LONG TERM GROUNDWATER MONITORING PLAN
DUPONT NECCO PARK
NIAGARA FALLS, NY

Date: April, 2005

Project No.: 18983203
DuPont No.: 7410

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1.0 INTRODUCTION

This Long-Term Groundwater Monitoring Plan (LGMP) has been developed for groundwater monitoring of the A-zone overburden and bedrock flow zones (B- through F-zones) at the DuPont Necco Park landfill located in Niagara Falls New York. This LGMP also addresses EPA comments concerning performance monitoring of the A-zone as described in the letter from EPA dated August 8, 2003.

This plan was prepared pursuant to Administrative Order (AO) Index No. II CERCLA-98-0215 dated September 28, 1998 issued by the United States Environmental Protection Agency (USEPA). Specifically, this plan describes monitoring required to evaluate the effectiveness of the groundwater extraction system in meeting the Performance Standards included in the Statement of Work (SOW), attached as Appendix B to the AO. In accordance with Section F.2.f of the SOW, the objective of the long-term monitoring is to evaluate groundwater quality in the source area and far-field through chemical analysis of groundwater samples and monitoring of hydraulic heads to evaluate extraction effectiveness. The monitoring will be implemented when the groundwater extraction system is operational.

This plan includes:

- ❑ Site description and background
- ❑ Site geology and hydrogeology
- ❑ Description of performance monitoring specific to assessing the effectiveness of B/C-zone pumping in controlling the A-zone source area including the installation of additional A-zone piezometers
- ❑ Description of performance monitoring, consisting of hydraulic and chemical measurements, to evaluate the effectiveness of the extraction system in achieving source area control in the A- through F-zones
- ❑ Description of the ongoing DNAPL observation and removal program

The existing well/piezometer network supplemented with additional A-zone piezometers (see below) will be used to meet the objectives of the LGMP. The hydraulic and chemistry data will be used to assess the extent of hydraulic control.

Detailed field and laboratory QA/QC program and analytical methods are described in the Necco Park Quality Assurance Project Plan. The Quality Assurance Project Plan (QAPP) was provided as Appendix A of the Necco Park Remedial Work Plan (RDWP, CRG, 2000).

This LGMP is dynamic in that modifications to monitoring locations may be made based on monitoring results and or performance of the extraction system. Changes to the LGMP will be documented in addenda to this plan.

2.0 SITE BACKGROUND

The DuPont Necco Park site is located approximately 1.5 miles north of the Niagara River in a predominantly industrial area of Niagara Falls, New York. Necco Park is a 24-acre inactive industrial waste disposal site that was originally used as a recreational park by the Niagara Electrochemical Company (from which Necco is derived). Necco Park is bounded on three sides by disposal facilities. Immediately north and east of the site lies the Newco solid waste landfill, an active Subtitle D facility owned by Allied Waste. Immediately south of the site are three inactive hazardous waste landfill cells and a wastewater pre-treatment facility owned by CECOS International, Inc. An access road and a CSX right-of-way bound the site to the west. Land in the vicinity of the site is predominately zoned for commercial or industrial use. Several major manufacturing facilities are located within one mile of the site, and two manufacturers – Durez Chemical and the Carbide/Graphite Group (formerly Airco Carbon) - are 2,000 feet and 300 feet from the site, respectively. The nearest residential neighborhoods are located approximately 2,000 feet to the south and 2,500 feet to the west.

As part of the initial investigations conducted at the site, an operational history for the site from the mid-1930s to 1977 was developed based on records and an interpretation of historic aerial photographs. During that period, the site received a number of liquid and solid wastes generated from a variety of processes operated at the nearby DuPont Niagara Plant. These wastes included flyash, sodium salts and cell bath residue (i.e., barium, calcium, and sodium chlorides), cell and building rubble, chlorinolysis wastes, and off-grade products. Liquid wastes were generally disposed of in shallow earthen lagoons on the southeastern portion of the site; the remainder of the site functioned primarily as a solid waste landfill.

Documentation of activities at Necco Park prior to 1964 is limited. The following wastes were disposed of in the largest quantities:

- ❑ Flyash
- ❑ Building demolition and miscellaneous plant debris
- ❑ Sodium sludge waste salts, cell bath, and floor sweepings (i.e., barium, calcium, and sodium chloride)
- ❑ Sodium cell rubble (i.e., thermal brick, corroded steel)
- ❑ Polyvinyl acetate solids and stilling bottoms (i.e., vinyl acetate with high boiling tars)
- ❑ Chlorinolysis wastes (i.e., high boiling residues including hexachlorobenzene, hexachlorobutadiene, and hexachloroethane)
- ❑ Liming residues [i.e., sludge saturated with tri- and tetrachloroethene (TCE and PCE)]
- ❑ Scrap organic mixtures, off-grade product
- ❑ Glycol polymer (Terathane®) scrap (i.e., filter press cloth, filter press sludge)

- Refined adiponitrile wastes (high boiler wastes)

In 1977, Necco Park was identified as a potential source of groundwater contamination, and disposal activities were promptly discontinued.

3.0 SITE GEOLOGY AND HYDROGEOLOGY

3.1 Site Geology

Overburden materials at the site consist of reworked native glacial deposits intermixed with waste and fill materials. Fill materials south of the landfill consist primarily of slag with an average thickness of 8 feet. Undisturbed glaciolacustrine silts, sands and clay have been identified beneath the properties adjacent to Necco Park. Overburden thickness at the site ranges from less than 2 feet in the southwest area to greater than 25 feet in the southeast portion. A glacial till consisting of a silty to sandy clay with varying amounts of gravel and lesser amounts of large boulders underlies the glaciolacustrine deposits. The till and glaciolacustrine deposits have a characteristically low permeability. The saturated zone within the overburden is referred to as the A-zone. A discontinuous top-of-clay water zone is present in the slag waste above the native sediments. Horizontal flow direction in the A-zone is generally across the site from the north to the south. The vertical gradient is generally downward from the A-zone to the upper bedrock zones (WCC, 1993).

