioremediation / MNA (>300 ppb)	**Goal:** Achieve 1 order magnitude reduction in concentration in impacted area after each injection. Repeat injections twice at 10-year intervals to achieve 3 order magnitude reduction Targeted Treatment limited to CVOCs > 300 ppb Pilot Study: Blend of Vegetable Oil & Whey or alternative (2,000 lbs over 4 days) **Round 1**: One injection vegetable oil & whey [~30,000 lbs (228,000) gal, over 20 days] 89 wells (40 nested shallow/deep well pairs west of Sycamore St and 9 shallow east of Sycamore St) **Round 2**: Reinjection after 10 years: assume 50% of original volume **Round 3**: Reinjection after 20 years: assume 25% of original volume Years 0-20 annual groundwater monitoring; Years 20-30 monitoring every other year More extensive monitoring - every 5 years for 30 years	27 Years	$ 2,393,000	$ 1,137,000	$ 3,530,000
GW-6*	**Horizontal Wells** - Soil Vapor Extraction / Air Sparging	4 SVE wells: installed ~4.5 ft bgs, above DTW. 950 LF riser/screen/well (ROI = 40 ft) 9 AS wells: installed ~45 ft bgs, 1,250 LF riser/screen each well (ROI = 20 ft) Less trenching required to System Enclosure (~ 200 LF) System to operate 5 years Routine system maintenance performed bi-monthly (26 events/year). Years 0-15: annual groundwater monitoring. Years 15-25: monitoring every other year. More extensive monitoring - every 5 years for 25 years	24 Years	$ 5,318,000	$ 2,874,000	$ 8,192,000

Notes:

*Costs based on remediation area of 905 ft X 184 ft x 34 ft west of Sycamore St and 338 ft x 126 ft x 23 ft east of Sycamore St.

**GWQS: Groundwater quality guidance value (NYSDEC TOGS 1.1.1). Used 4.25 µg/L, which is the average GA standard/guidance of 5 µg/L for PCE, TCE, and DCE, and 2 µg/L for VC. See Appendix A for calculations.

Table 5
Social Costs for Ash Road Offsite Remedial Alternatives

	Total Social Cost (2.5%)	Total Social Cost (2.0%)	Total Social Cost (1.5%)	Average
Alternative GW-1 - No Action	$ -	$ -	$ -	$ -
Alternative GW-2 - Monitored Natural Attenuation (MNA)	$ 2,375,499	$ 3,548,954	$ 5,561,037	$ 2,871,372
Alternative GW-3 - Full Scale In Situ Chemical Oxidation (ISCO) + MNA	$ 2,134,863	$ 3,189,448	$ 4,997,709	$ 2,580,505
Alternative GW-4 - Full Scale Enhanced In Situ Bioremediation (EISB) + MNA	$ 2,196,649	$ 3,281,756	$ 5,142,350	$ 2,655,189
Alternative GW-5 - Targeted EISB + MNA	$ 2,716,196	$ 4,057,950	$ 6,358,608	$ 3,283,188
Alternative GW-6 - Soil Vapor Extraction (SVE) W/ Air Sparge (AS) + MNA	$ 94,950,834	$ 141,854,901	$ 222,279,658	$ 114,771,348

*All values are in 2020 Dollars per metric ton of greenhouse gas (sum of carbon dioxide, methane and nitrous oxide) based on the social cost of carbon values in the NYSDEC Establishing A Value of Carbon: Guidelines for Use by State Agencies. April 2025.

Table 6
Ash Road Off-Site Feasibility Study

Environmental Footprint Summary

Core Element	Metric		Unit of Measure	Footprint					
				No Action	Monitored Natural Attenuation (MNA)	ISCO + MNA	EISB + MNA	Targeted EISB + MNA	SVE/AS + O&M + MNA
Materials & Waste	M&W-1	Refined materials used on-site	Tons	0.0	0.0	0.0	0.0	0.0	0.0
	M&W-2	% of refined materials from recycled or reused material	%						
	M&W-3	Unrefined materials used on-site	Tons	0.000	0.000	0.000	0.000	0.000	0.000
	M&W-4	% of unrefined materials from recycled or reused material	%						
	M&W-5	On-site hazardous waste disposed of off-site	Tons	0.0	0.0	0.0	0.0	0.0	0.0
	M&W-6	On-site non-hazardous waste disposed of off-site	Tons	0.0	0.0	0.0	0.0	0.0	0.0
	M&W-7	Recycled or reused waste	Tons	0.0	0.0	0.0	0.0	0.0	0.0
	M&W-8	% of total potential waste recycled or reused	%						
Water (used on-site)	W-1	Public water use	MG	0.0	0.0	0.0	0.0	0.0	0.0
	W-2	Groundwater use	MG	0.0	0.0	0.0	0.0	0.0	0.0
	W-3	Surface water use	MG	0.0	0.0	0.0	0.0	0.0	0.0
	W-4	Reclaimed water use	MG	0.0	0.0	0.0	0.0	0.0	0.0
	W-5	Storm water use	MG	0.0	0.0	0.0	0.0	0.0	0.0
	W-6	User-defined water resource #1	MG	0.0	0.0	0.0	0.0	0.0	0.0
	W-7	User-defined water resource #2	MG	0.0	0.0	0.0	0.0	0.0	0.0
	W-8	Wastewater generated	MG	0.0	0.0	0.0	0.0	0.0	0.0
Energy	E-1	Total energy used (on-site and off-site)	MMBtu	0.0	794.1	3,442.1	5,284.5	2,558.7	187,166.5
	E-2	Energy voluntarily derived from renewable resources							
	E-2A	On-site renewable energy generation or use + on-site biodiesel use + biodiesel and other renewable resource use for transportation	MMBtu	0.0	0.0	0.0	0.0	0.0	0.0
	E-2B	Voluntary purchase of renewable electricity	MWh	0.0	0.0	0.0	0.0	0.0	0.0
	E-3	Voluntary purchase of RECs	MWh	0.0	0.0	0.0	0.0	0.0	0.0
	E-4	On-site grid electricity use	MWh	0.000	0.000	0.000	0.000	0.000	15,660.000
Air	A-1	On-site NOx, SOx, and PM emissions	Pounds	0.0	0.0	2,385.6	2,558.6	808.6	1,046.0
	A-2	On-site HAP emissions	Pounds	0.0	0.0	0.1	0.1	0.0	0.0
	A-3	Total NOx, SOx, and PM emissions	Pounds	0.0	685.3	3,830.6	6,055.7	2,707.8	77,409.5
	A-3A	Total NOx emissions	Pounds	0.0	613.6	3,480.5	5,510.3	2,454.0	29,854.5
	A-3B	Total SOx emissions	Pounds	0.0	46.9	239.2	374.5	172.0	46,138.4
	A-3C	Total PM emissions	Pounds	0.0	24.7	110.9	170.9	81.8	1,416.6
	A-4	Total HAP emissions	Pounds	0.0	18.3	41.8	56.6	37.2	812.5
	A-5	Total greenhouse gas emissions	Tons CO_2e*	0.0	62.0	277.4	427.7	204.8	3,575.8
Land & Ecosystems	The ecological value of the site is negligible. The property does not have significant habitat because it is located in an urban/industrial area and is largely paved.								

** Total greenhouse gases emissions (in CO_2e) include consideration of CO_2, CH_4, and N_2O (Nitrous oxide) emissions.*
"MMBtu" = millions of Btus
"MG" = millions of gallons
"CO_2e" = carbon dioxide equivalents of global warming potential
"MWh" = megawatt hours (i.e., thousands of kilowatt-hours or millions of Watt-hours)
"Tons" = short tons (2,000 pounds)

The above metrics are consistent with EPA's Methodology for Understanding and Reducing a Project's Environmental Footprint (EPA 542-R-12-002), February 2012

Notes:

Table 7
Climate Vulnerability Comparison
Ash Road Off-Site Feasibility Study
Vestal, New York

Alternative	Description of concerns due to Climate Change	Climate Change Risk Factors			
		Precipitation	Temperature	Extreme Events	Rivers and Lakes
Alternative GW-1: No Further Action	Because contamination would remain untreated, increased precipitation could result in increased mobility of contamination and increased risk of exposure to contamination.	High	Low	High	Moderate
Alternative GW-2: MNA	Because contamination would remain untreated, increased precipitation could result in increased mobility of contamination and increased risk of exposure to contamination. Extreme heat events would increase the risk of heat-related illness for field personnel performing groundwater monitoring.	High	Low	High	Moderate
Alternative GW-3: ISCO / MNA	Increased precipitation may "flush" injectates through the remediation area quicker. Extreme heat events would increase the risk of heat-related illness for field personnel performing groundwater monitoring.	Moderate	Low	Moderate	Moderate
Alternative GW-4: EISB / MNA	Increased precipitation may "flush" injectates through the remediation area quicker. Extreme heat events would increase the risk of heat-related illness for field personnel performing groundwater monitoring.	Moderate	Low	Moderate	Moderate
Alternative GW-5: Targeted EISB / MNA	Increased precipitation may "flush" injectates through the remediation area quicker. Extreme heat events would increase the risk of heat-related illness for field personnel performing groundwater monitoring.	Moderate	Low	Moderate	Moderate
Alternative GW-6: SVE/AS / MNA	Increased precipitation would negatively impact the effectiveness of the SVE system. Extreme heat events would increase the risk of heat-related illness for field personnel performing groundwater monitoring and SVE monitoring and maintenance. Extreme storm events may also lead to disruptions in electricity service that would result in disruptions to the SVE/AS system operation.	High	Low	High	Moderate

Sources:
NYSERDA New York State Climate Impacts Assessment https://nysclimateimpacts.org/
FEMA Flood Maps https://msc.fema.gov/portal/home

FIGURES

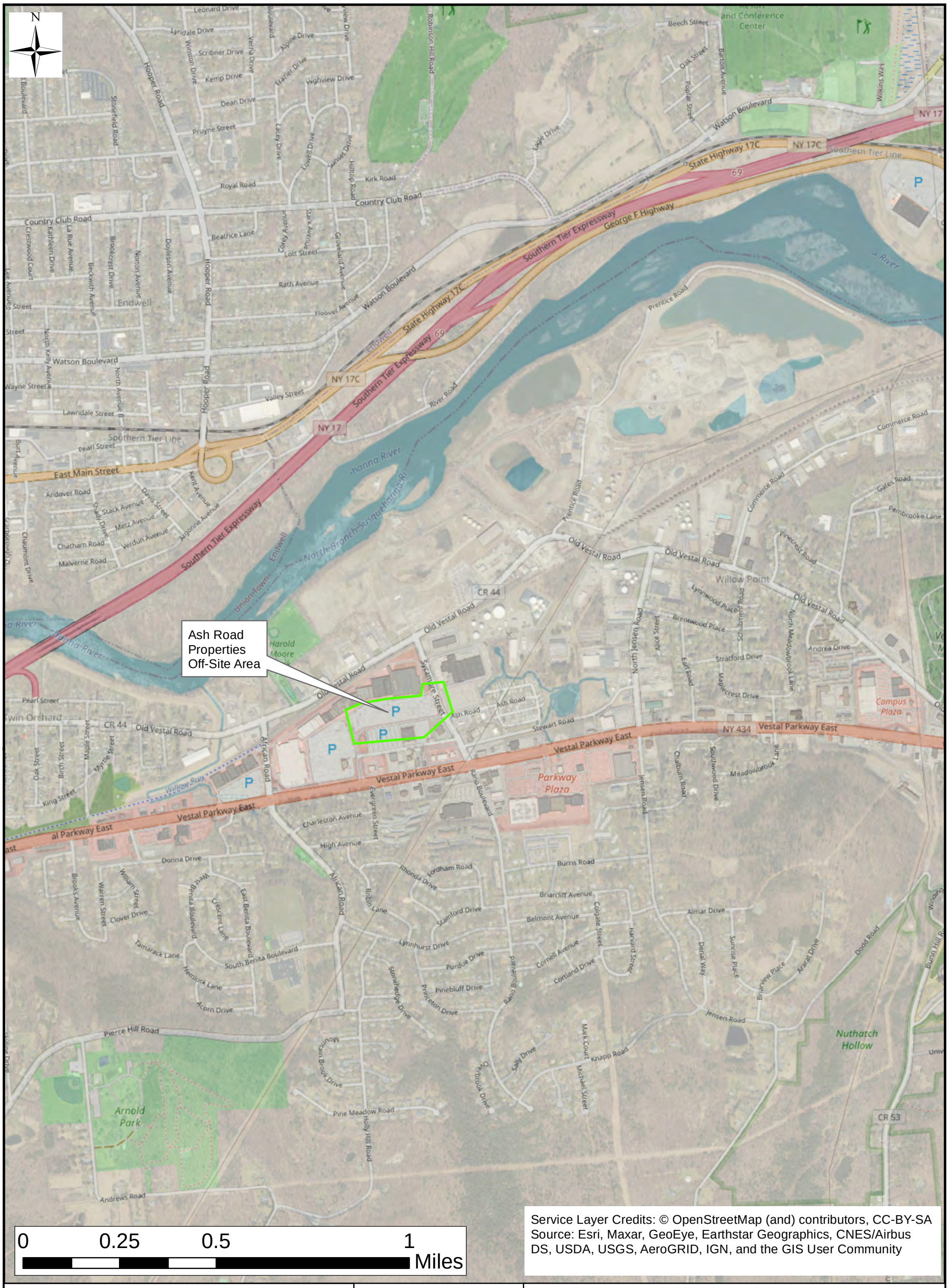




Figure 1

Ash Road Properties Off-Site
Feasibility Study Report

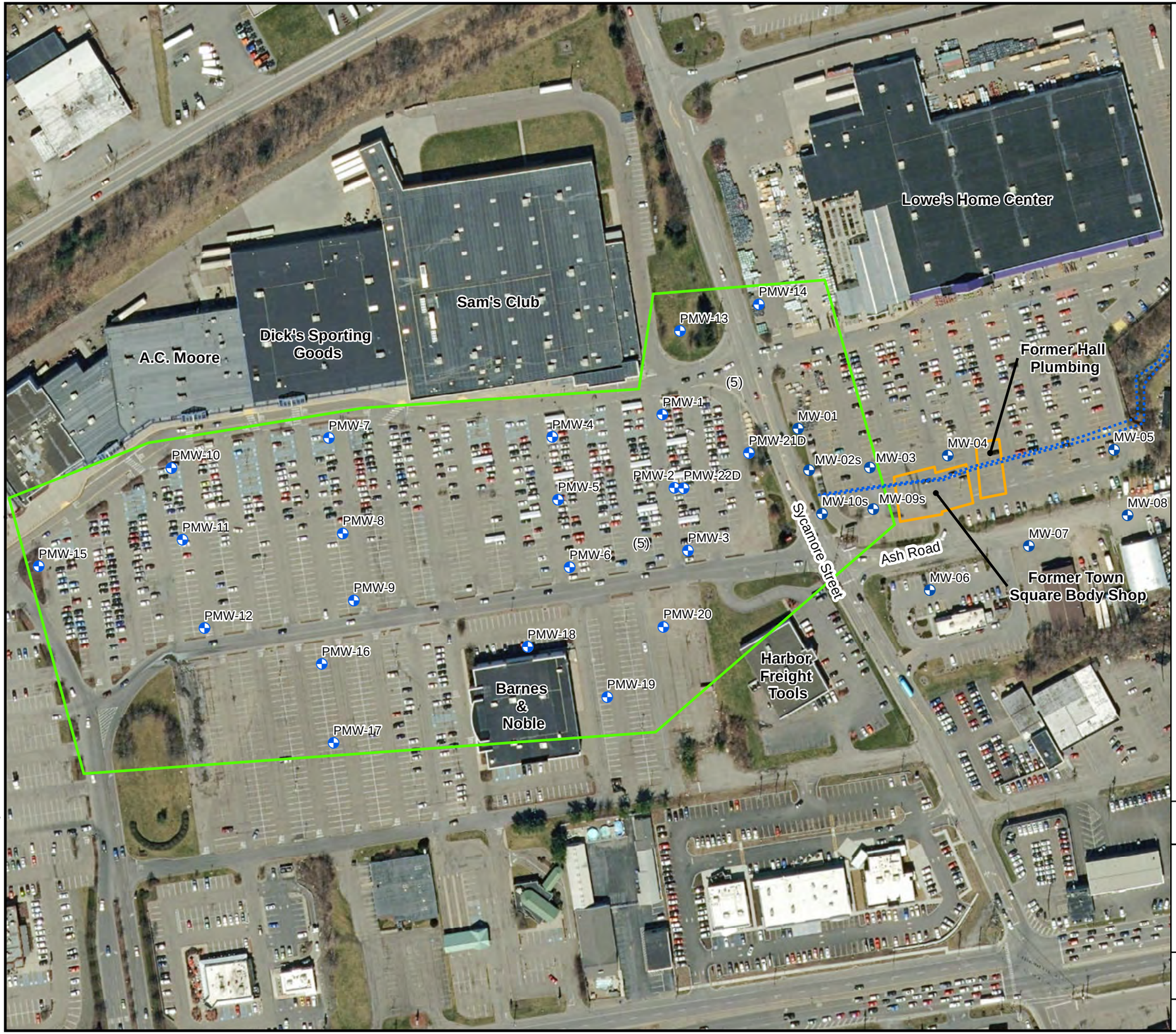
Town of Vestal, New York

Site Location Map

PARSONS

301 Plainfield Road, Suite 350; Syracuse, NY 13212 315-451-9560

File Name: Q:\GIS\NYSDEC\449445 WA #19 - Ash Road Properties\MXDs\FS\NYSDEC Ash Road FS Figure 1.mxd
Plot Date: 3/9/2021 Plotted By: Sisson, Evan



Legend

- Monitoring Well Point Location[1][2]
- Approximate Location of Former Creek Bed[4]
- Approximate Boundary of Ash Road Off-Site
- Former Building Outline[3]
- D Deep Groundwater Monitoring Well

Notes:

(1) Locations labeled MW-## are wells located to the east of the Ash Road Investigation Site and were installed by a different firm. Wells used to collect depth to water measurements and/or groundwater analytical samples.

(2) Locations labeled PMW-## are well points and were installed by Parsons in 2015 (PMW-1 though PMW-14) and in 2018 (PMW-15 through PMW-22). Both depth to water measurements and groundwater analytical samples were collected.

(3) Location of buildings responsible for subsurface contamination documented in 2009 and remediated in 2011 and 2015.

(4) Former creek bed location stops at edge of Sycamore Street. However, it is assumed that creek bed extends further to the west into Subject Property.

0 250 500 Feet

N

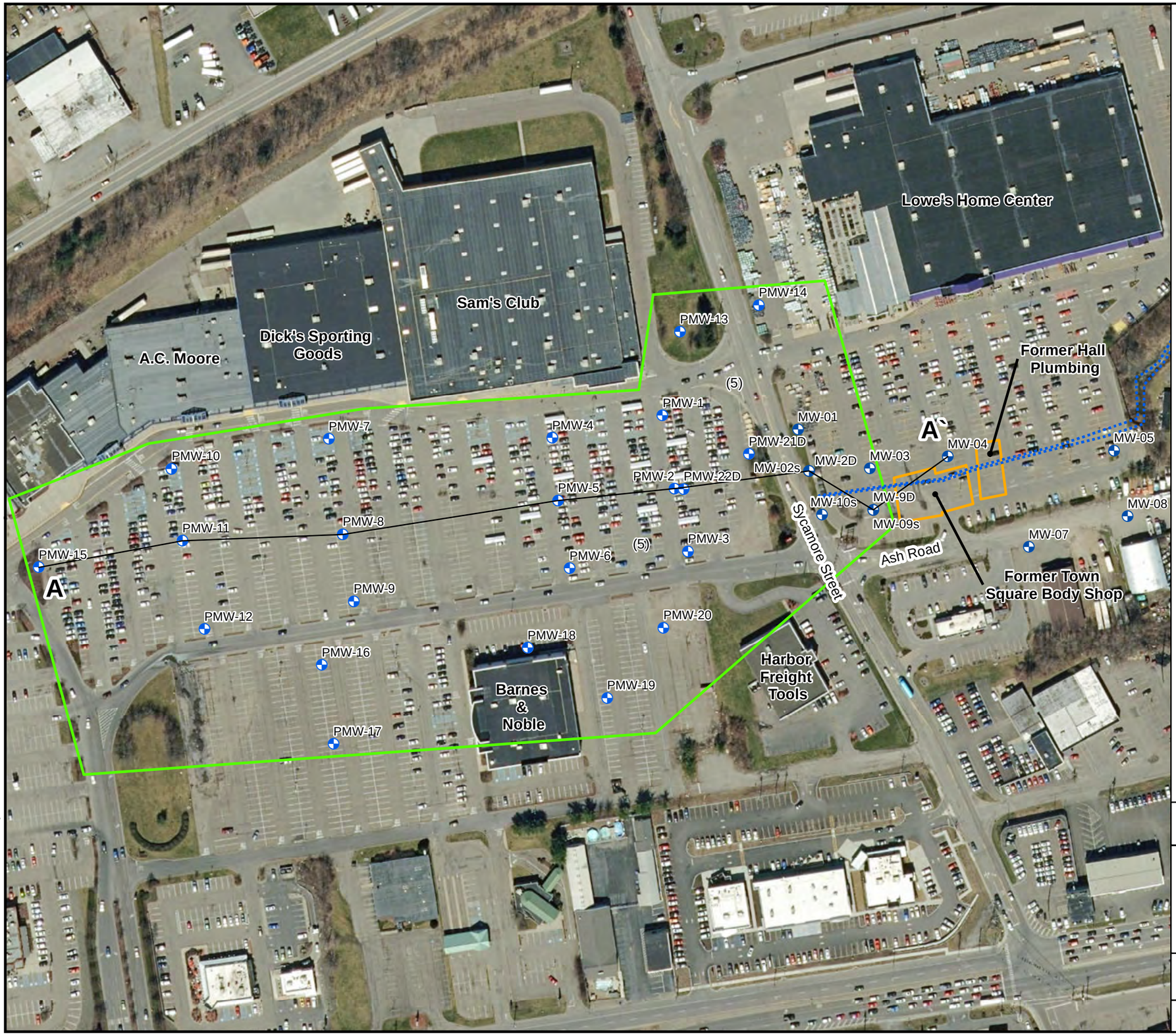
Figure 2

Ash Road Properties Off-Site
Feasibility Study Report
Town of Vestal, New York
Monitoring Well Points Location Map

PARSONS

301 Plainfield Road, Suite 350; Syracuse, NY 13212 315-451-9560

File Name: Q:\GIS\NYSDEC\449445 WA #19 - Ash Road Properties\MXDs\FS\NYSDEC Ash Road FS Figure 2.mxd
Plot Date: 3/23/2021 Plotted By: Sisson, Evan



Legend

- Monitoring Well Point Location[1][2]
- Approximate Boundary of Ash Road Off-Site
- Former Building Outline[3]
- Approximate Location of Former Creek Bed[4]
- D — Deep Groundwater Monitoring Well
- A — Start of Cross-Section
- A` — End of Cross-Section
- Cross-Section Transect

Notes:

(1) Locations labeled MW-## are wells located to the east of the Ash Road Investigation Site and were installed by a different firm. Wells used to collect depth to water measurements and/or groundwater analytical samples.

(2) Locations labeled PMW-## are well points and were installed by Parsons in 2015 (PMW-1 though PMW-14) and in 2018 (PMW-15 through PMW-22). Both depth to water measurements and groundwater analytical samples were collected.

(3) Location of buildings responsible for subsurface contamination documented in 2009 and remediated in 2011 and 2015.

(4) Former creek bed location stops at edge of Sycamore Street. However, it is assumed that creek bed extends further to the west into Subject Property.

(5) Well PMW-2 not used in transect A to A'.

0 250 500 Feet

N

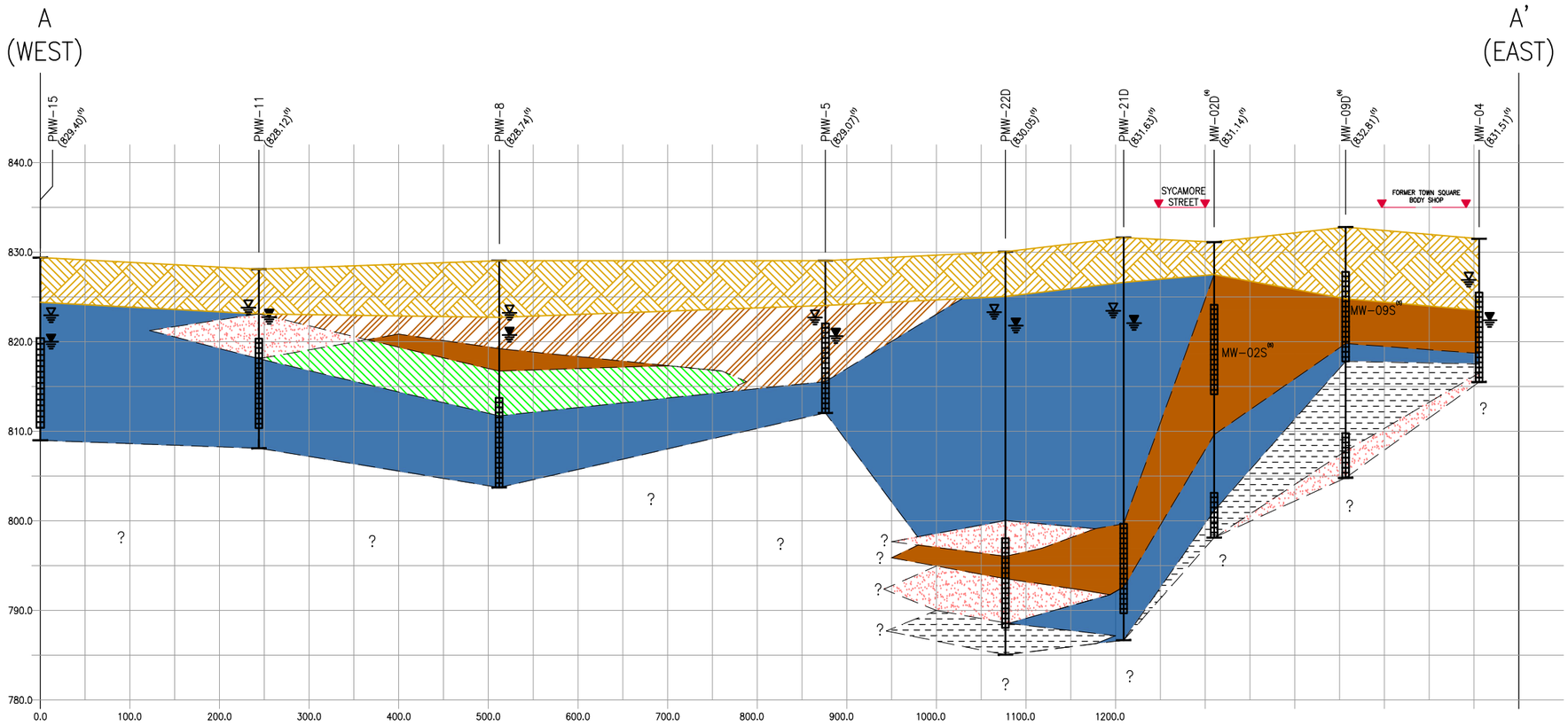
Figure 3

Ash Road Properties Off-Site
Feasibility Study Report
Town of Vestal, New York
Cross-Section Orientation Figure

PARSONS

301 Plainfield Road, Suite 350; Syracuse, NY 13212 315-451-9560

File Name: Q:\GIS\NYSDEC\449445 WA #19 - Ash Road Properties\MXDs\FS\NYSDEC Ash Road FS Figure 3.mxd
Plot Date: 3/10/2021 Plotted By: Sisson, Evan



LEGEND:

- MAXIMUM GROUNDWATER ELEVATION (MEAN SEA LEVEL (MSL) – FEET)(2)
- MINIMUM GROUNDWATER ELEVATION (MEAN SEA LEVEL (MSL) – FEET)(2)

NOTES:

1. TOP OF CASING ELEVATION AT WELL (MSL – FEET).
2. MAXIMUM AND MINIMUM GROUNDWATER ELEVATION AT WELL FROM 2015 TO 2019.
3. REFER TO FIGURE **3** FOR TRANSECT LOCATION.
4. NO GROUNDWATER ELEVATION MEASUREMENTS COLLECTED DURING PARSONS FIELD ACTIVITIES.
5. SHALLOW WELL INSTALLED ADJACENT TO DEEP WELL REPRESENTED BY SHALLOW SCREEN INTERVAL.

GENERAL LITHOLOGY DESCRIPTIONS:

- CLAYEY SILT WITH FINE TO MEDIUM GRAVEL
- FILL MATERIAL (FINE TO COARSE SAND, GRAVEL, GEOTEXTILE FABRIC, AND ASPHALT)
- FINE TO MEDIUM SAND TO SILTY SAND WITH FINE TO COARSE GRAVEL
- PEAT, SILT, AND ORGANIC PLANT MATERIAL
- SILT WITH FINE TO COARSE SAND AND FINE TO COARSE GRAVEL
- SILTY CLAY WITH FINE TO MEDIUM GRAVEL
- SILTY SAND AND GRAVEL
- ? LITHOLOGY UNKNOWN. DID NOT DRILL INTO UNIT.

HORIZONTAL SCALE

150 0 150 300

SCALE: 1"=150'

VERTICAL SCALE

15 0 15 30

SCALE: 1"=15'

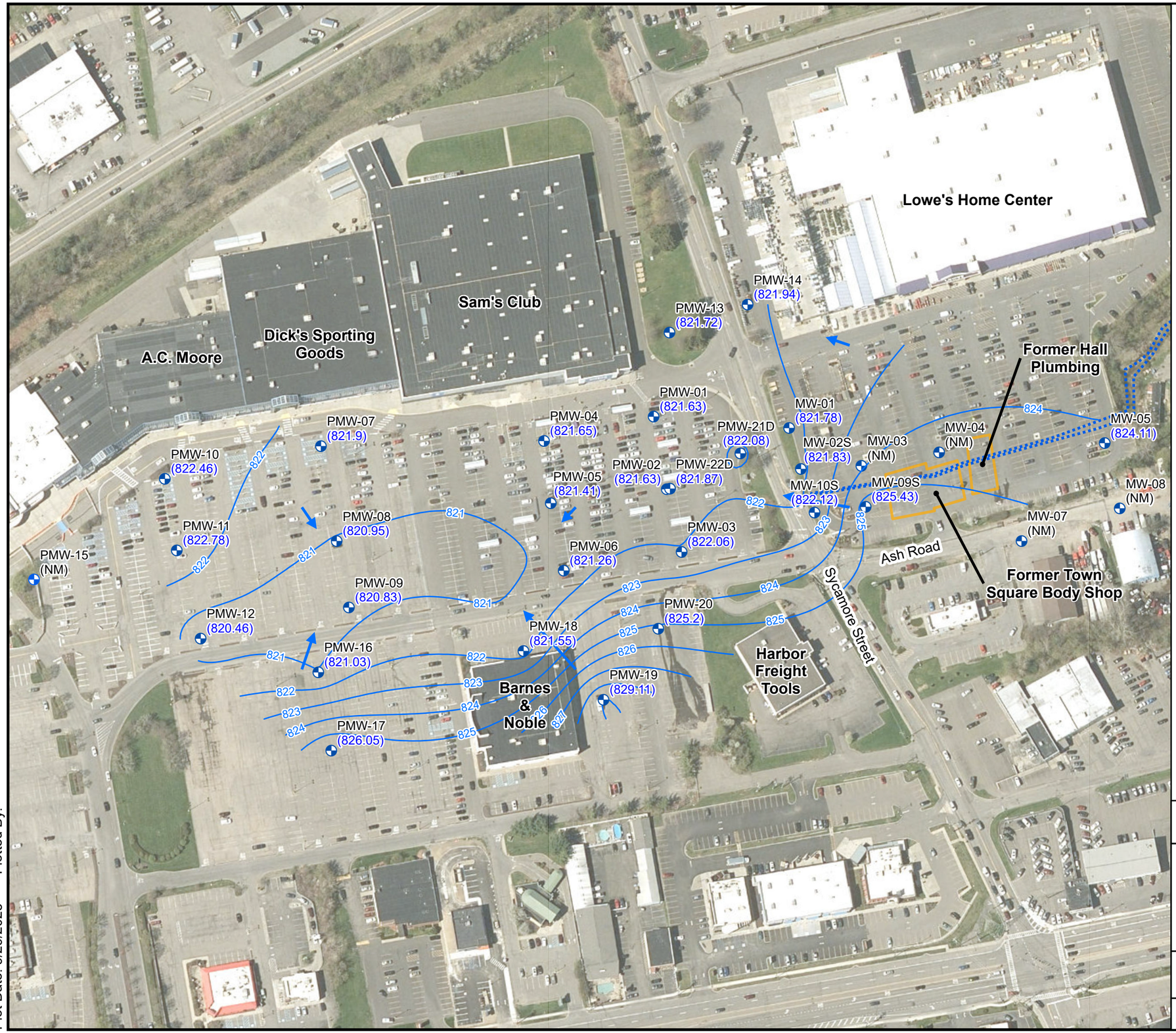
FIGURE 4

ASH ROAD PROPERTIES OFFSITE
FEASIBILITY STUDY REPORT
TOWN OF VESTAL, NEW YORK

A–A' CROSS SECTION TRANSECT VIEW FROM WEST TO EAST

PARSONS
290 ELWOOD DAVIS ROAD, SUITE 312, LIVERPOOL, N.Y. 13088, PHONE: 315–451–9560

FILE NAME: P:\NYSDEC PROGRAM\452330 – WA #16 – ASH ROAD PROPERTIES OFF–SITE FS\10.0 TECHNICAL CATEGORIES\CROSS SECTIONS\ASHRDXSEC.DWG
PLOT DATE: 3/21/2021 12:05 PM PLOTTED BY: MORANZ, KAITLYN



- Monitoring Well Point Location
- Groundwater Contours
- Groundwater Flow Direction
- Approximate Location of Former Creek Bed
- Former Building Outline[2]
- NM Not Measured

Notes:

(1a) Control established using Leica Viva GNSS and GSI6 Survey. Locations performed using Leica Robotic TCRP 1203 and NOVA MS50.

(1b) Coordinates and bearings are based on New York State Plane Central Zone NAD 83 (CORS2011) and NAVD 88 U.S. Survey feet.

(2) Location of buildings responsible for subsurface contamination documented in 2009 and remediated in 2011 and 2015.

(3) Former creek bed location stops at edge of Sycamore Street. However, it is assumed that creek bed extends further to the west into Subject Property.

0 250 500 Feet

N

Figure 5

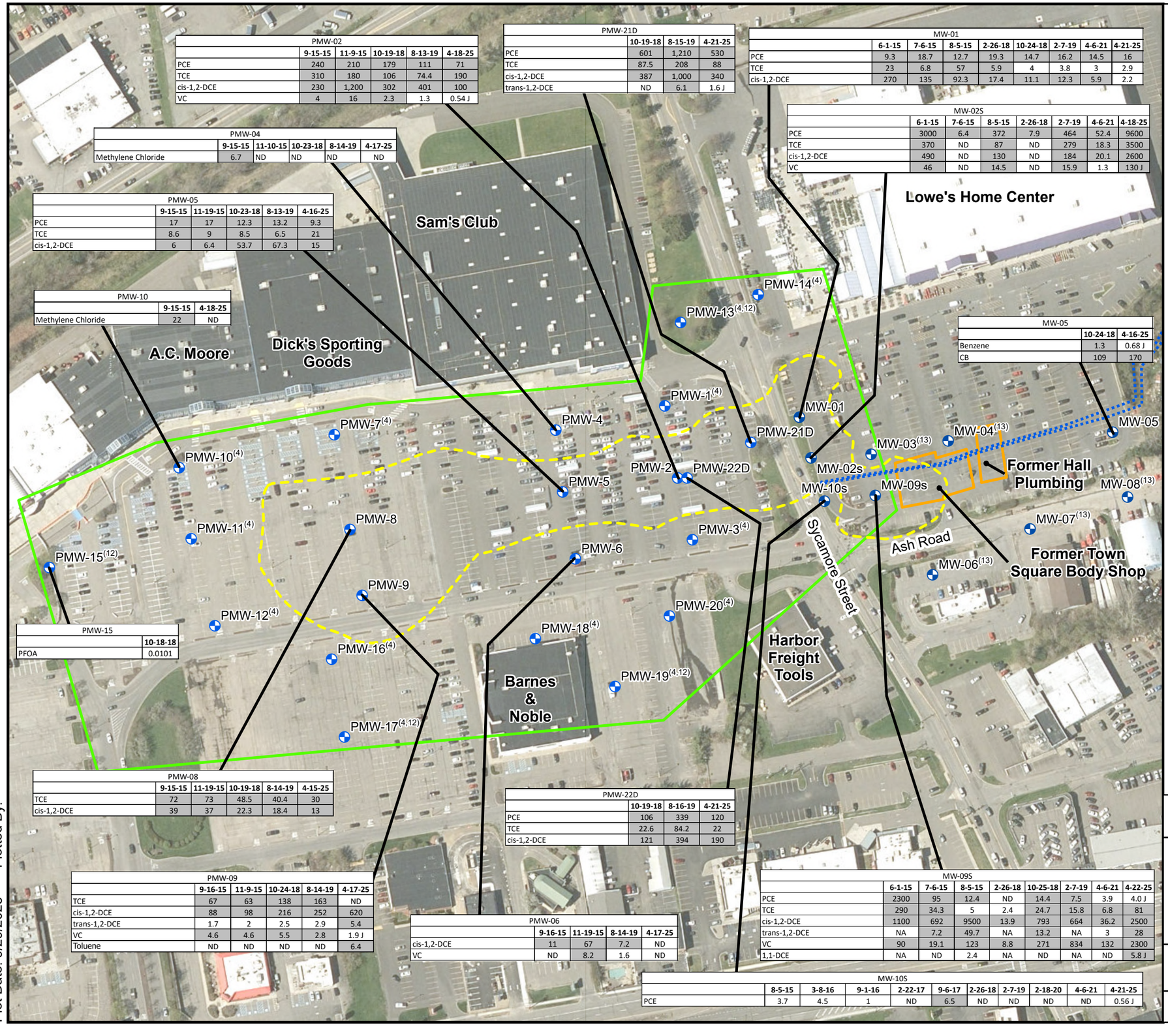
Ash Road Properties Off-Site
Feasibility Study Report
Town of Vestal, New York

Groundwater Contours
April 2025

PARSONS

301 Plainfield Road, Suite 350; Syracuse, NY 13212 315-451-9560

File Name: Q:\GIS\NYSDEC\449445 WA #19 - Ash Road Properties\MXDs\Ash Road GW Contours April 2025.aprx
Plot Date: 9/29/2025 Plotted By:



PMW-02	9-15-15	11-9-15	10-19-18	8-13-19	4-18-25
PCE	240	210	179	111	71
TCE	310	180	106	74.4	190
cis-1,2-DCE	230	1,200	302	401	100
VC	4	16	2.3	1.3	0.54 J

PMW-21D	10-19-18	8-15-19	4-21-25
PCE	601	1,210	530
TCE	87.5	208	88
cis-1,2-DCE	387	1,000	340
trans-1,2-DCE	ND	6.1	1.6 J

MW-01	6-1-15	7-6-15	8-5-15	2-26-18	10-24-18	2-7-19	4-6-21	4-21-25
PCE	9.3	18.7	12.7	19.3	14.7	16.2	14.5	16
TCE	23	6.8	57	5.9	4	3.8	3	2.9
cis-1,2-DCE	270	135	92.3	17.4	11.1	12.3	5.9	2.2

MW-02S	6-1-15	7-6-15	8-5-15	2-26-18	2-7-19	4-6-21	4-18-25
PCE	3000	6.4	372	7.9	464	52.4	9600
TCE	370	ND	87	ND	279	18.3	3500
cis-1,2-DCE	490	ND	130	ND	184	20.1	2600
VC	46	ND	14.5	ND	15.9	1.3	130 J

PMW-04	9-15-15	11-10-15	10-23-18	8-14-19	4-17-25
Methylene Chloride	6.7	ND	ND	ND	ND

PMW-05	9-15-15	11-19-15	10-23-18	8-13-19	4-16-25
PCE	17	17	12.3	13.2	9.3
TCE	8.6	9	8.5	6.5	21
cis-1,2-DCE	6	6.4	53.7	67.3	15

MW-05	10-24-18	4-16-25
Benzene	1.3	0.68 J
CB	109	170

PMW-10	9-15-15	4-18-25
Methylene Chloride	22	ND

PMW-15	10-18-18
PFOA	0.0101

PMW-08	9-15-15	11-19-15	10-19-18	8-14-19	4-15-25
TCE	72	73	48.5	40.4	30
cis-1,2-DCE	39	37	22.3	18.4	13

PMW-22D	10-19-18	8-16-19	4-21-25
PCE	106	339	120
TCE	22.6	84.2	22
cis-1,2-DCE	121	394	190

PMW-09	9-16-15	11-9-15	10-24-18	8-14-19	4-17-25
TCE	67	63	138	163	ND
cis-1,2-DCE	88	98	216	252	620
trans-1,2-DCE	1.7	2	2.5	2.9	5.4
VC	4.6	4.6	5.5	2.8	1.9 J
Toluene	ND	ND	ND	ND	6.4

PMW-06	9-16-15	11-19-15	8-14-19	4-17-25
cis-1,2-DCE	11	67	7.2	ND
VC	ND	8.2	1.6	ND

MW-09S	6-1-15	7-6-15	8-5-15	2-26-18	10-25-18	2-7-19	4-6-21	4-22-25
PCE	2300	95	12.4	ND	14.4	7.5	3.9	4.0 J
TCE	290	34.3	5	2.4	24.7	15.8	6.8	81
cis-1,2-DCE	1100	692	9500	13.9	793	664	36.2	2500
trans-1,2-DCE	NA	7.2	49.7	NA	13.2	NA	3	28
VC	90	19.1	123	8.8	271	834	132	2300
1,1-DCE	NA	ND	2.4	NA	ND	NA	ND	5.8 J

MW-10S	8-5-15	3-8-16	9-1-16	2-22-17	9-6-17	2-26-18	2-7-19	2-18-20	4-6-21	4-21-25
PCE	3.7	4.5	1	ND	6.5	ND	ND	ND	ND	0.56 J

- Monitoring Well Point Location[5][6]
- Approximate Boundary of Ash Road Off-Site
- Former Building Outline[7]
- Approximate Location of Former Creek Bed[8]
- Approximate Limits of Groundwater Impact Area on ARP Off-site Area.
- Exceeds NYSDEC Class GA Ambient Water Quality Standards (TOGS 1.1.1 Groundwater Criteria)
- D Deep Groundwater Monitoring Well
- ND Non-Detected
- NA Not Available

			NYSDEC TOGS 1.1.1 Groundwater Criteria for Parameter
PCE	=	Tetrachloroethylene	= 5
TCE	=	Trichloroethylene	= 5
cis-1,2-DCE	=	cis-1, 2-Dichloroethylene	= 5
trans-1,2-DCE	=	Trans-1, 2-Dichloroethene	= 5
VC	=	Vinyl Chloride	= 2
MC	=	Methylene Chloride	= 5
1,1-DCE	=	1,1-Dichloroethene	= 5
Benzene	=	Benzene	= 1
CB	=	Chlorobenzene	= 5
Toluene	=	Toluene	= 5
PFOA	=	Perflourooctanoic Acid	= 0.01

PMW-22D	10-19-18	8-16-19	4-21-25	Well ID
				Sample Date
PCE	106	339	120	Parameter/
TCE	22.6	84.2	22	Concentration
cis-1,2-DCE	121	394	190	of Parameter

Notes:

(1) Concentrations in micrograms per liter (ug/L).

(2) Only parameters that exceeded NYSDEC Ambient Water Quality Standards presented on TOGS 1.1.1 Groundwater Criteria shown on figure.

(3) Refer to Tables 6 through 8 in RI Report (Parsons, 2020) for detailed analysis of groundwater sampling event.

(4) Well points that have not exhibited parameter concentrations exceeding NYSDEC TOGS 1.1.1 Groundwater Criteria.

(5) Locations labeled MW-## are wells located to the east of the Ash Road Investigation Site and were installed by a different firm. Wells used to collect depth to water measurements and/or groundwater analytical samples.

(6) Locations labeled PMW-## are well points and were installed by Parsons in 2015 (PMW-1 though PMW-14) and in 2018 (PMW-15 through PMW-22). Both depth to water measurements and groundwater analytical samples were collected.

(7) Location of buildings responsible for subsurface contamination documented in 2009 and remediated in 2011 and 2015.

(8) Former creek bed location stops at edge of Sycamore Street. However, it is assumed that creek bed extends further to the west into Subject Property.

(9) The highest value was recorded if a field duplicate was also taken during sampling.

(10) The 2015, 2018 (except 10/24/18 and 10/25/18), 2019, and 2021 data for MW-01, MW-2S, MW-09S, and MW-10S came from the 2021 PRR (GeoLogic).

(11) June 1, 2015 data was collected prior to injection event on-site. For additional monitoring dates and data refer to Table 3 in 2021 PRR (GeoLogic).

(12) Wells not sampled during the April 2025 event include PMW-13, PMW-15 (not located), PMW-17, and PMW-19.

(13) MW-03, MW-04, MW-07 and MW-08 were last sampled 5/2012. VOC results were ND or less than TOGS 1.1.1 Groundwater criteria. MW-06 was last sampled in 2008. VOC results were ND. Well has been removed (GeoLogic 2013). MW-07 and MW-08 have been decommissioned per NYSDEC.

(14) On-site injections were completed in June 2015. Data from June 1, 2015 was collected prior to the injection event.

0 125 250 500 Feet

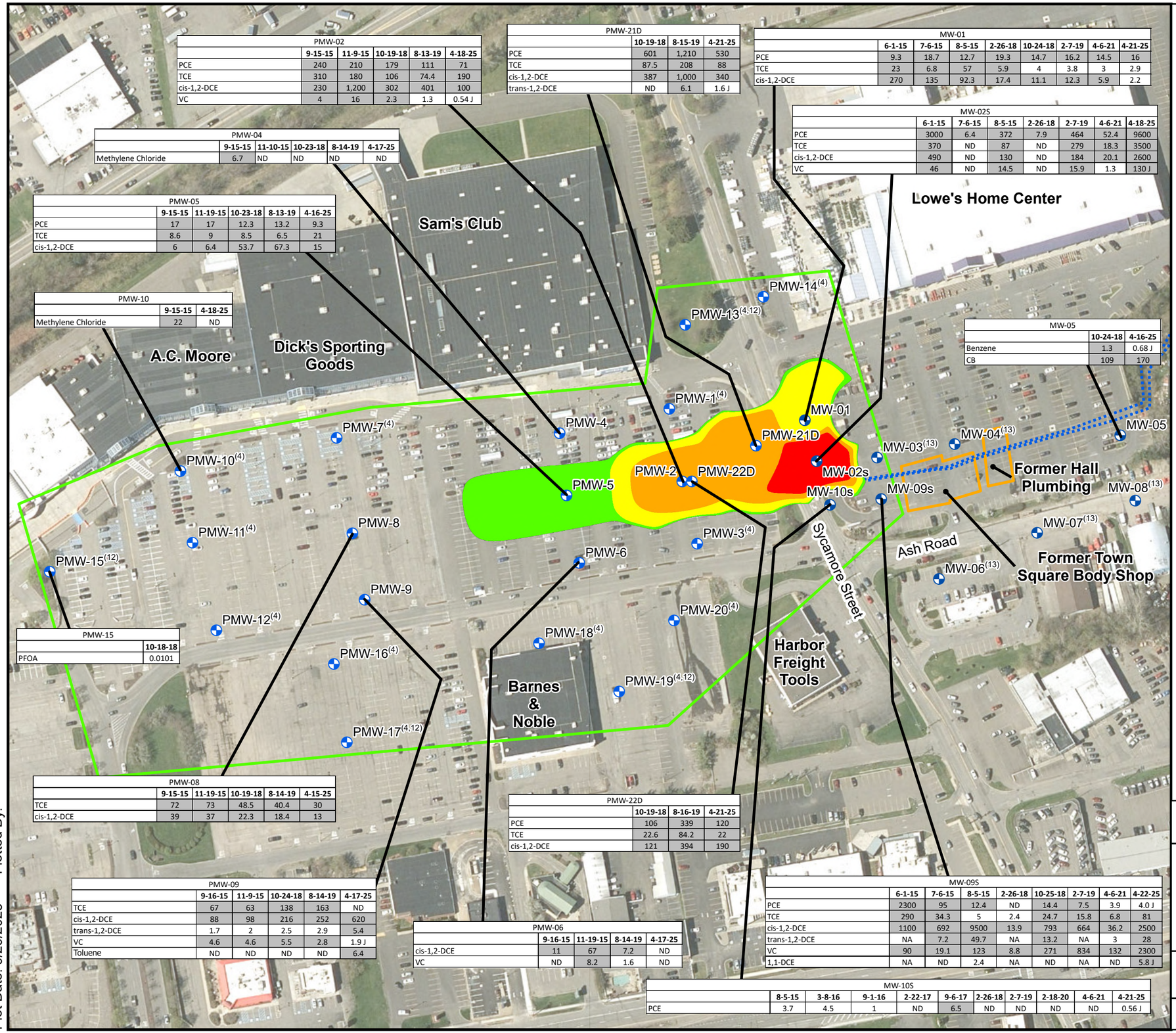
N

Figure 6

Ash Road Properties Off-Site
Feasibility Study Report
Town of Vestal, New York
Comprehensive Groundwater Analytical Data Summary Map
(2015 Through 2025)

PARSONS
301 Plainfield Road, Suite 350; Syracuse, NY 13212 315-451-9560

File Name: Q:\GIS\NYSDEC\449445 WA #19 - Ash Road Properties\MXDs\FS\NYSDEC Ash Road FS Figure 5 2025.aprx
Plot Date: 9/29/2025 Plotted By:



PMW-02	9-15-15	11-9-15	10-19-18	8-13-19	4-18-25
PCE	240	210	179	111	71
TCE	310	180	106	74.4	190
cis-1,2-DCE	230	1,200	302	401	100
VC	4	16	2.3	1.3	0.54 J

PMW-21D	10-19-18	8-15-19	4-21-25
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MW-01	6-1-15	7-6-15	8-5-15	2-26-18	10-24-18	2-7-19	4-6-21	4-21-25
PCE	9.3	18.7	12.7	19.3	14.7	16.2	14.5	16
TCE	23	6.8	57	5.9	4	3.8	3	2.9
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TCE	370	ND	87	ND	279	18.3	3500
cis-1,2-DCE	490	ND	130	ND	184	20.1	2600
VC	46	ND	14.5	ND	15.9	1.3	130 J

PMW-04	9-15-15	11-10-15	10-23-18	8-14-19	4-17-25
Methylene Chloride	6.7	ND	ND	ND	ND

PMW-05	9-15-15	11-19-15	10-23-18	8-13-19	4-16-25
PCE	17	17	12.3	13.2	9.3
TCE	8.6	9	8.5	6.5	21
cis-1,2-DCE	6	6.4	53.7	67.3	15

MW-05	10-24-18	4-16-25
Benzene	1.3	0.68 J
CB	109	170

PMW-10	9-15-15	4-18-25
Methylene Chloride	22	ND

PMW-15	10-18-18
PFOA	0.0101

PMW-08	9-15-15	11-19-15	10-19-18	8-14-19	4-15-25
TCE	72	73	48.5	40.4	30
cis-1,2-DCE	39	37	22.3	18.4	13

PMW-09	9-16-15	11-9-15	10-24-18	8-14-19	4-17-25
TCE	67	63	138	163	ND
cis-1,2-DCE	88	98	216	252	620
trans-1,2-DCE	1.7	2	2.5	2.9	5.4
VC	4.6	4.6	5.5	2.8	1.9 J
Toluene	ND	ND	ND	ND	6.4

PMW-22D	10-19-18	8-16-19	4-21-25
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cis-1,2-DCE	121	394	190

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VC	ND	8.2	1.6	ND

MW-09S	6-1-15	7-6-15	8-5-15	2-26-18	10-25-18	2-7-19	4-6-21	4-22-25
PCE	2300	95	12.4	ND	14.4	7.5	3.9	4.0 J
TCE	290	34.3	5	2.4	24.7	15.8	6.8	81
cis-1,2-DCE	1100	692	9500	13.9	793	664	36.2	2500
trans-1,2-DCE	NA	7.2	49.7	NA	13.2	NA	3	28
VC	90	19.1	123	8.8	271	834	132	2300
1,1-DCE	NA	ND	2.4	NA	ND	NA	ND	5.8 J

MW-10S	8-5-15	3-8-16	9-1-16	2-22-17	9-6-17	2-26-18	2-7-19	2-18-20	4-6-21	4-21-25
PCE	3.7	4.5	1	ND	6.5	ND	ND	ND	ND	0.56 J

Monitoring Well Point Location[5][6]

Approximate Boundary of Ash Road Off-Site

Former Building Outline[7]

Approximate Location of Former Creek Bed[8]

Exceeds NYSDEC Class GA Ambient Water Quality Standards (TOGS 1.1.1 Groundwater Criteria)

D Deep Groundwater Monitoring Well

ND Non-Detected

NA Not Available

Shallow Well Isopleth

PCE (ug/L)

- 5.1 - 10
- 10.1 - 100
- 100.1 - 1,000
- > 1,000

			NYSDEC TOGS 1.1.1 Groundwater Criteria for Parameter
PCE	= Tetrachloroethylene	=	5
TCE	= Trichloroethylene	=	5
cis-1,2-DCE	= cis-1, 2-Dichloroethylene	=	5
trans-1,2-DCE	= Trans-1, 2-Dichloroethene	=	5
VC	= Vinyl Chloride	=	2
MC	= Methylene Chloride	=	5
1,1-DCE	= 1,1-Dichloroethene	=	5
Benzene	= Benzene	=	1
CB	= Chlorobenzene	=	5
Toluene	= Toluene	=	5
PFOA	= Perflouroctanoic Acid	=	0.01

PMW-22D	10-19-18	8-16-19	4-21-25	Well ID
				Sample Date
PCE	106	339	120	Parameter/
TCE	22.6	84.2	22	Concentration
cis-1,2-DCE	121	394	190	of Parameter

Notes:

(1) Concentrations in micrograms per liter (ug/L).

(2) Only parameters that exceeded NYSDEC Ambient Water Quality Standards presented on TOGS 1.1.1 Groundwater Criteria shown on figure.

(3) Refer to Tables 6 through 8 in RI Report (Parsons, 2020) for detailed analysis of groundwater sampling event.

(4) Well points that have not exhibited parameter concentrations exceeding NYSDEC TOGS 1.1.1 Groundwater Criteria.

(5) Locations labeled MW-## are wells located to the east of the Ash Road Investigation Site and were installed by a different firm. Wells used to collect depth to water measurements and/or groundwater analytical samples.

(6) Locations labeled PMW-## are well points and were installed by Parsons in 2015 (PMW-1 though PMW-14) and in 2018 (PMW-15 through PMW-22). Both depth to water measurements and groundwater analytical samples were collected.

(7) Location of buildings responsible for subsurface contamination documented in 2009 and remediated in 2011 and 2015.

(8) Former creek bed location stops at edge of Sycamore Street. However, it is assumed that creek bed extends further to the west into Subject Property.

(9) The highest value was recorded if a field duplicate was also taken during sampling.

(10) The 2015, 2018 (except 10/24/18 and 10/25/18), 2019, and 2021 data for MW-01, MW-2S, MW-09S, and MW-10S came from the 2021 PRR (GeoLogic).

(11) June 1, 2015 data was collected prior to injection event on-site. For additional monitoring dates and data refer to Table 3 in 2021 PRR (GeoLogic).

(12) Wells not sampled during the April 2025 event include PMW-13, PMW-15 (not located), PMW-17, and PMW-19.

(13) MW-03, MW-04, MW-07 and MW-08 were last sampled 5/2012. VOC results were ND or less than TOGS 1.1.1 Groundwater criteria. MW-06 was last sampled in 2008. VOC results were ND. Well has been removed (GeoLogic 2013). MW-07 and MW-08 have been decommissioned per NYSDEC.

