



Infrastructure, buildings, environment, communications

Michael R. Schmoller  
South Central Region Headquarters  
Wisconsin Department of Natural Resources  
3911 Fish Hatchery Road  
Fitchburg, Wisconsin 53711

Subject:

Groundwater Remediation Summary and Additional Proposed Scope of Work and Cost Estimate, Middleton Cleaners, Middleton, Wisconsin.

Dear Mr. Schmoller:

In accordance with our phone conversation on November 2, 2004, this letter includes a summary of the groundwater remediation activities completed at the Middleton Cleaners site located at 6617-6619 University Avenue, in the city of Middleton, Wisconsin. The carbon injection events described herein have been effective in reducing the volatile organic compound (VOC) concentrations at the subject property.

This letter also includes a recommended scope of work and cost estimate for additional remediation and monitoring activities. ARCADIS has proposed a targeted, one-time carbon injection event near Monitoring Well MW-2 to continue to promote the degradation of VOCs in this area of the site. Also, a limited soil vapor extraction (SVE) event has been recommended on the southern portion of the property near the former dry cleaning shed to remove additional VOCs from the source area.

### Groundwater Remediation Activities

In accordance with our September 12, 2002 letter to the Wisconsin Department of Natural Resources (WDNR) and subsequent conversations, ARCADIS completed the following WDNR-approved scope of work over the period of October 2002 through October 2004.

- Installation of six additional injection wells to depths of approximately 55 feet below ground surface for the injection of the dilute carbon (molasses) solution as part of the groundwater remediation activities. The approximate locations of the injection wells are depicted on Figure 1.
- Coordination and disposal of soil cuttings generated from the well installation activities.
- Completion of four rounds of carbon injection events (injection events eight through eleven) during 2002 and 2003. A 10:1 solution of potable water and molasses (i.e., approximately 10 gallons of water for every 1 gallon of molasses) was injected into the impacted aquifer through the shallow injection wells.

ARCADIS G&M, Inc.  
126 North Jefferson Street  
Suite 400  
Milwaukee  
Wisconsin 53202  
Tel 414 276 7742  
Fax 414 276 7603

ENVIRONMENTAL

Date:  
2 December 2004

Contact:  
Jennine Cota Trask

Phone:  
414 276 7742

Email:  
jcota@arcadis-us.com

Our ref:  
WI000811.0004.00002

Approximately 250 gallons of the dilute molasses solution was injected into each shallow injection well. These events were completed in October 2002, March, June, and August 2003.

- Completion of three additional carbon injection events (injection events 12 through 14) during 2004. A 7:1 solution of potable water and molasses (i.e., approximately 7 gallons of water for every 1 gallon of molasses) was injected into the impacted aquifer through the shallow injection wells. Approximately 470 gallons of the dilute molasses solution was injected into each shallow injection well. These events were completed in March, June, and September 2004.
- Collection of groundwater samples from five monitoring wells (MW-4, MW-1, AGMW-2, MW-2, and AGMW-5) following completion of injection event nine (April 2003) for the analysis of total organic carbon (TOC), VOCs, and methane, ethene, and ethane.
- Collection of groundwater samples from the 15 monitoring wells/piezometers located at the site for the analysis of TOC, VOCs, and natural attenuation parameters was completed in August 2003, following injection event eleven.
- Collection of groundwater samples from four monitoring wells (MW-4, MW-1, AGMW-2, MW-2) following completion of injection Event 12 (April 2004) and injection Event 14 (October 2004) for the analysis of TOC, VOCs, methane, ethane, ethene, and natural attenuation parameters.
- Collection of air samples from four wells to determine levels of hydrogen sulfide and methane at the site was completed in April 2003, following injection event nine, and August 2003, following injection event eleven.
- Collection of air samples from two wells to determine levels of hydrogen sulfide and methane at the site following injection event twelve in April 2004 and injection event fourteen in October 2004.

The purpose of the carbon injection groundwater remediation process is to promote enhanced reductive dechlorination of tetrachloroethylene (PCE), which was the main constituent of concern at the start of the remediation program. The reductive dechlorination process involves the sequential removal of a chlorine atom from a chlorinated VOC, with the substitution of a hydrogen atom. The reductive dechlorination sequence for PCE is presented below:

PCE → trichloroethylene (TCE) → cis-1,2-dichloroethylene (DCE) → vinyl chloride (VC) → ethene → ethane → carbon dioxide and water

The effectiveness of the enhanced reductive dechlorination process is assessed based on concentration changes over time for the parent compound (PCE), relative to the breakdown products. Two key data patterns which indicate effective enhanced

*Use or disclosure of information contained on this sheet is subject to the restriction and disclaimer located on the signature page of this document.*

reductive dechlorination are an appreciable decrease in parent compound concentrations with corresponding short-term increases in intermediate breakdown compounds (e.g. DCE) and the production of non-toxic, innocuous end products (e.g., ethene, ethane, carbon dioxide).