Bedrock at the site is classified as the Middle Silurian Lockport Formation. The Lockport is subdivided into five principle members: Oak Orchard Member, Eramosa Member, Goat Island Member, Gasport Member, and Decew Member. The Lockport is generally described as a brownish gray to dark gray, fine to medium grained dolomite which contains vugs and carbonaceous partings, stylolites and poorly preserved fossil remnants (Zenger, 1965).

3.2 Site Hydrogeology

The geologic makeup of A-zone overburden materials south of the landfill are such that groundwater capacity and transmissivity are very low. The materials are comprised of glaciolacustrine silts and clays overlying a glacial till consisting of a stiff clay with varying amounts of silt, sand, and gravel. The till and glaciolacustrine clay south of the landfill have characteristically low hydraulic conductivities, ranging from 1×10^{-4} to 1×10^{-6} cm/sec. This is precisely the reason the CECOS secure cells utilized the existing lacustrine clay layer in the design of their cells. As a result, the predominant hydraulic gradient in the A-zone is downward to the more transmissive underlying B-zone.

The vertical distance between the bottom of the A-zone and the B-zone is only on the order of 3 to 5 feet. The pre-design investigations revealed that a strong degree of connection exists between these zones as a result of their close proximity. Considering the relative closeness of these zones and their existing connectiveness, groundwater extraction from the B-zone will only enhance preexisting conditions. As discussed in Section 4.0, a comprehensive hydraulic monitoring program will be implemented to evaluate the long-term effectiveness of the controlling the A-zone source area by pumping the upper bedrock.

A series of water-bearing horizontal bedding plane fracture zones have been identified during previous site investigations. These fracture zones, designated as hydrogeologic zones B through G (after Johnson, 1964), can be traced horizontally for miles and correspond well with bedding plane fracture zones identified during construction of the New York Power Authority (NYPA) conduits. Pumping tests conducted in these zones indicate groundwater flow beneath the site occurs primarily through these horizontal fracture zones. In general, these zones are characterized by relatively high horizontal hydraulic conductivity and semi-confined response to hydraulic stress. Vertical fractures are most prevalent in the upper 30 feet of the Lockport Formation where stress relief and solutioning have been the most pronounced. The underlying Rochester Shale Formation generally acts as a confining layer and restricts further downward groundwater migration.

Outside the influence of the existing site groundwater recovery wells and grout curtain, groundwater in the upper bedrock (B-and C-zones) generally flows to the south and groundwater in the lower bedrock (D, E and F-zones) generally flows to the west and southwest. Groundwater flow in the B and C-zones is toward the Falls Street tunnel storm sewer, located approximately 2,400 feet south of the site. Studies of regional groundwater flow in the Niagara Falls area by the United States Geological Survey (USGS) indicate this tunnel acts as a line discharge for the upper Lockport groundwater along its entire length. Groundwater from the D- though G-zones discharges to the NYPA conduit drain system located approximately 3,700 feet west of the site.

4.0 OVERBURDEN HYDRAULIC MONITORING

Results of pumping tests conducted during the pre-design investigation show that hydraulic control of the A-zone can be achieved through pumping of the B/C-zone upper bedrock. A key element of the long-term monitoring program will include comprehensive measures to monitor the effectiveness of controlling the A-zone source area by pumping the upper bedrock. These measures include:

- ❑ Installation of additional top-of-clay piezometers to monitor the saturated zone which may be present above the top-of-clay in the eastern portion of the site.
- ❑ Installation of two additional A-zone piezometers
- ❑ Hydraulic monitoring at new and existing A-zone and top-of-clay zone piezometer locations

As discussed in Section 4.1, the additional piezometers will be installed and monitored before the new extraction system is operational to establish baseline A-zone hydraulic head data.

4.1 Additional Piezometer Installation

To sufficiently monitor the top-of-clay zone in the eastern portion of the site, thirteen additional piezometers will be installed at a spacing of approximately 100 feet. As shown on Figure 4-1, the additional top-of-clay piezometers will be paired with existing A-zone piezometers installed during the Pre-Design Investigations (PDI's). To attain the 100-foot spacing of paired piezometers, two additional A-zone piezometers will be installed (186A and 195A). As indicated on Figure 4-1, some piezometers installed during the PDI have been given new ID numbers. With the installation of the additional piezometers, overburden hydraulic head data will be collected at 37 locations along the southern portion of the site. Hydraulic monitoring will be conducted in accordance with the site-specific QAPP.

The piezometers will be installed in accordance with the procedures used to construct piezometers during the Phase 3 PDI. A well construction diagram for the top-of-clay piezometers is provided on Figure 4-2. The piezometers will be constructed of PVC if DNAPL is not encountered. If DNAPL is encountered, the piezometers will be constructed using stainless steel. The piezometers will be constructed and developed so that samples can be collected for chemical analysis. All drilling equipment will be decontaminated between boring locations.

4.2 Hydraulic Monitoring

The additional top-of-clay piezometers will be installed approximately 6 months before start-up of the new extraction system. This will facilitate the collection of baseline A-zone and top-of-clay zone hydraulic head data. The existing extraction system will be shut down three months before the startup of the new system to establish baseline conditions and observe recovery and unstressed conditions in the overburden and bedrock zones.