(14) The higher of the two concentrations detected at PMW-2 (shallow) and PMW-22D (deep) were used to create the isopleth.

(15) Isopleths were created using the Inverse Distance Weighting tool in ArcPro 3.4.2

0 125 250 500 Feet

N

Figure 7

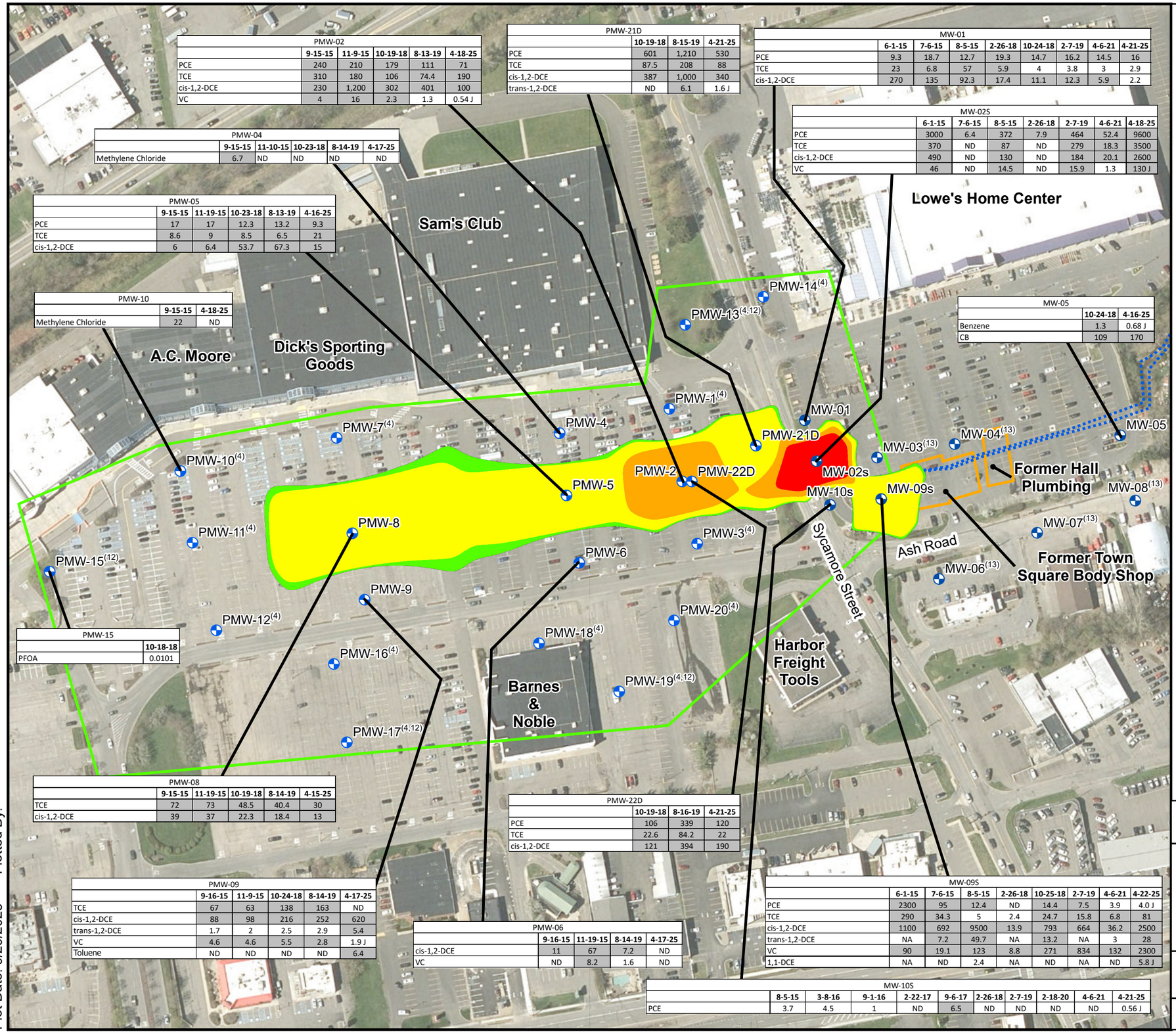
Ash Road Properties Off-Site
Feasibility Study Report
Town of Vestal, New York

PCE Concentration Isopleth (April 2025)

PARSONS

301 Plainfield Road, Suite 350; Syracuse, NY 13212 315-451-9560

File Name: Q:\GIS\NYSDEC\449445 WA #19 - Ash Road Properties\MXDs\FS\NYSDEC Ash Road FS Figure 5 2025.aprx
Plot Date: 9/29/2025 Plotted By:



PMW-02	9-15-15	11-9-15	10-19-18	8-13-19	4-18-25
PCE	240	210	179	111	71
TCE	310	180	106	74.4	190
cis-1,2-DCE	230	1,200	302	401	100
VC	4	16	2.3	1.3	0.54 J

PMW-21D	10-19-18	8-15-19	4-21-25
PCE	601	1,210	530
TCE	87.5	208	88
cis-1,2-DCE	387	1,000	340
trans-1,2-DCE	ND	6.1	1.6 J

MW-01	6-1-15	7-6-15	8-5-15	2-26-18	10-24-18	2-7-19	4-6-21	4-21-25
PCE	9.3	18.7	12.7	19.3	14.7	16.2	14.5	16
TCE	23	6.8	57	5.9	4	3.8	3	2.9
cis-1,2-DCE	270	135	92.3	17.4	11.1	12.3	5.9	2.2

MW-02S	6-1-15	7-6-15	8-5-15	2-26-18	2-7-19	4-6-21	4-18-25
PCE	3000	6.4	372	7.9	464	52.4	9600
TCE	370	ND	87	ND	279	18.3	3500
cis-1,2-DCE	490	ND	130	ND	184	20.1	2600
VC	46	ND	14.5	ND	15.9	1.3	130 J

PMW-04	9-15-15	11-10-15	10-23-18	8-14-19	4-17-25
Methylene Chloride	6.7	ND	ND	ND	ND

PMW-05	9-15-15	11-19-15	10-23-18	8-13-19	4-16-25
PCE	17	17	12.3	13.2	9.3
TCE	8.6	9	8.5	6.5	21
cis-1,2-DCE	6	6.4	53.7	67.3	15

MW-05	10-24-18	4-16-25
Benzene	1.3	0.68 J
CB	109	170

PMW-10	9-15-15	4-18-25
Methylene Chloride	22	ND

PMW-15	10-18-18
PFOA	0.0101

PMW-08	9-15-15	11-19-15	10-19-18	8-14-19	4-15-25
TCE	72	73	48.5	40.4	30
cis-1,2-DCE	39	37	22.3	18.4	13

PMW-22D	10-19-18	8-16-19	4-21-25
PCE	106	339	120
TCE	22.6	84.2	22
cis-1,2-DCE	121	394	190

PMW-09	9-16-15	11-9-15	10-24-18	8-14-19	4-17-25
TCE	67	63	138	163	ND
cis-1,2-DCE	88	98	216	252	620
trans-1,2-DCE	1.7	2	2.5	2.9	5.4
VC	4.6	4.6	5.5	2.8	1.9 J
Toluene	ND	ND	ND	ND	6.4

PMW-06	9-16-15	11-19-15	8-14-19	4-17-25
cis-1,2-DCE	11	67	7.2	ND
VC	ND	8.2	1.6	ND

MW-09S	6-1-15	7-6-15	8-5-15	2-26-18	10-25-18	2-7-19	4-6-21	4-22-25
PCE	2300	95	12.4	ND	14.4	7.5	3.9	4.0 J
TCE	290	34.3	5	2.4	24.7	15.8	6.8	81
cis-1,2-DCE	1100	692	9500	13.9	793	664	36.2	2500
trans-1,2-DCE	NA	7.2	49.7	NA	13.2	NA	3	28
VC	90	19.1	123	8.8	271	834	132	2300
1,1-DCE	NA	ND	2.4	NA	ND	NA	ND	5.8 J

MW-10S	8-5-15	3-8-16	9-1-16	2-22-17	9-6-17	2-26-18	2-7-19	2-18-20	4-6-21	4-21-25
PCE	3.7	4.5	1	ND	6.5	ND	ND	ND	ND	0.56 J

Monitoring Well Point Location[5][6]

Approximate Boundary of Ash Road Off-Site

Former Building Outline[7]

Approximate Location of Former Creek Bed[8]

Exceeds NYSDEC Class GA Ambient Water Quality Standards (TOGS 1.1.1 Groundwater Criteria)

D Deep Groundwater Monitoring Well

ND Non-Detected

NA Not Available

Shallow Well Isopleth

TCE (ug/L)

- 5.1 - 10
- 10.1 - 100
- 100.1 - 1,000
- > 1,000

			NYSDEC TOGS 1.1.1 Groundwater Criteria for Parameter
PCE	= Tetrachloroethylene	=	5
TCE	= Trichloroethylene	=	5
cis-1,2-DCE	= cis-1, 2-Dichloroethylene	=	5
trans-1,2-DCE	= Trans-1, 2-Dichloroethene	=	5
VC	= Vinyl Chloride	=	2
MC	= Methylene Chloride	=	5
1,1-DCE	= 1,1-Dichloroethene	=	5
Benzene	= Benzene	=	1
CB	= Chlorobenzene	=	5
Toluene	= Toluene	=	5
PFOA	= Perflouroctanoic Acid	=	0.01

PMW-22D	10-19-18	8-16-19	4-21-25	Well ID
PCE	106	339	120	Parameter/
TCE	22.6	84.2	22	Concentration
cis-1,2-DCE	121	394	190	of Parameter

Notes:

(1) Concentrations in micrograms per liter (ug/L).

(2) Only parameters that exceeded NYSDEC Ambient Water Quality Standards presented on TOGS 1.1.1 Groundwater Criteria shown on figure.

(3) Refer to Tables 6 through 8 in RI Report (Parsons, 2020) for detailed analysis of groundwater sampling event.

(4) Well points that have not exhibited parameter concentrations exceeding NYSDEC TOGS 1.1.1 Groundwater Criteria.

(5) Locations labeled MW-## are wells located to the east of the Ash Road Investigation Site and were installed by a different firm. Wells used to collect depth to water measurements and/or groundwater analytical samples.

(6) Locations labeled PMW-## are well points and were installed by Parsons in 2015 (PMW-1 though PMW-14) and in 2018 (PMW-15 through PMW-22). Both depth to water measurements and groundwater analytical samples were collected.

(7) Location of buildings responsible for subsurface contamination documented in 2009 and remediated in 2011 and 2015.

(8) Former creek bed location stops at edge of Sycamore Street. However, it is assumed that creek bed extends further to the west into Subject Property.

(9) The highest value was recorded if a field duplicate was also taken during sampling.

(10) The 2015, 2018 (except 10/24/18 and 10/25/18), 2019, and 2021 data for MW-01, MW-2S, MW-09S, and MW-10S came from the 2021 PRR (GeoLogic).

(11) June 1, 2015 data was collected prior to injection event on-site. For additional monitoring dates and data refer to Table 3 in 2021 PRR (GeoLogic).

(12) Wells not sampled during the April 2025 event include PMW-13, PMW-15 (not located), PMW-17, and PMW-19.

(13) MW-03, MW-04, MW-07 and MW-08 were last sampled 5/2012. VOC results were ND or less than TOGS 1.1.1 Groundwater criteria. MW-06 was last sampled in 2008. VOC results were ND. Well has been removed (GeoLogic 2013). MW-07 and MW-08 have been decommissioned per NYSDEC.

(14) The higher of the two concentrations detected at PMW-2 (shallow) and PMW-22D (deep) were used to create the isopleth.

(15) Isopleths were created using the Inverse Distance Weighting tool in ArcPro 3.4.2

0 125 250 500 Feet

N

Figure 8

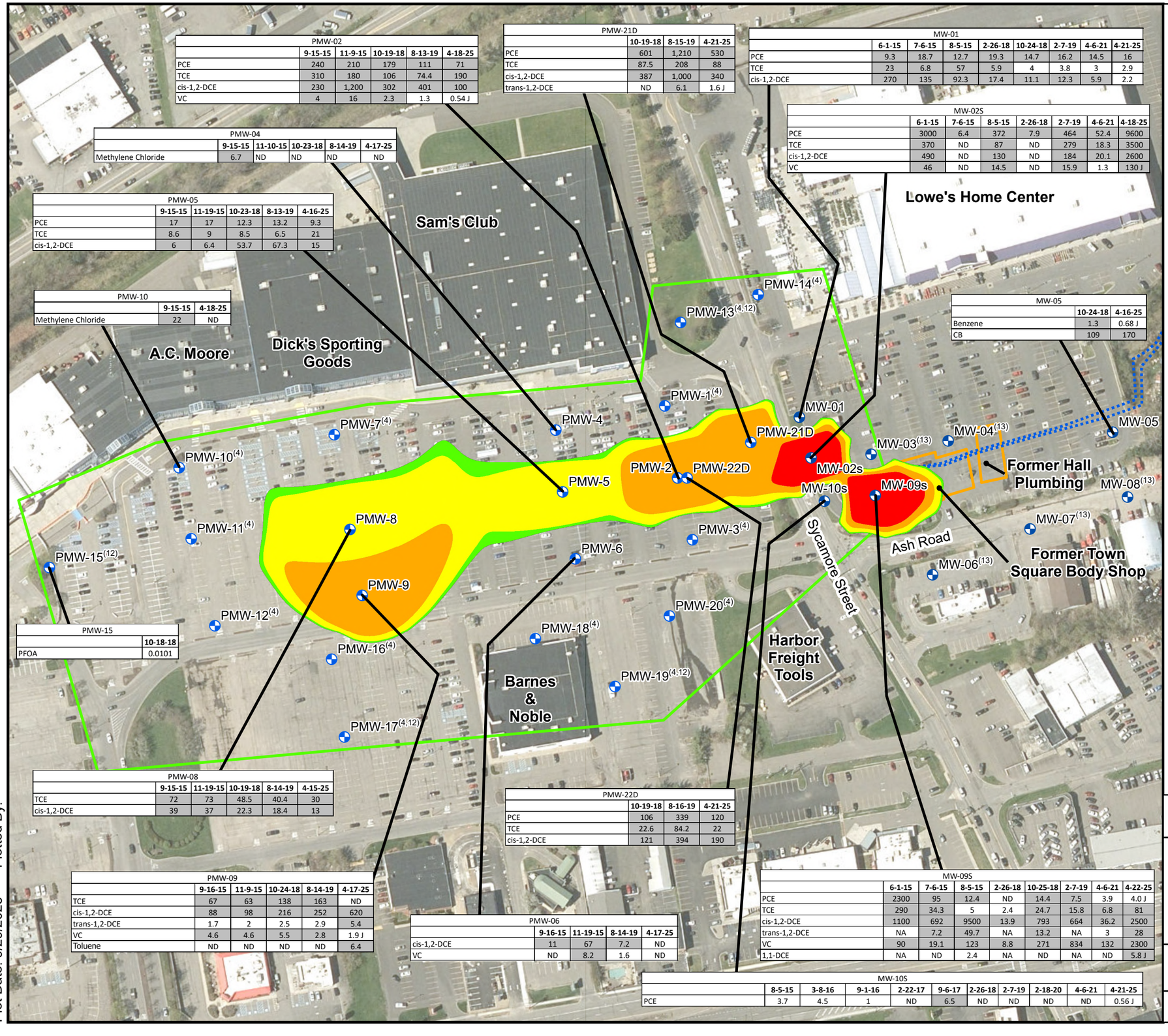
Ash Road Properties Off-Site
Feasibility Study Report
Town of Vestal, New York

TCE Concentration Isopleth (April 2025)

PARSONS

301 Plainfield Road, Suite 350; Syracuse, NY 13212 315-451-9560

File Name: Q:\GIS\NYSDEC\449445 WA #19 - Ash Road Properties\MXDs\FS\NYSDEC Ash Road FS Figure 5 2025.aprx
Plot Date: 9/29/2025 Plotted By:
NYSDEC Ash Road FS Figure 5 2025.aprx



PMW-02	9-15-15	11-9-15	10-19-18	8-13-19	4-18-25
PCE	240	210	179	111	71
TCE	310	180	106	74.4	190
cis-1,2-DCE	230	1,200	302	401	100
VC	4	16	2.3	1.3	0.54 J

PMW-21D	10-19-18	8-15-19	4-21-25
PCE	601	1,210	530
TCE	87.5	208	88
cis-1,2-DCE	387	1,000	340
trans-1,2-DCE	ND	6.1	1.6 J

MW-01	6-1-15	7-6-15	8-5-15	2-26-18	10-24-18	2-7-19	4-6-21	4-21-25
PCE	9.3	18.7	12.7	19.3	14.7	16.2	14.5	16
TCE	23	6.8	57	5.9	4	3.8	3	2.9
cis-1,2-DCE	270	135	92.3	17.4	11.1	12.3	5.9	2.2

PMW-04	9-15-15	11-10-15	10-23-18	8-14-19	4-17-25
Methylene Chloride	6.7	ND	ND	ND	ND

MW-02S	6-1-15	7-6-15	8-5-15	2-26-18	2-7-19	4-6-21	4-18-25
PCE	3000	6.4	372	7.9	464	52.4	9600
TCE	370	ND	87	ND	279	18.3	3500
cis-1,2-DCE	490	ND	130	ND	184	20.1	2600
VC	46	ND	14.5	ND	15.9	1.3	130 J

PMW-05	9-15-15	11-19-15	10-23-18	8-13-19	4-16-25
PCE	17	17	12.3	13.2	9.3
TCE	8.6	9	8.5	6.5	21
cis-1,2-DCE	6	6.4	53.7	67.3	15

MW-05	10-24-18	4-16-25
Benzene	1.3	0.68 J
CB	109	170

PMW-10	9-15-15	4-18-25
Methylene Chloride	22	ND

PMW-15	10-18-18
PFOA	0.0101

PMW-08	9-15-15	11-19-15	10-19-18	8-14-19	4-15-25
TCE	72	73	48.5	40.4	30
cis-1,2-DCE	39	37	22.3	18.4	13

PMW-22D	10-19-18	8-16-19	4-21-25
PCE	106	339	120
TCE	22.6	84.2	22
cis-1,2-DCE	121	394	190

PMW-09	9-16-15	11-9-15	10-24-18	8-14-19	4-17-25
TCE	67	63	138	163	ND
cis-1,2-DCE	88	98	216	252	620
trans-1,2-DCE	1.7	2	2.5	2.9	5.4
VC	4.6	4.6	5.5	2.8	1.9 J
Toluene	ND	ND	ND	ND	6.4

PMW-06	9-16-15	11-19-15	8-14-19	4-17-25
cis-1,2-DCE	11	67	7.2	ND
VC	ND	8.2	1.6	ND

MW-09S	6-1-15	7-6-15	8-5-15	2-26-18	10-25-18	2-7-19	4-6-21	4-22-25
PCE	2300	95	12.4	ND	14.4	7.5	3.9	4.0 J
TCE	290	34.3	5	2.4	24.7	15.8	6.8	81
cis-1,2-DCE	1100	692	9500	13.9	793	664	36.2	2500
trans-1,2-DCE	NA	7.2	49.7	NA	13.2	NA	3	28
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1,1-DCE	NA	ND	2.4	NA	ND	NA	ND	5.8 J

MW-10S	8-5-15	3-8-16	9-1-16	2-22-17	9-6-17	2-26-18	2-7-19	2-18-20	4-6-21	4-21-25
PCE	3.7	4.5	1	ND	6.5	ND	ND	ND	ND	0.56 J

Monitoring Well Point Location[5][6]

Approximate Boundary of Ash Road Off-Site

Former Building Outline[7]

Approximate Location of Former Creek Bed[8]

Exceeds NYSDEC Class GA Ambient Water Quality Standards (TOGS 1.1.1 Groundwater Criteria)

D Deep Groundwater Monitoring Well

ND Non-Detected

NA Not Available

Shallow Well Isopleth DCE (ug/L)

- 5.1 - 10
- 10.1 - 100
- 100.1 - 1,000
- > 1,000

			NYSDEC TOGS 1.1.1 Groundwater Criteria for Parameter
PCE	= Tetrachloroethylene	=	5
TCE	= Trichloroethylene	=	5
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trans-1,2-DCE	= Trans-1, 2-Dichloroethene	=	5
VC	= Vinyl Chloride	=	2
MC	= Methylene Chloride	=	5
1,1-DCE	= 1,1-Dichloroethene	=	5
Benzene	= Benzene	=	1
CB	= Chlorobenzene	=	5
Toluene	= Toluene	=	5
PFOA	= Perflouroctanoic Acid	=	0.01

PMW-22D	10-19-18	8-16-19	4-21-25	Well ID
PCE	106	339	120	Parameter/
TCE	22.6	84.2	22	Concentration
cis-1,2-DCE	121	394	190	of Parameter

Notes:

(1) Concentrations in micrograms per liter (ug/L).

(2) Only parameters that exceeded NYSDEC Ambient Water Quality Standards presented on TOGS 1.1.1 Groundwater Criteria shown on figure.

(3) Refer to Tables 6 through 8 in RI Report (Parsons, 2020) for detailed analysis of groundwater sampling event.

(4) Well points that have not exhibited parameter concentrations exceeding NYSDEC TOGS 1.1.1 Groundwater Criteria.

(5) Locations labeled MW-## are wells located to the east of the Ash Road Investigation Site and were installed by a different firm. Wells used to collect depth to water measurements and/or groundwater analytical samples.

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(9) The highest value was recorded if a field duplicate was also taken during sampling.

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(11) June 1, 2015 data was collected prior to injection event on-site. For additional monitoring dates and data refer to Table 3 in 2021 PRR (GeoLogic).

(12) Wells not sampled during the April 2025 event include PMW-13, PMW-15 (not located), PMW-17, and PMW-19.

(13) MW-03, MW-04, MW-07 and MW-08 were last sampled 5/2012. VOC results were ND or less than TOGS 1.1.1 Groundwater criteria. MW-06 was last sampled in 2008. VOC results were ND. Well has been removed (GeoLogic 2013). MW-07 and MW-08 have been decommissioned per NYSDEC.

(14) The higher of the two concentrations detected at PMW-2 (shallow) and PMW-22D (deep) were used to create the isopleth.

(15) Isopleths were created using the Inverse Distance Weighting tool in ArcPro 3.4.2

0 125 250 500 Feet

N

Figure 9

Ash Road Properties Off-Site
Feasibility Study Report
Town of Vestal, New York

Cis-1,2-DCE Concentration Isopleth (April 2025)

PARSONS

301 Plainfield Road, Suite 350; Syracuse, NY 13212 315-451-9560

File Name: Q:\GIS\NYSDEC\449445 WA #19 - Ash Road Properties\MXDs\FS\NYSDEC Ash Road FS Figure 5 2025.aprx
Plot Date: 9/29/2025 Plotted By:

File Name: Q:\GIS\NYSDEC\449445 WA #19 - Ash Road Properties\MXDs\FS\NYSDEC Ash Road FS Figure 5 2025.aprx
Plot Date: 9/29/2025 Plotted By:

PMW-02	9-15-15	11-9-15	10-19-18	8-13-19	4-18-25
PCE	240	210	179	111	71
TCE	310	180	106	74.4	190
cis-1,2-DCE	230	1,200	302	401	100
VC	4	16	2.3	1.3	0.54 J

PMW-21D	10-19-18	8-15-19	4-21-25
PCE	601	1,210	530
TCE	87.5	208	88
cis-1,2-DCE	387	1,000	340
trans-1,2-DCE	ND	6.1	1.6 J

MW-01	6-1-15	7-6-15	8-5-15	2-26-18	10-24-18	2-7-19	4-6-21	4-21-25
PCE	9.3	18.7	12.7	19.3	14.7	16.2	14.5	16
TCE	23	6.8	57	5.9	4	3.8	3	2.9
cis-1,2-DCE	270	135	92.3	17.4	11.1	12.3	5.9	2.2

MW-02S	6-1-15	7-6-15	8-5-15	2-26-18	2-7-19	4-6-21	4-18-25
PCE	3000	6.4	372	7.9	464	52.4	9600
TCE	370	ND	87	ND	279	18.3	3500
cis-1,2-DCE	490	ND	130	ND	184	20.1	2600
VC	46	ND	14.5	ND	15.9	1.3	130 J

PMW-04	9-15-15	11-10-15	10-23-18	8-14-19	4-17-25
Methylene Chloride	6.7	ND	ND	ND	ND

PMW-05	9-15-15	11-19-15	10-23-18	8-13-19	4-16-25
PCE	17	17	12.3	13.2	9.3
TCE	8.6	9	8.5	6.5	21
cis-1,2-DCE	6	6.4	53.7	67.3	15

MW-05	10-24-18	4-16-25
Benzene	1.3	0.68 J
CB	109	170

PMW-10	9-15-15	4-18-25
Methylene Chloride	22	ND

PMW-15	10-18-18
PFOA	0.0101

PMW-08	9-15-15	11-19-15	10-19-18	8-14-19	4-15-25
TCE	72	73	48.5	40.4	30
cis-1,2-DCE	39	37	22.3	18.4	13

PMW-22D	10-19-18	8-16-19	4-21-25
PCE	106	339	120
TCE	22.6	84.2	22
cis-1,2-DCE	121	394	190

PMW-09	9-16-15	11-9-15	10-24-18	8-14-19	4-17-25
TCE	67	63	138	163	ND
cis-1,2-DCE	88	98	216	252	620
trans-1,2-DCE	1.7	2	2.5	2.9	5.4
VC	4.6	4.6	5.5	2.8	1.9 J
Toluene	ND	ND	ND	ND	6.4

PMW-06	9-16-15	11-19-15	8-14-19	4-17-25
cis-1,2-DCE	11	67	7.2	ND
VC	ND	8.2	1.6	ND

MW-09S	6-1-15	7-6-15	8-5-15	2-26-18	10-25-18	2-7-19	4-6-21	4-22-25
PCE	2300	95	12.4	ND	14.4	7.5	3.9	4.0 J
TCE	290	34.3	5	2.4	24.7	15.8	6.8	81
cis-1,2-DCE	1100	692	9500	13.9	793	664	36.2	2500
trans-1,2-DCE	NA	7.2	49.7	NA	13.2	NA	3	28
VC	90	19.1	123	8.8	271	834	132	2300
1,1-DCE	NA	ND	2.4	NA	ND	NA	ND	5.8 J

MW-10S	8-5-15	3-8-16	9-1-16	2-22-17	9-6-17	2-26-18	2-7-19	2-18-20	4-6-21	4-21-25
PCE	3.7	4.5	1	ND	6.5	ND	ND	ND	ND	0.56 J

Sam's Club
Lowe's Home Center
A.C. Moore
Dick's Sporting Goods
Barnes & Noble
Harbor Freight Tools
Former Hall Plumbing
Former Town Square Body Shop
Sycamore Street
Ash Road

PMW-1(4)
PMW-2
PMW-3(4)
PMW-4
PMW-5
PMW-6
PMW-7(4)
PMW-8
PMW-9
PMW-10(4)
PMW-11(4)
PMW-12(4)
PMW-13(4,12)
PMW-14(4)
PMW-15(12)
PMW-16(4)
PMW-17(4,12)
PMW-18(4)
PMW-19(4,12)
PMW-20(4)
PMW-21D
PMW-22D
MW-01
MW-02s
MW-03(13)
MW-04(13)
MW-05
MW-06(13)
MW-07(13)
MW-08(13)
MW-09s
MW-10s

Monitoring Well Point Location(5)(6)
Approximate Boundary of Ash Road Off-Site
Former Building Outline(7)
Approximate Location of Former Creek Bed(8)
Exceeds NYSDEC Class GA Ambient Water Quality Standards (TOGS 1.1.1 Groundwater Criteria)
D Deep Groundwater Monitoring Well
ND Non-Detected
NA Not Available

Shallow Well Isopleth VC (ug/L)
2.1 - 10
10.1 - 100
100.1 - 1,000
> 1,000

			NYSDEC TOGS 1.1.1 Groundwater Criteria for Parameter
PCE	= Tetrachloroethylene	=	5
TCE	= Trichloroethylene	=	5
cis-1,2-DCE	= cis-1, 2-Dichloroethylene	=	5
trans-1,2-DCE	= Trans-1, 2-Dichloroethene	=	5
VC	= Vinyl Chloride	=	2
MC	= Methylene Chloride	=	5
1,1-DCE	= 1,1-Dichloroethene	=	5
Benzene	= Benzene	=	1
CB	= Chlorobenzene	=	5
Toluene	= Toluene	=	5
PFOA	= Perflouroctanoic Acid	=	0.01

PMW-22D	10-19-18	8-16-19	4-21-25	Well ID
PCE	106	339	120	Parameter/
TCE	22.6	84.2	22	Concentration
cis-1,2-DCE	121	394	190	of Parameter

Notes:

(1) Concentrations in micrograms per liter (ug/L).

(2) Only parameters that exceeded NYSDEC Ambient Water Quality Standards presented on TOGS 1.1.1 Groundwater Criteria shown on figure.

(3) Refer to Tables 6 through 8 in RI Report (Parsons, 2020) for detailed analysis of groundwater sampling event.

(4) Well points that have not exhibited parameter concentrations exceeding NYSDEC TOGS 1.1.1 Groundwater Criteria.

(5) Locations labeled MW-## are wells located to the east of the Ash Road Investigation Site and were installed by a different firm. Wells used to collect depth to water measurements and/or groundwater analytical samples.

(6) Locations labeled PMW-## are well points and were installed by Parsons in 2015 (PMW-1 though PMW-14) and in 2018 (PMW-15 through PMW-22). Both depth to water measurements and groundwater analytical samples were collected.

(7) Location of buildings responsible for subsurface contamination documented in 2009 and remediated in 2011 and 2015.

(8) Former creek bed location stops at edge of Sycamore Street. However, it is assumed that creek bed extends further to the west into Subject Property.

(9) The highest value was recorded if a field duplicate was also taken during sampling.

(10) The 2015, 2018 (except 10/24/18 and 10/25/18), 2019, and 2021 data for MW-01, MW-2S, MW-09S, and MW-10S came from the 2021 PRR (GeoLogic).

(11) June 1, 2015 data was collected prior to injection event on-site. For additional monitoring dates and data refer to Table 3 in 2021 PRR (GeoLogic).

(12) Wells not sampled during the April 2025 event include PMW-13, PMW-15 (not located), PMW-17, and PMW-19.

(13) MW-03, MW-04, MW-07 and MW-08 were last sampled 5/2012. VOC results were ND or less than TOGS 1.1.1 Groundwater criteria. MW-06 was last sampled in 2008. VOC results were ND. Well has been removed (GeoLogic 2013). MW-07 and MW-08 have been decommissioned per NYSDEC.

(14) The higher of the two concentrations detected at PMW-2 (shallow) and PMW-22D (deep) were used to create the isopleth.

(15) Isopleths were created using the Inverse Distance Weighting tool in ArcPro 3.4.2

0 125 250 500 Feet

N

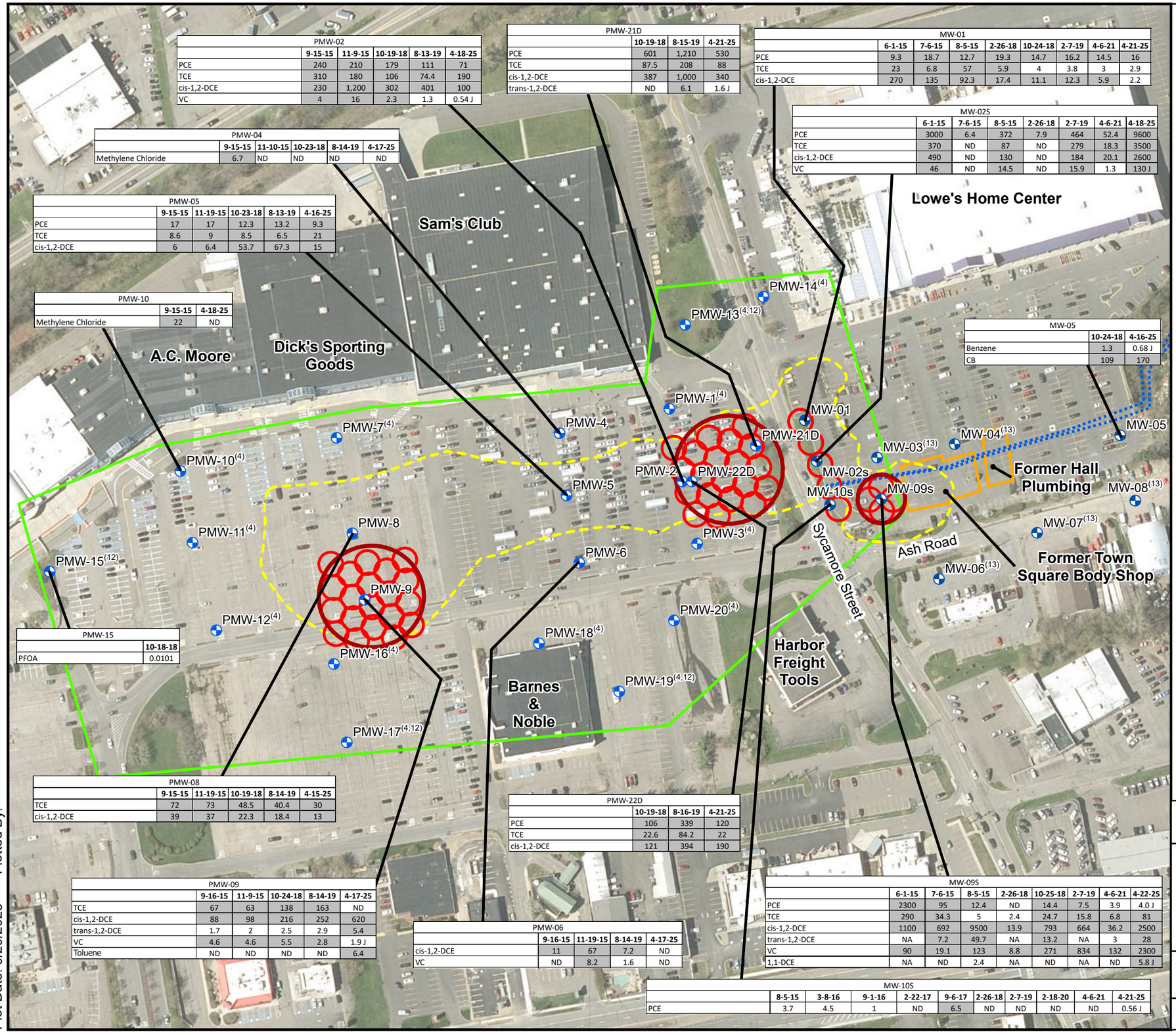
Figure 10

Ash Road Properties Off-Site
Feasibility Study Report
Town of Vestal, New York

Vinyl Chloride Concentration Isopleth (April 2025)

PARSONS

301 Plainfield Road, Suite 350; Syracuse, NY 13212 315-451-9560



PMW-02	9-15-15	11-9-15	10-19-18	8-13-19	4-18-25
PCE	240	210	179	111	71
TCE	310	180	106	74.4	190
cis-1,2-DCE	230	1,200	302	401	100
VC	4	16	2.3	1.3	0.54 J

PMW-21D	10-19-18	8-15-19	4-21-25
PCE	601	1,210	530
TCE	87.5	208	88
cis-1,2-DCE	387	1,000	340
trans-1,2-DCE	ND	6.1	1.6 J

MW-01	6-1-15	7-6-15	8-5-15	2-26-18	10-24-18	2-7-19	4-6-21	4-21-25
PCE	9.3	18.7	12.7	19.3	14.7	16.2	14.5	16
TCE	23	6.8	57	5.9	4	3.8	3	2.9
cis-1,2-DCE	270	135	92.3	17.4	11.1	12.3	5.9	2.2

MW-02S	6-1-15	7-6-15	8-5-15	2-26-18	2-7-19	4-6-21	4-18-25
PCE	3000	6.4	372	7.9	464	52.4	9600
TCE	370	ND	87	ND	279	18.3	3500
cis-1,2-DCE	490	ND	130	ND	184	20.1	2600
VC	46	ND	14.5	ND	15.9	1.3	130 J

PMW-04	9-15-15	11-10-15	10-23-18	8-14-19	4-17-25
Methylene Chloride	6.7	ND	ND	ND	ND

PMW-05	9-15-15	11-19-15	10-23-18	8-13-19	4-16-25
PCE	17	17	12.3	13.2	9.3
TCE	8.6	9	8.5	6.5	21
cis-1,2-DCE	6	6.4	53.7	67.3	15

MW-05	10-24-18	4-16-25
Benzene	1.3	0.68 J
CB	109	170

PMW-10	9-15-15	4-18-25
Methylene Chloride	22	ND

PMW-15	10-18-18
PFOA	0.0101

PMW-08	9-15-15	11-19-15	10-19-18	8-14-19	4-15-25
TCE	72	73	48.5	40.4	30
cis-1,2-DCE	39	37	22.3	18.4	13

PMW-22D	10-19-18	8-16-19	4-21-25
PCE	106	339	120
TCE	22.6	84.2	22
cis-1,2-DCE	121	394	190

PMW-09	9-16-15	11-9-15	10-24-18	8-14-19	4-17-25
TCE	67	63	138	163	ND
cis-1,2-DCE	88	98	216	252	620
trans-1,2-DCE	1.7	2	2.5	2.9	5.4
VC	4.6	4.6	5.5	2.8	1.9 J
Toluene	ND	ND	ND	ND	6.4

PMW-06	9-16-15	11-19-15	8-14-19	4-17-25
cis-1,2-DCE	11	67	7.2	ND
VC	ND	8.2	1.6	ND

MW-09S	6-1-15	7-6-15	8-5-15	2-26-18	10-25-18	2-7-19	4-6-21	4-22-25
PCE	2300	95	12.4	ND	14.4	7.5	3.9	4.0 J
TCE	290	34.3	5	2.4	24.7	15.8	6.8	81
cis-1,2-DCE	1100	692	9500	13.9	793	664	36.2	2500
trans-1,2-DCE	NA	7.2	49.7	NA	13.2	NA	3	28
VC	90	19.1	123	8.8	271	834	132	2300
1,1-DCE	NA	ND	2.4	NA	ND	NA	ND	5.8 J

MW-10S	8-5-15	3-8-16	9-1-16	2-22-17	9-6-17	2-26-18	2-7-19	2-18-20	4-6-21	4-21-25
PCE	3.7	4.5	1	ND	6.5	ND	ND	ND	ND	0.56 J

- Monitoring Well Point Location[5][6]
- Approximate Boundary of Ash Road Off-Site
- Former Building Outline[7]
- Approximate Location of Former Creek Bed[8]
- Approximate Limits of Groundwater Impact Area on ARP Off-site Area.
- Injection Well Locations
- Targeted Treatment Areas
- Exceeds NYSDEC Class GA Ambient Water Quality Standards (TOGS 1.1.1 Groundwater Criteria)
- D Deep Groundwater Monitoring Well
- ND Non-Detected
- NA Not Available

			NYSDEC TOGS 1.1.1 Groundwater Criteria for Parameter
PCE	=	Tetrachloroethylene	= 5
TCE	=	Trichloroethylene	= 5
cis-1,2-DCE	=	cis-1, 2-Dichloroethylene	= 5
trans-1,2-DCE	=	Trans-1, 2-Dichloroethene	= 5
VC	=	Vinyl Chloride	= 2
MC	=	Methylene Chloride	= 5
1,1-DCE	=	1,1-Dichloroethene	= 5
Benzene	=	Benzene	= 1
CB	=	Chlorobenzene	= 5
Toluene	=	Toluene	= 5
PFOA	=	Perflouorooctanoic Acid	= 0.01

Notes:

(1) Concentrations in micrograms per liter (ug/L).

(2) Only parameters that exceeded NYSDEC Ambient Water Quality Standards presented on TOGS 1.1.1 Groundwater Criteria shown on figure.

(3) Refer to Tables 6 through 8 in RI Report (Parsons, 2020) for detailed analysis of groundwater sampling event.

(4) Well points that have not exhibited parameter concentrations exceeding NYSDEC TOGS 1.1.1 Groundwater Criteria.

(5) Locations labeled MW-## are wells located to the east of the Ash Road Investigation Site and were installed by a different firm. Wells used to collect depth to water measurements and/or groundwater analytical samples.

(6) Locations labeled PMW-## are well points and were installed by Parsons in 2015 (PMW-1 though PMW-14) and in 2018 (PMW-15 through PMW-22). Both depth to water measurements and groundwater analytical samples were collected.

(7) Location of buildings responsible for subsurface contamination documented in 2009 and remediated in 2011 and 2015.

(8) Former creek bed location stops at edge of Sycamore Street. However, it is assumed that creek bed extends further to the west into Subject Property.

(9) The highest value was recorded if a field duplicate was also taken during sampling.

(10) The 2015, 2018 (except 10/24/18 and 10/25/18), 2019, and 2021 data for MW-01, MW-2S, MW-09S, and MW-10S came from the 2021 PRR (GeoLogic).

(11) June 1, 2015 data was collected prior to injection event on-site. For additional monitoring dates and data refer to Table 3 in 2021 PRR (GeoLogic).

(12) Wells not sampled during the April 2025 event include PMW-13, PMW-15 (not located), PMW-17, and PMW-19.

(13) MW-03, MW-04, MW-07 and MW-08 were last sampled 5/2012. VOC results were ND or less than TOGS 1.1.1 Groundwater criteria. MW-06 was last sampled in 2008. VOC results were ND. Well has been removed (GeoLogic 2013). MW-07 and MW-08 have been decommissioned per NYSDEC.

(14) On-site injections were completed in June 2015. Data from June 1, 2015 was collected prior to the injection event.

0 125 250 500 Feet

N

Figure 11

Ash Road Properties Off-Site
Feasibility Study Report

Town of Vestal, New York

Alternative GW-5: Proposed Injection Wells for Targeted Remedy (>300 ppb) - EISB/MNA

PARSONS

301 Plainfield Road, Suite 350; Syracuse, NY 13212 315-451-9560

File Name: Q:\GIS\NYSDEC\449445 WA #19 - Ash Road Properties\MXDs\FS\NYSDEC Ash Road FS Figure 5 2025.aprx
Plot Date: 9/29/2025 Plotted By:

APPENDIX A CALCULATIONS TO ACHIEVE GROUNDWATER QUALITY STANDARDS

Appendix A.1 Monitored Natural Attenuation

Appendix A.2 Full-Scale Remediation – Injections

Appendix A.3 Targeted Remediation

Appendix A.4 AS/SVE (Two-Order Magnitude Reduction)

APPENDIX A.1 MONITORED NATURAL ATTENUATION

Appendix A. 1: Summary for Time to Reach GWQS (Years): Monitored Natural Attenuation

Calculate Time to reach GWQS (years) - Using Average Decay Constant (k, -0.075/year)

Well	2025 Total Chloroethene (CE) Conc (µg/L)	Avg. Time to reach GWQS (years)	Notes
PMW-2	361.54	55.56	Calculated*
PMW-5	45.30	26.22	Calculated*
PMW-8	43.00	22.05	Calculated*
PMW-21D	959.60	77.15	Calculated*
PMW-22D	332.00	146.44	Calculated*
PMW-9	627.30	66.59	Estimated**
MW-01	21.10	21.36	Estimated**
MW-02S	15830.00	109.64	Estimated**
MW-09S	4918.80	94.05	Estimated**
		68.79	**Average**
		21.36	**Minimum**
		146.44	**Maximum**

* Time was calculated based on decay constant, k, for each well - see first order attenuation rate constant sheets

**MW-02S, MW-09S, and PMW-9 showed an increasing trend. As such, not able to perform first order attenuation rate constant calculations. Instead, calculated range of time to reach GWQS using the low and high decay constants calculated for PMW-2, PMW-5, PMW-8 and PMW-21D and 22D.

Calculate Estimated Time to reach GWQS (years) - Using Low k and High k

	Time to reach GWQS (years)***		
	Low K	High K	
	-0.03032	-0.1009	
MW-01	52.8	15.9	
MW-02S	271.2	81.5	
MW-09S	232.6	69.9	
PMW-9	164.7	49.5	
	180.4	54.2	**Average**
	52.8	15.9	**Minimum**
	271.2	81.5	**Maximum**

***MW-02S, MW-09S, and PMW-9 showed an increasing trend. As such, not able to perform first order attenuation rate constant calculations. Instead, calculated range of time to reach GWQS using the low and high decay constants calculated for PMW-2, PMW-5, PMW-8 and PMW-21D and 22D.

Monitored Natural Attenuation: Time to Reach GWQS (Years)

	MNA Duration (Years)
Global Min	81.5
Global Max	271.2
Global Avg	97.3

Appendix A.1 - MNA Calculations

First-Order Attenuation Rate Constant (K_{point}) for MNA and Time to Reach GWQS

(Reference: EPA/540/S-02/500, November 2002)

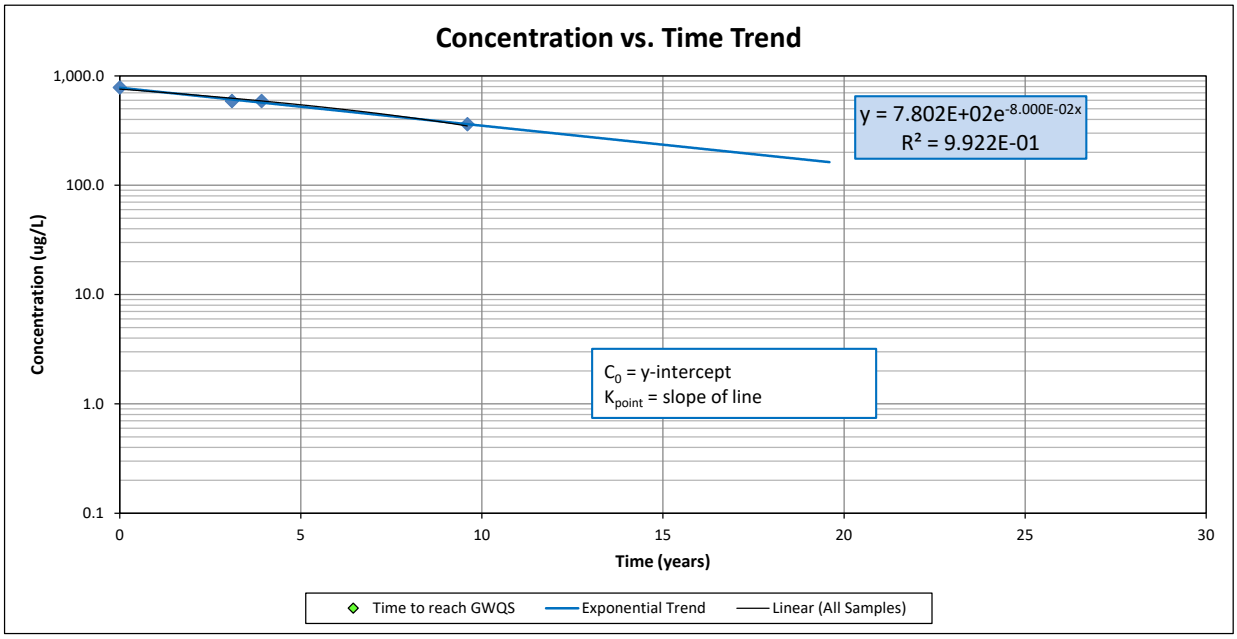
Site: Ash Road Properties Off-Site
Vestal, New York

Well: PMW-2
COC: Total Chloroethenes

Count	Date	total chloroethenes (ug/L)
1	09/15/15	784
2	10/19/18	589.3
3	08/13/19	587.7
4	04/18/25	361.54

GWQS (ug/L)*:	4.25		Time (t)
Initial sampling date:	09/15/15	0.0	years
First sample used to fit trendline:	09/15/15	0.0	years
Last sampling date:	04/18/25	9.6	years
Total number of samples:	4		
Number of samples used to fit trendline:	4		

*Note: 4.25 ug/L equals average GA standard/guidance of 5 ug/L for PCE, TCE, and DCE, and 2 ug/L for VC



First-Order (Exponential) Trendline Equation

$C_t = C_0 e^{k t}$

where:
C_t = Concentration at some future time
C_0 = Initial concentration (y-intercept)
e = exponential function
k = decay constant (or k_{point} = Attenuation Rate constant)
t = time (years); note that "t" is the x-axis and is substituted for "x" in the exponential trend equation

Re-arrange and solve for time (t) to reach the GWQS

$t = -\ln (GWQS / C_0)$

C_0 =	780	ug/L	(y-intercept from best-fit trendline, *not* the first groundwater sample result)
k_{point} =	-0.08000	per year	(equivalent to the "slope" of the exponential line)

Predicted time (t) to reach the GWQS:

Time to reach GWQS =	65.2	years from initial sampling date (t = 0)
	55.6	years from most recent sampling date
	10/25/80	date

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Appendix A.1 - MNA Calculations

First-Order Attenuation Rate Constant (K_{point}) for MNA and Time to Reach GWQS

(Reference: EPA/540/S-02/500, November 2002)

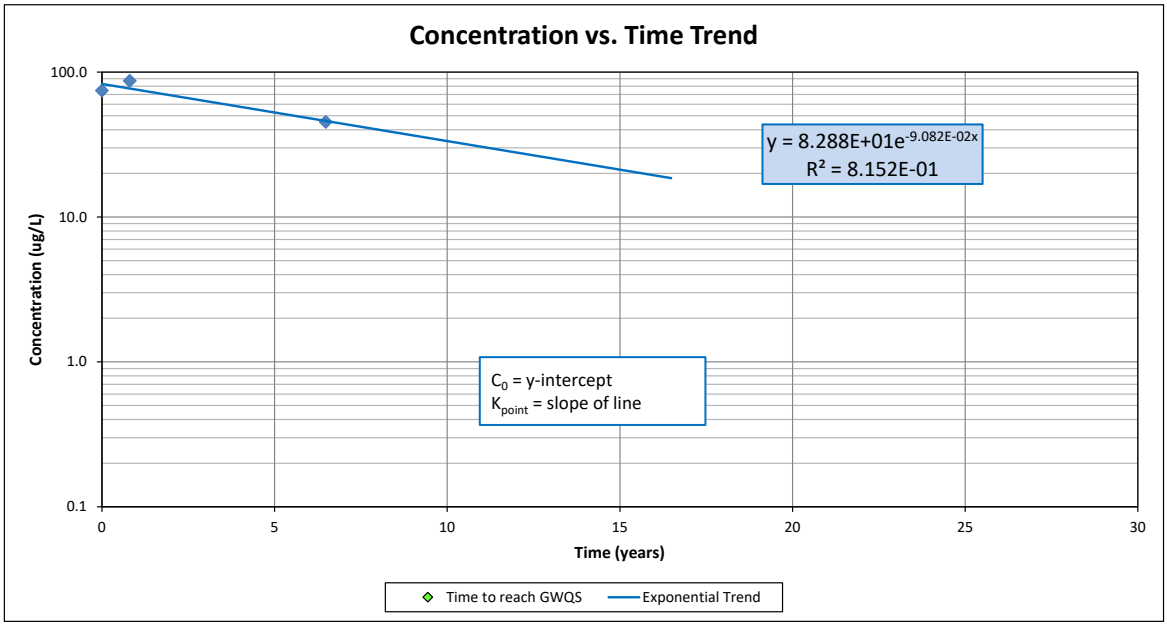
Site: Ash Road Properties Off-Site
Vestal, New York

Well: PMW-5
COC: Total Chloroethenes
GWQS (ug/L)*: 4.25 Time (t)

Count	Date	total chloroethenes (ug/L)
1	10/23/18	74.5
2	08/13/19	87
3	04/16/25	45.3

Initial sampling date:	10/23/18	0.0	years
First sample used to fit trendline:	10/23/18	0.0	years
Last sampling date:	04/16/25	6.5	years
Total number of samples:	3		
Number of samples used to fit trendline:	3		

*Note: 4.25 ug/L equals average GA standard/guidance of 5 ug/L for PCE, TCE, and DCE, and 2 ug/L for VC



First-Order (Exponential) Trendline Equation

$$C_t = C_0 e^{k t}$$

where:
C_t = Concentration at some future time
C_0 = Initial concentration (y-intercept)
e = exponential function
k = decay constant (or k_{point} = Attenuation Rate constant)
t = time (years); note that "t" is the x-axis and is substituted for "x" in the exponential trend equation

Re-arrange and solve for time (t) to reach the GWQS

$$t = \frac{-\ln (GWQS / C_0)}{k_{point}}$$

C_0 =	83	ug/L	(y-intercept from best-fit trendline, *not* the first groundwater sample result)
k_{point} =	-0.09082	per year	(equivalent to the "slope" of the exponential line)

Predicted time (t) to reach the GWQS:

Time to reach GWQS =	32.7	years from initial sampling date (t = 0)
	26.2	years from most recent sampling date
	6/30/2051	date

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Appendix A.1 - MNA Calculations

First-Order Attenuation Rate Constant (K_{point}) for MNA and Time to Reach GWQS

(Reference: EPA/540/S-02/500, November 2002)

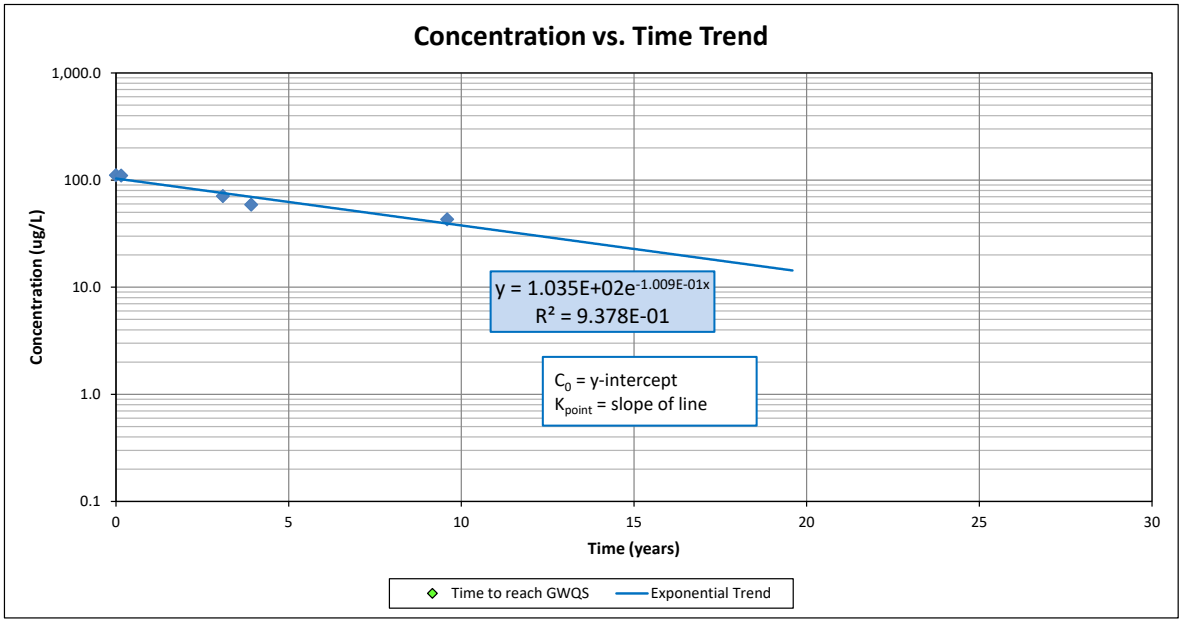
Site: Ash Road Properties Off-Site
Vestal, New York

Well: PMW-8
COC: Total Chloroethenes
GWQS (ug/L):* 4.25 Time (t)

Count	Date	total chloroethenes (ug/L)
1	9/15/2015	111
2	11/9/2015	110
3	10/19/2018	70.8
4	8/14/2019	58.8
5	4/15/2025	43

Initial sampling date:	09/15/15	0.0	years
First sample used to fit trendline:	09/15/15	0.0	years
Last sampling date:	04/15/25	9.6	years
Total number of samples:	5		
Number of samples used to fit trendline:	5		

*Note: 4.25 ug/L equals average GA standard/guidance of 5 ug/L for PCE, TCE, and DCE, and 2 ug/L for VC