The analytical results through October 2004 are presented on Figure 2. Based on a review of the analytical results, geochemical reducing conditions have developed at the site to promote the degradation of the chlorinated VOCs via reductive dechlorination processes. As shown on Figure 2, the concentration of PCE at the on-site Piezometers (PZ-1, AGPZ-1, AGPZ-2, AGPZ-3, AGPZ-3D, and AGPZ-4) was below the WDNR's Enforcement Standard (ES) at all of the Piezometers during the August 2003 sampling event. Furthermore, the mass of PCE in the shallow on-site Monitoring Wells (MW-1, MW-2, MW-4, AGMW-2, and AGMW-4) has been reduced by 55 percent to 96 percent since groundwater monitoring started at the site in August 1999.

The dramatic change in VOC concentrations at the location of Monitoring Well AGMW-2 confirms that reductive dechlorination is occurring in this area. Prior to the start of the remediation process (carbon injections) in the new injection wells (IW-10 through IW-15) in October 2002, the concentration of PCE at the location of Monitoring Well AGMW-2 was estimated to be 1,300 micrograms per liter ( $\mu\text{g/L}$ ). Over the two year period from October 2002 to October 2004, PCE concentrations at the location of Monitoring Well AGMW-2 decreased approximately three orders of magnitude to a non-detectable concentration ( $<20 \mu\text{g/L}$ ). Based on an estimated 1,300  $\mu\text{g/L}$  initial concentration, this translates to an approximate 96 percent reduction in PCE concentration. As expected, an increase in cis-1,2-DCE concentrations occurred in conjunction with the decrease in PCE concentrations. As the reductive dechlorination sequence continues, the concentration of cis-1,2-DCE will decrease in conjunction with a potential temporary increase in VC concentrations and a subsequent increase in the innocuous end products (ethene, ethane, carbon dioxide).

The groundwater flow across the site is to the east, which is consistent with historical results. Based on the estimated groundwater velocity at the site (75 to 100 feet per year), and the analytical results, the aquifer conditions created by the molasses injections have not yet influenced all of the chlorinated VOC-affected groundwater. Specifically, the groundwater conditions present at Monitoring Well MW-2 during the October 2004 groundwater sampling event show a limited impact from the injection events.

Table 1 presents the field activities completed at the site through October 2004. Fourteen carbon injection events have been completed at the Middleton Cleaners site from April 2001 through October 2004. The concentration trends for chlorinated VOCs and the concentration of organic carbon present were used to evaluate conditions within the aquifer and to evaluate the potential need to modify the current injection frequency. Based on the monitoring program results, it is recommended that an additional injection event be completed in March 2005 to continue to

*Use or disclosure of information contained on this sheet is subject to the restriction and disclaimer located on the signature page of this document.*

promote the degradation of chlorinated VOCs. As noted earlier, VOC concentrations at Monitoring Well MW-2 have remained largely unaffected by the injection program. Based on the recent analytical results and the groundwater velocity at the site, an additional targeted carbon injection event is recommended in the area of Monitoring Well MW-2. Recommended groundwater sampling will be completed in June 2004 to evaluate the need for additional injection events later in 2005.

Although significant success has been achieved at reducing PCE concentrations within the groundwater, it is noted that additional constituent mass is present in the soil. The depth to water at the site is approximately 45 feet. Based on the soil analytical results from the investigation activities completed at the site by Strand Associates, Inc., impacted soils are located in the southern portion of the property, near the former dry cleaning shed. Soil impacts occupy a relatively small area, but extend downward to the water table. These soils represent a continuing source of groundwater contamination. Because the closure requirements of NR 726 include source control, it is recommended that targeted remediation of the affected soils be completed. ARCADIS has developed a short-term, cost-effective method for addressing the impacted soil. It is recommended that a limited SVE event be completed in the area near the equipment building to remove additional mass from the subsurface.

A mobile SVE system will be temporarily parked at the property. All equipment and piping will be aboveground to reduce cost. The system will be operated for approximately 6 months to reduce VOC mass within the soil. Reduction in soil VOC concentration should further improve the results of the groundwater remediation program.

