REPORT ON
EVALUATION OF ALTERNATIVES
711 NORTH ROAD
SCOTTSVILLE, NEW YORK

by

Haley & Aldrich of New York
Rochester, New York

for

New York State Department of Environmental Conservation
Rochester, New York

File No. 70665-018
18 July 2013

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18 July 2013
File No. 70665-018

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Attention: Mr. Chris Marraro, Esq.

Subject: Evaluation of Additional Remedial Alternatives
CooperVision Inc., VCA Site #V00175
711 North Road, Scottsville, New York

Dear Mr. Marraro:

Haley & Aldrich of New York (Haley & Aldrich) is pleased to submit this report on the evaluation of additional remedial alternatives for the above-referenced site. This evaluation was required by the New York State Department of Environmental Conservation (NYSDEC) in its letter correspondence dated on 16 April 2013 based on the findings of the 2012 Periodic Review Report (PRR). This report briefly summarizes the current conceptual site model (CSM), presents a list of applicable remedial alternatives, an evaluation of the alternatives, and the preferred alternative that most meets the threshold and balancing criteria set forth in the NYSDEC *DER-10 Technical Guidance for Site Investigation and Remediation*, dated May 2010. Please do not hesitate to contact us if you have any questions or comments concerning the information in this report.

Sincerely yours,
HALEY & ALDRICH OF NEW YORK

Mark N. Ramsdell, P.E.
Senior Project Manager

Denis M. Conley
Senior Scientist

Vincent B. Dick
Senior Vice President

Enclosures:
Table 1 – MW-202 Alternatives Analysis Matrix
Figure 1 – Conceptual Design Injection of Carbon Substrate and/or Bio-Augmentation

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1. INTRODUCTION

The New York State Department of Environmental Conservation (NYSDEC) has required Cooper Vision, Inc. ("CooperVision") to conduct an evaluation of alternatives because the results of the Mann-Kendall Analysis described in the 2012 Periodic Review Report (PRR) for the site have indicated that concentrations of 1,1-dichloroethane (1,1-DCA) and 1,1-dichloroethene (1,1-DCE) show an increasing mathematical trend at MW-202 for two consecutive groundwater sampling events. Per Section 3.5 Groundwater Monitoring Contingency Plan of the SMP, this condition should be evaluated in the context of possible mitigation.

This report briefly summarizes the current groundwater conceptual site model (CSM), presents a list of applicable remedial alternatives, an evaluation of the alternatives, and the preferred alternative that most meets the threshold and balancing criteria set forth in the NYSDEC *DER-10 Technical Guidance for Site Investigation and Remediation*, dated May 2010.

1.1 Background

Soil, groundwater, and soil vapor at the site have been impacted historically by 1,1,1-trichloroethane (TCA) formerly used at the site, and its breakdown products 1,1-DCA, 1,1-DCE, and chloroethane and considered to be the contaminants of concern (COCs) in groundwater.

TCA is no longer used at the site, and there is no known continued source of TCA or its breakdown products being introduced to the site. In 2001, enhanced bioremediation using Hydrogen Release Compound (HRC) was conducted using direct injection techniques in the source and mid-gradient areas of the site to address residual contamination and to control migration of impacted groundwater. The impacted groundwater area of the site is broken down into three areas: 1) source area, 2) mid-gradient Area, and 3) down gradient area.

Following injection, the groundwater in the source, mid-gradient, and down gradient areas were evaluated semi-annually for a period of nine (9) years prior to submittal and approval of the Final Engineering Report (FER) and Site Management Plan (SMP) for the site in 2010. Per the SMP, exposure to the soil is restricted by maintenance of a site cover; and exposure to soil vapor is mitigated through the use of a sub-slab depressurization system on the site. Though use and exposure to groundwater is restricted by institutional controls, its condition continues to be monitored.

1.2 Geologic Conditions

Subsurface soils generally consist of a dense, relatively low hydraulic conductivity glacial till across the site. An upper layer of the till appeared to have been modified by ice melt or similar reworking. The reworked till consists of fine sand with trace coarse sand and gravel and occurs generally from ground surface to approximately 10 ft. depth in the center of the site, and has medium density. The unmodified till also consists of fine sand with trace coarse sand but is more dense than the reworked material.

Based on groundwater level data collected to-date, groundwater flow on the site is generally towards the east-southeast with low hydraulic conductivity (10^{-6} to 10^{-7} cm/sec range).