First-Order (Exponential) Trendline Equation

$C_t = C_0 e^{kt}$

where:
C_t = Concentration at some future time
C_0 = Initial concentration (y-intercept)
e = exponential function
k = decay constant (or k_{point} = Attenuation Rate constant)
t = time (years); note that "t" is the x-axis and is substituted for "x" in the exponential trend equation

Re-arrange and solve for time (t) to reach the GWQS

$$t = \frac{-\ln(GWQS / C_0)}{k_{point}}$$

Enter values from trend line equation (light blue box) shown on graph

C_0 =	104	ug/L	(y-intercept from best-fit trendline, *not* the first groundwater sample result)
k_{point} =	-0.1009	per year	(equivalent to the "slope" of the exponential line)

Predicted time (t) to reach the GWQS:

Time to reach GWQS =	31.6	years from initial sampling date (t = 0)
	22.1	years from most recent sampling date
	04/29/47	date

PARSONS

Appendix A.1 - MNA Calculations

First-Order Attenuation Rate Constant (K_{point}) for MNA and Time to Reach GWQS

(Reference: EPA/540/S-02/500, November 2002)

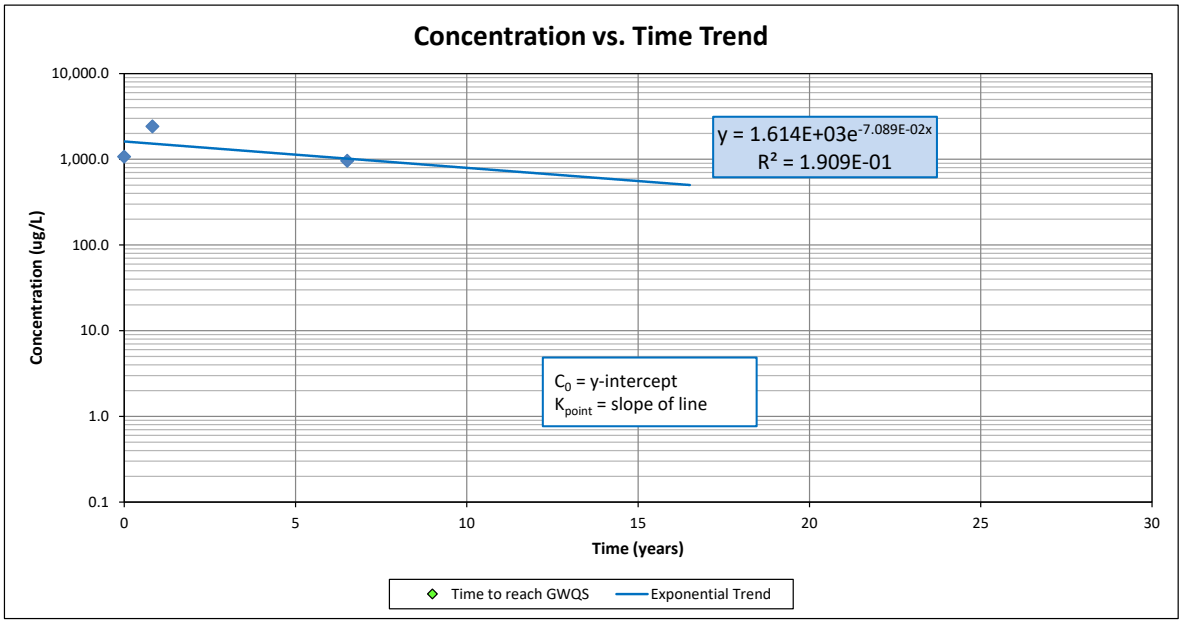
Site: Ash Road Properties Off-Site
Vestal, New York

Well: PMW-21D
COC: Total Chloroethenes
GWQS (ug/L):* 4.25 Time (t)

Count	Date	total chloroethenes (ug/L)
1	10/19/2018	1075.5
2	8/15/2019	2424
3	4/21/2025	959.6

Initial sampling date:	10/19/18	0.0	years
First sample used to fit trendline:	10/19/18	0.0	years
Last sampling date:	04/21/25	6.5	years
Total number of samples:	3		
Number of samples used to fit trendline:	3		

*Note: 4.25 ug/L equals average GA standard/guidance of 5 ug/L for PCE, TCE, and DCE, and 2 ug/L for VC



First-Order (Exponential) Trendline Equation

$C_t = C_0 e^{k t}$

where:
C_t = Concentration at some future time
C_0 = Initial concentration (y-intercept)
e = exponential function
k = decay constant (or k_{point} = Attenuation Rate constant)
t = time (years); note that "t" is the x-axis and is substituted for "x" in the exponential trend equation

Re-arrange and solve for time (t) to reach the GWQS

$$t = \frac{-\ln (GWQS / C_0)}{k_{point}}$$

Enter values from trend line equation (light blue box) shown on graph

C_0 =	1,614	ug/L	(y-intercept from best-fit trendline, *not* the first groundwater sample result)
k_{point} =	-0.071	per year	(equivalent to the "slope" of the exponential line)

Predicted time (t) to reach the GWQS:

Time to reach GWQS =	83.7	years from initial sampling date (t = 0)
	77.1	years from most recent sampling date
	05/26/02	date

PARSONS

Appendix A.1 - MNA Calculations

First-Order Attenuation Rate Constant (K_{point}) for MNA and Time to Reach GWQS

(Reference: EPA/540/S-02/500, November 2002)

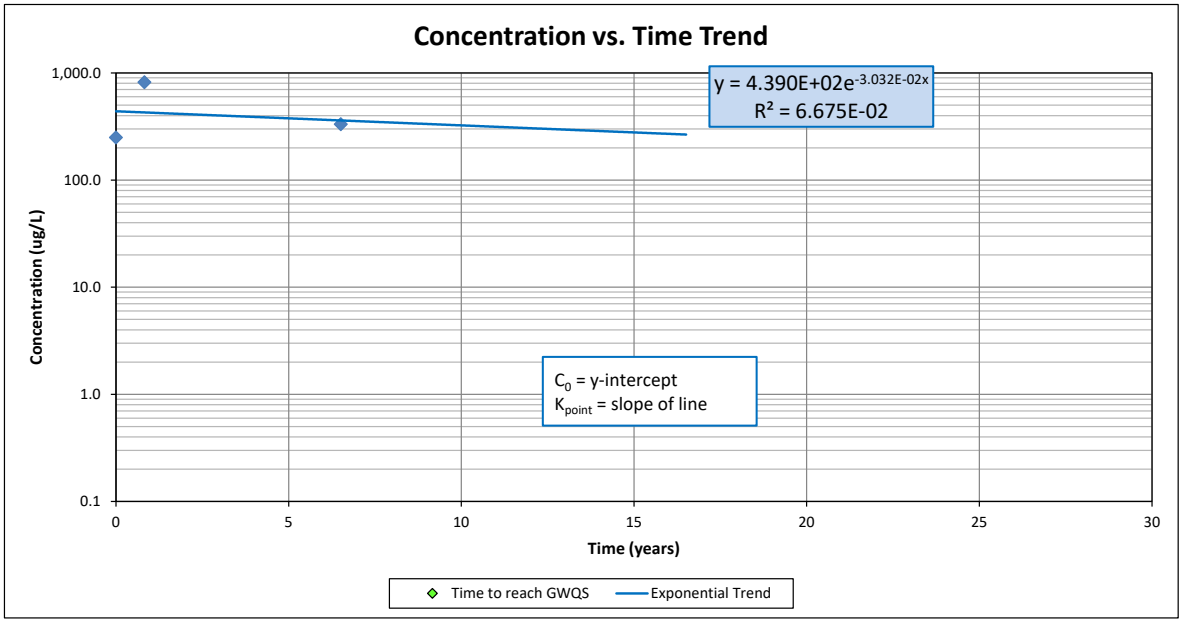
Site: Ash Road Properties Off-Site
Vestal, New York

Well: PMW-22D
COC: Total Chloroethenes
GWQS (ug/L):* 4.25 Time (t)

Count	Date	total chloroethenes (ug/L)
1	10/19/2018	249.6
2	8/16/2019	817.2
3	4/21/2025	332

Initial sampling date:	10/19/18	0.0	years
First sample used to fit trendline:	10/19/18	0.0	years
Last sampling date:	04/21/25	6.5	years
Total number of samples:	3		
Number of samples used to fit trendline:	3		

*Note: 4.25 ug/L equals average GA standard/guidance of 5 ug/L for PCE, TCE, and DCE, and 2 ug/L for VC



First-Order (Exponential) Trendline Equation

$C_t = C_0 e^{kt}$

where:
C_t = Concentration at some future time
C_0 = Initial concentration (y-intercept)
e = exponential function
k = decay constant (or k_{point} = Attenuation Rate constant)
t = time (years); note that "t" is the x-axis and is substituted for "x" in the exponential trend equation

Re-arrange and solve for time (t) to reach the GWQS

$$t = \frac{-\ln(GWQS / C_0)}{k_{point}}$$

Enter values from trend line equation (light blue box) shown on graph

C_0 =	439	ug/L	(y-intercept from best-fit trendline, *not* the first groundwater sample result)
k_{point} =	-0.03032	per year	(equivalent to the "slope" of the exponential line)

Predicted time (t) to reach the GWQS:

Time to reach GWQS =	153.0	years from initial sampling date (t = 0)
	146.4	years from most recent sampling date
	08/26/71	date

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APPENDIX A.2 FULL-SCALE REMEDIATION – INJECTIONS

Appendix A.2: Summary for Time to Reach GWQS (Years): Full-Scale Injections (Three Order Magnitude Reduction with Two Injections)

Calculate Time to reach GWQS (years) - Using Average Decay Constant (k, -0.075/year)

Well	Total CE Conc (µg/L)	Avg. Time to reach GWQS (years)	Notes
PMW-2	3.62	0.0	Calculated*
PMW-5	0.453	0.0	Calculated*
PMW-8	0.43	0.0	Calculated*
PMW-21D	9.60	12.3	Calculated*
PMW-22D	3.32	0.0	Calculated*
PMW-09	6.27	5.2	Estimated**
MW-01	0.21	0.0	Estimated**
MW-02S	15.83	17.6	Estimated***
MW-09S	4.92	2.0	Estimated***
		4.12	**Average**
		0	**Minimum**
		17.63	**Maximum**

* Time was calculated based on decay constant, k, for each well - see first order attenuation rate constant sheets

**MW-02S, MW-09S, and PMW-9 showed an increasing trend. As such, not able to perform first order attenuation rate constant calculations. Instead, calculated range of time to reach GWQS using the low and high decay constants calculated for PMW-2, PMW-5, PMW-8 and PMW-21D and 22D.

***MW-02S and MW-09s - starting concentrations were reduced 3 orders of magnitude where as all others were reduced two orders of magnitude to account for having to return to site to complete at least one additional injection after 10 years. The additional injection will also facilitate achieving target GWQS in a shorter time frame.

Calculate Estimated Time to reach GWQS (years) - Using Low k and High k

	Time to reach GWQS (years)***		
	Low K	High K	
	-0.03032	-0.1009	
MW-01	0.0	0.0	
MW-02S	43.4	13.0	
MW-09S	4.8	1.4	
PMW-09	12.8	3.9	
	15.3	4.6	**Average**
	0.0	0.0	**Minimum**
	43.4	13.0	**Maximum**

**MW-02S, MW-09S, and PMW-9 showed an increasing trend. As such, not able to perform first order attenuation rate constant calculations. Instead, calculated range of time to reach GWQS using the low and high decay constants calculated for PMW-2, PMW-5, PMW-8 and PMW-21D and 22D.

Monitored Natural Attenuation: Time to Reach GWQS (Years)

	MNA Duration (Years)
Global Min	0
Global Max	53
Global Avg	17

Appendix A.2 - Full-Scale Remediation Calculations

First-Order Attenuation Rate Constant (K_{point}) for MNA and Time to Reach GWQS

(Reference: EPA/540/S-02/500, November 2002)

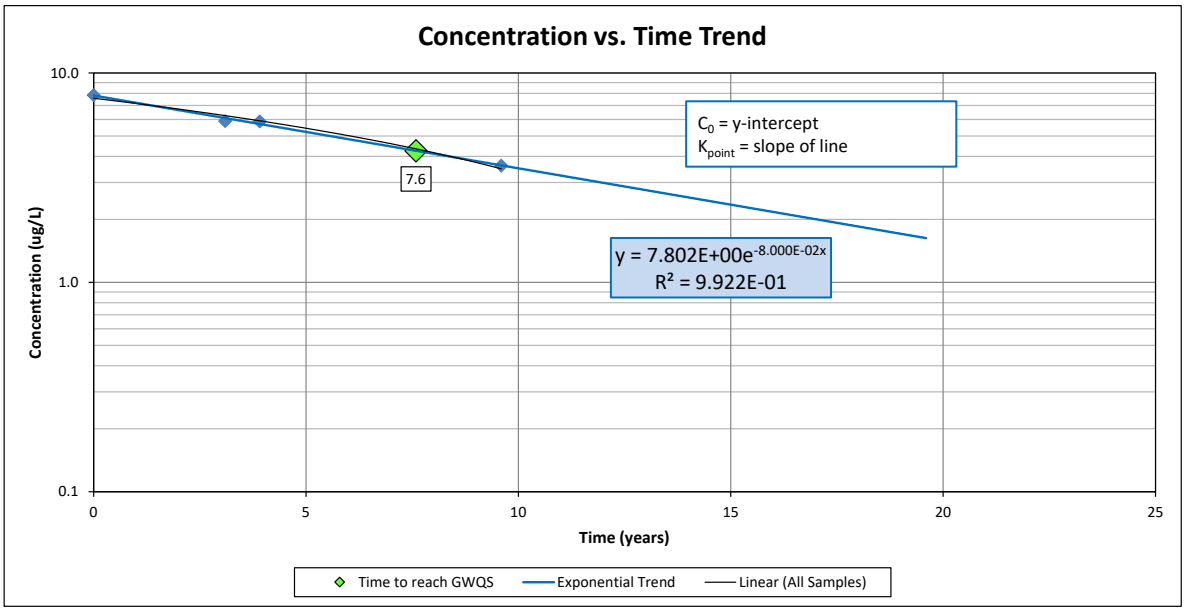
Site: Ash Road Properties Off-Site
Vestal, New York

Well: PMW-2
COC: Total Chloroethenes

Count	Date	total chloroethenes (ug/L)
1	09/15/15	7.84
2	10/19/18	5.89
3	08/13/19	5.88
4	04/18/25	3.6154

GWQS (ug/L)*:	4.25		Time (t)
Initial sampling date:	09/15/15	0.0	years
First sample used to fit trendline:	09/15/15	0.0	years
Last sampling date:	04/18/25	9.6	years
Total number of samples:	4		
Number of samples used to fit trendline:	4		

*Note: 4.25 ug/L equals average GA standard/guidance of 5 ug/L for PCE, TCE, and DCE, and 2 ug/L for VC



First-Order (Exponential) Trendline Equation

$C_t = C_0 e^{kt}$

where:
C_t = Concentration at some future time
C_0 = Initial concentration (y-intercept)
e = exponential function
k = decay constant (or k_{point} = Attenuation Rate constant)
t = time (years); note that "t" is the x-axis and is substituted for "x" in the exponential trend equation

Re-arrange and solve for time (t) to reach the GWQS

$$t = \frac{-\ln(GWQS / C_0)}{k_{point}}$$

C_0 =	7.80	ug/L	(y-intercept from best-fit trendline, *not* the first groundwater sample result)
k_{point} =	-0.08	per year	(equivalent to the "slope" of the exponential line)

Predicted time (t) to reach the GWQS:

Time to reach GWQS =	7.6	years from initial sampling date (t = 0)
	-2.0	years from most recent sampling date
	04/16/23	date

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Appendix A.2 - Full-Scale Remediation Calculations

First-Order Attenuation Rate Constant (K_{point}) for MNA and Time to Reach GWQS

(Reference: EPA/540/S-02/500, November 2002)

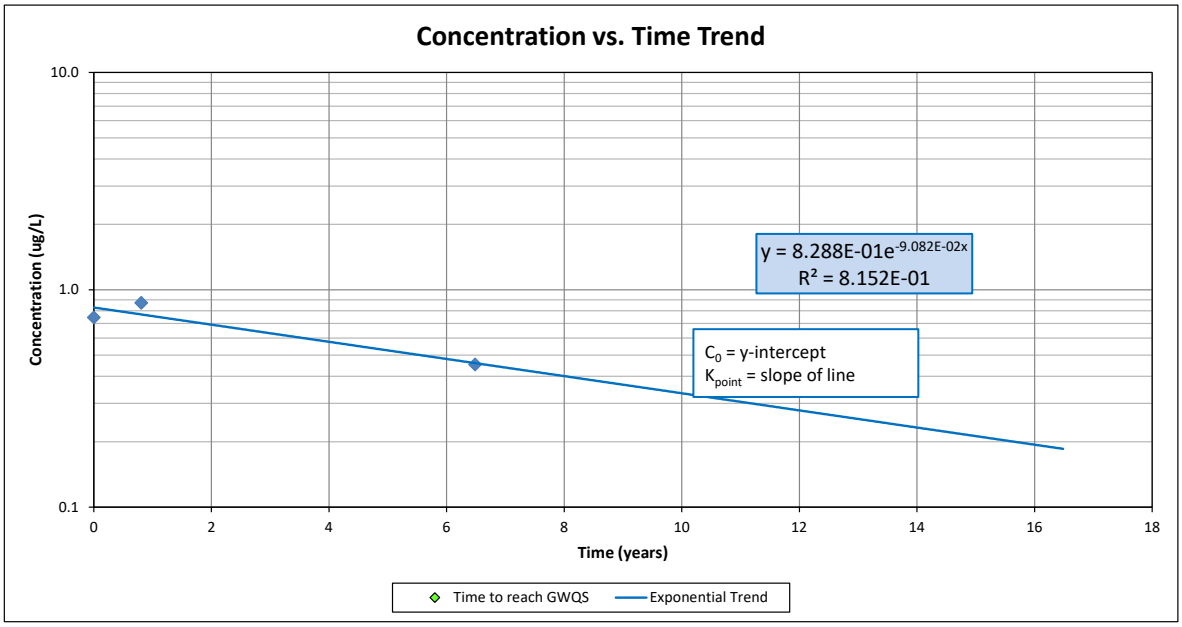
Site: Ash Road Properties Off-Site
Vestal, New York

Well: PMW-5
COC: Total PCE
GWQS (ug/L)*: 4.25

Count	Date	Total PCE (ug/L)
1	10/23/18	0.745
2	08/13/19	0.87
3	04/16/25	0.453

		Time (t)	
Initial sampling date:	10/23/18	0.0	years
First sample used to fit trendline:	10/23/18	0.0	years
Last sampling date:	04/16/25	6.5	years
Total number of samples:	3		
Number of samples used to fit trendline:	3		

*Note: Only PCE was analyzed due to increasing trend of total CE's.



First-Order (Exponential) Trendline Equation

$C_t = C_0 e^{k t}$

where:
C_t = Concentration at some future time
C_0 = Initial concentration (y-intercept)
e = exponential function
k = decay constant (or k_{point} = Attenuation Rate constant)
t = time (years); note that "t" is the x-axis and is substituted for "x" in the exponential trend equation

Re-arrange and solve for time (t) to reach the GWQS

$$t = \frac{-\ln (GWQS / C_0)}{k_{point}}$$

C_0 =	0.829	ug/L	(y-intercept from best-fit trendline, *not* the first groundwater sample result)
k_{point} =	-0.09082	per year	(equivalent to the "slope" of the exponential line)

Predicted time (t) to reach the GWQS:

Time to reach GWQS =	-18.0	years from initial sampling date (t = 0)
	-24.5	years from most recent sampling date
	10/27/2000	date

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Appendix A.2 - Full-Scale Remediation Calculations

First-Order Attenuation Rate Constant (K_{point}) for MNA and Time to Reach GWQS

(Reference: EPA/540/S-02/500, November 2002)

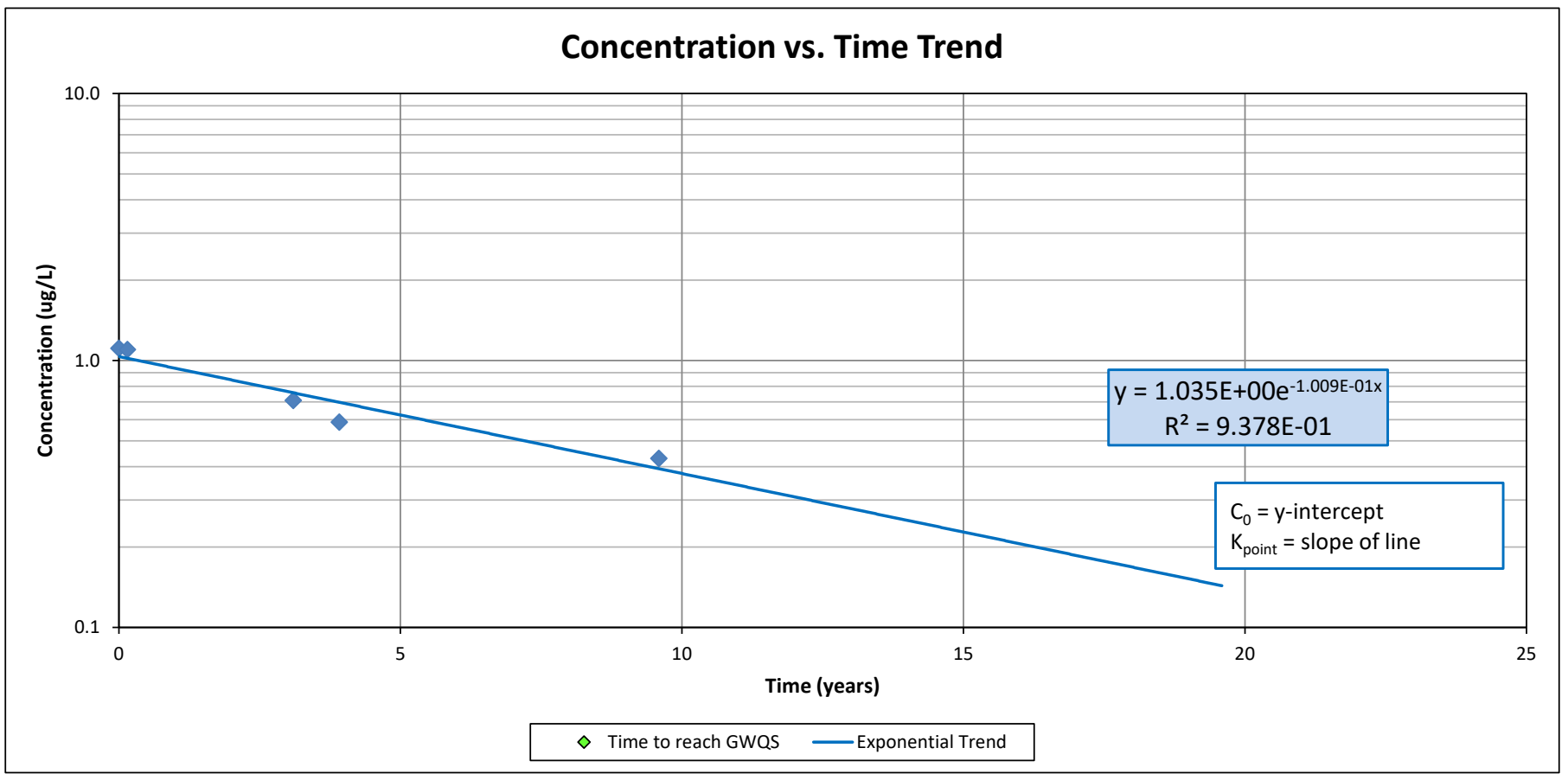
Site: Ash Road Properties Off-Site
Vestal, New York

Well: PMW-8
COC: Total Chloroethenes
GWQS (ug/L)*: 4.25 Time (t)

Count	Date	total chloroethenes (ug/L)
1	9/15/2015	1.11
2	11/9/2015	1.1
3	10/19/2018	0.708
4	8/14/2019	0.588
5	4/15/2025	0.43

Initial sampling date:	09/15/15	0.0	years
First sample used to fit trendline:	09/15/15	0.0	years
Last sampling date:	04/15/25	9.6	years
Total number of samples:	5		
Number of samples used to fit trendline:	5		

*Note: 4.25 ug/L equals average GA standard/guidance of 5 ug/L for PCE, TCE, and DCE, and 2 ug/L for VC



First-Order (Exponential) Trendline Equation

$C_t = C_0 e^{kt}$

where:
C_t = Concentration at some future time
C_0 = Initial concentration (y-intercept)
e = exponential function
k = decay constant (or k_{point} = Attenuation Rate constant)
t = time (years); note that "t" is the x-axis and is substituted for "x" in the exponential trend equation

Re-arrange and solve for time (t) to reach the GWQS

$$t = \frac{-\ln (GWQS / C_0)}{k_{point}}$$

Enter values from trend line equation (light blue box) shown on graph

C_0 =	1.04	ug/L	(y-intercept from best-fit trendline, *not* the first groundwater sample result)
k_{point} =	-0.1009	per year	(equivalent to the "slope" of the exponential line)

Predicted time (t) to reach the GWQS:

Time to reach GWQS =	-14.0	years from initial sampling date (t = 0)
	-23.6	years from most recent sampling date
	9/18/2001	date

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Appendix A.2 - Full-Scale Remediation Calculations

First-Order Attenuation Rate Constant (K_{point}) for MNA and Time to Reach GWQS

(Reference: EPA/540/S-02/500, November 2002)

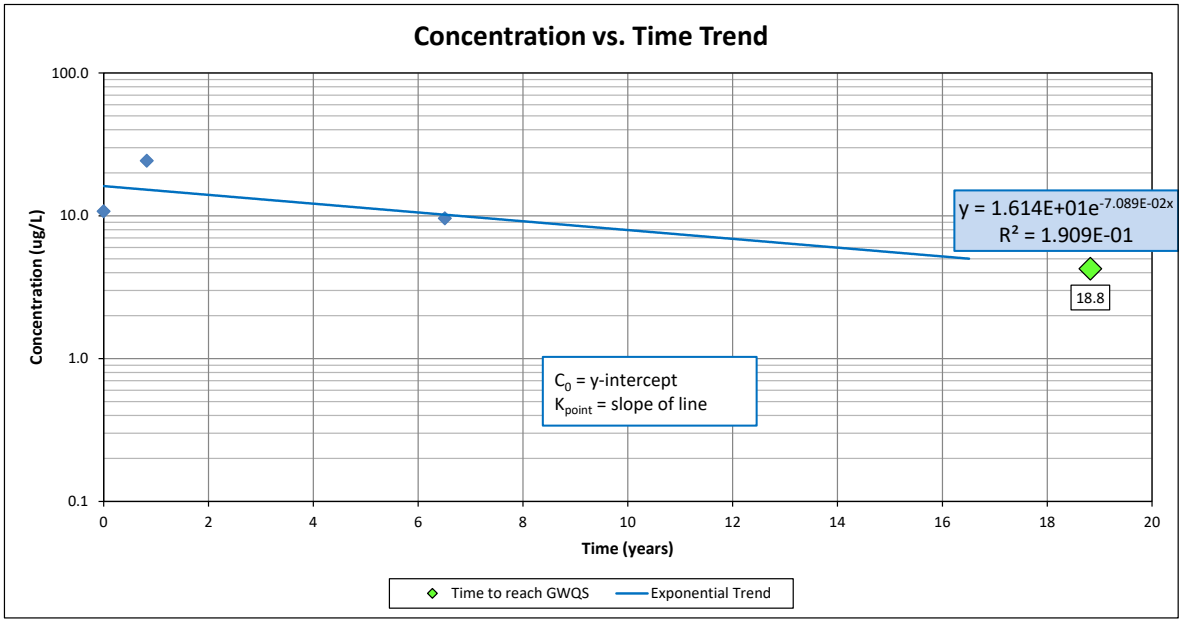
Site: Ash Road Properties Off-Site
Vestal, New York

Well: PMW-21D
COC: Total Chloroethenes
GWQS (ug/L):* 4.25 Time (t)

Count	Date	total chloroethenes (ug/L)
1	10/19/2018	10.755
2	8/15/2019	24.24
3	4/21/2025	9.596

Initial sampling date:	10/19/18	0.0	years
First sample used to fit trendline:	10/19/18	0.0	years
Last sampling date:	04/21/25	6.5	years
Total number of samples:	3		
Number of samples used to fit trendline:	3		

*Note: 4.25 ug/L equals average GA standard/guidance of 5 ug/L for PCE, TCE, and DCE, and 2 ug/L for VC



First-Order (Exponential) Trendline Equation

$C_t = C_0 e^{k t}$

where:
C_t = Concentration at some future time
C_0 = Initial concentration (y-intercept)
e = exponential function
k = decay constant (or k_{point} = Attenuation Rate constant)
t = time (years); note that "t" is the x-axis and is substituted for "x" in the exponential trend equation

Re-arrange and solve for time (t) to reach the GWQS

$$t = \frac{-\ln (GWQS / C_0)}{k_{point}}$$

Enter values from trend line equation (light blue box) shown on graph

C_0 =	16.1	ug/L	(y-intercept from best-fit trendline, *not* the first groundwater sample result)
k_{point} =	-0.07089	per year	(equivalent to the "slope" of the exponential line)

Predicted time (t) to reach the GWQS:

Time to reach GWQS =	18.8	years from initial sampling date (t = 0)
	12.3	years from most recent sampling date
	8/10/2037	date

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Appendix A.2 - Full-Scale Remediation Calculations

First-Order Attenuation Rate Constant (K_{point}) for MNA and Time to Reach GWQS

(Reference: EPA/540/S-02/500, November 2002)

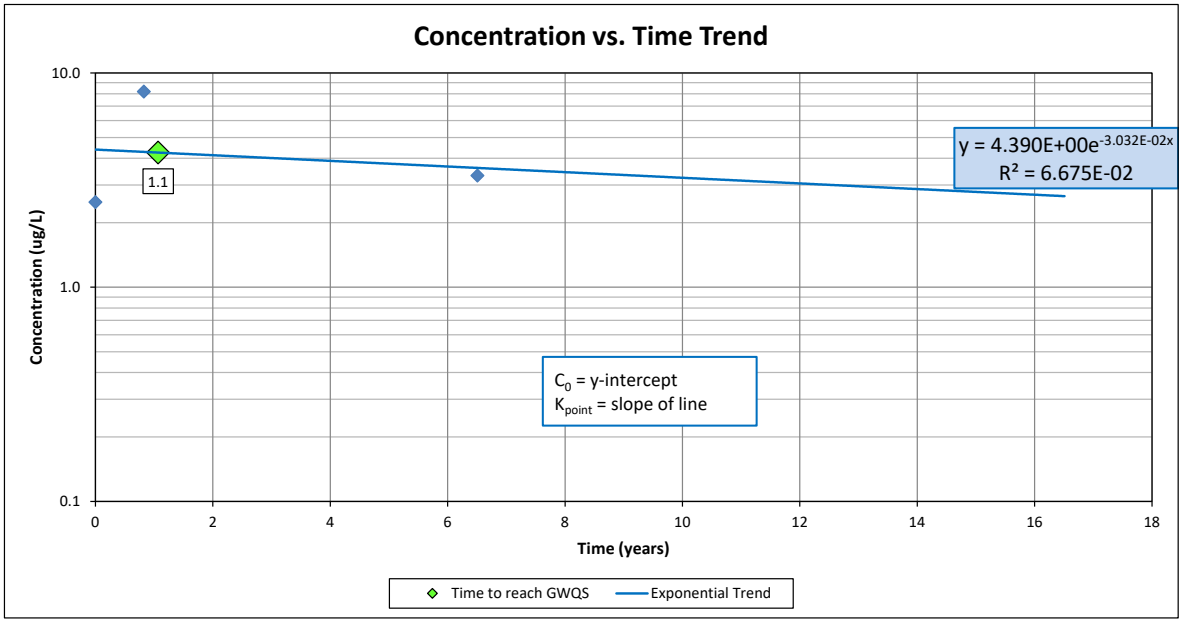
Site: Ash Road Properties Off-Site
Vestal, New York

Well: PMW-22D
COC: Total Chloroethenes
GWQS (ug/L):* 4.25 Time (t)

Count	Date	total chloroethenes (ug/L)
1	10/19/2018	2.496
2	8/16/2019	8.172
3	4/21/2025	3.32

Initial sampling date:	10/19/18	0.0	years
First sample used to fit trendline:	10/19/18	0.0	years
Last sampling date:	04/21/25	6.5	years
Total number of samples:	3		
Number of samples used to fit trendline:	3		

*Note: 4.25 ug/L equals average GA standard/guidance of 5 ug/L for PCE, TCE, and DCE, and 2 ug/L for VC



First-Order (Exponential) Trendline Equation

$C_t = C_0 e^{kt}$

where:
C_t = Concentration at some future time
C_0 = Initial concentration (y-intercept)
e = exponential function
k = decay constant (or k_{point} = Attenuation Rate constant)
t = time (years); note that "t" is the x-axis and is substituted for "x" in the exponential trend equation

Re-arrange and solve for time (t) to reach the GWQS

$$t = \frac{-\ln(GWQS / C_0)}{k_{point}}$$

Enter values from trend line equation (light blue box) shown on graph

C_0 =	4.39	ug/L	(y-intercept from best-fit trendline, *not* the first groundwater sample result)
k_{point} =	-0.03032	per year	(equivalent to the "slope" of the exponential line)

Predicted time (t) to reach the GWQS:

Time to reach GWQS =	1.1	years from initial sampling date (t = 0)
	-5.4	years from most recent sampling date
	11/13/2019	date

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APPENDIX A.3 TARGETED REMEDIATION

Appendix A.3: Summary for Time to Reach GWQS (Years): Targeted Injections (One Order Magnitude Reduction)

Calculate Time to reach GWQS (years) - Using Average Decay Constant (k, -0.075/year)

Well	Total CE Conc (µg/L)	Avg. Time to reach GWQS (years)	Notes
PMW-2	36.15	26.8	Calculated*
PMW-5	4.53	0.9	Calculated*
PMW-8	4.3	0.0	Calculated*
PMW-21D	95.96	44.8	Calculated*
PMW-22D	33.2	70.5	Calculated*
PMW-9	62.73	36.1	Estimated**
MW-01	2.11	0.0	Estimated**
MW-02S	1583	79.4	Estimated**
MW-09S	491.88	63.7	Estimated**
		35.8	**Average**
		0	**Minimum**
		79.4	**Maximum**

* Time was calculated based on decay constant, k, for each well - see first order attenuation rate constant sheets

**MW-02S, MW-09S, and PMW-9 showed an increasing trend. As such, not able to perform first order attenuation rate constant calculations. Instead, calculated range of time to reach GWQS using the low and high decay constants calculated for PMW-2, PMW-5, PMW-8 and PMW-21D and 22D.

Calculate Estimated Time to reach GWQS (years) - Using Low k and High k

	Time to reach GWQS (years)**		
	Low K	High K	
	-0.03032	-0.1009	
MW-01	0.0	0.0	
MW-02S	195.3	58.7	
MW-09S	156.7	47.1	
PMW-9	88.8	26.7	
	110.2	33.1	**Average**
	0.0	0.0	**Minimum**
	195.3	58.7	**Maximum**

**MW-02S, MW-09S, and PMW-9 showed an increasing trend. As such, not able to perform first order attenuation rate constant calculations. Instead, calculated range of time to reach GWQS using the low and high decay constants calculated for PMW-2, PMW-5, PMW-8 and PMW-21D and 22D.

Monitored Natural Attenuation: Time to Reach GWQS (Years)

	MNA Duration (Years)
Global Min	0.0
Global Max	195.3
Global Avg	56.0

Appendix A.3 - Targeted Remediation Calculations

First-Order Attenuation Rate Constant (K_{point}) for MNA and Time to Reach GWQS

(Reference: EPA/540/S-02/500, November 2002)

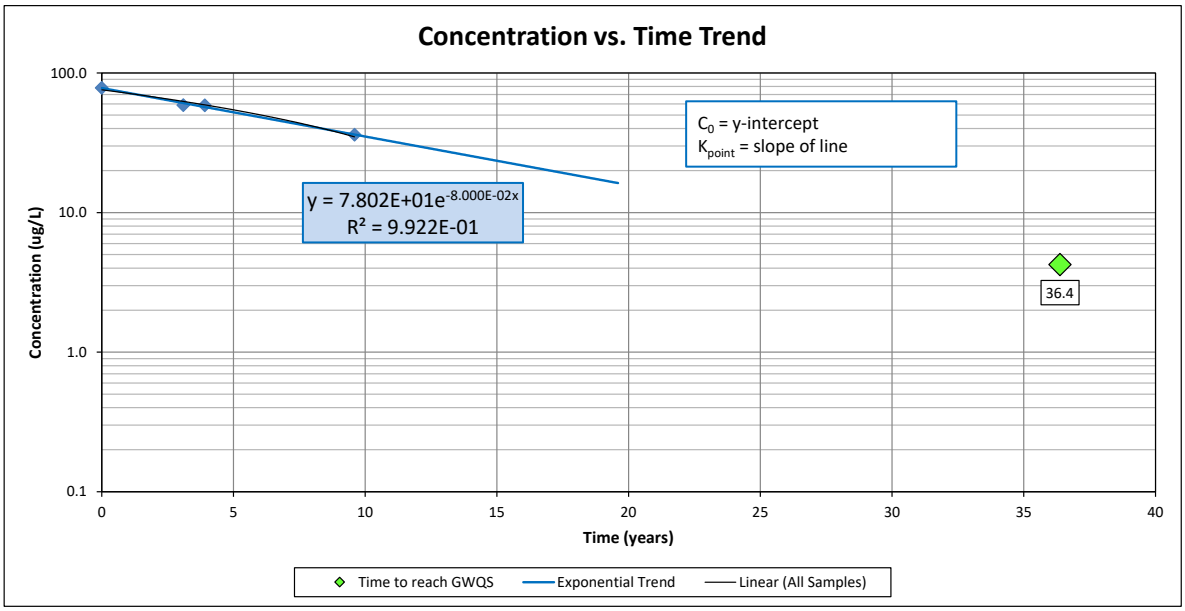
Site: Ash Road Properties Off-Site
Vestal, New York

Well: PMW-2
COC: Total Chloroethenes

Count	Date	total chloroethenes (ug/L)
1	09/15/15	78.4
2	10/19/18	58.93
3	08/13/19	58.77
4	04/18/25	36.154

		Time (t)	
GWQS (ug/L)*:	4.25		
Initial sampling date:	09/15/15	0.0	years
First sample used to fit trendline:	09/15/15	0.0	years
Last sampling date:	04/18/25	9.6	years
Total number of samples:	4		
Number of samples used to fit trendline:	4		

*Note: 4.25 ug/L equals average GA standard/guidance of 5 ug/L for PCE, TCE, and DCE, and 2 ug/L for VC



First-Order (Exponential) Trendline Equation

$C_t = C_0 e^{kt}$

where:
C_t = Concentration at some future time
C_0 = Initial concentration (y-intercept)
e = exponential function
k = decay constant (or k_{point} = Attenuation Rate constant)
t = time (years); note that "t" is the x-axis and is substituted for "x" in the exponential trend equation

Re-arrange and solve for time (t) to reach the GWQS

$$t = \frac{-\ln(GWQS / C_0)}{k_{point}}$$

C_0 =	78.0	ug/L	(y-intercept from best-fit trendline, *not* the first groundwater sample result)
k_{point} =	-0.08	per year	(equivalent to the "slope" of the exponential line)

Predicted time (t) to reach the GWQS:

Time to reach GWQS =	36.4	years from initial sampling date (t = 0)
	26.8	years from most recent sampling date
	01/21/52	date

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Appendix A.3 - Targeted Remediation Calculations

First-Order Attenuation Rate Constant (K_{point}) for MNA and Time to Reach GWQS

(Reference: EPA/540/S-02/500, November 2002)

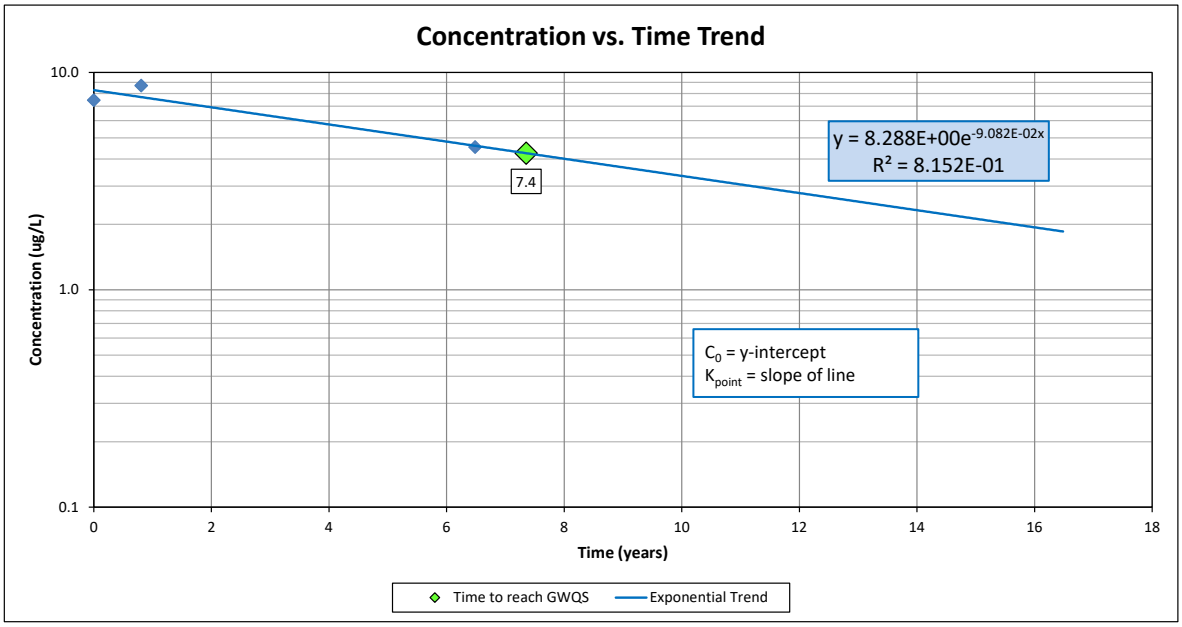
Site: Ash Road Properties Off-Site
Vestal, New York

Well: PMW-5
COC: Total PCE
GWQS (ug/L)*: 4.25

Count	Date	Total PCE (ug/L)
1	10/23/18	7.45
2	08/13/19	8.7
3	04/16/25	4.53

		Time (t)	
Initial sampling date:	10/23/18	0.0	years
First sample used to fit trendline:	10/23/18	0.0	years
Last sampling date:	04/16/25	6.5	years
Total number of samples:	3		
Number of samples used to fit trendline:	3		

*Note: Only PCE was analyzed due to increasing trend of total CE's.



First-Order (Exponential) Trendline Equation

$C_t = C_0 e^{k t}$

where:
C_t = Concentration at some future time
C_0 = Initial concentration (y-intercept)
e = exponential function
k = decay constant (or k_{point} = Attenuation Rate constant)
t = time (years); note that "t" is the x-axis and is substituted for "x" in the exponential trend equation

Re-arrange and solve for time (t) to reach the GWQS

$$t = \frac{-\ln (GWQS / C_0)}{k_{point}}$$

C_0 =	8.29	ug/L	(y-intercept from best-fit trendline, *not* the first groundwater sample result)
k_{point} =	-0.09082	per year	(equivalent to the "slope" of the exponential line)

Predicted time (t) to reach the GWQS:

Time to reach GWQS =	7.4	years from initial sampling date (t = 0)
	0.9	years from most recent sampling date
	2/27/2026	date

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Appendix A.3 - Targeted Remediation Calculations

First-Order Attenuation Rate Constant (K_{point}) for MNA and Time to Reach GWQS

(Reference: EPA/540/S-02/500, November 2002)

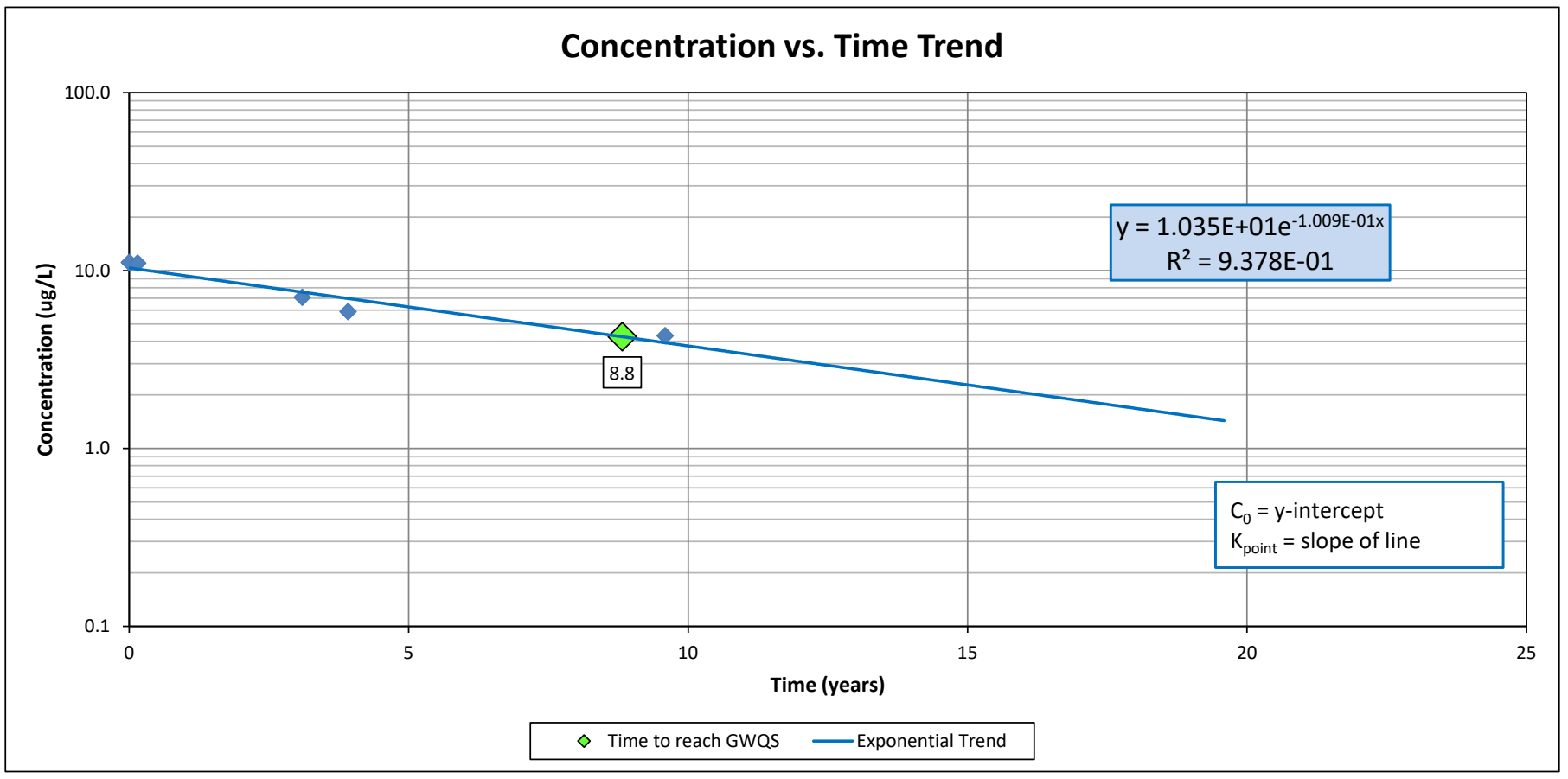
Site: Ash Road Properties Off-Site
Vestal, New York

Well: PMW-8
COC: Total Chloroethenes
GWQS (ug/L)*: 4.25 Time (t)

Count	Date	total chloroethenes (ug/L)
1	9/15/2015	11.1
2	11/9/2015	11
3	10/19/2018	7.08
4	8/14/2019	5.88
5	4/15/2025	4.3

Initial sampling date:	09/15/15	0.0	years
First sample used to fit trendline:	09/15/15	0.0	years
Last sampling date:	04/15/25	9.6	years
Total number of samples:	5		
Number of samples used to fit trendline:	5		

*Note: 4.25 ug/L equals average GA standard/guidance of 5 ug/L for PCE, TCE, and DCE, and 2 ug/L for VC



First-Order (Exponential) Trendline Equation

$C_t = C_0 e^{kt}$

where:
C_t = Concentration at some future time
C_0 = Initial concentration (y-intercept)
e = exponential function
k = decay constant (or k_{point} = Attenuation Rate constant)
t = time (years); note that "t" is the x-axis and is substituted for "x" in the exponential trend equation

Re-arrange and solve for time (t) to reach the GWQS

$$t = \frac{-\ln (GWQS / C_0)}{k_{point}}$$

Enter values from trend line equation (light blue box) shown on graph

C_0 =	10.350	ug/L	(y-intercept from best-fit trendline, *not* the first groundwater sample result)
k_{point} =	-0.1009	per year	(equivalent to the "slope" of the exponential line)

Predicted time (t) to reach the GWQS:

Time to reach GWQS =	8.8	years from initial sampling date (t = 0)
	-0.8	years from most recent sampling date
	7/8/2024	date

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Appendix A.3 - Targeted Remediation Calculations

First-Order Attenuation Rate Constant (K_{point}) for MNA and Time to Reach GWQS

(Reference: EPA/540/S-02/500, November 2002)

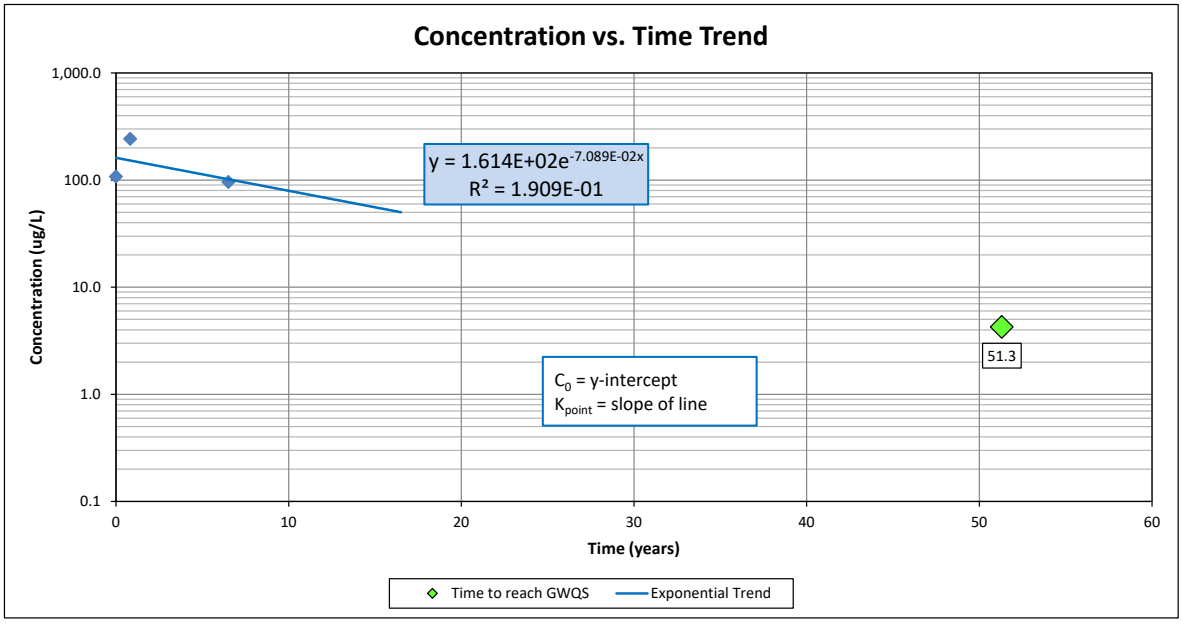
Site: Ash Road Properties Off-Site
Vestal, New York

Well: PMW-21D
COC: Total Chloroethenes
GWQS (ug/L):* 4.25 Time (t)

Count	Date	total chloroethenes (ug/L)
1	10/19/2018	107.55
2	8/15/2019	242.4
3	4/21/2025	95.96

Initial sampling date:	10/19/18	0.0	years
First sample used to fit trendline:	10/19/18	0.0	years
Last sampling date:	04/21/25	6.5	years
Total number of samples:	3		
Number of samples used to fit trendline:	3		

*Note: 4.25 ug/L equals average GA standard/guidance of 5 ug/L for PCE, TCE, and DCE, and 2 ug/L for VC



First-Order (Exponential) Trendline Equation

$C_t = C_0 e^{kt}$

where:
C_t = Concentration at some future time
C_0 = Initial concentration (y-intercept)
e = exponential function
k = decay constant (or k_{point} = Attenuation Rate constant)
t = time (years); note that "t" is the x-axis and is substituted for "x" in the exponential trend equation

Re-arrange and solve for time (t) to reach the GWQS

$$t = \frac{-\ln (GWQS / C_0)}{k_{point}}$$

Enter values from trend line equation (light blue box) shown on graph

C_0 =	161.4	ug/L	(y-intercept from best-fit trendline, *not* the first groundwater sample result)
k_{point} =	-0.07089	per year	(equivalent to the "slope" of the exponential line)

Predicted time (t) to reach the GWQS:

Time to reach GWQS =	51.3	years from initial sampling date (t = 0)
	44.8	years from most recent sampling date
	1/25/2070	date

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Appendix A.3 - Targeted Remediation Calculations

First-Order Attenuation Rate Constant (K_{point}) for MNA and Time to Reach GWQS

(Reference: EPA/540/S-02/500, November 2002)

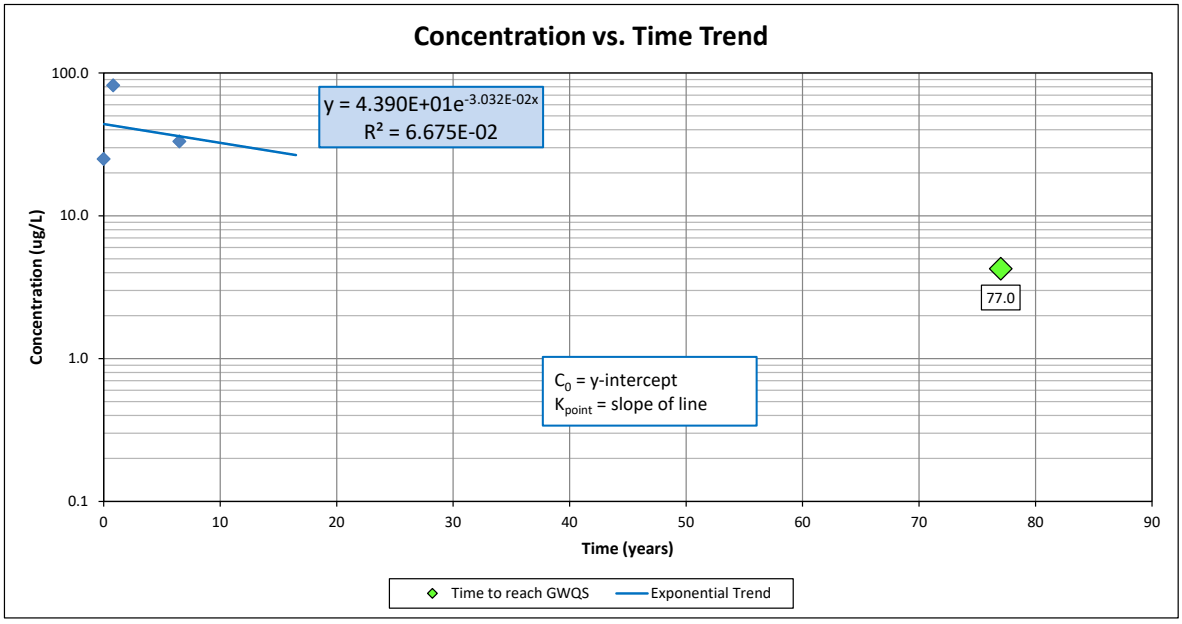
Site: Ash Road Properties Off-Site
Vestal, New York

Well: PMW-22D
COC: Total Chloroethenes
GWQS (ug/L):* 4.25 Time (t)

Count	Date	total chloroethenes (ug/L)
1	10/19/2018	24.96
2	8/16/2019	81.72
3	4/21/2025	33.2

Initial sampling date:	10/19/18	0.0	years
First sample used to fit trendline:	10/19/18	0.0	years
Last sampling date:	04/21/25	6.5	years
Total number of samples:	3		
Number of samples used to fit trendline:	3		

*Note: 4.25 ug/L equals average GA standard/guidance of 5 ug/L for PCE, TCE, and DCE, and 2 ug/L for VC



First-Order (Exponential) Trendline Equation

$C_t = C_0 e^{kt}$

where:
C_t = Concentration at some future time
C_0 = Initial concentration (y-intercept)
e = exponential function
k = decay constant (or k_{point} = Attenuation Rate constant)
t = time (years); note that "t" is the x-axis and is substituted for "x" in the exponential trend equation

Re-arrange and solve for time (t) to reach the GWQS

$$t = \frac{-\ln(GWQS / C_0)}{k_{point}}$$

Enter values from trend line equation (light blue box) shown on graph

C_0 =	43.9	ug/L	(y-intercept from best-fit trendline, *not* the first groundwater sample result)
k_{point} =	-0.03032	per year	(equivalent to the "slope" of the exponential line)

Predicted time (t) to reach the GWQS:

Time to reach GWQS =	77.0	years from initial sampling date (t = 0)
	70.5	years from most recent sampling date
	10/4/2095	date

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APPENDIX A.4 AS/SVE (TWO-ORDER MAGNITUDE REDUCTION)

Appendix A.4: Summary for Time to Reach GWQS (Years): AS/SVE (Two Order Magnitude Reductions)

Calculate Time to reach GWQS (years) - Using Average Decay Constant (k, -0.075/year)

Well	Total CE Conc (µg/L)	Avg. Time to reach GWQS (years)	Notes
PMW-2	3.62	0.0	Calculated*
PMW-5	0.453	0.0	Calculated*
PMW-8	0.43	0.0	Calculated*
PMW-21D	9.60	12.3	Calculated*
PMW-22D	3.32	0.0	Calculated*
PMW-09	6.27	5.2	Estimated**
MW-01	0.21	0.0	Estimated**
MW-02S	158.30	48.5	Estimated**
MW-09S	49.19	32.8	Estimated**
		10.99	**Average**
		0	**Minimum**
		48.5	**Maximum**

* Time was calculated based on decay constant, k, for each well - see first order attenuation rate constant sheets

**MW-02S, MW-09S, and PMW-9 showed an increasing trend. As such, not able to perform first order attenuation rate constant calculations. Instead, calculated range of time to reach GWQS using the low and high decay constants calculated for PMW-2, PMW-5, PMW-8 and PMW-21D and 22D.