Using an electronic water level indicator, monthly water levels will be collected at locations included in Table 5-1. Water levels will be collected monthly for a period of 6 months before system start-up. Once the new system is operational, water levels will be collected monthly for a period of one year. Hydraulic monitoring will include an assessment of atmospheric influences (e.g., pressure fronts or precipitation) on the top-of-clay zone by continuous monitoring at selected top-of-clay piezometers during precipitation events. Subsequent water levels for long term monitoring of the A-zone overburden will be collected on a quarterly basis. More frequent monitoring may be conducted, as appropriate.

5.0 PROPOSED GROUNDWATER MONITORING PROGRAM

The groundwater monitoring program will consist of the following elements:

- ❑ Hydraulic monitoring
- ❑ Chemical monitoring
- ❑ DNAPL monitoring

Locations where monitoring will be conducted are shown on Figure 5-1. Because the Plan is dynamic, modifications to monitoring locations may be made based on monitoring results and or performance of the groundwater extraction system.

5.1 Hydraulic Monitoring Program

Following implementation of additional remedial actions designed to further reduce migration of groundwater from the source area (zones A-F) to the far-field, a long-term hydraulic monitoring program will be implemented. The objective of the long-term monitoring will be to verify that hydraulic control of the source areas is maintained throughout the duration of the remedial action. Monitoring procedures, frequency, locations, and reporting schedule are described below.

See Section 4.2 for specific overburden monitoring schedules.

5.1.1 Monitoring Procedures and Frequency

Water levels will be measured to the nearest one hundredth of a foot using an electronic water level indicator. Wells and piezometers have a permanent mark placed on top of the well casing to identify the surveyed reference point and to standardize the measuring point for depth to water measurements. The water level indicator probe will be decontaminated between wells following the procedures described in the site-specific QAPP.

The frequency of hydraulic monitoring will be monthly for the first year of system operation. Thereafter, monitoring will be conducted on a quarterly basis. Groundwater level measurements will be collected from the wells and piezometers identified in Table 5-1. Water levels will be recorded at all the well locations immediately before system start-up to determine static levels. A schedule will be developed such that:

- ❑ The sequence of wells measured following the same order that will be from least to most contaminated
- ❑ The measurements will be taken over a two hour period
- ❑ Measurements shall not be taken less than two days after any monitoring well purging or sampling operations.
- ❑ Unless noted, measurements will not be taken within 48 hours of any time period during which pumping wells were not operating.

To account for observed tidal-like effects resulting from the New York Power Authority water withdrawal schedule, water level measurements at all wells which monitor the F and G-zones will be collected between the hours of 11:00 AM and 4:00 PM Eastern Standard Time. To monitor influence from the conduits, water levels from wells 136F and 136G will be recorded at the beginning and end of the monitoring round. Pumping rates from all pumping wells will be recorded at the beginning and end of groundwater level measurements events.

The following information will be recorded in the field notebook:

- ❑ Well number and letter designation.
- ❑ Date and time of each measurement.
- ❑ Depth to water (DTW) from the top of casing (to the nearest 0.01 foot).
- ❑ Well condition (i.e. bent casing, broken lock, etc.).

5.2 Chemical Monitoring Program

As described in the RDWP, an extensive database of groundwater analytical data has been accumulated during many years of hydrogeologic investigation at Necco Park. Quarterly and semi-annual groundwater sampling rounds from as many as 104 monitoring wells were conducted from the mid-1980s to 1993 pursuant to the investigative requirements of a 1986 Consent Decree and 1989 Administrative Consent Order (ACO). However, even after the 1989 ACO investigative requirements had been fulfilled, groundwater sampling and analysis continued through 1998. Groundwater sampling at 38 bedrock monitoring wells and the three bedrock groundwater recovery wells (RW-1, RW-2, RW-3) was continued on an annual basis from 1994 to 1998. The annual groundwater sampling program was designed to facilitate continued evaluation of the conceptual model for groundwater flow and contaminant transport developed for the AOA.

Groundwater sampling conducted during the pre-design investigations (2000 baseline event and 2002 source area re-assessment sampling), utilizing existing and new wells, have resulted in the establishment of a network of wells that will be used to meet the following objectives as defined in the SOW:

- ❑ Monitor the effectiveness of the extraction wells in reducing chemical concentrations in the zone-specific source areas
- ❑ Monitor the far-field groundwater chemistry to determine if the extraction system is controlling off-site migration of chemical constituents associated with the Necco Park site
- ❑ Monitor natural attenuation and intrinsic bioremediation in the source area and far-field
- ❑ Continue to evaluate the effectiveness of the remedial action

Using the 2000 baseline and 2002 source area reassessment results (CRG, 2001 and 2003), a list of wells that will be used for long-term monitoring has been prepared and is included in Table 5-2. The wells included in Table 5-2 will be sampled on a semi-annual basis during the first three years of system operation. Sampling frequency thereafter will be annually. Analytical parameters are included in Table 5-3. The first semi-annual event will occur within one month of system startup to establish baseline chemistry. Based on the annual sampling results, the wells used for chemical monitoring may be modified over the course of the remedial action.

5.2.1 Monitored Natural Attenuation

Wells to be used to monitor natural attenuation processes in the source area and far-field are included on Table 5-4. The monitored natural attenuation (MNA) parameters are included in Table 5-5. Based on an enhanced understanding of the physical, chemical, and processes that influence natural attenuation and intrinsic bioremediation, DuPont has modified the list of MNA parameters provided in the RDWP. This contemporary analyte list is a standard protocol for natural attenuation and intrinsic bioremediation remedy evaluations conducted by DuPont. The list of analytes includes a patented genetic marker identification technique that is used to determine the presence of dechlorinating microbes.

Results from the MNA sampling conducted in 2000 as part of the RD baseline sampling showed that natural attenuation of site constituents is occurring under anaerobic degradation processes. The continued effectiveness of natural attenuation (and intrinsic bioremediation) will be defined by a “lines of evidence” approach explained below. Annual monitoring be conducted over a five year period to monitor and evaluate natural attenuation in this complex fractured bedrock system. During the first year, chemical and geochemical parameters should be analyzed twice (semi-annually) to afford an “improved” baseline monitoring condition.

First, chlorocarbon concentration decreases along the longitudinal, downgradient direction of the plume will be monitored and evaluated. This includes parent compounds and daughter products within the various groundwater zones. As appropriate, the molar flux in the downgradient direction will be reviewed and evaluated. In situ attenuation rates will be calculated and evaluated using the spatial technique of Buscheck (1993), et.al. (as described in Appendix A). Moreover, downgradient wells near the plume periphery will also be monitored to evaluate plume status (static, shrinking, etc.).

Second, geochemical indicators of natural attenuation will be monitored and evaluated. This includes redox conditions, evidence of conditions conducive to biodegradation, and overall redox state of the groundwater zones.

Third, biological evidence of the dehalorespiring organism *Dehalococoides Ethenogenese*, (DHE), will be obtained for the various groundwater zones. This entails utilization of DuPont’s patent pending 16SrRNA genetic identification technique for DHE. Such analysis will be conducted twice during the recommended five year sampling regime, once at the beginning and once in the third year to confirm the continuing presence of these microbes.

5.3 DNAPL Monitoring Program

Monitoring for the occurrence of DNAPL has been conducted routinely at the Necco Park site since the early 1980's. A monitoring and recovery program was instituted in 1989 to remove free-phase DNAPL from monitoring and extraction wells. A total of approximately 7,000 gallons of DNAPL have been recovered to date. As part of the 2000 pre-design activities, a comprehensive DNAPL survey utilizing over 150 wells was conducted. Results of the survey were provided in the *Necco Park Source Area Report* (CRG 2001). Based on findings of subsequent pre-design investigations, a second comprehensive DNAPL survey will be conducted at all new and existing wells where any of the DNAPL criteria has historically been exceeded. The well locations are provided on Table 5-6. Based on the DNAPL observations made during the supplemental DNAPL evaluation, a list of wells and observation frequencies will be prepared and provided as an addendum to this plan.

DNAPL observations will be conducted as described in Section 4.4.2.1 of the QAPP. As such, the observations will be completed at least one week prior to the baseline groundwater chemistry sampling. Recovery of DNAPL will be conducted at locations where recoverable quantities of DNAPL are observed. DNAPL removal will be conducted to the extent technically feasible.

5.4 Reporting

Quarterly reports, to be submitted 30 days after the end of the quarter, will include the following:

- ❑ Water levels
- ❑ Potentiometric surface maps contoured at one foot intervals
- ❑ DNAPL observation and removal summary
- ❑ Summary of system operations

The quarterly report will not include an interpretation of the results. Data analysis and interpretation will be provided in the annual report. The annual report will include the following:

- ❑ Groundwater and DNAPL monitoring data from the previous year's sampling event
- ❑ An analysis of the sampling results to determine whether groundwater contaminant migration has been effectively prevented or stabilized
- ❑ Time versus concentration plots for contaminants and wells to represent reductions or changes in the concentration of contaminants in groundwater
- ❑ An evaluation of whether the concentration trends in the groundwater plume are consistent with the predictions of groundwater movement in the Remedial Design and AOA

Annual reports will be submitted to EPA no later than 90 days after the end of the calendar year in which the data was collected.

6.0 REFERENCES

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TABLES

Table 5-1: Hydraulic Monitoring List
Long-Term Monitoring
DuPont - Necco Park
Niagara Falls, NY

Well ID	Zone	Monitoring Frequency	Well ID	Zone	Monitoring Frequency	Well ID	Zone	Monitoring Frequency
53	A	Monthly	102B	B	Quarterly	139C	C	Quarterly
111A	A	Monthly	112B	B	Quarterly	145C	C	Quarterly
117A[1]	A	Monthly	115B*	B	Quarterly	146C	C	Quarterly
119A	A	Monthly	116B	B	Quarterly	149C	C	Quarterly
123A	A	Monthly	118B	B	Quarterly	150C	C	Quarterly
129A	A	Monthly	119B	B	Quarterly	151C	C	Quarterly
130A*	A	Monthly	120B	B	Quarterly	159C	C	Quarterly
131A	A	Monthly	129B	B	Quarterly	160C	C	Quarterly
137A	A	Monthly	130B	B	Quarterly	161C	C	Quarterly
139A	A	Monthly	136B	B	Quarterly	162C	C	Quarterly
146AR	A	Monthly	137B	B	Quarterly	168C	C	Quarterly
150A	A	Monthly	138B	B	Quarterly	105D	D	Quarterly
159A	A	Monthly	139B	B	Quarterly	111D**	D	Quarterly
163A	A	Monthly	145B	B	Quarterly	115D	D	Quarterly
173A	A	Monthly	146B	B	Quarterly	129D	D	Quarterly
174A	A	Monthly	149B	B	Quarterly	130D	D	Quarterly
175A	A	Monthly	150B	B	Quarterly	136D	D	Quarterly
176A	A	Monthly	151B	B	Quarterly	137D	D	Quarterly
178A	A	Monthly	159B	B	Quarterly	139D	D	Quarterly
179A	A	Monthly	160B	B	Quarterly	145D	D	Quarterly
184A+	A	Monthly	161B	B	Quarterly	148D	D	Quarterly
185A+	A	Monthly	163B	B	Quarterly	149D	D	Quarterly
186A	A	Monthly	167B	B	Quarterly	158D	D	Quarterly
187A+	A	Monthly	168B	B	Quarterly	159D	D	Quarterly
188A+	A	Monthly	169B	B	Quarterly	163D	D	Quarterly
189A+	A	Monthly	170B	B	Quarterly	164D	D	Quarterly
190A+	A	Monthly	171B	B	Quarterly	165D	D	Quarterly
191A+	A	Monthly	172B	B	Quarterly	RW-8	D/E/F	Quarterly
192A+	A	Monthly	BZTW-1	B	Quarterly	RW-9	D/E/F	Quarterly
193A+	A	Monthly	BZTW-2	B	Quarterly	129E	E	Quarterly
194A+	A	Monthly	BZTW-4	B	Quarterly	136E	E	Quarterly
D-11	A	Monthly	D-23	B	Quarterly	145E	E	Quarterly
D-9	A	Monthly	D-10	B/C	Quarterly	146E	E	Quarterly
RDB-3	A	Monthly	D-14	B/C	Quarterly	150E	E	Quarterly
RDB-5	A	Monthly	RW-1	B/C	Quarterly	163E	E	Quarterly
D-13	A	Monthly	RW-10	B/C	Quarterly	164E	E	Quarterly
119AT	AT	Monthly	RW-2	B/C	Quarterly	165E	E	Quarterly
129AT	AT	Monthly	RW-4	B/C	Quarterly	112F**	F	Quarterly
180AT	AT	Monthly	RW-5	B/C	Quarterly	130F	F	Quarterly
184AT	AT	Monthly	TRW-6	B/C	Quarterly	136F	F	Quarterly
185AT	AT	Monthly	TRW-7	B/C	Quarterly	145F	F	Quarterly
186AT	AT	Monthly	105C	C	Quarterly	146F	F	Quarterly
187AT	AT	Monthly	112C	C	Quarterly	148F	F	Quarterly
188AT	AT	Monthly	115C	C	Quarterly	150F	F	Quarterly
189AT	AT	Monthly	123C	C	Quarterly	163F	F	Quarterly
190AT	AT	Monthly	129C	C	Quarterly	164F	F	Quarterly
191AT	AT	Monthly	130C	C	Quarterly	165F	F	Quarterly
192AT	AT	Monthly	136C	C	Quarterly	130G	G	Quarterly
193AT	AT	Monthly	137C	C	Quarterly	141G**	G	Quarterly
194AT	AT	Monthly	138C	C	Quarterly	143G	G	Quarterly
PZ-195**	AT	Monthly						
PZ-196**	AT	Monthly						
PZ-197**	AT	Monthly						
MW-198**	AT	Monthly						
PZ-199**	AT	Monthly						
PZ-200**	AT	Monthly						

* Well Abandoned ** Well added after approval of LTGMP +Well Renamed AT = Top-of-clay
[1] Well 117A removed from list for hydraulic monitoring. Well used for DNAPL observations only.

Note: All B, B/C, D, E, F, and G zone wells will be monitored monthly during the first year of new system operation. Water levels will be recorded quarterly thereafter.

Table 5-2: Chemical Monitoring List
Long-Term Monitoring
DuPont - Necco Park
Niagara Falls, NY

MONITORING WELL	ZONE	MONITORING WELL	ZONE
D-11	A	**105D**	D
D-13	A	123D	D
D-9	A	136D	D
137A	A	**137D**	D
145A	A	145D	D
146AR	A	148D	D
150A	A	**139D**	D
111B	B	147D	D
136B	B	149D*	D
137B	B	156D	D
139B	B	165D	D
141B	B	136E	E
145B*	B	145E	E
146B	B	146E	E
149B*	B	150E	E
150B	B	156E	E
151B*	B	165E	E
153B	B	136F	F
168B	B	146F	F
171B	B	147F	F
172B	B	150F*	F
105C	C	156F	F
136C	C	147G1	G1
137C	C	147G2	G2
141C*	C	147G3	G3
145C*	C		
146C*	C		
149C	C		
150C*	C		
151C	C		
168C	C		

*Well does not meet bedrock zone water bearing criteria ($k<10^{-4}$ cm/sec).

Wells shown in **bold** are used solely for the MNA evaluation and will not be used for Long-term chemistry monitoring.

Table 5-3: Indicator Parameter List
Long-Term Monitoring
DuPont - Necco Park
Niagara Falls, NY

INORGANIC AND GENERAL WATER QUALITY PARAMETERS	VOLATILE ORGANIC COMPOUNDS	SEMIVOLATILE ORGANIC COMPOUNDS
pH*	Vinyl chloride	Hexachloroethane
Specific conductivity*	1,1-dichloroethene	Hexachlorobutadiene
Temperature*	Trans-1,2-dichloroethene	Phenol
Turbidity*	Cis-1,2-dichloroethene	2,4,6-trichlorophenol
Dissolved oxygen *	Chloroform	2,4,5-trichlorophenol
Redox potential*	Carbon tetrachloride	Pentachlorophenol
Chloride	1,2-dichloroethane	Hexachlorobenzene
Dissolved barium	Trichloroethene	4-methlyphenol
	1,1,2-trichloroethane	TIC-1
	Tetrachloroethene	
	1,1,2,2-tetrachloroethane	

*Field parameter

Table 5-4: Wells to be used for Monitoring Natural Attenuation
DuPont - Necco Park
Niagara Falls, NY

111B	137D
137B	139D
139B	147D
141B	148D
145B	149D
151B	156D
153B	165D
105C	136E
137C	145E
141C	146E
145C	156E
149C	146F
151C	150F
105D	
136D	

Table 5-5: Monitored Natural Attenuation Parameter List
Long-Term Monitoring
DuPont - Necco Park
Niagara Falls, NY

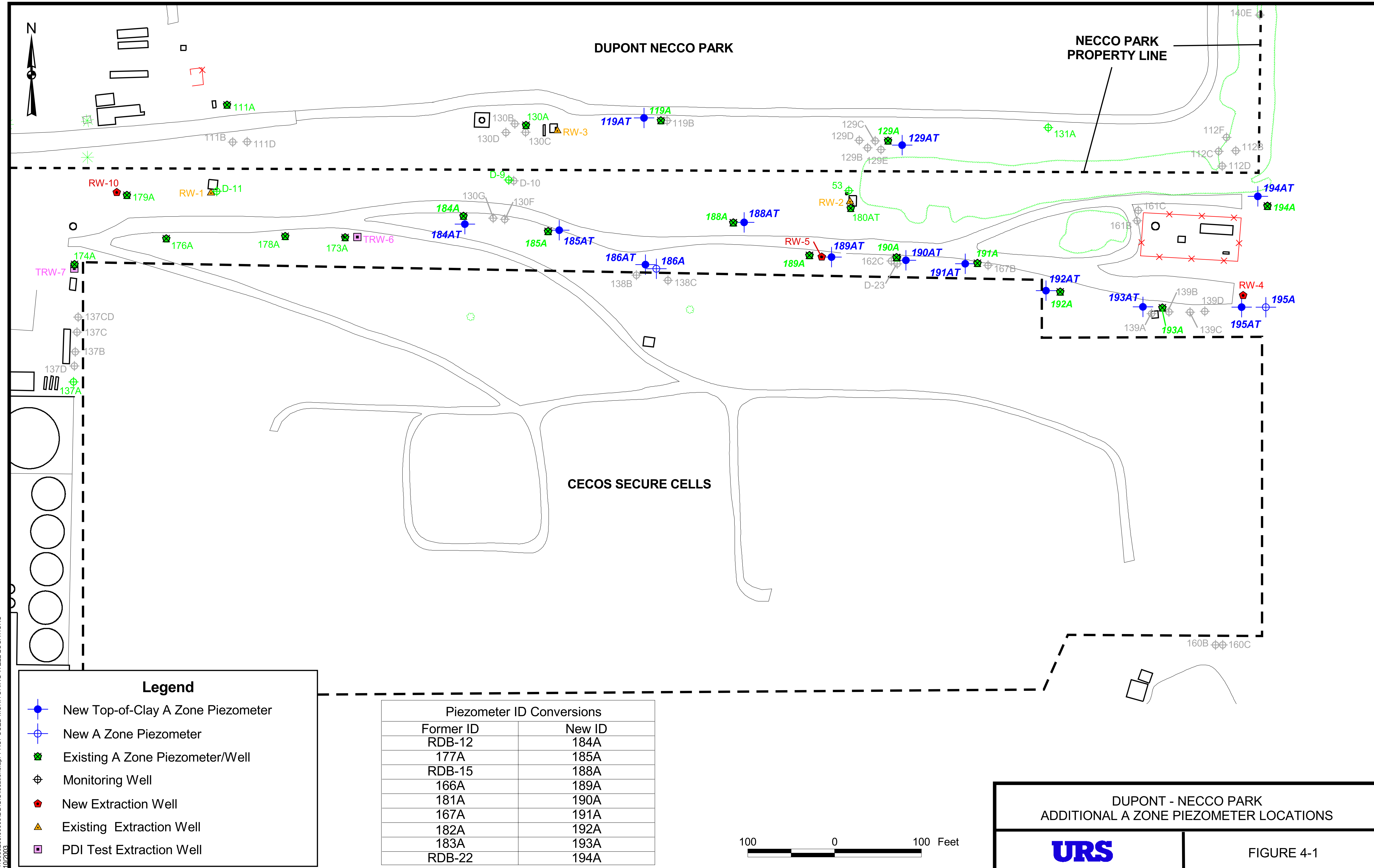
Primary Analytes for Groundwater	Analytical Method	Holding Time	Sample Volume	Reason for Analysis
Alkalinity	310.1	14 days	100 ml	CO_2 and CO_3/HCO_3 buffering capacity
Chloride	300.0A	28 days	100 ml	End product of chlorinated organic reduction
Dissolved oxygen	Field	-	-	Electron acceptor
Temperature (C^o)	Field	-	-	Affects rate of microbal metabolism
Ethene, ethane, methane, propane	8015B-MOD (RSK-175)**	14 days	40 ml	Intermediate product of degradation
Iron (dissolved)	SW-846 3010A / 6010B	180 days	1 Liter	Growth - electron acceptor
Nitrate/nitrite (total)	353.2	28 days	500 ml	Electron acceptor
pH	Field	-	-	Optimum range 5 to 9
Redox (mv)	Field	-	-	Reducing environment
Sulfate	300.0A	28 days	100 ml	Electron acceptor
Volatile organics (all isomers)	SW-846 5030B / 8260B	14 days	40 ml	Original contaminants and degradation compounds
Sulfide	376.1	7 days	250 ml	Reducing environment
Total organic carbon	415.1	28 days	100 ml	Substrate available
Manganese (dissolved)	SW-846 3010A / 6010B	180 days	1 Liter	Electron acceptor
DNA* (16S rRNA probes)	SiREM Protocol	Ship overnight	500 ml	Determine if dechlorinating microbes are present

* Analyzed twice during monitoring regime.
** RSK-175 replaces the older GC-0019 listed in the original submittal.