1.3 Current Groundwater Conditions

Per the Site Management Plan (SMP), the groundwater at the site continues to be monitored on a semi-annual basis. The current trends identified in the three (3) areas are described below:

- Source Area: This area is located on the northwestern side of the building parking lot and contains currently monitoring wells MW-205 and OWS-302S. This is the area of highest concentration of COCs. TCA and 1,1-DCA concentrations in MW-205 have fluctuated since the HRC injection between 41 mg/L and 300 mg/L. Currently, the concentrations do not show a decreasing or increasing trend.

- Mid-gradient Area: This area is located on the south side of the building that fronts North Road and contains currently monitored wells MW-3, MW-501, and MW-502. This area has most effectively shown the reductive dechlorination trend as a result of enhanced bioremediation. Concentrations of COCs in the mid-gradient area have ranged between 10 mg/L and non-detect since the HRC injection, and have for the most part steadily decreased. TCA and 1,1-DCE have not been detected in the mid-gradient wells since 2005. Low levels of 1,1-DCA continue to be detected at around 0.1 mg/L in MW-3 and MW-502.

- Down gradient Area: This area is located to the east and south of the building and includes the area on the eastern side of the site near the property boundary. It includes currently monitored wells MW-202, MW-203, MW-204, and OW-306. Concentrations of VOCs in MW-203 and OW-306 have not been detected since implementation of the SMP. MW-204, has shown detections of 1,1-DCA and 1,1-DCE with periodic detections of 1,1,1-TCA below the NYSDEC regulatory limit protective of drinking water (0.005 mg/L). Historically, VOCs were not detected in MW-202, however concentrations of 1,1-DCE and 1,1-DCA, the breakdown products of TCA, have recently been detected between 0.030 and 0.050 mg/L in MW-202 and according to the Mann-Kendall trending analysis indicate an increasing mathematical trend. Since groundwater is not used in the area and given incompleteness of other potential exposure pathways in this area of the site, the detection of 1,1-DCE and 1,1-DCE does not indicate a potential for significant health or environmental exposure.

1.4 Evaluation of Dissolved Phase Plume

Given the steady and decreasing trends shown in the source and mid-gradient areas, the enhanced bioremediation activities have been effective in reducing the mass of VOCs in this area through enhanced biodegradation and controlling the migration of contaminated groundwater from these areas. Monitoring data to-date provides evidence that the source and mid-gradient plume is not expanding or that additional source material is being introduced, which would impact the down gradient area.

It is not anticipated that the condition at MW-202 is a result of instability in the source and mid-gradient area, nor is it the result of introduction of a new source of contamination for the following reasons:

- Conditions in the mid-gradient area have steadily been decreasing over time as shown in historical and current groundwater data and Mann Kendall analyses conducted in recent PRRs. It is not likely that a decreasing condition up gradient of MW-202 would result in an increase of VOCs in that well.

- TCA, which is the parent/source contaminant at the site, has not been historically or currently detected in MW-202. Only, the breakdown compounds 1,1-DCE and 1,1-DCA have been detected, which is an indication that concentrations detected in MW-202 are representative of the leading edge of the down gradient end of the plume and not likely the result of an independent source of contamination, nor likely an indication of significant offsite migration. Notably, these two breakdown products are produced individually from TCA by abiotic and biologically-facilitated means, therefore we would not expect to see the biologically-produced breakdown product (1,1-DCA) if the mass of contaminant at MW-202 had not been produced, at least in part, by activity in the mid-gradient area.

It is anticipated that the down gradient disconnected dissolved phase plume made evident by the condition at MW-202 will naturally attenuate over time. However, several alternatives to address the plume have been evaluated as described in the next section.

2. EVALUATION OF ALTERNATIVES

Five (5) remedial alternatives were evaluated to address the groundwater conditions identified at MW-202. These alternatives included: Additional Soil Vapor Monitoring using existing points, Installation and monitoring of Offsite Groundwater Wells, On-Site Injection of a Carbon Substrate with Bio-augmentation, On-site Installation of a Permeable Reactive Barrier (PRB) and Groundwater Hydraulic Control and Treatment. The analysis of these alternatives is based on the approved SMP and NYSDEC's 16 April 2013 letter and was conducted using the Threshold and Balancing Criteria prescribed in the NYSDEC DER-10 Technical Guidance for Site Investigation and Remediation, May 2010.

2.1 Threshold Criteria

- Protective of Human Health and Environment,
- Compliance with Standards, Criteria and Guidance,

2.2 Balancing Criteria

- Long-Term Effectiveness and Permanence
- Reduction of Toxicity, Mobility or Volume
- Short-term Impacts and Effectiveness
- Implementability
- Land Use and Estimated Cost

Based on the evaluation of the site conditions, remedial objectives and the applicable technologies, the focused injection of an emulsified vegetable oil (EVO) as an additional bioremediation treatment zone design between the source area treatment zone and MW-202 is the alternative that most meets the NYSDEC DER-10 threshold and balancing criteria. The analysis of remedial alternatives is discussed below and a detailed summary is presented on Table 1.

2.3 No Additional Measures with Expanded Offsite Monitoring

This alternative assumes that the groundwater contamination identified at MW-202 will attenuate over time without additional remedial intervention. This alternative does not consider any additional mitigation or remedial measures, but to assess the potential for offsite migration of groundwater or soil vapor, the following monitoring alternatives would be implemented:

2.3.1 Soil Vapor Monitoring

This alternative includes the sampling of existing soil vapor points present in the eastern right-of-way adjacent to the property on the east side of Briarwood Lane.

2.3.2 Installation and monitoring of Offsite Groundwater Monitoring Wells

This alternative also includes the installation of additional groundwater monitoring wells in the right-of-way along the east side of Briarwood Lane to evaluate the potential of offsite migration of impacted groundwater.

2.3.2.1 Threshold Criteria:

- Protection of Human Health and the Environment: The groundwater is not used for potable or industrial purposes therefore the only route of exposure to site related contaminants is from contaminated soil vapor. Additional monitoring data will be used to assess the potential for adverse impacts from contaminated soil vapor to offsite properties.
- Compliance with Standards, Criteria and Guidance (SCG): VOCs detected in the soil vapor and groundwater is primarily the breakdown products of the parent compound (TCA) present in the source area. There is evidence that the concentration of TCA and the daughter products are decreasing in the mid-gradient area. As such, it is anticipated that the VOCs detected in the down gradient groundwater and the overlying soil vapor will attenuate and decrease over time and achieve the applicable SCG.

2.3.2.2 Balancing criteria:

- Long-Term Effectiveness and Permanence: Periodic monitoring is a component of the Site Management Plan (SMP) at the site which indirectly addresses the potential of offsite migration of contaminants.

- Reduction of Toxicity, Mobility or Volume: Monitoring would not contribute to a any faster reduction of VOC toxicity, mobility or volume beyond natural attenuation.

- Short-term Impacts and Effectiveness: Monitoring could assess potential for offsite migration.

- Implementability: Installation of additional monitoring locations in the right-of-way could be conducted using conventional equipment without interruption of normal site activities. The additional locations could be sampled during regularly scheduled monitoring events. However, offsite monitoring would delay the process because potentially significant time would be required in obtaining access agreements from the Town of Wheatland.

- Land Use and Estimated Cost: This alternative would not alter the current land use of the site but would require additional monitoring wells.

2.4 In-Situ Groundwater Treatment

The in-situ groundwater treatment alternative includes the installation of a treatment barrier between the source area and MW-202 to destroy contaminants present in groundwater prior to reaching the property boundary. Two (2) in-situ groundwater treatment technologies were considered:

2.4.1 Injection of a Carbon Substrate with Bio-Augmentation

Similarly to the Hydrogen Release Compound (HRC) is a remedial technology that reduces toxicity and involves injection performed in the source and mid-gradient areas. This alternative would include the injection of a soluble carbon substrate and a microbial consortium to further enhance biologically mediated reductive dechlorination processes to breakdown the VOC to benign endpoints (methane and chloride).

2.4.1.1 Threshold Criteria

- Protection of Human Health and the Environment: Emulsified vegetable oils (EVO) are food grade materials and safe to inject into the environment. Reductive dechlorination processes has already been safely implemented at the Site without adverse impacts.

- Compliance with Standards, Criteria and Guidance (SCG): It is anticipated that the in-situ treatment using EVO will significantly reduce the VOC concentrations in groundwater in the down gradient area. The EVO will create in-situ conditions in the down gradient groundwater to promote the growth of micro organisms that will directly and indirectly metabolize the VOC and reduce the concentration to below the SCGs.

2.4.1.2 Balancing Criteria:

- Long Term Effectiveness and Permanence: Complete destruction of chlorinated compounds is possible.

- Reduction of Toxicity, Volume and Mobility: This technology has been proven to be effective to reduce the VOC in groundwater at many Sites.

- Short-term Impacts/Effectiveness: The injection of substrate/bio-augmentation in the down gradient area proximate to MW-202 would intercept the impacted groundwater and enhance intrinsic biodegradation processes already observed on-site. The injection program will have some short term impacts to on-site facility operations.

- Implementability: Carbon substrate/microbes suitable for injection at the site are readily soluble in water. The installation process would use conventional drilling techniques.

- Cost - Non-toxic and emulsified vegetable oil is readily available and less expensive than other technologies.

- Land Use – This technology can be implemented without restricting access or use of the treatment area for the current uses (employee parking).

2.4.2 Permeable Reactive Barrier

A permeable reactive barrier (PRB) is a technology which would involve the installation of a trench below the static groundwater table filled with a reactive media such as zero valent iron (ZVI) to intercept the down gradient VOC groundwater plume and chemically (abiotically) transform the contaminants to benign endpoints (ethene, ethane and chloride).

2.4.2.1 Threshold Criteria

- Protection of Human Health and the Environment: A permeable reactive barrier (PRB) is a passive groundwater treatment technology that uses natural processes (iron oxidation) to destroy VOC.

- Compliance with Standards, Criteria and Guidance (SCG): It is anticipated that the in-situ groundwater treatment using a PRB could reduce the VOC concentrations in groundwater in the down gradient area through direct chemical reaction processes to levels below the SCGs.

2.4.2.2 Balancing Criteria

- Long Term Effectiveness Permanence: Destruction of most chlorinated compounds is possible if sufficient groundwater residence time with the reactive media within the PRB. A PRB is a permanent technology intended to reduce VOC in the groundwater that passes through the structure for many years.

- Reduction of Toxicity, Volume and Mobility: The treatment process is dependent upon the controlled movement of groundwater through a permeable reactive barrier (PRB) to chemically react with the groundwater to reduce the toxicity, mobility and volume of contaminants. However, groundwater can bypass the PRB if the PRB becomes less permeable than the surrounding formation and would not be as certain as the preferred alternative to reducing the contaminants.

- Short-Term Impacts/Effectiveness: With the low hydraulic conductivity of the groundwater bearing unit at the site, it is anticipated that the installation of a PRB in the down gradient area proximate to MW-202 could destroy the VOCs in groundwater. However, interruption of facility business operations is required during installation and thus, it is not a favored technology.

- Implementability: This alternative would require the installation of a trench below the groundwater table to create the permeable reactive barrier (PRB). The installation process would have significant adverse impacts on facility operations. The depth and width of the PRB needed to provide effective treatment would need to be determined.

- Cost: Installation cost is highly variable and more expensive than the preferred alternative due to fluctuating prices for the reactants (ZVI). Additional costs would include additional parameters of analysis as part of the current monitoring program.

- Land Use: After installation, this technology could be implemented without restricting access or use of the treatment area for the current land uses (employee parking).

2.5 Ex-Situ Groundwater Treatment (Pumping and Treatment)

Ex-situ groundwater treatment includes the installation of groundwater recovery wells between the source are and MW-202 to pump the groundwater and prevent offsite migration.

2.5.1 Pumping & Treatment

This alternative would involve the installation of pumping equipment proximate to the property line near MW-202 that would draw down the water table at the location inhibiting offsite migration of impacted groundwater with conveyance to the facility for treatment of VOC concentrations and discharge to the sewer for additional offsite treatment at the local Public Operating Treatment Works (POTW). This alternative would require additional ongoing operational monitoring for discharge permit compliance and maintenance of the mechanical systems.

2.5.1.1 Threshold Criteria

- Protective of Human Health and Environment: The pumping and treatment system would mitigate the migration of any impacted groundwater and the groundwater will be pumped to the surface and discharged to the sewer following treatment. This would be a closed system. However; the potential for exposure to the VOC is greater than with alternatives that do not generate waste water.

- Compliance with Standards, Criteria and Guidance: Pumping with treatment would reduce the concentration of VOC in groundwater but will not achieve the SCG.

2.5.1.2 Balancing Criteria

- Long-Term Effectiveness and Permanence: Pumping and treatment requires the design and installation of mechanical and/or electrical components. Such equipment has the potential to malfunction/breakdown and will require maintenance and permits will be required for discharge of generated wastewater to the sewer.

- Reduction of Toxicity, Mobility or Volume: While this technology wcould be effective at controlling impacted groundwater mobility, it will not reduce the toxicity, or volume of VOC in groundwater.

- Short-term Impacts and Effectiveness: The installation of the pumping wells, transfer piping and ex-situ treatment/discharge system will adversely impact the facility business operations and it is not likely that pumping will significantly reduce VOC concentrations in the short-term.

- Implementability: The pump and treatment system would require the installation of recovery wells, design and construction of transfer piping and discharge system, and construction to house system components. The system would require periodic maintenance including replacing filters, and treatment media.

Given the site soil conditions, a pump test would need to be performed prior to implementation to assess feasibility and effectiveness.

- Land Use and Cost: This alternative would not alter the current land use of the site, however it will require the construction of a structure to house pumping equipment and conveyance piping back to the building for sampling, treatment and discharge to the sanitary sewer. Additional costs not required of the other technologies evaluated, would include pumping test, installation of recovery wells, piping and discharge equipment. Additional costs to inspect and maintain the system, and dispose of treatment media and filters would also be incurred.

3. PREFERRED ALTERNATIVE

3.1 Alternative 3 - In-Situ Groundwater Treatment – Emulsified Vegetable Oil (EVO) Injection

Based on the evaluation of the site conditions, remedial objectives and the applicable technologies for the mitigation of the VOC impacted groundwater, the focused injection of EVO in a barrier design between the source area treatment zone and MW-202 is the alternative that most meets the NYSDEC DER-10 threshold and balancing criteria, if further action is required.

In-situ enhanced anaerobic bioremediation is a remediation approach for groundwater impacted with VOC and their associated breakdown products. The alternative includes the injection of an organic carbon substrate to stimulate bacterial growth that produces molecular hydrogen for anaerobic respiration of the VOC. Readily available organic carbon substrates include food grade materials such as vegetable oils, lactic acid, molasses, chitin, and cheese whey. Based on the soil conditions at the Site, emulsified non-toxic vegetable oil (EVO) was determined to be the most appropriate carbon substrate.

The injected emulsified vegetable oil (EVO) will adhere to the soil particles and the resulting fermentation process will produce hydrogen and low molecular weight fatty acids. The primary objective of the EVO injection is to stimulate the growth of dechlorinating bacteria in the subsurface. However, since the rate of biodegradation is directly related to the dechlorinating bacteria population, a consortia of bacteria available from a commercial vendor will also be injected into the treatment area after in-situ (anaerobic) conditions have been established.

Figure 1 presents a conceptual layout of the EVO injection program with locations that can be accessed in the future for the introduction of appropriate microbial consortia to further enhance the anaerobic respiration of the VOC detected in groundwater at the Site.

REFERENCES

1. "Site Management (SM) Periodic Review Report (PRR) Response Letter, 711 North Road (Cooper Vision), Scottsville, Monroe County, Site No.: V00175" dated April 16, 2013, prepared by New York State Department of Environmental Conservation.

2. "2012 Periodic Review Report, CooperVision, 711 North Street, Scottsville, New York," dated 28 January 2013, prepared by Haley & Aldrich of New York.

3. "Revised Site Management Plan, CooperVision, Inc., Scottsville, New York, VCA Site #V00175" dated 16 June 2010, prepared by Haley & Aldrich of New York.

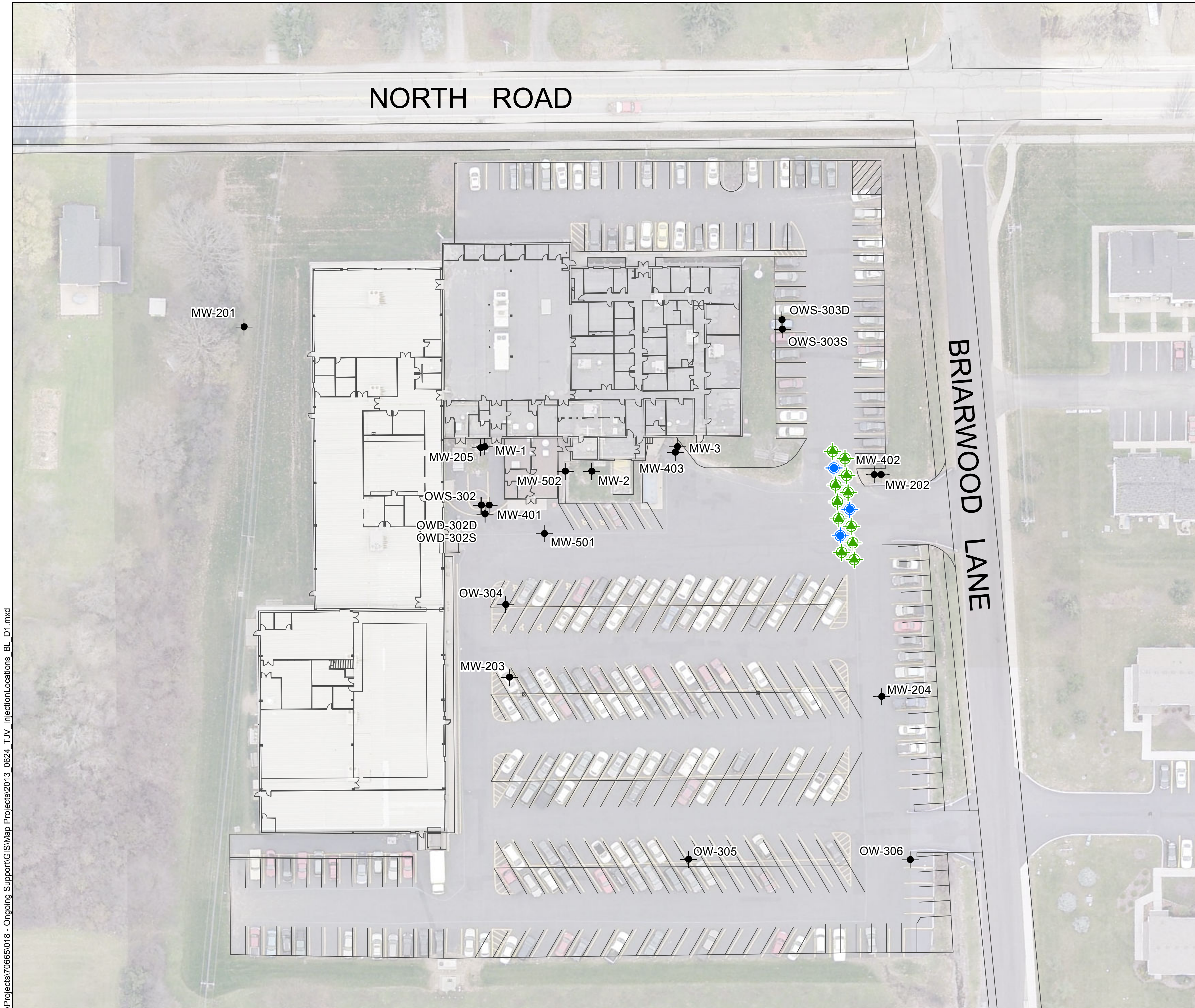
4. "Report on Revised Final Engineering Report, CooperVision, Inc., Scottsville, New York," dated 16 June 2010, prepared by Haley & Aldrich of New York.

5. "DER-10 - Technical Guidance for Site Investigation and Remediation", NYSDEC Division of Environmental Remediation, May 2010