Calculate Estimated Time to reach GWQS (years) - Using Low k and High k

	Time to reach GWQS (years)***		
	Low K	High K	
	-0.03032	-0.1009	
MW-01	0.0	0.0	
MW-02S	119.3	35.9	
MW-09S	80.8	24.3	
PMW-09	12.8	3.9	
	53.2	16.0	**Average**
	0.0	0.0	**Minimum**
	119.3	35.9	**Maximum**

**MW-02S, MW-09S, and PMW-9 showed an increasing trend. As such, not able to perform first order attenuation rate constant calculations. Instead, calculated range of time to reach GWQS using the low and high decay constants calculated for PMW-2, PMW-5, PMW-8 and PMW-21D and 22D.

Monitored Natural Attenuation: Time to Reach GWQS (Years)

	MNA Duration (Years)
Global Min	36
Global Max	119
Global Avg	24

Appendix A.4 - Full-Scale Remediation Calculations

First-Order Attenuation Rate Constant (K_{point}) for MNA and Time to Reach GWQS

(Reference: EPA/540/S-02/500, November 2002)

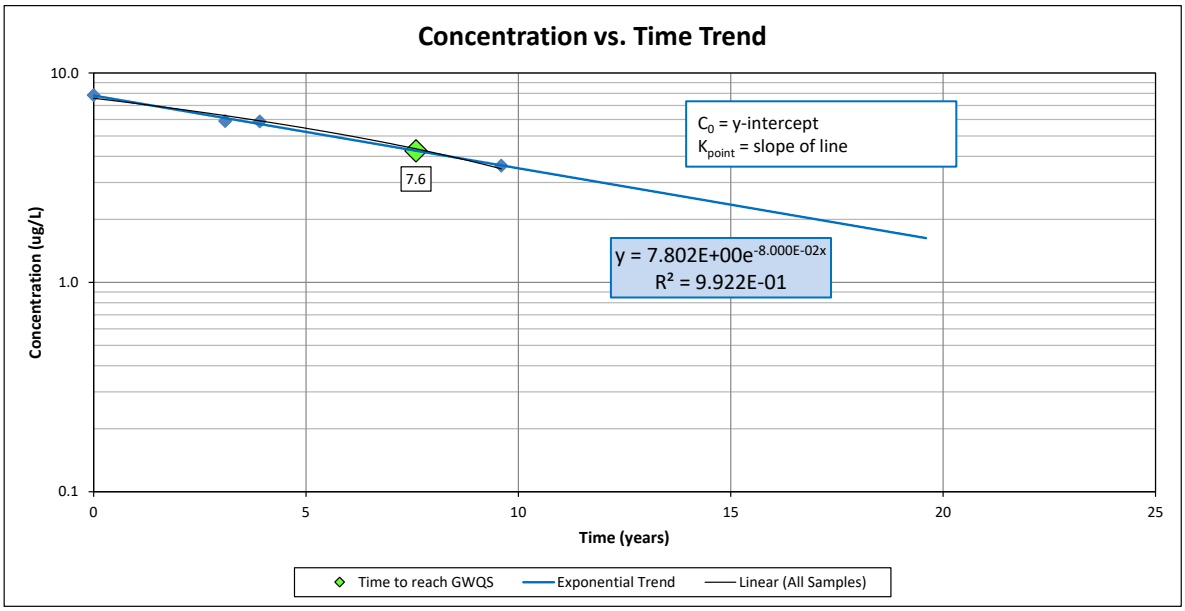
Site: Ash Road Properties Off-Site
Vestal, New York

Well: PMW-2
COC: Total Chloroethenes

Count	Date	total chloroethenes (ug/L)
1	09/15/15	7.84
2	10/19/18	5.89
3	08/13/19	5.88
4	04/18/25	3.6154

		Time (t)	
GWQS (ug/L)*:	4.25		
Initial sampling date:	09/15/15	0.0	years
First sample used to fit trendline:	09/15/15	0.0	years
Last sampling date:	04/18/25	9.6	years
Total number of samples:	4		
Number of samples used to fit trendline:	4		

*Note: 4.25 ug/L equals average GA standard/guidance of 5 ug/L for PCE, TCE, and DCE, and 2 ug/L for VC



First-Order (Exponential) Trendline Equation

$C_t = C_0 e^{kt}$

where:
C_t = Concentration at some future time
C_0 = Initial concentration (y-intercept)
e = exponential function
k = decay constant (or k_{point} = Attenuation Rate constant)
t = time (years); note that "t" is the x-axis and is substituted for "x" in the exponential trend equation

Re-arrange and solve for time (t) to reach the GWQS

$$t = \frac{-\ln(GWQS / C_0)}{k_{point}}$$

C_0 =	7.80	ug/L	(y-intercept from best-fit trendline, *not* the first groundwater sample result)
k_{point} =	-0.08	per year	(equivalent to the "slope" of the exponential line)

Predicted time (t) to reach the GWQS:

Time to reach GWQS =	7.6	years from initial sampling date (t = 0)
	-2.0	years from most recent sampling date
	04/16/23	date

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Appendix A.4 - Full-Scale Remediation Calculations

First-Order Attenuation Rate Constant (K_{point}) for MNA and Time to Reach GWQS

(Reference: EPA/540/S-02/500, November 2002)

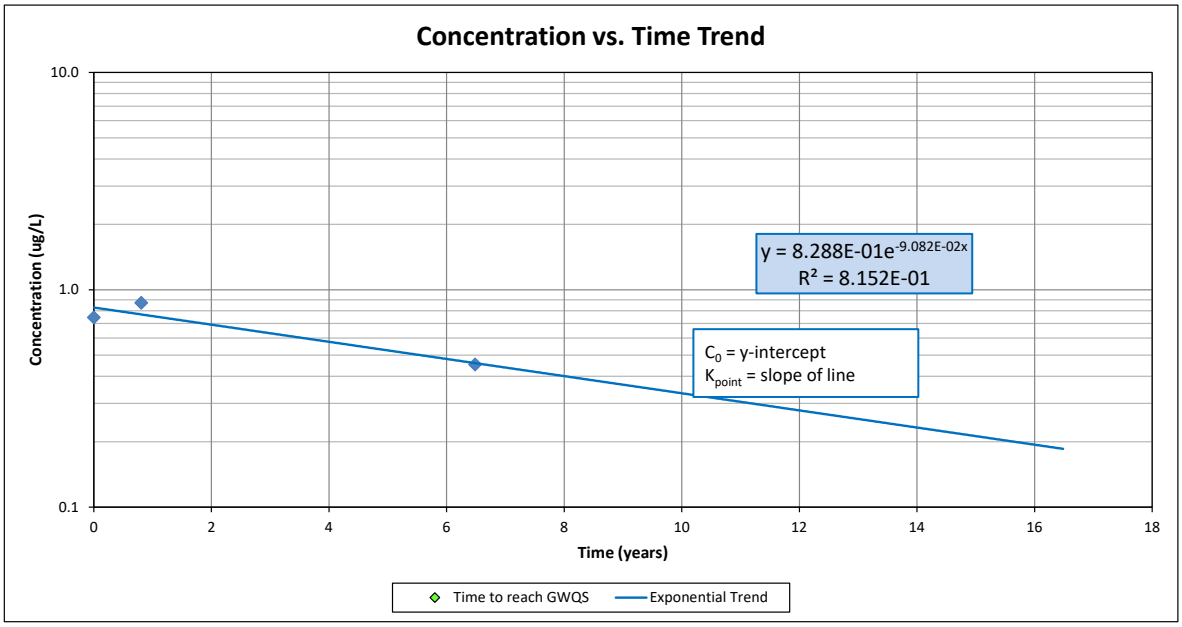
Site: Ash Road Properties Off-Site
Vestal, New York

Well: PMW-5
COC: Total PCE
GWQS (ug/L)*: 4.25

Count	Date	Total PCE (ug/L)
1	10/23/18	0.745
2	08/13/19	0.87
3	04/16/25	0.453

		Time (t)	
Initial sampling date:	10/23/18	0.0	years
First sample used to fit trendline:	10/23/18	0.0	years
Last sampling date:	04/16/25	6.5	years
Total number of samples:	3		
Number of samples used to fit trendline:	3		

*Note: Only PCE was analyzed due to increasing trend of total CE's.



First-Order (Exponential) Trendline Equation

$$C_t = C_0 e^{k t}$$

where:
C_t = Concentration at some future time
C_0 = Initial concentration (y-intercept)
e = exponential function
k = decay constant (or k_{point} = Attenuation Rate constant)
t = time (years); note that "t" is the x-axis and is substituted for "x" in the exponential trend equation

Re-arrange and solve for time (t) to reach the GWQS

$$t = \frac{-\ln (GWQS / C_0)}{k_{point}}$$

C_0 =	0.829	ug/L	(y-intercept from best-fit trendline, *not* the first groundwater sample result)
k_{point} =	-0.09082	per year	(equivalent to the "slope" of the exponential line)

Predicted time (t) to reach the GWQS:

Time to reach GWQS =	-18.0	years from initial sampling date (t = 0)
	-24.5	years from most recent sampling date
	10/27/2000	date

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Appendix A.4 - Full-Scale Remediation Calculations

First-Order Attenuation Rate Constant (K_{point}) for MNA and Time to Reach GWQS

(Reference: EPA/540/S-02/500, November 2002)

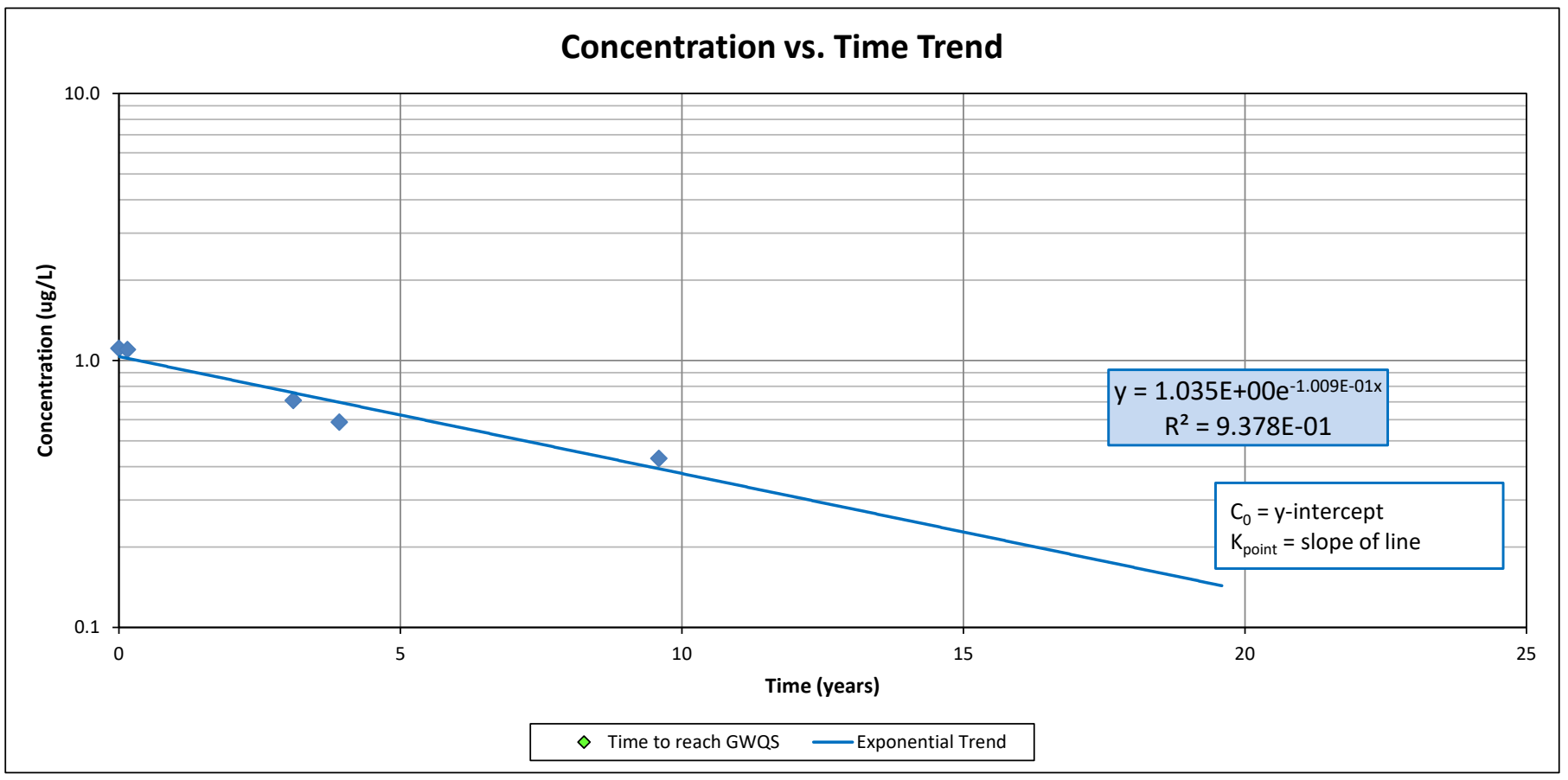
Site: Ash Road Properties Off-Site
Vestal, New York

Well: PMW-8
COC: Total Chloroethenes
GWQS (ug/L)*: 4.25 Time (t)

Count	Date	total chloroethenes (ug/L)
1	9/15/2015	1.11
2	11/9/2015	1.1
3	10/19/2018	0.708
4	8/14/2019	0.588
5	4/15/2025	0.43

Initial sampling date:	09/15/15	0.0	years
First sample used to fit trendline:	09/15/15	0.0	years
Last sampling date:	04/15/25	9.6	years
Total number of samples:	5		
Number of samples used to fit trendline:	5		

*Note: 4.25 ug/L equals average GA standard/guidance of 5 ug/L for PCE, TCE, and DCE, and 2 ug/L for VC



First-Order (Exponential) Trendline Equation

$C_t = C_0 e^{kt}$

where:
C_t = Concentration at some future time
C_0 = Initial concentration (y-intercept)
e = exponential function
k = decay constant (or k_{point} = Attenuation Rate constant)
t = time (years); note that "t" is the x-axis and is substituted for "x" in the exponential trend equation

Re-arrange and solve for time (t) to reach the GWQS

$$t = \frac{-\ln (GWQS / C_0)}{k_{point}}$$

Enter values from trend line equation (light blue box) shown on graph

C_0 =	1.04	ug/L	(y-intercept from best-fit trendline, *not* the first groundwater sample result)
k_{point} =	-0.1009	per year	(equivalent to the "slope" of the exponential line)

Predicted time (t) to reach the GWQS:

Time to reach GWQS =	-14.0	years from initial sampling date (t = 0)
	-23.6	years from most recent sampling date
	9/18/2001	date

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Appendix A.4 - Full-Scale Remediation Calculations

First-Order Attenuation Rate Constant (K_{point}) for MNA and Time to Reach GWQS

(Reference: EPA/540/S-02/500, November 2002)

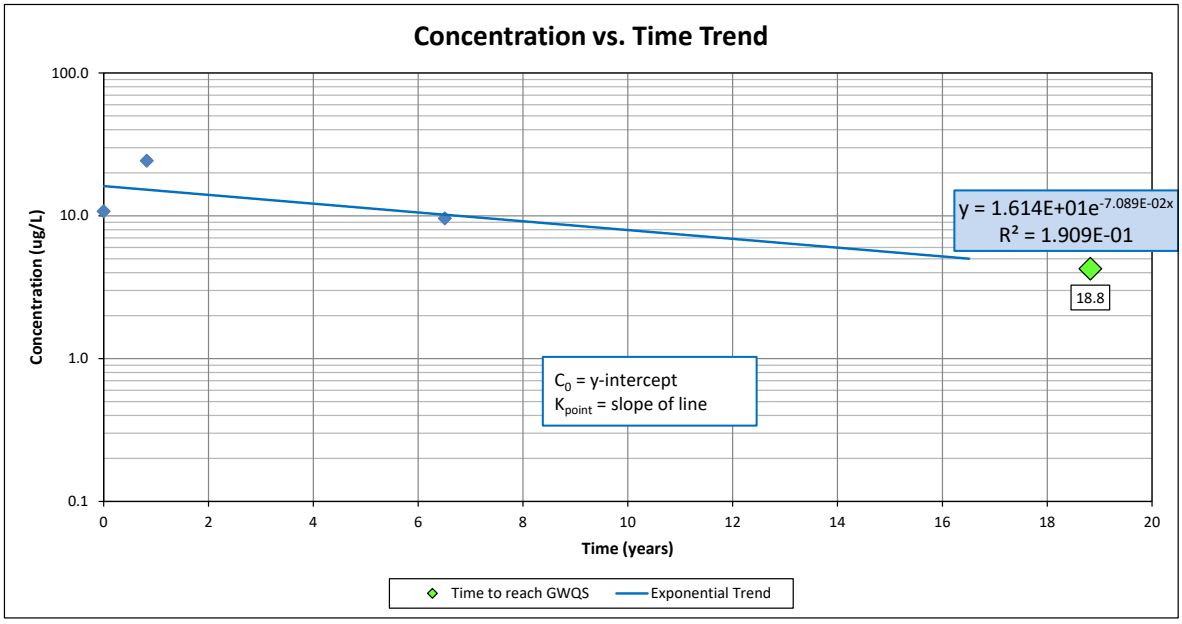
Site: Ash Road Properties Off-Site
Vestal, New York

Well: PMW-21D
COC: Total Chloroethenes
GWQS (ug/L):* 4.25 Time (t)

Count	Date	total chloroethenes (ug/L)
1	10/19/2018	10.755
2	8/15/2019	24.24
3	4/21/2025	9.596

Initial sampling date:	10/19/18	0.0	years
First sample used to fit trendline:	10/19/18	0.0	years
Last sampling date:	04/21/25	6.5	years
Total number of samples:	3		
Number of samples used to fit trendline:	3		

*Note: 4.25 ug/L equals average GA standard/guidance of 5 ug/L for PCE, TCE, and DCE, and 2 ug/L for VC



First-Order (Exponential) Trendline Equation

$C_t = C_0 e^{k t}$

where:
C_t = Concentration at some future time
C_0 = Initial concentration (y-intercept)
e = exponential function
k = decay constant (or k_{point} = Attenuation Rate constant)
t = time (years); note that "t" is the x-axis and is substituted for "x" in the exponential trend equation

Re-arrange and solve for time (t) to reach the GWQS

$$t = \frac{-\ln (GWQS / C_0)}{k_{point}}$$

Enter values from trend line equation (light blue box) shown on graph

C_0 =	16.1	ug/L	(y-intercept from best-fit trendline, *not* the first groundwater sample result)
k_{point} =	-0.07089	per year	(equivalent to the "slope" of the exponential line)

Predicted time (t) to reach the GWQS:

Time to reach GWQS =	18.8	years from initial sampling date (t = 0)
	12.3	years from most recent sampling date
	8/10/2037	date

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Appendix A.4 - Full-Scale Remediation Calculations

First-Order Attenuation Rate Constant (K_{point}) for MNA and Time to Reach GWQS

(Reference: EPA/540/S-02/500, November 2002)

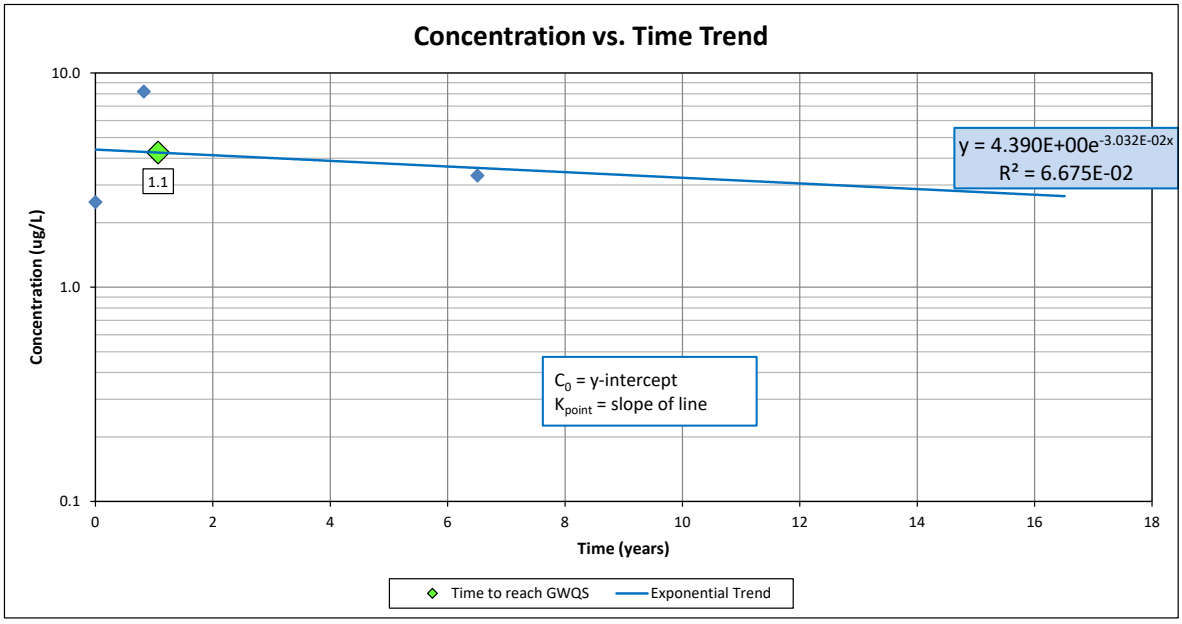
Site: Ash Road Properties Off-Site
Vestal, New York

Well: PMW-22D
COC: Total Chloroethenes
GWQS (ug/L):* 4.25 Time (t)

Count	Date	total chloroethenes (ug/L)
1	10/19/2018	2.496
2	8/16/2019	8.172
3	4/21/2025	3.32

Initial sampling date:	10/19/18	0.0	years
First sample used to fit trendline:	10/19/18	0.0	years
Last sampling date:	04/21/25	6.5	years
Total number of samples:	3		
Number of samples used to fit trendline:	3		

*Note: 4.25 ug/L equals average GA standard/guidance of 5 ug/L for PCE, TCE, and DCE, and 2 ug/L for VC



First-Order (Exponential) Trendline Equation

$C_t = C_0 e^{kt}$

where:
C_t = Concentration at some future time
C_0 = Initial concentration (y-intercept)
e = exponential function
k = decay constant (or k_{point} = Attenuation Rate constant)
t = time (years); note that "t" is the x-axis and is substituted for "x" in the exponential trend equation

Re-arrange and solve for time (t) to reach the GWQS

$$t = \frac{-\ln(GWQS / C_0)}{k_{point}}$$

Enter values from trend line equation (light blue box) shown on graph

C_0 =	4.39	ug/L	(y-intercept from best-fit trendline, *not* the first groundwater sample result)
k_{point} =	-0.03032	per year	(equivalent to the "slope" of the exponential line)

Predicted time (t) to reach the GWQS:

Time to reach GWQS =	1.1	years from initial sampling date (t = 0)
	-5.4	years from most recent sampling date
	11/13/2019	date

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APPENDIX B COST ESTIMATES FOR REMEDIATION ALTERNATIVES

TABLE B.1
ASH ROAD PROPERTIES OFF-SITE FEASIBILITY STUDY
ALTERNATIVE GW-2 - MNA

NYSDEC Site: **Ash Road Properties Off-Site** Location: **Vestal, New York** Phase: **Feasibility Study; +50%/-30% accuracy** Base Year: **2025** Date: **November 14, 2025**	Project title: **Alternative # GW-2 - MNA, assumes 30 years of annual groundwater monitoring, with a more robust project review every 5 years. Estimated 15 wells sampled per monitoring event.**

CAPITAL COSTS

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL COST
DIRECT CONSTRUCTION COSTS				
1.) Baseline Groundwater sampling and reporting	1	LS	$37,000	$37,000
2.) Scope of Work / Work Plan development	1	LS	$10,000	$10,000
SUBTOTAL DIRECT CONSTRUCTION COSTS				**$47,000**
OTHER CAPITAL COSTS				
1. Indirect Construction Costs (% of direct construction costs)	1	Lot	0%	$0
2. Contingency (% of direct construction costs)	1	Lot	20%	$9,400
3. Engineering, Design & Construction Oversight (% of direct construction costs and contingency)	1	Lot	0%	$0
SUBTOTAL OTHER CAPITAL COSTS				**$9,400**
TOTAL CAPITAL COSTS				**$56,400**

ANNUAL OPERATION, MAINTENANCE, AND MONITORING COSTS

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL COST
1. Project Management Administration, and Reporting	1	LS	$16,000	$16,000
2. Groundwater Monitoring	1	LS	$30,000	$30,000
3. Institutional Controls	1	LS	$5,000	$5,000
SUBTOTAL ANNUAL O&M COSTS				**$51,000**
4. Contingency (% of subtotal)	20%			$10,200
5. Technical Support/Troubleshooting (% of subtotal and contingency)	10%			$6,120
TOTAL ANNUAL O&M COSTS				**$67,320**

PERIODIC COSTS

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL COST
1. Project Review (once every 5 years)	1	LS	$35,000	$35,000
TOTAL PERIODIC COSTS				**$35,000**

PRESENT VALUE ANALYSIS					
COST TYPE	YEAR	TOTAL COST	TOTAL COST PER YEAR	DISCOUNT FACTOR (7%)	PRESENT VALUE
Capital Cost	0	$56,400	$56,400	1.000	$56,400
Annual OM&M Cost	1-30	$2,019,600	$67,320	12.409	$835,377
Periodic Cost	5	$35,000	$35,000	0.713	$24,955
Periodic Cost	10	$35,000	$35,000	0.508	$17,792
Periodic Cost	15	$35,000	$35,000	0.362	$12,686
Periodic Cost	20	$35,000	$35,000	0.258	$9,045
Periodic Cost	25	$35,000	$35,000	0.184	$6,449
Periodic Cost	30	$35,000	$35,000	0.131	$4,598
TOTAL PRESENT VALUE OF ALTERNATIVE					**$967,000**

Notes:
1. Period of analysis is equivalent to the estimated project duration.
2. Present value of alternative is rounded to the nearest $1,000.

PRESENT VALUE CALCULATION **Annual Discount Factor =** **7.0%**

YEAR	CAPITAL COSTS	ANNUAL O&M COSTS	PERIODIC COSTS	TOTAL COST	DISCOUNT FACTOR (7%)	PRESENT VALUE
0	$56,400	$0	$0	$56,400	1.000	$56,400
1	$0	$67,320	$0	$67,320	0.935	$62,916
2	$0	$67,320	$0	$67,320	0.873	$58,800
3	$0	$67,320	$0	$67,320	0.816	$54,953
4	$0	$67,320	$0	$67,320	0.763	$51,358
5	$0	$67,320	$35,000	$102,320	0.713	$72,953
6	$0	$67,320	$0	$67,320	0.666	$44,858
7	$0	$67,320	$0	$67,320	0.623	$41,924
8	$0	$67,320	$0	$67,320	0.582	$39,181
9	$0	$67,320	$0	$67,320	0.544	$36,618
10	$0	$67,320	$35,000	$102,320	0.508	$52,014
11	$0	$67,320	$0	$67,320	0.475	$31,983
12	$0	$67,320	$0	$67,320	0.444	$29,891
13	$0	$67,320	$0	$67,320	0.415	$27,935
14	$0	$67,320	$0	$67,320	0.388	$26,108
15	$0	$67,320	$35,000	$102,320	0.362	$37,085
16	$0	$67,320	$0	$67,320	0.339	$22,804
17	$0	$67,320	$0	$67,320	0.317	$21,312
18	$0	$67,320	$0	$67,320	0.296	$19,918
19	$0	$67,320	$0	$67,320	0.277	$18,615
20	$0	$67,320	$35,000	$102,320	0.258	$26,441
21	$0	$67,320	$0	$67,320	0.242	$16,259
22	$0	$67,320	$0	$67,320	0.226	$15,195
23	$0	$67,320	$0	$67,320	0.211	$14,201
24	$0	$67,320	$0	$67,320	0.197	$13,272
25	$0	$67,320	$35,000	$102,320	0.184	$18,852
26	$0	$67,320	$0	$67,320	0.172	$11,592
27	$0	$67,320	$0	$67,320	0.161	$10,834
28	$0	$67,320	$0	$67,320	0.150	$10,125
29	$0	$67,320	$0	$67,320	0.141	$9,463
30	$0	$67,320	$35,000	$102,320	0.131	$13,441
TOTAL	**$56,400**	**$2,020,000**	**$210,000**	**$2,286,000**	**---**	**$968,000**

Notes and Assumptions:
1.) Cost estimates are developed at a FS level for comparative evaluation of alternative, level of accuracy is +50% / -30%.
2.) Estimate unit cost were developed using 2025 labor and material costs, and refined production rates based on Parsons experience and current industry standards.
3.) Present Worth analysis has been developed based on a 7% discount factor.

TABLE B.2
Ash Road Properties Off-Site Feasibility Study Groundwater
ALTERNATIVE 3 - Full-Scale Injection ISCO/MNA

NYSDEC Site: **Ash Road Properties Off-Site** Location: **Vestal, New York** Phase: **Feasibility Study; +50%/-30% accuracy** Base Year: **2025** Date: **November 14, 2025**	Project title: **Alternative # GW-3 - ISCO/MNA, with sodium permanganate. Second round of injections at Year 10. Assumes 10 years of annual groundwater monitoring, followed by monitoring every other year for years 11-20, with more robust project review every 5 years for a 20 year period.**

CAPITAL COSTS

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL COST
DIRECT CONSTRUCTION COSTS				
1.) Contractor Workplan Development	1	LS	$30,000	$30,000
2.) Required Submittals	1	LS	$20,000	$20,000
3.) Pre-design investigation	1	allowance	$60,000	$60,000
4.) Baseline Groundwater sampling and reporting	15	wells	$2,300	$34,500
5.) Installation of nested injection wells (shallow/deep)	150	per well	$7,500	$1,125,000
6.) Mobilization (Pilot Study)	1	LS	$5,000	$5,000
7.) Purchase Sodium Permanganate (Pilot Study)	2,000	gallons	$8.00	$16,000
8.) Daily injection crew and equipment (Pilot Study)	2	days	$12,000	$24,000
9.) Post Pilot study groundwater sampling and reporting	15	wells	$2,300	$34,500
10.) Mobilization (Full Scale Injection - Round 1)	1	LS	$12,000	$12,000
11.) Purchase Sodium Permanganate (Full Scale Injection - Round 1)	207,000	gallons	$8.00	$1,656,000
12.) Daily injection crew and equipment (Full Scale Injection - Round 1)	25	days	$12,000	$300,000
13.) Post Injection groundwater sampling and reporting	15	wells	$2,300	$34,500
14.) Demobilization	1	LS	$10,000	$10,000
SUBTOTAL DIRECT CONSTRUCTION COSTS				**$3,361,500**
OTHER CAPITAL COSTS				
1. Indirect Construction Costs (% of direct construction costs)	1	Lot	17%	$571,455
2. Contingency (% of direct construction costs)	1	Lot	20%	$672,300
3. Engineering, Design & Construction Oversight (% of direct construction costs and contingency)	1	Lot	18%	$726,084
SUBTOTAL OTHER CAPITAL COSTS				**$1,969,839**
TOTAL CAPITAL COSTS				**$5,331,000**

ANNUAL OPERATION, MAINTENANCE, AND MONITORING COSTS

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL COST
1. Project Management Administration, and Reporting	1	LS	$16,000	$16,000
2.Groundwater Monitoring	1	LS	$30,000	$30,000
3. Institutional Controls	1	LS	$5,000	$5,000
SUBTOTAL ANNUAL O&M COSTS				**$51,000**
4. Contingency (% of subtotal)	20%			$10,200
5. Technical Support/Troubleshooting (% of subtotal and contingency)	10%			$6,120
TOTAL ANNUAL O&M COSTS				**$67,320**

PERIODIC COSTS

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL COST
1. Project Review (once every 5 years)	1	LS	$35,000	$35,000
2. Round 2 Injections (50% original volume, Year 10)	1	LS	$1,038,000	$1,038,000
TOTAL PERIODIC COSTS				**$1,073,000**

PRESENT VALUE ANALYSIS

COST TYPE	YEAR	TOTAL COST	TOTAL COST PER YEAR	DISCOUNT FACTOR (7%)	PRESENT VALUE
Capital Cost	0	$5,331,000	$5,331,000	1.000	$5,331,000
Annual OM&M Cost	1-5	$336,600	$67,320	4.100	$276,025
Annual OM&M Cost	6-10	$336,600	$67,320	2.923	$196,802
Periodic Cost	5	$35,000	$35,000	0.713	$24,955
Periodic Cost	10	$1,073,000	$1,073,000	0.508	$545,459
Periodic Cost	12	$67,320	$67,320	0.444	$29,891
Periodic Cost	14	$67,320	$67,320	0.388	$26,108
Periodic Cost	15	$35,000	$35,000	0.362	$12,686
Periodic Cost	16	$67,320	$67,320	0.339	$22,804
Periodic Cost	18	$67,320	$67,320	0.296	$19,918
Periodic Cost	20	$35,000	$35,000	0.258	$9,045
TOTAL PRESENT VALUE OF ALTERNATIVE					**$6,495,000**

Notes:
1. Period of analysis is equivalent to the estimated project duration.
2. Present value of alternative is rounded to the nearest $1,000.

PRESENT VALUE CALCULATION **Annual Discount Factor =** **7.0%**

YEAR	CAPITAL COSTS	ANNUAL O&M COSTS	PERIODIC COSTS	TOTAL COST	DISCOUNT FACTOR (7%)	PRESENT VALUE
0	$5,331,000	$0	$0	$5,331,000	1.000	$5,331,000
1	$0	$67,320	$0	$67,320	0.935	$62,916
2	$0	$67,320	$0	$67,320	0.873	$58,800
3	$0	$67,320	$0	$67,320	0.816	$54,953
4	$0	$67,320	$0	$67,320	0.763	$51,358
5	$0	$67,320	$35,000	$102,320	0.713	$72,953
6	$0	$67,320	$0	$67,320	0.666	$44,858
7	$0	$67,320	$0	$67,320	0.623	$41,924
8	$0	$67,320	$0	$67,320	0.582	$39,181
9	$0	$67,320	$0	$67,320	0.544	$36,618
10	$0	$67,320	$1,073,000	$1,140,320	0.508	$579,681
11	$0	$0	$0	$0	0.475	$0
12	$0	$67,320	$0	$67,320	0.444	$29,891
13	$0	$0	$0	$0	0.415	$0
14	$0	$67,320	$0	$67,320	0.388	$26,108
15	$0	$0	$35,000	$35,000	0.362	$12,686
16	$0	$67,320	$0	$67,320	0.339	$22,804
17	$0	$0	$0	$0	0.317	$0
18	$0	$67,320	$0	$67,320	0.296	$19,918
19	$0	$0	$0	$0	0.277	$0
20	$0	$0	$35,000	$35,000	0.258	$9,045
TOTAL	**$5,331,000**	**$942,000**	**$1,178,000**	**$7,451,000**	**---**	**$6,495,000**

TABLE B.3
Ash Road Properties Off-Site Feasibility Study Groundwater
ALTERNATIVE GW-4 - Full Scale EISB / MNA

NYSDEC Site: **Ash Road Properties Off-Site** Location: **Vestal, New York** Phase: **Feasibility Study; +50%/-30% accuracy** Base Year: **2025** Date: **November 14, 2025**	Project title: **Alternative # GW-4 - Full-Scale EISB/MNA with emulsified vegetable oil (EVO)/whey blend (or alternative). Second round of injections at Year 10. Assumes 10 years of annual groundwater monitoring, followed by monitoring every other year for years 11-20, with more robust project review every 5 years for a 20 year period.**

CAPITAL COSTS

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL COST
DIRECT CONSTRUCTION COSTS				
1.) Contractor Workplan Development	1	LS	$30,000	$30,000
2.) Required Submittals	1	LS	$20,000	$20,000
3.) Pre-design Investigation	1	LS	$60,000	$60,000
4.) Baseline groundwater sampling and reporting	15	wells	$2,300	$34,500
5.) Installation nested injection wells (shallow/deep)	150	per well	$7,500	$1,125,000
6.) Mobilization (Pilot Test)	1	LS	$5,000	$5,000
7.) Purchase Emulsified Vegetable Oil/whey (Pilot Test)	2,000	pounds	$16.34	$32,680
8.) Daily injection crew and equipment (Pilot Test)	4	days	$12,000	$48,000
9.) Post pilot test groundwater sampling and reporting	15	wells	$2,300	$34,500
10.) Mobilization (Full Scale Injection - Round 1)	1	LS	$12,000	$12,000
11.) Purchase Emulsified Vegetable Oil/whey (Full Scale Injection Round 1)	94,000	pounds	$16.34	$1,535,960
12.) Daily injection crew & equipment (Full Scale Injection Round 1, 2 crews)	50	days	$18,000	$900,000
13.) Post injection groundwater sampling and reporting	15	wells	$2,300	$34,500
14.) Demobilization	1	LS	$10,000	$10,000
SUBTOTAL DIRECT CONSTRUCTION COSTS				**$3,882,140**
OTHER CAPITAL COSTS				
1. Indirect Construction Costs (% of direct construction costs)	1	Lot	17%	$659,964
2. Contingency (% of direct construction costs)	1	Lot	20%	$776,428
3. Engineering, Design & Construction Oversight (% of direct construction costs and contingency)	1	Lot	18%	$838,542
SUBTOTAL OTHER CAPITAL COSTS				**$2,274,934**
TOTAL CAPITAL COSTS				**$6,157,000**

ANNUAL OPERATION, MAINTENANCE, AND MONITORING COSTS

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL COST
1. Project Management Administration, and Reporting	1	LS	$16,000	$16,000
2.Groundwater Monitoring	1	LS	$30,000	$30,000
3. Institutional Controls	1	LS	$5,000	$5,000
SUBTOTAL ANNUAL O&M COSTS				**$51,000**
4. Contingency (% of subtotal)	20%			$10,200
5. Technical Support/Troubleshooting (% of subtotal and contingency)	10%			$6,120
TOTAL ANNUAL O&M COSTS				**$67,320**

PERIODIC COSTS

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL COST
1. Project Review (once every 5 years)	1	LS	$35,000	$35,000
2. Round 2 Injections (50% original volume, Year 10)	1	LS	$1,244,080	$1,244,080
TOTAL PERIODIC COSTS				**$1,279,080**

PRESENT VALUE ANALYSIS

COST TYPE	YEAR	TOTAL COST	TOTAL COST PER YEAR	DISCOUNT FACTOR (7%)	PRESENT VALUE
Capital Cost	0	$6,157,000	$6,157,000	1.000	$6,157,000
Annual OM&M Cost	1-5	$336,600	$67,320	4.100	$276,025
Annual OM&M Cost	6-10	$336,600	$67,320	2.923	$196,802
Periodic Cost	5	$35,000	$35,000	0.713	$24,955
Periodic Cost	10	$1,279,080	$1,279,080	0.508	$650,219
Periodic Cost	12	$67,320	$67,320	0.444	$29,891
Periodic Cost	14	$67,320	$67,320	0.388	$26,108
Periodic Cost	15	$35,000	$35,000	0.362	$12,686
Periodic Cost	16	$67,320	$67,320	0.339	$22,804
Periodic Cost	18	$67,320	$67,320	0.296	$19,918
Periodic Cost	20	$35,000	$35,000	0.258	$9,045
TOTAL PRESENT VALUE OF ALTERNATIVE					**$7,425,000**

Notes:
1. Period of analysis is equivalent to the estimated project duration.
2. Present value of alternative is rounded to the nearest $1,000.

PRESENT VALUE CALCULATION **Annual Discount Factor =** **7.0%**

YEAR	CAPITAL COSTS	ANNUAL O&M COSTS	PERIODIC COSTS	TOTAL COST	DISCOUNT FACTOR (7%)	PRESENT VALUE
0	$6,157,000	$0	$0	$6,157,000	1.000	$6,157,000
1	$0	$67,320	$0	$67,320	0.935	$62,916
2	$0	$67,320	$0	$67,320	0.873	$58,800
3	$0	$67,320	$0	$67,320	0.816	$54,953
4	$0	$67,320	$0	$67,320	0.763	$51,358
5	$0	$67,320	$35,000	$102,320	0.713	$72,953
6	$0	$67,320	$0	$67,320	0.666	$44,858
7	$0	$67,320	$0	$67,320	0.623	$41,924
8	$0	$67,320	$0	$67,320	0.582	$39,181
9	$0	$67,320	$0	$67,320	0.544	$36,618
10	$0	$67,320	$1,279,080	$1,346,400	0.508	$684,441
11	$0	$0	$0	$0	0.475	$0
12	$0	$67,320	$0	$67,320	0.444	$29,891
13	$0	$0	$0	$0	0.415	$0
14	$0	$67,320	$0	$67,320	0.388	$26,108
15	$0	$0	$35,000	$35,000	0.362	$12,686
16	$0	$67,320	$0	$67,320	0.339	$22,804
17	$0	$0	$0	$0	0.317	$0
18	$0	$67,320	$0	$67,320	0.296	$19,918
19	$0	$0	$0	$0	0.277	$0
20	$0	$0	$35,000	$35,000	0.258	$9,045
TOTAL	**$6,157,000**	**$942,000**	**$1,384,080**	**$8,484,000**	**---**	**$7,425,000**

Notes and Assumptions:
1.) Cost estimates are developed at a FS level for comparative evaluation of alternative, level of accuracy is +50% / -30%.
2.) Estimate unit cost were developed using 2025 labor and material costs, and refined production rates based on Parsons experience and current industry standards.
3.) Present Worth analysis has been developed based on a 7% discount factor.

TABLE B.4
Ash Road Properties Off-Site Feasibility Study Groundwater
ALTERNATIVE GW-5 - Targeted EISB/MNA

NYSDEC Site: **Ash Road Properties Off-Site** Location: **Vestal, New York** Phase: **Feasibility Study; +50%/-30% accuracy** Base Year: **2025** Date: **November 14, 2025**	Project title: **Alternative # GW-5 - Targeted: EISB/MNA, with emulsified vegetable oil/whey (or alternative). Second round of injections at Year 10. Third round of injections at Year 20. Assumes annual groundwater monitoring Years 1-20, monitoring every other year for Years 21-30) with more robust project review every 5 years for a 30 year period.**

CAPITAL COSTS

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL COST
DIRECT CONSTRUCTION COSTS				
1.) Contractor Workplan Development	1	LS	$30,000	$30,000
2.) Required Submittals	1	LS	$20,000	$20,000
3.) Pre-design investigation	1	allowance	$60,000	$60,000
4.) Baseline Groundwater sampling and reporting	15	wells	$2,300	$34,500
5.) Installation of nested injection wells (shallow/deep)	45	per well	$7,500	$337,500
6.) Mobilization (Pilot Study)	1	LS	$5,000	$5,000
7.) Purchase Emulsified Vegetable Oil/whey (Pilot Test)	2,000	pounds	$16.34	$32,680
8.) Daily injection crew and equipment (Pilot Study)	4	days	$12,000	$48,000
9.) Post Pilot study groundwater sampling and reporting	15	wells	$2,300	$34,500
10.) Mobilization (Full Scale Injection - Round 1)	1	LS	$12,000	$12,000
11.) Purchase Emulsified Vegetable Oil/whey (Full Scale Injection Round 1)	30,000	pounds	$16.34	$490,200
12.) Daily injection crew & equipment (Full Scale Injection Round 1, 2 crews)	20	days	$18,000	$360,000
13.) Post Injection groundwater sampling and reporting	15	wells	$2,300	$34,500
14.) Demobilization	1	LS	$10,000	$10,000
SUBTOTAL DIRECT CONSTRUCTION COSTS				**$1,508,880**
OTHER CAPITAL COSTS				
1. Indirect Construction Costs (% of direct construction costs)	1	Lot	17%	$256,510
2. Contingency (% of direct construction costs)	1	Lot	20%	$301,776
3. Engineering, Design & Construction Oversight (% of direct construction costs and contingency)	1	Lot	18%	$325,918
SUBTOTAL OTHER CAPITAL COSTS				**$884,204**
TOTAL CAPITAL COSTS				**$2,393,000**

ANNUAL OPERATION, MAINTENANCE, AND MONITORING COSTS

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL COST
1. Project Management Administration, and Reporting	1	LS	$16,000	$16,000
2.Groundwater Monitoring	1	LS	$30,000	$30,000
3. Institutional Controls	1	LS	$5,000	$5,000
SUBTOTAL ANNUAL O&M COSTS				**$51,000**
4. Contingency (% of subtotal)	20%			$10,200
5. Technical Support/Troubleshooting (% of subtotal and contingency)	10%			$6,120
TOTAL ANNUAL O&M COSTS				**$67,320**

PERIODIC COSTS

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL COST
1. Project Review (once every 5 years)	1	LS	$35,000	$35,000
2. Round 2 Injections (50% original volume, Year 10)	1	LS	$463,440	$463,440
2. Round 3 Injections (25% original volume, Year 20)	1	LS	$242,720	$242,720
TOTAL PERIODIC COSTS				**$741,160**

TABLE B.4
Ash Road Properties Off-Site Feasibility Study Groundwater
ALTERNATIVE GW-5 - Targeted EISB/MNA

PRESENT VALUE ANALYSIS

COST TYPE	YEAR	TOTAL COST	TOTAL COST PER YEAR	DISCOUNT FACTOR (7%)	PRESENT VALUE
Capital Cost	0	$2,393,000	$2,393,000	1.000	$2,393,000
Annual OM&M Cost	1-5	$336,600	$67,320	4.100	$276,025
Annual OM&M Cost	6-10	$336,600	$67,320	2.923	$196,802
Annual OM&M Cost	11-15	$336,600	$67,320	2.084	$140,317
Annual OM&M Cost	16-20	$336,600	$67,320	1.486	$100,044
Periodic Cost	5	$35,000	$35,000	0.713	$24,955
Periodic Cost	10	$498,440	$498,440	0.508	$253,382
Periodic Cost	15	$35,000	$35,000	0.362	$12,686
Periodic Cost	20	$277,720	$277,720	0.258	$71,768
Periodic Cost	22	$67,320	$67,320	0.226	$15,195
Periodic Cost	24	$67,320	$67,320	0.197	$13,272
Periodic Cost	25	$35,000	$35,000	0.184	$6,449
Periodic Cost	26	$67,320	$67,320	0.172	$11,592
Periodic Cost	28	$67,320	$67,320	0.150	$10,125
Periodic Cost	30	$35,000	$35,000	0.131	$4,598
TOTAL PRESENT VALUE OF ALTERNATIVE					**$3,530,000**

Notes:
1. Period of analysis is equivalent to the estimated project duration.
2. Present value of alternative is rounded to the nearest $1,000.

PRESENT VALUE CALCULATION — **Annual Discount Factor =** **7.0%**

YEAR	CAPITAL COSTS	ANNUAL O&M COSTS	PERIODIC COSTS	TOTAL COST	DISCOUNT FACTOR (7%)	PRESENT VALUE
0	$2,393,000	$0	$0	$2,393,000	1.000	$2,393,000
1	$0	$67,320	$0	$67,320	0.935	$62,916
2	$0	$67,320	$0	$67,320	0.873	$58,800
3	$0	$67,320	$0	$67,320	0.816	$54,953
4	$0	$67,320	$0	$67,320	0.763	$51,358
5	$0	$67,320	$35,000	$102,320	0.713	$72,953
6	$0	$67,320	$0	$67,320	0.666	$44,858
7	$0	$67,320	$0	$67,320	0.623	$41,924
8	$0	$67,320	$0	$67,320	0.582	$39,181
9	$0	$67,320	$0	$67,320	0.544	$36,618
10	$0	$67,320	$498,440	$565,760	0.508	$287,604
11	$0	$67,320	$0	$67,320	0.475	$31,983
12	$0	$67,320	$0	$67,320	0.444	$29,891
13	$0	$67,320	$0	$67,320	0.415	$27,935
14	$0	$67,320	$0	$67,320	0.388	$26,108
15	$0	$67,320	$35,000	$102,320	0.362	$37,085
16	$0	$67,320	$0	$67,320	0.339	$22,804
17	$0	$67,320	$0	$67,320	0.317	$21,312
18	$0	$67,320	$0	$67,320	0.296	$19,918
19	$0	$67,320	$0	$67,320	0.277	$18,615
20	$0	$67,320	$277,720	$345,040	0.258	$89,165
21	$0	$0	$0	$0	0.242	$0
22	$0	$67,320	$0	$67,320	0.226	$15,195
23	$0	$0	$0	$0	0.211	$0
24	$0	$67,320	$0	$67,320	0.197	$13,272
25	$0	$0	$35,000	$35,000	0.184	$6,449
26	$0	$67,320	$0	$67,320	0.172	$11,592
27	$0	$0	$0	$0	0.161	$0
28	$0	$67,320	$0	$67,320	0.150	$10,125
29	$0	$0	$0	$0	0.141	$0
30	$0	$0	$35,000	$35,000	0.131	$4,598
TOTAL	**$2,393,000**	**$1,616,000**	**$916,160**	**$4,925,000**	**---**	**$3,530,000**

Notes and Assumptions:
1.) Cost estimates are developed at a FS level for comparative evaluation of alternative, level of accuracy is +50% / -30%.
2.) Estimate unit cost were developed using 2025 labor and material costs, and refined production rates based on Parsons experience and current industry standards.
3.) Present Worth analysis has been developed based on a 7% discount factor.

PARSONS

TABLE B.6
ASH ROAD FEASIBILITY STUDY
GROUNDWATER ALTERNATIVE 6 - AS/SVE (HORIZONTAL)

NYSDEC Site: **Ash Road Properties Off-Site** Location: **Vestal, New York** Phase: **Feasibility Study; +50%/-30% accuracy** Base Year: **2025** Date: **November 14, 2025**	Project title: **Alternative # 6 - Air Sparge/Soil Vapor Extraction (Horizontal Configuration). System to operate for 5 years. Assumes annual groundwater monitoring Years 1-15, monitoring every other year for Years 16-25) with more robust project review every 5 years for a 25 year period.**

CAPITAL COSTS

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL COST
DIRECT CONSTRUCTION COSTS				
1.) Contractor Workplan Development	1	LS	$30,000	$30,000
2.) Required Submittals	1	LS	$20,000	$20,000
3.) Pre-design investigation	1	allowance	$60,000	$60,000
4.) Baseline Groundwater sampling and reporting	15	wells	$2,300	$34,500
5.) Installation of SVE wells (4*950 ft)	3,800	per ft	$175	$665,000
6.) Installation of AS wells (9*1250)	11,250	per ft	$175	$1,968,750
7.) Pilot Study	1	LS	$15,000	$15,000
8.) Trenching	200	per ft	$290.00	$58,000
9.) System (not including treatment)	1	LS	$407,000	$407,000
10.) Installation of electric service	1	LS	$95,000	$95,000
SUBTOTAL DIRECT CONSTRUCTION COSTS				**$3,353,250**
OTHER CAPITAL COSTS				
1. Indirect Construction Costs (% of direct construction costs)	1	Lot	17%	$570,053
2. Contingency (% of direct construction costs)	1	Lot	20%	$670,650
3. Engineering, Design & Construction Oversight (% of direct construction costs and contingency)	1	Lot	18%	$724,302
SUBTOTAL OTHER CAPITAL COSTS				**$1,965,005**
TOTAL CAPITAL COSTS				**$5,318,000**

ANNUAL OPERATION, MAINTENANCE, AND MONITORING COSTS

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL COST
1. Project Management Administration, and Reporting	1	LS	$16,000	$16,000
2. Cost to Operate the system	1	LS	$75,000	$75,000
3. Groundwater Monitoring	1	LS	$30,000	$30,000
4. Institutional Controls	1	LS	$5,000	$5,000
5. Electricity for Remedial System	12	month	$26,100	$313,200
SUBTOTAL ANNUAL O&M COSTS				**$439,200**
6. Contingency (% of subtotal)	20%			$87,840
7. Technical Support/Troubleshooting (% of subtotal and contingency)	10%			$52,704
TOTAL ANNUAL O&M COSTS				**$579,744**

TABLE B.6
ASH ROAD FEASIBILITY STUDY
GROUNDWATER ALTERNATIVE 6 - AS/SVE (HORIZONTAL)

PERIODIC COSTS

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL COST
1. Project Review (once every 5 years)	1	LS	$35,000	$35,000
TOTAL PERIODIC COSTS				**$35,000**

PRESENT VALUE ANALYSIS

COST TYPE	YEAR	TOTAL COST	TOTAL COST PER YEAR	DISCOUNT FACTOR (7%)	PRESENT VALUE
Capital Cost	0	$5,318,000	$5,318,000	1.000	$5,318,000
Annual OM&M Cost	1-5	$2,898,720	$579,744	4.100	$2,377,065
Annual OM&M Cost	6-10	$336,600	$67,320	2.923	$196,802
Annual OM&M Cost	11-15	$336,600	$67,320	2.084	$140,317
Periodic Cost	5	$35,000	$35,000	0.713	$24,955
Periodic Cost	10	$35,000	$35,000	0.508	$17,792
Periodic Cost	15	$35,000	$35,000	0.362	$12,686
Periodic Cost	16	$67,320	$67,320	0.339	$22,804
Periodic Cost	18	$67,320	$67,320	0.296	$19,918
Periodic Cost	20	$102,320	$102,320	0.258	$26,441
Periodic Cost	22	$67,320	$67,320	0.226	$15,195
Periodic Cost	24	$67,320	$67,320	0.197	$13,272
Periodic Cost	25	$35,000	$35,000	0.184	$6,449
TOTAL PRESENT VALUE OF ALTERNATIVE					**$8,192,000**

Notes:
1. Period of analysis is equivalent to the estimated project duration.
2. Present value of alternative is rounded to the nearest $1,000.