Table 5-6: Supplemental DNAPL Observation Locations
DuPont - Necco Park
Niagara Falls, NY

105C	136G	147D	160B
105CD	137A	147F	160C
105D	137B	147G1	161B
111B	137C	147G2	161C
111D	137D	147G3	168B
112A	138B	148D	168C
112B	138C	149A	171B
112C	139A	149D	172B
112D	139B	150E	145D
112F	139D	150F	145G3
112J	140A	153D	145J
117A	140B	153FG	146AR
117C	140C	153G3	147B
117E	140E	155ER	148B
123D	141B	156A	149B
128A	141C	156E	149C
129B	141D	53	150A
129C	141E	C-72	150B
129D	141G	D-11	150C
129E	141J	D-13	151C
129F	142A	D-14	152A
129G	142B	D-23	152BC
130B	142C	D-3	153E
130C	143G	D-7	153G2
130D	145A	RW-1	155A
130G	145B	RW-2	155D
131A	145C	RW-3	156F
136B	145E	RW-4	C-83
136C	145G2	RW-5	D-9
136D	146C	TRW-6	130G
136E	146E	TRW-7	116CD2
136F	146F	RW-8	136F
136J	147C	RW-10	189A
			193A

FIGURES



Legend

- New Top-of-Clay A Zone Piezometer
- New A Zone Piezometer
- Existing A Zone Piezometer/Well
- Monitoring Well
- New Extraction Well
- Existing Extraction Well
- PDI Test Extraction Well

Piezometer ID Conversions	
Former ID	New ID
RDB-12	184A
177A	185A
RDB-15	188A
166A	189A
181A	190A
167A	191A
182A	192A
183A	193A
RDB-22	194A

DUPONT - NECCO PARK
ADDITIONAL A ZONE PIEZOMETER LOCATIONS

URS

FIGURE 4-1

N:\18983203.00005\DB\GIS\locations.apr PROPOSED MONITORING WELL LOCATIONS
9/10/2003

DRILLING SUMMARY

Geologist:

Drilling Company:

Driller:

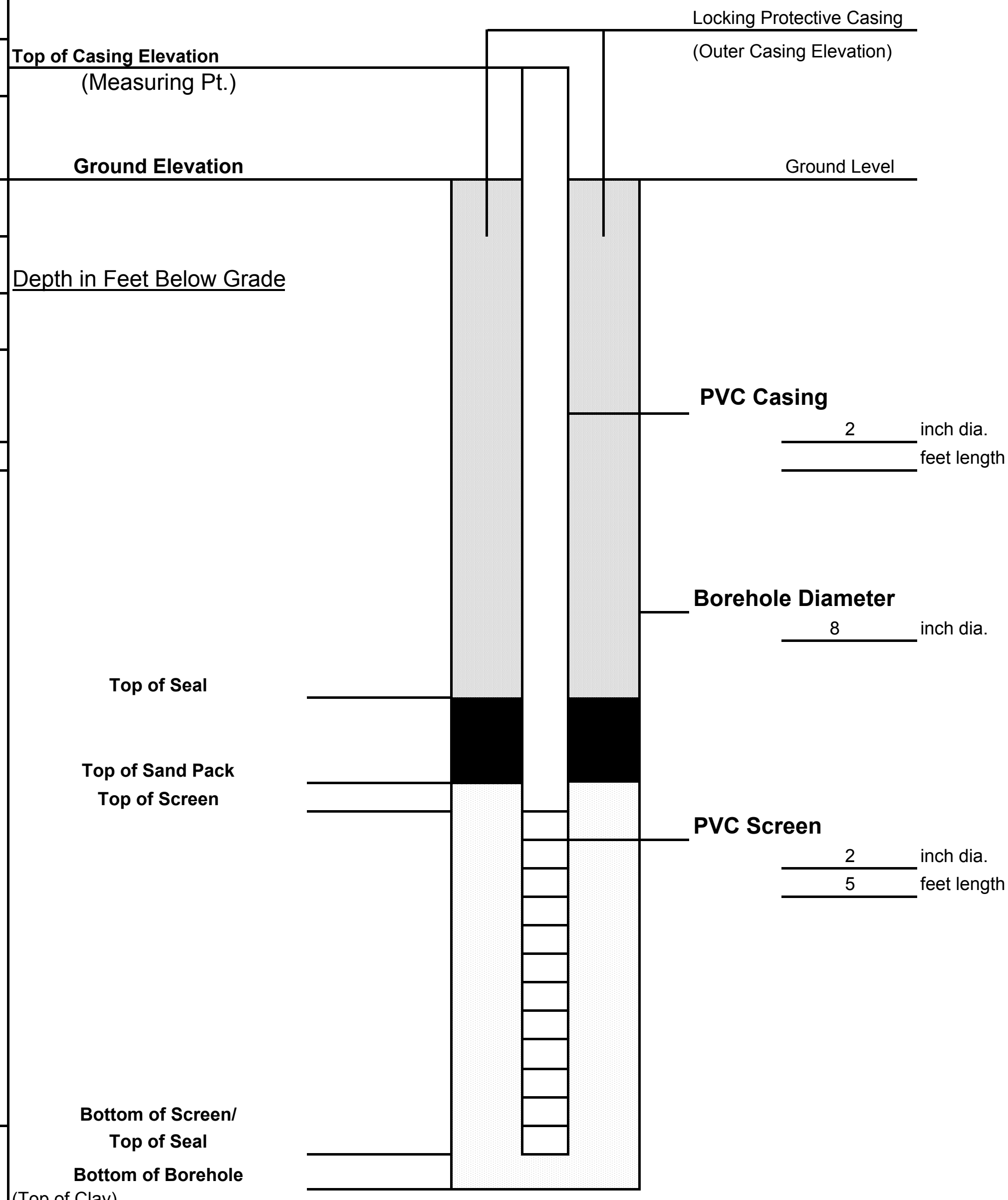
Rig Make/Model:

Date:

GEOLOGIC LOG

Depth(ft.)	Description

WELL DESIGN



CASING MATERIAL		SCREEN MATERIAL		FILTER MATERIAL
Surface:	Steel protective cover (Stick Up)	**Type:**	Schedule 40 PVC	**Type:** Morie "O" well sand **Setting:**
				SEAL MATERIAL
Monitor:	PVC	**Slot Size:**	0.020"	**Type 1:** Bentonite pellets **Setting:**

COMMENTS:

LEGEND

- Cement Grout
- Bentonite Seal
- Sand Pack

Client: DuPont CRG	**Location: Necco Park**	**Project No.: 18983996**
URS Diamond	**TOP-OF-CLAY PEIZOMETER CONSTRUCTION DETAILS**	**Well Number:** **FIGURE 4-2**

necco LTGMP fig 4-2.xls/typ top-of clay peizo

Legend

- DuPont Monitoring Well
- Allied Waste Monitoring Well
- DuPont Extraction Well
- Former DuPont Extraction Well
- DuPont Peizometer
- Chemical Monitoring Location

NOTE: Wells in bold will be used for the MNA evaluation.

Peizometer ID Conversions	
New ID	Former ID
184A	RDB-12
185A	177A
187A	RDB-15
188A	166A
189A	181A
190A	167A
191A	182A
192A	183A
193A	RDB-22

WARNING

IT IS VIOLATION OF SECTION 7209, SUBDIVISION 2, OF THE NEW YORK STATE EDUCATION LAW FOR ANY PERSON OTHER THAN WHOSE SEAL APPEARS ON THIS DRAWING, TO ALTER IN ANY WAY AN ITEM ON THIS DRAWING. IF AN ITEM IS ALTERED, THE ALTERING ENGINEER SHALL AFFIX TO TO THE ITEM HIS SEAL AND THE NOTATION "ALTERED BY" FOLLOWED BY HIS SIGNATURE AND THE DATE OF SUCH ALTERATION, AND A SPECIFIC DESCRIPTION OF THE ALTERATION.

N:\18983203.00005\DB\GIS\locations.apr CHEMICAL MONITORING LOCATIONS_2
11/8/2005

NO.	DATE	DESCRIPTION	NO.	DATE	DESCRIPTION
1	11/08/05	REVISION #1			

REVISIONS

DESIGNED BY: SPM
DRAWN BY: CNE
CHECKED BY: XXX
PROJ. ENGR. XXX

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JOB No. 18983203.00005

DUPONT
NECCO PARK

NIAGARA FALLS NEW YORK

WELL AND PEIZOMETER LOCATIONS
DUPONT NECCO PARK

175 0 175 350 Feet

Scale: 1" = 175' - 0'

Date: OCT 2005

FIGURE 5-1

APPENDICES

APPENDIX A

IN SITU ATTENUATION RATE CALCULATIONS

Buscheck et.al.(1993) developed a simplified technique to quantify natural attenuation (including intrinsic bioremediation) of PCE, TCE, and BTEX plumes in groundwater at several field sites. Their evaluation included plots for concentration versus time (temporal) and concentration versus distance (spatial) that defined apparent first order decay rates for steady state plumes. For temporal regression analysis, their data indicate apparent first order decay rates for PCE ranging from 0.34% (k= -0.0034) to 0.46% (k= -0.0046) per day and TCE ranging from 0.26% (k= -0.0026) to .3% (k= -0.003) per day. Additionally, for spatial regression analysis of data, Weaver, et.al. (1996) estimated apparent decay rates for TCE ranging from (k= -0.0076/week) to (k= -0.024/week) (half-life ranging from 638 days to 186 days) using a similar method. The Buscheck et. al. technique involved semi-log plots of chlorocarbon concentration versus time(temporal regression) and chlorocarbon concentration versus distance (spatial regression). The apparent first order decay rates were then calculated from the slope of the regression line plot. For this formulation, aquifer sorption sites were assumed to be saturated and steady state plume equilibria existed. A first order equation was used as follows to derive the various estimates of biodegradation:

$$dC/dt = -kC \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ 1$$

where t is time

k is the first order decay rate (per time)

C is the dissolved plume concentration

The solution for this differential equation was given for the two cases under study, namely for the temporal and then the spatial cases.

Temporal:

$$C(t)= e^{-kt} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ 2$$

where; C(t) is concentration as a function of time(t)

Co is the concentration at t=0

k is the decay rate (per time)

Spatial:

$$C(x) = Co\ e^{-k(x/v)} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ 3$$

where; C(x) is concentration as a function of distance(x)
Co is the concentration at x=0
k is the decay rate(per time)
x/v is the distance(x)/pore water velocity (v)

These authors concluded that at the four sites studied, apparent first order decay rates were demonstrated and measurements of other analytes (dissolved oxygen, redox potential, and alternative electron acceptors) were also indicative of intrinsic bioremediation.