

Remedial Work Plan

Midler City Industrial Park Site Brownfield Cleanup

City of Syracuse
Onondaga County, New York

NYSDEC BROWNFIELD SITE # C734103

Prepared for
Pioneer Midler Avenue, LLC

By



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December 2007

Certifications

I certify that the Interim Remedial Measure Work Plan was implemented and that all construction activities were completed in substantial conformance with the Department-approved Interim Remedial Measure Work Plan and were personally witnessed by me or a person under my direct supervision.



Signature: 
Engineer: Robert N. Duclos, P.E.
Registration Number: 070428
State: New York
Date: 12/27/2007

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- The data submitted to the Department demonstrates that the remediation requirements set forth in the remedial work plan and any other relevant provisions of ECL 27-1419 have been or will be achieved in accordance with the time frames, if any, established in the work plan.
 - Any use restrictions, institutional controls, engineering controls and/or any operation and maintenance requirements applicable to the site are contained in an environmental easement created and recorded pursuant to ECL 7 1-3605 and that any affected local governments, as defined in ECL 7 1-3603, have been notified that such easement has been recorded.
 - A Site Management Plan has been submitted by the applicant for the continual and proper operation, maintenance, and monitoring of any engineering controls employed at the site including the proper maintenance of any remaining monitoring wells, and that such plan has been approved by the Department.

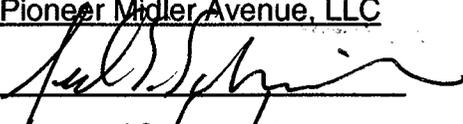
Owner: Pioneer Midler Avenue, LLC
Signature: 
Date: 12/27/07

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DRAFT REMEDIAL WORK PLAN

MIDLER CITY INDUSTRIAL PARK BROWNFIELD SITE

A. Introduction

C&S Engineers, Inc., on behalf of our client Pioneer Midler Avenue, LLC, has prepared this Remedial Work plan for the above-referenced site. This work plan has been developed based on information presented in the Interim Remedial Measure (IRM) report dated October 2007, the Remedial Investigation / Remedial Alternatives Analysis (RI/RAA) report dated October 2007 and the October 19, 2007 letter report concerning indicators of natural attenuation at existing monitoring well MW 13-D.

Data generated for and documented in each of the above-referenced reports culminated in developing the following lines of evidence which indicate natural attenuation is a viable component of the overall remedy for site groundwater.

The term *chlorinated volatile organic compounds* (CVOCs), as used in this work plan, refers to the suite of compounds made up of tetrachloroethene (PCE), trichloroethene (TCE), vinyl chloride (VC), *cis*-1,2-dichloroethene (*cis*-1,2-DCE), and *trans*-1,2-dichloroethene (*trans*-1,2-DCE).

B. Remedial Goals

The remedial goals for this work plan are the following:

- Elimination to the extent feasible potential onsite environmental or public health exposures to on-site contamination that may remain in soil, groundwater, and soil vapor.
- To prevent migration of contamination from the site to the extent feasible.

C. Lines of Evidence Supporting Monitored Natural Attenuation

1. The Midler Avenue City Industrial Park Brownfield Site was occupied by the Prosperity Company, Inc., a manufacturer of industrial dry cleaning equipment. That plant operated from approximately 1940 to 1963 when the plant permanently closed. During the 44 years since the plant closed, the site had remained underutilized. The presence of PCE and TCE in four primary source areas at the site (as documented in the November 2005 Remedial Investigation Data Report and the July 2006 IRM Work Plan) have been attributed to the manufacturing process and testing of dry cleaning equipment, as well as waste management practices during the operation of the plant.
2. Assessment of soil quality data in the July 2006 IRM Work plan indicated the average concentration of chlorinated volatile organic compounds (CVOCs) in the four source areas ranged from 57,745 ug/kg to 18,927,326 ug/kg. However, Pre-IRM groundwater quality data downgradient of those source areas at the southern property line revealed minimal impact by CVOCs.
3. Subsurface investigations performed at the site as documented in the November 2005 Remedial Investigation Data Report and the July 2006 IRM Work Plan revealed that the site is underlain by peat layers or peat mixed with marl. Below that stratum at a depth of approximately 20 to 25 feet is a deposit of clay. Soils above the clay unit were analyzed for Total Organic Carbon (TOC) which revealed an average of 8%, ranging from 3.5% to 19.6%. During subsurface investigation work, a noticeable odor similar to hydrogen sulfide was detected in samples that encountered the peat. The occurrence of the hydrogen sulfide-like odor may be an indicator of anaerobic activity.
4. Analysis of groundwater and contaminant movement documented in the July 2006 IRM work plan, revealed the following conclusions:
 - A general north to south direction of groundwater flow within the peat/marl unit with an average horizontal hydraulic gradient of 0.0122 foot/foot.