PRESENT VALUE CALCULATION — **Annual Discount Factor =** **7.0%**

YEAR	CAPITAL COSTS	ANNUAL O&M COSTS	PERIODIC COSTS	TOTAL COST	DISCOUNT FACTOR (7%)	PRESENT VALUE
0	$5,318,000	$0	$0	$5,318,000	1.000	$5,318,000
1	$0	$579,744	$0	$579,744	0.935	$541,817
2	$0	$579,744	$0	$579,744	0.873	$506,371
3	$0	$579,744	$0	$579,744	0.816	$473,244
4	$0	$579,744	$0	$579,744	0.763	$442,284
5	$0	$579,744	$35,000	$614,744	0.713	$438,304
6	$0	$67,320	$0	$67,320	0.666	$44,858
7	$0	$67,320	$0	$67,320	0.623	$41,924
8	$0	$67,320	$0	$67,320	0.582	$39,181
9	$0	$67,320	$0	$67,320	0.544	$36,618
10	$0	$67,320	$35,000	$102,320	0.508	$52,014
11	$0	$67,320	$0	$67,320	0.475	$31,983
12	$0	$67,320	$0	$67,320	0.444	$29,891
13	$0	$67,320	$0	$67,320	0.415	$27,935
14	$0	$67,320	$0	$67,320	0.388	$26,108
15	$0	$67,320	$35,000	$102,320	0.362	$37,085
16	$0	$67,320	$0	$67,320	0.339	$22,804
17	$0	$0	$0	$0	0.317	$0
18	$0	$67,320	$0	$67,320	0.296	$19,918
19	$0	$0	$0	$0	0.277	$0
20	$0	$67,320	$35,000	$102,320	0.258	$26,441
21	$0	$0	$0	$0	0.242	$0
22	$0	$67,320	$0	$67,320	0.226	$15,195
23	$0	$0	$0	$0	0.211	$0
24	$0	$67,320	$0	$67,320	0.197	$13,272
25	$0	$0	$35,000	$35,000	0.184	$6,449
TOTAL	**$5,318,000**	**$3,909,000**	**$175,000**	**$9,402,000**	**---**	**$8,192,000**

Notes and Assumptions:
1.) Cost estimates are developed at a FS level for comparative evaluation of alternative, level of accuracy is +50% / -30%.
2.) Estimate unit cost were developed using 2025 labor and material costs, and refined production rates based on Parsons experience and current industry standards.
3.) Present Worth analysis has been developed based on a 7% discount factor.

PARSONS

APPENDIX C SOCIAL COSTS FOR REMEDIAL ALTERNATIVES

Alternative 2 - Monitored Natural Attenuation (MNA)
Ash Road Off-Site

General Assumptions for Alternative GW-2						
		MNA Period	*MNA Frequency (Years)*	*Distance from Waste Handler*	*Distance from Haz-Waste Handler*	
		30	1	200	400	
MNA Visit Travel Distance (one-way miles)	**MNA Travel Distance Same for each Instance?**		**MNA Vehicle Type**	**Total Trips for Waste Handler Non-Haz**	**Total Trip for Waste Handler Haz**	
90	TRUE		Large SUV	30	30	

Alternative 2 Calculations

Emission Categories	Impact Categories				Discount Rates				Total Social Cost			
	MNA	*N/A*	Waste T&D	*Total*	*2.5%*	*2.0%*	*1.5%*		*2.5%*	*2.0%*	*1.5%*	
m TON CO_2	2.01E+01	0.00E+00	3.55E+01	5.56E+01	$ 133	$ 215	$ 365		$ 7,397	$ 11,958	$ 20,301	
m TON CH4	5.28E-04	0.00E+00	1.88E-04	7.16E-04	$ 1,657	$ 2,101	$ 2,823		$ 92,161	$ 116,856	$ 157,013	
mTON N_2O	1.94E-04	0.00E+00	8.55E-04	1.05E-03	$ 40,920	$ 61,492	$ 96,796		$ 2,275,940	$ 3,420,140	$ 5,383,722	
								Totals	$ 2,375,499	$ 3,548,954	$ 5,561,037	$ -

Construction Equipment Emissions Calculations

Emissions from Equipment (Diesel

Equipment Type	Emissions Factors (lbs./Hour)			Total Runtime	Total Emissions (lbs.)			Total Emissions (mTons)		
	CO2	*CH4*	*N2O*	*Hours*	*CO2*	*CH4*	*N2O*	*CO2*	*CH4*	*N2O*
None	0.00E+00	0.00E+00	0.00E+00							
							Total Equipment GHG Emissions	0.00E+00	0.00E+00	0.00E+00

Emissions from Transportation to Site (Gasoline)

Vehicle Type	MPG	Total Miles Driven	Total Gallons Used	Emissions Factors			Total Emissions (lbs.)			Total Emissions (mTons)		
				CO2 lbs./gallon	*CH4 lbs./mile*	*N2O lbs./mile*	*CO2*	*CH4*	*N2O*	*CO2*	*CH4*	*N2O*
None				19.36	2.04E-05	7.47E-06						
									Total Transportation GHG Emissions	0.00E+00	0.00E+00	0.00E+00

Emissions from Materials Delivery (Diesel)

Delivery Vehicle	Material Delivered	MPG	Total Miles	Emissions Factors			Total Emissions (lbs.)			Total Emissions (mTons)		
				CO2 lbs./gallon	*CH4 lbs./mile*	*N2O lbs./mile*	*CO2*	*CH4*	*N2O*	*CO2*	*CH4*	*N2O*
None				22.51	2.09E-05	9.50E-05						
									Total Delivery GHG Emissions	0.00E+00	0.00E+00	0.00E+00
									EISB GHG Emissions Grand Total	0.00E+00	0.00E+00	0.00E+00

Alternative 2 - Monitored Natural Attenuation (MNA)
Ash Road Off-Site

MNA Emissions (Gasoline												
Year	No. of Visits	Total Distance Driven	Fuel Spent	Emissions Factors			Total Emissions (lbs.)			Total Emissions (mTons)		
		Miles	*Gallons*	*CO2 lbs./gallon*	*CH4 lbs./mile*	*N2O lbs./mile*	*CO2*	*CH4*	*N2O*	*CO2*	*CH4*	*N2O*
1	8	1440	57.6	19.36	2.04E-05	7.47E-06	1,115.13	0.029323063	0.010751447	0.55756512	1.46615E-05	5.37572E-06
2	8	1440	57.6	19.36	2.04E-05	7.47E-06	1115.13024	0.029323063	0.010751447	0.55756512	1.46615E-05	5.37572E-06
3	8	1440	57.6	19.36	2.04E-05	7.47E-06	1115.13024	0.029323063	0.010751447	0.55756512	1.46615E-05	5.37572E-06
4	8	1440	57.6	19.36	2.04E-05	7.47E-06	1115.13024	0.029323063	0.010751447	0.55756512	1.46615E-05	5.37572E-06
5	16	2880	115.2	19.36	2.04E-05	7.47E-06	2230.26048	0.058646125	0.021502894	1.11513024	2.93231E-05	1.07514E-05
6	8	1440	57.6	19.36	2.04E-05	7.47E-06	1115.13024	0.029323063	0.010751447	0.55756512	1.46615E-05	5.37572E-06
7	8	1440	57.6	19.36	2.04E-05	7.47E-06	1115.13024	0.029323063	0.010751447	0.55756512	1.46615E-05	5.37572E-06
8	8	1440	57.6	19.36	2.04E-05	7.47E-06	1115.13024	0.029323063	0.010751447	0.55756512	1.46615E-05	5.37572E-06
9	8	1440	57.6	19.36	2.04E-05	7.47E-06	1115.13024	0.029323063	0.010751447	0.55756512	1.46615E-05	5.37572E-06
10	16	2880	115.2	19.36	2.04E-05	7.47E-06	2230.26048	0.058646125	0.021502894	1.11513024	2.93231E-05	1.07514E-05
11	8	1440	57.6	19.36	2.04E-05	7.47E-06	1115.13024	0.029323063	0.010751447	0.55756512	1.46615E-05	5.37572E-06
12	8	1440	57.6	19.36	2.04E-05	7.47E-06	1115.13024	0.029323063	0.010751447	0.55756512	1.46615E-05	5.37572E-06
13	8	1440	57.6	19.36	2.04E-05	7.47E-06	1115.13024	0.029323063	0.010751447	0.55756512	1.46615E-05	5.37572E-06
14	8	1440	57.6	19.36	2.04E-05	7.47E-06	1115.13024	0.029323063	0.010751447	0.55756512	1.46615E-05	5.37572E-06
15	16	2880	115.2	19.36	2.04E-05	7.47E-06	2230.26048	0.058646125	0.021502894	1.11513024	2.93231E-05	1.07514E-05
16	8	1440	57.6	19.36	2.04E-05	7.47E-06	1115.13024	0.029323063	0.010751447	0.55756512	1.46615E-05	5.37572E-06
17	8	1440	57.6	19.36	2.04E-05	7.47E-06	1115.13024	0.029323063	0.010751447	0.55756512	1.46615E-05	5.37572E-06
18	8	1440	57.6	19.36	2.04E-05	7.47E-06	1115.13024	0.029323063	0.010751447	0.55756512	1.46615E-05	5.37572E-06
19	8	1440	57.6	19.36	2.04E-05	7.47E-06	1115.13024	0.029323063	0.010751447	0.55756512	1.46615E-05	5.37572E-06
20	16	2880	115.2	19.36	2.04E-05	7.47E-06	2230.26048	0.058646125	0.021502894	1.11513024	2.93231E-05	1.07514E-05
21	8	1440	57.6	19.36	2.04E-05	7.47E-06	1115.13024	0.029323063	0.010751447	0.55756512	1.46615E-05	5.37572E-06
22	8	1440	57.6	19.36	2.04E-05	7.47E-06	1115.13024	0.029323063	0.010751447	0.55756512	1.46615E-05	5.37572E-06
23	8	1440	57.6	19.36	2.04E-05	7.47E-06	1115.13024	0.029323063	0.010751447	0.55756512	1.46615E-05	5.37572E-06
24	8	1440	57.6	19.36	2.04E-05	7.47E-06	1115.13024	0.029323063	0.010751447	0.55756512	1.46615E-05	5.37572E-06
25	16	2880	115.2	19.36	2.04E-05	7.47E-06	2230.26048	0.058646125	0.021502894	1.11513024	2.93231E-05	1.07514E-05
26	8	1440	57.6	19.36	2.04E-05	7.47E-06	1115.13024	0.029323063	0.010751447	0.55756512	1.46615E-05	5.37572E-06
27	8	1440	57.6	19.36	2.04E-05	7.47E-06	1115.13024	0.029323063	0.010751447	0.55756512	1.46615E-05	5.37572E-06
28	8	1440	57.6	19.36	2.04E-05	7.47E-06	1115.13024	0.029323063	0.010751447	0.55756512	1.46615E-05	5.37572E-06
29	8	1440	57.6	19.36	2.04E-05	7.47E-06	1115.13024	0.029323063	0.010751447	0.55756512	1.46615E-05	5.37572E-06
30	16	2880	115.2	19.36	2.04E-05	7.47E-06	2230.26048	0.058646125	0.021502894	1.11513024	2.93231E-05	1.07514E-05
									Grand Total MNA GHG Emissions	20.07234432	0.000527815	0.000193526

Emissions from T&D Transportation (Diesel)													
Material	No. of Trips	MPG	Total Miles	Total Gallons	Emissions Factors			Total Emissions (lbs.)			Total Emissions (mTons)		
					CO2 lbs./gallon	*CH4 lbs./mile*	*N2O lbs./mile*	*CO2*	*CH4*	*N2O*	*CO2*	*CH4*	*N2O*
Hazardous Waste T&D	30	5.7	12000	2105.263158	22.51	2.09E-05	9.50E-05	4.74E+04	2.51E-01	1.14E+00	2.37E+01	1.26E-04	5.70E-04
Non-Hazardous Waste T&D	30	5.7	6000	1052.631579	22.51	2.09E-05	9.50E-05	23697.94737	0.125661376	0.57010582	11.84897368	6.28307E-05	0.0002851
										Total T&D Transportation GHG Emissions	3.55E+01	1.88E-04	8.55E-04

Alternative 3 - Full-Scale In Situ Chemical Oxidation (ISCO) + MNA
Ash Road Off-Site

General Assumptions for Alternative GW-3							
ISCO reagent volume (gal)	*Work Hours/ Day*	*MNA Period*		*Distance from Waste Handler*	*Distance from Haz-Waste Handler*		
209000	10	20		200	400		
MNA Visit Travel Distance (one-way miles)	**MNA Travel Distance Same for each Instance?**		**MNA Vehicle Type**	**Total Trips for Waste Handler Non-Haz**	**Total Trip for Waste Handler Haz**		
90	TRUE		Large SUV	20	20		
Well Completion Rate (Wells/day)	**No of Wells**	**Time to Complete**	**Gallons of Reagent Per shipment**	**Total Shipments**	**Injection rate (gal/day)**	**Total Days for Injections**	**Buffer For Injections (days)**
1	150	150	4,800	44	9,000	25	**2**

Alternative 3 Calculations

Emission Categories	Impact Categories				Discount Rates				Total Social Cost			
	MNA	*ISCO*	Waste T&D	*Total*	*2.5%*	*2.0%*	*1.5%*		*2.5%*	*2.0%*	*1.5%*	
m TON CO_2	1.06E+01	1.57E+01	2.37E+01	5.00E+01	$ 133	$ 215	$ 365		$ 6,648	$ 10,747	$ 18,245	
m TON CH4	2.79E-04	1.42E-02	1.26E-04	1.46E-02	$ 1,657	$ 2,101	$ 2,823		$ 82,825	$ 105,019	$ 141,108	
mTON N_2O	1.02E-04	9.54E-03	5.70E-04	1.02E-02	$ 40,920	$ 61,492	$ 96,796		$ 2,045,390	$ 3,073,683	$ 4,838,356	
								Totals	$ 2,134,863	$ 3,189,448	$ 4,997,709	

Construction Equipment Emissions Calculations

Emissions from Equipment (Diesel

Equipment Type	Emissions Factors (lbs./Hour)			Total Run-time	Total Emissions (lbs.)			Total Emissions (mTons)			
	CO2	*CH4*	*N2O*	*Hours*	*CO2*	*CH4*	*N2O*	*CO2*	*CH4*	*N2O*	Comment
Skid Steer	4.50E-02	4.01E-03	2.47E-03	1500	6.75E+01	6.02E+00	3.70E+00	3.38E-02	3.01E-03	1.85E-03	For drilling activities
Skid Steer	4.50E-02	4.01E-03	2.47E-03	20	9.00E-01	8.02E-02	4.94E-02	4.50E-04	4.01E-05	2.47E-05	For pilot test
Drill Rig	1.35E-01	1.20E-02	7.41E-03	1500	2.03E+02	1.81E+01	1.11E+01	1.01E-01	9.03E-03	5.56E-03	Drill Rig for well construction
Drill Rig	1.35E-01	1.20E-02	7.41E-03	250	3.38E+01	3.01E+00	1.85E+00	1.69E-02	1.50E-03	9.26E-04	Drill Rig for Injections
							Total Equipment GHG Emissions	1.52E-01	1.36E-02	8.36E-03	

Emissions from Transportation to Site (Gasoline)

Vehicle Type	MPG	Total Miles Driven	Total Gallons Used	Emissions Factors			Total Emissions (lbs.)			Total Emissions (mTons)			
				CO2 lbs./gallon	*CH4 lbs./mile*	*N2O lbs./mile*	*CO2*	*CH4*	*N2O*	*CO2*	*CH4*	*N2O*	Comment
Light Pickup	21	360	17.14285714	19.36	2.04E-05	7.47E-06	3.32E+02	7.33E-03	2.69E-03	1.66E-01	3.67E-06	1.34E-06	Pilot Test (2 Days)
Light Pickup	21	4500	214.2857143	19.36	2.04E-05	7.47E-06	4.15E+03	9.16E-02	3.36E-02	2.07E+00	4.58E-05	1.68E-05	Full Scale Injection (25 days)
Large SUV	25	27000	1080	19.36	2.04E-05	7.47E-06	2.09E+04	5.50E-01	2.02E-01	1.05E+01	2.75E-04	1.01E-04	Oversight for Well Construction
Large SUV	25	1440	57.6	19.36	2.04E-05	7.47E-06	1.12E+03	2.93E-02	1.08E-02	5.58E-01	1.47E-05	5.38E-06	Pre-pilot test baseline monitoring
Large SUV	25	1440	57.6	19.36	2.04E-05	7.47E-06	1.12E+03	2.93E-02	1.08E-02	5.58E-01	1.47E-05	5.38E-06	Post-pilot study monitoring
Large SUV	25	1440	57.6	19.36	2.04E-05	7.47E-06	1.12E+03	2.93E-02	1.08E-02	5.58E-01	1.47E-05	5.38E-06	Post-injection monitoring
Large SUV	25	2700	108	19.36	2.04E-05	7.47E-06	2.09E+03	5.50E-02	2.02E-02	1.05E+00	2.75E-05	1.01E-05	volume)
									Total Transportation GHG Emissions	1.54E+01	3.96E-04	1.45E-04	

Emissions from Materials Delivery (Diesel)

Delivery Vehicle	Material Delivered	MPG	Total Miles	Emissions Factors			Total Emissions (lbs.)			Total Emissions (mTons)		
				CO2 lbs./gallon	*CH4 lbs./mile*	*N2O lbs./mile*	*CO2*	*CH4*	*N2O*	*CO2*	*CH4*	*N2O*
Class 8 Truck	Sodium Permanganate (Slack Chemical - Carthage NY)	5.7	14520	22.51	2.09E-05	9.50E-05	1.28E+02	3.04E-01	1.38E+00	6.42E-02	1.52E-04	6.90E-04
Class 8 Truck	Sodium Permanganate (Slack Chemical - Carthage NY) - Round 2	5.7	7260	22.51	2.09E-05	9.50E-05	1.28E+02	1.52E-01	6.90E-01	6.42E-02	7.60E-05	3.45E-04
								Total Delivery GHG Emissions		1.28E-01	2.28E-04	1.03E-03
								ISCO GHG Emissions Grand Total		1.57E+01	1.42E-02	9.54E-03

Alternative 3 - Full-Scale In Situ Chemical Oxidation (ISCO) + MNA
Ash Road Off-Site

MNA Emissions (Gasoline

Year	No. of Visits	Total Distance Driven	Fuel Spent	Emissions Factors			Total Emissions (lbs.)			Total Emissions (mTons)		
		Miles	*Gallons*	*CO2 lbs./gallon*	*CH4 lbs./mile*	*N2O lbs./mile*	*CO2*	*CH4*	*N2O*	*CO2*	*CH4*	*N2O*
1	8	1440	57.6	19.36	2.04E-05	7.47E-06	1.12E+03	2.93E-02	1.08E-02	5.58E-01	1.47E-05	5.38E-06
2	8	1440	57.6	19.36	2.04E-05	7.47E-06	1.12E+03	2.93E-02	1.08E-02	5.58E-01	1.47E-05	5.38E-06
3	8	1440	57.6	19.36	2.04E-05	7.47E-06	1.12E+03	2.93E-02	1.08E-02	5.58E-01	1.47E-05	5.38E-06
4	8	1440	57.6	19.36	2.04E-05	7.47E-06	1.12E+03	2.93E-02	1.08E-02	5.58E-01	1.47E-05	5.38E-06
5	16	2880	115.2	19.36	2.04E-05	7.47E-06	2.23E+03	5.86E-02	2.15E-02	1.12E+00	2.93E-05	1.08E-05
6	8	1440	57.6	19.36	2.04E-05	7.47E-06	1.12E+03	2.93E-02	1.08E-02	5.58E-01	1.47E-05	5.38E-06
7	8	1440	57.6	19.36	2.04E-05	7.47E-06	1.12E+03	2.93E-02	1.08E-02	5.58E-01	1.47E-05	5.38E-06
8	8	1440	57.6	19.36	2.04E-05	7.47E-06	1.12E+03	2.93E-02	1.08E-02	5.58E-01	1.47E-05	5.38E-06
9	8	1440	57.6	19.36	2.04E-05	7.47E-06	1.12E+03	2.93E-02	1.08E-02	5.58E-01	1.47E-05	5.38E-06
10	16	2880	115.2	19.36	2.04E-05	7.47E-06	2.23E+03	5.86E-02	2.15E-02	1.12E+00	2.93E-05	1.08E-05
11				19.36	2.04E-05	7.47E-06						
12	8	1440	57.6	19.36	2.04E-05	7.47E-06	1.12E+03	2.93E-02	1.08E-02	5.58E-01	1.47E-05	5.38E-06
13				19.36	2.04E-05	7.47E-06						
14	8	1440	57.6	19.36	2.04E-05	7.47E-06	1.12E+03	2.93E-02	1.08E-02	5.58E-01	1.47E-05	5.38E-06
15	8	1440	57.6	19.36	2.04E-05	7.47E-06	1.12E+03	2.93E-02	1.08E-02	5.58E-01	1.47E-05	5.38E-06
16	8	1440	57.6	19.36	2.04E-05	7.47E-06	1.12E+03	2.93E-02	1.08E-02	5.58E-01	1.47E-05	5.38E-06
17				19.36	2.04E-05	7.47E-06						
18	8	1440	57.6	19.36	2.04E-05	7.47E-06	1.12E+03	2.93E-02	1.08E-02	5.58E-01	1.47E-05	5.38E-06
19				19.36	2.04E-05	7.47E-06						
20	16	2880	115.2	19.36	2.04E-05	7.47E-06	2.23E+03	5.86E-02	2.15E-02	1.12E+00	2.93E-05	1.08E-05
									Grand Total MNA GHG Emissions	1.06E+01	2.79E-04	1.02E-04

Emissions from T&D Transportation (Diesel)

Material	No. of Trips	MPG	Total Miles		Emissions Factors			Total Emissions (lbs.)			Total Emissions (mTons)		
				Total Gallons	*CO2 lbs./gallon*	*CH4 lbs./mile*	*N2O lbs./mile*	*CO2*	*CH4*	*N2O*	*CO2*	*CH4*	*N2O*
Hazardous Waste T&D	20	5.7	8000	1403.508772	22.51	2.09E-05	9.50E-05	3.16E+04	1.68E-01	7.60E-01	1.58E+01	8.38E-05	3.80E-04
Non-Hazardous Waste T&D	20	5.7	4000	701.754386	22.51	2.09E-05	9.50E-05	1.58E+04	8.38E-02	3.80E-01	7.90E+00	4.19E-05	1.90E-04
										Total T&D Transportation GHG Emissions	2.37E+01	1.26E-04	5.70E-04

Alternative 4 - Full-Scale Enhanced In Situ Bioremediation (EISB) + MNA
Ash Road Off-Site

General Assumptions For Alternative GW-4							
Total EISB agent volume (gal)	*Work Hours/ Day*	*MNA Period*		*Distance from Waste Handler*	*Distance from Haz-Waste Handler*		
729600	10	20		200	400		
MNA Visit Travel Distance (one-way miles)	**MNA Travel Distance Same for each Instance?**		**MNA Vehicle Type**	**Total Trips for Waste Handler Non-Haz**	**Total Trip for Waste Handler Haz**		
90	TRUE		Large SUV	20	20		
Well Completion Rate (Wells/day)	**No of Wells**	**Time to Complete**	**Gallons of Reagent Per shipment**	**Total Shipments**	**Injection rate (gal/day)**	**Total Days for Injections**	**Buffer for Injections (day)**
1	150	150	4,800	152	**15,000**	**50**	1

Alternative 4 Calculations

Emission Categories	Impact Categories				Discount Rates				Total Social Cost			
	MNA	*EISB*	Waste T&D	*Total*	*2.5%*	*2.0%*	*1.5%*		*2.5%*	*2.0%*	*1.5%*	
m TON CO_2	1.06E+01	1.71E+01	2.37E+01	5.14E+01	$ 133	$ 215	$ 365		$ 6,840	$ 11,058	$ 18,773	
m TON CH4	2.79E-04	1.64E-02	1.26E-04	1.69E-02	$ 1,657	$ 2,101	$ 2,823		$ 85,222	$ 108,058	$ 145,192	
mTON N_2O	1.02E-04	1.34E-02	5.70E-04	1.40E-02	$ 40,920	$ 61,492	$ 96,796		$ 2,104,586	$ 3,162,640	$ 4,978,386	
								Totals	$ 2,196,649	$ 3,281,756	$ 5,142,350	

Construction Equipment Emissions Calculations

Emissions from Equipment (Diesel

Equipment Type	Emissions Factors (lbs./Hour)			Total Runtime	Total Emissions (lbs.)			Total Emissions (mTons)			
	CO2	*CH4*	*N2O*	*Hours*	*CO2*	*CH4*	*N2O*	*CO2*	*CH4*	*N2O*	Comment
Skid Steer	4.50E-02	4.01E-03	2.47E-03	1.50E+03	6.75E+01	6.02E+00	3.70E+00	3.38E-02	3.01E-03	1.85E-03	For drilling activities
Skid Steer	4.50E-02	4.01E-03	2.47E-03	4.00E+01	1.80E+00	1.60E-01	9.88E-02	9.00E-04	8.02E-05	4.94E-05	For pilot test
Drill Rig	1.35E-01	1.20E-02	7.41E-03	5.00E+02	6.75E+01	6.02E+00	3.70E+00	3.38E-02	3.01E-03	1.85E-03	Drill Rig for Injections
Drill Rig	1.35E-01	1.20E-02	7.41E-03	1.50E+03	2.03E+02	1.81E+01	1.11E+01	1.01E-01	9.03E-03	5.56E-03	Drill Rig for well construction
							Total Equipment GHG Emissions	1.70E-01	1.51E-02	9.31E-03	

Emissions from Transportation to Site (Gasoline)

Vehicle Type	MPG	otal Miles Drive	Total Gallons Used	Emissions Factors			Total Emissions (lbs.)			Total Emissions (mTons)			Comment
				CO2 lbs./gallon	*CH4 lbs./mile*	*N2O lbs./mile*	*CO2*	*CH4*	*N2O*	*CO2*	*CH4*	*N2O*	
Mid Size Car	27	27000	1000	19.36	2.04E-05	7.47E-06	1.94E+04	5.50E-01	2.02E-01	9.68E+00	2.75E-04	1.01E-04	Drilling Oversight
Light Pickup	21	720	34.28571429	19.36	2.04E-05	7.47E-06	6.64E+02	1.47E-02	5.38E-03	3.32E-01	7.33E-06	2.69E-06	Pilot Test
Large SUV	25	9000	360	19.36	2.04E-05	7.47E-06	6.97E+03	1.83E-01	6.72E-02	3.48E+00	9.16E-05	3.36E-05	Full Scale Injections
Large SUV	25	1440	57.6	19.36	2.04E-05	7.47E-06	1.12E+03	2.93E-02	1.08E-02	5.58E-01	1.47E-05	5.38E-06	Pre-pilot test baseline monitoring
Large SUV	25	1440	57.6	19.36	2.04E-05	7.47E-06	1.12E+03	2.93E-02	1.08E-02	5.58E-01	1.47E-05	5.38E-06	Post-pilot study monitoring
Large SUV	25	1440	57.6	19.36	2.04E-05	7.47E-06	1.12E+03	2.93E-02	1.08E-02	5.58E-01	1.47E-05	5.38E-06	Post-injection monitoring
Large SUV	25	4320	172.8	19.36	2.04E-05	7.47E-06	3.35E+03	8.80E-02	3.23E-02	1.67E+00	4.40E-05	1.61E-05	Round 2 injections @ 10 years (50 percent volume)
									Total Transportation GHG Emissions	1.68E+01	4.62E-04	1.69E-04	

Emissions from Materials Delivery (Diesel)

Delivery Vehicle	Material Delivered	MPG	Total Miles	Emissions Factors			Total Emissions (lbs.)			Total Emissions (mTons)		
				CO2 lbs./gallon	*CH4 lbs./mile*	*N2O lbs./mile*	*CO2*	*CH4*	*N2O*	*CO2*	*CH4*	*N2O*
Class 8 Truck	Vegetable Oil/ Whey (Emerling Foods - Depew NY)	5.7	54720	22.51	2.09E-05	9.50E-05	1.28E+02	1.15E+00	5.20E+00	6.42E-02	5.73E-04	2.60E-03
Class 8 Truck	Vegetable Oil/ Whey (Emerling Foods - Depew NY) - Round 2	5.7	27360	22.51	2.09E-05	9.50E-05	1.28E+02	5.73E-01	2.60E+00	6.42E-02	2.87E-04	1.30E-03
									Total Delivery GHG Emissions	1.28E-01	8.60E-04	3.90E-03
									EISB GHG Emissions Grand Total	1.71E+01	1.64E-02	1.34E-02

Alternative 4 - Full-Scale Enhanced In Situ Bioremediation (EISB) + MNA
Ash Road Off-Site

MNA Emissions (Gasoline													
Year	No. of Visits	Total Distance	Fuel Spent	Emissions Factors			Total Emissions (lbs.)			Total Emissions (mTons)			
		Miles	*Gallons*	*CO2 lbs./gallon*	*CH4 lbs./mile*	*N2O lbs./mile*	*CO2*	*CH4*	*N2O*	*CO2*	*CH4*	*N2O*	
1	8	1440	57.6	19.36	2.04E-05	7.47E-06	1.12E+03	2.93E-02	1.08E-02	5.58E-01	1.47E-05	5.38E-06	
2	8	1440	57.6	19.36	2.04E-05	7.47E-06	1.12E+03	2.93E-02	1.08E-02	5.58E-01	1.47E-05	5.38E-06	
3	8	1440	57.6	19.36	2.04E-05	7.47E-06	1.12E+03	2.93E-02	1.08E-02	5.58E-01	1.47E-05	5.38E-06	
4	8	1440	57.6	19.36	2.04E-05	7.47E-06	1.12E+03	2.93E-02	1.08E-02	5.58E-01	1.47E-05	5.38E-06	
5	16	2880	115.2	19.36	2.04E-05	7.47E-06	2.23E+03	5.86E-02	2.15E-02	1.12E+00	2.93E-05	1.08E-05	
6	8	1440	57.6	19.36	2.04E-05	7.47E-06	1.12E+03	2.93E-02	1.08E-02	5.58E-01	1.47E-05	5.38E-06	
7	8	1440	57.6	19.36	2.04E-05	7.47E-06	1.12E+03	2.93E-02	1.08E-02	5.58E-01	1.47E-05	5.38E-06	
8	8	1440	57.6	19.36	2.04E-05	7.47E-06	1.12E+03	2.93E-02	1.08E-02	5.58E-01	1.47E-05	5.38E-06	
9	8	1440	57.6	19.36	2.04E-05	7.47E-06	1.12E+03	2.93E-02	1.08E-02	5.58E-01	1.47E-05	5.38E-06	
10	16	2880	115.2	19.36	2.04E-05	7.47E-06	2.23E+03	5.86E-02	2.15E-02	1.12E+00	2.93E-05	1.08E-05	
11				19.36	2.04E-05	7.47E-06							
12	8	1440	57.6	19.36	2.04E-05	7.47E-06	1.12E+03	2.93E-02	1.08E-02	5.58E-01	1.47E-05	5.38E-06	
13				19.36	2.04E-05	7.47E-06							
14	8	1440	57.6	19.36	2.04E-05	7.47E-06	1.12E+03	2.93E-02	1.08E-02	5.58E-01	1.47E-05	5.38E-06	
15	8	1440	57.6	19.36	2.04E-05	7.47E-06	1.12E+03	2.93E-02	1.08E-02	5.58E-01	1.47E-05	5.38E-06	
16	8	1440	57.6	19.36	2.04E-05	7.47E-06	1.12E+03	2.93E-02	1.08E-02	5.58E-01	1.47E-05	5.38E-06	
17				19.36	2.04E-05	7.47E-06							
18	8	1440	57.6	19.36	2.04E-05	7.47E-06	1.12E+03	2.93E-02	1.08E-02	5.58E-01	1.47E-05	5.38E-06	
19				19.36	2.04E-05	7.47E-06							
20	16	2880	115.2	19.36	2.04E-05	7.47E-06	2.23E+03	5.86E-02	2.15E-02	1.12E+00	2.93E-05	1.08E-05	
									Grand Total MNA GHG Emissions	10.59373728	0.000278569	0.000102139	

Emissions from T&D Transportation (Diesel)													
Material	No. of Trips	MPG	Total Miles		Emissions Factors			Total Emissions (lbs.)			Total Emissions (mTons)		
				Total Gallons	*CO2 lbs./gallon*	*CH4 lbs./mile*	*N2O lbs./mile*	*CO2*	*CH4*	*N2O*	*CO2*	*CH4*	*N2O*
Hazardous Waste T&D	20	5.7	8000	1403.508772	22.51	2.09E-05	9.50E-05	3.16E+04	1.68E-01	7.60E-01	1.58E+01	8.38E-05	3.80E-04
Non-Hazardous Waste T&D	20	5.7	4000	701.754386	22.51	2.09E-05	9.50E-05	1.58E+04	8.38E-02	3.80E-01	7.90E+00	4.19E-05	1.90E-04
										Total T&D Transportation GHG Emissions	2.37E+01	1.26E-04	5.70E-04

Alternative 5 - Targeted EISB + MNA
Ash Road Off-Site

General Assumptions for Alternative GW-5								
	Work Hours/ Day	*MNA Period*		*Distance from Waste Handler*		*Distance from Haz-Waste Handler*		
	10	30		200		400		
MNA Visit Travel Distance (one-way miles)	**MNA Travel Distance Same for each Instance?**		**MNA Vehicle Type**	**otal Trips for Waste Handler Non-H**		**Total Trip for Waste Handler Haz**		
90	TRUE		Large SUV	30		30		
Well Completion Rate (Wells/day)	**Number of Wells**	**Days to complete Wells**	**Gallons of Reagent Per shipment**	***EISB agent Volume***	***Number of Shipments***	***Injection Rate (gal/day)***	***Buffer for Injections (days)***	***Total Days of Injections***
1	45	45	4,800	243,200	51	15,000	3	20

Alternative 5 Calculations

Emission Categories	Impact Categories				Discount Rates				Total Social Cost			
	MNA	*EISB*	Waste T&D	*Total*	*2.5%*	*2.0%*	*1.5%*		*2.5%*	*2.0%*	*1.5%*	
m TON CO_2	1.73E+01	1.08E+01	3.55E+01	6.36E+01	$ 133	$ 215	$ 365		$ 8,458	$ 13,673	$ 23,213	
m TON CH4	4.55E-04	5.38E-03	1.88E-04	6.02E-03	$ 1,657	$ 2,101	$ 2,823		$ 105,379	$ 133,616	$ 179,532	
mTON N_2O	1.67E-04	4.02E-03	8.55E-04	5.04E-03	$ 40,920	$ 61,492	$ 96,796		$ 2,602,359	$ 3,910,661	$ 6,155,863	
								Totals	$ 2,716,196	$ 4,057,950	$ 6,358,608	$ -

Construction Equipment Emissions Calculations

Emissions from Equipment (Diesel

Equipment Type	Emissions Factors (lbs./Hour)			Total Runtime	Total Emissions (lbs.)			Total Emissions (mTons)			Comment
	CO2	*CH4*	*N2O*	*Hours*	*CO2*	*CH4*	*N2O*	*CO2*	*CH4*	*N2O*	
Skid Steer	4.50E-02	4.01E-03	2.47E-03	450	2.0E+01	1.8E+00	1.1E+00	1.0E-02	9.0E-04	5.6E-04	For drilling activities
Skid Steer	4.50E-02	4.01E-03	2.47E-03	40	1.8E+00	1.6E-01	9.9E-02	9.0E-04	8.0E-05	4.9E-05	For pilot test
Drill Rig	1.35E-01	1.20E-02	7.41E-03	200	2.7E+01	2.4E+00	1.5E+00	1.4E-02	1.2E-03	7.4E-04	Drill Rig for Injections
Drill Rig	1.35E-01	1.20E-02	7.41E-03	450	6.1E+01	5.4E+00	3.3E+00	3.0E-02	2.7E-03	1.7E-03	Drill Rig for well construction
	0.00E+00	0.00E+00	0.00E+00								

Emissions from Transportation to Site (Gasoline)

Vehicle Type	MPG	Total Miles Driven	Total Gallons Used	Emissions Factors			Total Emissions (lbs.)			Total Emissions (mTons)			Comment
				CO2 lbs./gallon	*CH4 lbs./mile*	*N2O lbs./mile*	*CO2*	*CH4*	*N2O*	*CO2*	*CH4*	*N2O*	
Mid Size Car	27	16200	600	19.36	2.04E-05	7.47E-06	1.16E+04	3.30E-01	1.21E-01	5.81E+00	1.65E-04	6.05E-05	Drilling Oversight
Light Pickup	21	720	34.28571429	19.36	2.04E-05	7.47E-06	6.64E+02	1.47E-02	5.38E-03	3.32E-01	7.33E-06	2.69E-06	Pilot Test
Light Pickup	21	3600	171.4285714	19.36	2.04E-05	7.47E-06	3.32E+03	7.33E-02	2.69E-02	1.66E+00	3.67E-05	1.34E-05	Full Scale Injections
Large SUV	25	1440	57.6	19.36	2.04E-05	7.47E-06	1.12E+03	2.93E-02	1.08E-02	5.58E-01	1.47E-05	5.38E-06	Pre-pilot test baseline monitoring
Large SUV	25	1440	57.6	19.36	2.04E-05	7.47E-06	1.12E+03	2.93E-02	1.08E-02	5.58E-01	1.47E-05	5.38E-06	Post-pilot study monitoring
Large SUV	25	1440	57.6	19.36	2.04E-05	7.47E-06	1.12E+03	2.93E-02	1.08E-02	5.58E-01	1.47E-05	5.38E-06	Post-injection monitoring
Large SUV	25	1800	72	19.36	2.04E-05	7.47E-06	1.39E+03	3.67E-02	1.34E-02	6.97E-01	1.83E-05	6.72E-06	Round 2 injections @ 10 years (50 percent
Large SUV	25	900	36	19.36	2.04E-05	7.47E-06	6.97E+02	1.83E-02	6.72E-03	3.48E-01	9.16E-06	3.36E-06	Round 3 injections @ 20 years (25 percent volume)
									Total Transportation GHG Emissions	1.05E+01	2.80E-04	1.03E-04	

Emissions from Materials Delivery (Diesel)

Delivery Vehicle	Material Delivered	MPG	Total Miles	Emissions Factors			Total Emissions (lbs.)			Total Emissions (mTons)		
				CO2 lbs./gallon	*CH4 lbs./mile*	*N2O lbs./mile*	*CO2*	*CH4*	*N2O*	*CO2*	*CH4*	*N2O*
Class 8 Truck	Vegetable Oil/ Whey (Emerling Foods - Depew NY)	5.7	18360	22.51	2.09E-05	9.50E-05	1.3E+02	3.8E-01	1.7E+00	6.4E-02	1.9E-04	8.7E-04
Class 8 Truck	Vegetable Oil/ Whey (Emerling Foods - Depew NY) - Round 2 (50% volume)	5.7	360	22.51	2.09E-05	9.50E-05	1.3E+02	7.5E-03	3.4E-02	6.4E-02	3.8E-06	1.7E-05
Class 8 Truck	Vegetable Oil/ Whey (Emerling Foods - Depew NY)- Round 3 (25% volume)	5.7	360	22.51	2.09E-05	9.50E-05	1.3E+02	7.5E-03	3.4E-02	6.4E-02	3.8E-06	1.7E-05
				22.51	2.09E-05	9.50E-05						
									EISB GHG Emissions Grand Total	1.08E+01	5.38E-03	4.02E-03

Alternative 5 - Targeted EISB + MNA
Ash Road Off-Site

MNA Emissions (Gasoline												
Year	No. of Visits	Total Distance Driven	Fuel Spent	Emissions Factors			Total Emissions (lbs.)			Total Emissions (mTons)		
		Miles	*Gallons*	*CO2 lbs./gallon*	*CH4 lbs./mile*	*N2O lbs./mile*	*CO2*	*CH4*	*N2O*	*CO2*	*CH4*	*N2O*
1	8	1440	57.6	19.36	2.04E-05	7.47E-06	1.12E+03	2.93E-02	1.08E-02	5.58E-01	1.47E-05	5.38E-06
2	8	1440	57.6	19.36	2.04E-05	7.47E-06	1.12E+03	2.93E-02	1.08E-02	5.58E-01	1.47E-05	5.38E-06
3	8	1440	57.6	19.36	2.04E-05	7.47E-06	1.12E+03	2.93E-02	1.08E-02	5.58E-01	1.47E-05	5.38E-06
4	8	1440	57.6	19.36	2.04E-05	7.47E-06	1.12E+03	2.93E-02	1.08E-02	5.58E-01	1.47E-05	5.38E-06
5	16	2880	115.2	19.36	2.04E-05	7.47E-06	2.23E+03	5.86E-02	2.15E-02	1.12E+00	2.93E-05	1.08E-05
6	8	1440	57.6	19.36	2.04E-05	7.47E-06	1.12E+03	2.93E-02	1.08E-02	5.58E-01	1.47E-05	5.38E-06
7	8	1440	57.6	19.36	2.04E-05	7.47E-06	1.12E+03	2.93E-02	1.08E-02	5.58E-01	1.47E-05	5.38E-06
8	8	1440	57.6	19.36	2.04E-05	7.47E-06	1.12E+03	2.93E-02	1.08E-02	5.58E-01	1.47E-05	5.38E-06
9	8	1440	57.6	19.36	2.04E-05	7.47E-06	1.12E+03	2.93E-02	1.08E-02	5.58E-01	1.47E-05	5.38E-06
10	16	2880	115.2	19.36	2.04E-05	7.47E-06	2.23E+03	5.86E-02	2.15E-02	1.12E+00	2.93E-05	1.08E-05
11	8	1440	57.6	19.36	2.04E-05	7.47E-06	1.12E+03	2.93E-02	1.08E-02	5.58E-01	1.47E-05	5.38E-06
12	8	1440	57.6	19.36	2.04E-05	7.47E-06	1.12E+03	2.93E-02	1.08E-02	5.58E-01	1.47E-05	5.38E-06
13	8	1440	57.6	19.36	2.04E-05	7.47E-06	1.12E+03	2.93E-02	1.08E-02	5.58E-01	1.47E-05	5.38E-06
14	8	1440	57.6	19.36	2.04E-05	7.47E-06	1.12E+03	2.93E-02	1.08E-02	5.58E-01	1.47E-05	5.38E-06
15	16	2880	115.2	19.36	2.04E-05	7.47E-06	2.23E+03	5.86E-02	2.15E-02	1.12E+00	2.93E-05	1.08E-05
16	8	1440	57.6	19.36	2.04E-05	7.47E-06	1.12E+03	2.93E-02	1.08E-02	5.58E-01	1.47E-05	5.38E-06
17	8	1440	57.6	19.36	2.04E-05	7.47E-06	1.12E+03	2.93E-02	1.08E-02	5.58E-01	1.47E-05	5.38E-06
18	8	1440	57.6	19.36	2.04E-05	7.47E-06	1.12E+03	2.93E-02	1.08E-02	5.58E-01	1.47E-05	5.38E-06
19	8	1440	57.6	19.36	2.04E-05	7.47E-06	1.12E+03	2.93E-02	1.08E-02	5.58E-01	1.47E-05	5.38E-06
20	16	2880	115.2	19.36	2.04E-05	7.47E-06	2.23E+03	5.86E-02	2.15E-02	1.12E+00	2.93E-05	1.08E-05
21				19.36	2.04E-05	7.47E-06						
22	8	1440	57.6	19.36	2.04E-05	7.47E-06	1.12E+03	2.93E-02	1.08E-02	5.58E-01	1.47E-05	5.38E-06
23				19.36	2.04E-05	7.47E-06						
24	8	1440	57.6	19.36	2.04E-05	7.47E-06	1.12E+03	2.93E-02	1.08E-02	5.58E-01	1.47E-05	5.38E-06
25	8	1440	57.6	19.36	2.04E-05	7.47E-06	1.12E+03	2.93E-02	1.08E-02	5.58E-01	1.47E-05	5.38E-06
26	8	1440	57.6	19.36	2.04E-05	7.47E-06	1.12E+03	2.93E-02	1.08E-02	5.58E-01	1.47E-05	5.38E-06
27				19.36	2.04E-05	7.47E-06						
28	8	1440	57.6	19.36	2.04E-05	7.47E-06	1.12E+03	2.93E-02	1.08E-02	5.58E-01	1.47E-05	5.38E-06
29				19.36	2.04E-05	7.47E-06						
30	16	2880	115.2	19.36	2.04E-05	7.47E-06	2.23E+03	5.86E-02	2.15E-02	1.12E+00	2.93E-05	1.08E-05
				19.36	2.04E-05	7.47E-06						

Emissions from T&D Transportation (Diesel)													
Material	No. of Trips	MPG	Total Miles	Total Gallons	Emissions Factors			Total Emissions (lbs.)			Total Emissions (mTons)		
					CO2 lbs./gallon	*CH4 lbs./mile*	*N2O lbs./mile*	*CO2*	*CH4*	*N2O*	*CO2*	*CH4*	*N2O*
Hazardous Waste T&D	30	5.7	12000	2105.263158	22.51	2.09E-05	9.50E-05	4.74E+04	2.51E-01	1.14E+00	2.37E+01	1.26E-04	5.70E-04
Non-Hazardous Waste T&D	30	5.7	6000	1052.631579	22.51	2.09E-05	9.50E-05	2.37E+04	1.26E-01	5.70E-01	1.18E+01	6.28E-05	2.85E-04
										Total T&D Transportation GHG Emissions	**3.55E+01**	**1.88E-04**	**8.55E-04**

Alternative 6 - Soil Vapor Extraction (SVE) with Air Sparge (AS) + MNA
Ash Road Off-Site

General Assumptions for Alternative GW-6								
	Work Hours/ Day	*MNA Period*		*Distance from Waste Handler*		*Distance from Haz-Waste Handler*		
	10	25		200		400		
MNA Visit Travel Distance (one-way miles)	**MNA Travel Distance Same for each Instance?**		**MNA Vehicle Type**	**Total Trips for Waste Handler Non-Haz**		**Total Trip for Waste Handler Haz**		
180	TRUE		Large SUV	23		23		
Estimated Monthly Electric (Cold)(kwh) (3 months)	**Estimated Monthly Electric (Warm) (kwh) (9 Months)**		**Power Profiler Region**	**SVE\AS System Online time (Years)**		**HSVE Wells**	**AS Wells**	
324,000	240,000		NPCC Upstate NY	5		4	9	
HSVE System Well installation rate (Well/ Day)	**AS System Well Installation Rate (Hours/Well)**		**Days to install HSVE wells**	**Total Hours for AS Wells**	**Total Days to install Wells**	**Buffer for Well Install**		
0.5	0.5		8	18	30	4		

Alternative 6 Calculations													
Emission Categories	**Impact Categories**				**Discount Rates**				**Total Social Cost**				
	O&M + Electricity	*Construction*	*Waste T&D*	*Total*	*2.5%*	*2.0%*	*1.5%*		*2.5%*	*2.0%*	*1.5%*		
m TON CO_2	2.20E+03	1.04E-01	2.73E+01	2.22E+03	$ 133	$ 215	$ 365		$ 295,679	$ 477,978	$ 811,451		
m TON CH4	1.19E-01	2.41E-03	1.45E-04	1.21E-01	$ 1,657	$ 2,101	$ 2,823		$ 3,683,763	$ 4,670,843	$ 6,275,959		
mTON N_2O	1.61E-02	1.50E-03	6.56E-04	1.83E-02	$ 40,920	$ 61,492	$ 96,796		$ 90,971,392	$ 136,706,080	$ 215,192,249		
								Totals	$ 94,950,834	$ 141,854,901	$ 222,279,658		

Construction Equipment Emissions Calculations

Emissions from Equipment (Diesel

Equipment Type	**Emissions Factors (lbs./Hour)**			**Total Runtime**	**Total Emissions (lbs.)**			**Total Emissions (mTons)**			
	CO2	*CH4*	*N2O*	*Hours*	*CO2*	*CH4*	*N2O*	*CO2*	*CH4*	*N2O*	**Comment**
Skid Steer	4.50E-02	4.01E-03	2.47E-03	300	1.35E+01	1.20E+00	7.41E-01	6.75E-03	6.02E-04	3.70E-04	For drilling activities
Drill Rig	1.35E-01	1.20E-02	7.41E-03	300	4.05E+01	3.61E+00	2.22E+00	2.03E-02	1.81E-03	1.11E-03	Drill Rig for well construction
							Total Equipment GHG Emissions	2.70E-02	2.41E-03	1.48E-03	

Emissions from Transportation to Site (Gasoline)

Vehicle Type	**MPG**	**Total Miles Driven**	**Total Gallons Used**	**Emissions Factors**			**Total Emissions (lbs.)**			**Total Emissions (mTons)**			
				CO2 lbs./gallon	*CH4 lbs./mile*	*N2O lbs./mile*	*CO2*	*CH4*	*N2O*	*CO2*	*CH4*	*N2O*	**Comment**
Mid Size Car	#SPILL!	#SPILL!		19.36	2.04E-05	7.47E-06							Drilling Oversight
Mid Size Car				19.36	2.04E-05	7.47E-06							AS/SVE System piping install
Large SUV				19.36	2.04E-05	7.47E-06							Baseline GW Sampling Event
Large SUV				19.36	2.04E-05	7.47E-06							AS/SVE Shed Install/Setup
									Total Transportation GHG Emissions	0.00E+00	0.00E+00	0.00E+00	

Emissions from Materials Delivery (Diesel)

Delivery Vehicle	**Material Delivered**	**MPG**	**Total Miles**	**Emissions Factors**			**Total Emissions (lbs.)**			**Total Emissions (mTons)**		
				CO2 lbs./gallon	*CH4 lbs./mile*	*N2O lbs./mile*	*CO2*	*CH4*	*N2O*	*CO2*	*CH4*	*N2O*
Delivery Truck	Well Risers (Arrives with Drillers - Assume 150 Miles)	6.8	300	22.51	2.09E-05	9.50E-05	1.53E+02	6.28E-03	2.85E-02	7.65E-02	3.14E-06	1.43E-05
									Total Delivery GHG Emissions	7.65E-02	3.14E-06	1.43E-05
									EISB GHG Emissions Grand Total	**1.04E-01**	**2.41E-03**	**1.50E-03**

Alternative 6 - Soil Vapor Extraction (SVE) with Air Sparge (AS) + MNA
Ash Road Off-Site

O&M Emissions (Gasoline)												
Year	No. of Visits	Total Distance Driven	Fuel Spent	Emissions Factors			Total Emissions (lbs.)			Total Emissions (mTons)		
		Miles	*Gallons*	*CO2 lbs./gallon*	*CH4 lbs./mile*	*N2O lbs./mile*	*CO2*	*CH4*	*N2O*	*CO2*	*CH4*	*N2O*
1	34	12240	489.6	19.36	2.04E-05	7.47E-06	9.48E+03	2.49E-01	9.14E-02	4.74E+00	1.25E-04	4.57E-05
2	34	12240	489.6	19.36	2.04E-05	7.47E-06	9.48E+03	2.49E-01	9.14E-02	4.74E+00	1.25E-04	4.57E-05
3	34	12240	489.6	19.36	2.04E-05	7.47E-06	9.48E+03	2.49E-01	9.14E-02	4.74E+00	1.25E-04	4.57E-05
4	34	12240	489.6	19.36	2.04E-05	7.47E-06	9.48E+03	2.49E-01	9.14E-02	4.74E+00	1.25E-04	4.57E-05
5	42	15120	604.8	19.36	2.04E-05	7.47E-06	1.17E+04	3.08E-01	1.13E-01	5.85E+00	1.54E-04	5.64E-05
6	8	2880	115.2	19.36	2.04E-05	7.47E-06	2.23E+03	5.86E-02	2.15E-02	1.12E+00	2.93E-05	1.08E-05
7	8	2880	115.2	19.36	2.04E-05	7.47E-06	2.23E+03	5.86E-02	2.15E-02	1.12E+00	2.93E-05	1.08E-05
8	8	2880	115.2	19.36	2.04E-05	7.47E-06	2.23E+03	5.86E-02	2.15E-02	1.12E+00	2.93E-05	1.08E-05
9	8	2880	115.2	19.36	2.04E-05	7.47E-06	2.23E+03	5.86E-02	2.15E-02	1.12E+00	2.93E-05	1.08E-05
10	16	5760	230.4	19.36	2.04E-05	7.47E-06	4.46E+03	1.17E-01	4.30E-02	2.23E+00	5.86E-05	2.15E-05
11	8	2880	115.2	19.36	2.04E-05	7.47E-06	2.23E+03	5.86E-02	2.15E-02	1.12E+00	2.93E-05	1.08E-05
12	8	2880	115.2	19.36	2.04E-05	7.47E-06	2.23E+03	5.86E-02	2.15E-02	1.12E+00	2.93E-05	1.08E-05
13	8	2880	115.2	19.36	2.04E-05	7.47E-06	2.23E+03	5.86E-02	2.15E-02	1.12E+00	2.93E-05	1.08E-05
14	8	2880	115.2	19.36	2.04E-05	7.47E-06	2.23E+03	5.86E-02	2.15E-02	1.12E+00	2.93E-05	1.08E-05
15	16	5760	230.4	19.36	2.04E-05	7.47E-06	4.46E+03	1.17E-01	4.30E-02	2.23E+00	5.86E-05	2.15E-05
16				19.36	2.04E-05	7.47E-06						
17	8	2880	115.2	19.36	2.04E-05	7.47E-06	2.23E+03	5.86E-02	2.15E-02	1.12E+00	2.93E-05	1.08E-05
18				19.36	2.04E-05	7.47E-06						
19	8	2880	115.2	19.36	2.04E-05	7.47E-06	2.23E+03	5.86E-02	2.15E-02	1.12E+00	2.93E-05	1.08E-05
20	8	2880	115.2	19.36	2.04E-05	7.47E-06	2.23E+03	5.86E-02	2.15E-02	1.12E+00	2.93E-05	1.08E-05
21	8	2880	115.2	19.36	2.04E-05	7.47E-06	2.23E+03	5.86E-02	2.15E-02	1.12E+00	2.93E-05	1.08E-05
22				19.36	2.04E-05	7.47E-06						
23	8	2880	115.2	19.36	2.04E-05	7.47E-06	2.23E+03	5.86E-02	2.15E-02	1.12E+00	2.93E-05	1.08E-05
24				19.36	2.04E-05	7.47E-06						
25	16	5760	230.4	19.36	2.04E-05	7.47E-06	4.46E+03	1.17E-01	4.30E-02	2.23E+00	5.86E-05	2.15E-05
									O&M TravelGHG Emissions	4.60E+01	1.21E-03	4.43E-04

Electricity Usage													
System Run Time	Estimated Usage (Bi Yearly)		Total Usage		Emissions Rates Lbs./MwH			Total Emissions lbs.			Total Emissions mTons		
Years	*Cold Season*	*Warm Season*	*kwh*	*MwH*	*CO2*	*CH4*	*N2O*	*CO2*	*CH4*	*N2O*	*CO2*	*CH4*	*N2O*
5	972000	2160000	15660000	15660	274.559	0.015	0.002	4.30E+06	2.35E+02	3.13E+01	2.15E+03	1.17E-01	1.57E-02
										O&M Travel + Electricity Emissions Grand total	**2.20E+03**	**1.19E-01**	**1.61E-02**

