Tables

Table 3-1
Preliminary Evaluation of Remedial Measure Technologies for Soil

Feasibility Study
Former George A. Robinson Company., Inc. Site
477 Whitney Road, Penfield, New York

ARCADIS

Response Actions	Remedial Technologies	Process Options	Description	Retained: Yes or No	Decision Rationale
No Action	Not Applicable	No Action	Not Applicable	Yes	Use as a baseline for comparison to other alternatives.
Institutional Control	Not Applicable	Deed Restrictions	Deed restrictions to limit the property use and implementation of a Site Management Plan.	Yes	Minimize potential for exposure to residual concentrations in soil.
Engineering Control	Not Applicable	Access Restrictions	Place access restrictions along the property boundary (i.e., fencing and signage).	Yes	Minimize potential for exposure to residual concentrations in soil.
	Infiltration Control or Capping	Soil, Asphalt and Concrete Cover	Prevent direct contact and infiltration through the use of cover.	Yes	Maintaining / adding asphalt or concrete over impacted soil would eliminate contact and infiltration. May require import of materials to stabilize grassed areas prior to capping.
In Situ Treatment	Physical	Soil Flushing	Flush soil with liquid to desorb contaminants.	No	Limited effectiveness for CVOCs because of low solubilities. Ineffective in lower permeability soils and till because of distribution and injection challenges and the need to have direct contact with the contaminant mass. Requires capture, collection, and treatment of flushed liquid.
		Surfactant Flushing	Flush soil with surfactant solution to promote the desorption and solubilization of hydrophobic contaminants.	No	Does not enhance metals solubility. Ineffective in lower permeability soils and till because of distribution and injection challenges and the need to have direct contact with the contaminant mass. Requires capture, collection, and treatment of flushed liquid.
		Thermal Treatment	Subsurface heating. May require total fluids recovery, including vapor extraction and treatment of vapor stream.	Yes	Effective for CVOCs. Effective for PFAS. Ineffective for metals. May be combined with other process options.
	Chemical	Oxidation	Inject oxidizing agent to oxidize contaminants.	Yes	Effective for CVOCs. Ineffective for PFAS. Ineffective for metals. May be ineffective in lower permeability soils and till because of distribution and injection challenges and the need to have direct contact with the contaminant mass. Requires multiple injections. May be combined with other process options.
		Stabilization/ Solidification	Treatment/fixation of soil and contaminants by mixing.	Yes	Effective for CVOCs and metals. Effective for reducing the overall mass flux of PFAS by reducing leachability to groundwater. May be ineffective in lower permeability soils and till because of distribution and injection challenges and the need to have direct contact with the contaminant mass. Likely to require demolition of Buildings 52, 64, and 101 for access.
	Biological	Enhanced Reductive Dechlorination	Inject a substrate to facilitate biodegradation of soil COPCs by microorganisms.	Yes	Only effective for CVOCs in the saturated zone. Ineffective for PFAS. Ineffective for metals. May be ineffective in lower permeability soils and till because of distribution and injection challenges and the need to have direct contact with the contaminant mass. Requires multiple injections. May be combined with other process options.
		Bioventing	Add oxygen to vadose zone to stimulate aerobic microorganisms for the catabolization of contaminants.	No	Soil COPCs do not have viable aerobic degradation pathways.
Removal	Excavation	Excavation	Remove soil through mechanical methods.	Yes	Effective for CVOCs, PFAS, and metals. Implementable in unconsolidated deposits and till. Likely to require demolition of Buildings 52, 64, and 101 for access. Requires dewatering and treatment of recovered water. Backfill with reactive media would mitigate soil recontamination by CVOC and/or PFAS-impacted groundwater re-entering the excavation.
	Extraction	SVE	Apply a vacuum to extraction wells to enhance VOC volatilization. Recover and treat vapor.	Yes	Effective for VOCs. Ineffective for PFAS. Ineffective for metals. Limited effectiveness in low permeability soils and till. Stripping at the air/water interface would have minimal effect on VOCs in saturated soil. May be combined with other process options
		Multi-Phase Extraction	Apply a vacuum to extraction wells to enhance fluids recovery. Treat and dispose of extracted fluids.	No	Limited effectiveness in low permeability soils and till. Ineffective for PFAS.

See Notes on Page 2.

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Preliminary Evaluation of Remedial Measure Technologies for Soil

Feasibility Study
Former George A. Robinson Company., Inc. Site
477 Whitney Road, Penfield, New York

Response Actions	Remedial Technologies	Process Options	Description	Retained: Yes or No	Decision Rationale
Ex Situ Treatment	Physiochemical	Soil Washing	Physical separation of contaminated soil from non-contaminated soil followed by chemical desorption to remove contaminants from the soil.	Yes	Effective for CVOCs, PFAS, and metals. Effectiveness is limited by the ability to achieve direct contact with the contaminant mass. Requires onsite treatment of contaminated fines and wash water prior to disposal.
	Physical	Low-Temperature Thermal Treatment	Heat soil using a conveyor and burner system to promote the volatilization of VOCs. Heat of hydration when water mixes with calcium oxide (e.g., quicklime) can also promote volatilization. Requires dedicated, access-restricted site area for treatment operations.	No	Ineffective for metals. Cost per unit volume of treated soil would make combination of thermal treatment with other ex situ process options infeasible.
		On-site Incineration	Heat soil using a conveyor and burner system to thermally oxidize VOCs. Requires dedicated, access-restricted site area for treatment operations.	No	Ineffective for PFAS. Ineffective for metals. Requires recovery and treatment of vapors. Cost per unit volume of treated soil would make combination of incineration with other ex situ process options infeasible. Lower permeability soils and till require intense mixing to effectively contact mass trapped in interior pore space.
	Chemical	Stabilization/ Solidification	Fixation of soil and contaminants by mixing. Requires dedicated, access-restricted site area for treatment operations.	Yes	Effective for CVOCs, PFAS, and metals.
		Oxidation	Oxidize contaminants	No	Ineffective for PFAS. Ineffective for metals. Requires dedicated, access-restricted site area for treatment operations.
	Biological	Land Farming	Stockpile and till soils to promote aerobic biodegradation.	No	Ineffective for contaminants that degrade under anaerobic conditions (e.g., CVOCs), PFAS, and metals.
Disposal	Disposal	On-site	Disposal or reuse of soil onsite. Generally requires treatment prior to disposal. See ex situ treatment options above.	Yes	Feasible in conjunction with other process options if onsite space available. Requires treatment of soil and approval from regulators and site owner.
		Off-site	Disposal of soil or remediation process residuals offsite.	Yes	Effective and implementable. Disposal location will depend on soil concentrations. May require pre-treatment due to land ban regulations.

Note:
Shaded cells indicate technologies not retained.

Abbreviations:
COPC - constituent of potential concern
CVOC - chlorinated volatile organic compound
PFAS - per- and polyfluoroalkyl substances
SVE - soil vapor extraction
VOC - volatile organic compound

Table 3-2
Preliminary Evaluation of Remedial Measure Technologies for Vapor Intrusion

Feasibility Study
Former George A. Robinson Company, Inc. Site
477 Whitney Road, Penfield, New York

Response Actions	Remedial Technologies	Process Options	Description	Retained: Yes or No	Decision Rationale
No Action	Not Applicable	Not Applicable	Not Applicable	Yes	Use as a baseline for comparison to other alternatives.
Institutional Control	Not Applicable	Deed Restrictions	Deed restrictions to limit the property use and implementation of a Site Management Plan.	Yes	Minimize potential for exposure to residual concentrations.
Containment	Building Sealing	Caulking/Sealing	Seal pathways for vapor to enter building (slab, walls, etc.) through caulking, epoxy/polymer coatings, and minor concrete repair, as necessary.	Yes	Effective and implementable. Implementation requires disruption of ongoing activities in Building 102. Requires ongoing inspection to preserve effectiveness.
		Concrete	Thicken the existing concrete pad.	No	Effective and implementable. Implementation requires substantial disruption of ongoing activities in Building 102.
	Passive Barrier	Passive Barrier	Install a spray applied, polyvinyl chloride, or rubber liner during new building construction. Liner to be sealed to perimeter footings, post footings, piping and other protrusions.	No	Effective for new construction. Implementation requires demolition and reconstruction of Building 102.
Mitigation	Building Pressurization	HVAC Adjustments	Keep doors closed and adjust HVAC systems to maintain a higher pressure within the building than under the slab to prevent vapors from entering.	No	Low effectiveness and difficult to implement in aging buildings. Building 102 is not airtight. Requires modification of worker behavior to prevent doors being left open.
	Air Cleaning	Filtering of Indoor Air	Install carbon filter on HVAC systems or as stand alone units to remove volatile organic compounds from the indoor air.	No	May be ineffective at Building 102 because of building size and the large volume of indoor air to filter. Does not prevent vapors from entering the buildings.
	Passive Venting	Passive Venting	Install vent pipes from the subslab to the atmosphere.	No	Effective for new construction. May require collection and treatment of vented vapor. Implementation requires demolition and reconstruction of Building 102.
	SSDS	Individual Fans	Depressurize the subslab using inline fans to prevent vapors from entering the buildings.	Yes	Effective and implementable for minimizing potential exposure to residual concentrations.
		Centralized Systems	Depressurize the subslab using a centralized blower to prevent vapors from entering the buildings.	Yes	Effective and implementable for minimizing potential exposure to residual concentrations.
	SSVS	Individual Fans	Dilute the subslab vapors by introducing fresh air into the subslab using inlet pipes.	No	Best suited for very porous soils. Requires significant infrastructure. May increase potential for vapor intrusion.
		Centralized Systems	Dilute the subslab vapors by introducing fresh air into the subslab using inlet pipes.	No	Best suited for very porous soils. Requires significant infrastructure. May increase potential for vapor intrusion.
	SSP	Individual Fans or Centralized System	Force fresh air beneath the slab to push vapors away from the subslab.	No	Best suited for very porous soils. Requires significant infrastructure. May increase potential for vapor intrusion.
Removal	Demolition	Building Demolition	Demolish a building to remove the potential for vapor intrusion into indoor air.	No	Highly effective but has implementability challenges and high costs. Implementation would eliminate future use of Building 102 or incur additional cost for reconstruction.

Note:
Shaded cells indicate technologies not retained.

Abbreviations:
HVAC - heating ventilation and air conditioning
SSDS - subslab depressurization system
SSVS - subslab ventilation system
SSP - subslab pressurization

Table 3-3
Preliminary Evaluation of Remedial Measure Technologies for Groundwater

Feasibility Study
Former George A. Robinson Company, Inc. Site
477 Whitney Road, Penfield, New York

Response Actions	Remedial Technologies	Process Options	Description	Retained: Yes or No	Decision Rationale
No Action	Not Applicable	No Action	Not Applicable	Yes	Use as a baseline for comparison to other alternatives.
Institutional Control	Not Applicable	Deed Restrictions	Deed restrictions to limit the property use and implementation of a Site Management Plan.	Yes	Minimize potential for exposure to residual concentrations in groundwater.
Monitoring	Groundwater Monitoring	Long-Term Monitoring	Monitor groundwater quality.	Yes	Minimize potential for exposure to residual concentrations in groundwater.
		Monitored Natural Attenuation	Monitor natural attenuation parameters and groundwater quality.	Yes	Observation of degradation products indicates attenuation of some CVOCs. Ineffective as a standalone response. May be combined with other process options.
Containment	Infiltration Control or Capping	Impermeable Cover	Impermeable cover (concrete and asphalt) to minimize infiltration.	Yes	Addition of asphalt or concrete over grassed portions of the Site would reduce infiltration. May require import of materials to stabilize grassed areas prior to capping.
	Barriers (Horizontal or Vertical)	Grout Injection	Pressure injection of grout to provide a low permeability confining unit.	Yes	Must be combined with groundwater extraction and treatment or similar technology. Requires key-in to low permeability deposits to prevent underflow. Does not prevent vertical groundwater migration within the containment area.
		Trenched Cut-off Wall	Low permeability wall to prevent horizontal migration of groundwater.	Yes	Must be combined with groundwater extraction and treatment or similar technology. Requires key-in to low permeability deposits to prevent underflow. Does not prevent vertical groundwater migration within the containment area.
		Sheet Piling	Sheet pile wall to prevent horizontal migration of groundwater.	Yes	Must be combined with groundwater extraction and treatment or similar technology. Requires key-in to low permeability deposits to prevent underflow. Does not prevent vertical groundwater migration within the containment area.
In Situ Treatment	Physical	Thermal Treatment	Subsurface heating. May require total fluids recovery, including vapor extraction and treatment of vapor stream.	No	Effective for PFAS. Ineffective for metals. May be combined with other process options.
		Permeable Reactive Barrier or Funnel and Gate	A passive treatment wall across the groundwater flow path.	No	Effective for CVOCs, PFAS, and metals with different reactive media. Requires key-in to low permeability deposits to prevent underflow.
		Air Sparging	Strip Site COPCs using air injection wells.	No	Ineffective for PFAS. Ineffective for metals. Requires groundwater flow to move contaminants to the recovery area. Ineffective in lower permeability soils and till where groundwater flow may not move a large enough portion of the mass through the target area.
		In-well Air Stripping	Strip Site COPCs in a dual-screened well that controls groundwater flow.	No	Ineffective for PFAS. Ineffective for metals. Requires groundwater flow to move contaminants to the recovery area. Ineffective in lower permeability soils and till where groundwater flow may not move a large enough portion of the mass through the target area.
	Chemical	Oxidation	Oxidize contaminants.	Yes	Effective for chlorinated VOCs. Ineffective for PFAS. Ineffective for metals. May be ineffective in lower permeability soils and till because of distribution and injection challenges and the need to have direct contact with the contaminant mass. Requires multiple injections. May be combined with other process options.
		Precipitation	Fixation of contaminants to soil by amendment injection.	Yes	Effective for metals. Amendment will also enhance reductive dechlorination of CVOCs. Ineffective for PFAS. May be ineffective in lower permeability soils and till because of distribution and injection challenges and the need to have direct contact with the contaminant mass. May be combined with other process options.
		Chemical Reduction	Use a reductant or reductant generating material (i.e., zero valent iron) to degrade contaminants.	Yes	Effective for CVOCs. Ineffective for PFAS. Ineffective for metals. May be ineffective in lower permeability soils and till because of distribution and injection challenges and the need to have direct contact with the contaminant mass. May be combined with other process options.

See Notes on Page 3.

Table 3-3
Preliminary Evaluation of Remedial Measure Technologies for Groundwater

Feasibility Study
Former George A. Robinson Company, Inc. Site
477 Whitney Road, Penfield, New York

Response Actions	Remedial Technologies	Process Options	Description	Retained: Yes or No	Decision Rationale
In Situ Treatment (cont.)	Biological	Enhanced Reductive Dechlorination	Inject a degradable substrate to facilitate biodegradation of groundwater COPCs by microorganisms.	Yes	Effective for CVOCs. Ineffective for PFAS. Ineffective for metals. May be ineffective in lower permeability soils and till because of distribution and injection challenges and the need to have direct contact with the contaminant mass. Requires multiple injections.
Removal	Removal	Excavation/Dewatering	Remove impacted groundwater through excavation and dewatering.	Yes	Effective in areas where soil and groundwater impacts are co-located. Likely to require demolition of Buildings 52, 64, and 102 for access. Requires dewatering and ex situ treatment and disposal of extracted fluids. Has the potential to mobilize DNAPL and PFAS.
		Groundwater Extraction	Hydraulic containment through the extraction of groundwater using vertical wells.	Yes	Effective for Site groundwater COPCs. Limited effectiveness in low permeability soils and till because of low achievable recovery and recharge. Requires ex situ treatment and disposal of extracted fluids. Has the potential to mobilize DNAPL and PFAS.
		Multi-Phase Extraction	Apply a moderate to high vacuum (i.e., higher than 10 mmHg) to a series of extraction wells for enhanced total fluids recovery.	No	Limited effectiveness in low permeability soils and till. Requires ex situ treatment and disposal of extracted fluids. DNAPL has not been observed to accumulate in wells.
		Groundwater Recovery Trenches	Trenches, drains and piping, used to passively collect groundwater.	Yes	Effective for Site groundwater COPCs. Requires groundwater flow to move contaminants to the recovery area. Limited effectiveness for mass removal in low permeability soils and till because of low achievable recovery and recharge. Requires ex situ treatment and disposal of extracted fluids.
Ex Situ Treatment	Physical	Air Stripping	Transfer contaminants from an aqueous to a vapor phase. Off-gas may require additional treatment.	Yes	Effective and implementable technology for ex situ groundwater treatment of VOCs. Ineffective for PFAS. Ineffective for metals. May be combined with other ex situ treatment options.
		Carbon Adsorption	Remove contaminants from the aqueous or vapor phase onto activated carbon.	Yes	Effective and implementable technology for ex situ groundwater treatment of VOCs. Ineffective for PFAS. Generally ineffective for metals. May be combined with other ex situ treatment options.
		IX Adsorption	Remove contaminants from the aqueous phase onto IX resin.	Yes	Effective and implementable technology for ex situ groundwater treatment of metals. Ineffective for CVOCs. Ineffective for PFAS. May be combined with other process options.
	Chemical	UV/Chemical Oxidation	Destroy VOCs by changing the oxidation state of target contaminants using UV radiation and chemical oxidants.	No	Effective and implementable technology for ex situ groundwater treatment of CVOCs. Ineffective for PFAS. Ineffective for metals. Cost per unit volume of treated groundwater would make combination of UV/chemical oxidation with other ex situ process options infeasible.
		Precipitation	Removal of COPCs from groundwater through precipitation by amendment addition	Yes	Effective for metals. Ineffective for PFAS. Amendment will also enhance reductive dechlorination of chlorinated VOCs but requires long treatment time. May be combined with other ex situ process options.
		Ozone Oxidation	Oxidize contaminants.	Yes	Effective and implementable technology for ex situ groundwater treatment of chlorinated VOCs. Ineffective for PFAS. Ineffective for metals. May be combined with other ex situ treatment options.
	Biological	Aerobic Bioreactor	Aerobic biodegradation performed in an engineered bioreactor for contaminant removal from a process stream.	No	Site COPCs do not have viable aerobic degradation pathways.
		Anaerobic Bioreactor	Biodegradation in the absence of oxygen performed in an engineered bioreactor for contaminant removal from a process stream.	No	Effective and implementable technology for ex situ groundwater treatment of CVOCs. Ineffective for PFAS. Ineffective for metals. Long hydraulic retention times for complete mineralization of chlorinated ethenes require large reactor volumes.

See Notes on Page 3.

Table 3-3
Preliminary Evaluation of Remedial Measure Technologies for Groundwater

Feasibility Study
Former George A. Robinson Company, Inc. Site
477 Whitney Road, Penfield, New York

Response Actions	Remedial Technologies	Process Options	Description	Retained: Yes or No	Decision Rationale
Disposal/ Discharge	Disposal	POTW	Offsite discharge to a POTW.	Yes	Effective but may require onsite pretreatment and permits with the POTW.
		Treatment Facility	Offsite disposal of liquids to be containerized and treated by a second party.	Yes	Effective and implementable technology for ex situ groundwater treatment of site COPCs.
	Reuse	Facility Use	Non-potable onsite reuse of treated groundwater.	No	No onsite use of non-potable water is occurring.
		Reinjection	Reinject treated groundwater.	Yes	Implementable in unconsolidated deposits but reinjection volume will be limited in lower permeability soils.
	Discharge	Surface Water Discharge	Discharge treated groundwater to the Thomas or Irondequoit Creeks.	Yes	Effective and implementable assuming a SPDES permit equivalency can be obtained.
		Air Discharge	Discharge from air treatment system.	Yes	Granular activated carbon or air stripper can be used to achieve regulatory air discharge standards for VOCs.

Note:
Shaded cells indicate technologies not retained.

Abbreviations:
COPC - constituent of potential concern
CVOC - chlorinated volatile organic compound
DNAPL - dense nonaqueous phase liquid
IX - ion exchange
mmHg - millimeters of mercury
PFAS - per- and polyfluoroalkyl substances
POTW - Public Owned Treatment Works
SPDES - State Pollutant Discharge Elimination System
UV - ultraviolet
VOC - volatile organic compound

Table 3-4
Process Options Screening for Soil

Feasibility Study
Former George A. Robinson Company, Inc. Site
477 Whitney Road, Penfield, New York

Remedial Technologies	Process Options	Effectiveness Evaluation		Implementability Evaluation		Relative Cost Evaluation		Retained?	
Not Applicable	No Action	Low	No effect on soil concentrations. Effectiveness, if any, is attributed to naturally occurring processes.	High	Easily implemented.	Low	No additional costs.	Yes	Use as a baseline for comparison to other alternatives.
Not Applicable	Deed Restrictions	Low	No effect on soil concentrations. Placing deed restrictions and maintaining the Site Management Plan will reduce potential exposure to residual concentrations.	High	Easily implemented.	Low	Negligible costs.	Yes	Considered in conjunction with other process options.
	Access Restrictions	Low	No effect on soil concentrations. Limiting site access will reduce potential for exposure to residual concentrations.	High	Easily implemented.	Low	Negligible costs.	Yes	Considered in conjunction with other process options.
Infiltration Control or Capping	Impermeable Cover	Low	Use/maintain cover to prevent direct contact and rainwater infiltration. Does not limit leaching to groundwater traversing the area.	High	May require extension of impermeable cover (i.e., asphalt, concrete).	Low	Low capital and O&M costs since most surface is already covered.	Yes	Considered in conjunction with other process options.
In Situ Physical Treatment	Thermal Treatment	High	Effective for chlorinated solvents and other VOCs in saturated soil. Effective for PFAS. Ineffective for metals. Effectively reach treatment goals in a short time frame.	Moderate	Predesign sampling needed to confirm treatment area. Requires installation and maintenance of electrodes or heater wells and recovery and treatment of vapors. The density of the soil would need to be analyzed to determine spacing. Likely to require demolition of Buildings 52, 64, and 101 for access.	High	High capital cost for installation of infrastructure and off-gas capture and treatment. High O&M costs.	Yes	Considered in conjunction with other process options for metals.
In Situ Chemical Treatment	Oxidation	Moderate	Effective for CVOCs. Effective for PFAS. Ineffective for metals. Effectiveness is limited by the ability to achieve direct contact with the contaminant mass.	Moderate	Predesign sampling needed to confirm treatment area. Requires multiple injections to be effective. May experience reduced distribution and CVOC contact in till.	Moderate	Moderate capital cost and O&M costs for multiple injections using injection wells installed in close proximity in smaller treatment areas. High O&M costs for multiple injections using direct push injections in larger treatment areas.	Yes	Considered in conjunction with other process options for metals.
	Stabilization/ Solidification	High	Effective for fixing CVOCs and metals in soil but does not reduce contaminant concentrations in soil. Effective for reducing the overall mass flux of PFAS by reducing leachability to groundwater. Effectiveness is limited by the ability to achieve direct contact with the contaminant mass.	High	Predesign sampling needed to confirm treatment area. Likely to require demolition of Buildings 52, 64, and 101 for access. May be ineffective in lower permeability soils and till.	High	High capital cost for building demolition.	Yes	Poses higher cost than other considered methods and greater design/engineering challenges. Does not reduce contaminant concentrations in soil.
In Situ Biological Treatment	Enhanced Reductive Dechlorination	Moderate	Only effective for CVOCs in the saturated zone. Ineffective for PFAS. Ineffective for metals. Effectiveness is limited by the ability to achieve direct contact with the contaminant mass.	Moderate	Predesign sampling needed to confirm treatment area. Requires multiple injections to be effective. May experience reduced distribution and CVOC contact in till.	Moderate	Moderate capital cost and O&M costs for multiple injections using injection wells installed in close proximity in smaller treatment areas. High O&M costs for multiple injections using direct push injections in larger treatment areas.	Yes	Considered in conjunction with other process options for metals.
Removal	Excavation	High	Effective for mass removal in areas where DNAPL and PFAS are contributing to soil and groundwater concentrations or in shallow unsaturated soils. Replaced clean soils may become recontaminated by CVOC and/or PFAS-impacted groundwater re-entering the excavation.	Moderate/ Low	Predesign sampling needed to confirm treatment area. Likely to require demolition of Buildings 52, 64, and 101 for access. Requires active dewatering of the excavation and treatment or offsite disposal. Backfill with reactive media may be implemented to prevent recontamination by CVOC and/or PFAS-impacted groundwater entering the excavation.	High	High capital cost for building demolition. Offsite disposal of excavated material and extracted groundwater and import of backfill would be required.	Yes	Effective for all Site soil COPCs. Considered in conjunction with other process options.
	SVE	Low	Effective for VOC removal from higher permeability vadose zone soil. Ineffective for PFAS. Ineffective for metals.	Low/ Moderate	Not easily implementable in lower permeability soil and till.	High	High capital cost to install SVE wells in close proximity in larger treatment areas. Moderate to high operations and maintenance costs.	No	High cost and lower effectiveness in comparison to other process options.

See Notes on Page 2.

Table 3-4
Process Options Screening for Soil

Feasibility Study
Former George A. Robinson Company, Inc. Site
477 Whitney Road, Penfield, New York

ARCADIS

Remedial Technologies	Process Options	Effectiveness Evaluation		Implementability Evaluation		Relative Cost Evaluation		Retained?	
Ex Situ Physiochemical Treatment	Soil Washing	High	Effective for CVOCs, PFAS, and metals. Effectiveness is limited by the ability to achieve direct contact with the contaminant mass. Requires on-site treatment of contaminated fines and wash water prior to disposal.	Low	Requires a high degree of certainty and optimization of the volume of soil requiring treatment and may be less amenable to a field pilot scale trial than other ex situ technologies.	Moderate /High	Cost dependent on the extent of ex situ treatment required. If excavation extends beyond 20 feet below ground surface, this technology becomes cost prohibitive.	Yes	Considered in conjunction with other process options for shallow soil.
Ex Situ Chemical Treatment	Stabilization/ Solidification	High	Effective for CVOCs, PFAS, and metals. Effectiveness is limited by the ability to achieve direct contact with the contaminant mass.	Low/ Moderate	Implementable. Requires the use of a pug mill and addition of water to create plasticity in tight clays.	High	High capital cost for soil excavation and backfill. Not all of the material would be used as backfill so disposal would be required.	No	High capital cost and difficult Implementability in comparison to other process options. Does not reduce contaminant concentrations in soil.
Disposal	On-site	Moderate	Requires onsite soil treatment prior to disposal.	Low/ Moderate	Requires treatment of soil and approval from regulators and site owner for implementation. Requires available onsite space for staging and treatment.	Moderate	Cost dependent on the extent of ex situ treatment required.	Yes	Considered in conjunction with removal process options.
	Off-site	High	Removes the contaminants from the site.	Moderate	Used in conjunction with excavation. Requires coordination and acceptance of material at an offsite location.	Moderate/ High	Cost dependent on the classification of the soil for disposal and the level of required pre-treatment.	Yes	Considered in conjunction with removal process options.