- An average hydraulic conductivity of 1.4×10^{-4} cm/sec for the four locations investigated.
- An average estimated linear velocity of groundwater flow in the peat/marl unit of 4.4 feet per year.

Also, the United States Environmental Protection Agency (USEPA) *On-Site On-Line Tools for Site Assessment* was utilized to estimate CVOC transport within the subsurface at the site. That assessment indicates probable rates of migration for the CVOCs ranging from 5 to 330 times slower than the rate of groundwater flow. Based on the existing information developed prior to the IRM, vinyl chloride detected in MW-13D, absent of any further reductive chlorination or dispersion would theoretically reach the southern (downgradient) property line in approximately 63 to 300 years (assuming the migration of vinyl chloride to be approximately 0.18 to 0.86 feet /year).

Hydrogeologic and contaminant transport characteristics identified in the IRM work plan are consistent with the site soil CVOC analytical data which identified four distinct PCE/TCE source areas where concentrations of those constituents in soil were several orders of magnitude greater than in surrounding areas. Outside of those source areas degradation compounds predominate at concentrations that decline with distance from the source areas.

6. One sample from each of three site monitoring wells (MW-3D, MW-11D, and SB-7-1) was collected in October 2005 (using sample kits provided by Microbial Insights of Rockford, Tennessee) to assess the presence of dechlorinating microbes in the site groundwater regime. The samples were analyzed by Microbial Insights for the presence of Dehalococcoides (dechlorinating bacteria) and for functional genes and phylogenetic groups associated with dechlorinating conditions. The data generated indicated the presence of Dehalococcoides and functional genes at each of the wells.
7. As documented in the IRM report dated October 2007, laboratory analysis of vapors created by the in-situ thermal desorption (ISTD) treatment of the three source areas, revealed the presence of PCE and related daughter compounds, including vinyl chloride.

8. Laboratory analysis of groundwater from MW-13D in October 2007 for total *Dehalococcoides* and Vinyl Chloride Reductase (*vcrA*) gene identification, as well as dissolved ethene, was performed by SiRem Laboratory, Guelph, Ontario, Canada. Other inorganic parameters and dissolved methane, as well as VOC contaminant analysis, was performed by Test America. As part of the sampling effort, a variety of field parameters were measured including ORP, dissolved oxygen, and temperature. Those field measurements revealed the following:

- Field ORP was recorded to be – 324 mV.
- Field dissolved oxygen readings in the well were 0 mg/l.
- Temperature of groundwater was 85.6° F. The previous readings taken in September and August 2007 were 90.8° F and 93.6° F, respectively.

The analytical laboratory results as well as the field parameters were then assessed using the screening/scoring procedure shown in USEPA's *Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Groundwater*, dated September 1998. Based on the data from MW-13D it was concluded that there is strong evidence to support anaerobic biodegradation. Table 24 of the Remedial Investigation / Remedial Alternatives Analysis Report provides a calculation of a site score. According to the USEPA's scoring criteria, a site score exceeding 20 indicates that there is strong evidence for reductive dechlorination at the site; the score for the Pioneer Midler Avenue site from the October groundwater sampling at MW-13D is 22.

D. Institutional and Engineering Controls

Other components associated with the remedial action at the Midler Avenue site include Institutional Controls (ICs) and Engineering Controls (ECs). Detailed information regarding the ICs and ECs for the Midler Site can be found in the *Site Management Plan* and the *Remedial Investigation and Alternatives Analysis Report*. Institutional Controls will include deed

restrictions and/or covenants that will restrict the use of the property to commercial/industrial. Additionally, the withdrawal and use of groundwater from beneath the site will be prohibited as well. The Midler site is currently being redeveloped, which includes new buildings, parking, and landscaped areas. To the extent reasonable, surfaces outside of the building footprints are to be paved or covered with conventional asphalt or concrete. Areas beneath the asphalt and/or concrete pavement are to receive one foot of clean Type 1 or 2 crushed limestone from an approved Quarry (i.e. T. H. Kinsella, Hansen). Areas outside of buildings and paved areas will receive either a combination of clean crushed limestone fill, and/or clean topsoil to a depth of one foot. The clean crushed limestone fill and/or topsoil will be maintained to avoid direct contact with pre-existing urban fill material and native soils.