Emissions from T&D Transportation (Diesel)													
Material	No. of Trips	MPG	Total Miles	Total Gallons	Emissions Factors			Total Emissions (lbs.)			Total Emissions (mTons)		
					CO2 lbs./gallon	*CH4 lbs./mile*	*N2O lbs./mile*	*CO2*	*CH4*	*N2O*	*CO2*	*CH4*	*N2O*
Hazardous Waste T&D	23	5.7	9200	1614.035088	22.51	2.09E-05	9.50E-05	3.63E+04	1.93E-01	8.74E-01	1.82E+01	9.63E-05	4.37E-04
Non-Hazardous Waste T&D	23	5.7	4600	807.0175439	22.51	2.09E-05	9.50E-05	1.82E+04	9.63E-02	4.37E-01	9.084213158	4.81702E-05	0.000218541
										Total T&D Transportation GHG Emissions	2.73E+01	1.45E-04	6.56E-04

APPENDIX D CARBON FOOTPRINT ANALYSIS FOR REMEDIAL ALTERNATIVES

Input Summary

Remedy Component Number →			2	3	4	5	6
		Column headings in Row 6 must match the name of "Input" tabs in this workbook for Columns C - P in this table to be populated					
Item		No Action	Monitored Natural Attenuation	ISCO+MNA	EISB+MNA	Targeted EISB+MNA	SVE+AS+OM&M+MNA
On-Site							
On-site Renewable Energy							
Renewable electricity generated on-site	MWh		0	0	0	0	0
Landfill gas combusted on-site for energy use	ccf CH_4		0	0	0	0	0
On-site biodiesel use	gal		0	0	0	0	0
On-site biodiesel use - Other	gal		0	0	0	0	0
User-defined on-site renewable energy use #1	TBD		0	0	0	0	0
User-defined on-site renewable energy use #2	TBD		0	0	0	0	0
On-Site Conventional Energy							
Grid electricity	MWh		0	0	0	0	15660
On-site diesel use - Other	Gal		0	13342.5	14310	4522.5	5850
On-site diesel use <75 hp	Gal		0	0	0	0	0
On-site diesel use 75<hp<750	Gal		0	0	0	0	0
On-site diesel use >750 hp	Gal		0	0	0	0	0
On-site gasoline use - Other	Gal		0	0	0	0	0
On-site gasoline use <25 hp	Gal		0	0	0	0	0
On-site gasoline use >25 hp	Gal		0	0	0	0	0
On-site natural gas use	ccf		0	0	0	0	0
On-site compressed natural gas use - Other	ccf		0	0	0	0	0
On-site compressed natural gas use	ccf		0	0	0	0	0
On-site liquified petroleum gas use - Other	gal		0	0	0	0	0
On-site liquified petroleum gas use	gal		0	0	0	0	0
Other forms of on-site conventional energy use #1	TBD		0	0	0	0	0
Other forms of on-site conventional energy use #2	TBD		0	0	0	0	0
Other On-site Emissions							
On-site HAP process emissions	Lbs		0	0	0	0	0
On-site GHG emissions	Lbs CO2e		0	0	0	0	0
On-site carbon storage	Lbs CO2e		0	0	0	0	0
GHG avoided by flaring on-site landfill methane	ccf CH4		0	0	0	0	0
Other on-site NOx emissions or reductions	Lbs		0	0	0	0	0
Other on-site SOx emissions or reductions	Lbs		0	0	0	0	0
Other on-site PM emissions or reductions	Lbs		0	0	0	0	0
Electricity Generation							
Grid electricity	MWh		0	0	0	0	15660
Voluntary purchase of renewable electricity	MWh		0	0	0	0	0
Voluntary purchase of RECs	MWh		0	0	0	0	0
Transportation							
Transportation Fuel Use Breakdown							
Biodiesel use - Personnel Transport	gal		0	0	0	0	0
Biodiesel use - Personnel Transport - User Defined	gal		0	0	0	0	0
Biodiesel use - Equipment Transport	gal		0	0	0	0	0
Biodiesel use - Equipment Transport - User Defined	gal		0	0	0	0	0
Biodiesel use - Material Transport	gal		0	0	0	0	0
Biodiesel use - Material Transport - User Defined	gal		0	0	0	0	0
Biodiesel use - Waste Transport	gal		0	0	0	0	0
Biodiesel use - Waste Transport - User Defined	gal		0	0	0	0	0
Diesel use - Personnel Transport - other vehicles	gal		0	3821.1	14400	5684.2	44.1
Diesel use - Personnel Transport - car	gal		0	0	0	0	0
Diesel use - Personnel Transport - passenger truck	gal		0	17.1	0	0	0
Diesel use - Personnel Transport - User Defined	gal		0	0	0	0	0
Diesel use - Equipment Transport	gal		0	126.4	126.4	126.4	119.3
Diesel use - Equipment Transport - User Defined	gal		0	0	0	0	0
Diesel use - Material Transport	gal		0	0	0	0	0
Diesel use - Material Transport - User Defined	gal		0	0	0	0	0
Diesel use - Waste Transport	gal		3157.9	2105.3	2105.3	3157.9	2421
Diesel use - Waste Transport - User Defined	gal		0	0	0	0	0
Gasoline use - Personnel Transport - other vehicles	gal		0	0	-4.54747E-13	-4.54747E-13	0
Gasoline use - Personnel Transport - car	gal		1920	2635.2	2880	2858.4	2730.7
Gasoline use - Personnel Transport - passenger truck	gal		0	0	34.3	34.3	0
Gasoline use - Personnel Transport - User Defined	gal		0	0	0	0	0
Gasoline use - Equipment Transport	gal		0	0	0	0	0
Gasoline use - Equipment Transport - User Defined	gal		0	0	0	0	0
Natural Gas use - Personnel Transport	ccf		0	0	0	0	0
Natural Gas use - Personnel Transport - User Defined	ccf		0	0	0	0	0
Natural Gas use - Equipment Transport	ccf		0	0	0	0	0

Input Summary

Remedy Component Number →			2	3	4	5	6
		Column headings in Row 6 must match the name of "Input" tabs in this workbook for Columns C - P in this table to be populated					
Item		No Action	Monitored Natural Attenuation	ISCO+MNA	EISB+MNA	Targeted EISB+MNA	SVE+AS+OM&M+MNA
Conventional Energy							
Transportation diesel use	gal		3157.9	6069.9	16631.7	8968.5	2584.4
Transportation gasoline use	gal		1920	2635.2	2914.3	2892.7	2730.7
Transportation natural gas use	ccf		0	0	0	0	0
User-defined conventional energy transportation #1	TBD		10	10	10	10	10
User-defined conventional energy transportation #2	TBD		0	0	0	0	0
Renewable Energy							
Transportation biodiesel use	gal		0	0	0	0	0
User-defined renewable energy transportation #1	TBD		0	0	0	0	0
User-defined renewable energy transportation #2	TBD		0	0	0	0	0
Off-Site							
Construction Materials							
Aluminum, Rolled Sheet	lb		0	0	0	0	0
Asphalt, mastic	lb		0	0	0	0	0
Asphalt, paving-grade	lb		0	0	0	0	0
Ethanol, Corn, 95%	lb		0	0	0	0	0
Ethanol, Corn, 99.7%	lb		0	0	0	0	0
Ethanol, Petroleum, 99.7%	lb		0	0	0	0	0
Gravel/Sand Mix, 65% Gravel	lb		0	0	0	0	0
Gravel/sand/clay	lb		0	0	0	0	0
HDPE	lb		0	0	0	0	0
Photovoltaic system (installed)	W		0	0	0	0	0
PVC	lb		0	0	0	0	0
Portland cement, US average	lb		0	0	0	0	0
Ready-mixed concrete, 20 MPa	ft3		0	0	0	0	0
Round Gravel	lb		0	0	0	0	0
Sand	lb		0	0	0	0	0
Stainless Steel	lb		0	0	0	0	0
Steel	lb		0	0	0	0	0
Other refined construction materials	lb		0	0	0	0	0
Other unrefined construction materials	lb		0	0	0	0	0
Treatment Materials & Chemicals							
Cheese Whey	lbs		0	0	0	0	0
Emulsified vegetable oil	lbs		0	0	0	0	0
Granular activated carbon, primary	lbs		0	0	0	0	0
Granular activated carbon, regenerated	lbs		0	0	0	0	0
Hydrogen Peroxide, 50% in H2O	lbs		0	0	0	0	0
Iron (II) Sulfate	lbs		0	0	0	0	0
Lime, Hydrated, Packed	lbs		0	0	0	0	0
Molasses	lbs		0	0	0	0	0
Phosphoric Acid, 70% in H2O	lbs		0	0	0	0	0
Potassium Permanganate	lbs		0	0	0	0	0
Sodium Hydroxide, 50% in H2O	lbs		0	0	0	0	0
Other Treatment Chemicals & Materials	lbs		0	0	0	0	0
Material Type							
Total Virgin Refined Materials	tons		0	0	0	0	0
Total Recycled Refined Materials	tons		0	0	0	0	0
Total Reused Refined Materials	tons		0	0	0	0	0
Total Refined Material	tons		0	0	0	0	0
Total Virgin Unrefined Materials	tons		0	0	0	0	0
Total Recycled Unrefined Materials	tons		0	0	0	0	0
Total Reused Unrefined Materials	tons		0	0	0	0	0
Total Unrefined Material	tons		0	0	0	0	0
Fuel Processing							
Biodiesel produced	gal		0	0	0	0	0
Diesel produced	gal		3157.9	19412.4	30941.7	13491	8434.4
Gasoline produced	gal		1920	2635.2	2914.3	2892.7	2730.7
Compressed natural gas produced	ccf		0	0	0	0	0
Liquified petroleum gas produced	gal		0	0	0	0	0
Natural gas produced	ccf		0	0	0	0	0
Water Use							
Public Water Supply	gal x 1000		0	0	0	0	0
Extracted Groundwater	gal x 1000		0	0	0	0	0
Surface Water	gal x 1000		0	0	0	0	0
Reclaimed Water	gal x 1000		0	0	0	0	0
Collected/Diverted Storm Water	gal x 1000		0	0	0	0	0
User-defined water resource #1	gal x 1000		0	0	0	0	0
User-defined water resource #2	gal x 1000		0	0	0	0	0

Input Summary

Remedy Component Number →			2	3	4	5	6
		Column headings in Row 6 must match the name of "Input" tabs in this workbook for Columns C - P in this table to be populated					
Item		No Action	Monitored Natural Attenuation	ISCO+MNA	EISB+MNA	Targeted EISB+MNA	SVE+AS+OM&M+MNA
Waste/Recycle Handling							
Hazardous waste incineration	lbs		0	0	0	0	0
Off-site waste water treatment (POTW)	gal x 1000		0	0	0	0	0
Off-site non-hazardous waste landfill	tons		0	0	0	0	0
Off-site hazardous waste landfill	tons		0	0	0	0	0
Recycled/Reused On-Site	tons		0	0	0	0	0
Recycled/Reused Off-Site	tons		0	0	0	0	0
Solid Waste Totals							
Total Non-Hazardous Waste	tons		0	0	0	0	0
Total Hazardous Waste	tons		0	0	0	0	0
Total Recycled/Reused	tons		0	0	0	0	0
Total Waste (all types)	tons		0	0	0	0	0
Lab Services							
Off-site Laboratory Analysis - Other	sample		0	0	0	0	0
Off-site Laboratory Analysis - Metals	sample		0	0	0	0	0
Off-site Laboratory Analysis - Mercury	sample		0	0	0	0	0
Off-site Laboratory Analysis - Inorganic Anions	sample		0	0	0	0	0
Off-site Laboratory Analysis - Alkalinity	sample		0	0	0	0	0
Off-site Laboratory Analysis - Perchlorate	sample		0	0	0	0	0
Off-site Laboratory Analysis - Nitrogen/Nitrate	sample		0	0	0	0	0
Off-site Laboratory Analysis - Sulfate	sample		0	0	0	0	0
Off-site Laboratory Analysis - PCBs	sample		0	0	0	0	0
Off-site Laboratory Analysis - VOCs	sample		0	0	0	0	0
Off-site Laboratory Analysis - SVOCs	sample		0	0	0	0	0
Resource Extraction for Electricity							
Coal extraction and processing	MWh		0	0	0	0	939.6
Natural gas extraction and processing	MWh		0	0	0	0	1566
Nuclear fuel extraction and processing	MWh		0	0	0	0	313.2
Oil extraction and processing	MWh		0	0	0	0	783
Other fuel extraction and processing	MWh		0	0	0	0	0
Electricity Transmission							
Transmission and distribution losses	MWh		0	0	0	0	15660

No Action - On-Site Footprint (Scope 1)

Contributors to Footprints	Units	Usage	Energy		GHG		NOx		SOx		PM		HAPs	
			Conv. Factor	MMBtus	Conv. Factor	lbs CO2e	Conv. Factor	lbs	Conv. Factor	lbs	Conv. Factor	lbs	Conv. Factor	lbs
On-Site														
On-site Renewable Energy														
Renewable electricity generated on-site	MWh	0	3.413	0										
Landfill gas combusted on-site for energy use	ccf CH4	0	0.103	0	13.1	0	0.01	0	0.0000063	0	0.00076	0	0.0000084	0
On-site biodiesel use	gal	0	0.127	0	22.3	0	0.2	0	0	0	0.00099	0	NP	
On-site biodiesel use - User Defined	gal	0	0.127	0	22.3	0	0.2	0	0	0	0.00099	0	NP	
User-defined on-site renewable energy use #1	gal	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined on-site renewable energy use #2	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
On-site Renewable Energy Subtotals				**0**		**0**		**0**		**0**		**0**		**0**
Notes:														
On-site Conventional Energy														
On-site grid electricity	MWh	0	3.413	0										
On-site diesel use - Other	Gal	0	0.139	0	22.5	0	0.17	0	0.0054	0	0.0034	0	0.0000052	0
On-site diesel use <75 hp	Gal	0	0.139	0	22.21	0	0.1565	0	0.000145	0	0.0145	0	0.00004	0
On-site diesel use 75<hp<750	Gal	0	0.139	0	22.24	0	0.101	0	0.00013	0	0.009	0	0.00004	0
On-site diesel use >750 hp	Gal	0	0.139	0	22.24	0	0.149	0	0.00013	0	0.006	0	0.00004	0
On-site gasoline use - Other	Gal	0	0.124	0	19.6	0	0.11	0	0.0045	0	0.00054	0	0.000039	0
On-site gasoline use <25 hp	Gal	0	0.124	0	17.48	0	0.037	0	0.00025	0	0.165	0	0.00008	0
On-site gasoline use >25 hp	Gal	0	0.124	0	19.93	0	0.032	0	0.00029	0	0.002	0	0.00009	0
On-site natural gas use	ccf	0	0.103	0	13.1	0	0.01	0	0.0000063	0	0.00076	0	0.0000084	0
On-site compressed natural gas use - Other	ccf	0	NP		1957.835	0	16.0325	0	0.023045	0	0.2775	0	0	0
On-site compressed natural gas use	ccf	0	NP		1957.835	0	16.0325	0	0.023045	0	0.2775	0	0	0
On-site liquified petroleum gas use - Other	gal	0	NP		12.69	0	0.021	0	0.00013	0	0.001	0	0	0
On-site liquified petroleum gas use	gal	0	NP		12.69	0	0.021	0	0.00013	0	0.001	0	0	0
Other forms of on-site conventional energy use #1	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
Other forms of on-site conventional energy use #2	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
On-site Conventional Energy Subtotals				**0**		**0**		**0**		**0**		**0**		**0**
Notes:														
Other On-site Emissions														
On-site HAP process emissions	lbs	0											1	0
On-site GHG emissions	lbs CO2e	0			1	0								
On-site carbon storage	lbs CO2e	0			1	0								
GHG avoided by flaring on-site landfill methane	Lbs	0			-262	0	0.01	0	0.0000063	0	0.00076	0	0.0000084	0
Other on-site NOx emissions or reductions	lbs	0					1	0						
Other on-site SOx emissions or reductions	lbs	0							1	0				
Other on-site PM emissions or reductions	lbs	0									1	0		
User-defined recycled/reused on-site #2	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined recycled/reused on-site #3	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined recycled/reused off-site #1	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
Notes:														
On-site Totals				**0.00**		**0**		**0**		**0**		**0**		**0**

No Action - Electricity Generation Footprint (Scope 2)

Contributors to Footprints	Units	Usage	Energy		GHG		NOx		SOx		PM		HAPs	
			Conv. Factor	MMBtus	Conv. Factor	lbs CO2e	Conv. Factor	lbs	Conv. Factor	lbs	Conv. Factor	lbs	Conv. Factor	lbs
Electricity Generation														
Grid electricity	MWh	0	6.929	0	1124.3	0	2.2421	0	4.6078874	0	0.057518	0	0.2102371	0
Voluntary purchase of renewable electricity	MWh	0												
Voluntary purchase of RECs	MWh	0												
Notes:														

No Action - Transportation Footprint (Scope 3a)

Category	Units	Usage	Energy		Greenhouse Gas		NOx		SOx		PM		HAPs	
			Conv. Factor	MMBtus	Conv. Factor	lbs CO2e	Conv. Factor	lbs	Conv. Factor	lbs	Conv. Factor	lbs	Conv. Factor	lbs
Conventional Energy														
Transportation diesel use	gal	0	0.139	0	22.5	0	0.17	0	0.0054	0	0.0034	0	0.0000052	0
Transportation diesel use - car	gal	0	0.139	0	22.57	0	0.015	0	0.0002	0	0.003	0	0.00252	0
Transportation diesel use - passenger truck	gal	0	0.139	0	22.545	0	0.0585	0	0.0002	0	0.007	0	0.002605	0
Transportation diesel use - User Defined	gal	0	0.139	0	22.5	0	0.17	0	0.0054	0	0.0034	0	0.0000052	0
Transportation gasoline use	gal	0	0.124	0	19.6	0	0.11	0	0.0045	0	0.00054	0	0.000039	0
Transportation gasoline use - car	gal	0	0.124	0	19.77	0	0.027	0	0.00036	0	0.003	0	0.0067	0
Transportation gasoline use - passenger truck	gal	0	0.124	0	19.79	0	0.035	0	0.00036	0	0.003	0	0.00661	0
Transportation gasoline use - User Defined	gal	0	0.124	0	19.6	0	0.11	0	0.0045	0	0.00054	0	0.000039	0
Transportation natural gas use	ccf	0	0.103	0	13.1	0	0.01	0	0.0000063	0	0.00076	0	0.0000084	0
Transportation natural gas use - User Defined	ccf	0	0.103	0	13.1	0	0.01	0	0.0000063	0	0.00076	0	0.0000084	0
User-defined conventional energy transportation #1	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined conventional energy transportation #2	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
Conventional Energy Subtotals				**0**		**0**		**0**		**0**		**0**		**0**
Notes:														
Renewable Energy														
Transportation biodiesel use	gal	0	0.127	0	22.3	0	0.2	0	0	0	0.00099	0	NP	
Transportation biodiesel use - User Defined	gal	0	0.127	0	22.3	0	0.2	0	0	0	0.00099	0	NP	
User-defined renewable energy transportation #1	TBD	0	Biodiesel		0	0	0	0	0	0	0	0	Ref.	
User-defined renewable energy transportation #2	TBD	0	npg or pmp		0	0	0	0	0	0	0	0	0	0
Renewable Energy Subtotals				**0**		**0**		**0**		**0**		**0**		**0**
Notes:														
Transportation Totals				**0**		**0**		**0**		**0**		**0**		**0**

No Action - Off-Site Footprint (Scope 3b)

Category	Units	Usage	Energy		Greenhouse Gas		NOx		SOx		PM		HAPs	
			Conv. Factor	MMBtus	Conv. Factor	lbs CO2e	Conv. Factor	lbs	Conv. Factor	lbs	Conv. Factor	lbs	Conv. Factor	lbs
Construction Materials														
Aluminum, Rolled Sheet	lb	0	0.0633	0	9.15	0	0.0148	0	0.0283	0	0.0088	0	0.00102	0
Asphalt, mastic	lb	0	0.0412	0	0.85	0	0.00271	0	0.00798	0	0.000766	0	0.00107	0
Asphalt, paving-grade	lb	0	0.5	0	8.58	0	0.0299	0	0.0969	0	0.0091	0	0.0133	0
Ethanol, Corn, 95%	lb	0	0.0318	0	-0.0199	0	0.00425	0	0.00303	0	0.000469	0	0.0000846	0
Ethanol, Corn, 99.7%	lb	0	0.0324	0	0.0591	0	0.00431	0	0.0031	0	0.000472	0	0.000087	0
Ethanol, Petroleum, 99.7%	lb	0	0.0205	0	1.25	0	0.00199	0	0.00214	0	0.000277	0	0.0000589	0
Gravel/Sand Mix, 65% Gravel	lb	0	0.0000248	0	0.0024	0	0.000018	0	4.52E-06	0	2.61E-06	0	3.08E-07	0
Gravel/sand/clay	lb	0	0.000028	0	0.00335	0	0.0000165	0	0.000015	0	0.000002	0	2.05E-10	0
HDPE	lb	0	0.0332	0	1.94	0	0.00325	0	0.00409	0	0.000439	0	0.0000641	0
Photovoltaic system (installed)	W	0	0.0336	0	4.47	0	0.015	0	0.032	0	0.00063	0	0.0000029	0
PVC	lb	0	0.0262	0	2.02	0	0.004	0	0.00274	0	0.000372	0	0.000375	0
Portland cement, US average	lb	0	0.0139	0	1.34	0	0.00654	0	0.0104	0	0.00378	0	0.00097	0
Ready-mixed concrete, 20 MPa	ft3	0	0.217	0	19.5	0	0.0975	0	0.154	0	0.057	0	0.0141	0
Round Gravel	lb	0	0.0000248	0	0.0024	0	0.000018	0	4.52E-06	0	2.61E-06	0	3.08E-07	0
Sand	lb	0	0.0000248	0	0.0024	0	0.000018	0	4.52E-06	0	2.61E-06	0	3.08E-07	0
Stainless Steel	lb	0	0.0116	0	3.4	0	0.0075	0	0.012	0	0.0044	0	0.000144	0
Steel	lb	0	0.0044	0	1.1	0	0.0014	0	0.0017	0	0.00056	0	0.000067	0
Other refined construction materials	lb	0	0.01885	0	2.115	0	0.0040375	0	0.0051325	0	0.0014428	0	0.0001625	0
Other unrefined construction materials	lb	0	0.000028	0	0.00335	0	0.0000165	0	0.000015	0	0.000002	0	2.05E-10	0
Notes:														

No Action - Off-Site Footprint (Scope 3b)

Category	Units	Usage	Energy		Greenhouse Gas		NOx		SOx		PM		HAPs	
			Conv. Factor	MMBtus	Conv. Factor	lbs CO2e	Conv. Factor	lbs	Conv. Factor	lbs	Conv. Factor	lbs	Conv. Factor	lbs
Treatment Materials & Chemicals														
Cheese Whey	lbs	0	0.0025	0	0.031	0	0.000062	0	0.000033	0	0.000002	0	NP	
Emulsified vegetable oil	lbs	0	0.0077	0	3.44	0	0.0066	0	0.0019	0	0.000033	0	NP	
Granular activated carbon, primary	lbs	0	0.0356	0	4.82	0	0.0793	0	0.128	0	0.000987	0	0.000657	0
Granular activated carbon, regenerated	lbs	0	0.00873	0	1.7	0	0.00733	0	0.0129	0	0.000886	0	0.000671	0
Hydrogen Peroxide, 50% in H2O	lbs	0	0.00979	0	1.19	0	0.00142	0	0.0024	0	0.000308	0	0.0000629	0
Iron (II) Sulfate	lbs	0	0.00147	0	0.167	0	0.000316	0	0.000589	0	0.000103	0	0.000023	0
Lime, Hydrated, Packed	lbs	0	0.00206	0	0.762	0	0.000513	0	0.000358	0	0.00013	0	6.57E-06	0
Molasses	lbs	0	0.0044	0	0.48	0	0.0011	0	0.00024	0	0.0000041	0	NP	
Phosphoric Acid, 70% in H2O	lbs	0	0.0067	0	0.882	0	0.00282	0	0.0294	0	0.00171	0	0.000163	0
Potassium Permanganate	lbs	0	0.00981	0	1.16	0	0.00234	0	0.0032	0	0.000422	0	0.000122	0
Sodium Hydroxide, 50% in H2O	lbs	0	0.00977	0	1.09	0	0.00194	0	0.00352	0	0.000403	0	0.000129	0
Other Treatment Chemicals & Materials	lbs	0	0.015	0	1.67	0	0.003	0	0.0065	0	0.00061	0	0.000016	0
Notes:														
Fuel Processing														
Biodiesel produced	gal	0	0.029	0	-16.8	0	0.018	0	0.033	0	0.00082	0	NP	
Diesel produced	gal	0	0.017	0	3.02	0	0.0051	0	0.0062	0	0.0017	0	0.0011	0
Gasoline produced	gal	0	0.033	0	2.8	0	0.0046	0	0.005	0	0.0015	0	0.001	0
Liquefied Petroleum Gas Produced	gal	0	0.088	0	1.47	0	0.0016	0	0.0024	0	0.0007	0	0.0003	0
Natural Gas - Compressed Produced	ccf	0	19.983	0	343.92	0	0.4732	0	2.1651	0	0.1846	0	0.2895	0
Natural Gas Produced	ccf	0	0.0052	0	2.2	0	0.0037	0	0.0046	0	0.000072	0	0.0000061	0
Fuel Processing Subtotals				**0**		**0**		**0**		**0**		**0**		**0**
Notes:														
Public water	gal x 1000	0	0.0092	0	5	0	0.0097	0	0.0059	0	0.016	0	0.000015	0
User-defined water resource #1	gal x 1000	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined water resource #2	gal x 1000	0	0	0	0	0	0	0	0	0	0	0	0	0
Notes:														

No Action - Off-Site Footprint (Scope 3b)

Category	Units	Usage	Energy		Greenhouse Gas		NOx		SOx		PM		HAPs	
			Conv. Factor	MMBtus	Conv. Factor	lbs CO2e	Conv. Factor	lbs	Conv. Factor	lbs	Conv. Factor	lbs	Conv. Factor	lbs
Off-Site Services														
Hazardous waste incineration	lb	0	0.00609	0	2.43	0	0.0016	0	0.00167	0	0.000209	0	0.000087	0
Off-site waste water treatment (POTW)	gal x 1000	0	0.015	0	4.4	0	0.016	0	0.015	0	NP		NP	
Off-site non-hazardous waste landfill	ton	0	0.16	0	25	0	0.14	0	0.075	0	0.4	0	0.0014	0
Off-site hazardous waste landfill	ton	0	0.18	0	27.5	0	0.154	0	0.0825	0	0.44	0	0.00154	0
Off-site Laboratory Analysis - Other	sample	0	0.058071	0	6.8534384	0	0.131402	0	0.3038758	0	0.0455698	0	0.0330165	0
Off-site Laboratory Analysis - Metals	sample	0	0.212	0	27.4693	0	0.6423	0	1.5072	0	0.2264	0	0.1643	0
Off-site Laboratory Analysis - Mercury	sample	0	0.0731715	0	9.325458	0	0.2127439	0	0.4982396	0	0.0747359	0	0.0542332	0
Off-site Laboratory Analysis - Inorganic Anions	sample	0	0.0074025	0	0.6459478	0	0.0067681	0	0.0147929	0	0.0022024	0	0.0015542	0
Off-site Laboratory Analysis - Alkalinity	sample	0	0.0174398	0	1.3381922	0	0.0070106	0	0.0132496	0	0.00194	0	0.0012831	0
Off-site Laboratory Analysis - Perchlorate	sample	0	0.023885	0	1.8717054	0	0.0079807	0	0.0141535	0	0.0020547	0	0.0012875	0
Off-site Laboratory Analysis - Nitrogen/Nitrate	sample	0	0.0336475	0	4.29897	0	0.0954592	0	0.2226646	0	0.0335099	0	0.0242506	0
Off-site Laboratory Analysis - Sulfate	sample	0	0.0141225	0	1.4726728	0	0.0079807	0	0.0136024	0	0.0019797	0	0.0012015	0
Off-site Laboratory Analysis - PCBs	sample	0	0.0512769	0	5.224902	0	0.0833339	0	0.1904774	0	0.0284393	0	0.0212083	0
Off-site Laboratory Analysis - VOCs	sample	0	0.0762045	0	9.016814	0	0.104498	0	0.2270738	0	0.0339508	0	0.0235892	0
Off-site Laboratory Analysis - SVOCs	sample	0	0.0715602	0	7.870422	0	0.1459445	0	0.3373038	0	0.0504853	0	0.0372577	0
Notes:														
Resource Extraction for Electricity														
Coal extraction and processing	MWh	0	3.1	0	180.0	0	0.8	0	0.2	0	0.0	0	NP	
Natural gas extraction and processing	MWh	0	1.6	0	270.0	0	0.2	0	13.0	0	0.0	0	NP	
Nuclear fuel extraction and processing	MWh	0	0.2	0	25.0	0	0.2	0	0.5	0	0.0	0	NP	
Oil extraction and processing	MWh	0	2.3	0	270.0	0	1.7	0	0.1	0	0.0	0	NP	
Other fuel extraction and processing	MWh	0	0	0	0	0	0	0	0	0	0	0	0	0
Resource Extraction Subtotals				**0**		**0**		**0**		**0**		**0**		**0**
Notes:														
Electricity Transmission														
Transmission and distribution losses	MWh	0	1.0342	0	112.43	0	0.22421	0	0.4607887	0	0.0057518	0	0.0210237	0
Notes:														

No Action - Off-Site Footprint (Scope 3b)

Category	Units	Usage	Energy		Greenhouse Gas		NOx		SOx		PM		HAPs	
			Conv. Factor	MMBtus	Conv. Factor	lbs CO2e	Conv. Factor	lbs	Conv. Factor	lbs	Conv. Factor	lbs	Conv. Factor	lbs
User-defined Materials														
User-defined material #1	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #2	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #3	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #4	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #5	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #6	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #7	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #8	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #9	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #10	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #11	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #12	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #13	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #14	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #15	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #16	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #17	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #18	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #19	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #20	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
Notes:														
User-defined Waste Destinations														
User-defined recycled/reused off-site #1	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined recycled/reused off-site #2	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined recycled/reused off-site #3	TBD	0	gy(MMBtu/u		(lbs CO2e/u		Ox(lbs/unit)		Ox(lbs/unit)		M(lbs/unit)		APs(lbs/unit	
User-defined non-hazardous waste destination #1	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined non-hazardous waste destination #2	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined non-hazardous waste destination #3	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined hazardous waste destination #1	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined hazardous waste destination #2	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined hazardous waste destination #3	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
Notes:														
Off-site Totals				**0**		**0**		**0**		**0**		**0**		**0**

No Action - Intermediate Totals

Category	Units	Usage	Energy		Greenhouse Gas		NOx		SOx		PM		HAPs	
			Conv. Factor	MMBtus	Conv. Factor	lbs CO2e	Conv. Factor	lbs	Conv. Factor	lbs	Conv. Factor	lbs	Conv. Factor	lbs
Total Grid Electricity Footprint														
On-site grid electricity	MWh	0	3.413	0										
Electricity Generation														
Grid electricity	MWh	0	6.929	0	1124.3	0	2.2421	0	4.6078874	0	0.057518	0	0.2102371	0
Resource Extraction for Electricity														
Coal extraction and processing	MWh	0	3.1	0	180.0	0	0.8	0	0.2	0	0.0	0	NP	
Natural gas extraction and processing	MWh	0	1.6	0	270.0	0	0.2	0	13.0	0	0.0	0	NP	
Nuclear fuel extraction and processing	MWh	0	0.2	0	25.0	0	0.2	0	0.5	0	0.0	0	NP	
Oil extraction and processing	MWh	0	2.3	0	270.0	0	1.7	0	0.1	0	0.0	0	NP	
Other fuel extraction and processing	MWh	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
Electricity Transmission														
Transmission and distribution losses	MWh	0	1.0342	0	112.43	0	0.22421	0	0.4607887	0	0.0057518	0	0.0210237	0
Total Grid Electricity Footprint				**0**		**0**		**0**		**0**		**0**		**0**
Total Fuel Footprints														
Total Gasoline Footprint														
On-site gasoline use - Other	gal	0	0.124	0	19.6	0	0.11	0	0.0045	0	0.00054	0	0.000039	0
On-site gasoline use <25 hp	gal	0	0.124	0	17.48	0	0.037	0	0.00025	0	0.165	0	0.00008	0
On-site gasoline use >25 hp	gal	0	0.124	0	19.93	0	0.032	0	0.00029	0	0.002	0	0.00009	0
Transportation gasoline use	gal	0	0.124	0	19.6	0	0.11	0	0.0045	0	0.00054	0	0.000039	0
Transportation gasoline use - car	gal	0	0.124	0	19.77	0	0.027	0	0.00036	0	0.003	0	0.0067	0
Transportation gasoline use - passenger truck	gal	0	0.124	0	19.79	0	0.035	0	0.00036	0	0.003	0	0.00661	0
Transportation gasoline use - User Defined	gal	0	0.124	0	19.6	0	0.11	0	0.0045	0	0.00054	0	0.000039	0
Gasoline produced	gal	0	0.033	0	2.8	0	0.0046	0	0.005	0	0.0015	0	0.001	0
Total Gasoline Footprint		**0**		**0**		**0**		**0**		**0**		**0**		**0**

Total Diesel Footprint														
On-site diesel use - Other	gal	0	0.139	0	22.5	0	0.17	0	0.0054	0	0.0034	0	0.0000052	0
On-site diesel use <75 hp	gal	0	0.139	0	22.21	0	0.1565	0	0.000145	0	0.0145	0	0.00004	0
On-site diesel use 75<hp<750	gal	0	0.139	0	22.24	0	0.101	0	0.00013	0	0.009	0	0.00004	0
On-site diesel use >750 hp	gal	0	0.139	0	22.24	0	0.149	0	0.00013	0	0.006	0	0.00004	0
Transportation diesel use	gal	0	0.139	0	22.5	0	0.17	0	0.0054	0	0.0034	0	0.0000052	0
Transportation diesel use - car	gal	0	0.139	0	22.57	0	0.015	0	0.0002	0	0.003	0	0.00252	0
Transportation diesel use - passenger truck	gal	0	0.139	0	22.545	0	0.0585	0	0.0002	0	0.007	0	0.002605	0
Transportation diesel use - User Defined	gal	0	0.139	0	22.5	0	0.17	0	0.0054	0	0.0034	0	0.0000052	0
Diesel produced	gal	0	0.017	0	3.02	0	0.0051	0	0.0062	0	0.0017	0	0.0011	0
Total Diesel Footprint		**0**		**0**		**0**		**0**		**0**		**0**		**0**
Total Biodiesel Footprint														
On-site biodiesel use	gal	0	0.127	0	22.3	0	0.2	0	0	0	0.00099	0	NP	
On-site biodiesel use - User Defined	gal	0	0.127	0	22.3	0	0.2	0	0	0	0.00099	0	NP	
Transportation biodiesel use	gal	0	0.127	0	22.3	0	0.2	0	0	0	0.00099	0	NP	
Transportation biodiesel use - User Defined	gal	0	0.127	0	22.3	0	0.2	0	0	0	0.00099	0	NP	
Biodiesel produced	gal	0	0.029	0	-16.8	0	0.018	0	0.033	0	0.00082	0	NP	
Total Biodiesel Footprint		**0**		**0**		**0**		**0**		**0**		**0**		**0**
Total Natural Gas Footprint														
On-site natural gas use	ccf	0	0.103	0	13.1	0	0.01	0	0.0000063	0	0.00076	0	0.0000084	0
Transportation natural gas use	ccf	0	0.103	0	13.1	0	0.01	0	0.0000063	0	0.00076	0	0.0000084	0
Transportation natural gas use - User Defined	ccf	0	0.103	0	13.1	0	0.01	0	0.0000063	0	0.00076	0	0.0000084	0
Natural gas produced	ccf	0	0.0052	0	2.2	0	0.0037	0	0.0046	0	0.000072	0	0.0000061	0
Total Natural Gas Footprint		**0**		**0**		**0**		**0**		**0**		**0**		**0**
Total Liquified Petroleum Gas Footprint														
On-site liquified petroleum gas use - Other	ccf	0	NP		12.69	0	0.021	0	0.00013	0	0.001	0	0	0
On-site liquified petroleum gas use	ccf	0	NP		12.69	0	0.021	0	0.00013	0	0.001	0	0	0
Liquified petroleum gas produced	ccf	0	0.088	0	1.47	0	0.0016	0	0.0024	0	0.0007	0	0.0003	0
Total Natural Gas Footprint		**0**		**0**		**0**		**0**		**0**		**0**		**0**
Total Compressed Gas Footprint														
On-site compressed gas use - Other	ccf	0	NP		1957.835	0	16.0325	0	0.023045	0	0.2775	0	0	0
On-site compressed gas use	ccf	0	NP		1957.835	0	16.0325	0	0.023045	0	0.2775	0	0	0
Compressed gas produced	ccf	0	19.983	0	343.92	0	0.4732	0	2.1651	0	0.1846	0	0.2895	0
Total Natural Gas Footprint		**0**		**0**		**0**		**0**		**0**		**0**		**0**

Notes:

Note: Please refer to the "Default Conversions" tab for references for the default conversion factors used on this calculation sheet.

Space below available for notes and calculations:

Monitored Natural Attenuation (MNA) - On-Site Footprint (Scope 1)

			Energy		GHG		NOx		SOx		PM		HAPs	
Contributors to Footprints	**Units**	**Usage**	**Conv. Factor**	**MMBtus**	**Conv. Factor**	**lbs CO2e**	**Conv. Factor**	**lbs**	**Conv. Factor**	**lbs**	**Conv. Factor**	**lbs**	**Conv. Factor**	**lbs**
On-Site														
On-site Renewable Energy														
Renewable electricity generated on-site	MWh	0	3.413	0										
Landfill gas combusted on-site for energy use	ccf CH4	0	0.103	0	13.1	0	0.01	0	0.0000063	0	0.00076	0	0.0000084	0
On-site biodiesel use	gal	0	0.127	0	22.3	0	0.2	0	0	0	0.00099	0	NP	
On-site biodiesel use - User Defined	gal	0	0.127	0	22.3	0	0.2	0	0	0	0.00099	0	NP	
User-defined on-site renewable energy use #1	gal	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined on-site renewable energy use #2	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
On-site Renewable Energy Subtotals				**0**		**0**		**0**		**0**		**0**		**0**
Notes:														
On-site Conventional Energy														
On-site grid electricity	MWh	0	3.413	0										
On-site diesel use - Other	Gal	0	0.139	0	22.5	0	0.17	0	0.0054	0	0.0034	0	0.0000052	0
On-site diesel use <75 hp	Gal	0	0.139	0	22.21	0	0.1565	0	0.000145	0	0.0145	0	0.00004	0
On-site diesel use 75<hp<750	Gal	0	0.139	0	22.24	0	0.101	0	0.00013	0	0.009	0	0.00004	0
On-site diesel use >750 hp	Gal	0	0.139	0	22.24	0	0.149	0	0.00013	0	0.006	0	0.00004	0
On-site gasoline use - Other	Gal	0	0.124	0	19.6	0	0.11	0	0.0045	0	0.00054	0	0.000039	0
On-site gasoline use <25 hp	Gal	0	0.124	0	17.48	0	0.037	0	0.00025	0	0.165	0	0.00008	0
On-site gasoline use >25 hp	Gal	0	0.124	0	19.93	0	0.032	0	0.00029	0	0.002	0	0.00009	0
On-site natural gas use	ccf	0	0.103	0	13.1	0	0.01	0	0.0000063	0	0.00076	0	0.0000084	0
On-site compressed natural gas use - Other	ccf	0	NP		1957.835	0	16.0325	0	0.023045	0	0.2775	0	0	0
On-site compressed natural gas use	ccf	0	NP		1957.835	0	16.0325	0	0.023045	0	0.2775	0	0	0
On-site liquified petroleum gas use - Other	gal	0	NP		12.69	0	0.021	0	0.00013	0	0.001	0	0	0
On-site liquified petroleum gas use	gal	0	NP		12.69	0	0.021	0	0.00013	0	0.001	0	0	0
Other forms of on-site conventional energy use #1	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
Other forms of on-site conventional energy use #2	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
On-site Conventional Energy Subtotals				**0**		**0**		**0**		**0**		**0**		**0**
Notes:														
Other On-site Emissions														
On-site HAP process emissions	lbs	0											1	0
On-site GHG emissions	lbs CO2e	0			1	0								
On-site carbon storage	lbs CO2e	0			1	0								
GHG avoided by flaring on-site landfill methane	Lbs	0			-262	0	0.01	0	0.0000063	0	0.00076	0	0.0000084	0
Other on-site NOx emissions or reductions	lbs	0					1	0						
Other on-site SOx emissions or reductions	lbs	0							1	0				
Other on-site PM emissions or reductions	lbs	0									1	0		
User-defined recycled/reused on-site #2	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined recycled/reused on-site #3	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined recycled/reused off-site #1	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
Notes:														
On-site Totals				**0.00**		**0**		**0**		**0**		**0**		**0**

Monitored Natural Attenuation (MNA) - Electricity Generation Footprint (Scope 2)

Contributors to Footprints	Units	Usage	Energy		GHG		NOx		SOx		PM		HAPs	
			Conv. Factor	MMBtus	Conv. Factor	lbs CO2e	Conv. Factor	lbs	Conv. Factor	lbs	Conv. Factor	lbs	Conv. Factor	lbs
Electricity Generation														
Grid electricity	MWh	0	6.929	0	352	0	1.504	0	1.46966	0	0.07546	0	0.0454035	0
Voluntary purchase of renewable electricity	MWh	0												
Voluntary purchase of RECs	MWh	0												
Notes:														

Spreadsheets for Environmental Footprint Analysis (SEFA) Version 3.0, November 2019

Ash Road Off-Site
Alternative Analysis
Monitored Natural Attenuation (MNA)

Monitored Natural Attenuation (MNA) - Transportation Footprint (Scope 3a)

Category	Units	Usage	Energy		Greenhouse Gas		NOx		SOx		PM		HAPs	
			Conv. Factor	MMBtus	Conv. Factor	lbs CO2e	Conv. Factor	lbs	Conv. Factor	lbs	Conv. Factor	lbs	Conv. Factor	lbs
Conventional Energy														
Transportation diesel use	gal	3157.9	0.139	438.9481	22.5	71052.75	0.17	536.843	0.0054	17.05266	0.0034	10.73686	0.0000052	0.0164211
Transportation diesel use - car	gal	0	0.139	0	22.57	0	0.015	0	0.0002	0	0.003	0	0.00252	0
Transportation diesel use - passenger truck	gal	0	0.139	0	22.545	0	0.0585	0	0.0002	0	0.007	0	0.002605	0
Transportation diesel use - User Defined	gal	0	0.139	0	22.5	0	0.17	0	0.0054	0	0.0034	0	0.0000052	0
Transportation gasoline use	gal	0	0.124	0	19.6	0	0.11	0	0.0045	0	0.00054	0	0.000039	0
Transportation gasoline use - car	gal	1920	0.124	238.08	19.77	37958.4	0.027	51.84	0.00036	0.6912	0.003	5.76	0.0067	12.864
Transportation gasoline use - passenger truck	gal	0	0.124	0	19.79	0	0.035	0	0.00036	0	0.003	0	0.00661	0
Transportation gasoline use - User Defined	gal	0	0.124	0	19.6	0	0.11	0	0.0045	0	0.00054	0	0.000039	0
Transportation natural gas use	ccf	0	0.103	0	13.1	0	0.01	0	0.0000063	0	0.00076	0	0.0000084	0
Transportation natural gas use - User Defined	ccf	0	0.103	0	13.1	0	0.01	0	0.0000063	0	0.00076	0	0.0000084	0
User-defined conventional energy transportation #1	TBD	10	0	0	0	0	0	0	0	0	0	0	0	0
User-defined conventional energy transportation #2	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
Conventional Energy Subtotals				**677**		**109,011**		**589**		**18**		**16**		**13**
Notes:														
Renewable Energy														
Transportation biodiesel use	gal	0	0.127	0	22.3	0	0.2	0	0	0	0.00099	0	NP	
Transportation biodiesel use - User Defined	gal	0	0.127	0	22.3	0	0.2	0	0	0	0.00099	0	NP	
User-defined renewable energy transportation #1	TBD	0	Biodiesel		0	0	0	0	0	0	0	0	Ref.	
User-defined renewable energy transportation #2	TBD	0	mpg or pmp		0	0	0	0	0	0	0	0	0	0
Renewable Energy Subtotals				**0**		**0**		**0**		**0**		**0**		**0**
Notes:														
Transportation Totals				**677**		**109011**		**589**		**18**		**16**		**13**

Monitored Natural Attenuation (MNA) - Off-Site Footprint (Scope 3b)

Category	Units	Usage	Energy		Greenhouse Gas		NOx		SOx		PM		HAPs	
			Conv. Factor	MMBtus	Conv. Factor	lbs CO2e	Conv. Factor	lbs	Conv. Factor	lbs	Conv. Factor	lbs	Conv. Factor	lbs
Construction Materials														
Aluminum, Rolled Sheet	lb	0	0.0633	0	9.15	0	0.0148	0	0.0283	0	0.0088	0	0.00102	0
Asphalt, mastic	lb	0	0.0412	0	0.85	0	0.00271	0	0.00798	0	0.000766	0	0.00107	0
Asphalt, paving-grade	lb	0	0.5	0	8.58	0	0.0299	0	0.0969	0	0.0091	0	0.0133	0
Ethanol, Corn, 95%	lb	0	0.0318	0	-0.0199	0	0.00425	0	0.00303	0	0.000469	0	0.0000846	0
Ethanol, Corn, 99.7%	lb	0	0.0324	0	0.0591	0	0.00431	0	0.0031	0	0.000472	0	0.000087	0
Ethanol, Petroleum, 99.7%	lb	0	0.0205	0	1.25	0	0.00199	0	0.00214	0	0.000277	0	0.0000589	0
Gravel/Sand Mix, 65% Gravel	lb	0	0.0000248	0	0.0024	0	0.000018	0	4.52E-06	0	2.61E-06	0	3.08E-07	0
Gravel/sand/clay	lb	0	0.000028	0	0.00335	0	0.0000165	0	0.000015	0	0.000002	0	2.05E-10	0
HDPE	lb	0	0.0332	0	1.94	0	0.00325	0	0.00409	0	0.000439	0	0.0000641	0
Photovoltaic system (installed)	W	0	0.0336	0	4.47	0	0.015	0	0.032	0	0.00063	0	0.0000029	0
PVC	lb	0	0.0262	0	2.02	0	0.004	0	0.00274	0	0.000372	0	0.000375	0
Portland cement, US average	lb	0	0.0139	0	1.34	0	0.00654	0	0.0104	0	0.00378	0	0.00097	0
Ready-mixed concrete, 20 MPa	ft3	0	0.217	0	19.5	0	0.0975	0	0.154	0	0.057	0	0.0141	0
Round Gravel	lb	0	0.0000248	0	0.0024	0	0.000018	0	4.52E-06	0	2.61E-06	0	3.08E-07	0
Sand	lb	0	0.0000248	0	0.0024	0	0.000018	0	4.52E-06	0	2.61E-06	0	3.08E-07	0
Stainless Steel	lb	0	0.0116	0	3.4	0	0.0075	0	0.012	0	0.0044	0	0.000144	0
Steel	lb	0	0.0044	0	1.1	0	0.0014	0	0.0017	0	0.00056	0	0.000067	0
Other refined construction materials	lb	0	0.01885	0	2.115	0	0.0040375	0	0.0051325	0	0.0014428	0	0.0001625	0
Other unrefined construction materials	lb	0	0.000028	0	0.00335	0	0.0000165	0	0.000015	0	0.000002	0	2.05E-10	0
Notes:														

Monitored Natural Attenuation (MNA) - Off-Site Footprint (Scope 3b)

			Energy		Greenhouse Gas		NOx		SOx		PM		HAPs	
Category	Units	Usage	Conv. Factor	MMBtus	Conv. Factor	lbs CO2e	Conv. Factor	lbs	Conv. Factor	lbs	Conv. Factor	lbs	Conv. Factor	lbs
Treatment Materials & Chemicals														
Cheese Whey	lbs	0	0.0025	0	0.031	0	0.000062	0	0.000033	0	0.000002	0	NP	
Emulsified vegetable oil	lbs	0	0.0077	0	3.44	0	0.0066	0	0.0019	0	0.000033	0	NP	
Granular activated carbon, primary	lbs	0	0.0356	0	4.82	0	0.0793	0	0.128	0	0.000987	0	0.000657	0
Granular activated carbon, regenerated	lbs	0	0.00873	0	1.7	0	0.00733	0	0.0129	0	0.000886	0	0.000671	0
Hydrogen Peroxide, 50% in H2O	lbs	0	0.00979	0	1.19	0	0.00142	0	0.0024	0	0.000308	0	0.0000629	0
Iron (II) Sulfate	lbs	0	0.00147	0	0.167	0	0.000316	0	0.000589	0	0.000103	0	0.000023	0
Lime, Hydrated, Packed	lbs	0	0.00206	0	0.762	0	0.000513	0	0.000358	0	0.00013	0	6.57E-06	0
Molasses	lbs	0	0.0044	0	0.48	0	0.0011	0	0.00024	0	0.0000041	0	NP	
Phosphoric Acid, 70% in H2O	lbs	0	0.0067	0	0.882	0	0.00282	0	0.0294	0	0.00171	0	0.000163	0
Potassium Permanganate	lbs	0	0.00981	0	1.16	0	0.00234	0	0.0032	0	0.000422	0	0.000122	0
Sodium Hydroxide, 50% in H2O	lbs	0	0.00977	0	1.09	0	0.00194	0	0.00352	0	0.000403	0	0.000129	0
Other Treatment Chemicals & Materials	lbs	0	0.015	0	1.67	0	0.003	0	0.0065	0	0.00061	0	0.000016	0
Notes:														
Fuel Processing														
Biodiesel produced	gal	0	0.029	0	-16.8	0	0.018	0	0.033	0	0.00082	0	NP	
Diesel produced	gal	3157.9	0.017	53.6843	3.02	9536.858	0.0051	16.10529	0.0062	19.57898	0.0017	5.36843	0.0011	3.47369
Gasoline produced	gal	1920	0.033	63.36	2.8	5376	0.0046	8.832	0.005	9.6	0.0015	2.88	0.001	1.92
Liquefied Petroleum Gas Produced	gal	0	0.088	0	1.47	0	0.0016	0	0.0024	0	0.0007	0	0.0003	0
Natural Gas - Compressed Produced	ccf	0	19.983	0	343.92	0	0.4732	0	2.1651	0	0.1846	0	0.2895	0
Natural Gas Produced	ccf	0	0.0052	0	2.2	0	0.0037	0	0.0046	0	0.000072	0	0.0000061	0
Fuel Processing Subtotals				**117.0443**		**14912.858**		**24.93729**		**29.17898**		**8.24843**		**5.39369**
Notes:														
Public water	gal x 1000	0	0.0092	0	5	0	0.0097	0	0.0059	0	0.016	0	0.000015	0
User-defined water resource #1	gal x 1000	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined water resource #2	gal x 1000	0	0	0	0	0	0	0	0	0	0	0	0	0
Notes:														

Monitored Natural Attenuation (MNA) - Off-Site Footprint (Scope 3b)

			Energy		Greenhouse Gas		NOx		SOx		PM		HAPs	
Category	Units	Usage	Conv. Factor	MMBtus	Conv. Factor	lbs CO2e	Conv. Factor	lbs	Conv. Factor	lbs	Conv. Factor	lbs	Conv. Factor	lbs
Off-Site Services														
Hazardous waste incineration	lb	0	0.00609	0	2.43	0	0.0016	0	0.00167	0	0.000209	0	0.000087	0
Off-site waste water treatment (POTW)	gal x 1000	0	0.015	0	4.4	0	0.016	0	0.015	0	NP		NP	
Off-site non-hazardous waste landfill	ton	0	0.16	0	25	0	0.14	0	0.075	0	0.4	0	0.0014	0
Off-site hazardous waste landfill	ton	0	0.18	0	27.5	0	0.154	0	0.0825	0	0.44	0	0.00154	0
Off-site Laboratory Analysis - Other	sample	0	0.058071	0	6.8534384	0	0.131402	0	0.3038758	0	0.0455698	0	0.0330165	0
Off-site Laboratory Analysis - Metals	sample	0	0.212	0	27.4693	0	0.6423	0	1.5072	0	0.2264	0	0.1643	0
Off-site Laboratory Analysis - Mercury	sample	0	0.0731715	0	9.325458	0	0.2127439	0	0.4982396	0	0.0747359	0	0.0542332	0
Off-site Laboratory Analysis - Inorganic Anions	sample	0	0.0074025	0	0.6459478	0	0.0067681	0	0.0147929	0	0.0022024	0	0.0015542	0
Off-site Laboratory Analysis - Alkalinity	sample	0	0.0174398	0	1.3381922	0	0.0070106	0	0.0132496	0	0.00194	0	0.0012831	0
Off-site Laboratory Analysis - Perchlorate	sample	0	0.023885	0	1.8717054	0	0.0079807	0	0.0141535	0	0.0020547	0	0.0012875	0
Off-site Laboratory Analysis - Nitrogen/Nitrate	sample	0	0.0336475	0	4.29897	0	0.0954592	0	0.2226646	0	0.0335099	0	0.0242506	0
Off-site Laboratory Analysis - Sulfate	sample	0	0.0141225	0	1.4726728	0	0.0079807	0	0.0136024	0	0.0019797	0	0.0012015	0
Off-site Laboratory Analysis - PCBs	sample	0	0.0512769	0	5.224902	0	0.0833339	0	0.1904774	0	0.0284393	0	0.0212083	0
Off-site Laboratory Analysis - VOCs	sample	0	0.0762045	0	9.016814	0	0.104498	0	0.2270738	0	0.0339508	0	0.0235892	0
Off-site Laboratory Analysis - SVOCs	sample	0	0.0715602	0	7.870422	0	0.1459445	0	0.3373038	0	0.0504853	0	0.0372577	0
Notes:														
Resource Extraction for Electricity														
Coal extraction and processing	MWh	0	3.1	0	180.0	0	0.8	0	0.2	0	0.0	0	NP	
Natural gas extraction and processing	MWh	0	1.6	0	270.0	0	0.2	0	13.0	0	0.0	0	NP	
Nuclear fuel extraction and processing	MWh	0	0.2	0	25.0	0	0.2	0	0.5	0	0.0	0	NP	
Oil extraction and processing	MWh	0	2.3	0	270.0	0	1.7	0	0.1	0	0.0	0	NP	
Other fuel extraction and processing	MWh	0	0	0	0	0	0	0	0	0	0	0	0	0
Resource Extraction Subtotals				**0**		**0**		**0**		**0**		**0**		**0**
Notes:														
Electricity Transmission														
Transmission and distribution losses	MWh	0	1.0342	0	35.2	0	0.1504	0	0.146966	0	0.007546	0	0.0045403	0
Notes:														

Monitored Natural Attenuation (MNA) - Off-Site Footprint (Scope 3b)

			Energy		Greenhouse Gas		NOx		SOx		PM		HAPs	
			Conv.		Conv.		Conv.		Conv.		Conv.		Conv.	
Category	Units	Usage	Factor	MMBtus	Factor	lbs CO2e	Factor	lbs	Factor	lbs	Factor	lbs	Factor	lbs
User-defined Materials														
User-defined material #1	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #2	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #3	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #4	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #5	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #6	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #7	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #8	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #9	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #10	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #11	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #12	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #13	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #14	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #15	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #16	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #17	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #18	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #19	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Notes:														
User-defined Waste Destinations														
User-defined recycled/reused off-site #1	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined recycled/reused off-site #2	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined recycled/reused off-site #3	TBD	0	y(MMBtu/u		(lbs CO2e/u		Ox(lbs/unit		Ox(lbs/unit)		M(lbs/unit)		APs(lbs/unit	
User-defined non-hazardous waste destination #1	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined non-hazardous waste destination #2	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined non-hazardous waste destination #3	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined hazardous waste destination #1	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined hazardous waste destination #2	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined hazardous waste destination #3	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
Notes:														
Off-site Totals				**117.0443**		**14912.858**		**24.93729**		**29.17898**		**8.24843**		**5.39369**

Monitored Natural Attenuation (MNA) - Intermediate Totals

			Energy		Greenhouse Gas		NOx		SOx		PM		HAPs	
Category	Units	Usage	Conv. Factor	MMBtus	Conv. Factor	lbs CO2e	Conv. Factor	lbs	Conv. Factor	lbs	Conv. Factor	lbs	Conv. Factor	lbs
Total Grid Electricity Footprint														
On-site grid electricity	MWh	0	3.413	0										
Electricity Generation														
Grid electricity	MWh	0	6.929	0	1124.3	0	2.2421	0	4.6078874	0	0.057518	0	0.2102371	0
Resource Extraction for Electricity														
Coal extraction and processing	MWh	0	3.1	0	180.0	0	0.8	0	0.2	0	0.0	0	NP	
Natural gas extraction and processing	MWh	0	1.6	0	270.0	0	0.2	0	13.0	0	0.0	0	NP	
Nuclear fuel extraction and processing	MWh	0	0.2	0	25.0	0	0.2	0	0.5	0	0.0	0	NP	
Oil extraction and processing	MWh	0	2.3	0	270.0	0	1.7	0	0.1	0	0.0	0	NP	
Other fuel extraction and processing	MWh	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
Electricity Transmission														
Transmission and distribution losses	MWh	0	1.0342	0	112.43	0	0.22421	0	0.4607887	0	0.0057518	0	0.0210237	0
Total Grid Electricity Footprint				**0**		**0**		**0**		**0**		**0**		**0**
Total Fuel Footprints														
Total Gasoline Footprint														
On-site gasoline use - Other	gal	0	0.124	0	19.6	0	0.11	0	0.0045	0	0.00054	0	0.000039	0
On-site gasoline use <25 hp	gal	0	0.124	0	17.48	0	0.037	0	0.00025	0	0.165	0	0.00008	0
On-site gasoline use >25 hp	gal	0	0.124	0	19.93	0	0.032	0	0.00029	0	0.002	0	0.00009	0
Transportation gasoline use	gal	0	0.124	0	19.6	0	0.11	0	0.0045	0	0.00054	0	0.000039	0
Transportation gasoline use - car	gal	1920	0.124	238.08	19.77	37958.4	0.027	51.84	0.00036	0.6912	0.003	5.76	0.0067	12.864
Transportation gasoline use - passenger truck	gal	0	0.124	0	19.79	0	0.035	0	0.00036	0	0.003	0	0.00661	0
Transportation gasoline use - User Defined	gal	0	0.124	0	19.6	0	0.11	0	0.0045	0	0.00054	0	0.000039	0
Gasoline produced	gal	1920	0.033	63.36	2.8	5376	0.0046	8.832	0.005	9.6	0.0015	2.88	0.001	1.92
Total Gasoline Footprint		**1920**		**301.44**		**43334.4**		**60.672**		**10.2912**		**8.64**		**14.784**
Total Diesel Footprint														
On-site diesel use - Other	gal	0	0.139	0	22.5	0	0.17	0	0.0054	0	0.0034	0	0.0000052	0
On-site diesel use <75 hp	gal	0	0.139	0	22.21	0	0.1565	0	0.000145	0	0.0145	0	0.00004	0
On-site diesel use 75<hp<750	gal	0	0.139	0	22.24	0	0.101	0	0.00013	0	0.009	0	0.00004	0
On-site diesel use >750 hp	gal	0	0.139	0	22.24	0	0.149	0	0.00013	0	0.006	0	0.00004	0
Transportation diesel use	gal	3157.9	0.139	438.9481	22.5	71052.75	0.17	536.843	0.0054	17.05266	0.0034	10.73686	0.0000052	0.0164211
Transportation diesel use - car	gal	0	0.139	0	22.57	0	0.015	0	0.0002	0	0.003	0	0.00252	0
Transportation diesel use - passenger truck	gal	0	0.139	0	22.545	0	0.0585	0	0.0002	0	0.007	0	0.002605	0
Transportation diesel use - User Defined	gal	0	0.139	0	22.5	0	0.17	0	0.0054	0	0.0034	0	0.0000052	0
Diesel produced	gal	3157.9	0.017	53.6843	3.02	9536.858	0.0051	16.10529	0.0062	19.57898	0.0017	5.36843	0.0011	3.47369
Total Diesel Footprint		**3157.9**		**492.6324**		**80589.608**		**552.94829**		**36.63164**		**16.10529**		**3.4901111**
Total Biodiesel Footprint														
On-site biodiesel use	gal	0	0.127	0	22.3	0	0.2	0	0	0	0.00099	0	NP	
On-site biodiesel use - User Defined	gal	0	0.127	0	22.3	0	0.2	0	0	0	0.00099	0	NP	
Transportation biodiesel use	gal	0	0.127	0	22.3	0	0.2	0	0	0	0.00099	0	NP	
Transportation biodiesel use - User Defined	gal	0	0.127	0	22.3	0	0.2	0	0	0	0.00099	0	NP	
Biodiesel produced	gal	0	0.029	0	-16.8	0	0.018	0	0.033	0	0.00082	0	NP	
Total Biodiesel Footprint		**0**		**0**		**0**		**0**		**0**		**0**		**0**
Total Natural Gas Footprint														
On-site natural gas use	ccf	0	0.103	0	13.1	0	0.01	0	0.0000063	0	0.00076	0	0.0000084	0
Transportation natural gas use	ccf	0	0.103	0	13.1	0	0.01	0	0.0000063	0	0.00076	0	0.0000084	0
Transportation natural gas use - User Defined	ccf	0	0.103	0	13.1	0	0.01	0	0.0000063	0	0.00076	0	0.0000084	0
Natural gas produced	ccf	0	0.0052	0	2.2	0	0.0037	0	0.0046	0	0.000072	0	0.0000061	0
Total Natural Gas Footprint		**0**		**0**		**0**		**0**		**0**		**0**		**0**
Total Liquified Petroleum Gas Footprint														
On-site liquified petroleum gas use - Other	ccf	0	NP		12.69	0	0.021	0	0.00013	0	0.001	0	0	0
On-site liquified petroleum gas use	ccf	0	NP		12.69	0	0.021	0	0.00013	0	0.001	0	0	0
Liquified petroleum gas produced	ccf	0	0.088	0	1.47	0	0.0016	0	0.0024	0	0.0007	0	0.0003	0
Total Natural Gas Footprint		**0**		**0**		**0**		**0**		**0**		**0**		**0**
Total Compressed Gas Footprint														
On-site compressed gas use - Other	ccf	0	NP		1957.835	0	16.0325	0	0.023045	0	0.2775	0	0	0
On-site compressed gas use	ccf	0	NP		1957.835	0	16.0325	0	0.023045	0	0.2775	0	0	0
Compressed gas produced	ccf	0	19.983	0	343.92	0	0.4732	0	2.1651	0	0.1846	0	0.2895	0
Total Natural Gas Footprint		**0**		**0**		**0**		**0**		**0**		**0**		**0**

Notes:

Note: Please refer to the "Default Conversions" tab for references for the default conversion factors used on this calculation sheet.