## Scope of Work

Supplemental remediation activities will further reduce constituent mass in the groundwater, address the source area within the soil, and provide additional data to close this project. Based on the above results, ARCADIS proposes the following scope of work:

- Installation of two vapor extraction wells to depths of approximately 35 feet below ground surface (ft bgs) for extraction of soil vapors. The vapor extraction wells will be screened from approximately 10 to 35 ft bgs. Following the installation of the vapor extraction wells, ARCADIS will connect a mobile SVE trailer system to the extraction wells for a period of 6 months. ARCADIS will coordinate with Madison Gas & Electric to supply power to the trailer unit, and with the WDNR to submit a Notification to Treat or Dispose Form for the site. Additionally, ARCADIS will periodically collect air samples from the SVE system to assess the concentration of VOCs discharging to the atmosphere in accordance with NR 419. Air flow readings will also be collected to determine the mass removed from the soil gas. It is anticipated that these activities will be initiated in December 2004.

*Use or disclosure of information contained on this sheet is subject to the restriction and disclaimer located on the signature page of this document.*

- Installation of two soil borings near Monitoring Well MW-2. The soil borings will be drilled to a depth of approximately 50 ft bgs. ARCADIS will then inject approximately 1000 gallons of a 20:1 carbon solution (i.e., approximately 20 gallons of potable water for every 1 gallon of molasses) into each of the open soil borings. Following the one-time injections, the soil borings will be abandoned in accordance with Wisconsin Administrative Code Chapter NR 141 requirements. It is anticipated that these activities will be initiated in December 2004.
- Coordination and disposal of soil cuttings generated from the soil boring and vapor probe drilling activities. It is assumed that one soil sample will need to be collected for characterization and profiling. For cost purposes it is assumed that all soil cuttings will be handled as hazardous waste pending the results of the soil sampling.
- Completion of one additional carbon injection event (injection event 15). A 20:1 solution of potable water and molasses (i.e., approximately 20 gallons of water for every 1 gallon of molasses) will be injected into the impacted aquifer through the shallow injection wells. Approximately 470 gallons of the dilute molasses solution will be injected into each shallow injection well. This event will be scheduled during March 2005.
- Collection of groundwater samples from the 15 monitoring wells/piezometers located at the site for the analysis of TOC, VOCs, methane, ethane, ethene, and natural attenuation parameters in June 2005.
- Upon the completion of field activities, ARCADIS will prepare a letter to the WDNR summarizing the results of the supplemental remediation activities. ARCADIS will also request a meeting with the WDNR to discuss the results of the activities.

## Estimated Costs

The costs to conduct the scope of work described above are estimated to be \$57,950 and are presented in Table 2. The costs for the completion of supplemental investigation and remediation services and the first year of operation, maintenance, and monitoring were included in Tables 1 and 2 of the "*Scope of Work and Cost Estimate, Supplemental Investigation and Remediation Services*" dated February 4, 2000. The original cost estimate was approved by the WDNR. Approximately \$13,200 remains in the original WDNR authorized budget for the site. Therefore, ARCADIS, on behalf of Northern Properties, Inc., is requesting a change order for the additional scope of services presented herein for the amount of \$46,750. These activities will be performed on a time and materials basis in accordance with the existing Services Agreement between Northern Properties, Inc. and ARCADIS. The estimated costs presented herein will not be exceeded without prior authorization from the WDNR in accordance with the Drycleaner Environmental Response

*Use or disclosure of information contained on this sheet is subject to the restriction and disclaimer located on the signature page of this document.*

Program (DERP). It is anticipated that the costs associated with the above scope of work will be reimbursable under the DERP.

**Closing**

Thank you again for your cooperation with this project. Should you have any questions regarding the information contained herein, please feel free to call at your convenience.

Sincerely,

ARCADIS G&M, Inc.



Jennine Cota Trask, PE  
Environmental Engineer



Edmund A. Buc, PE  
Senior Engineer



Michael S. Maierle, PE  
Area Manager

Copies:  
Aubrey R. Fowler – Fowler & Wiederhoeft  
Donald P. Gallo – Reinhart Boerner et al  
Dr. Edward R. Hommel

*This proposal and its contents shall not be duplicated, used, or disclosed—in whole or in part—for any purpose other than to evaluate the proposal. This proposal is not intended to be binding or form the terms of a contract. The scope and price of this proposal will be superseded by the contract. If this proposal is accepted and a contract is awarded to ARCADIS as a result of—or in connection with—the submission of this proposal, ARCADIS and/or the client shall have the right to make appropriate revisions of its terms, including scope and price, for purposes of the contract. Further, client shall have the right to duplicate, use, or disclose the data contained in this proposal only to the extent provided in the resulting contract.*

# ARCADIS

**Table 1. Completed Field Activities, Middleton Cleaners, Middleton, Wisconsin.**

<b>Date</b>	<b>Action</b>
7-18-00 → 7-21-00	Well Installation (Monitoring Wells)
7-24-00 → 7-28-00	Groundwater Sampling (Low-Flow)
9-26-00	Survey Tops of Casing and Groundwater Elevation for Well Installation
12-4-00 → 12-8-00	Well Installation (Injection Wells and Monitoring Wells)
12-12-00 → 12-16-00	Well Installation (Well Nest and Injection Wells)
2-19-01 → 2-21-01	Groundwater Sampling (Well Development, Low-Flow)
3-12-01 → 3-21-01	Groundwater Sampling (Low-Flow, Bennett Pump)
4-5-01	Injection of Molasses (Shallow Wells 25:1, Deep Wells 20:1)
5-7-01	Injection of Molasses (Shallow Wells 25:1, Deep Wells 20:1)
6-4-01	Injection of Molasses (Shallow Wells 25:1, Deep Wells 20:1)
6-18-01 → 6-22-01	Groundwater Sampling
9-10-01 → 9-12-01	Injection of Molasses (All Wells 10:1)
10-8-01 → 10-10-01	Injection of Molasses (All Wells 10:1)
11-5-01 → 11-7-01	Injection of Molasses (All Wells 10:1)
11-12-01 → 11-20-01	Groundwater Sampling (Low-Flow, Bennett Pump)
12-18-01 → 11-19-01	Injection of Molasses (All Wells 10:1)
1-30-02	Groundwater Sampling (Injection Wells)
6-13-02	Groundwater Sampling (Low-Flow, Bennett Pump)
10-22-02 → 10-25-02	Well Installation (Drill and Install Injection Wells IW-10 through IW-15)
10-29-02 → 10-31-02	Injection of Molasses (All Wells 10:1)
2-28-03	Oversee Drum Pick-up
3-24-03 → 3-26-03	Injection of Molasses (All Wells 10:1)
4-8-03 → 4-9-03	Groundwater Sampling (Low-Flow)
4-28-03	Groundwater Sampling (Low-Flow)
6-4-03 → 6-5-03	Injection of Molasses (Shallow Wells Only 10:1)
7-10-03	Check and Repair Damaged Wells
8-4-03 → 8-5-03	Injection of Molasses (Shallow Wells Only 10:1)
8-18-03 → 8-21-03	Groundwater Sampling (Low-Flow)
3-15-04 → 3-17-04	Injection of Molasses (Shallow Wells Only 7:1)
4-13-04 → 4-14-04	Groundwater Sampling (Low-Flow)
6-22-04	Injection of Molasses (Shallow Wells Only 7:1)
9-14-04	Injection of Molasses (Shallow Wells Only 7:1)
10-4-04	Groundwater Sampling (Low-Flow)

# ARCADIS

**Table 2. Cost Estimate for Remediation Activities, Middleton Cleaners, Middleton, Wisconsin.**

**Task 1 - Drilling Activities (Soil Borings & Extraction Wells)**

ARCADIS Services	
Labor	\$3,750
Expenses	\$1,000
Subcontracted Services	
Drilling	\$7,500
Soil Analytical	\$200
Soil Disposal	\$2,800
	<hr/>
Subtotal Task 1	\$15,250

**Task 2 - Soil Vapor Extraction and Air Sampling**

ARCADIS Services	
Labor	\$6,500
Expenses	\$2,000
Soil Vapor Extraction Trailer	\$9,000
Subcontracted Services	
Electricity Permit and Power Drop	\$1,000
Electrician	\$500
Cost of Electricity	\$1,800
Air Analytical (12 samples)	\$1,600
	<hr/>
Subtotal Task 2	\$22,400

**Task 3 - Groundwater Injections (1 Event)**

ARCADIS Services	
Labor	\$2,500
Expenses	\$1,000
Subcontracted Services	
Tanker Truck	\$1,700
	<hr/>
Subtotal Task 3	\$5,200

**Task 4 - Groundwater Sampling (June 2005)**

ARCADIS Services	
Labor	\$7,000
Expenses	\$2,500
Subcontracted Services	
Groundwater Analytical	\$3,600
	<hr/>
Subtotal Task 4	\$13,100

**Task 5 - Reporting and Project Management**

ARCADIS Services	
Labor	\$3,500
Expenses	\$500
	<hr/>
Subtotal Task 5	\$4,000

Total Tasks 1 through 5	<hr/>	\$59,950
-------------------------	-------	----------