With regard to ECs, each building currently under construction or constructed in the future will have an active subslab depressurization system (SSDS) as well as an HVAC system that normally creates a positive pressure within the building envelope. Design of the SSDS at each existing and future building will be consistent with the New York State Department of Health (NYSDOH) *Guidance for Evaluating Soil Vapor Intrusion in the State of New York* dated October 2006. In addition, the entire site will be covered with a combination of buildings, paving, crushed limestone, and landscaping/top soil.

Details pertaining to ICs/ECs will be presented in the Operation, Maintenance, and Monitoring Program consistent with the requirements of the New York State Department of Environmental Conservation (NYSDEC) DER-10, Section 6.

E. Groundwater Remedial Action

The following table summarizes the proposed quarterly monitoring program. Details are provided below.

Wells to be sampled quarterly	MW-2D, MW-9D, MW-10D, MW-12R, MW-13D, MW-14D, MW-15D, MW-16D	
Parameters	Volatile organic compounds Temperature Dissolved oxygen Ferrous iron Dissolved inorganic carbon Dissolved organic carbon Dissolved methane Dissolved ethane	ORP pH Ferric iron Total Iron Sulfate Sulfide Dissolved ethene Microbial analysis

Given the data and conclusions presented in the reports cited above, as well as supporting lines of evidence, a means to implement a monitored natural attenuation program is required. The elements of the proposed Groundwater Remedial Action are:

- Installing one new groundwater monitoring well (proposed monitoring well MW-14D) south (downgradient) of the former B-1 thermal treatment area and situated near the former temporary monitoring well SB-13-2;
- Installing a second new groundwater monitoring well (proposed groundwater monitoring well MW-16D) south (downgradient) of the former B-3 thermal treatment area and situated near the former temporary monitoring well SB-12-1; and
- Installing a third new monitoring well (proposed groundwater monitoring well MW-15D) south (downgradient) of existing monitoring well 13-D at a location as close as practical to the southern property line.
- Development of rate constants relative to estimations of time required to achieve remedial goals, and to tracking changes within the CVOC plumes. Further discussion of rate constants is provided in Section G of this work plan.
- Implementing the monitoring plan.

New Groundwater Monitoring Wells

Figure 1 shows the approximate location of each of the three proposed new monitoring wells, numbered “MW-14D”, “MW-15D”, and “MW-16D”. Final location will require consideration of accessibility and security and will be agreed upon via consultation between Pioneer Midler Avenue, LLC and NYSDEC.

Each of the new wells will be installed so that the bottom of the screened interval will be at the top of the clay unit which is anticipated to be approximately 18 to 22 feet below ground surface. Characterization of lithology above the top of the clay unit, as well as confirmation of the depth to the clay, will be accomplished by hollow stem augers and continuous split spoon sampling. Soil samples retrieved by the split spoon sampler will be visually examined with regard to color, moisture content, and visual evidence of discoloration. Additionally, the soil samples will be screened for the presence/absence of volatile organic vapors via conventional headspace techniques using a photoionization detector equipped with a 10.6 eV lamp.

Once the top of clay unit is reached in each borehole, the monitoring well will be constructed using a 10 foot section of 2-inch diameter 10-slot well screen with sufficient 2-inch diameter PVC riser to complete the well. The sand pack placed around the well screen will consist of '0' grade quartz sand and will extend approximately 1 to 2 feet above the top of screen. A minimum of 2 feet of bentonite will be placed on top of the sand pack and the remainder of the annular space will be grouted back with a Portland cement bentonite mixture. Depending on the location of a particular well, the use of steel protective casing or a flush mount curb box will be used to finish the installation. Consistent with previous work at the site, the location and elevation of the new wells will be surveyed and incorporated into an updated site plan which shows all existing and viable monitoring wells.

Fluids and solids generated by drilling operations will be containerized for future characterization and disposal. All downhole tools will be decontaminated using a high-pressure, low-volume hot water wash. Those fluids will be containerized as well.