Space below available for notes and calculations:

ISCO + MNA - On-Site Footprint (Scope 1)

			Energy		GHG		NOx		SOx		PM		HAPs	
Contributors to Footprints	**Units**	**Usage**	**Conv. Factor**	**MMBtus**	**Conv. Factor**	**lbs CO2e**	**Conv. Factor**	**lbs**	**Conv. Factor**	**lbs**	**Conv. Factor**	**lbs**	**Conv. Factor**	**lbs**
On-Site														
On-site Renewable Energy														
Renewable electricity generated on-site	MWh	0	3.413	0										
Landfill gas combusted on-site for energy use	ccf CH4	0	0.103	0	13.1	0	0.01	0	0.0000063	0	0.00076	0	0.0000084	0
On-site biodiesel use	gal	0	0.127	0	22.3	0	0.2	0	0	0	0.00099	0	NP	
On-site biodiesel use - User Defined	gal	0	0.127	0	22.3	0	0.2	0	0	0	0.00099	0	NP	
User-defined on-site renewable energy use #1	gal	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined on-site renewable energy use #2	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
On-site Renewable Energy Subtotals				**0**		**0**		**0**		**0**		**0**		**0**
Notes:														
On-site Conventional Energy														
On-site grid electricity	MWh	0	3.413	0										
On-site diesel use - Other	Gal	13342.5	0.139	1854.6075	22.5	300206.25	0.17	2268.225	0.0054	72.0495	0.0034	45.3645	0.0000052	0.069381
On-site diesel use <75 hp	Gal	0	0.139	0	22.21	0	0.1565	0	0.000145	0	0.0145	0	0.00004	0
On-site diesel use 75<hp<750	Gal	0	0.139	0	22.24	0	0.101	0	0.00013	0	0.009	0	0.00004	0
On-site diesel use >750 hp	Gal	0	0.139	0	22.24	0	0.149	0	0.00013	0	0.006	0	0.00004	0
On-site gasoline use - Other	Gal	0	0.124	0	19.6	0	0.11	0	0.0045	0	0.00054	0	0.000039	0
On-site gasoline use <25 hp	Gal	0	0.124	0	17.48	0	0.037	0	0.00025	0	0.165	0	0.00008	0
On-site gasoline use >25 hp	Gal	0	0.124	0	19.93	0	0.032	0	0.00029	0	0.002	0	0.00009	0
On-site natural gas use	ccf	0	0.103	0	13.1	0	0.01	0	0.0000063	0	0.00076	0	0.0000084	0
On-site compressed natural gas use - Other	ccf	0	NP		1957.835	0	16.0325	0	0.023045	0	0.2775	0	0	0
On-site compressed natural gas use	ccf	0	NP		1957.835	0	16.0325	0	0.023045	0	0.2775	0	0	0
On-site liquified petroleum gas use - Other	gal	0	NP		12.69	0	0.021	0	0.00013	0	0.001	0	0	0
On-site liquified petroleum gas use	gal	0	NP		12.69	0	0.021	0	0.00013	0	0.001	0	0	0
Other forms of on-site conventional energy use #1	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
Other forms of on-site conventional energy use #2	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
On-site Conventional Energy Subtotals				**1,855**		**300,206**		**2,268**		**72**		**45**		**0**
Notes:														
Other On-site Emissions														
On-site HAP process emissions	lbs	0											1	0
On-site GHG emissions	lbs CO2e	0			1	0								
On-site carbon storage	lbs CO2e	0			1	0								
GHG avoided by flaring on-site landfill methane	Lbs	0			-262	0	0.01	0	0.0000063	0	0.00076	0	0.0000084	0
Other on-site NOx emissions or reductions	lbs	0					1	0						
Other on-site SOx emissions or reductions	lbs	0							1	0				
Other on-site PM emissions or reductions	lbs	0									1	0		
User-defined recycled/reused on-site #2	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined recycled/reused on-site #3	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined recycled/reused off-site #1	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
Notes:														
On-site Totals				**1,854.61**		**300,206**		**2,268**		**72**		**45**		**0**

ISCO + MNA - Electricity Generation Footprint (Scope 2)

Contributors to Footprints	Units	Usage	Energy		GHG		NOx		SOx		PM		HAPs	
			Conv. Factor	MMBtus	Conv. Factor	lbs CO2e	Conv. Factor	lbs	Conv. Factor	lbs	Conv. Factor	lbs	Conv. Factor	lbs
Electricity Generation														
Grid electricity	MWh	0	6.929	0	352	0	1.504	0	1.46966	0	0.07546	0	0.0454035	0
Voluntary purchase of renewable electricity	MWh	0												
Voluntary purchase of RECs	MWh	0												
Notes:														

Spreadsheets for Environmental Footprint Analysis (SEFA) Version 3.0, November 2019

Ash Road Off-Site
Alternative Analysis
ISCO + MNA

ISCO + MNA - Transportation Footprint (Scope 3a)

Category	Units	Usage	Energy		Greenhouse Gas		NOx		SOx		PM		HAPs	
			Conv. Factor	MMBtus	Conv. Factor	lbs CO2e	Conv. Factor	lbs	Conv. Factor	lbs	Conv. Factor	lbs	Conv. Factor	lbs
Conventional Energy														
Transportation diesel use	gal	6052.8	0.139	841.3392	22.5	136188	0.17	1028.976	0.0054	32.68512	0.0034	20.57952	0.0000052	0.0314746
Transportation diesel use - car	gal	0	0.139	0	22.57	0	0.015	0	0.0002	0	0.003	0	0.00252	0
Transportation diesel use - passenger truck	gal	17.1	0.139	2.3769	22.545	385.5195	0.0585	1.00035	0.0002	0.00342	0.007	0.1197	0.002605	0.0445455
Transportation diesel use - User Defined	gal	0	0.139	0	22.5	0	0.17	0	0.0054	0	0.0034	0	0.0000052	0
Transportation gasoline use	gal	0	0.124	0	19.6	0	0.11	0	0.0045	0	0.00054	0	0.000039	0
Transportation gasoline use - car	gal	2635.2	0.124	326.7648	19.77	52097.904	0.027	71.1504	0.00036	0.948672	0.003	7.9056	0.0067	17.65584
Transportation gasoline use - passenger truck	gal	0	0.124	0	19.79	0	0.035	0	0.00036	0	0.003	0	0.00661	0
Transportation gasoline use - User Defined	gal	0	0.124	0	19.6	0	0.11	0	0.0045	0	0.00054	0	0.000039	0
Transportation natural gas use	ccf	0	0.103	0	13.1	0	0.01	0	0.0000063	0	0.00076	0	0.0000084	0
Transportation natural gas use - User Defined	ccf	0	0.103	0	13.1	0	0.01	0	0.0000063	0	0.00076	0	0.0000084	0
User-defined conventional energy transportation #1	TBD	10	0	0	0	0	0	0	0	0	0	0	0	0
User-defined conventional energy transportation #2	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
Conventional Energy Subtotals				**1,170**		**188,671**		**1,101**		**34**		**29**		**18**
Notes:														
Renewable Energy														
Transportation biodiesel use	gal	0	0.127	0	22.3	0	0.2	0	0	0	0.00099	0	NP	
Transportation biodiesel use - User Defined	gal	0	0.127	0	22.3	0	0.2	0	0	0	0.00099	0	NP	
User-defined renewable energy transportation #1	TBD	0	Biodiesel		0	0	0	0	0	0	0	0	Ref.	
User-defined renewable energy transportation #2	TBD	0	mpg or pmp		0	0	0	0	0	0	0	0	0	0
Renewable Energy Subtotals				**0**		**0**		**0**		**0**		**0**		**0**
Notes:														
Transportation Totals				**1170**		**188671**		**1101**		**34**		**29**		**18**

ISCO + MNA - Off-Site Footprint (Scope 3b)

			Energy		Greenhouse Gas		NOx		SOx		PM		HAPs	
Category	Units	Usage	Conv. Factor	MMBtus	Conv. Factor	lbs CO2e	Conv. Factor	lbs	Conv. Factor	lbs	Conv. Factor	lbs	Conv. Factor	lbs
Construction Materials														
Aluminum, Rolled Sheet	lb	0	0.0633	0	9.15	0	0.0148	0	0.0283	0	0.0088	0	0.00102	0
Asphalt, mastic	lb	0	0.0412	0	0.85	0	0.00271	0	0.00798	0	0.000766	0	0.00107	0
Asphalt, paving-grade	lb	0	0.5	0	8.58	0	0.0299	0	0.0969	0	0.0091	0	0.0133	0
Ethanol, Corn, 95%	lb	0	0.0318	0	-0.0199	0	0.00425	0	0.00303	0	0.000469	0	0.0000846	0
Ethanol, Corn, 99.7%	lb	0	0.0324	0	0.0591	0	0.00431	0	0.0031	0	0.000472	0	0.000087	0
Ethanol, Petroleum, 99.7%	lb	0	0.0205	0	1.25	0	0.00199	0	0.00214	0	0.000277	0	0.0000589	0
Gravel/Sand Mix, 65% Gravel	lb	0	0.0000248	0	0.0024	0	0.000018	0	4.52E-06	0	2.61E-06	0	3.08E-07	0
Gravel/sand/clay	lb	0	0.000028	0	0.00335	0	0.0000165	0	0.000015	0	0.000002	0	2.05E-10	0
HDPE	lb	0	0.0332	0	1.94	0	0.00325	0	0.00409	0	0.000439	0	0.0000641	0
Photovoltaic system (installed)	W	0	0.0336	0	4.47	0	0.015	0	0.032	0	0.00063	0	0.0000029	0
PVC	lb	0	0.0262	0	2.02	0	0.004	0	0.00274	0	0.000372	0	0.000375	0
Portland cement, US average	lb	0	0.0139	0	1.34	0	0.00654	0	0.0104	0	0.00378	0	0.00097	0
Ready-mixed concrete, 20 MPa	ft3	0	0.217	0	19.5	0	0.0975	0	0.154	0	0.057	0	0.0141	0
Round Gravel	lb	0	0.0000248	0	0.0024	0	0.000018	0	4.52E-06	0	2.61E-06	0	3.08E-07	0
Sand	lb	0	0.0000248	0	0.0024	0	0.000018	0	4.52E-06	0	2.61E-06	0	3.08E-07	0
Stainless Steel	lb	0	0.0116	0	3.4	0	0.0075	0	0.012	0	0.0044	0	0.000144	0
Steel	lb	0	0.0044	0	1.1	0	0.0014	0	0.0017	0	0.00056	0	0.000067	0
Other refined construction materials	lb	0	0.01885	0	2.115	0	0.0040375	0	0.0051325	0	0.0014428	0	0.0001625	0
Other unrefined construction materials	lb	0	0.000028	0	0.00335	0	0.0000165	0	0.000015	0	0.000002	0	2.05E-10	0
Notes:														

ISCO + MNA - Off-Site Footprint (Scope 3b)

			Energy		Greenhouse Gas		NOx		SOx		PM		HAPs	
Category	Units	Usage	Conv. Factor	MMBtus	Conv. Factor	lbs CO2e	Conv. Factor	lbs	Conv. Factor	lbs	Conv. Factor	lbs	Conv. Factor	lbs
Treatment Materials & Chemicals														
Cheese Whey	lbs	0	0.0025	0	0.031	0	0.000062	0	0.000033	0	0.000002	0	NP	
Emulsified vegetable oil	lbs	0	0.0077	0	3.44	0	0.0066	0	0.0019	0	0.000033	0	NP	
Granular activated carbon, primary	lbs	0	0.0356	0	4.82	0	0.0793	0	0.128	0	0.000987	0	0.000657	0
Granular activated carbon, regenerated	lbs	0	0.00873	0	1.7	0	0.00733	0	0.0129	0	0.000886	0	0.000671	0
Hydrogen Peroxide, 50% in H2O	lbs	0	0.00979	0	1.19	0	0.00142	0	0.0024	0	0.000308	0	0.0000629	0
Iron (II) Sulfate	lbs	0	0.00147	0	0.167	0	0.000316	0	0.000589	0	0.000103	0	0.000023	0
Lime, Hydrated, Packed	lbs	0	0.00206	0	0.762	0	0.000513	0	0.000358	0	0.00013	0	6.57E-06	0
Molasses	lbs	0	0.0044	0	0.48	0	0.0011	0	0.00024	0	0.0000041	0	NP	
Phosphoric Acid, 70% in H2O	lbs	0	0.0067	0	0.882	0	0.00282	0	0.0294	0	0.00171	0	0.000163	0
Potassium Permanganate	lbs	0	0.00981	0	1.16	0	0.00234	0	0.0032	0	0.000422	0	0.000122	0
Sodium Hydroxide, 50% in H2O	lbs	0	0.00977	0	1.09	0	0.00194	0	0.00352	0	0.000403	0	0.000129	0
Other Treatment Chemicals & Materials	lbs	0	0.015	0	1.67	0	0.003	0	0.0065	0	0.00061	0	0.000016	0
Notes:														
Fuel Processing														
Biodiesel produced	gal	0	0.029	0	-16.8	0	0.018	0	0.033	0	0.00082	0	NP	
Diesel produced	gal	19412.4	0.017	330.0108	3.02	58625.448	0.0051	99.00324	0.0062	120.35688	0.0017	33.00108	0.0011	21.35364
Gasoline produced	gal	2635.2	0.033	86.9616	2.8	7378.56	0.0046	12.12192	0.005	13.176	0.0015	3.9528	0.001	2.6352
Liquefied Petroleum Gas Produced	gal	0	0.088	0	1.47	0	0.0016	0	0.0024	0	0.0007	0	0.0003	0
Natural Gas - Compressed Produced	ccf	0	19.983	0	343.92	0	0.4732	0	2.1651	0	0.1846	0	0.2895	0
Natural Gas Produced	ccf	0	0.0052	0	2.2	0	0.0037	0	0.0046	0	0.000072	0	0.0000061	0
Fuel Processing Subtotals				**416.9724**		**66004.008**		**111.12516**		**133.53288**		**36.95388**		**23.98884**
Notes:														
Public water	gal x 1000	0	0.0092	0	5	0	0.0097	0	0.0059	0	0.016	0	0.000015	0
User-defined water resource #1	gal x 1000	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined water resource #2	gal x 1000	0	0	0	0	0	0	0	0	0	0	0	0	0
Notes:														

ISCO + MNA - Off-Site Footprint (Scope 3b)

			Energy		Greenhouse Gas		NOx		SOx		PM		HAPs	
Category	Units	Usage	Conv. Factor	MMBtus	Conv. Factor	lbs CO2e	Conv. Factor	lbs	Conv. Factor	lbs	Conv. Factor	lbs	Conv. Factor	lbs
Off-Site Services														
Hazardous waste incineration	lb	0	0.00609	0	2.43	0	0.0016	0	0.00167	0	0.000209	0	0.000087	0
Off-site waste water treatment (POTW)	gal x 1000	0	0.015	0	4.4	0	0.016	0	0.015	0	NP		NP	
Off-site non-hazardous waste landfill	ton	0	0.16	0	25	0	0.14	0	0.075	0	0.4	0	0.0014	0
Off-site hazardous waste landfill	ton	0	0.18	0	27.5	0	0.154	0	0.0825	0	0.44	0	0.00154	0
Off-site Laboratory Analysis - Other	sample	0	0.058071	0	6.8534384	0	0.131402	0	0.3038758	0	0.0455698	0	0.0330165	0
Off-site Laboratory Analysis - Metals	sample	0	0.212	0	27.4693	0	0.6423	0	1.5072	0	0.2264	0	0.1643	0
Off-site Laboratory Analysis - Mercury	sample	0	0.0731715	0	9.325458	0	0.2127439	0	0.4982396	0	0.0747359	0	0.0542332	0
Off-site Laboratory Analysis - Inorganic Anions	sample	0	0.0074025	0	0.6459478	0	0.0067681	0	0.0147929	0	0.0022024	0	0.0015542	0
Off-site Laboratory Analysis - Alkalinity	sample	0	0.0174398	0	1.3381922	0	0.0070106	0	0.0132496	0	0.00194	0	0.0012831	0
Off-site Laboratory Analysis - Perchlorate	sample	0	0.023885	0	1.8717054	0	0.0079807	0	0.0141535	0	0.0020547	0	0.0012875	0
Off-site Laboratory Analysis - Nitrogen/Nitrate	sample	0	0.0336475	0	4.29897	0	0.0954592	0	0.2226646	0	0.0335099	0	0.0242506	0
Off-site Laboratory Analysis - Sulfate	sample	0	0.0141225	0	1.4726728	0	0.0079807	0	0.0136024	0	0.0019797	0	0.0012015	0
Off-site Laboratory Analysis - PCBs	sample	0	0.0512769	0	5.224902	0	0.0833339	0	0.1904774	0	0.0284393	0	0.0212083	0
Off-site Laboratory Analysis - VOCs	sample	0	0.0762045	0	9.016814	0	0.104498	0	0.2270738	0	0.0339508	0	0.0235892	0
Off-site Laboratory Analysis - SVOCs	sample	0	0.0715602	0	7.870422	0	0.1459445	0	0.3373038	0	0.0504853	0	0.0372577	0
Notes:														
Resource Extraction for Electricity														
Coal extraction and processing	MWh	0	3.1	0	180.0	0	0.8	0	0.2	0	0.0	0	NP	
Natural gas extraction and processing	MWh	0	1.6	0	270.0	0	0.2	0	13.0	0	0.0	0	NP	
Nuclear fuel extraction and processing	MWh	0	0.2	0	25.0	0	0.2	0	0.5	0	0.0	0	NP	
Oil extraction and processing	MWh	0	2.3	0	270.0	0	1.7	0	0.1	0	0.0	0	NP	
Other fuel extraction and processing	MWh	0	0	0	0	0	0	0	0	0	0	0	0	0
Resource Extraction Subtotals				**0**		**0**		**0**		**0**		**0**		**0**
Notes:														
Electricity Transmission														
Transmission and distribution losses	MWh	0	1.0342	0	35.2	0	0.1504	0	0.146966	0	0.007546	0	0.0045403	0
Notes:														

ISCO + MNA - Off-Site Footprint (Scope 3b)

			Energy		Greenhouse Gas		NOx		SOx		PM		HAPs	
			Conv.		Conv.		Conv.		Conv.		Conv.		Conv.	
Category	Units	Usage	Factor	MMBtus	Factor	lbs CO2e	Factor	lbs	Factor	lbs	Factor	lbs	Factor	lbs
User-defined Materials														
User-defined material #1	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #2	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #3	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #4	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #5	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #6	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #7	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #8	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #9	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #10	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #11	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #12	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #13	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #14	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #15	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #16	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #17	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #18	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #19	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #20	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
Notes:														
User-defined Waste Destinations														
User-defined recycled/reused off-site #1	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined recycled/reused off-site #2	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined recycled/reused off-site #3	TBD	0	y(MMBtu/u		(lbs CO2e/u		Ox(lbs/unit		Ox(lbs/unit)		M(lbs/unit)		APs(lbs/unit	
User-defined non-hazardous waste destination #1	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined non-hazardous waste destination #2	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined non-hazardous waste destination #3	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined hazardous waste destination #1	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined hazardous waste destination #2	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined hazardous waste destination #3	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
Notes:														
Off-site Totals				**416.9724**		**66004.008**		**111.12516**		**133.53288**		**36.95388**		**23.98884**

ISCO + MNA - Intermediate Totals

Category	Units	Usage	Energy		Greenhouse Gas		NOx		SOx		PM		HAPs	
			Conv. Factor	MMBtus	Conv. Factor	lbs CO2e	Conv. Factor	lbs	Conv. Factor	lbs	Conv. Factor	lbs	Conv. Factor	lbs
Total Grid Electricity Footprint														
On-site grid electricity	MWh	0	3.413	0										
Electricity Generation														
Grid electricity	MWh	0	6.929	0	1124.3	0	2.2421	0	4.6078874	0	0.057518	0	0.2102371	0
Resource Extraction for Electricity														
Coal extraction and processing	MWh	0	3.1	0	180.0	0	0.8	0	0.2	0	0.0	0	NP	
Natural gas extraction and processing	MWh	0	1.6	0	270.0	0	0.2	0	13.0	0	0.0	0	NP	
Nuclear fuel extraction and processing	MWh	0	0.2	0	25.0	0	0.2	0	0.5	0	0.0	0	NP	
Oil extraction and processing	MWh	0	2.3	0	270.0	0	1.7	0	0.1	0	0.0	0	NP	
Other fuel extraction and processing	MWh	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
Electricity Transmission														
Transmission and distribution losses	MWh	0	1.0342	0	112.43	0	0.22421	0	0.4607887	0	0.0057518	0	0.0210237	0
Total Grid Electricity Footprint				**0**		**0**		**0**		**0**		**0**		**0**
Total Fuel Footprints														
Total Gasoline Footprint														
On-site gasoline use - Other	gal	0	0.124	0	19.6	0	0.11	0	0.0045	0	0.00054	0	0.000039	0
On-site gasoline use <25 hp	gal	0	0.124	0	17.48	0	0.037	0	0.00025	0	0.165	0	0.00008	0
On-site gasoline use >25 hp	gal	0	0.124	0	19.93	0	0.032	0	0.00029	0	0.002	0	0.00009	0
Transportation gasoline use	gal	0	0.124	0	19.6	0	0.11	0	0.0045	0	0.00054	0	0.000039	0
Transportation gasoline use - car	gal	2635.2	0.124	326.7648	19.77	52097.904	0.027	71.1504	0.00036	0.948672	0.003	7.9056	0.0067	17.65584
Transportation gasoline use - passenger truck	gal	0	0.124	0	19.79	0	0.035	0	0.00036	0	0.003	0	0.00661	0
Transportation gasoline use - User Defined	gal	0	0.124	0	19.6	0	0.11	0	0.0045	0	0.00054	0	0.000039	0
Gasoline produced	gal	2635.2	0.033	86.9616	2.8	7378.56	0.0046	12.12192	0.005	13.176	0.0015	3.9528	0.001	2.6352
Total Gasoline Footprint		**2635.2**		**413.7264**		**59476.464**		**83.27232**		**14.124672**		**11.8584**		**20.29104**
Total Diesel Footprint														
On-site diesel use - Other	gal	13342.5	0.139	1854.6075	22.5	300206.25	0.17	2268.225	0.0054	72.0495	0.0034	45.3645	0.0000052	0.069381
On-site diesel use <75 hp	gal	0	0.139	0	22.21	0	0.1565	0	0.000145	0	0.0145	0	0.00004	0
On-site diesel use 75<hp<750	gal	0	0.139	0	22.24	0	0.101	0	0.00013	0	0.009	0	0.00004	0
On-site diesel use >750 hp	gal	0	0.139	0	22.24	0	0.149	0	0.00013	0	0.006	0	0.00004	0
Transportation diesel use	gal	6052.8	0.139	841.3392	22.5	136188	0.17	1028.976	0.0054	32.68512	0.0034	20.57952	0.0000052	0.0314746
Transportation diesel use - car	gal	0	0.139	0	22.57	0	0.015	0	0.0002	0	0.003	0	0.00252	0
Transportation diesel use - passenger truck	gal	17.1	0.139	2.3769	22.545	385.5195	0.0585	1.00035	0.0002	0.00342	0.007	0.1197	0.002605	0.0445455
Transportation diesel use - User Defined	gal	0	0.139	0	22.5	0	0.17	0	0.0054	0	0.0034	0	0.0000052	0
Diesel produced	gal	19412.4	0.017	330.0108	3.02	58625.448	0.0051	99.00324	0.0062	120.35688	0.0017	33.00108	0.0011	21.35364
Total Diesel Footprint		**19412.4**		**3028.3344**		**495405.22**		**3397.2046**		**225.09492**		**99.0648**		**21.499041**
Total Biodiesel Footprint														
On-site biodiesel use	gal	0	0.127	0	22.3	0	0.2	0	0	0	0.00099	0	NP	
On-site biodiesel use - User Defined	gal	0	0.127	0	22.3	0	0.2	0	0	0	0.00099	0	NP	
Transportation biodiesel use	gal	0	0.127	0	22.3	0	0.2	0	0	0	0.00099	0	NP	
Transportation biodiesel use - User Defined	gal	0	0.127	0	22.3	0	0.2	0	0	0	0.00099	0	NP	
Biodiesel produced	gal	0	0.029	0	-16.8	0	0.018	0	0.033	0	0.00082	0	NP	
Total Biodiesel Footprint		**0**		**0**		**0**		**0**		**0**		**0**		**0**
Total Natural Gas Footprint														
On-site natural gas use	ccf	0	0.103	0	13.1	0	0.01	0	0.0000063	0	0.00076	0	0.0000084	0
Transportation natural gas use	ccf	0	0.103	0	13.1	0	0.01	0	0.0000063	0	0.00076	0	0.0000084	0
Transportation natural gas use - User Defined	ccf	0	0.103	0	13.1	0	0.01	0	0.0000063	0	0.00076	0	0.0000084	0
Natural gas produced	ccf	0	0.0052	0	2.2	0	0.0037	0	0.0046	0	0.000072	0	0.0000061	0
Total Natural Gas Footprint		**0**		**0**		**0**		**0**		**0**		**0**		**0**
Total Liquified Petroleum Gas Footprint														
On-site liquified petroleum gas use - Other	ccf	0	NP		12.69	0	0.021	0	0.00013	0	0.001	0	0	0
On-site liquified petroleum gas use	ccf	0	NP		12.69	0	0.021	0	0.00013	0	0.001	0	0	0
Liquified petroleum gas produced	ccf	0	0.088	0	1.47	0	0.0016	0	0.0024	0	0.0007	0	0.0003	0
Total Natural Gas Footprint		**0**		**0**		**0**		**0**		**0**		**0**		**0**
Total Compressed Gas Footprint														
On-site compressed gas use - Other	ccf	0	NP		1957.835	0	16.0325	0	0.023045	0	0.2775	0	0	0
On-site compressed gas use	ccf	0	NP		1957.835	0	16.0325	0	0.023045	0	0.2775	0	0	0
Compressed gas produced	ccf	0	19.983	0	343.92	0	0.4732	0	2.1651	0	0.1846	0	0.2895	0
Total Natural Gas Footprint		**0**		**0**		**0**		**0**		**0**		**0**		**0**

Notes:

Note: Please refer to the "Default Conversions" tab for references for the default conversion factors used on this calculation sheet.

Space below available for notes and calculations:

EISB + MNA - On-Site Footprint (Scope 1)

			Energy		GHG		NOx		SOx		PM		HAPs	
Contributors to Footprints	**Units**	**Usage**	**Conv. Factor**	**MMBtus**	**Conv. Factor**	**lbs CO2e**	**Conv. Factor**	**lbs**	**Conv. Factor**	**lbs**	**Conv. Factor**	**lbs**	**Conv. Factor**	**lbs**
On-Site														
On-site Renewable Energy														
Renewable electricity generated on-site	MWh	0	3.413	0										
Landfill gas combusted on-site for energy use	ccf CH4	0	0.103	0	13.1	0	0.01	0	0.0000063	0	0.00076	0	0.0000084	0
On-site biodiesel use	gal	0	0.127	0	22.3	0	0.2	0	0	0	0.00099	0	NP	
On-site biodiesel use - User Defined	gal	0	0.127	0	22.3	0	0.2	0	0	0	0.00099	0	NP	
User-defined on-site renewable energy use #1	gal	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined on-site renewable energy use #2	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
On-site Renewable Energy Subtotals				**0**		**0**		**0**		**0**		**0**		**0**
Notes:														
On-site Conventional Energy														
On-site grid electricity	MWh	0	3.413	0										
On-site diesel use - Other	Gal	14310	0.139	1989.09	22.5	321975	0.17	2432.7	0.0054	77.274	0.0034	48.654	0.0000052	0.074412
On-site diesel use <75 hp	Gal	0	0.139	0	22.21	0	0.1565	0	0.000145	0	0.0145	0	0.00004	0
On-site diesel use 75<hp<750	Gal	0	0.139	0	22.24	0	0.101	0	0.00013	0	0.009	0	0.00004	0
On-site diesel use >750 hp	Gal	0	0.139	0	22.24	0	0.149	0	0.00013	0	0.006	0	0.00004	0
On-site gasoline use - Other	Gal	0	0.124	0	19.6	0	0.11	0	0.0045	0	0.00054	0	0.000039	0
On-site gasoline use <25 hp	Gal	0	0.124	0	17.48	0	0.037	0	0.00025	0	0.165	0	0.00008	0
On-site gasoline use >25 hp	Gal	0	0.124	0	19.93	0	0.032	0	0.00029	0	0.002	0	0.00009	0
On-site natural gas use	ccf	0	0.103	0	13.1	0	0.01	0	0.0000063	0	0.00076	0	0.0000084	0
On-site compressed natural gas use - Other	ccf	0	NP		1957.835	0	16.0325	0	0.023045	0	0.2775	0	0	0
On-site compressed natural gas use	ccf	0	NP		1957.835	0	16.0325	0	0.023045	0	0.2775	0	0	0
On-site liquified petroleum gas use - Other	gal	0	NP		12.69	0	0.021	0	0.00013	0	0.001	0	0	0
On-site liquified petroleum gas use	gal	0	NP		12.69	0	0.021	0	0.00013	0	0.001	0	0	0
Other forms of on-site conventional energy use #1	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
Other forms of on-site conventional energy use #2	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
On-site Conventional Energy Subtotals				**1,989**		**321,975**		**2,433**		**77**		**49**		**0**
Notes:														
Other On-site Emissions														
On-site HAP process emissions	lbs	0											1	0
On-site GHG emissions	lbs CO2e	0			1	0								
On-site carbon storage	lbs CO2e	0			1	0								
GHG avoided by flaring on-site landfill methane	Lbs	0			-262	0	0.01	0	0.0000063	0	0.00076	0	0.0000084	0
Other on-site NOx emissions or reductions	lbs	0					1	0						
Other on-site SOx emissions or reductions	lbs	0							1	0				
Other on-site PM emissions or reductions	lbs	0									1	0		
User-defined recycled/reused on-site #2	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined recycled/reused on-site #3	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined recycled/reused off-site #1	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
Notes:														
On-site Totals				**1,989.09**		**321,975**		**2,433**		**77**		**49**		**0**

EISB + MNA - Electricity Generation Footprint (Scope 2)

Contributors to Footprints	Units	Usage	Energy		GHG		NOx		SOx		PM		HAPs	
			Conv. Factor	MMBtus	Conv. Factor	lbs CO2e	Conv. Factor	lbs	Conv. Factor	lbs	Conv. Factor	lbs	Conv. Factor	lbs
Electricity Generation														
Grid electricity	MWh	0	6.929	0	352	0	1.504	0	1.46966	0	0.07546	0	0.0454035	0
Voluntary purchase of renewable electricity	MWh	0												
Voluntary purchase of RECs	MWh	0												
Notes:														

Spreadsheets for Environmental Footprint Analysis (SEFA) Version 3.0, November 2019

Ash Road Off-Site
Alternative Analysis
EISB + MNA

EISB + MNA - Transportation Footprint (Scope 3a)

Category	Units	Usage	Energy		Greenhouse Gas		NOx		SOx		PM		HAPs	
			Conv. Factor	MMBtus	Conv. Factor	lbs CO2e	Conv. Factor	lbs	Conv. Factor	lbs	Conv. Factor	lbs	Conv. Factor	lbs
Conventional Energy														
Transportation diesel use	gal	16631.7	0.139	2311.8063	22.5	374213.25	0.17	2827.389	0.0054	89.81118	0.0034	56.54778	0.0000052	0.0864848
Transportation diesel use - car	gal	0	0.139	0	22.57	0	0.015	0	0.0002	0	0.003	0	0.00252	0
Transportation diesel use - passenger truck	gal	0	0.139	0	22.545	0	0.0585	0	0.0002	0	0.007	0	0.002605	0
Transportation diesel use - User Defined	gal	0	0.139	0	22.5	0	0.17	0	0.0054	0	0.0034	0	0.0000052	0
Transportation gasoline use	gal	-4.55E-13	0.124	-5.64E-14	19.6	-8.91E-12	0.11	-5E-14	0.0045	-2.05E-15	0.00054	-2.46E-16	0.000039	-1.77E-17
Transportation gasoline use - car	gal	2880	0.124	357.12	19.77	56937.6	0.027	77.76	0.00036	1.0368	0.003	8.64	0.0067	19.296
Transportation gasoline use - passenger truck	gal	34.3	0.124	4.2532	19.79	678.797	0.035	1.2005	0.00036	0.012348	0.003	0.1029	0.00661	0.226723
Transportation gasoline use - User Defined	gal	0	0.124	0	19.6	0	0.11	0	0.0045	0	0.00054	0	0.000039	0
Transportation natural gas use	ccf	0	0.103	0	13.1	0	0.01	0	0.0000063	0	0.00076	0	0.0000084	0
Transportation natural gas use - User Defined	ccf	0	0.103	0	13.1	0	0.01	0	0.0000063	0	0.00076	0	0.0000084	0
User-defined conventional energy transportation #1	TBD	10	0	0	0	0	0	0	0	0	0	0	0	0
User-defined conventional energy transportation #2	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
Conventional Energy Subtotals				**2,673**		**431,830**		**2,906**		**91**		**65**		**20**
Notes:														
Renewable Energy														
Transportation biodiesel use	gal	0	0.127	0	22.3	0	0.2	0	0	0	0.00099	0	NP	
Transportation biodiesel use - User Defined	gal	0	0.127	0	22.3	0	0.2	0	0	0	0.00099	0	NP	
User-defined renewable energy transportation #1	TBD	0	Biodiesel		0	0	0	0	0	0	0	0	Ref.	
User-defined renewable energy transportation #2	TBD	0	mpg or pmp		0	0	0	0	0	0	0	0	0	0
Renewable Energy Subtotals				**0**		**0**		**0**		**0**		**0**		**0**
Notes:														
Transportation Totals				**2673**		**431830**		**2906**		**91**		**65**		**20**

EISB + MNA - Off-Site Footprint (Scope 3b)

			Energy		Greenhouse Gas		NOx		SOx		PM		HAPs	
Category	Units	Usage	Conv. Factor	MMBtus	Conv. Factor	lbs CO2e	Conv. Factor	lbs	Conv. Factor	lbs	Conv. Factor	lbs	Conv. Factor	lbs
Construction Materials														
Aluminum, Rolled Sheet	lb	0	0.0633	0	9.15	0	0.0148	0	0.0283	0	0.0088	0	0.00102	0
Asphalt, mastic	lb	0	0.0412	0	0.85	0	0.00271	0	0.00798	0	0.000766	0	0.00107	0
Asphalt, paving-grade	lb	0	0.5	0	8.58	0	0.0299	0	0.0969	0	0.0091	0	0.0133	0
Ethanol, Corn, 95%	lb	0	0.0318	0	-0.0199	0	0.00425	0	0.00303	0	0.000469	0	0.0000846	0
Ethanol, Corn, 99.7%	lb	0	0.0324	0	0.0591	0	0.00431	0	0.0031	0	0.000472	0	0.000087	0
Ethanol, Petroleum, 99.7%	lb	0	0.0205	0	1.25	0	0.00199	0	0.00214	0	0.000277	0	0.0000589	0
Gravel/Sand Mix, 65% Gravel	lb	0	0.0000248	0	0.0024	0	0.000018	0	4.52E-06	0	2.61E-06	0	3.08E-07	0
Gravel/sand/clay	lb	0	0.000028	0	0.00335	0	0.0000165	0	0.000015	0	0.000002	0	2.05E-10	0
HDPE	lb	0	0.0332	0	1.94	0	0.00325	0	0.00409	0	0.000439	0	0.0000641	0
Photovoltaic system (installed)	W	0	0.0336	0	4.47	0	0.015	0	0.032	0	0.00063	0	0.0000029	0
PVC	lb	0	0.0262	0	2.02	0	0.004	0	0.00274	0	0.000372	0	0.000375	0
Portland cement, US average	lb	0	0.0139	0	1.34	0	0.00654	0	0.0104	0	0.00378	0	0.00097	0
Ready-mixed concrete, 20 MPa	ft3	0	0.217	0	19.5	0	0.0975	0	0.154	0	0.057	0	0.0141	0
Round Gravel	lb	0	0.0000248	0	0.0024	0	0.000018	0	4.52E-06	0	2.61E-06	0	3.08E-07	0
Sand	lb	0	0.0000248	0	0.0024	0	0.000018	0	4.52E-06	0	2.61E-06	0	3.08E-07	0
Stainless Steel	lb	0	0.0116	0	3.4	0	0.0075	0	0.012	0	0.0044	0	0.000144	0
Steel	lb	0	0.0044	0	1.1	0	0.0014	0	0.0017	0	0.00056	0	0.000067	0
Other refined construction materials	lb	0	0.01885	0	2.115	0	0.0040375	0	0.0051325	0	0.0014428	0	0.0001625	0
Other unrefined construction materials	lb	0	0.000028	0	0.00335	0	0.0000165	0	0.000015	0	0.000002	0	2.05E-10	0
Notes:														

EISB + MNA - Off-Site Footprint (Scope 3b)

			Energy		Greenhouse Gas		NOx		SOx		PM		HAPs	
Category	Units	Usage	Conv. Factor	MMBtus	Conv. Factor	lbs CO2e	Conv. Factor	lbs	Conv. Factor	lbs	Conv. Factor	lbs	Conv. Factor	lbs
Treatment Materials & Chemicals														
Cheese Whey	lbs	0	0.0025	0	0.031	0	0.000062	0	0.000033	0	0.000002	0	NP	
Emulsified vegetable oil	lbs	0	0.0077	0	3.44	0	0.0066	0	0.0019	0	0.000033	0	NP	
Granular activated carbon, primary	lbs	0	0.0356	0	4.82	0	0.0793	0	0.128	0	0.000987	0	0.000657	0
Granular activated carbon, regenerated	lbs	0	0.00873	0	1.7	0	0.00733	0	0.0129	0	0.000886	0	0.000671	0
Hydrogen Peroxide, 50% in H2O	lbs	0	0.00979	0	1.19	0	0.00142	0	0.0024	0	0.000308	0	0.0000629	0
Iron (II) Sulfate	lbs	0	0.00147	0	0.167	0	0.000316	0	0.000589	0	0.000103	0	0.000023	0
Lime, Hydrated, Packed	lbs	0	0.00206	0	0.762	0	0.000513	0	0.000358	0	0.00013	0	6.57E-06	0
Molasses	lbs	0	0.0044	0	0.48	0	0.0011	0	0.00024	0	0.0000041	0	NP	
Phosphoric Acid, 70% in H2O	lbs	0	0.0067	0	0.882	0	0.00282	0	0.0294	0	0.00171	0	0.000163	0
Potassium Permanganate	lbs	0	0.00981	0	1.16	0	0.00234	0	0.0032	0	0.000422	0	0.000122	0
Sodium Hydroxide, 50% in H2O	lbs	0	0.00977	0	1.09	0	0.00194	0	0.00352	0	0.000403	0	0.000129	0
Other Treatment Chemicals & Materials	lbs	0	0.015	0	1.67	0	0.003	0	0.0065	0	0.00061	0	0.000016	0
Notes:														
Fuel Processing														
Biodiesel produced	gal	0	0.029	0	-16.8	0	0.018	0	0.033	0	0.00082	0	NP	
Diesel produced	gal	30941.7	0.017	526.0089	3.02	93443.934	0.0051	157.80267	0.0062	191.83854	0.0017	52.60089	0.0011	34.03587
Gasoline produced	gal	2914.3	0.033	96.1719	2.8	8160.04	0.0046	13.40578	0.005	14.5715	0.0015	4.37145	0.001	2.9143
Liquefied Petroleum Gas Produced	gal	0	0.088	0	1.47	0	0.0016	0	0.0024	0	0.0007	0	0.0003	0
Natural Gas - Compressed Produced	ccf	0	19.983	0	343.92	0	0.4732	0	2.1651	0	0.1846	0	0.2895	0
Natural Gas Produced	ccf	0	0.0052	0	2.2	0	0.0037	0	0.0046	0	0.000072	0	0.0000061	0
Fuel Processing Subtotals				**622.1808**		**101603.97**		**171.20845**		**206.41004**		**56.97234**		**36.95017**
Notes:														
Public water	gal x 1000	0	0.0092	0	5	0	0.0097	0	0.0059	0	0.016	0	0.000015	0
User-defined water resource #1	gal x 1000	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined water resource #2	gal x 1000	0	0	0	0	0	0	0	0	0	0	0	0	0
Notes:														

EISB + MNA - Off-Site Footprint (Scope 3b)

			Energy		Greenhouse Gas		NOx		SOx		PM		HAPs	
Category	Units	Usage	Conv. Factor	MMBtus	Conv. Factor	lbs CO2e	Conv. Factor	lbs	Conv. Factor	lbs	Conv. Factor	lbs	Conv. Factor	lbs
Off-Site Services														
Hazardous waste incineration	lb	0	0.00609	0	2.43	0	0.0016	0	0.00167	0	0.000209	0	0.000087	0
Off-site waste water treatment (POTW)	gal x 1000	0	0.015	0	4.4	0	0.016	0	0.015	0	NP		NP	
Off-site non-hazardous waste landfill	ton	0	0.16	0	25	0	0.14	0	0.075	0	0.4	0	0.0014	0
Off-site hazardous waste landfill	ton	0	0.18	0	27.5	0	0.154	0	0.0825	0	0.44	0	0.00154	0
Off-site Laboratory Analysis - Other	sample	0	0.058071	0	6.8534384	0	0.131402	0	0.3038758	0	0.0455698	0	0.0330165	0
Off-site Laboratory Analysis - Metals	sample	0	0.212	0	27.4693	0	0.6423	0	1.5072	0	0.2264	0	0.1643	0
Off-site Laboratory Analysis - Mercury	sample	0	0.0731715	0	9.325458	0	0.2127439	0	0.4982396	0	0.0747359	0	0.0542332	0
Off-site Laboratory Analysis - Inorganic Anions	sample	0	0.0074025	0	0.6459478	0	0.0067681	0	0.0147929	0	0.0022024	0	0.0015542	0
Off-site Laboratory Analysis - Alkalinity	sample	0	0.0174398	0	1.3381922	0	0.0070106	0	0.0132496	0	0.00194	0	0.0012831	0
Off-site Laboratory Analysis - Perchlorate	sample	0	0.023885	0	1.8717054	0	0.0079807	0	0.0141535	0	0.0020547	0	0.0012875	0
Off-site Laboratory Analysis - Nitrogen/Nitrate	sample	0	0.0336475	0	4.29897	0	0.0954592	0	0.2226646	0	0.0335099	0	0.0242506	0
Off-site Laboratory Analysis - Sulfate	sample	0	0.0141225	0	1.4726728	0	0.0079807	0	0.0136024	0	0.0019797	0	0.0012015	0
Off-site Laboratory Analysis - PCBs	sample	0	0.0512769	0	5.224902	0	0.0833339	0	0.1904774	0	0.0284393	0	0.0212083	0
Off-site Laboratory Analysis - VOCs	sample	0	0.0762045	0	9.016814	0	0.104498	0	0.2270738	0	0.0339508	0	0.0235892	0
Off-site Laboratory Analysis - SVOCs	sample	0	0.0715602	0	7.870422	0	0.1459445	0	0.3373038	0	0.0504853	0	0.0372577	0
Notes:														
Resource Extraction for Electricity														
Coal extraction and processing	MWh	0	3.1	0	180.0	0	0.8	0	0.2	0	0.0	0	NP	
Natural gas extraction and processing	MWh	0	1.6	0	270.0	0	0.2	0	13.0	0	0.0	0	NP	
Nuclear fuel extraction and processing	MWh	0	0.2	0	25.0	0	0.2	0	0.5	0	0.0	0	NP	
Oil extraction and processing	MWh	0	2.3	0	270.0	0	1.7	0	0.1	0	0.0	0	NP	
Other fuel extraction and processing	MWh	0	0	0	0	0	0	0	0	0	0	0	0	0
Resource Extraction Subtotals				**0**		**0**		**0**		**0**		**0**		**0**
Notes:														
Electricity Transmission														
Transmission and distribution losses	MWh	0	1.0342	0	35.2	0	0.1504	0	0.146966	0	0.007546	0	0.0045403	0
Notes:														

EISB + MNA - Off-Site Footprint (Scope 3b)

			Energy		Greenhouse Gas		NOx		SOx		PM		HAPs	
			Conv.		Conv.		Conv.		Conv.		Conv.		Conv.	
Category	Units	Usage	Factor	MMBtus	Factor	lbs CO2e	Factor	lbs	Factor	lbs	Factor	lbs	Factor	lbs
User-defined Materials														
User-defined material #1	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #2	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #3	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #4	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #5	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #6	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #7	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #8	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #9	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #10	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #11	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #12	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #13	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #14	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #15	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #16	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #17	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #18	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #19	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #20	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
Notes:														
User-defined Waste Destinations														
User-defined recycled/reused off-site #1	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined recycled/reused off-site #2	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined recycled/reused off-site #3	TBD	0	y(MMBtu/u		(lbs CO2e/u		Ox(lbs/unit		Ox(lbs/unit)		M(lbs/unit)		APs(lbs/unit	
User-defined non-hazardous waste destination #1	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined non-hazardous waste destination #2	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined non-hazardous waste destination #3	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined hazardous waste destination #1	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined hazardous waste destination #2	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined hazardous waste destination #3	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
Notes:														
Off-site Totals				**622.1808**		**101603.97**		**171.20845**		**206.41004**		**56.97234**		**36.95017**

EISB + MNA - Intermediate Totals

Category	Units	Usage	Energy		Greenhouse Gas		NOx		SOx		PM		HAPs	
			Conv. Factor	MMBtus	Conv. Factor	lbs CO2e	Conv. Factor	lbs	Conv. Factor	lbs	Conv. Factor	lbs	Conv. Factor	lbs
Total Grid Electricity Footprint														
On-site grid electricity	MWh	0	3.413	0										
Electricity Generation														
Grid electricity	MWh	0	6.929	0	1124.3	0	2.2421	0	4.6078874	0	0.057518	0	0.2102371	0
Resource Extraction for Electricity														
Coal extraction and processing	MWh	0	3.1	0	180.0	0	0.8	0	0.2	0	0.0	0	NP	
Natural gas extraction and processing	MWh	0	1.6	0	270.0	0	0.2	0	13.0	0	0.0	0	NP	
Nuclear fuel extraction and processing	MWh	0	0.2	0	25.0	0	0.2	0	0.5	0	0.0	0	NP	
Oil extraction and processing	MWh	0	2.3	0	270.0	0	1.7	0	0.1	0	0.0	0	NP	
Other fuel extraction and processing	MWh	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
Electricity Transmission														
Transmission and distribution losses	MWh	0	1.0342	0	112.43	0	0.22421	0	0.4607887	0	0.0057518	0	0.0210237	0
Total Grid Electricity Footprint				**0**		**0**		**0**		**0**		**0**		**0**
Total Fuel Footprints														
Total Gasoline Footprint														
On-site gasoline use - Other	gal	0	0.124	0	19.6	0	0.11	0	0.0045	0	0.00054	0	0.000039	0
On-site gasoline use <25 hp	gal	0	0.124	0	17.48	0	0.037	0	0.00025	0	0.165	0	0.00008	0
On-site gasoline use >25 hp	gal	0	0.124	0	19.93	0	0.032	0	0.00029	0	0.002	0	0.00009	0
Transportation gasoline use	gal	-4.55E-13	0.124	-5.64E-14	19.6	-8.91E-12	0.11	-5E-14	0.0045	-2.05E-15	0.00054	-2.46E-16	0.000039	-1.77E-17
Transportation gasoline use - car	gal	2880	0.124	357.12	19.77	56937.6	0.027	77.76	0.00036	1.0368	0.003	8.64	0.0067	19.296
Transportation gasoline use - passenger truck	gal	34.3	0.124	4.2532	19.79	678.797	0.035	1.2005	0.00036	0.012348	0.003	0.1029	0.00661	0.226723
Transportation gasoline use - User Defined	gal	0	0.124	0	19.6	0	0.11	0	0.0045	0	0.00054	0	0.000039	0
Gasoline produced	gal	2914.3	0.033	96.1719	2.8	8160.04	0.0046	13.40578	0.005	14.5715	0.0015	4.37145	0.001	2.9143
Total Gasoline Footprint		**2914.3**		**457.5451**		**65776.437**		**92.36628**		**15.620648**		**13.11435**		**22.437023**
Total Diesel Footprint														
On-site diesel use - Other	gal	14310	0.139	1989.09	22.5	321975	0.17	2432.7	0.0054	77.274	0.0034	48.654	0.0000052	0.074412
On-site diesel use <75 hp	gal	0	0.139	0	22.21	0	0.1565	0	0.000145	0	0.0145	0	0.00004	0
On-site diesel use 75<hp<750	gal	0	0.139	0	22.24	0	0.101	0	0.00013	0	0.009	0	0.00004	0
On-site diesel use >750 hp	gal	0	0.139	0	22.24	0	0.149	0	0.00013	0	0.006	0	0.00004	0
Transportation diesel use	gal	16631.7	0.139	2311.8063	22.5	374213.25	0.17	2827.389	0.0054	89.81118	0.0034	56.54778	0.0000052	0.0864848
Transportation diesel use - car	gal	0	0.139	0	22.57	0	0.015	0	0.0002	0	0.003	0	0.00252	0
Transportation diesel use - passenger truck	gal	0	0.139	0	22.545	0	0.0585	0	0.0002	0	0.007	0	0.002605	0
Transportation diesel use - User Defined	gal	0	0.139	0	22.5	0	0.17	0	0.0054	0	0.0034	0	0.0000052	0
Diesel produced	gal	30941.7	0.017	526.0089	3.02	93443.934	0.0051	157.80267	0.0062	191.83854	0.0017	52.60089	0.0011	34.03587
Total Diesel Footprint		**30941.7**		**4826.9052**		**789632.18**		**5417.8917**		**358.92372**		**157.80267**		**34.196767**
Total Biodiesel Footprint														
On-site biodiesel use	gal	0	0.127	0	22.3	0	0.2	0	0	0	0.00099	0	NP	
On-site biodiesel use - User Defined	gal	0	0.127	0	22.3	0	0.2	0	0	0	0.00099	0	NP	
Transportation biodiesel use	gal	0	0.127	0	22.3	0	0.2	0	0	0	0.00099	0	NP	
Transportation biodiesel use - User Defined	gal	0	0.127	0	22.3	0	0.2	0	0	0	0.00099	0	NP	
Biodiesel produced	gal	0	0.029	0	-16.8	0	0.018	0	0.033	0	0.00082	0	NP	
Total Biodiesel Footprint		**0**		**0**		**0**		**0**		**0**		**0**		**0**
Total Natural Gas Footprint														
On-site natural gas use	ccf	0	0.103	0	13.1	0	0.01	0	0.0000063	0	0.00076	0	0.0000084	0
Transportation natural gas use	ccf	0	0.103	0	13.1	0	0.01	0	0.0000063	0	0.00076	0	0.0000084	0
Transportation natural gas use - User Defined	ccf	0	0.103	0	13.1	0	0.01	0	0.0000063	0	0.00076	0	0.0000084	0
Natural gas produced	ccf	0	0.0052	0	2.2	0	0.0037	0	0.0046	0	0.000072	0	0.0000061	0
Total Natural Gas Footprint		**0**		**0**		**0**		**0**		**0**		**0**		**0**
Total Liquified Petroleum Gas Footprint														
On-site liquified petroleum gas use - Other	ccf	0	NP		12.69	0	0.021	0	0.00013	0	0.001	0	0	0
On-site liquified petroleum gas use	ccf	0	NP		12.69	0	0.021	0	0.00013	0	0.001	0	0	0
Liquified petroleum gas produced	ccf	0	0.088	0	1.47	0	0.0016	0	0.0024	0	0.0007	0	0.0003	0
Total Natural Gas Footprint		**0**		**0**		**0**		**0**		**0**		**0**		**0**
Total Compressed Gas Footprint														
On-site compressed gas use - Other	ccf	0	NP		1957.835	0	16.0325	0	0.023045	0	0.2775	0	0	0
On-site compressed gas use	ccf	0	NP		1957.835	0	16.0325	0	0.023045	0	0.2775	0	0	0
Compressed gas produced	ccf	0	19.983	0	343.92	0	0.4732	0	2.1651	0	0.1846	0	0.2895	0
Total Natural Gas Footprint		**0**		**0**		**0**		**0**		**0**		**0**		**0**

Notes:

Note: Please refer to the "Default Conversions" tab for references for the default conversion factors used on this calculation sheet.