Note:
Shaded cells indicate technologies not retained.

Abbreviations:
COPC - constituent of potential concern
CVOC - chlorinated volatile organic compound
DNAPL - dense nonaqueous phase liquid
O&M - operation and maintenance
PFAS - per- and polyfluoroalkyl substances
SVE - soil vapor extraction
VOC - volatile organic compound

Table 3-5
Process Options Screening for Vapor Intrusion

Feasibility Study
Former George A. Robinson Company, Inc. Site
477 Whitney Road, Penfield, New York

ARCADIS

Remedial Technologies	Process Options	Effectiveness Evaluation		Implementability Evaluation		Relative Cost Evaluation		Retained for Consideration	
Not Applicable	No Action	Low	No effect on VOC concentrations in soil vapor or indoor air. Effectiveness, if any, is attributed to naturally occurring processes.	High	Easily implemented.	Low	No additional costs.	Yes	Use as a baseline for comparison to other alternatives.
Not Applicable	Deed Restrictions	Moderate	No effect on VOC concentrations in soil vapor or indoor air. Placing deed restrictions and maintaining the Site Management Plan will reduce potential exposure.	High	Easily implemented.	Low	Negligible costs.	Yes	Considered in in conjunction with other process options.
Building Sealing	Caulking/Sealing	Low/ Moderate	Limits the migration of VOCs in subslab soil vapor into the building.	Moderate/ High	Relatively easy to seal cracks; more difficult to seal entire slab. May require relocation of some building activities during implementation.	Low	Uses standard caulking or sealing methods.	Yes	Considered in in conjunction with other process options.
	Concrete	Moderate	Limits the migration of VOCs in subslab soil vapor into the building.	Low	Requires building modification to thicken the concrete pad and limited access during construction. May require relocation of some building activities during implementation.	High	High installation cost.	No	High capital cost and difficulty to implement in comparison to other process options.
SSDS	Individual Fans	High	Limits the migration of VOCs in subslab soil vapor into the building. Removes VOC mass and prevents future accumulation of mass below the slab.	Moderate	Systems can be easily installed.	Moderate	Moderate installation cost. Low operating cost. Requires long-term O&M.	Yes	Considered in in conjunction with other process options.
	Centralized Systems	High	Limits the migration of VOCs in subslab soil vapor into the building. Removes VOC mass present and prevents future accumulation of mass below the slab.	Moderate	System can be easily installed and existing systems can be easily modified.	Moderate	Moderate installation cost. Using multiple low horse power blowers would keep operating costs comparable to SSDS with individual fans. Requires long-term O&M.	Yes	Considered in in conjunction with other process options.

Note:
Shaded cells indicate technologies not retained.

Abbreviations:
O&M - operation and maintenance
SSDS - subslab depressurization system
VOC - volatile organic compound

Table 3-6
Process Options Screening for Groundwater

Feasibility Study
Former George A. Robinson Company, Inc. Site
477 Whitney Road, Penfield, New York

ARCADIS

Remedial Technologies	Process Options	Effectiveness Evaluation		Implementability Evaluation		Relative Cost Evaluation		Retained for Consideration	
Not Applicable	No Action	Low	Effectiveness, if any, is attributed to naturally occurring processes.	High	Easily implemented.	Low	No additional costs.	Yes	Use as a baseline for comparison to other alternatives.
Not Applicable	Deed Restrictions	Moderate	No effect on groundwater concentrations. Maintaining the Site Management Plan will reduce potential exposure to residual concentrations.	High	Easily implemented.	Low	Negligible costs.	Yes	Considered in conjunction with other process options.
Groundwater Monitoring	Long-Term Monitoring	Low	Effectiveness, if any, is attributed to naturally occurring processes.	High	Easily implemented.	Low/ Moderate	Likely to require expansion of existing monitoring well network. Long term O&M required.	Yes	Considered in conjunction with other process options. No protectiveness in areas not targeted for active remediation.
	Monitored Natural Attenuation	Moderate	Natural attenuation processes would require an extended timeframe to reduce COPC concentrations to cleanup goals. Effectiveness would improve following source removal/treatment.	High	Degradation of CVOCs and some attenuation evident in groundwater results.	Low/ Moderate	Likely to require expansion of existing monitoring well network. Long term O&M required.	Yes	Considered in conjunction with other process options. Limited protectiveness in areas not targeted for active remediation.
Containment	Impermeable Cover	Low	Use/maintain cover to prevent direct contact and rainwater infiltration.	Moderate	Requires extension of impermeable cover (i.e., asphalt, concrete).	Moderate	Moderate capital and O&M costs. May require import of materials to stabilize grassed areas prior to capping.	Yes	Considered in conjunction with other process options. Limited protectiveness in areas not targeted for active remediation.
	Grout Injection	Moderate/ High	Effective for arresting further horizontal migration of dissolved Site COPCs downgradient of the grout injection area.	Moderate/ High	Requires key-in to low permeability deposits to prevent underflow. Requires groundwater extraction and treatment upgradient of the flow barrier to prevent groundwater mounding. Requires long-term set aside of onsite area for treatment facility.	High	High capital cost for flow barrier and treatment system installation. Long-term O&M costs.	Yes	Effectively treats all Site groundwater COPCs in conjunction with ex situ treatment options.
	Trenched Cut-off Wal	Moderate/ High	Effective for arresting further horizontal migration of dissolved Site COPCs downgradient of the cut-off wall.	Moderate/ High	Requires key-in to low permeability deposits to prevent underflow. Requires groundwater extraction and treatment upgradient of the flow barrier to prevent groundwater mounding. Requires long-term set aside of onsite area for treatment facility.	High	High capital cost for flow barrier and treatment system installation. Long-term O&M costs.	Yes	Effectively treats all Site groundwater COPCs in conjunction with ex situ treatment options.
	Sheet Piling	Moderate/ High	Effective for arresting further horizontal migration of dissolved Site COPCs downgradient of the sheet piling.	Low/ Moderate	Requires key-in to low permeability deposits to prevent underflow. Requires groundwater extraction and treatment upgradient of the flow barrier to prevent groundwater mounding. Requires long-term set aside of onsite area for treatment facility.	High	High capital cost for flow barrier and treatment system installation. Long-term O&M costs.	No	Higher cost and greater implementation challenges in comparison to other process options.
In Situ Physical Treatment	Thermal Treatment	High	Effective for treating dissolved chlorinated solvents and VOCs in groundwater through volatilization. Effective for PFAS. Can effectively reach treatment goals in a short time frame.	Low/ Moderate	Predesign sampling needed to confirm treatment area. Requires installation and maintenance of electrodes or heater wells and recovery and treatment of vapors. The density of the soil would need to be analyzed to determine spacing. Likely to require demolition of Buildings 52, 64, and 101 for access. Would require a large footprint of treatment to target dissolved concentrations.	High	High capital cost for installation of infrastructure and off-gas capture and treatment in large treatment area. High O&M costs.	No	Ineffective for metals. Ineffective for complete destruction of the vapor phase and waste product generation (hydrogen fluoride) being released during treatment of PFAS. Considered in conjunction with other process options.
	Permeable Reactive Barrier or Funnel and Gate	Moderate/ High	Effective for CVOCs, PFAS, and metals with different reactive media. Effectiveness is limited by the ability to achieve full contact with impacted groundwater.	Moderate/ High	Requires key-in to low permeability deposits to prevent underflow.	High	High capital cost for installation. Long-term O&M costs are dependent on the reactive media used.	Yes	Effective for all Site groundwater COPCs. Considered in conjunction with other process options.

See Notes on Page 3.

Table 3-6
Process Options Screening for Groundwater

Feasibility Study
Former George A. Robinson Company, Inc. Site
477 Whitney Road, Penfield, New York

ARCADIS

Remedial Technologies	Process Options	Effectiveness Evaluation		Implementability Evaluation		Relative Cost Evaluation		Retained for Consideration	
In Situ Chemical Treatment	Oxidation	Moderate/ High	Effective for CVOCs. Ineffective for PFAS. Ineffective for metals. Effectiveness is limited by the ability to achieve full contact with impacted groundwater.	Moderate	Predesign sampling needed to confirm treatment area. May experience reduced distribution and contact with impacted groundwater in till.	High	Moderate capital cost and O&M costs for multiple injections using injection wells installed in close proximity in smaller treatment areas. High O&M costs for multiple injections using direct push injections in larger treatment areas.	Yes	Considered in conjunction with other process options.
	Precipitation	Moderate/ High	Effective for CVOCs and metals. Ineffective for PFAS. Amendment can be targeted to precipitate metals and enhance reductive dechlorination of CVOCs. Metals removed from groundwater are precipitated onto and remail in site soil. Effectiveness is limited by the ability to achieve full contact with impacted groundwater.	Moderate	Predesign sampling needed to confirm treatment area. May experience reduced distribution and contact with impacted groundwater in till.	High	Moderate capital cost and O&M costs for multiple injections using injection wells installed in close proximity in smaller treatment areas. High O&M costs for multiple injections using direct push injections in larger treatment areas.	Yes	Considered in conjunction with other process options.
	Chemical Reduction	Moderate/ High	Effective for CVOCs. Ineffective for PFAS. Ineffective for metals. Effectiveness is limited by the ability to achieve full contact with impacted groundwater.	Moderate	Predesign sampling needed to confirm treatment area. May experience reduced distribution and contact with impacted groundwater in till.	High	Moderate capital cost and O&M costs for multiple injections using injection wells installed in close proximity in smaller treatment areas. High O&M costs for multiple injections using direct push injections in larger treatment areas.	Yes	Considered in conjunction with other process options.
In Situ Biological Treatment	Enhanced Reductive Dechlorination	Moderate/ High	Effective for CVOCs. Ineffective for PFAS. Ineffective for metals. Effectiveness is limited by the ability to achieve full contact with impacted groundwater.	Moderate	Predesign sampling needed to confirm treatment area. May experience reduced distribution and contact with impacted groundwater in till.	High	Moderate capital cost and O&M costs for multiple injections using injection wells installed in close proximity in smaller treatment areas. High O&M costs for multiple injections using direct push injections in larger treatment areas.	Yes	Lower effectiveness in comparison to other in situ process options.
Removal	Excavation/Dewatering	Moderate	Effective for mass removal in areas where DNAPL, soil impacts, and groundwater concentrations are coincident. Groundwater treatment would be limited to the amount of impacted water entering the excavated area and the transport of impacted groundwater to the excavated area.	Moderate	Likely to require demolition of Buildings 64 and 52 (western side of Site) and Building 101 (eastern side of Site) for access. Would require dewatering of the excavation and treatment of recovered water or offsite disposal.	High	High capital cost for building demolition. Offsite disposal of treated groundwater and excavated material and import of backfill would be required.	No	Higher cost and greater implementation challenges in comparison to other process options.
	Groundwater Extraction	High	Effective for all Site COPCs. Effectiveness is limited by the ability to fully intercept impacted groundwater. Requires ex-situ treatment and reuse/discharge of treated groundwater (see below).	Moderate	Requires long-term set aside of onsite area for treatment facility.	High	Moderate capital cost to install extraction wells. High capital costs for treatment system installation. Long-term O&M costs.	Yes	Effectively treats all Site groundwater COPCs. Limited effectiveness in low permeability soils and till.
	Groundwater Recovery Trenches	High	Effective for all Site COPCs. Effectiveness is limited by the ability to fully intercept impacted groundwater. Requires ex situ treatment and reuse/discharge of treated groundwater (see below).	Moderate	May require building demolition for implementation. Requires long-term set aside of onsite area for treatment facility.	High	High capital cost for trench and treatment system installation. Long-term O&M costs.	Yes	Effectively treats all Site groundwater COPCs.
Ex Situ Physical Treatment	Air Stripping	Moderate	Effective for ex-situ treatment of VOCs in groundwater. Ineffective for PFAS. Ineffective for metals.	High	Implemented using an air stripping unit.	Low	Low capital cost.	Yes	Considered in conjunction with other ex situ removal technologies.
	Carbon Adsorption	Moderate	Effective for ex-situ treatment of CVOCs in groundwater. Effective for PFAS. Likely ineffective for metals.	High	Carbon absorption capacity for CVOC degradation products such as vinyl chloride is reduced.	Moderate/ High	High infrastructure costs; moderate long-term O&M cost because of carbon regeneration.	No	Higher cost in comparison to other ex situ removal technologies.
	IX Adsorption	Moderate	Effective for ex-situ treatment of metals in groundwater. Ineffective for CVOCs. Ineffective for PFAS.	High	May require different resins in series for removal of all Site groundwater COPCs.	Low	Low capital cost; moderate long-term O&M cost because of IX regeneration.	Yes	Considered in conjunction with other ex situ removal technologies.

See Notes on Page 3.

Table 3-6
Process Options Screening for Groundwater

Feasibility Study
Former George A. Robinson Company, Inc. Site
477 Whitney Road, Penfield, New York

Remedial Technologies	Process Options	Effectiveness Evaluation		Implementability Evaluation		Relative Cost Evaluation		Retained for Consideration	
Ex Situ Chemical Treatment	Precipitation	Moderate/ High	Effective for ex-situ treatment of metals in groundwater. Ineffective for CVOCs. Ineffective for PFAS.	High	Implementability depends on maintaining appropriate redox conditions. Different metals may require different amendments.	High	Low capital cost.	Yes	Considered in conjunction with other ex situ removal technologies.
	Ozone Oxidation	Moderate /High	Effective for ex-situ treatment of CVOCs in groundwater. Ineffective for PFAS. Ineffective for metals.	Moderate	Implementability contingent upon addressing health and safety concerns from strong oxidant. Requires production or delivery of ozone in a gaseous state.	High	High capital cost; low to moderate O&M cost.	No	Higher cost and greater implementation challenges in comparison to other ex situ removal technologies.
Disposal	POTW	High	Requires the lowest level of treatment prior to discharge.	Moderate	Requires permitting and construction of discharge line to discharge to POTW.	Moderate	Moderate capital cost and moderate O&M cost.	Yes	Considered in conjunction with removal technologies.
	Treatment Facility	High	Removes the contaminated media from the site.	Moderate	Requires acceptance from disposal facility.	High	High transport cost; disposal cost dependent on the COPCs and concentrations.	Yes	Considered in conjunction with removal technologies.
Reuse	Reinjection	High	Requires high level of treatment to meet discharge standards.	Low/ Moderate	Requires permitting and construction of recharge infrastructure on site. Implementability is dictated by the transmissivity of the site materials and the availability of onsite space for recharge infrastructure.	High	High capital cost and moderate O&M cost.	No	Greater implementation challenges in comparison to other process options.
Discharge	Surface Water Discharge	High	Requires high level of treatment to meet discharge standards.	High	Implementability is dictated by SPDES permit requirements.	Low	Negligible capital cost; minimal O&M cost.	Yes	Considered in conjunction with ex situ physical treatment technologies.
	Air Discharge	High	Requires high level of treatment to meet discharge standards.	High	Implementability is dictated by permit requirements.	Low	Low capital cost; low O&M cost.	Yes	Considered in conjunction with ex situ physical treatment technologies.

Note:
Shaded cells indicate technologies not retained.

Abbreviations:
COPC - constituent of potential concern
CVOC - chlorinated volatile organic compound
DNAPL - dense nonaqueous phase liquid
IX - ion exchange
MNA - Monitored Natural Attenuation
O&M - operation and maintenance
PFAS - per- and polyfluoroalkyl substances
POTW - Public Owned Treatment Works
SPDES - State Pollutant Discharge Elimination System
VOC - volatile organic compound

Table 4-1
Summary of Costs for Remedial Alternatives

Feasibility Study Report
Former George A. Robinson Company, Inc. Site
477 Whitney Road, Penfield, New York

ARCADIS

Remedial Alternative	Capital Cost	One-Time Future Cost		One-Time Future Cost		Annual O&M and LTM Cost	Total Estimated Cost (Undiscounted)	Total Estimated Cost (Present Value)
1 - No Action	$110,000					$0	$110,000	$110,000
2 - Return to Predisposal Condition	$5,290,000					$430,000	$14,750,000	$13,050,000
3 - Source Excavation, Soil Cover, and Groundwater Treatment	$4,670,000	$220,000	Year 2	$270,000	Year 4	$80,000	$6,360,000	$6,254,000
4 - Source Excavation and Groundwater Treatment	$4,810,000	$220,000	Year 2	$270,000	Year 4	$80,000	$6,500,000	$6,474,000
5 - Partial Source Excavation and Prevention of Offsite Migration	$6,290,000	$190,000	Year 2	$190,000	Year 4	$80,000	$8,270,000	$7,848,000
6 - Partial Source Excavation, Soil cover, and Prevention of Offsite Migration	$8,060,000					$80,000	$9,660,000	$9,504,000

Notes:
LTM = Long-term monitoring
O&M = Operation and maintenance
Present value cost based on 1% annual discount rate (difference between 10-year treasury and US inflation rates).

Table 4-2
Remedial Alternatives Screening Summary

Feasibility Study
Former George A. Robinson Company, Inc. Site
477 Whitney Road, Penfield, New York

Threshold and Balancing Criteria	Alternative 1: No Action	Rating	Alternative 2: Return to Pre-Disposal Conditions	Rating	Alternative 3: Source Soil Excavation, Soil Treatment, and Groundwater Treatment	Rating
Overall protection of public health and the environment	Would not be protective of human health and the environment because soil and groundwater containing COPCs at concentrations greater than applicable soil and groundwater standards would remain at the site. Potential exposure to contaminated soil and groundwater by site workers and/or visitors would remain.	**No**	Metals and VOCs at concentrations above criteria in source soils would be eliminated via excavation and off-site disposal. PFAS and VOCs at concentrations above criteria in both on- and off-site groundwater would be reduced through groundwater extraction and treatment. LTM combined with a limited monitored natural attenuation (MNA) assessment would be used to monitor and/or further reduce contaminant concentrations over time to ensure protection of human health and the environment during implementation. Following groundwater extraction and treatment implementation, LTM/MNA would be used to evaluate decreasing COPC concentrations over time.	**Yes**	Metals and VOCs at concentrations above criteria in source soils would be eliminated via excavation or, for metals, controlled via in-situ stabilization. VOCs at concentrations above criteria in site groundwater would be reduced through ISCO injections and reductions would be confirmed/tracked through post injection monitoring. PFAS concentrations in site groundwater would be reduced and controlled through injection of colloidal carbon. Offsite groundwater impacts would attenuate and/or be reduced over time due to treatment of on-site sources. LTM/MNA would be used to further reduce and/or track COPC concentrations over time to ensure protection of human health and the environment during remedial implementation and achieve/confirm PFAS, VOCs, and metals concentrations below criteria in groundwater.	**Yes**
Compliance with standards, criteria, and guidance (SCGs)	Would not meet the SCGs because contamination would persist at concentrations greater than standards/guidelines in soil and groundwater.	**No**	Would meet soil SCGs over the short term by removing impacted soil and is expected to meet groundwater SCGs over the long term by treating impacted groundwater	**Yes**	Excavation, in-situ treatment, performance monitoring, and reporting would be conducted in compliance with federal and state requirements	**Yes**
Long-term effectiveness and permanence	Would not meet the SCGs over the long term because contamination would persist at concentrations greater than standards/guidelines in soil and groundwater	--	High. VOCs and metals in source soils would be removed from the site via excavation. VOCs and PFAS concentrations in groundwater would be significantly reduced over time through groundwater extraction and treatment and natural attenuation for VOCs. Following remedy implementation, concentrations of VOCs, PFAS, and metals in soil and groundwater would be reduced to low levels and show established downward trends to ensure continued compliance with NYSDEC Class GA Standard or Guidance Values.	**5**	High/Moderate VOCs and metals in source soils would be removed from the site via excavation resulting in long-term effectiveness and permanence. Metals in source soils that remain on site would be in a stabilized form preventing/limiting further leaching to groundwater. VOCs in source area groundwater would be directly targeted and their concentrations reduced via ISCO injection. Desorption of PFAS could occur over time, reducing long-term permanence. Concentrations of VOCs and PFAS that remain in groundwater post remediation are expected to attenuate over time and/or be reduced through reduction of mass flux from treated source soils. Follow up injections of either ISCO and/or colloidal carbon may be necessary for long-term effectiveness and permanence.	**4**
Reduction of toxicity, mobility, and volume	Would not reduce the toxicity or mobility of the contaminants; however, the volume of contamination may be reduced over the long term through natural attenuation and/or off-site migration.	--	High. Would result in the permanent and significant reduction of toxicity, mobility, and volume of VOCs, PFAS, and metals through removal of source soils and removal and treatment of VOCs and PFAS in groundwater.	**5**	High/Moderate. Would reduce the toxicity, mobility, and volume of VOCs, metals, and PFAS in on-site soil and groundwater. Off-site downgradient groundwater impacts would be reduced over time as a result of reduced mass flux from the site but not be targeted directly.	**4**
Short-term effectiveness	No to minimal risk to workers during limited scope associated with well abandonment.	--	Moderate. Manageable risk to workers who excavate soil and operate the treatment system due to the use of heavy equipment during excavation, system install and trenching, and physical demands of the job.	**3**	Moderate. Manageable risk to workers who excavate soil due to the use of heavy equipment, chemicals, and physical demands of the job. DPT injections will add risk to workers due to chemical handling and physical hazards.	**4**

See Notes on Page 5.

Table 4-2
Remedial Alternatives Screening Summary

Feasibility Study
Former George A. Robinson Company, Inc. Site
477 Whitney Road, Penfield, New York

Threshold and Balancing Criteria	Alternative 1: No Further Action	Rating	Alternative 2: Return to Pre-Disposal Conditions	Rating	Alternative 3: Source Soil Excavation, Soil Treatment, and Groundwater Treatment	Rating
Implementability	Can be easily implemented but would not be compliant with NYSDEC regulations/policy	--	Low. Would be implemented using readily available technologies; however, implementation would require extensive site controls, significant clearing both onsite and offsite, significant trenching both on- and off-site in challenging terrain to connect extraction wells to the system, and ability to secure and maintain access agreements with off-site properties. Complex geology poses challenges for effectively targetting impacted groundwater. Periodic redevelopment and/or replacement of extraction wells would likely be required.	2	Moderate. Would be implemented using readily available technologies; however, implementation would require extensive site control, pilot testing, and predesign investigation to design an effective treatment approach. Treatment of VOCs in groundwater via ISCO and PFAS via colloidal carbon would be difficult to effectively implement due to complex geology.	3
Cost	Approximately $110K for monitoring well abandonment	--	High. $14.8 million	1	Moderate. $6.5 million	3
Land use	Would not achieve criteria for the current or anticipated future (i.e., commercial or restricted residential) land use	--	Unrestricted Use (Soil and Groundwater). Would return the site to pre-disposal conditions resulting in unrestricted land use.	5	Unrestricted Use (Soil) and Restricted Use (Groundwater). COPCs in site soil would be reduced to below Protection of Groundwater SCOs. COPCs in groundwater would be addressed through in-situ treatment but their concentrations would still exceed NYSDEC Class GA Standard or Guidance Values.	4
Green and sustainable remediation	Physical footprint would be negligible, but the alternative would not be resilient and would pose risks to community.	--	Low. Waste management and heavy equipment operation would have significant footprints and be disruptive to the community. Pump and treat system operation would incur long-term waste generation and infrastructure.	1	Moderate. Source area excavation would have lower waste footprint compared to Alternative 2. Injections and stabilization would have relatively low footprints for long-term benefits.	3
Screening Score Summary						
		--		22		25

See Notes on Page 5.

Table 4-2
Remedial Alternatives Screening Summary

Feasibility Study
Former George A. Robinson Company, Inc. Site
477 Whitney Road, Penfield, New York

Threshold and Balancing Criteria	Alternative 4: Source Soil Excavation and Groundwater Treatment	Rating	Alternative 5: Partial Source Soil Excavation and Prevention of Offsite Migration	Rating	Alternative 6: Partial Source Soil Removal, Cover, and Prevention of Offsite Migration	Rating
Overall protection of public health and the environment	Metals and VOCs at concentrations above criteria in source soils would be eliminated via excavation. VOCs at concentrations above criteria in site groundwater would be reduced through ISCO injections and reductions would be confirmed/tracked through post injection monitoring. PFAS concentrations in site groundwater would be reduced and controlled through injection of colloidal carbon. Offsite groundwater impacts would attenuate and/or be reduced over time due to treatment of on-site sources. LTM/MNA would be used to further reduce and/or track COPC concentrations over time to ensure protection of human health and the environment during remedial implementation and achieve/confirm PFAS, VOCs, and metals concentrations below criteria in groundwater.	**Yes**	Metals and VOCs at concentrations above criteria in source area soils would be partially eliminated via excavation. PFAS concentrations in site groundwater would be reduced and controlled through injection of colloidal carbon. VOCs at concentrations above criteria in on-site groundwater near and downgradient of Building 64 would be reduced through ISCO injections and reductions would be confirmed/tracked through post injection monitoring. Off-site migration of VOC-impacted groundwater near Building 101 would be controlled through PRBs installed at targeted areas along the property boundary. Off-site groundwater impacts would attenuate and/or be reduced over time due to removal of on-site sources. LTM/MNA would be used to further reduce and/or track COPC concentrations over time to ensure protection of human health and the environment during remedial implementation and achieve/confirm PFAS, VOCs, and metals concentrations below criteria in groundwater over time.	**Yes**	Metals and VOCs at concentrations above criteria in source area soils would be partially eliminated via excavation. A cover would be installed over remining soils with metals at concentrations exceeding criteria to minimize contact and further leaching to groundwater. PFAS concentrations in site groundwater would be reduced and controlled through injection of colloidal carbon. Off-site migration of VOC-impacted groundwater would be controlled through PRBs installed at targeted areas along the property boundary. Off-site groundwater impacts would attenuate and/or be reduced over time due to source area remediation. LTM/MNA would be used to further reduce and/or track COPC concentrations over time to ensure protection of human health and the environment during remedial implementation and achieve/confirm PFAS, VOCs, and metals concentrations below criteria in groundwater over time.	**Yes**
Compliance with standards, criteria, and guidance (SCGs)	Excavation, in-situ treatment, performance monitoring, and reporting would be conducted in compliance with federal and state requirements	**Yes**	Excavation, performance monitoring, and reporting would be conducted in compliance with federal and state requirements.	**Yes**	Expected to meet soil and groundwater SCGs over the long term. Excavation, cover installation, performance monitoring, and reporting would be conducted in compliance with federal and state requirements.	**Yes**
Long-term effectiveness and permanence	High/Moderate VOCs and metals in source soils would be removed from the site via excavation resulting in long-term effectiveness and permanence. VOCs in source area groundwater would be directly targeted and their concentrations reduced via ISCO injection. Desorption of PFAS and/or other bound compounds could occur over time, reducing long-term permanence. Concentrations of VOCs and PFAS that remain in groundwater post remediation are expected to attenuate over time and/or be reduced through reduction of mass flux from removal of source soils. Follow up injections of either ISCO and/or colloidal carbon may be necessary for long-term effectiveness and permanence.	**4**	High/Moderate VOCs and metals in source soils would be removed from the site via excavation resulting in long-term effectiveness and permanence. VOCs in source area groundwater surrounding Building 64 would be directly targeted and their concentrations reduced via ISCO injection. Desorption of PFAS could occur over time, reducing long-term permanence. Concentrations of VOCs and PFAS that remain in groundwater post remediation are expected to attenuate over time and/or be reduced through reduction of mass flux from removal of source soils. Follow up injections of either ISCO and/or colloidal carbon may be necessary for long-term effectiveness and permanence.The effectiveness of the PRB in treating VOCs will require on-going monitoring and potential maintenance.	**4**	Moderate VOCs and metals in source soils would be removed from the site via excavation resulting in long-term effectiveness and permanence. Would not implement source treatment of groundwater for VOCs lowering the effectiveness rating. Desorption of PFAS could occur over time, reducing long-term permanence. Concentrations of VOCs and PFAS that remain in groundwater post remediation are expected to attenuate over time and/or be reduced through reduction of mass flux from removal of source soils. Follow up injections of either ISCO and/or colloidal carbon may be necessary for long-term effectiveness and permanence.The effectiveness of the PRB in treating VOCs will require on-going monitoring and potential maintenance.	**3**
Reduction of toxicity, mobility, and volume	High/Moderate. Would reduce the toxicity, mobility, and volume of VOCs, metals, and PFAS in on-site soil and groundwater. Off-site downgradient groundwater impacts would be reduced over time as a result of reduced mass flux from the site but not be targeted directly.	**4**	High/Moderate. Would reduce the toxicity, mobility, and volume of onsite CVOCs, metals, and PFAS contaminants in both soil and groundwater. Off site downgradient groundwater impacts to the south of Building 101 would rely on the PRB to treat VOCs in groundwater at the fence and decrease mass flux from the site over time.	**4**	Moderate. Would reduce the toxicity, mobility, and volume of onsite CVOCs, metals, and PFAS contaminants in soil. Would not directly treat source VOC contaminants in groundwater but rather rely on containment and treatment as it migrates off-site to reduce mobility.	**3**
Short-term effectiveness	Moderate. Manageable risk to workers who excavate soil due to the use of heavy equipment and physical demands of the job. DPT injections will add risk to workers due to chemical handling and physical hazards.	**4**	Moderate. Manageable risk to workers excavating soil, conducting the colloidal carbon injection, and installing the PRB.	**4**	Moderate. Manageable risk to workers excavating soil, conducting the colloidal carbon injection, and installing the PRB.	**4**

See Notes on Page 5.

Table 4-2
Remedial Alternatives Screening Summary

Feasibility Study
Former George A. Robinson Company, Inc. Site
477 Whitney Road, Penfield, New York

Threshold and Balancing Criteria	Alternative 4: Source Soil Excavation and Groundwater Treatment	Rating	Alternative 5: Partial Source Soil Excavation and Prevention of Offsite Migration	Rating	Alternative 6: Partial Source Soil Removal, Cover, and Prevention of Offsite Migration	Rating
Implementability	Moderate. Would be implemented using readily available technologies; however, implementation would require extensive site controls, pilot testing, and predesign investigation to design an effective treatment approach. Treatment of VOCs in groundwater via ISCO and PFAS via colloidal carbon would be difficult to effectively implement due to complex geology.	**3**	Moderate. Would be implemented using readily available technologies; however, implementation would require extensive site controls, pilot testing and predesign investigation to design an effective treatment approach. Treatment of VOCs in groundwater via ISCO and PFAS via colloidal carbon would be difficult to effectively implement due to complex geology. Installation of the PRB is challenging due to site constraints, site access, depth of groundwater, and heterogeneous and complicated geology.	**3**	Moderate. Would be implemented using readily available technologies; however, implementation would require extensive site controls, pilot testing, and predesign investigation to design an effective treatment approach. Treatment of PFAS via colloidal carbon would be difficult to effectively implement due to complex geologyy. Installation of the PRBs is challenging due to site constraints, site access, depth of groundwater, and heterogeneous and complicated geology.	**3**
Cost	Moderate. $6.6 million	**3**	High $6.3 million	**2**	High. $6.8 million	**1**
Land use	Unrestricted Use (Soil) and Restricted Use (Groundwater). Site contaminants in soil would be addressed through excavation and treatment and reduced to below Protection of Groundwater SCOs. Contaminants in groundwater would be addressed through treatment but would still exceed NYSDEC Class GA Standard or Guidance Values.	**4**	Restricted Use (Soil and Groundwater). Unrestricted use would not be attained for soil or groundwater. Site contaminants would continue to exceed NYSDEC Class GA Standard or Guidance Values and SCOs.	**2**	Restricted Use (Soil and Groundwater). Unrestricted use would not be attained for soil or groundwater. Site contaminants would continue to exceed NYSDEC Class GA Standard or Guidance Values and SCOs.	**2**
Green and sustainable remediation	Moderate. Source area excavation would have lower waste footprint compared to Alternative 2. Injections would have relatively low footprints for long-term benefits.	**3**	Moderate. Partial source area excavation and PRB would reduce waste generation. Source area excavation would have lower waste footprint compared to Alternative 2. Without demolition of Building 101, or removal of the soils beneath, these areas could be vulnerable to future extreme weather conditions and could result in potential for migration of impacts. Materials would be needed for the PRB construction. Injections would have relatively low footprints for long-term benefits.	**3**	Moderate. Partial source area excavation, cap, and PRB would reduce waste generation. Source area excavation would have lower waste footprint compared to Alternative 2. Without demolition of Building 101, or removal of the soils beneath, these areas could be vulnerable to future extreme weather conditions and could result in potential for migration of impacts. Materials would be needed for the cap and PRB construction. Injections would have relatively low footprints for long-term benefits.	**3**
Screening Score Summary						
		25		**22**		**19**

See Notes on Page 5.

Table 4-2
Remedial Alternatives Screening Summary

Feasibility Study
Former George A. Robinson Company, Inc. Site
477 Whitney Road, Penfield, New York

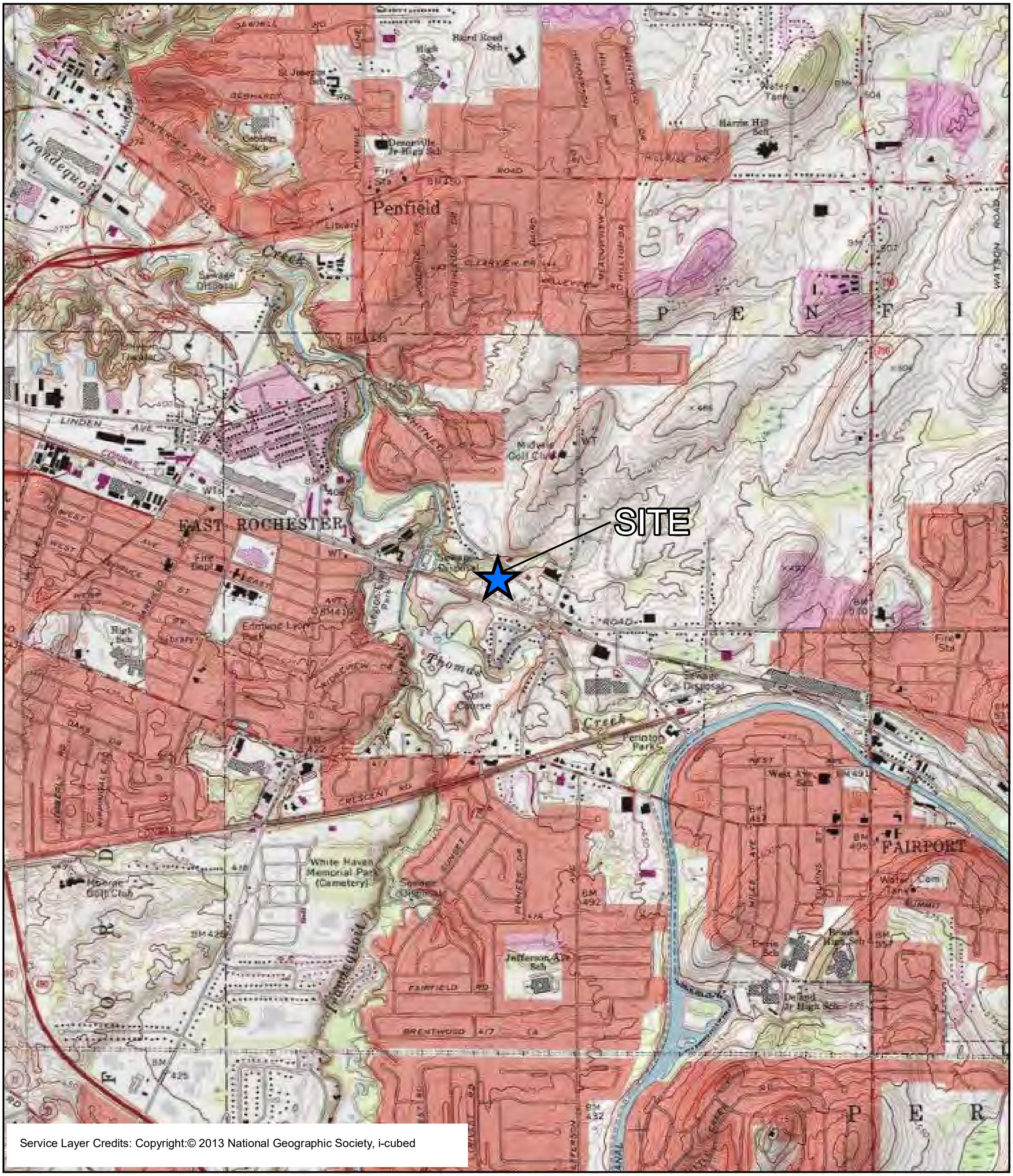
Notes:
All costs are estimated to an accuracy of +50% to -30% (USEPA 2000).
State acceptance and community acceptance modifying criteria will not be given a rating; these will be reflected during the Proposed Plan process.

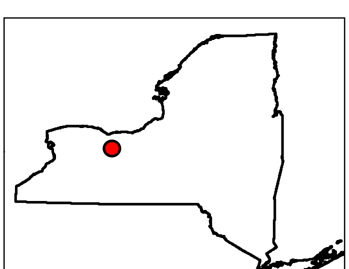
Acronyms and Abbreviations:
ARAR = applicable or relevant and appropriate requirement
CFR = Code of Federal Regulations
CMR = Code of Massachusetts Regulations
LUC = land use control
MCL = maximum contaminant level
NIA = North Impact Area
NPDWSA = non-potential drinking water source area
PFAS = per- and polyfluoroalkyl substances
RAOs = Remedial Action Objectives
RCRA = Resource Conservation and Recovery Act
redox = oxidation-reduction

Color Code:
Threshold criteria are Pass / Fail
More desirable
Neutral
Less desirable

Rating categories for Threshold and Balancing and Other Criteria (Excluding Cost):
(0) None
(1) Low
(2) Low to moderate
(3) Moderate
(4) Moderate to high
(5) High

Figures





GEORGE A. ROBINSON & CO., INC. (SITE #8-28-065)
477 WHITNEY ROAD
PENFIELD, NEW YORK
FEASIBILITY STUDY REPORT

SITE LOCATION

ARCADIS

FIGURE
1-1

Document Path: T:_ENV\NYSDEC\George Robinson\mxd\Feasibility Study\Figure 1-1 Site Location.mxd

0 125 250 500 750 1,000 Feet

Legend

- Site Boundary
- Site Fence
- Historical Settling Pond
- Historical Wastewater Lagoon

Note: Historical boundaries are approximate.

Aerial Basemap: Google Satellite

N

GEORGE A. ROBINSON & CO., INC. (SITE #8-28-065)
477 WHITNEY ROAD
PENFIELD, NEW YORK
FEASIBILITY STUDY REPORT

SITE MAP

ARCADIS

FIGURE
1-2

Document Path: T:_ENV\NYSDEC\George Robinson\mxd\Feasibility Study\Figure 1-2 Site Map.mxd

GEORGE A. ROBINSON & CO., INC. (SITE #8-28-065)
477 WHITNEY ROAD
PENFIELD, NEW YORK
FEASIBILITY STUDY REPORT

SURROUNDING PROPERTY MAP

ARCADIS

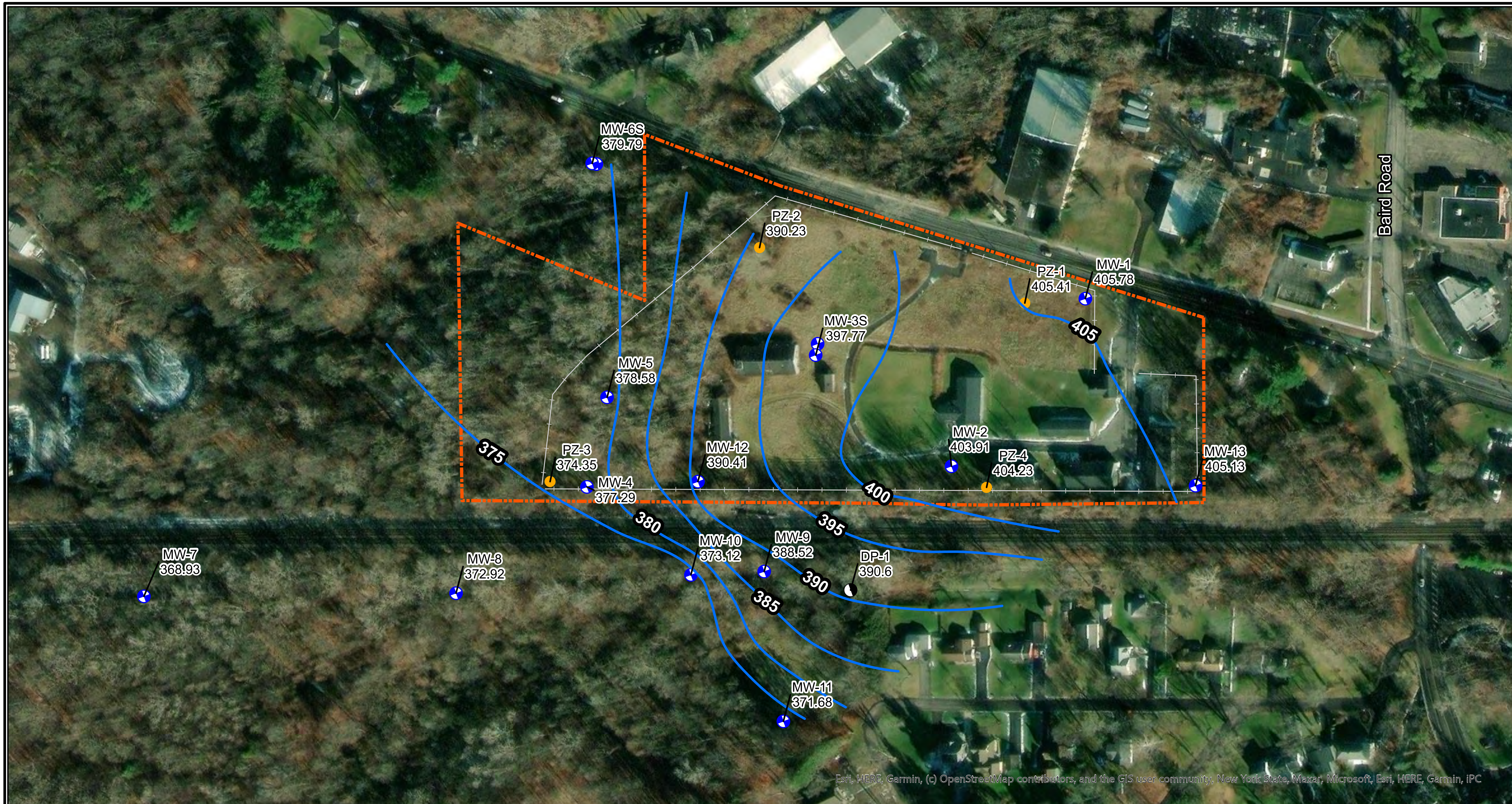
FIGURE
1-3

Legend

Site Boundary

Note: Historical boundaries are approximate.

Aerial Basemap: Google Satellite



Legend

- Drive Point
- Monitoring Well
- Piezometer
- Site Boundary
- Site Fence (Approximate)

372.92 Groundwater Elevation (in feet above mean sea level)

375 Groundwater Contour (in feet above mean sea level)

GEORGE A. ROBINSON & CO., INC. (SITE #8-28-065)
477 WHITNEY ROAD
PENFIELD, NEW YORK
REMEDIAL INVESTIGATION

GROUNDWATER ELEVATIONS OCTOBER 2019

ARCADIS

FIGURE 1-4

G:\GIS\MOD\00266422.0000\SiteMap.mxd

0 125 250 500 750 1,000
Feet

Legend

- Drive Point
- Monitoring Well
- Piezometer
- Site Boundary
- Equal Elevation Potentiometric Contour
- 368.34 Groundwater Elevation (in feet above mean sea level)
- 375 Groundwater Contour (in feet above mean sea level)

DP-1 was a temporary monitoring point and was not measured in 2022.

Aerial Basemap: Google Satellite

N

GEORGE A. ROBINSON & CO., INC. (SITE #8-28-065)
477 WHITNEY ROAD
PENFIELD, NEW YORK
FEASIBILITY STUDY

POTENTIOMETRIC CONTOURS
AUGUST 2022

ARCADIS

FIGURE
1-5

City: Clifton Park Div/Group: ENV Created By: Last Saved By: LJohns
Project NG Rotterdam
\\arcadis-us.com\app\GIS\Processing_ENV\NYSDEC\George Robinson\aprx\Feasibility Study Figures\Feasibility Study Figures.aprx 11/17/2023 2:13 PM

Document Path: Clifton Park New York Office T:_ENV\NYSDEC\George Robinson\mxd\Cross Section Transects.mxd

0 200 400 800 1,200 1,600 Feet

Legend

- Drive Point
- Monitoring Well
- 1-inch Monitoring Well
- Site Characterization Soil Boring
- Remedial Investigation Soil Boring
- Sediment Sample Location
- Surface Water Sample
- Site Boundary (Approximate)
- Wet Area
- World Transportation

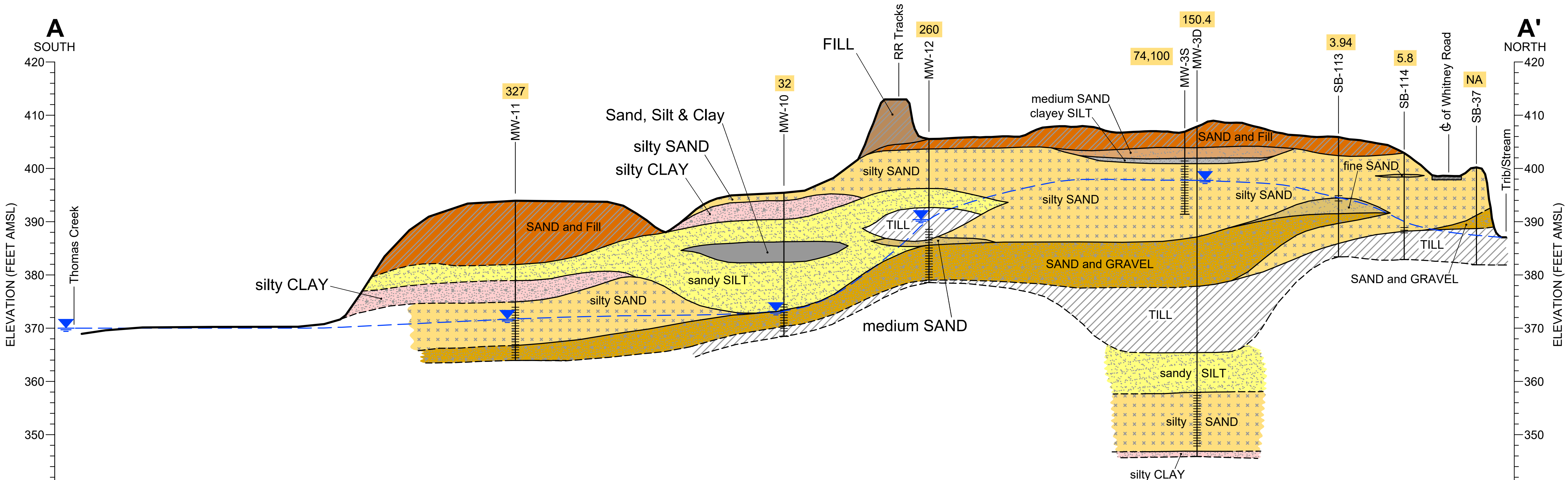
N

GEORGE A. ROBINSON & CO., INC. (SITE #8-28-065)
477 WHITNEY ROAD
PENFIELD, NEW YORK
FEASIBILITY STUDY

GEOLOGIC CROSS SECTION TRANSECT MAP

ARCADIS

FIGURE 1-6



LEGEND:

35.75 — Total VOCs IN GROUNDWATER (µg/L)

MW-9S — WELL/BORING ID

APPROXIMATE GROUND SURFACE

LITHOLOGIC CONTACT (DASHED WHERE INFERRED)

INFERRED GROUNDWATER ELEVATION WITH WATER LEVEL MARKER

WELL SCREEN

WELL/BORING BOTTOM

LITHOGRAPHIC KEY:

- SAND and Fill
- FILL
- fine SAND
- silty CLAY
- sandy SILT
- silty SAND
- clayey SILT
- medium SAND
- SAND and GRAVEL
- Interbedded Sand, Silt & Gravel
- TILL

NOTES:

1. CROSS SECTION BASED ON AVAILABLE LITHOLOGY DATA FROM REMEDIAL INVESTIGATION AND SITE CHARACTERIZATION.
2. GROUNDWATER ELEVATIONS FROM THE OCTOBER 2019 EVENT WERE USED TO DEPICT WATER LEVELS.

0 120' 240'
HORIZONTAL SCALE

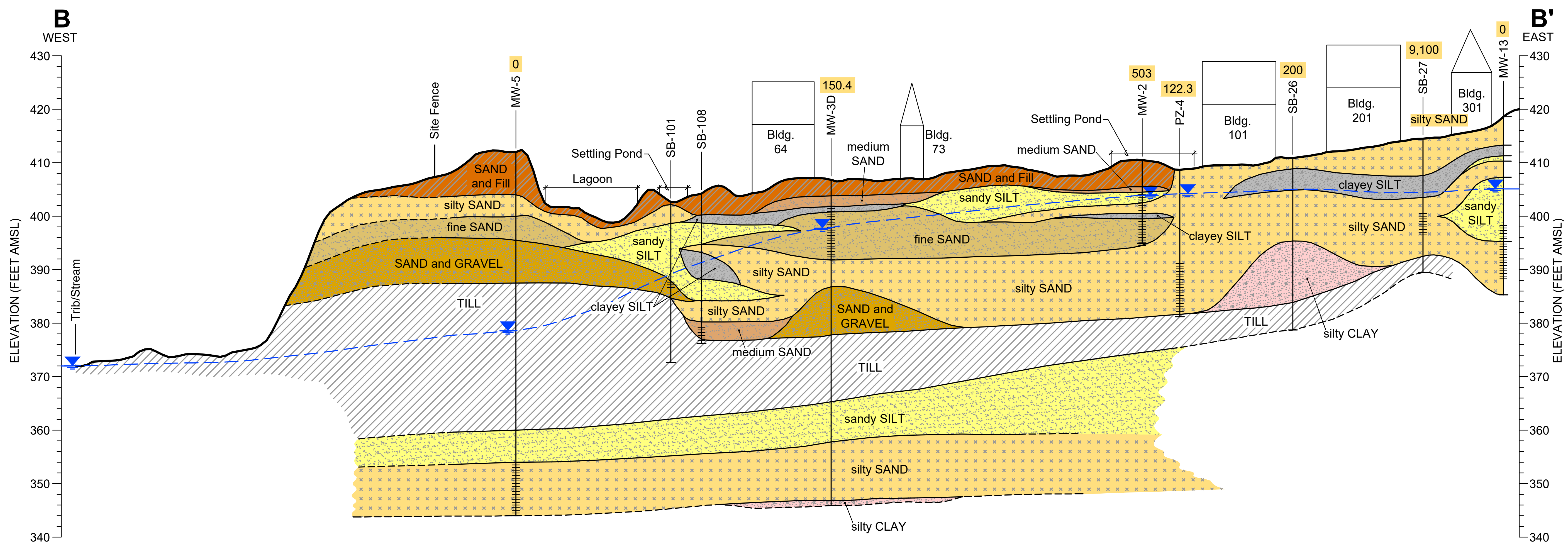
0 20' 40'
VERTICAL SCALE

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
GEORGE A. ROBINSON, PENFIELD, NEW YORK
FEASIBILITY STUDY

CROSS-SECTION A-A'

ARCADIS

FIGURE
1-7



LEGEND:

76.48 — Total VOCs IN GROUNDWATER (µg/L)

SB-108 — WELL/BORING ID

APPROXIMATE GROUND SURFACE

LITHOLOGIC CONTACT (DASHED WHERE INFERRED)

INFERRED GROUNDWATER ELEVATION WITH WATER LEVEL MARKER

WELL SCREEN

WELL/BORING BOTTOM

LITHOGRAPHIC KEY:

- SAND and Fill
- fine SAND
- silty CLAY
- sandy SILT
- silty SAND
- clayey SILT
- medium SAND
- SAND and GRAVEL
- TILL

NOTES:

1. CROSS SECTION BASED ON AVAILABLE LITHOLOGY DATA FROM REMEDIAL INVESTIGATION AND SITE CHARACTERIZATION.
2. GROUNDWATER ELEVATIONS FROM THE OCTOBER 2019 EVENT WERE USED TO DEPICT WATER LEVELS.
3. SETTLING PONDS AND LAGOON NO LONGER IN USE.
4. MW-3D SCREEN DEPICTED IN CROSS SECTION REPRESENTS MW-3S SCREENED INTERVAL.