Each new well will be developed by alternating surging and pumping procedures using an automated Waterra system or other suitable motorized pump. Surging will be accomplished through the use of a surge block for several minutes followed by pumping at least one well volume of fluids. The surging and pumping routine will be completed for 12 cycles.

During the well development efforts, removed fluids will be containerized and the following will be recorded:

- Beginning and end time of surging.
- Water level before and after pumping.
- Beginning and end time of pumping.
- Turbidity at beginning and end of pumping.
- Elapsed time for the well to recover to 90% of pre-pumping levels, or, should the well be slow to recover, then the percent of recovery that is attained in five minutes.
- Estimated volume of fluids removed from the well during each pumping event.

Consistent with previously approved site procedures, turbidity samples may be archived in clear glass jars and re-agitated prior to measurement. Should the samples be highly turbid, visual comparison to previously obtained samples will be used in lieu of a nephelometer. If after the completion of 12 surge/pump cycles there is no discernable decrease in turbidity (visual or by nephelometer) then development efforts will cease.

Existing Groundwater Monitoring Wells

Existing monitoring wells MW-2, MW-2D, MW-7, MW-8, MW-9D, MW-10D, MW-12R, and MW-13D (locations shown on Figure 1) are assumed to be viable, although it is expected that minor repairs and new curb boxes will be required after final site grades are established. Of those wells, MW-2D, MW-9D, MW-10D, MW-12R, and MW-13D will be included in the MNA program. Each of these monitoring wells will be sampled and analyzed for the same laboratory and field parameters as the three new wells. Groundwater level measurements recorded at the existing wells will be incorporated with measurements from the three new wells as to facilitate the making of an updated groundwater contour map.

We propose to abandon RI monitoring wells MW-2, MW-7, MW-8, each of which:

- is not within or downgradient of a former source area;
- was not installed to the “top-of-clay”;
- has been sampled three times during the RI; and
- has exhibited no VOC impacts exceeding Class GA Groundwater Standards.

Sampling and analysis

Once well development is complete, each well will be sampled using low flow techniques. If sampling occurs more than 24 hours after well development, the well will be purged a minimum of three well volumes. Analysis is as described in the table above. The Health and Safety Plan for the previously completed Remedial Investigation will be used for this work.

F. Evaluation of Groundwater Data

Groundwater data (quality and water level) will be tabulated and accumulated after each quarterly round of sampling. Chemical constituent degradation products (e.g., vinyl chloride, ethene) detected in groundwater samples will be the primary means to assess the progress of natural attenuation. That data will also be used to establish and refine theoretical rate constants described in the following section of this work plan. Parameters that are indicative of natural attenuation (ORP, dissolved ethene, etc.) will also be monitored to help detect changes in environmental conditions that may indicate a reduced efficacy of natural attenuation. The overall objective of this effort is to demonstrate that natural attenuation is occurring according to expectations.

G. Establishment and Evaluation of Rate Constants

Introduction

The NYSDEC has expressed concern regarding the levels of vinyl chloride in groundwater at monitoring well MW-13D. Concentrations of VC have increased at this location while levels of other CVOCs have declined. This trend, further evidence of the dynamic conditions associated with thermal treatment, is shown in the following table.

Parameter	Concentration (µg/l)	
	08/23/07	10/11/07
PCE	100 U	2,000 U
TCE	100 U	2,000 U
cis-1,2 DCE	1,600	560 J
trans-1,2-DCE	96 J	2,000 U
VC	16,000	21,000

This section discusses the development of a degradation rate constant for vinyl chloride. This value, when compared to the contaminant flow rate, will be used to assess whether the vinyl chloride is breaking down into relatively harmless compounds faster than it is moving towards the property line.

Rate Constants During ISTD Cool-Down

During thermal remediation, the rate of change of CVOC concentrations in groundwater with respect to time is accelerated far beyond that which could be achieved under natural conditions. That rate could be calculated from pre-IRM and post-IRM groundwater CVOC concentrations within a thermal treatment zone (MW-12R) at this site. Such a calculation would be useless for purposes of MNA. Outside the thermal treatment areas, dynamic thermal conditions have varied considerably whether considered spatially or temporally and, in our opinion, would be associated with fluctuating rates of reductive dechlorination. Tracking these data during the cool-down period, could offer insights into the temperature sensitivity of various components of natural attenuation, but would also be of negligible value with respect to long-term assessment of the MNA program.