TABLE 1
REMEDIAL ALTERNATIVES ANALYSIS MATRIX
COOPERVISION VCA SITE #V00175
SCOTTSVILLE, NEW YORK

		No Further Remedial Action		In-Situ Treatment		Ex-Situ Treatment
	Treatment Option	Monitoring Existing Soil Vapor Points	Install Additional GW Monitoring wells in Right-of-Way	Injection of Carbon Substrate and/or bio-augmentation consortia	Install and Operate a Permeable Reactive Barrier (PRB)	Pumping and Treatment
Threshold Criteria	Protective of Human Health & Environment	✓ The primary route of exposure to human receptors is from contaminated soil vapor as groundwater is not used for potable, or industrial purposes. Soil vapor data can be used to assess the potential for adverse impact to adjacent properties from contaminated soil vapor.	✓ Groundwater is not used for potable, or industrial purposes in the vicinity. Additional monitoring wells installed within the Right of Way of Briarwood Lane will assess the potential for impacted groundwater to adversely affect adjacent properties.	✓ Onsite groundwater is not used for potable or industrial purposes. The carbon substrate injection/bio-augmentation will enhance the attenuation of the VOC impacted groundwater to mitigate the potential for offsite impacts.	✓ Onsite groundwater is not used for potable or industrial purposes. The Permeable Reactive Barrier (PRB) will breakdown the VOC in groundwater to mitigate the potential for offsite impacts.	✓ Onsite groundwater is not used for potable or industrial purposes. The pumping and treatment system will mitigate the migration of impacted groundwater. Impacted groundwater will be pumped to the surface and discharged to the sewer following treatment (if necessary). The potential for human and environmental exposure to VOC is greater than in-situ remedial alternatives that do not generate waste water.
	Compliance with Standards, Criteria, and Guidance (SCGs)	✓ VOCs historically detected in the soil vapor are breakdown products of the parent compound (1,1,1-TCA) present in groundwater. The VOC concentrations are decreasing in the mid-gradient area. As such, it is anticipated that the VOCs detected in soil vapor in the downgradient area will attenuate and decrease and achieve the SCG.	✓ VOCs detected in the groundwater on-site are breakdown products of the parent compound (1,1,1-TCA) present in the source area. The concentration of VOC are decreasing in the mid-gradient area. As such, it is anticipated that the VOCs detected in the downgradient groundwater will continue to attenuate and decrease over time and achieve the SCG.	✓ Injection of carbon substrate/bio-augmentation consortia will likely enhance the reductive dechlorination process already observed at the site and reduce the timeframe to achieve the SCG.	✓ It is anticipated that a PRB will reduce the VOC concentrations in groundwater in the downgradient area where groundwater passes through the barrierand reduce the timeframe to achieve the SCG.	✓ VOCs will naturally attenuate and degrade. Groundwater pumping will control impacted groundwater migration by pumping, but will not achieve the SCG.
Balancing Criteria	Long-Term Effectiveness and Permanence	*Neutral* Periodic monitoring is a component of the Site Management Plan (SMP) at the site and can effectively address the potential of offsite migration of contaminated soil vapor. If offsite contaminated soil vapor migration is identified, additional remedial options can be considered and implemented.	*Neutral* Periodic groundwater monitoring is already a part of the approved SMP at the site. Monitoring however does not address potential offsite migration of impacted groundwater. If offsite groundwater impacts are identified, additional remedial measures can be considered and implemented.	*Positive* Injection of carbon substrate is a proven long-term effective technology at the site for the source and midgradient areas, and it is anticipated that it will reducing VOC concentrations in groundwater.	*Positive* PRBs have been an effective technology for reducing VOC concentrations in groundwater at similar sites. Long-term effectiveness is dependent upon adequate contact time with impacted groundwater.	*Neutral* Pumping and treatment requires the design and installation of long-term mechanical and/or electrical components. Such equipment has the potential to malfunction/breakdown and will require routine maintenance. While this technology is effective at controlling groundwater migration over the long-term, it will not likely reduce VOC concentrations.
	Reduction of Toxicity, Mobility or Volume	*Negative* Additional soil vapor monitoring does not contribute to enhanced or additional reduction of VOC toxicity, mobility or volume beyond intrinsic processes already in place.	*Negative* Additional groundwater monitoring does not contribute to enhanced or additional reduction of VOCs in the groundwater beyond natural attenuation.	*Positive* In addition to natural attenuation of VOCs with time, areas that are within the area of injection are anticipated to exhibit accelerated reduction in VOC toxicity and volume . The injection process does however have the potential to increase solubilization/mobilization of the VOCs within the subsurface.	*Positive* A PRB installed with a reactant such as zero valent iron (ZVI) will chemically react with VOCs and reduce their toxicity, mobility and volume. Hopwever, impacted groundwater could migrate around the PRB and evade treatment . This condition would be assessed through continued groundwater monitoring around the PRB.	*Neutral* Pumping groundwater will reduce the mobility of impacted groundwater however given the geology of the region (dense glacial till) and relatively low concentrations of VOCs, it is not likely that pumping and treatment will contribute to significant reduction of VOC toxicity or volume.
	Short-Term Impacts and Effectiveness	*Neutral* Monitoring would occur to assess potential for offsite exposure. Additional soil vapor monitoring points and sampling activities will not have ant short term impacts on site activities. However, if offsite impacts are identified, additional remedial measures would need to be considered.	*Neutral* Monitoring would occur to assess potential for offsite exposure. The installation of additional groundwater monitoring wells could have short term adverse impacts on site activities and adjacent properties.	*Positive* The injection of substrate/bio-augmentation in the downgradient area proximate to MW-202 would intercept the impacted groundwater and enhance intrinsic biodegradation processes already observed on-site. The injection program will have some short term impacts to on-site facility operations.	*Positive* The installation of a PRB in the downgradient area proximate to MW-202 would effectively treat the mass of impacted groundwater and destroy the VOCs in groundwater. The PRB installation process will have some adverse short term impacts to on-site faciltiy operations.	*Neutral* Given the geology of the region (dense glacial till) and relatively low concentrations of VOCs, it is not likely that pumping and treatment will not reduce VOC concentrations in the short-term. However, it would be effective in mitigating potential impacted groundwater migration. The installation of the pump and treat system will have significant short term impacts on facility operations.
	Implementability	*Positive* Permanent soil vapor points were installed in the right-of-way during the remedial investigation. Provided those points are still viable, no additional installation activities would be needed. Offsite soil vapor monitoring would require obtaining access agreements from the Town of Wheatland and adjacent property owners/tenants.	*Positive* Installation of additional monitoring wells in the right-of-way can be implemented using conventional drilling equipment without interruption of normal site activities. The additional wells can be monitored during regularly scheduled monitoring events but would require access agreements from the Town of Wheatland and adjacent property owners for well installation and sampling.	*Neutral* Carbon substrate/microbes suitable for injection at the site are readily available. The installation process would require the use of conventional drilling techniques.	*Negative* The reactant (ZVI) is an engineered material and the installation process to create the PRB would require excavation of soils to a depth of approximately 20 feet below ground surface.	*Negative* Implementation of an ex-situ treatment system requires installation of recovery wells, design and construction of a treatment system, and availability and procurement of treatment media as well as some limited construction to house system components.The system will require periodic maintenance including replacing filters, and treatment media. Given the site soil conditions, a pump test would need to be performed to assess feasibility and effectiveness.
	Cost	*Positive* Additional costs incurred to sample the existing soil vapor points during a regularly scheduled monitoring event would be in the order of $5,000 per sampling event for labor, laboratory analysis and reporting. Installation of additional soil vapor points would be an additional $3,000 to $5,000 depending on the location and number of points.	*Positive* Additional costs incurred to install additional monitoring wells (3 are assumed) in the right-of-way would be approximately $7500. Additional O&M costs to sample the additional wells would be approximately $500-$1,000 per sampling event.	*Neutral* Costs incurred to inject substrate would be on the order of magnitude of $75,000. Limited additional costs would include performance monitoring as part of the current monitoring program.	*Neutral* Costs incurred to assess soil conditions and install the PRB would be on the order of magnitude of $120,000. Installation cost is highly variable due to fluctuating material costs (ZVI). Additional costs would include performance monitoring as part of the current monitoring program.	*Negative* Costs incurred to assess soil conditions (pumping test), install recovery wells, install treatment system and housing, and procure equipment would be on the order of magnitude of $165,000. Additional proposed O&M costs to inspect and maintain the system, and dispose of and replace treatment media and filters would be on the order of magnitude of $15,000 per year.
	Land Use	*Positive* This alternative would not alter the current land use of the site, nor would it require additional infrastructure beyond the installation of the additional soil vapor points.	*Positive* This alternative would not alter the current land use of the site, but would require additional infrastructure.	*Positive* This alternative would not alter the current land use of the site. Installation of the injection points and monitoring locations would initially disrupt site activities, however once installed, the site would be returned to its original condition and use.	*Positive* This alternative would not alter the current land use of the site. Construction and installation of the trench would significantly impact site operations, however once installed, the site would be returned to its original condition and use.	*Neutral* This alternative would not alter the current land use of the site, however it may require the additional construction of a shed to house pumping equipment and the maintenace of conveyance piping back to the building for sampling, treatment and discharge to the sanitary sewer.

Assumptions:
1. Soil vapor sampling in the right-of-way will utilize existing soil vapor test points.
2. Cost estimates are order of magnitude for evaluation purposes and subject to change



LEGEND

AUGMENTATION POINT (3)

INJECTION POINT (10-12)

MONITORING WELL LOCATION

NOTES:

1. PLAN BASED ON "ALTA/ASCM LAND TITLE SURVEY MAY" PREPARED BY RONALD W. STAUB LAND SURVEYORS, ROCHESTER, NEW YORK, DATED 17 DECEMBER 1996.
2. EXPLORATION LOCATIONS ARE APPROXIMATE.

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SCALE IN FEET

HALEY & ALDRICH

COOPERVISION FACILITY INVESTIGATION
711 NORTH ROAD
SCOTTSVILLE, NEW YORK

INJECTION OF CARBON SUBSTRATE AND/OR BIO-AUGMENTATION

SCALE: AS SHOWN
JULY 2013

FIGURE 1

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