0 120' 240'
HORIZONTAL SCALE

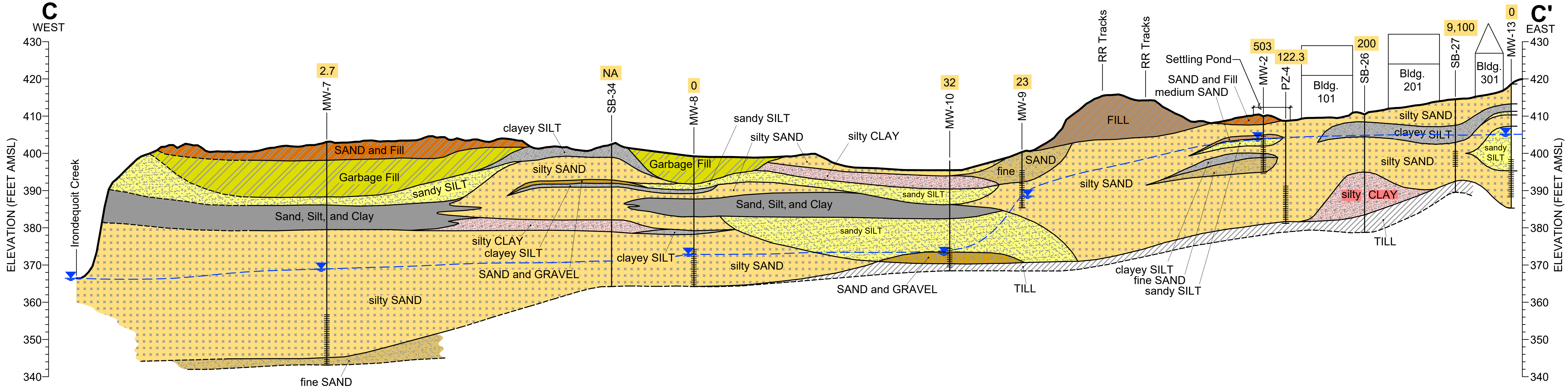
0 20' 40'
VERTICAL SCALE

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
GEORGE A. ROBINSON, PENFIELD, NEW YORK
FEASIBILITY STUDY

CROSS-SECTION B-B'

ARCADIS

FIGURE
1-8



LEGEND:

5.20 — Total VOCs IN GROUNDWATER (µg/L)

MW-7 — WELL/BORING ID

APPROXIMATE GROUND SURFACE

LITHOLOGIC CONTACT (DASHED WHERE INFERRED)

INFERRED GROUNDWATER ELEVATION WITH WATER LEVEL MARKER

WELL SCREEN

WELL/BORING BOTTOM

LITHOGRAPHIC KEY:

- FILL
- SAND and Fill
- Garbage Fill
- fine SAND
- silty CLAY
- sandy SILT
- silty SAND
- clayey SILT
- medium SAND
- SAND and GRAVEL
- INTERBEDDED SAND, SILT and CLAY
- TILL

NOTES:

1. CROSS SECTION BASED ON AVAILABLE LITHOLOGY DATA FROM REMEDIAL INVESTIGATION AND SITE CHARACTERIZATION.
2. GROUNDWATER ELEVATIONS FROM THE OCTOBER 2019 EVENT WERE USED TO DEPICT WATER LEVELS.
3. SETTLING POND NO LONGER IN USE.
4. NA = NOT AVAILABLE.

0 160' 280'
HORIZONTAL SCALE

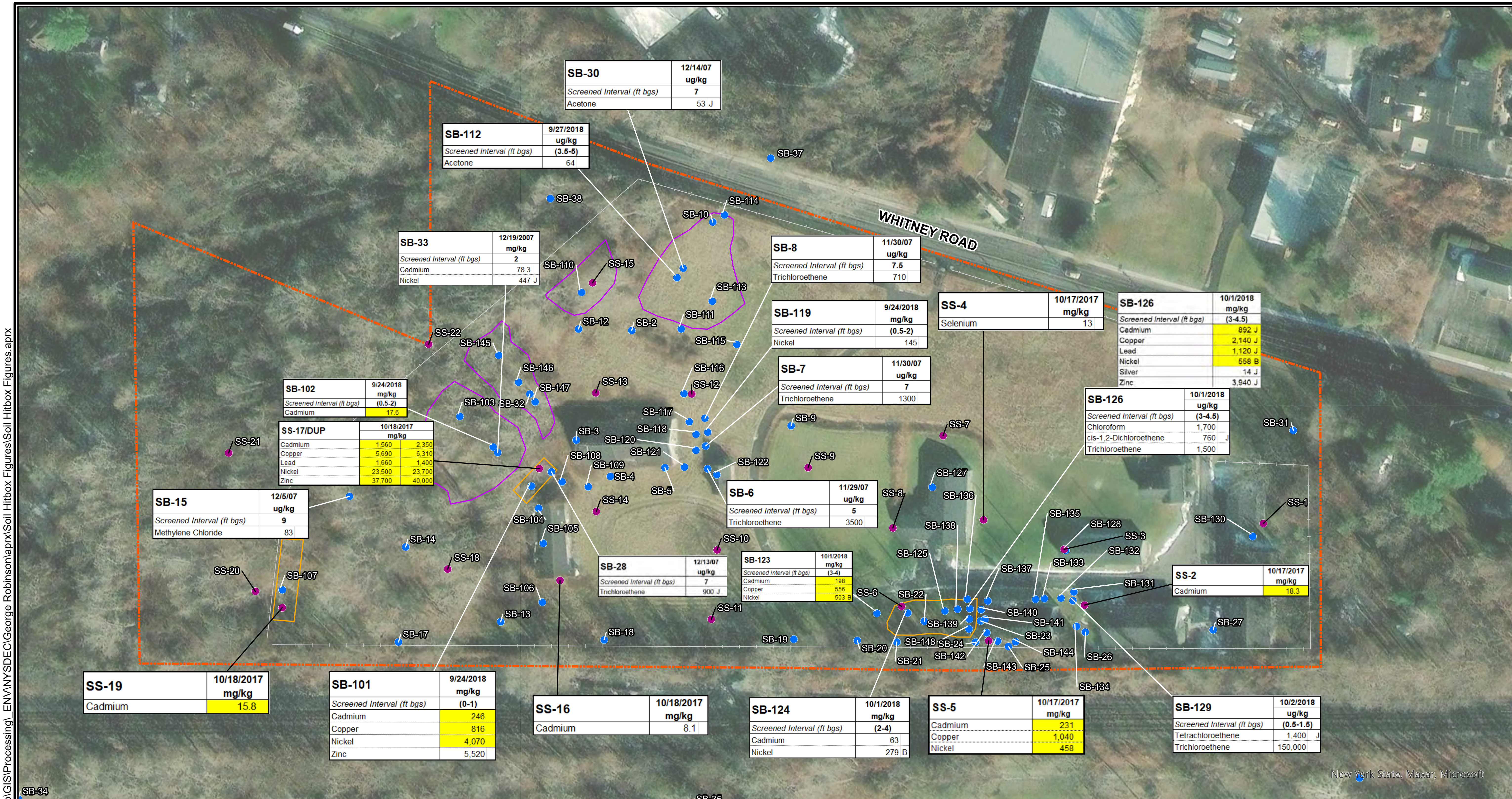
0 26.6' 53.3'
VERTICAL SCALE

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
GEORGE A. ROBINSON, PENFIELD, NEW YORK
FEASIBILITY STUDY

CROSS-SECTION C-C'

ARCADIS

FIGURE
1-9



0 80 160 320 480 640 Feet

Legend

- Surface Soil Sample
- Soil Boring
- Site Boundary
- Site Fence (Approximate)
- Settling Pond (Approximate)
- Historic Wastewater Lagoon (Approximate)

Definitions

J - Estimated value
ug/kg - micrograms per kilogram
mg/kg - milligrams per kilogram

NOTE: The yellow highlighted data exceed the Commercial Use Soil Cleanup Objective and the unhighlighted data exceed the Protection of Groundwater Soil Cleanup Objective.

	6 NYCRR Part 375 Protection of Groundwater Soil Cleanup Objective mg/kg	6 NYCRR Part 375 Commercial Use Soil Cleanup Objective mg/kg
Cadmium	7.5	9.3
Copper	1720	270
Lead	450	1,000
Nickel	130	310
Selenium	4	1,500
Zinc	2480	10,000

	6 NYCRR Part 375 Protection of Groundwater Soil Cleanup Objective ug/kg	6 NYCRR Part 375 Commercial Use Soil Cleanup Objective ug/kg
Acetone	50	500,000
Chloroform	370	350,000
cis-1,2-Dichloroethene	250	500,000
Methylene Chloride	50	500,000
Trichloroethene	470	200,000

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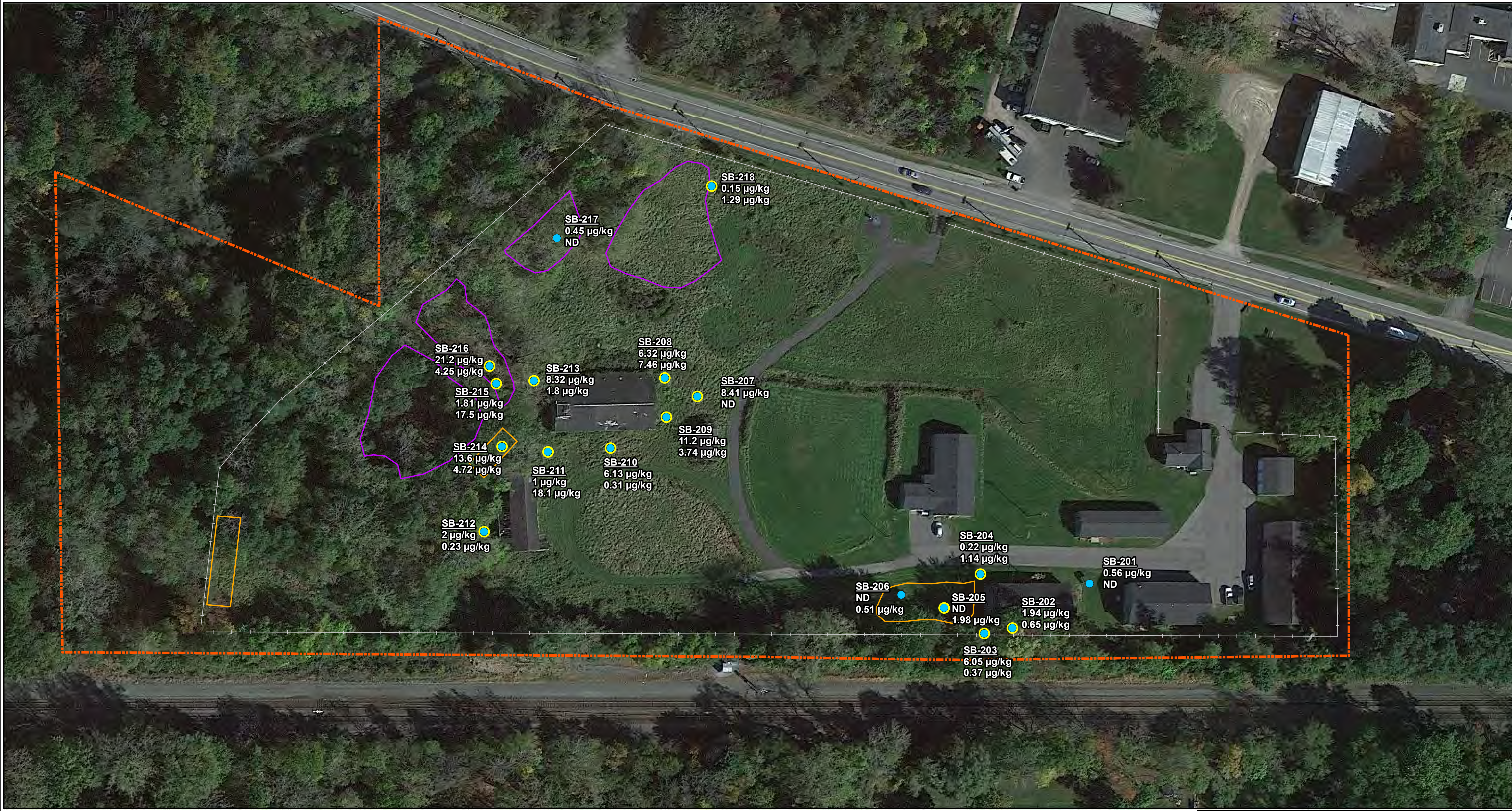
GEORGE A. ROBINSON & CO., INC. (SITE #8-28-065)
477 WHITNEY ROAD
PENFIELD, NEW YORK
FEASIBILITY STUDY

VOCs and Metals in Unsaturated Soil with Concentrations Exceeding Protection of Groundwater SCOs

ARCADIS

FIGURE
2-1



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Legend

2023 Soil Boring

- No PFOS Exceedances
- Protection of Groundwater PFOS Exceedance

Protection of Groundwater Guideline Value = 1.0 µg/kg
µg/kg = micrograms per kilogram
PFOS = Perfluorooctanesulfonic acid
ND = Not Detected

- Site Boundary
- Site Fence (Approximate)
- Settling Pond (Approximate)
- Historic Wastewater Lagoon (Approximate)

0 75 150 300 450 600 Feet

N

SB-112 Location ID
2.0 ng/L Surface Soil PFOS Concentration
0.22 ng/L Shallow Soil PFOS Concentration

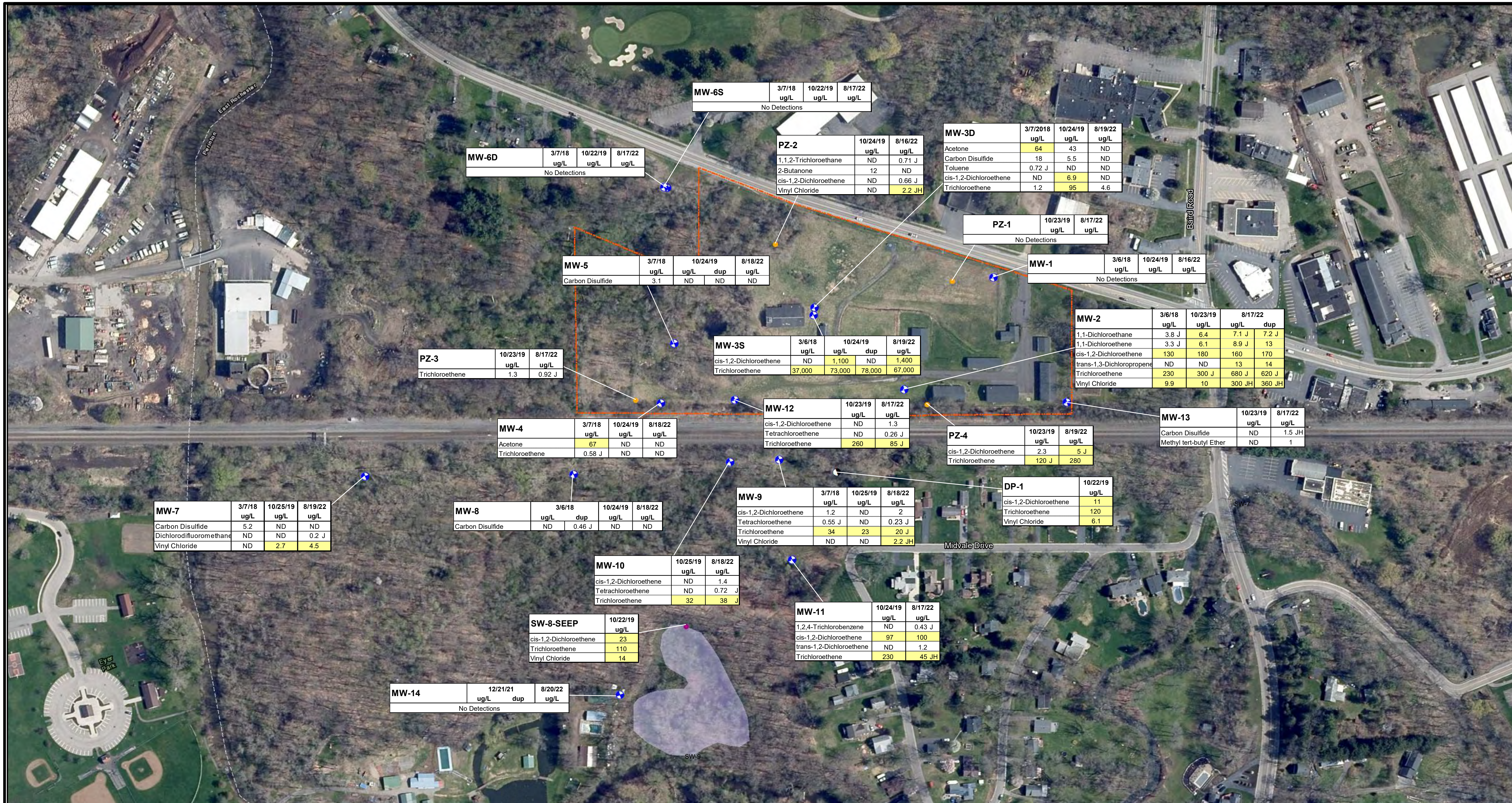
Background Aerial: Google Satellite

GEORGE A. ROBINSON & CO., INC. (SITE #8-28-065)
477 WHITNEY ROAD
PENFIELD, NEW YORK
FEASIBILITY STUDY

PFOS EXCEEDANCES IN SOIL

ARCADIS

FIGURE 2-2



MW-6S	3/7/18 ug/L	10/22/19 ug/L	8/17/22 ug/L
No Detections			

MW-6D	3/7/18 ug/L	10/22/19 ug/L	8/17/22 ug/L
No Detections			

PZ-2	10/24/19 ug/L	8/16/22 ug/L
1,1,2-Trichloroethane	ND	0.71 J
2-Butanone	12	ND
cis-1,2-Dichloroethene	ND	0.66 J
Vinyl Chloride	ND	2.2 JH

MW-3D	3/7/2018 ug/L	10/24/19 ug/L	8/19/22 ug/L
Acetone	64	43	ND
Carbon Disulfide	18	5.5	ND
Toluene	0.72 J	ND	ND
cis-1,2-Dichloroethene	ND	6.9	ND
Trichloroethene	1.2	95	4.6

PZ-1	10/23/19 ug/L	8/17/22 ug/L
No Detections		

MW-1	3/6/18 ug/L	10/24/19 ug/L	8/16/22 ug/L
No Detections			

MW-5	3/7/18 ug/L	10/24/19 ug/L	10/24/19 dup	8/18/22 ug/L
Carbon Disulfide	3.1	ND	ND	ND

MW-2	3/6/18 ug/L	10/23/19 ug/L	8/17/22 ug/L	8/17/22 dup
1,1-Dichloroethane	3.8 J	6.4	7.1 J	7.2 J
1,1-Dichloroethene	3.3 J	6.1	8.9 J	13
cis-1,2-Dichloroethene	130	180	160	170
trans-1,3-Dichloropropene	ND	ND	13	14
Trichloroethene	230	300 J	680 J	620 J
Vinyl Chloride	9.9	10	300 JH	360 JH

MW-3S	3/6/18 ug/L	10/24/19 ug/L	10/24/19 dup	8/19/22 ug/L
cis-1,2-Dichloroethene	ND	1,100	ND	1,400
Trichloroethene	37,000	73,000	78,000	67,000

PZ-3	10/23/19 ug/L	8/17/22 ug/L
Trichloroethene	1.3	0.92 J

MW-12	10/23/19 ug/L	8/17/22 ug/L
cis-1,2-Dichloroethene	ND	1.3
Tetrachloroethene	ND	0.26 J
Trichloroethene	260	85 J

MW-13	10/23/19 ug/L	8/17/22 ug/L
Carbon Disulfide	ND	1.5 JH
Methyl tert-butyl Ether	ND	1

MW-4	3/7/18 ug/L	10/24/19 ug/L	8/18/22 ug/L
Acetone	67	ND	ND
Trichloroethene	0.58 J	ND	ND

PZ-4	10/23/19 ug/L	8/19/22 ug/L
cis-1,2-Dichloroethene	2.3	5 J
Trichloroethene	120 J	280

DP-1	10/22/19 ug/L
cis-1,2-Dichloroethene	11
Trichloroethene	120
Vinyl Chloride	6.1

MW-7	3/7/18 ug/L	10/25/19 ug/L	8/19/22 ug/L
Carbon Disulfide	5.2	ND	ND
Dichlorodifluoromethane	ND	ND	0.2 J
Vinyl Chloride	ND	2.7	4.5

MW-8	3/6/18 ug/L	3/6/18 dup	10/24/19 ug/L	8/18/22 ug/L
Carbon Disulfide	ND	0.46 J	ND	ND

MW-9	3/7/18 ug/L	10/25/19 ug/L	8/18/22 ug/L
cis-1,2-Dichloroethene	1.2	ND	2
Tetrachloroethene	0.55 J	ND	0.23 J
Trichloroethene	34	23	20 J
Vinyl Chloride	ND	ND	2.2 JH

MW-10	10/25/19 ug/L	8/18/22 ug/L
cis-1,2-Dichloroethene	ND	1.4
Tetrachloroethene	ND	0.72 J
Trichloroethene	32	38 J

MW-11	10/24/19 ug/L	8/17/22 ug/L
1,2,4-Trichlorobenzene	ND	0.43 J
cis-1,2-Dichloroethene	97	100
trans-1,2-Dichloroethene	ND	1.2
Trichloroethene	230	45 JH

SW-8-SEEP	10/22/19 ug/L
cis-1,2-Dichloroethene	23
Trichloroethene	110
Vinyl Chloride	14

MW-14	12/21/21 ug/L	12/21/21 dup	8/20/22 ug/L
No Detections			

0 200 400 800 1,200 1,600
Feet

Legend
- Seep Sample
- Drive Point
- Monitoring Well
- 1-inch Monitoring Well
- Approximate Wet Area
- Site Boundary

Notes:
ND = Not Detected.
J = Estimated value.
JH= Estimated, with a bias high.
Units are in micrograms per liter (ug/l)
Concentration exceeds corresponding NYSDEC GA Standard or Guidance Value

N

GEORGE A. ROBINSON & CO., INC. (SITE #8-28-065)
477 WHITNEY ROAD
PENFIELD, NEW YORK
FEASIBILITY STUDY

VOLATILE ORGANIC COMPOUND CONCENTRATIONS IN GROUNDWATER

ARCADIS

FIGURE
2-3

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MW-6S	3/7/2018 ug/L	10/22/2019 ug/L	8/17/2022 ug/L
Antimony	ND	ND	15 J
Arsenic	29	42	35 J
Iron	58,100	64,100	67000 J
Magnesium	38,000	39,100	43000 J
Manganese	3,500	3,900	3700 J

MW-6D	3/7/2018 ug/L	10/22/2019 ug/L	8/17/2022 ug/L
Iron	870	420	1100 J
Magnesium	31,800	33,700	39000 J

PZ-2	10/24/2019 ug/L	8/17/2022 ug/L
Arsenic	41	47 JL
Chromium	77	4.9 JL
Iron	46,700	47000 JL
Manganese	4,700	5000 JL

MW-3D	3/7/2018 ug/L	10/24/2019 ug/L	8/17/2022 ug/L
Iron	40 J	ND	600 J
Magnesium	20,400	1,900	39000 JH

PZ-1	10/24/2019 ug/L	8/17/2022 ug/L
Iron	28,500	54,000
Magnesium	19,000	190000 J
Manganese	490	7,400
Thallium	ND	46 J

MW-5	3/7/2018 ug/L	10/25/2019 ug/L	10/25/2019 Dup	8/17/2022 ug/L
Iron	320	210	230	750
Magnesium	21,000	27,800	27,600	40000 J

MW-1	3/6/2018 ug/L	10/24/2019 ug/L	8/17/2022 ug/L
Magnesium	44,300	17,300	16000 JL

PZ-3	10/25/2019 ug/L	8/17/2022 ug/L
Arsenic	35	11 JH
Berylium	3.3	ND
Chromium	150	120
Hexavalent Chr	NR	73
Iron	134,000	73,000
Lead	54	ND
Magnesium	132,000	190000 J
Manganese	3,900	5,200
Nickel	130	71

MW-3S	3/6/2018 ug/L	10/24/2019 ug/L	10/24/2019 Dup	8/17/2022 ug/L
Chromium	93	15	14	8.4 J
Hexavalent Chr	88	5.8 J	ND	ND
Manganese	490	250	230	450 JH
Nickel	140	73	69	110 J

MW-2	3/6/2018 ug/L	10/23/2019 ug/L	8/17/2022 ug/L	8/17/2022 DUP
Arsenic	31	37	27 J	100 J
Cadmium	180	140	370 J	220 J
Copper	1,100	550	1300 J	890 J
Iron	13,500	3,400	1800 J	2000 J
Manganese	2,400	4,400	3100 J	3200 J
Nickel	9,400	2,200	2900 J	4300 J

MW-12	10/23/2019 ug/L	8/17/2022 ug/L
Manganese	69	640 J

MW-13	10/23/2019 ug/L	8/17/2022 ug/L
No Exceedances		

MW-4	3/7/2018 ug/L	10/24/2019 ug/L	8/17/2022 ug/L
Iron	450	ND	830 JH
Magnesium	15,800	7,500	36000 JH

PZ-4	10/24/2019 ug/L	8/17/2022 ug/L
Cadmium	28	21 JH
Chromium	53	36 J
Iron	6,300	8500 J
Magnesium	29,500	44000 JH
Manganese	320	470 JH

MW-7	3/8/2018 ug/L	10/25/2019 ug/L	8/17/2022 ug/L
Iron	1,100	3,100	3500 J
Magnesium	38,000	56,700	61000 JH

MW-8	3/6/2018 ug/L	3/6/2018 Dup	10/24/2019 ug/L	8/17/2022 ug/L
Iron	2,500	2,400	1,300	41000 JH
Magnesium	49,000	46,900	40,300	42000 JH

MW-9	3/6/2018 ug/L	10/25/2019 ug/L	8/17/2022 ug/L
Iron	110	ND	880
Magnesium	36,500	39,300	38,000
Manganese	190	55	370

DP-1	10/24/2019 ug/L
Antimony	10 J
Arsenic	90
Beryllium	5.3
Chromium	200
Copper	260
Iron	231,000
Lead	110
Magnesium	247,000
Manganese	7,600
Mercury	1.1
Nickel	290

MW-10	10/25/2019 ug/L	8/17/2022 ug/L
Magnesium	34,700	35000 J

MARSH AREA / SW-8-SEEP	4/10/2019 ug/L	10/22/2019 ug/L
No Exceedances		

MW-11	10/24/2019 ug/L	8/17/2022 ug/L
Magnesium	47,800	66,000
Manganese	2,400	3,000

MW-14	12/21/2021 ug/L	8/17/2022 ug/L
Manganese	68	310 JH

0 200 400 800 1,200 1,600
Feet

Legend

- Seep Sample
- Drive Point
- Monitoring Well
- 1-inch Monitoring Well
- Approximate Wet Area
- Site Boundary

Notes:
ND = Not Detected.
J = Estimated value.
JH = Estimated, with a bias high.
Units are micrograms per liter (ug/l).
MARSH AREA and SW-8-SEEP samples were collected from the same location
MARSH AREA and SW-8-SEEP sample results were for Dissolved Metals
MARSH AREA and SW-8-SEEP sample results are compared against TOGS 1.1.1 H(WS) Classes A-C Standards

Concentration exceeds corresponding NYSDEC GA Standard or Guidance Value

N

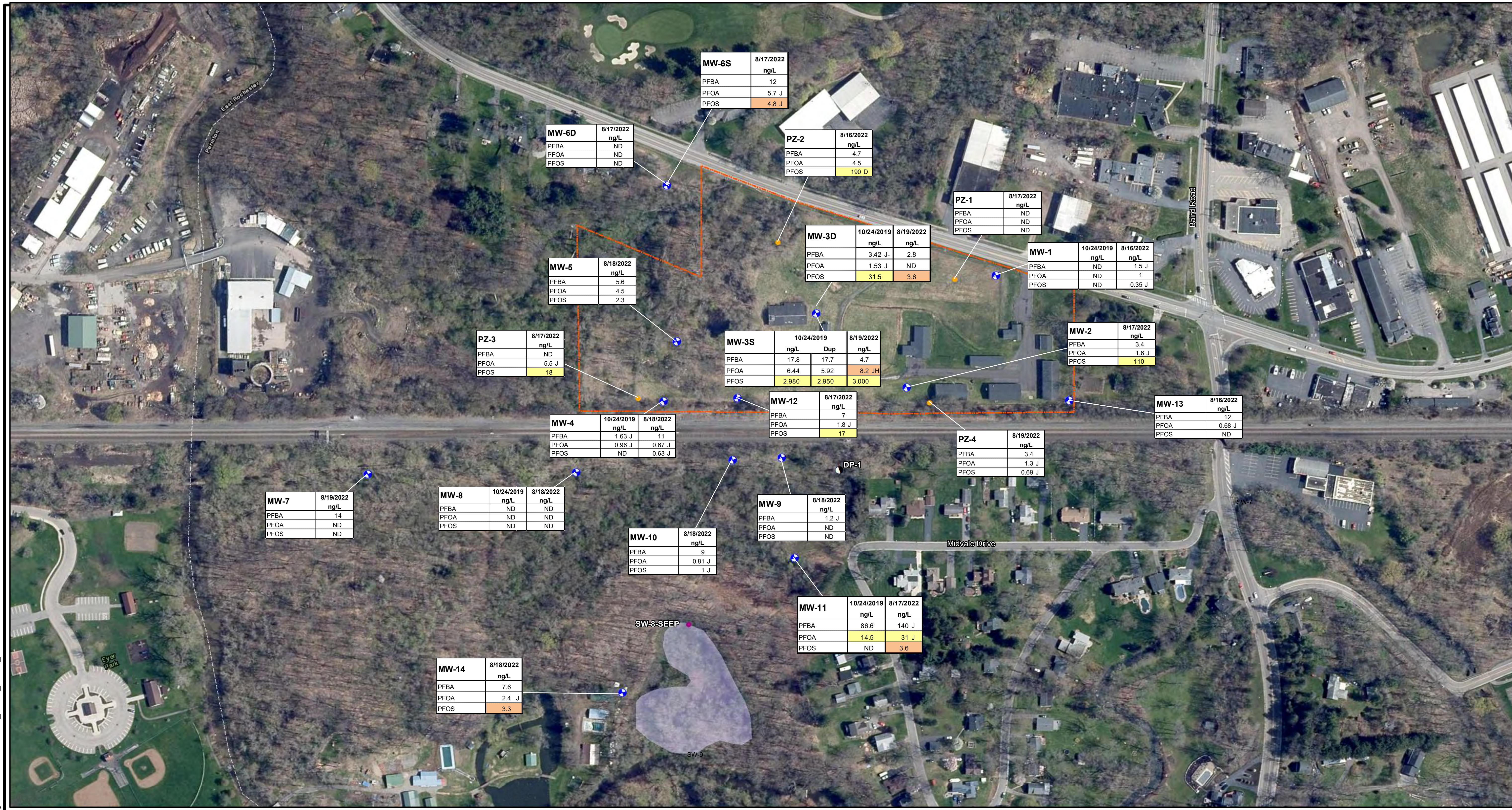
GEORGE A. ROBINSON & CO., INC. (SITE #8-28-065)
477 WHITNEY ROAD
PENFIELD, NEW YORK
FEASIBILITY STUDY

METALS CONCENTRATIONS IN GROUNDWATER

ARCADIS

FIGURE
2-4

Document Path: \\arcadis-us.com\app\GIS\Processing_ENV\NYSDEC\George Robinson\mxd\GW_Wells_Metals_Hitbox - 2022.mxd



0 200 400 800 1,200 1,600 Feet

N

Legend

- Seep Sample
- Drive Point
- Monitoring Well
- 1-inch Monitoring Well
- Approximate Wet Area
- Site Boundary

Notes:
J = Estimated value.
J- = Estimated value; may have a low bias.
D = A dilution was performed by the laboratory.
Units are nanograms per liter (ng/l)
PFBA - Perfluorobutanoic acid
PFOA - Perfluorooctanoic acid
PFOS - Perfluorooctanesulfonic acid

Exceeds NYSDEC Ambient Water Quality Guidance Value for Protection of Human Health (PFOA = 6.7 ng/L, PFOS = 2.7 ng/L), April 2023.
Exceeds NYSDEC Ambient Water Quality Guidance Value and New York State MCLs for PFOA and PFOS in drinking water.

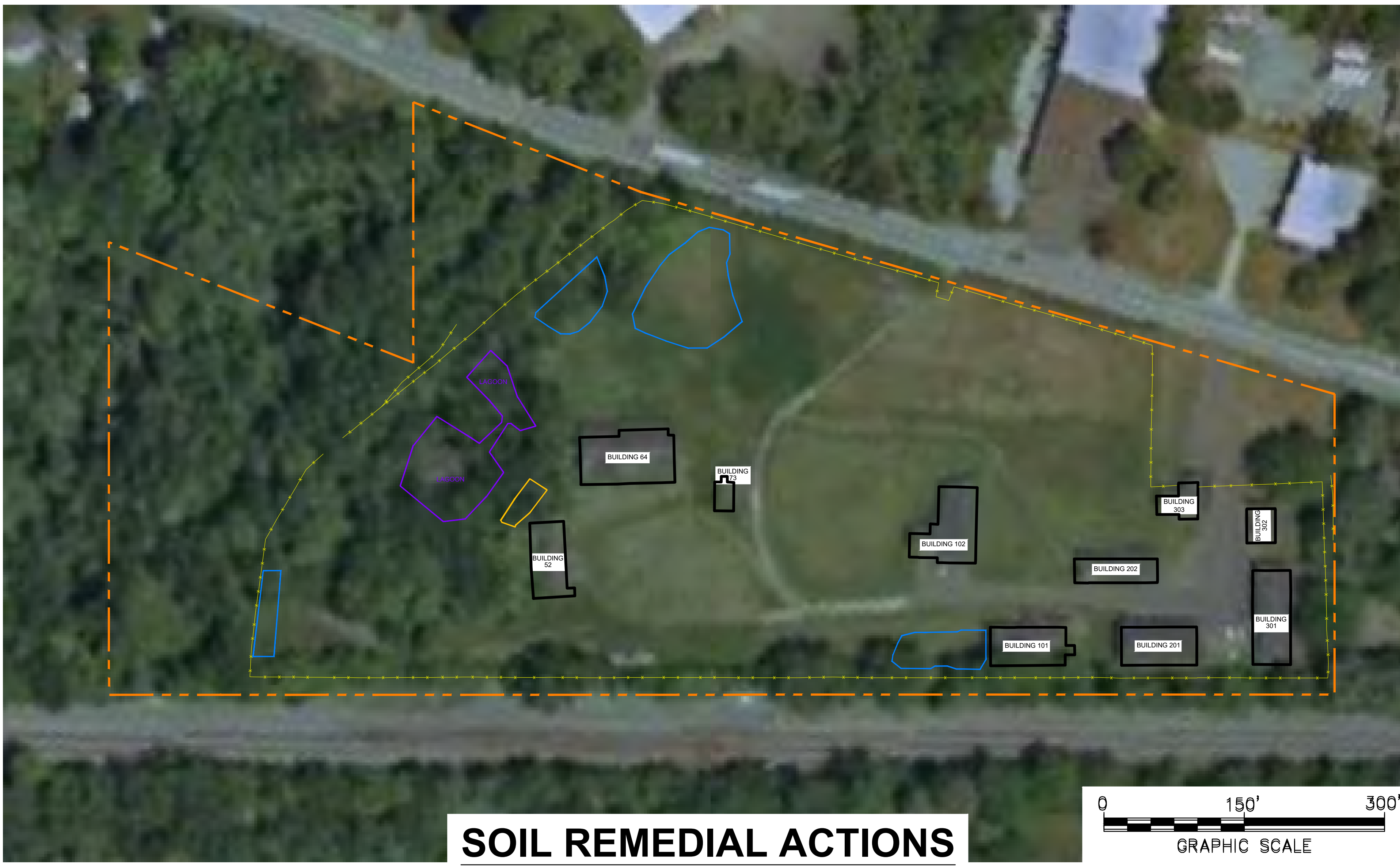
GEORGE A. ROBINSON & CO., INC. (SITE #8-28-065)
477 WHITNEY ROAD
PENFIELD, NEW YORK
REMEDIAL INVESTIGATION

PFAS CONCENTRATIONS IN GROUNDWATER

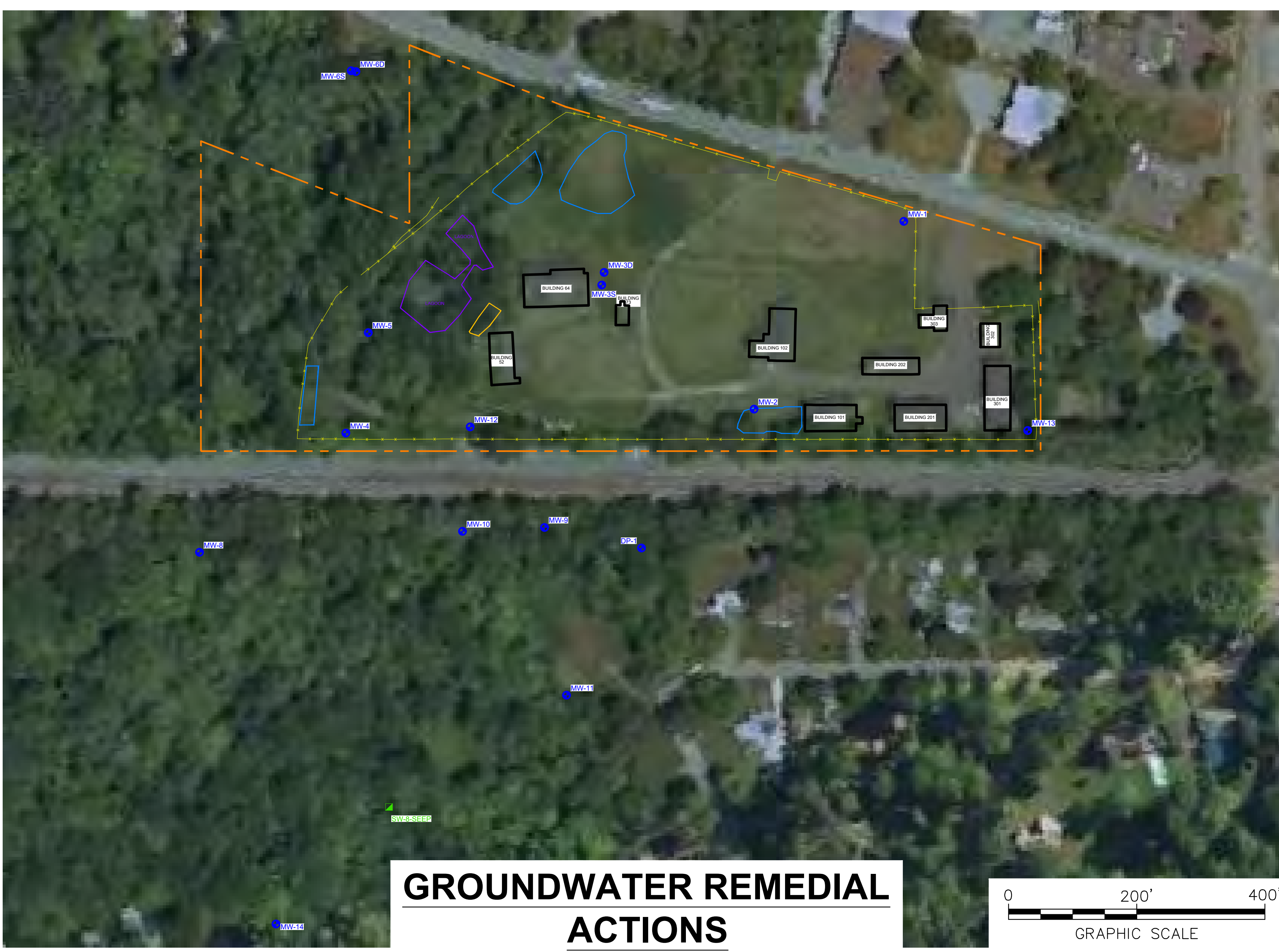
ARCADIS

FIGURE
22

Document Path: T:_ENV\NYSDEC\George Robinson\mxd\GW_Wells_PFAS_Hitbox - 2022.mxd



SOIL REMEDIAL ACTIONS



GROUNDWATER REMEDIAL ACTIONS

LEGEND:

- SITE BOUNDARY
- SITE FENCE
- HISTORICAL SETTLING POND
- HISTORICAL WASTEWATER LAGOON
- MONITORING WELL TO BE ABANDONED
- SEEP LOCATION

NOTE:

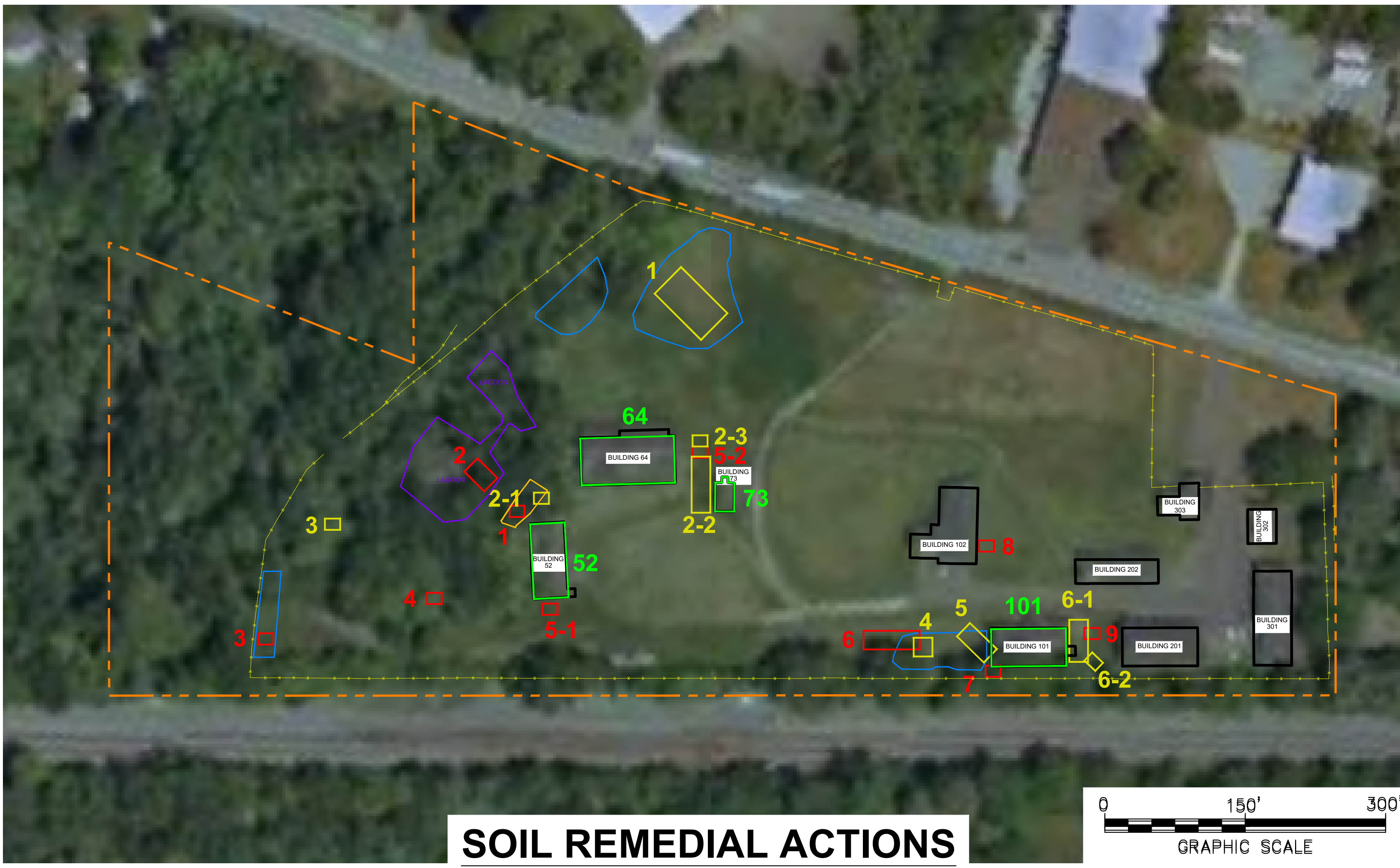
HISTORICAL BOUNDARIES ARE APPROXIMATE.

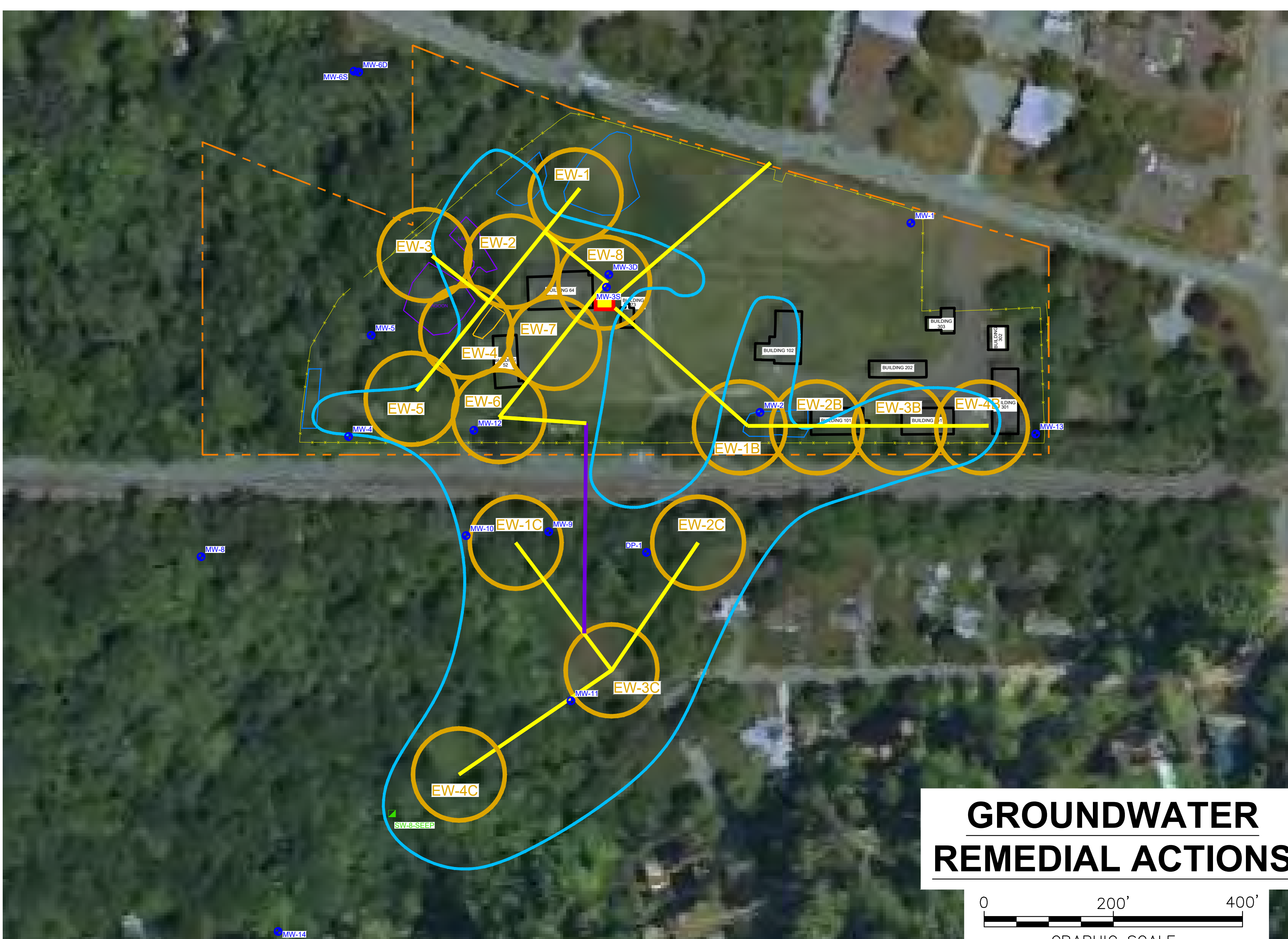
GEORGE A. ROBINSON & CO. INC. (SITE #8-28-065)
477 WHITNEY ROAD
PENFIELD, NEW YORK
FEASIBILITY STUDY REPORT

ALTERNATIVE 1: NO ACTION

ARCADIS

FIGURE
4-1





LEGEND:

- SITE BOUNDARY
- SITE FENCE
- HISTORICAL SETTLING POND
- HISTORICAL WASTEWATER LAGOON
- 3 4 52 EXCAVATION AREA IDENTIFICATION NUMBER
- EXCAVATION TO ADDRESS METALS IN SOIL
- EXCAVATION TO ADDRESS VOCs IN SOIL
- POST-BUILDING DEMOLITION EXCAVATION
- AREA WITH GROUNDWATER CONCENTRATION GREATER THAN CLASS GA STANDARDS
- ASSUMED EXTRACTION WELL RADIUS OF INFLUENCE
- TREATMENT SYSTEM
- TRENCH
- HORIZONTAL DRILLING TO CONNECT OFF-SITE EXTRACTION WELLS
- MONITORING WELL LOCATION
- SEEP LOCATION

NOTE:

HISTORICAL BOUNDARIES ARE APPROXIMATE.

GEORGE A. ROBINSON & CO. INC. (SITE #8-28-065)
477 WHITNEY ROAD
PENFIELD, NEW YORK

FEASIBILITY STUDY REPORT

ALTERNATIVE 2: RESTORATION TO PRE-DISPOSAL CONDITIONS

ARCADIS

FIGURE

4-2

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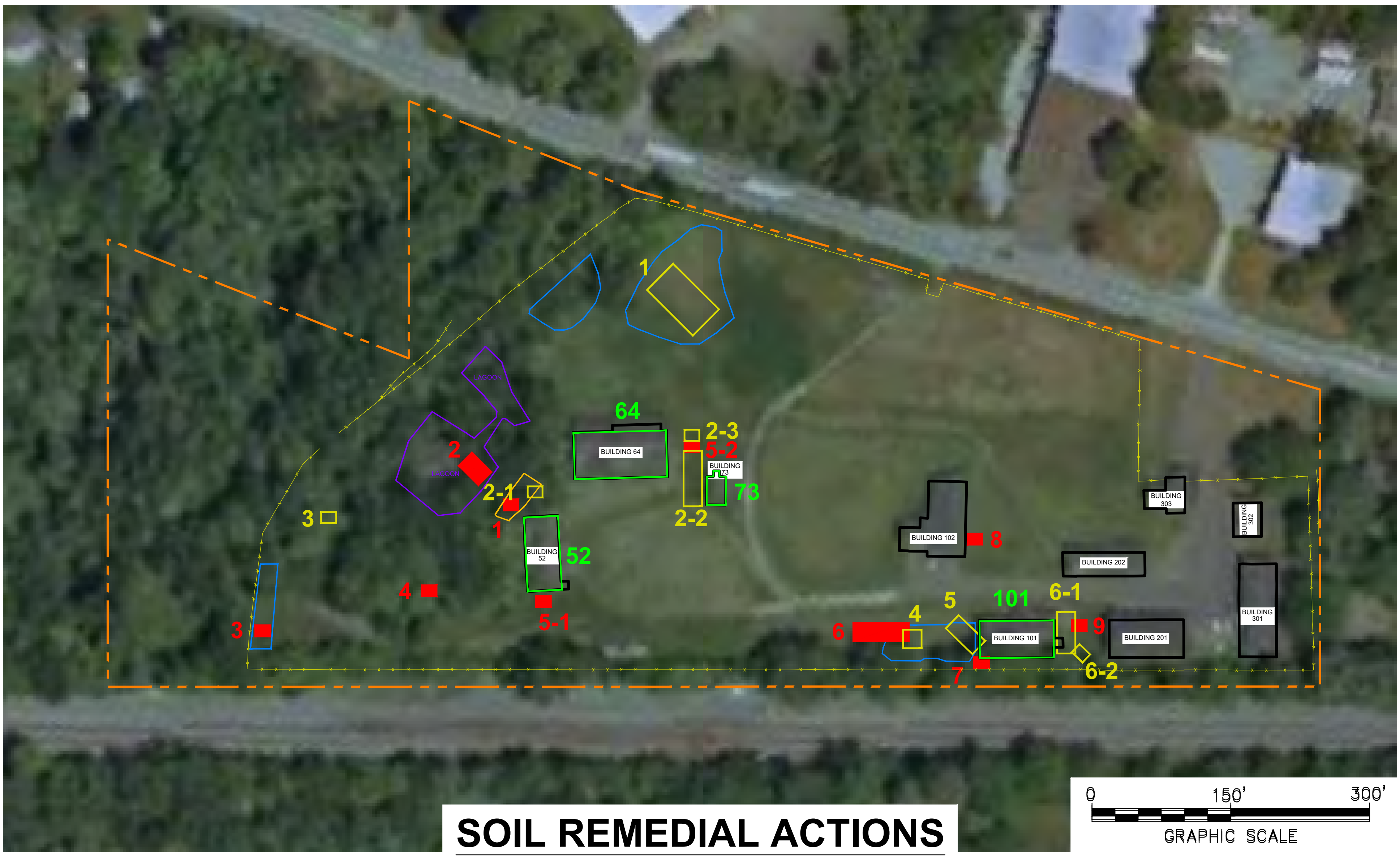
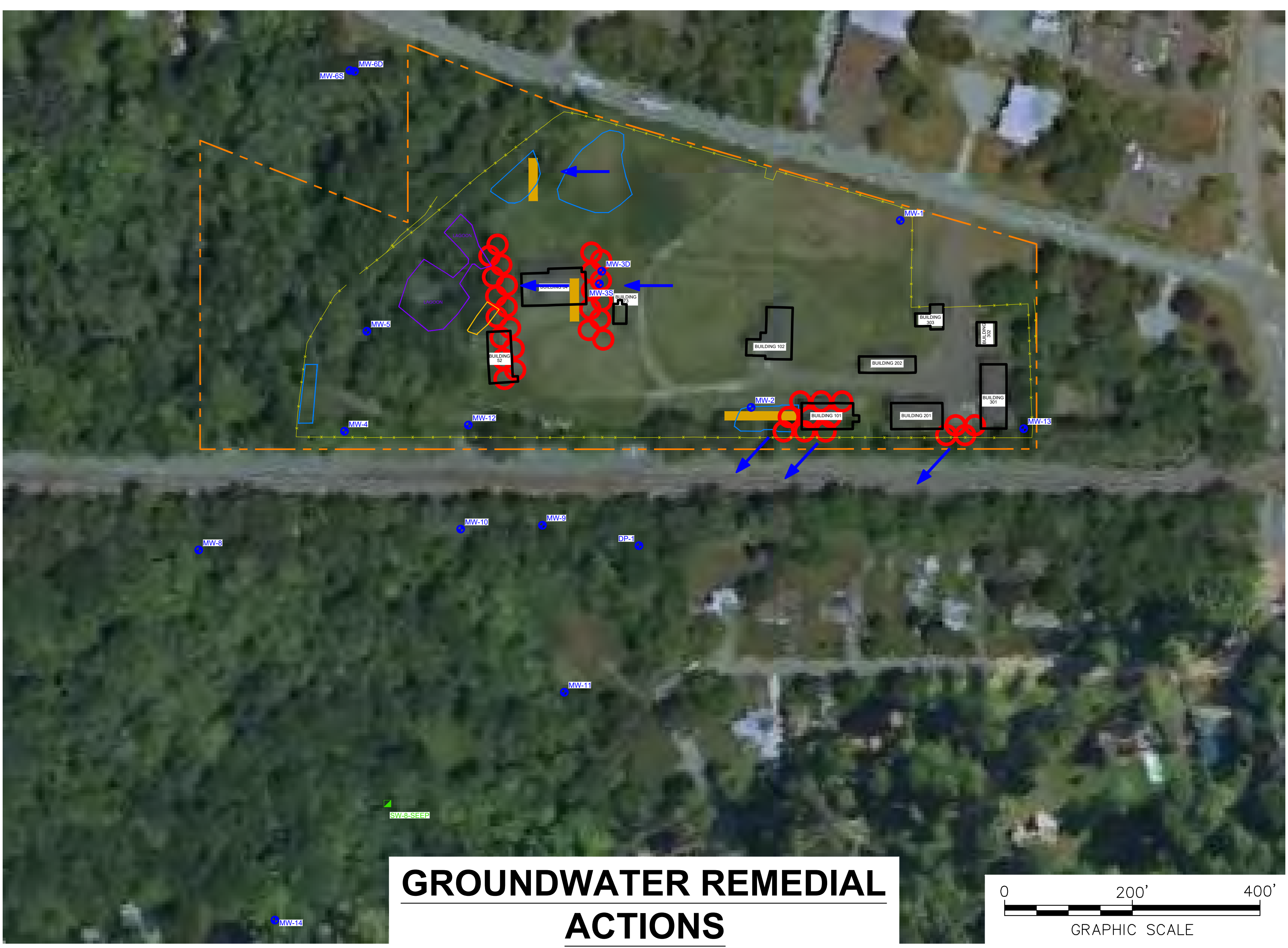


SOIL REMEDIAL ACTIONS



GROUNDWATER REMEDIAL ACTIONS

LEGEND:

- SITE BOUNDARY
- SITE FENCE
- HISTORICAL SETTLING POND
- HISTORICAL WASTEWATER LAGOON
- 3 4 52 EXCAVATION AREA IDENTIFICATION NUMBER
- IN-SITU STABILIZATION TO ADDRESS METALS IN SOIL
- EXCAVATION TO ADDRESS VOCs IN SOIL
- POST-BUILDING DEMOLITION EXCAVATION
- ISCO DPT INJECTION POINT (15' ROI)
- COLLOIDAL CARBON INJECTION AREA
- GROUNDWATER FLOW DIRECTION
- MONITORING WELL LOCATION
- SEEP LOCATION

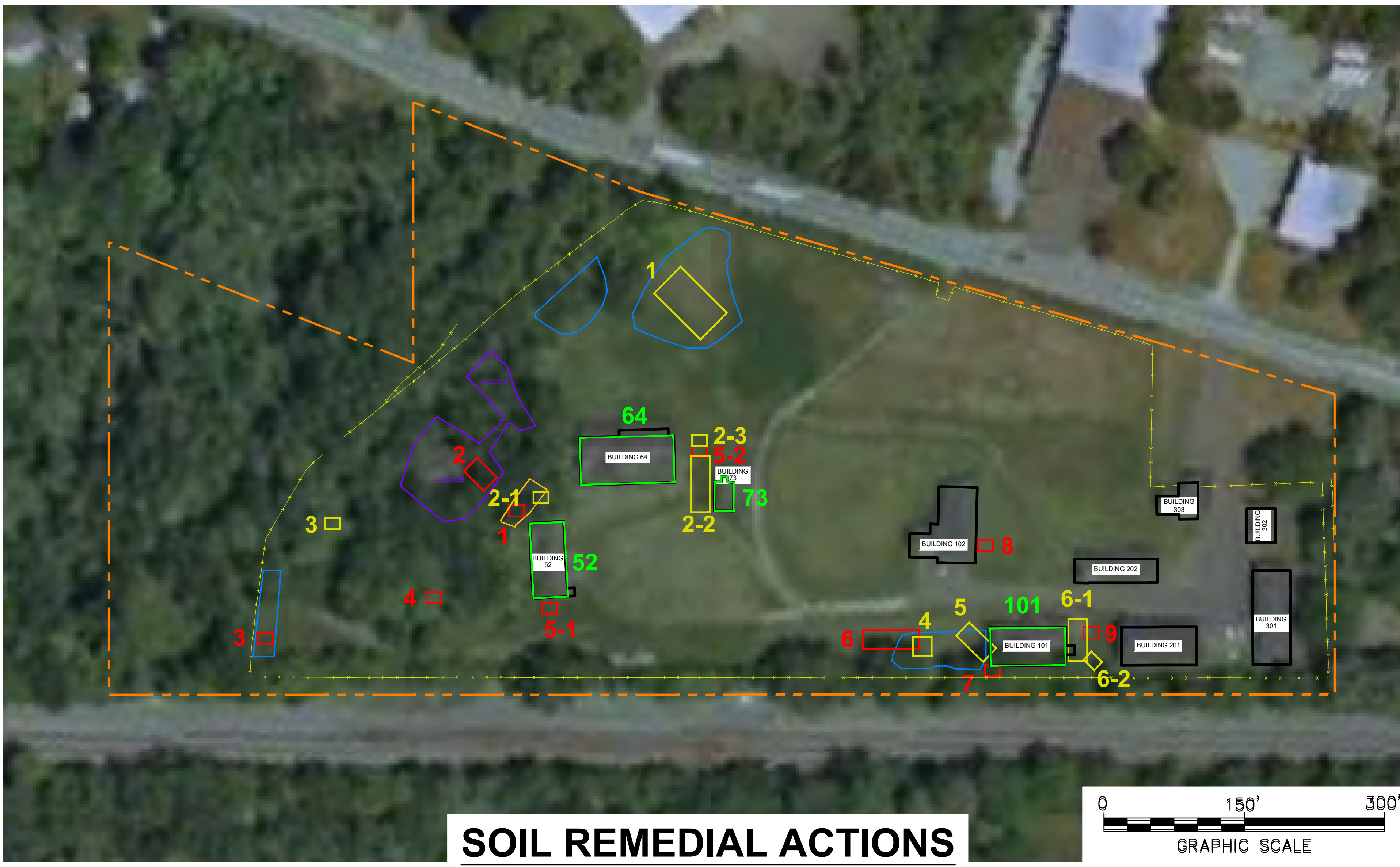
NOTE: HISTORICAL BOUNDARIES ARE APPROXIMATE.

GEORGE A. ROBINSON & CO. INC. (SITE #8-28-065)
477 WHITNEY ROAD
PENFIELD, NEW YORK
FEASIBILITY STUDY REPORT

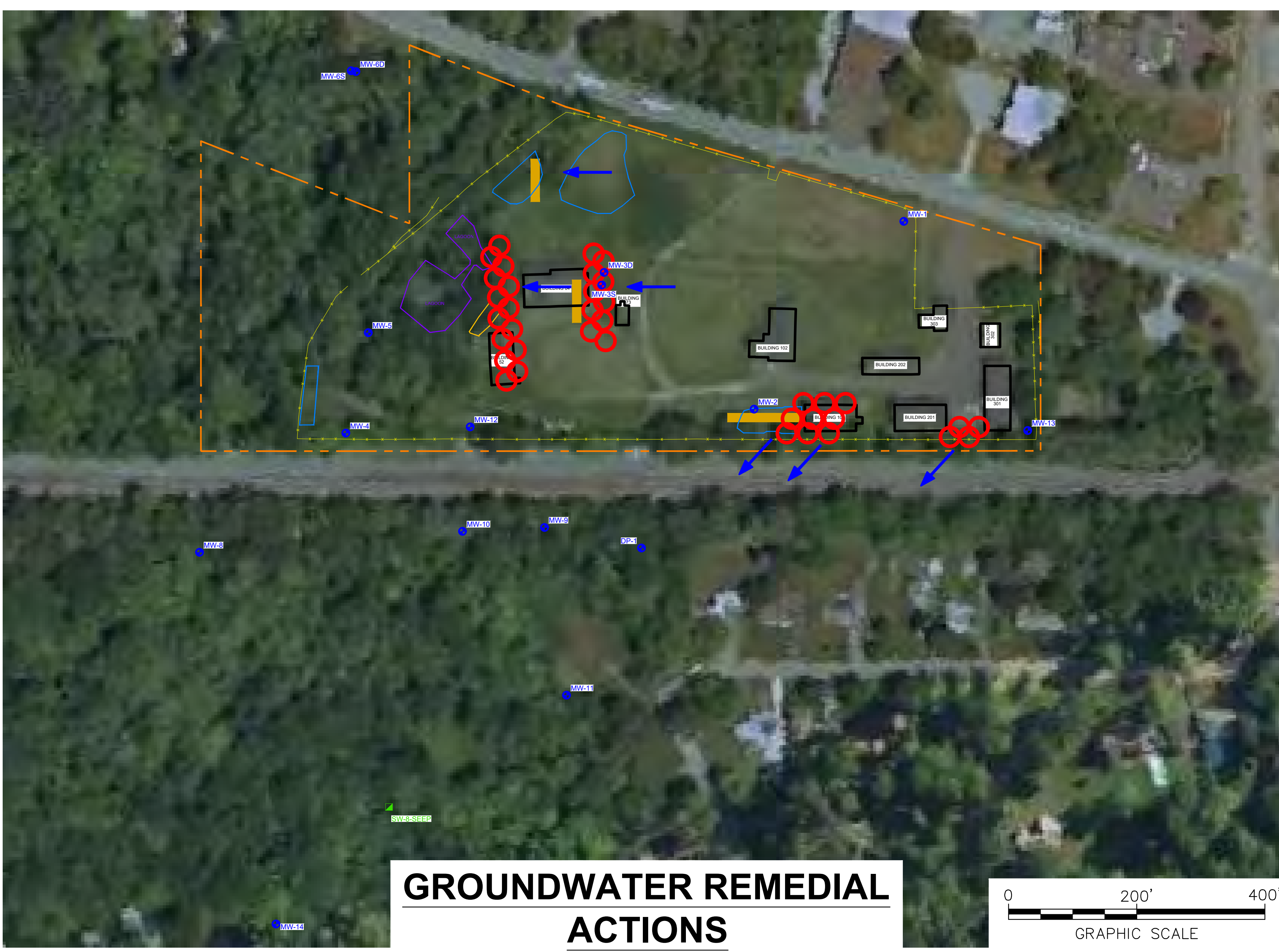
ALTERNATIVE 3: SOURCE SOIL EXCAVATION, SOIL TREATMENT, AND GROUNDWATER TREATMENT

ARCADIS

FIGURE
4-3



SOIL REMEDIAL ACTIONS



GROUNDWATER REMEDIAL ACTIONS

LEGEND:

- SITE BOUNDARY
- SITE FENCE
- HISTORICAL SETTLING POND
- HISTORICAL WASTEWATER LAGOON
- 3 4 52 EXCAVATION AREA IDENTIFICATION NUMBER
- EXCAVATION TO ADDRESS METALS IN SOIL
- EXCAVATION TO ADDRESS VOCs IN SOIL
- POST-BUILDING DEMOLITION EXCAVATION
- ISCO DPT INJECTION POINT (15' ROI)
- PERFORMANCE MONITORING WELL
- COLLOIDAL CARBON INJECTION AREA
- GROUNDWATER FLOW DIRECTION
- MONITORING WELL LOCATION
- SEEP LOCATION

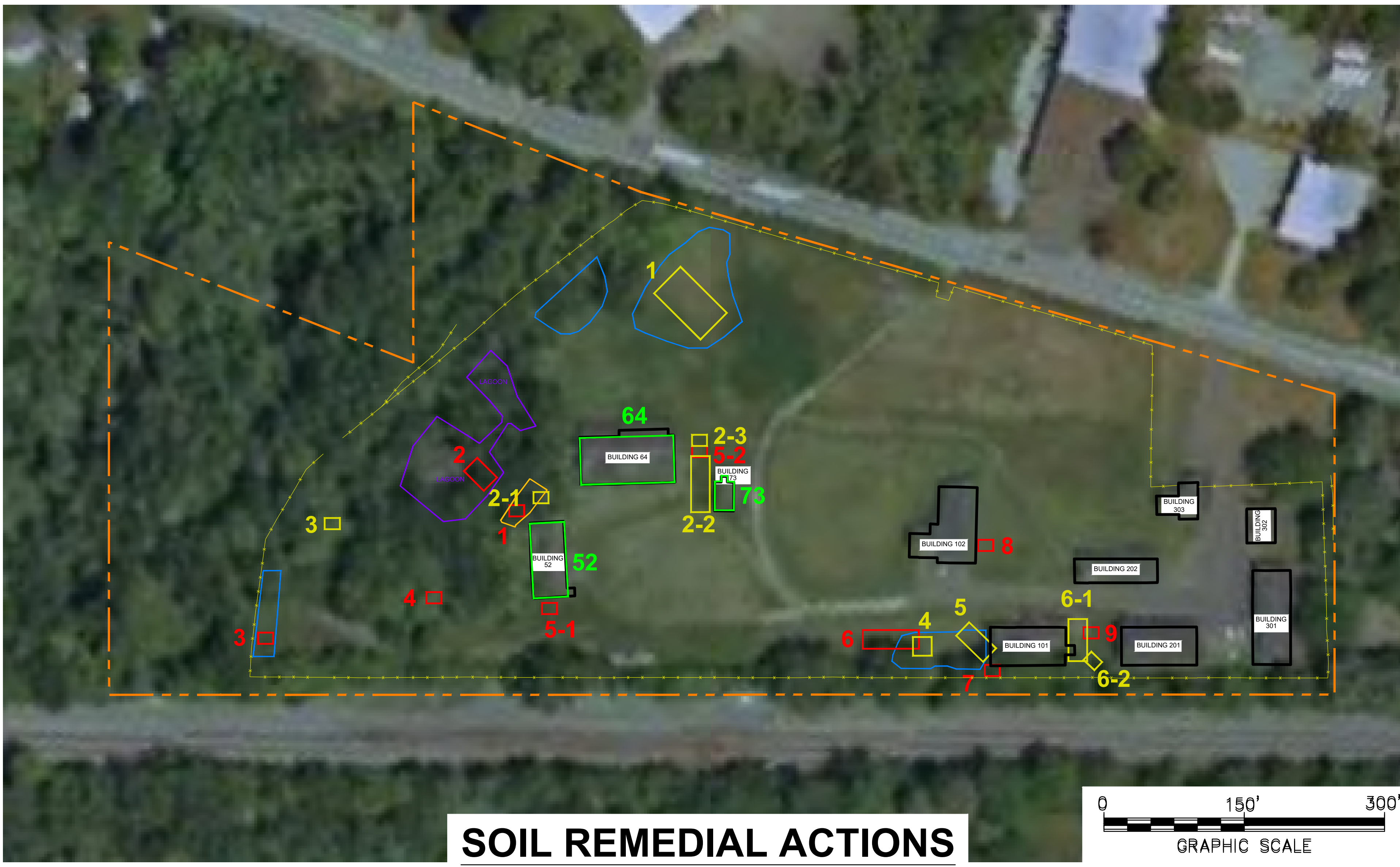
NOTE: HISTORICAL BOUNDARIES ARE APPROXIMATE.

GEORGE A. ROBINSON & CO. INC. (SITE #8-28-065)
477 WHITNEY ROAD
PENFIELD, NEW YORK
FEASIBILITY STUDY REPORT

ALTERNATIVE 4: SOURCE SOIL EXCAVATION AND GROUNDWATER TREATMENT

ARCADIS

FIGURE
4-4



SOIL REMEDIAL ACTIONS

GROUNDWATER REMEDIAL ACTIONS

LEGEND:

- SITE BOUNDARY
- SITE FENCE
- HISTORICAL SETTLING POND
- HISTORICAL WASTEWATER LAGOON
- 3 4 52 EXCAVATION AREA IDENTIFICATION NUMBER
- EXCAVATION TO ADDRESS METALS IN SOIL
- EXCAVATION TO ADDRESS VOCs IN SOIL
- POST-BUILDING DEMOLITION EXCAVATION
- PERMEABLE REACTIVE BARRIER
- ISCO DPT INJECTION POINT (15' ROI)
- COLLOIDAL CARBON INJECTION AREA
- MONITORING WELL LOCATION
- SEEP LOCATION

NOTE:

HISTORICAL BOUNDARIES ARE APPROXIMATE.

GEORGE A. ROBINSON & CO. INC. (SITE #8-28-065)
477 WHITNEY ROAD
PENFIELD, NEW YORK
FEASIBILITY STUDY REPORT

ALTERNATIVE 5: PARTIAL SOURCE SOIL EXCAVATION AND PREVENTION OF OFFSITE MIGRATION

ARCADIS

FIGURE
4-5

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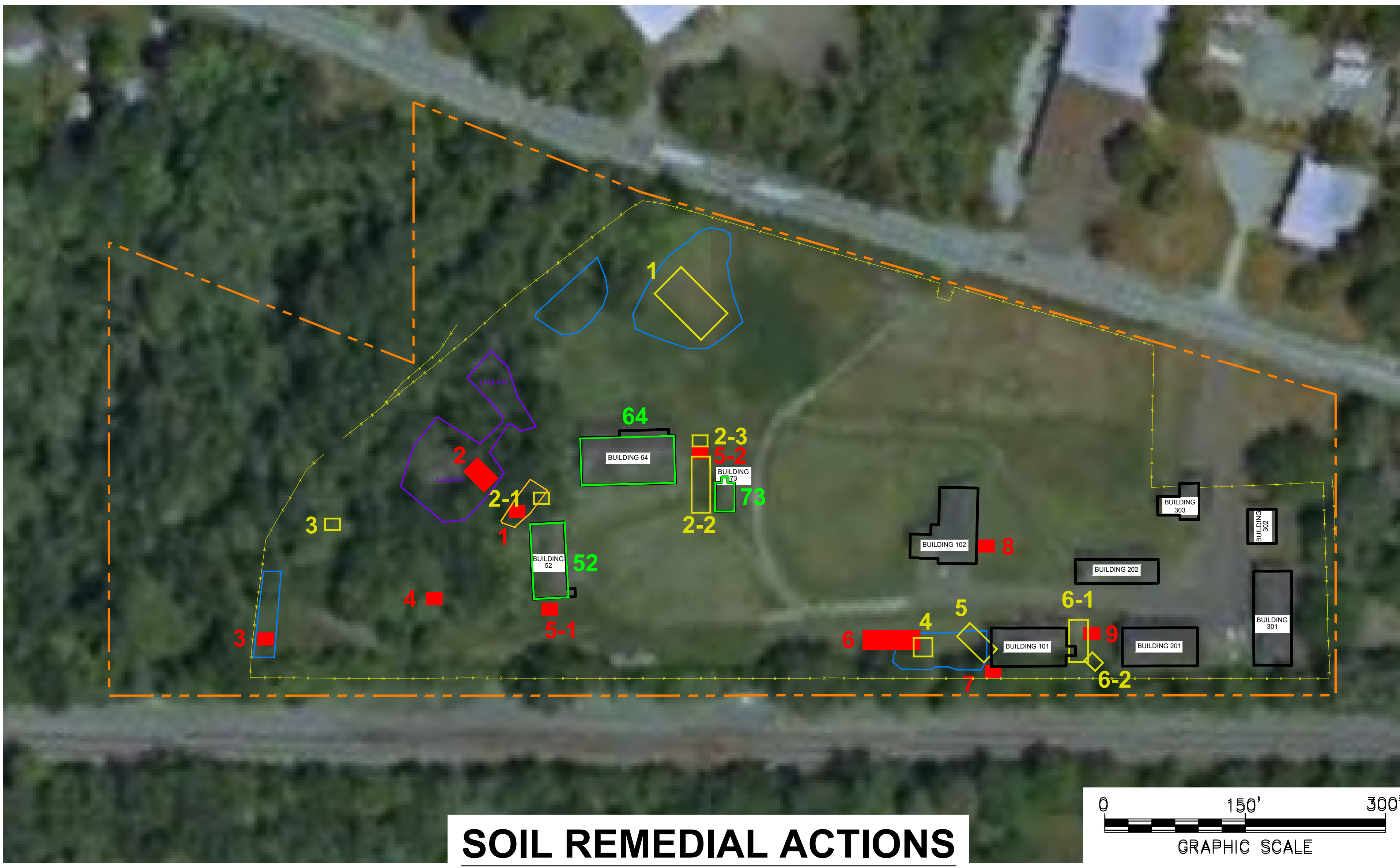
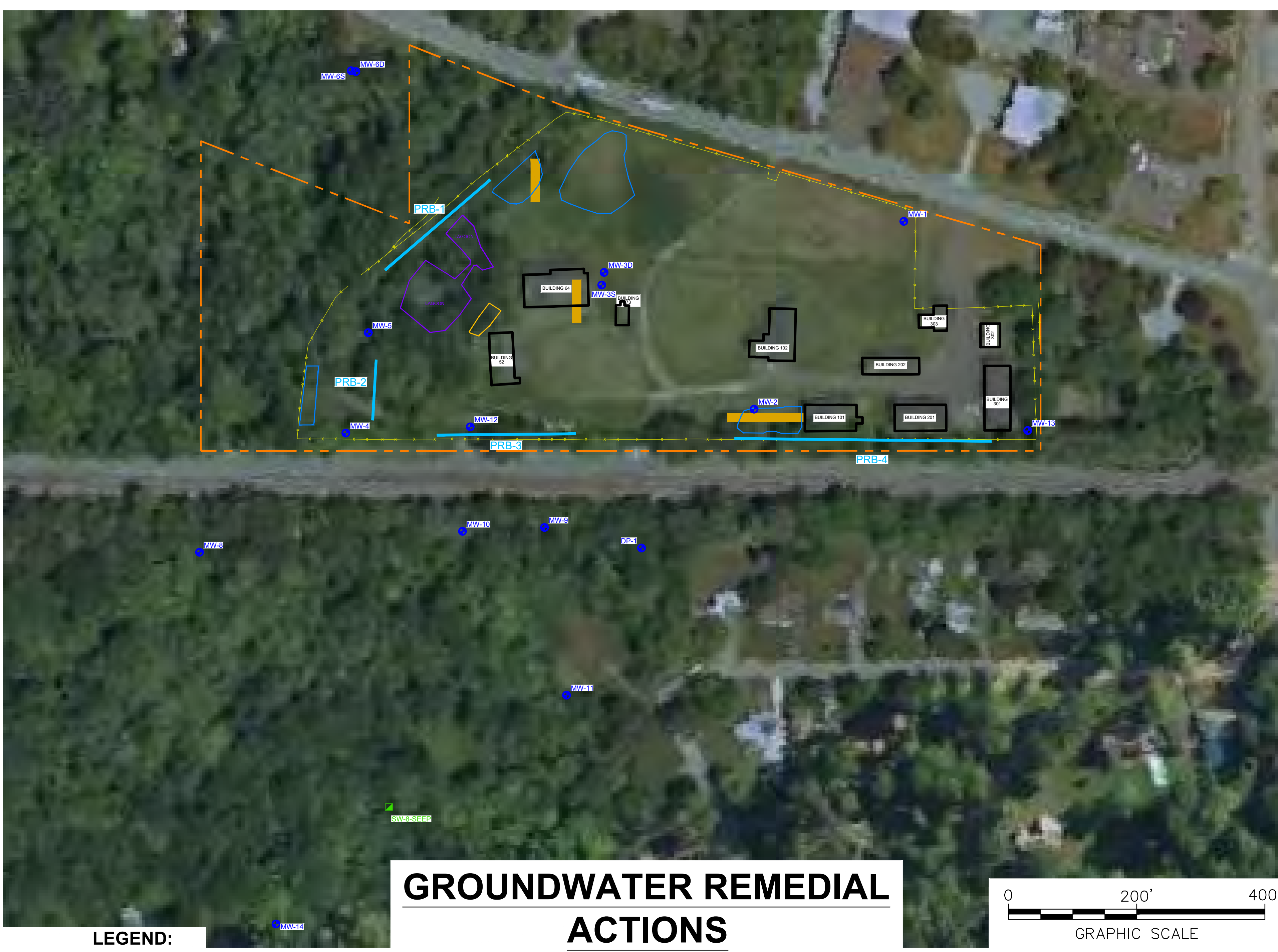


SOIL REMEDIAL ACTIONS



GROUNDWATER REMEDIAL ACTIONS

LEGEND:

- SITE BOUNDARY
- SITE FENCE
- HISTORICAL SETTLING POND
- HISTORICAL WASTEWATER LAGOON
- 3 4 52 EXCAVATION AREA IDENTIFICATION NUMBER
- SOIL COVER TO ADDRESS METALS IN SOIL
- EXCAVATION TO ADDRESS VOCs IN SOIL
- POST-BUILDING DEMOLITION EXCAVATION
- PERMEABLE REACTIVE BARRIER
- COLLOIDAL CARBON INJECTION AREA
- MONITORING WELL LOCATION
- SEEP LOCATION

NOTE:

HISTORICAL BOUNDARIES ARE APPROXIMATE.

GEORGE A. ROBINSON & CO. INC. (SITE #8-28-065)
477 WHITNEY ROAD
PENFIELD, NEW YORK
FEASIBILITY STUDY REPORT

ALTERNATIVE 6: PARTIAL SOURCE SOIL EXCAVATION, COVER, AND PREVENTION OF OFFSITE MIGRATION

ARCADIS

FIGURE
4-6

Appendix A

Environmental Justice Screening Tool (EJScreen) Community Report

EJScreen Community Report

This report provides environmental and socioeconomic information for user-defined areas, and combines that data into environmental justice and supplemental indexes.

Monroe County, NY

Blockgroup: 360550119015
Population: 607
Area in square miles: 1.04

LANGUAGES SPOKEN AT HOME

LANGUAGE	PERCENT
English	86%
Spanish	2%
Russian, Polish, or Other Slavic	2%
Other Indo-European	1%
Chinese (including Mandarin, Cantonese)	1%
Other Asian and Pacific Island	3%
Arabic	5%
Other and Unspecified	1%
Total Non-English	14%

COMMUNITY INFORMATION

- Low income: 49 percent
- People of color: 4 percent
- Less than high school education: 3 percent
- Limited English households: 3 percent
- Unemployment: 6 percent
- Persons with disabilities: 16 percent
- Male: 44 percent
- Female: 56 percent
- 80 years — Average life expectancy
- $32,606 — Per capita income
- Number of households: 290
- Owner occupied: 88 percent

BREAKDOWN BY RACE

- White: 96%
- Black: 0%
- American Indian: 0%
- Asian: 4%
- Hawaiian/Pacific Islander: 0%
- Other race: 0%
- Two or more races: 0%
- Hispanic: 0%

BREAKDOWN BY AGE

From Ages 1 to 4	0%
From Ages 1 to 18	23%
From Ages 18 and up	77%
From Ages 65 and up	15%

LIMITED ENGLISH SPEAKING BREAKDOWN

Speak Spanish	0%
Speak Other Indo-European Languages	100%
Speak Asian-Pacific Island Languages	0%
Speak Other Languages	0%

Notes: Numbers may not sum to totals due to rounding. Hispanic population can be of any race.
Source: U.S. Census Bureau, American Community Survey (ACS) 2017 -2021. Life expectancy data comes from the Centers for Disease Control.

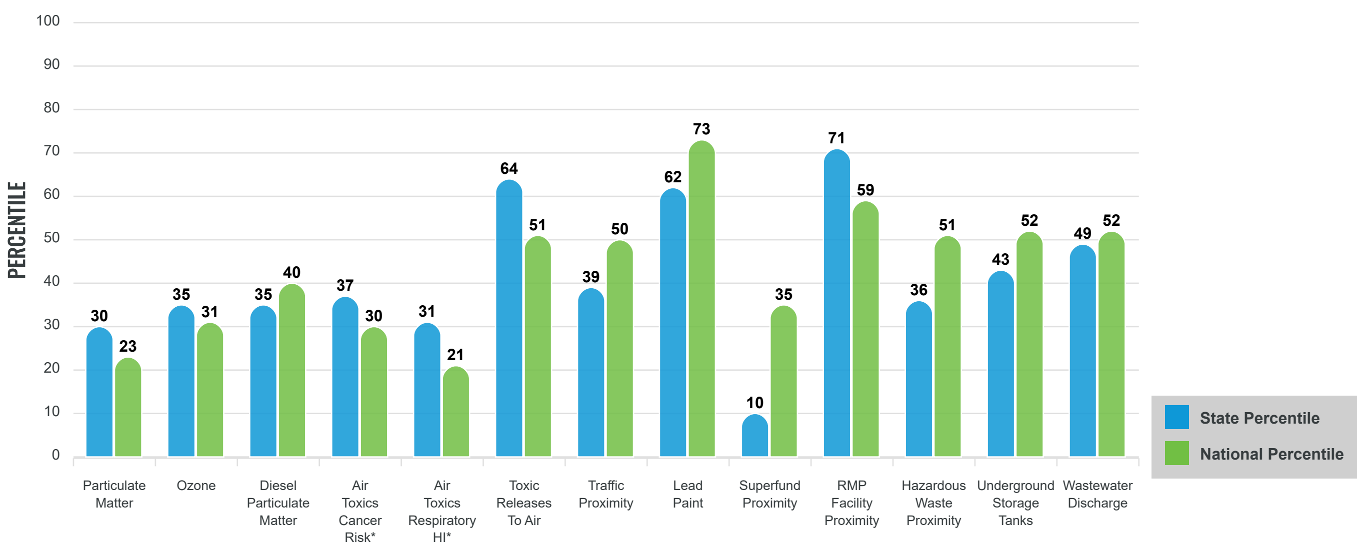
Environmental Justice & Supplemental Indexes

The environmental justice and supplemental indexes are a combination of environmental and socioeconomic information. There are thirteen EJ indexes and supplemental indexes in EJScreen reflecting the 13 environmental indicators. The indexes for a selected area are compared to those for all other locations in the state or nation. For more information and calculation details on the EJ and supplemental indexes, please visit the EJScreen website.

EJ INDEXES

The EJ indexes help users screen for potential EJ concerns. To do this, the EJ index combines data on low income and people of color populations with a single environmental indicator.

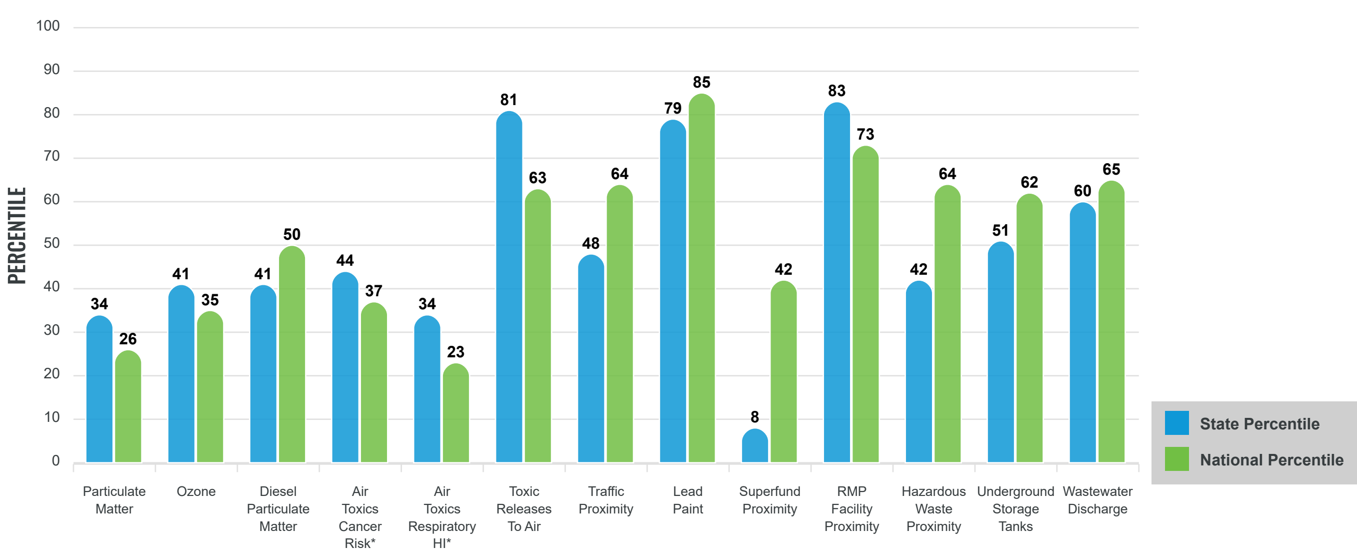
EJ INDEXES FOR THE SELECTED LOCATION



SUPPLEMENTAL INDEXES

The supplemental indexes offer a different perspective on community-level vulnerability. They combine data on percent low-income, percent linguistically isolated, percent less than high school education, percent unemployed, and low life expectancy with a single environmental indicator.

SUPPLEMENTAL INDEXES FOR THE SELECTED LOCATION



These percentiles provide perspective on how the selected block group or buffer area compares to the entire state or nation.

Report for Blockgroup: 360550119015

EJScreen Environmental and Socioeconomic Indicators Data

SELECTED VARIABLES	VALUE	STATE AVERAGE	PERCENTILE IN STATE	USA AVERAGE	PERCENTILE IN USA
POLLUTION AND SOURCES					
Particulate Matter ($\mu g/m^3$)	6.76	7.71	18	8.08	16
Ozone (ppb)	57.9	62.6	25	61.6	23
Diesel Particulate Matter ($\mu g/m^3$)	0.153	0.525	23	0.261	32
Air Toxics Cancer Risk* (lifetime risk per million)	20	25	5	25	5
Air Toxics Respiratory HI*	0.2	0.33	5	0.31	4
Toxic Releases to Air	530	450	85	4,600	47
Traffic Proximity (daily traffic count/distance to road)	77	430	33	210	50
Lead Paint (% Pre-1960 Housing)	0.81	0.55	76	0.3	92
Superfund Proximity (site count/km distance)	0.029	0.24	5	0.13	27
RMP Facility Proximity (facility count/km distance)	0.26	0.21	84	0.43	64
Hazardous Waste Proximity (facility count/km distance)	0.47	4.3	26	1.9	49
Underground Storage Tanks ($count/km^2$)	0.99	7.7	34	3.9	47
Wastewater Discharge (toxicity-weighted concentration/m distance)	0.0012	5	43	22	50
SOCIOECONOMIC INDICATORS					
Demographic Index	26%	35%	47	35%	44
Supplemental Demographic Index	16%	14%	67	14%	64
People of Color	4%	42%	11	39%	10
Low Income	49%	28%	83	31%	79
Unemployment Rate	6%	6%	64	6%	66
Limited English Speaking Households	3%	7%	59	5%	70
Less Than High School Education	3%	12%	23	12%	24
Under Age 5	0%	5%	0	6%	0
Over Age 64	15%	17%	48	17%	49
Low Life Expectancy	18%	17%	57	20%	34

*Diesel particulate matter, air toxics cancer risk, and air toxics respiratory hazard index are from the EPA's Air Toxics Data Update, which is the Agency's ongoing, comprehensive evaluation of air toxics in the United States. This effort aims to prioritize air toxics, emission sources, and locations of interest for further study. It is important to remember that the air toxics data presented here provide broad estimates of health risks over geographic areas of the country, not definitive risks to specific individuals or locations. Cancer risks and hazard indices from the Air Toxics Data Update are reported to one significant figure and any additional significant figures here are due to rounding. More information on the Air Toxics Data Update can be found at: https://www.epa.gov/haps/air-toxics-data-update.

Sites reporting to EPA within defined area:

Superfund	0
Hazardous Waste, Treatment, Storage, and Disposal Facilities	0
Water Dischargers	4
Air Pollution	1
Brownfields	0
Toxic Release Inventory	2

Other community features within defined area:

Schools	1
Hospitals	0
Places of Worship	0

Other environmental data:

Air Non-attainment	Yes
Impaired Waters	Yes

Selected location contains American Indian Reservation Lands*	No
Selected location contains a "Justice40 (CEJST)" disadvantaged community	No
Selected location contains an EPA IRA disadvantaged community	No

Report for Blockgroup: 360550119015

EJScreen Environmental and Socioeconomic Indicators Data

HEALTH INDICATORS

INDICATOR	HEALTH VALUE	STATE AVERAGE	STATE PERCENTILE	US AVERAGE	US PERCENTILE
Low Life Expectancy	18%	17%	56	20%	34
Heart Disease	7.5	5.6	91	6.1	77
Asthma	9.9	10	52	10	52
Cancer	9.1	6	97	6.1	96
Persons with Disabilities	14.1%	11.8%	70	13.4%	60

CLIMATE INDICATORS

INDICATOR	HEALTH VALUE	STATE AVERAGE	STATE PERCENTILE	US AVERAGE	US PERCENTILE
Flood Risk	10%	11%	67	12%	67
Wildfire Risk	0%	1%	0	14%	0

CRITICAL SERVICE GAPS

INDICATOR	HEALTH VALUE	STATE AVERAGE	STATE PERCENTILE	US AVERAGE	US PERCENTILE
Broadband Internet	5%	13%	28	14%	27
Lack of Health Insurance	3%	5%	39	9%	20
Housing Burden	No	N/A	N/A	N/A	N/A
Transportation Access	Yes	N/A	N/A	N/A	N/A
Food Desert	No	N/A	N/A	N/A	N/A

Footnotes

Report for Blockgroup: 360550119015

Appendix B

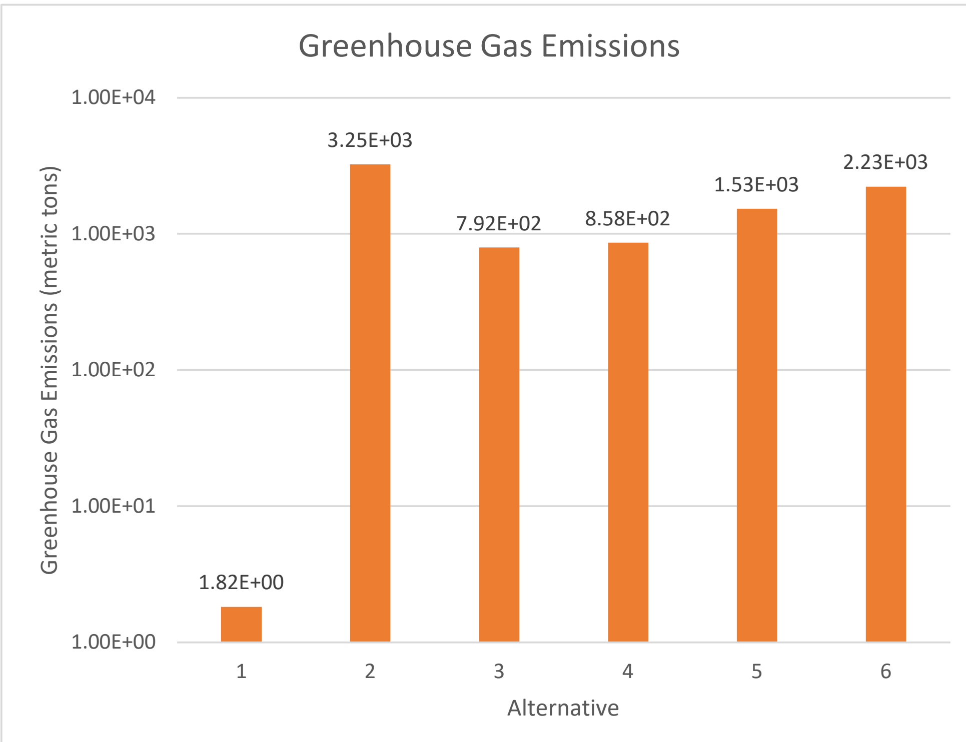
Green and Sustainable Remediation Evaluation

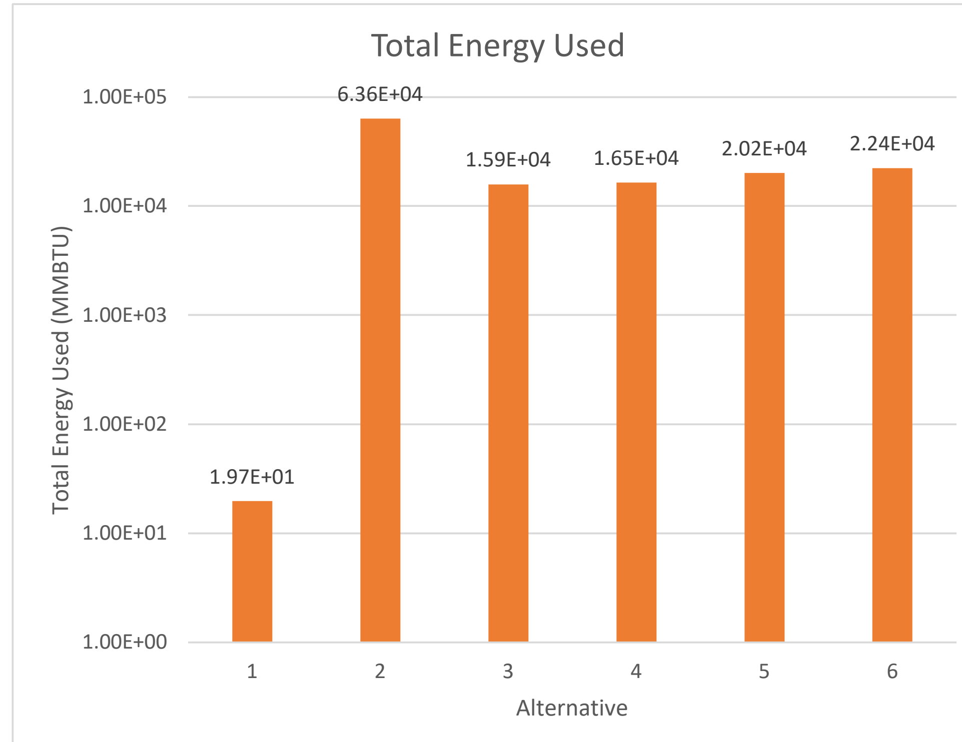
Appendix B
Green and Sustianable Remediation Evaluation

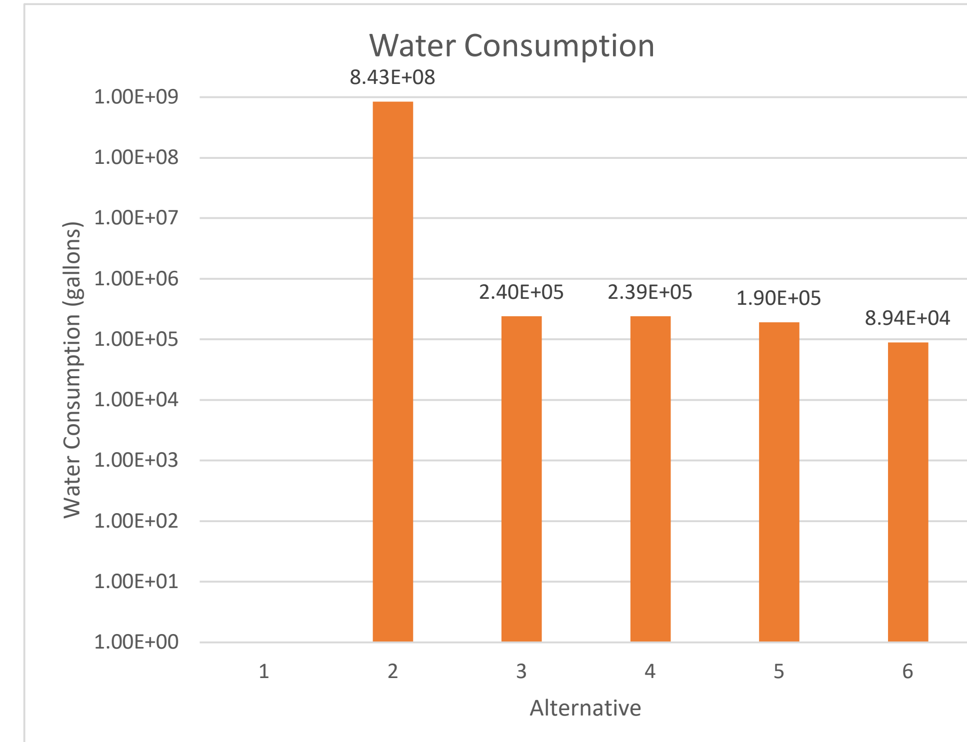
Feasibility Study
Former George A. Robinson Company, Inc. Site
477 Whitney Road, Penfield, New York

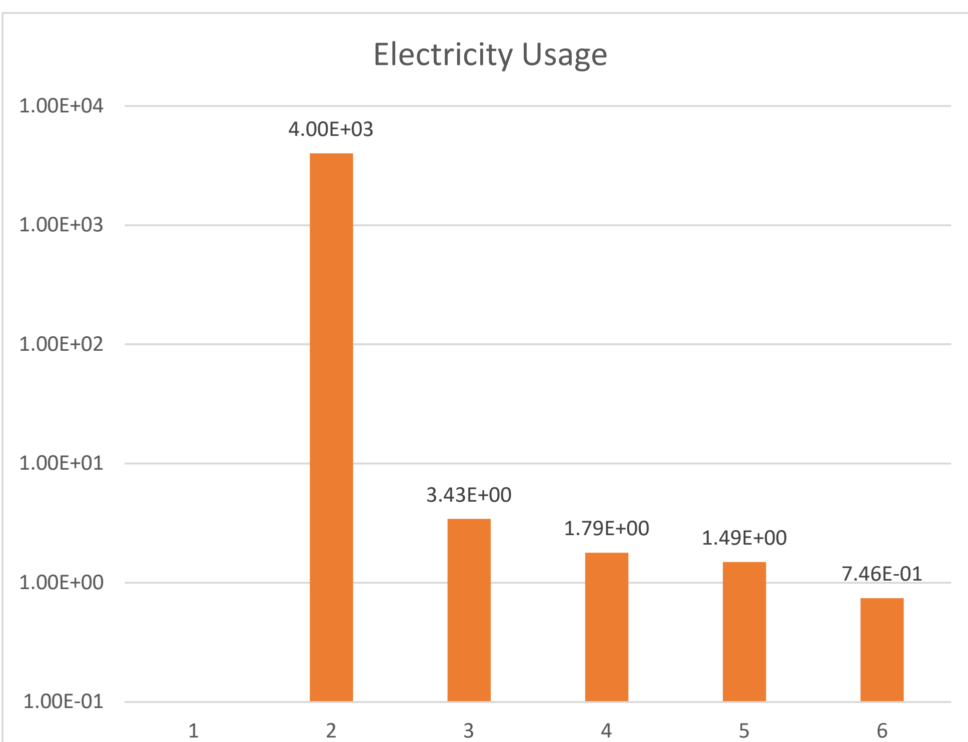
Remedial Alternative	Remediation	Greenhouse Gas Emissions	Total Energy Used	Water Consumption	Electricity Usage	Onsite NOx Emissions	Onsite SOx Emissions	Onsite PM10 Emissions	Total NOx Emissions	Total SOx Emissions	Total PM10 Emissions	Non-Hazardous Waste Landfill Space	Topsoil Consumption	Lost Hours - Injury
		metric ton	MMBTU	gallons	MWH	metric ton	metric ton	metric ton	metric ton	metric ton	metric ton	tons	cubic yards	hours
Alternative 1	Well Destruction	1.82E+00	1.97E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.31E-03	1.79E-03	4.40E-04	0.00E+00	0.00E+00	0.00E+00
	TOTAL	**1.82E+00**	**1.97E+01**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**1.31E-03**	**1.79E-03**	**4.40E-04**	**0.00E+00**	**0.00E+00**	**1.51E-02**
Alternative 2	Soil Remediation	8.55E+02	1.22E+04	0.00E+00	0.00E+00	4.00E-03	8.39E-04	7.74E-04	1.36E+00	1.20E+00	1.70E+00	7.50E+03	5.00E+02	2.10E+00
	Groundwater Remediation	1.34E+02	1.10E+04	1.76E+03	0.00E+00	1.17E-01	1.27E-02	1.14E-02	1.84E-01	9.88E-02	3.04E-02	1.39E+01	0.00E+00	6.50E-01
	Long-Term Monitoring and O&M	2.25E+03	4.03E+04	8.43E+08	4.00E+03	0.00E+00	0.00E+00	0.00E+00	2.76E+00	3.59E+00	1.17E+00	0.00E+00	0.00E+00	5.52E+00
	Building 101 Demolition	1.49E+01	2.09E+02	0.00E+00	0.00E+00	5.20E-03	9.56E-04	6.27E-04	2.21E-02	8.03E-03	3.73E-02	2.00E+02	0.00E+00	7.37E-02
	TOTAL	**3.25E+03**	**6.36E+04**	**8.43E+08**	**4.00E+03**	**1.26E-01**	**1.45E-02**	**1.28E-02**	**4.32E+00**	**4.89E+00**	**2.94E+00**	**7.71E+03**	**5.00E+02**	**8.33E+00**
Alternative 3	Soil Remediation	6.25E+02	9.25E+03	8.37E+02	1.64E+00	3.89E-03	8.09E-04	7.52E-04	1.04E+00	9.94E-01	1.20E+00	5.10E+03	5.00E+02	1.46E+00
	Groundwater Remediation	8.65E+01	5.60E+03	2.36E+05	1.79E+00	7.38E-02	7.54E-03	6.64E-03	2.23E-01	2.39E-01	5.59E-02	4.17E+00	0.00E+00	5.25E-01
	Long-Term Monitoring and O&M	6.57E+01	8.50E+02	3.48E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.05E-02	5.20E-04	2.44E-03	0.00E+00	0.00E+00	3.63E-01
	Building 101 Demolition	1.49E+01	2.09E+02	0.00E+00	0.00E+00	5.20E-03	9.56E-04	6.27E-04	2.21E-02	8.03E-03	3.73E-02	2.00E+02	0.00E+00	7.37E-02
	TOTAL	**7.92E+02**	**1.59E+04**	**2.40E+05**	**3.43E+00**	**8.29E-02**	**9.30E-03**	**8.02E-03**	**1.31E+00**	**1.24E+00**	**1.29E+00**	**5.30E+03**	**5.00E+02**	**2.42E+00**
Alternative 4	Soil Remediation	6.91E+02	9.85E+03	0.00E+00	0.00E+00	3.18E-03	6.67E-04	6.16E-04	1.10E+00	9.76E-01	1.36E+00	6.00E+03	5.00E+02	1.67E+00
	Groundwater Remediation	8.65E+01	5.60E+03	2.36E+05	1.79E+00	7.38E-02	7.54E-03	6.64E-03	2.23E-01	2.39E-01	5.59E-02	4.17E+00	0.00E+00	5.25E-01
	Long-Term Monitoring and O&M	6.57E+01	8.50E+02	3.48E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.05E-02	5.20E-04	2.44E-03	0.00E+00	0.00E+00	3.63E-01
	Building 101 Demolition	1.49E+01	2.09E+02	0.00E+00	0.00E+00	5.20E-03	9.56E-04	6.27E-04	2.21E-02	8.03E-03	3.73E-02	2.00E+02	0.00E+00	7.37E-02
	TOTAL	**8.58E+02**	**1.65E+04**	**2.39E+05**	**1.79E+00**	**8.22E-02**	**9.16E-03**	**7.88E-03**	**1.37E+00**	**1.22E+00**	**1.46E+00**	**6.20E+03**	**5.00E+02**	**2.63E+00**
Alternative 5	Soil Remediation	6.60E+02	9.42E+03	0.00E+00	0.00E+00	3.00E-03	6.29E-04	5.81E-04	1.06E+00	9.42E-01	1.30E+00	5.70E+03	5.00E+02	1.59E+00
	Groundwater Remediation	7.83E+02	9.72E+03	1.86E+05	1.49E+00	7.63E-02	8.92E-03	7.41E-03	1.50E+00	2.49E+00	8.29E-01	1.70E+03	5.00E+02	1.03E+00
	Long-Term Monitoring and O&M	8.23E+01	1.06E+03	4.32E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.57E-02	6.47E-04	3.03E-03	0.00E+00	0.00E+00	4.50E-01
	TOTAL	**1.53E+03**	**2.02E+04**	**1.90E+05**	**1.49E+00**	**7.93E-02**	**9.55E-03**	**7.99E-03**	**2.58E+00**	**3.43E+00**	**2.13E+00**	**7.40E+03**	**1.00E+03**	**3.07E+00**
Alternative 6	Soil Remediation	5.82E+02	8.33E+03	0.00E+00	0.00E+00	3.27E-03	6.84E-04	6.33E-04	9.52E-01	8.75E-01	1.12E+00	4.80E+03	6.85E+02	1.40E+00
	Groundwater Remediation	1.58E+03	1.31E+04	8.54E+04	7.46E-01	3.46E-02	5.63E-03	4.17E-03	2.74E+00	5.10E+00	1.11E+00	2.61E+02	5.00E+02	1.39E+00
	Long-Term Monitoring and O&M	6.92E+01	8.95E+02	4.00E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.16E-02	5.50E-04	2.57E-03	0.00E+00	0.00E+00	3.82E-01
	TOTAL	**2.23E+03**	**2.24E+04**	**8.94E+04**	**7.46E-01**	**3.79E-02**	**6.32E-03**	**4.80E-03**	**3.71E+00**	**5.98E+00**	**2.23E+00**	**5.06E+03**	**1.19E+03**	**3.17E+00**

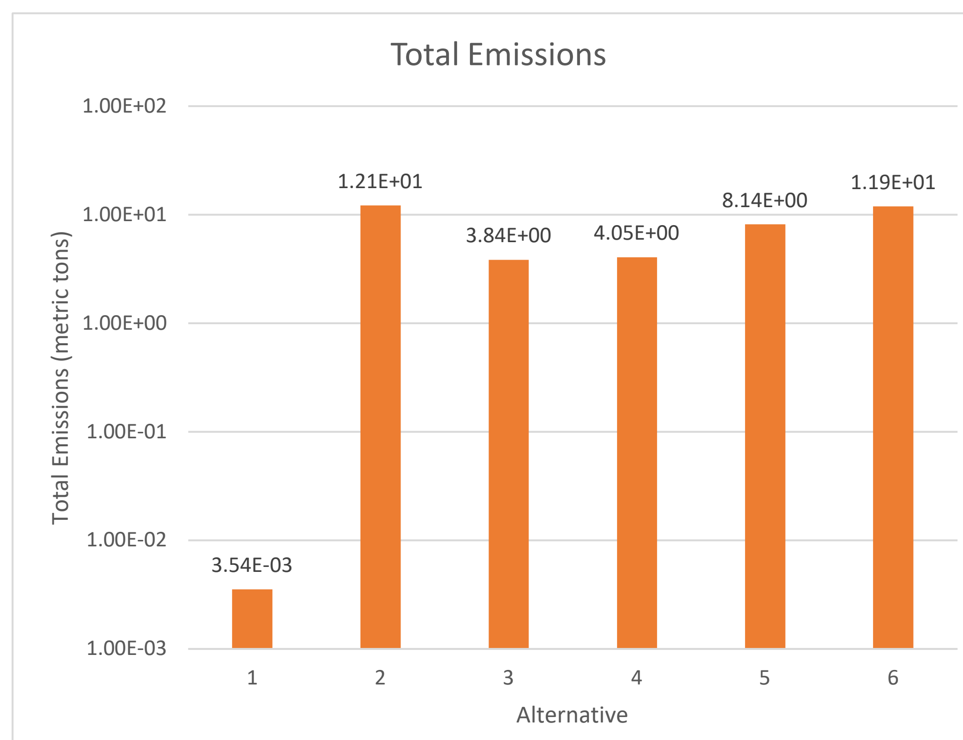
Abbreviations:
MMBTU = one million British thermal units
MWH = megawatt hours
NOx = nitrogen oxides
PM10 = particulate matter with a diameter of 10 micometers or less
SOx = sulfur oxides

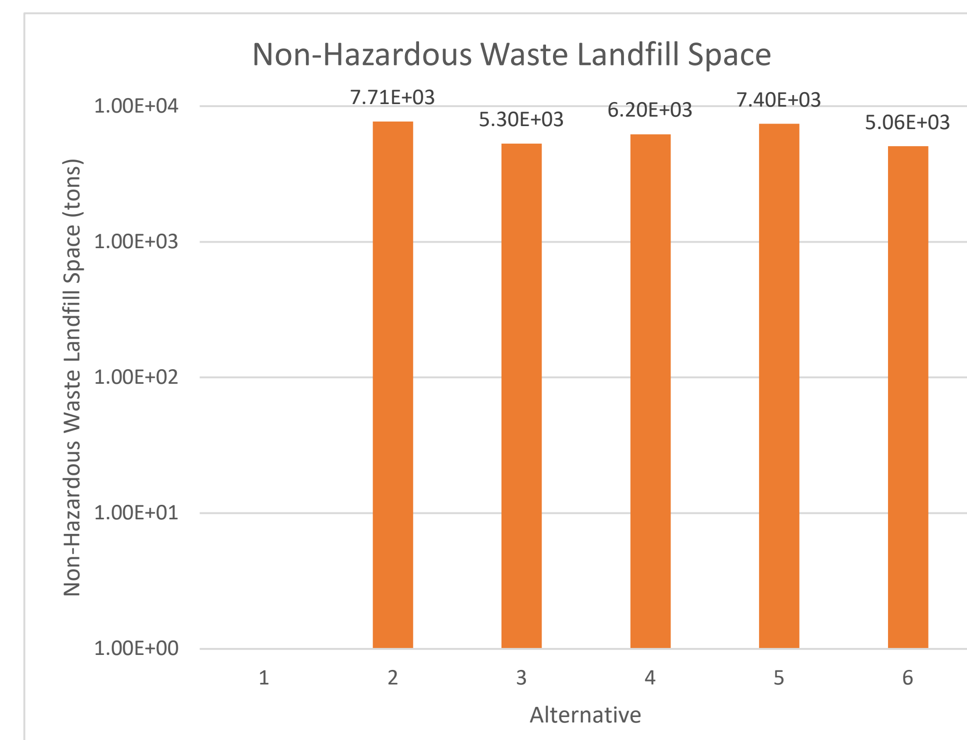

Greenhouse Gas Emissions
Greenhouse Gas Emissions (metric tons)
1.00E+04
1.00E+03
1.00E+02
1.00E+01
1.00E+00
1.82E+00
3.25E+03
7.92E+02
8.58E+02
1.53E+03
2.23E+03
1
2
3
4
5
6
Alternative


Total Energy Used
Total Energy Used (MMBTU)
1.00E+05
1.00E+04
1.00E+03
1.00E+02
1.00E+01
1.00E+00
1.97E+01
6.36E+04
1.59E+04
1.65E+04
2.02E+04
2.24E+04
1
2
3
4
5
6
Alternative


Water Consumption
Water Consumption (gallons)
1.00E+09
1.00E+08
1.00E+07
1.00E+06
1.00E+05
1.00E+04
1.00E+03
1.00E+02
1.00E+01
1.00E+00
8.43E+08
2.40E+05
2.39E+05
1.90E+05
8.94E+04
1
2
3
4
5
6
Alternative


Electricity Usage
1.00E+04
1.00E+03
1.00E+02
1.00E+01
1.00E+00
1.00E-01
4.00E+03
3.43E+00
1.79E+00
1.49E+00
7.46E-01
1
2
3
4
5
6


Total Emissions
Total Emissions (metric tons)
1.00E+02
1.00E+01
1.00E+00
1.00E-01
1.00E-02
1.00E-03
3.54E-03
1.21E+01
3.84E+00
4.05E+00
8.14E+00
1.19E+01
1
2
3
4
5
6
Alternative


Non-Hazardous Waste Landfill Space
Non-Hazardous Waste Landfill Space (tons)
1.00E+04
1.00E+03
1.00E+02
1.00E+01
1.00E+00
7.71E+03
5.30E+03
6.20E+03
7.40E+03
5.06E+03
1
2
3
4
5
6
Alternative

Appendix C

Remedial Alternatives Cost Detail

Table C-1
Summary of Costs for Alternative 1

Feasibility Study Report
Former George A. Robinson Company, Inc. Site
477 Whitney Road, Penfield, New York

Item Description	Estimated Quantity	Unit	Unit Price	Cost
Capital Costs				
Alternative Implementation				
Well Abandonment	20	Well	$3,600	$72,000
			Subtotal	**$72,000**
Management				
Close-Out Reporting	1	Lump Sum	$17,000	$17,000
			Subtotal	**$17,000**
			Total Capital Costs	**$89,000**
		Construction Contingency (20%)		**$14,400**

CAPITAL COST (ROUNDED)	**$110,000**
ONE TIME FUTURE COSTS	**$0**
O&M COST	**$0**
LTM COST	**$0**
TOTAL UNDISCOUNTED COST (30 YEARS)	**$110,000**
PRESENT VALUE	**$110,000**

Note: Present value cost based on 1% annual discount rate (difference between 10-year treasury and US inflation rates).

Table C-2
Summary of Costs for Alternative 2

Feasibility Study Report
Former George A. Robinson Company, Inc. Site
477 Whitney Road, Penfield, New York

ARCADIS

Item Description	Estimated Quantity	Unit	Unit Price	Cost
Capital Costs				
Site Preparation / Final Remedial Design				
Demolition of Buildings 52, 64, 73, and 101	1	Lump Sum	$870,000	$870,000
Pre-Design Investigation	1	Lump Sum	$80,000	$80,000
Site Preparation and Submittals	1	Lump Sum	$170,000	$170,000
			Subtotal	**$1,120,000**
Alternative Implementation				
Installation of Sheet Piling	2,500	Vertical Square Feet	$50	$125,000
Excavation and Loadout of Soil Source Areas	4,400	Cubic Yard	$70	$308,000
Transportation and Disposal of Excavated Soils	7,500	Ton	$90	$675,000
Backfill of Excavated Areas	7,500	Ton	$45	$337,500
Site Restoration Post Excavation	1	Lump Sum	$40,000	$40,000
System Installation Preparation	1	Lump Sum	$30,000	$30,000
Extraction Well Installation, Trenching, and Infrastructure	1	Lump Sum	$790,000	$790,000
Treatment System and Building	1	Lump Sum	$330,000	$330,000
			Subtotal	**$2,635,500**
Management				
Engineering Design and Coordination	1	Lump Sum	$140,000	$140,000
Construction Oversight	1	Lump Sum	$640,000	$640,000
			Subtotal	**$780,000**
			Total Capital Cost	**$4,535,500**
		Construction Contingency (20%)		**$751,100**
Operation and Maintenance (O&M) Costs				
Annual Operation and Maintenance				
Inspection (twice a week) and Oversight	1	Per Year	$165,000	$165,000
System Expenses	1	Per Year	$160,000	$160,000
Data Compilation, Oversight, and Reporting	1	Per Year	$25,000	$25,000
			Subtotal	**$350,000**
Annual Long-Term Monitoring (LTM)				
Semi-Annual Sampling and Analysis for 20 Wells	1	Per Year	$50,000	$50,000
Semi-Annual Data Analysis and Reporting	1	Per Year	$30,000	$30,000
			Subtotal	**$80,000**

CAPITAL COST (ROUNDED)	**$5,290,000**
ONE TIME FUTURE COSTS	**$0**
ANNUAL O&M	$350,000
ANNUAL LTM	$80,000
ANNUAL O&M and LTM	**$430,000**
TOTAL O&M COST (20 YEARS)	$7,000,000
TOTAL LTM COST (20 YEARS)	$1,600,000
TOTAL UNDISCOUNTED COST (20 YEARS)	**$14,750,000**
PRESENT VALUE (20 Years)	**$13,050,000**

Note: Present value cost based on 1% annual discount rate (difference between 10-year treasury and US inflation rates).

Table C-3
Summary of Costs for Alternative 3

Feasibility Study Report
Former George A. Robinson Company, Inc. Site
477 Whitney Road, Penfield, New York

Item Description	Estimated Quantity	Unit	Unit Price	Cost
Capital Costs				
Site Preparation / Final Remedial Design				
Demolition of Buildings 52, 64, 73, and 101	1	Lump Sum	$870,000	$870,000
Pre-Design Investigation	1	Lump Sum	$70,000	$70,000
Site Preparation and Submittals	1	Lump Sum	$150,000	$150,000
			Subtotal	**$1,090,000**
Alternative Implementation				
Installation of Sheet Piling	2,030	Vertical Square Feet	$50	$101,500
Excavation and Loadout of Soil Source Areas	3,000	Cubic Yard	$70	$210,000
Excavation and Staging for Mixing Area	500	Cubic Yard	$35	$17,500
Transportation and Disposal of Excavated Soils	5,100	Ton	$90	$459,000
Backfill of Excavated Areas	5,100	Ton	$45	$229,500
Site Restoration Post Excavation	1	Lump Sum	$40,000	$40,000
Terrabond ® 3% By Weight	26	Ton	$400	$10,200
Amendment Mixing and Backfill of Treated Soils	500	Cubic Yard	$50	$25,000
In-Situ Chemical Oxidation (ISCO) Injection Subcontractors	1	Lump Sum	$94,000	$94,000
Oxidant (sodium permanganate)	58,000	Pounds	$3	$192,000
Other ISCO Injection Supplies / Analytical	1	Lump Sum	$30,000	$30,000
ISCO Performance Monitoring Well Installation and Initial Sampling Round	9	Well	$3,640	$32,800
Colloidal Carbon Injection Subcontractors	1	Lump Sum	$120,000	$120,000
Colloidal Carbon	168	Injection Point	$5,000	$840,000
Other Colloidal Carbon Injection Supplies / Analytical	1	Lump Sum	$30,000	$30,000
			Subtotal	**$2,431,500**
Management				
Engineering Design and Coordination	1	Lump Sum	$90,000	$90,000
Construction Oversight	1	Lump Sum	$350,000	$350,000
			Subtotal	**$440,000**
			Total Capital Cost	**$3,961,500**
			Construction Contingency (20%)	**$704,300**
Operation and Maintenance (O&M) Costs				
ISCO Performance Monitoring (Year 2)				
Baseline and 7 post-monitoring sampling events	12	Well	$15,500	$190,000
Reporting	1	Lump Sum	$30,000	$30,000
			Subtotal	**$220,000**
Follow-up ISCO Injection (Year 4)				
ISCO Injection Subcontractors	1	Lump Sum	$70,000	$70,000
Oxidant (sodium permanganate)	38,280	Pound	$3	$127,000
Other Injection Supplies/Analytical	1	Lump Sum	$30,000	$30,000
Oversight	1	Lump Sum	$40,000	$40,000
			Subtotal	**$267,000**
Annual Long-Term Monitoring				
Semi-Annual Sampling and Analysis for 20 Wells	1	Per Year	$50,000	$50,000
Semi-Annual Data Analysis and Reporting	1	Per Year	$30,000	$30,000
			Subtotal	**$80,000**

CAPITAL COST (ROUNDED)	**$4,670,000**
ONE-TIME FUTURE COSTS (YEAR 2)	**$220,000**
ONE-TIME FUTURE COSTS (YEAR 4)	**$270,000**
ANNUAL LTM COST	**$80,000**
UNDISCOUNTED LTM COST (15 YEARS)	$1,200,000
TOTAL UNDISCOUNTED COST (15 YEARS)	**$6,360,000**
PRESENT VALUE ONE-TIME FUTURE COSTS (YEAR 2) (ROUNDED)	$216,000
PRESENT VALUE ONE-TIME FUTURE COSTS (YEAR 4) (ROUNDED)	$259,000
PRESENT VALUE OF LTM	$1,109,000
Present Value (15 Years)	**$6,254,000**

Note: Present value cost based on 1% annual discount rate (difference between 10-year treasury and US inflation rates).

Table C-4
Summary of Costs for Alternative 4

Feasibility Study Report
Former George A. Robinson Company, Inc. Site
477 Whitney Road, Penfield, New York

Item Description	Estimated Quantity	Unit	Unit Price	Cost
Capital Costs				
Site Preparation / Final Remedial Design				
Demolition of Buildings 52, 64, 73, and 101	1	Lump Sum	$870,000	$870,000
Pre-Design Investigation	1	Lump Sum	$70,000	$70,000
Site Preparation and Submittals	1	Lump Sum	$160,000	$160,000
			Subtotal	**$1,100,000**
Alternative Implementation				
Installation of Sheet Piling	2,030	Vertical Square Feet	$50	$101,500
Excavation and Loadout of Soil Source Areas	3,500	Cubic Yard	$70	$245,000
Transportation and Disposal of Excavated Soils	6,000	Ton	$90	$540,000
Backfill of Excavated Areas	6,000	Ton	$45	$270,000
Site Restoration Post Excavation	1	Lump Sum	$40,000	$40,000
In-Situ Chemical Oxidation (ISCO) Injection Subcontractors	1	Lump Sum	$94,000	$94,000
Oxidant (sodium permanganate)	58,000	Pounds	$3	$192,000
Other ISCO Injection Supplies / Analytical	1	Lump Sum	$30,000	$30,000
ISCO Performance Monitoring Well Installation and Initial Sampling Round	9	Well	$3,460	$31,100
Colloidal Carbon Injection Subcontractors	1	Lump Sum	$120,000	$120,000
Colloidal Carbon	168	Injection Point	$5,000	$840,000
Other Colloidal Carbon Injection Supplies / Analytical	1	Lump Sum	$30,000	$30,000
			Subtotal	**$2,533,600**
Management				
Engineering Design and Coordination	1	Lump Sum	$90,000	$90,000
Construction Oversight	1	Lump Sum	$350,000	$350,000
			Subtotal	**$440,000**
			Total Capital Cost	**$4,073,600**
			Construction Contingency (20%)	**$726,720**
Operation and Maintenance (O&M) Costs				
ISCO Performance Monitoring (Year 2)				
Baseline and 7 post-monitoring sampling events	12	Well	$15,500	$190,000
Reporting	1	Lump Sum	$30,000	$30,000
			Subtotal	**$220,000**
Follow-up ISCO Injection (Year 4)				
ISCO Injection Subcontractors	1	Lump Sum	$70,000	$70,000
Oxidant (sodium permanganate)	38,280	Pound	$3	$127,000
Other Injection Supplies/Analytical	1	Lump Sum	$30,000	$30,000
Oversight	1	Lump Sum	$40,000	$40,000
			Subtotal	**$267,000**
Annual Long-Term Monitoring				
Semi-Annual Sampling and Analysis for 20 Wells	1	Per Year	$50,000	$50,000
Semi-Annual Data Analysis and Reporting	1	Per Year	$30,000	$30,000
			Subtotal	**$80,000**

CAPITAL COST (ROUNDED)	**$4,810,000**
ONE-TIME FUTURE COSTS (YEAR 2)	**$220,000**
ONE TIME FUTURE COSTS (YEAR 4)	**$270,000**
ANNUAL LTM COST	**$80,000**
UNDISCOUNTED LTM COST (15 YEARS)	$1,200,000
TOTAL UNDISCOUNTED COST (15 YEARS)	**$6,500,000**
PRESENT VALUE ONE-TIME FUTURE COSTS (YEAR 2) (ROUNDED)	$216,000
PRESENT VALUE ONE-TIME FUTURE COSTS (YEAR 4) (ROUNDED)	$259,000
PRESENT VALUE OF LTM	$1,109,000
Present Value (15 Years)	**$6,474,000**

Table C-5
Summary of Costs for Alternative 5

Feasibility Study Report
Former George A. Robinson Company, Inc. Site
477 Whitney Road, Penfield, New York

Item Description	Estimated Quantity	Unit	Unit Price	Cost
Capital Costs				
Site Preparation / Final Remedial Design				
Demolition of Buildings 52, 64, and 73	1	Lump Sum	$790,000	$790,000
Pre-Design Investigation	1	Lump Sum	$110,000	$110,000
Site Preparation and Submittals	1	Lump Sum	$390,000	$390,000
			Subtotal	**$1,290,000**
Alternative Implementation				
Installation of Sheet Piling	2,030	Vertical Square Feet	$50	$101,500
Excavation and Loadout of Soil Source Areas	3,300	Cubic Yard	$70	$231,000
Transportation and Disposal of Excavated Soils	5,700	Ton	$90	$513,000
Backfill of Excavated Areas	5,700	Ton	$45	$256,500
Site Restoration Post Excavation	1	Lump Sum	$40,000	$40,000
In-Situ Chemical Oxidation (ISCO) Injection Subcontractors	1	Lump Sum	$72,000	$72,000
Oxidant (sodium permanganate)	40,000	Pounds	$3	$132,000
Other ISCO Injection Supplies / Analytical	1	Lump Sum	$20,000	$20,000
ISCO Performance Monitoring Well Installation and Initial Sampling Round	9	Well	$2,440	$22,000
Permeable Reactive Barrier (PRB) Installation Subcontractor	1	Lump Sum	$350,000	$350,000
Loadout, Transportation, and Disposal of Soil from PRB Areas	1,000	Cubic Yard	$125	$125,000
PRB Zero Valent Iron	473	Ton	$1,200	$567,000
PRB Sand for construction	1,400	Ton	$55	$77,000
PRB Restoration (surface completion and restoration of the installation area, removing the working platforms, reseeding)	1	Lump Sum	$40,000	$40,000
Colloidal Carbon Injection Subcontractors	1	Lump Sum	$120,000	$120,000
Colloidal Carbon	168	Injection Point	$5,000	$840,000
Other Colloidal Carbon Injection Supplies / Analytical	1	Lump Sum	$30,000	$30,000
			Subtotal	**$3,537,000**
Management				
Engineering Design and Coordination	1	Lump Sum	$90,000	$90,000
Construction Oversight	1	Lump Sum	$400,000	$400,000
			Subtotal	**$490,000**
			Total Capital Cost	**$5,317,000**
			Construction Contingency (20%)	**$965,400**
Operation and Maintenance (O&M) Costs				
ISCO Performance Monitoring (Year 2)				
Baseline and 7 post-monitoring sampling events	8	Well	$19,400	$160,000
Reporting	1	Lump Sum	$30,000	$30,000
			Subtotal	**$190,000**
Follow-up ISCO Injection (Year 4)				
ISCO Injection Subcontractors	1	Lump Sum	$48,000	$48,000
Oxidant (sodium permanganate)	26,400	Pound	$3	$88,000
Other Injection Supplies/Analytical	1	Lump Sum	$24,000	$24,000
Oversight	1	Lump Sum	$30,000	$30,000
			Subtotal	**$190,000**
Annual Long-Term Monitoring				
Semi-Annual Sampling and Analysis for 20 Wells	1	Per Year	$50,000	$50,000
Semi-Annual Data Analysis and Reporting	1	Per Year	$30,000	$30,000
			Subtotal	**$80,000**

CAPITAL COST (ROUNDED)	**$6,290,000**
ONE-TIME FUTURE COSTS (YEAR 2)	**$190,000**
ONE TIME FUTURE COSTS (YEAR 4)	**$190,000**
ANNUAL LTM COST	**$80,000**
UNDISCOUNTED LTM COST (20 YEARS)	$1,600,000
TOTAL UNDISCOUNTED COST (20 YEARS)	**$8,270,000**
PRESENT VALUE ONE-TIME FUTURE COSTS (YEAR 2) (ROUNDED)	$186,000
PRESENT VALUE ONE-TIME FUTURE COSTS (YEAR 4) (ROUNDED)	$183,000
PRESENT VALUE OF LTM	$1,109,000
Present Value (20 Years)	**$7,848,000**

Note: Present value cost based on 1% annual discount rate (difference between 10-year treasury and US inflation rates).

Table C-6
Summary of Costs for Alternative 6

Feasibility Study Report
Former George A. Robinson Company, Inc. Site
477 Whitney Road, Penfield, New York

ARCADIS

Item Description	Estimated Quantity	Unit	Unit Price	Cost
Capital Costs				
Site Preparation / Final Remedial Design				
Demolition of Buildings 52, 64, and 73	1	Lump Sum	$790,000	$790,000
Pre-Design Investigation	1	Lump Sum	$110,000	$110,000
Site Preparation and Submittals	1	Lump Sum	$740,000	$740,000
			Subtotal	**$1,640,000**
Alternative Implementation				
Installation of Sheet Piling	2,030	Vertical Square Feet	$50	$101,500
Excavation and Loadout of Soil Source Areas	2,800	Cubic Yard	$70	$196,000
Transportation and Disposal of Excavated Soils	4,800	Ton	$90	$432,000
Backfill of Excavated Areas	4,800	Ton	$45	$216,000
1-Foot Cover	315	Ton	$45	$14,000
Site Restoration Post Excavation	1	Lump Sum	$40,000	$40,000
Permeable Reactive Barrier (PRB) Installation Subcontractor	1	Lump Sum	$860,000	$860,000
Loadout, Transportation, and Disposal of Soil from PRB Areas	2,300	Cubic Yard	$125	$287,500
PRB Zero Valent Iron	1,087	Ton	$1,200	$1,304,100
PRB Sand for construction	3,200	Ton	$55	$176,000
PRB Restoration (surface completion and restoration of the installation area, removing the working platforms, reseeding)	1	Lump Sum	$40,000	$40,000
Colloidal Carbon Injection Subcontractors	1	Lump Sum	$120,000	$120,000
Colloidal Carbon	168	Injection Point	$5,000	$840,000
Other Colloidal Carbon Injection Supplies / Analytical	1	Lump Sum	$30,000	$30,000
			Subtotal	**$4,657,100**
Management				
Engineering Design and Coordination	1	Lump Sum	$90,000	$90,000
Construction Oversight	1	Lump Sum	$410,000	$410,000
			Subtotal	**$500,000**
			Total Capital Cost	**$6,797,100**
		Construction Contingency (20%)		**$1,259,420**
Long-Term Monitoring (LTM) Costs				
Annual Long-Term Monitoring				
Semi-Annual Sampling and Analysis for 20 Wells	1	Per Year	$50,000	$50,000
Semi-Annual Data Analysis and Reporting	1	Per Year	$30,000	$30,000
			Subtotal	**$80,000**

CAPITAL COST (ROUNDED)	**$8,060,000**
ONE TIME FUTURE COSTS	**$0**
TOTAL O&M COST	**$0**
ANNUAL LTM COST	**$80,000**
UNDISCOUNTED LTM COSTS (YEARS 1-20)	$1,600,000
TOTAL UNDISCOUNTED COST (20 YEARS)	**$9,660,000**
PRESENT VALUE OF LTM	$1,444,000
Present Value (20 Years)	**$9,504,000**

Note: Present value cost based on 1% annual discount rate (difference between 10-year treasury and US inflation rates).

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