Development of Site Specific Rate Constant

USEPA provides guidance with respect to development and use of rate constants in their November 2002 Ground Water Issue *Calculation and Use of First-Order Rate Constants for Monitored Natural Attenuation Studies* (EPA/540/S-02/500). Page 14 of that document provides a “Key Point” associated with the use of data to project the time required to reach a clean-up goal, which states: “...First, an appreciable record of long-term monitoring data must be available to make a statistically valid projection of the rate of monitored natural attenuation. As a practical matter, it is difficult to extract rate constants that are statistically significant with

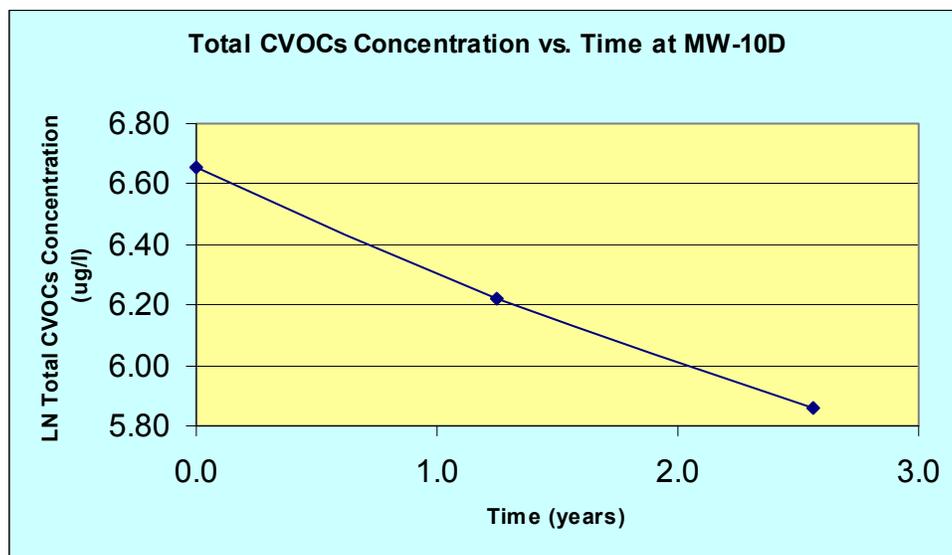
fewer than six sampling dates or with a sampling interval of less than three years. Second, it is unrealistic to expect just a few years of monitoring data to accurately predict plume behavior several decades into the future. Third, it is important to realize that these estimates are merely estimates and that the true rate may change over time.” The following rate constant calculation for the Pioneer Midler Avenue site is provided with deference to the above guidance.

Since the preponderance of applicable site groundwater data are from locations directly affected by thermal treatment, we selected downgradient monitoring well MW-10D to calculate a preliminary concentration vs. time rate constant. The following table and graph provide analyses associated with “Total CVOCs” for MW-10D, as derived from the three RI sampling events:

Rate Constant Calculation for total CVOCs at MW-10D

Sample Date	Totals CVOCs (ug/l)	LN (conc)	Time (days)	Time (years)
1/31/2005	778	6.66	0	0
5/2/2006	502	6.22	456	1.25
8/23/2007	351	5.86	934	2.56
Target concentration	2	0.69		19.19 (theoretical)

$$k = -0.31074$$



The above analysis indicates a rate constant of -0.311 and an anticipated time of 19.2 years to achieve a CVOC concentration of 2 µg/l (Class GA groundwater standard for vinyl chloride) at MW-10D.

For comparison purposes, the expected time for groundwater to reach a concentration of 2 µg/l was also estimated using the half-life of VC based on the USEPA publication *Calculation and Use of First-Order Rate Constants for Monitored Natural Attenuation Studies*. In that report, the half life of vinyl chloride was reported to be between approximately 60 and 625 days. Using a conservative half-life value of 520 days, the concentration after 19 years would be expected to 2.1 µg/l.

For reasons stated in the above USEPA reference, this result, while instructional, would not appear to be statistically significant. However, using two different means for determining the rate constant for VC resulted in similar values, giving some validity to the resultant values.

In the previously submitted *Interim Remedial Measure Work Plan*, calculations of VC transport rates were provided based on information from the USEPA *On-line Tools for Site Assessment Calculation* web site. That information indicated that VC would be expected to migrate at a rate of approximately 0.44 feet per year. Monitoring well MW-13D is located 55 feet from the Midler site property line. C&S performed a similar evaluation utilizing a range of Total Organic Carbon (TOC) values instead of an average value. Twelve subsurface soil samples were analyzed for TOC. The range of data for these twelve samples was 3.6% to 49.8% TOC, with an average of 10.80. Consistent with the Geologic report, and because of the high standard deviation, the low and high values were dropped resulting in a new range of 3.5% to 19.6% with an average of 8.0. The table below shows CVOC velocities for the different (minimum, mean, maximum) TOC concentrations.

Parameter	CVOC velocity in feet/year		
	Low (TOC = 3.5%)	Mean (TOC = 8.0%)	High (TOC = 19.6%)
PCE	0.07	0.03	0.01
TCE	0.23	0.10	0.04
DCEs	0.24	0.11	0.04
VC	0.86	0.44	0.18

Based on these values, movement of VC at MW-13D would be expected to take approximately 63 to 300 years.

In summary, it appears that, based on literature values, theoretical values, and available site data, the VC found at MW-13D would be completely degraded decades before it could move off-site. This analysis does not consider potential recharge of VC via partitioning or dechlorination pathways (which would increase the time period to achieve clean-up goals) or accelerated dechlorination during the cool-down period (which could decrease the period). Analytical data from MW-13D indicate that parent compounds are not present. Soil verification data from the 3D area indicate an average of 2,851 ppb PCE approximately 25 feet away.

MNA Site Specific Rate Constants

A preliminary rate constant will be calculated during the cool-down period sampling events (likely the first two to three quarterly events) under the MNA program. After groundwater temperatures in all monitoring wells vary by no more than five degrees Fahrenheit, ensuing data will be used to develop a site-specific rate constant and to assess long-term expectations associated with the MNA program, as described below. At the conclusion of two years of quarterly sampling, those data may be statistically significant with respect to long-term site trends.

After the site returns to static conditions, rate constants associated with specific CVOC parameters and three of the former source area CVOC plumes (B-1, B-3, and MW-3D), will be established. To establish those rate constants, CVOC data from the following well sets will be evaluated:

Former Source Area	Monitoring Well Sets
B-1	MW-14D / MW-9D
B-3	MW-12R / MW-16D & MW-10D
MW-3D	MW-13D / MW-15D

Consistent with the methodology set forth in USEPA's November 2002 Ground Water Issue Calculation and Use of First-Order Rate Constants for Monitored Natural Attenuation Studies (EPA/540/S-02/500), the following will be calculated:

- A concentration versus time rate constant for each sampling point (monitoring well); and
- A concentration versus distance (bulk attenuation) rate constant for each well set/pair.

Application of these constants will be used to develop estimates of the time required to achieve site remedial goals and to assess whether the attenuating plumes are expanding or contracting.

H. Monitoring Program and Decision Points

Within 30 days of NYSDEC approving this Remedial Work Plan, each of the new and existing monitoring wells will be sampled and analyzed as described above. Subsequent sampling events will occur on a quarterly basis for a period of two (2) years after the first event is completed.

Once the quarterly data is received, it will be summarized in tabular form and submitted to the NYSDEC. After the first four (4) quarters of data has been generated, an annual report will be prepared. That first annual report will:

- Document the site activities of the previous 12 months including installation of the new well and in-situ hydraulic conductivity testing.
- Summarize groundwater quality data in tabular form.
- Include refined rate constants using actual site data.

- Identify trends in geochemical or microbial changes.
- Assess the apparent efficiencies of natural attenuation.
- Provide recommendations for adjustments in the sampling program.

After the second year of groundwater monitoring is complete, a report similar to the first annual report will be prepared. In the event the data presented in the second annual report indicates inconclusive trends of dechlorination, then the quarterly groundwater monitoring program will continue for another year.

Conversely, if data from the preceding six (6) quarters demonstrates a progression of continued reductive dechlorination, the frequency of sampling and the number of monitoring wells included in the program may, after consultation with and approval of NYSDEC, be reduced.

If at the end of the third year, it is determined that dechlorination is not progressing, then Pioneer will evaluate continued monitoring and the feasibility of additional remedial measures that could be implemented to enhance degradation of CVOCs. Subsequently, the selection and implementation of additional measures and the monitoring program will be subject to review and approval by the NYSDEC.

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