Space below available for notes and calculations:

Targeted EISB + MNA - On-Site Footprint (Scope 1)

			Energy		GHG		NOx		SOx		PM		HAPs	
Contributors to Footprints	**Units**	**Usage**	**Conv. Factor**	**MMBtus**	**Conv. Factor**	**lbs CO2e**	**Conv. Factor**	**lbs**	**Conv. Factor**	**lbs**	**Conv. Factor**	**lbs**	**Conv. Factor**	**lbs**
On-Site														
On-site Renewable Energy														
Renewable electricity generated on-site	MWh	0	3.413	0										
Landfill gas combusted on-site for energy use	ccf CH4	0	0.103	0	13.1	0	0.01	0	0.0000063	0	0.00076	0	0.0000084	0
On-site biodiesel use	gal	0	0.127	0	22.3	0	0.2	0	0	0	0.00099	0	NP	
On-site biodiesel use - User Defined	gal	0	0.127	0	22.3	0	0.2	0	0	0	0.00099	0	NP	
User-defined on-site renewable energy use #1	gal	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined on-site renewable energy use #2	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
On-site Renewable Energy Subtotals				**0**		**0**		**0**		**0**		**0**		**0**
Notes:														
On-site Conventional Energy														
On-site grid electricity	MWh	0	3.413	0										
On-site diesel use - Other	Gal	4522.5	0.139	628.6275	22.5	101756.25	0.17	768.825	0.0054	24.4215	0.0034	15.3765	0.0000052	0.023517
On-site diesel use <75 hp	Gal	0	0.139	0	22.21	0	0.1565	0	0.000145	0	0.0145	0	0.00004	0
On-site diesel use 75<hp<750	Gal	0	0.139	0	22.24	0	0.101	0	0.00013	0	0.009	0	0.00004	0
On-site diesel use >750 hp	Gal	0	0.139	0	22.24	0	0.149	0	0.00013	0	0.006	0	0.00004	0
On-site gasoline use - Other	Gal	0	0.124	0	19.6	0	0.11	0	0.0045	0	0.00054	0	0.000039	0
On-site gasoline use <25 hp	Gal	0	0.124	0	17.48	0	0.037	0	0.00025	0	0.165	0	0.00008	0
On-site gasoline use >25 hp	Gal	0	0.124	0	19.93	0	0.032	0	0.00029	0	0.002	0	0.00009	0
On-site natural gas use	ccf	0	0.103	0	13.1	0	0.01	0	0.0000063	0	0.00076	0	0.0000084	0
On-site compressed natural gas use - Other	ccf	0	NP		1957.835	0	16.0325	0	0.023045	0	0.2775	0	0	0
On-site compressed natural gas use	ccf	0	NP		1957.835	0	16.0325	0	0.023045	0	0.2775	0	0	0
On-site liquified petroleum gas use - Other	gal	0	NP		12.69	0	0.021	0	0.00013	0	0.001	0	0	0
On-site liquified petroleum gas use	gal	0	NP		12.69	0	0.021	0	0.00013	0	0.001	0	0	0
Other forms of on-site conventional energy use #1	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
Other forms of on-site conventional energy use #2	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
On-site Conventional Energy Subtotals				**629**		**101,756**		**769**		**24**		**15**		**0**
Notes:														
Other On-site Emissions														
On-site HAP process emissions	lbs	0											1	0
On-site GHG emissions	lbs CO2e	0			1	0								
On-site carbon storage	lbs CO2e	0			1	0								
GHG avoided by flaring on-site landfill methane	Lbs	0			-262	0	0.01	0	0.0000063	0	0.00076	0	0.0000084	0
Other on-site NOx emissions or reductions	lbs	0					1	0						
Other on-site SOx emissions or reductions	lbs	0							1	0				
Other on-site PM emissions or reductions	lbs	0									1	0		
User-defined recycled/reused on-site #2	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined recycled/reused on-site #3	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined recycled/reused off-site #1	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
Notes:														
On-site Totals				**628.63**		**101,756**		**769**		**24**		**15**		**0**

Targeted EISB + MNA - Electricity Generation Footprint (Scope 2)

Contributors to Footprints	Units	Usage	Energy		GHG		NOx		SOx		PM		HAPs	
			Conv. Factor	MMBtus	Conv. Factor	lbs CO2e	Conv. Factor	lbs	Conv. Factor	lbs	Conv. Factor	lbs	Conv. Factor	lbs
Electricity Generation														
Grid electricity	MWh	0	6.929	0	352	0	1.504	0	1.46966	0	0.07546	0	0.0454035	0
Voluntary purchase of renewable electricity	MWh	0												
Voluntary purchase of RECs	MWh	0												
Notes:														

Spreadsheets for Environmental Footprint Analysis (SEFA) Version 3.0, November 2019

Ash Road Off-Site
Alternative Analysis
Targeted EISB + MNA

Targeted EISB + MNA - Transportation Footprint (Scope 3a)

Category	Units	Usage	Energy		Greenhouse Gas		NOx		SOx		PM		HAPs	
			Conv. Factor	MMBtus	Conv. Factor	lbs CO2e	Conv. Factor	lbs	Conv. Factor	lbs	Conv. Factor	lbs	Conv. Factor	lbs
Conventional Energy														
Transportation diesel use	gal	8968.5	0.139	1246.6215	22.5	201791.25	0.17	1524.645	0.0054	48.4299	0.0034	30.4929	0.0000052	0.0466362
Transportation diesel use - car	gal	0	0.139	0	22.57	0	0.015	0	0.0002	0	0.003	0	0.00252	0
Transportation diesel use - passenger truck	gal	0	0.139	0	22.545	0	0.0585	0	0.0002	0	0.007	0	0.002605	0
Transportation diesel use - User Defined	gal	0	0.139	0	22.5	0	0.17	0	0.0054	0	0.0034	0	0.0000052	0
Transportation gasoline use	gal	-4.55E-13	0.124	-5.64E-14	19.6	-8.91E-12	0.11	-5E-14	0.0045	-2.05E-15	0.00054	-2.46E-16	0.000039	-1.77E-17
Transportation gasoline use - car	gal	2858.4	0.124	354.4416	19.77	56510.568	0.027	77.1768	0.00036	1.029024	0.003	8.5752	0.0067	19.15128
Transportation gasoline use - passenger truck	gal	34.3	0.124	4.2532	19.79	678.797	0.035	1.2005	0.00036	0.012348	0.003	0.1029	0.00661	0.226723
Transportation gasoline use - User Defined	gal	0	0.124	0	19.6	0	0.11	0	0.0045	0	0.00054	0	0.000039	0
Transportation natural gas use	ccf	0	0.103	0	13.1	0	0.01	0	0.0000063	0	0.00076	0	0.0000084	0
Transportation natural gas use - User Defined	ccf	0	0.103	0	13.1	0	0.01	0	0.0000063	0	0.00076	0	0.0000084	0
User-defined conventional energy transportation #1	TBD	10	0	0	0	0	0	0	0	0	0	0	0	0
User-defined conventional energy transportation #2	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
Conventional Energy Subtotals				**1,605**		**258,981**		**1,603**		**49**		**39**		**19**
Notes:														
Renewable Energy														
Transportation biodiesel use	gal	0	0.127	0	22.3	0	0.2	0	0	0	0.00099	0	NP	
Transportation biodiesel use - User Defined	gal	0	0.127	0	22.3	0	0.2	0	0	0	0.00099	0	NP	
User-defined renewable energy transportation #1	TBD	0	Biodiesel		0	0	0	0	0	0	0	0	Ref.	
User-defined renewable energy transportation #2	TBD	0	mpg or pmp		0	0	0	0	0	0	0	0	0	0
Renewable Energy Subtotals				**0**		**0**		**0**		**0**		**0**		**0**
Notes:														
Transportation Totals				**1605**		**258981**		**1603**		**49**		**39**		**19**

Targeted EISB + MNA - Off-Site Footprint (Scope 3b)

			Energy		Greenhouse Gas		NOx		SOx		PM		HAPs	
Category	Units	Usage	Conv. Factor	MMBtus	Conv. Factor	lbs CO2e	Conv. Factor	lbs	Conv. Factor	lbs	Conv. Factor	lbs	Conv. Factor	lbs
Construction Materials														
Aluminum, Rolled Sheet	lb	0	0.0633	0	9.15	0	0.0148	0	0.0283	0	0.0088	0	0.00102	0
Asphalt, mastic	lb	0	0.0412	0	0.85	0	0.00271	0	0.00798	0	0.000766	0	0.00107	0
Asphalt, paving-grade	lb	0	0.5	0	8.58	0	0.0299	0	0.0969	0	0.0091	0	0.0133	0
Ethanol, Corn, 95%	lb	0	0.0318	0	-0.0199	0	0.00425	0	0.00303	0	0.000469	0	0.0000846	0
Ethanol, Corn, 99.7%	lb	0	0.0324	0	0.0591	0	0.00431	0	0.0031	0	0.000472	0	0.000087	0
Ethanol, Petroleum, 99.7%	lb	0	0.0205	0	1.25	0	0.00199	0	0.00214	0	0.000277	0	0.0000589	0
Gravel/Sand Mix, 65% Gravel	lb	0	0.0000248	0	0.0024	0	0.000018	0	4.52E-06	0	2.61E-06	0	3.08E-07	0
Gravel/sand/clay	lb	0	0.000028	0	0.00335	0	0.0000165	0	0.000015	0	0.000002	0	2.05E-10	0
HDPE	lb	0	0.0332	0	1.94	0	0.00325	0	0.00409	0	0.000439	0	0.0000641	0
Photovoltaic system (installed)	W	0	0.0336	0	4.47	0	0.015	0	0.032	0	0.00063	0	0.0000029	0
PVC	lb	0	0.0262	0	2.02	0	0.004	0	0.00274	0	0.000372	0	0.000375	0
Portland cement, US average	lb	0	0.0139	0	1.34	0	0.00654	0	0.0104	0	0.00378	0	0.00097	0
Ready-mixed concrete, 20 MPa	ft3	0	0.217	0	19.5	0	0.0975	0	0.154	0	0.057	0	0.0141	0
Round Gravel	lb	0	0.0000248	0	0.0024	0	0.000018	0	4.52E-06	0	2.61E-06	0	3.08E-07	0
Sand	lb	0	0.0000248	0	0.0024	0	0.000018	0	4.52E-06	0	2.61E-06	0	3.08E-07	0
Stainless Steel	lb	0	0.0116	0	3.4	0	0.0075	0	0.012	0	0.0044	0	0.000144	0
Steel	lb	0	0.0044	0	1.1	0	0.0014	0	0.0017	0	0.00056	0	0.000067	0
Other refined construction materials	lb	0	0.01885	0	2.115	0	0.0040375	0	0.0051325	0	0.0014428	0	0.0001625	0
Other unrefined construction materials	lb	0	0.000028	0	0.00335	0	0.0000165	0	0.000015	0	0.000002	0	2.05E-10	0
Notes:														

Targeted EISB + MNA - Off-Site Footprint (Scope 3b)

			Energy		Greenhouse Gas		NOx		SOx		PM		HAPs	
Category	Units	Usage	Conv. Factor	MMBtus	Conv. Factor	lbs CO2e	Conv. Factor	lbs	Conv. Factor	lbs	Conv. Factor	lbs	Conv. Factor	lbs
Treatment Materials & Chemicals														
Cheese Whey	lbs	0	0.0025	0	0.031	0	0.000062	0	0.000033	0	0.000002	0	NP	
Emulsified vegetable oil	lbs	0	0.0077	0	3.44	0	0.0066	0	0.0019	0	0.000033	0	NP	
Granular activated carbon, primary	lbs	0	0.0356	0	4.82	0	0.0793	0	0.128	0	0.000987	0	0.000657	0
Granular activated carbon, regenerated	lbs	0	0.00873	0	1.7	0	0.00733	0	0.0129	0	0.000886	0	0.000671	0
Hydrogen Peroxide, 50% in H2O	lbs	0	0.00979	0	1.19	0	0.00142	0	0.0024	0	0.000308	0	0.0000629	0
Iron (II) Sulfate	lbs	0	0.00147	0	0.167	0	0.000316	0	0.000589	0	0.000103	0	0.000023	0
Lime, Hydrated, Packed	lbs	0	0.00206	0	0.762	0	0.000513	0	0.000358	0	0.00013	0	6.57E-06	0
Molasses	lbs	0	0.0044	0	0.48	0	0.0011	0	0.00024	0	0.0000041	0	NP	
Phosphoric Acid, 70% in H2O	lbs	0	0.0067	0	0.882	0	0.00282	0	0.0294	0	0.00171	0	0.000163	0
Potassium Permanganate	lbs	0	0.00981	0	1.16	0	0.00234	0	0.0032	0	0.000422	0	0.000122	0
Sodium Hydroxide, 50% in H2O	lbs	0	0.00977	0	1.09	0	0.00194	0	0.00352	0	0.000403	0	0.000129	0
Other Treatment Chemicals & Materials	lbs	0	0.015	0	1.67	0	0.003	0	0.0065	0	0.00061	0	0.000016	0
Notes:														
Fuel Processing														
Biodiesel produced	gal	0	0.029	0	-16.8	0	0.018	0	0.033	0	0.00082	0	NP	
Diesel produced	gal	13491	0.017	229.347	3.02	40742.82	0.0051	68.8041	0.0062	83.6442	0.0017	22.9347	0.0011	14.8401
Gasoline produced	gal	2892.7	0.033	95.4591	2.8	8099.56	0.0046	13.30642	0.005	14.4635	0.0015	4.33905	0.001	2.8927
Liquefied Petroleum Gas Produced	gal	0	0.088	0	1.47	0	0.0016	0	0.0024	0	0.0007	0	0.0003	0
Natural Gas - Compressed Produced	ccf	0	19.983	0	343.92	0	0.4732	0	2.1651	0	0.1846	0	0.2895	0
Natural Gas Produced	ccf	0	0.0052	0	2.2	0	0.0037	0	0.0046	0	0.000072	0	0.0000061	0
Fuel Processing Subtotals				**324.8061**		**48842.38**		**82.11052**		**98.1077**		**27.27375**		**17.7328**
Notes:														
Public water	gal x 1000	0	0.0092	0	5	0	0.0097	0	0.0059	0	0.016	0	0.000015	0
User-defined water resource #1	gal x 1000	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined water resource #2	gal x 1000	0	0	0	0	0	0	0	0	0	0	0	0	0
Notes:														

Targeted EISB + MNA - Off-Site Footprint (Scope 3b)

			Energy		Greenhouse Gas		NOx		SOx		PM		HAPs	
Category	Units	Usage	Conv. Factor	MMBtus	Conv. Factor	lbs CO2e	Conv. Factor	lbs	Conv. Factor	lbs	Conv. Factor	lbs	Conv. Factor	lbs
Off-Site Services														
Hazardous waste incineration	lb	0	0.00609	0	2.43	0	0.0016	0	0.00167	0	0.000209	0	0.000087	0
Off-site waste water treatment (POTW)	gal x 1000	0	0.015	0	4.4	0	0.016	0	0.015	0	NP		NP	
Off-site non-hazardous waste landfill	ton	0	0.16	0	25	0	0.14	0	0.075	0	0.4	0	0.0014	0
Off-site hazardous waste landfill	ton	0	0.18	0	27.5	0	0.154	0	0.0825	0	0.44	0	0.00154	0
Off-site Laboratory Analysis - Other	sample	0	0.058071	0	6.8534384	0	0.131402	0	0.3038758	0	0.0455698	0	0.0330165	0
Off-site Laboratory Analysis - Metals	sample	0	0.212	0	27.4693	0	0.6423	0	1.5072	0	0.2264	0	0.1643	0
Off-site Laboratory Analysis - Mercury	sample	0	0.0731715	0	9.325458	0	0.2127439	0	0.4982396	0	0.0747359	0	0.0542332	0
Off-site Laboratory Analysis - Inorganic Anions	sample	0	0.0074025	0	0.6459478	0	0.0067681	0	0.0147929	0	0.0022024	0	0.0015542	0
Off-site Laboratory Analysis - Alkalinity	sample	0	0.0174398	0	1.3381922	0	0.0070106	0	0.0132496	0	0.00194	0	0.0012831	0
Off-site Laboratory Analysis - Perchlorate	sample	0	0.023885	0	1.8717054	0	0.0079807	0	0.0141535	0	0.0020547	0	0.0012875	0
Off-site Laboratory Analysis - Nitrogen/Nitrate	sample	0	0.0336475	0	4.29897	0	0.0954592	0	0.2226646	0	0.0335099	0	0.0242506	0
Off-site Laboratory Analysis - Sulfate	sample	0	0.0141225	0	1.4726728	0	0.0079807	0	0.0136024	0	0.0019797	0	0.0012015	0
Off-site Laboratory Analysis - PCBs	sample	0	0.0512769	0	5.224902	0	0.0833339	0	0.1904774	0	0.0284393	0	0.0212083	0
Off-site Laboratory Analysis - VOCs	sample	0	0.0762045	0	9.016814	0	0.104498	0	0.2270738	0	0.0339508	0	0.0235892	0
Off-site Laboratory Analysis - SVOCs	sample	0	0.0715602	0	7.870422	0	0.1459445	0	0.3373038	0	0.0504853	0	0.0372577	0
Notes:														
Resource Extraction for Electricity														
Coal extraction and processing	MWh	0	3.1	0	180.0	0	0.8	0	0.2	0	0.0	0	NP	
Natural gas extraction and processing	MWh	0	1.6	0	270.0	0	0.2	0	13.0	0	0.0	0	NP	
Nuclear fuel extraction and processing	MWh	0	0.2	0	25.0	0	0.2	0	0.5	0	0.0	0	NP	
Oil extraction and processing	MWh	0	2.3	0	270.0	0	1.7	0	0.1	0	0.0	0	NP	
Other fuel extraction and processing	MWh	0	0	0	0	0	0	0	0	0	0	0	0	0
Resource Extraction Subtotals				**0**		**0**		**0**		**0**		**0**		**0**
Notes:														
Electricity Transmission														
Transmission and distribution losses	MWh	0	1.0342	0	35.2	0	0.1504	0	0.146966	0	0.007546	0	0.0045403	0
Notes:														

Targeted EISB + MNA - Off-Site Footprint (Scope 3b)

			Energy		Greenhouse Gas		NOx		SOx		PM		HAPs	
			Conv.		Conv.		Conv.		Conv.		Conv.		Conv.	
Category	Units	Usage	Factor	MMBtus	Factor	lbs CO2e	Factor	lbs	Factor	lbs	Factor	lbs	Factor	lbs
User-defined Materials														
User-defined material #1	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #2	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #3	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #4	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #5	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #6	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #7	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #8	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #9	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #10	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #11	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #12	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #13	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #14	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #15	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #16	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #17	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #18	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #19	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #20	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
Notes:														
User-defined Waste Destinations														
User-defined recycled/reused off-site #1	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined recycled/reused off-site #2	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined recycled/reused off-site #3	TBD	0	y(MMBtu/t		(lbs CO2e/t		Ox(lbs/unit		Ox(lbs/unit)		M(lbs/unit)		APs(lbs/unit	
User-defined non-hazardous waste destination #1	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined non-hazardous waste destination #2	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined non-hazardous waste destination #3	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined hazardous waste destination #1	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined hazardous waste destination #2	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined hazardous waste destination #3	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
Notes:														
Off-site Totals				**324.8061**		**48842.38**		**82.11052**		**98.1077**		**27.27375**		**17.7328**

Targeted EISB + MNA - Intermediate Totals

Category	Units	Usage	Energy		Greenhouse Gas		NOx		SOx		PM		HAPs	
			Conv. Factor	MMBtus	Conv. Factor	lbs CO2e	Conv. Factor	lbs	Conv. Factor	lbs	Conv. Factor	lbs	Conv. Factor	lbs
Total Grid Electricity Footprint														
On-site grid electricity	MWh	0	3.413	0										
Electricity Generation														
Grid electricity	MWh	0	6.929	0	1124.3	0	2.2421	0	4.6078874	0	0.057518	0	0.2102371	0
Resource Extraction for Electricity														
Coal extraction and processing	MWh	0	3.1	0	180.0	0	0.8	0	0.2	0	0.0	0	NP	
Natural gas extraction and processing	MWh	0	1.6	0	270.0	0	0.2	0	13.0	0	0.0	0	NP	
Nuclear fuel extraction and processing	MWh	0	0.2	0	25.0	0	0.2	0	0.5	0	0.0	0	NP	
Oil extraction and processing	MWh	0	2.3	0	270.0	0	1.7	0	0.1	0	0.0	0	NP	
Other fuel extraction and processing	MWh	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
Electricity Transmission														
Transmission and distribution losses	MWh	0	1.0342	0	112.43	0	0.22421	0	0.4607887	0	0.0057518	0	0.0210237	0
Total Grid Electricity Footprint				**0**		**0**		**0**		**0**		**0**		**0**
Total Fuel Footprints														
Total Gasoline Footprint														
On-site gasoline use - Other	gal	0	0.124	0	19.6	0	0.11	0	0.0045	0	0.00054	0	0.000039	0
On-site gasoline use <25 hp	gal	0	0.124	0	17.48	0	0.037	0	0.00025	0	0.165	0	0.00008	0
On-site gasoline use >25 hp	gal	0	0.124	0	19.93	0	0.032	0	0.00029	0	0.002	0	0.00009	0
Transportation gasoline use	gal	-4.55E-13	0.124	-5.64E-14	19.6	-8.91E-12	0.11	-5E-14	0.0045	-2.05E-15	0.00054	-2.46E-16	0.000039	-1.77E-17
Transportation gasoline use - car	gal	2858.4	0.124	354.4416	19.77	56510.568	0.027	77.1768	0.00036	1.029024	0.003	8.5752	0.0067	19.15128
Transportation gasoline use - passenger truck	gal	34.3	0.124	4.2532	19.79	678.797	0.035	1.2005	0.00036	0.012348	0.003	0.1029	0.00661	0.226723
Transportation gasoline use - User Defined	gal	0	0.124	0	19.6	0	0.11	0	0.0045	0	0.00054	0	0.000039	0
Gasoline produced	gal	2892.7	0.033	95.4591	2.8	8099.56	0.0046	13.30642	0.005	14.4635	0.0015	4.33905	0.001	2.8927
Total Gasoline Footprint		**2892.7**		**454.1539**		**65288.925**		**91.68372**		**15.504872**		**13.01715**		**22.270703**
Total Diesel Footprint														
On-site diesel use - Other	gal	4522.5	0.139	628.6275	22.5	101756.25	0.17	768.825	0.0054	24.4215	0.0034	15.3765	0.0000052	0.023517
On-site diesel use <75 hp	gal	0	0.139	0	22.21	0	0.1565	0	0.000145	0	0.0145	0	0.00004	0
On-site diesel use 75<hp<750	gal	0	0.139	0	22.24	0	0.101	0	0.00013	0	0.009	0	0.00004	0
On-site diesel use >750 hp	gal	0	0.139	0	22.24	0	0.149	0	0.00013	0	0.006	0	0.00004	0
Transportation diesel use	gal	8968.5	0.139	1246.6215	22.5	201791.25	0.17	1524.645	0.0054	48.4299	0.0034	30.4929	0.0000052	0.0466362
Transportation diesel use - car	gal	0	0.139	0	22.57	0	0.015	0	0.0002	0	0.003	0	0.00252	0
Transportation diesel use - passenger truck	gal	0	0.139	0	22.545	0	0.0585	0	0.0002	0	0.007	0	0.002605	0
Transportation diesel use - User Defined	gal	0	0.139	0	22.5	0	0.17	0	0.0054	0	0.0034	0	0.0000052	0
Diesel produced	gal	13491	0.017	229.347	3.02	40742.82	0.0051	68.8041	0.0062	83.6442	0.0017	22.9347	0.0011	14.8401
Total Diesel Footprint		**13491**		**2104.596**		**344290.32**		**2362.2741**		**156.4956**		**68.8041**		**14.910253**
Total Biodiesel Footprint														
On-site biodiesel use	gal	0	0.127	0	22.3	0	0.2	0	0	0	0.00099	0	NP	
On-site biodiesel use - User Defined	gal	0	0.127	0	22.3	0	0.2	0	0	0	0.00099	0	NP	
Transportation biodiesel use	gal	0	0.127	0	22.3	0	0.2	0	0	0	0.00099	0	NP	
Transportation biodiesel use - User Defined	gal	0	0.127	0	22.3	0	0.2	0	0	0	0.00099	0	NP	
Biodiesel produced	gal	0	0.029	0	-16.8	0	0.018	0	0.033	0	0.00082	0	NP	
Total Biodiesel Footprint		**0**		**0**		**0**		**0**		**0**		**0**		**0**
Total Natural Gas Footprint														
On-site natural gas use	ccf	0	0.103	0	13.1	0	0.01	0	0.0000063	0	0.00076	0	0.0000084	0
Transportation natural gas use	ccf	0	0.103	0	13.1	0	0.01	0	0.0000063	0	0.00076	0	0.0000084	0
Transportation natural gas use - User Defined	ccf	0	0.103	0	13.1	0	0.01	0	0.0000063	0	0.00076	0	0.0000084	0
Natural gas produced	ccf	0	0.0052	0	2.2	0	0.0037	0	0.0046	0	0.000072	0	0.0000061	0
Total Natural Gas Footprint		**0**		**0**		**0**		**0**		**0**		**0**		**0**
Total Liquified Petroleum Gas Footprint														
On-site liquified petroleum gas use - Other	ccf	0	NP		12.69	0	0.021	0	0.00013	0	0.001	0	0	0
On-site liquified petroleum gas use	ccf	0	NP		12.69	0	0.021	0	0.00013	0	0.001	0	0	0
Liquified petroleum gas produced	ccf	0	0.088	0	1.47	0	0.0016	0	0.0024	0	0.0007	0	0.0003	0
Total Natural Gas Footprint		**0**		**0**		**0**		**0**		**0**		**0**		**0**
Total Compressed Gas Footprint														
On-site compressed gas use - Other	ccf	0	NP		1957.835	0	16.0325	0	0.023045	0	0.2775	0	0	0
On-site compressed gas use	ccf	0	NP		1957.835	0	16.0325	0	0.023045	0	0.2775	0	0	0
Compressed gas produced	ccf	0	19.983	0	343.92	0	0.4732	0	2.1651	0	0.1846	0	0.2895	0
Total Natural Gas Footprint		**0**		**0**		**0**		**0**		**0**		**0**		**0**

Notes:

Note: Please refer to the "Default Conversions" tab for references for the default conversion factors used on this calculation sheet.

Space below available for notes and calculations:

SVE/AS + O&M + MNA - On-Site Footprint (Scope 1)

			Energy		GHG		NOx		SOx		PM		HAPs	
Contributors to Footprints	**Units**	**Usage**	**Conv. Factor**	**MMBtus**	**Conv. Factor**	**lbs CO2e**	**Conv. Factor**	**lbs**	**Conv. Factor**	**lbs**	**Conv. Factor**	**lbs**	**Conv. Factor**	**lbs**
On-Site														
On-site Renewable Energy														
Renewable electricity generated on-site	MWh	0	3.413	0										
Landfill gas combusted on-site for energy use	ccf CH4	0	0.103	0	13.1	0	0.01	0	0.0000063	0	0.00076	0	0.0000084	0
On-site biodiesel use	gal	0	0.127	0	22.3	0	0.2	0	0	0	0.00099	0	NP	
On-site biodiesel use - User Defined	gal	0	0.127	0	22.3	0	0.2	0	0	0	0.00099	0	NP	
User-defined on-site renewable energy use #1	gal	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined on-site renewable energy use #2	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
On-site Renewable Energy Subtotals				**0**		**0**		**0**		**0**		**0**		**0**
Notes:														
On-site Conventional Energy														
On-site grid electricity	MWh	15660	3.413	53447.58										
On-site diesel use - Other	Gal	5850	0.139	813.15	22.5	131625	0.17	994.5	0.0054	31.59	0.0034	19.89	0.0000052	0.03042
On-site diesel use <75 hp	Gal	0	0.139	0	22.21	0	0.1565	0	0.000145	0	0.0145	0	0.00004	0
On-site diesel use 75<hp<750	Gal	0	0.139	0	22.24	0	0.101	0	0.00013	0	0.009	0	0.00004	0
On-site diesel use >750 hp	Gal	0	0.139	0	22.24	0	0.149	0	0.00013	0	0.006	0	0.00004	0
On-site gasoline use - Other	Gal	0	0.124	0	19.6	0	0.11	0	0.0045	0	0.00054	0	0.000039	0
On-site gasoline use <25 hp	Gal	0	0.124	0	17.48	0	0.037	0	0.00025	0	0.165	0	0.00008	0
On-site gasoline use >25 hp	Gal	0	0.124	0	19.93	0	0.032	0	0.00029	0	0.002	0	0.00009	0
On-site natural gas use	ccf	0	0.103	0	13.1	0	0.01	0	0.0000063	0	0.00076	0	0.0000084	0
On-site compressed natural gas use - Other	ccf	0	NP		1957.835	0	16.0325	0	0.023045	0	0.2775	0	0	0
On-site compressed natural gas use	ccf	0	NP		1957.835	0	16.0325	0	0.023045	0	0.2775	0	0	0
On-site liquified petroleum gas use - Other	gal	0	NP		12.69	0	0.021	0	0.00013	0	0.001	0	0	0
On-site liquified petroleum gas use	gal	0	NP		12.69	0	0.021	0	0.00013	0	0.001	0	0	0
Other forms of on-site conventional energy use #1	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
Other forms of on-site conventional energy use #2	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
On-site Conventional Energy Subtotals				**54,261**		**131,625**		**995**		**32**		**20**		**0**
Notes:														
Other On-site Emissions														
On-site HAP process emissions	lbs	0											1	0
On-site GHG emissions	lbs CO2e	0			1	0								
On-site carbon storage	lbs CO2e	0			1	0								
GHG avoided by flaring on-site landfill methane	Lbs	0			-262	0	0.01	0	0.0000063	0	0.00076	0	0.0000084	0
Other on-site NOx emissions or reductions	lbs	0					1	0						
Other on-site SOx emissions or reductions	lbs	0							1	0				
Other on-site PM emissions or reductions	lbs	0									1	0		
User-defined recycled/reused on-site #2	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined recycled/reused on-site #3	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined recycled/reused off-site #1	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
Notes:														
On-site Totals				**54,260.73**		**131,625**		**995**		**32**		**20**		**0**

SVE/AS + O&M + MNA - Electricity Generation Footprint (Scope 2)

Contributors to Footprints	Units	Usage	Energy		GHG		NOx		SOx		PM		HAPs	
			Conv. Factor	MMBtus	Conv. Factor	lbs CO2e	Conv. Factor	lbs	Conv. Factor	lbs	Conv. Factor	lbs	Conv. Factor	lbs
Electricity Generation														
Grid electricity	MWh	15660	6.929	108508.14	352	5512320	1.504	23552.64	1.46966	23014.876	0.07546	1181.7036	0.0454035	711.01878
Voluntary purchase of renewable electricity	MWh	0												
Voluntary purchase of RECs	MWh	0												
Notes:														

Spreadsheets for Environmental Footprint Analysis (SEFA) Version 3.0, November 2019

Ash Road Off-Site
Alternative Analysis
SVE/AS + O&M + MNA

SVE/AS + O&M + MNA - Transportation Footprint (Scope 3a)

Category	Units	Usage	Energy		Greenhouse Gas		NOx		SOx		PM		HAPs	
			Conv. Factor	MMBtus	Conv. Factor	lbs CO2e	Conv. Factor	lbs	Conv. Factor	lbs	Conv. Factor	lbs	Conv. Factor	lbs
Conventional Energy														
Transportation diesel use	gal	2584.4	0.139	359.2316	22.5	58149	0.17	439.348	0.0054	13.95576	0.0034	8.78696	0.0000052	0.0134389
Transportation diesel use - car	gal	0	0.139	0	22.57	0	0.015	0	0.0002	0	0.003	0	0.00252	0
Transportation diesel use - passenger truck	gal	0	0.139	0	22.545	0	0.0585	0	0.0002	0	0.007	0	0.002605	0
Transportation diesel use - User Defined	gal	0	0.139	0	22.5	0	0.17	0	0.0054	0	0.0034	0	0.0000052	0
Transportation gasoline use	gal	0	0.124	0	19.6	0	0.11	0	0.0045	0	0.00054	0	0.000039	0
Transportation gasoline use - car	gal	2730.7	0.124	338.6068	19.77	53985.939	0.027	73.7289	0.00036	0.983052	0.003	8.1921	0.0067	18.29569
Transportation gasoline use - passenger truck	gal	0	0.124	0	19.79	0	0.035	0	0.00036	0	0.003	0	0.00661	0
Transportation gasoline use - User Defined	gal	0	0.124	0	19.6	0	0.11	0	0.0045	0	0.00054	0	0.000039	0
Transportation natural gas use	ccf	0	0.103	0	13.1	0	0.01	0	0.0000063	0	0.00076	0	0.0000084	0
Transportation natural gas use - User Defined	ccf	0	0.103	0	13.1	0	0.01	0	0.0000063	0	0.00076	0	0.0000084	0
User-defined conventional energy transportation #1	TBD	10	0	0	0	0	0	0	0	0	0	0	0	0
User-defined conventional energy transportation #2	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
Conventional Energy Subtotals				**698**		**112,135**		**513**		**15**		**17**		**18**
Notes:														
Renewable Energy														
Transportation biodiesel use	gal	0	0.127	0	22.3	0	0.2	0	0	0	0.00099	0	NP	
Transportation biodiesel use - User Defined	gal	0	0.127	0	22.3	0	0.2	0	0	0	0.00099	0	NP	
User-defined renewable energy transportation #1	TBD	0	Biodiesel		0	0	0	0	0	0	0	0	Ref.	
User-defined renewable energy transportation #2	TBD	0	mpg or pmp		0	0	0	0	0	0	0	0	0	0
Renewable Energy Subtotals				**0**		**0**		**0**		**0**		**0**		**0**
Notes:														
Transportation Totals				**698**		**112135**		**513**		**15**		**17**		**18**

SVE/AS + O&M + MNA - Off-Site Footprint (Scope 3b)

Category	Units	Usage	Energy		Greenhouse Gas		NOx		SOx		PM		HAPs	
			Conv. Factor	MMBtus	Conv. Factor	lbs CO2e	Conv. Factor	lbs	Conv. Factor	lbs	Conv. Factor	lbs	Conv. Factor	lbs
Construction Materials														
Aluminum, Rolled Sheet	lb	0	0.0633	0	9.15	0	0.0148	0	0.0283	0	0.0088	0	0.00102	0
Asphalt, mastic	lb	0	0.0412	0	0.85	0	0.00271	0	0.00798	0	0.000766	0	0.00107	0
Asphalt, paving-grade	lb	0	0.5	0	8.58	0	0.0299	0	0.0969	0	0.0091	0	0.0133	0
Ethanol, Corn, 95%	lb	0	0.0318	0	-0.0199	0	0.00425	0	0.00303	0	0.000469	0	0.0000846	0
Ethanol, Corn, 99.7%	lb	0	0.0324	0	0.0591	0	0.00431	0	0.0031	0	0.000472	0	0.000087	0
Ethanol, Petroleum, 99.7%	lb	0	0.0205	0	1.25	0	0.00199	0	0.00214	0	0.000277	0	0.0000589	0
Gravel/Sand Mix, 65% Gravel	lb	0	0.0000248	0	0.0024	0	0.000018	0	4.52E-06	0	2.61E-06	0	3.08E-07	0
Gravel/sand/clay	lb	0	0.000028	0	0.00335	0	0.0000165	0	0.000015	0	0.000002	0	2.05E-10	0
HDPE	lb	0	0.0332	0	1.94	0	0.00325	0	0.00409	0	0.000439	0	0.0000641	0
Photovoltaic system (installed)	W	0	0.0336	0	4.47	0	0.015	0	0.032	0	0.00063	0	0.0000029	0
PVC	lb	0	0.0262	0	2.02	0	0.004	0	0.00274	0	0.000372	0	0.000375	0
Portland cement, US average	lb	0	0.0139	0	1.34	0	0.00654	0	0.0104	0	0.00378	0	0.00097	0
Ready-mixed concrete, 20 MPa	ft3	0	0.217	0	19.5	0	0.0975	0	0.154	0	0.057	0	0.0141	0
Round Gravel	lb	0	0.0000248	0	0.0024	0	0.000018	0	4.52E-06	0	2.61E-06	0	3.08E-07	0
Sand	lb	0	0.0000248	0	0.0024	0	0.000018	0	4.52E-06	0	2.61E-06	0	3.08E-07	0
Stainless Steel	lb	0	0.0116	0	3.4	0	0.0075	0	0.012	0	0.0044	0	0.000144	0
Steel	lb	0	0.0044	0	1.1	0	0.0014	0	0.0017	0	0.00056	0	0.000067	0
Other refined construction materials	lb	0	0.01885	0	2.115	0	0.0040375	0	0.0051325	0	0.0014428	0	0.0001625	0
Other unrefined construction materials	lb	0	0.000028	0	0.00335	0	0.0000165	0	0.000015	0	0.000002	0	2.05E-10	0
Notes:														

SVE/AS + O&M + MNA - Off-Site Footprint (Scope 3b)

			Energy		Greenhouse Gas		NOx		SOx		PM		HAPs	
Category	Units	Usage	Conv. Factor	MMBtus	Conv. Factor	lbs CO2e	Conv. Factor	lbs	Conv. Factor	lbs	Conv. Factor	lbs	Conv. Factor	lbs
Treatment Materials & Chemicals														
Cheese Whey	lbs	0	0.0025	0	0.031	0	0.000062	0	0.000033	0	0.000002	0	NP	
Emulsified vegetable oil	lbs	0	0.0077	0	3.44	0	0.0066	0	0.0019	0	0.000033	0	NP	
Granular activated carbon, primary	lbs	0	0.0356	0	4.82	0	0.0793	0	0.128	0	0.000987	0	0.000657	0
Granular activated carbon, regenerated	lbs	0	0.00873	0	1.7	0	0.00733	0	0.0129	0	0.000886	0	0.000671	0
Hydrogen Peroxide, 50% in H2O	lbs	0	0.00979	0	1.19	0	0.00142	0	0.0024	0	0.000308	0	0.0000629	0
Iron (II) Sulfate	lbs	0	0.00147	0	0.167	0	0.000316	0	0.000589	0	0.000103	0	0.000023	0
Lime, Hydrated, Packed	lbs	0	0.00206	0	0.762	0	0.000513	0	0.000358	0	0.00013	0	6.57E-06	0
Molasses	lbs	0	0.0044	0	0.48	0	0.0011	0	0.00024	0	0.0000041	0	NP	
Phosphoric Acid, 70% in H2O	lbs	0	0.0067	0	0.882	0	0.00282	0	0.0294	0	0.00171	0	0.000163	0
Potassium Permanganate	lbs	0	0.00981	0	1.16	0	0.00234	0	0.0032	0	0.000422	0	0.000122	0
Sodium Hydroxide, 50% in H2O	lbs	0	0.00977	0	1.09	0	0.00194	0	0.00352	0	0.000403	0	0.000129	0
Other Treatment Chemicals & Materials	lbs	0	0.015	0	1.67	0	0.003	0	0.0065	0	0.00061	0	0.000016	0
Notes:														
Fuel Processing														
Biodiesel produced	gal	0	0.029	0	-16.8	0	0.018	0	0.033	0	0.00082	0	NP	
Diesel produced	gal	8434.4	0.017	143.3848	3.02	25471.888	0.0051	43.01544	0.0062	52.29328	0.0017	14.33848	0.0011	9.27784
Gasoline produced	gal	2730.7	0.033	90.1131	2.8	7645.96	0.0046	12.56122	0.005	13.6535	0.0015	4.09605	0.001	2.7307
Liquefied Petroleum Gas Produced	gal	0	0.088	0	1.47	0	0.0016	0	0.0024	0	0.0007	0	0.0003	0
Natural Gas - Compressed Produced	ccf	0	19.983	0	343.92	0	0.4732	0	2.1651	0	0.1846	0	0.2895	0
Natural Gas Produced	ccf	0	0.0052	0	2.2	0	0.0037	0	0.0046	0	0.000072	0	0.0000061	0
Fuel Processing Subtotals				**233.4979**		**33117.848**		**55.57666**		**65.94678**		**18.43453**		**12.00854**
Notes:														
Public water	gal x 1000	0	0.0092	0	5	0	0.0097	0	0.0059	0	0.016	0	0.000015	0
User-defined water resource #1	gal x 1000	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined water resource #2	gal x 1000	0	0	0	0	0	0	0	0	0	0	0	0	0
Notes:														

SVE/AS + O&M + MNA - Off-Site Footprint (Scope 3b)

			Energy		Greenhouse Gas		NOx		SOx		PM		HAPs	
Category	Units	Usage	Conv. Factor	MMBtus	Conv. Factor	lbs CO2e	Conv. Factor	lbs	Conv. Factor	lbs	Conv. Factor	lbs	Conv. Factor	lbs
Off-Site Services														
Hazardous waste incineration	lb	0	0.00609	0	2.43	0	0.0016	0	0.00167	0	0.000209	0	0.000087	0
Off-site waste water treatment (POTW)	gal x 1000	0	0.015	0	4.4	0	0.016	0	0.015	0	NP		NP	
Off-site non-hazardous waste landfill	ton	0	0.16	0	25	0	0.14	0	0.075	0	0.4	0	0.0014	0
Off-site hazardous waste landfill	ton	0	0.18	0	27.5	0	0.154	0	0.0825	0	0.44	0	0.00154	0
Off-site Laboratory Analysis - Other	sample	0	0.058071	0	6.8534384	0	0.131402	0	0.3038758	0	0.0455698	0	0.0330165	0
Off-site Laboratory Analysis - Metals	sample	0	0.212	0	27.4693	0	0.6423	0	1.5072	0	0.2264	0	0.1643	0
Off-site Laboratory Analysis - Mercury	sample	0	0.0731715	0	9.325458	0	0.2127439	0	0.4982396	0	0.0747359	0	0.0542332	0
Off-site Laboratory Analysis - Inorganic Anions	sample	0	0.0074025	0	0.6459478	0	0.0067681	0	0.0147929	0	0.0022024	0	0.0015542	0
Off-site Laboratory Analysis - Alkalinity	sample	0	0.0174398	0	1.3381922	0	0.0070106	0	0.0132496	0	0.00194	0	0.0012831	0
Off-site Laboratory Analysis - Perchlorate	sample	0	0.023885	0	1.8717054	0	0.0079807	0	0.0141535	0	0.0020547	0	0.0012875	0
Off-site Laboratory Analysis - Nitrogen/Nitrate	sample	0	0.0336475	0	4.29897	0	0.0954592	0	0.2226646	0	0.0335099	0	0.0242506	0
Off-site Laboratory Analysis - Sulfate	sample	0	0.0141225	0	1.472672	0	0.0079807	0	0.0136024	0	0.0019797	0	0.0012015	0
Off-site Laboratory Analysis - PCBs	sample	0	0.0512769	0	5.224902	0	0.0833339	0	0.1904774	0	0.0284393	0	0.0212083	0
Off-site Laboratory Analysis - VOCs	sample	0	0.0762045	0	9.016814	0	0.104498	0	0.2270738	0	0.0339508	0	0.0235892	0
Off-site Laboratory Analysis - SVOCs	sample	0	0.0715602	0	7.870422	0	0.1459445	0	0.3373038	0	0.0504853	0	0.0372577	0
Notes:														
Resource Extraction for Electricity														
Coal extraction and processing	MWh	939.6	3.1	2869.35048	180.0	169128	0.8	723.492	0.2	140.94	0.0	16.9128	NP	
Natural gas extraction and processing	MWh	1566	1.6	2555.3988	270.0	422820	0.2	281.88	13.0	20358	0.0	11.1186	NP	
Nuclear fuel extraction and processing	MWh	313.2	0.2	48.6938304	25.0	7830	0.2	46.98	0.5	156.6	0.0	0.4698	NP	
Oil extraction and processing	MWh	783	2.3	1797.2982	270.0	211410	1.7	1331.1	0.1	54.027	0.0	32.886	NP	
Other fuel extraction and processing	MWh	0	0	0	0	0	0	0	0	0	0	0	0	0
Resource Extraction Subtotals				**7270.74131**		**811188**		**2383.452**		**20709.567**		**61.3872**		**0**
Notes:														
Electricity Transmission														
Transmission and distribution losses	MWh	15660	1.0342	16195.572	35.2	551232	0.1504	2355.264	0.146966	2301.4876	0.007546	118.17036	0.0045403	71.101878
Notes:														

SVE/AS + O&M + MNA - Off-Site Footprint (Scope 3b)

			Energy		Greenhouse Gas		NOx		SOx		PM		HAPs	
			Conv.		Conv.		Conv.		Conv.		Conv.		Conv.	
Category	Units	Usage	Factor	MMBtus	Factor	lbs CO2e	Factor	lbs	Factor	lbs	Factor	lbs	Factor	lbs
User-defined Materials														
User-defined material #1	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #2	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #3	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #4	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #5	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #6	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #7	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #8	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #9	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #10	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #11	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #12	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #13	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #14	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #15	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #16	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #17	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #18	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #19	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined material #20	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
Notes:														
User-defined Waste Destinations														
User-defined recycled/reused off-site #1	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined recycled/reused off-site #2	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined recycled/reused off-site #3	TBD	0	y(MMBtu/u		(lbs CO2e/u		Ox(lbs/unit		Ox(lbs/unit)		M(lbs/unit)		APs(lbs/unit	
User-defined non-hazardous waste destination #1	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined non-hazardous waste destination #2	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined non-hazardous waste destination #3	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined hazardous waste destination #1	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined hazardous waste destination #2	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
User-defined hazardous waste destination #3	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0
Notes:														
Off-site Totals				**23699.8112**		**1395537.8**		**4794.2927**		**23077.001**		**197.99209**		**83.110418**

SVE/AS + O&M + MNA - Intermediate Totals

			Energy		Greenhouse Gas		NOx		SOx		PM		HAPs	
Category	Units	Usage	Conv. Factor	MMBtus	Conv. Factor	lbs CO2e	Conv. Factor	lbs	Conv. Factor	lbs	Conv. Factor	lbs	Conv. Factor	lbs
Total Grid Electricity Footprint														
On-site grid electricity	MWh	15660	3.413	53447.58										
Electricity Generation														
Grid electricity	MWh	15660	6.929	108508.14	1124.3	17606538	2.2421	35111.286	4.6078874	72159.517	0.057518	900.73188	0.2102371	3292.3128
Resource Extraction for Electricity														
Coal extraction and processing	MWh	0	3.1	0	180.0	0	0.8	0	0.2	0	0.0	0	NP	
Natural gas extraction and processing	MWh	0	1.6	0	270.0	0	0.2	0	13.0	0	0.0	0	NP	
Nuclear fuel extraction and processing	MWh	0	0.2	0	25.0	0	0.2	0	0.5	0	0.0	0	NP	
Oil extraction and processing	MWh	0	2.3	0	270.0	0	1.7	0	0.1	0	0.0	0	NP	
Other fuel extraction and processing	MWh	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
Electricity Transmission														
Transmission and distribution losses	MWh	15660	1.0342	16195.572	112.43	1760653.8	0.22421	3511.1286	0.4607887	7215.9517	0.0057518	90.073188	0.0210237	329.23128
Total Grid Electricity Footprint				**178151**		**19367192**		**38622**		**79375**		**991**		**3622**
Total Fuel Footprints														
Total Gasoline Footprint														
On-site gasoline use - Other	gal	0	0.124	0	19.6	0	0.11	0	0.0045	0	0.00054	0	0.000039	0
On-site gasoline use <25 hp	gal	0	0.124	0	17.48	0	0.037	0	0.00025	0	0.165	0	0.00008	0
On-site gasoline use >25 hp	gal	0	0.124	0	19.93	0	0.032	0	0.00029	0	0.002	0	0.00009	0
Transportation gasoline use	gal	0	0.124	0	19.6	0	0.11	0	0.0045	0	0.00054	0	0.000039	0
Transportation gasoline use - car	gal	2730.7	0.124	338.6068	19.77	53985.939	0.027	73.7289	0.00036	0.983052	0.003	8.1921	0.0067	18.29569
Transportation gasoline use - passenger truck	gal	0	0.124	0	19.79	0	0.035	0	0.00036	0	0.003	0	0.00661	0
Transportation gasoline use - User Defined	gal	0	0.124	0	19.6	0	0.11	0	0.0045	0	0.00054	0	0.000039	0
Gasoline produced	gal	2730.7	0.033	90.1131	2.8	7645.96	0.0046	12.56122	0.005	13.6535	0.0015	4.09605	0.001	2.7307
Total Gasoline Footprint		**2730.7**		**428.7199**		**61631.899**		**86.29012**		**14.636552**		**12.28815**		**21.02639**
Total Diesel Footprint														
On-site diesel use - Other	gal	5850	0.139	813.15	22.5	131625	0.17	994.5	0.0054	31.59	0.0034	19.89	0.0000052	0.03042
On-site diesel use <75 hp	gal	0	0.139	0	22.21	0	0.1565	0	0.000145	0	0.0145	0	0.00004	0
On-site diesel use 75<hp<750	gal	0	0.139	0	22.24	0	0.101	0	0.00013	0	0.009	0	0.00004	0
On-site diesel use >750 hp	gal	0	0.139	0	22.24	0	0.149	0	0.00013	0	0.006	0	0.00004	0
Transportation diesel use	gal	2584.4	0.139	359.2316	22.5	58149	0.17	439.348	0.0054	13.95576	0.0034	8.78696	0.0000052	0.0134389
Transportation diesel use - car	gal	0	0.139	0	22.57	0	0.015	0	0.0002	0	0.003	0	0.00252	0
Transportation diesel use - passenger truck	gal	0	0.139	0	22.545	0	0.0585	0	0.0002	0	0.007	0	0.002605	0
Transportation diesel use - User Defined	gal	0	0.139	0	22.5	0	0.17	0	0.0054	0	0.0034	0	0.0000052	0
Diesel produced	gal	8434.4	0.017	143.3848	3.02	25471.888	0.0051	43.01544	0.0062	52.29328	0.0017	14.33848	0.0011	9.27784
Total Diesel Footprint		**8434.4**		**1315.7664**		**215245.89**		**1476.8634**		**97.83904**		**43.01544**		**9.3216989**
Total Biodiesel Footprint														
On-site biodiesel use	gal	0	0.127	0	22.3	0	0.2	0	0	0	0.00099	0	NP	
On-site biodiesel use - User Defined	gal	0	0.127	0	22.3	0	0.2	0	0	0	0.00099	0	NP	
Transportation biodiesel use	gal	0	0.127	0	22.3	0	0.2	0	0	0	0.00099	0	NP	
Transportation biodiesel use - User Defined	gal	0	0.127	0	22.3	0	0.2	0	0	0	0.00099	0	NP	
Biodiesel produced	gal	0	0.029	0	-16.8	0	0.018	0	0.033	0	0.00082	0	NP	
Total Biodiesel Footprint		**0**		**0**		**0**		**0**		**0**		**0**		**0**
Total Natural Gas Footprint														
On-site natural gas use	ccf	0	0.103	0	13.1	0	0.01	0	0.0000063	0	0.00076	0	0.0000084	0
Transportation natural gas use	ccf	0	0.103	0	13.1	0	0.01	0	0.0000063	0	0.00076	0	0.0000084	0
Transportation natural gas use - User Defined	ccf	0	0.103	0	13.1	0	0.01	0	0.0000063	0	0.00076	0	0.0000084	0
Natural gas produced	ccf	0	0.0052	0	2.2	0	0.0037	0	0.0046	0	0.000072	0	0.0000061	0
Total Natural Gas Footprint		**0**		**0**		**0**		**0**		**0**		**0**		**0**
Total Liquified Petroleum Gas Footprint														
On-site liquified petroleum gas use - Other	ccf	0	NP		12.69	0	0.021	0	0.00013	0	0.001	0	0	0
On-site liquified petroleum gas use	ccf	0	NP		12.69	0	0.021	0	0.00013	0	0.001	0	0	0
Liquified petroleum gas produced	ccf	0	0.088	0	1.47	0	0.0016	0	0.0024	0	0.0007	0	0.0003	0
Total Natural Gas Footprint		**0**		**0**		**0**		**0**		**0**		**0**		**0**
Total Compressed Gas Footprint														
On-site compressed gas use - Other	ccf	0	NP		1957.835	0	16.0325	0	0.023045	0	0.2775	0	0	0
On-site compressed gas use	ccf	0	NP		1957.835	0	16.0325	0	0.023045	0	0.2775	0	0	0
Compressed gas produced	ccf	0	19.983	0	343.92	0	0.4732	0	2.1651	0	0.1846	0	0.2895	0
Total Natural Gas Footprint		**0**		**0**		**0**		**0**		**0**		**0**		**0**

Notes:

Note: Please refer to the "Default Conversions" tab for references for the default conversion factors used on this calculation sheet.

Space below available for notes and calculations: